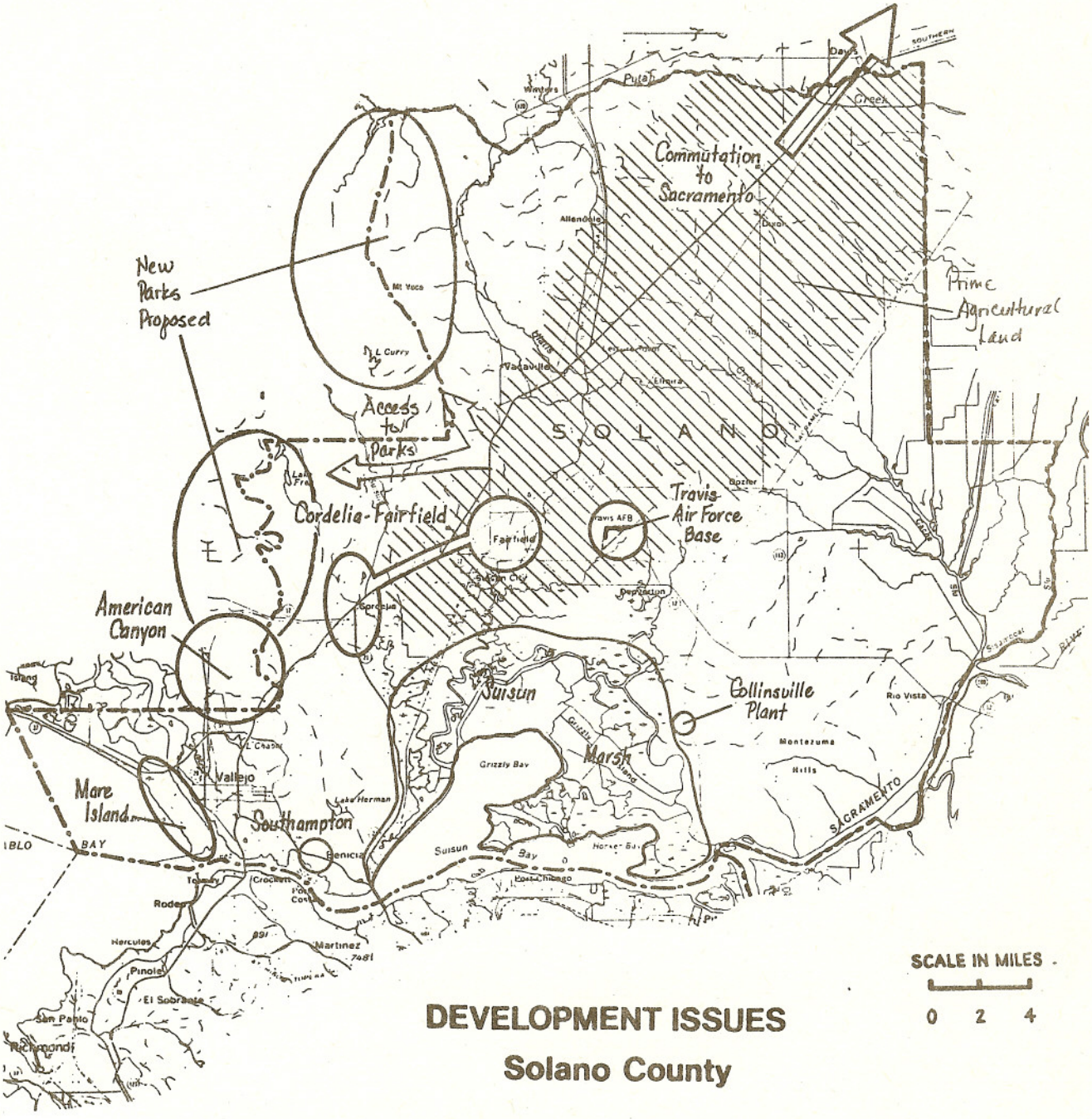

DEVELOPMENT ISSUES

Solano County

Source: ABAG. 1974. Regional Plan Review/Update Report.

2.826 b. South San Francisco - San Mateo. Oyster Point Marina in South San Francisco berths 287 boats and Coyote Point Harbor in San Mateo berths 485 boats. Both facilities have waiting lists for 200 more berths.

2.827 c. Redwood City Harbor. Recreational boating is an important land and water use in Redwood City, and is likely to become increasingly so. Three of the five existing marinas in San Mateo County are on Redwood Creek. Current berthing capacity in Redwood City is 590. A ramp at the municipal marina handles additional boaters. Waiting time for applicants for berthing space is up to eight years.

2.828 Two marinas are proposed for Redwood City on slough locations, and another two more nearby, at Belmont and Foster City. If all the proposed marinas were built, boating activities in the region would nearly triple. If all the projected needs by 1990 were met, the increase would be at least five-fold. Boating and water skiing is generally regarded as the highest of 12 categories of recreation needs in this area (this category does not include sailing or canoeing).

2.829 Redwood Creek recreational boating is dependent upon maintenance dredging. Any new marinas would require additional initial and maintenance dredging.

2.830 d. Palo Alto - Alviso. The Palo Alto Yacht Harbor has 201 berths completely filled and a waiting list of 50. Palo Alto Yacht Club berths 16 boats and Alviso Marina berths 39.

2.831 e. San Leandro Marina. This marina is strictly recreation oriented and is part of the 1800-acre Shoreline Recreation Area situated along the 4.5 mile bayfront of San Leandro. The marina includes 475 berths, two major restaurants, two yacht clubs, boat sales and repair establishments, family park and picnic areas, riding trails, a fishing pier, two public boat launching ramps, a separate 23 acre sail boat lagoon, and a nine hole golf course. The marina is being expanded to include 70 additional berths with the ultimate goal of a 500-berth marina.

2.832 Boats registered at the marina are from all parts of the Bay area, with most representing Alameda and Santa Clara counties. An average of 450 boats per month enter and leave the marina and another 225 boats per month are launched from the boat ramps. Sport fishing is popular from the pier as well as from the breakwaters protecting the marina. Angler usage is approximately 6,800 angler days per year with the principal catches being surfperches, sculpins, rays and small sharks. The parks, picnic areas, golf course and riding trails (used by bikers and horseback riders) are also popular.

2.833 f. Oakland Harbor. The federal channels were constructed for waterborne commerce but thousands of recreational boaters per year navigate the channels, particularly Oakland Inner. The Oakland estuary is well protected from most storms and is therefore ideal for small boat harbors and marinas. On the Alameda side there are seven marinas and on the Oakland waterfront there are thirteen. Together, the 20 marinas berth close to 3,000 recreational boats (Table II-88).

2.834 g. Emeryville - Berkeley. The Emeryville Marina berths 265 boats, and the Berkeley Marina, the largest marina in the Bay Area, berths 1,100 boats with a waiting list for 1,500 additional berths.

