AN ANALYSIS OF THE BENEFICIAL USES OF DREDGED MATERIAL AT UPLAND SITES IN THE SAN FRANCISCO ESTUARY

June 1994

San Francisco Bay Conservation and Development Commission

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, Ca. 94105-3901

18 July 1994

MEMORANDUM

SUBJECT: Transmittal of Report Concerning the Beneficial Uses of Dredged Material in Upland Sites in the San Francisco Estuary

FROM: Sam Ziegler
Project Officer

TO: Interested Parties

I am pleased to transmit the enclosed report entitled ***"An Analysis of the Beneficial Uses of Dredged Material at Uplands Sites in the San Francisco Estuary."*** This report was prepared by the San Francisco Bay Conservation and Development Commission (BCDC) for the San Francisco Estuary Project (SFEP) through a grant that was administered by the U.S. Environmental Protection Agency (EPA). SFEP was a cooperative effort of diverse environmental, social and economic interests, working to promote the effective management of the San Francisco Bay-Delta Estuary. In 1993, SFEP participants completed a Comprehensive Conservation and Management Plan (CCMP) that presents a blueprint to help restore and maintain the chemical, physical and biological integrity of the Bay and Delta. The CCMP includes a Dredging and Waterway Modification Program Area that identifies key goals, objectives and actions related to this issue.

This report was produced for SFEP as one of several demonstration projects to promote the early implementation of CCMP actions. SFEP's intention in funding this and other demonstration projects was to provide necessary information to facilitate the implementation of priority actions to restore and protect estuarine resources. We anticipate that this report will assist in addressing some of the challenging issues associated with the disposal of dredged material from San Francisco Bay, particularly with regard to upland reuse of dredged material for beneficial purposes (such as for marsh restoration or levee stabilization).

For more information concerning the implementation of the Bay-Delta CCMP, please contact the San Francisco Estuary Project at 510/286-0460.

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June 1994

Prepared for:
San Francisco Estuary Project
Pursuant to EPA Grant CE-009608-01-3

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BACKGROUND

Approximately eight million cubic yards (cy) of sediment are dredged annually from San Francisco Bay for maritime trade, recreational boating, and other purposes. There are also proposals to deepen existing harbors and berths which could generate an additional 16 million cy of material that would need to be disposed.

Historically, most dredged materials have been disposed in the Bay at sites located primarily for the convenience of the dredgers. However, in recent years, dredging and disposal in the Bay have become increasingly controversial. In late 1982, an underwater mound was found to have formed unexpectedly and be increasing in size at the primary Bay disposal site off Alcatraz Island, raising concerns about the capacity of Bay dredging disposal sites. In addition, there was growing concern about the potential effects of dredged material disposal on fisheries, water quality, and wildlife.

The apparent finite capacity of Bay disposal sites and the possible adverse impacts of disposal on Bay resources led to the following actions:

1. The San Francisco Bay Conservation and Development Commission (BCDC), the San Francisco Bay Regional Water Quality Control Board (Regional Board), the U.S. Army Corps of Engineers (Corps), and the U.S. Environmental Protection Agency (EPA) joined in a cooperative effort to develop the Long Term Management Strategy (LTMS) to guide dredging and disposal of materials from San Francisco Bay over the next 50 years.

2. BCDC and the Regional Board adopted new policies encouraging disposal of dredged materials at non-tidal areas or in the ocean and setting target volumes for the amount of material disposed annually at existing Bay disposal sites.

3. The San Francisco Estuary Project (SFEP), an EPA-sponsored effort to develop the Comprehensive Conservation and Management Plan to restore and maintain the estuary's resources, identified dredging and dredged material disposal as one of five critical issues facing the estuary and undertook a detailed study to better define and characterize the issues.

4. In 1986, the Corps began requiring that material disposed at the Alcatraz site be broken up or disposed as a slurry (mixed with water) to promote dispersion and minimize accumulation. The Corps has recently proposed additional reductions in target volumes for the Alcatraz site.

Central to all these efforts to better manage Bay dredging and disposal is the identification and evaluation of disposal options, such as the use of Bay sites, ocean sites, and the potential of using dredged materials as a resource at upland locations around the Bay and Delta. The LTMS envisions that several disposal options will be available, depending on the volumes and composition of the dredged material and the location of the dredging project. An array of disposal options is necessary because it is unlikely that a single approach will accommodate all future dredging needs.

BCDC's main role in the LTMS is to identify, analyze and assist opportunities for using dredged materials from San Francisco Bay for beneficial uses at upland locations. Possible upland uses include fill for new construction, levee maintenance, landfill cover, and marsh restoration. Dredged materials from San Francisco Bay have already been successfully used in these ways and are being used for similar projects throughout the United States. However, upland disposal is generally not a dredger's first choice because: (1) it is usually more costly than Bay disposal; (2) most upland sites have a limited capacity; (3) few upland sites are currently available; and (4) environmental protection regulations make it difficult to get quick approval for upland disposal.

To help determine if upland use is a viable long-term disposal option, BCDC, with financial assistance from the SFEP, undertook this analysis to determine the current feasibility and constraints of using dredged material as a beneficial resource in upland areas around the San Francisco Estuary. By demonstrating the successes or failures of a variety of upland disposal demonstration projects, BCDC hopes to provide information that can be used in planning and implementing future projects.

BCDC identified 13 upland projects that could potentially use dredged materials in a beneficial manner. BCDC's staff then sought to facilitate these projects wherever possible by providing assistance that ranged from expediting BCDC approvals to meeting with other regulatory agencies in an effort to recommend solutions and help remove obstacles. Approximately $30,000 was set aside to help fund a field demonstration project, money that remains unspent because progress on most of the upland disposal projects in the estuary has been much slower than anticipated with considerable institutional barriers.

This report discusses the progress and current status of the 13 projects, five of which have been largely completed; the remaining eight projects are in varying stages of planning. The following conclusions and recommendations on actions needed to foster upland use of dredged material are based on the experience gained in the facilitation of these projects.

General Conclusions and Recommendations

For over 140 years, dredged materials have been used in the Bay and Delta to build levees, and to provide construction and fill material. Demand for dredged material remains high, particularly for rehabilitating levees and restoring wetlands. But as the experience of the 13 demonstration projects reviewed in this report indicates, there are obstacles to upland use of dredged materials. Chief among these obstacles are: (1) the high relative cost of upland disposal; (2) concern about the environmental and health

risks posed by contaminants in dredged materials; (3) concern about the impacts of using dredged material on existing habitats, particularly on seasonal wetlands*; (4) limited coordination among government agencies in processing dredging permits and the absence of a broadly accepted public policy advocating the beneficial use of dredged material; and (5) institutional caution resulting from the lack of experience with the effects and performance of beneficial use of dredged material.

Despite these obstacles, dredged materials have been used to stabilize levees in the Delta (Sherman and Twitchell Islands), in landfills as lining and cover material (Tri-Cities and Redwood Landfills), and as engineered fill for a marine terminal (Port of Oakland's Berth 30). There is also widespread support for the concept of using dredged material for marsh restoration. These successes suggest that upland disposal remains an important option for disposal of material dredged from San Francisco Bay and provide impetus to resolving current obstacles to upland disposal.

1. **Cost Differential**

a. ***Conclusions.*** Upland disposal projects will likely be significantly more expensive than the historical cost of Bay disposal. Historically, Bay disposal costs have been very low—between $3 to $6 per cy. These figures do not reflect the true total cost of Bay disposal because they do not include costs of monitoring disposal sites or mitigation for adverse impacts, costs to fishermen or the environment, or the costs of redredging the deposited material. Costs for upland disposal and use vary depending on the location and size of projects, and can range from about $6 per cy to over $30 per cy. Dredgers are likely to continue to opt for the least expensive disposal alternative available, which will probably remain Bay disposal. This conflicts with BCDC's and the Regional Board's dredging policies that view Bay disposal as the least preferred option, and the position of many state and federal resource agencies that additional restrictions on Bay disposal may be warranted. The creation of economic incentives and disincentives for dredging projects, such as institution of a dredging mitigation fee, can lessen or eliminate the cost differential of different disposal options. Fees from Bay disposal could be used to monitor and manage Bay disposal sites as well as defray some of the added cost of upland and ocean disposal.

Beyond the general cost difference, if a dredger does not have access to an existing upland disposal facility, the cost of securing a new non-tidal disposal site is substantial. A new site would require substantial up-front costs for site acquisition, planning and permitting, constructing on-site improvements, constructing off-loading and pumping facilities, and providing any needed mitigation. To make the per-cubic-yard costs of such projects feasible, the site will need to be large enough to achieve economies of scale. New federal programs may provide up to 75 percent of the cost of environmental enhancement projects associated with a federal dredging project, but funds will still be needed to contribute to the local cost share for such projects. Needed funds could be obtained through a regional reclamation district, new state and federal funding authorization, or accumulated dredging mitigation fees.

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* While this concern has been raised most recently for projects proposing to use dredged materials to accelerate tidal marsh restoration on lands with some seasonal wetlands, this concern is likely to be raised for any project where one scarce habitat is converted to another or is temporarily lost during project construction (e.g., maintaining levees in the Suisun Marsh).

In the Port of Oakland's Berth 30 project, much of the extra cost to dispose the dredged material upland arose from the need to stockpile the material, an unexpected cost that could have been avoided if a user for excess dredged sediment had been identified before dredging commenced. Both the Berth 30 project and the Port Sonoma-Marin's rehandling facility encountered problems that demanded an immediate remedial response, such as repairing failed levees. Better project planning may have prevented these problems, helping to avoid the expense of remedial actions.

b. ***Recommendations.*** As part of its implementation strategy, the LTMS should determine how additional funding sources and increased funding can be established to help defray the extra costs associated with upland disposal. Funding sources could include creation of a regional reclamation district, institution of a permanent dredging mitigation fee, or a new state or federal funding assistance program.

The Corps' laws, policies, and regulations should be changed to allow greater Corps sponsorship and funding for upland disposal and beneficial use options.

Sponsors of upland disposal projects should carefully plan all elements of the project in order to reduce the risk of events and circumstances occurring that can increase the cost of upland disposal.

2. **Contaminants**

a. ***Conclusions.*** Dredged material disposal in any environment, whether in the Bay, the ocean, or at an upland location, can increase the risks that contaminants buried with or bound to the dredged sediments may be released with potentially harmful effect. Because Bay disposal sites were selected partly because they are highly dispersive, disposing dredged material at Bay sites increases the chance that contaminants in the material will become biologically available and widely dispersed through the estuary. These risks appear to be of less concern for upland disposal where the contaminants in the dredged material can be managed and contained. Nonetheless, because there is limited information about the relative risk of contaminant exposure with the various disposal options, fear of contaminant risks is an issue that will accompany any disposal option.

Bay sediments range from being virtually free of contaminants to sediments containing higher levels of certain chemicals. The clean sediments proposed for many upland uses pose few environmental risks; most of the concern and research has focused on the handling of sediments containing elevated levels of contaminants. While there is good understanding of the processes that restrict contaminant mobility and biological availability, management practices similar to those that have proven effective for containing contaminants in other environments are still under development in this region for some of the proposed upland uses (such as containment under marsh restoration projects). As a result, there has been some concern that upland disposal and use of dredged materials will release contaminants into the environment, a concern that arises from: (1) a lack of experience in the region in managing contaminants for some proposed upland uses; (2) the difficulty in drawing general conclusions regarding the contaminant risks of upland disposal because these risks are determined by numerous project-specific factors including sediment characteristics, contaminant levels, and the characteristics of individual disposal sites; (3) the visibility of most upland uses contrasted with the largely unseen effects of aquatic disposal; and (4) the fact that testing standards and protocols for materials disposed upland are relatively new.

To help evaluate the environmental risks of using sediments containing contaminants, the Regional Board, as part of the LTMS, has reviewed existing literature and current research and has sponsored studies on the levels and toxicities of contaminants in Bay sediments and the possible accumulation of contaminants in living tissue. The results of these studies have led to the development of screening criteria and testing requirements for sediments proposed for upland uses; other LTMS studies are addressing improved testing procedures. However, further work needs to be done to better define safe contaminant levels and the best methods to prevent potential contaminant effects associated with some of the proposed upland disposal options.

Some aspects of upland disposal, such as the amount of material placed, description of disposal operations, and sediment characterization, are best monitored and documented by dredgers. However, for Bay and ocean disposal, long-term site evaluation of possible contaminant effects on water quality, bioaccumulation, off-site impacts, and impacts on fish and wildlife resources have been mainly the responsibility of state and federal programs. The Corps regularly surveys the primary Bay disposal site at Alcatraz; significant monitoring is proposed at the ocean site to be designated in 1994. It is reasonable to expect the same level of federal participation in funding and monitoring all disposal options, including upland disposal. Additional funding could come from dredger contributions to a Bay-wide monitoring program involving intensive, long-term monitoring of aquatic and upland disposal.

b. ***Recommendations***. The LTMS should actively promote research regarding contaminant effects at Bay Area universities and colleges and at federal research agencies, such as U.S. Geological Surveys and the Corps Waterways Experiment Station. Grant applications for conducting needed research should be supported, and the results of these research efforts widely disseminated. In addition, continuing work is needed to refine the testing procedures to make them shorter and more cost-effective. Efforts should continue to improve technical knowledge and regulatory controls to ensure proper management of dredged materials used in upland disposal. It is essential that contaminant monitoring be an integral part of upland use projects and that the monitoring be conducted over an extended period of time so that long-term effects can be detected.

Federal and state resource and water quality agencies should establish additional programs and guidelines for managing and monitoring contaminant effects from the disposal and beneficial use of dredged materials at upland sites.

Sponsors of upland disposal projects should be required by state and federal regulatory agencies to contribute to project monitoring and the evaluation of sediment screening criteria, biological uptake of contaminants, and the methods used to reduce contaminant mobility and availability. Their level of contribution should be the same as required of project sponsors for other disposal alternatives.

The State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Resource Control Boards, the California Environmental Protection Agency, and the U.S. Environmental Protection Agency should undertake further studies to more comprehensively determine: (1) safe levels of different contaminants commonly found in Bay dredged materials for different upland disposal alternatives; (2) the general dispersion of contaminants from upland disposal through the Bay-Delta ecosystem; and (3) the accumulation of contaminants in the tissues of Bay and Delta aquatic organisms.

3. Impacts of Habitat Conversion

a. ***Conclusions.*** Using dredged sediments to elevate subsided land to restore or enhance tidal, seasonal, or managed marshlands can result in the conversion of existing habitats, particularly seasonal wetlands.

Most of the projects where dredged materials are proposed for use in marsh restoration involve placing dredged materials in subsided, diked historic baylands to accelerate the restoration of these lands to tidal wetlands. These diked baylands consist of over 80 square miles of diked land that historically were part of the Bay and were either tidal marsh or mudflats. These areas represent the best opportunity for enlarging the Bay and restoring lost natural resource values. However, the seasonal wetlands which have formed on portions of these areas may serve as important habitat for Bay species, particularly for shorebirds and migratory waterfowl. Restoring tidal action to these lands usually converts these seasonal wetlands to tidal wetlands, although dredged materials can also be used to create seasonal wetlands and at least one proposed project has been designed to include seasonal wetlands within the area restored to tidal action. The U.S. Fish and Wildlife Service (USFWS) and some environmentalists believe that mitigation should be required for all seasonal wetland losses, including losses resulting from restoring lands that are currently diked and contain some seasonal wetlands back to tidal wetlands. Other resource agencies believe that mitigation is inappropriate for projects that will result in substantial increases in wetland habitat, albeit of a different type.

A regional approach to enhancement of Bay resources, including determining optimum acreages and locations of different habitat types, will help ensure that the habitat needs of Bay area wildlife will be met by optimally using available land. Ensuring that there is no time lag between the loss of a particular wetland habitat and its restoration elsewhere will be an important component of this regional wetland plan. The LTMS upland studies are being augmented to provide an analysis of the functions and values provided by seasonal wetlands and information on the location of such wetlands. This information should help address the issue of habitat conversion and serve as a foundation for a regional wetland plan. In addition, EPA has sponsored an initiative to prepare a comprehensive resource plan for the North Bay diked baylands, including habitat goals, and which involves interested federal and state agencies, property owners, and the public. BCDC has proposed to build on the foundation established by EPA by forming a partnership with North Bay local governments to prepare a North Bay Special Area Plan. The goal of the plan will be to ensure the protection and enhancement of North Bay wetlands and other natural resources while permitting appropriate development and upland disposal projects to occur in a more predictable and expeditious manner.

b. ***Recommendations.*** Comprehensive management programs to protect, restore, and enhance Bay Area wetlands should be prepared and adopted jointly by federal and state resource, water quality, and land use planning and regulatory agencies, and local governments. The first management program should be for the North Bay because most of the promising marsh restoration sites are located in this area.

4. Improved Government Coordination and Clear Policy Direction

a. ***Conclusions.*** Government actions, or in some cases inactions, can delay and jeopardize potential upland use projects.

Upland use projects are not readily addressed by existing regulatory programs, which contributes to delays and obstacles in implementing these projects. The experimental nature of some of the proposed uses creates further problems for regulatory review.

Most regulatory programs allow discretion in the interpretation of agency policy. To date, primarily because of uncertainties about the potential risks of contaminants in dredged materials and concerns about the impacts to existing wetland habitat at upland disposal sites, some regulatory agencies have interpreted their policies conservatively with regard to upland disposal. Although the environmental risks associated with Bay disposal are no better understood or more certain, regulatory agencies are often more willing to accept those risks and uncertainties because aquatic disposal represents the status quo. While there are no environmental benefits from Bay disposal, upland projects that restore wetlands and improve existing levees provide considerable benefits to wildlife and water quality. To address this inequity, the same level of information and the same risk assessment should be required of all disposal options. In addition, senior agency personnel need to actively work with their regulatory and environmental staffs in setting reasonable standards and criteria for evaluating upland projects involving the use of dredged material and in balancing the impacts of upland disposal with the impacts of continued Bay disposal.

Delays and postponement of upland projects have arisen, in part, from the following:

(1) The Construction and Operations Division of the Corps' San Francisco District, which is responsible for carrying out the overwhelming majority of the dredging in the estuary, has only recently begun to coordinate its actions with LTMS. Because obtaining cost-sharing agreements, permits, leases, and site preparation for most upland use projects requires considerable lead time, the Corps' Construction and Operations Division and other large dredging project proponents should notify LTMS at the very earliest project planning stages and continue to work with LTMS throughout the planning process so that dredging projects can be matched with suitable upland sites.

(2) The Clean Water Act requires that the least environmentally damaging practicable alternative be authorized for any given project. The Corps and EPA have interpreted this policy to mean that in implementing upland projects where dredged materials will be used beneficially, even for projects that will result in an environmental benefit, such as creating wetlands, the property which has the least existing environmental resource values at the time a project is proposed is the only one that can be authorized. This interpretation ignores the difficulty in determining a reasonable array of practicable alternatives and the problems in comparing sites where there is great disparity in the amount of information available (i.e., well-studied sites will almost always appear to have more resource values than sites only superficially surveyed). This interpretation further leads to the conclusion that to implement beneficial use projects, one must begin on the one property that has the least environmental resource values at the time a project is proposed and move sequentially through the pool of alternatives in setting up new project sites. Such an approach could preclude achieving the objective of having many potential use sites available throughout the estuary at any given time to maximize the efficiency of upland use of dredged materials. In the case of wetland restoration projects, this approach ignores the regional benefits of implementing the proposed project. Senior agency personnel need to actively work with their regulatory and environmental staffs to review the Clean Water Act and determine if this interpretation is the most reasonable one; the Corps and EPA may wish to develop guidelines to clarify their position.

(3) Local governments lack understanding of LTMS goals and how the accomplishment of those goals will benefit their community and the region. Most local governments have little experience and no expertise in dealing with dredged material for upland uses. As a result, they view upland use projects as creating additional obstacles to future dredging projects, creating safety hazards within their community, or removing agricultural lands from production. The LTMS program needs to involve local government as an active partner in upland use projects, and to be certain that relevant information, particularly on the risks associated with contaminants in dredged materials and ways to minimize those risks, is distributed to local government.

(4) The length of time involved in obtaining permits and the uncertainty of the permit process have led to significant delays in implementing potential upland use projects. LTMS's goal of implementing a cooperative permitting framework for dredging permits should put particular emphasis on the permitting process for upland use. The ideal approach will be simple, quick and efficient, protective of the environment, consistent with the laws and policies of the agencies, acceptable to dredgers and the regulated public, and easy to implement. This should be readily achieved for routine maintenance projects, which constitute the great majority of dredging permits. The first component would involve adoption by the agencies of a single application form for Bay dredging and disposal permits. The second component would involve simultaneous processing of administrative dredging permits by the agencies, perhaps using an interagency "sediment management committee" composed of staff from the regulatory and resource agencies.

(5) The Integrated Waste Management Board (IWMB) believes that dredged material rehandling facilities can be treated in one of two ways: either as a landfill or as a transfer facility. If the site is considered a landfill, then all the applicable requirements for landfills will likely be required by the local enforcement agency (usually the County Health Department), including double liners under the site, monitoring wells, etc. However, if the IWMB considers the facility a transfer facility for material that is being recycled, then the applicable standards will be far less rigorous. The difference in cost between these regulatory definitions may be millions of dollars. The Regional Boards face a similar choice. If they consider a rehandling facility a landfill, the requirements will be similar to those required by the IWMB. Alternatively, the Regional Board may regulate the facility as a land farming operation such as where composted sewage sludge from sewage treatment plants is applied to land as an alternative soil amendment and fertilizer for agriculture. Again, the difference in cost for project construction is likely to be millions of dollars. What is important is that the appropriate management practices be determined and specified commensurate with the environmental risks posed by the sediments to be handled at the facility.

b. ***Recommendations***. Existing government regulatory, construction, and environmental programs need to be modified to improve interagency coordination and cooperation. In addition, there must be clear comprehensive policy direction to promote upland use projects, not only to facilitate wetland habitat creation and enhancement, but to help solve the region-wide dredged material disposal problem.

Specific Upland Use Conclusions and Recommendations

In addition to the general conclusions and recommendations discussed above which apply to most upland disposal projects, some issues, conclusions, and recommendations are unique to each specific upland use.

1. **Marsh Restoration**

a. ***Conclusions.*** Dredged materials can be placed on subsided diked former baylands to accelerate marsh restoration processes or enhance existing wetlands by raising land to elevations suitable for marsh vegetation. Dredged materials have been successfully used in this way throughout the United States. In the San Francisco estuary, tidal marsh has become established at three former upland disposal sites (Muzzi Marsh in Corte Madera, Marin County; Faber Tract in Palo Alto, Santa Clara County; and Salt Pond No. 3 in Fremont, Alameda County) and dredged materials have been used to enhance resource values and management capabilities on managed wetlands in the Suisun Marsh, Solano County (Family Club, Island Farms, and Delta Farms). In addition, other upland disposal sites in the Bay area support seasonal wetlands. Results from past studies and LTMS studies currently underway suggest that a primary factor governing the development of tidal marsh at these former disposal sites is fill elevation; channel development and tidal inundation is much slower in those portions of a site filled too high and the marsh vegetation is less vigorous in these high areas. Although portions of some of these sites were overfilled, all support valuable natural resources, including endangered species. Despite this apparent success, the last effort to use dredged materials to restore tidal marsh in the Bay Area was in 1975. The approximate capacity of Sonoma Baylands, Montezuma Wetlands, and Hamilton Antennae Field, three of the marsh restoration projects reviewed in this report, is 25 million cy.

Using dredged materials for wetland restoration or enhancement raises engineering issues that include: (1) monitoring elevations as dredged materials are placed to avoid overfilling; (2) determining how best to transport, off-load, and place dredged materials at desired locations; (3) accounting for differential settlement of dredged materials in the marsh design; (4) minimizing the effects of wave energy on flood protection levees and marsh development; (5) designing perimeter levees to withstand seismic events; (6) ensuring that completed projects do not promote flooding in adjacent areas; (7) minimizing the erosion of newly placed dredged material into the Bay; and (8) dewatering and managing the water content of the newly placed dredged material.

Using dredged materials to restore wetlands also raises a number of environmental issues, including: (1) determining the optimum elevations for placing dredged materials that will promote the development of drainage channels and the establishment of targeted habitat types; (2) ensuring that contaminant levels in the dredged materials are sufficiently low or contained to pose no significant risk to adjacent habitats or to organisms expected to colonize the site, monitoring to ensure there are no adverse effects, and having remedial measures in place to correct possible problems; (3) devising tests that more accurately measure the suitability of dredged material for wetland creation; (4) deciding whether off-site mitigation should be provided for losses of existing habitat that may result when dredged materials are placed on a site and the site is restored to wetlands, or whether such projects are self-mitigating; (5) avoiding creating attractive habitat for nuisance predators such as the red fox; and (6) determining whether small-scale planting may speed the development of a diverse plant community and reduce erosion of dredged material.

b. ***Recommendations.*** Based on existing information, the marsh restoration projects at Sonoma Baylands and Montezuma Wetlands, with some refinements, will provide far greater natural resource values than currently exist at either site. If the environmental analysis corroborates that these projects pose little environmental risk, these projects should be brought on-line quickly and used to field test restoration

design, ways to control fill elevation, the risks associated with contaminants, techniques to restrict contaminant availability in tidal wetlands, and the adequacy of current sediment testing and evaluation protocols.

Efforts to better determine the values provided by seasonal wetlands should be continued by the upland studies group of the LTMS, the Department of Fish and Game, EPA's North Bay Initiative, and BCDC's North Bay Management Program; the results should help guide future restoration projects.

2. **Levee Repair and Stabilization**

a. ***Conclusions.*** For over 140 years, many of the estuary's levees have been constructed and repaired using dredged materials usually obtained from immediately adjacent borrow areas. Dredged materials are still the primary source of repair material for salt pond, duck club and many agricultural levees in the region. The largest demand for levee repair material comes from the Department of Water Resources (DWR) which estimates that approximately 52 million cy of material is needed to improve approximately 760 miles of Delta levees. DWR has reported that it has successfully used dredged materials from both the Bay and Delta to repair levees and has requested more material.

Much of the Delta has subsided by as much as 20 feet below National Geodetic Vertical Datum (NGVD) and there are few sources of material to repair levees. DWR and some farmers view dredged material from San Francisco Bay as a potential source of needed material if it can be obtained at reasonable costs and if concerns about the potential impacts of adding contaminants, particularly salts, to a freshwater environment can be resolved. DWR reports that water quality results from two small demonstration projects where sands dredged from the Bay were used for improving Delta levees found no soil contamination or any adverse impact on water quality. However, these results are based on small quantities of material, or on dredged material that had been placed on land for a number of years (approximately six or seven years) prior to being brought to the Delta. Future demonstration projects involving systematic monitoring of larger quantities and different kinds of Bay sediment should help define the contamination risks of using material originating from the Bay.

