ENVIRONMENTAL IMPACT STATEMENT

FOR

SAN DIEGO (LA-5)
OCEAN DREDGED MATERIAL DISPOSAL SITE

SITE DESIGNATION

U.S. Environmental Protection Agency
Region 9
San Francisco, California

09 OCT 1987

U.S. Environmental Protection Agency
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ENVIRONMENTAL IMPACT STATEMENT FOR SAN DIEGO (LA-5) OCEAN DREDGED MATERIAL DISPOSAL SITE SITE DESIGNATION

U.S. Environmental Protection Agency
Region 9
San Francisco, California

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#20057645

Comments must be received no later than:

23 NOV, 1987 which is 45 days after publication of the notice of availability in the Federal Register for the DEIS.

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301 North Los Angeles Street
Los Angeles, California

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Copies of the EIS may be obtained from:

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ABSTRACT

The proposed action is the designation of an ocean disposal site for dredged material off San Diego, California. The site will be used in conjunction with dredged material disposal for Federal projects and permits issued under Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended. The interim site, referred to as LA-5, has been used for disposal of material dredged from the navigation channels of San Diego Harbor since the 1970s.

Continued use of the site is not expected to cause any significant long-term adverse environmental effects. The sediments and the benthic community have been altered by previous disposal operations at the proposed site. The smothering effect on the benthos caused by sediment inundation is expected to continue, but it is not considered to be a significant environmental impact at the LA-5 site. Water quality impacts, which are temporarily experienced during disposal operations, are expected to be minimal. Short-term effects on inhabitants of the water column will be negligible. Few of the potentially adverse environmental effects of dredged material disposal at the proposed site are likely to be irreversible or involve any irretrievable commitment of resources. A management plan, to be developed in a subsequent document by EPA and COE as a major part of the site designation process, will ensure that environmental impacts do not become significant.

The seven major alternatives considered in this draft environmental impact statement are: 1) No Action, 2) Delayed Action, 3) Landfilling of Port Areas, 4) Landfilling at Sanitary Landfills, 5) Beach Nourishment, 6) Ocean Disposal at the LA-5 Site, and 7) Ocean Disposal at Two Alternative Ocean Sites. After detailed field investigations and analysis of each alternative, the U.S. Army Corps of Engineers, Los Angeles District determined that ocean disposal at a designated dredged material disposal site was the only viable alternative for the proposed action. The three sites considered for designation include: the LA-5 site, a shallow water site, and a deep water site. The preferred alternative identified in this environmental impact statement is the designation of the LA-5 site for continued use. This decision is based on the lack of significant long-term environmental impacts at the LA-5 site, the potential for disposal activities to adversely affect the alternative sites, and the demonstrated need for an ocean disposal site for dredged material.

ENVIRONMENTAL IMPACT STATEMENT
FOR
SAN DIEGO (LA-5)
OCEAN DREDGED MATERIAL DISPOSAL SITE
SITE DESIGNATION

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LIST OF ABBREVIATIONS

As	arsenic
ASBS	Areas of Special Biological Significance
B	boron
BLM	U.S. Bureau of Land Management
BOD	biological oxygen demand
CalCOFI	California Cooperative Oceanic Fisheries Investigations
Cd	cadmium
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
Co	cobalt
CO	carbon monoxide
COD	chemical oxygen demand
COE	U.S. Army Corps of Engineers
Cr	chromium
CSWQCB	California State Water Quality Control Board
CSWRCB	California State Water Resources Control Board
Cu	copper
DO	dissolved oxygen
DOE	U.S. Department of Energy
EIR	environmental impact report
EIS	environmental impact statement
EPA	Environmental Protection Agency
Fe	iron
FWS	U.S. Fish and Wildlife Service
HC	hydrocarbons
Hg	mercury

JWPCP	Joint Water Pollution Control Project
LACSD	Los Angeles County Sanitation District
LPC	limited permissible concentration
Mb	molybdenum
MMS	U.S. Minerals Management Service
Mn	manganese
MPRSA	Marine Protection, Research, and Sanctuaries Act of 1972
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NO_x	nitrogen oxides
OCS	outer continental shelf
ODMDS	Ocean Dredged Material Disposal Site
Oz	ozone
PAR	Port Access Routes
Pb	lead
PCB	polychlorinated biphenyl
pH	hydrogen ion concentration
RCRA	Resource Conservation and Recovery Act
SCCWRP	Southern California Coastal Water Research Project
Se	selenium
SHPO	State Historic Preservation Officer
TDS	total dissolved solids
TSP	total suspended particulates
TSS	Traffic Separation Schemes
USCG	U.S. Coast Guard
Zn	zinc

List of Measurements

cm/s	centimeters per second
ft	feet
g/m^2	grams per square meter
$g/C/m^2/day$	grams per Centigrade degree per square meter per day
km	kilometers
m	meters
mg/l	milligrams per liter
mg/m^2	milligrams per square meter
mm	millimeters
m^3	cubic meters
mph	miles per hour
nmi	nautical miles
ppt	parts per thousand
ug/g	microgram per gram
ug/kg	microgram per kilogram
ug/l	microgram per liter
um	micrometers
yd^3	cubic yards

Conversions

1 fathom = 1.829 meters

1 meter = 3.281 feet

1 nautical mile = 1.852 kilometers

1 kilometer = 0.6214 statute miles

cubic meters = 1.308 cubic yards

EXECUTIVE SUMMARY

S.1. INTRODUCTION

This Environmental Impact Statement (EIS) evaluates the designation of an ocean dredged material disposal site (ODMDS) located southwest of San Diego Bay in southern California (Figures S-1, S-2). The Environmental Protection Agency (EPA), Region 9 is issuing this EIS, in close cooperation with the Army Corps of Engineers (COE), Los Angeles District, according to Title I of the Marine Protection, Research and Sanctuaries Act (MPRSA) of 1972 and as required by EPA's national policy on the designation of ocean disposal sites (39 FR 37119, October 24, 1974).

The EIS has been prepared to document compliance with EPA's site designation criteria at 40 CFR 228. A full range of alternatives has been examined to determine the best means for managing ocean disposal of dredged material. The goal of this management program is to authorize disposal of dredged material without unreasonable degradation of the ocean with respect to human health and the marine environment.

The preferred alternative is to designate the LA-5 site, as the site for disposal of dredged material from the Port of San Diego and the San Diego Naval Station. This site has been used as an interim disposal site since the 1970s. Maintenance dredging of channels and expansion of dock capacities in San Diego Bay are essential to sustain economic growth and strategic use of the ports. The designated site can be used for the disposal of dredged material from Federal projects and permit applications only after the applicant establishes that the dredged material will not exceed the capacity of the site and that the material is in compliance with EPA and COE criteria and regulations. The LA-5 site and the two alternative ocean disposal sites were evaluated according to EPA's site selection criteria (40 CFR 228.5 and 228.6). No advantages were found in moving the disposal site from the interim LA-5 location to a shallow water or a deep water location.

A wide range of alternatives were considered in the EIS to determine the most suitable disposal site. These alternatives included:

A. Ocean Disposal at the LA-5 Site (Preferred Alternative),
B. No Action,
C. Delayed Action,
D. Landfilling in Port Areas,
E. Landfilling at Sanitary Landfill Sites,
F. Beach Nourishment,
G. Ocean Disposal at a Shallow Water Site (LA-4), and
H. Ocean Disposal at a Deep Water Site.

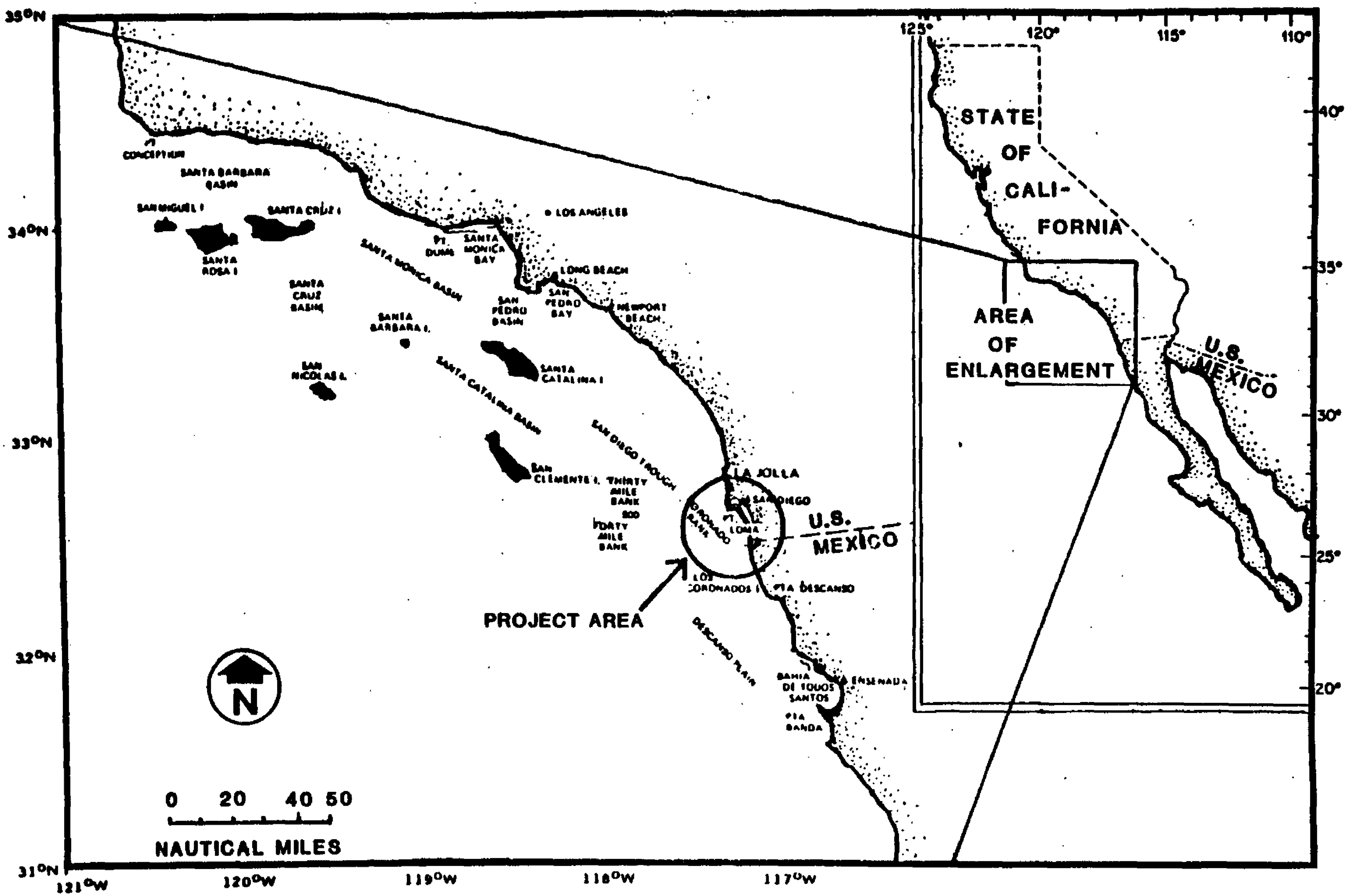

FIGURE S-1. MAP OF PROJECT REGION

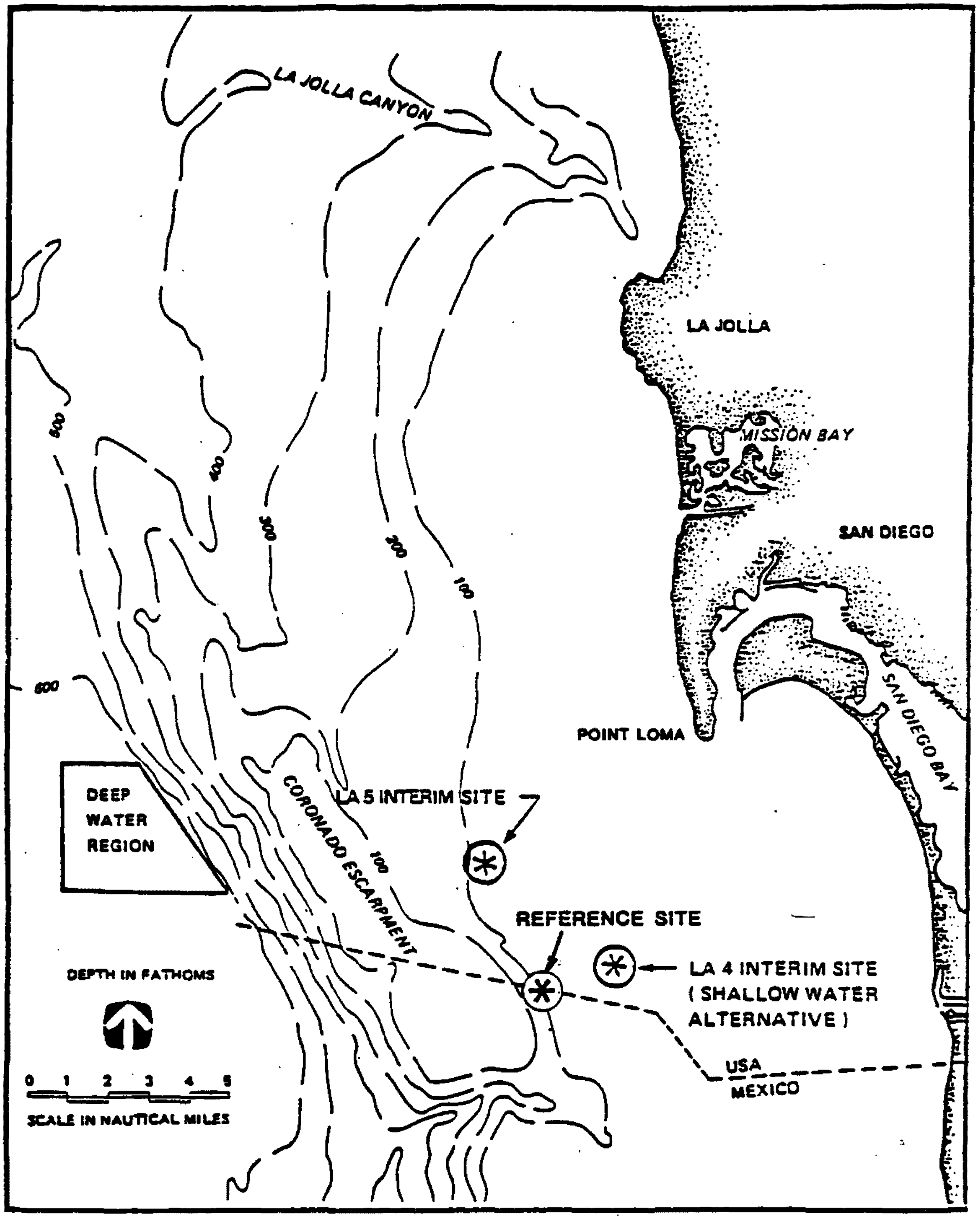

FIGURE S-2. MAP OF THE PROJECT AREA

Preliminary analyses indicated that alternatives other than ocean disposal were either inadequate, not feasible, or more environmentally damaging. The major alternatives evaluated through detailed environmental analyses were ocean disposal at the LA-5 site, a shallow water site, and a deep water site. The other alternatives were considered infeasible for the adequate disposal of dredged material from the San Diego Harbor area.

S.2. PHYSICAL ENVIRONMENT

The three potential ocean disposal sites are located on the mainland shelf off San Diego, on the slope between this shelf and the Coronado Bank, and in the San Diego Trough. They are outer shelf, slope, and deep water regions, respectively. The slope site is the location of the interim disposal site, referred to as the LA-5 site. This area of the Southern California Bight is characterized by a narrow mainland shelf followed by a complex series of basins and ridges. Prominent sediment deposits of sands and muds are present on the shelf, basins, and intervening slopes.

Physical oceanographic conditions in the Southern California Bight are dominated by the California current system. This system consists of the California Current, the California Undercurrent, the Southern California Countercurrent, upwelling conditions present from March to June, and associated eddies that affect coastal areas. The oceanic currents that flow over the shelf are complex and variable. Surface currents are influenced by wind patterns, while the deeper currents are influenced by the tides, geostrophic currents, and complex submarine topography. Offshore San Diego, predominant current direction is to the northwest at net speeds of 2-3 centimeters per second (cm/s).

Water quality at the LA-5 site is indistinguishable from the water quality of nearby areas. Temperature, dissolved oxygen, pH, salinity, turbidity, and concentrations of metals, oil and grease, and chlorinated hydrocarbons are not significantly different from a nearby reference site. Water quality at the LA-4 shallow water site and the deep water site are expected to be similar to that of the LA-5 site.

Sediment quality at the LA-5 site is significantly different from a nearby reference site. A greater range of fine and coarse sediments are present, they are more poorly sorted, and concentrations of metals, pesticides and polychlorinated biphenyls (PCBs) are higher. This is a result of past disposal activities during the interim designation period.

Sediments at the deep water site are relatively undisturbed by previous activities, although dissolved oxygen levels would be low as a result of natural conditions at great depths. The deeper sediments, composed of silts and clays, are expected to be finer than the LA-5 site. Levels of contaminants would be low; however, concentrations of some metals are naturally high in deep basin sediments because these ions are released in reduced, oxygen-depleted environments.

Sediment quality at the LA-4 shallow water site is expected to show a moderate degree of grain size alteration and contamination due to a limited amount of previous disposal activities.

A field survey conducted for this EIS indicates that disposal activities have caused significant changes in the characteristics of bottom sediments. If permanent designation were approved for dredged material disposal, sediment degradation would be a continuing effect at the LA-5 site, while it would be a new effect at the deep water site and a renewed effect at the LA-4 shallow water site.

S.3. BIOLOGICAL ENVIRONMENT

The benthic community will be affected most by disposal activities at any of the designated disposal sites. Benthic infauna and epifauna of the LA-5 site are typical of the southern California slope community (Jones and Fauchald, 1977) although diversity is depressed in comparison to a nearby reference site. The benthic infauna of the deep water site is low in biomass and diversity (Hartman and Barnard, 1958; Fauchald and Jones, 1978b), while at the shallow water site it is more diverse and abundant than at the LA-5 site (SCCWRP, 1973).

Disposal of dredged material may cause lower species diversity and species abundance of infauna, epifauna and demersal fish at each site. Direct causes of these changes are smothering, alteration of sediment characteristics, the potential increase in the concentration of toxic substances, and increased body tissue burdens of some chlorinated hydrocarbons. This would be a continuation of the observed conditions at the LA-5 site, a renewed effect at the LA-4 shallow water site, and a new effect at the deep water site. Impacts to deep water infauna and epifauna may be less than presently occurring at LA-5 because material reaching the deep basin will be dispersed over a greater area.

Organisms such as plankton, pelagic fish, coastal birds, pinnepeds and cetaceans are not expected to be affected by disposal activities in the ocean. Most of the threatened and endangered species found in southern California waters do not require any of the potential disposal areas for critical habitat. No significant impacts are expected on any of these organisms.

There are four State ecological reserves and a National Wildlife Refuge at Los Penasquitas Marsh in the vicinity of the LA-5 site (Figure S-3). Two of the State reserves and refuges

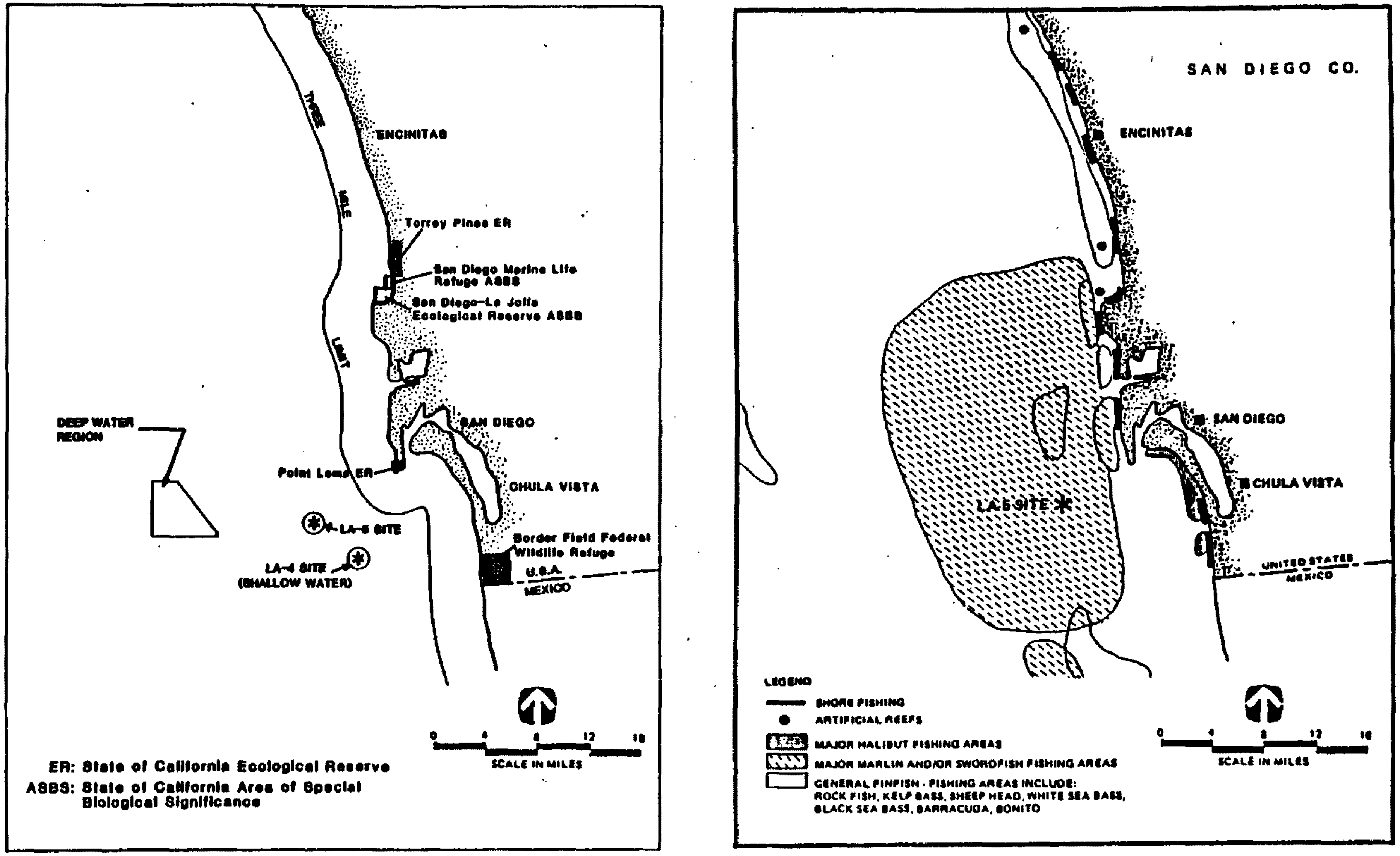

FIGURE S-3. MAPS OF MAJOR BIOLOGICAL RESOURCES IN THE PROJECT AREA are also designated as Areas of Special Biological Significance. The closest of these reserves, the Point Loma Ecological Reserve, is located approximately 6 nautical miles (nmi) (19 kilometers or km) north of the LA-5 site. This small underwater reserve would probably not be impacted by the ODMDS disposal activities because of the prevailing currents which carry any contaminants away from this area. All of the other designated areas of biological significance are 12 or more nmi (22 or more km) from the LA-5 site. No significant environmental impacts are expected to affect any of these State or Federal areas.