2.835 h. Richmond Harbor. Although the harbor is commercially oriented, there are nine recreational marinas and one public boat launching ramp in the area. The lauching ramp and two of the marinas are located around the Santa Fe Channel. These two marinas are the Channel Marina Yacht Club with 71 berths and the San Pablo Yacht Club with 48 berths. A third marina called the San Pablo Sportsman Club is located in the Inner Harbor Basin with 164 berths. Probably the largest and busiest marina is Decker's Richmond Yacht Club, situated at Point Richmond, with a berthing capacity for 260 boats. Two marinas are located in Outer Harbor and include Redrock Marina and Point San Pablo Yacht Harbor. Redrock Marina is situated at Castro Point, just beneath the Richmond-San Rafael Bridge, with a 150-berth facility. Point San Pablo Yacht Club has 170 berths and, as the name implies, is at Point San Pablo. Also located in Richmond Harbor are: Paradise Cay Yacht Harbor with 100 berths, Brickyard Cove Harbor with 250 berths, and Richmond Yacht Harbor with 54 berths.

2.836 Most of the marinas are filled to capacity with a waiting list, and a few anticipate future expansion. The majority of boats are recreational but a smaller number of party boats, commercial salmon and shrimp boats are permanently berthed in some of the marinas. In addition to the marinas there are at least two boat repair shops with boat launching ramps.

2.837 i. Angel Island. At Angel Island State Park there are berths for 40 boats.

2.838 j. San Rafael. Along the San Rafael Creek channel are approximately 1,000 berths and 1,050 boats. The Loch Lomond marina just outside the mouth of the creek is the largest, with 550 berths. The Marin Yacht Club has 109 berths; the Lowrie Yacht Harbor has 120 berths and may add 30 more along the face of the creek; the San Rafael Yacht Harbor has 140 berths; and the Marina Vista Improvement Club, a group of homeowners situated along a narrow channel off the mouth of the creek, has 27 berths. If it is assumed that each boat makes two trips per month, approximately 25,000 boat trips per year are made along the San Rafael Creek channel dredged by the Corps of Engineers. Just east of San Rafael Creek the Peacock Gap Club berths 40 boats.

2.839 k. Marinas along Sausalito waterfront. There are five yacht harbors along the Sausalito waterfront which berth a total of about 1,500 recreation boats: Marinship Yacht Harbor (adjacent to the pier previously used to berth Corps dredges and debris boats) with 450 berths; 300 berths at Sausalito Yacht Harbor; Clipper Yacht Harbor with 677 berths; and Kappa's Yacht Harbor with 300 berths (Plate I-17). The number of berths at Portofino Riviera Yacht Club has not yet been available to the Corps. The recreational boats operating from these yacht harbors do not require the 23-foot depth of the Corps channel. Seven new developments are proposed for the Sausalito waterfront. The total number of proposed berths is 323 in the Marinship area and 576 in the central waterfront area. Another proposed development, the Schoonmaker project, has been denied by the City of Sausalito (104).

2.840 1. Tiburon - Belvedere. The Corinthian Yacht Club berths 86 boats and the San Francisco Yacht Club berths 190.

2.841 m. Petaluma River. Recreational boating is sparse along the Petaluma River. There are 10-20 cruisers and 20-30 outboard, some of which may use the San Pablo Bay Section of the channel. Because of the lack of berthing facilities, pleasure boating activities are transitory and concentrated in the lower reach of the river. The Port Sonoma Development Project proposed by Shellmaker, Inc., would add three marinas totalling 440 berths at the mouth of the river. This development, which includes marina-related facilities, such as sewage pumpout depository, dry dock, restaurant, parking landscaping, offices and commercial buildings, dredge equipment storage and disposal area, would vastly increase recreational usage of the San Pablo Bay Section dredged by the Corps of Engineers. Shellmaker, Inc., has applied to the Corps for a permit to construct this facility.

2.842 n. Vallejo - Napa River. There are seven marinas in this area. Vallejo Municipal Marina, owned by the City of Vallejo, has 496 berths, with an estimated two trips per month per boat. This marina is planning to expand in the near future, doubling the number of berths. The Vallejo Yacht Club, a private organization adjacent to the Municipal Marina, has 118 berths - nearly all occupied by sailboats. This marina is more active, with an estimated three trips per month per boat. The Vallejo Boat Center has 24 berths, Glen Cove Marina has 68, and the Vallejo Launching Ramp has 12 overnight slips. These marinas do not depend on Corps dredging since the boats are shallow-draft vessels which do not require the 26- to 30- foot depths of the main channel through Mare Island Strait. Nelson's Fishing Resort on the Napa River has 15 berths and Napa Valley has 100.

2.843 o. Carquinez Strait. The Rodeo Marina, located along the southwest side of Carquinez Strait, berths 140 boats. Other marinas include Dowrelio's Boat Harbor at Crockett with 107 berths, Pierce Harbor and Reel Inn at Benicia with 50 berths, Sam's Harbor Restaurant, also at Benicia with 8 berths, and the Martinez Marina with 232 berths.

2.844 p. Suisun City. Four marinas are located here, at the head of Suisun Slough: Paul's Boat Harbor with 22 berths, Suisun Pacific Marina with 200 berths, Solano Yacht Club with 26 berths, and Suisun City Public Fishing with 6 berths.

2.845 q. Pittsburg. McAvoy Yacht Harbor in southeastern Suisun Bay has 200 berths, Harris Yacht Harbor also has 200, and Pittsburg Marina has 190 berths.

2.846 r. Horseshoe Cove. This facility is reserved for use by the Sixth Army. The Fort Baker Yacht Club located at the Cove operates 47 recreational boats with maximum drafts of seven feet and a party fishing boat. Expansion to accommodate an additional 10 to 20 boats is being planned. No public boats are berthed in Horseshoe Cove but transients are allowed to put in during inclement weather.

2.847 s. Individual berths. In addition to the marinas discussed above, there are numerous individual boat docks throughout the Bay Area, particularly in the Richardson Bay - Corte Madera Creek area. No accurate statistics have been compiled on these individual docks.

2.848 t. Other Water Sports. Sportfishing and waterfowl hunting are also popular in the Bay Area. Striped bass and salmon are caught in the Central Bay, San Pablo Bay and Suisun Bay. Waterfowl hunting is most popular in the Suisun Marsh. Swimming is once again becoming popular. In the early 1960's levels of coliform bacteria were higher in most areas of the Bay than those permitted by public health authorities for water contact sports. More recent surveys by the Department of Public Health show an improvement in coliform levels especially in the area from the San Mateo Bridge to the Mare Island Breakwater where bathing standards are now generally being met (28).

2.849 10. Scenic Resources. Perhaps the most intangible value of the Bay is its scenic beauty. The Bay acts as a unifying element linking the rugged Marin headlands with the cityscape of San Francisco by means of the Golden Gate Bridge, thence to the East Bay cities by means of the Bay Bridge. North and south, the Richmond-San Rafael and San Mateo Bridges cross the wide expanse of the Bay. Tourists and residents alike find their lives enriched by the pleasures of viewing the waters. The many moods of the Bay, and its psychological impact on those who view it, have often been

written about. Though difficult to measure, it is estimated that a Bay view adds 8 to 10 percent to the value of buildings in San Francisco. Appreciation of the Bay as a major scenic resource is an extremely important element in planning for its future. The physical qualities of the Bay are described in greater detail under Physical Characteristics.