Dredged materials are also needed to repair Suisun Marsh levees, and levees along North Bay sloughs and tributaries. Concerns raised by the Corps and USFWS about potential impacts to wetlands and endangered species have stalled all recent efforts to repair levees in the Suisun Marsh.

The engineering issues involved in using dredged materials for levee repair include: (1) determining the most efficient and cost-effective means of transporting and placing dredged materials at proposed levee repair sites; (2) proper levee design and placement to avoid problems of differential settlement, cracking, erosion, and earthquake failure; (3) evaluating the need for and effectiveness of sediment fences or berms to contain dredged materials; (4) determining the structural suitability of the material; and (5) preventing excessive wetting and drying of levee soils which can make the levees loose and erodible.

Such use also raises environmental issues, such as: (1) determining effects on endangered or special status species; (2) evaluating impacts of contaminants, including salts, on water quality; and (3) ensuring that dredged materials placed on levees do not erode into adjoining wetland or wildlife areas.

b. ***Recommendations.*** Providing dredged material for a larger demonstration project, such as that proposed at Jersey Island, and performing the appropriate water and soil quality tests should be a high priority for LTMS and the Corps' Construction and Operations Branch which is responsible for conducting the estuary's major dredging projects.

The Central Valley Regional Water Quality Control Board and the San Francisco Bay Regional Water Quality Control Board should jointly develop sediment screening criteria that specify appropriate contaminant (including salinity) levels for sediment dredged from the Bay and proposed for Delta use.

Dredged material rehandling facilities, particularly ones located close to the Delta such as at the Montezuma wetlands site, would facilitate the use of dredged sediments in the Delta and in the Suisun Marsh.

Because most of the Suisun Marsh's endangered species are associated with tidal wetlands, resource agencies should support the restoration to tidal marsh of large parcels such as the Montezuma Wetlands and a few strategically located duck clubs which have been poorly managed. The Corps should work with the Suisun Marsh Resource Conservation District to develop an acceptable levee standard for marsh levee repairs. Projects constructed in accord with the standard should receive quick Corps approval.

3. **Use As Engineered Fill**

a. ***Conclusions.*** Dredged materials, primarily coarse sands, have been and will continue to be an important source of construction material. Treasure Island, much of Bay Farm Island, and part of the Oakland Waterfront were constructed using dredged sediments. Large scale future use of such material will largely be dependent on the construction or modernization of marine terminals, water-related industry and airports, as well as on the state of the economy. Some dredged materials with contaminant levels too high for aquatic disposal can still be safely used as engineered fill.

Such use poses engineering issues that include: (1) assuring that the dredged material is suitable for the proposed use; (2) dewatering the dredged material so as to preclude water quality impacts from return water; (3) sorting the material to remove any debris; and (4) instituting appropriate mitigation measures to minimize impacts to roadways, storm drains, etc.

The environmental issues raised by using dredged materials for engineered fill include: (1) possible water quality impacts if runoff or leachate from the dredged materials contains significant levels of contaminants; (2) public perception that contaminants in dredged materials pose a health risk; and (3) increasing concern over the liability that may be incurred by accepting dredged materials that are later discovered to have unacceptably high contaminant levels.

b. ***Recommendations.*** Wherever a port or water-related industry proposes both dredging and filling for new construction, and the dredged sediments can be used at a reasonable cost as engineered fill for the proposed use, the use of dredged material for construction should be required as a permit condition.

To keep costs down, such projects need to determine disposal sites or markets for *all* dredged material to minimize rehandling and stockpiling costs.

Upland disposal in urban areas will require assessment of potential impacts to human health and the initiation of public information programs to allay public fears about safety hazards.

4. **Rehandling Facilities**

a. ***Conclusions.*** Rehandling facilities are midshipment points for dredged materials that cannot be hauled directly to the site where it will be ultimately used; they are also sites where dredged materials can be dried or treated to remove or reduce salinity or other contaminants and thus enable a wider range of disposal options to be pursued for sediments that may initially contain higher levels of contaminants. Because rehandling facilities allow the disposal and use of dredged materials for which disposal options are not readily available, rehandling facilities are an important part of the mix of upland uses that should be made available to future dredging projects. Rehandling facilities enable alternatives for disposing dredged material with contaminant levels too high for aquatic disposal but low enough for specified upland uses. Rehandled materials may also be an important source of levee repair and landfill cover material in areas where alternative sources are more distant, such as in the Suisun Marsh and Sacramento-San Joaquin Delta. Rehandling large volumes of material will likely require expansion of existing facilities, such as at Port Sonoma-Marin, or the development of new ones. Operational efficiencies are needed to maximize capacity and reduce costs.

Rehandling facilities raise engineering issues that include: (1) determining optimum locations for rehandling facilities and the most efficient and cost effective means of transporting, placing, and removing dredged materials at such facilities; (2) determining the optimum depth to which dredged materials should be placed to promote drying; (3) assuring that containment levees are adequate; (4) instituting reliable and cost-effective water quality monitoring protocols to test water runoff from the site; and (5) assuring that containment and management measures are appropriate for the type of sediment and contaminants to be rehandled at the facility.

Environmental issues that are likely to be raised with rehandling facilities include: (1) mitigating for any habitat losses that would occur with construction of the rehandling facility; (2) managing the site so contaminants in the rehandling ponds will not pose a danger to wildlife attracted to the ponds to roost, feed, or drink; and (3) zoning and local permit issues.

b. ***Recommendations.*** The LTMS should continue to promote the establishment of rehandling facilities at strategic locations throughout the estuary in proximity to water and land transport and to potential users of the material. The Corps should be directed to construct and use regional rehandling facilities.

5. **Use at Landfills**

a. ***Conclusions.*** The high clay and fine silt content found in much of the dredged material from San Francisco Bay are often suitable for use as cover, capping, or liner material at sanitary landfills. Some dredged materials not suited for other disposal options can be used at landfills for a variety of uses. As with rehandling facilities, landfills provide an alternative for disposing dredged material with contaminant levels too high for aquatic disposal but low enough for specified upland uses. Redwood Landfill in Marin County has used dredged materials in the past and will likely continue to accept and use dredged

material in the future, particularly if its plans to expand and improve existing operations are approved. Tri-Cities Landfill in Fremont, Alameda County also currently uses dredged material. Other Bay Area landfills where dredged material may be accepted for use in the future include West Contra Costa Landfill in Richmond and Portrero Hills Landfill near Suisun City in Solano County. Use of large volumes of material at Redwood (or at other landfills where dredged material cannot be delivered directly by barge or that have limited on-site rehandling capacity) will likely require expansion of existing rehandling facilities (such as Port Sonoma-Marin) or the creation of new rehandling facilities (such as Leonard Ranch and Cargill North Bay Crystallizer Salt Ponds) currently under study through the LTMS.

Engineering issues raised in using dredged materials at landfills include: (1) evaluating physical and chemical characteristics of the sediments to determine how best to use them; (2) minimizing transportation costs; (3) minimizing wear and tear on public roadways; and (4) determining how and where to dry and treat the sediments prior to transport and use at landfills.

Using dredged materials at landfills should result in a net environmental benefit because sediments are removed from the Bay and used at a location and in such a manner that any contaminants in the material are fully contained.

b. ***Recommendations***. The LTMS should continue developing plans for bringing dredged material to landfills, including identifying needed rehandling facilities, so that dredged material use at landfills can continue and expand.

CHAPTER 1

INTRODUCTION

Dredging San Francisco Bay to maintain maritime trade, recreational boating, and other public trust uses generates approximately eight million cubic yards (cy) of dredged material annually. Moreover, proposals to deepen existing channels and berths could generate an additional 16 million cy. Annually, more than $5.4 billion of economic activity directly depend on commerce using navigational channels and berthing areas in the San Francisco Bay region. San Francisco Bay is also an estuary of international importance whose natural systems are impacted by human activities, including dredging and the disposal of dredged material. Potential disposal options to meet the region's dredging requirements include ocean sites, sites in the Bay, and the use of dredged material in beneficial ways including marsh creation projects and levee repair and stabilization.

Historically, most dredged materials from San Francisco Bay have been disposed at numerous aquatic sites throughout the Bay located primarily for the convenience of dredging projects; as many as 23 such sites existed in the late 1960s. In 1973, to minimize sediments drifting back into dredged areas and to reduce disposal impacts on the Bay, the U.S. Army Corps of Engineers (Corps), which regulates dredging and dredged material disposal, limited Bay disposal to four sites: (1) Carquinez Strait; (2) San Pablo Bay; (3) Suisun Bay channel; and (4) off Alcatraz Island, with the majority of the disposal occurring at the Alcatraz site. These sites were selected because of their proximity to major ongoing dredging projects and because it was believed that currents and tides would disperse most of the material and carry it out the Golden Gate.

But there was growing concern about the environmental impacts of Bay disposal. Because most dredging occurs in port and water-related industrial areas or at military facilities supporting past and present sources of toxic substances, there was concern that disposing dredged materials in the Bay would resuspend and redistribute contaminants buried in the sediments, impacting Bay organisms. Fishermen alleged that Bay disposal was adversely impacting commercial and sport fisheries. There was also concern that dredged materials were burying bottom dwelling organisms at disposal sites and reducing sandy and rocky areas providing habitat for commercially valuable fish species. The increased turbidity resulting from aquatic disposal was also suspected of physically harming organisms by abrasion, clogging gill and mouth organs, and causing mortality during sensitive life stages. Additionally, high turbidity was thought to reduce light penetration and lower the productivity of aquatic Bay plants and, by reducing the sensory abilities of Bay fish species, impair their ability to find prey and reproduce. In late 1982, an approximately 80-foot-high underwater mound was found to have formed unexpectedly and was increasing in size at the

Alcatraz disposal site, raising concerns about the capacity of Bay disposal sites. Disposal alternatives were needed to accommodate future dredging.

The importance of dredging to the regional economy and concern about the impacts of dredging and disposal on Bay resources led to several efforts to better understand and manage dredging and disposal in San Francisco Bay. In the late 1980s, the San Francisco Regional Water Quality Control (Regional Board) and the San Francisco Bay Conservation and Development Commission (BCDC) modified their policies on Bay dredging and disposal to encourage disposal of dredged materials in non-tidal areas or in the ocean, and set target volumes for the amount of material disposed annually at the various designated Bay disposal sites. In 1988, under the Clean Water Act of 1987, the U.S. Environmental Protection Agency (EPA) established the San Francisco Estuary Project (SFEP), a broad-based effort to develop a plan to restore and maintain the estuary's resources. Dredging and dredged material disposal was identified as one of the five critical issues facing the estuary and, after an in-depth analysis of the issue, the SFEP recommended upland use of dredged materials as a primary goal. In addition, in July 1990, BCDC, the Corps, the EPA, and the Regional Board formed a consensus-based program to develop the Long Term Management Strategy (LTMS) to guide the dredging and disposal of materials from San Francisco Bay in an economic and environmentally sensitive manner. Responsibilities under LTMS are divided among the cooperating agencies: the Corps oversees the overall management of the program; the EPA is responsible for ocean studies geared to designating an acceptable ocean disposal site; the Regional Board is responsible for studies evaluating disposal of dredged materials in the Bay; and BCDC is evaluating the potential for using dredged materials as a resource at upland locations around the Bay and Delta.

The upland studies managed by BCDC have three objectives: (1) identify, develop, and analyze opportunities for the upland disposal and beneficial use of material dredged from San Francisco Bay, including contaminated sediments that are unacceptable for aquatic (e.g., in the Bay) disposal, in upland locations around the Bay and in the Sacramento-San Joaquin River Delta area; (2) identify, analyze and, where possible, resolve the physical, regulatory, and institutional constraints to using dredged material for beneficial uses in upland areas; and (3) develop and evaluate implementation strategies and programs for the beneficial use of dredged material at upland sites generally, as well as site-specific plans and implementation programs for selected proposed disposal projects.

In 1990, BCDC received a grant from SFEP to assist BCDC's efforts to identify and facilitate projects demonstrating the beneficial uses of dredged material. This assistance took many forms, including: (1) expediting BCDC approvals; (2) drafting plan amendments to eliminate conflicts between upland projects and existing government policies; (3) preparing Corps permit applications and meeting with regulatory agencies to expedite approval of projects involving the beneficial use of dredged materials; (4) seeking funding sources and project sponsors; (5) funding studies that would help determine the potential for using dredged materials at given sites; and (6) reviewing and commenting on administrative drafts of environmental documents prepared for projects where dredged material would be used as a resource. Wherever possible, staff attempted to recommend solutions and help remove obstacles to the upland use of dredged sediment.

In addition to assisting BCDC in its efforts to evaluate the feasibility of upland disposal, it was hoped that a portion of the grant would be used to help fund a field demonstration project. Demonstration projects and case studies evaluate the feasibility of using dredged material as a resource and provide information

on how such projects should be conducted. For this reason, demonstration projects are an important component of the LTMS/SFEP programs. Upland projects include wetland restoration and enhancement, levee construction and maintenance, use in approved fills, use in sanitary landfills, and drying and rehandling for use as upland construction material. Approximately $30,000 was set aside to help implement such a field demonstration, money that remains unspent because progress on all dredging projects in the estuary has been much slower than anticipated.

This report documents the status of 13 projects which BCDC staff helped facilitate in an effort to demonstrate the problems and potential benefits of upland use. For each site, the size and capacity, existing ownership, zoning, environmental setting, project background, and costs are described. Most of these projects were selected in 1990 at the beginning of the LTMS planning process because they represented a wide range of potential upland beneficial uses and appeared to be the most likely to be completed or underway within the first two years of the LTMS program; a few additional projects have been included because they provide valuable information to guide future upland disposal efforts. The 13 projects include five where dredged materials would be used to accelerate marsh restoration (Sonoma Baylands, Montezuma Wetlands, Cullinan Ranch, Hamilton Antennae Field, and Suisun City's mitigation marsh); four proposing to use dredged material to raise or stabilize existing levees (Sherman, Twitchell, and Jersey Islands, and the Wings Landing duck club); one that would use dredged material to construct low interior levees on agricultural lands so that they can be flooded to provide seasonal wetland habitat (Staten Island); one that used dredged materials in the construction of a marine terminal (the Port of Oakland's Berth 30); one involving using a rehandling facility (Port Sonoma-Marin) as a midshipment point before dredged materials are taken to their ultimate destination and one where dredged materials will be used to cap and cover an operating landfill (Redwood Landfill). To date five of these projects are essentially complete, and plans for the remaining eight projects are in varying stages of development (see Figure 1).

Reviewing the experience of each project leads to some obvious conclusions about the obstacles facing upland use, which are presented in the report's summary and general conclusions and recommendations section.

Figure 1

SOURCE: LTMS, 1993

Location of Selected Demonstration Projects in the San Francisco Estuary

1a Port of Oakland Berth 30 (formerly Carnation Terminal)

1b Primary Stockpile Area for Port of Oakland's Berth 30 Material

2 Hamilton Antennae Field

3 Redwood Landfill

4 Port Sonoma-Marin

5 Sonoma Baylands

6 Cullinan Ranch

7 Suisun City Marina Dredging/ Suisun Marsh Wetlands Restoration and Levee Maintenance

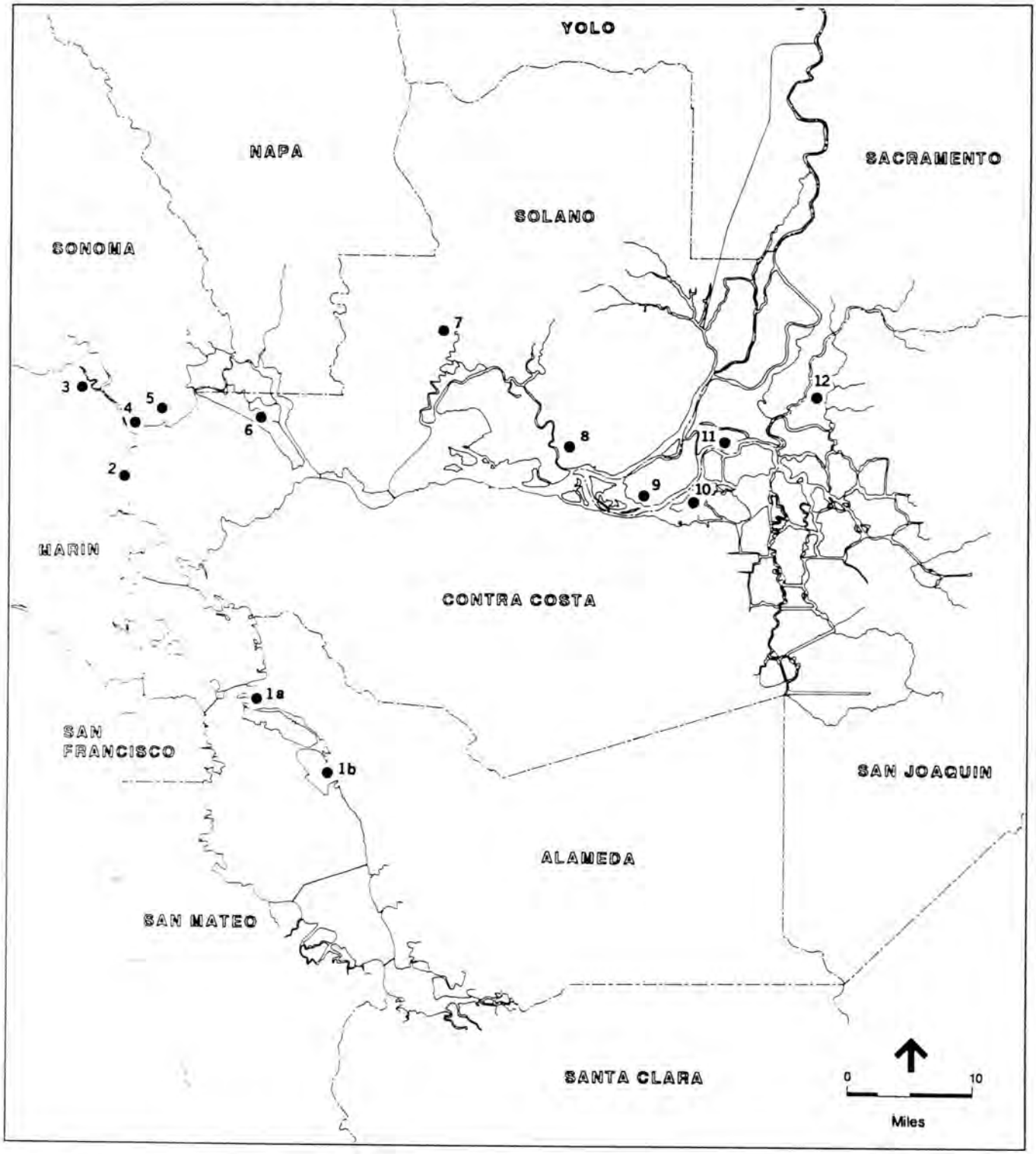
8 Montezuma Wetlands

9 Sherman Island

10 Jersey Island

11 Twitchell Island

12 Staten Island



CHAPTER 2

WETLAND CREATION, RESTORATION, AND ENHANCEMENT

Over 90 percent of the Estuary's historic wetlands have been significantly altered or no longer exist, which has led to a drastic reduction in the wildlife populations that depend on them. Efforts to restore and enhance the estuary's wetlands have focused on properties that had been diked off from the Bay, usually for agriculture. Agricultural practices over many years have caused these lands to subside so that current land elevations are many feet below sea level, far below the elevation necessary to support most marsh vegetation. Simply breaching the perimeter levees of such lands would result in creating a tidal lake until enough sediments accumulate to raise the bottom level to provide the necessary periods of inundation and exposure for marsh plants. Placing dredged materials on subsided, diked former baylands can accelerate the tidal marsh restoration process by raising ground level to the appropriate height.

Dredged materials have been successfully used in marsh restoration throughout the United States. In the San Francisco estuary, tidal marsh has been established at three former upland disposal sites: Muzzi Marsh in Corte Madera, Marin County; Faber Tract in Palo Alto, Santa Clara County; and Salt Pond No. 3 in Fremont, Alameda County and dredged material has been used successfully to enhance natural resource values and management capability at managed wetlands in the Suisun Marsh (Family Club, Island Farm, Delta Farms). In addition, seasonal wetlands have become established at other upland disposal sites in the Bay Area. Results from past studies and LTMS studies currently underway suggest that a primary factor governing the development of tidal marsh at these sites is fill elevation. Channel development is much slower and tidal inundation is much less in sites filled too high and the marsh vegetation is less vigorous in these high areas. However, even the high areas of these former upland disposal sites support valuable natural resources, including endangered species. Despite this apparent success, the last effort to use dredged materials to restore tidal marsh in the Bay Area was in 1975.

Creating wetlands with dredged materials have environmental risks. First, dredged materials may contain contaminants that could move through the ecosystem, stressing plants and animals. Our understanding of contaminant effects on wetland organisms is incomplete and there are no widely accepted standards or tests for determining safe contaminant levels in dredged materials used in wetland creation. Second, such projects may result in the loss of existing habitats, particularly seasonal wetlands. Third, there is a danger of overfilling sites with dredged materials, creating upland rather than wetland habitat.

Despite these risks, using dredged materials for wetland creation and restoration has great promise because it addresses two of the Bay's most pressing problems—the historical loss of Bay wetlands and the need to find environmentally sound, as well as economic, ways to dispose of dredged material.

This chapter analyzes wetland creation, restoration, and enhancement demonstration projects at Sonoma Baylands, Montezuma Wetlands, Cullinan Ranch, Suisun Marsh, and Hamilton Field and reports the conclusions reached from the analysis.

Sonoma Baylands

1. **Project Overview and Goals**. The Sonoma Land Trust, with a grant from the State Coastal Conservancy (Conservancy), acquired 830 acres of land in southern Sonoma County near the mouth of the Petaluma River with the goal of enhancing wetlands on the site. The site is located south and west of the intersection of Lakeville Highway and Highway 37 in Sonoma County (see Figure 2).

The southernmost 322 acres of the site is known as the Sonoma Baylands and is planned to be returned to tidal action to provide habitat for endangered species such as the salt marsh harvest mouse and the California clapper rail. The project proposes using approximately 2.5 million cy of clean dredged material to accelerate attaining elevations suitable for marsh vegetation.

A 31-acre portion at the west end of the larger Sonoma Baylands restoration site has been designated as a pilot project under the Corps' Coastal America Program, which allocated $78,000 for the project. The pilot project will implement a portion of the overall restoration plan, and is anticipated will provide information useful in implementing the larger Baylands project as well as other proposed restoration projects. Despite numerous delays, the pilot project site is now slated to be returned to tidal action two to two and one-half years prior to the return to tidal action of the overall Sonoma Baylands project site.

2. **Environmental Setting**. The Sonoma Baylands is bounded by Port Sonoma-Marin and the Petaluma River to the west, the Northwestern Pacific railroad line to the north, San Pablo Bay to the south, and farmland to the east. The southern boundary of the site borders the San Pablo Bay National Wildlife Refuge.

Historically, Sonoma Baylands was part of an extensive tidal marsh that characterized northern San Pablo Bay. In the 1920s, the area was diked off from tidal action and converted to agricultural lands. Currently, most of the site is in oat hay production. The existing perimeter levee supports a diverse assemblage of primarily invasive plants such as ripgut grass, wild radish, slender wildoat, and coyote brush. Brackish and saltmarsh plants such as alkali bulrush, pickleweed and salt grass are found in the large channel that runs around much of the site's perimeter. A total of 68 bird species have been observed over a six-year period on the site, including 23 species of water birds whose irregular use of the site is correlated with the amount of ponded water present during the rainy season.

3. **Project Details**

a. ***Background***. Agricultural practices, such as tilling and draining the soils, have oxygenated (oxidized) the organic matter in the former estuarine sediments, resulting in subsidence of the land

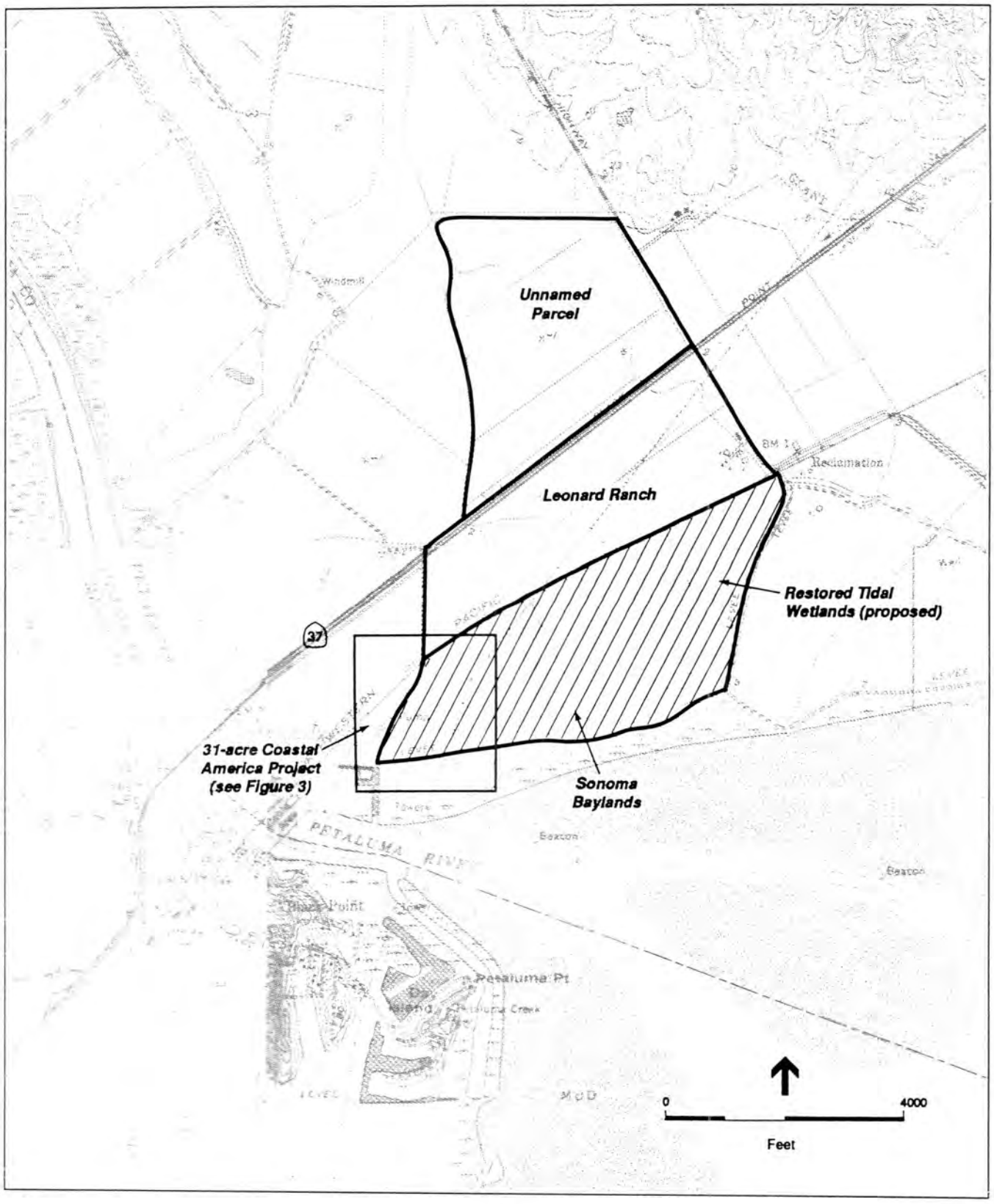
San Francisco Bay Conservation and Development Commission

SOURCE: U.S.G.S., 1980

Figure 2

Sonoma Baylands

Dredged materials would be placed on the southernmost parcel (indicated by shading) of these former baylands to accelerate tidal marsh restoration processes by raising the land to elevations suitable for marsh vegetation. Plans for Leonard Ranch and the unnamed parcel north of Highway 37 are still being developed.



surface. As a result of long-term subsidence, elevations at the project site are generally below -2 feet National Geodetic Vertical Datum (NGVD, which is approximately mean sea level). Simply breaching the perimeter levee and restoring the site to tidal action would result in creating a large tidal lake for many years until natural sedimentation brings site elevations up to a level conducive to marsh plant growth. The project proposes using dredged materials to accelerate the process.

b. ***Project Design.*** The Conservancy has completed a preliminary design for tidal marsh enhancement based on technical studies of the site and experience at two Bay restoration sites —Muzzi Marsh in Corte Madera, Marin County, and Salt Pond No. 3 in Hayward, Alameda County—where dredged materials were used to restore tidal marsh. Three additional sites were studied to help determine the appropriate fetch length so that waves do not limit marsh evolution; this information guided the placement of peninsulas at the restoration site.