S.4. SOCIOECONOMIC ENVIRONMENT

The San Diego area is an important center for commercial fishing. In 1983, about 85 million pounds of fish and marine invertebrates valued at $38.0 million were landed at San Diego. The fish species commonly landed at San Diego include tuna (yellowfin, bluefin, skipjack, and albacore), swordfish, Pacific bonito, and rockfish. These accounted for over 90% of all landings during the 1981-1983 period. In general, the productivity of most of the blocks of origin in the vicinity of the LA-5 site increased over the 1976-1981 period. The annual fluctuations in the catch are more a reflection of the market demand for fish, rather than the productivity of the blocks.

The Port of San Diego includes one of the largest Navy establishments in the country. It is the home base for 120 Navy ships, which constitute more than 18% of the Navy's active fleet. Areas offshore of San Diego are used extensively for various military operations (Figure S-4). Although most of the military operations take place far beyond the immediate coastal areas, traffic between the port and the operations areas is quite heavy. Annually, Navy ships make more than 7,000 trips in and out of San Diego Bay.

San Diego Bay is a major Naval, commercial and recreational center for the southwest United States. The Navy has facilities at the inner north end of San Diego Bay. Between 1,200 to 1,400 commercial and other vessels called annually at the Port of San Diego during the 1979-1983 period. While existing ship channnel depths and widths appear adequate for the foreseeable planning period, growing ship size is expected to continue placing greater demand on the need for deeper channels and expanded terminal areas in the long-term future.

There is no oil and gas development offshore of San Diego County. In the Federal waters, some tracts were proposed for leasing several times, but have been deleted as a result of State and local opposition. The State waters within the three mile limit have been designated by the State as oil and gas sanctuaries. This precludes any oil and gas development in these areas.

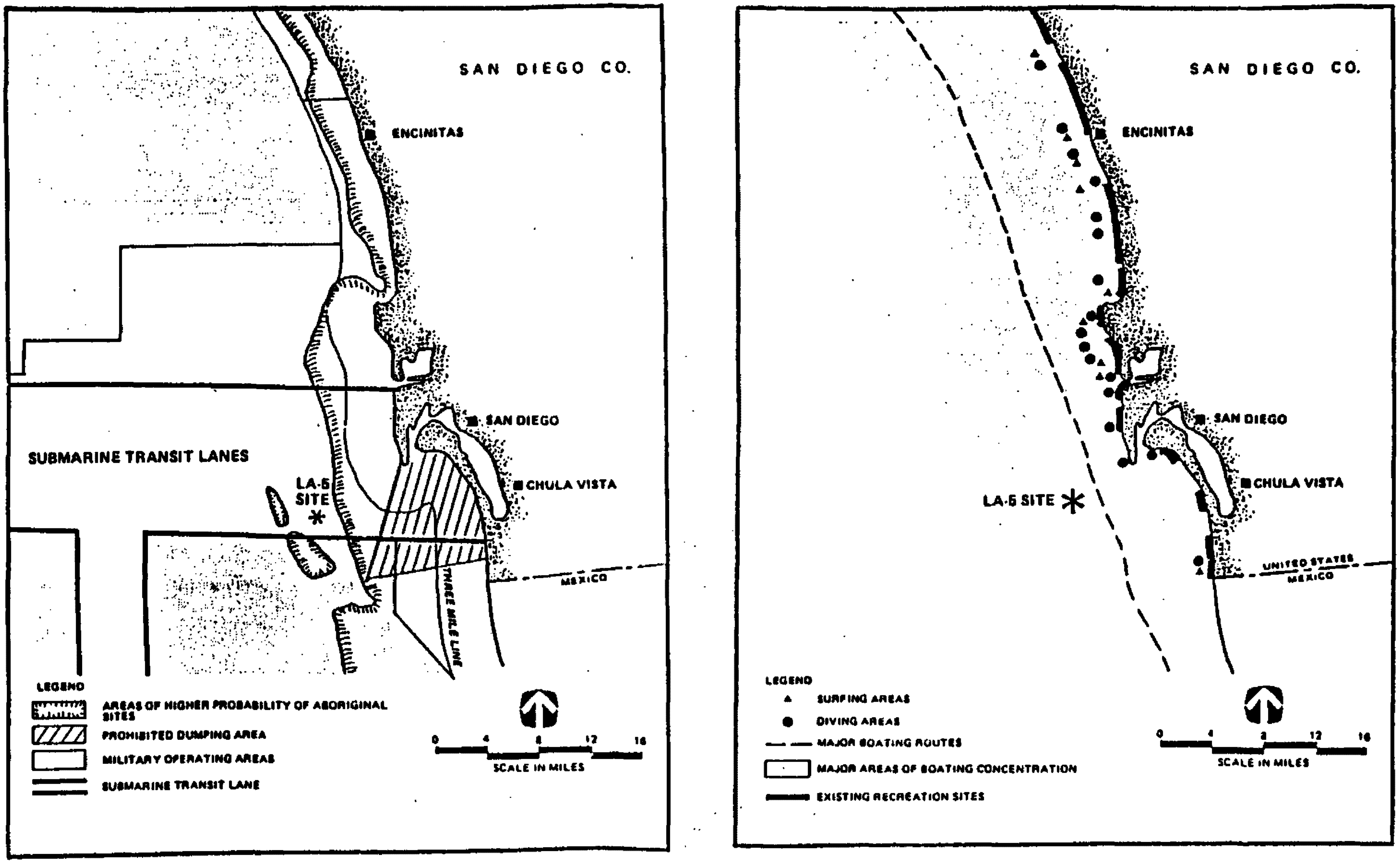

FIGURE S-4. MAPS OF MAJOR SOCIOECONOMIC FEATURES IN THE PROJECT AREA

Sportfishing in the San Diego area occurs out of several harbors and at a number of piers (Figure S-3). In 1977 the San Diego area reported almost 150,000 anglers catching more than 700,000 fish. Over 70 species of fish have been recorded in the San Diego area sport catch. However, only 10 species are caught in large numbers. California Department of Fish and Game Block 878, which contains the LA-5 site, is not a very productive block in terms of sport fisheries partly due to its distance from the shore, and partly due to the depth of water which is not suitable for sportfishing.

Most recreational boating is done close to the coastline in shallow waters (Figure S-4). Once the boats leave San Diego Bay at Point Loma, their destination usually is either to the north towards Los Angeles, or to the south along the Mexican coast. There are approximately 4,000 boat slips in use and there is a high demand for additional slips.

The offshore region of southern California is believed to contain numerous cultural resources (Figure S-4). There are over 50 known and recorded marine prehistoric sites in the inner basins of southern California extending from Los Angeles to San Diego. All of these sites are in State waters, close to shore and relatively shallow. According to the Minerals Management Service (MMS, 1984), over 450 known historic shipwrecks have occurred in the inner banks area. There are 10 wrecks reported off Point Loma, and four off the San Diego area. The tract containing the LA-5 site as well as most other tracts in its immediate vicinity are high probability cultural resource areas as a result of these wrecks.

As stated in MPRSA, no materials considered to be hazardous may be disposed at an ODMDS. Therefore, the potential for health hazards is considered to be minimal because increases in disposal activities beyond those permitted in the past several years are not anticipated. Potential impacts to human safety are considered very low because strict monitoring of traffic by the United States Coast Guard in the zone of operation will be maintained. Public health and safety effects are similar at the two alternative disposal sites.

S.5. MAJOR CONCLUSIONS

1. The preferred alternative is the formal designation of the LA-5 site as an ODMDS for continuing use according to EPA directive 40 CFR 228.5 (e).

2. The alternatives of No Action, Delayed Action, Landfilling in Port Areas, Disposal at Sanitary Landfills, and Beach Nourishment are not feasible, nor can they accommodate the major portion of the dredged material expected to be generated by future dredging projects.

3. Compared to a nearby reference site and to some extent other sites in the area, the LA-5 site has a greater range of grain sizes and more poorly sorted sediments, elevated levels of trace metals and chlorinated hydrocarbons, oils and greases in the sediment, less diverse infauna, less abundant epifauna, and less diverse demersal fish.

4. Disposal of dredged material at the LA-5 site would maintain the conditions listed in Conclusion 3. Designation of the LA-4 shallow water site as a permanent disposal site would reinstate these conditions, while disposal at the deep water site would introduce these conditions as new environmental impacts. Therefore, the LA-5 site is the most environmentally suitable site for disposal of dredged material, primarily because the environmental effects of disposal activities already exist and designation will prevent degradation of other areas.

5. Disposal is not expected to have significant adverse effects on other aspects of the physical and biological environment.

6. Disposal is not expected to have significant effects on socioeconomic resources for any of the three alternative sites.

7. The moderate, localized environmental effects of ocean disposal of dredged material are considered acceptable in light of the economic benefits of dredging and the infeasibility and/or adverse environmental effects of alternative disposal methods.

Tables S-1, S-2, S-3, and S-4 summarize the impacts and potential mitigation measures for disposal at the LA-5 site, no action, and disposal at the shallow water or deep water sites. Classes of environmental impacts used in these tables are defined as:

- Class I - Significantly adverse impacts that cannot be mitigated to insignificance. This means that no measures could be taken to avoid or reduce these adverse effects to insignificant or negligible levels.

- Class II - Significant adverse impacts that can be mitigated to insignificance. These impacts are potentially similar in significance to Class I impacts, but the severity of the impact can be reduced or avoided by implementation of mitigation measures discussed under each heading.

- Class III - Adverse but insignificant impacts, or no effect anticipated. No mitigation measures are required for these impacts or effects.

- Class IV - Beneficial impacts. These impacts would improve conditions relative to the preproject baseline conditions. They are further subdivided as significant or insignificant where applicable.

Chapter 4 of this EIS describes these impacts in detail and discusses their significance.

Table S-1. Summary of Impacts and Mitigation Measures for the LA-5 Site (Refer to text in Chapter 4 for detailed explanation.)

Impacts										Potential Mitigation Measures
	Class				Scope (1)			Term (2)		
Description	I	II	III	IV	S	L	R	S	E	
PHYSICAL ENVIRONMENT										
Air Quality			X			X		X		
Water Quality			X			X			X	
- turbidity, DO	X					X		X		No mitigation measures proposed because effects are short-term.
- trace metals, DDTs, PCBs, oils and greases	X					X		X		
Geology										
- sediment grain size	X				X				X	
- sediment quality	X				X				X	
BIOLOGICAL ENVIRONMENT										
Plankton			X			X		X		
Kelp			X				X		X	
Benthic Infauna	X				X				X	
Benthic Epifauna	X				X				X	
Demersal Fish	X					X		X		
Pelagic Fish			X			X			X	
Coastal Birds			X				X		X	
Marine Mammals			X			X			X	
Threatened and Endangered Species			X			X			X	
Marine Sanctuaries and ASBS			X				X		X	

(CONTINUED)

(1) = Scope Definitions
- S = site, 1000 yd (914 m) radius from center of designated ODMDS.
- L = local, up to 1 nmi outside of site.
- R = region, beyond local vicinity of ODMDS.

(2) = Term
- S = short, less than or equal to 5 hours.
- E = extended, greater than 5 hours.

Table S-1 (continued). Summary of Impacts and Mitigation Measures for the LA-5 Site (Refer to text in Chapter 4 for detailed explanation.)

Impacts										Potential Mitigation Measures
	Class				Scope (1)			Term (2)		
Description	I	II	III	IV	S	L	R	S	E	
SOCIOECONOMIC ENVIRONMENT										
Commercial Fishing										
- fish stocks			X				X		X	
- fishing fleet safety			X			X			X	
Commercial Shipping				X			X		X	
- safety			X			X		X		
- mounding			X		X				X	
- port access				X			X		X	
Oil and Gas Development			X			X			X	
Military Usage										
- traffic interference			X			X	X		X	
- naval ship access				X			X		X	
Sport Fishing			X			X			X	
Other Recreational Activities			X			X			X	
Cultural Uses			X			X			X	
Public Health and Welfare										
- health			X				X		X	
- safety			X			X		X		

(1) = Scope Definitions
S = site, 1000 yd (914 m) radius from center of designated ODMDS.
L = local, up to 1 nmi outside of site.
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E = extended, greater than 5 hours.

Table S-2. Summary of Impacts and Mitigation Measures for the No Action Alternative (Refer to text in Chapter 4 for detailed explanation.)

Impacts										Potential Mitigation Measures
Description	Class I	Class II	Class III	Class IV	Scope (1) S	Scope (1) L	Scope (1) R	Term (2) S	Term (2) E	
PHYSICAL ENVIRONMENT				X	X				X	
BIOLOGICAL ENVIRONMENT				X	X				X	
SOCIOECONOMIC ENVIRONMENT										
Commercial Shipping and Military Use	X						X		X	
Public Health, Safety, Aesthetics				X		X			X	

(1) = Scope Definitions
S = site, 1000 yd (914 m) radius from center of designated ODMDS.
L = local, up to 1 nmi outside of site.
R = region, beyond local vicinity of ODMDS.

(2) = Term
S = short, less than or equal to 5 hours.
E = extended, greater than 5 hours.

Table S-3. Summary of Impacts and Mitigation Measures for the Shallow Water Alternative (Refer to text in Chapter 4 for detailed explanation.)

Impacts										Potential Mitigation Measures
	Class				Scope (1)			Term (2)		
Description	I	II	III	IV	S	L	R	S	E	
PHYSICAL ENVIRONMENT										
Air Quality			X			X		X		
Water Quality			X			X			X	
- turbidity, DO	X					X		X		No mitigation measures proposed because effects are short-term.
- trace metals, DDTs, PCBs, oils and greases	X					X		X		
Geology										
- sediment grain size	X				X				X	
- sediment quality	X				X				X	
BIOLOGICAL ENVIRONMENT										
Plankton			X			X		X		
Kelp			X				X		X	
Benthic Infauna	X				X				X	
Benthic Epifauna	X				X				X	
Demersal Fish	X					X		X		
Pelagic Fish			X			X			X	
Coastal Birds			X				X		X	
Marine Mammals			X			X			X	
Threatened and Endangered Species			X			X			X	
Marine Sanctuaries and ASBS			X				X		X	

(CONTINUED)

(1) = Scope Definitions
S = site, 1000 yd (914 m) radius from center of designated ODMDS.
L = local, up to 1 nmi outside of site.
R = region, beyond local vicinity of ODMDS.

(2) = Term
S = short, less than or equal to 5 hours.
E = extended, greater than 5 hours.

Table S-3 (continued). Summary of Impacts and Mitigation Measures for the Shallow Water Alternative (Refer to text in Chapter 4 for detailed explanation.)

Impacts										Potential Mitigation Measures
	Class				Scope (1)			Term (2)		
Description	I	II	III	IV	S	L	R	S	E	
SOCIOECONOMIC ENVIRONMENT										
Commercial Fishing										
- fish stocks			X				X		X	
- fishing fleet safety			X			X			X	
Commercial Shipping				X			X		X	
- safety			X			X		X		
- mounding			X		X				X	
- port access				X			X		X	
Oil and Gas Development			X			X			X	
Military Usage										
- traffic interference			X			X	X		X	
- naval ship access				X			X		X	
Sport Fishing			X			X			X	
Other Recreational Activities			X			X			X	
Cultural Uses		X			X	X			X	Close coordination with the SHPO to prevent damage.
Public Health and Welfare										
- health			X				X		X	
- safety			X			X		X		

(1) = Scope Definitions
S = site, 1000 yd (914 m) radius from center of designated ODMDS.
L = local, up to 1 nmi outside of site.
R = region, beyond local vicinity of ODMDS.

(2) = Term
S = short, less than or equal to 5 hours.
E = extended, greater than 5 hours.

Table S-4. Summary of Impacts and Mitigation Measures for the Deep Water Alternative (Refer to text in Chapter 4 for detailed explanation.)

Impacts										Potential Mitigation Measures
	Class				Scope (1)			Term (2)		
Description	I	II	III	IV	S	L	R	S	E	
PHYSICAL ENVIRONMENT										
Air Quality			X			X		X		
Water Quality			X			X			X	
- turbidity, DO	X					X		X		
- trace metals, DDTs, PCBs, oils and greases	X					X		X		
Geology										
- sediment grain size	X				X				X	
- sediment quality	X				X				X	
BIOLOGICAL ENVIRONMENT										
Plankton			X			X		X		
Kelp			X			X			X	
Benthic Infauna	X					X			X	
Benthic Epifauna	X					X			X	
Demersal Fish	X					X		X		
Pelagic Fish			X			X			X	
Coastal Birds			X				X		X	
Marine Mammals			X			X			X	
Threatened and Endangered Species			X			X			X	
Marine Sanctuaries and ASBS			X				X		X	
										(CONTINUED)

(1) = Scope Definitions
S = site, 1000 yd (914 m) radius from center of designated ODMDS.
L = local, up to 1 nmi outside of site.
R = region, beyond local vicinity of ODMDS.

(2) = Term
S = short, less than or equal to 5 hours.
E = extended, greater than 5 hours.

Table S-4 (continued). Summary of Impacts and Mitigation Measures for the Deep Water Alternative (Refer to text in Chapter 4 for detailed explanation.)

Impacts									Potential Mitigation Measures
Description	Class				Scope (1)			Term (2)	
	I	II	III	IV	S	L	R	S	E
SOCIOECONOMIC ENVIRONMENT									
Commercial Fishing			X			X	X		X
Commercial Shipping									
- interference			X				X		X
- port access				X			X		X
Oil and Gas Development			X			X			X
Military Usage			X			X	X		X
Sport Fishing			X			X			X
Other Recreational Activities			X			X			X
Cultural Uses			X			X			X
Public Health and Welfare									
- health			X				X		X
- safety			X			X			X

(1) = Scope Definitions
S = site, 1000 yd (914 m) radius from center of designated ODMDS.
L = local, up to 1 nmi outside of site.
R = region, beyond local vicinity of ODMDS.

(2) = Term
S = short, less than or equal to 5 hours.
E = extended, greater than 5 hours.

CHAPTER 1. INTRODUCTION

1.1. GENERAL INTRODUCTION

1.1.1. Historical Background

The U.S. Environmental Protection Agency (EPA) designated the LA-5 ocean dredged material disposal site (ODMDS) (Figure 1-1) as an interim site for disposal of dredged material off San Diego, California. This was made possible through EPA's authority under Section 102 of the Marine Protection, Research and Sanctuaries Act (MPRSA) of 1972 (33 U.S.C. 1401 et seq.). The Act established a permit program for ocean disposal of dredged and nondredged material that mandated the determination of environmental impacts, designation of sites, enforcement of permit conditions and management of the disposal sites. EPA's regulations pertaining to MPRSA require that, during the interim period, the effects of dredged material disposal on the marine environment be fully considered prior to final designation of a site.

Interim designation was originally issued for a three year period, but in 1980 EPA extended the interim designation of the LA-5 site and issued a schedule for final designation by February 1, 1983 as the result of litigation (National Wildlife Federation v. Costle, 14 ERC 1600, et seq., 1980). Subsequently, an extension until December 31, 1988 was granted (50 FR 6943 February 19, 1985) to allow completion of field studies, environmental evaluation and preparation of the environmental impact statement (EIS).

It is EPA's policy to publish an EIS for all ODMDS designations (39 FR 37119, October 21, 1974). As a result of the need of the U.S. Army Corps of Engineers (COE) for an ODMDS off San Diego, EPA requested that the COE, Los Angeles District prepare the disposal site EIS because they had the necessary technical expertise to evaluate conditions on the San Diego Shelf and Basin and they issued permits for ocean disposal at the interim site. EPA retains responsibility for the EIS and related public coordination.

Since 1977, COE has issued permits for disposal of approximately 4.3 million cubic yards (yd^3) of dredged material at the LA-5 site (Table 1-1). Most of these permits were issued for specific disposal projects. According to the information obtained by COE and the San Diego Unified Port District, the Port Authority used this site only once between 1977 and 1984, during the period February through June 1983. At that time, 89,500 yd^3 of dredged material were disposed of at the site. The COE is not required to issue itself permits for Federal dredging projects; however, NEPA documentation is prepared in which the need for ocean disposal is evaluated.

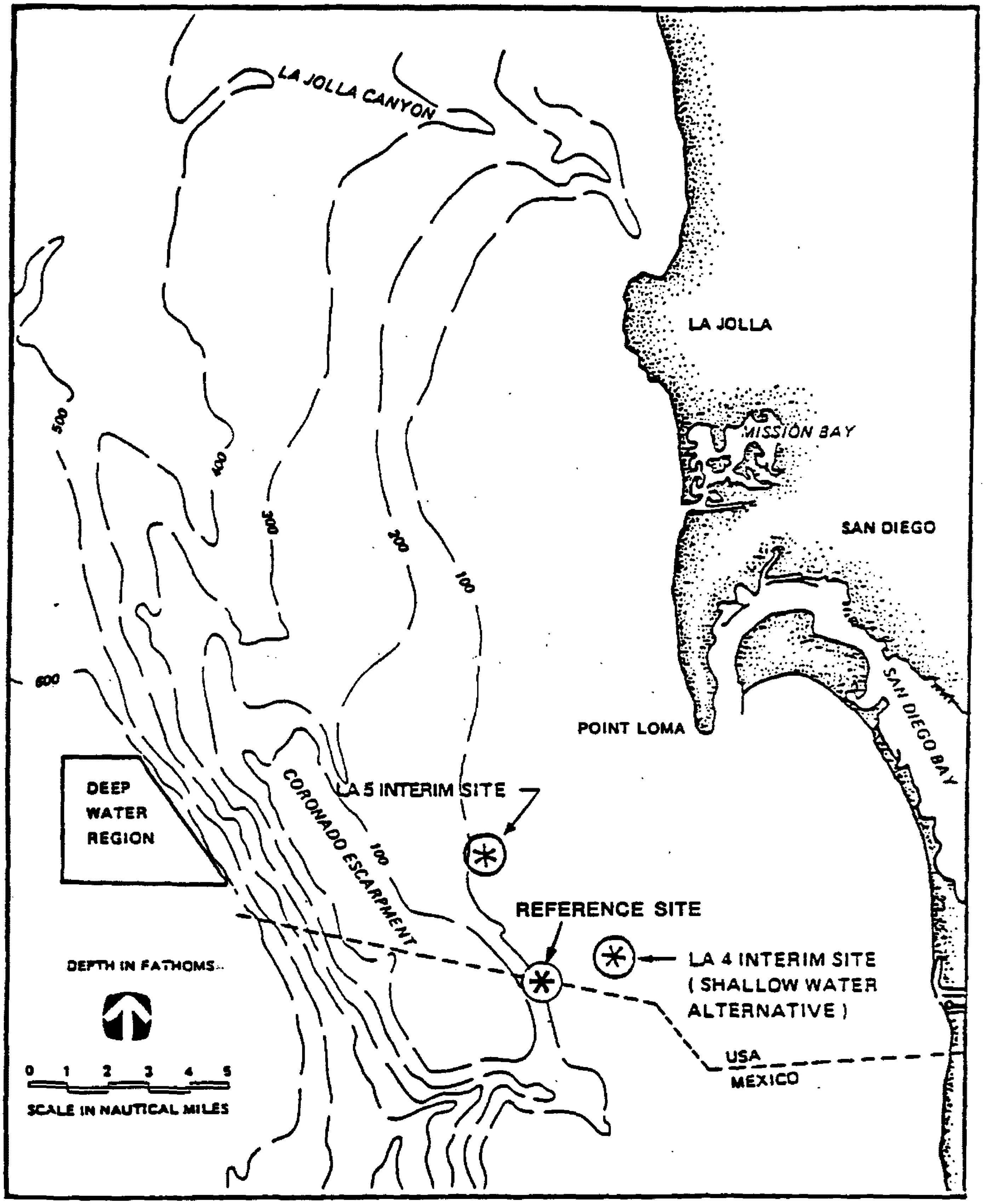


FIGURE 1-1. MAP OF THE PROJECT AREA

Table 1-1. Permits Issued by the COE for Disposal of Dredged Material at the LA-5 Site (a)

Year Final Action Taken	Permit Application Number	Amount of Disposal Allowed (b)	Actual Annual Disposal Under COE Permits (b)
1977	77-0103	171,000	165,000
	77-0159	35,000	34,000
1978	78-0157	425,000	425,000
1979	-------	-------	-------
1980	80-0197	1,041,000	0
1981	-------	-------	-------
1982	81-0055	71,140	71,140
	82-0069	201,000	201,000
	82-0139	355,000	0
1983	80-0253	28,700	28,700
	82-0193	300,000	300,000
	82-0167	17,000	17,000
	82-0197	410,000	410,000
	83-0018	74,000	74,000
1984	84-0026	331,800	331,800
	84-0162	60,000	60,000
1985	84-176	35,000	35,000
	85-054	26,659	26,659
1986	85-129	100,000	80,000
	86-066	528,000	528,000
	86-084	68,000	0
	86-251	36,000	0
TOTAL		4,314,299	2,787,299

(a) All dredged material disposed was silt/sand.

