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DETAILED STUDY OF DREDGED MATERIAL LAND DISPOSAL ALTERNATIVES

FINAL REPORT

DEPARTMENT OF THE ARMY
San Francisco District, Corps of Engineers
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SUMMARY

DETAILED STUDY OF DREDGED MATERIAL LAND DISPOSAL ALTERNATIVES

I. STUDY OVERVIEW

The San Francisco District, U.S. Army Corps of Engineers, is investigating disposal options for sediments dredged from San Francisco Bay. A variety of approaches and options are being explored under the Dredged Material Disposal Management Program (DMP).

This report presents the results of the Detailed Study of Dredged Material Land Disposal Alternatives. The purpose of this study is summarized as follows:

1) Update the potential dredged material land disposal site inventory resulting from previous studies and identify additional land disposal sites, if applicable.

2) Develop criteria for detailed evaluation of feasible land disposal sites, including engineering, economic, environmental and institutional criteria.

3) Evaluate, compare and rank the recommended feasible dredged material land disposal sites.

The initial phase of the study included updates of previously identified sites, research and extensive interviews. As part of developing evaluation criteria, critical issues were identified through discussions with personnel from resource agencies, local government jurisdictions, developers and other interested parties. The most critical issues affecting upland disposal of dredged material were determined to be environmentally based. The wetland and critical habitat issues are continually the focus of the regulatory approval process.

The essence of this study has been to assess feasibility of land sites for dredged material disposal. In order to develop the planning level cost estimates required for the feasibility analysis, four federally authorized civil works dredging projects were selected as representative dredging areas. These dredging areas are Oakland Inner and Outer Harbor, Richmond Harbor, Mare Island Strait and Pinole Shoal.

As a result of the critical issues determination and site evaluation, three sites were selected as most feasible. These sites are summarized below:

Napa River: Located in North San Pablo Bay, east of the Napa River and north of the City of Vallejo.

Crowley: Located on Suisun Bay, west of Pacheco Creek near Avon, CA.

Montezuma: Located east of Montezuma Slough in the Lower Sacramento River Delta.

Preliminary design and operations plans were developed for dredging and disposal scenarios for each site. A portion of the Montezuma Site was designed to provide 520 acres of salt marsh habitat in addition to accommodating 2.6 million cubic yards of dredged material. Preliminary level cost estimates for dredging, pumpout, disposal site construction and mitigation were developed and are contained in this report.

This study provides a basis for the comparison of upland dredged material disposal alternatives with other dredged material disposal options. Further site investigations, environmental analysis and alternatives assessment will be required as part of the process to establish and approve an upland dredged material disposal site.

INTRODUCTION

II. INTRODUCTION

A. Since 1978 disposal of material dredged from San Francisco Bay has primarily been limited to three Bay in-water sites: Carquinez Strait (SF-9), San Pablo Bay (SF-10) and Alcatraz (SF-11). Principal disposal occurs at Alcatraz which receives approximately 3.0 million cyds of the over 6.0 million cyds disposed at the three sites annually.[1] These sites were selected based on the likelihood for disposed sediments to disperse through the Bay and into the Pacific Ocean. In the early 1980's it was determined that sediments disposed at Alcatraz were not dispersing as expected. Mounding at Alcatraz was hindering navigation and indicated that the Alcatraz site may have a finite capacity to accommodate the required dredging of the Bay's navigation channels.

B. Recognizing the severity of the Alcatraz disposal site shoaling problem, the San Francisco District, U.S. Army Corps of Engineers initiated the Dredged Material Disposal Management Program (DMP) in 1984. The program is designed to address the following issues:

1) Material accumulation at the Alcatraz disposal site (SF-11).

2) Periodic bathymetric monitoring of the two north bay disposal sites: Carquinez Strait (SF-9) and San Pablo Bay (SF-10).

3) Availability and feasibility of potential alternate dredged material disposal options.

4) Fate of dredged material as a result of open-water disposal.

5) Ocean disposal site designation.

C. As part of its mandate to identify availability and feasibility of potential alternative disposal options, (3) above) the San Francisco District initiated this Dredged Material Land Disposal Alternatives Study in June 1988. The study area is designated in Figure 1: Project Location Map.

D. This Dredged Material Land Disposal Alternatives Study is a detailed feasibility study which has as its basis investigations of potential land disposal of dredged material made during previous San Francisco District, U.S. Army Corps of Engineers reconnaissance level studies. These previous studies are:

a) U.S. Army Corps of Engineers, Dredge Disposal Alternatives Study, Task 3, Land Disposal Alternatives, January, 1987.

b) U.S. Army Corps of Engineers, Report on Mare Island Maintenance Dredging; Preliminary Land Disposal Analysis, prepared by San Francisco District in coordination with the U.S. Fish and Wildlife Service, November, 1981.

c) U.S. Army Corps of Engineers, Dredge Disposal Study: San Francisco Bay and Estuary; Appendix J: Land Disposal, October, 1974.

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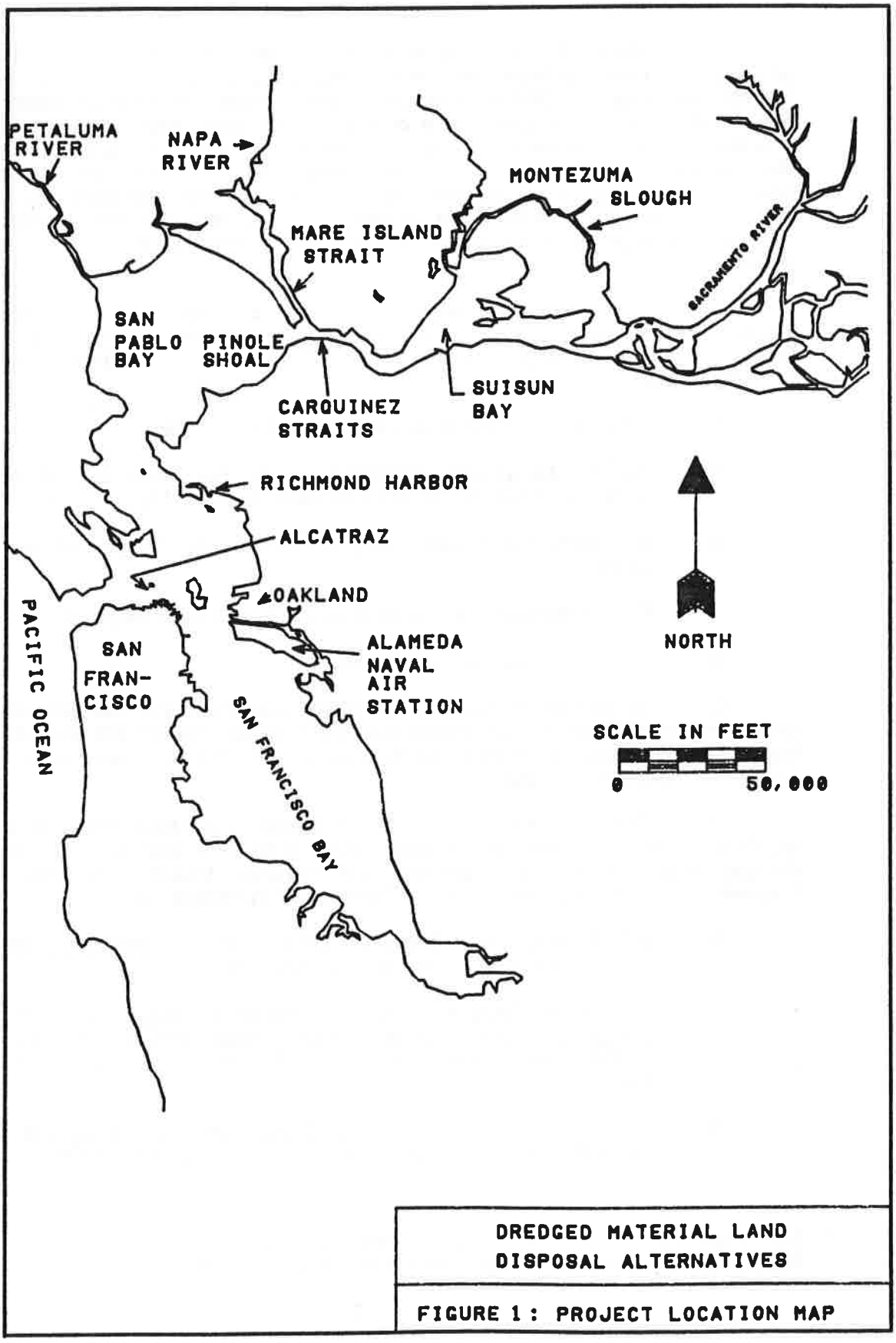
[1] San Francisco District, U.S. Army Corps of Engineers Dredged Material Disposal Management Program for the San Francisco Bay Area, Undated



DREDGED MATERIAL LAND DISPOSAL ALTERNATIVES

FIGURE 1: PROJECT LOCATION MAP

The purpose of this study is summarized as follows:

1) Update the potential dredged material land disposal site inventory resulting from the above referenced previous studies and identify additional land disposal sites, if applicable.

2) Develop criteria for detailed evaluation of feasible land disposal sites, including engineering, economic, environmental and institutional criteria.

3) Evaluate, compare and rank the recommended feasible dredged material land disposal sites.

E. Approach

1. The Dredged Material Land Disposal Alternatives Study was performed in three primary phases. The initial phase was an update of the sites identified in the January, 1987 USACE land disposal study[2] with special concentration on those sites listed as most feasible. The January 1987 study reflected the findings of previous studies and contained the most recent site information. Investigation of new land disposal site opportunities and fill requirements were made by interviews with ports, private industry and others. During Phase Two critical issues relating to land disposal site feasibility were identified and evaluation criteria developed. During Phase Three the most feasible land disposal sites were selected and refined. This Phase included preliminary design, cost estimates and regulatory feasibility analysis.

2. The essence of this study is to assess feasibility of land sites for dredged material disposal in San Francisco Bay. Four federal civil works projects were selected as being representative of projects in San Francisco Bay. Their annual volumes, locations, sediment type and other characteristics were used as the basis for planning level cost estimates and for some design parameters, such as material settleability. The dredging reaches and their approximate annual volumes are:

Dredging Area	Average Annual Volume Cubic Yards
Oakland Inner/Outer Harbor	500,000
Richmond Harbor	900,000
Mare Island Strait	800,000
Pinole Shoal	250,000
Total Average Annual:	2,450,000[3]

[2] U.S. Army Corps of Engineers, Dredge Disposal Alternatives Study, Task 3, Land Disposal Alternatives, January, 1987.

[3] U.S. Army Corps of Engineers, San Francisco District, 1988

3. This report summarizes the findings of each study phase. It provides site engineering for the three most feasible dredged material land disposal alternatives and preliminary design level cost estimates for disposal site construction, dredging, mitigation and associated facilities. The institutional framework in which sites must be approved is also addressed.

It is the intent of this study to provide dredged material land disposal alternatives at a detailed level to enable decision making for long term disposal management. The need for dredged material disposal sites has been the foremost consideration. Site engineering, cost estimates, regulatory approaches and other elements have been developed to facilitate long term dredged material disposal management policy decisions.

DISPOSAL SITE

INVENTORY

III. DISPOSAL SITE INVENTORY

A. Previous studies distinguished between permanent land disposal sites and reclamation processing sites. Reclamation/processing sites are temporary plants established to make dredged material reusable. The process involves dewatering the material and often a mechanical mixing operation is used to accelerate improvement of the material.

B. Permanent dredged material disposal sites are for the permanent placement of material. End use objectives may be increasing site elevations for development, creating dikes or levees, or accommodating dredged material on a long term basis. Permanent disposal sites are often managed to meet the objectives of their end use, even if that objective is only to maximize capacity as a permanent disposal site.

C. The January 1987 USACE report established seven feasible land disposal sites, all located in the San Pablo Bay and Suisun Bay locales. Of these seven sites, all were determined to be feasible for reclamation/processing disposal, and two also feasible for permanent disposal. The following lists the designated sites:

(1)	Hamilton AFB South	Reclamation
(2)	Hamilton AFB North	Reclamation
(3)	Petaluma River	Reclamation
(4)	Sonoma Creek	Reclamation
(5)	Napa River	Permanent and Reclamation
(6)	Montezuma	Permanent and Reclamation
(7)	Sherman Island	Reclamation

These sites may be located on Figure 2: Feasible Dredged Material Land Disposal Sites, January, 1987. Detailed site descriptions from the feasibility analysis are contained in Appendix A. All sites have potential Section 10 River and Harbor Act and Section 404 Clean Water Act jurisdiction (see Appendix C for regulatory discussion). For purposes of this investigation, status of the sites was investigated and information updated where applicable. Changes from the information contained in Appendix A are summarized in the following sections.

1. **Hamilton AFB South:** This 1150 acre site remains primarily under the ownership of the Archdiocese of San Francisco. Direct barge access is not available. Permanent and reclamation/processing disposal site inconsistent with BCDC[4] policy for diked historic baylands.

2. **Hamilton AFB North:** Novato Sanitary District has long term lease on northern portions of site, owned by Marin County Flood Control District. Novato indicates they would not accept dredged material. Other owners include Leveroni Ranch who also indicate property is unavailable for disposal. Bel Marin Keys project still pending; fill may be required. Permanent and reclamation/processing disposal site inconsistent with BCDC policy for diked historic baylands.

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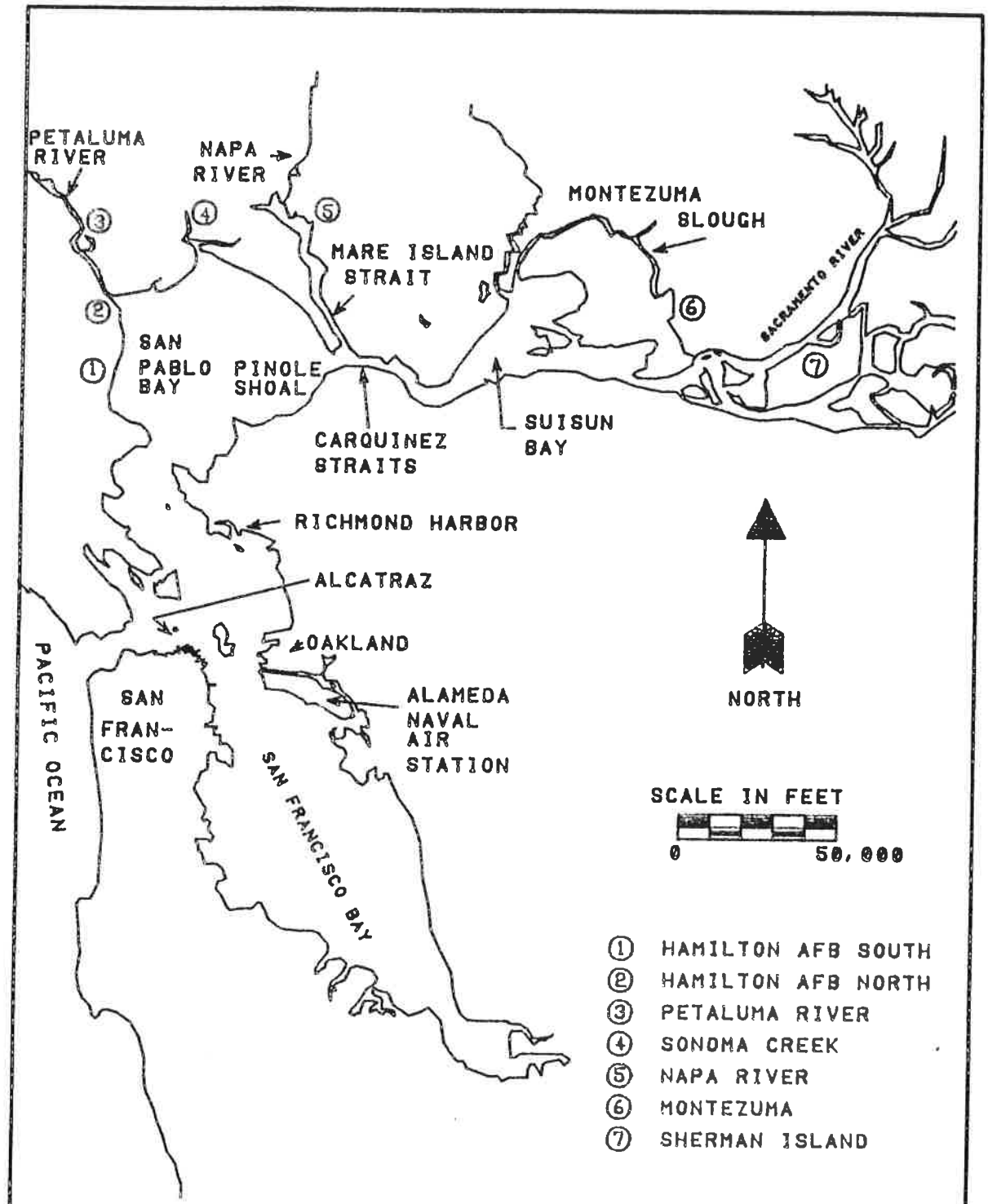
[4] San Francisco Bay Conservation and Development Commission. See Appendix C for a discussion of regulatory agencies and their jurisdictions.



DREDGED MATERIAL LAND DISPOSAL ALTERNATIVES

FIGURE 2: FEASIBLE DREDGED MATERIAL LAND DISPOSAL SITES
JANUARY, 1987

3. **Petaluma River:** Direct barge access unavailable without extensive Petaluma River dredging. Sonoma Land Trust owns Herzog Ranch (520 acres) and has option on approximately 800 additional acres. May require fill to increase elevations for planned mitigation projects. Permanent and reclamation/processing disposal site inconsistent with BCDC policy for diked historic baylands.

4. **Sonoma Creek:** Direct barge access remains unavailable to site. Permanent and reclamation/processing disposal site inconsistent with BCDC policy for diked historic baylands.

5. **Napa River:** Ownership is Southern Pacific Railroad, Novato Construction Company, AE&I Associates and private. Zoning is Industrial, Agriculture and Residential. Breeched dike in southwest portion has caused submerging of an area recently purchased by California State Lands Commission. Development underway on east-central portion of southern parcel.

6. **Montezuma:** Site owned by Santa Fe Pacific Realty. Zoning is Marsh Protection and Industrial Water Dependent.

7. **Sherman Island:** Owned by California Department of Fish & Game and private owners. Approximately 50 existing buildings; 200 people live on island. State listed rare plants on island (waterside). Plans exist for purchase of site by California Department of Water Resources. Site is within the jurisdiction of the Sacramento District, Corps of Engineers.

D. Infeasible Site Update

In addition to updating the seven feasible sites outlined above, an update of previously identified infeasible site possibilities was performed. These sites had been determined infeasible for disposal primarily because of pending development plans or incompatible existing uses. Site updates determined that these previous infeasible sites largely remained infeasible for permanent and reclamation disposal operations. The following summarizes the current status of these sites.

Aliviso-Milpitas: Pending development, reserved for future plant expansion.

South Fremont: Northern subarea almost entirely developed. Sanitary landfill operation exists on southern subarea. Development, including a general aviation airport, is planned on portions of the southern subarea. Wildlife refuge legislation currently pending in Congress would affect site.

North Fremont: Development plans are pending on agricultural portion of site. Wildlife refuge legislation currently pending in Congress may affect site.

Bair Island: The small separate parcel to the north of Steinberger Slough is under active development as part of the Redwood Shores Development. Development of the larger parcel opposite Steinberger Slough is planned, but not in the immediate future. Endangered species concerns State owned easternmost island.

Bay Farm Island: Developed.

Hayward Shorelands: Development applications pending. Extensive portions of the site under Section 10/404 jurisdiction. Endangered species concerns. Possible future fill requirement.

Avon: Landfill on site currently in closure; wetlands, uplands and contaminated ponds surround site.

Thomasson: Status unchanged. Lacks direct barge access; nine mile pumping distances required.

Travis AFB: Status unchanged. Lacks direct barge access: twelve mile pumping distances required.

Development plans are underway or are pending on the majority of remaining sites. In addition, sites in the South Bay may be affected by proposed legislation in Congress to increase wildlife refuge area there. Some sites awaiting development, such as Hayward Shorelands, will require substantial fill for development purposes and are included in Appendix B.

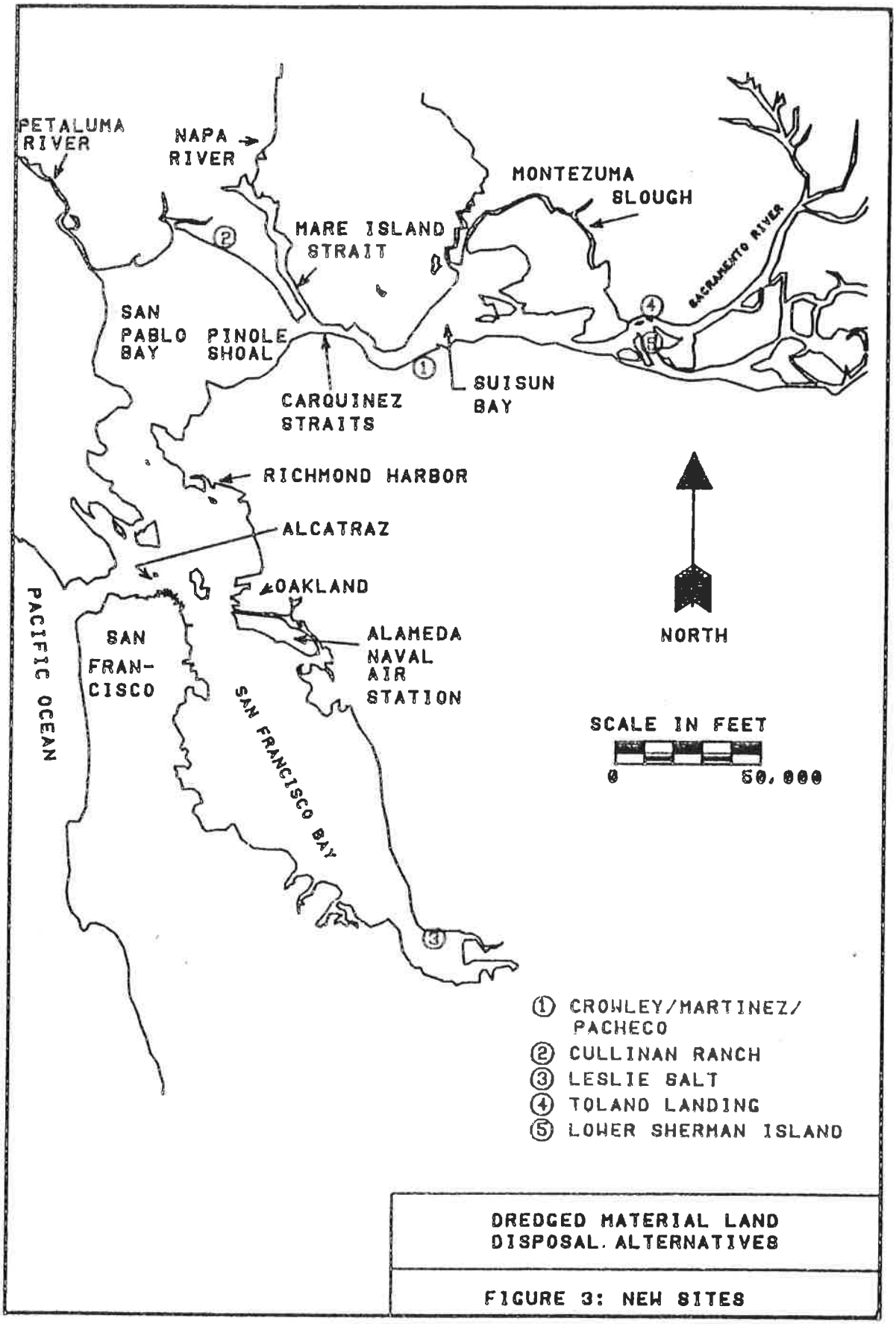
E. New Site Opportunities

New dredged material land disposal site opportunities were investigated. Field visits, discussions with local, state and federal agencies and developers and previous investigations were used to identify large, undeveloped sites with barge access.