The project will be constructed in two phases. The first phase consists of on-site improvements necessary to protect adjacent lands from inundation and to protect the site from wave erosion. Phase One improvements include: (1) building a new levee immediately south of the railroad right-of-way to protect inland areas from tidal flooding; and (2) constructing a series of low-lying, interior peninsulas from on-site material to increase habitat diversity, promote sedimentation and reduce wave erosion of the dredged materials and northern levee (see Figure 3).

In Phase Two, dredged materials will be placed to approximately +2 feet NGVD, approximately one and one-half feet below marsh plain elevations of neighboring tidal marshes. Placing materials slightly below the expected ultimate marsh plain elevation will allow natural sedimentation to complete the process and was determined to be the optimal elevation for promoting the rapid development of a tidal drainage system throughout the restored marsh. By using dredged material to raise site elevations, a young intertidal marsh is expected to form in approximately ten years.

c. ***Permits.*** Sonoma County has zoned the site for Land Extensive Agriculture. No County permits are required for Phase One improvements; the county has stated that it will require a permit for the placement of dredged materials in Phase Two.

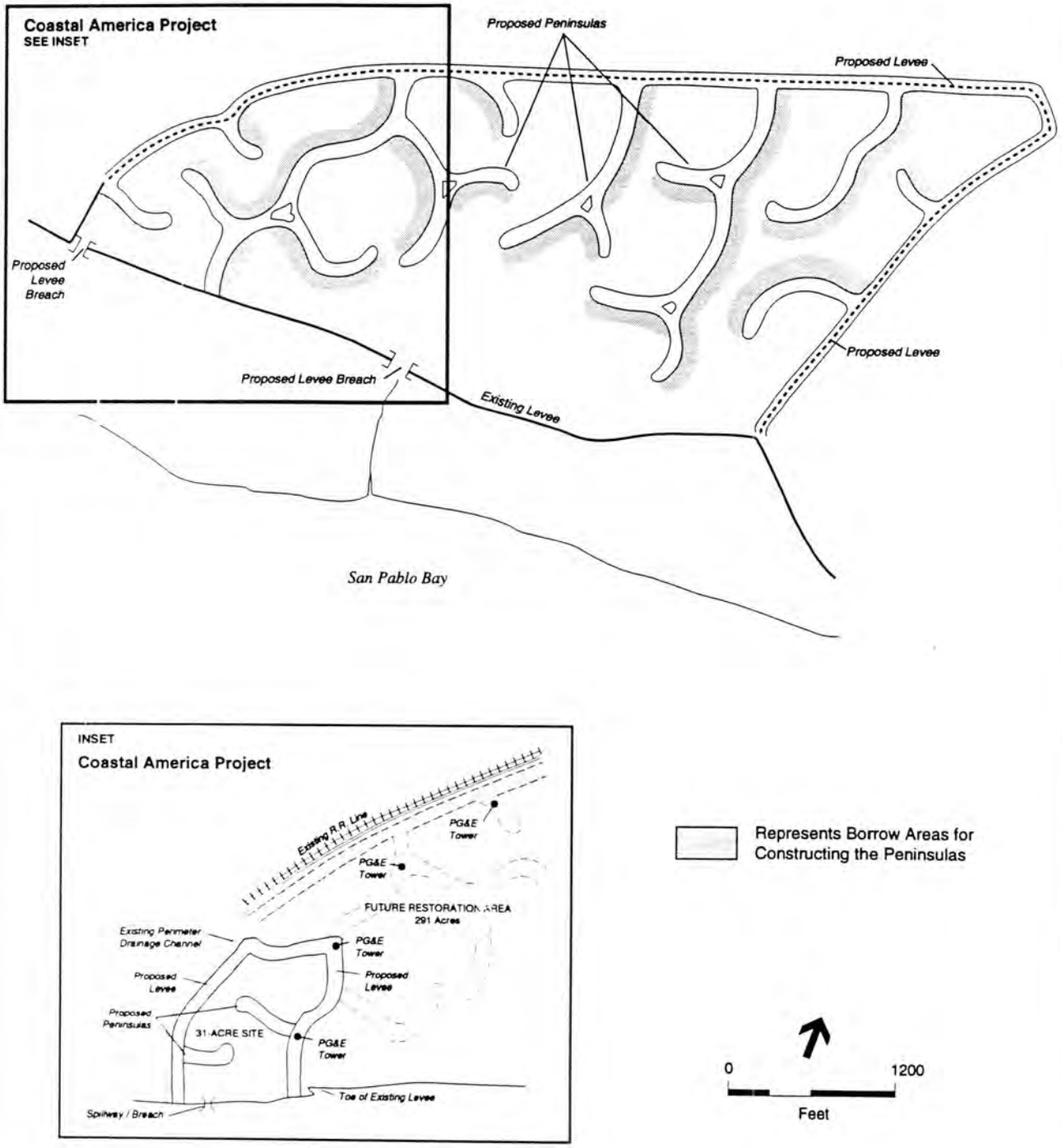
Permitting for this project is proceeding on two tracks. The Conservancy has obtained BCDC Permit No. M91-61 for Phase One (preparing the site for marsh restoration by constructing the northern levee and interior peninsulas). The permit is currently being amended to allow the perimeter levee to be breached, which would return the site to tidal action, and provide public access at the site. The Conservancy has also obtained waste discharge requirements for the project (Order No. 93-081) from the Regional Board specifying the allowed levels of contaminants in any dredged material placed on site, and requiring a monitoring plan for the project. The Corps has published a public notice (PN No. 19651N39) for the site preparations, but has not yet issued a permit. The actual placement of dredged materials, including the off-loading facilities needed to bring dredged materials to the site (Phase Two), will require additional environmental documentation and separate authorization.

However, if the Corps becomes the project sponsor, as anticipated, a BCDC consistency determination would be required in lieu of the existing permit. The need for a separate Corps permit would therefore be eliminated.

SOURCE: B.C.D.C., 1994

Figure 3

Sonoma Baylands Tidal Restoration Plan



d. ***Issues, Project Results and Current Status***

(1) **Overall Project.** Sonoma Baylands' potential for restoring wetland habitat while providing an alternative to Bay disposal has garnered support from the California Legislature, Governor Wilson, the U.S. Congress and President Clinton. This support has led the State Legislature to authorize $2 million for the project and Congress to designate Sonoma Baylands as a federal wetlands demonstration project and appropriate $4 million for its implementation. As a result, the Corps is currently preparing preconstruction design plans for the project.

The widespread support for alternatives to aquatic disposal led to the passage of amendments to the Water Resource Development Act (WRDA) specifying that the Corps may pay 75 percent of extra costs incurred for resource enhancement in its projects throughout the United States. These amendments benefit both Sonoma Baylands and future upland use projects because previously local sponsors requesting an environmental project were responsible for all additional costs. In addition, the Planning and Conservation League has qualified an initiative (CalPaw 94) scheduled for a vote in June 1994 that will provide funding for wetland restoration projects using dredged materials.

But the Sonoma Baylands project has also encountered a number of hurdles, including:

• ***Seasonal Wetlands.*** The United States Fish and Wildlife Service (USFWS) and some environmentalists believe that in-kind mitigation should be required for the loss of approximately 56 acres of seasonal wetlands that will occur when Sonoma Baylands is restored to tidal marsh. Other resource agencies believe that mitigation is inappropriate for projects that will result in substantial increases in wetland habitat, albeit of a different type. In an effort to resolve this issue, the Conservancy contracted with an independent biological consultant to participate in a Habitat Evaluation Procedure (HEP) to compare existing habitat values with expected values once the site is restored. This dispute led LTMS to augment the upland studies to provide an analysis of the values provided by seasonal wetlands and map their location in the North Bay. In addition, two planning efforts are expected to commence shortly that will also address this issue of habitat conversion: (1) an EPA-sponsored initiative involving federal and state agencies, property owners and the public to prepare a comprehensive plan for the North Bay diked baylands, including habitat goals; and (2) BCDC's proposal to work with North Bay local governments to prepare a North Bay Management Program that will protect wetlands and other natural resources while permitting upland disposal projects and appropriate development. Unfortunately, these efforts are not likely to be completed before decisions are made on Sonoma Baylands. The Conservancy and USFWS have resolved this issue based on the Conservancy's plans to enhance seasonal wetlands on other portions of the 830-acre site and the regional wetland planning efforts described above.

• ***Power Lines.*** A major Pacific Gas and Electric Company (PG&E) high-voltage transmission line crosses the site and must be relocated onto the peninsulas to provide: (1) required safety clearance between on-site water levels and the towers; and (2) maintenance vehicle access. It will cost an estimated $140,000 to relocate four towers. After an extensive search, funds for the relocation were pledged by the Shell Oil Spill Litigation Settlement Committee ($70,000), the Wildlife Conservation Board ($35,000), PG&E ($20,000), and the Conservancy ($15,000). The USFWS has expressed concern that the PG&E lines may cause mortality and injury to large waterfowl or raptors and has suggested placing the lines underground or making the lines more visible. BCDC's Bay Plan also recommends that

high-voltage transmission lines be placed underground as soon as this is technically and economically feasible. The Conservancy has responded that placing the lines underground is impractical, but has not yet responded to the request to make the lines more visible.

• ***Predators***. USFWS has been concerned that the peninsulas will be used by the introduced red fox, a major predator of the endangered California clapper rail. In response, the proposed "as-built" height of the peninsulas has been reduced from +8.0 feet NGVD to +5.0 feet so that the peninsulas will be high enough to reduce wave erosion and promote sedimentation, yet be only a few inches above the marsh plain after ten years through subsidence and compaction.

• ***Perimeter Levee***. There have been disagreements between the Conservancy and the Corps regarding the design of the proposed new levee to prevent inland flooding. The Corps' design criteria would require a much more substantial levee than proposed by the Conservancy. The Conservancy questions whether such a substantial levee is needed. While the Corps and Conservancy have come to agreement on some aspects of the design, such as the height and degree of compaction of the new levee, the Corps insists that a larger levee is required. Because a larger levee would cost more, this design difference affects the cost to the Conservancy for its 25 percent cost share for the project.

In addition, the USFWS has recommended that the bayside slope of the new levee be flattened from the proposed 5:1 to 10:1 to increase the size of the transition area between marsh and upland and provide a larger buffer area between the public access proposed on the top of the levee and the marsh, a suggestion the Conservancy has rejected because it would diminish the amount of wetland habitat restored.

• ***Leonard Ranch***. While not part of the Sonoma Baylands project, the 220-acre Leonard Ranch was part of the Sonoma Baylands acquisition and is immediately north of the project. Early plans for Leonard Ranch envisioned restoring and enhancing seasonal wetlands on the site. Recently however, Leonard Ranch has been considered as a potential site for a rehandling facility, a proposal supported by the Bay Area Congressional Delegation. USFWS believes that the proposed rehandling facility at Leonard Ranch and marsh restoration at Sonoma Baylands are related projects that must be considered as a single course of action, a conclusion the Conservancy disputes. USFWS is concerned that creation of a rehandling facility at Leonard Ranch will result in further seasonal wetland losses and that wildlife using Sonoma Baylands will be attracted to the rehandling facility where they will be exposed to higher levels of contaminants. USFWS recommends that Leonard Ranch be enhanced as seasonal wetland habitat as originally proposed. This issue remains unresolved.

• ***Corps Permit***. The Conservancy submitted an application for a Corps permit in March 1992; the Corps Public Notice for the Sonoma Baylands was not released until May 18, 1993, nearly 14 months later. This extended delay was partly due to the time it took the Corps to determine if a wetland delineation was necessary and then to complete the delineation.

The Corps subsequently determined that an Environmental Assessment prepared under the National Environmental Policy Act was needed to evaluate the environmental impacts of the project. The assessment has not yet been completed and, as a result, the permit has not yet been issued. The Corps expects that a permit will be issued in May 1994, but these delays have created concern that

the necessary Corps permit will not be obtained in sufficient time to complete the site preparations for receiving dredged materials from the Port of Oakland's deepening project, the project most often considered as a source of materials for the restoration of Sonoma Baylands.

The above issues are unique to Sonoma Baylands. Other concerns that have been raised during the extended review of this project include issues common to most marsh restoration projects proposing to use dredged sediments. These issues include:

- Monitoring the placement of dredged sediments to ensure that target elevations are not exceeded. Too high an elevation could affect the amount of tidal inundation, the development of drainage channels, and the health of the restored marsh.

- Evaluating the impacts of contaminants on marsh plants and animals. Even though only "clean" dredged materials will be used at the site, the standards and testing procedures for defining acceptable levels of various chemicals and heavy metals in dredged materials used for marsh restoration are relatively new and unproven. There is strong support for extensive monitoring to determine the risks posed by contaminants.

- Keeping the dredged materials wet and anaerobic (without oxygen) to reduce the bioavailability of any contaminants.

- Minimizing the amount of unconsolidated dredged sediments that would erode and be deposited off-site when levee breaches restore tidal circulation to the site.

- Developing a monitoring program that addresses such issues as natural sedimentation rate, channel formation, revegetation, plant succession, presence of endangered species, and colonization by non-native species.

(2) **Coastal America Project.** The Coastal America project planned for the western 31-acre portion of the site was initially intended to provide information helpful in implementing the larger Baylands project. It entails raising four PG&E high-voltage transmission towers, constructing approximately 3,600 linear feet of new levee around the perimeter of the restoration site, and modifying the existing agricultural drainage system to allow continued farming on the remainder of the parcel. Also, the plan proposed placing approximately 300,000 cy of sediment from the scheduled 1992-93 fiscal year maintenance dredging of the Corps' Petaluma River channel, breaching the bayfront levee to return the site to full tidal action, and monitoring wetland development on the site. The difficulty in finding funds to relocate the PG&E towers (part of the local cost share) and identifying sufficient quantities of "clean" dredged material for the project (less material than expected had accumulated in the Petaluma River Channel which led to a proposal to do advanced maintenance dredging of the River Channel to obtain enough dredged material), among other reasons, has delayed the project. As of May, 1994, site preparation for the Coastal America project has been combined with the larger project to reduce project costs. Plans call for site preparation at the Coastal America project to be completed approximately three months prior to completion of the rest of the overall project; dredged material from Petaluma River will immediately be placed on site. Tidal action will be returned to the site in April or September, 1995, pending a determination of possible effects on the California clapper rail.

e. *Costs*. Approximately $1.5 million was expended to acquire the entire 830-acre parcel. The Conservancy paid approximately $400,000 to complete technical studies and a preliminary enhancement plan for the Sonoma Baylands project. The Corps estimates that it will cost approximately $7.85 million to develop preconstruction design plans, complete site preparations, and manage the project.

4. **Conclusions**

- There is strong public and political support for the Sonoma Baylands project. This support has led to the passage of legislation, funding authorization, and changes in how existing policies are interpreted that should make it easier for future projects to gain necessary approvals.

- Identifying funding sources for the local cost share is a continuing problem. For other Corps projects where a local cost share is required, such as maintaining navigation channels or constructing flood control improvements, the sponsoring agency typically has existing mechanisms for generating the required local cost share. No such funding mechanism exists for environmental projects.

- The environmental issue of most concern is whether off-site mitigation should be provided for the 56 acres of seasonal wetlands that will be lost when the site is returned to tidal action, an issue that remains unresolved.

Montezuma Wetlands

1. **Project Overview and Goals**. The goal of the project is to use up to 20 million cy of dredged materials to create approximately 1,800 acres of tidal and seasonal wetlands at the eastern mouth of Montezuma Slough in the Suisun Marsh. The project is not only the largest proposed upland disposal site in the estuary, it is also one of the few that is privately sponsored, thus affording an opportunity to evaluate whether the private sector can make a profit helping solve a regional problem. Several studies have been completed to assist in designing and evaluating the project and a joint Environmental Impact Report (EIR)/Environmental Impact Statement (EIS) is in preparation.

2. **Environmental Setting**. The proposed Montezuma Wetlands site lies immediately west of Collinsville in the Suisun Marsh, Solano County. The site is bordered on the south by the Sacramento River, on the west by Montezuma Slough, and on the north by Birds Landing Road (see Figure 4).

The proposed site is located near a critical point in the estuary—the historic location of the entrapment zone, the area where the inland flow of saline ocean water moving at the bottom of the estuary mixes with the inflowing fresh water from the Sacramento and San Joaquin Rivers and net upwelling occurs. The entrapment zone is one of the most biologically productive areas within the estuary, but it has moved inland to the lower river channels of the Delta in recent years as a result of drought and increased water diversions. The great importance of the entrapment zone, and the fact that it may again be located near Montezuma, presents a great opportunity to benefit Bay resources by returning 1,800 acres to tidal action; it also puts a major responsibility on the proponent to ensure that the project does not create an environmental hazard.

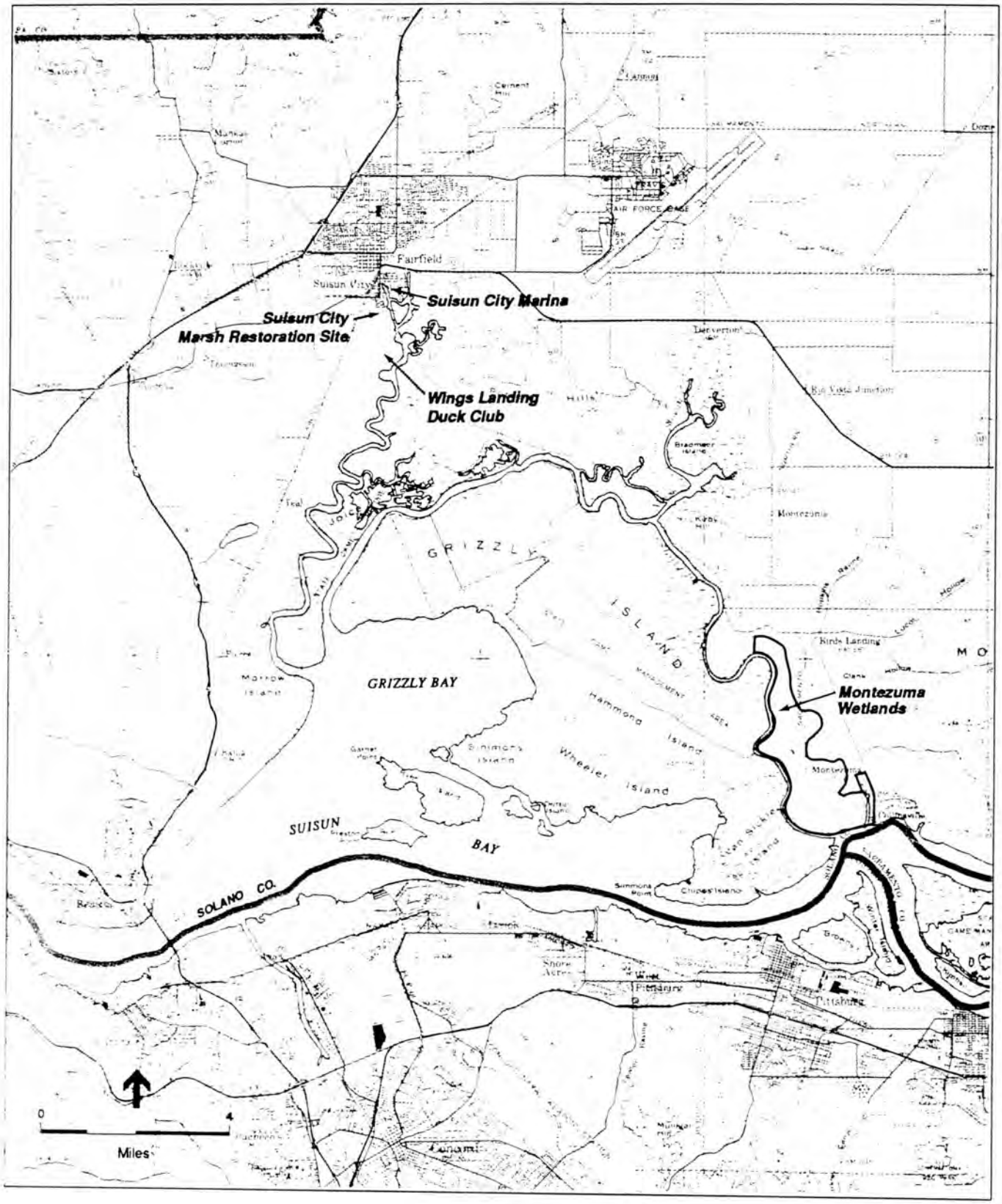
San Francisco Bay Conservation and Development Commission

SOURCE: U.S.G.S., 1970

Figure 4

Suisun Marsh

Location of the Montezuma Wetlands Project, the Suisun City marsh restoration project, and Wings Landing levee repair project.



Historically the project site was part of the Suisun Marsh, a vast tidal marsh supporting a diverse mosaic of plant communities adapted to brackish water. The site was diked for agriculture around 1888 and was used primarily for agriculture and cattle grazing since that time. Currently, most of the site is used for cattle grazing.

A detailed plant survey of the site in 1992 concluded that the site is severely disturbed with several different habitat types. The dominant vegetation type at Montezuma is grassland, although approximately 500 acres of mostly degraded seasonal wetlands are found scattered throughout the site. A total of 252 plant species were identified with the greatest number of species (74) and the greatest proportion of native plants occurring in the 30 acres (approximately one percent of the total project area) of existing tidal marsh outboard of the perimeter levees.

Eighty-nine species of birds have been recorded on the site. As with the vegetation, the comparatively small wetland habitats on the site support considerably higher densities and diversity of birds than did the larger grassland areas. This data suggest that restoring the site to wetland habitat, if successful, would result in much greater natural resource value than currently exists and has the potential to fully mitigate for project impacts to botanical and wildlife resources.

Endangered species found on the site include the salt marsh harvest mouse in some of the degraded seasonal wetlands and Mason's lilaeopsis on the bayward side of the perimeter levee. Fifteen special status bird species (species being evaluated for possible listing on rare and endangered species lists) have been recorded at various locations throughout the site.

3. **Project Details**

a. ***Background.*** Diking and agricultural practices have resulted in considerable subsidence so that portions of the site are now as low as -8 feet NGVD. Simply breaching the dikes and returning Montezuma to tidal action would result in a vast tidal lake for many years until sufficient natural sedimentation occurs so that marsh vegetation could become established. Placing dredged materials on the site can significantly shorten the time for attaining elevations suitable for the establishment of marsh vegetation.

The Montezuma Wetlands Project is a joint venture between Levine-Fricke, an environmental science and engineering firm responsible for conducting technical studies, project planning, and obtaining necessary permits for the project, and Catellus Development Corporation, the real estate development branch of the Santa Fe Railroad Company and the landowner of the project site. Levine-Fricke expects to make a profit charging dredgers a fee of approximately $7-$8 per cy for off-loading and placing dredged materials at the site.

The site's low elevations provide an opportunity to accept two categories of dredged sediment: (1) wetlands creation cover material which, based on chemical concentrations and toxicity information, is acceptable for use in wetland restoration, levee enhancement, or other beneficial use projects; and (2) wetlands creation noncover material, which is generally unacceptable for aquatic disposal in the Bay, but can be used in wetland restoration if it can be isolated from the environment under a three-foot layer of cover material. Both kinds of sediment are considered relatively "clean," with

noncover material having higher levels of potentially harmful chemicals specified in the Regional Board's *Sediment Screening Criteria and Testing Requirements for Wetland Creation and Upland Beneficial Reuse.* The site contains enough depth to fulfill the requirement that noncover material be overlain with three feet of cover sediment.

The project site has excellent deep water access (one of the key reasons it has been designated for water-related industrial/port development) and is likely to require no dredging and only minimal filling to develop off-loading facilities. Dredged material will be barged to the site where it will be hydraulically pumped as far as 21,000 feet to proposed marsh creation sites. An approximately 165-acre rehandling facility is also proposed to process dredged materials for use in on-site levee construction and off-site sale.

b. ***Project Design.*** Approximately 20 million cy of material will be placed on the site to create diverse marsh habitat including: (1) 800 acres of high marsh and seasonal wetlands at elevations approximately +0.75 feet above Mean Higher High Water; and (2) 1,000 acres of low marsh at elevations -0.25 feet below Mean High Water, just below the expected elevation of the tidal marsh plain. Dredged material will be placed on the site in four phases; each phase will have an independent tidal connection to Montezuma Slough or the Sacramento River and will be hydraulically independent of the neighboring phases. Interior levees will be constructed prior to sediment placement to delimit fill cells and larger channels and ponds. Medium-sized channels will be excavated after sediment placement; smaller channels are expected to form through scouring once the site is opened to tidal action (see Figure 5). To reduce the oxidation of contaminants in the dredged material which would increase their biological availability and create acidic conditions, the dredged materials will be kept wet until the site is returned to tidal action.

c. ***Permits.*** Solano County has zoned most of the site for Marsh Preservation, but the eastern edge of the project includes areas zoned for Water-Dependent Industrial uses. BCDC's *Suisun Marsh Protection Plan* designates the area zoned for Marsh Preservation as primary management area and the area zoned for Water-Dependent Industrial as water-related industry within the secondary management area (see Figure 5). The Water-Dependent Industrial area is designated in the BCDC/Metropolitan Transportation Commission's (MTC) *San Francisco Bay Area Seaport Plan* for both water-related industry and port priority uses.