TABLE II-88

MARINAS IN SAN FRANCISCO BAY AREA

Location	Name	No. of Berths
San Francisco	San Francisco Small Craft Harbor	723
San Francisco	Mission Rock Boat Center	33
San Francisco	Fisherman's Wharf	198
South SF	Oyster Point Marina	287
San Mateo	Coyote Point Harbor	485
Redwood City	Dock Town	112
Redwood City	Redwood Municipal Marina	200
Redwood City	Pete's Harbor	295
Palo Alto	Palo Alto Yacht Club	16
Palo Alto	Palo Alto Yacht Harbor	201
Alviso	Alviso Marina	39
San Leandro	San Leandro Marina	475
Alameda	Ballena Bay	495
Alameda	Alameda Marina	483
Alameda	Red Sails	15
Alameda	Alameda Yacht Harbor	385
Alameda	Pacific Marina	206
Alameda	John Beery Co.	400
Alameda	Encinal Yacht Club	50
Oakland	Oakland Marina	120
Oakland	Oakland Yacht Club	112
Oakland	Seabreeze Yacht Center	75
Oakland	Jack London Marina	220
Oakland	Sailboats, Inc.	105
Oakland	Lani Kai Harbor	67
Oakland	Barnhill Marina	no data
Oakland	Embarcadero Cove	no data
Oakland	Fifth Avenue Marina	no data
Oakland	Westwind Basin	no data
Oakland	Portobello Marina	60
Oakland	Evans Radio Dock	60
Oakland	Aeolian Yacht Club	39
Emeryville	Emeryville Marina	265
Berkeley	Berkeley Marina	1100
Richmond	Decker's Yacht Harbor	260
Richmond	Channel Marina Yacht Club	71
Richmond	Redrock Marina	150
Richmond	Point San Pablo Yacht Harbor	170
Richmond	San Pablo Sportsman Club	164
Richmond	Paradise Cay Yacht Harbor	100
Richmond	Brickyard Cove Harbor	250
Richmond	Richmond Yacht Harbor	54
Richmond	San Pablo Yacht Club	48

TABLE II-88 (Cont'd)

Location	Name	No. of Berths
Angel Island	Angel Island State Park	40
San Rafael	Loch Lomond Marina	550
San Rafael	Lowrie Yacht Harbor	120
San Rafael	Marin Yacht Club	109
San Rafael	Peacock Gap Club	40
San Rafael	San Rafael Yacht Harbor	140
San Rafael	Marina Vista Improvement Club	27
Sausalito	Sausalito Yacht Harbor	450
Sausalito	Kappa's Yacht Harbor	300
Sausalito	Marinship Yacht Harbor	96
Sausalito	Clipper Yacht Harbor	677
Sausalito	Portofino Riviera Yacht Club	no data
Tiburon	Corinthian Yacht Club	86
Belvedere	San Francisco Yacht Club	190
Rodeo	Rodeo Marina	140
Vallejo	Vallejo Municipal Marina	496
Vallejo	Vallejo Yacht Club	118
Vallejo	Vallejo Boat Center	24
Vallejo	Glen Cove Marina	68
Vallejo	Vallejo Launching Ramp	12
Napa River	Nelson's Fishing Resort	15
Napa	Napa Valley Marina	100
Crockett	Dowrelio's Boat Harbor	107
Benicia	Pierce Harbor & Reel Inn	50
Benicia	Sam's Harbor Restaurant	8
Martinez	Martinez Marina	232
Suisun City	Paul's Boat Harbor	22
Suisun City	Suisun City Public Fishing	6
Suisun City	Suisun Pacific Marina	200
Suisun City	Solano Yacht Club	26
Pittsburg	McAvoy Yacht Harbor	200
Pittsburg	Harris Yacht Harbor	200
Pittsburg	Pittsburg Marina	190
Horseshoe Cove	Fort Baker Yacht Club	47
TOTAL		13,674

Sources:

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Relationship of Maintenance Dredging & Disposal to Land & Water Use Plans

III

SECTION III

RELATIONSHIP OF MAINTENANCE DREDGING AND DISPOSAL TO LAND AND WATER USE PLANS

A. INTRODUCTION

3.001 The twenty maintenance dredging projects and permit activities discussed in the Composite Environmental Statement are closely linked to port development plans. The long-range development plans are discussed in detail on the following pages in order to explore the vital role which dredging plays in the future of the complicated, interwoven Bay Area port system. Several of the projects are also vital to water-oriented recreation. Disposal of dredged material is discussed in relationship to land use plans and water use controls.

B. COMPATIBILITY OF DREDGING AND PORT DEVELOPMENT.

3.002 1. ABAG Regional Plan. The Association of Bay Area Governments (ABAG) is a voluntary council of local governments formed to meet regional problems by cooperative action of cities and counties. All 92 cities and 9 counties in the San Francisco Bay Area can be voting members. Currently 84 cities and 7 counties are members. ABAG works toward solution of regional problems and it is the area-wide comprehensive planning agency for the Bay region.

3.003 ABAG's Regional Plan 1970:1990 provides guidelines to encourage actions by local agencies (8). It is based on the concept of a "City-Centered Region," a system of dense urban communities surrounded by predominantly open space. The advantages of this concept are a reduction in commuting time and transportation requirements, and the preservation of open space for wildlife, recreation, and more orderly future development. The Regional Plan reflects an increasing awareness of the value of the natural environment, and the growing realization that suburban sprawl is a wasteful use of land, energy, and other natural resources.

3.004 Within the City-Centered Region, urban growth would occur "by infilling or as an orderly extension of existing development" and densities would be "highest near major transportation interchange points." Maintenance dredging of existing navigation channels is in conformance with these guidelines. Recent surveys have shown that virtually every type of economic activity is represented in the port areas of the Bay. By supporting navigation commerce at the existing ports of San Francisco, Oakland, Richmond, Redwood City, Stockton, Sacramento, and Navy facilities, maintenance dredging indirectly supports economic growth at the existing urban centers where these port facilities are located.

3.005 2. BCDC Bay Plan. The San Francisco Bay Conservation and Development Commission (BCDC) was created by the McAteer-Petris Act in 1965. The Commission consists of 27 members representing two Federal and five State agencies, nine Bay Area counties, four cities, and seven public representatives. The Commission was created as a limited regional governmental agency specifically authorized and directed to carry out the Bay Plan, and empowered to raise sufficient funds for this purpose.

3.006 The San Francisco Bay Plan has been in effect since 20 September 1968, the date of its approval by BCDC (152). The Bay Plan was adopted into law on 7 August 1969, when the Governor signed the McAteer-Petris Act. Operating under the McAteer-Petris Act and the Bay Plan, BCDC has been generally regarded as an example of a successful regional planning agency with adequate regulatory powers. The objectives of the Bay Plan are to protect the Bay as a great natural resource for the benefit of present and future generations and to develop the Bay and its shoreline to their highest potential with a minimum of Bay filling. With regard to port development, major plan proposals are:

a. Port expansion should be planned for Benicia, Oakland, Redwood City, Richmond, and San Francisco.

b. Major shipping channels should be deepened from the Golden Gate to the Delta, and to Oakland, Redwood City, Richmond, and San Francisco.

c. Waterfront land now used by industries that require access to deepwater shipping should be continued in this use, and sufficient additional waterfront acreage should be reserved for future water-related industry.

3.007 In addition, substantial redevelopment is suggested for existing facilities at Alameda, Oakland and San Francisco, and possible new shallow-draft terminals near Napa, Petaluma, and San Jose. However, to avoid unnecessary landfills in the Bay and promote efficient port financing, the Bay Plan opposes unnecessary duplication of facilities by competing ports. Corps maintenance dredging appears to be in complete conformance with these general plan proposals for port development.