Five new disposal site opportunities were identified and preliminary feasibility investigated. These sites are located on Figure 3: New Sites. In preliminary work, several independent areas near the mouth of Pacheco Creek in Suisun Bay were identified. For purposes of feasibility analysis, these sites were aggregated into a new "Crowley" site, Crowley/Martinez/Pacheco. New sites are summarized in the following paragraphs.

1. Crowley/Martinez/Pacheco: Located near mouth of Pacheco Creek on Suisun Bay, these sites are included in the same industrial area as the previously identified Avon site. As outlined in D. above, the previously identified Avon site is a sanitary landfill owned by Acme Fill Corp. which is currently being closed. Approximately 700,000 cubic yards of fill is required for the closure and is being supplied in part by excavation of material on the nearby Crowley property and trucking to the site. Existing elevations and soil stability questions resulting from the newly closed landfill preclude it from further consideration.

a. The Crowley portion of this site, located north of Waterfront Road and west of Pacheco Creek, consists of 175 acres of uplands surrounded by portions of seasonal wetlands. The site is currently owned by Crowley Maritime Corp. At the time of this report a 20 acre portion near the channel was in escrow. The purchaser planned to operate a resource recovery facility on the site. Another offer was pending on the balance of the site and the purchaser was planning on siting a solid waste recovery plant at the site. The site is less than 1,000 feet from the Stockton Ship Channel and is accessible by truck. BCDC has direct jurisdiction over the first 100' of shoreline and the site is zoned Industrial by Contra Costa County.



DREDGED MATERIAL LAND DISPOSAL ALTERNATIVES

FIGURE 3: NEW SITES

b. Martinez Terminal Ltd. owns the 70 acres directly west of Crowley. The site is for sale and is zoned Industrial by Contra Costa County. The site is outside BCDC jurisdiction. Site is approximately 1,500 feet from Stockton Ship Channel and is accompanied by a wharf which extends from the Crowley site to the edge of the channel. Martinez Terminals have a long term lease on a wetland strip from their site to the wharf.

c. Pacheco Creek includes properties owned by IT Corporation, the Martinez Gun Club, Contra Costa County Sanitation District, Tosco Corporation and other private parties. The Industrial zoning of these properties, their locations near water and their current uses as sanitary landfills, toxic waste ponds and other disposal-related uses, made them favorable candidates for disposal pending further investigation of technical issues.

2. Cullinan Ranch is a previously identified potential disposal site which was not studied in detail because of uncertainties about near-term availability. The site is located northwest of Mare Island and extends westward along the north side of Route 37. It is approximately 1,500 acres. Pending development of the site has stalled and the U.S. Fish and Wildlife Service is currently negotiating to purchase the site for wildlife preservation from its Japanese owners. Extensive portions of the site appear to be under Section 10 jurisdiction with smaller portions under Section 404 jurisdiction. The San Francisco District, Corps of Engineers, is currently mapping the site's wetlands to determine Section 10 and Section 404 jurisdictions. The site may provide habitat for the salt marsh harvest mouse. If US Fish & Wildlife is successful in purchasing the site, fill will likely be required to restore the site to tidal marsh.

3. Leslie Salt Ponds, located in South San Francisco Bay, require fill for dike enhancement and have been past dredged material disposal sites for Navy dredging of Guadalupe Slough. The site has potential requirement for fill to restore to tidal marsh as its salt pond usage declines. The salt ponds themselves, however, provide habitat for ducks and also have some fishery values. Discussions with U.S. Fish and Wildlife, National Marine Fisheries, Bay Conservation and Development Commission and California State Fish and Game indicate that because of the high existing habitat value of the salt ponds, it is unlikely they would favor abandoning the site's current habitat values to create tidal marsh. Pending Congressional legislation would include the Leslie Salt Ponds in the San Francisco Bay Wildlife Refuge.

4. Toland Landing is located east of Collinsville in the Lower Sacramento River delta. Site characteristics similar to Montezuma.

5. Lower Sherman Island is owned by the State Department of Fish and Game and is a wildlife management area. The island has barge access and is currently in the permitting stages for approval as a Sacramento River maintenance dredging disposal area. Disposed material will be used to increase elevations of the island and enhance its wildlife value. Its estimated capacity of one million cubic yards would not accommodate enough dredged material disposal to economically justify its development.

6. Additional development related fill requirements were identified and are summarized in Appendix B. However, they are generally constrained by 1) requirement for new technologies to complete, 2) regulatory concerns, 3) mitigation requirements and 4) timing. Because of these constraints, they are not included in further detailed analysis.

7. Habitat Creation

a. The Corps of Engineers has done considerable research on the beneficial uses of dredged material.[5] The emphasis throughout the United States on resource preservation has resulted in proven technologies for reclaiming dredged material for habitat enhancement as well as other uses.

b. Discussions with San Francisco Bay resource agencies often focused on the use of dredged material to construct marsh enhancement projects. Marsh creation projects often require extensive fill to increase elevations into the tidal range, especially where the site has been diked and lands have subsided. Repeatedly this use was characterized by agency representatives as being a disposal alternative most likely to be approved in San Francisco Bay. The issue is well illustrated by U.S. Fish & Wildlife[6].

> "While most of the coastal wetlands exist along the Alaskan, Atlantic and Gulf Coasts, San Francisco Bay represents an interesting example of tidal wetland alteration. San Francisco Bay is an important wintering area for waterfowl, especially whistling swans, pintails, shovelers, canvasbacks, scaup and ruddy ducks. Originally more than 200,000 acres of coastal marshes existed in the Bay region. Today, less than 20% remain. Most of the original wetlands were filled for urban and industrial development, while many remaining tidal marshlands were diked to create salt-evaporating ponds. Since 1976, coastal wetlands have been protected through the California State Coastal Act, while the San Francisco Bay Conservation and Development Commission has been active in wetlands preservation since 1969. Efforts are now needed to restore degraded or modified wetlands to a more natural condition, so that they can once again serve as valuable fish and wildlife habitats."

Besides wide public appeal, marsh creation projects provide new biological communities, erosion control potential and may have economic benefits if they provide a disposal area for dredged material.

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[5] U.S. Army Corps of Engineers Beneficial Uses of Dredged Material, EM 1110-2-5026, June, 1987

[6] U.S. Fish and Wildlife, Wetlands of the United States: Current Status and Recent Trends, U.S. Department of the Interior, March, 1984

EVALUATION CRITERIA

DEVELOPMENT

IV. EVALUATION CRITERIA DEVELOPMENT

A. Critical Issues

1. The initial step in potential dredged material disposal site evaluation criteria development was to identify critical issues surrounding disposal in San Francisco Bay. Identified critical issues are predominantly regulatory-related as opposed to being driven by engineering or economic criteria. It can be reasoned that economics drive the initial selection of upland disposal sites by requiring them to be near water, therefore causing the wetland and regulatory issues to assume predominance. The following issues were identified as critical.

a. Permanent disposal and/or reclamation operations of dredged material in wetlands is generally inconsistent with regulatory policy but may be allowed with on-site mitigation and satisfaction of the Section 404(b)(1) guidelines.

b. Permanent disposal **and/or** reclamation/processing of dredged material within diked historic baylands is generally inconsistent with BCDC policies and would likely be resisted by BCDC. However, BCDC, with certain exceptions, generally has no regulatory authority behind dikes.

c. Sites with endangered species and/or critical habitat will not be approved for permanent and/or reclamation disposal operations unless "reasonable and prudent" alternatives are developed.

d. Site acceptability and approval is dependent on the interaction, consensus building and negotiation between an applicant and a variety of resource agencies with different mandates and objectives. It is unpredictable.

e. Dredged material disposal operations require waterfront site for transfer facility with permanent disposal site within 8,000 feet of the transfer station.

2. Based on the critical issues identified, evaluation criteria were developed to guide selection of the most feasible alternatives. Evaluation criteria are separated into four areas: environmental, engineering, economic and institutional.

a. Environmental criteria focus on the wetland issues that will ultimately affect regulatory approvals. Discussion with agency representatives indicated that for regulatory purposes, no significant distinction exists between year-around wetlands and seasonal wetlands. This determination in effect negates the conclusions made in earlier studies that reclamation/reprocessing disposal activities would likely be approved in seasonal wetlands. The following environmental criteria were applied in the evaluation process.

(1) **Less than 25% of site is wetland with on-site/in-kind mitigation available.** Preservation of wetlands is a high priority. Where wetlands are involved, on-site mitigation is preferred. Based on West Coast experience, when more than 25% of the site is dedicated to mitigation, it tends to create diseconomies for developing the balance of the site because of the impacts on available land for development.

(2) **No designated endangered species and/or critical habitat exist on the site.** Sites with endangered species and/or critical habitat will generally not survive the regulatory approval process.

b. Engineering/Economic criteria establish minimum standards for site design, based on accepted disposal site design criteria. The following engineering/economic criteria were applied in the evaluation process.

(1) **Boundaries: Within San Francisco Bay upstream to Sherman Island.** Upland disposal sites should be within reasonable proximity of dredging sites to avoid high costs associated with long haul and pumping distances.

(2) **Site Accessibility:**

(a) **Minimum Water Depth at MLLW, not less than 15' to allow scows of 1,500 to 3,000 cyd capacity minimum.** Scows must have enough draft to pull aside the pumpout facility.

(b) **Waterfront site available and permittable for a landing and pumpout facility. Site should be a minimum of 500' long, 100' in depth and front on the water at depths, with minor dredging, of 15' MLLW.** Site for pumpout facility is required to be available throughout the life of the disposal operation.

(c) **The closest edge of the usable portion of the disposal area should be within 8,000 feet of the landing for the pumpout facility.** Material dredged from San Francisco Bay can be pumped this distance without the addition of booster pumps.

(d) **A pipeline easement or right-of-way must be attainable between the pumpout landing and the disposal area within the 8,000 foot distance criteria.** The pumpout facility and pipeline right-of-way must be available and permittable for the life of the disposal operation.

(3) **Diking and Retention of Material:**

(a) **Retention dikes to 12 feet high feasible with native material.** Material for dike construction should be available on-site to avoid the costs of importing suitable dike materials.

(b) **Soils will support dikes to 12' high.** Native soils should support dike construction without the expenses associated with extensive site consolidation and preparation measures.

(c) **Gravity or natural drainage available for return water.** Gravity based drainage systems allow the disposal area to continue draining over time without the expense and maintenance of complex pumping systems.

(d) **Natural drainage can accept clean brackish water.** The dredging areas will be in salt water resulting in pumpout slurries being salty or brackish.

(e) **Minimum of 8.0 million cubic yards of capacity available.** To determine costs and analyze feasibility, it is necessary to establish a minimum site size and annual volume. A site size of 8.0 million cubic yards and annual volumes of 800,000 cubic yards provides a large enough capacity to amortize improvements and provide for a ten year site life.

(4) **Minimum Annual Volume for Planning Purposes: 800,000 cyd/year or 2x1,500 cyd barges per working day.** See 3(e) above.

c. Institutional criteria include regulatory and jurisdictional factors most likely to affect site permitting. Institutional criteria are closely tied to environmental criteria since land use designations, zoning and special protection areas are generally most affected by environmental site characteristics. Institutional criteria applied during site evaluation are outlined below.

(1) **Priority sites are existing Agricultural land use, not covered by Williamson Act Agreement.** Sites not restricted to agricultural use under the Williamson Act generally provide long term availability, low land costs and lower potential for impact on existing activities.

(2) **Priority sites are zoned for Industrial/Water Dependent Industry.** Sites zoned through local planning processes as Industrial/Water Dependent have been subjected to an initial needs analysis and have been determined suitable for water dependent industrial development.

TABLE 1
EVALUATION CRITERIA SUMMARY

ENVIRONMENTAL:

- Less than 25% of site is wetland with on-site/in-kind mitigation available.
- No designated endangered species or critical habitat exist on the site.

ENGINEERING/ ECONOMIC:

- **Boundaries:** Within San Francisco Bay upstream to Sherman Island.
- **Site Accessibility:** Minimum Water Depth at MLLW, not less than 15' to allow scows of 1,500 to 3,000 cyd capacity minimum.

  Waterfront site available and permittable for a landing and pumpout facility. Site should be a minimum of 500' long, 100' in depth and front on the water at depths, with minor dredging, of 15' MLLW.

  The closest edge of the usable portion of the disposal area should be within 8,000 feet of the landing for the pumpout facility.

  A pipeline easement or right of way must be attainable between landing and the disposal area within the 8,000 foot distance criteria.
- **Diking and Retention of Material:** Retention dikes to 12' high feasible with native material.

  Soils will support dikes to 12' high.

  Gravity or natural drainage available for return water.

  Natural drainage can accept clean brackish water.

  Minimum of 8.0 million cubic yards of capacity available.
- **Minimum Annual Volume for Planning Purposes:** 800,000 cyd/year or 2x1,500 cyd barges per working day.

INSTITUTIONAL:

- Priority sites are existing Agricultural land use, not covered by Williamson Act Agreement.
- Priority sites are zoned Industrial/Water Dependent Industry.

FINAL SITE

CONSIDERATIONS

V. FINAL SITE CONSIDERATIONS

A. Reclamation/Reprocessing

1. Previous investigations[7] identified construction fill and landfill cover as feasible alternatives to permanent upland disposal of dredged material. The same study also recognized that supply exceeds demand for fill, and Bay mud and silts dredged from normal maintenance projects are not an optimum material for reuse.

2. Approximately 0.5 million cubic yards of material are required for landfill cover in the study area per year. Landfill closure plans may be subject to prolonged permitting processes themselves, making their demand for fill material unreliable. The small yardage requirements and undependable timelines, combined with economic inefficiencies in siting a reprocessing operation to maximize its landfill market, led to dropping reclamation/processing sites as feasible for detailed analysis.

3. Requirements for construction fill are discussed in III.A.6 above and Appendix B.

B. Wetlands Designations

1. As discussed in Section IV.A. **Critical Issues,** dredged material disposal on sites containing wetlands raise critical regulatory issues which must be considered in assessing overall site feasibility. It was not possible within the scope of this study to inventory and evaluate specific wetlands, or to determine jurisdictional relationships. Based on meetings with resource agencies and review of applicable agency policies and regulations it is clear that early resolution of site-specific wetlands issues is of key importance to final site selection and development.

2. The regulatory framework for wetlands considerations is reviewed in Appendix C. The principal agencies with regulatory authority responsible for wetlands protection are the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, Regional Water Quality Control Board and the Bay Conservation and Development Commission. In addition, a number of trustee agencies function in an advisory capacity to the regulatory agencies, including U.S. Fish and Wildlife Service, National Marine Fisheries Service, California Department of Fish and Game, California Resources Agency and the State Lands Commission. Much of the regulatory authority is overlapping among the agencies, with similar, but not identical, requirements, policies and areas of jurisdiction. Within the regulatory framework, interpretive flexibility exists, which can result in conflicting determinations for a given project proposal. This confirms the need for resolution of wetlands issues early in the project planning process.

3. The thrust of the interagency regulatory approach to protection of wetlands is contained in comprehensive Guidelines promulgated by EPA under Section 404(b)(1) of the federal Clean Water Act. The Guidelines do not permit discharges to public waters (filling of wetlands) if there is a feasible alternative which would have less impact on the aquatic ecosystem. Under application of the Guidelines, fill of wetlands is permitted only under the following conditions:

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[7] U.S. Army Corps of Engineers, Dredged Disposal Alternatives Study, Task 1: Sand Reuse, San Francisco District, December, 1986

- o If the proposed project is **water dependent,** requiring access or proximity to water to fulfill its basic purpose. (Disposal of dredged material for navigation channel development and maintenance are not deemed water dependent by U.S. Fish and Wildlife and the Environmental Protection Agency although arguments have been promulgated to the contrary.[8])

- o If the project is **not** water dependent, alternatives that do not involve wetland fill are presumed available. A wetland fill can be permitted only if no other feasible alternative exists. The applicant must clearly demonstrate that all practicable alternatives have been considered and that no feasible alternative is available.

- o Justification for a wetland fill requires selection of the alternative having the least adverse impacts. Non-wetland alternatives are presumed to have lesser adverse impacts unless clearly demonstrated otherwise.

- o All practicable steps are taken to minimize adverse impacts, including mitigation of unavoidable adverse impacts.

4. The essence of the Guidelines is that wetland fills can only be permitted if they are water dependent and/or there are no feasible alternatives with lesser adverse impacts. All practicable alternatives must be identified and evaluated in selecting the project and in minimizing (mitigating) unavoidable adverse impacts.

5. Individual agency approaches vary from basic positions opposing all wetland fills, with a view toward preservation and enhancement, to recognizing the need to fill certain areas for substantial public benefit, such as port, airport, water related industry, and waterfront park, provided that there are no feasible alternatives and impacts are mitigated. Within this context it is not practical to expect agency consensus and commitment for filling wetlands with dredged materials without a comprehensive and site-specific process involving identification and evaluation of wetlands, alternative sites and methods, and impacts. Such a major undertaking is beyond the scope of this feasibility level study.

6. The approach used to select alternative disposal sites for this study was based on Fish & Wildlife Service National Wetlands Inventory Maps, review of U.S. Fish and Wildlife[9] and Corps of Engineers[10] methodologies, field reconnaissance and the experience of the study team. It was not possible within the study timeframe to secure Corps of Engineers site-specific wetlands delineation and determination of values. Best judgement was applied to select alternatives with minimum apparent impacts on wetlands and with potential on-site mitigation capability. Preference was also given to sites with existing local/state planning designations for water dependent industrial uses. No specific

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[8] Boerger, Frank C., Harding-Lawson Associates, "Landfill Problems in San Francisco Bay", 1987

[9] U.S. Department of the Interior, Fish and Wildlife Service, "Classification of Wetlands and Deepwater Habitats of the United States", 1979

[10] Department of the Army, U.S. Army Corps of Engineers, "Corps of Engineers Wetlands Delineation Manual, Final Report, TR Y-87-1", Waterways Experiment Station, 1987

evaluation of wetlands values was conducted nor did this study consider alternatives other than upland disposal. These latter elements are critical to future successful selection and development of any proposed filling of wetlands for disposal of dredged materials.

7. Resolution of wetlands issues must be accomplished within the framework of interagency application of the Section 404(b)(1) or similar state/local Guidelines. Ultimate success will be measured by agency approvals of the selected final plan after complete evaluation of applicable alternatives. Based on discussion with resource agencies it is unlikely that the necessary findings can be made without site-specific consideration of alternatives and impacts. Opportunities to fully consider and resolve wetlands issues are limited by agency resources. Consequently, agencies are generally best able to input and commit to alternatives in a framework requiring formal comment/approval based on a site specific proposal.

8. Requirements for proceeding with final selection of alternatives for maintenance dredging needs are contained in Corps regulations "Discharge of Dredged Materials into Waters of the U. S. or Ocean Waters; Operation and Maintenance; Final Rule (33 CFR Parts 209, 335 through 338, April 26, 1988). This Rule provides the procedural and technical requirements for identifying and evaluating dredged material disposal alternatives as the basis for final site/method selection. Central to the process is preparation of an Environmental Assessment and/or Environmental Impact Statement identifying and evaluating all practicable alternatives and providing the opportunity for agency and public input.

9. Within the above Rule, it is recognized that "Most wetland areas constitute a productive and valuable resource, the unnecessary alteration or destruction of which should be discouraged as contrary to the public interest." (Sect. 336.1 (c)(4)). Section 404(b)(1) Guidelines provide the basis for selecting alternatives based on needs and minimizing environmental impacts. Site-specific determinations are the necessary basis for evaluating alternatives; therefore, the following initial steps are important to effective evaluation of proposed wetland sites:

a. Site-specific wetlands inventory and related determination of wetlands values by Corps of Engineers regulatory staff. This will provide the basis for early input and decisions concerning the prospect of approvable filling and options for mitigation. It will also provide a common basis of knowledge necessary to effective agency/public input.

b. Early review and input by key resource agencies. While not required, this step can result in effective communication at a time when planning input can be best utilized.

c. Identification of all practicable alternatives, including other than wetland fills. For Corps of Engineers Operation & Maintenance projects in San Francisco Bay, such alternatives may include in-water disposal to ocean and/or Bay sites.

10. In summary, most feasible upland disposal sites for dredged materials from San Francisco Bay appear to contain wetland areas subject to varied interagency jurisdictions. Although protection of wetlands is given highest priority by all agencies, some filling of wetlands may be approvable where justified by public benefit and a clear demonstration that alternatives with lesser impacts are not available and unavoidable impacts are mitigated. Final site selections are dependent on site-specific considerations appropriately developed within a comprehensive study of all practicable alternatives

required under section 404(b)(1) Guidelines. A formal planning framework will help insure effective agency input and commitment to site selection. Proceeding directly to final selection of dredged materials disposal sites under the comprehensive planning requirements of 33 CFR Parts 209, 335 through 338 appears to provide the needed forum for identifying and resolving related wetlands issues.

SITE ANALYSIS

VI. SITE ANALYSIS

A. A weighted system was developed for evaluating sites based on the environmental, engineering, economic and institutional criteria. If a site was considered feasible regarding a criterion, it was given a value of "1". If the site was considered marginally feasible, or inadequacies could be overcome by engineering or prolonged timelines, the site was given a value of "2". Infeasible site characteristics were valued at "3". High priority sites were those with the resulting lowest values.

B. Original sites often encompassed two or more existing uses, land or zoning designations, separate parcels or other characteristics that require a combined rating. In these instances, ratings were combined. For instance, a site with both Agriculture and Residential zoning would receive a rating of "2": a "3" rating for Residential combined with a "1" for Agriculture.

C. Sites rated during final evaluation are listed below.

(1) Hamilton AFB South
(2) Hamilton AFB North
(3) Petaluma River
(4) Sonoma Creek
(5) Napa River
(6) Montezuma
(7) Sherman Island
(8) Crowley/Martinez/Pacheco
(9) Cullinan Ranch
(10) Leslie Salt Ponds
(11) Toland Landing
(12) Lower Sherman Island

Evaluations are summarized on Table 2: Site Evaluation Summary. The wetlands/mitigation issues are the most significant factors affecting site acceptability. This is primarily because earlier studies determined that fill in seasonal wetlands would, in the case of reclamation/processing sites, be compatible. This study does not carry that theory forward. (See BCDC discussion in Appendix C.)

D. Three final sites resulted from the evaluation process: Napa River, Montezuma and Crowley/Martinez/Pacheco. These three sites had a final ratings in the 7 - 9 range. Although Hamilton AFB North and South rated 10 each, their poor ratings on wetlands issues and poor accessibility did not support their inclusion in final site analysis and design.

Additional site visits were made to the final sites. Further information was developed for each site to assist in site evaluation. Data was mapped to a 1" = 2000' scale as overlays to aerial photographs of the sites. Specific data required for site engineering and further analysis is depicted on those maps and summarized below:

- Zoning, Land Use and Jurisdictions
- Topographic

The final sites are illustrated in Figures 4 through 9.