The project site is in the Suisun Marsh and will require marsh development permits from both Solano County (for that portion of the project within the secondary management area) and BCDC (for that portion of the project within the primary management area), and a BCDC permit (for that portion within BCDC's Bay jurisdiction). In addition, both the Corps and the Regional Board must issue permits prior to project commencement.

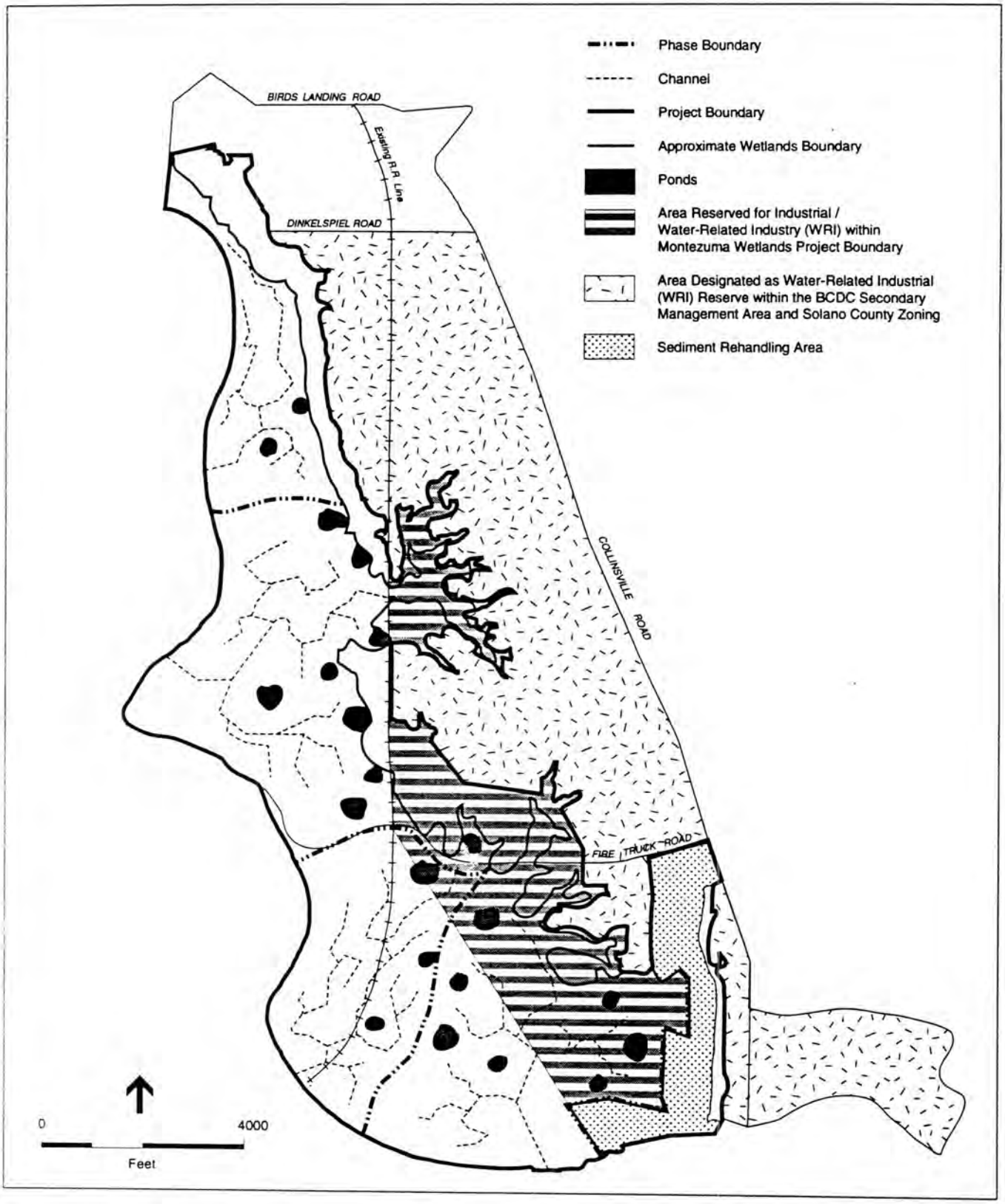
Because a portion of the restoration site lies within an area designated for Water-Related Industry and Port Priority use in the *San Francisco Bay Plan* and as a Water-Dependent Industrial District in Solano County's Local Protection Program, the applicant has requested amendments to both the county's Local Protection Program component and BCDC's *Marsh Plan*. Such amendments would state that those portions of the site presently supporting seasonal wetlands are not suitable for industrial development, and that the natural resources in these areas can and should be enhanced. The proposed amendments would also retain the right to build trestles or bridges to cross these restored areas in the water-related industrial area if necessary to accommodate water-related industry on the site.

San Francisco Bay Conservation and Development Commission

SOURCE: B.C.D.C. 1994

Figure 5

Montezuma Wetlands Tidal Marsh Restoration Plan



d. ***Issues, Project Results and Current Status***. The proponent has completed extensive physical, chemical and biological surveys of the project site, has convened a technical advisory committee with representatives from government and conservation organizations to assist in project design, and is developing more detailed plans for site restoration and dredged material management. An administrative draft EIR/EIS has been prepared and is currently being reviewed by Solano County and the Corps; the project proponent, the Regional Board, and BCDC reviewed earlier drafts of the document. The county has also been working with BCDC staff to craft amendments to the county's Local Protection ProgramComponent and the *Suisun Marsh Protection Plan* that will allow the project to proceed. The Draft EIR/EIS is scheduled for release for public review in early 1994, approximately a year later than scheduled.

A number of issues have been raised regarding the Montezuma Wetlands project, including:

• ***Contaminants***. The environmental issue that has raised the most concern is the possibility that contaminants in the dredged materials may be released into the environment, harming plant, fish, and wildlife populations. Much of the concern arises from: (1) the lack of experience with some of the proposed approaches to isolate contaminants and reduce their biological availability; (2) poor understanding among the public of processes restricting contaminant mobility and availability in tidal wetlands; and (3) the fact that sediment testing and evaluation protocols are relatively new and untested. For example, the proposed sediment screening criteria which will distinguish cover from noncover material has not been field-tested. Further, there is concern that contaminants in the noncover material may not be sufficiently isolated by the three-foot cap of cover material and may enter the environment through plant uptake, or through erosion of the cover material. While many resource agencies are satisfied that the Regional Board and the project proponent are proposing sufficient safeguards to minimize environmental risks, the potential release of contaminants into the Suisun Marsh, the Sacramento River, and their respective ecosystems is likely to be a continuing subject of debate for the life of the project.

• ***Environmental Document***. While there have been many reasons for the delays in completing the Draft EIR/EIS for Montezuma, chief among them has been the extended discussion centering on what constitutes an acceptable alternatives analysis for the project. Greatly simplified, the problem arises from the Clean Water Act's provision that projects involving fill in waters of the United States (which include the seasonal wetlands at Montezuma) can only be authorized if they are the least environmentally damaging, practicable alternative. Problems arise: (1) in determining what constitutes a reasonable range of project alternatives; (2) in equitably comparing alternatives when there is great disparity in the amount of information available for different sites; and (3) in determining whether the alternatives analysis leads inevitably to the conclusion that to implement beneficial use projects, one must begin on whichever property has the least environmental resource values at the time a project is proposed and move sequentially through the total pool of potential alternatives; thus, the LTMS objective of having many potential sites available throughout the estuary at any given time to maximize the efficiency of upland use of dredged materials would be precluded. This issue was resolved when Levine-Fricke clarified their project purpose so that it was understood that noncover material would be used to create and enhance wetlands. This decision effectively limited the range of alternatives evaluated in the EIR/EIS to those sites with sufficient depth to receive both cover and noncover material (i.e., at least a four- to five-foot depth), greatly reducing the number of alternatives investigated in the environmental document. But this decision is not without risks to the project proponent. One of the mitigation measures discussed for

this project is to condition the project so that only "clean" (cover) material can be used in marsh restoration. However, the Corps contends that such a requirement could reopen the alternatives analysis to include a much larger potential pool of projects.

• ***Marsh Design***. The endangered salt marsh harvest mouse currently is found on the project site. Levine-Fricke proposes to mitigate for project impacts to the mouse by creating 800 acres of high marsh habitat by placing dredged materials to an elevation nine inches above Mean Higher High Water (the marsh plain elevation). But as discussed earlier, filling too high has been the factor most responsible for retarding the development of marshes at other disposal sites. High areas in restored marshes as well as in natural marshes are flooded so infrequently that little natural sediment deposition occurs and the tidal prism is too small to carve new channels, processes that are constantly occurring in low-lying areas of natural marshes. In addition, it is problematic whether existing technology is capable of creating a high marsh within such narrow elevation tolerances. Some biologists have questioned whether it is desirable to design so much of the marsh (approximately 44 percent of the total project area) for one species. Even though many other plant and animal species would benefit from the creation of salt marsh harvest mouse habitat, these biologists believe that lower marsh would be more productive and would benefit more species, including many special status fish and wildlife species. This issue remains unresolved.

• ***Salinity Impacts***. The project site is located adjacent to the Montezuma Slough Control Structure, operated by the Department of Water Resources (DWR) to control the salinity in the slough and adjacent wetlands. There was concern that opening the site to tidal action would impact operation of the water control structure and would consequently modify salinity levels in the Suisun Marsh. However, modeling tests indicate that the project will likely have negligible impacts on salinity.

e. ***Costs***. Levine-Fricke has paid approximately $500,000 to prepare the environmental document and estimates that approximately $2 million will be spent on technical studies, preliminary and final design, and permitting. Preliminary cost estimates for the site improvements needed before dredged materials can be placed in the first phase of the project (affecting approximately 35 percent of the total site) range between four and five million dollars and include constructing levees and installing dredged sediment off-loading facilities, pumps, pipelines, an on-site lab, and other necessary initial improvements.

4. **Conclusions**

- In terms of site capacity and size (approximately 20 million cy placed on 1,800 acres), Montezuma Wetlands is the largest of the proposed upland disposal sites, and the only privately sponsored project using dredged materials to restore a marsh. The project thus affords an excellent opportunity for evaluating the feasibility of private sector participation in solving a regional problem.

- The proposed rehandling facility, located near the western end of the Delta where approximately 52 million cy of material is needed for levee improvements, may be an economical source of material for rehabilitating Delta and Suisun Marsh levees.

- The Corps' narrow interpretation of laws and policies requiring analysis of a reasonable range of practical project alternatives may lead to exhaustive investigations of potential sites; this may discourage future upland disposal efforts. In addition, the Corps' position that upland

disposal sites with the least environmental resource values must be used before sites where resource values are higher will preclude achieving the LTMS objective of having many potential upland sites available throughout the estuary to maximize the efficiency of upland disposal.

- Many of the concerns surrounding upland disposal arise because the tests evaluating contaminant risks are experimental. There is little regional experience with some of the methods proposed for ensuring that marsh restoration sites are not overfilled, and our understanding of how contaminants affect living organisms is rudimentary. Such unknowns make project monitoring essential to ensure that future projects benefit from past experience.

Cullinan Ranch

1. **Project Overview and Goals.** The USFWS acquired the 1,493-acre Cullinan Ranch in 1991 with the goal of restoring the site to tidal marsh. Studies are underway to determine how best to accomplish this goal—through natural sedimentation or through the use of dredged materials.

2. **Environmental Setting.** Cullinan Ranch is located in Solano and Napa Counties, immediately north of Highway 37, west of the City of Vallejo, near the northeast shore of San Pablo Bay (see Figure 6). Formerly marshland, the site was diked and drained for agriculture in the late 1800s. In recent years, it has been dry-farmed for oat hay.

3. **Project Details**

a. ***Background.*** The former marsh soils of the site have been significantly altered by drainage and oxidation. These processes have caused the soils to shrink which, together with approximately 0.7 feet of sea level rise since the land was diked, places the ranch's surface elevation as much as six feet below 0.0 feet NGVD. Oxidation and drying have also made the soil acidic and slightly saline. Restoration of this site to tidal marsh will require either significant sedimentation or placement of dredged materials to an elevation that provides the necessary periods of inundation and exposure for marsh vegetation.

Possible sources of tidal waters for flooding the land are Dutchman Slough, South Slough, and San Pablo Bay. Concentrations of suspended sediment in the two sloughs are much lower than those near the shore of San Pablo Bay because sediments in tidal flows from San Pablo Bay deposit in the dredged portion of Mare Island Strait before these waters reach the mouth of Dutchman Slough.* Thus, if the two sloughs are the primary source of sediment for Cullinan Ranch, it will be many years before surface elevations will be at levels sufficient to support marsh vegetation.

b. ***Project Design.*** A design for restoring wetlands at Cullinan is pending completion of technical studies that will characterize the site and a decision concerning the best method to ensure successful restoration of the site.

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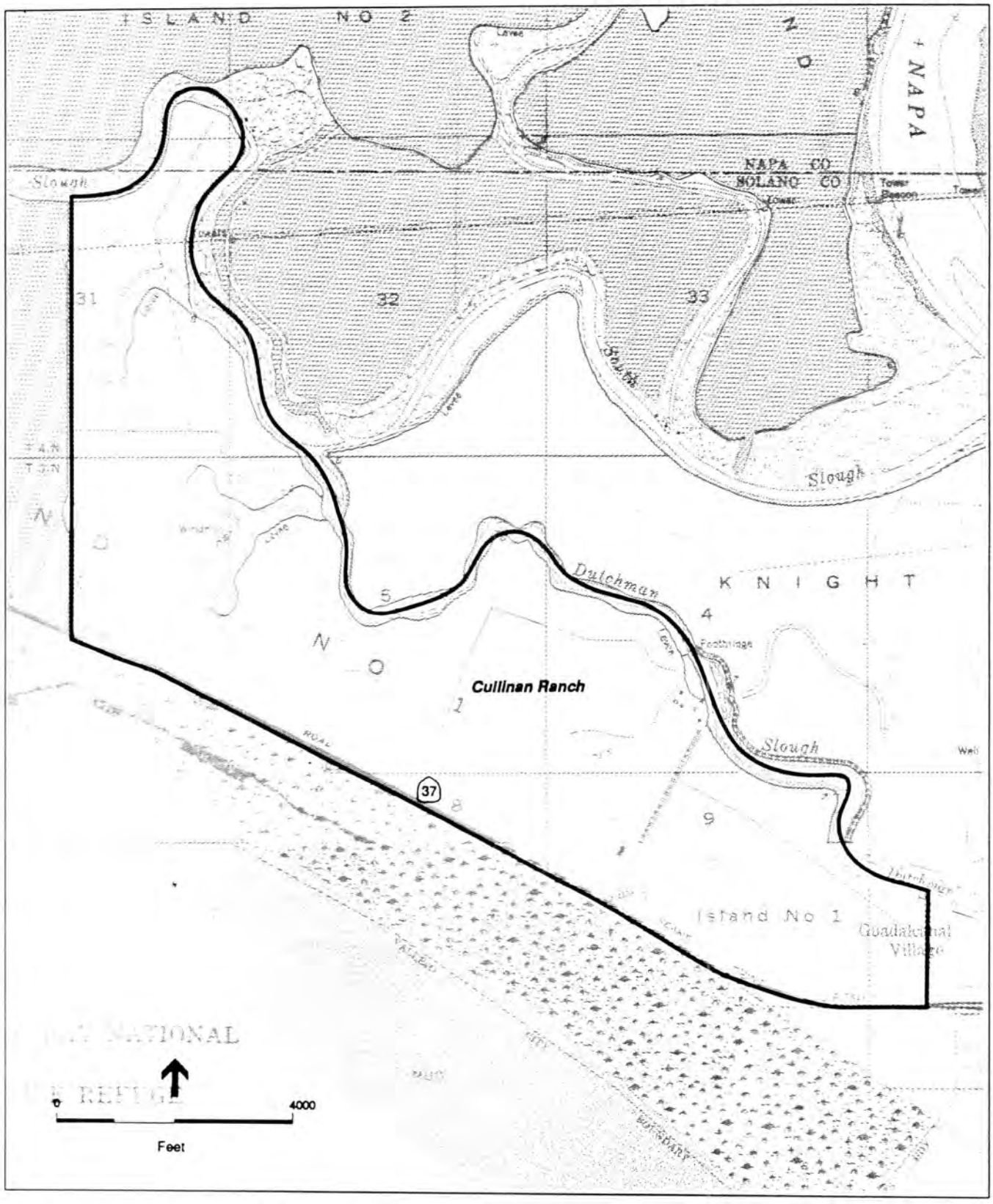
* The closure of Mare Island Naval Shipyard may affect how frequently Mare Island Strait is dredged, which in turn may alter the amount of suspended sediments in the waters of the Sloughs.

SOURCE: U.S.G.S., 1980

Figure 6

Cullinan Ranch

Dredged materials may be placed on these former baylands to accelerate tidal marsh restoration processes by raising the land to elevations suitable for marsh vegetation.



c. ***Permits***. The largest portion of the site is in Solano County where it is zoned for agriculture.

The USFWS is investigating several different approaches for restoring Cullinan Ranch to tidal marsh. Regulatory requirements for the project will vary depending on the methods used to restore the site. A BCDC consistency determination will be needed for any work, such as breaching levees or constructing off-loading facilities, proposed in the tidelands surrounding the site. Federal permit requirements will vary depending on which federal agency Congress authorizes and funds to carry out the project (e.g., the Corps does not issue permits to itself, but requires permits of other federal agencies).

d. ***Issues, Project Results and Current Status***. A series of studies are underway to provide information necessary to plan the Ranch's restoration to tidal marsh. A topographic survey of the site and a topographic map at one-foot contour intervals were completed in October 1993. This topographic information is used in hydrologic and sedimentation modeling, scheduled for completion in June 1994. The modeling work is evaluating three alternatives for restoring the site: (1) flooding with waters from San Pablo Bay through culverts placed under Highway 37; (2) flooding with waters from Dutchman Slough and South Slough; and (3) flooding with water from San Pablo Bay and both sloughs. For each of these alternatives, two options are being evaluated: (1) allowing natural sedimentation to build the marsh from its present elevation; or (2) using dredged materials to bring elevations up to within a few inches of the desired marsh plain elevations and allowing natural sediment deposition to complete the building of the marsh. For each of these alternatives and options, the modeling will predict the time required for sedimentation to achieve marsh plain elevations and the evolution of the marsh after initial establishment of marsh vegetation.

In addition, a draft monitoring plan has been prepared by USFWS that will establish baseline site conditions and provide a framework for following the progress of restoration over a 20-year period. The draft monitoring plan includes sampling plant and animal populations, assessing concentration levels of potentially harmful chemicals, and evaluating dispersal and colonization of representative salt marsh species. The USFWS expects that the information collected will guide future conversions of agricultural land to tidal marsh.

While plans for restoring wetlands at Cullinan Ranch have not yet been prepared, the site's history, topography, and environmental setting closely parallel those of Sonoma Baylands; it can be anticipated that this project will face similar environmental issues.

e. ***Costs***. The costs for the various studies completed or now underway for restoration planning are as follows: topographic survey of Cullinan Ranch and an adjoining 1,500-acre area within the refuge—$85,700; hydrologic and sedimentation modeling—$85,000; surveys establishing baseline conditions at Cullinan, including surveys to determine the presence of the salt marsh harvest mouse and the location of seasonal wetlands, and preparation of a monitoring plan—$47,000. Additional money will be needed to complete an environmental assessment and develop a restoration plan.

4. **Conclusions**

- USFWS has limited financial and technical resources to apply to this project and is actively seeking assistance in restoring the site to tidal wetlands. Because funds are scarce, it will probably be several years before the site is returned to tidal action.

- A better understanding of how potentially harmful chemicals in dredged materials move through ecosystems and affect plants and animals would greatly assist planning efforts to use dredged materials to accelerate marsh restoration. Concern about potential toxic effects of certain chemicals has made USFWS hesitant to use dredged materials for creating a wildlife refuge; if dredged materials are used in Cullinan's restoration, USFWS is likely to insist that only "clean" dredged material be used.

- Because of the site's size and the fact that only large federal dredging projects will generate sufficient volumes of dredged materials to create wetlands at the site, it is likely that federal authorization and funding will be needed to direct dredged materials from future dredging projects to the site.

Hamilton Antennae Field

1. **Project Overview and Goals.** Formerly part of Hamilton Air Force Base, the 250-acre Hamilton Antennae Field was deeded to the State of California in 1984 as part of a title settlement. The Corps, the Department of Fish and Game, and the State Lands Commission are jointly developing a marsh restoration plan for the site using dredged materials.

2. **Environmental Setting.** Hamilton Antennae Field is bordered on the south by the Hamilton Army Airfield runway, on the east by San Pablo Bay, and on the north and west by oat hay fields owned by Venture Corporation, which proposes to develop the area with single-family residences, a marina, a golf course, and commercial uses (Bel Marin Keys Unit 5). The tidal areas east of the bayfront levee are part of the 12,433-acre San Pablo Bay State Wildlife Area (see Figure 7).

The Antennae Field is located on former tidal mudflats that were diked and drained many years ago. The site is essentially flat, with the exception of a road and some drilling spoils which are a few feet higher than the surrounding land. Although a system of drainage channels and pumps keep the site well-drained, shallow ponds form over much of the site immediately after heavy rains.

Remnants of the site's former use as an Air Force base are scattered throughout the site and include a few old buildings, some standing antennae, several antennae footings, an above-ground storage tank, and a small paved parking area.

Various non-native herbs adapted to disturbed conditions (e.g., yellow star thistle, fennel, and curly dock) cover approximately ninety-seven percent of the site. Only a small amount of wetland vegetation (approximately five acres) is found on the site, mostly associated with the drainage channels or levee borrow areas. No plant or animal species listed as threatened or endangered have been reported for this site.

3. **Project Details**

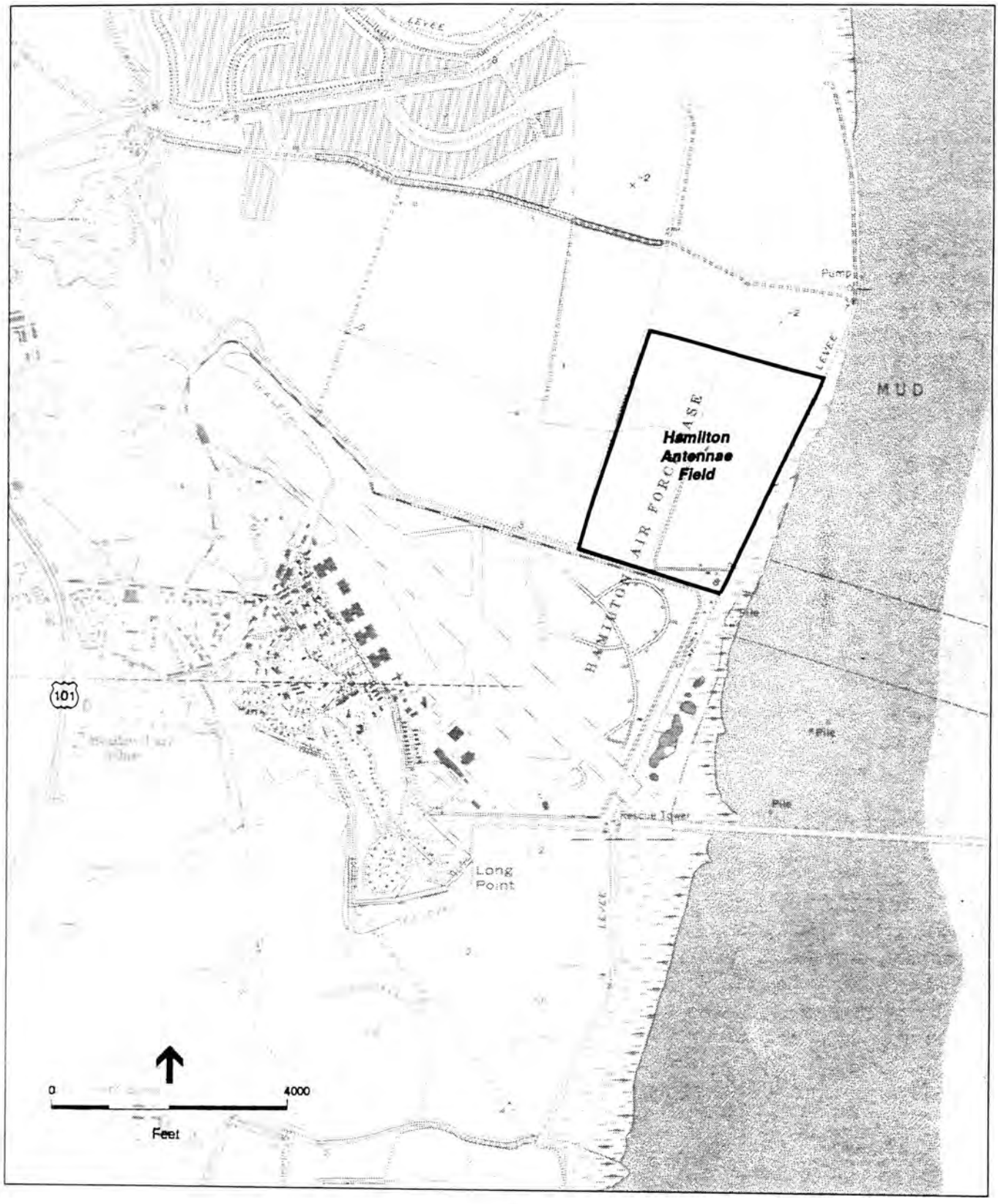
a. ***Background.*** The site owner, the State Lands Commission, acquired the property with the goal of restoring it to tidal marsh. When ownership of the Hamilton Antennae Field was deeded to the State of California, several easements and covenants were reserved by the federal government, including: (1) a levee easement for constructing, maintaining, improving or replacing levee or flood control works along

SOURCE: U.S.G.S., 1980

Figure 7

Hamilton Antennae Field

Dredged materials may be placed on these former baylands to accelerate tidal marsh restoration processes by raising the land to elevations suitable for marsh vegetation.



all four sides of the site; (2) a covenant preventing the state from removing any portion of the bayfront levee (this covenant has been interpreted by the Corps as being intended to ensure that the airfield and contiguous lands would continue to be protected from tidal flooding); (3) a 50-foot-wide sewer and gas line easement along the site's southern boundary; (4) the right to enforce bird and animal hazard control measures necessary for the safe operation of the airport; (5) the right to emit aircraft noise; and (6) a perpetual right of overflight.