3.008 The BCDC Bay Plan Supplement proposes shipping channels of up to 45-foot depth in the Bay, thus further recognizing the vital role of shipping in the Bay Area (153).

3.009 Under grants, the Federal ownership and control of Bayside lands last only as long as the military installation is maintained; upon abandonment of the military installation, the tidal and submerged lands revert automatically to the State. The majority of Bay lands owned by the State are administered by the State Lands Commission, though some small parcels are under jurisdiction of the State Department of Beaches and Parks, State Department of Fish and Game, and the State Division and Highways. The policy of BCDC directed toward Federal installations and properties is to treat them as if they were subject to State jurisdiction (though not legally subject to State laws or local ordinances, it has been Federal policy to conform, if the State and local regulations do not unduly interfere with national objectives) (153).

3.010 The BCDC San Francisco Bay Plan and its supplement do not propose to develop areas around San Francisco Bay without the sanction of local governments. The policies of BCDC as stated in the San Francisco Bay Plan and its supplement are inclusive of the land use proposals of many local planning agencies. In addition, BCDC has adopted in April 1975 a Special Area Plan, No. 1, which sets specific guidelines for future permits along the San Francisco Waterfront.

3.011 3. Port of San Francisco. The Master Plan of the San Francisco Port Commission, as described in their Resolution No. 74-3 dated 13 March 1974, calls for intensive development of the Islais Creek area where the Corps maintenance dredging project is located (156). Piers 80 and 86 will continue to be modernized. Piers 84 and 88 are reserved for future LASH, ocean barge, and other maritime uses. Piers 94, 96 and 98 will be developed for LASH and containerized cargo operations. All these developments are partially dependent on Corps maintenance dredging and are shown on Plate I-4. (Development of Piers 94 and 98 is described in greater detail under Port and Terminal Characteristics.) The general intent of the Port of San Francisco is to shift most shipping to south of the Bay Bridge, reserving the waterfront north of the bridge for tourist-oriented commercial development.

3.012 4. Port of Oakland. The latest land use plan for the Port of Oakland was prepared by Wilsey and Ham in February 1968 (260). The plan proposes filling 450 acres in the Bay north of the Bay Bridge (just west of Emeryville) to construct a "North Harbor" containerized cargo terminal; major reconstruction of the existing Outer Harbor terminals to accommodate containerized cargo; reconstruction of the existing Grove and Market Street Terminals to accommodate combined general and containerized cargo; filling of Clinton Basin at the Ninth Avenue terminal to provide a containership facility; a major distribution center near the Oakland Airport; and recreational access to the water such as pier fishing and promenading, restaurants and marinas, and preservation of the general character of San Leandro Bay's shoreline for recreation-related uses.

3.013 Since the plan was prepared seven years ago, major changes have occurred. The Port is proceeding with other alternatives for developing additional marine terminal capacity before pursuing a North Harbor project. Most of the Outer Harbor terminals now accommodate containerized cargo and reconstruction is still planned for 60 acres of Berths 1, 2 and 3, to be called the Outer Harbor Container Terminal. The Port would have an interest in the Naval Supply Center property if it ever became surplus. At the present time, however, this does not seem to be likely.

Reconstruction is still planned for the Grove Street and Ninth Avenue Terminals to accommodate containerized cargo. A distribution center now exists on Seventh Street at the nexus of the Outer Harbor container terminals. With regard to recreational access, a pier and promenade area has recently been constructed in the Inner Harbor south of Jack London Square.

3.014 The Port of Oakland plans to expand, renovate and modernize to accommodate the increasing volume of containerized cargo. Since San Leandro Bay and the Emeryville mudflats must be preserved, the Port can only expand in the Inner Harbor. Like almost all public marine terminals throughout the country, the container-ship terminals planned for this area at Grove and Market Streets would be dependent on continued maintenance dredging by the Corps in both the Inner and Outer Harbors and may eventually require an increase in the channel depth to 40 feet. Corps dredging is therefore at the cornerstone of the Port of Oakland's operations.

3.015 The Oakland Policy Plan by the City of Oakland (125) emphasizes an industrial belt extending along the entire length of the Inner and Outer Harbors (with the exception of Jack London Square) and therefore supports planned expansion by the Port of Oakland and - indirectly - continued maintenance dredging by the Corps of Engineers.

3.016 5. City of Alameda. A Comprehensive General Plan - 1990 was prepared for the City of Alameda and adopted by the City Council in 1969 (42). The General Plan states that although expansion will probably occur at the Todd Shipyard repair facility, general cargo shipping by deep-draft vessels at Alameda will decrease because "the physical limitations of the Estuary will preclude their docking at Alameda's wharves." A more important physical limitation not mentioned in the General Plan is the fact that Alameda is an island with limited access to the mainland, which puts it at a competitive disadvantage with the Port of Oakland. A further competitive disadvantage is Alameda's weaker financial position as a privately owned port. It "does not enjoy the tax-free status and greater bonding capacity of public agencies such as the Port of Oakland." Due to these disadvantages, the General Plan recommends "Reduction of industrial land use along the Estuary." There are no known plans for immediate development of navigation facilities nor are there any known potential facilities to be constructed on the Alameda waterfront. No mention is made of Corps maintenance dredging in the General Plan.

3.017 6. Port of Richmond. The Richmond Coastline Plan was adopted by the City Council and added to the Richmond General Plan in March 1973 (143). Major proposals for port development are:

a. expand, modernize and renovate existing port facilities;

b. encourage shipping firms to utilize local terminals;

c. develop a container port facility on 150 acres of land to the west of the Inner Harbor Basin;

d. designate 50 acres of land adjacent to the container facility for port-related activities;

e. designate an additional 30 acres of nearby land for industrial activity;

f. designate 170 acres as a land bank for interim development compatible with nearby port-related activities (the proposed development would have a residential density of approximately 30 units per acre in the areas around the Inner Harbor Basin) (144);

g. continue utilizing Shipyard 3 for ship repairs;

h. reserve segments of the shoreline for marine terminal use, specifically, Point Potrero, Point Richmond Terminal No. 1, Ferry Point (Santa Fe), Point Orient, and Point San Pablo;

i. urge that a channel be dredged across Southampton Shoal; and

j. discourage scattered development of industry.

3.018 Perhaps the single most important proposal above is the 150-acre, four-berth container port facility. A detailed report on this proposed facility was written in 1974 by Bechtel Incorporated for the City of Richmond (14). The project is still in the planning stage. It would be built in a "blighted" and "underdeveloped" area already zoned for industrial use. Deep-draft container ships using the proposed port would require the entire 35-foot authorized depth of the Inner Harbor Channel.

3.019 The proposals of the Richmond Coastline Plan also allow for continued use of all existing port facilities in both the inner and outer harbors. Maintenance dredging is in full accord with this guideline.

3.020 7. City of Petaluma. Since maintenance dredging for the Petaluma River has been scheduled for 1975, a separate environmental statement has been prepared and was released in August 1975. As mentioned in the environmental statement, the Petaluma Area General Plan proposes to confine urban development to the area around the upper limit of the Petaluma River. Any expansion would be located away from the river, saving as much open space southeast of the city as possible. The maintenance dredging will maintain the river as a usable waterway for planned recreational boating, existing and future industrial water transportation needs and does not conflict with Petaluma's land use plan.