TABLE 2

SITE EVALUATION SUMMARY

CRITERIA	Crowley/Martinez/Pacheco	Cullinan Ranch	Hamilton AFB North	Hamilton AFB South	Leslie Salt	Lower Sherman Island	Montezuma	Napa River	Petaluma River	Sherman Island	Sonoma Creek	Toland Landing
Wetlands/Mitigation	1	2	3	3	3	3	2	1	3	3	3	1
Critical Habitat	1	3	1	1	2	2	2	1	2	1	1	1
Boundaries	1	1	1	1	1	1	1	1	1	1	1	3
Site Accessibility	1	1	2	2	1	1	1	1	3	1	3	1
Diking and Retention	1	1	1	1	3	1	1	1	1	1	1	1
Volume	2	1	1	1	1	3	1	1	1	3	2	3
Zoning	1	3	1	1	3	1	1	1	3	1	1	1
RATING:	8	12	10	10	14	12	9	7	14	11	12	11

Rating Key:

Feasible: 1

Marginal: 2

Infeasible: 3


SOLANO COUNTY
STATE OF CALIFORNIA
NOT IN USE
WRECKING YARD
CITY OF MARTINEZ
CONTRA COSTA COUNTY
MARTINEZ TERMINAL
NOT IN USE
ACME LAND FILL
PONDS
BCDC DIKED HISTORIC BAYLAND STUDY LINE
Industrial
Residential
CROCKETT
PERO

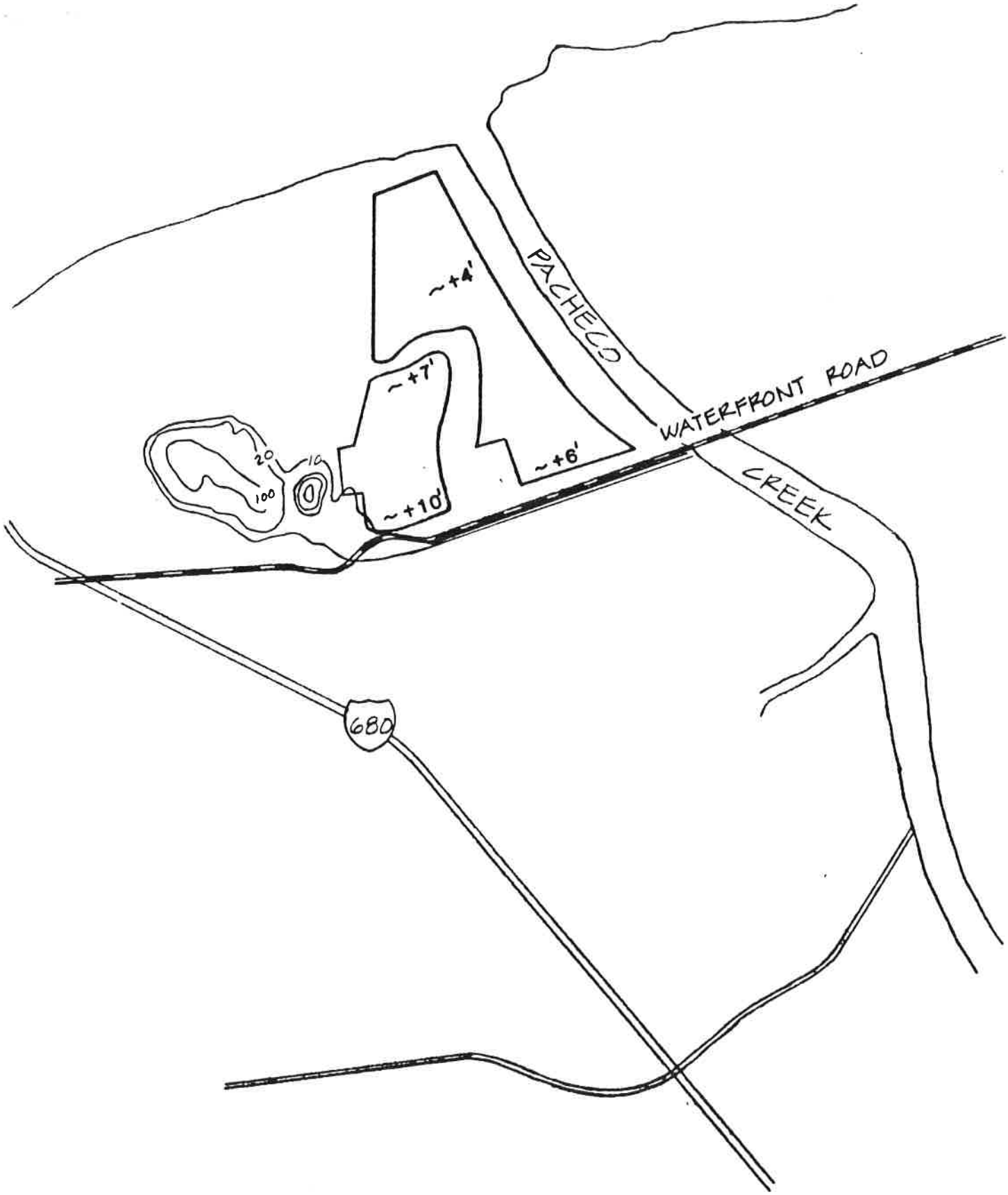


FIG. 5

CROWLEY SITE: TOPOGRAPHIC INFORMATION

SCALE: 1" = 2000' (APPROX.)

DISPOSAL SITE OPERATION

AND DESIGN

VII. DISPOSAL SITE OPERATION AND DESIGN

The purpose of this section is to provide (1) an overview of operations generic to upland dredged material disposal and (2) site-specific design features for Crowley, Napa River and Montezuma sites.

A. *Disposal Site Operation*

The upland dredged material disposal sites covered in this report would require the following elements.

- Real estate acquisition or lease of acreage for pumpout facility, pipeline right-of-way and disposal site.
- Construction and maintenance of an in-water or shoreside docking and pumpout facility with discharge pipe and right-of-way to the confined upland disposal site.
- Initial site preparation, including dike construction, permanent installation of discharge pipe and wye connections as necessary, construction of drop box style overflow weirs and return channel for slurry water.
- Continuing operation of the site as a dredged material disposal site after initial site preparation.
- Closure of the disposal site, including removal of pumpout facility, discharge pipe and overflow weirs, conditioning of sediments and final construction of habitat restoration features, revegetation and/or other actions for compatible end-use and erosion control.

1. Containment dikes would be constructed to form a confined surface area into which the dredged sediments would be pumped. Loaded barges would dock at the pumpout facility and hook up to the discharge pipeline. The dredged material would be hydraulically pumped into containment areas in an approximate 25% sediment and 75% water slurry. The pipeline to the containment area would be approximately 24" inside diameter and would discharge into the diked area from temporary shorepipe positioned along the top of the dike.

2. Dredged materials are be composed of a wide range of sediment grain sizes, from medium sands to fine silts and clays. The coarser materials, such as sand and in some cases clay balls (grain sizes greater than No. 200 sieve), would rapidly fall out of slurry suspension near the dredge discharge pipe location, forming a mound. Fine grained materials would continue to disperse throughout the containment area with most solids settling out of suspension.

3. Routine control and repositioning of the discharge pipe along the disposal site perimeter is necessary to avoid excessive mound formation. Repositioning also assures uniform deposition of the discharged sediments throughout the total surface area enclosed by the dikes. Usually, the dredging contractor using the site is responsible for the discharge pipe position and other site maintenance during disposal.

4. To promote effective sediment distribution and maintain slurry effluent water quality, ponded water elevations are controlled in a confined disposal area by the elevation of the weir crest. Pond elevations are adjusted routinely during the life of the site as the thickness of the deposition layer increases. Slurry effluent flow rate for Napa,

Crowley and Montezuma sites would be approximately equal to influent sediment slurry flow rates. Withdrawal of clarified water from the top few inches of the disposal pond surface is controlled by the length of weir provided. A minimum ponding depth greater than one (1) foot assures little or no resuspension of the sediments into the overflow that becomes return effluent water.

5. Site designs for the Napa, Crowley and Montezuma sites include a drop inlet sluice. This type of sluice is the most common type of discharge facility. It consists of a vertical inlet riser connected to an outlet pipe leading from the base of the riser through the dike to the exterior of the confined disposal area. The inlet structure is typically a wood or metal framed overflow drop box that allows variable inlet elevation and ponding depths through use of a gate or stoplogs. These stoplogs can be added or removed as necessary to raise or lower the ponding depth. Crest of the inlet structure becomes the overflow weir, and crest length controls the surface water depth that is allowed to pass through the outlet pipe.

6. Surface and subsurface site elements are affected differently at disposal sites depending on such factors as sediment characteristics, rate of deposition, and design of the site. Generally, disposal operations aim for a consistent elevation, or flat surface, at the conclusion of disposal. The surface condition therefore is a factor of the type of sediments deposited, combined with volume and capacity. Surface elements can be affected, as in the case of habitat restoration, to achieve a certain end use. Regarding subsurface characteristics, consolidation of the annual dredged sediment layers and settlement of existing ground sediments under the weight of the deposits would occur. Continued dike surveillance would be necessary to identify and correct significant top of dike elevation changes or loss of dike integrity due to foundation settlement. This settlement and material consolidation would also cause a decrease in the volume occupied by the deposited layers and a corresponding increase in storage capacity for future disposal. Following each annual dredging period, a dewatering activity such as continuous trenching, lowering of the weir stoplogs and other actions would allow surface water to decant and assists natural drying forces to dewater the dredged materials. Timely consolidation contributes to maximizing site storage capacity.

7. Continued dewatering, revegetation, and other action for disposal site closure follows completion of disposal. Depending on the planned end use, disposal sites may be compacted, graded, revegetated, or left as is until a specific use is designated.

B. *Disposal Site Design*

Engineering and cost estimates were developed for the three disposal sites considered acceptable under the criteria established. Site engineering for Crowley, Napa River and Montezuma is discussed in detail in this section.

1. Crowley

a. Site Description

(1) The Crowley site is located at the western end of Suisun Bay near the community of Avon. The "Crowley" site proposed in the 1987 Corps of Engineers investigation was south of Waterfront Road and west of Pacheco Creek. This site was precluded from feasibility because of its existing sanitary landfill use. During this investigation, a site to the north of Waterfront Road was identified and is the actual site considered feasible as an upland confined disposal area.

(2) Crowley includes two parcels of land as identified in Figure 10. The larger parcel is owned by Crowley Maritime, Inc. and includes approximately 173 acres of diked land. Site visits revealed that the site had apparently been diked and filled during three separate filling operations in the past. Operations to screen existing fill sediments and truck haul them to the sanitary landfill site across Waterfront Road for cover materials were occurring during this investigation. The entire site is void of any vegetation except a narrow corridor extending riverward from a midpoint of the site. This corridor of vegetation provides drainage for a wetland adjacent the parcel and between the two proposed disposal areas.

(3) The smaller parcel is approximately 75 acres owned by the Martinez Terminals. It has been filled to an elevation above that of the Crowley site. Bare earth with some volunteer upland vegetation was present.

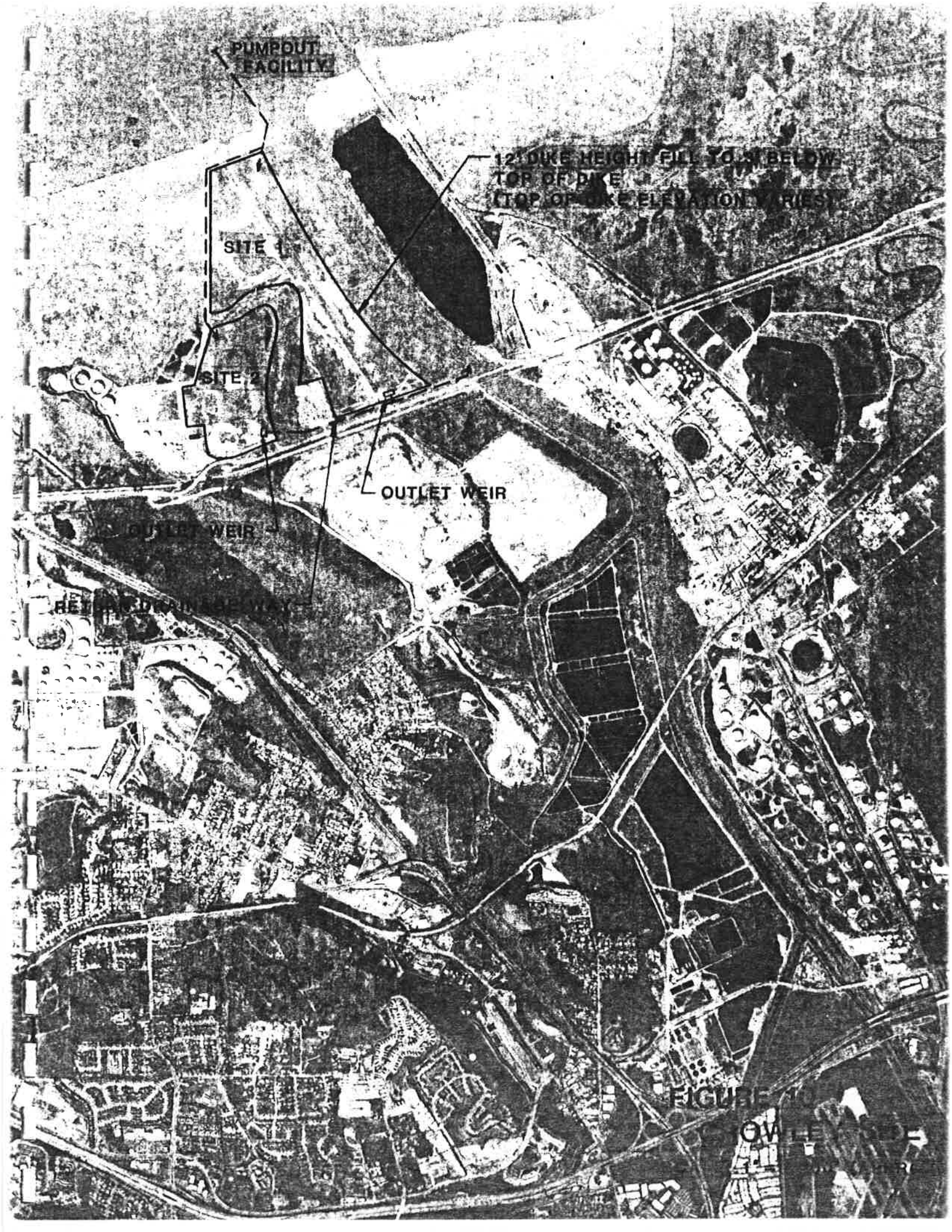
b. Proposed Site Development

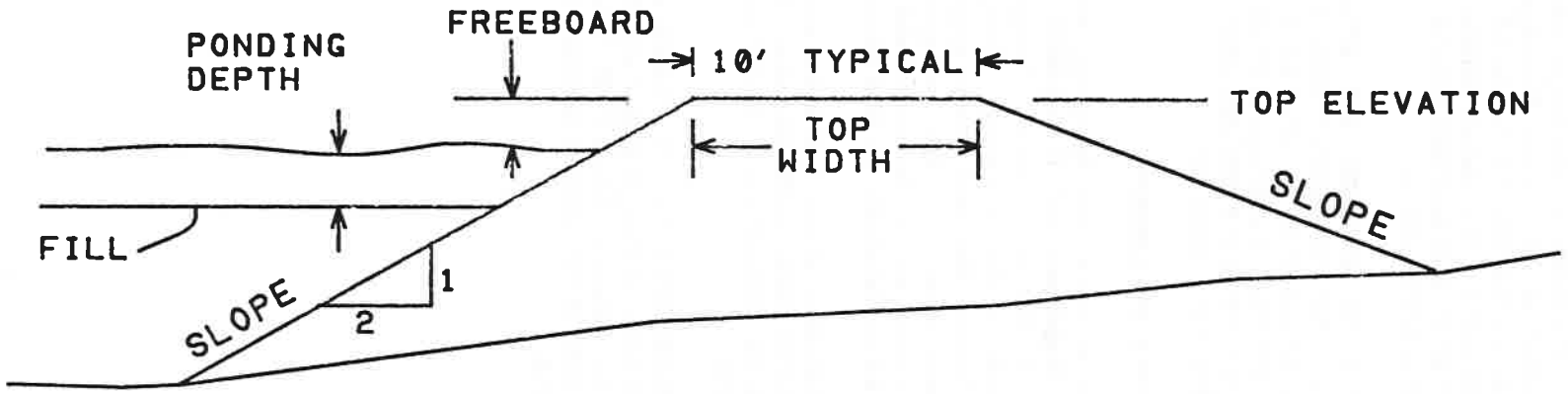
(1) To accommodate upland disposal of dredged material, the site would be diked to an elevation of approximately 20 feet, with 12 foot high dikes above the existing ground elevation. Dike construction can be accomplished using sediments on site, providing the ongoing sediment removal for sanitary landfill cover does not exhaust the sediment volume.

(2) Dike cross sections would provide a typical one on two (1:2) slope with a ten (10) foot top width. Approximately 15,400 lineal feet of dike on the Crowley parcel and 7,600 lineal feet on the Martinez Terminals parcel would require 284,000 cubic yards of sediment. This equals removal of approximately one foot of sediment from the Crowley parcel and the Martinez Terminals parcel. Typical dike cross section is illustrated in Figure 11.

(3) Dike elevations of 12 feet provide a typical fill elevation of nine (9) feet over the site, allowing a minimum of two (2) foot freeboard and a one (1) foot ponding depth at the overflow weir. A one (1) foot ponding depth is considered adequate for sediment retention and effluent water quality for the barge pumpout system operation. A minimum ponding depth assures no settled solids would be resuspended by the higher local velocities created from local flow concentrations near the weir overflow. As a general rule, a minimum two (2) foot ponding depth is often identified as adequate to avoid resuspension. However, resuspension is a function of both the ponding depth and the weir length, with a longer weir creating less chance for local velocities to resuspend sediments at any depth. A one (1) foot ponding depth and influent rate of 47 cfs requires a weir length of 150 feet or more. Final design length would depend on effluent standards imposed. Also, a ponding depth less than two (2) feet at each site would be experienced only during the deposition of the final one (1) foot of site fill.

(4) The dredged material pumpout facility is proposed to be placed along the navigation channel at a distance from the shoreline commensurate with the existing Martinez Terminals dock and the upstream dock facility. This placement allows use of the site by both haul barges and hopper dredges equipped with pumpout hook ups. Pumpout would discharge sediment slurries into northern ends of both the Crowley and Martinez parcels. Discharge pipe would be placed along the bottom and anchored. Pipe would remain unburied to allow for raising the pipe if future repairs are required.


PUMPOUT FACILITY
12' DIKE HEIGHT FILL TO 3' BELOW TOP OF DIKE
TOP OF DIKE ELEVATION VARIES
SITE 1
SITE 2
OUTLET WEIR
OUTLET WEIR



DREDGED MATERIAL LAND
DISPOSAL ALTERNATIVES

FIGURE 11: TYPICAL DIKE CROSS SECTION

(5) The pipeline extension to the Martinez parcel is proposed to be placed along the dike and cross the wetland area between the two parcels on a suspended support. Capability to discharge into either site would be provided by placement of a wye section at the Crowley discharge location. This option extends the life of a site since it allows the intermittent use of a site while dewatering and settlement of another site takes place. This allows continued use and longer site life by providing necessary ponding depth and sediment volume capacity that would be lost if sediments were saturated with a bulked volume.

(6) Ponding elevation and effluent return would be controlled by installing a drop box weir structure approximately at the location illustrated in Figure 10. Effluent waters are proposed to be returned to Pacheco Creek via a discharge culvert through the dikes and along a drainage ditch adjacent Waterfront Road. Proposed location of the drop box weir structures provides good hydraulic conditions for sediment retention time and slurry flow within each site.

c. Site Hydraulics and Capacity

(1) Guidelines for site hydraulics and capacity analysis are available in U.S. Army Corps of Engineers EM 1110-2-5027, Confined Disposal of Dredged Material and were used in the following analysis. Design procedures presented in the EM are based on gravity settling of dredged solids. Design data from laboratory testing would be required for the Crowley site final design analysis. For purposes of preliminary design, sample values were taken from data and curves available for similar conditions. Conclusions in this section are to be considered representative of the sediment types to be dredged, but are not adequate for final design.

(2) Evaluation of site hydraulics and capacity is based on an average sediment input of 800,000 cubic yards per year. For planning purposes, typical daily sediment discharge into the disposal site is 16,200 cubic yards. Reference the cost estimate section of this report.

(3) Median grain size of dredged sediments was derived from the U.S. Army Corps of Engineers, Dredge Disposal Alternatives Study, Task 1, Sand Reuse, December, 1986 and are based on Corps FY86 maintenace dredging data. Applying the four dredging areas, a ratio of fine grained sediment to sand size sediments was developed as identified in Table 3.

TABLE 3
SEDIMENT CHARACTERISTICS OF DREDGED SEDIMENTS BY PROJECT

Project	Median Size (mm)	% Sand (> #200)	Total (cyds)	Sand (cyds)	Fines (cyds)
Oakland	.005	7	500,000	35,000	465,000
Richmond	.006	5	900,000	45,000	855,000
Pinole Sh	.115	70	250,000	175,000	75,000
Mare Isl	.003	2	800,000	16,000	784,000
	Totals		**2,450,000**	**271,000**	**2,179,000**

(4) Laboratory settling test data would determine the dredged material slurry settling process. Depending on test results, the material slurry would settle either by zone processes or flocculent processes. Zone processes are common for salt water sediments and have been assumed for this site evaluation.

(5) For 800,000 cubic yards annual disposal at the Crowley site, the estimated bulking factor for fine grained sediments is 1.76. This equates to a total disposal site volume of 1,425,000 cubic yards of bulked fine grained sediments and 70,000 cubic yards of sand materials not bulked. This represents sediment volume immediately following dredging and pumpout disposal at the site.

(6) The Crowley site has a diked area of 248 acres. The bulked sediment volume would occupy 3.7 feet of disposal site fill thickness at the end of the first year. This filling would result over an approximate time of 62 dredging days. Assuming a ponding depth of one (1) foot or greater, the retention time of the dredged sediment slurry would be a minimum of 32 hours in the Crowley site and 15 hours in the Martinez Terminals site. Referencing data curves from EM 1110-2-5027, the suspended sediments concentration profile would have less than 9% and 25% of the initial suspended sediment concentration in the ponded water column for Crowley and Martinez sites, respectively.

(7) The Crowley site has a hydraulic inefficiencies factor of 1.76, based on the length to width ratio of 3.3. A minimum area requirement for zone sedimentation at this site is 40 acres, assuming a zone settling velocity of 0.24 feet per second. The Martinez Terminal site has a hydraulic inefficiency factor of 2.11, and requires a minimum of 47.5 acres surface area.

(8) Weir requirements for zone settling and a one foot ponding depth were determined by applying the approach illustrated in Figure 12. Design flow for the disposal site is based on the pumpout system discharge of 38 cubic feet per second dredged sediment slurry. A 150 foot length weir is required.

(9) Long term management of the site would include removal of ponded water by controlling weir elevation after each year's site use. The relatively thin lift thickness of the annual disposal quantity would dewater quickly and should approach total consolidation prior to the start of the next year's maintenance

dredging and disposal activities. Concurrent use of both the Crowley and Martinez sites during any one year would be most effective. Life of the Crowley disposal site would approach 4.5 years at 800,000 cubic yards per annum.

d. Site Issues

(1) Site Availability: This site is presently zoned as Industrial. Based on recent transactions, land costs are between $40,000 and $60,000 per acre. The site has recent buy/sell activity and is considered available in this price range.

Martinez Terminals is presently undergoing bankruptcy proceedings. In this process the Martinez site may be sold to a developer prior to 1989. Buyer's intended use of the site is presently unknown.

(2) Wetland Concerns: It is proposed to use the entire Crowley site as identified in Figure 10. This would include the narrow strip presently used for drainage which is approximately 1.9 acres of marginal wetland. To mitigate for this loss, the expansion of the existing wetland area between the two disposal parcels could be accomplished by excavation of the Crowley parcel. This would replace two (2) acres of marginal wetland with two acres of improved wetland, and maintain the site uniformity for disposal without additional diking requirements.