(b) cubic yards

Source: COE, unpublished information, 1987.

The U.S. Navy and two private industrial establishments, National Steel and Shipbuilding Corporation, and Southwest Marine, Inc., have been the other major users of the LA-5 site over the past ten years. The U.S. Navy has disposed of more than 1.5 million yd^3 and the two industrial concerns almost one million yd^3 of materials at the LA-5 site.

San Diego Unified Port District has a permit for dumping about 75,000 yd of material at the LA-5 site as part of the development of East Basin for marina development in 1984. They have also indicated that permits for disposal of approximately 1 million yd may be requested from COE over the next five years, if the proposed South Bay dredging project is authorized and implemented (San Diego Unified Port District, personal communication, April 1984).

Prior to 1977, the LA-5 site was used occasionally for disposal of dredged material and no disposal of dredged material resulting from COE projects has taken place at LA-5. The total amount of material disposed at the LA-5 site from COE-permitted projects has averaged approximately 280,000 yd^3 per year, with a range between 17,000 yd^3 and 425,000 yd^3 over the past ten years. Future disposal activity is not expected to be greater than the historic use of the site because dredged material from newly planned port projects may be used for landfills in harbor area or harbor expansion projects.

Dredging operations are usually short-term activities involving a few days or weeks in a given year. During the dredging period, barges make two to four trips a day depending upon the size of the barge.

Formal designation of the LA-5 site would continue ocean disposal of environmentally acceptable material at this interim location. Permitted projects would include disposal of dredged materials from areas within the port that do not involve approved diked disposal plans and disposal of acceptable dredged material from areas within the port, provided that there are no practicable alternatives to ocean disposal.

1.1.2. <u>Dredged Material Permitting</u>

Use of the LA-5 site for dredged material disposal will be assessed on an individual project basis in accordance with the provisions of EPA's Ocean Dumping Regulations (40 CFR 220-225, 227-228) and COE's dredged material disposal permitting process under Section 103 of MPRSA. Each application for a COE permit to dispose of dredged material at the LA-5 site is reviewed for environmental acceptability in accordance with established guidelines and in compliance with mitigative restrictions that will be defined in the final site designation EIS. Figure 1-2 outlines the cycle used by EPA and COE to evaluate permit requests for ocean disposal of dredged material.

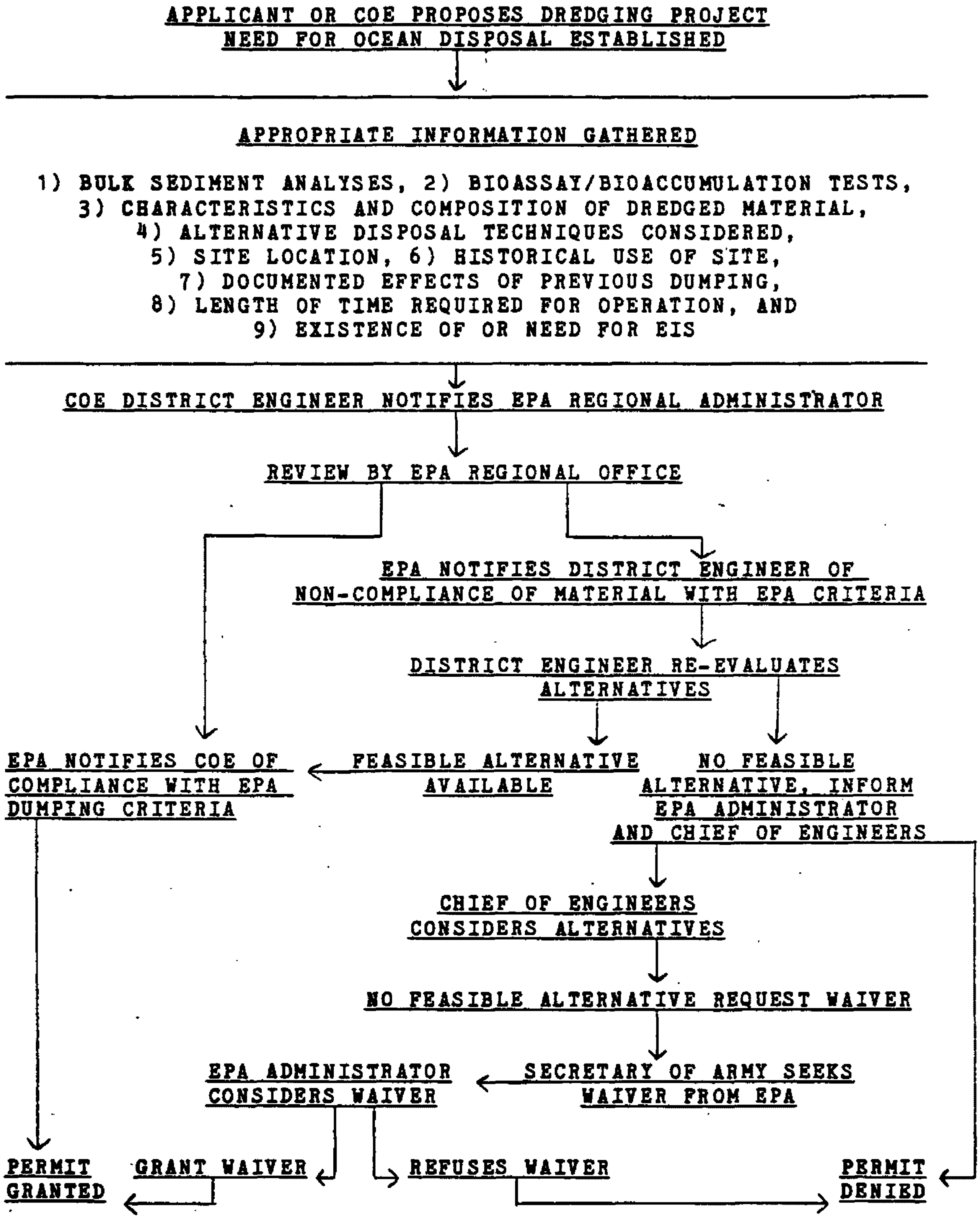


Figure 1-2. Evaluation Process for Dredged Material Permit Review.

Dredged material must meet several COE criteria before it can be considered for ocean disposal. The material can be disposed of without further testing if it meets the following criteria (33 CFR 227.13):

A. The material is composed predominantly of rock, sand or gravel and it will be dredged from areas of high current or wave energy;

B. The material is composed predominantly of sand, gravel or shell compatible in grain size with the receiving beach; or

C. The material is substantially the same as substrate at the proposed disposal site and it is from a location far removed from known existing or historical pollution sources so as to provide reasonable assurance of being unpolluted.

If the material does not meet these criteria, EPA regional policy requires that the material be subjected to bulk sediment analyses (including priority pollutant scans, tests for organotin derivatives and other pollutants identified by the California State Water Resources Control Board as potentially toxic substances); and the liquid, suspended particulate, and solid phases must be subjected to bioassay and bioaccumulation tests with appropriate sensitive species. The suspended particulate and solid phase tests must not indicate significant mortality or sublethal effects, including bioaccumulation of contaminants. The liquid phase must comply with applicable State water quality standards and Federal marine water quality criteria. The liquid phase should not exceed 0.01% of the concentration shown to be acutely toxic to the marine organisms used in the bioassay tests (33 CFR 227.13(a)(2)). In addition, the dredged material must not contain certain prohibited materials such as high level radioactive wastes or more than trace levels of certain other materials such as organohalogens, mercury compounds, cadmium, oil of all kinds, or known carcinogens (40 CFR 227.6).

The liquid phase of the disposal plume must be in compliance with the limited permissible concentration (LPC) of contaminants after allowance for initial mixing (40 CFR 227.27). When there are no applicable water quality criteria, the levels of contaminants in the receiving water may not exceed 0.01% of the concentration shown to be acutely toxic (33 CFR 227.27). If the dredged material is found to be unsuitable for ocean disposal, it must be disposed of by other means, such as a sanitary landfill or a diked disposal area. Otherwise, a dredging permit will not be issued.

1.1.3. Dredging Operations

Several alternative operational procedures for ocean disposal of dredged material may be used. In general, dredge operations involve either hopper, clamshell or hydraulic techniques. The dredged material is emptied into split hull barges with a capacity ranging from 500 to 4,000 yd^3. During the barge loading phase, attempts are made to maximize the density of dredged material so that the number of haul cycles can be reduced.

Barges are towed by tug boats which travel the most direct route practicable between the project site and the dump site. Ocean dumping, which can occur during permitted times, commences once the barge has moved into the designated position within the disposal site. The site is typically an area with a 1,000 yard radius (920 meters or m). Material is released by opening the bottom of the split hull barge, or by pumping the contents through an onboard pipeline to a submerged outlet.

1.2. PURPOSE OF AND NEED FOR ACTION

MPRSA requires EPA and COE to consider "human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities" (Section 103(a)) in their evaluation of Federal projects and permit applications for ocean disposal of dredged material. As part of this evaluation, consideration must be given to utilizing ocean disposal sites designated by EPA pursuant to Section 102(c) of MPRSA and 40 CFR 228.12.

Since 1977, ocean disposal of dredged material permitted by COE Los Angeles District has been authorized at the LA-5 site which has been designated by EPA on an interim basis. Use of this site for ocean disposal has been an essential element of COE's compliance with the requirements of MPRSA and their ability to carry out their statutory responsibility for maintaining the nation's navigation waterways.

In order to maintain waterways in San Diego Bay, COE considers it essential that an environmentally acceptable ocean disposal site be identified, evaluated, and permanently designated for continued use. This site may be used only after each dredging project has been reviewed by EPA and COE to certify that the proposed ocean disposal of dredged material complies with the criteria and requirements of EPA and COE regulations.

Dredged material from previous dredging projects in the San Diego area has been dumped at sites on land and in the ocean. Locations of these disposal sites are decided on a case-by-case basis, depending upon environmental and economic considerations. COE first examines material dredged from San Diego Bay to determine if it is appropriate for alternative means of disposal including, but not limited to, land disposal, beach nourishment, and capping techniques. Past environmental investigations for port dredging projects revealed that land disposal alternatives generally are not practicable due to the densely urbanized character of the surrounding area. If these alternatives are not appropriate, then materials that comply with the EPA's environmental impact criteria of 440 CFR 227 are usually dumped in the ocean. A designated ocean disposal site is required to meet COE's permitting needs.

In this EIS several alternatives to ocean disposal of large amounts of dredged material have been evaluated in detail. The conclusions reached by this EIS have eliminated options other than ocean disposal due to feasibility of disposal and economic criteria.

Final designation of the LA-5 dredged material disposal site will provide a long term means for ocean disposal of dredged material principally from the Port of San Diego and the San Diego Naval Station within San Diego Bay. The Port of San Diego is an important commercial harbor. Foreign and domestic cargo ships annually carry as much as 2 million tons of cargo to and from this port. The majority of these ships are deep-draft vessels. Additionally, naval vessels calling at the San Diego Naval Station include aircraft carriers, destroyers, submarines, supply and tender ships, amphibious vehicles, and others. Maintenance of channel depths and expansion of dock capacities are critical to sustaining the port as an important component of the national defense as well as State and national economics.

COE requested that EPA permanently designate an ocean disposal site suitable for disposal of dredged material from San Diego Bay. In response to COE's stated need, EPA and COE have completed the necessary studies for selection and evaluation of the most suitable site for the ocean disposal of dredged material (40 CFR 228.4(e)). This document, prepared through a cooperative effort between EPA and COE, provides the public and decision-makers with relevant information to assess the impacts associated with the designation of the ODMDS serving the San Diego area.

1.3. PROPOSED ACTION

The proposed action is the designation of an ODMDS for continued use. A number of alternatives were considered to identify the most suitable and least environmentally damaging site. These included: 1) No Action; 2) Delayed Action; 3) Landfilling in Port Areas; 4) Landfill at Sanitary Landfill Sites; 5) Beach Nourishment; 6) LA-5 ODMDS; and 7) two alternative ocean disposal sites, the LA-4 shallow water site and a deep water site.

Preliminary analyses indicated that all alternatives other than ocean disposal were either inadequate, not feasible, or more environmentally damaging. Detailed environmental analyses were carried out for the three ocean disposal sites. The goal of this document is to identify the most suitable and least environmentally damaging site for ocean disposal of dredged materials. Determination of the need for ocean disposal for individual Federal projects and COE permitted projects is accomplished as part of the permitting process on a case-by-case basis; consequently, these determinations are beyond the scope of the EIS.

The LA-5 site and the two alternative ocean disposal sites were evaluated according to criteria established in EPA's Ocean Disposal Regulations and Criteria. No advantages were seen inmoving the site from the interim location to either the deep water or the shallow water location. Final designation of the existing LA-5 ODMDS was determined to be the preferred alternative.

1.4. AREAS OF CONTROVERSY

In general, the issue of disposing of various materials in the ocean is controversial. This controversy tends to be focused on ocean disposal of materials such as radioactive waste, toxic chemicals, explosives, etc. In sufficient quantities and at sensitive locations, these materials pose significant environmental hazards; however, disposal of these materials is not permitted at an ODMDS.

Ocean disposal of dredged material has not been particularly controversial historically because:

A. The permitted material is exclusively composed of marine and/or estuarine sediment that has passed stringent quality control criteria (33 CFR 227),

B. Ocean disposal of this type of material is not expected to have long-term adverse environmental effects, and

C. Detailed bioassay and chemical tests are used to screen the material before ocean disposal is authorized.

The findings of this EIS support the relatively noncontroversial nature of ocean disposal of dredged material. There are no known major areas of controversy with concerned agencies that were contacted. Although there is indirect evidence that past disposal at the LA-5 site has affected sediment characteristics and biota, these effects appear to be moderate in nature and localized. There is no evidence of regional environmental effects. Levels of contaminants in sediments and tissues of organisms are not significantly elevated above those observed in organisms from a nearby reference site. Despite heavy commercial, military, and recreational use of the San Diego area, no significant interference between dredged material disposal and these other uses has been reported.

One concern related to designation of ocean disposal sites is the enforcement of the barge dumping location. There is widespread concern that barge operators may sometimes dispose of dredged material outside the dump site. This practice, known as "short-dumping," is the disposal of material prior to arrival at the designated site to save costs associated with a longer haul.

Under MPRSA, the United States Coast Guard (USCG) is assigned responsibility by the Secretary of Transportation for conducting surveillance of disposal operations to ensure compliance with the permit conditions and to discourage unauthorized disposal (33 U.S.C. 1417(c)). Surveillance is accomplished by means of spot checks of disposal vessels for valid permits, interception or escorting of dump vessels, use of shipriders, and aircraft overflights during dumping.

Alleged violations are referred by USCG to EPA for appropriate enforcement action (33 U.S.C. 1415 and 40 CFR 22.36). Civil penalties include a maximum fine of $50,000, and criminal penalties involve a maximum fine of $50,000 and/or a one year jail term. If administrative enforcement action is not appropriate, the Department of Justice may be requested to initiate actions in court for criminal violations of the terms of MPRSA.

1.5. ISSUES TO BE RESOLVED

This EIS shows that the LA-5 site differs from a nearby reference site and other nearby sites in sediment characteristics, abundance and diversity of biota, and concentrations of sediment contaminants. In order to conservatively evaluate the environmental impacts associated with the proposed project, this EIS assumes that the differences listed above are effects of past disposal of dredged material at the LA-5 site. The possibility that these differences are at least partly due to natural or human causative factors not related to dredged material disposal is discussed in Chapter 4, Environmental Consequences.

COE has collected data and evaluated previous reports to resolve issues related to environmental impacts from disposal of dredged material. The dynamic nature of the coastal marine environment of the Southern California Bight has made it extremely difficult to determine the exact causes of effects of environmental variations observed in the vicinity of LA-5.

The mechanisms governing environmental characteristics at the disposal site will be significantly clarified through a site management program jointly developed and administered by EPA Region 9 and COE Los Angeles District. The two Federal agencies will evaluate potential impacts through studies of the physical and environmental effects of disposal activities at the site, laboratory and field studies of the effects of dredged material on biological communities, and extensive sampling of environmental parameters along distance gradients from the disposal site to determine cumulative effects on surrounding habitats. This document incorporates the results of oceanographic studies at other sites in the area to provide relevant information on the direction, magnitude and variability of currents and vertical mixing characteristics in the offshore environment. A field survey was also undertaken at the LA-5 site and a nearby reference site during 1983 and 1984 to collect comparative data on water chemistry and sediment and biologic characteristics. The results of this field survey are discussed in detail in Chapter 3. Appropriate monitoring may also be performed as part of the site management program.

During the interagency workshop held for the designation study, it was suggested that pelagic fish should be sampled and the potential impact from suspended sediment on these species should be assessed. There was particular concern for the northern anchovy (Engraulis mordax) because of its commercial and ecological importance, its prevalence over the shelf-slope break area containing the LA-5 site, and the fact that it is a particulate filter feeder. A specific study of anchovies in the area of the LA-5 site was not possible for inclusion in the EIS. All indications are that dredged material disposal adversely affects water quality only temporarily until mixing and currents disperse the suspended sediment to background levels (see Appendix C., C-31). Based on this, it is concluded that there would be no significant effect on pelagic fish, including the northern anchovy.

Despite these assumptions, the issue of the effect of disposal activities on pelagic fish species is somewhat unresolved due to the lack of data on the sensitivity to suspended sediment of these species. A more conclusive assessment of the impact of disposal on pelagic fish would require sampling of the community at the disposal site at several depths and on several occasions, preferably in all seasons of the year. It would also require field and/or laboratory studies of the effect of suspended sediment and associated contaminants on anchovies and other pelagic species.

It was also suggested at the interagency workshop that histopathological studies be performed on organisms collected at the disposal site in lieu of determination of contaminant tissue burdens. Histopathologic studies are considered to be a more direct measure of the biological effects of toxic substances than determining the tissue concentration of the substances. Histopathology is, indeed, a useful diagnostic tool where the organisms under investigation are resident in the area of potential contamination and cannot or would not leave as contaminant levels rise. However, the usefulness of this technique would probably be limited in studies of very mobile or transient demersal or pelagic fishes. Tissue burdens of any absorbed or ingested contaminants might indicate the potential for pathological effects but actual histopathological evidence of these effects would be extremely difficult to collect because the affected animals would either leave the contaminated area or be sufficiently debilitated to be removed from the population by predation before detectable histopathologies could be found.

Because of the lack of precedent for histopathologic studies as part of site designation and budget constraints, this type of analysis was not included in the EIS investigations. A systematic histopathologic examination of selected resident organisms might prove to be a very useful tool in future monitoring programs of the selected site.

1.6. REGULATORY FRAMEWORK

An international treaty, as well as Federal and State laws and regulations, apply to the designation of an ODMDS. The relevance of these statutes to the proposed action and related compliance requirements are described below. Table 1-2 summarizes the compliance status of these laws in regard to the proposed action.

1.6.1. International Treaty

The principal international agreement governing ocean dumping is the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (26 UST 2403: TIAS 8165), also known as the London Dumping Convention. This agreement became effective on August 30, 1975, after ratification by 15 contracting countries, including the United States. Ocean dumping criteria incorporated into MPRSA permits for ocean dumping, have been adapted from the provisions of the London Dumping Convention. Thus, when a material is found to be acceptable for ocean disposal under MPRSA, it is also acceptable under the London Dumping Convention.

1.6.2. Federal Laws and Regulations

1.6.2.1. Marine Protection, Research and Sanctuaries Act of 1972, as amended (33 U.S.C. 1401 *et seq*.)

MPRSA regulates the transportation and ultimate disposal of materials in the ocean, and prohibits ocean disposal of certain wastes. Section 102 of the Act allows EPA to promulgate environmental evaluation criteria for COE permit actions, to retain review authority over the COE permits, and to designate ocean disposal sites for dredged material disposal. EPA's regulations for ocean dumping are published at 40 CFR 220 to 229. This EIS relates to designation of an ocean disposal site rather than permitting of dredged material disposal; therefore, it only relates to the last category of these criteria.

Section 103 of the Act sets forth requirements for obtaining COE permits to transport dredged material for the purpose of ocean disposal. COE's regulations for ocean dumping are published at 33 CFR 209.145 and 33 CFR 320 to 330.

Table 1-2. Summary of Compliance of Alternatives with Environmental Protection Statutes and Other Environmental Requirements

Federal	Preferred Alternative (LA-5 Site)	LA-4 Shallow Water Alternative	Deep Water Alternative
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention), 26 UST 2403: TIAS 8165.	Full	Full	Full
Marine Protection, Research and Sanctuaries Act, 22 U.S.C. 1401, *et seq*.	Full	Full	Full
National Environmental Policy Act as amended, 42 U.S.C. 4341 *et seq*.	Partial*	Partial*	Partial*
Clean Water Act as amended (Federal Water Pollution Control Act) 33 U.S.C. 1251 *et seq*.	N/A	N/A	N/A
Clean Air Act as amended, 42 U.S.C. 1451, *et seq*.	N/A	Partial*	N/A
Fish and Wildlife Coordination Act as amended, U.S.C. 661 *et seq*.	N/A	N/A	N/A
Coastal Zone Management Act as amended, 16 U.S.C. 1456 *et seq*.	Partial*	Partial*	Partial*
Endangered Species Act as amended, 16 U.S.C. 1531 *et seq*.	Full	Full	Full
National Historic Preservation Act as amended, 16 U.S.C. 470, *et seq*.	Full	Full	Full
Executive Order 11593, Protection and Enhancement of the Cultural Environment, 36 FR 8921.	Full	Full	Full

(Continued)

Table 1-2 (Continued). Summary of Compliance of Alternatives with Environmental Protection Statutes and Other Environmental Requirements

Federal	Preferred Alternative (LA-5 Site)	LA-4 Shallow Water Alternative	Deep Water Alternative
Executive Order 12372, Intergovernmental Review of Major Federal Programs, 47 FR 3059.	Full	Full	Full
California Coastal Act of 1976, as amended, PRC Sec. 3000, et seq.	N/A	N/A	N/A
California Environmental Quality Act, PRC Sec. 21001.	N/A	N/A	N/A

* Full compliance upon issuance of a Final Environmental Impact Statement.