As with other former marshlands that have been diked and drained, the soils have shrunk, oxidized, and compacted so that surface elevations are now four to six feet below NGVD. Simply breaching the levee would not result in conditions conducive to the establishment of tidal marsh until the site's elevations are raised several feet, a process that can be accelerated using dredged materials. The Corps' San Francisco District is using a $150,000 grant from the Corps' wetland research program to explore the potential of using dredged material to promote marsh restoration, and estimates that 2.7 million cy will be needed to raise the surface elevation to +2 feet NGVD.

b. ***Project Design***. Although a design has not yet been prepared for restoring tidal wetlands on the site, the Corps indicates that the eventual design will likely follow the criteria and objectives used in designing Sonoma Baylands.

c. ***Permits***. Located in the City of Novato, Marin County, Hamilton Antennae Field is zoned as a planned community district; this zoning allows for flexible planning of large land parcels such as the Antennae Field. The entire former Hamilton Air Force Base, including the Antennae Field, is designated for airport priority use in the San Francisco Bay Plan. The Bay Plan map includes a note that the airfield should be converted to general aviation use when no longer needed by the military and areas of the base not needed for airport use should be developed for uses compatible with general aviation and restoration of wetlands and wildlife habitat.

Regulatory requirements for the project will vary depending on the methods used to restore the site and whether a private contractor or federal agency is the project applicant. Permit requirements also depend on which federal agency Congress authorizes and funds to carry out the project (e.g., the Corps does not issue permits to itself, but requires permits of other federal agencies).

d. ***Issues, Project Results and Current Status***. A topographic map and vegetation survey was recently completed, and a draft plan defining restoration objectives was prepared to provide a framework for restoration planning. The draft restoration plan is based largely on the objectives and design developed for Sonoma Baylands—to use dredged material to accelerate the creation of tidal marsh and maximize habitat for endangered species (see discussion of Sonoma Baylands).

e. *Costs*. To date, approximately $51,000 of a $100,000 grant from the Corps Waterways Experiment Station's Wetlands Research Program has been spent to complete topographic and plant surveys of the site and to prepare a site description.

4. **Conclusions**

- Hamilton Antennae Field's limited existing natural resource values and sizable capacity make it attractive for using dredged materials to accelerate marsh restoration.

- Sufficient depth is available at Hamilton so that dredged materials meeting the Regional Board's requirement for "noncover wetland creation" material could be used in marsh restoration (see discussion of the Regional Board's sediment screening and testing requirements in analysis of the Montezuma Wetlands project above).

- The major obstacles for using dredged material to promote the creation of tidal marsh at Hamilton Antennae Field are the costs and difficulties of transporting dredged materials across the extensive mudflats fronting the site.

Suisun Marsh Wetlands Restoration and Levee Maintenance

1. **Project Overview and Goals.** Approximately 5,000 cy of dredged materials from Suisun City's marina redevelopment project will be used in two upland projects in the Suisun Marsh. One project involves using dredged material to accelerate marsh restoration at a 1.4-acre mitigation site being restored to offset for wetland losses caused by the marina development project. The other project involves using 1,300 cy of dredged material to raise 1,200 feet of levee at the Wings Landing Duck Club, a managed wetland in the Suisun Marsh.

2. **Environmental Setting.** The Suisun City marina redevelopment project is located at the extreme northern end of Suisun Slough, in Solano County. Approximately 3,700 cy of dredged material will be trucked approximately one half mile to a 1.4-acre mitigation site. The remaining material, approximately 1,300 cy, will be barged to Wings Landing, a duck club in the primary management area of the Suisun Marsh, located approximately one and a half miles south of the marina on the western bank of Suisun Slough between Peytonia and Boynton Slough (see Figure 8).

The marina basin is surrounded by urban development including City Hall, remnants of a former oil transfer facility, and various existing marina facilities.

The mitigation site is bounded by residential development on the north and the Department of Fish and Game's Peytonia Slough Ecological Reserve to the east, south, and west. The mitigation site is part of a 17-acre site, which was partly filled prior to 1969 and is owned by the Suisun Marsh Natural History Association. Prior to project construction, the site was vegetated with a mix of non-native upland species adapted to disturbed conditions, such as fennel, and degraded seasonal wetlands dominated by salt grass and weedy upland species.

Wings Landing Duck Club, owned by Rudolph and Sletten, Inc., is one of 150 privately owned duck clubs in the Suisun Marsh. Enclosed by a perimeter levee, most of the 300-acre club is flooded in the fall and drained in the spring to provide wintering habitat for migratory waterfowl. A man-made pond on the northern edge of the club provides year-round wetland habitat for resident species. Fat hen, pickleweed, and bulrush are the dominant vegetation at the site.

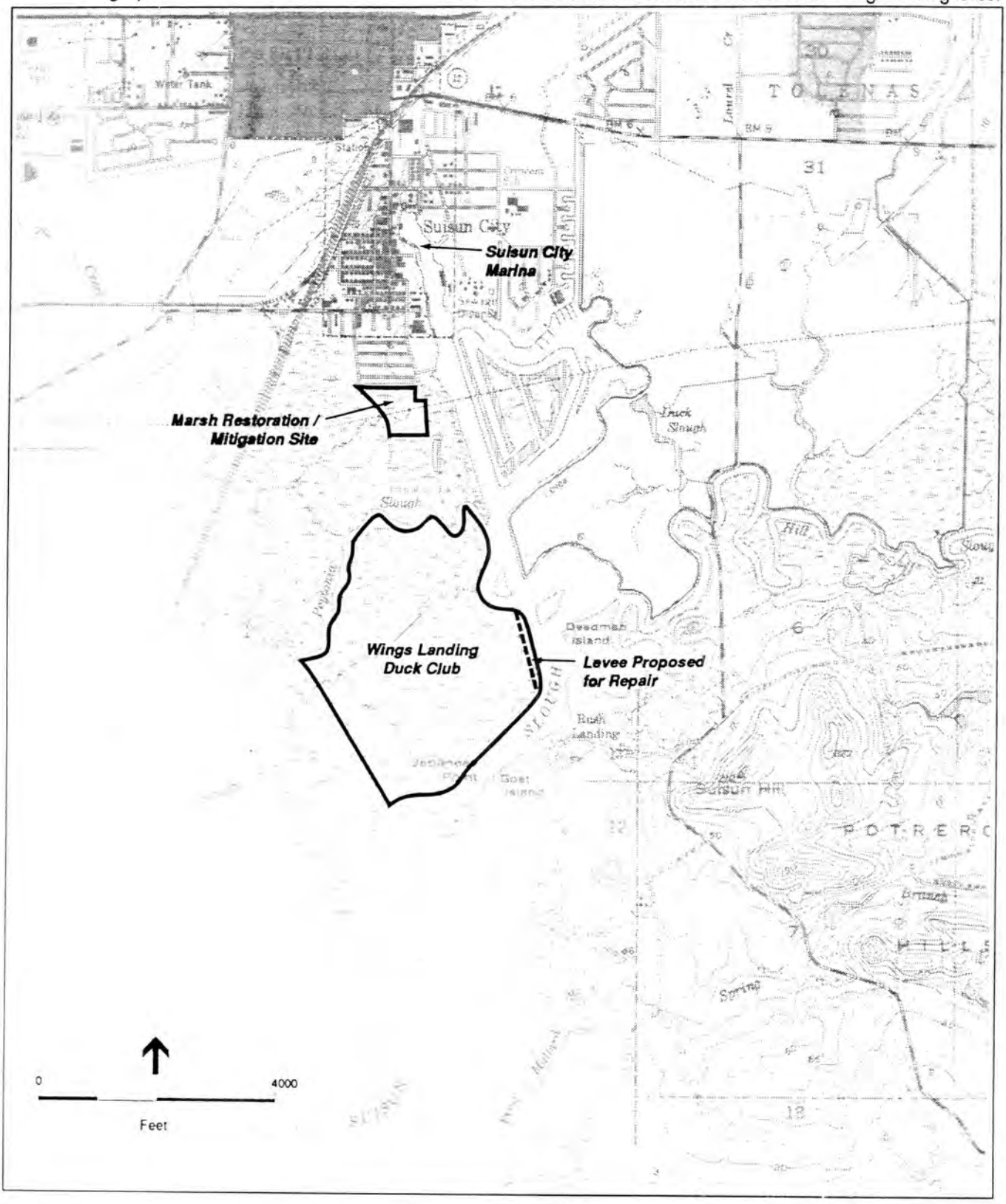
Historically, all three sites were once part of the greater Suisun Marsh, a vast tidal, brackish water marsh. In the late 1800s, much of the marsh was diked and drained for agriculture and later converted to private duck clubs. Extending over 57,310 acres, duck clubs of the Suisun marsh comprise the largest diked seasonal wetland complex in the San Francisco Bay Estuary, and constitute approximately 12 percent of California's remaining wetlands.

Figure 8

SOURCE: U.S.G.S., 1980

Suisun Marsh Wetlands Restoration and Levee Maintenance Projects

Dredged materials from Suisun City's Marina Redevelopment Project would be used to cap sediments with slightly elevated levels of contaminants at the marsh restoration site and to raise a section of the Wings Landing levee.



3. **Project Details**

a. ***Background***

(1) **Marsh Restoration.** Suisun City was required to restore 1.4 acres of tidal marsh to mitigate 0.7 acres of wetland vegetation lost in constructing the marina.

(2) **Levee Repair.** State and federal water projects reduce freshwater inflow to San Francisco Bay leading to increased salinity in Suisun Marsh. As a result, Suisun Marsh duck clubs must carefully manage water to leach out salts in the soil thereby creating conditions conducive to the establishment of brackish water species attractive to waterfowl. The better-managed lands undergo two or three leach cycles each spring, are flooded when salinity levels in adjoining slough channels are low, and subsequently drained to remove salts that have leached into the water.

Effective water management requires good drainage and sound levees. Because levees constructed of organic material on peat soils may shrink 30 to 50 percent of their constructed height, there is a continuing need for material to repair levees and fill low-lying areas to promote drainage. BCDC, in coordination with the Suisun Resource Conservation District (SRCD), contacted ten duck clubs along or near Suisun Slough to determine their interest in using dredged material to rehabilitate levees. Since levees at these clubs had recently been overtopped by high tides, those contacted were interested in using dredged materials to repair them. The clubs did not have a precise estimate of the amount of material needed, but identified thousands of linear feet of levee that needed raising or repair.

BCDC attempted to identify a source of dredged material for levee improvements at the ten sites. The only upcoming dredging project in the vicinity was Suisun City's planned redevelopment of the City's marina. BCDC selected Wings Landing Duck Club to receive dredged material from this project because: (1) it was the closest club to the dredging site; (2) it was located along a navigable channel—the Suisun Slough Ship Channel; and (3) regular mowing of the levee has reduced the resource value of the areas where dredged materials would be placed and used in levee rehabilitation.

b. ***Project Design***

(1) **Marsh Restoration.** The restoration plan is designed to create a tidal wetland with mudflats, low brackish marsh, high brackish marsh, and transitional uplands. Fill will be removed from the mitigation site and channels dug to allow water circulation from an existing tidal channel. Elevated arsenic concentrations in soil samples from the mitigation site, and low-level mortality in test organisms exposed to the soils in bioassays led to a decision to remove additional soil from the mitigation site and use dredged materials to place a one-foot cap over suspect sediments. The marsh will be monitored for five years and is expected to be 70 percent vegetated at the end of this period.

(2) **Levee Repair.** A barge-mounted crane will place approximately 1,300 cy of dredged material on top of 1,200 linear feet of existing levee. Prior to the placement of any dredged material, a small berm will be constructed on top of the levee to prevent material from slipping onto the levee slopes and into adjacent wetlands. The dredged materials will be placed to a maximum height of three feet to minimize compaction of the underlying peat soils. After the material has dried sufficiently, a grader will grade the material into place. The project should raise this section of the levee approximately one foot.

c. *Permits*

(1) **Marsh Restoration.** The dredging of Suisun City's marina was authorized in BCDC Permit No. 20-91 and Corps PN 19097E60. Both authorizations required Suisun City to create 1.4 acres of tidal marsh from uplands adjacent to Peytonia Slough as mitigation for approximately 0.7 acres of marsh vegetation lost as a result of project construction. The Regional Board issued a waiver for the project.

(2) **Levee Repair**. Duck club levees repaired in conformance with the SRCD's approved local protection program do not need BCDC authorization. Until June 1, 1993, SRCD had a Corps general permit that allowed private duck clubs to perform routine levee maintenance. Concerned that levee maintenance was adversely impacting wetlands and endangered species, the Corps has not granted SRCD's request to extend its maintenance permit. The levee repair at Wings Landing, which had been covered under the provisions of the lapsed maintenance permit, now requires separate authorization.

Further complications arise because the Corps has stated that permits may not be necessary for levee repairs that simply restore a levee to its preexisting condition and do not impact wetlands. Most of the levees in the marsh were not engineered and there is little reliable information about their previous dimensions. Also, wetland vegetation covers most of the Suisun Marsh, including interior levee slopes; almost any levee work will involve disruption or loss of wetland species. To ensure compliance with Corps regulations, BCDC staff assisted Wings Landing by preparing and submitting an application for using dredged material from Suisun City's marina for levee repair. The Corps application was submitted in September 1993, but after
BCDC met with the Corps to discuss the application, the application was withdrawn and will be resubmitted when suggested revisions are complete.

d. *Issues, Project Results and Current Status*

(1) **Marsh Restoration.** Dredged material was placed at the mitigation site in November 1993. A clamshell dredge excavated material and loaded it directly onto trucks for transport to the mitigation site where it was graded into position within one week of placement. Plans called for close monitoring of the dredged materials to assure that it remained moist to avoid increasing the dredged material's acidity and oxidizing any contaminants that may be present, thereby increasing their mobility and availability for biological uptake (it has not been possible to ascertain with certaintly whether or not such monitoring occurred). In December 1993, the site was opened to tidal action when the desired grades and elevations were established.

The site was initially filled too high and some material was subsequently removed. The project has significantly improved tidal circulation to the site and wetland plants such as tules, cattails, and rushes have begun colonizing the newly placed dredged materials. However, much of the mitigation site appears too high to be frequently inundated and is being colonized by upland grasses.

(2) **Levee Repair**. Use of dredged material to raise the levee at Wings Landing is dependent on receiving a Corps permit in time to plan the transport and placement of dredged materials on the levee before Suisun City completes dredging the marina. The Corps estimates that it will take approximately

four months to process Wings Landing's permit application once the application is resubmitted. If the marina dredging proceeds as scheduled, the permit will not be obtained in time. However, if the marina dredging is delayed, which it has been several times, the Corps permit may be issued by the time dredging occurs allowing the project to go forward as planned.

e. *Costs.*

(1) **Marsh Restoration.** Suisun City spent $99,000 on the mitigation project. Of this total, approximately $29,000 was not directly related to using dredged materials, such as clearing vegetation, excavating channels to connect the restoration site with nearby tidal channels, relocating culverts, etc. The City paid $5 cy for dredging, $3.50 cy for mobilization, $6.55 cy for hauling the material to the mitigation site and grading it, and $2.80 for miscellaneous earth work for a total of approximately $17.00 cy.

(2) **Levee Repair.** BCDC staff has spent considerable time identifying: (a) potential sites for using dredged materials in levee repair; (b) possible sources of dredged materials; and (c) potential means of funding the project. In addition, BCDC staff has prepared a Corps application and has spent approximately $2,000 to consultants to assist in plant surveys and prepare exhibits for the Corps permit application.

4. **Conclusions**

- Although a precise estimate is not available, the compressibility, shrinkage, and subsidence of peat soils that underlie much of the Suisun Marsh ensures a continuing demand for materials to raise, stabilize, and strengthen levees throughout the Marsh. Because dredged materials are a potential source of much needed material, a program should be established with the SRCD and the LTMS to use dredged materials for Suisun Marsh maintenance projects.

- Using dredged materials to repair levees will likely be economical only for clubs and refuges in close proximity to navigable waterways, such as Suisun and Montezuma Sloughs, because of the costs and difficulty of transporting material to remote areas. Although dredged slurries can be pumped to inland locations, large areas are needed to dry hydraulically dredged material. As most of the Suisun Marsh is marshland, there are few large areas where hydraulically dredged materials could be placed without affecting a substantial amount of wetlands.

- The difficulty in obtaining federal authorization is a major obstacle to using dredged material in Suisun Marsh for beneficial purposes. The Corps' decision not to renew the SRCD's general permit authorizing duck clubs to perform routine maintenance activities makes it much more difficult for any maintenance project to go forward because of the long lead time needed to obtain a Corps permit, the fact that construction activity in the marsh is limited to the period between April 15 and October 15 (to avoid disturbing migratory waterfowl and hunting activities), and the difficulty in coordinating maintenance work with a specific dredging project. The LTMS should make every effort to streamline the permitting process for dredging projects, particularly ones where dredged materials will be used to benefit natural resources such as wildlife.

- The LTMS must involve local government in the development of beneficial upland use programs. Suisun City, although mildly cooperative, apparently sees little benefit in promoting upland uses of dredged materials and avoids any changes to their project that might trigger reopening the Corps permit or regulatory process. The City seems to view the LTMS program as creating potential obstacles for future dredging projects.

CHAPTER 3

LEVEE MAINTENANCE

Dredged materials have often been used to construct Bay and Delta levees. Typically a dragline or clamshell would be used to excavate material from either side of the proposed levee, piling the material along the proposed alignment. When sufficiently dry, the material would be graded to form the levee.

Repairs to levees are often performed the same way. Using dredged material for levee repair and maintenance would therefore seem to be an obvious upland disposal option, providing a needed resource to landowners who continually need material. Because of their similar origins, dredged materials often have similar properties as existing levee soils, improving levee stability and structural strength.

But using dredged material for rehabilitating levees is not without problems. Placing dissimilar soils on levees can lead to uneven settlement and structural failures. Levees needing repair are often distant from navigable channels, creating transport and placement problems. Methods for containing dredged materials at disposal sites can be expensive and only partially effective. Excessive wetting and drying of levee soils can make levees loose and erodible. And there is concern that salts and contaminants in the dredged material may pollute adjacent waters.

But all these potential problems can be avoided or mitigated and the use of dredged materials for levee repair remains a promising potential use of dredged material. This chapter discusses the use of dredged material in levee maintenance projects in the West Delta Islands (Sherman and Twitchell Islands) and on Staten Island, which is also in the Delta.

West Delta Islands

1. **Project Overview and Goals**. Since 1990, DWR, in coordination with the Corps, BCDC, the Central Valley Regional Water Control Board (CVRWQCB), and various Delta reclamation districts, have completed two projects using dredged materials from San Francisco Bay to repair levees on Sherman and Twitchell Islands. A third project planned for Jersey Island was postponed when the dredging that was to provide the material was delayed. These projects were conducted to evaluate: (1) the feasibility of importing Bay dredged materials to repair Delta levees; (2) how such use impacts Delta water quality; and (3) ways to expedite the permit and approval process for future projects.

2. **Environmental Setting.** Prior to 1850, the Delta consisted of a network of channels and approximately 80 low-lying islands supporting dense marsh vegetation. The accumulation of sediments and marsh growth produced rich organic soils that attracted agricultural development. The first Delta levee was constructed in 1852, and by 1900, the 60 largest islands had all been diked and drained for agriculture. Approximately 80 percent of the Delta is now farmed. Despite intensive cultivation, a large variety of natural habitats are still found scattered throughout the Delta.

Most Delta levees were constructed using soils from the islands' interior and dredged materials from nearby channels. Levees are typically kept free of trees and bushes because: (1) vegetation prevents easy visual inspection of the levee; (2) vegetation slows flood flows increasing flood risks; and (3) tree roots extending into the channel produce eddies that speed erosion of unreinforced soils. Thus, repairs to Delta levees typically do not impact mature riparian vegetation.

3. **Project Details**

a. ***Background.*** Since 1980, 24 Delta islands and tracts have flooded. Many of the levee breaks were caused by structural failure due to unstable organic soils underlying the levee or used in their construction. Subsidence of island surfaces, which has dropped the interiors of the larger islands by as much as 20 feet below mean sea level, also contributes to levee failure by increasing the hydrostatic pressure on the levee.

Levee failures jeopardize farms, wildlife habitat, homes, utility lines, major aqueducts, highways and railroads. The levees are also critical to protecting Delta water quality and serve a significant function in the state's water transfer system. For these reasons, the California Legislature passed the Delta Flood Protection Act (Senate Bill 34) in March 1988 directing DWR to develop and implement flood protection projects on eight western Delta Islands near the confluence of the Sacramento and San Joaquin Rivers, immediately east of Suisun Bay, in Sacramento and Contra Costa County. The act also stated the Legislature's intent to appropriate $12,000,000 annually for Delta flood protection for ten years, beginning in July 1988. Senate Bill 34 requires DWR to seek cost-sharing with levee owners and operators, others that may benefit from the flood control project, and federal agencies having an interest in flood protection.

Since the passage of Senate Bill 34, DWR has undertaken 15 levee projects under the special projects provisions of the Bill. Preferring sandy material because it dries quickly, is easy to handle and requires less re-working after placement than other materials, DWR identified sediments from Bay channels as a potentially valuable resource for rehabilitating Delta levees.

The primary constraint to using dredged sediments from the Bay for repairing Delta levees are the potential effects of adding contaminants, particularly heavy metals and salinity, to a freshwater environment. Past freshwater diversions and agricultural drainage have increased salinity in the Delta. Because the Delta's freshwater is used as drinking water for millions of Californians and for irrigating thousands of acres of farmland, the CVRWQCB regulates sources of salt into the Delta to avoid further degradation of Delta water quality. The CVRWQCB has been concerned that importing dredged sediments from the Bay may increase the salinity of Delta water. To determine the viability of using Bay

material in the Delta, DWR began conducting demonstration projects in 1990. The first project involved placing 1,600 cy of Bay sediment on Sherman Island to construct a stabilizing berm and monitor its impact on water quality (see Figure 9). Following the success of this initial project, 50,000 cy of Bay sediment was transported to Twitchell Island and incorporated into the levee (see Figure 10). DWR is currently seeking sources of Bay material and sponsors for a larger demonstration project.

b. ***Project Design.*** All three projects involved (or will involve) using dredged materials to raise levee crowns (Twitchell Island), or for constructing stabilizing berms on the landward side of levees (Sherman, Twitchell, and Jersey Islands). To avoid stressing levee foundations soils, stabilizing berms are constructed by placing material in shallow (between two and four feet) lifts approximately 60 to 120 feet wide on the landward side of the levee at one to three month intervals. As many as three lifts may be involved to create a berm of the desired height. The purpose of the berms is to improve levee stability by consolidating and strengthening the foundation on which the levee rests. The weight of the berm also counters sliding forces thereby improving levee slope stability.

c. ***Permits and Contracts***

(1) **Sherman Island.** The 1,600 cy placed on Sherman Island originated from the Corps' maintenance dredging of Suisun Slough, authorized in BCDC Consistency Determination CN 7-90. The Delta Islands are outside BCDC jurisdiction, hence BCDC authorization was not required for disposal. As the Corps does not issue permits for its own activities, a Corps permit was not required. The CVRWQCB approved the project, requiring extensive monitoring to determine the project's impact on Delta water quality. This project was a cooperative effort between DWR, the Corps, and Sherman Island Reclamation District, RD341, with a contract specifying the responsibilities and associated costs of each of the participating agencies.

(2) **Twitchell Island.** The 50,000 cy of Bay sediment placed on Twitchell Island originated from the Corps' dredging of the John F. Baldwin Ship Channel authorized in BCDC Consistency Determination CN 6-85. The material had originally been placed on Simmons Island in the Suisun Marsh in 1986, but exceeded the amount authorized and was removed pursuant to an agreement between the Corps and BCDC. No Corps permit was required because of the Corps' involvement in the project. The CVRWQCB required DWR to monitor salinity effects of the dredged material, but did not require the extensive testing for dissolved metals, suspended solids, pH, etc. required of the Sherman Island project because: (1) the extensive monitoring of dredged material placed at Sherman Island had detected no adverse water quality impacts; (2) the material placed at Twitchell Island originated from a less saline environment; and (3) the material used at Twitchell had been stockpiled on Simmons Island a number of years, increasing the likelihood that any contaminants present had already leached from the material. The project was a cooperative effort between DWR, the Corps, and Twitchell Island Reclamation District, RD1601, with each agency's responsibilities specified in a contract.