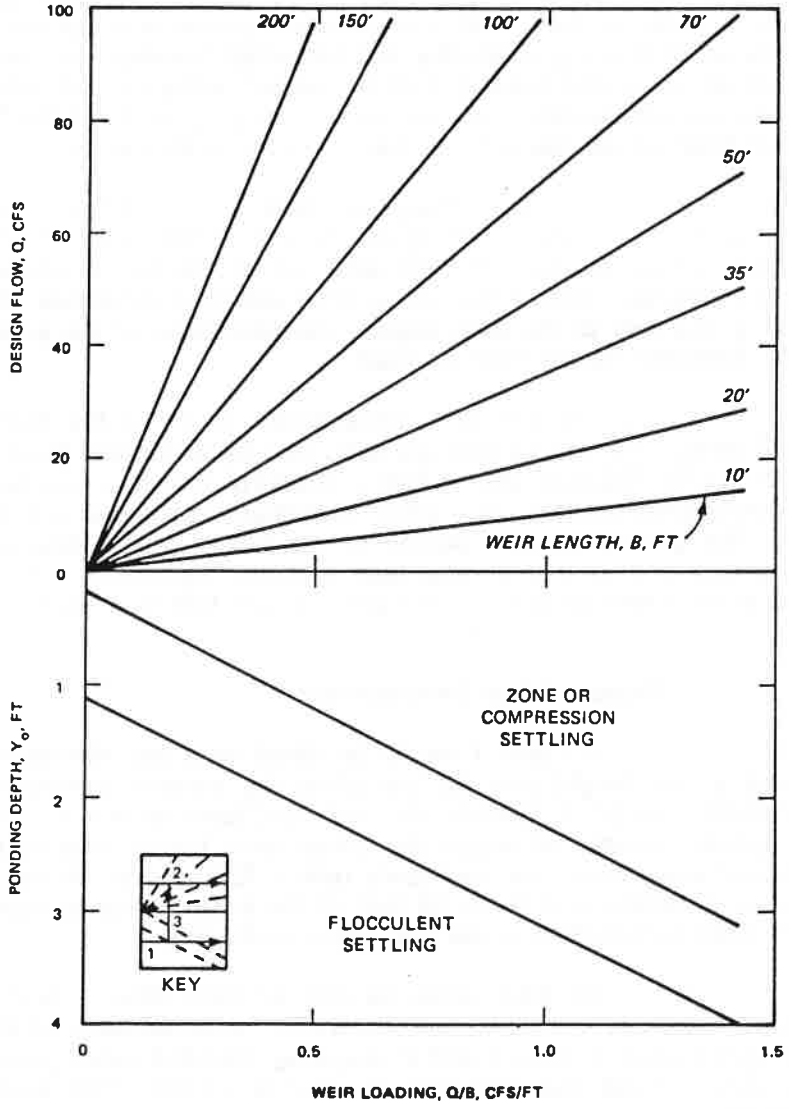


FIGURE 12: DREDGED MATERIAL LAND DISPOSAL ALTERNATIVES, WEIR DESIGN NOMOGRAPH

2. Napa River

a. Site Description

(1) The original Napa River site encompassed 200 acres in a northern parcel and 1,000 acres in a southern parcel, located adjacent to and east of Napa River. The majority of the 1,000 acre southern parcel was deleted from further consideration because of existing residential and industrial development, land elevations, historic bayland diked areas and existing Port of Oakland wetlands and mitigation areas. The final areas considered available are two parcels located south of the Napa County airport and east of approximate Napa River mile 8. Refer to Figure 13.

(2) The primary site, Site 1, is a 470 acre tract presently under ownership of Southern Pacific Railroad, Novato Construction Company, AE&I Associates, and two private parties. Present land use at this site is pasture/agriculture and the zoning is Industrial. Site 1 has an existing elevation difference of +15 feet at the west edge to a +45 feet at the east edge. The east edge of the property abuts a branch line of the Southern Pacific Railroad track.

(3) Site 2 is immediately south of the first site and is approximately 330 acres. The two parcels are separated by residential property, a branch track of Southern Pacific Railroad and industrial property that has two tenants at this time. Site 2 covers approximately 200 acres of pasture/agriculture and 130 acres of forested upland. The general eastern portion of the site is zoned Industrial, while the remaining pasture land and all the forested land is zoned Agriculture. This parcel also slopes from east to west with an eastern elevation of +25 feet to a western elevation of +5 feet.

b. Proposed Site Development

(1) Site 1 would be diked to a top elevation of +43 feet mllw. This means a dike height over 12 feet along the western perimeter of the site, exceeding the criteria outlined in Section IV. Soil conditions at this site are a dense, sandy silt that appear capable of supporting dikes over twenty feet in height. More detailed geotechnical evaluations are necessary before final design. Actual dike heights would vary between a minimum of three (3) feet at the eastern limit to about 28 feet at the western limit. Dike construction would use native sediments.

(2) Dike cross section for both Sites 1 and 2 include a typical one on two (1:2) slope with a 10 foot top width. Approximately 26,950 lineal feet of dike would be constructed in Sites 1 and 2, requiring 838,000 cubic yards of material. Site 1 requires 13,900 lineal feet and Site 2 requires 13,050. This material can be obtained from the site.

(3) Site 1 dike top elevation of +43' mllw provides a typical fill elevation of +40', allowing a minimum of two (2) feet freeboard and one (1) foot overflow. Site 2 dike top elevation would be at + 25 feet, providing a fill elevation of +22 feet and allowing a minimum of two (2) feet freeboard and one (1) foot ponding. A one (1) foot ponding depth is considered adequate for sediment retention and effluent water quality for the barge pumpout system operation. A minimum ponding depth assures no settled solids are resuspended by the higher local velocities created from local flow concentrations near the weir overflow. As a general rule, a minimum two (2) foot ponding depth is often identified as adequate to avoid resuspension. However, resuspension is a function of both the ponding depth and the weir length, with a longer weir creating less chance for local velocities to resuspend sediments at any depth. A one (1) foot ponding depth and influent rate of 47 cfs requires a weir length of 150 feet or more. Final design length would depend on effluent standards imposed. Also, a ponding depth less than two (2) feet at each site would be experienced only during the deposition of the final one (1) foot of site fill.

(4) Two pumpout facilities would be placed in the river along the navigation channel. Site 1 proposal includes a pumpout station located at Duttons Landing, approximate river mile 8, immediately downstream of the railroad bridge. Discharge pipe is proposed to come ashore adjacent and south of the railroad right-of-way, then parallel that right-of-way to the disposal site. The discharge pipe would cross under the railroad right-of-way through an existing drainage structure to avoid the need for tunneling under the rail. Length of the discharge line approaches 8,000 feet.

(5) Site 2 can use the same structure as Site 1 with a wye located in the discharge line at the intersection of Green Island Road and the branch track. This creates a line length for Site 2 of 8,000 feet. An alternative would be to construct a second pumpout facility located at approximate river mile 5. Discharge line from that site would be 4,500 feet. Reference Figure 13.

(6) A discharge line of 8,000 feet approaches the maximum line length considered feasible for a sandy silts without a booster pump. Pumpout discharge rates are low at this distance for the proposed pumpout design horsepower. See Section IX for pumpout system discussion .

(7) Ponding elevation and effluent return would be controlled by a drop box weir structure located as illustrated in Figure 13 Effluent waters would be returned to the Napa River via discharge culvert through the dike and along a drainage ditch adjacent the Airport property to Green Island Road for Site 1 and along an extension of the Green Island Road ditch for Site 2. The proposed drop box weir structure locations provide a good hydraulic condition for sediment retention, avoid flow short circuiting in the fill and allow the fill materials to more evenly spread across the entire site during pumpout.

a. Site Hydraulics and Capacity

(1) Design data from laboratory testing must be obtained to complete future final design analysis as provided in EM 1110-2-5027. For site evaluation purposes, sample values were taken from data and curves available in the manual. Conclusions in this section are to be considered representative of the sediment types to be dredged, but are not adequate for final design.

(2) Evaluation of site hydraulics and capacity is based on an average sediment input of 800,000 cubic yards per year. Physical characteristics of the sediments to be disposed are characterized in Table 3. Laboratory settling test data is required to determine the dredged material slurry settling process. Depending on those test results, the material slurry would settle either by zone processes or flocculent processes. Zone processes are common for salt water sediments and have been assumed for this site evaluation.

(3) For an annual 800,000 cubic yards disposal at the Napa River site, the estimated bulking factor for fine grained sediments is 1.76 based on data in EM 1110-2-5027. This equates to a total volume in the disposal site of 1,425,000 cubic yards of bulked fine grained sediments and 70,000 cubic yards of sand materials that were not bulked. This represents sediment volume immediately following dredging and pumpout disposal at the site.

(4) The Napa River site includes two areas considered feasible for dredged sediment disposal. Site 1 has a diked area of 470 acres and Site 2 has a diked area of 330 acres to total 800 acres. The bulked sediment volume would occupy 1.4 feet of disposal site fill thickness at the end of the first year. Filling would occur over approximately 62 dredging days. Assuming a ponding depth of one (1) foot or greater, the retention time of the dredged sediment slurry would be a minimum of 127 hours in Site 1 and 55 hours in Site 2. Referencing data curves from EM 1110-2-5027 depicted in Figure 14, the suspended sediments concentration profile is predicted to have significantly less than 8% of the initial suspended sediment concentration in the ponded water column for either site.

(5) Site 1 has a hydraulic inefficiencies factor of 3.24, based on the length to width ratio of 1.4. A minimum area requirement for zone sedimentation at this site is 73 acres, assuming a zone settling velocity of 0.24 feet per second. Site 2 has a hydraulic inefficiency factor of 2.46, based on a length to width ratio of two (2). This requires an estimated minimum of 55 acres surface area. Both minimum requirements are easily satisfied by the available diked areas of both sites, and interior dikes or multiple weirs to improve hydraulic efficiency are not required.

(6) Weir requirements for zone settling and a one foot ponding depth were determined by application of Figure 9. Design flow for the disposal site is based on the pumpout system discharge of 65 cubic feet per second dredged sediment slurry. A 200 foot length weir is required. Typical weir configuration is illustrated in Figure 15.

(7) Long term management of the site should include removal of ponded water by controlling weir elevation after each year's site use. The thin lift thickness of 1.4 feet bulked for annual disposal quantity would dewater quickly and should approach total consolidation prior to the start of the next year's dredging and disposal activities. Concurrent use of Sites 1 and 2 during any one year would not be required. Life of the Napa River site approaches 20 years at 800,000 cubic yards per annum. With availability of only Site 1, it would be 11 years and with only Site 2 it would be 9 years.

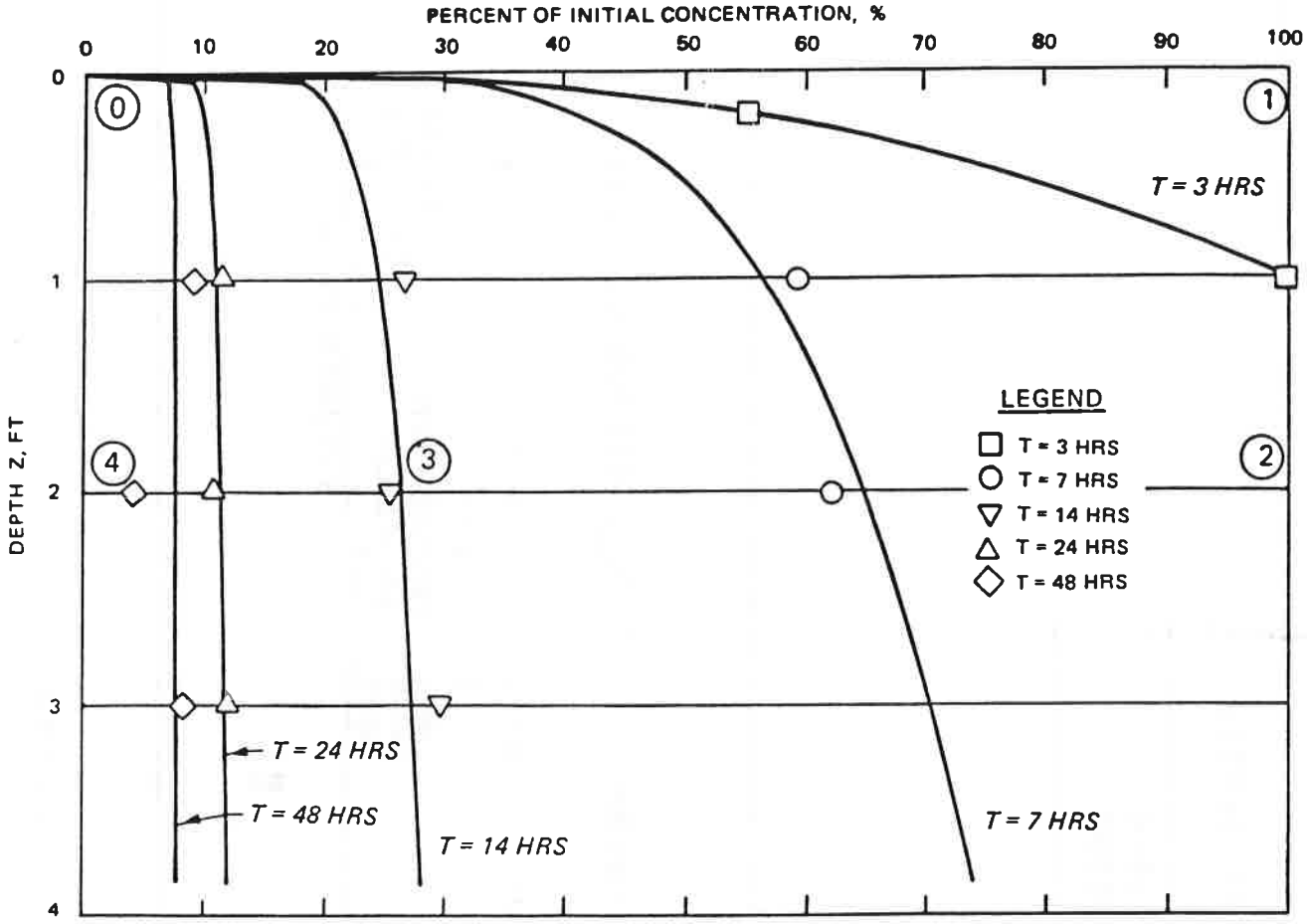
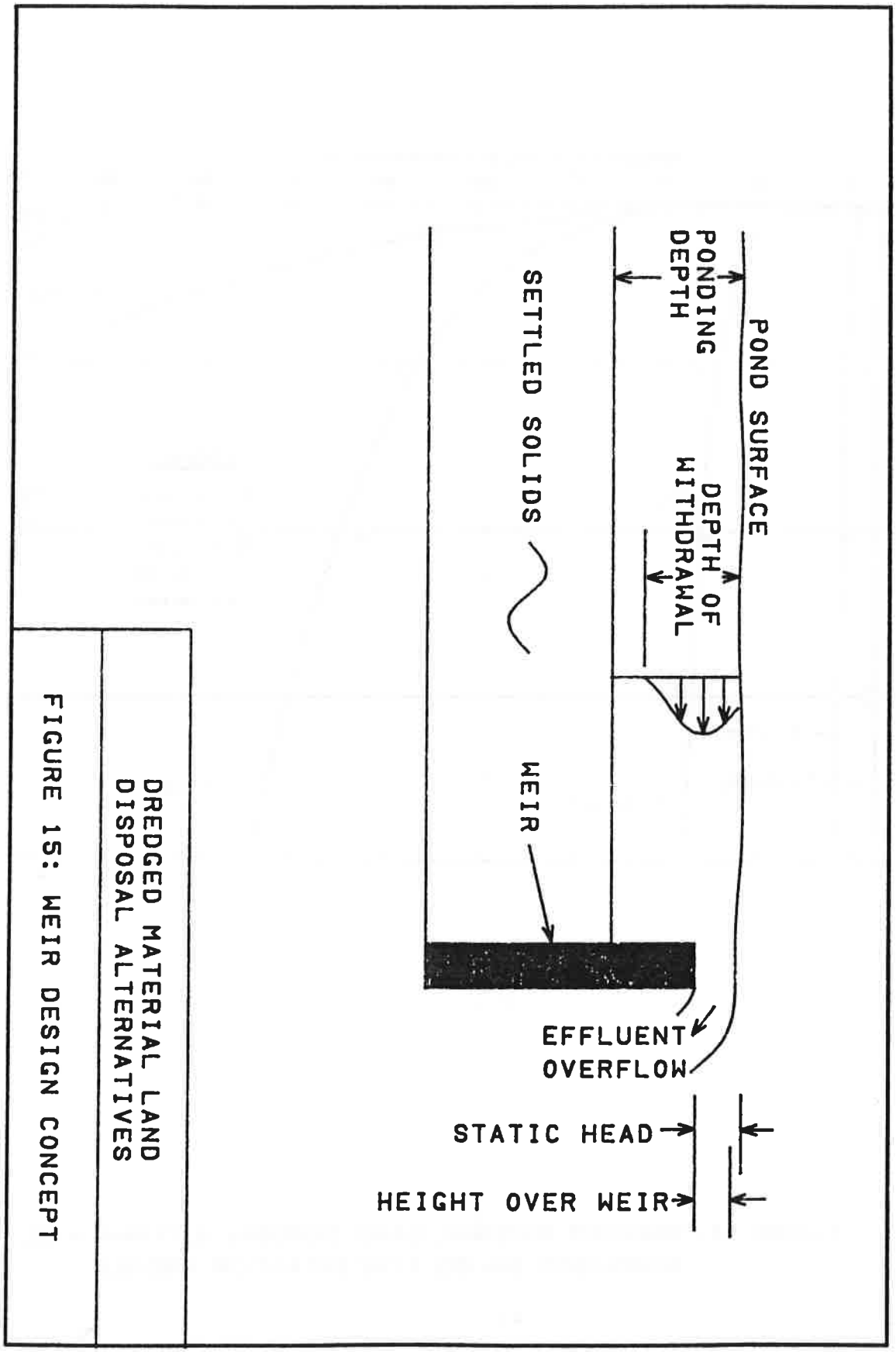


FIGURE 14: DREDGED MATERIAL LAND DISPOSAL ALTERNATIVES, SUSPENDED SOLIDS CONCENTRATION PROFILE


POND SURFACE
PONDING DEPTH
DEPTH OF WITHDRAWAL
SETTLED SOLIDS
WEIR
EFFLUENT OVERFLOW
STATIC HEAD
HEIGHT OVER WEIR
DREDGED MATERIAL LAND DISPOSAL ALTERNATIVES
FIGURE 15: WEIR DESIGN CONCEPT

d. Site Issues

(1) Site Availability: During field investigation, road construction was ongoing along Green Island Road from Highway 12 to the Kirk and Hatch Engine Industrial plant. Site 2 disposal site dikes would be constructed around the south and west limit of Kirk and Hatch. Setback of Site 1 from Green River Road and setback of Site 2 west of the apparent industrial sites could alleviate immediate development problems.

(2) Vegetation: Site 2 has approximately 120 acres of forested land. Public concern regarding loss of established trees may be a problem. This may be addressed by associating project development with upland habitat creation. No identified endangered species or habitat has been associated with the area.

(3) Channel Depths: Channel depths in Napa River are given as 15' from Mare Island Causeway to Goodluck Point, approximate river mile 6. Controlling depth from Goodluck Point to Duttons Landing is 7.6' (US Corps of Engineers, Sept. 1987). The upstream controlling depth limits use of larger barges with draft requirements approaching 13'-16' (Great Lakes, 1988). Maintenance dredging of the Napa River channel is scheduled for September and October of 1988.

(4) Wetland Concerns: Approximately 15 acres of wetlands exist within the proposed diked limits of Site 2. This wetland area is zoned Agriculture. Nine (9) acres of this wetland could be mitigated by setback of dike alignment and excavation for dike materials in what is now upland to create nine acres of replacement wetland. This would mitigate wetland loss while providing better disposal area hydraulics and less diking volume.

(5) Habitat Creation: Wetland habitat creation opportunity exists along the southwestern limits of Site 2. This area is presently a diked seasonally flooded wetland within the limits of historic diked wetlands.

3. Montezuma Slough Site

a. Site Description

(1) The Montezuma Slough Site is designed to meet two objectives: 1) requirements for upland disposal and 2) requirements for increased wetland habitat values in San Francisco Bay. Salt and fresh water marsh habitat is proposed to be created on one-third of the total designated site area.

(2) The Montezuma site is located east of Montezuma Slough and north of the Sacramento River. It parallels the Collinsville Road as a long, narrow disposal area from Birds Landing to the Sacramento River at Collinsville, approximately 4.4 miles. The entire site is presently in pasture or has scrub shrub growth.

(3) The Montezuma site has two distinct land features. The total area is primarily upland with the remainder classified as seasonally flooded or semipermanently flooded wetland. Site 1, the southern area, covers 310 acres and is predominantly dike impounded seasonally flooded wetland. The northern area, Site 2,

covers 750 acres and is primarily upland with some seasonally flooded or semipermanently flooded wetland that is dike impounded. The major wetlands in Site 2 are part of the Clank Hollow drainage basin.

(4) Site 3 is a 520 acre area immediately west of Site 1. The site is predominantly low elevation land that is currently protected by flood dike structures. Existing ground elevations within the area are typically at 0 to -5 mllw. The site is wetland with apparent marginal wetland value. To create salt marsh habitat, dredged material would be placed on the site to increase elevations to a range of 0 to +5. Following disposal to achieve the appropriate elevations, finger channels and tributaries would be constructed, the site revegetated and dikes removed to create an enhanced wetland marsh area.

b. Proposed Site Development

(1) Sites 1 and 2 would be separated into two disposal cells by construction of a cross dike along the Montezuma Slough salt gate access road. This dike would extend from the +15 foot elevation contour to the slough dike at the salt gate structure.

(2) Site 1 is south of the salt gate cross dike. A majority of the area has ground elevations of 0 mllw. It would have dike top elevations of + 12 feet. Site 2 would have dike construction on three sides and take advantage of the site slope conditions for the east side containment of pumpout slurries. Dike top elevations for Site 2 will approach +17 foot mllw elevation. Existing ground elevations along the proposed dike alignment are +5. Dike alignment as depicted in Figure 16 will be along the existing flood dike structure and the old railroad fill. Total dike volume approaches 585,000 cubic yards for Sites 1 and 2 dike structures. Materials for both Sites 1 and 2 dikes are assumed to be obtained from Site 2 for purpose of conservative concept design and cost estimating purposes. Site 1 is predominantly low, with elevations at or near 0 mllw. Site 2 has higher elevations and would not appear to have groundwater problems with borrow excavation for the dikes. Field investigations to confirm geotechnical characteristics will be necessary prior to final design.

(3) Dike elevations provide a top of fill elevation at +9 feet in Site 1 and + 14 feet in Site 2. This is based on a two (2) foot freeboard and a one (1) foot ponding depth at the end of site fill. A one (1) foot ponding depth is considered adequate for sediment retention and effluent water quality for the barge pumpout system operation. A minimum ponding depth assures no settled solids will be resuspended by the higher local velocities created from local flow concentrations near the weir overflow. As a general rule, a minimum two (2) foot ponding depth is often identified as adequate to avoid resuspension. However, resuspension is a function of both the ponding depth and the weir length, with a longer weir creating less chance for local velocities to resuspend sediments at any depth. A one (1) foot ponding depth and influent rate of 47 cfs will require a weir length of 150 feet or more. Final design length will depend on effluent standards imposed. Also, a ponding depth less than two (2) feet at each site will be experienced only during the deposition of the final one (1) foot of site fill.

(4) Two pumpout facilities are provided for in this disposal site plan. A pumpout station is located adjacent the Sacramento River channel in water depths adequate for hopper dredges as well as access for large and small haul barges. This pumpout station will serve Site 1 disposal as well as Site 3 for proposed marsh creation and enhancement. Discharge line lengths approach 2500 to 3500 feet.

(5) A second pumpout facility is located in Montezuma Slough immediately south of the new salt gate. Discharge pipeline length can be relatively short at this station, approaching 2000 feet.

(6) Ponding elevation and effluent return are controlled by drop box weir structures located at the northwest corner and southwest corner of Sites 1 and 2 respectively. Effluent waters are returned by a drainage ditch to the Montezuma Slough at a location downstream of the salt gate structure.

(7) The basis for recommending two pumpout stations and overflow weir structure positioning is to maintain fresh water conditions in the slough and adjacent wetlands above the salt gate. Saline waters reaching the slough as overflow effluent will always be below the salt gate structure and cross dike. Location of the drop box weir structures as proposed will also provide a good hydraulic condition within the areas for sediment retention, avoid short circuiting of slurry water and allow the fill materials to distribute evenly along the sites during pumpout operations.

c. Site Hydraulics and Capacity

(1) Guidelines for site hydraulics and capacity analysis were obtained from EM 1110-2-5027, Confined Disposal of Dredged Material. The design procedures presented in that document are based on gravity settling of dredged solids. Design data from laboratory testing must be obtained to complete future final design analysis. In an effort to evaluate the sites, sample values were taken from data and from curves available in the manual. Conclusions in this section are to be considered representative of the sediment types to be dredged, but are not adequate for final design.

(2) Evaluation of the site hydraulics and capacity is based on an average sediment input of 800,000 cubic yards per year. For conservative design purposes and to avoid site overloading, it has been assumed that two projects would be ongoing at the same time to establish a typical daily sediment input to the disposal site of 16,200 cubic yards per day. This was derived from the daily average dredging rate per project of 8,100 cubic yards per day.