3.021 8. The Larkspur Ferry Terminal. The transit plan presented by the Golden Gate Bridge, Highway and Transportation District is expected to substantially increase the mobility of the general public in the Golden Gate Corridor (272) and is separate from Corps dredging. However, a permit application will be required from BCDC and the Corps. There is no relationship between the Corps maintenance dredging operations and this transit plan except for the relative proximity of three projects: San Rafael Creek, Sausalito baseyard operations and Horseshoe Cove.

3.022 9. Port of Redwood City. In August 1974 the Development Program for the Port of Redwood City was prepared by consultants Williams-Kuebelbeck and Associates (W-KA) for the Board of Port Commissioners and City Council (259). The program was approved in concept by the City and the Port in September 1974. W-KA analyzed the port's present status and proposed a series of definite steps the port should take to stop its decline and recapture much of the cargo volume it has recently lost, at the same time placing itself back on a sound financial basis. The steps would result in the following developments:

a. acquisition of adjacent Leslie salt ponds for general industrial development;

b. Ideal Cement property reserved for future shipping and warehousing;

c. acquisition of Leslie salt property under and around the salt pile for development of a bulk cargo terminal;

d. new port offices, a restaurant and retail shops, and marina expansion;

e. two wildlife habitat areas with public access;

f. a commuter ferry service to San Francisco; and

g. potential seafood production as an alternate use of the salt ponds.

3.023 Corps maintenance dredging of the main channel in Redwood City Harbor appears to be in conformance with the W-KA plan.

3.024 The City of Redwood City strongly supports development of the port area, but wishes to reserve the maximum possible land for open space and recreation. The Waterfront Development Plan, prepared by the city's Planning Department in April 1974, states "The Port of Redwood City has been and will continue to be a major asset to the rest of the city" (142). The city plan follows essentially the same land use arrangement as the port's W-KA plan, and in fact allows a portion of Bair Island for port industrial use, even though W-KA makes no recommendation for use of this marsh area. However, the city plan reserves virtually all salt ponds for open space, whereas W-KA recommends most of the ponds for industrial development. Corps maintenance dredging is apparently in conformance with the general intent of both the city plan and port plan.

3.025 10. Port of Stockton. All available deepwater frontage lands at the Port of Stockton have already been utilized for wharves and piers. However, the Port hopes to upgrade its container wharf and renovate its bulk material wharf. Since it is an inland port, Stockton is heavily dependent on Corps maintenance dredging in the Bay Area.

3.026 Stockton is an industrial city. In its General Plan Report No. 3, the city planning department reserves over 8000 acres for industrial use, or 19 percent of the city's total developed area (187). This is nearly twice the percentage of land reserved for industry when compared with similar-sized cities. Although the General Plan Report indicates sufficient data is not available to determine port needs, it reserves a large block of land for industry adjacent to the port, which suggests that shipping is vital to the city's welfare. It should be noted, however, that industry is not entirely favored. The General Plan Report also reserves area for four parks along the Stockton Deepwater Channel.

3.027 11. Port of Sacramento. Three new wharves are being considered as part of the Port's long-range plan but would not be constructed unless warranted by increased commerce. Similar to the Port of Stockton, the Port of Sacramento as an inland port is heavily dependent on Corps maintenance dredging.

3.028 The Preliminary 1974 General Plan for Sacramento (150), prepared by the City Planning Department, closely resembles the policies of ABAG by discouraging sprawl along the urban fringe and supporting an orderly extension of existing urban centers.

Nearly 7000 acres are reserved for industrial use, with a large block of industrial land completely surrounding the Port of Sacramento. The entire port area is zoned as a major public/ quasi-public transportation facility, and thus is in conformance with continued ship channel maintenance.

3.029 12. City of Sonoma. Sonoma does not have a deep water port. No indications of facilities for a deep water port are given in the general plan as a future proposal. Industrial policies of the General Plan, City of Sonoma, adopted in 1974 (286) indicate that general development should be guided towards an "industrial park" setting in the southeastern part of Sonoma's general plan.

3.030 13. City of Martinez. The Martinez General Plan (109), prepared by the city planning commission, favors orderly expansion of the petroleum refining and related industries, consistent with conservation of natural resources, and thus indirectly supports maintenance of petroleum shipping channels.

3.031 14. City of Antioch. The Antioch General Plan (3), prepared by the city planning department, allocates over 2000 acres for industrial use, but proposes riverfront or natural feature industrial areas be planned with consideration to public use and enjoyment and maintain high environmental quality.

3.032 15. City of Benicia. The most recent plan organized for the Benicia area is the Benicia Waterfront Plan and Amendment to the Comprehensive Plan (297). In this waterfront plan, the area zoned for industry is relocated eastward to East Fifth Street. This area unzoned from industrial use has been designated for water-related commercial and recreational activities to act as a buffer area between the industrial and residential characters of the waterfront.

3.033 16. City of Vallejo. The City of Vallejo has undertaken several steps toward redeveloping the waterfront area of Mare Island Strait. The General Plan has set guidelines in conformance with land use designations of both ABAG's Regional Plan and BCDC's Bay Plan. The Plan Map of Vallejo's General Plan (298) designates an area fronting Mare Island Strait to the south as an "Employment Center." This same area is designated "water-related industrial use" in BCDC's Bay Plan. The text of Vallejo's General Plan indicates that the industrial use of the area is "Vallejo's principal opportunity for deep water-related industry" (298).

3.034 17. Solano County. The County General Plan has been developed by individual planning areas. No specific area in the County is planning development of port facilities. However, the

policies of the Southeast Planning Area clearly stipulate that harbor facilities are to be encouraged with emphasis on provisions for year-round employment that does not adversely affect the environment (271). A major portion of Solano County consists of Suisun Marsh and related open space. This marsh area is to be maintained as governed by the Suisun Marsh Protection Act of 1974. Although industrial growth is planned (north of the Collinsville area), this development is to be limited due to its proximity to the Suisun Marsh. The areas to the east of Collinsville Harbor are suitable for those industrial activities dependent upon the Sacramento deep water channel for their products.

3.035 18. Contra Costa County. The county is preparing a new general plan to be published in late 1975; however, the original Land Use and Circulation Plan (39) prepared in 1963 is still considered intact. The 1963 plan states, "Contra Costa County has yet to realize its potential as an industrial area" and proposes "Numerous industrial areas...all well located on waterway, railroads or major highways." At the time the plan was prepared, the total area available for industry was approximately 32,000 acres or over two and one half times the area being used at that time. Generally speaking, Contra Costa County continues to support port development and thus maintenance dredging.

3.036 In general, maintenance dredging of shipping channels is compatible with, and in fact is essential to, port development plans in the Bay Area.

C. COMPATIBILITY OF DREDGING AND WATER-ORIENTED RECREATION PLANS

3.037 1. General. Although the master or general plan of each governing body in the Bay Area contains a recreation element, recreational boating is generally not affected by dredging, with the exceptions of San Rafael Creek and San Leandro Marina, described below.

3.038 2. San Rafael Creek. The City of San Rafael is currently preparing a redevelopment plan. Although the final plan has not yet been published, it may reasonably be expected that the plan will support the existing marinas along San Rafael Creek and thus will be in conformance with maintenance dredging of the creek. The recently prepared San Rafael General Plan proposes long-term use of the Canal (San Rafael Creek) as a "predominantly water-oriented recreational or open space use area" (160).