1.6.2.2. National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4341 et seq.)

NEPA requires that environmental consequences and alternatives be considered before a decision is made to implement a Federal project. It also establishes requirements for preparation of an environmental impact statement for major Federal projects having potentially significant environmental impacts. This EIS has been prepared to fulfill NEPA requirements.

The President's Council on Environmental Quality has published regulations for implementing NEPA at 40 CFR 1500-1508. EPA'S NEPA regulations are published at 40 CFR 6 and COE's regulations for implementing NEPA are published at 33 CFR 220.

1.6.2.3. Clean Water Act of 1977 (33 U.S.C. 1251 et seq.)

This Act was passed to restore and maintain the chemical, physical and biological integrity of the nation's waters. Specific sections of the Act control the discharge of pollutants and wastes into aquatic and marine environments. Section 404 established a permit program to regulate the discharge of dredged material into the waters of the United States inside of the boundary line drawn to differentiate coastal waters from oceanic waters. This section is not applicable to the proposed action because it does not apply to the designation of ODMDS.

A major section of the Clean Water Act that applies to ocean disposal of dredged material is Section 401. This section concerns the certification by the State that the permitted action complies with State water quality standards. The applicability of Section 401 water quality certification by the State for ocean dumping projects is being evaluated by EPA and COE at this time.

1.6.2.4. Clean Air Act as Amended (42 U.S.C. 1451 et seq.)

This Act is intended to protect the nation's air quality by regulating the emission of air pollutants. It is not applicable to the proposed action (designation of an ocean dredged material disposal site). The Act is applicable to permits and planning procedures related to actual disposal within the three mile territorial sea limit.

1.6.2.5. Fish and Wildlife Coordination Act of 1958 (16 U.S.C. 661 et seq.)

This Act requires that water resource development programs be performed in consideration of wildlife conservation. The Act is not applicable to dredged material disposal site designation, but is applicable to the evaluation of permits and water resource development projects. All permitted uses of a designated disposal site will comply with the Act.

1.6.2.6. Coastal Zone Management Act of 1972 (16 U.S.C. 1456 et seq.)

This Act regulates development and use of the coastal zone, and encourages the State to develop and implement coastal zone management programs. Federally permitted projects must be certified consistent with approved State programs under Section 307(c) of the Act.

Although the proposed disposal site lies outside the three mile boundary of State waters, use of the site could potentially affect the State's coastal zone. In accordance with a 1984 decision by the U.S. Supreme Court (Watt v. California), the California Coastal Commission has indicated it will not review administrative actions such as site designations for consistency with the California Coastal Zone Management Plan. The California Coastal Commission will continue to review permit applications for dredging projects, review Federal determination of consistency for Federal dredge projects and transport of dredged materials through the coastal zone, for consistency with the California plan.

1.6.2.7. Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.)

This Act protects species federally designated as threatened or endangered by prohibiting Federal actions from jeopardizing the continued existence of such species. Section 7 of the Act requires that consultation regarding protection of such species be conducted with the U.S. Fish and Wildlife Service (USFWS) and/or the National Marine Fisheries Service (NMFS) prior to project implementation. This consultation is documented in Chapter 5, Exhibits 9, 10 and 11.

1.6.2.8. National Historic Preservation Act of 1966 (16 U.S.C. 470 et seq.)

This Act is intended to preserve and protect historic and prehistoric resources. Federal agencies are required to identify cultural resources that may be impacted by a project, and to coordinate project activities with the State Historic Preservation Officer (SHPO). The SHPO has determined that the designation of LA-5 does not involve cultural resources listed on or eligible for the National Register of Historic Places. This consultation process is documented in Chapter 5, Exhibit 12.

1.6.3. Executive Orders

1.6.3.1. Executive Order 11593, Protection and Enhancement of the Cultural Environment (36 FR 8921, May 15, 1971)

This executive order requires the initiation by Federal agencies of measures necessary to direct their policies, plans and programs in such a way so that federally owned sites, structures and objects of historical, architectural or archaeological significance are preserved, restored and maintained for the inspiration and benefit of the people. Compliance with this order was coordinated with SHPO and is documented in Chapter 5, Exhibit 12.

1.6.3.2. Executive Order 12372, Intergovernmental Review of Major Federal Programs (47 FR 3059, July 16, 1982)

Requires Federal agencies, to the extent permitted by law, to utilize the State process to determine official views of State and local elected officials and communicate with State and local officials as early in the program planning cycle as is reasonably feasible to explain specific plans of action. The Resources Agency of California was contacted to notify appropriate State agencies (see Chapter 5, Exhibit 5).

1.6.4. State of California

1.6.4.1. California Coastal Act of 1976, Public Resources Code Section 3000 et seq.

This Act establishes the California Coastal Zone Management Plan, which has been approved by the U.S. Department of Commerce. All Federal actions which affect the coastal zone must be determined to be as consistent as practicable with this plan.

In accordance with a U.S. Supreme Court decision, the California Coastal Commission has indicated that it will not conduct consistency reviews for administrative Federal actions such as disposal site designation. The Coastal Commission will conduct consistency review of permit applications for dredging projects and transport of dredged material through the coastal zone for disposal (see Exhibit 13).

1.6.4.2. California Environmental Quality Act (CEQA), June, 1986 Public Resources Code Section 21001

CEQA establishes requirements similar to those of NEPA for consideration of environmental impacts and alternatives, and preparation of an environmental impact report (EIR) prior to implementation of applicable projects. Although the proposed action is a Federal action concerning sites outside State boundaries and does not fall under the purview with CEQA, this EIS is consistent with CEQA requirements.

1.7. RELATIONSHIP TO PREVIOUS NEPA ACTIONS OR OTHER FACILITIES THAT MAY BE AFFECTED BY DESIGNATION OF THE DISPOSAL SITE

There are NEPA actions or facilities in the project area which could possibly be affected by continued disposal of dredged material at the preferred or alternative sites. Since disposal activity occurs over open ocean water, no facilities or structures are directly impacted. Rather, distribution of dredged material from the disposal site could interact with disposal from other projects causing cumulative impacts to the water quality, sediment quality, and marine biological environment. These projects are briefly described below and their locations are shown in Figure 1-3.

The sewage treatment plant of the City of San Diego has a single outfall pipe at Point Loma which discharges an average of 177 million gallons of advanced primary treated municipal waste per day. The discharge pipe extends approximately 2 nmi (4 km) seaward from Point Loma to a "Y" shaped diffuser end located in approximately 37 fathoms (67 m) of water. This outfall is more than 5 nmi (9 km) from the LA-5 site, 5 nmi (10 km) from the LA-4 shallow water site, and 10 nmi (19 km) from the deep water site.

The nearest interim or finally designated dredged material disposal site is the San Diego Point Loma Site (LA-4), which is located approximately 3 nmi (5.5 km) southeast of the LA-5 site. The shallow water alternative to final designation of the LA-5 site is final designation of the LA-4 site, whose interim status is scheduled to expire in December 1988. This site is located south and inshore of the LA-5 site, in approximately 45 fathoms (82 m) of water. This site has received little disposal use in the past; however, if any continued use of this site were made in the future, some cumulative effects with impacts from the LA-5 site could be expected.

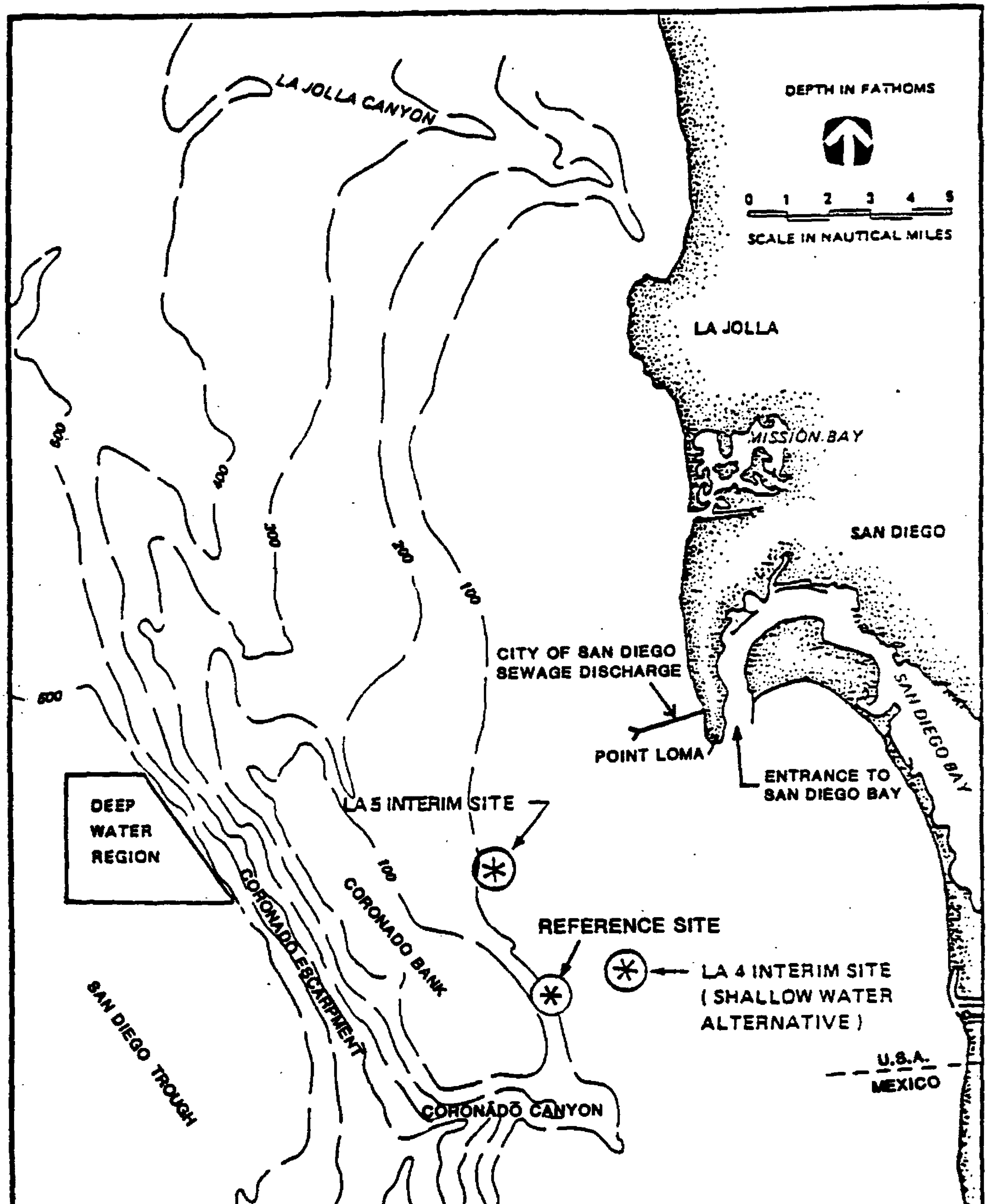


FIGURE 1-3. OTHER MAJOR FACILITIES IN THE PROJECT VICINITY

CHAPTER 2. ALTERNATIVES

This chapter of the EIS includes a description of each of the major alternatives considered during the development of the preferred alternative. Evaluation of a reasonable range of alternatives is required by NEPA at 40 CFR 1502.14. Comparisons of potentially feasible alternatives in relation to EPA's five general disposal site criteria and 11 specific disposal site selection criteria (40 CFR 228.5 and 228.6) are presented to summarize the information for the potential sites. The detailed discussion of each specific criterion can be found in Chapters 3 and 4.

2.1. DESCRIPTION OF ALTERNATIVES

2.1.1. Preferred Alternative (LA-5 ODMDS)

The preferred alternative for designation of a site for disposal of dredged material from the Port of San Diego and adjacent areas is final designation and continued use of the LA-5 ODMDS. This is also the environmentally preferred alternative because it is desirable to restrict existing environmental effects to one site and not impose them at new sites or compound environmental impacts observed at already stressed sites.

The LA-5 site is located at coordinates 32° 36' 50" north and 117° 20' 40" west, which is about 10 nautical miles (nmi) (5 kilometers or km) offshore from San Diego, California and outside of the 3 mile territorial sea limit (Figure 1-1). The site includes all areas within a 1,000 yard (914 m) radius of the center coordinates. The underlying seafloor is a west facing slope with a minimum depth of about 80 fathoms (146 m) and a maximum of about 110 fathoms (201 m). Beyond the site limits, the slope continues downward, eventually ending at a bottom depth of about 160 fathoms (293 m) east of the Coronado Escarpment.

The nearest interim or finally designated dredged material disposal site is the San Diego Point Loma Site (LA-4), which is located approximately 4 nmi (2.2 km) southeast of the LA-5 site. The LA-4 site has interim designated status that ends in December 1988.

When the LA-5 site is fully designated, EPA will formally remove interim designation of the LA-4 site. This procedure will remove LA-4 from the list of sites under 40 CFR 228.12(a)(3).

The LA-5 ODMDS has been identified as the preferred alternative because:

A. The site is close enough to the expected dredging sites to keep transportation distances and costs to an acceptable level,

B. The site is far enough offshore and in deep enough water to prevent disposed material from reaching productive nearshore habitats or amenity areas and minimize potential environmental damage,

C. The site has been used for dredged material disposal on an interim basis since 1977, and

D. The site characteristics comply with EPA's siting criteria (40 CFR 228.5 and 228.6).

2.1.2. <u>No Action Alternative</u>

Selection of the No Action Alternative would mean that final designation of an appropriate ODMDS would not be made by EPA. This would cause the interim status of the LA-5 and LA-4 sites to expire and there would no longer be a readily accessible site of ocean disposal of dredged material in the vicinity of San Diego.

Under the EPA's Ocean Dumping Regulations and Criteria (40 CFR 228.12(a) and in accordance with the requirements of Section 102(a) of MPRSA, "various sites were approved for ocean dumping ... on an interim basis pending completion of baseline or trend assessment surveys and designation for continuing use or termination of use." The criteria further state that the interim designations were based upon historical usage and were not intended to satisfy the criteria for final designation and continuing use.

If EPA selected the No Action Alternative, which would prevent final designation of the site for continued use and prohibit further use of the LA-5 site, the action would be in conflict with the intent of MPRSA. COE would then be required to either:

A. Develop an acceptable alternative disposal method (e.g., land-based or within a confined water body),

B. Independently develop information sufficient to select an acceptable ocean site for disposal under Section 103(d) of MPRSA, or

C. Modify or cancel dredging projects that depend on ocean disposal as the only feasible method for disposal of the dredged material (40 CFR 228.4).

As discussed in Chapter 1, dredging is essential to the maintenance and operation of the nationally important Port of San Diego and the San Diego Naval Station, as well as other adjacent areas. Therefore, the No Action Alternative is not an acceptable alternative because it would eliminate an ocean disposal site within a reasonable distance of the ports, and severely affect existing and planned uses of San Diego Bay.

2.1.3. Delayed Action Alternative

EPA designated the LA-5 site as an interim site for a three year period (42 FR 2462, January 11, 1977). In 1980, the agency extended the interim designation and issued a schedule for publishing the EIS and final designation based on a consent agreement that was reached in a law suit concerning the disposition of ocean disposal sites. Three additional extensions of interim status for the site were granted by EPA in order to allow time for field studies, EIS preparation, and public review. The final date for designation of consent agreement sites has now been set for December 31, 1988.

A Delayed Action Alternative should be considered only if a completely new alternative is being developed, and delaying the start of the process could have some environmental or economic benefits based on new information. Since the LA-5 site has been used for a substantial period, EPA and COE do not anticipate that alternative sites, other than the two discussed in this EIS, will be developed for disposal of large quantities of dredged material. If the proposed action is delayed, the interim designation may expire and dumping at the LA-5 interim site would not be authorized unless another extension was granted by EPA. EPA cannot continue to grant extensions without valid reasons for doing so in light of the court's decision on the consent agreement.

In this instance, the need for ocean disposal of dredged material is a continuing concern and requires conclusion of the site designation process in the most expeditious manner possible. Delaying the designation of a site would not be a viable alternative nor would it provide any advantage over the preferred alternative. Unless this study is found to be unacceptable on scientific grounds, the Delayed Action Alternative cannot be considered as an acceptable alternative.

2.1.4. Landfilling Alternatives in Port Areas

Use of dredged material for landfilling, also referred to as the creation of fastlands, is reviewed here as a possible alternative to ocean disposal. Although several landfill projects can be anticipated in the San Diego Harbor, the timing of these projects may or may not coincide with the timing of maintenance dredging. This alternative is already being utilized for creating fastlands (landfills) as the need arises and as the dredged material is found to be acceptable for landfill use. This, however, does not eliminate the need for ocean disposal or disposal at other sites.

2.1.4.1. Landfilling of Marine Areas

Essential dredging in the harbors is not expected to coincide with the need to create new land areas, an issue that has been experienced with previous projects as well. It is also possible that a large portion of dredged material may not comply with guidelines issued to regulate dredging and filling projects under Section 404 of the Clean Water Act. Material dredged from the harbors is not always suitable for fill because the proportion of fine sediments may be high compared to the requirements of permits and the Section 404(b)(1) guidelines. COE must have alternative means for disposal of the dredged material if the landfilling alternatives are not approved. Options for landfilling will be evaluated on a project-by-project basis. For the purposes of this EIS, EPA and COE are assuming that a major portion of the material dredged from the ports will have to be disposed of at a suitable ocean disposal site. Consequently, the landfilling alternative in marine areas is not a viable alternative to dispose of this material.

2.1.5. Land Disposal Alternatives at Sanitary Landfills

There are three large sanitary landfill sites in San Diego County which could be considered as possible alternative sites. These are: the San Marcos site in North County, the Sycamore site in the central part of the County, and the Otay site in the southern part of the County. All three sites are Class II-1 landfills. A Class II-1 landfill can accept solid waste, certain solid hazardous wastes, some nonhazardous liquids such as petroleum products, but no liquid hazardous waste. All material disposed at these Class II-1 landfills must comply with the provisions of the Resource Conservation and Recovery Act (RCRA). The three landfills can accept dredged material suitable for ocean disposal, or dredged material considered too contaminated for ocean disposal, if it meets permit conditions under the RCRA, and the capacity of the landfills can accommodate the dredged material.

The Otay landfill is limited to accepting a maximum of 1,000 tons of material per day. Port dredging usually produces much more than 1,000 tons (dry) of materials per day for a period of several weeks. This would use all of Otay capacity for the duration of a dredging project. The port cannot be permitted to monopolize this landfill capacity for this period of time because it is needed by many other users.

The San Marcos and Sycamore sites are both located in the interior of the County--the San Marcos site is almost 40 miles (25 km) away in the North County area and the Sycamore Landfill is more than 20 miles (12 km) east of San Diego Bay. Handling of wet dredged material through the City streets will create unacceptable traffic and sanitation problems. These sites are therefore not considered viable alternatives to ocean disposal.

Handling of materials by trucks would create increased transportation and air pollution impacts that may be unacceptable. This option would be feasible for a limited number and size of dredging projects; however, it is not considered a viable alternative to ocean disposal for large dredging projects.

2.1.6. Beach Nourishment Alternative

The use of dredged material for beach nourishment is encouraged in areas suffering from erosion, especially if the material is compatible with the grain size distribution of the receiving beach. Impacts on biological communities and water quality must also be considered before beach nourishment is permitted.

This method of dredged material disposal is often infeasible for dredging projects because grain size distribution of the material is not compatible with beaches in the area. A large dredging project in the Port of San Diego would produce large quantities of primarily fine sediments, most of which could not be used for beach nourishment due to grain size incompatibility, nor disposed of in a sanitary landfill due to dewatering, odor, capacity, and transport problems.

Selection of the beach nourishment and/or land disposal methods are evaluated by COE on a case-by-case basis for each permit, and are not feasible alternatives for disposal of large amounts of dredged material removed from the bay. Therefore, the beach disposal alternative has been eliminated from further consideration in this EIS.

2.1.7. Alternative Ocean Disposal Sites

The disposal of large amounts of acceptable dredged material in the ocean may be the best solution to long-term management of the overall dredging program for the Port of San Diego and the San Diego Naval Station. The Purpose of and Need for Action section of this EIS (Section 1.2) outlines the major advantages and necessities for designation of an ODMDS. The two alternatives discussed below were developed as a range of NEPA alternatives to the preferred alternative.

The LA-5 and LA-4 sites are presently the only sites with established locations (Figure 2-1). Table 2-1 is a brief comparative table that shows the major differences in the three potential ocean disposal sites. The alternative sites would be located in two regions: a shallow water region and a deep water region. These two areas were chosen to assess the relative logistical and environmental advantages and/or disadvantages of designating the disposal site in other oceanic locations. There is no advantage in moving the site to a new location at a similar depth.

Changing the location of the site to another area would not result in decreased disposal impacts, but would cause new environmental impacts at a location that previously experienced disposal activities or one that has been undisturbed. Discussion of the deep water alternative site is not limited to any specific site within the deep water region. This approach precludes an arbitrary choice of a site location and allows maximum consideration of the feasibility of using a particular site within the region.