(3) Physical characteristics of the sediments to be dredged are summarized in Table 3. Laboratory settling test data will determine the dredged material slurry settling process. Depending on those test results, the material slurry will settle either by zone processes or flocculent processes. Zone processes are common for salt water sediments and have been assumed for this site evaluation.

(4) For the 800,000 cubic yards of annual disposal at Montezuma, the estimated bulking factor for fine grained sediments is 1.76. This equals a total volume in the disposal site of 1,425,000 cubic yards of bulked fine grained sediments and 70,000 cubic yards of unbulked sand materials. This represents sediment volume immediately following dredging and pumpout disposal at the site.

(5) The Montezuma site is separated into three areas for dredged sediment disposal. Site 1 has a diked area of 310 acres, Site 2 has a diked area of 750 acres and Site 3 a diked area of 520 acres to total 1580 acres. The bulked sediment volume will occupy 0.9 feet of disposal site fill thickness at the end of the first year. This filling will result over an approximate time of 62 dredging days. Assuming a

ponding depth of one (1) foot or greater, the retention time of the dredged sediment slurry is a minimum of 57 hours in Site 1 and 139 hours in Site 2. The suspended sediments concentration profile is predicted to have significantly less than 8% of the initial suspended sediment concentration in the ponded water column for either site.

(6) Site 3 accommodates disposal of materials in the diked lowland area immediately west of Site 1 for intertidal marsh creation. Approximately 520 acres of salt marsh habitat will be created and enhanced within the diked area south of the salt gate and west of the Site 1 disposal site. Approximately three years of dredged disposal material, or 2.6 million cubic yards of sediments, will be pumped behind existing dikes where existing elevations are typically 0' mllw. A disposal volume of 2.6 million cubic yards will raise the site the typical three (3) feet to five (5) necessary to create suitable salt marsh habitat. Material will be dewatered, channeled for feeder tributaries and revegetated with Pacific glasswort, saltwort and other plants appropriate to the California coastal salt and brackish wetlands. Flood dikes will then be removed and the area opened to natural tidal movement of the bay waters.

(a) Site 3 fill will be placed through use of the Site 1 pumpout station, and diverting discharge pipe into the marsh habitat area. This will be done prior to removal of the flood levees now present. Fill elevation within the site would be controlled by construction of confinement berms to control the sediment slurry movement and sediment settlement through the site. An overflow weir structure to remove slurry effluent from behind the flood levees is required.

(b) Actual marsh construction and site enhancement will follow after final disposal and subsequent dewatering of the dredged sediments. This would occur after an estimated three years of marsh site filling by diverted pumpout sediments. The disposal fill will create an area that has an average elevation of +2.5' mllw. Finger channels will then be excavated into the site, with the channel excavation placed in piles to form gentle mounds for varied ground elevation and site diversity. The final action prior to removing the flood levees will be ground conditioning and revegetation of the site with suitable marsh plantings. The site would then be open to the bay waters.

(7) Site 1 has a hydraulic inefficiencies factor of 3.67, based on the length to width ratio of 1.2. A minimum area requirement for zone sedimentation at this site is 83 acres, assuming a zone settling velocity of 0.24 feet per second. Site 2 has a hydraulic inefficiency factor of 1.15, based on a length to width ratio of 11. This requires an estimated minimum of 26 acres surface area. Both minimum requirements are easily satisfied by the available diked areas of both sites, and interior dikes or multiple weirs to improve hydraulic efficiency are not required.

(a) Weir requirements for zone settling and a one foot ponding depth were determined by use of Figure 12. Design flow for the disposal site is based on the pumpout system discharge of 65 cubic feet per second dredged sediment slurry. A 200 foot length weir is required.

(b) Long term management of the site will include removal of ponded water by controlling weir elevation after each year's site use. The thin lift thickness of 0.9 feet bulked for annual disposal quantity will dewater quickly and should approach total consolidation prior to the start of the next year's dredging and disposal activities. Concurrent use of both areas for the Montezuma site during any one year would not be required.

(c) Disposal life of the Montezuma Slough site exceeds 18 years at 800,000 cubic yards per annum. With only Site 1 availability it is eight years, with only Site 2 it is seven years and with only Site 3 availability it is three years.

d. Site Issues

(1) Availability: The entire site is presently under single ownership of the Sante Fe Realty Company. The site is zoned Marsh Protection under the Suisun Bay Marsh Protection Plan and Industrial Water Dependent. For cost estimating purposes, land costs are estimated at $1,400 per acre based on discussions with the owner and realtors knowledgeable about the area.

(2) Wetland Concerns

(a) All of Site 1 is identified as seasonally flooded wetlands that are dike impounded. Mitigation for Site 1 wetland loss would occur on Site 3, the salt marsh creation project. This means that 310 acres of the 520 acre salt marsh creation project would mitigate directly for Site 1 losses. Enhancement measures would include limited fill of the site prior to dike removal, construction of intertidal and subtidal channels and vegetation propagation.

(b) Approximately 260 acres within Site 2 appear to be seasonally flooded wetlands. Mitigation for this wetland loss is planned by fresh water wetland enhancement of 150 acres in the lowland area between Site 2 and the Montezuma Slough, above the salt gate, or creation of a similar acreage of wetlands from existing upland immediately north of Site 2. Total wetland enhancement for Site 2 would also include 110 acres of the 520 acres of salt marsh benefits derived from Site 3.

COST ESTIMATES

VIII. DREDGING COST ESTIMATE

Cost estimates were developed for the four principal areas affecting upland dredged disposal site feasibility: dredging and transport, pumpout, disposal site construction and mitigation. The purpose of these report cost estimates is to provide a basis for evaluation of alternatives and decisionmaking regarding future action. The cost estimate section discusses the rationale and methodology applied to cost estimate development. Cost estimate details are contained in Appendix D.

A. Description of Dredging Areas

1. The dredging cost for each of the four major dredging areas was estimated for the three final disposal sites. The dredging areas considered were:

Oakland Inner/Outer Harbor
Richmond Harbor
Mare Island Strait
Pinole Shoal

2. These areas are shown in Figures 17, 18 and 19. Cost estimate details are summarized in Appendix D, Tables D1 through D4. A major factor in the cost estimate is the annual volume that needs to be removed from each dredging area. These quantities were obtained from the U.S. Army Corps of Engineers San Francisco District. In general, dredged quantities over the last 10 or 15 years were averaged to obtain an annual volume. As outlined in Section II.E., Richmond Harbor requires the largest volume of dredging at 900,000 cyds, Mare Island Strait requires 800,000 cyds, Oakland Inner/Outer Harbor requires 500,000 cyds and Pinole Shoal requires the least volume of dredging at 250,000 cyds.

B. The haul distance from each dredging site to each disposal site was plotted on navigation charts and measured. The shortest distance through navigable channels was used. This distance ranged from 6.5 nautical miles to 47 nautical miles. The distance to the Napa Site and the Crowley site were virtually the same except for dredging at Mare Island Strait. The distance to the Montezuma site is approximately 12 nautical miles further than to the other sites. These distances are only to the docking point of each disposal site. The cost associated with the distance necessary to carry the material in rehandling is covered in the disposal site cost figures. The haul distance is critical in the estimation of dredging costs since it determines the number of barges necessary to keep the dredging operation continually running.

C. Dredging and Hauling Equipment

1. Typical equipment size and capacity were chosen for the San Francisco Bay area. These were dependent upon the availability of equipment, the type of sediment being dredged, the quantity and geometry of the dredging project, and past experience in the area. The dredge chosen for this area was an 18 cyd bucket clamshell to cover a large area with each pass of the bucket. Although this dredge has an 18 cyd bucket, the average payload per swing was taken as only nine (9) cyds to account for overlap between bucket loads and limitation on depths of dredging. Typical available scows in the area range from 1,500 to 4,000 cyd capacity. The 3,000 cyd scow size was selected because of their availability and suitability to the shallower drafts on the Napa River. Since a pumpout system will be used at the disposal site, bottom dumping barges are not necessary. Tugs capable of handling 3,000 to 4,000 cyd scows are usually in the 1,200 to 1,500 horsepower range.

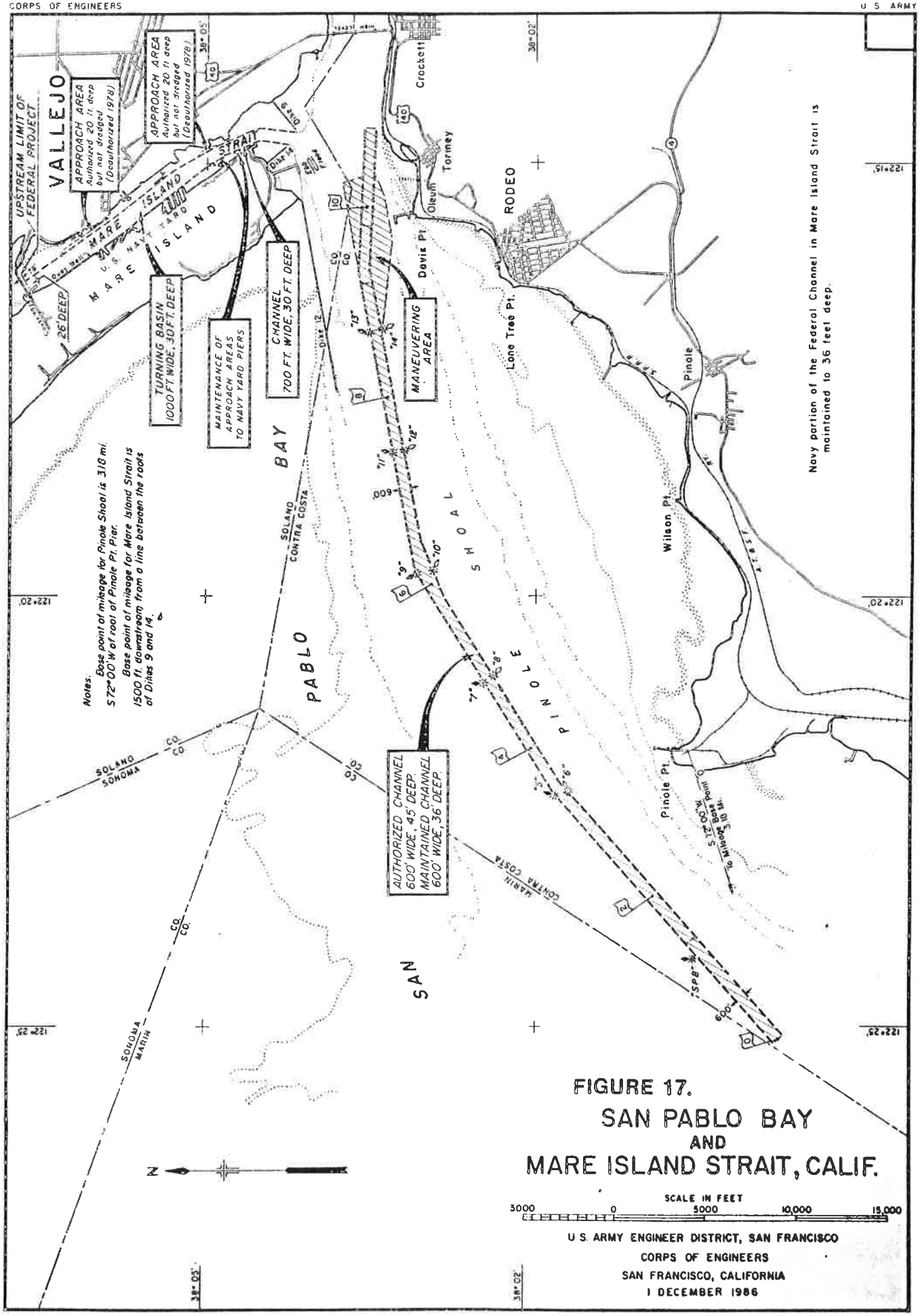


FIGURE 17.

SAN PABLO BAY AND MARE ISLAND STRAIT, CALIF.

U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO
CORPS OF ENGINEERS
SAN FRANCISCO, CALIFORNIA
1 DECEMBER 1986

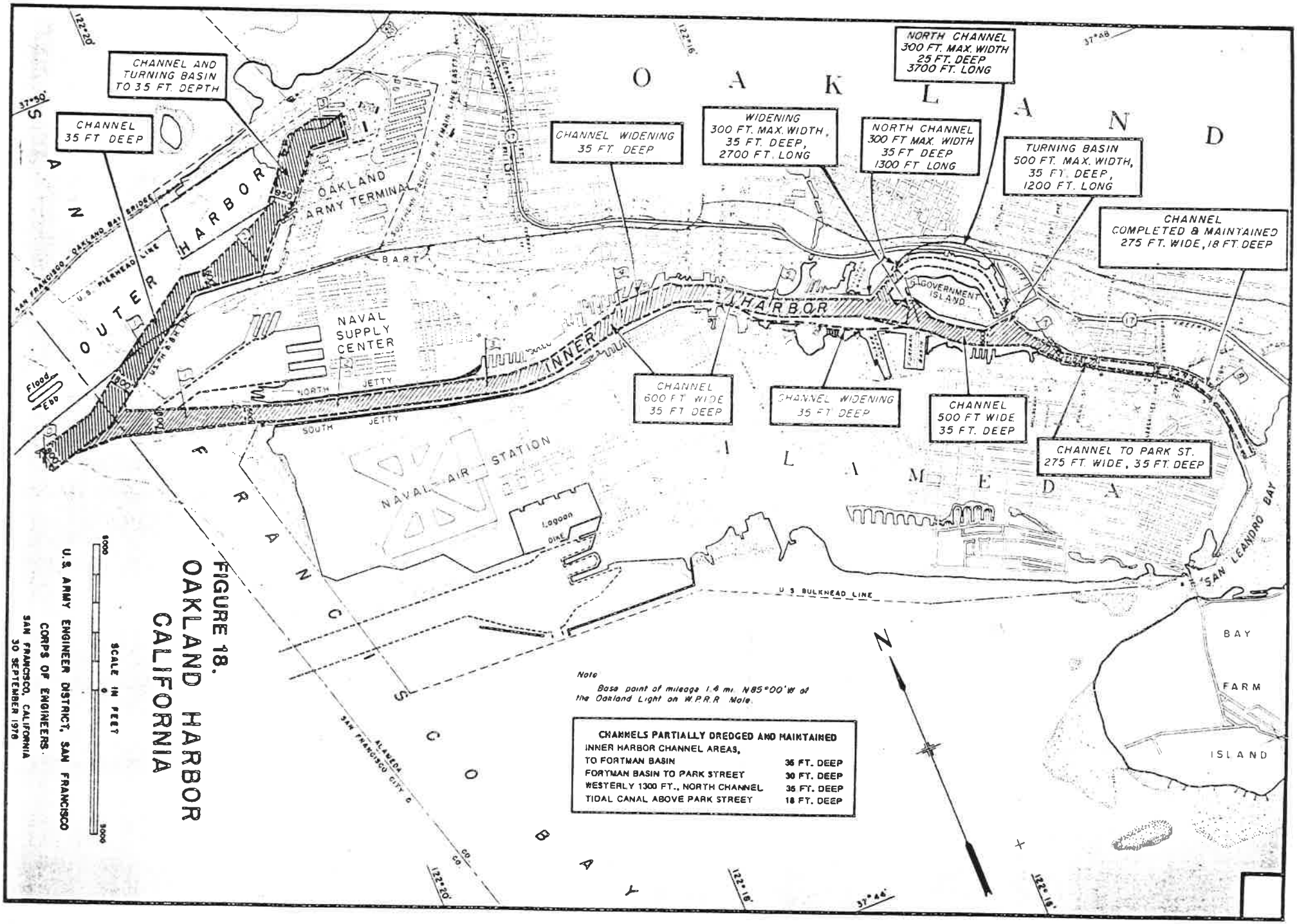
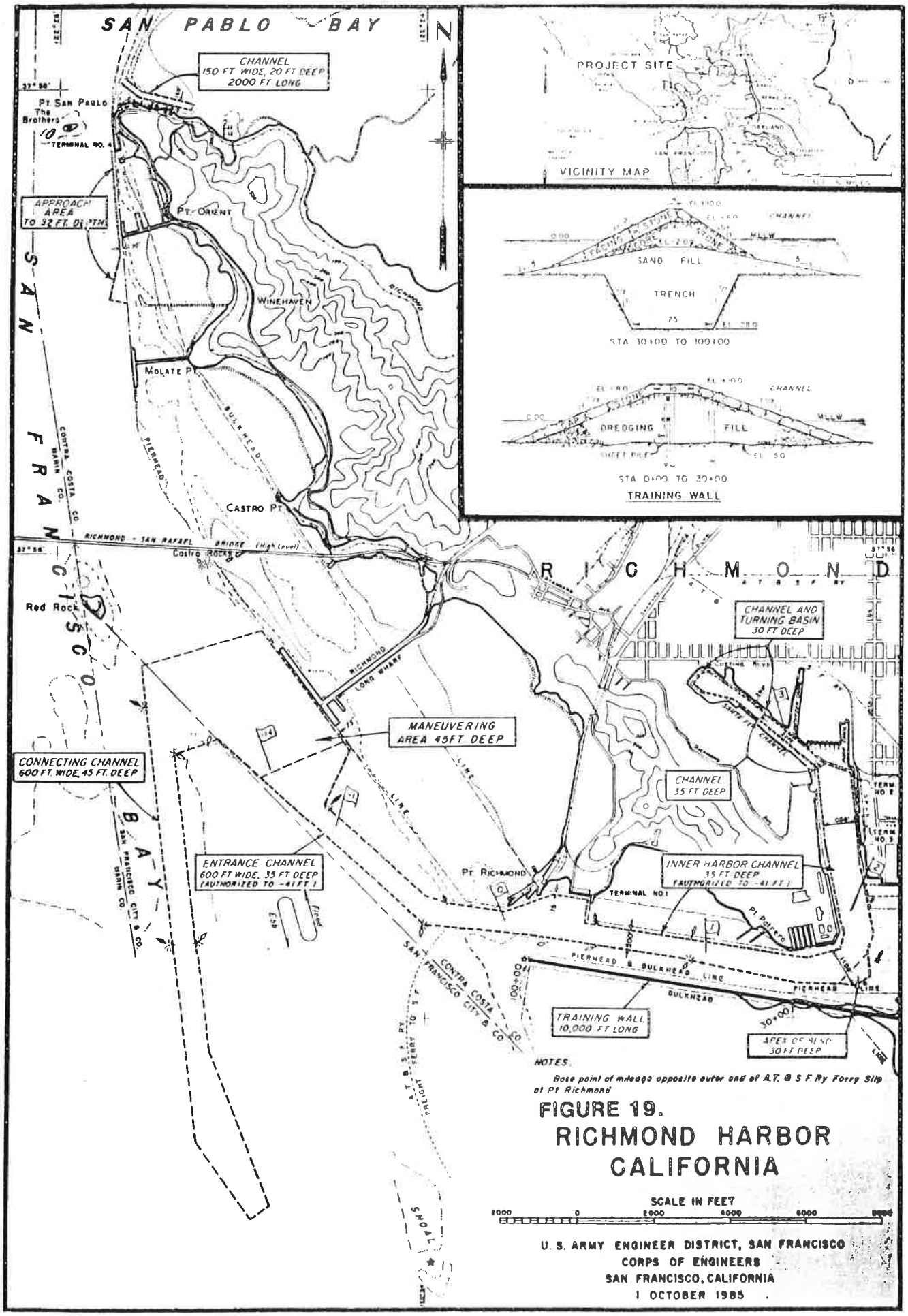


FIGURE 18.
OAKLAND HARBOR
CALIFORNIA

U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO
CORPS OF ENGINEERS
SAN FRANCISCO, CALIFORNIA
30 SEPTEMBER 1978



NOTES.

Base point of mileage opposite outer end of A.T. & S.F. Ry Ferry Slip at Pt Richmond

FIGURE 19.
RICHMOND HARBOR CALIFORNIA

U. S. ARMY ENGINEER DISTRICT, SAN FRANCISCO
CORPS OF ENGINEERS
SAN FRANCISCO, CALIFORNIA
1 OCTOBER 1985

D. Production and Cost

1. Dredging work would be accomplished on a 24 hours per day basis. Of this time, 18 hours will be active dredging time (80% efficiency), with the rest of the time being for maintenance, shift changes, and breakdowns. With nine (9) cyds per bucket load and 50 bucket swings per hour, the daily production rate of the dredge is approximately 8,100 cyds. For example, at Oakland Harbor the annual dredging volume is 500,000 cyds. At 8,100 cyds per day, it would take 62 days to dredge this volume (500,000 cyds / 8,100 cyds per day = 62 days). The cost for this type of dredge is estimated at $12,000 per day. This includes rental, fuel, labor, maintenance and insurance but not profit. The dredge cost per year is the cost per day of the dredge times the number of days per year. A lump sum of $50,000 was added for dredge mobilization for each project on the assumption that the equipment required for the work is available in the Bay.

2. It was estimated that it would take six hours to load each barge to 90% capacity. The tug/scow combination could travel at approximately six (6) knots when loaded and eight (8) knots when empty. The speed of travel strongly depends on tides, fog conditions and maneuverability. The time to haul to and from the disposal site was calculated by dividing the haul distance by the speed of travel. For example, for Oakland Harbor the time needed to travel to the Napa disposal site was 25.5 nautical miles divided by six (6) knots or 4.2 hours. At the disposal site, two hours were allowed for the pumpout process. Two hours were added to each cycle for lost time. The speed of travel was reduced from Mare Island Strait to the Napa site to three (3) knots loaded and four (4) knots unloaded because maneuvering up the Napa River would be difficult and take more time. For the other dredging areas to the Napa site this difficulty in maneuvering was compensated for by adding an additional small tug that would travel the Napa River exclusively. The additional cost of this tug is $2,400/day as illustrated in Appendix Tables D1 through D4. The number of scows and tugs was optimized so that the most expensive piece of equipment, the dredge, was kept in operation for the most economical amount of time. For example, at Oakland Harbor the optimum combination of scows and tugs for disposal at the Napa site would be four (4) barges and three (3) tugs with an extra tug stationed in the Napa River. At $1,500 per scow per day, $3,600 per tug per day and $2,400 per smaller tug per day, the total scow cost per year and the total tug cost per year were calculated.

3. A launch would also be necessary for the dredging operations which would cost approximately $1,200 per day.

4. The total dredging direct costs per year were calculated by adding the annual dredge, dredge mobilization, scow, tug and launch costs. In keeping with Corps of Engineer practice, contractor overhead (12%), bond (1%) and profit (10%) were added to this figure. The direct and indirect total was divided by the annual number of cyds to be dredged for a total cost per cyd. Twenty-five percent for contingencies was added to this cubic yard price. The resulting costs per cubic yard of material ranged from $4.10 per cyd to $6.30 per cyd. The most expensive area to dredge is the Oakland Harbor which has the longest haul distances. The least expensive area is Mare Island Strait which is closest to the disposal sites. The Montezuma disposal site, which is farthest from the dredging sites, is the most expensive. The Napa site is more expensive than the Crowley site since an extra tug is required for the Napa River, except of the dredging of the Mare Island Strait.

IX. THE PUMPOUT SYSTEM

A. During disposal operations, loaded barges would be towed to the pumpout station and positioned alongside a pumpout barge which will be specially designed for the project. The criteria used to develop the pumpout barge cost estimate are:

- o Pumping distance: 6,000 to 8,000 feet.
- o Lift from pumpout barge to discharge point: 25 feet.
- o Line size: 24" OD poly pipe; 21" to 22" ID.
- o Pumpout rates required: Minimum 3,500 cubic yards in two hours.

B. A series of runs were made on the computer program PIPELINE (Ogden Beeman & Associates, Inc., 1982) to calculate pump horsepower and size requirements for the range of operating conditions expected. These runs were then checked against manufacturers' data on marine engines and dredge pumps to assure they represented a realistic solution. Pumpout productions are higher than those of comparable hydraulic dredges because the slurry feed can be optimized and held steady throughout the pumpout cycle.