3.039 3. San Leandro Marina. The General Plan 1990 (158), prepared by the City of San Leandro, designates the entire waterfront area within city limits for recreation, including the marina, and thus supports continued maintenance dredging in that area.

3.040 Additional recreational areas are proposed in the vicinity of Corps dredging projects. The General Plan for Sausalito proposes use of the Sausalito Base Yard for recreation if the Corps declares its property as surplus (163). BCDC's Bay Plan similarly proposes use of Point Molate for recreation should the Navy declare its property surplus.

D. COMPATIBILITY OF LAND DISPOSAL AND LOCAL LAND USE PLANS

1. Proposed Land Sites

3.041 a. San Rafael. The land disposal site for this dredging project has not yet been determined. The redevelopment plan currently being prepared by the City of San Rafael will determine land use priorities in this area when it is published. The preliminary version of the plan proposes improvement of the canal for increased capacity (161). The recently prepared San Rafael General Plan, as mentioned above, proposes long-term use of the Canal as a "predominantly water-oriented recreational or open space use area" (160).

3.042 b. San Leandro. The disposal site for this dredging project also has not yet been identified, but may be along the nearby shoreline. The General Plan 1990 (158), prepared by the City of San Leandro, reserves all shoreline area within city limits for recreation, including four proposed golf courses and a park, which have not yet been constructed. Shoreline disposal is not expected to conflict with these plans.

3.043 c. Redwood City. The four potential disposal sites in this area are shown on Plate I-15. Sites 1, 2, and 3 and part of Site 4 are reserved for industrial use by both the BCDC Bay Plan (152) and the Waterfront Development Plan of Redwood City (142). These plans would therefore appear to be in conformance with use of any of the four sites for dredge disposal.

3.044 In 1965, at the time that the McAteer-Petris Act (establishing BCDC) went into effect, Site 1 was cut off from tidal action by the levee on Corkscrew Slough. The subsequent dike breach and marshland reestablishment prompted BCDC in 1971 to propose redesignation of Port priority lands as "Tidal Marsh." It was agreed by both the Port and BCDC that the breach remain open, but that Port lands continue to be recognized as Port priority, and that a proposed dike be built inside the boundaries of the old dike to protect this designation.

3.045 The Development Program for the Port of Redwood City (259), prepared for the Port by Williams-Kuebelbeck and Associates, Inc., designates Site 1 as "Future Port Expansion Area" which is not proposed for development within the time span of their 10-15 year implementation program. The area is considered "available for long-range expansion subject to road, rail and utility access." Site 2 has no designation and is not part of the development program. Site 3 is designated as a future bulk cargo terminal, and Site 4 is designated for general industrial use. Disposal of dredged material at Sites 3 or 4 would appear to be in conformance with this plan in providing a portion of the fill required for port development.

3.046 The San Francisco Bay National Wildlife Refuge is a plan developed by the U.S. Fish and Wildlife Service for acquisition of up to 23,000 acres in the South Bay for preservation as a wildlife refuge (242). Plate I-13 shows that the boundary of the proposed refuge borders Site 1, labeled as port project land. Due to the proximity of the proposed refuge, both the U.S. Fish and Wildlife Service (244) and the California Department of Fish and Game (57) have expressed concern over use of Site 1 for dredge disposal.

3.047 The San Mateo County General Plan for 1990 (159), is out of date with present land use plans, and the Redwood City General Plan (141) does not include the Port. ABAG's Regional Plan 1970:1990 (8), designates the four potential disposal sites and adjacent areas for "predominantly basic employment," and suggests that development be organized to serve all planned needs of the community.

2. Alternative Land Disposal Sites

3.048 a. Petaluma River Area (Site No. 8, Plate VI-4). The northern portion of Petaluma sub-area 1 is zoned for rural use by the Petaluma Area General Plan (100), and by the Sonoma County Interim General Plan (185). The southeast portion of sub-area 1 is reserved for water-related industry by BCDC's Bay Plan.

3.049 All of sub-area 2 is zoned for rural use by the Petaluma Area and Sonoma County plans mentioned above. Sonoma County has considered both the upper and lower parts of sub-area 2 in a draft flood plain zoning plan (184). It was proposed that the upper part be zoned "F-1" (Primary Flood Plain) and the lower part "F-2" (Secondary Flood Plain). "F-1" zones cannot be obstructed if the flood hazard will be increased by so doing; "F-2" areas are subject to flooding but are not required to carry off or store flood waters. These definitions would tend to allow the use of the lower site for fill disposal but not the upper. The proposed flood plain zoning has not been adopted as of this writing, however.

3.050 Sub-area 3 is reserved for urban open space by the Preliminary Marin Countywide Plan (108). The nearness of the site to U.S. 101 and the County Airport will affect ultimate land use and put a premium on close coordination with those responsible for land use planning in the area. BCDC's Bay Plan reserves portions of sub-area 3 as tidal marsh.

3.051 ABAG's Regional Plan 1970:1990 (8) designates sub-areas 1 and 2 as permanent open space and sub-area 3 as predominantly residential space.

3.052 The U.S. Fish and Wildlife Service does not consider any of the Petaluma area sites suitable for dredge disposal (181).

3.053 b. Montezuma Area (Site No. 12, Plate VI-5). Solano County has designated a portion of this site as agricultural, grazing and watershed land, with the remainder as industrial (183). Their plan notes the importance of this area as one of the few remaining areas along the river where water-related industry can be located. A recent State Senate Bill (#1981), known as the Suisun Marsh Preservation Act, has created a buffer zone around the marsh area of Montezuma. ABAG designates the site as urban developed or controlled open space land, while BCDC's Bay Plan shows the site potentially available to water-related industry. The U.S. Fish and Wildlife Service feels that disposing at Montezuma would pose major impacts on the high wildlife value of this area, and that area below MHHW could be readily restored to tidal action (181). The joint owners of this property are the Southern Pacific Railway Company and the National Steel Corporation.

3.054 c. Sherman Island (Site No. 13, Plate VI-5). BCDC and ABAG have no jurisdiction in this area. The Sacramento County Comprehensive Zoning Plan classifies Sherman Island as AG-20 and AG-80 (agricultural). There do not appear to be any administrative constraints to the use of the island for disposal of dredged material.

3.055 In general, land disposal is not in conflict with local plans but is objected to by State and Federal agencies due to possible loss of valuable wildlife habitat. For further details, refer to Alternative Land Disposal Sites in Section VI.

E. COMPATIBILITY OF AQUATIC DISPOSAL AND WATER USE CONTROLS

3.056 In 1971, the Environmental Protection Agency (EPA) first established national guidelines to regulate the disposal of dredged sediments based on bulk sediment analysis. The criteria were entitled "Criteria for Determining Acceptability of Dredge Spoil Disposal to the Nation's Waters," which were a first attempt to regulate indiscriminate dumping of all dredged material on a national scale.

3.057 Although type of sediments disposed of was being regulated by the above criteria, the locations for aquatic disposal were not. In 1972, Region IX of EPA, in cooperation with the U.S. Army Corps of Engineers, promulgated standard aquatic disposal sites for dredged material in San Francisco Bay. Corps Public Notice No. 72-61 in May 1972 discussed five aquatic sites west of Carquinez Straits which were to be used for all open water disposal of dredged material in the Bay. These five sites were subsequently reduced to three, and in 1973, the 100-fathom ocean site south of the Farallones was added. Plate I-2 shows the presently used aquatic sites.