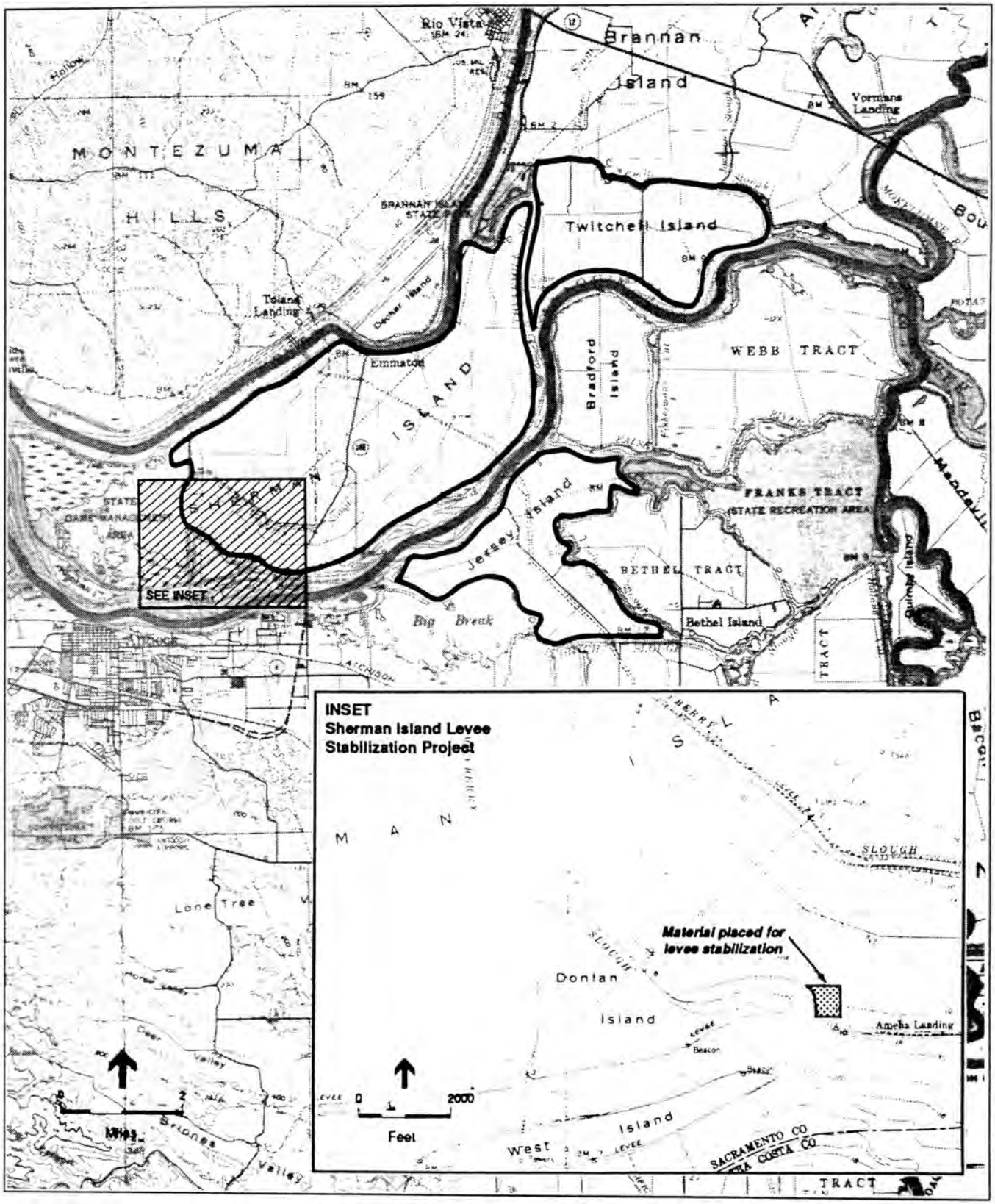
(3) **Jersey Island.** Permits had not yet been obtained when this project was postponed. It would have been a cooperative effort between DWR, the Corps and Oakley Sanitation District, the owner of Jersey Island.

SOURCE: U.S.G.S., 1970

Figure 9

West Delta Islands: Sherman Island

Dredged materials were used to stabilize a levee section.



d. *Issues, Project Results and Current Status*

(1) **Sherman Island**. Sixteen hundred cy of dredged material from the lower reach of Suisun Slough, Solano County, was barged to the demonstration site approximately one-half mile west of the Antioch Bridge on the south side of Sherman Island. A dredger placed material on the levee face and a grader then moved the material into a contained area immediately inland of the levee. Runoff from the dredged material was sampled over a two-year period and analyzed for dissolved metals, suspended solids, salinity, pH, oil, and grease. Extensive monitoring showed no soil contamination or any adverse impact on water quality resulting from the placement of these marine sediments and, with the concurrence of the CVRWQCB, monitoring was discontinued in late 1992.

(2) **Twitchell Island**. In August and September of 1992, approximately 50,000 cy of dredged material previously placed on Simmons Island in the Suisun Marsh was barged to Twitchell Island and stockpiled near Oulton Point (see Figure 10). Two ditches were cut adjacent to the stockpiled material to aid in monitoring runoff; monitoring began after the first significant rainfall on November 5, 1992. Beginning in January 1993, the 50,000 cy of Bay material, 400,000 cy of material dredged from Clifton Court Forebay in the southern Delta, and 50,000 cy from a commercial source located down river from Rio Vista in Solano County, were used to rehabilitate approximately 26,000 linear feet of levee on Twitchell Island. Standpipes in the newly constructed levee berm allowed for continued salinity monitoring (see Figure 11). DWR has stated that water quality monitoring through October 1993 has not found any significant increase in salinity and DWR has requested permission from the CVRWQCB to discontinue the monitoring program.

A few problems arose in using dredged materials to stabilize the levee. The dredged material from Clifton Court Forebay was very wet and as a result, difficult to place. Working the wet material took more time and required increased equipment maintenance.

Placing material on the peat soils also stressed the levee and its foundation, and cracks appeared at the levee toe and in the levee embankment. However, this problem was expected and minimized by placing the material in two four-foot lifts and having an engineer on-site to direct the filling of any cracks formed from loading the peat soils with new levee material.

(3) **Jersey Island**. In early 1993, DWR requested the Corps to provide dredged material to repair and maintain the levee on Jersey Island. DWR had entered into a cost share agreement with the Oakley Sanitation District and asked the Corps' Construction-Operations Branch to conduct dredging and transport of materials to the levee site. The Suisun Bay Channel was identified as a suitable source of material for rehabilitating Jersey Island's levees—historically, an average of 220,000 cy has been annually dredged from this channel, and the material is 99 percent sand. However, bathymetric surveys of the channel conducted in the spring of 1993 indicated that only 25,000 cy had accumulated in the channel since it was last dredged and the project was postponed.

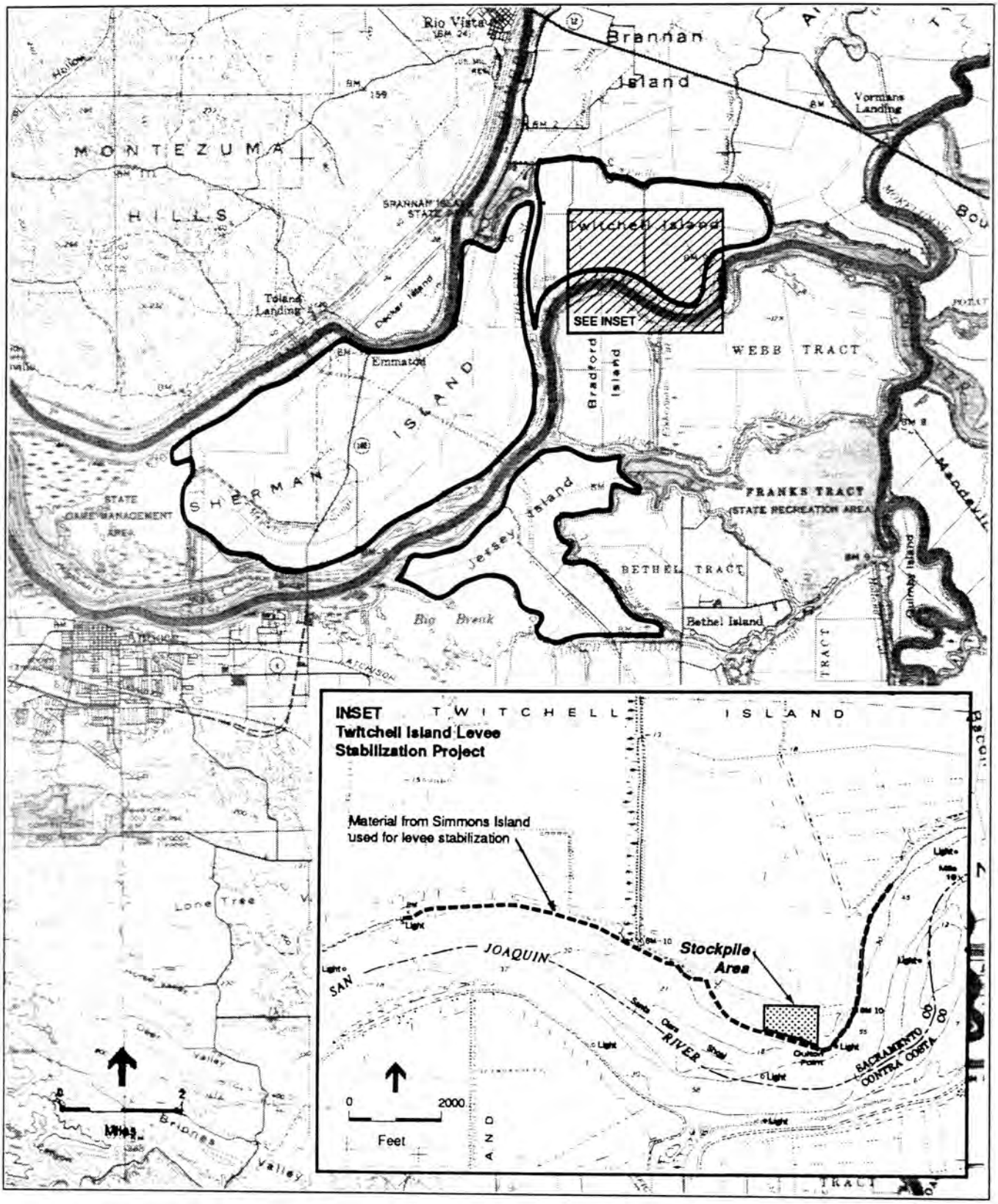
e. *Costs*. The Corps spent $900,000 to excavate 50,000 cy ($18/cy) of dredged material from Simmons Island in the Suisun Marsh, haul and load the material on barges, and off-load the material at the stockpile area on Twitchell Island. DWR estimates that it cost approximately $140,000 to monitor the material placed at Sherman Island and approximately $10,000 to monitor the Twitchell Island material.

SOURCE: U.S.G.S., 1970

Figure 10

West Delta Islands: Twitchell Island

Dredged materials were used to stabilize a levee section.



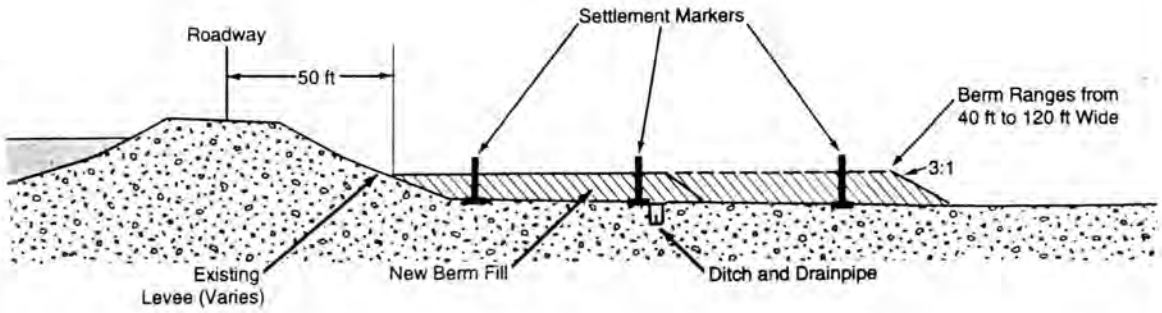


Figure 11
Delta Levee Profile

SOURCE: Roger Foott Associates, Inc., 1992

Dredged materials were placed to create a new berm to stabilize the levee.

DWR spent approximately $17 per cy to dredge Clifton Court Forebay and transport the material 26 miles for delivery and placement on Twitchell Island.

4. Conclusions

- The eight western Delta islands can use approximately 10,600,000 cy of material to improve approximately 117 miles of levees. The Delta, with approximately 760 miles of levees, could use an estimated 52,000,000 cy of material for levee improvements.

- For many projects, dredged material originating from the Bay may provide an economical source of material for rehabilitating Delta levees, particularly because there is little material currently available in the Delta. Dredged materials originating from the Delta and upper watershed areas for which there are few disposal options may also provide important sources of levee repair material and may, when used in conjunction with Bay material, allow the use of Bay sediments that otherwise would not be permitted in the Delta.

- The primary constraint to using Bay sediments in rehabilitating Delta levees is the potential effects of adding contaminants, particularly salts, to a freshwater environment. However, water quality monitoring of two relatively small demonstration projects where sands dredged from the Bay were used for improving Delta levees found no soil contamination or any adverse impact on water quality. Future demonstration projects involving larger quantities and different kinds of Bay sediment should help define the contamination impacts of using material originating from the Bay on Delta water quality.

- Water quality monitoring is expensive and complex. Extensive monitoring may not be necessary for many Bay sediments proposed for use in the Delta. The San Francisco Bay Regional Water Quality Control Board and the Central Valley Regional Water Quality

Control Board should jointly develop sediment screening criteria that specifies appropriate contaminant (including salinity) levels for sediment dredged from the Bay and proposed for Delta use.

- A long lead time is needed to develop cost share agreements, obtain necessary authorizations, and prepare sites for dredged material use. As the major Bay dredger, the Corps Construction-Operations Branch should inform DWR and LTMS agencies as soon as possible of planned dredging projects so that potential upland use projects can be identified and planned.

- Dredged material rehandling facilities, particularly ones located close to the Delta, such as at the Montezuma wetlands site (see above) would likely facilitate the use of dredged sediments in the Delta.

Staten Island

1. **Project Overview and Goals**. The project involves using dredged material to construct low interior levees on agricultural land on Staten Island in the eastern Delta. The new levees will allow portions of the Island to be managed as seasonal waterfowl habitat for six months of the year; the land will be farmed for the remaining six months. The periodic inundation is expected to arrest erosion and subsidence of the farmland and help control weeds, thereby reducing the use of herbicides and increasing profitability. Lack of a project sponsor has stopped progress on this demonstration project.

2. **Environmental Setting**. Staten Island is located in San Joaquin County and is bordered by the North Fork of the Mokelumne River on the west, the South Fork of the Mokelumne River on the east and the Mokelumne River to the south (see Figure 12). It is one of the many low-lying islands farmed in the Delta. Essentially flat, the surface of Staten Island slopes from 0 feet NGVD (approximately mean sea level) at its northern end to -18 feet NGVD at its southern end. Thus, pumping is needed to keep the ground water table below the root zone (i.e., three to five feet below the ground surface).

The M&T Ranch occupies all of Staten Island and is divided into 150 agricultural fields covering over 9,200 acres. Wheat and corn are the primary crops produced on the island. It has been costly to maintain yields through application of herbicides and current flooding practices which involve yearly construction and disassembling of levees.

The island's soils are primarily peat. The soils map of San Joaquin County (1952) shows that the pH values in the southern parts of the island vary between 5 and 6 (corresponding with "Staten" and "Venice" peaty muck) while pH values in the middle and northern areas range between 6 and 7 (corresponding with "Ryde silty clay loam" and "Egbert muck"). These soil characteristics influence the mobility of any potential chemicals present in the dredged materials, and thus whether the chemicals are released into ground and surface waters.

3. **Project Details**

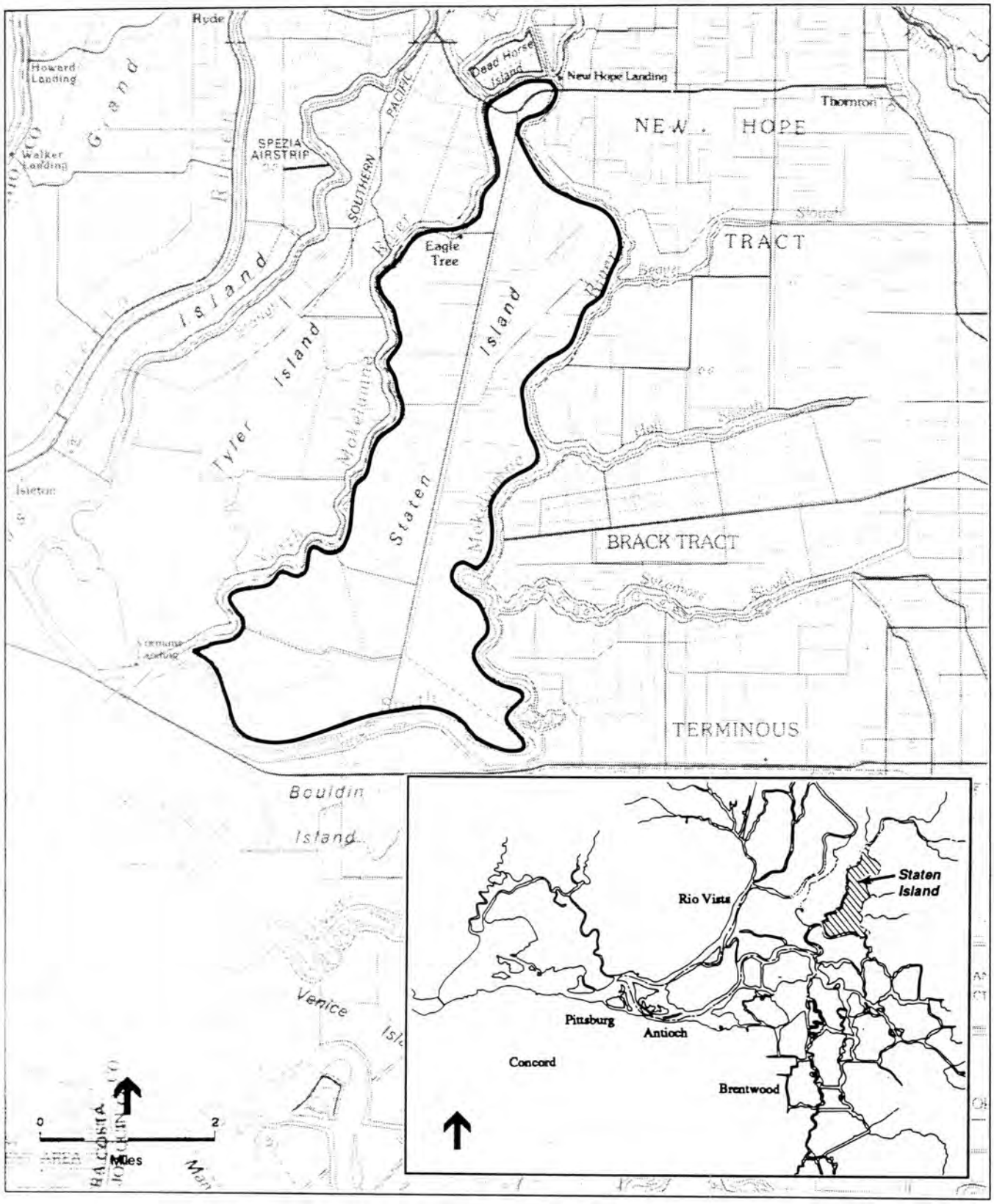
a. ***Background***. The proposed demonstration project involves using dredged material from San Francisco Bay to construct low interior levees which will allow portions of the M&T Ranch to be flooded

SOURCE: U.S.G.S., 1978

Figure 12

Staten Island

Dredged materials would be used to construct low interior levees to allow seasonal flooding of agriculture fields.



during the six winter months to create seasonal wetlands. After draining the fields in the spring, the land will again be cultivated. In addition to providing habitat for wintering waterfowl, seasonal flooding of the island is expected to reduce subsidence and control weeds, reducing the need for herbicides and increasing the farm's profitability.

Currently, M&T Ranch uses soil from adjoining fields to construct temporary levees to flood portions of the island. But the peat soils of the ranch make poor levee material and after the fields are drained, the levees are removed and the soil is spread on adjacent agriculture fields.

b. ***Project Design***. The ranch is interested in constructing as many as 20 permanent low interior levees at various locations throughout the ranch which will enable adjacent fields to be flooded with up to 2.5 feet of water. The levees will be 15 feet wide and range from one to three feet in height. Drainage ditches four feet wide by eight feet deep will be constructed adjacent to the levees to facilitate drainage. The amount of material needed to construct each individual levee ranges from 6,000 to 9,000 cy, depending on levee length and height.

The demonstration project involves constructing one or more interior levees; the number of levees constructed will depend on the amount of dredged material available, testing constraints and regulatory requirements. The levee(s) chosen for construction will be determined by crop rotation and the time of year dredged material is available. For example, dredged material available in early summer will be used to construct levees adjacent to fields in wheat production which is harvested earlier than corn. However, the Ranch's preferred option is to construct two parallel levees at the southeast corner of the island, which would require approximately 20,000 cy of dredged material. These levees would permit up to 1,500 acres of farmland to be seasonally flooded.

The river channels bordering the island are deep and can easily accommodate standard-sized barges. There are several locations suitable for off-loading barges on the island. As with the levees, the exact location chosen for off-loading will depend on the time of year the dredged material is available and on crop rotation. Wherever the dredged material is offloaded, two 5-acre areas will be provided for off-loading and drying the material. Once the dredged material has sufficiently dried, a Reynolds scraper will transport the material to the site of the new levee(s) where a grader and bulldozer will shape the material into levees.

Because the dredged material will be contained within levees to dry, little or no runoff is expected. However, a monitoring program will be developed with regulatory agencies to sample any leachate draining from the site and assess impacts on groundwater, surface water, and soils.

c. ***Permits***. The San Joaquin County Planning Department will be the lead agency for determining what environmental document, if any, will be required for the project. Permits from San Joaquin County, the Corps (San Francisco and Sacramento Districts), the San Francisco and Central Valley Regional Water Quality Control Boards and possibly the State Lands Commission, Department of Health Services, the Air Quality Control Board and the State Water Resources Control Board will be required prior to project construction.

d. ***Issues, Project Results and Current Status***. The landowner has agreed to be responsible for drying the material and constructing the levees. However, sources of dredged material and potential

funding have not yet been identified. BCDC has offered assistance in preparing needed applications and coordinating with various regulatory agencies, but the cost of obtaining needed permits, completing the required environmental document, and implementing a monitoring program may be high. Project sponsor(s) are needed to: (1) provide suitable dredged material; (2) transport the dredged material to the site; and (3) monitor the impacts of dredged material use on Staten Island and the adjacent waterways.

e. *Costs*. BCDC staff has spent considerable time developing preliminary project plans, contacting potential project sponsors, and determining likely regulatory requirements for the project. In the absence of a project sponsor and a source of dredged materials, however, no funds have been expended on this project.

4. Conclusions

- The principal environmental concern of using dredged material from the Bay in Delta upland use projects is whether such use would adversely affect Delta water quality, particularly salinity.

- Currently, there are no established standards for determining whether sediments from the Bay are likely to lead to adverse water quality impacts when used in the Delta. In August 1992, the Regional Board released a Draft Report entitled *Sediment Screening Criteria and Testing Requirements for Wetland Creation and Upland Beneficial Reuse*, which sets protocols for upland use of Bay sediments based on the concentration of certain constituents and on site-specific conditions. However, no similar approach has yet been developed for the Delta. The proposed demonstration projects on Staten and Jersey Islands, in conjunction with the two completed demonstration projects at Sherman and Twitchell Islands (see above discussion) provide excellent opportunities to further evaluate possible water quality impacts of using dredged material from the Bay for use in the Delta. Such information can be used to develop sediment standards to guide future projects.

- While water quality impacts should be the primary focus of the monitoring program, monitoring should also evaluate: (1) the project's effectiveness in arresting soil subsidence and erosion on the island; (2) the project's effectiveness in controlling weeds and improving crop yields; (3) the problems encountered in transporting, drying and placing the dredged material and recommendations for avoiding or minimizing such problems in the future; and (4) the costs of implementing this project and recommendations for reducing costs for future Delta projects.

CHAPTER 4

USE IN APPROVED FILL PROJECTS

Naturally occurring sand deposits in the Bay have been an important source of construction material for many years, unlike Bay muds, which are generally unsuitable for use as engineered fill because of their lack of structural strength. Typically, new construction associated with water-related industry and ports involves dredging and Bay fill. In these instances, sands dredged to create new berths or deepen navigation channels can be used to provide an engineered base for marine terminals or construction yards. The use of dredged material in constructing the Port of Oakland's Carnation Terminal is analyzed in this chapter.

Port of Oakland's Berth 30 Redevelopment*

1. **Project Overview and Goals.** In January 1992, BCDC granted the Port of Oakland (Port) a permit to redevelop the former Carnation Mill and marine terminal into a modern container terminal to be known as Berth 30. As part of the redevelopment, the Port planned to deepen the existing berth by dredging 143,000 cy of consolidated sands; most of this material would be used to provide an engineered base for the new Berth 30 container terminal. The remaining sand would be used to compensate for subsidence at other Port properties, or sold.

2. **Environmental Setting.** Berth 30 is located at the entrance to the Seventh Street Terminal Complex at the Port of Oakland's Outer Harbor (see Figure 13). Formerly occupied by the Carnation Mill and marine terminal, the site was relatively flat with an approximate elevation of 12 feet NGVD prior to redevelopment. Neighboring land uses include container yards, various industries, and numerous railroad tracks. Seventh Street, a heavily used four-lane roadway, bisected the site and was relocated to accommodate the new Berth 30 marine terminal. The entire Seventh Street Terminal Complex is located on historic bay fill.

3. **Project Details**

a. ***Background.*** As part of the construction of Berth 30, the Port dredged approximately 143,000 cy to deepen the existing berth by ten feet. The material dredged to deepen the berth was primarily

* Much of the information presented in this chapter about the Berth 30 project is derived from a presentation at the July 1993 Symposium on Coastal and Ocean Management entitled *Upland Reuse of Dredged Material As An Alternative to Aquatic Disposal: The Port of Oakand's Berth 30 Terminal Redevelopment, A Case Study* by Patricia Murphy and Jody Zaitlin, current Port of Oakland employees.