C. The proposed pumpout unit is a 100' x 40' x 8' barge with a 24" x 20" dredge pump and 1,200 HP diesel drive engine mounted on the barge. A feedwater pump capable of 18,000 GPM driven by a 300 HP diesel engine will be used to rewater the dredged material in the barge. The unit will be operated by an operator, one deckhand and one watch engineer. The unit will be moored against two wood pile dolphins and there will be four other wood pile dolphins for breasting the dump scows along the pumpout unit. The suction and feed water lines for the pumpout unit will be relatively fixed in a horizontal plane but will be moveable up and down to reach the material in the dump scow. The scow will be slowly winched across the face of the pumpout unit during pumpout so the material in the scow is continually fed to the suction pipe. The proposed pumpout facility is illustrated in Figure 21. This facility should be able to handle the materials from all projects except Pinole Shoal at the line lengths required. The predominantly sandy material at Pinole could only be handled on the shorter line lengths at Montezuma and Crowley.

D. Capital costs for the system are:

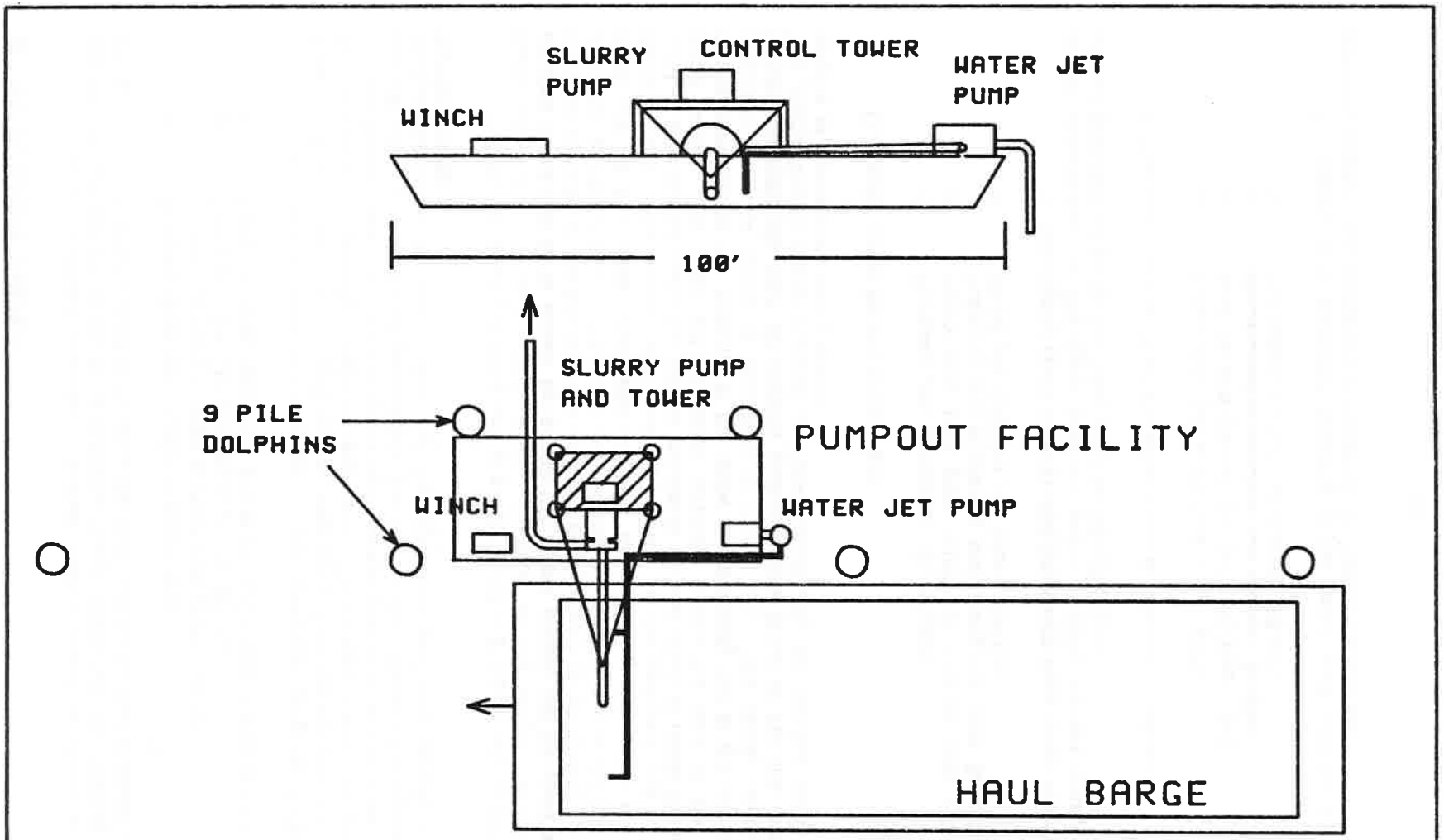
- o Pumpout unit, complete: $1,200,000
- o Heavy duty poly pipe, 4,000' @ 110 psi and 4,000' @ 65 psi. Including cost of placing and fusing the units: $200,000
- o Wood pile dolphins, six total: $50,000

1. The capital costs total $1,450,000 which have been rounded up to $1.5 million. Amortization of this figure over ten years at 8.5% interest results in an annual cost of $229,000 of $0.29 per cubic yard for 800,000 cyds.

E. The operating costs of the system are estimated as follows:

- o Labor cost, per eight hour shift. $900
- o Fuel, oil and grease, per pumping hour. $45
- o Miscellaneous supplies, per month. $1,000.
- o Maintenance cost, per month. $5,000.

F. Detailed cost estimates resulting in per cubic yard cost for each of the four dredging reaches are contained in Appendix D, Tables D5 and D6.



DREDGED MATERIAL LAND DISPOSAL ALTERNATIVES

FIGURE 20: PUMPOUT FACILITY

X. DISPOSAL SITE COST ESTIMATE

A. Disposal site costs include both the cost of land acquisition and site preparation and completion. Detailed site cost estimates are contained in Appendix D, Tables D7 through D10. Operation and design elements of the individual sites were discussed in Section VII. This section summarizes the basic elements of the cost estimates.

B. Land acquisition costs were estimated based on interviews with realtors and developers with recent experience in the immediate area, landowners and county tax records. Estimated acreage costs range from approximately $1,400 per acre at Montezuma to $50,000 per acre at Crowley. Land costs include the purchase of pipeline right-of-way from the pumpout station to the disposal site where applicable.

C. Dike construction costs include site preparation, soil testing, excavation, grading and dike compaction. Cost estimates include equipment and labor, plus overhead and profit. A five percent mobilization cost and ten percent contingency is added. Individual elements of dike construction are summarized in the following section.

1. Surveying and Staking: Includes dike alignment surveys and staking toes of dike. Estimated at $0.70 per lineal foot of dike.

2. Clearing and Grubbing: Includes removal of overburden and surface vegetation between toes of dike preparatory to material placement. Estimated at $450 per acre.

3. Foundation Preparation: Includes soil conditioning and existing ground compaction prior to dike construction. Estimated at $600 per acre.

4. Soil Testing: Includes obtaining and testing two shallow sediment cores per acre of material excavated for dike construction. Standard physical tests included as well as some chemical testing as indicated by site-specific conditions. Estimated at $650 per core.

5. Clearing and Grubbing of Excavation Area: Includes removal of overburden and surface vegetation of areas to be excavated for dike material. Estimated at $450 per acre.

6. Excavation, Grade, Fill and Dike Compaction: Includes equipment, excavation, grading and dike compaction for construction of dikes. Estimated at $8.00 per cubic yard.

D. Detailed site acquisition and construction cost estimates are provided in Appendix D, Tables D7 through D10. Cost are summarized on a per cubic yard basis in Table 4.

TABLE 4
DISPOSAL SITE SUMMARY

Disposal Site	Capacity (M. cyds)	Life (yrs)	Initial Cost ($)	Cost $/cubic yards
CROWLEY				
(1)	2.5	3	10,376,336	4.15
(2)	1.0	1	4,857,048	4.86
NAPA				
(1)	8.8	10	14,630,225	1.66
(2)	6.9	8	4,611,082	.67
MONTEZUMA				
(1)	6.4	8	2,666,448	.42
(2)	5.5	6	4,614,172	.84
(3)	2.6	3	7,906,215	3.04

XI. WETLAND MITIGATION COST ESTIMATE

A. Wetland loss will be mitigated as part of project approvals and permitting. This section addresses mitigation plans for Crowley, Napa River and Montezuma.

B. Crowley

1. On-site wetlands areas will be created to mitigate loss of wetlands in the proposed diked disposal site development. Wetlands lost due to site development include two acres of marginal wetlands within the boundaries of the Crowley diked site. It is proposed to excavate a two (2) acre area of the Crowley site immediately adjacent the existing wetland area between Crowley and Martinez properties. This excavation is included in the cost of dike construction for the Crowley site. Sediments removed to obtain a 0' to 5' elevation will be used for dike construction or wasted within the diked perimeter.

2. Revegetation costs for disposal site habitat are based on experience at similar West Coast mitigation and disposal sites, and discussion with technical personnel at the Waterways Experiment Station, Vicksburg, MS. Estimated cost for revegetation is $6,000 per acre. This includes all additional costs to recover two (2) acres of improved wetland for the loss of the drainage corridor.

C. Napa River Site

1. Wetland loss due to site development include approximately 15 acres of seasonally flooded wetlands within the boundaries of the Site 2 diked site. Excavation for dike materials in what is now upland is proposed to create a 15 acre replacement wetland. This excavation will be included in the cost of the dike construction for Site 2. Sediments removed to obtain a 0' to 5' elevation will be used for dike construction or wasted within the diked perimeter.

2. Estimated cost for the revegetation of the site is $6,000 per acre. This includes all additional costs to recover 15 acres of improved wetland for the loss of the existing seasonally flooded wetland area to be filled.

D. Montezuma Site

1. Construction of the diked disposal site at Montezuma will result in a loss of 570 acres of seasonally and permanently flooded wetlands that are presently diked. This includes all 520 acres of Site 1 and 50 acres within Site 2. Site 1, although wetlands, is zoned Water Dependent Industrial by Solano County.

2. Wetland fill on Sites 1 and 2 will be partially mitigated by salt marsh habitat creation at Site 3. Creation of the salt marsh habitat is discussed in Section VII, Montezuma, and will be accomplished by placement of approximately 2.6 million cubic yards of disposal sediments within the area prior to removal of the flood dikes now present. This would be accomplished by diversion of the pumpout discharge pipe to the identified area, and placement of an overflow weir structure to remove slurry effluent from behind the flood dikes.

3. Marsh construction will follow the final year of disposal and dewatering of the dredged sediments. The disposal fill will create an area that has an average elevation of +2.5' mllw. Finger channels will then be excavated into the site, with the channel excavation placed as small mounds for varied ground elevation and site diversity. The final action prior to breaking the flood dikes will be to work and revegetate the site with suitable marsh plants. The site would then be opened to the Bay waters.

4. Cost estimate for salt marsh revegetation is $10,000 per acre (WES, 1988). Channelization and mound construction costs are dependent on the extent of finger channels and tributaries required to satisfy habitat diversity. Based on cost per acre for development of mitigation sites at other locations, a $6,000 per acre cost is estimated (Port of Kalama, 1986). Cost to relocate the discharge pipe for three years disposal and construction of an adequate overflow weir assembly is identified in Table 5. Partial removal of the existing flood dike structure will be accomplished to allow free tidal exchange and circulation of bay waters into the site.

5. A loss of 50 acres of seasonally flooded wetland will be mitigated by excavating dike materials in what is now upland at the north end of Site 2 to create a 50 acre replacement wetland. This excavation will be included in the cost of the dike construction for Site 2. Sediments removed to obtain a 0' to 5' elevation will be used for dike construction or wasted within the diked perimeter. Establishment of wetland vegetation is costed at $10,000 per acre.

TABLE 5
WETLAND MITIGATION COST ESTIMATE

Site:	CROWLEY	NAPA 2	MONTEZUMA 1	MONTEZUMA 2
Acres:	2	15	520	50
Development Costs:				
Revegetate	$12,000	$90,000	$5,200,000	$300,000
Channelize	0	0	780,000	0
Pumpout Fill	0	0	50,000	0
Flood Dike Exc	0	0	500,000	0
Subtotal Cost	$12,000	$90,000	$6,530,000	$300,000
Contingency at 10%:	1,200	9,000	653,000	30,000
Total:	$13,200	$99,000	$7,183,000	$330,000
Site Cyd	2,500,000	6,900,000	9,000,000*	5,500,000
Cost/Cyd	**$0.01/cyd**	**$0.01/cyd**	**$0.80/cyd**	**$0.06/cyd**

*Nine million cubic yards is the quantity disposed in both Montezuma Sites 1 and 3. Under this scenario, Site 1 cannot be developed without the co-development of Site 3. Therefore, Site 3 development costs are a mitigation cost to Site 1.

XII. DREDGING AND DISPOSAL SITE SUMMARY COMPARISON

A. This report is a detailed study of permanent upland dredged material disposal options. It provides site engineering for the three most feasible alternatives and preliminary design level cost estimates for dredging, pumpout facility, disposal site construction, maintenance, mitigation and associated facilities.

B. The dredging cost for each of the four major dredging areas in San Francisco Bay was estimated for applicability to the three feasible sites. Dredging areas considered were:

Oakland Inner/Outer Harbor
Richmond Harbor
Mare Island Strait
Pinole Shoal

Total volume of sediments dredged on the average annually for the four dredging areas is 2,450,000 cubic yards. For purposes of this report, the feasible disposal sites are considered to receive 800,000 cubic yards per year of the total quantity dredged.

C. Three feasible disposal sites are identified. They include:

Crowley Site
Napa Site
Montezuma Site

D. The Crowley and Napa Sites include two diked areas physically separated from each other. The Montezuma Site is the largest land area of the three, and is the only continuous single land area site. It was evaluated as three distinct disposal areas because of site conditions and operational considerations.

E. In terms of total capacity, the Napa Site offers the greatest opportunity and life of the three alternatives with a total capacity of 15.7 million cubic yards. Montezuma capacity includes 2.6 million cubic yards of disposal for the creation of salt marsh habitat and totals 14.5 million cubic yards.

F. Accessibility of the Crowley and Montezuma Sites is considered better than the Napa site. Both Crowley and Montezuma can have pumpout stations established along the deeper main shipping channel. The Napa Site requires pumpout station located on the Napa River and restricts draft of the user. The Crowley and Montezuma Sites can be used by hopper dredge as well as haul barge pumpout.

G. Subsite development at each of the three final sites provides a matrix of seven sites for cost comparison. The detailed cost estimates for the sites are contained in Appendix D, Tables D7 through D10. Summary tables are provided in Tables 6 through 12. Comparison of costs is a unit cost value per cubic yard disposed at each site.

TABLE 6
CROWLEY (1)

	Dredging Area			
	Oakland	Richmond	Mare Isl	Pinole
Dredging	$ 5.90	$ 4.80	$ 4.80	$ 4.10
Pumpout	.68	.68	.68	.68
Disposal	4.15	4.15	4.15	4.15
Mitigation	.01	.01	.01	.01
Cost/cyd	**$10.74**	**$ 9.64**	**$ 9.64**	**$ 8.94**

TABLE 7
CROWLEY (2)

	Dredging Area			
	Oakland	Richmond	Mare Isl	Pinole
Dredging	$ 5.90	$ 4.80	$ 4.80	$ 4.10
Pumpout	.68	.68	.68	.68
Disposal	4.86	4.86	4.86	4.86
Mitigation	.00	.00	.00	.00
Cost/cyd	**$11.44**	**$10.34**	**$10.34**	**$ 9.64**

TABLE 8
NAPA (1)

	Dredging Area			
	Oakland	Richmond	Mare Isl	Pinole
Dredging	$ 6.30	$ 5.30	$ 4.80	N/A
Pumpout	.68	.68	.68	
Disposal	1.66	1.66	1.66	
Mitigation	.00	.00	.00	
Cost/cyd	**$ 8.64**	**$ 7.64**	**$ 7.14**	

TABLE 9
NAPA (2)

	Dredging Area			
	Oakland	Richmond	Mare Isl	Pinole
Dredging	$ 6.30	$ 5.30	$ 4.80	N/A
Pumpout	.68	.68	.68	
Disposal	.67	.67	.67	
Mitigation	.01	.01	.01	
Cost/cyd	**$ 7.66**	**$ 6.66**	**$ 6.16**	

TABLE 10
MONTEZUMA (1)

	Dredging Area			
	Oakland	Richmond	Mare Isl	Pinole
Dredging	$ 5.90	$ 5.80	$ 4.80	$ 5.50
Pumpout	.68	.68	.68	.68
Disposal	.30	.30	.30	.30
Mitigation	.80	.80	.80	.80
Cost/cyd	**$ 7.68**	**$ 7.58**	**$ 6.58**	**$ 7.28**

TABLE 11
MONTEZUMA (2)

	Dredging Area			
	Oakland	Richmond	Mare Isl	Pinole
Dredging	$ 5.90	$ 5.80	$ 4.80	$ 5.50
Pumpout	.68	.68	.68	.68
Disposal	.84	.84	.84	.84
Mitigation	.06	.06	.06	.06
Cost/cyd	**$ 7.48**	**$ 7.38**	**$ 6.38**	**$ 7.08**

TABLE 12
MONTEZUMA (3)

	Dredging Area			
	Oakland	Richmond	Mare Isl	Pinole
Dredging	$ 5.90	$ 5.80	$ 4.80	$ 5.50
Pumpout	.68	.68	.68	.68
Disposal	3.04	3.04	3.04	3.04
Mitigation	.00	.00	.00	.00
Cost/cyd	**$ 9.62**	**$ 9.52**	**$ 8.52**	**$ 9.22**

H. The costs of Montezuma Site 3, as shown in Table 12, are for development of Site 3 without development of Montezuma Site 1. The cost of salt marsh development is included in the disposal cost of $3.04 per cubic yard and is based on a site capacity of 2,600,000 cubic yards.

I. Site Rankings

1. Prioritizing of dredged material land disposal sites is dependent on the policy and objectives of the U.S. Army Corps of Engineers. If the objective is to provide a dredged material land disposal site for a shorter term, perhaps while pursuing other disposal options, the Crowley Site provides 3,500,000 cubic yards of capacity. In addition, the Crowley Site appears to be the site most likely to obtain timely regulatory approval because of the minimal wetlands involved.

2. If the objective is to provide a dredged material land disposal site for the longest term, the Napa and Montezuma Sites provide the longest life. The Napa Site provides the largest capacity at 15,700,000 cubic yards. At disposal to full capacity, Napa Sites 1 and 2 per cubic yard cost is $1.23. The Montezuma Site provides 14,500,000 cubic yards of capacity. At disposal to full capacity, total disposal cost is $1.05 per cubic yard. However, the Montezuma Site affords an opportunity to establish 520 acres of salt marsh habitat. The benefits associated with this habitat development should be considered in any further benefit and cost analysis.

APPENDIX A

SITE DESCRIPTIONS

U.S. Army Corps of Engineers, Dredge Disposal Alternatives Study, Task 3, Land Disposal Alternatives

C. SAN PABLO BAY/NAPA RIVER AREA

Hamilton AFB South (Site 6)

Area: 1,150 acres

Location: This site is located on the west shore of San Pablo Bay in Marin County, and is bounded on the north by Hamilton Field, on the west by the Northwestern Pacific Railroad, and on the south by Gallinas Creek.

Land Use: Most of the site is currently dry-farmed with some grazing in the southern and southwestern portions of the site. Approximately 200 acres in the southern portion of the site, along Gallinas Creek, has been acquired by the County for a new park.

Environmental Conditions: The site consists entirely of diked historic bayland and is predominantly in seasonal wetland except for a 75-acre area of upland located at the southwest corner of the site. The site is separated from the bay by mud flats and tidal marshes.

Regulatory Constraints: As a seasonal wetland, the site is under the regulatory authority of the Corps of Engineers. It is doubtful that the Corps would be receptive to permanent dredge disposal at the site because of the wetland which would be eliminated and because permanent disposal may be seen as filling which could be a prelude to urban development. However, a reclamation/processing operation might be acceptable provided the loss of wetland habitat was properly mitigated.

BCDC has jurisdiction over the 100-foot shoreline along the eastern edge of the site and would have to approve any related transfer facilities within the tidal marshes.

The Marin County General Plan designates the site for Agriculture, and the applicable zoning is the Bayland Conservation zone under which a reclamation/processing operation may be acceptable.

Accessibility: Since the site is separated from the Bay by mud flats and tidal marshes, direct barge access would not be available. It may be possible to pipe the dredged materials to the site from barges stationed off-shore in San Pablo Bay.

Land Values: There have been no recent real estate transactions involving comparable properties in the vicinity. Based on the latest transaction involving similar land in the vicinity of the Marin County Airport to the north, fair market value is estimated at about $10,000 per acre.

Economic Feasibility: The economic analysis indicated that the unit costs associated with a disposal/reclamation operation at the site would range from $6.95 to 11.35 per cy. (See Chapter V for detailed discussion.) The feasibility of the site is inhibited by lack of direct barge access, but is enhanced by its central location relative to maintenance dredging projects.

Availability: Since the site is undeveloped, it might be available. It was learned that the site is owned by the Archdiocese of San Francisco.

Conclusion: Further investigation of the site as a potential reclamation/processing site is probably not warranted under current conditions. Unit costs of disposal at this site would probably be too high to make it attractive for any of the dredging projects in the area. The lack of direct barge access, and the necessity of laying pipe over tidal marshes, reduce the attractiveness for this site from both economic and environmental standpoints.

Hamilton AFB North (Site 7)

Area: 3,850 acres

Location: The site is divided into three main subareas. The southern subarea lies along the bay, between Hamilton Field and the community of Bel Marin Keys, and is about 1,400 acres in area. The central subarea lies between Bel Marin Keys and Route 37, and is about 1,100 acres in size. The northern subarea comprises an area of about 1,300 acres and lies to the north of Route 37, bounded on the west by Route 101, and on the north and east by surrounding hills.

Land Use: All three subareas are predominantly dry-farmed for hay, except for the northern portion of the northern subarea, which is in pasture. The entire southern subarea is currently proposed for development of the next phase of the Bel Marin Keys project. However, as discussed under "Availability" below, there is some potential that the project will not go forward, so this subarea was retained in the analysis. It was learned that the central and northern subareas may be owned by the Marin County Flood Central District which uses the areas for floodplain management. However, this information was not confirmed.

Environmental Conditions: The entire site lies within the area of diked historic baylands and is comprised totally of wetlands, with seasonal wetlands predominating.

Regulatory Constraints: As seasonal wetland, the site is within the regulatory jurisdiction of the Corps of Engineers. Under the currently applicable regulations, permanent disposal of dredged materials would not be looked upon favorably by the Corps or the resource agencies with which the Corps is required to consult. BCDC has shoreline jurisdiction but would also strongly oppose permanent disposal within the diked baylands. A reclamation processing operation might be considered favorably by the agencies, if no environmentally preferable upland site were available or practicable, and if the loss of wetland was adequately mitigated.

The Marin County General Plan designates southern subarea of the site for Planned Residential uses, and the central and northern subareas are designated for Agriculture. The site is zoned Bayland Conservation Zone.

Accessibility: The southern subarea is separated from the bay by mud flats and tidal marshes, precluding direct access by water. The central and northern subareas are landlocked. Dredged materials would therefore have to be piped to the site from barges stationed off-shore in San Pablo Bay.

Land Values: Since the southern subarea is planned for residential development, land costs for this area would probably be prohibitive. If the area becomes available, in the event it is deemed unsuitable for development, land values were assumed to be the same as for Site 6, at $10,000 per acre. The same values were assumed to hold at the central and northern subareas.

Economic Feasibility: The economic analysis for the site indicated that the costs associated with a reclamation/processing operation at the site would range from $6.45 to $10.95 per cy for the upper and central subareas, and $6.15 to $11.35 per cy for the southern subarea. Feasibility of the site is inhibited by lack of direct barge access, and enhanced by its central location relative to dredging projects.