3.058 The 1971 criteria were radically modified by the Ocean Dumping regulation of 1973 (pursuant to the Marine Protection, Research and Sanctuaries Act of 1972) which governed dredge disposal into the territorial sea and applied to inshore, navigable waters. The 1973 regulation defined polluted sediments based on three conditions: (1) the type of sediment, such as silts and clay versus sand; (2) adequacy of water quality at the dredge site based on State water quality standards and general health of the biota associated with the sediments; and (3) a standard elutriate test in which the concentration of contaminants exceeded 1.5 times the concentration of the same contaminants in the water at the disposal site. Bulk sediment analysis was not included in the 1973 regulation.

3.059 On 6 May 1975, the proposed guidelines for discharge of dredged sediments in navigable waters, pursuant to Section 404 of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) were issued in the Federal Register. Determination of whether sediment testing is required or not was established. Conditions not requiring laboratory analysis are: (1) dredge volume less than 500 cubic yards; (2) materials at least 80 percent sand and/or gravel; and (3) that the District Engineer and the Regional EPA agree that (a) material is substantially the same as the substrate at the disposal site, (b) dredge site sufficiently removed from sources of pollution such that the material is not considered contaminated, and (c) discharge is in such a manner that is not damaging to the environment outside the disposal site.

3.060 On 5 September 1975, revised guidelines for the discharge of dredged or fill material were issued in the Federal Register. The guidelines do not specify tests or numerical limits on any parameters. The guidelines serve as the basis for the District Engineer making an ecological evaluation. The format for the evaluation is being developed.

3.061 If dredge and/or disposal conditions do not meet the requirements outlined above, laboratory analysis should be performed. This proposed regulation generally incorporates the 1973 Ocean Dumping regulation elutriate test, and further incorporates bulk sediment analysis when deemed necessary by the Regional EPA and the District Engineer. The elutriate test is defined using the 1.5 factor on the level of contaminants in the water from the dredged site (not disposal site as required in the Ocean Dumping Regulation) after a dilution factor of 10 is applied to the elutriate results.

3.062 The 6 May 1975 proposed guideline also applies the elutriate test to the return flow of upland disposal sites, which have not been regulated on a national scale. The San Francisco Regional Water Quality Control Board (RWQCB) has, however, regulated return discharge from land disposal sites on a case-by-case basis around the Bay for a number of years.

3.063 On 5 September 1975, the Federal Register published interim final guidelines for the discharge of dredged or fill material in navigable waters based on comments on the 6 May 1975 guidelines. As mentioned in paragraph 2.142 the 5 September 1975 guidelines provide guidance for implementing the permit program under Section 404 of the Water Pollution Control Act Amendments of 1972 (P.L. 92-500). These guidelines do not provide specific limitations defining pollution, but do allow the Regional EPA to make interpretive remarks concerning the criteria.

3.064 In addition to the above regulations, Region IX of EPA has implemented regional dredge disposal criteria for navigable waters, with several subsequent revisions, since 1973 pursuant to Public Law 92-500, and are now making further revisions in line with the interim final guidelines. It is uncertain at this time what revision EPA Region IX will make to the interim final criteria.

3.065 Table II-8 of this report lists recent standard elutriate test results for those project areas having data. As mentioned in Section II of this report, disposal site water was used and is assumed, for comparative purposes only, that the water quality (which is primarily based on concentrations of certain chemical constituents) from the dredge site is the same as that at the disposal site. See Section II, Elutriate Analysis as Dredge Disposal Criteria, for further explanation.

Impacts of Maintenance Dredging & Disposal Operations IV

SECTION IV

ENVIRONMENTAL IMPACTS OF MAINTENANCE DREDGING AND DISPOSAL OPERATIONS

A. INTRODUCTION

4.001 One must bear in mind when considering the impacts of dredge/disposal operations on the natural environment, that the San Francisco Bay environment is no longer pristine and has not been since the onset of rapid urbanization in the 1840's. The Gold-Rush Era especially, must have had a profound effect on the biota of the Bay when perhaps billions of extra cubic yards of sediments were washed down the Sacramento and San Joaquin Rivers from massive mine excavations in the Sierras, as well as from land-filling along the Bay shoreline. The Bay is also a natural seaport, and as such, safe navigation routes in the Bay have been important and regularly maintained.

4.002 All 20 Federal navigation projects discussed here have been routinely maintained for a number of years and some of them have been dredged annually for over 60 years. Initial excavation of a project doubtlessly annihilated much of the bottom fauna in the channels and basins and possibly, some of those demersal organisms dependent on the bottom fauna for life support. This section discusses dredge/disposal impacts on a natural environment that has been routinely disturbed in the past by one way or another and not on any pristine or relatively undisturbed area.

4.003 The discussion of impacts on the estuarine biota is based on the District's Dredge Disposal Study as well as on the latest related studies around the country; much of the data yet to be formally published. It should be emphasized that not all questions on dredge/disposal effects are answered, simply because the accelerated thrust on studying dredge/disposal impacts is relatively recent and certain, potential impacts have not been adequately studied. Some of the areas that require further study are behavior and toxicity of petroleum products associated with disturbed sediments; microbial mediation of pollutants (such as uptake and biomagnification); and behavior and effects of mud fluid layers (similar to density currents) created after disposal; as well as other topic areas.

4.004 In addition to impacts of maintenance dredge/disposal operations on the natural environment, impacts on air quality, on the regional economy and on social aspects (such as on historical and archaeological resources) are discussed. Impacts on the regional economy are more of a reflection of no maintenance dredging as opposed to continued maintenance. Potential economic effects resulting from a hypothesized moratorium of dredging in the Bay are discussed under Section VI.

4.005 Discussion of impacts of dredge/disposal at the 100-Fathom Disposal Site is also in Section VI, Alternatives, since ocean disposal is considered an alternative to aquatic disposal in the Bay.

4.006 All the impacts discussed in this section and parts of those discussed under Section VI, Alternatives, are summarized in Table IV-28.

B. IMPACTS ON THE NATURAL ENVIRONMENT

1. Impact on Bay Estuarine Environment.

a. Sediment Disturbance.

4.007 (1) Introduction. Familiar to all, dredging and aquatic disposal operations in San Francisco Bay cause a redistribution and disturbance of the Bay sediments. In this section, impacts on the aquatic environment will be discussed in terms of the degree of sediment disturbance (resuspension and transport) in the water column and on the Bay floor as induced by dredging operations in the project areas, and occurring during release of dredged sediments at the disposal sites.

4.008 The effects of the sediment disturbance will then be discussed in terms of the associated physical and chemical effects on the biological community of the Bay on a short and long-term basis. Chemical effects are dependent on the pollutant burden of the particular dredged material and the physical-chemical characteristics of the environment in which it is moved. These effects could include the release of hydrogen sulfide and heavy metals, increase availability of hydrocarbon fractions, etc. Even with no toxic effects associated with an operation, there will always be some degree of mechanical disturbance which could result in physical environmental impacts.

4.009 Physical effects affiliated with the dredging operation occur on the bottom and in the water column. The initial impact occurs on the bottom with the disruption of the channel sediments. When the material is removed from the project area, entrapped organisms are also removed. A secondary impact of the disruption is the redeposition of the suspended sediments on sessile organisms' juxtaposition of the project. This can cause burial and possible smothering of the affected organisms. A more detailed discussion of chemical and physical effects of dredge/disposal operations follow the Sediment Disturbance discussion.