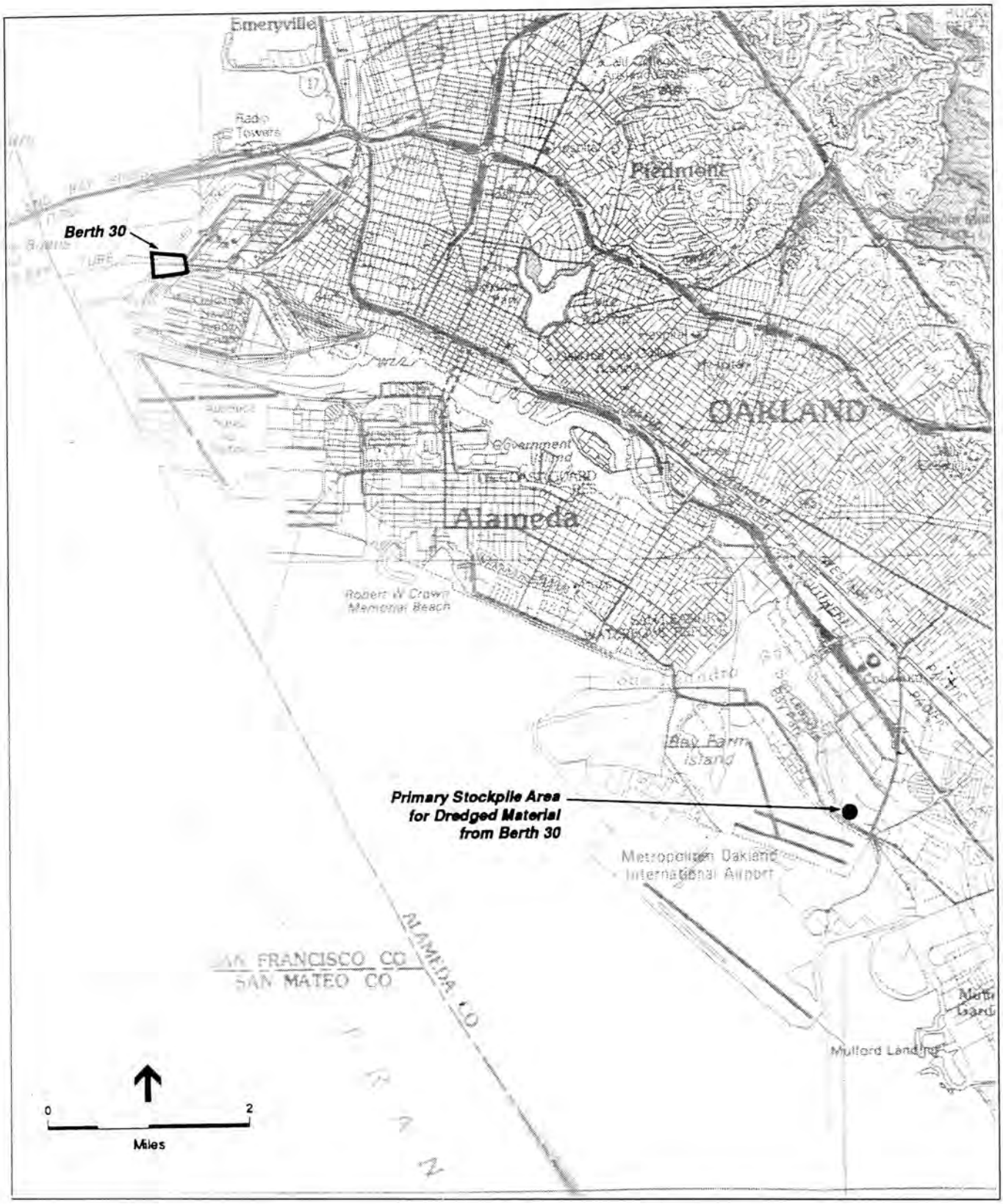
SOURCE: U.S.G.S. 1970

Figure 13

Port of Oakland's Berth 30 Project

(formerly the Carnation Terminal)

Dredged materials were used in constructing a ship terminal.



consolidated Merritt sand which the Port proposed to use as a sub-base for the new marine terminal and to fill low spots at Berths 8 and 9. Excess material would be stockpiled at various locations throughout the Port, incorporated into other Port projects, and then sold.

The Port elected to dispose the dredged material upland for several reasons. First, Bay disposal would likely result in a lengthy and difficult permitting process due to restrictions placed on Bay disposal because of concerns about the impacts of aquatic disposal on Bay organisms and because a large mound had formed at the Alcatraz disposal site, limiting capacity. Second, the prospective tenant's agreement to help finance construction and occupy the berth was predicated on Berth 30 being completed within three years. Third, the Port needed material to construct the terminal and had found that Merritt sand was a seismically stable foundation material which had performed well as engineered fill during the 1989 Loma Prieta earthquake.

b. ***Project Design***. While the Port needed some fill material to construct Berth 30, the amount needed was small. The Port chose to use a total of 80,000 cy of dredged materials in terminal construction to raise the terminal elevation approximately one and one-half feet. Material dredged from the berthing area was placed onshore where it was trucked to a nearby stockpile area, sorted and dried. A small berm with a weir was constructed around the stockpile area to prevent eroded sediments from returning to the Bay. Once the material had sufficiently dried, extraneous material removed (primarily rocks from a previous shoreline revetment), and necessary site preparation had occurred (such as constructing the wharf face), the dredged material was trucked back to the terminal and incorporated in the engineered base soil.

c. ***Permits***. Berth 30 is owned by the Port of Oakland and the site is designated for shipping uses in the Port's master plan. The City of Oakland's Comprehensive Plan designates the site for shipping, industrial, utility or transportation uses. The BCDC San Francisco Bay Plan designates the site a port priority use area and the BCDC/MTC Seaport Plan designates the site for near-term marine terminal development.

The Port's decision to dispose the dredged material upland was welcomed by the regulatory community and led to a simplified environmental review and regulatory process. BCDC issued Permit No. 12-91 authorizing the new dredging with upland disposal. The Regional Board permitted the dredged sediments to be used as fill in the container yard without any special provisions for containment. After requiring some additional testing, the Regional Board also determined that the stockpiled material could be stored without a cap or other containment measures.

d. ***Issues, Project Results and Current Status***. Approximately 80,000 cy of dredged material was used as engineered sub-base for the marine terminal. Another 25,000 cy was used to compensate for subsidence at Berths 8 and 9. The remainder, approximately 38,000 cy, is stockpiled at various locations throughout the Port with most of the material temporarily stored at a location near the Metropolitan Oakland International Airport. Construction of Berth 30 is now nearing completion; it should be completed in early 1994.

There were few problems in using the dredged sand to construct Berth 30. Some debris was found in the sand (e.g., creosoted wood pilings) requiring that the material be sorted, but this would have been required for aquatic disposal as well. The dredged sand worked well in providing an engineered base

for the marine terminal. Some employees of a nearby light industry complained of adverse health effects during disposal, but air quality monitoring requested by the County Health Department found no airborne contaminants.

A number of issues arose, however, concerning the stockpiled material. Although the stockpiles were only three to four feet high, several people complained about their visual impact. Many more complained about objectionable odors, although Port personnel have been unable to detect any odors. This is probably because most of the material is sand with little of the organic matter typically responsible for generating odors.

Some of the earthen berms built to contain the stockpiled material failed during the unusually heavy winter rains of 1992-93 and some of the material eroded onto adjacent properties and into storm drains. However, the temporary levees were shored up by placing hay bales and screen cloth at low spots, and material was prevented from flowing into storm drain by placing filter fabric over drains.

Trucking the dredged material to the stockpiles during the rainy season also created problems. The Port found it was important to notify neighbors about the duration of the operation and the nature of the material being transported. The Port also employed two sweeper trucks to clean the mud tracked onto the streets; trucks carrying dredged material were hosed and swept off before leaving the disposal site.

The Port also found it difficult to find sufficient upland space to stockpile the material.

Lastly, the Port found it far more challenging to find buyers or uses for the stockpiled material than it had anticipated. The prolonged recession has dampened the market for sand, and the contractor's discovery of lead contamination in an adjoining upland area increased potential buyer's fears that the dredged material could be contaminated even though testing had found the dredged material to be nonhazardous. Fearing liability if contaminants are later found in the sand, potential users of the material want the Port to indemnify them prior to agreeing to accept the material.

e. *Costs*. The Port's original estimate for upland disposal was $14 per cy. The Port has stated that its actual cost for disposing Berth 30 material has been much higher–approximately $30 per cy or $4.4 million (total) and may rise when the remaining stockpiled material is taken to its ultimate destination. The Port attributes the high cost to the fact that so much of the material had to be stockpiled and markets for the material have been difficult to find.

4. **Conclusions**

- Dredged sands can be used as engineered fill for a variety of projects, including constructing new marine terminals and compensating for subsidence.

- A major drawback in using dredged materials for construction is the additional cost to dredgers. The Port of Oakland estimates that it cost approximately $30 per cy to dredge Berth 30 and dispose the material upland compared to approximately $4 per cy for disposal at the federally designated Bay disposal site at Alcatraz. According to the Port, these final costs could increase depending on the Port's involvement in the ultimate disposition of the

remaining stockpiled material. A breakdown of the Port's cost is not yet available, making it difficult to evaluate the factors contributing to the high cost. Some of the costs, such as sorting wooden piers from the dredged materials, would have been required for aquatic disposal as well, increasing the cost of aquatic disposal. Other costs, for example those incurred in taking remedial actions such as hiring sweeper trucks and rebuilding containment levees, may have been reduced had they been anticipated. Costs would have been reduced with better planning, for the contractor had based his bid price on taking the material to the Delta for possible sale without having contacted regulatory agencies such as the CVRWQCB which has been cautious in allowing use of Bay sediments in the Delta. The uncertainties of obtaining necessary approvals led to the elimination of the Delta option and resulted in stockpiling a large percentage of the material. If users had been identified and contractually bound to take the material prior to commencement of dredging operations, it is likely that disposal costs would have been significantly lower. While the extra handling involved in upland disposal makes it more costly than aquatic disposal, the cost differential reported for Berth 30 is much higher than that reported for other upland use projects. Despite the higher costs, the availability of an upland disposal site permitted the Berth 30 project to proceed at a time when Bay disposal was becoming increasingly controversial and restricted, and obtaining authorization for aquatic disposal would likely have resulted in delays and associated costs.

- Visual impacts, air quality impacts, impacts to public roadways and storm drains should be anticipated early in the planning process so that appropriate mitigation measures can be incorporated into the project design.

- More difficult to address is the public perception that contaminants in dredged materials pose a health risk. While public information programs initiated early in the project can allay some public fears about the dangers involved in upland disposal, some people do not believe assurances that dredged materials are nonhazardous. With standards and guidelines for determining acceptable contaminant levels in dredged materials still in the formative stage, a certain amount of skepticism about the relative dangers of contaminants in dredged material is likely to persist until more experience is gained in reusing dredged materials. Similarly, with increasing concern over hazardous waste liability, some potential end-users will probably continue to demand indemnification before accepting dredged materials until some mechanism is in place to limit their exposure to litigation.

CHAPTER 5

DREDGED MATERIAL REHANDLING AND DRYING

Rehandling facilities are midshipment points for dredged materials that cannot be hauled directly to the site where it will be ultimately used. They are also locations where dredged materials can be dried or treated to remove or reduce salinity or contaminants. Typically, rehandling facilities accept relatively small volumes of material originating from specific dredging projects. In the Bay Area, rehandling facilities are located at Port Sonoma-Marin, near the mouth of the Petaluma River, in the City of Petaluma, Sonoma County, and in the City of San Leandro, Alameda County. Currently the Corps does not own or fund rehandling facilities because it believes it would need explicit congressional authorization to do so.

Port Sonoma-Marin

1. **Project Overview and Goals.** In 1991 and 1992, BCDC helped facilitate two projects in which materials dredged from the Port of San Francisco and the Port of Oakland were taken to Port Sonoma-Marin to dry prior to being taken to eventual sites for use such as Redwood Sanitary Landfill in Marin County.

2. **Environmental Setting.** Port Sonoma-Marin is a private marina located immediately southeast of the Highway 37 bridge crossing the Petaluma River in southern Sonoma County. The Petaluma River connects the marina to San Pablo Bay and is a federal navigation channel maintained to -8 feet NGVD.

Due to naturally high siltation rates, Port Sonoma-Marin annually dredges approximately 45,000 cy of material from its marina basin. The material is pumped hydraulically into one of two basins or rehandling ponds located adjacent to the marina to dry (Figure 14). The two ponds (one six and the other ten acres) have a combined capacity of 110,000 cy and negligible natural resource value because of ongoing use.

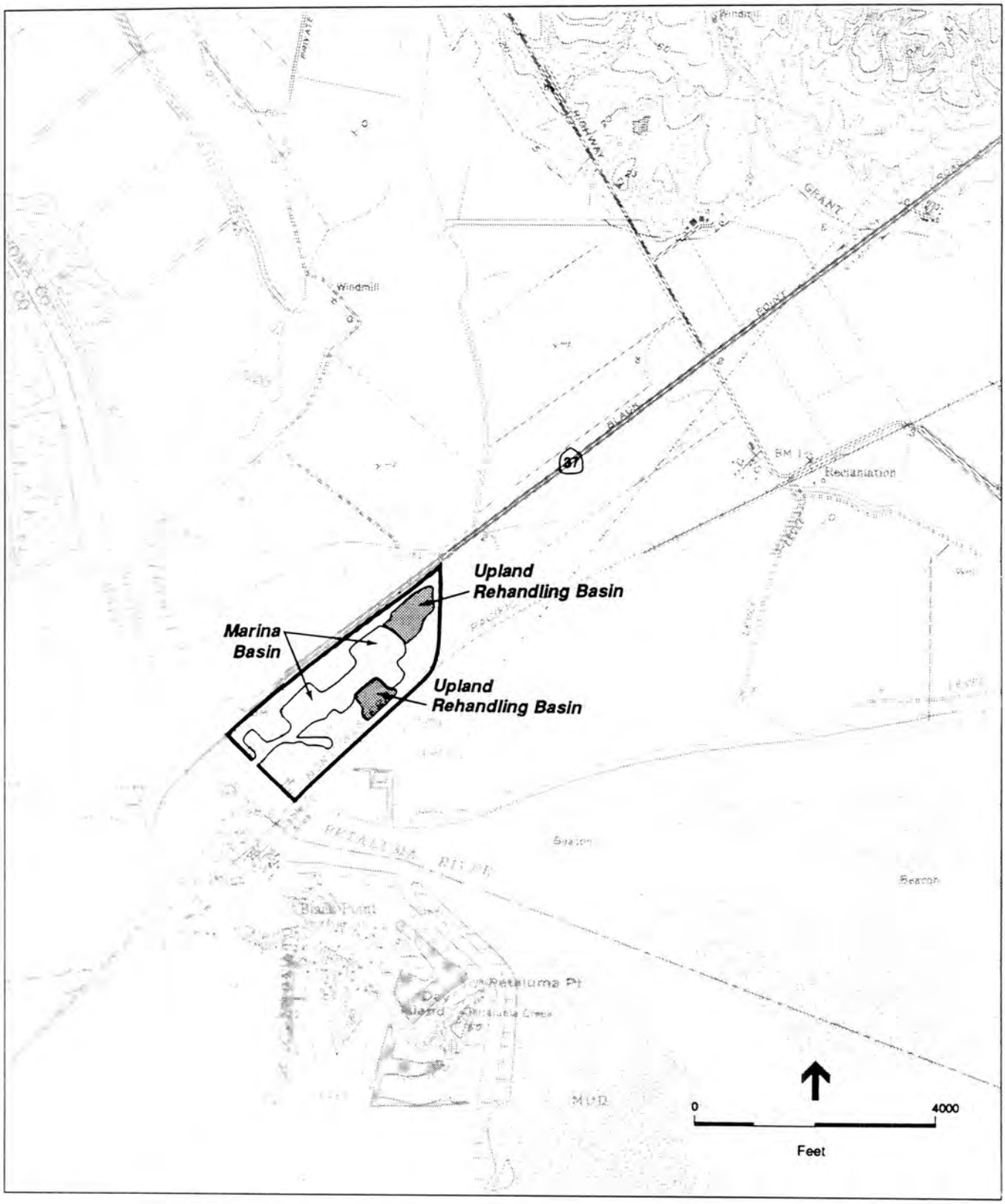
Fine-grained material (silts), such as that dredged at Port Sonoma-Marin, has a low permeability rate and can be used to line and cap landfills. Pursuant to an existing agreement, Port Sonoma-Marin pays $0.25 per cy to Redwood Landfill to excavate and haul dried dredged material from its rehandling ponds for use at the landfill site, located 13 highway miles from Port Sonoma-Marin.

SOURCE: U.S.G.S., 1980

Figure 14

Port Sonoma-Marin Rehandling Facility

Dredged materials from Port of San Francisco and Port of Oakland are dried prior to use elsewhere.



3. **Project Details**

a. ***Port of San Francisco***

(1) **Background**. In the fall of 1991, the Port of San Francisco planned to maintenance dredge approximately 136,000 cy from various ship berths. However, the National Marine Fisheries Service objected to the Port of San Francisco's proposed open-water disposal of approximately 12,000 cy of this material because of concerns that elevated levels of polynuclear aromatic hydrocarbons (PAHs) in the material could impact the fall run of the Chinook salmon, an endangered species. Re-testing the suspect material to verify its contaminant levels and suitability for Bay disposal would have been costly and could have delayed the project until the following spring due to restrictions on Bay disposal during the winter herring spawning season.

Hoping to avoid such costs and delays, the Port of San Francisco requested assistance from BCDC, which had been working to increase opportunities for using dredged material at upland sites. BCDC contacted Redwood Landfill Inc., which operated one of the few upland sites where dredged material had been previously used to construct levees and line disposal areas. Redwood Landfill, in conjunction with the Regional Board, determined that the physical and chemical quality of the material proposed to be dredged by the Port of San Francisco was consistent with the existing Waste Discharge Requirements (WDRs) for the landfill. However, direct barge access to Redwood Landfill was infeasible without dredging Black John Slough, the only feasible water access to the landfill. Dredging Black John Slough would have been both costly (estimated at $420,000 to $480,000) and would have likely involved a lengthy and difficult environmental review and permit process because of the potential impacts of dredging on existing wetlands.

Knowing that Port Sonoma-Marin—which was accessible to barges—was interested in expanding its rehandling operations, BCDC asked Port Sonoma-Marin whether it would be agreeable to serving as mid-shipment, or transfer, point for the Port of San Francisco's dredged material with the final destination being the Redwood Landfill. Port Sonoma-Marin agreed to cooperate in the project.

(2) **Project Design**. Dredged materials were placed in one of two existing basins constructed for the disposal of dredged materials from the marina; no modifications to the basin were necessary. Eleven-foot-high levees enclose the basins and water decanted from the dredged materials is discharged through a four-foot-wide weir.

(3) **Permits and Contracts**. Port Sonoma-Marin is zoned for Recreation and Visitor use by Sonoma County.

BCDC amended Port Sonoma-Marin's existing permit to allow 12,000 cy of material dredged from the Port of San Francisco to be disposed at the marina's rehandling ponds. The Regional Board reviewed the proposal on an expedited basis and found it consistent with the existing WDRs for both the rehandling ponds and Redwood Landfill.

Port Sonoma-Marin and the Port of San Francisco entered into a contract that included the following provisions: (1) barges could enter and depart from Port Sonoma-Marin at high tides only;

(2) the dredging contractor was responsible for setting up and removing off-loading equipment and was liable for any on-site damages resulting from negligence; (3) the Port of San Francisco would pay $0.50 per cy to Port Sonoma-Marin for rehandling services; and (4) Port Sonoma-Marin would assume immediate responsibility for the material once it was placed in the rehandling ponds. Redwood Landfill was not a party to the contract.

(4) **Issues, Project Results and Current Status.** A clamshell was used to off-load dredged material directly from the barge to the six-acre rehandling pond. During off-loading, the material failed to disperse and concentrated adjacent to the off-loading area. This increased lateral load resulted in partial failure of the perimeter levee which then needed to be repaired. Ultimately 12,000 cy of material was off-loaded at Port Sonoma-Marin over fifteen days—about 800 cy of material per day. The material was placed to a depth of eight feet.

Several factors slowed off-loading operations. The shallowness of the marina basin limited barge access to the rehandling ponds. With water depths at the marina's entrance of -9.8 feet NGVD and -7.8 ft NGVD at the off-loading site, fully loaded large barges could not cross the marina basin even at high tide. Barges could only be loaded with 600 to 800 cy, and off-loaded by clamshell over a four-hour period. The failure of the dredged material to disperse at the rehandling site and the partial failure of the perimeter levee also delayed off-loading, as did inclement weather and the dredging contractor's decision not to work at night and during holidays.

Pursuant to the site's WDRs, Port Sonoma-Marin monitored water quality impacts of the discharged effluent from the Port of San Francisco's dredged material. Monitoring results indicated no adverse impacts on Bay water quality.

(5) **Costs.** The Port of San Francisco ultimately paid approximately $22.50 per cy or about $270,000 to dredge, barge, and off-load 12,000 cy of material. These costs reflect payment of $0.50 per cy for material rehandled by Port Sonoma-Marin and the costs to repair the levee at the off-loading site.

b. ***U.S. Army Corps of Engineers/Port of Oakland***

(1) **Background.** In January 1992, 21,000 cy of a total of 565,000 cy of material that the Corps planned to dredge from the Port of Oakland was deemed unsuitable for open-water disposal because of elevated levels of PAHs and toxicity in bioassays. As the Corps' local sponsor, the Port of Oakland was responsible for securing an upland disposal site for this material, and contacted Redwood Landfill and Port Sonoma-Marin.

(2) **Project Design.** Some as for the Port of San Francisco project described above.

(3) **Permits and Contracts.** The disposal of the 21,000 cy of dredged material from the Port of Oakland required a further amendment to BCDC's permit to Port Sonoma-Marin and new WDRs from the Regional Board. New WDRs were required because the earlier ones did not specifically address the operation of a long-term sediment handling facility at the site. Sonoma County was initially concerned that Port Sonoma-Marin's rehandling ponds were being converted from temporary drying facilities for the marina's dredged material into long-term storage ponds for contaminated waste generated outside the

county. After further review the county decided that the sediment from the Port of Oakland was non-hazardous and that drying the material at the rehandling ponds was not a significant intensification of use. Therefore, the county determined that no new permits or revisions to existing permits were necessary.

In June 1992, the Port of Oakland, Port Sonoma-Marin, and Redwood Landfill entered into a contract that included many of the same provisions as the contract between Port Sonoma-Marin and the Port of San Francisco. Although the Port of Oakland's material was determined non-hazardous, Port Sonoma-Marin believed that potential users might be concerned about the material's contaminant levels and thus not interested in taking the dried material. To ensure that the Port of Oakland's material would not permanently reside at its rehandling ponds thereby reducing capacity for other potential customers, Port Sonoma-Marin insisted that the Port of Oakland secure a user for its material prior to accepting the material; it was for the purpose of securing a user for the material that Redwood Landfill was included in the contract. The contract included a provision that Redwood Landfill be paid $2 per cy to excavate up to 21,000 cy of existing material at Port Sonoma-Marin's rehandling ponds to make room for the Port of Oakland's material.

(4) **Issues, Project Results and Current Status.** In the fall of 1992, Redwood Landfill excavated 21,000 cy of dried dredged material from the 10-acre rehandling pond at Port Sonoma-Marin and hauled it to the landfill. Port Sonoma-Marin planned to use a five-acre portion of the pond to dry dredged material from its marina and preferred that its material remain separate from the Port of Oakland's. For this reason, using on-site material, an impermeable barrier was constructed dividing the pond in half prior to receiving the Port of Oakland material. As with the Port of San Francisco project, transport of dredged material to the rehandling ponds was slowed by the shallowness of the marina basin, which permitted access to the off-loading site only at high tides. A clamshell was used to lift the material from the barges into the rehandling pond, but the off-loaded material failed to disperse and tractors were used to distribute the material to a depth of eight feet.

The site's WDRs contain a detailed Self Monitoring Program (SMP) which requires Port Sonoma-Marin to monitor water quality impacts of discharged effluent from the Port of Oakland's material. To minimize costs, Port Sonoma-Marin will discharge effluent only when necessary (e.g., at the end of a particularly rainy period) to limit the amount of monitoring performed. Thus, drying occurs primarily through evaporation, which extends the drying period considerably. Monitoring results to date have not indicated any adverse water quality impacts related to the project. Currently, the material continues to dry at Port Sonoma-Marin and is expected to be ready for removal in spring of 1994 when it will be transported to Redwood Landfill for use as daily cover.

(5) **Costs.** The Port of Oakland paid approximately $18 per cy or about $200,000 to dredge, barge, and off-load 21,000 cy of material. These costs include $2 per cy to Redwood Landfill for excavating and disposing material from Port Sonoma-Marin's rehandling ponds to ensure capacity for the Port of Oakland project and $1 per cy for material rehandled by Port Sonoma-Marin.

4. Conclusions

- Given that Bay disposal would have cost approximately $4 per cy, upland disposal costs of approximately $18 per cy were comparatively high due in part to: (1) the relatively slow and

complicated off-loading operations; (2) the relatively small volume of material rehandled; and (3) the experimental nature of both projects. The relatively high upland disposal costs could be reduced by: (1) improving barge access to Port Sonoma-Marin through dredging the entrance and off-loading areas and/or developing new rehandling sites with better barge access; (2) ensuring that critical rehandling site features such as perimeter levees are sufficient to handle expected loads; and (3) undertaking operations earlier in the season when weather conditions are generally more favorable.

- Despite the high costs, rehandling material that had failed water quality tests allowed both the Port of San Francisco and the Port of Oakland to dredge critical berthing areas in a timely manner. Delays in dredging would have limited the use of some harbor areas resulting in potential loss of revenue. (The costs provided in this report do not reflect the economic benefit gained by both the Port of San Francisco and the Port of Oakland as a result of the opportunity to dispose dredged material at upland sites). Thus rehandling facilities may provide a viable alternative for disposing dredged material with contaminant levels too high for aquatic disposal but low enough for specified upland uses.

- Rehandling large volumes of material will likely require expansion of existing facilities, such as at Port Sonoma-Marin, or the development of new ones.

- Existing capacity at rehandling facilities should be maximized by limiting the depth that dredged material is placed to ensure a shorter drying time. According to Port Sonoma-Marin, a placement height of four feet is ideal as it permits bulldozers to "work" the material to facilitate aeration and shorten drying time (Bulldozers frequently get stuck in wet dredged materials placed to depths greater than four feet). At a depth of four feet, material dredged from the marina at Port Sonoma-Marin and placed in its rehandling ponds dries in approximately six months whereas material from the Port of San Francisco and the Port of Oakland placed to a depth of eight feet takes 18 months or longer to dry completely.

- Comprehensive contractual arrangement between parties involved with upland use projects are necessary to clearly define each parties' responsibilities.

- Off-loading procedures need to be improved to ensure a more even distribution of clamshell-dredged material in rehandling ponds and avoid the problems of materials concentrating in one area which can lead to levee failures.

- Costs related to monitoring water quality impacts of discharged effluent from rehandling ponds can be reduced by limiting discharge from the site and allowing material to dry through evaporation. However, this approach increases drying time, and results in loss of capacity.

CHAPTER 6

USE AT LANDFILLS

The clays and fine silts that comprise most dredged materials from the Bay are often suitable for use as cover, capping, or lining material at sanitary landfills. Because landfills need a large amount of material for daily cover and for capping when landfill operations cease, they are a ready market for dredged material.

Using dredged materials at landfills is attractive for several reasons. Landfills are typically highly disturbed sites with limited natural resource values. Thus, using dredged materials at landfills are likely to impact few existing natural resources. Landfills also are designed to contain contaminants and manage runoff so using dredged materials at landfills will result in a net environmental benefit by removing contaminants from the Bay. One major obstacle to using dredged material at Bay Area landfills is transporting dredged material to the sites. Most of the bayside landfills are closed and gaining water access to the region's remaining landfills would require extensive dredging and construction of off-loading facilities.

Bay Area landfills where dredged material have been used in the past or may be accepted for use in the future include Redwood Landfill in Marin County, West Contra Costa Landfill in Richmond, Contra Costa County, Portrero Hills Landfill near Suisun City in Solano County, and Tri-Cities Landfill in Fremont, Alameda County. Large volumes of material used at these landfills, where currently dredged material cannot be delivered directly by barge or that have limited on-site rehandling capacity, will likely require expansion of existing rehandling facilities (such as Port Sonoma-Marin) or the creation of new rehandling facilities (such as Leonard Ranch and Cargill North Bay Crystallizer Salt Ponds) currently under study through the LTMS.