Availability: Since the southern subarea is the subject of a pending development proposal, it may not be available as a reclamation/processing site. The developer intends to balance dredging and fill in the proposed water-oriented community, so additional material from outside sources is not likely to be required. However, the proposed development plan apparently has serious deficiencies which may result in its denial at the local level. If so, there may be potential for a reclamation/processing operation at the site. The central and northern subareas are apparently owned by the Marin County Flood Control District, which may be receptive to a reclamation/processing operation on these lands. The District was not contacted on this matter.

Conclusion: The southern subarea may be precluded from use by pending development. In any event, further investigation of this site as a potential reclamation/processing site is probably not warranted under current conditions. The unit costs of disposal at this site would probably be too high to make this site an attractive alternative for any of the dredging projects in the bay. As with Site 6 to the south, the lack of direct barge access, and the necessity of laying pipe over tidal marshes, reduce the attractiveness of this site from both economic and environmental standpoints.

Petaluma River (Site 8)

Area: 8,600 acres

Location: This site is comprised of three separate subareas: a southern subarea of 5,700 acres, bounded on the east by the Lakeville Highway (Route 116), on the west by the Petaluma River, and on the south by San Pablo Bay; a northern subarea of 1,300 acres located along the east side of the Petaluma River between Petaluma and Lakeville, on the west side of Route 116; and a central subarea of 1,600 acres located on the west side of the Petaluma River around the Marin County Airport.

Land Use: The lands comprising this site are predominantly in agricultural use for hay production or grazing. In the central section of the northerly subarea, an area of approximately 140 acres is in use for settling ponds associated with the Petaluma sewage treatment plant.

Environmental Conditions: All three subareas lie within the area of diked historic baylands, and are entirely in wetlands. The northern and southern subareas are in seasonal wetland while the central subarea is composed of marshlands with higher habitat value.

Regulatory Constraints: As wetlands, all three subareas are subject to the regulatory authority of the Corps of Engineers. The Corps and the participating resource agencies might be favorably disposed for the use of the northern and southern subareas for a reclamation/processing operation. The central subarea has higher habitat value and any use of that area would likely be resisted. Since none of the lands within the Petaluma River site are in uplands, any proposal for permanent disposal would also likely be opposed.

BCDC has no direct jurisdiction over this site except along the shoreline of San Pablo Bay (its shoreline jurisdiction ends at the Route 37 bridge at Port Sonoma). However, BCDC has considerable influence in decisions involving the diked baylands. BCDC might not oppose a reclamation/processing operation within the seasonal wetlands on the northern and southern subareas, but would likely object to the conversion of the higher quality habitat areas found in the central subarea around the Marin County Airport.

The Sonoma County General Plan designates the northern and southern subareas and for Agricultural uses. The Marin County General Plan also designates central subarea for Agriculture. Both Counties might be receptive to a reclamation/processing operation, although environmental groups active in the area could present strong opposition. A previous proposal to use part of the northern subarea for dredge disposal as part of an agricultural enhancement project was initially given favorable response by the County Board of Supervisors, but was ultimately denied in the face of well-organized

opposition from conservation groups. Since the project involved permanent disposal of dredge materials, albeit in relatively small quantities, the opponents claimed that the action would constitute fill which could improve the site and thereby enhance the attractiveness of the site for ultimate urban development.

Accessibility: The areas of the northern subarea and the areas of the southern subarea which front onto the Petaluma River, appear to be accessible by barge. The southern half of the southern subarea is separated from the bay by mud flats and tidal marshes and would not be directly accessible by water. The material could be pumped to the southern portions of the site from a transfer point at Port Sonoma.

Land Values: Information on recent land transactions indicate that current land values in the southern subarea and southern half of the northern subarea are in the range of $2,500 to $3,000 per acre. In the northern half of the northern subarea, near Petaluma, land values range from $4,000 to $5,000 per acre.

Economic Feasibility: A cost analysis of a site selected in the southern subarea at the Twin House Ranch indicated that costs associated with a reclamation/processing operation at the ranch site would range from $3.50 to $9.50 per cy. The represents the lowest threshold costs among the sites evaluated. The economic feasibility of the site is enhanced by both direct barge access and central location, which would keep overall transportation and transfer costs to a minimum. Disposal costs are slightly higher in the lower portion of the southern subarea, south of Route 37, which is not directly accessible by barge. Unit costs for disposal in this area range form $4.15 to $8.25 per cy. Unit costs for disposal at the northern subarea are also slightly higher at $4.30 to $10.30 per cy due to longer barge travel distances.

Availability: Since the site is undeveloped it might be available. Current ownership and potential for acquisition were not specifically investigated. However, it was learned at the 550-acre Herzog Ranch, located on north of side of Highway 37, northeast of the Petaluma River, was recently acquired by the Sonoma County Land Trust. The Land Trust intends to restrict the use of the property with a conservation easement and then resell the ranch site for agricultural uses. The conservation easement would likely preclude the future use of the Ranch for a reclamation/processing operation. The Land Trust is also in the process of acquiring the Twin House Ranch to the northwest, along the eastern banks of the Petaluma River (see Figure 4). Representatives of the Land Trust indicated interest in cooperating in any efforts to utilize the northern half of the Ranch (220 acres) for a dredged material reclamation/processing operation.

In addition, it was learned that a 100-acre parcel in the extreme southeast corner of the site, across from Tubbs Island, was acquired by a developer for a mitigation site, and returned to tidal action.

Conclusion: The portion of the site located along the Petaluma River appear to have excellent potential for a reclamation/ processing operation, particularly since this area is directly accessible by barge and is centrally located relative to most of the maintenance dredging projects. Based on a comparison of unit costs for ocean disposal, sites in this area appear to be an attractive alternative for nearby dredging projects in Richmond and Marin County, as well as dredging sites to the east. Any potential disposal sites in inland portions of the site and the areas south of Route 37 are less attractive economically since dredged material would have to be pumped to these areas.

Other lands within the site also warrant further study, except for the Herzog Ranch site which would be precluded from use by the pending conservation easement. The central subarea, around the Marin County Airport also does not warrant further study under current conditions since the prevailing policies of the resource agencies would strongly favor retaining this site in its present state due to its relatively high habitat value.

Any proposal for a dredged material disposal operation at Site 8 should take into consideration the potential for opposition from conservation groups active in the area, which could result in rejection of such a proposal at the County level.

Sonoma Creek (Site 9)

Area: 10,600 acres

Location: This site consists of the low-lying diked agricultural lands generally bounded by the Sonoma Mountains on the west, the Southern Pacific railway tracks on the north, the Napa County line on the east, and San Pablo Bay on the south. The site does not include the Skaggs Island Naval Reservation.

Land Use: The entire site is in agricultural use, predominantly in hay production with some grazing land along the northern periphery.

Environmental Conditions: The site lies entirely within the area of diked historic baylands, and is almost entirely in seasonal wetland, except for an upland area of approximately 460 acres located along the northwestern periphery of the site, between Route 121 and Sonoma Creek. However, this upland area is interspersed with isolated marshes of varying size. The largest area of upland absent of wetlands is only about 130 acres in size. Another 1,100-acre area, located north of the Third Napa Slough contains variations of seasonal wetland and upland throughout.

Regulatory Constraints: The wetland areas of the site fall under the jurisdiction of the Corps of Engineers which, along with the resource agencies, would likely oppose permanent disposal but might not object to a reclamation/processing operation. The 130-acre area of upland described above could be deemed acceptable for permanent disposal but the area is too small for practical use.

BCDC has direct jurisdiction over only the southern and eastern shoreline of Tubbs Island, at the southern end of the site. (However, Tubbs Island is not available, as discussed below.) BCDC has some influence over land use decisions within the diked bayland area, and would likely support the positions of the Corps and the resource agencies.

The Sonoma County General Plan designates the site for Agriculture which is also reflected in the applicable zoning. The Sonoma County Board of Supervisors might be less inclined to oppose dredged material disposal at this site, versus Site 8 - Petaluma River, since pressure from environmentalists to oppose it may not be as great in this area, where development pressures are generally lower.

Accessibility: The site is not accessible by water from either the bay or Sonoma Creek, which is not navigable by the required barge traffic. Tubbs Island is separated from the bay by mud flats and tidal marshes. Dredged material could be piped to the northern portions of the site, along the railway tracks from the Napa River in the east, a distance of about 3 miles. A pipeline could also

extend along the railway tracks from the south, originating at a transfer station near Port Sonoma.

Land Values: The value of land in this area is currently estimated at $2,500 to $3,000 per acre.

Economic Feasibility: The feasibility study for the use of this site as a reclamation/processing operation indicated unit costs for disposal and processing would range from $7.25 to $11.75 per cy. The economic feasibility of this site is largely inhibited by the cost of pumping the material a distance of at least 16,000 feet from the Napa River to the east.

Availability: Since the site is undeveloped, land for a reclamation/processing site might be available. Current ownership and potential for acquisition were not specifically investigated. However, it was learned that the lower two-thirds of Tubbs Island, an area of approximately 1,000 acres located south of Route 237, is owned by the Vallejo Sanitation and Flood Control Office, which uses the land to dispose of sewage sludge. The material is spread over fields on a rotating basis to enhance agricultural productivity. Approximately 1,700 cy of material are disposed of annually. The land is leased by the Sears Point Farming Company, which also owns the northern one-third of Tubbs Island. The City of Vallejo and the farming company intend to expand the disposal and enhancement program to the northern portion of the island partly for the purpose of increasing the life of the sludge disposal operation. According to City officials, the island will be needed exclusively for the sludge disposal operation, and is not available for disposal of dredged material.

Conclusion: Since the regulating agencies may not be opposed to the use of a portion of the Sonoma Creek site as a reclamation/processing site, it may warrant further study. Lack of direct barge access and long pumping distances reduce the attractiveness of this site economically, compared with Site 8. However, the central location of this site may make it an economically attractive alternative to nearby dredging projects at Mare Island and Suisun Bay.

Napa River (Site 10)

Area: 1,900 acres

Location: This site is generally located to the east of the Napa River, north of the City of Vallejo. It is divided into two subareas: a northerly subarea consisting of approximately 650 acres, which is bounded on the north by the Napa County Airport, on the west by the Southern Pacific railroad tracks, on the south by Green Island Road, and on the east by an abandoned Southern Pacific line. The southern subarea consists of about 1,250 acres, and lies generally between the community of American Canyon and the salt ponds and marshes along the easterly banks of the Napa River. This southern area is bounded on the north by Green Island Road, and on the south by residential development and the Napa River.

Land use: The northern subarea is largely in agricultural use for hay production, with some scattered development occurring along the north side of Green Island Road. The southern subarea is largely undeveloped pasture land. A 150-acre area in the southern-most portion of the southern subarea, which lies within the City of Vallejo in Solano County, has been developed for residential tract housing. Just to the north of the County line, the western edge of this subarea partially overlaps the "American Canyon mitigation site" which is planned to be prepared for habitat enhancement as compensation for the elimination of wetlands resulting from the Oakland Airport expansion.

Environmental Conditions: The northern subarea is almost entirely in upland, with only an ephemeral stream crossing the subarea from east to west. The southern subarea is also predominantly in upland, with only a narrow 140-acre band of wetland running along the western margin of the site.

Regulatory Constraints: The wetland areas on the western margins of the southern subarea, and the ephemeral stream in the northern subarea, would be subject to the jurisdiction of the Corps of Engineers. The upland areas would be outside the Corps jurisdiction unless site investigations determined the existence of seasonal wetlands not identified on the National Wetlands Inventory maps. Since the site is largely absent of wetlands it may be suitable for permanent disposal and/or reclamation/processing under the current regulatory context.

BCDC's direct jurisdiction extends only as far as the salt ponds adjacent to the west. A small band of wetland along the western margin of the site is within the area of diked historic bayland, and BCDC would be asked to comment on anything proposed within this area.

The Napa County General Plan designates the entire northern subarea for Industrial uses. Although no specific proposals for industrial development have been received to date, the Board of Supervisors recently redesignated this area to industrial in an effort to promote economic development in the County. The northern subarea is part of a larger industrially designated area located along the west side of Route 29, east of the airport. It is expected that the lands along the highway will be developed first, and that the less accessible inland area, which constitutes the northern subarea of Site 10 will not be developed for at least another 20 years.

The southern subarea is designated in the General Plan for Agricultural use, which may allow for disposal of dredged material. It should be noted, however, that the Board of Supervisors is generally disinclined to allow disposal of waste material generated outside the County. For example, the Board was opposed to a previous proposal by the City of San Francisco to use the existing sanitary landfill site located to the west of the site to dispose of its solid waste.

Accessibility: The site does not have direct access to water, so any dredged material would likely have to be pumped in from barges stationed off-shore on the nearby Napa River.

Land Values: Land values within this site are estimated by a County appraiser to be on the order of $5,000 per acre, based on a recent transaction involving comparable land in the vicinity. With the recent designation of the northern subarea for industrial uses, these values can be expected to escalate.

Availability: Current ownership and potential for acquisition were not investigated.

Economic Feasibility: The economic evaluation for the site indicated unit costs ranging from $6.15 to $11.70 per cy for permanent disposal, and $7.00 to $11.50 per cy for a reclamation/processing operation. Site economics are inhibited by pumping costs associated with the required 10,000 feet of pipeline, and enhanced by proximity to maintenance dredging projects. The total capacity of the site for permanent disposal is estimated to be 22.5 million cy (6.5 million in the northern subarea, and 16.0 million in the southern subarea.)

Conclusion: Since this site is predominantly comprised of upland, it is the site closest to the major maintenance dredging projects which has potential for permanent disposal. Economically, this site could be an attractive alternative for nearby dredging sites at Mare Island and Suisun Bay. Due to the site's central location, any future studies should investigate a possible disposal operation involving both permanent disposal and reclamation/processing.

Sherman Island (Site 13)

Area: 10,000 acres

Location: This site is located at the extreme western end of the San Joaquin-Sacramento River Delta.

Land Use: The island is predominantly in agricultural use for row crops. The island is dotted with gas wells and major utilities such as high voltage power lines and gas transmission lines.

Environmental Conditions: The island is well below MSL and is mapped as wetland on the National Wetlands Inventory maps. The island has habitat value for migrating waterfowl.

Regulatory Constraints: As with the other wetland sites, the Corps has primary regulatory authority over activity on the island. Permanent disposal would likely not be acceptable, although a reclamation/processing operation might be acceptable from a regulatory standpoint.

Accessibility: Barge access is available along both the Sacramento and San Joaquin Rivers. The site also has good road access via Route 116 and the Antioch Bridge which connects the island to Contra Costa County to the south.

Land Values: The Sacramento County Assessors Office estimates land values on the island to be about $2,000 per acre.

Economic Feasibility: The economic analysis indicated that unit costs would range from $5.35 to $11.25 per cy for a reclamation/processing operation at the site. The economics of the site are enhanced by its direct accessibility by barge, and inhibited by its distance from major maintenance dredging projects.

Availability: Current ownership and potential for acquisition were not investigated. It is highly likely that land use on the island is restricted by Williamson Act contracts.

Conclusion: This site has potential as a reclamation/processing site and may be a feasible alternative to ocean disposal for nearby dredging projects at Suisun Bay and Mare Island. This site may also hold some advantages for marketability of processed material, particularly because it has direct barge access, and also good access by road to construction sites and sanitary landfill sites in Contra Costa and Solano Counties. For these reasons, further study of this site for a reclamation/processing operation may be warranted.

Montezuma (Site 12)

Area: 3,000 acres

Location: This site is located at the eastern margins of Suisun Marsh between Montezuma Slough and Collinsville Road. The site is bounded on the southeast by the Sacramento River.

Land Use: The site is predominantly in agricultural use for hay production and grazing. The marshlands in the northwestern portion of the site are owned and managed by a duck club.

Environmental Conditions: The major portion of the site is in wetlands, with marshlands predominating in the northwestern portion of the site, and with seasonal wetlands occurring in the western and southern areas along Montezuma Slough. The land gradually rises to become upland in the eastern portion of the site, toward the Montezuma Hills.

Regulatory Constraints: The wetland areas are under the jurisdiction of the Corps of Engineers. BCDC has direct jurisdiction over the managed wetlands in the northwest portion of the site and in the 100-foot shoreline along the Sacramento River. This site is included in the area covered by the State-mandated Suisun Marsh Protection Plan, which was adopted by BCDC in 1976. The Plan designates the wetland areas in the western half of the site as a Primary Management Area, which is to be preserved for wildlife habitat. The plan also designates the portion of the site extending north from the Sacramento River for Water-Related Industrial Uses. This area is known as the "Collinsville site" in the Plan. With respect to this site, the Suisun Marsh Protection plan states: "[it] is the largest vacant site with deep-water access within the Bay Area and will therefore be of major importance in the future development of water-related industry." The plan states that despite its habitat value, the lower areas of the designated industrial site should be reserved for industrial use. Subsequent to adoption of the Plan, Solano County adopted a Specific Plan for the Collinsville site, in conformance with the designation and policies of BCDC's Plan. The County's plan permits filling of a 500-acre portion of the industrial site lying below 10 feet MSL, "when [such filling] is part of an engineered fill for a proposed water-related industry". It is uncertain whether use of the site as a dredged material disposal site, in the absence of a specific proposal for industrial development, would be received favorably. However, BCDC staff indicates that such disposal would be preferable to the use of a wetland site which is not designated for ultimate industrial development.

In addition, BCDC's Protection Plan stipulates that at the time of industrial development, the substantial area between the industrial area and Montezuma Slough to the west is to be returned to tidal

action or managed as a wetland. Potentially, this could involve the restoration of the area to tidal marsh. Since much of that area lies at -5 feet MSL, dredged material could be useful as fill to bring the area up to elevations that would be subject to the range of tidal action, and conducive to the formation of tidal marsh habitat.

Accessibility: The site has excellent access via the deep water channel in the Sacramento River. The remote location of the site and poor road access, particularly to the developing areas of Contra Costa County to the south, would reduce the marketability of any dredged material that might be reclaimed at the site. This in turn reduces the potential feasibility of the site as a reclamation site, although some materials could be reclaimed if needed for nearby sanitary landfill sites or for levee repair in the delta.

Land Values: According to a representative of the Santa Fe Pacific Realty Company, which owns the site, fair market value of the site was recently appraised at $2,000 per acre.

Availability: Santa Fe Pacific has been actively seeking buyers for the site for about the past year. Since the lower portions of the industrially designated areas are at -5 feet MSL, Santa Fe Pacific or future owners may well be receptive to the permanent disposal of dredged material at the site to raise site elevations for flood protection.

Economic Feasibility: The economic analysis of the site for permanent disposal indicated unit costs ranging from $4.70 to $11.60 per cy. Unit costs for a reclamation/processing operation at the site range from $4.55 to $10.45 per cy. The economics of the site are enhanced by the availability of direct barge access, and inhibited by its remote location relative to the major maintenance dredging projects. The total site capacity for permanent disposal is estimated to be 18.0 million cy.

Conclusion: The southeastern portion of the Montezuma site has excellent potential as a permanent disposal site, primarily since it has good barge access and because the landowner has indicated an interest in accepting the material or selling the land. Economically, this site could be an attractive alternative for maintenance dredging projects located close by, such as Suisun Bay and Mare Island. If land disposal is pursued as a disposal method, this site should be given serious consideration as either a permanent disposal site or reclamation/processing site, or both.

APPENDIX B

PLANNED DEVELOPMENT PROJECTS
WHICH HAVE THE POTENTIAL FOR
USING DREDGED MATERIAL AS FILL

POTENTIAL FILL REQUIREMENTS

The following planned development projects may provide potential opportunities for disposal of dredged material since fill is required for site development. However, these projects are generally constrained by 1) requirement for new technologies to complete, 2) regulatory concerns, 3) mitigation requirements and 4) timing. Because of these constraints, they are not included in further detailed analysis.

Project	Acres	Fill Requirement (cyds)	Timing
First Venture Corp. South SF Airport	109	1.0 million	5-10 yrs
Bay Bridge Terminal Port of Oakland	55	1.3 million	10 yrs
Redwood Shores	500	1.6 million	10 yrs
Citation San Leandro	200	1.6 million	2-10 yrs
Venetia Industries Venetia	50	0.5 million	10 yrs
Hayward Shorelands	640	5.2 million	10 yrs
Oakland Airport Second Runway	300	7.2 million	10-15 yrs

Other Potential Projects

Delta islands levee strengthening requires approximately 2.0 million cyds annually.
Local duck clubs require 0.5 million cubic yards annually to raise lands.
Sanitary landfill capping requires 0.5 million cyds annually.
Metropolitan Transportation Commission Seaport Plan identifies the Bay Area will require 4.8 million cyds of fill for near and long term marine terminal expansion over the next 25 year period.

APPENDIX C

REGULATORY ASPECTS

REGULATORY ASPECTS

Development of dredged material disposal sites must take place within a framework of local, regional, state and federal requirements. These requirements range from simple planning guidance to enforceable regulations. Four issues emerge as critical to successful development of dredged material disposal sites on land:

- o Local/Regional planning and zoning restricting use of the land.
- o Requirements to conserve and enhance wetland values.
- o Protection of threatened and endangered species, including habitat.
- o Need for an critical institutional entity to provide the focus for project development and resolution of issues.

Of these, wetlands considerations and the need for a responsible entity to focus resolution of issues become the most significant factors for the three sites evaluated.

A description of the regulatory context for disposal site development is contained in Nolte, et al.(1987). Aspects primarily related to the above critical issues are reviewed in the following discussion.

PLANNING AND ZONING

Local

City and county governments are responsible for developing and implementing local land use plans. Any proposed dredged material land disposal site would require approval at the local level based on consistency with the land use and zoning requirements. In general no zoning category precludes the use of fill materials in preparing the land for a future conforming use. Consequently, lands zoned for agriculture, industrial, urban or residential uses may be candidate for fill if the ultimate use is preserved.

Project approvals at the local level involve opportunity for public input. Environmentally sensitive proposals, e.g., filling of wetlands, may be successfully opposed by environmental groups. This potential uncertainty should be considered early in the project planning stage.

San Francisco Bay Regional Plan

The San Francisco Bay Plan developed by the Bay Conservation and Development Commission identifies priority uses for the Bay and shoreline areas. Implementation is guided by a comprehensive set of planning maps and policies oriented to minimize loss of baylands by filling, and to maximize use and conservation of Bay natural resources for public access and benefit and for wildlife. Designated priority shoreline uses include development of port and water-related industry in selected areas. All of the proposed Avon site and a substantial portion of the Montezuma site are designated for Port development and water-related industry under the Bay Plan.

While giving highest priority to preservation of wetlands, the Plan also recognizes the potential need to fill certain areas where consistent with final use and public benefit considerations. The Bay Plan includes provisions for mitigation of adverse impacts resulting

from unavoidable wetland fills. In addition, BCDC has developed policies to protect diked historic baylands, including areas beyond its present jurisdiction, with a view toward eventual restoration of lost wetland values. All of the Avon site and portions of both the Napa and Montezuma sites are within diked historic baylands boundaries.

WETLANDS

Each of the three selected dredged material disposal study sites contain areas identified as wetlands on U.S. Fish and Wildlife Service Wetlands Inventory Maps. In addition, each site encompasses areas of diked historic baylands designated by BCDC. Consequently, filling of these sites would be subject to the requirements of a number of state and federal agencies. The principal agencies with regulatory authority responsible for wetlands protection are the U.S. Army Corps of Engineers, the Environmental Protection Agency, the Regional Water Quality Control Board, and the Bay Conservation and Development Commission. In addition a number of trustee agencies function in an advisory capacity to the regulatory agencies. These include U.S. Fish and Wildlife Service, National Marine Fisheries Service, California Department of Fish and Game, the California Resources Agency and the State Lands Commission.

Much of the regulatory authority is overlapping among the agencies, with similar requirements, policies and areas of jurisdictions. However, interpretive flexibility does exist which sometimes results in conflicting determinations for a given project proposal. This potential should also be accounted for early in the project planning process.