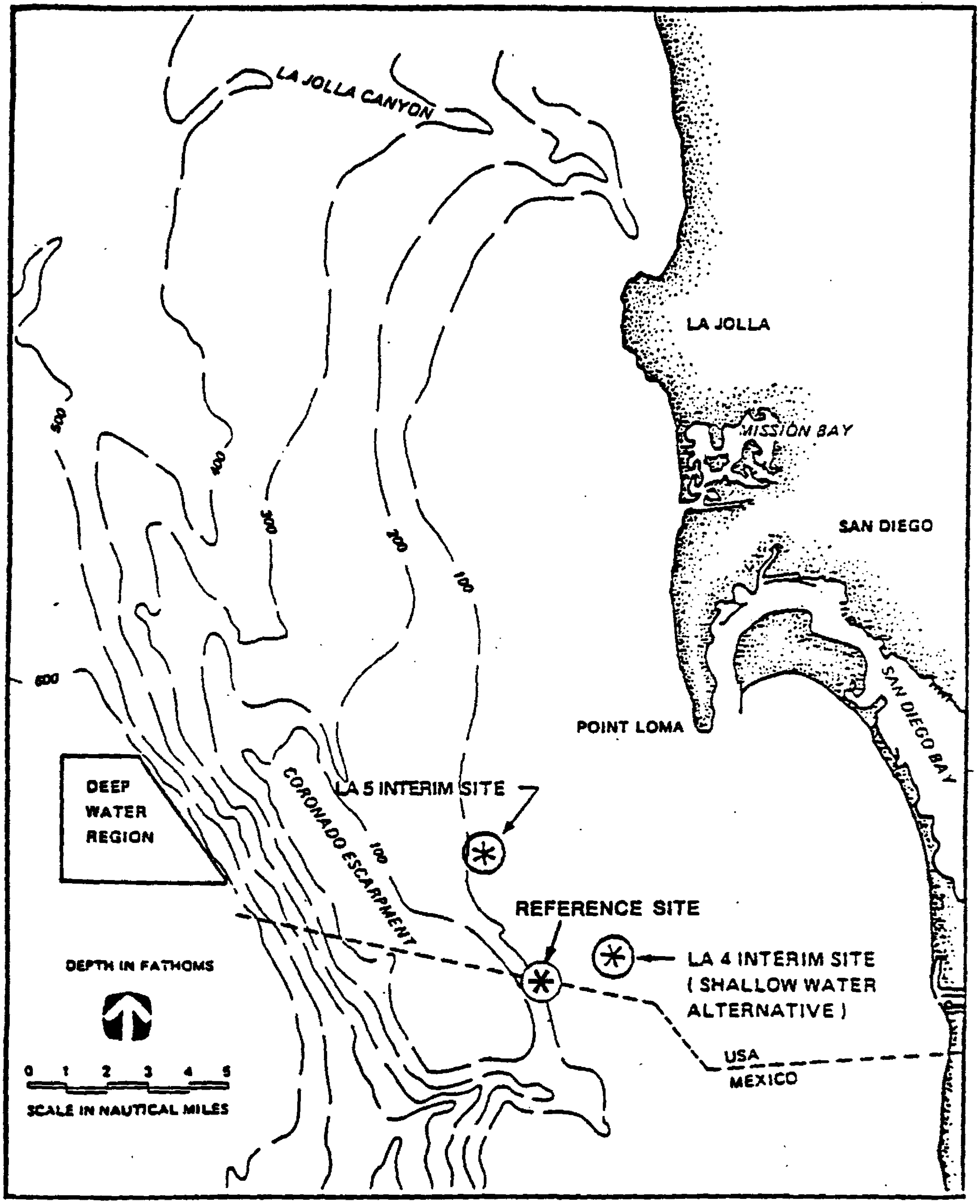


FIGURE 2-1. LOCATION OF ALTERNATIVE DISPOSAL SITES IN THE SAN DIEGO SHELF AND BASIN

Table 2-1. General Comparison Between Geographical Position, Depth of Water, Bottom Topography, and Distance from the Coast for the Alternative Ocean Disposal Sites

Site	Coordinates or Region	Water Depth Fathoms (m)	Bottom Topography	Distance Offshore (nmi/km)
LA-5	Centered at 32° 36' 50" North by 117° 20' 40" West	100 (182)	Ridge Slope	6/11
Shallow Water	Centered at 32° 35' 00" North by 117° 17' 30" West	45 (82)	Ridge Slope	6/11
Deep Water	Slope or Basin Region	600 (1,092)	Gently Sloping to Flat Plain	12-16/22-30

2.1.7.1. Shallow Water Site

The shallow water alternative to final designation of the LA-5 site is final designation of the LA-4 site, whose interim status is scheduled to expire in December 1988. This site is located south and inshore of the LA-5 site, in approximately 45 fathoms (82 m) of water (Figure 2-1). This site has received little disposal use in the past. Principal considerations in evaluating this site are the likely enriched benthic fauna due to the shallower depth (compared to LA-5), conflicts with fishing and recreational boating, potential for cultural resources, and proximity to the Mexican border.

2.1.7.2. Deep Water Site

The location of the deep water region was determined by the need for the site to be far enough offshore to have the environmental advantages of a deep water offshore location, but also close enough to San Diego Bay to keep barging distance feasible. The site would be located west of the LA-5 site in a basin area west of the Coronado Escarpment, at a depth of about 600 fathoms (1100 m) (Figure 2-1). This site would be 6-11 nmi (11-20 km) west of the LA-5 site and 12-16 nmi (22-30 km) from shore.

Major considerations in evaluating this site are: distance from shore, potential oil and gas activities, conflicts with commercial fishing, and potential for increases in short dumping. Advantages of this site include a naturally depauperate benthic fauna and a disposal site that is off the mainland shelf.

Disadvantages of the site include: increased dispersal of sediment throughout the water column which could potentially affect fish populations, and dispersal over a larger area of ocean bottom creating a larger, unconcentrated area of impact. Increased distance to the site will result in proportionately increased degradation of air quality and increased consumption of limited energy resources; however, these impacts are considered to be negligible. COE determined that this site should be evaluated in detail in this EIS.

2.2. DISCUSSION OF ALTERNATIVES

2.2.1. Alternatives Not Considered for Further Analysis

The No Action Alternative and the Delayed Action Alternative were completely eliminated from further consideration in the EIS. Neither of these two alternatives would satisfy the basic purpose of the site designation process, nor are they in the best interest of economic growth of the San Diego Harbor. EPA and COE have determined that one of the best solutions to harbor dredging operations is to dispose of the dredged material in the ocean at a fully designated site.

The alternatives for Landfilling in Port Areas, Land Disposal at Sanitary Landfills and Beach Nourishment will be evaluated by COE and EPA on a permit-specific basis. These options are not viable for disposal of large quantities of dredged material that are predicted from major port projects in the coming years. Consequently, these alternatives have been eliminated from further evaluation in this site designation EIS, but they remain as options to be considered in individual permits.

2.2.2. Compliance of the Three ODMDS Alternatives with General Criteria for the Selection of Sites (40 CFR 228.5)

2.2.2.1. General Criteria 40 CFR 228.5(a)

> The dumping of materials into the ocean will be permitted only at sites or in areas selected to minimize the interference of disposal activities with other activities in the marine environment, particularly avoiding areas of existing fisheries or shellfisheries, and regions of commercial or recreational navigation.

Disposal at the LA-5 site has not interfered with commercial fishing, sportfishing or recreational activities in the area. Vessel traffic interference has been insignificant despite considerable use of nearby areas by commercial, military and recreational vessels. The present situation is sufficiently free from hazard to be acceptable to the U.S.C.G. and special conditions imposed by COE on disposal permits will assure negligible risks from interference between disposal operations and shipping. The alternative sites have been specially selected so as to minimize the potential impact of commercial or recreational activities.

2.2.2.2. General Criteria 40 CFR 228.5(b)

> Locations and boundaries of the disposal sites will be so chosen that temporary perturbations in water quality or other environmental conditions during initial mixing caused by disposal operations anywhere within the site can be expected to be reduced to normal ambient seawater levels or to undetectable concentrations or effects before reaching any beach, shoreline, marine sanctuary, or known geographically limited fishery or shellfishery.

The LA-5 and LA-4 sites are 6 nmi (3 km) from the nearest beach or shoreline, 12.3 nmi (7 km) from the nearest federal wildlife sanctuary at the mouth of the Tia Juana River, and 17 nmi (9 km) from the nearest Area of Special Biological Significance (ASBS) at the San Diego-La Jolla Ecological Reserve. Dilution and dispersal by local mixing currents will reduce water quality perturbations resulting from disposal at the LA-5, LA-4 shallow water site, or deep water sites to background levels in much shorter distances, so that there is essentially no likelihood of disturbance of such areas from disposal at these sites. There are no geographically limited fisheries in the region.

2.2.2.3. General Criteria 40 CFR 228.5(c)

If at any time during or after disposal site evaluation studies, it is determined that existing disposal sites presently approved on an interim basis for ocean dumping do not meet the criteria for site selection set forth in Sections 228.5 through 228.6, the use of such sites will be terminated as soon as suitable alternate disposal sites can be designated.

There is no indication that disposal at the LA-5 site or the alternate sites do not or would not meet these criteria. Chapters 3 and 4 discuss these criteria in detail.

2.2.2.4. General Criteria 40 CFR 228.5(d)

The sizes of ocean disposal sites will be limited in order to localize for identification and control any immediate adverse impacts and permit the implementation of effective monitoring and surveillance programs to present adverse long-range impacts. The size, configuration, and location of any disposal site will be determined as a part of the disposal site evaluation or designation study.

The size of the proposed ocean disposal sites is limited to a circular area with a 1,000 yard (914 m) radius. This will limit possible environmental effects to the immediate vicinity of the designated site. Effective surveillance and monitoring of disposal operations (33 USC 1417) at the designated site are feasible given this restricted area. The size, configuration and location of the site is prescribed as part of this site evaluation study.

2.2.2.5. General Criteria 40 CFR 228.5(e)

EPA will, wherever feasible, designate ocean dumping sites beyond the edge of the continental shelf and other such sites that have been used historically.

The LA-5 site is located at the 100 fathom (182 m) contour on the continental shelf. The LA-5 site has been used for disposal of dredged material on an interim basis since 1977. This is the only site that meets the criteria for designation of a site that has been used for disposal of dredged material in the past.

Selection of other alternative sites was made deliberately to examine the merits of sites other than the LA-5 site. The deep water site was chosen in an oceanic basin, off the continental shelf, while the shallow water site was chosen close to shore on the shelf. Neither of these sites completely satisfy the above general criteria.

2.2.3. Comparison of the Three ODMDS to EPA's 11 Specific Criteria for Site Selection 40 CFR 228.6(a)

The detailed discussion of each of the 11 criteria is contained in the Chapter 3, Affected Environment, and Chapter 4, Environmental Consequences. A summary table of these comparisons (Table 2-2) is presented here to support the decision process in selecting the preferred alternative over the other viable alternatives.

2.2.4. Selection of the Preferred Alternative

Introduction of large amounts of sediment are expected to alter the natural environmental conditions at any site. The LA-5 site has been affected by the disposal of dredged material in the past. The key issue for the LA-5 ODMDS is that the dredged material disposal impacts have not unreasonably degraded the marine environment over the past ten years.

The predicted environmental effects of a dredged material disposal site in the deep water region are similar to those identified for the LA-5 site, although greater impacts to pelagic fish and lesser impacts to benthic organisms may occur at the deep water site. The severity of the environmental impacts at the deep water site are expected to be insignificant. The predicted environmental effects for a dredged material disposal site at the shallow water site are predicted to be similar to the effects at the other two sites.

Changing the location of the ODMDS from the LA-5 site would impact the deep water site which previously has not been affected by disposal of large amounts of dredged material, or disposal would contribute significantly to environmental impacts already imposed on the shallow water site. If a new site was designated, two sites off the California coast would be experiencing environmental impacts, including the initial recovery phase at the LA-5 site and the initial detrimental phase imposed on the newly designated site. Surveillance of dumping by USCG and other agencies which, necessary to discourage illegal dumping activities, would be considerably more difficult at the deep water site than it is presently at the LA-5 site. For these reasons and others, the U.S. Fish and Wildlife Service opposes moving the site to an unimpacted location (Jack Fancher, FWS, personal communication, June 26, 1984).

EPA and COE have determined that the final designation of the ODMDS site should be the preferred alternative. Implementation of this action will involve a detailed site management program, including a site monitoring program of biological resources, effects on the surrounding area and tracking of all disposal activities. This program will be published by EPA and COE in a separate document. Before the site management program is released in a final form, a draft will be made available for public review and comment.

Table 2-2. Comparison of Alternative Ocean Disposal Sites Based on EPA's 11 Specific Site Designation Criteria

40 CFR 228.6(a) Criteria	LA-5 Site	LA-4, Shallow Water Site	Deep Water Site
1. Geographical position, depth of water, bottom topography and distance from coast.	32° 36' 50" north by 117° 2' 40" west, depth 100 fathoms (182 m), ridge slope, 6 nmi from coast.	32° 35' 00" north by 117° 17' 30" west, depth 45 fathoms (82 m), ridge slope, 6 nmi from coast.	See Figure 2-1, depth 600 fathoms (1,092 m), gentle slope to flat basin, 12 to 16 nmi from coast.
2. Location in relation to breeding, spawning, nursery, feeding or passage areas of living resources in adult or juvenile stages.	Feeding and breeding area for resident species. No known special migratory breeding or nursery areas. Nearby gray whale migration route.	Feeding and breeding area for resident species. No known special migratory breeding or nursery areas. Nearby gray whale migration route.	Feeding and breeding area for resident species. Fauna less abundant and less diverse than in shallow water region. Nearby gray whale migration route.
3. Location in relation to beaches and other amenity areas.	Approximately 6 nmi from Point Loma beaches. Other areas too far to be of concern.	Approximately 6 nmi from Point Loma beaches. Other areas too far to be of concern.	Approximately 22 nmi from Point Loma beaches. Others too distant to be of concern.
4. Types and quantities of wastes proposed to be disposed of, and proposed methods of release, including methods of release, including methods of packing the waste, if any.	Predominantly silts and clays dredged from San Diego Harbor. Average annual volume expected to be approximately 500,000 yd^3. Predominantly split hull barges.	Same as LA-5 site.	Same as LA-5 site.

Table 2-2 (Continued). Comparison of Alternative Ocean Disposal Sites Based on EPA's 11 Specific Site Designation Criteria

40 CFR 228.6(a) Criteria	LA-5 Site	LA-4, Shallow Water Site	Deep Water Site
5. Feasibility of surveillance and monitoring.	USCG conducts spot surveillance. Monitoring feasible, but somewhat complicated by depth and topography.	USCG conducts spot surveillance. Monitoring feasible, but somewhat complicated by depth and topography.	USCG conducts spot surveillance. Monitoring feasible, but complicated by great depth and long travel time.
6. Dispersal, horizontal transport and vertical mixing characteristics of the area, including prevailing current direction and velocity, if any.	Vertical mixing and currents will disperse fine material to the northwest, the prevailing current direction, or southeast. Coarser sediment reaching the bottom would be transported offshore by currents and sediment slumping on the slope.	More material would reach the bottom than at the LA-5 site because the site is shallower. Material not deposited would be dispersed along the coast and possibly inshore of the site. Prevailing current direction to the northwest. Material reaching the bottom would be transported offshore.	Less material would reach the bottom due greater depths. Suspended material would be widely transported to the southeast and northwest deep in the San Diego Trough. Little transport of material would occur at the bottom.
7. Existence and effects of current and previous discharges and dumping in the area (including cumulative effects).	Some negative impacts on sediments and biota detected from past disposal. No expected interaction with other discharges.	Little disposal to date with presumed insignificant effects. No expected interaction with other discharges.	No known discharges or dumping.

Table 2-2 (Continued). Comparison of Alternative Ocean Disposal Sites Based on EPA's 11 Specific Site Designation Criteria

40 CFR 228.6(a) Criteria	LA-5 Site	LA-4, Shallow Water Site	Deep Water Site
8. Interference with shipping, fishing, recreation, mineral extraction, desalination, fish and shellfish culture, areas of special scientific importance and other legitimate uses of the ocean.	Minor interference with shipping and fishing. No impacts to other uses of the ocean.	Minor interference with shipping and fishing. No impacts to other uses of the ocean.	Minor interference with shipping and fishing. Impacts to other uses of the ocean negligible.
9. Existing water quality and ecology of the site as determined by available data or by trend assessment or baseline surveys.	Good water quality. Significantly adverse effects of past disposal operations on sediment quality and the community structure of benthic fauna and demersal fish have been detected.	Good water quality. Some effects of occasional disposal operations in the past on sediment quality and community structure of benthic fauna and demersal fish probably detectable.	Water quality and benthic ecology generally undisturbed and near natural conditions.
10. Potentiality for the development of nuisance species at the disposal site.	Species characteristic of stressed conditions have been detected at the site and determination of nuisance status still has to be identified.	Species characteristic of stressed conditions probably present at the site and determination of nuisance status still has to be identified.	Nuisance species not present at this previously undisturbed site.
11. Existence at or in close proximity to the site of any significant natural or cultural features of historical importance.	No known shipwrecks in vicinity. No known aboriginal remains at the site.	No known shipwrecks in vicinity. No known aboriginal remains at the site.	Some potential for shipwrecks in the deep water region, impact depends on location of the site. No known aboriginal remains.

CHAPTER 3. AFFECTED ENVIRONMENT

3.1. OCEAN DISPOSAL SITE CHARACTERISTICS

The three alternative disposal sites are within an open embayment along Southern California, called the Southern California Bight. This continental borderland consists of a narrow, shallow and flat mainland shelf; a complex series of deep basins, submergent ridges or islands; and, at its westernmost edge, the continental slope which descends to the abyssal depths of the Pacific Ocean. Slopes leading down to the basins from the mainland shelf or the intervening ridges are an additional physical feature of importance. Submarine canyons bisect the mainland and insular shelves throughout the bight.

The LA-4, LA-5, and deep water disposal sites are respectively outer shelf, slope, and basin environments (see Figure 3-1). The shallow water LA-4 site at approximately 45 fathoms (82 m) is located on the outer edge of the mainland shelf on gently sloping surface 6.5 nmi (12 km) from the entrance to San Diego Bay. The LA-5 site is located on a ridged slope at a depth of 100 fathoms (183 m) and 7 nmi (14 km) from the entrance to San Diego Bay. The deep water site is in a basin called the San Diego Trough, at depths greater than 600 fathoms (1,097 m) and 13-16 nmi (24-31 km) from the entrance to San Diego Bay.

The ocean floor off San Diego has a complex topography and does not have a continuously deepening slope from shore to the deep basin of the San Diego Trough. Instead, a portion of the intervening ocean floor rises 65 fathoms (120 m) to form the Coronado Bank, somewhat isolating the LA-5 and LA-4 sites from the deep water basin to the west. On the western side of the Coronado Bank, the Coronado Escarpment descends steeply into the San Diego Trough. On the southern side of the Coronado Bank and somewhat south of the LA-5 and LA-4 sites, is a steep submarine canyon, the Coronado Canyon.

In describing the affected environment, this chapter will focus on features of the Southern California Bight which are typical of the three alternative disposal sites. Whenever possible, values typical of mainland shelves, slopes, and deep water basins are presented for comparison. It should be recognized that the LA-5 and LA-4 sites are in close proximity and do not have a great difference in depth. Consequently, they can be expected to have similar physical and biological features.

Values are also presented from a field survey undertaken for this EIS at the LA-5 site and a nearby reference site. The reference site has depths approximately the same as the LA-5 site, and no disposal activities have occurred there. Samples were collected at these two sites of the water column, sediment, and marine fauna in August and December 1983, and February/March

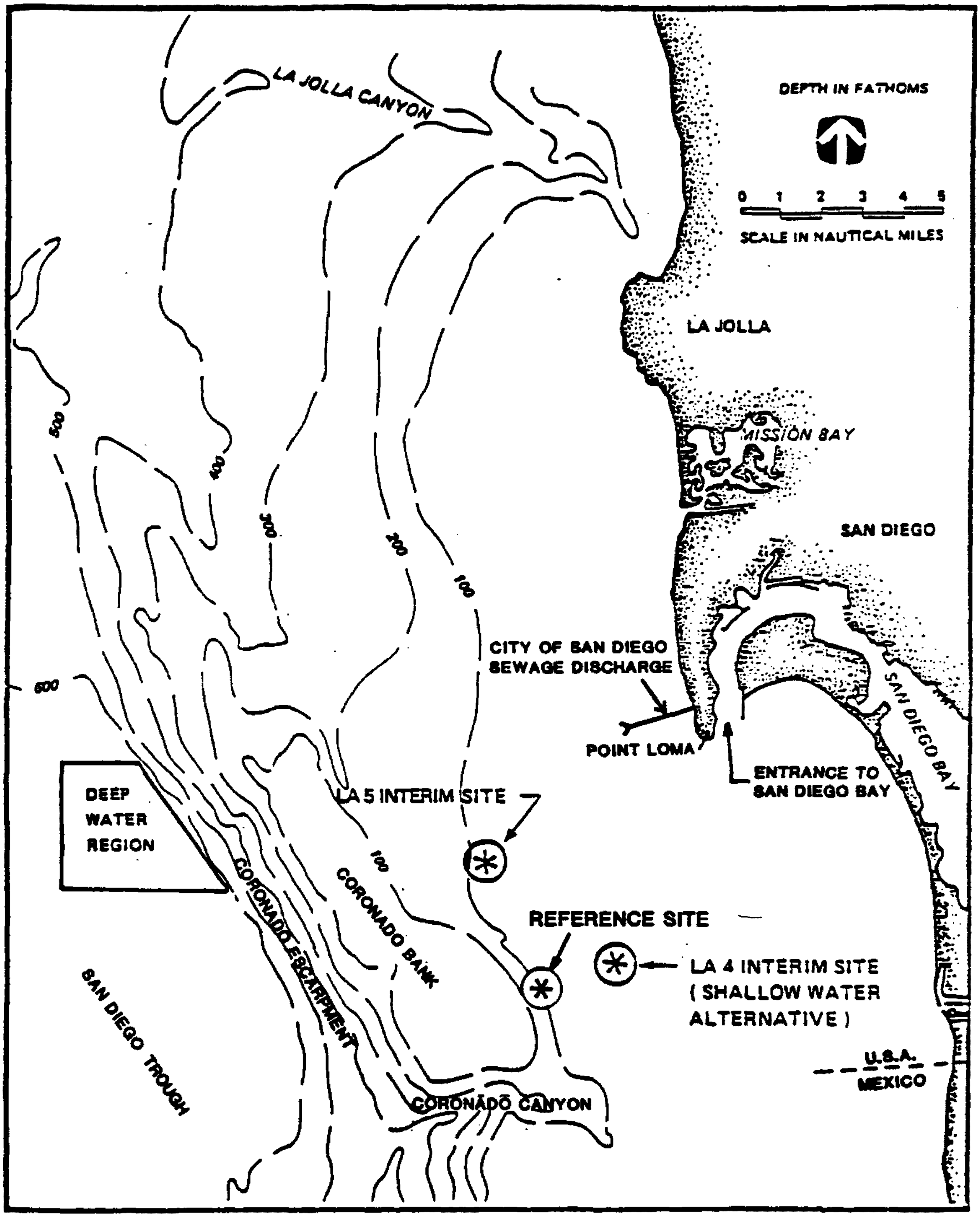


FIGURE 3-1. LOCATION OF DISCHARGE OUTFALLS AND OTHER OCEAN DISPOSAL SITES IN THE PROJECT AREA

and April/May 1984. Data from the field survey (Appendix A) is presented in this chapter as an indication of the existing conditions of the LA-5 site. In Chapter 4, field survey data is further examined as an indication of past and future impacts of dredged material disposal.

3.1.1. Proposed Use of the Site

The ocean dredged material disposal site (ODMDS) will be used solely for the disposal of dredged material that has been evaluated by permitting criteria of COE and EPA (33 CFR 227 and 40 CFR 225), and authorized for dumping under Section 103 of MPRSA. The site will be designated for continuing use subject to the design of a site management program, site monitoring data, and the needs of site users (40 CFR 228.3 and 228.7 through 228.10). If unreasonable environmental impacts are detected by EPA and/or COE during any phase of the management and evaluation process, modification of the disposal site location or its continued use may be made (40 CFR 228.11).

The total amount of material to be disposed at the site should average 280,000 yd^3 per year. The dredged material consists predominantly of sand, silt, and clays dredged from projects within San Diego Bay or nearby locations. Dredging operations will be conducted a few days or weeks in any given year, and will generate two to four barge trips a day during that time period. At the dredge site, split hull barges having volumes from 500 to 4,000 yd^3 will be loaded and towed by tug boats to the dump site. At the dump site, material will be released by opening the bottom of the split hull barge, or by pumping the contents through an onboard pipeline to a submerged outlet.

3.1.2. Existence and Effects of Current and Previous Discharges and Dumping in the Area, Including Cumulative Effects 40 CFR 228.6(a)(7)

There are many discharges into the marine environment in the Southern California Bight. It is not feasible or necessary to describe all of them and their effects in the EIS. This section is intended to describe significant discharges into the ocean in the vicinity of the ODMDS alternatives where potential cumulative or synergistic impacts are possible. Consequently, the only discharge described is the municipal sewage outfall from the City of San Diego. There are no other current significant discharges to the marine environment close enough to any of the alternative sites to have a potential for interacting with the environmental effects of dredged material disposal.