The demonstration project at Redwood Landfill is evaluated in this chapter.

Dredged Material Use at Redwood Landfill

1. **Project Overview and Goals.** In 1991 and 1992, BCDC helped coordinate projects with the Ports of San Francisco and Oakland where dredged materials will be used at Redwood Landfill in Marin County.

2. **Environmental Setting.** Redwood Landfill Inc. (Redwood), a wholly owned subsidiary of Sanifill, Inc., is located four miles north of Novato, along San Antonio Creek, a tributary of the Petaluma River (see Figure 15). The landfill is located on former Bay tidal marsh and has been in operation since 1958, receiving about 95 percent of all Marin County municipal solid waste, about 1,350 tons daily. The landfill uses approximately 350 cy of earth material daily for cover, or roughly 125,000 cy annually.

In July 1993, Marin County issued a Draft Environmental Impact Report (Draft EIR) for a proposed vertical expansion and other changes to the landfill. Under the proposal, the landfill would have an operating life of approximately 48 years. The Draft EIR proposes using dredged materials from a variety of sources (including Port Sonoma-Marin and the Ports of San Francisco and Oakland) to construct a two-foot thick liner for a sludge processing area and for levee construction and repair.

A network of artificial channels and natural sloughs nearly encircle the site. San Antonio Creek, the largest of these waterways, is not currently deep or wide enough to accommodate deep draft barge traffic. It would cost $420,000 to $480,000 to dredge San Antonio Creek to provide barge access to the site; any proposal to dredge the creek would likely involve a lengthy and difficult environmental review and permit process due to the potential impacts of dredging on existing wetlands.

3. **Project Details**

a. ***Background.*** Since 1990, Redwood has accepted approximately 500,000 cy of dredged materials from the Petaluma River, Gallinas Creek, and Port Sonoma-Marin, which have been incorporated into the landfill as waste or used for on-site construction material and liners. Since Redwood is one of the few Bay Area landfills that has demonstrated an interest in accepting and using dredged material, it was selected as a potential site for using dredged material from two projects which BCDC helped facilitate and coordinate.

The two projects involve using 12,000 cy of dredged material from the Port of San Francisco and 21,000 cy of material from the Port of Oakland at Redwood (see section on the Rehandling Facility at Port Sonoma-Marin for a complete discussion of these two dredging projects). In both cases, the material was determined to have contaminant levels too high for Bay disposal but low enough for use at the landfill. Because of the lack of barge access to Redwood, dredged material from the Port of San Francisco and the Port of Oakland was initially taken to the Port Sonoma-Marin rehandling facility in November 1991 and October 1992, respectively, where it is currently drying. Once dry, the material will be trucked to the landfill and used where needed.

b. ***Project Design.*** There is no specific plan for use of the dredged material at the landfill; the material will simply be incorporated into the facility when and where it is needed.

c. ***Permits and Contracts.*** Zoned for agricultural use, Redwood has operated at its current site pursuant to a County Use Permit issued in 1958. Since 1978, Redwood's operations have been governed by a Solid Waste Facilities permit issued by Marin County Environmental Health Services with the concurrence of the California Integrated Waste Management Board. The landfill is outside BCDC's jurisdiction, and only two very small wetlands along the edge of the 460-acre landfill are subject to wetland regulatory authority. These wetlands are not affected by current disposal operations.

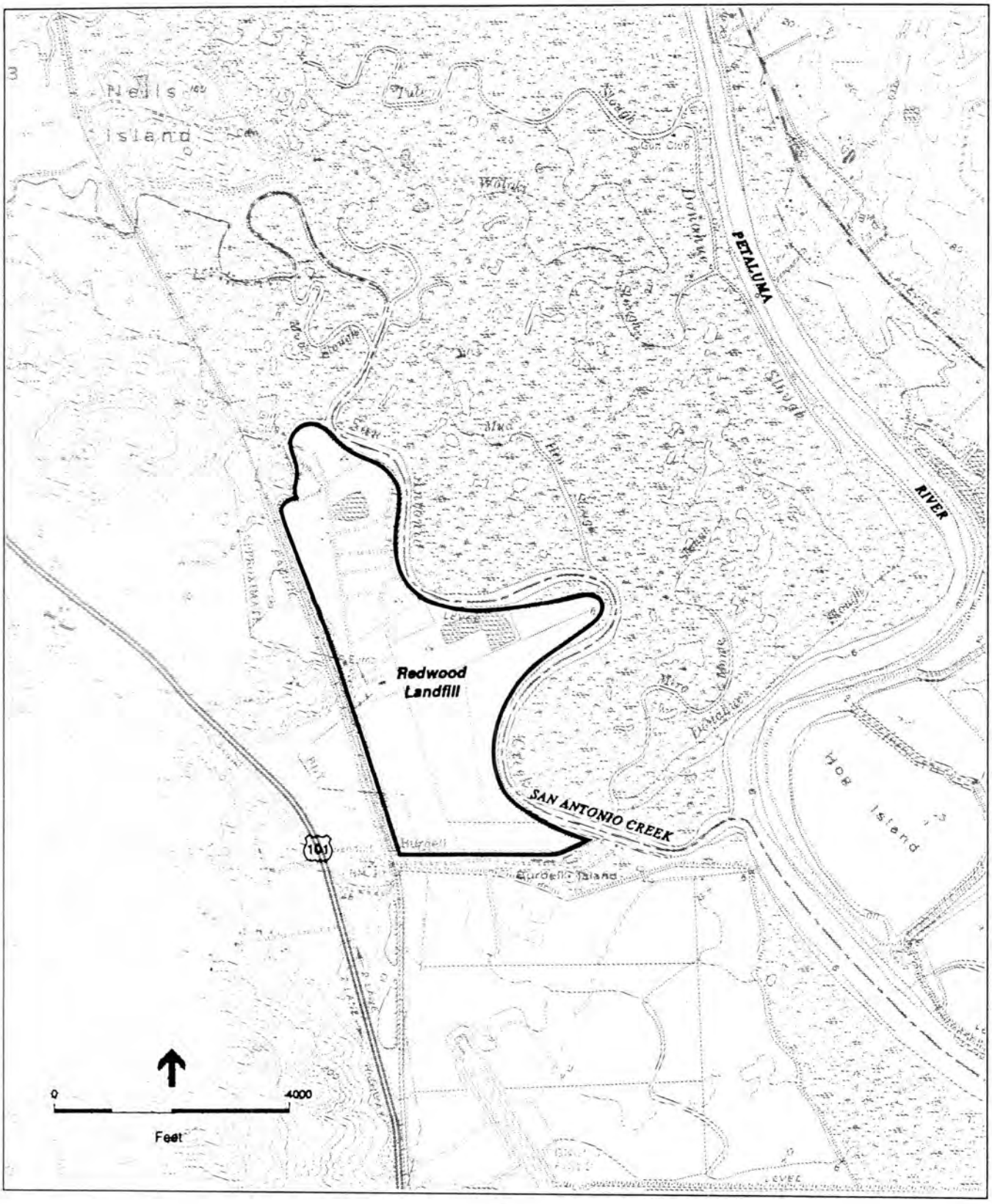
San Francisco Bay Conservation and Development Commission

SOURCE: U.S.G.S., 1980

Figure 15

Redwood Landfill

Dredged materials from the Port of Oakland and possibly from the Port of San Francisco will be incorporated into the landfill or used as cover material.



Redwood, in conjunction with the Regional Board, determined that the dredged material from both the Port of San Francisco and the Port of Oakland were non-hazardous, consistent with the site's WDR, and suitable for use as daily cover.

The Port of San Francisco entered into a contract with Port-Sonoma Marin to rehandle 12,000 cy of the Port's material. Redwood has an existing agreement with Port Sonoma-Marin whereby Port Sonoma-Marin pays $0.25 per cy to Redwood to excavate and haul dried dredged material from its rehandling ponds. Approximately 4,000 cy of the Port of San Francisco's material has been hauled to the landfill for use. Port Sonoma-Marin is currently looking for other users to excavate and haul the remaining material at no charge to avoid the $0.25 per cy charged by Redwood for material taken to the landfill.

For the Port of Oakland material, Port Sonoma-Marin was concerned that the notoriety surrounding the material's contaminant levels would deter potential users from accepting the material. To ensure that the Port of Oakland's material would not permanently reside at its rehandling ponds thereby reducing capacity for other potential customers, Port Sonoma-Marin insisted that the Port of Oakland first secure a user for its material before agreeing to accept it. It was for this reason that Redwood was included in the contractual agreement between the Port of Oakland and Port Sonoma-Marin for the disposal of the Port's material.

d. ***Issues, Project Results and Current Status***. To date, the material from both dredging projects continues to dry at Port Sonoma-Marin's rehandling ponds, with the exception of approximately 4,000 cy of the Port of San Francisco's material which has been taken to Redwood Landfill. It is anticipated that the Port of Oakland's material will be dry enough for transport to Redwood by the spring of 1994.

e. ***Costs***. The Port of San Francisco ultimately paid approximately $22.50 per cy or a total of about $270,000 to dredge, barge, and off-load 12,000 cy of material. The Port of Oakland paid about $18 per cy or a total of $378,000 for dredging, hauling, and off-loading 21,000 cy of material.

4. **Conclusions**

- Dredged materials, including these deemed unsuitable for open-water disposal, can be used at landfills for daily cover, capping material, liners, and levee construction.

- The higher cost is the major drawback of disposing dredged materials at landfills. It cost the Port of Oakland $18 per cy and the Port of San Francisco $22.50 per cy to dispose of dredged materials at Redwood Landfill, compared with approximately $4 per cy for disposal at the federally designated Bay Alcatraz disposal site. In evaluating disposal costs, however, it is important to remember that the contaminant levels of the dredged materials taken to Redwood were too high for Bay disposal. The availability of an upland disposal site, despite the higher costs, enabled both dredging projects to proceed in a timely manner, thereby benefiting both Ports by allowing their facilities to remain open to shipping.

- The two factors most responsible for the higher costs associated with disposal of dredged material at landfills are: (1) the extra handling needed to off-load barges, "work" the dredged material to promote drying, load trucks and transport the materials to landfills; and (2)

increased transportation costs due to longer distances traveled. The experimental nature of the projects and the relatively small volumes of material disposed also contributed to higher costs.

- Higher costs are also linked to the characteristics of the disposed material. Finer-grained materials with lower water permeability can be used for capping and lining wastes and thus are more valuable to landfills which would charge less for their disposal. According to Redwood, the material from both dredging projects was fairly permeable and useful only as daily cover.

- Redwood will likely continue to accept and use dredged material in the future, particularly if its plans to expand and improve existing operations are approved.

CHAPTER 7

GENERAL CONCLUSIONS AND RECOMMENDATIONS

For over 140 years, dredged materials have been used in the Bay and Delta to build levees and to provide construction and fill material. Demand for dredged material remains high, particularly for rehabilitating levees and restoring wetlands. But as the experience of the 13 demonstration projects reviewed in this report indicates, there are obstacles to upland use of dredged materials. Chief among these obstacles are: (1) the high relative cost of upland disposal; (2) concern about the environmental and health risks posed by contaminants in dredged materials; (3) concern about the impacts of using dredged material on existing habitats, particularly on seasonal wetlands*; (4) limited coordination among government agencies in processing dredging permits and the absence of a broadly accepted public policy advocating the beneficial use of dredged material; and (5) institutional caution resulting from the lack of experience with the effects and performance of beneficial use of dredged material.

Despite these obstacles, dredged materials have been used to stabilize levees in the Delta (Sherman and Twitchell Islands), in landfills as lining and cover material (Tri-Cities and Redwood Landfills), and as engineered fill for a marine terminal (Port of Oakland's Berth 30). There is also widespread support for using dredged material for marsh restoration. These successes suggest that upland disposal remains an important option for disposal of material dredged from San Francisco Bay and provide impetus to resolving current obstacles to upland disposal.

Cost Differential

1. **Conclusions**. Upland disposal projects will likely be significantly more expensive than the historical cost of Bay disposal. Historically, Bay disposal costs have been very low—between $3 to $6 per cy. These figures do not reflect the true total cost of Bay disposal because they do not include costs of monitoring disposal sites or mitigation for adverse impacts, costs to commercial or sport fisherman, the environment, or the costs of redredging the deposited material. Costs for upland disposal and use vary depending on the location and size of projects, and can range from about $6 per cy to over $30 per cy. Dredgers are likely to continue to opt for the least expensive disposal alternative available, which will probably remain Bay disposal. This conflicts with BCDC's and the Regional Board's dredging policies

* While this concern has been raised most recently for projects proposing to use dredged materials to accelerate tidal marsh restoration on lands with some seasonal wetlands, this concern is likely to be raised for any project where one scarce habitat is converted to another or is temporarily lost during project construction (e.g., maintaining levees in the Suisun Marsh).

that view Bay disposal as the least preferred option, and the position of many state and federal resource agencies that additional restrictions on Bay disposal may be warranted. The creation of economic incentives and disincentives for dredging projects, such as institution of a dredging mitigation fee, can lessen or eliminate the cost differential of different disposal options. Fees from Bay disposal could be used to monitor and manage Bay disposal sites as well as defray some of the added cost of upland and ocean disposal.

Beyond the general cost difference, if a dredger does not have access to an existing upland disposal facility, the cost of securing a new non-tidal disposal site is substantial. A new site would require substantial up-front costs for site acquisition, planning and permitting, constructing on-site improvements, constructing off-loading and pumping facilities, and providing any needed mitigation. To make the per-cubic-yard costs of such projects feasible, the site will need to be large enough to achieve economies of scale. New federal programs may provide up to 75 percent of the cost of environmental enhancement projects associated with a federal dredging project, but funds will still be needed to contribute to the local cost share for such projects. Needed funds could be obtained through a regional reclamation district, new state and federal funding authorization, or accumulated dredging mitigation fees.

In the Port of Oakland's Berth 30 project, much of the extra cost to dispose the dredged material upland arose from the need to stockpile the material, an unexpected cost that could have been avoided if a user for excess dredged sediment had been identified before dredging commenced. Both the Berth 30 project and the Port Sonoma-Marin's rehandling facility encountered problems that demanded an immediate remedial response, such as repairing failed levees. Better project planning may have prevented these problems, helping to avoid the expense of remedial actions.

2. **Recommendations**

- As part of its implementation strategy, the LTMS should determine how additional funding sources and increased funding can be established to help defray the extra costs associated with upland disposal. Funding sources could include creation of a regional reclamation district, institution of a permanent dredging mitigation fee, or a new state or federal funding assistance program.

- The Corps' laws, policies, and regulations should be changed to allow greater Corps sponsorship and funding for upland disposal and beneficial use options.

- Sponsors of upland disposal projects should carefully plan all elements of the project to reduce the risk of events and circumstances occurring that can increase the cost of upland disposal.

Contaminants

1. **Conclusions.** Dredged material disposal in any environment, whether in the Bay, the ocean, or at an upland location, can increase the risks that contaminants buried with or bound to the dredged sediments may be released with potentially harmful effect. Because Bay disposal sites were selected partly because they are highly dispersive, disposing dredged material at Bay sites increases the chance that contaminants in the material will become biologically available and widely dispersed through the estuary. These risks appear to be of less concern for upland disposal where the contaminants in the dredged

material can be managed and contained. Nonetheless, because there is limited information about the relative risk of contaminant exposure with the various disposal options, fear of contaminant risks is an issue that will accompany any disposal option.

Bay sediments range from being virtually free of contaminants to sediments containing higher levels of certain chemicals. The clean sediments proposed for many upland uses pose few environmental risks; most of the concern and research has focused on the handling of sediments containing elevated levels of contaminants. While there is good understanding of the processes that restrict contaminant mobility and biological availability, management practices similar to those that have proven effective for containing contaminants in other environments are still under development in this region for some of the proposed upland uses (such as containment under marsh restoration projects). As a result, there has been some concern that upland disposal and use of dredged materials will release contaminants into the environment, a concern that arises from: (1) a lack of experience in the region in managing contaminants for some proposed upland uses; (2) the difficulty in drawing general conclusions regarding the contaminant risks of upland disposal because these risks are determined by numerous project-specific factors including sediment characteristics, contaminant levels, and the characteristics of individual disposal sites; (3) the visibility of most upland uses contrasted with the largely unseen effects of aquatic disposal; and (4) the fact that testing standards and protocols for materials disposed upland are relatively new.

To help evaluate the environmental risks of using sediments containing contaminants, the Regional Board, as part of the LTMS, has reviewed existing literature and current research and has sponsored studies on the levels and toxicities of contaminants in Bay sediments and the possible accumulation of contaminants in living tissue. The results of these studies have led to the development of screening criteria and testing requirements for sediments proposed for upland uses; other LTMS studies are addressing improved testing procedures. However, further work needs to be done to better define safe contaminant levels and the best methods to prevent potential contaminant effects associated with some of the proposed upland disposal options.

Some aspects of upland disposal, such as the amount of material placed, description of disposal operations, and sediment characterization, are best monitored and documented by dredgers. However, for Bay and ocean disposal, long-term site evaluation of possible contaminant effects on water quality, bio-accumulation, off-site impacts, and impacts on fish and wildlife resources have been mainly the responsibility of state and federal programs. The Corps regularly surveys the primary Bay disposal site at Alcatraz; significant monitoring is proposed at the ocean site to be designated in 1994. It is reasonable to expect the same level of federal participation in funding and monitoring all disposal options, including upland disposal. Additional funding could come from dredger contributions to a Bay-wide monitoring program involving intensive, long-term monitoring of aquatic and upland disposal.

2. **Recommendations**

- The LTMS should actively promote research regarding contaminant effects at Bay Area universities and colleges and at federal research agencies, such as U.S. Geological Survey and the Corps Waterways Experiment Station. Grant applications for conducting needed research should be supported and the results of these research efforts widely disseminated. In addition, continuing work is needed to refine the testing procedures to make them shorter and more cost-effective. Efforts should continue to

improve technical knowledge and regulatory controls to ensure proper management of dredged materials used in upland disposal. It is essential that contaminant monitoring be an integral part of upland use projects and that the monitoring be conducted over an extended period of time so that long-term effects can be detected.

- Federal and state resource and water quality agencies should establish additional programs and guidelines for managing and monitoring contaminant effects from the disposal and beneficial use of dredged materials at upland sites.

- Sponsors of upland disposal projects should be required by state and federal regulatory agencies to contribute to project monitoring and the evaluation of sediment screening criteria, biological uptake of contaminants, and the methods used to reduce contaminant mobility and availability. Their level of contribution should be the same as required of project sponsors for other disposal alternatives.

- The State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Resource Control Boards, the California Environmental Protection Agency, and the U.S. Environmental Protection Agency should undertake further studies to more comprehensively determine: (1) safe levels of different contaminants commonly found in Bay dredged materials for different upland disposal alternatives; (2) the general dispersion of contaminants from upland disposal through the Bay-Delta ecosystem; and (3) the accumulation of contaminants in the tissues of Bay and Delta aquatic organisms.

Impacts of Habitat Conversion

1. **Conclusions.** Using dredged sediments to elevate subsided land to restore or enhance tidal, seasonal, or managed marshlands can result in the conversion of existing habitats, particularly seasonal wetlands.

Most of the projects where dredged materials are proposed for use in marsh restoration involve placing dredged materials in subsided, diked historic baylands to accelerate the restoration of these lands to tidal wetlands. These diked baylands consist of over 80 square miles of diked land that historically were part of the Bay and were either tidal marsh or mudflats. These areas represent the best opportunity for enlarging the Bay and restoring lost natural resource values. However, the seasonal wetlands which have formed on portions of these areas may serve as important habitat for Bay species, particularly for shorebirds and migratory waterfowl. Restoring tidal action to these lands usually converts these seasonal wetlands to tidal wetlands, although dredged materials can also be used to create seasonal wetlands and at least one proposed project has been designed to include seasonal wetlands within the area restored to tidal action. USFWS and some environmentalists believe that mitigation should be required for all seasonal wetland losses, including losses resulting from restoring lands that are currently diked and contain some seasonal wetlands. Other resource agencies believe that mitigation is inappropriate for projects that will result in substantial increases in wetland habitat, albeit of a different type.

A regional approach to enhancement of Bay resources, including determining optimum acreage and locations of different habitat types, will help ensure that the habitat needs of Bay Area wildlife will be met by optimally using available land. Ensuring that there is no time lag between the loss of a particular wetland habitat and its restoration elsewhere will be an important component of this regional wetland plan.

The LTMS upland studies are being augmented to provide an analysis of the functions and values provided by seasonal wetlands and information on the location of such wetlands. This information should help address the issue of habitat conversion and serve as a foundation for a regional wetland plan. In addition, EPA has sponsored an initiative to prepare a comprehensive resource plan for the North Bay diked baylands, including habitat goals, which involves interested federal and state agencies, property owners, and the public. BCDC has proposed to build on the foundation established by EPA by forming a partnership with North Bay local governments to prepare a North Bay Special Area Plan. The goal of the plan will be to ensure the protection and enhancement of North Bay wetlands and other natural resources while permitting appropriate development and upland disposal projects to occur in a more predictable and expeditious manner.

2. **Recommendation**

- Comprehensive management programs to protect, restore, and enhance Bay Area wetlands should be prepared and adopted jointly by federal and state resource, water quality, and land use planning and regulatory agencies, and local governments. The first management program should be for the North Bay because most of the promising marsh restoration sites are located in this area.

Improved Government Coordination and Clear Policy Direction

1. **Conclusions**. Government actions, or in some cases inactions, can delay and jeopardize potential upland use projects.

Upland use projects are not readily addressed by existing regulatory programs, which contributes to delays and obstacles in implementing these projects. The experimental nature of some of the proposed uses creates further problems for regulatory review.

Most regulatory programs allow discretion in the interpretation of agency policy. To date, primarily because of uncertainties about the potential risks of contaminants in dredged materials and concerns about the impacts to existing wetland habitat at upland disposal sites, some regulatory agencies have interpreted their policies conservatively with regard to upland disposal. Although the environmental risks associated with Bay disposal are no better understood or more certain, regulatory agencies are often more willing to accept those risks and uncertainties because aquatic disposal represents the status quo. While there are no environmental benefits from Bay disposal, upland projects that restore wetlands and improve existing levees provide considerable benefits to wildlife and water quality. To address this inequity, the same level of information and the same risk assessment should be required of all disposal options. In addition, senior agency personnel need to actively work with their regulatory and environmental staffs in setting reasonable standards and criteria for evaluating upland projects involving the use of dredged material and in balancing the impacts of upland disposal with the impacts of continued Bay disposal.

Delays and postponement of upland projects have arisen, in part, from the following:

a. The Construction and Operations Division of the Corps' San Francisco District, which is responsible for carrying out the overwhelming majority of the dredging in the estuary, has only recently begun to coordinate its actions with LTMS. Because obtaining cost-sharing agreements, permits, leases,

and site preparation for most upland use projects requires considerable lead time, the Corps' Construction and Operations Division and other large dredging project proponents should notify LTMS at the very earliest project planning stages and continue to work with LTMS throughout the planning process so that dredging projects can be matched with suitable upland sites.

b. The Clean Water Act requires that the least environmentally damaging, practicable alternative be authorized for any given project. The Corps and EPA have interpreted this policy to mean that in implementing upland projects where dredged materials will be used beneficially, even for projects that will result in an environmental benefit, such as creating wetlands, the property which has the least existing environmental resource values at the time a project is proposed is the only one that can be authorized. This interpretation ignores the difficulty in determining a reasonable range of practicable alternatives and the problems in comparing sites where there is great disparity in the amount of information available (i.e., well-studied sites will almost always appear to have more resource values than sites only superficially surveyed). This interpretation further leads to the conclusion that to implement beneficial use projects, one must begin on the property that has the least environmental resource values at the time a project is proposed and move sequentially through the pool of alternatives in setting up new project sites. Such an approach could preclude achieving the objective of having many potential use sites available throughout the estuary at any given time to maximize the efficiency of upland use of dredged materials. In the case of wetland restoration projects, this approach ignores the regional benefits of implementing the proposed project. Senior agency personnel need to actively work with their regulatory and environmental staffs to review the Clean Water Act and determine if this interpretation is the most reasonable one; the Corps and EPA may wish to develop guidelines to clarify their position.

c. Local governments lack understanding of LTMS goals and how the accomplishment of those goals will benefit their community and the region. Most local governments have little experience and no expertise in dealing with dredged material for upland uses. As a result, they view upland use projects as creating additional obstacles to future dredging projects, creating safety hazards within their community, or removing agricultural lands from production. The LTMS program needs to involve local government as an active partner in upland use projects, and to be certain that relevant information, particularly on the risks associated with contaminants in dredged materials and ways to minimize those risks, is distributed to local government.

d. The length of time involved in obtaining permits and the uncertainty of the permit process have led to significant delays in implementing potential upland use projects. LTMS's goal of implementing a cooperative permitting framework for dredging permits should put particular emphasis on the permitting process for upland use. The ideal approach will be simple, quick and efficient, protective of the environment, consistent with the laws and policies of the agencies, acceptable to dredgers and the regulated public, and easy to implement. This should be readily achieved for routine maintenance projects, which constitute the great majority of dredging permits. The first component would involve adoption by the agencies of a single application form for Bay dredging and disposal permits. The second component would involve simultaneous processing of administrative dredging permits by the agencies, perhaps using an interagency "sediment management committee" composed of staff from the regulatory and resource agencies.

e. The Integrated Waste Management Board (IWMB) believes that dredged material rehandling facilities can be treated either as a landfill or as a transfer facility. If the site is considered a landfill,

then all the applicable requirements for landfills will likely be required by the local enforcement agency (usually the County Health Department), including double liners under the site, monitoring wells, etc. However, if the IWMB considers the facility a transfer facility for material that is being recycled, then the applicable standards will be far less rigorous. The difference in cost between these regulatory definitions may be millions of dollars. The Regional Boards face a similar choice. If they consider a rehandling facility a landfill, the requirements will be similar to those required by the IWMB. Alternatively, the Regional Board may regulate the facility as a land farming operation such as where composted sewage sludge from sewage treatment plants is applied to land as an alternative soil amendment and fertilizer for agriculture. Again, the difference in cost for project construction is likely to be millions of dollars. What is important is that the appropriate management practices be determined and specified commensurate with the environmental risks posed by the sediments to be handled at the facility.

2. **Recommendation**

- Existing government regulatory, construction, and environmental programs need to be modified to improve interagency coordination and cooperation. In addition, there must be clear comprehensive policy direction to promote upland use projects, not only to facilitate wetland habitat creation and enhancement, but to help solve the region-wide dredged material disposal problem.