Application of the regulatory framework to the wetland and/or diked historic bayland portions of the proposed disposal sites is outlined below:

Corps of Engineers

The Corps is the principal regulatory agency with authority over wetlands. Jurisdiction is derived from both the Rivers and Harbors Act of 1899 (Sects. 9 and 10) and the Clean Water Act of 1977 (Sect. 404). The Rivers and Harbors Act applies to construction in navigable waters, including dredging and filling, and Section 404 of the CWA applies to the placement (discharge) of dredged materials into public waters. Under the Rivers and Harbors Act, jurisdiction extends to the 'mean high water line' as it existed in its 'natural' state; thus authority extends beyond existing dikes where lands lie below the historic mean high tide level. Under Section 404 Corps jurisdiction extends to the highest tide line in tidal waters, to the 'ordinary high water mark' in non-tidal waters, and additionally includes regulatory authority over adjacent wetlands. For the purposes of section 404, a wetland is defined as:

> Those areas that are inundated or saturated by ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps marshes, bogs, and similar areas.

Portions of the three study sites appear to be under Corps jurisdiction, although Corps Wetland determinations have not been made.

The Corps makes both a 'public interest review' to assure balance between project benefits and potential impacts, and a review in accordance with Section 404 to protect the aquatic ecosystem including wetlands. The provisions of the two applicable statutes are implemented by Corps of Engineers regulation set forth in 40 CFR 230.10.

The wetlands review is by comprehensive Section 404(b)(1) Guidelines promulgated EPA. The Guidelines do not permit discharge of materials to public waters (filling of wetlands) if there was a practicable alternative which would have less adverse impact on the aquatic ecosystem. Under application of the Guidelines, filling of wetlands is permitted only under the following conditions:

- o If the proposed project is **water dependent,** i.e., requires access or proximity to the water to fulfill its basic purpose.
- o If the project is **not** water dependent, alternatives that do not involve wetlands fill are presumed available. A wetland fill can be permitted only if no other feasible alternative exists. It is the applicant's responsibility to clearly demonstrate that all practicable alternatives have been evaluated and that no feasible alternatives are available.
- o Justification for a wetland fill requires selection of the alternative having the least adverse impacts. Non-wetland alternatives are presumed to have lesser adverse impacts unless clearly demonstrated otherwise.
- o All practicable steps are taken to minimize adverse impacts of the selected alternative. This requires mitigation of unavoidable adverse impacts.

The essence of the Guidelines is that wetland fills can only be permitted if the project is water dependent and/or there are no feasible alternatives with lesser adverse impacts. All practicable alternatives must be identified and evaluated in selecting the project and in minimizing (mitigating) adverse impacts.

The Corps public interest review is inter-related with the Sect. 404 wetlands evaluation. It considers the need for the project and weighs expected benefits against probable impacts on the public interest. A wide variety of factors are considered including natural and cultural resources, environment, economics, public safety and commerce. Wetlands issues are weighed in accordance with the Section 404 guidelines. The Corps decision to authorize a proposal, and the conditions under which it will be allowed, are determined by the outcome of this general balancing process.

Criteria for public interest evaluation and approvals are somewhat qualitative and ambiguous. This can result in varying interpretations of the criteria based on best judgement. One aspect of the criteria raised by agencies contacted during the study is a need for improved consideration of public benefits expected to accrue from creation or restoration of wetlands. Often such wetland enhancement is weighed primarily as a mitigation cost to maintain equivalent values. However, it is probable that wetlands enhancement, e.g., restoration of a tidal marsh in diked baylands, would accrue large monetary environmental and wildlife benefits in the public interest over the long term future. Accounting for such benefits could be an important factor in justifying a well planned dredged material disposal site involving a combination of wetland fill and enhancement. An example of potentially significant creation of long term wetland benefits in the public interest is the proposed creation of an intertidal wetlands by disposing of dredged sediments and breaching the dike in the lower quality diked bayland of the south and west portion of the Montezuma site (this report).

U.S. Environmental Protection Agency

EPA has primary authority for administering the Clean Water Act and promulgated the Section 404(b)(1) Guidelines. Administration of the Section 404 permit program for discharges of dredged or fill material into US waters is delegated to the Corps of Engineers. EPA retains oversight authority and may become involved in individual permit reviews at the Regional Office (USEPA, Region 9) level. The Corps will not issue a permit if EPA proposes permit denial based on Section 404 requirements.

U.S. Fish and Wildlife Service

The USF&WS provides advice to the Corps in making wetlands determinations and in development of mitigation plans based on evaluation of wetland values. As part of its National Wetlands Inventory mapping effort the Service has prepared comprehensive wetland maps for the entire area surrounding San Francisco Bay, including each of the three study sites.

There are two areas of potential conflict between the Corps and the Service approach to wetlands:

1. Policy of the USF&WS in protecting wetlands in the Bay area is to oppose projects in areas which are potentially restorable to tidal action, e.g., diked baylands, unless the project is shown to be water dependent. In comparison, the Corps may allow wetland fills for non-water dependent uses if there are no feasible alternatives, the proposal is in the public interest and adequate mitigation is provided.

2. The Service definition of wetlands is broader than that of the Corps by including the potential for wetlands characteristics, based on soil and/or hydrologic conditions at the site. This can result in Service designation of wetlands in areas which do not presently support the required "...prevalence of vegetation typically adapted for life in saturated soil conditions" reflected in Corps regulation.

California Department of Fish and Game

The California Department of Fish and Game has responsibility to protect fish and wildlife resources including wetland habitats. The Corps consults the Department on all applications involving wetlands. State policy allows wetland fills only for water dependent uses, and requires mitigation on an acre-for-acre basis. This also applies to proposed fills in areas of historic wetlands.

Regional Water Quality Control Board

The Clean Water Act requires the Corps to seek State water quality certification under section 401 for discharges of dredged or fill materials into waters of the U.S, including the placement of fills in wetlands. This requires a finding that the proposed discharge complies with water quality standards established by the State Basin Plan. The State may withhold certification if the proposed discharge would not comply, thereby stopping the project. Responsibility for Section 401 certification is delegated to the Regional Board.

In conformance with state policies concerning wetlands protection, the Board will require that any proposed fill activity within its regulatory jurisdiction include mitigation such that there will be no net loss of wetland acreage and no net loss of wetland value when the project area and mitigation area are evaluated together. The Regional Board will also consider EPA's Section 404(b)(1) Guidelines in determining the circumstances under which filling of wetlands may be permitted (Water Resources Control board, 1987).

San Francisco Bay Conservation and Development Commission (BCDC)

BCDC has permit authority for shoreline development within 100 feet inland from the line of "highest tidal action" in San Francisco Bay. BCDC's jurisdiction also includes additional specific water areas including the Suisun Marsh Protection Area which includes a portion of the proposed Montezuma disposal site. Sediment transfer facilities such as docks and pipelines within 100 feet of the shoreline would be within BCDC permit jurisdiction.

Federal agencies are not directly subject to BCDC permit procedures but generally do give full consideration to BCDC comments on substantive requirements including those related to diked baylands. For federal projects, BCDC would make determination under the Coastal Zone Management Act as to whether the proposed activity was consistent with the San francisco Bay Plan. [However, a federal project involving fill on privately sponsored upland property within BCDC's jurisdiction may be directly subject to the Plan and permitting requirements.]

While BCDC permit jurisdiction is primarily limited to the 100 ft. shoreline strip the agency has major policy influence over filling of diked baylands. Under state authority, BCDC developed and implements guidelines to protect diked historic baylands from filling in favor of eventual restoration of these areas to tidal influence and wetland values. The Corps consults BCDC with full consideration on all applications for filling of diked baylands.

BCDC's coastal zone determinations and comments are based on the San Francisco Bay Regional Plan, including the historic baylands policies. The Plan identifies priority uses and policies for protection and development of the shoreline area in the public interest. These priorities include wildlife preservation, public access to the shoreline and economic development. Special priority is given to protecting and enhancing wetland areas, including the diked historic baylands. Within this framework the Plan recognizes the need for navigation and port development, and the dredging and disposal necessary to support these uses.

Highest priority for shoreline disposal of dredged materials is to upland areas requiring fill. However, the Plan also provides that some Bay filling may be justified for purposes providing substantial public benefit if these same benefits could not be achieved equally well without filling. The Plan supplement on historic baylands provides "Certain diked historic bayland sites are within areas designated in the Bay Plan for priority use. These land uses--port, airport, water related industry and waterfront park, beach and wildlife area--are recognized as essential to the public welfare of the Bay Area. Although filling baylands for these uses would have detrimental effect on wildlife resources, development will also reduce pressure to fill the Bay itself and contribute to the economic vitality of the region. Further, "Mitigation, enhancement, or restoration projects must be carefully designed to assure that the project increases total wildlife values.." (Diked Historic Baylands of San Francisco, BCDC, 1982).

In summary, although highest priority is to avoid wetland fills, the Plan provides that selected filling may be conducted if it is in accordance with designated uses, practical alternatives are not available, fill is minimized and adequate mitigation is provided. This basis for considering some filling acceptable appears compatible with Corps requirements under Section 404(b)(1). All of the Avon site, a major portion of the Montezuma site and the Napa site are recognized in the Bay Plan for priority use as water related/industrial development sites.

THREATENED AND ENDANGERED SPECIES

The federal Endangered Species Act declares the intention of congress to conserve threatened and endangered species and the ecosystems upon which those species depend. The Act requires that federal agencies, in consultation with the U.S. Fish and Wildlife Service and the National Matrine Fisheries Service, use their authorities and resources to further the intent of Congress. This requires that agencies assure that their activities are not likely to jeopardize the continued existence of such species or result in destruction or adverse impacts on critical habitats. The State of California has similar preservation programs for implementation at the state and local levels.

The salt marsh harvest mouse (Reithrodontomys ravinventris) and the California clapper rail (Rallus longirostris obsoletus) were given federal endangered species status in 1970; the State of California listed these species as endangered in 1971. The U.S. Fish and Wildlife Service approved a Recovery Plan for both species in the San Francisco Bay area in 1984. The Recovery Plan identifies actions and site-specific 'essential habitat' areas necessary to protection and recovery of these species. An area in private ownership adjacent to the Avon site is identified as essential habitat for the clapper rail with a goal of public acquisition and management. Development of the Avon site for Corps disposal of dredged materials should consider its potential relationship to the clapper rail habitat and the Recovery Plan.

APPENDIX D

COST ESTIMATE DATA

TABLE D1
DREDGING COST ESTIMATE

DREDGING AREA NAME: Oakland Outer/Inner		DISPOSAL SITES NAPA	MONTEZUMA	CROWLEY
Annual volume	500,000 cyds			
Haul Dist-one way		35 NM	47 NM	34 NM
Dredge size	18 cyd Clamshell			
Scow size	3,000 cyds			
Tug size	1200-1500 hp			
DREDGING				
Average load	9 cyds			
Cycles per hour	50			
Hours per day	18 hrs			
Daily rate-c.y.	8100 cyds			
Days per year	62			
Dredge cost/day	$12,000			
Dredge cost/year		$744,000	$744,000	$744,000
Dredge Mobilization		$50,000	$50,000	$50,000
SCOW COST				
Hours to load	6 hrs			
Haul to area		5.8 hrs	7.8 hrs	5.8 hrs
Rehandle time		2.0 hrs	2.0 hrs	2.0 hrs
Haul from area		4.4 hrs	5.9 hrs	4.4 hrs
Lost time		2.0 hrs	2.0 hrs	2.0 hrs
Total time		14.2 hrs	17.7 hrs	14.2 hrs
Scow cost/day	$1500	$6,000	$6,000	$6,000
Scow cost/year		$372,000 (4B/3T)	$372,000 (4B/3T)	$372,000 (4B/3T)
TUG COST		+$2400/day		
Hours per day	24			
Days per year	62			
Tug cost per day	$3600	$13,200	$10,800	$10,800
Tug cost per year		$818,400	$669,600	$669,600
LAUNCH cost/day	$1200			
Launch cost/year		$74,400	$74,400	$74,400
DREDGING COST				
Subtotal/year		$2,058,800	$1,910,000	$1,910,000
+23% overhead,bond,profit		$2,532,324	$2,349,300	$2,349,300
Total cost/cyd		$5.10	$4.70	$4.70
+25% contingency per cyd		$6.30	$5.90	$5.90

TABLE D2
DREDGING COST ESTIMATE

DREDGING AREA NAME: Richmond Harbor		DISPOSAL SITES NAPA	MONTEZUMA	CROWLEY
Annual volume	900,000 cyds			
Haul Dist-one way		25.5 NM	38 NM	25 NM
Dredge size	18 cyd Clamshell			
Scow size	3,000 cyds			
Tug size	1200-1500 hp			
DREDGING				
Average load	9 cyds			
Cycles per hour	50			
Hours per day	18 hrs			
Daily rate-c.y.	8100 cyds			
Days per year	111			
Dredge cost/day	$12,000			
Dredge cost/year		$1,332,000	$1,332,000	$1,332,000
Dredge Mobilization		$50,000	$50,000	$50,000
SCOW COST				
Hours to load	6 hrs			
Haul to area		4.2 hrs	6.3 hrs	4.2 hrs
Rehandle time		2.0 hrs	2.0 hrs	2.0 hrs
Haul from area		3.2 hrs	4.7 hrs	3.1 hrs
Lost time		2.0 hrs	2.0 hrs	2.0 hrs
Total time		11.4 hrs	15.0 hrs	11.3 hrs
Scow cost/day	$1500	$4,500	$6,000	$4,500
Scow cost/year		$499,500 (3B/2T)	$666,000 (4B/3T)	$499,500 (3B/2T)
TUG COST		+$2400/day		
Hours per day	24			
Days per year	111			
Tug cost per day	$3600	$9,600	$10,800	$7,200
Tug cost per year		$1,065,600	$1,198,800	$799,200
LAUNCH cost/day	$1200			
Launch cost/year		$133,200	$133,200	$133,200
DREDGING COST				
Subtotal/year		$3,080,300	$3,380,000	$2,813,900
+23% overhead,bond,profit		$3,788,769	$4,157,400	$3,461,097
Total cost/cyd		$4.20	$4.60	$3.80
+25% contingency per cyd		$5.30	$5.80	$4.80

TABLE D3
DREDGING COST ESTIMATE

DREDGING AREA NAME: Mare Island Strait		DISPOSAL SITES NAPA	MONTEZUMA	CROWLEY
Annual volume	800,000 cyds			
Haul Dist-one way		6.5 NM	23 NM	10 NM
Dredge size	18 cyd Clamshell			
Scow size	3,000 cyds			
Tug size	1,200-1,500 hp			
DREDGING				
Average load	9 cyds			
Cycles per hour	50			
Hours per day	18 hrs			
Daily rate-c.y.	8,100 cyds			
Days per year	99			
Dredge cost/day	$12,000			
Dredge cost/year		$1,188,000	$1,188,000	$1,188,000
Dredge Mobilization		$50,000	$50,000	$50,000
SCOW COST				
Hours to load	6 hrs			
Haul to area		2.2hr(3kn)	3.8 hrs	1.6 hrs
Rehandle time		2.0 hrs	2.0 hrs	2.0 hrs
Haul from area		1.6hr(4kn)	2.9 hrs	1.3 hrs
Lost time		2.0 hrs	2.0 hrs	2.0 hrs
Lost time		7.8 hrs	10.7 hrs	6.9 hrs
Scow cost/day	$1,500 each	$4,500	$4,500	$4,500
Scow cost/year		$445,500 (3B/2T)	$445,500 (3B/2T)	$445,500 (3B/2T)
TUG COST				
Hours per day	24			
Days per year	99			
Tug cost per day	$3,600	$7,200	$7,200	$7,200
Tug cost per year		$712,800	$712,800	$712,800
LAUNCH cost/day	$1,200			
Launch cost/year		$118,800	$118,800	$118,800
DREDGING COST				
Subtotal/year		$2,515,100	$2,515,100	$2,515,100
+23% overhead,bond,profit		$3,093,573	$3,093,573	$3,093,573
Subtotal cost/cyd		$3.90	$3.90	$3.90
Total Cost Per Yard w/ 25% contingency		$4.80	$4.80	$4.80

TABLE D4
DREDGING COST ESTIMATE

DREDGING AREA NAME: Pinole Shoal		DISPOSAL SITES NAPA	MONTEZUMA	CROWLEY
Annual volume	250,000 cyds			
Haul Dist-one way		12 NM	25 NM	12 NM
Dredge size	18 cyd Clamshell			
Scow size	3000 cyds			
Tug size	1200-1500 hp			
DREDGING				
Average load	9 cyds			
Cycles per hour	50			
Hours per day	18 hrs			
Daily rate-c.y.	8100 cyds			
Days per year	31			
Dredge cost/day	$12,000			
Dredge cost/year		$372,000	$372,000	$372,000
Dredge Mobilization		$50,000	$50,000	$50,000
SCOW COST				
Hours to load	6 hrs			
Haul to area		2.0 hrs	4.2 hrs	2.0 hrs
Rehandle time		2.0 hrs	2.0 hrs	2.0 hrs
Haul from area		1.5 hrs	3.1 hrs	1.5 hrs
Lost time		2.0 hrs	2.0 hrs	2.0 hrs
Total time		7.5 hrs	11.3 hrs	7.5 hrs
Scow cost/day	$1500	$3,000	$4,500	$3,000
Scow cost/year		$93,000 (2B/1T)	$139,500 (3B/2T)	$93,000 (2B/1T)
TUG COST		+$2400/day		
Hours per day	24			
Days per year	31			
Tug cost per day	$3600	$6,000	$7,200	$3,600
Tug cost per year		$186,000	$223,200	$111,600
LAUNCH cost/day	$1200			
Launch cost/year		$37,200	$37,200	$37,200
DREDGING COST				
Subtotal/year		$738,200	$821,900	$663,800
+23% overhead,bond,profit		$907,986	$1,101,937	$816,474
Total cost/cyd		$3.60	$4.40	$3.30
+25% contingency per cyd		$4.50	$5.50	$4.10

TABLE D5
PUMPOUT COST ESTIMATE

DREDGING AREA NAME	Oakland Outer /Inner Harbor	Richmond Harbor
Annual Volume (cyds)	500,000	900,000
Days in year	62	111
LABOR COST		
8 hr shifts per year	185	333
Cost per 8 hour shift	$900	$900
Labor cost/year	$166,667	$300,000
FUEL COSTS		
Pumping hours per year	370	667
Fuel cost/pumping hour	$45	$45
Fuel cost/year	$16,667	$30,000
MISCELLANEOUS SUPPLIES		
Months per year	2.1	3.7
Cost per month	$1,000	$1,000
Misc. cost/year	$2,058	$3,704
MAINTENANCE COSTS		
Months per year	2.1	3.7
Cost per month	$5,000	$5,000
Maintenance cost/year	$10,288	$18,519
OPERATION COST		
Cost/year	$195,679	$352,222
Cost/cyd	$0.39	$0.39
CAPITAL COST		
Cost/cyd	$0.29	$0.29
PUMPOUT COST		
Total Cost/cyd	$0.68	$0.68

TABLE D6
PUMPOUT COST ESTIMATE

DREDGING AREA NAME	Mare Island Strait	Pinole Shoal
Annual Volume (cyds)	800,000	250,000
Days in year	99	31
LABOR COST		
8 hr shifts per year	296	93
Cost per 8 hour shift	$900	$900
Labor cost/year	$266,667	$83,333
FUEL COSTS		
Pumping hours per year	593	185
Fuel cost/pumping hour	$45	$45
Fuel cost/year	$26,667	$8,333
MISCELLANEOUS SUPPLIES		
Months per year	3.3	1.0
Cost per month	$1,000	$1,000
Misc. cost/year	$3,292	$1,029
MAINTENANCE COSTS		
Months per year	3.3	1.0
Cost per month	$5,000	$5,000
Maintenance cost/year	$16,461	$5,144
Total cost/year	$313,086	$97,840
Total Cost/cyd	$0.39	$0.39
CAPITAL COST		
Cost/cyd	$0.29	$0.29
PUMPOUT COST		
Total Cost/cyd	$0.68	$0.68

TABLE D7
DISPOSAL SITE COST ESTIMATE

CROWLEY SITE

	SITE 1 QUANTITY	SITE 1 UNIT COST	SITE 1 TOTAL	SITE 2 QUANTITY	SITE 2 UNIT COST	SITE 2 TOTAL	TOTAL
1. Dike Construction							
A. Surveying & Staking	15,400 Lin.Ft.	$0.70	$10,780	7,600 Lin.Ft.	$0.70	$5,320	$16,100
B. Clearing & Grubbing	20.5 Acres	$450.00	$9,225	10.1 Acres	$450.00	$4,545	$13,770
C. Ground Compaction	20.5 Acres	$600.00	$12,300	10.1 Acres	$600.00	$6,060	$18,360
D. Soil Testing	82 Cores	$625.00	$51,250	54 Cores	$625.00	$33,750	$85,000
E. Clear & Grub Excav. Are	41 Acres	$450.00	$18,450	27 Acres	$450.00	$12,150	$30,600
F. Excav., Grade, Fill & Dike Compaction	173,000 Cyds	$8.00	$1,384,000	111,000 Cyds	$8.00	$888,000	$2,272,000
TOTAL			$1,486,005			$949,825	$2,435,830
MOBILIZATION (+5%)			$74,300			$47,491	$121,792
SUBTOTAL			$1,560,305			$997,316	$2,557,622
CONTINGENCY (+10%)			$156,031			$99,732	$255,762
DIKE CONSTRUCTION TOTAL			$1,716,336			$1,097,048	$2,813,384
OUTLET WEIRS	2 @ $10,000 each		$10,000			$10,000	$20,000
TOTAL			$1,726,336			$1,107,048	$2,833,384

	SITE 1 QUANTITY	SITE 1 UNIT COST	SITE 1 TOTAL	SITE 2 QUANTITY	SITE 2 UNIT COST	SITE 2 TOTAL	TOTAL
2. Land Acquisition							
A. Upland Area	173 Acre	$50,000	$8,650,000	75 Acre	$50,000	$3,750,000	$12,400,000
B. Pipeline Right of Way	0 Acre	$0	$0	0 Acre	$0	$0	$0
			$8,650,000			$3,750,000	$12,400,000
3. Totals			$10,376,336			$4,857,048	$15,233,384

TABLE D8
DISPOSAL SITE COST ESTIMATE

NAPA SITE

	SITE 1 QUANTITY	SITE 1 UNIT COST	SITE 1 TOTAL	SITE 2 QUANITY	SITE 2 UNIT COST	SITE 2 TOTAL	TOTAL
1. Dike Construction							
A. Surveying & Staking	13,900 Lin.Ft.	$0.70	$9,730	13,050 Lin.Ft.	$0.70	$9,135	$18,865
B. Clearing & Grubbing	23.2 Acres	$450.00	$10,440	20.3 Acres	$450.00	$9,135	$19,575
C. Foundation Preparation	23.2 Acres	$600.00	$13,920	20.3 Acres	$600.00	$12,180	$26,100
D. Soil Testing	240 Cores	$625.00	$150,000	158 Cores	$625.00	$98,750	$248,750
E. Clear & Grub Excav.Area	123.6 Acres	$450.00	$55,620	78.3 Acres	$450.00	$35,235	$90,855
F. Excav., Grade, Fill & Dike Compaction	504,000 Cyds	$8.00	$4,032,000	334,000 Cyds	$8.00	$2,672,000	$6,704,000
TOTAL			$4,271,710			$2,836,435	$7,108,145
MOBILIZATION (+5%)			$213,586			$141,822	$355,407
SUBTOTAL			$4,485,296			$2,978,257	$7,463,552
CONTINGENCY (+10%)			$448,530			$297,826	$746,355
DIKE CONSTRUCTION TOTAL			$4,933,825			$3,276,082	$8,209,907
OUTLET WEIRS	2 @ $10,000 each		$10,000			$10,000	$20,000
			$4,943,825			$3,286,082	
TOTAL							$8,229,907

	SITE 1 QUANTITY	SITE 1 UNIT COST	SITE 1 TOTAL	SITE 2 QUANTITY	SITE 2 UNIT COST	SITE 2 TOTAL	TOTAL
2. Land Acquisition							
A. Upland Area	300 Acre	$30,000	$9,000,000				$9,000,000
B. Lowland Area	170 Acre	$4,000	$680,000	330 Acre	$4,000	$1,320,000	$2,000,000
C. Pipeline Right of Way	1.6 Acre	$4,000	$6,400	1.25 Acre	$4,000	$5,000	$11,400
			$9,686,400			$1,325,000	
3. Totals			$14,630,225			$4,611,082	$19,241,307