3.1.2.1. Municipal Waste Discharges at Point Loma

The sewage treatment plant of the City of San Diego discharges an average of 177 million gallons per day of advanced primary treated municipal waste through an outfall seaward of

Point Loma (Figure 3-1). The discharge pipe is approximately 2 nmi (4 km) long with a seaward Y-shaped diffuser end at an approximate depth of 37 fathoms (67 m). This discharge has been shown to have significant adverse effects on water quality, sediment quality, benthic invertebrate communities and demersal fish populations in the vicinity of the discharge pipes. These effects are limited to local areas near the outfall and do not extend to the vicinity of the LA-5 site (5 nmi or 9 km from the outfall), the LA-4 shallow water site (5 nmi or 10 km from the outfall), or the deep water site (10 nmi or 19 km from the outfall). Therefore, there is little likelihood of cumulative interaction between dredged material disposal at any of the alternative sites and the discharge from the City of San Diego sewage outfall.

3.1.3. Feasibility of Surveillance and Monitoring 40 CFR 228.6(a)(5)

Surveillance and site management are conducted by USCG, EPA and COE. Under Section 107 of MPRSA, the USCG conducts surveillance to ensure compliance with the permit conditions and to discourage unauthorized disposal (33 USC 1417). Additional surveillance, site management and enforcement responsibilities are delegated to EPA (40 CFR 22.36) and COE (33 CFR 226).

Monitoring operations at all three alternative sites would require considerable time and effort to provide the type of high quality data that is necessary for ODMDS management (40 CFR 228.3). Bottom topographic features, oceanic conditions, and meteorological conditions affect most sampling efforts. Sampling difficulty increases as the depth of the site increases; however, accurate sampling is possible at all sites.

Monitoring the impacts at the LA-4 shallow water site would require a similar effort to that needed to monitor the LA-5 site as they are similar in distance from the entrance to San Diego Bay. On the other hand, the shallower depth would reduce sampling time for deployment and retrieval of sampling gear.

Monitoring the deep water site would require more time to deploy and retrieve sampling equipment, and travel time to and from the site would be longer. An advantage of the deep water site is that the bottom is a flat plain of soft sediment and bottom sampling should be relatively easy. Therefore, the deep water site may not be much more expensive to monitor than the shallow water site of the LA-5 site.

3.2. PHYSICAL ENVIRONMENT

3.2.1. Meteorology and Air Quality

The climate of the southern California coastal and offshore area is of the Mediterranean coastal type, with warm dry summers and relatively wet, mild winters. Temperature extremes are uncommon. The mean air temperature ranges from about 12° to 15° C (53° to 59°F) in January, and from 14° to 22°C (58° to 72°F) in August. Mean maximum temperatures for January are 16° to 17°C (61° to 63°F) over the water and 18° to 19°C (64° to 66°F) at adjacent coastal stations. The mean maximum temperatures for August are about 6°C (10°F) higher for the offshore region, and approximately 8°C (15°F) greater for the coast than the mean maximum temperatures for January. The mean sea surface temperatures are about 14°C (58°F) in January and 20°C (68°F) in August (Kimura, 1974).

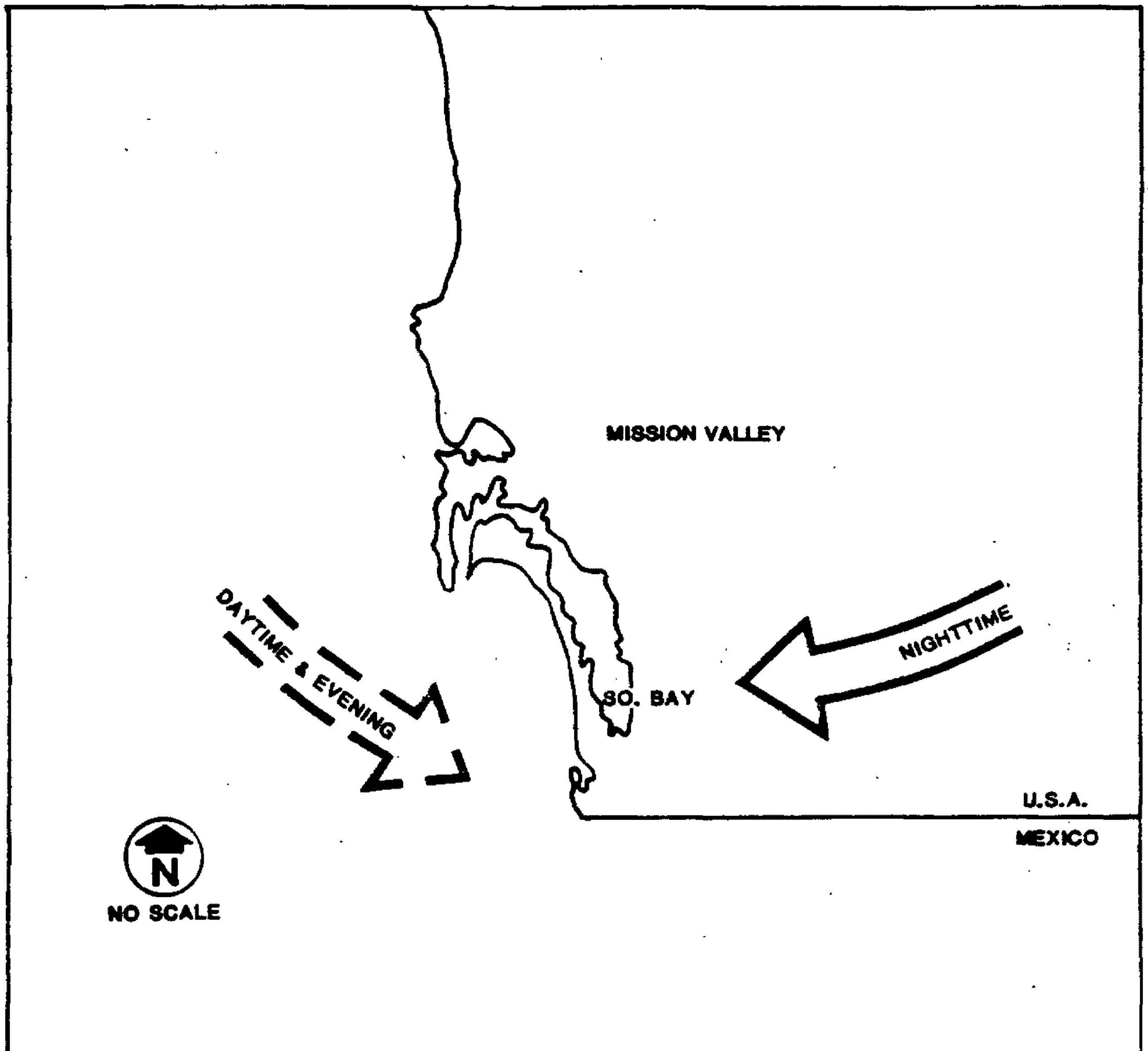
Average annual precipitation in the coastal region ranges between 10 and 15 inches. Precipitation tends to decrease as the distance offshore increases. Most precipitation occurs during the months of October through April, but wide variations take place in monthly and seasonal totals.

The dominant wind pattern for southern California is one of northwest winds offshore, modified near the coast by local topography and land-sea breeze phenomenon. During daytime hours, the predominant winds from the northwest blow at an annual average speed of 9.5 miles per hour (mph). In the evening, the winds calm to an average of 4.1 mph but retain their northwesterly pattern (San Diego Air Pollution Control District, 1959). The night-time hours experience a shift in wind direction from northwesterly to northeasterly as the air drains toward the ocean (Figure 3-2). The average speed of the night-time winds measures 3.6 mph. The spring and early summer winds are influenced by the Catalina Eddy which causes northwesterly winds to shift southeasterly along the coastal gradient (Kimura, 1974). The winds follow the orientation of the mountains and the coast and the eddy is caused by the abrupt change of their orientation from north-south to east-west. This occurs immediately north of Point Conception.

No wind measurements are available for the individual dump sites. As the alternative sites are relatively close, wind conditions are expected to be similar.

Air quality in a particular area depends upon the prevailing weather conditions, local terrestrial topography and the amount of pollutants being emitted into the air. In California, the pollutants that frequently exceed air quality standards are ozone (Oz), total suspended particulates (TSP), nitrogen oxides (NO_x), and carbon monoxide (CO) (California Air Resources Board, 1981).

The proposed project would involve ships hauling dredged material and consequently, there would be an increase in the amount of NO_x, CO, TSP, and hydrocarbons (HC) released in the region. Utilizing the standard dispersion equations, it was determined, based on the hauling ships' horsepower, the ships' fuel consumption, the number of round trips per year, and the distance of each trip, that there would be no significant impact



Source: San Diego Air Pollution Control Board, 1959

FIGURE 3-2. GENERALIZED DEPICTION OF GENERAL WIND REGIMES IN THE SAN DIEGO VICINITY on southern California air quality. Therefore, the amount of air pollutants generated by hauling dredged material to any of the proposed dump sites would be insignificant.

3.2.2. Physical Oceanography of the Southern California Bight 40 CFR 228.6(a)(6)

This section summarizes regional and local information concerning ocean currents, upwelling, waves, and tides in the Southern California Bight with an emphasis on nearshore circulation. A more detailed account of the various aspects of the regional currents can be found in Hickey (1979).

3.2.2.1. System of Currents

The dominant hydrographic feature along the California coast is the California Current which controls the general water character and circulation of the area (Jones, 1971) (Figure 3-3). The California Current originates in colder northern waters and flows southward along the west coast of the North American continent. At Point Conception where the coastline turns in an easterly direction, the California Current continues in a southerly direction along the continental slope. It is considered the western boundary of the Southern California Bight. Beneath the California Current at a depth of approximately 275 fathoms (500 m), the California Undercurrent flows in a northerly direction.

Near the 32° latitude, the California Current swings eastward toward Baja California, and splits into northerly and southerly flows. The portion which flows northerly enters the Southern California Bight and is called the Southern California Countercurrent. It occupies the top 110 fathoms (200 m) of the water column. Upon encountering the Channel Islands and Point Conception, this flow either continues northward or turns back and flows southeast along the continental shelf. This looping feature of the surface current system is sometimes called the Southern California Eddy (Jones, 1971).

This current system manifests three seasons as shown in the seasonal current patterns for the study area (Figure 3-4) and described below:

A. During the Oceanic period from July to November, the southward flowing California Current dominates the nearshore current patterns, and the Southern California Eddy is well developed.

B. During the Davidson period from December to February, the California Undercurrent becomes stronger and partially displaces the California Current westward. The Southern California Eddy is weak.

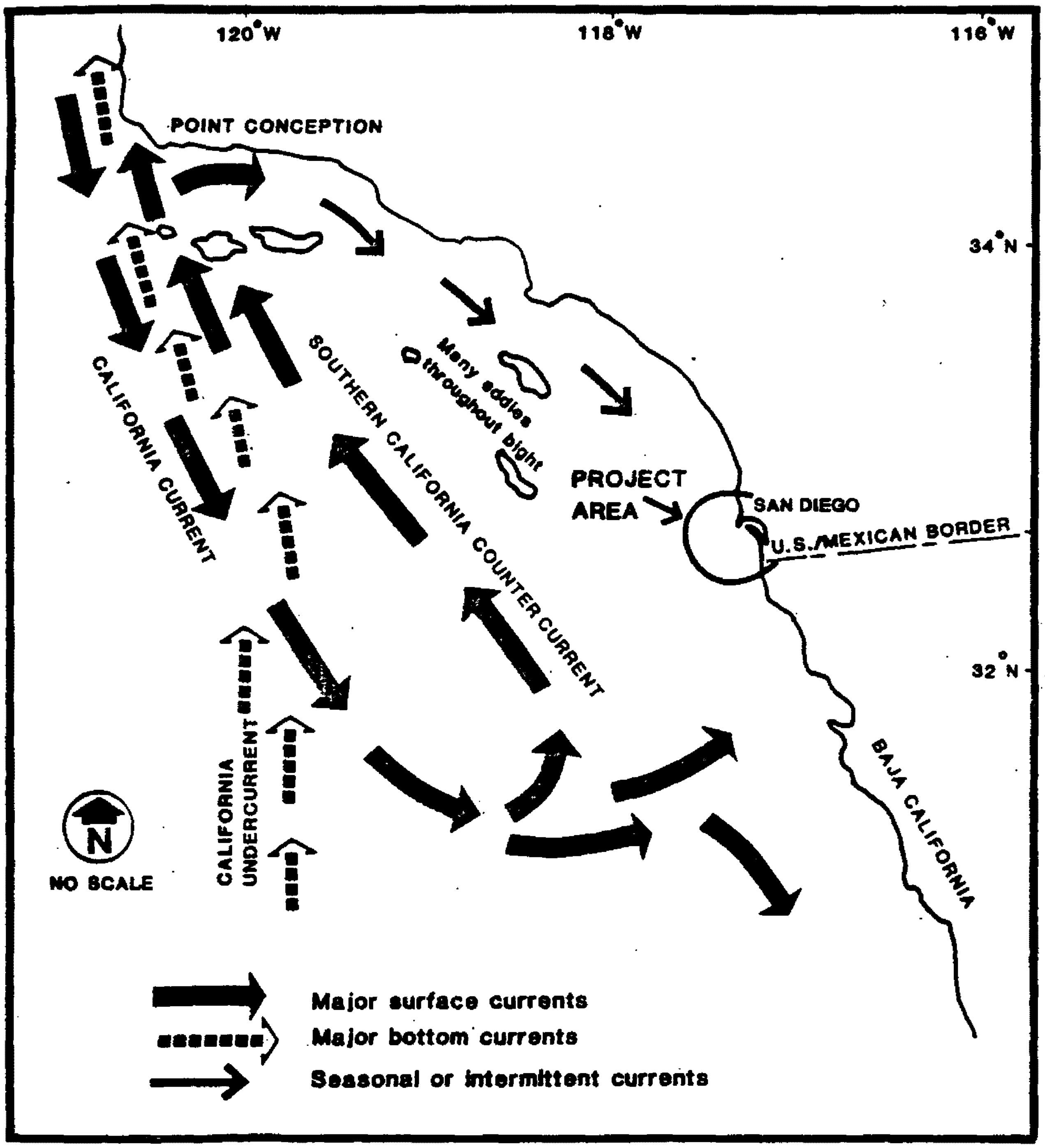
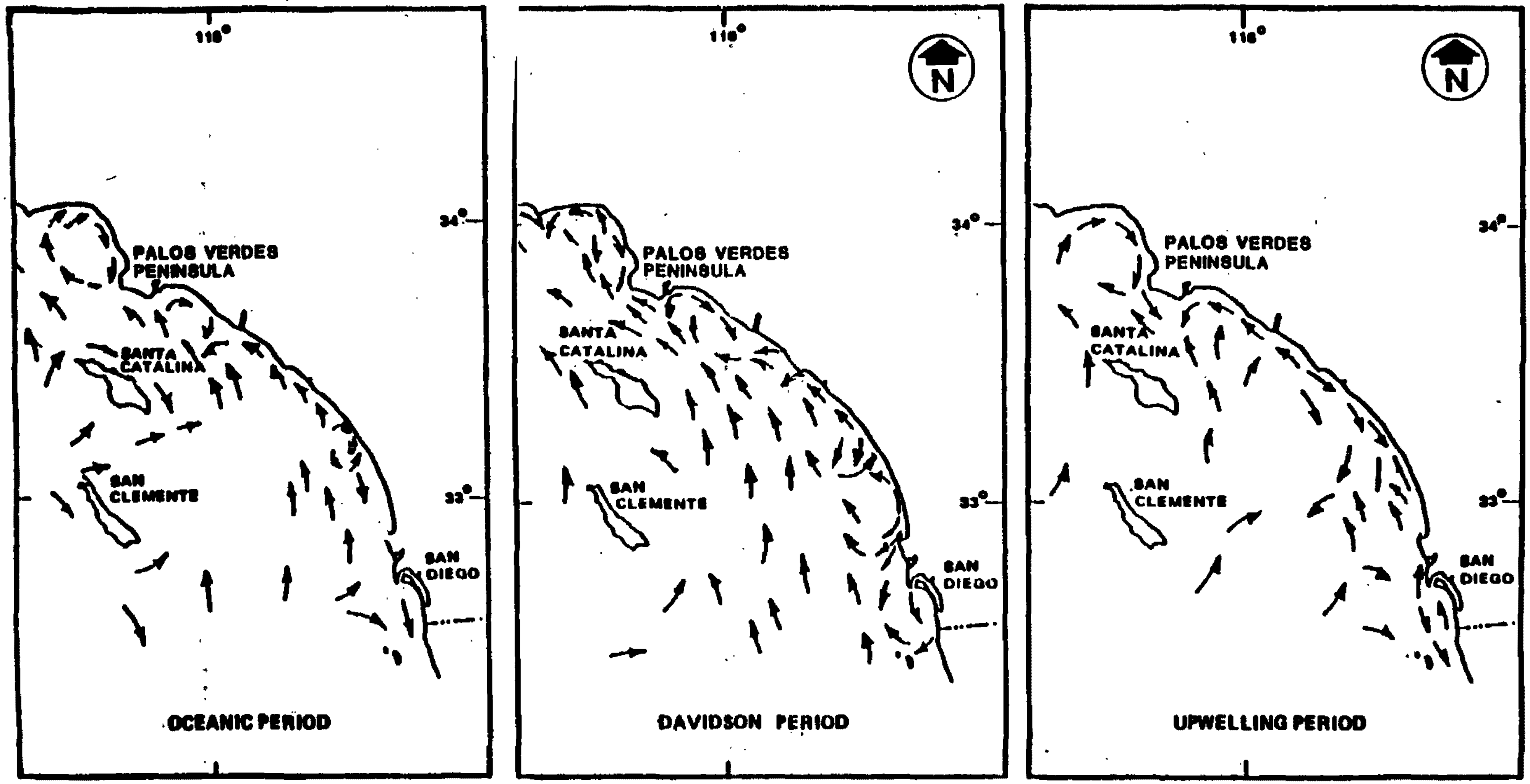


FIGURE 3-3. THREE MAJOR CURRENTS WHICH INFLUENCE THE SOUTHERN CALIFORNIA BIGHT



SOURCE: BLM, 1978

FIGURE 3-4. SEASONAL VARIATIONS IN CURRENTS OF THE SOUTHERN CALIFORNIA BIGHT

C. During the Upwelling period from March to June, alongshore winds strengthen and drive surface water offshore due to the Coriolis Effect. At deeper layers, cold water flows toward the shore and rises to compensate for the displaced surface water. This is a coastal event that may be more intense in certain locations depending on the bottom topography and current strength.

Parachute drouge and drift bottle studies show that the currents in the Southern California Eddy have a complex nature of flow and that flows calculated based on the geostrophic currents may not be completely valid. Countercurrents, eddy currents and upwelling conditions form a complicated system that has both large and small scale variations in flow direction (Maloney and Chan, 1974).

Surface currents are heavily influenced by wind forces and submarine topography. Deeper currents are mainly influenced by tides, undercurrent, and basin topography. Localized eddies and other current features are constantly forming, interacting and dissipating. Despite the three recognized current periods, the prevailing current at a particular time and place is changeable and difficult to predict. Current fluctuations much shorter than the recognized current periods are observed in mainland shelf waters (T.J. Hendricks, Physical Oceanographer, Southern California Coastal Water Research Project, personal communication, 1984).

Several studies indicate how current conditions may vary in the San Diego area of the bight. Hendricks and Harding (1974) used parachute drouges to measure currents off Point Loma, San Diego at the surface and at a depth of 21 fathoms (39 m) in May 1972. South flowing surface currents of 15 to 71 cm/s, averaging 45 cm/s were recorded. The deep drouge moved at speeds of 3.1 to 12 cm/s, averaging 7.3 cm/s to the south.

In a study of currents at 33 fathoms (60 m) off the City of Del Mar, Winant and Bratkovich (1981) found mean surface currents to the south in all seasons. Mean surface currents were weakest during the fall. During the spring and summer when the water column is thermally stratified, they found longshore surface currents to the south while longshore bottom currents were to the north. During the fall and winter when the water column is less stratified, they found longshore flow did not reverse with depth, instead, southerly flowing currents decreased in intensity with depth. Upwelling is known to occur south and southwest of the Point Loma headland.

Offshore San Diego, predominant current direction is upcoast (north to north-northwest) at depths of 11 to 33 fathoms (20 to 60 m) (SCCWRP, 1973). Currents in the downcoast direction are common also, so that net current speeds are only 2 to 3 cm/s upcoast. Typical instantaneous current speeds are 10 to 20 cm/s. Current periodicities on the order of a few weeks are prevalent. Currents have apparently not been measured in the range of the 109 fathom (200 m) depth of the LA-5 site, but currents there can be expected to be somewhat slower but comparable in direction and variability to those in shallower water.

In the deep waters of the bight's basins, bottom waters are filled by the California Undercurrent flowing across the continental slope (Malouta et al., 1981), and moving through the basins in a northwesterly direction. Emery (1960) infers that deep water currents in the San Diego Trough move in a northerly direction.

3.2.2.2. Waves

Waves (swell) from the northern Pacific dominate the winter and spring oceanic conditions of the bight when major storm systems are more intense. Southerly swells occur during summer and fall when hurricanes are off southern Mexico and tropical storms are present in the southern Pacific.

Wind waves (sea) formed locally respond to northwest winds from the Pacific high pressure regions, winds of the Santa Catalina Eddy, and the offshore Santa Ana winds. Wave convergence zones affect bottom topographic features to depths of approximately 182 fathoms (100 m).

No large tsunamis have been recorded in the southern California area because the wave refraction over the basin and ridge bathymetry of the region dissipates the force of the waves. No tsunamis have been formed by local earthquakes during historical times.

3.2.2.3. Tides

Southern California has mixed semidiurnal tides that move from southeast to the northwest. These tides are characterized by unequal tidal amplitudes causing two high and low tides each day. During periods when the unequal tidal amplitude is great, the tides tend to resemble diurnal tides, one high and one low per day. The daily tidal range varies from 1 to 3 m.

3.2.3. Water Column Characteristics 40 CFR 228.6(a)(9)

3.2.3.1. Temperature

Surface temperatures in the southern California Bight normally range between 12.5°C in the winter, to 19.5°C in the summer (Maloney and Chan, 1974), with maximum variations between 11°C and 23°C (BLM, 1978). Maximum temperatures in the surface mixed layer occur from August through October, while minimum temperatures are reached between February and April. Daily and seasonal effects are registered in the water column between 5 and 27 fathoms (10 and 50 m). Spring upwelling events bring cold water nearshore, displace warm water, and so create strong thermal gradients.

In a study of water conditions at 33 fathoms (60 m) off the City of Del Mar, Winant and Bratkovich (1981) found that the water column during the summer showed a warm surface layer rarely greater than 3 fathoms (5 m), a thermocline approximately 11 fathoms (20 m) thick in which the temperature gradient was nearly constant, and a colder bottom layer. In the winter, temperature throughout the water column was much more constant with no distinct thermocline and the bottom only a few degrees colder than the surface. At depths between 55 and 165 fathoms (100 to 300 m), the water temperatures of the Southern California Bight generally decrease to a range between 6.5° to 11° C (BLM, 1978).