4.010 (2) Characterization of Bay Sediments. With the exception of the sandy sediments associated with the San Francisco Bar Channel, South Hampton Shoal, Pinole Shoal and Suisun Bay, maintenance dredging operations deal with Bay mud. Bay mud consists of soft, plastic, black-to-grey silty clay or clayey silt with minor organic material and clayey fine-grained sand which has been deposited in the Bay largely from its flocculation in salt water. Flocculation is the process whereby the chemistry of the salt water causes suspended clay and colloidal particles to aggregate, and then settle out of the water column.

4.011 Bay mud tends to flow and has very little bearing strength (ability to support weight). It is easily resuspended by wind-wave action, freshet (freshwater inflow) and tidal currents. These characteristics of Bay mud result in a very dynamic system with sediment recirculation through scoured channels and on-and-off extensive mudflats. The properties of Bay mud can be explained by the low in-place density (weight per unit volume) and water content (the weight of water compared to the dry weight of the sediment). Table IV-1 gives typical ranges of the physical properties of the sediment. The type of sediment (such as sand versus silt or clay) and the condition of the sediment (such as the amount of water within the sediment) are controlling parameters in evaluating the degree of sediment disturbance. These same parameters also apply to the duration of the disturbance, such as the time required for particles to settle out of the water column and the transport of sediment from the aquatic disposal sites. Without flocculation, a large portion of the sediments (fine silts and clays) would remain suspended indefinitely in the water column. However, as the sediment aggregate and concentrate in the lower water column, the rate of settling decreases because of particles interfering with one another. This phenomenon is referred to as "hindered settling" and results in the establishment of a fluff zone. The fluff zone is a transition zone between the water column and the Bay floor.

TABLE IV-1
PHYSICAL PROPERTIES OF BAY SEDIMENTS 1/

Physical Properties	Mare Island Strait	Oakland Outer Harbor	Oakland Inner Inner
Dispersed Grain Size 2/			
% Sand (0.075 mm)	12	5	15
% Silt	46	39	37
% Clay (0.002 mm)	42	56	48
Non-dispersed Grain Size 2/			
% Sand (0.075 mm)	13	17	20
% Silt	87	83	75
% Clay (0.002 mm)	0	0	5
Organic Carbon (% 2/	1.56	1.28	1.62
In-place Density 3/ (grams/cu. cm)	1.30	1.43	-
Water Content (%) 3/	102	124	-

1/ Information is based on single samples and does not necessarily represent project areas as a whole.
2/ Dredge Disposal Study, Appendix F, Crystalline Matrix, 1975.
3/ Dredge Disposal Study, Appendix J, Land Disposal, 1974.

4.012 Several methods are used for measuring sediment disturbance or turbidity. They are divided in terms of light transmission, light reflectance, weight of sediment, and volume of sediment. Unfortunately, correlation between the various methods is generally poor. The differences in measurement are due to the type, shape and size of the sediment particles, the organic content, and water characteristics. For example, the same light transmission reading for fines with organics in suspension versus sand in suspension would not represent the same weight of sediment. Inversely, fifty milligrams of sediment per liter may have 20 percent transmission in Mare Island Strait as compared to 50 percent transmission in Richmond Harbor (223).

4.013 (3) Dredging and Sediment Disturbance. In general, three types of dredges are utilized in San Francisco Bay: the trailing suctionhead hopper dredge, the grapple or clamshell dredge, and the hydraulic cutterhead dredge. Each type of equipment disturbs the sediment in a different manner. Table IV-2 summarizes the operation of each of the three types contributing to the sediment disturbance.

TABLE IV-2
AREAS OF OPERATION CAUSING SEDIMENT DISTURBANCE

Vessel Type	Vessel Movement	Time of Operation	Cutting	Lifting thru Water	Loading
Trailing Suction Hopper Dredge	Yes	Intermittent (About 1 hr. cycle)	Yes	No	Yes
Grapple or Clamshell Dredge	No	Continuous	Yes	Yes	Yes
Hydraulic Cutterhead Dredge	No	Continuous	Yes	No	No

4.014 The trailing suction hopper dredge, because of its size, is the only one of the three dredges that disturbs the bottom material as a result of vessel passage and prop-wash. However, this phenomenon is not unique to a hopper dredge, but occurs whenever a vessel with a relatively deep draft uses a channel (177). All three dredges cause agitation of the sediments during the cutting operation. The hopper dredge disrupts the bottom sediments when its two trailing drags pass through the shoal material. The grapple or clamshell dredge disturbs and resuspends bottom material as the "bucket" bites into the sediment and breaks free upon being hoisted. The hydraulic cutterhead dredge is continually resuspending sediments as long as the cutter is crowding the sediment face. Not all of the sediments

being suspended by the hydraulic cutterhead are drawn into the suction pipe; varying amounts can be carried away by currents. The pipelines of the cutterhead and hopper dredges reduce disturbances in the water column as the sediments are moved from the Bay floor to the surface. In contrast, the bucket of the grapple dredge loses sediments as it is raised through the water column. These sediments continue to be lost during the loading operation as the bucket breaks free of the water surface and is swung to the dump scow or barge. Water charged with particulates can re-enter the water column when water is intentionally displaced from the scow or when inadvertent spillage occurs. Similarly, the hopper dredge discharges particulates during overflow periods. These overflow periods in the loading of both the hopper and the barge are intended to displace the water in the vessels with solids to obtain the highest practical solids density (called economic load). At the start of filling the hopper or barge, water occupies the volume of the vessel below the water surface. This is because the bottom gates, through which the sediments are released, are not water tight.

4.015 In addition to the type and size of equipment, site conditions also affect the degree of disturbance. Site conditions include the sediment characteristics as previously discussed, depth or face of the cut, spacing and shape of the dredging areas and channel restrictions. These parameters influence the efficiency of the dredging operation and therefore influence the degree of sediment disturbance. An example would be using an oversized hydraulic cutterhead for a long, narrow, shallow shoal. Another example is the restriction placed on dredging over certain areas, such as the Alameda Tubes in Oakland Inner Harbor. For safety of the tunnels, dredging equipment is limited to the trailing suction hopper dredge. The length and shape of the cut, however, decreases the operating efficiency of the drag arms, thereby increasing the amount of water pumped and, in turn, increasing the overflow from the hoppers.

4.016 Table IV-3 presents typical turbidity plume dimensions and levels of suspended solids measured during dredging at selected project areas in San Francisco Bay. Although not indicated in Table IV-3, the hydraulic cutterhead dredge suspends the least amount of solids in the water column, followed by the trailing suction hopper dredge without overflow (223, 254). The grapple dredge and the trailing suction dredge,during periods of overflow,produce the highest levels of turbidity and suspended solids in the water column. The high levels adjacent to the dredge are immediately dispersed to typical ranges shown in Table IV-3. Duration of these concentrations is typically less than fifteen minutes when the salinity is above one ppt (the level at which flocculation begins to occur). However, under turbulent conditions or periods of very low salinity, they may last an hour or more. The table also shows that turbidity differences between various project areas exist. Conditions have also been observed on Mare Island Strait whereby the mixing of the