Water temperature measurements made during the field study compared favorably with these values (Appendix A, p. A-19). Maximum surface temperatures recorded in the August survey ranged from 21.6° to 22.5°C. Minimum surface temperatures recorded in the March survey ranged from 14.9° to 15.6°C. The yearly surface temperature variation was between 6.6° and 7.4°C depending on the station.

At 55 fathoms (100 m), temperatures showed a smaller range from 9.8° to 13.2°C. Maximum temperatures were again found in the August survey, while minimum temperatures at most stations were found during the May survey. With the maximum depth at the eight sampling stations ranging from 73 to 102 fathoms (134 to 186 m), the bottom temperatures ranged from 8.7° to 13.1°C. Maximum values were found for all stations during August, while minimum values for most stations were found during the May survey.

These figures indicate stratification in the water column. During the summer, the field survey indicated an upper water column thermocline existed between 5 and 27 fathoms (10 and 50 m). The thermocline was essentially absent in winter, with temperatures decreasing more or less steadily from surface to bottom.

There were no significant water temperature differences between LA-5 and the reference site (Appendix A, p. 22). In waters of the Southern California Bight deeper than 165 fathoms (300 m), temperatures are generally less than 8°C (Chan, 1974). In the deep waters of the San Diego Trough, Emery (1960) found average temperatures at 3.4°C near the bottom of the basin.

3.2.3.2. <u>Salinity</u>

Salinity values are not known to be highly variable in the Southern California Bight. The surface water is more saline during the summer and autumn than in the winter and spring due to the greater amount of rain in the winter and the increased evaporation in the summer. The salinity variation of offshore San Diego is small both horizontally and vertically ranging between 33.5 and 34.5 parts per thousand (ppt) (Allan Hancock Foundation, 1965).

On the mainland shelf, while the surface water varies due to the influence of freshwater runoff and evaporation, at depths below 8 fathoms (15 m), salinity is frequently isohaline. At slope and basin depths of 110 to 275 fathoms (200 to 500 m), the mixing zone between major surface currents and undercurrents occurs. Here the salinity can vary from 33.8 to 34.4 ppt depending on the dominance of these currents (Maloney and Chan, 1974).

Salinity measurements taken during the field survey showed a wider range with many values lower than has been historically reported. Although the wet months of November and December of 1983 may explain some of the low values, other values are considered errors in measurement. Not including those values considered most questionable, the range was 30.9 to 35.7 ppt with many of these values falling near the lower half (Appendix-A, p. A-22). There were no significant salinity differences between the LA-5 site and the reference site. Salinity generally incresed slightly from surface to bottom.

3.2.3.3. Hydrogen Ion Concentration (pH)

A narrow range of pH values is expected for waters in the Southern California Bight because the ocean is a well buffered solution. The Allan Hancock Foundation (1965) found a range of pH from 7.5 to 8.6 along the southern California coast with an average of 8.1.

At 38 to 55 fathoms (70 to 100 m), the pH generally decreases to a range of 7.6 to 7.8, while at the deep oxygen-minimum layer in the basins, the pH has been reported at 7.5. In the field survey, pH ranged from 7.1 to 8.6 with a mean of 7.9. At 55 fathoms (100 m), the pH ranged from 7.3 to 8.1. Concentrations of pH showed a general decrease with depth and there were no significant differences between the LA-5 and reference sites (Appendix A, p. A-25).

3.2.3.4. Turbidity

Turbidity in the water column is caused by suspended inorganic and organic material. It limits the amount of light transmission and therefore affects the level of photosynthesis. The inorganic particles are mostly sediments entering the water through river outfalls and land erosion. Waves and currents may also resuspend small particles on the bottom of shallow waters particularly during periods of upwelling. As a result, water over sandy bottoms tends to be clearer than water over muddy bottoms. The concentration of plankton influences turbidity, with seasonal blooms of these organisms restricting the depth of light penetration. Sewage outfalls introduce both organic and inorganic sediments which locally increase turbidity.

On mainland shelves, turbidity generally decreases seaward of the shoreline (Karl, 1980). Shallow waters tend to have a high degree of turbidity throughout the water column. Turbidity generally decreases as the turbid water moves toward deeper waters and is diluted by the greater volume of water. Fine sized sediments such as clays and silts often remain in suspension for longer periods of time than sands, and are distributed by local water circulation patterns (Gorsline et al., 1984).

Water clarity conditions at the alternative disposal sites is expected to follow these general patterns but vary widely under natural conditions. Transmissivity is a measurement of light transmitted through the water column, and is one indication of turbidity. Transmissivity measured during the field survey averaged 94.8% and showed little variation with depth (Appendix A, p. A-25). No significant differences were noted during the study period or at any sample station. Turbidity is also closely associated with sediment transport, as discussed in Section 3.2.5.2.

3.2.3.5. Dissolved Oxygen

The surface layers of the ocean are usually saturated with dissolved oxygen (DO), and DO concentration generally decreases with increasing depth. Average DO values in the vicinity of the project site are 5.5 to 5.9 milligrams per liter (mg/l) in the surface waters and decrease to 1.8 to 2.2 mg/l at 110 fathoms (200 m) (National Ocean Data Center, 1974).

During the field surveys, surface DO levels ranged from 8.4 to 10.0 mg/l (Appendix A, p. A-22). DO levels were lower at the bottom, ranging from 3.6 to 7.4 mg/l. Much of this variation was due to variation in the depth of bottom stations. Although dissolved oxygen generally decreased with depth, a maximum was usually noted at depths of 6 to 27 fathoms (10 to 50 m) in the May and December surveys. Such a subsurface maximum has been associated in other studies with thermal stratification in the water column. Under such a condition, oxygen is entrapped in upper layers by the seasonal thermocline (Reid, 1962). There were no significant differences in dissolved oxygen between LA-5 and the reference site (Appendix A, p. A-22).

In the deeper waters of the basins, dissolved oxygen levels are extremely low. For example, in San Pedro Basin, where the depths can be as great as 500 fathoms (896 m), the DO at the bottom of the water column has been reported at a level of 0.2 mg/l (EPA, 1985). The San Diego Trough would be expected to have similiarly low levels.

3.2.3.6. Nutrients

The most important nutrients for the growth of phytoplankton in marine waters are nitrates, phosphates, and silicates. Concentrations of the three nutrients tend to be low near the surface and generally increase in concentration with depth until approximately 275 to 825 fathoms (500 to 1,500 m). At these depths concentrations of nitrates and phosphates then decrease (EPA, 1985). The highest nutrient concentrations occur during the upwelling season.

Near the surface where light penetration is greatest, nitrate is the primary limiting factor for the growth of phytoplankton. Surface nitrate concentrations vary from 0.1 mg/l during the Davidson period to more than 8.0 mg/l during the upwelling period. At 50 fathoms (90 m) nitrate concentrations range from 0.2 to 0.4 mg/l (SCCWRP, 1973). The concentration of phosphate is between 0.5 and 0.8 mg/l in surface waters, approximately 3.0 mg/l at 275 fathoms (500 m), and a maximum of approximately 3.7 mg/l is reached at 495 fathoms (900 m) (Chan, 1974; BLM, 1978). Silicate concentrations increase more or less steadily with depth. Surface silicate concentrations vary between 10 and 20 mg/l. Nutrient concentrations were not sampled during the field survey.

3.2.3.7. <u>Trace Metals</u>

Low concentrations of trace metals are essential for metabolic processes. Some of these metals include boron (B), cobalt (Co), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mb), selenium (Se), and zinc (Zn). These same metals may also be toxic at higher concentrations when bioaccumulation of the elements causes diverse affects higher trophic levels (SCCWRP, 1973).

Trace metals enter the ocean from natural sources associated with suspended particles, as dissolved ions carried in runoff, or resuspended from sediment layers. These natural concentrations plus amounts added by anthropogenic activities, mainly associated with the discharges of municipal and industrial waste treatment plants, are the main sources of heavy metals. Through various chemical pathways over a long period of time, heavy metals precipitate out of the water column and become incorporated into the sediments.

Analysis of trace metal concentration is especially difficult in the water column as water movement makes these levels highly transitory. Analyses of heavy metal concentrations are also made difficult because:

A. Concentrations of metals in marine waters and sediments may be near their limit of detection by present analytical techniques;

B. Uncertainty about the physical/chemical state of the metals and sample contamination add a degree of analytic variability; and

C. Concentrations of particular heavy metals vary with distance from shore or discharge points, depth, rainfall, currents, upwelling, plankton populations, size of suspended particulate and sediment grain size (SCCWRP, 1973).

Concentrations of trace metals tend to be low in the Southern California Bight, except near sewage outfalls and other pollution sources. Most metals detected in the water column are those associated with suspended particulates. A study conducted for the U.S. Bureau of Land Management (BLM) (Bruland and Franks, 1977), compared the concentrations of heavy metals as suspended particulates in nearshore and basin water masses off southern California. They found that nearshore waters away from pollution sources tend to have lower metal concentrations than offshore areas. Suspended particulates include only a portion of the trace metals in the water column, as dissolved metals are also present. However, the particulate trace metal concentration is often the only parameter examined as it is more easily measured with accuracy, and it is assumed to more readily expose anthropogenic perturbations in the marine environment (Bruland and Franks, 1977).

Table 3-1 shows nearshore values found in the BLM study which indicate possible levels prior to dumping at the LA-5 and LA-4 sites; this table also shows values found in inner basins such as the San Diego Trough.

In the field study, concentrations of arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), and zinc (Zn) were not detected in the water column (Appendix A, p. A-29). However, the limits of detection in this field survey were near or above typical levels reported by the BLM study for these metals (see Appendix A, p. A-16). As a consequence, the only conclusion which can be drawn from the field survey is that previous dumping at the LA-5 site has not appreciably elevated the level of these metals in the water column on a long term basis.

Most trace metal analyses have been limited to nearshore studies in the Southern California Bight related to municipal discharges (SCCWRP, 1973). Because of the difficulties in measuring low levels of trace metals in the water column in areas away from such discharge points, more emphasis has been placed on examining metal concentration in sediments. Section 3.2.5.3 discusses typical levels found in sediments.

3.2.3.8. Hydrocarbons

A BLM study has found a range of dissolved hydrocarbons in the waters of the Southern California Bight from <0.001 to 0.02 mg/l (BLM, 1981b). Because of difficulties in sampling and analyzing hydrocarbons in the water column, more emphasis has been placed on examining levels of hydrocarbons in sediments as discussed in Section 3.2.5.4.

Table 3-1. Concentrations of Trace Metals as Suspended Particulates in the Water Column in Micrograms Per Liter (ug/l).

	ARSENIC (Ar)	CADMIUM (Cd)	CHROMIUM (Cr)	COPPER (Cu)	LEAD (Pb)	MERCURY (Hg)	ZINC (Zn)
BLM Study (a)							
Nearshore							
Surface Water	ND	0.0012	ND	≤0.0038	0.0032	ND	0.016
Deep Water	ND	≤0.0015	0.062	0.012	0.0053	ND	0.011
Inner Basins							
Surface Water	ND	0.0018	ND	<0.0025	0.0025	ND	0.016
Deep Water	ND	0.0005	ND	<0.0034	0.0018	ND	0.008
Field Survey (b)	No concentrations of metals were detected in the field survey at these levels of detection:						
Levels of Detection	2	2	20	10	50	0.2	5

(a) = Bruland and Franks, 1977.
(b) = Appendix A, p. A-29
ND = No Data

Historically, natural offshore oil and gas seeps have been observed in several locations in the Southern California Bight near the numerous faults and folds of the Los Angeles area (Dennis, 1974). The San Diego area is not known for such natural seeps.

Oils and greases are also introduced to the bight's water by human activities, with the highest concentrations generally found in or near harbors and urban centers.

In the field survey, oil and grease, were undetected at levels of 0.1 mg/l.

For chlorinated hydrocarbons such as DDTs and PCBs, McDermott and Heesen (1975) found levels outside the San Diego Harbor fell within a range of 0.000001 to 0.000015 mg/l. Payne et al. (1976) reported ranges of values for surface and nearbottom water in the Southern California Bight: 0.00003 to 0.02 mg/l for the dissolved fraction and <0.000002 to 0.002 mg/l for the particulate fraction. In the field survey chlorinated hydrocarbon concentrations (DDTs and PCBs) in the water column were below detection limits at both the LA-5 and the reference sites. The detection limits for the hydrocarbons tested in this field survey are listed in Appendix A (p. A-16). As the levels of detection for the field survey were greater than or close to the maximum levels reported by McDermott and Heesen (1975) and Payne et al. (1976), it follows that no DDTs or PCBs would be detected. As a consequence, the only conclusion which can be drawn from the field survey is that previous dumping at the LA-5 site has not appreciably elevated the levels of chlorinated hydrocarbons in the water column on a long term basis.

3.2.4. Regional Geology

The features seaward of the San Diego area are a submerged extensions of the Peninsular Ranges of southern California and Baja California (Figure 3-1). The irregular topography of the basins and ridges parallel the structural orientation of the onshore ranges. The mainland shelf seaward of the San Diego Harbor consists mainly of tightly folded late Neogene sandstone and shale, covered extensively with Quarternary sands and muds (MMS, 1983). It is wide and slopes gently downward for 5 nmi (9.5 km) offshore to depths of approximately 55 fathoms (100 m), and then drops off into a steeper slope of approximately 2 to 4 nmi (3 to 8 km) with depths as great as 137 fathoms (250 m). The Coronado Bank forms a submerged terrace at approximately 82 fathoms (150 m) before the Coronado Escarpment drops off sharply into the deep basin of the San Diego Trough.

The Coronado Bank fault is an active fault in the area. Several other fault traces trending northwest to southeast have also been mapped. However, very few earthquakes have been reported off the San Diego coast since 1900.

3.2.5. Sediment Characteristics

Mainland shelf areas are characterized by the presence of coarse, terrigenous sediments (Allan Hancock Foundation, 1959). In deeper slope habitats, finer sediments are present (MMS, 1983); occasional slumping of finer sediments creates unstable substrate on the continental slope and also provides sediment to the basin floors. Nearshore basins typically have high sedimentation rates dominated by land-derived detritus. Terrigenous materials have accumulated in the inner basins, producing extensive basin plains. The characteristics of sediment in the slope areas are intermediate between that of shelf and basin areas.

3.2.5.1. Grain Size

Characteristics of the bottom sediments in the Southern California Bight are influenced by local submarine features and oceanographic conditions. The finer sediment fractions of silt and clay are common in the deeper portion of the bight, while at intermediate depth locations, such as that of the LA-5 and LA-4 sites, roughly equal proportions of sand and fine sediment are typically found. In shallower waters on the mainland shelf, coarser sand fractions increase.

In the field survey, samples of bottom sediments were generally sandy-silt (Appendix A, p. A-56). The size of the sediments at the LA-5 site showed a greater range on the average than those at the reference site (Table 3-2). The mean grain size of samples taken at the LA-5 site was 4.31 phi units (50.4 um) (variance of 1.01, 95% confidence level of $\pm$ 0.22), while the mean grain size of samples taken at the reference site was 4.51 phi units (43.9 um) (variance of 0.41, 95% confidence level of $\pm$ 0.12). The LA-5 site samples averaged 3% gravel, 52% sand, 33% silt, and 12% clay. The reference site averaged less than 1% gravel, 57% sand, 35% silt, and 8% clay (Appendix A, p. A-58 to A-61).

In studies of another inner basin of the Southern California Bight, San Pedro Basin, bottom sediments at approximately 250 fathoms (457 m) consisted of primarily greenish mud and varying amounts of "oozy, blue, green gray muds". Mean particle size was less than 62 um in diameter (Hartman and Barnard, 1958). The San Diego Trough is expected to also have fine particles as bottom sediments.

3.2.5.2. Sediment Transport

Sediment is expected to follow the surface and bottom currents as described in Section 3.2.2.1. Net movement at all three of the offshore alternative dumping sites is expected to be in a north to northwest direction at most times, although transport may occasionally be in a southerly direction. Most

Table 3-2. Grain Size Distribution for the LA-5 and Reference Sites.

Range of Grain Size (PHI)	LA-5 Site		Reference Site	
	$\bar{x}$	95% C.I.	$\bar{x}$	95% C.I.
-1 to 00	1.4	1.0 - 1.9	<0.1	<0.1
00 to 01	4.7	3.7 - 5.6	0.2	<0.1 - 0.3
01 to 02	10.0	8.4 - 11.5	0.8	0.4 - 1.1
02 to 03	20.7	18.6 - 22.9	9.2	6.7 - 11.8
03 to 04	14.4	12.9 - 15.8	46.2	43.7 - 48.7
04 to 05	16.7	14.2 - 19.3	22.5	20.5 - 24.4
05 to 06	8.6	7.4 - 9.7	7.3	6.8 - 7.9
06 to 07	4.1	3.6 - 4.6	3.1	2.7 - 3.5
07 to 08	3.2	2.6 - 3.8	2.1	1.9 - 2.4
08 to 09	2.3	2.0 - 2.5	1.7	1.4 - 2.0
09 to 10	1.3	1.1 - 1.5	1.2	1.0 - 1.4
10 to 11	3.5	3.1 - 3.9	1.9	1.5 - 2.3
11 to 12	1.6	1.3 - 1.9	1.1	0.8 - 1.3
12 to 13	2.3	2.0 - 2.6	1.2	0.9 - 1.5
13 to 14	0.9	0.8 - 1.1	0.6	0.4 - 0.8
14 to 15	0	0	0	0

95% Confidence Interval (C.I.) = $\bar{x} \pm 1.96 \frac{s}{\sqrt{n}}$

PHI unit = $-\log_2 x$ where x is diameter in millimeters

Appendix A, p. A-62 to A-65

material initially deposited on the mainland shelf is expected to be resuspended and eventually transported down the gradient of slopes and basin floors (Schwalbach and Gorsline, 1985). Fine particles which remain suspended for longer periods of time are expected to follow the same route in a more direct fashion (Gorsline et al., 1984). The slopes of the mainland shelf and canyons are also subject to slides, delivering additional sediment to the basins (Field and Edwards, 1980). Some of these slides are several kilometers wide and 50 m thick. This is an important process transporting sediment downslope and into the basins.

Within the San Diego Trough, sediment is expected to flow slowly to the north with the weak currents and descend through the water column until it reaches the bottom or achieves neutral buoyancy (Appendix C).

3.2.5.3. Trace Metals

Trace metals are incorporated into benthic sediments in a variety of ways similar to the means discussed in the section on water column characteristics (Section 3.2.3.7). Sediment metal concentrations tend to be higher in basins than on the mainland shelf in southern California, but the highest levels occur near sewage outfalls (SCCWRP, 1973).

Table 3-3 presents values for trace metal concentration in sediments of the Southern California Bight, along with those values found in the field survey. For some studies, only ranges are given because concentrations of trace metals vary considerably in coastal waters and average values are too easily misinterpreted (SCCWRP, 1973).

The first set of values presented for comparison shows ranges for trace metals which have been found in dredged materials of San Diego Bay. Even though the LA-5 site values are often elevated compared to those at the reference site, they are considerably lower than those levels found in these undiluted dredged materials.

The second set of values is from the Word and Mearns (1978) study undertaken in 1977. Various parameters along the 33 fathom (60 m) isobath were measured from Point Conception to the US/Mexico border, and control stations were chosen as representing background levels not overly influenced by pollutants. This set of values represents shallow water concentrations of metals under relatively undisturbed conditions. They are presented here as general indicators of undisturbed conditions.

The third and fourth set of values for comparison are from a BLM study of baseline conditions in the Southern California Bight on the mainland shelf and in the southern inner basins (BLM, 1981b). These shelf and inner basin values are presented in Table 3-3 as an indication of pre-dredging conditions at the LA-5 and LA-4 sites.

Table 3-3. Concentrations of Trace Metals in Sediments, Micrograms Per Gram Dry Weight (ug/g), Mean, Range.

	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
FIELD SURVEY (a)						
LA-5 Site	1.13 0.33-5.06	21.93 4.67-111.93	34.81 12.02-241.22	29.29 7.61-163.47	0.18 2.13-00.12	120 20.30-860.92
Reference Site	0.98 (0.88-1.08) 0.49-1.79	13.17 (12.19-14.4) 1.00-21.47	11.30 (10.50-12.13) 2.60-20.10	12.47 (11.69-13.25) 7.50-21.10	0.01 (0.01-0.02) <0.01-0.06	70.03 (24.81-115.26) 9.63-847.50
DREDGED MATERIAL (b)	0.51-22.7	42.4-175.0	80.4-638.5	ND	0.51-18.5	ND
MAINLAND SHELF						
Word & Mearns, 60 m control stations (c)	0.39 0.1-1.4	23.1 6.5-43	9.1 2.8-31	6.6 2.7-12	ND	42.2 9.8-62
BLM Study (d)	0.59 ± 0.24	57.6 ± 25.3	14.9 ± 8.4	17.3 ± 7.7	ND	56.9 ± 22.2
INNER BASINS						
South Coast, BLM Study (d)	0.42 + 0.20	88.4 ± 28.0	31.8 ± 6.0	24.5 ± 11.7	ND	106.3 ± 18.7
DEEP BASINS (e)	1.0-2.0	90-150	28-35	5-30	ND	85-100

ND = no data

(a) Appendix C
(b) Salazer and Salazer, 1983a,b
(c) Word & Mearns, 1978
(d) BLM, 1981b.
(e) Bruland et al., 1974, in Hershelman et al., 1977.

The final set of values is from anaerobic sediments in the deep waters of Santa Barbara and Soledad Basins. It is presented here as an indication of existing conditions at the deep water site.

In the field study, concentrations of Cd, Cr, Cu, Pb, and Zn at the reference site were within the range of values found for sediments in other studies within the region (Table 3-3). None of the other studies reviewed included measurement of As or Hg. Concentrations of all the metals studied at the LA-5 site, however, generally exceeded regional values and also those found at the reference site (Appendix A, p. A-42) with the following exceptions:

- The mean concentration of As at the LA-5 site was slightly less than at the reference site. The LA-5 site had a range with higher values, however.

- The mean Cd concentrations at both sites were almost equal, again with the LA-5 site showing some higher values in the range.

Samples from the LA-5 site of all the metals showed inconsistent contamination.

3.2.5.4. Hydrocarbons

Petroleum hydrocarbons encountered in the marine environment may originate from man's activities, such as offshore drilling and production operations, oil tanker operations, coastal refineries, atmospheric transport of combustion products, coastal municipal and nonrefinery industrial wastes, and urban and river runoff. Natural sources of hydrocarbons include biological production by organisms and submarine oil seeps. Distinction of environmental hydrocarbons among these various sources has only recently been attempted (Winzler and Kelly, 1977). For example, pentacyclic triterpenes have been used to distinguish crude oils from biologically derived hydrocarbons (BLM, 1981b).

Baseline studies found a wide range of hydrocarbon concentrations in sediments throughout the bight, with the highest associated with harbors and urban centers (BLM, 1981b). Kaplan (1977) states that the wide range of values reflects the variety of depositional environments and the complexity of contributing sources. In stations south of Newport Beach (including the San Diego area), Kaplan found hexane and benzene fractions of 50 ug/g to 100 ug/g in basin sediments, and less than 50 ug/g in sediments of the outer banks and ridges. Word and Mearns (1979) reported an average level of 243 $\pm$ 44 ug/g of hexane extractable materials in sediments of the bight, with values that ranged up to several thousand ug/g.

Total hydrocarbons were not evaluated in the field survey; however, concentrations of oil and grease at the LA-5 site averaged 90 ug/g and were not significantly greater than those at the reference site (Appendix A, p. A-37). Contamination appeared to be variable.

The major input of chlorinated hydrocarbons, especially pesticides and PCBs, to southern California sediments is thought to be municipal wastewater discharges. Other significant sources include industrial wastes, past dumping practices, river and surface runoff, and aerial fallout. The highest concentrations of chlorinated hydrocarbons are found in or near harbors and urban centers (California State Water Resources Control Board, 1980).

Although emissions of chlorinated hydrocarbons from municipal discharges have decreased in recent years, concentrations in sediments remain high, particularly near outfalls. Word and Mearns (1978) reported a mean dry weight concentration of 0.02 ug/g for total DDT, and 0.01 ug/g for total PCBs at control stations where the influence of polluting sources was judged to be minimal. Total DDTs and total PCBs in sediments of control stations near San Diego have been found in dry weight concentrations of 0.0034 ug/g and 0.015 ug/g, respectively (Heesen and Young, 1977).

Sediment concentrations of DDTs and PCBs at the LA-5 site were higher than those at the reference site and showed variable contamination (Appendix A. p. A-37) (Table 3-4). The mean total DDT dry weight concentration at LA-5 was approximately 0.023 ug/g which is within the range for control stations of Word and Mearns, but is higher than the 0.005 ug/g mean total DDT dry weight concentration for the reference site. Of the DDT isomers at the LA-5 site, only p,p-DDT showed significantly elevated levels above the reference site. The mean total dry weight concentration of PCB at the LA-5 was 0.138 ug/g which exceeds the range for control stations of Word and Mearns and the 0.033 mean total PCB dry weight concentration at the reference site, but is less than levels at other sites in the bight. In this field survey, there was considerable variation in levels of PCB, and analytical difficulties with interference from other substances. As a consequence, all values for PCB levels should be interpreted with caution. Other pesticides were not detected in sediments during the field survey at the levels of detection indicated in Appendix A (p. A-16).

3.3. BIOLOGICAL ENVIRONMENT

The Southern California Bight is geographically situated in a biological transition zone between the cold water biota of the Oregonian Province north of Point Conception and the warm water, subtropical biota of the Panamic Province south of Magdalena Bay, Mexico. Intermixing of currents from these two provinces in this region of extremely variable geology, from rugged submarine rock outcroppings to very fine sediment deposits,

Table 3-4. Concentrations of Hydrocarbons in Sediments in Micrograms per Gram Dry Weight (ug/g)

CHLORINATED HYDROCARBONS	Mean, (95% Confidence Interval) Range	
	DDTs	PCBs
Shallow Water Control Sites (a)	0.02 (0-0.04) <0.001 - 0.09	0.01 (0.002-0.02) <0.002 - 0.04
Southern California Bight (b)	<0.03 - 0.7	<0.002 - 0.4
San Diego Control Sites (c)	0.0034	0.015
Field Survey (d)		
LA-5 Site	0.023 (0.008 - 0.038) 0.001 - 0.303	0.138 (0.098 - 0.179) 0.011 - 0.541
Reference Site	0.005 (0.004 - 0.006) 0.001 - 0.012	0.033 (0.014 - 0.052) 0.006 - 0.136

(a) Word & Mearns, 1978.
(b) Young & Gossett, 1980.
(c) Heesen & Young, 1977.
(d) Appendix A, p. A-39 and Appendix C.

encourages rich and diverse biological associations. A large number of endemic species and numerous representatives of the adjacent provinces are found throughout the Bight.

This section of the EIS describes the biological environment to document compliance with EPA's 11 specific site selection criteria. General ecological descriptions 40 CFR 228.6(a)(9) and the location of these resources in relation to spawning, nursery, feeding, and areas of living resources 40 CFR 228.6(a)(2) are discussed throughout this section.

3.3.1. Plankton Community

The mixing of waters from northern and southern currents influences the species diversity and abundance of planktonic organisms in the Southern California Bight. Primary productivity is regulated by water temperatures, light intensity, and the availability of nutrients in the euphotic zone, the latter usually resulting from the upwelling of colder, deep waters into warmer, surface waters. Plankton productivity is highest during the summer (July to October) and lowest during the winter months (October to December) (Owen, 1974). Primary productivity varies in proportion to the distance from shore, higher in nearshore regions and decreasing with distance offshore.

3.3.1.1. Phytoplankton

Approximately 280 species of phytoplankton from California waters were reported by Riznyk (1977): 160 diatom; 112 dinoflageliate, and 6 silicoflagellate species. Phytoplankton work previously conducted offshore of southern California includes the works of Allen (summarized in Riznyk, 1974), Balech (1960), Resig (1961), and California State Water Quality Control Board (CSWQCB, 1965). Because of the mixing action of the California Current, plankton species present at each of the sites discussed in this section are expected to be very similar. Table 3-5 lists common phytoplankton of the Southern California Bight. The relative abundance of a particular species may vary somewhat from the inshore reference sites to the offshore deep sites. The distribution of the species and their abundances are controlled by several factors including amount of light, currents, intensity of grazing, temperature and upwelling events (BLM, 1981b). Phytoplankton variability is evident on a seasonal basis as well as over long-term periods in which it has been related to oceanographic and meteorological events (Balech, 1960).

California Cooperative Oceanic Fisheries Investigations (CalCOFI) data presented for 1969 (Owen, 1974) in BLM (1981b) displays primary productivity variations for the Southern California Bight region. Values are highest within the near-shore regions and decrease with distance offshore. Standing

Table 3-5. Common Phytoplankton Species of the Study Area

DIATOMS	DINOFLAGELLATES
Asterionella japonica	*Ceratium fusus*
Biddulphia longicruris	*C. tripos*
Chaetoceros compressus	*C. furca*
C. debilis	*Dinophysis acuminata*
C. didymus	*Gonyaulax polyedra*
C. socialis	*Gymnodinium splendens*
Ditylum brightwellii	*Noctiluca scintillans*
Eucampia zoodiacus	*Peridinium* sp.
Nitzschia spp.	*Prorocentrum micans*
Rhizosolenia spp.	
Skeletonema costatum	SILICOFLAGELLATES
Thalassionema nitzschioides	
	Dictyocha fibula
HAPTOPHYTES	*Distephanus speculum*
Phaeocystis pouchetti	

Riznyk, 1974.

decreasing offshore beyond a highly productive band 51 to 108 nmi (100 to 200 km) along the coast. Production values for an area of coastal waters from San Pedro to San Diego range from 20 grams per square meter (g/m^2) (October to December) to 90 g/m^2 (July to September). Productivity ranges from approximately 0.3 to 1.4 $g/C/m^2$/day, integrated over the euphotic zone. Near sewage outfalls such as Point Loma, productivity can increase to 2.0 to 2.5 $g/C/m^2$/day (Epply et al., 1972).

3.3.1.2. Zooplankton

Zooplankton are instrumental in the transfer of energy from the phytoplankton to the higher trophic levels including fishes, birds, and marine mammals. Studies dealing with Southern California Bight zooplankton are listed in Seapy (1974).

In the California Current system, at least 546 invertebrate and 2,000 vertebrate species of fish larvae are estimated to occur (Kramer and Smith, 1972), representing 23 major taxa among 9 animal phyla. The zooplankton include both temporary (nanoplanktonic) and permanent (holoplanktonic) forms which range in depth distribution from the surface to at least 3,282 fathoms (6,000 m) (Holton et al. 1977).

The primary source of zooplanktonic information is the California Cooperative Oceanic Fisheries Investigations (CalCOFI) program which originated in 1949. Data are available from numerous sampling stations within the Southern California Bight region from surface to depths of 77 fathoms (140 m).

The horizontal and vertical distribution and abundance, as well as the species composition, of southern California zooplankton is highly variable. It is influenced by many environmental factors, including season, advection or currents and the winds that cause currents, long-term meteorological and oceanographic changes (Berner and Reid, 1961, Radovich, 1961) and nutrient/temperature relationships (Reid, 1962). Unlike phytoplankton, zooplankton are found throughout the water column, but are generally most abundant in the euphotic zone. The ability of many zooplankton to migrate vertically affects their distribution by currents. Seasonal fluctuations in abundance are highly variable, but zooplankton tend to be most abundant in spring and summer, and least abundant in the winter. Seapy (1974) reported zooplankton densities of 64-256 cc/1,000m^3 for February - July, and 16-64 cc/1,000m^3 from October - January.

Several endemic species occur within the California Current system. Most species, however, vary geographically, seasonally, and yearly due primarily to changes in current patterns. These include the chaetognath Sagitta bierii, the copepod Eucalanus

Table 3-6. Major Zooplankton Taxa in the Southern California Bight

Major Taxa	Common Species	Distribution Remarks
CNIDARIA	Syncoryne eximia	Hydromedusae
	Phialiadium gregarium	Hydromedusae
CTENOPHORA	Pleurobrachia bachei	Common in nearshore plankton.
	Beroe sp.	Reported from south of the area. Densities of less than 50/10,000 m^3 of water in the upper 60 fathoms (110 m).
CHAETOGNATHA	Sagitta euneritica	No seasonability pattern or inshore to offshore difference in abundance.
	S. bierei	
	S. enflata	
	S. minima	
POLYCHAETA	Vanadis formosa	Offshore distribution to (200 km).
	Torrea candida	
	Tomopteris elegans	Can be extremely abundant.
	Travisiopsis lobifera	Cold water form.
MOLLUSCA		
Pelecypoda	Mytilus spp.	
Pteropoda	Limacina helicina	
Heteropoda	Atlanta peron	
	Atlanta sp.	
	Carinaria japonica	
Cephalopoda	Abraliopsis felis	
	Gonatus onyx	
CRUSTACEA		
Copepoda	Libinocera trispinosa	Dominant in surface samples in Santa Barbara Channel, maximum abundance in November.
	Acartia tonsa	
	A. clausi	Abundant in summer months.
	Calanus helgolandicus	All stages abundant in May to June.
	C. pacificus	Most common species.
	Rhincalanus nasutus	Juveniles abundant in July to August, adults abundant in May to June.
	Oithona similis	Most abundant cyclopoid copepod from samples off Scripps Institution.

(CONTINUED)

Table 3-6 (Continued). Major Zooplankton Taxa in the Southern California Bight

Major Taxa	Common Species	Distribution Remarks
Cirripeda	*Balanus* spp.	Barnacles
Amphipoda	*Vibilia armata*	Captured at surface at night and at 109 fathoms (200 m) in the day.
Cladocera	*Penila avirostris*	Maximally abundant in December, 1969 in Santa Barbara Channel
	Evadne nordmanni	Abundant in July to August, 1968 in nearshore waters off La Jolla
	Podon polyphemoides	
	Evadne spinifera	
	E. tergestina	
Euphausida	*Euphausia pacifica*	
	Nematoscelis difficilis	
	Nyctipnanes simplex	
	Stylocheiron longicorne	
	Thysanoessa gregaria	
	T. spinifera	
Decapoda	*Sergestes similis*	Recorded from 356 fathoms (650 m) trawls.
	Cancer magister	Dungeness crab
	Pandalus jordani	Pink shrimp
	Pugettia producta	Kelp crab
	Crangon spp.	Shrimp
THALIACEA	*Doliolum denticulatum*	Abundant in nearshore waters in summer.

(BLM, 1978)

bungi californicus, the hyperiid amphipod Hyperietta stebbingi, and the squid Abcaliopsis jelis. Table 3-6 summarizes the major zooplankton taxa in the bight (BLM, 1978).

Nearshore waters have been found to support higher populations of benthic invertebrates and fishes than offshore waters, including the larval stages of the Dungeness crabs Cancer magister, pink shrimp Pandalus jordanni, Crangon shrimp, and several species of bottom dwelling flatfishes (BLM, 1981b).

Patterns of vertical distribution of zooplankton relate to such variables as light, phytoplankton density, food, and life history patterns. Individual species show differing depth maxima (Alvarino, 1964). Most species within the waters of the continental slope are neritic forms, with occasional oceanic and migratory abyssal forms found during upwelling periods.

3.3.2. Kelp Community

Beds of giant kelp, Macrocytis pyrifera, grow on rocky substrate off La Jolla, the Point Loma peninsula, and near Imperial Beach. These kelp forests provide food and shelter for marine fish and invertebrates, many with importance to sport and commercial fisheries. They are also popular diving areas and the kelp is harvested for commercial use. A detailed description of the ecology of kelp beds can be found in Foster and Schiel, 1985.

In 1977, the Point Loma kelp forest was approximately 6 nmi (11 km) long and one half nmi (1 km) wide at depths between 3 and 14 fathoms (6 and 25 m) (Foster and Schiel, 1985). Between 1964 and 1982 the Point Loma beds have increased from 670 acres to 1,880 acres (Dale Glantz, Marine Biologist, Kelco, personal communication, June 19, 1987).

Man-made and natural factors have been identified as influencing progressive decline in size since the 1930s and recent recovery since the 1970s of these kelp beds. Negative factors include: ocean disposal of sewage, overgrazing by sea urchins and other herbivores, the elimination of sea urchin predators such as the sea otter (Enhydra lutris), increased sedimentation, storm damage, and perhaps warm temperatures with an associated decrease in nutrients in ocean waters. Positive factors include: a reduction in the volume of suspended solids and toxic substances discharged from the sewage outfalls, the relocation of the City of San Diego sewage discharge site from San Diego Bay to a deepwater location 1 nautical mile (2 km) offshore of the kelp beds, control of sea urchins, and favorable environmental conditions such as improved transparency of the ocean waters (Wilson et al., 1980).

3.3.3. Benthic Biology

The macrofauna of subtidal benthic communities in general within the Southern California Bight are influenced by a variety of factors including bathymetry, substrate type, oceanic and localized currents, biogeographic location, and oxygen concentrations. To facilitate comparisons of various sites and coordinate findings with those in the literature, benthic invertebrate fauna are divided into infauna, animals living in bottom sediments and epifauna, animals living on the surface of the sediments. This distinction is not completely valid for some forms which occupy both habitats but is useful for the following discussion.

3.3.3.1. Infauna

The benthic infauna communities of the Southern California Bight have been the subject of many studies (Hartman, 1955 and 1966; Hartman and Barnard, 1958; Allan Hancock Foundation, 1965; Jones, 1969; SCCWRP, 1973; Jones and Fauchald, 1977; Fauchald and Jones, 1978a,b,c; Word and Mearns, 1979). These studies have described five major marine benthic environments in the Southern Califonia Bight, each with several habitats determined primarily by sediment characteristics. The five environments are: 1) the mainland shelf between the shoreline and 5 fathoms (10 m), 2) the island shelf between 0 and 55 fathoms (100 m), 3) the slope and irregular areas between 55 fathoms (100 m) and the deep-sea basins, 4) the ridge and bank tops between (55 and 164 fathoms (100 and 300 m), and 5) the deep basin habitats in excess of 164 fathoms (300 m). Various biological communities occur within each habitat. The mainland shelf, continental slope, and basin habitats are most relevant to the alternative ODMDS sites.

Mainland shelf environments exhibit high species abundance and standing crop compared to other major habitats. Polychaetes, mollusks and crustaceans are the major taxonomic groups represented. Total infaunal density varies greatly, averaging approximately 5,000 organisms/m^2 (BLM, 1978).

Species richness, biomass, and density of the mainland shelf benthos has been shown to be significantly reduced in the area of sewage outfalls compared to other inshore shelf locations (Thompson, 1982, Swartz et al., 1986). Seasonal changes in inshore benthic communities are more evident than those in deeper areas of the shelf and basin owing to storm patterns, current and water temperature effects. Peak reproduction occurs in late winter through early summer and juvenile recruitment occurs through late summer. Dynamic ocean processes and high community diversity in nearshore mainland shelf habitats produce patchy distributions of organisms (Jones, 1969). Table 3-7 lists dominant infaunal invertebrates of the mainland shelf.

Table 3-7. Dominant Benthic Infauna of the Mainland Shelf from 9.3 Fathoms (17 m) to 131 Fathoms (240 m).

Taxa	Abundance ($\bar{x}$ individuals/sample)
POLYCHAETA	
Lumbrineris cruzensis	4.8
Prionospio malmgrani	3.6
Pectinaria californiensis	1.7
Cirratulidae spp.	8.1
Glycera spp.	2.9
MOLLUSCA	
Pelecypoda	
Parvilucina tenuisculpta	10.7
Teilina carpenteri	3.2
Axinopsida serricata	2.7
Macoma yoldiformis	1.3
CRUSTACEAN	
Ostracoda	
Euphilomedes carcharondonta	4.8
NEMERTEA spp.	3.2
ECHINODERMATA	
Opiuroidea	
Amphiuridae sp.	5.8

(Jones, 1969)

The continental slope macrofauna populations exhibit random patterns with respect to distribution, abundance, and diversity of species. These values are lower than mainland shelf areas because the population factors are related to depth. The slope fauna is a transitional community between shelf species and obligate deep-sea fauna. As with the shelf fauna, polychaetes tend to dominate, followed by crustaceans, mollusks and echinoderms.

Total density of infauna ranges from approximately 2,000 organisms/m^2 to 11,000 organisms/m^2 (Jones, 1969). Table 3-8 lists the dominant benthic infauna of the slope offshore of Huntington Beach/Laguna Beach, an area in the Southern California Bight for which extensive data are available. Species abundance decreases with depth, due to decreasing dissolved oxygen concentrations (Jones and Fauchald, 1977). The dominant feeding methods of the fauna are surface deposit feeding and suspension feeding. Little seasonal change has been observed in deep slope faunal communities because environmental conditions remain relatively constant.

The deep-sea basins of southern California support a depauperate benthic fauna (Hartman and Barnard, 1958; Fauchald and Jones, 1978c), due primarily to extremely low dissolved oxygen levels. Infaunal density ranges from 11 organisms/m^2 to 120 organisms/m^2 (BLM, 1978). Surface deposit feeders dominate the community and populations of species vary considerably among basins; however, a few species of polychaetes and mollusks are present in most of the basins. Two species of polychaetes, Eclysippe trilobatus and Phyllochaetopterus limicolus, are particularly widespread. Dominant benthic infauna of the basins of the Southern California Bight are listed in Table 3-9.

3.3.3.2. Infauna of LA-5 Site

The LA-5 site lies on the continental slope and encompasses approximately 238 to 347 fathoms (130 to 190 m) water depth. The benthic infauna of the site are generally similar to those reported for other slope locations in the region. Surface deposit feeders and suspension feeders predominate. In approximate order of abundance and diversity, the dominant groups are polychaetes, crustaceans, mollusks and echinoderms. Abundant species in samples using a modified Van Veen grab were the polychaetes Mediomastus anbiseta, Tauberia gracilis, and Spiophanes berkeleyorum; the ostracod Euphilomedes producta; the brittlestar Amphiodia urtica; and the bivalve mollusks Adonthorina cyclia and Axinopsida serricata.

Total density of infauna ranged from 1,600 to 8,000 organisms/m^2. Number of species per 0.1 m^2 ranged from 34 to 89, and neither density nor number varied significantly between the depths of 65 to 95 fathoms (130 to 190 m) (Appendix A, Figures A-10 to A-13). It is difficult to compare these values to those of other studies because sampling gear and mesh sizes

Table 3-8. Dominant Benthic Infauna of the Slope Off Huntington and Laguna Beaches from 88 Fathoms (161 m) to 284 Fathoms (520 m).

Taxa	Abundance ($\bar{x}$ Individuals/Site)
POLYCHAETA	
Pectinaria californensis	3.2
Maldane sarsi	2.1
Lumbrineris sp.	1.4
Paraprionospio pinnata	0.9
Mediomastus californensis	0.7
Prionospio cirrifera	0.5
MOLLUSCA	
Aplacophora	
Limifossor fratula	0.6
Pelecypoda	
Mysella tumida	1.0
Cyclocardia ventricossa	0.5
CRUSTACEA	
Ampelisca macrocephala	1.4
ECHINODERMATA	
Amphiodia urtica	1.1

Jones and Fauchald (1977)

Table 3-9. Dominant Benthic Infauna of the Basins of the Southern California Bight from 340 Fathoms (622 m) to 485 Fathoms (888 m).

Taxa	Abundance ($\bar{x}$ Individuals/sample)
POLYCHAETA	
Eclysippe trilobatus	4.9
Aricidea complex	1.4
Phyllochaetopteros spp.	4.9
Spiophanes sp.	1.9
MOLLUSCA	
Mitrella permodesta	2.7
Tomburchus redondoensis	0.4
Cadulus californicus	0.3
CRUSTACEA	
Liljeborgia cota	0.3

Fauchald and Jones (1978c)

were different; however, comparisons between LA-5 and the reference site were possible. Compared to the reference site, infauna at LA-5 were less diverse but approximately equally abundant, and the most abundant species were more dominant numerically. These differences were associated with differences between the two sites in sediment characteristics. LA-5 sediments were both coarser and more poorly sorted than the reference site (Appendix A, p. A-62).

The species composition of the LA-5 site is indicative of moderate pollution stress, according to the classification of Thompson (1982). Of the indicator species identified, those typical of the transition zone that are found at LA-5 include Mediomastas sp., Axinopsida serricata, Parvilucina teniusculpta, and Euphilomedes producta. Species that characterize the control zone, Amphiodia urtica and Spiophanes missionensis, and the contaminated zone, Capitella capitata and Tharyx sp., were also prevalent. This would seem to indicate an overall level of pollution or disturbance comparable to Thompson's transition zone.

3.3.3.3. Epifauna

Unlike the infauna, the abundance of epifauna generally increases with depth over the mainland shelf and much of the continental slope (Word and Mearns, 1977). Species abundance and diversity of epifauna decrease very sharply in the deep basins (Brown and Shenton, 1973). Many classes of epifaunal species have very large depth ranges. Echinoderms, for example, are the numerically dominant class of organisms at most depths, although their diversity is often low. Common species include the sea urhins Lytechinus pictus and Allocentrotus fragilis, the sea cucumber Parastichopus californicus, and the seastar Astropecten verrilli. The shrimp Sicyonia ingentis is also a species that is commonly collected in trawls. Surveys by the Southern California Coastal Water Research Project (SCCWRP) have shown the epifauna off Point Loma to be dispersed in both biomass and number of species, presumably an effect of sewage discharge from the Point Loma outfall (Word and Mearns, 1978; Moore et al., 1983).

The two most commonly used methods of sampling benthic fauna are grab/core samplers, and trawls. Grabs and cores are used primarily to sample infauna, while trawls are used to sample demersal fish and, somewhat incidentally, epibenthic fauna. The two methods produce very different results, as can be seen by comparing species lists from grab/core studies in the Southern California Bight such as Fauchald and Jones (1979) and Jones (1969) to those from trawl studies such as those conducted by the Southern California Coastal Water Research Project (SCCWRP, 1973; Moore et al., 1983). It is, therefore, not useful to compare the present data to results from grab/core studies. The following sections summarize and discuss these data in a manner commensurate with the nonquantitative nature of the sampling. Because the primary purpose of the trawling was to collect animals for tissue contaminant analysis, no attempt was made to sample in a rigorous quantitative manner, for example, by careful measuring the area swept by each trawl. Therefore, the data cannot support detailed quantitative analysis of density, diversity, biomass, etc. The data can be used, however, to characterize in general the epibenthic macroinvertebrate fauna of the sites by assessing major trends and patterns in principal species present, number of species and overall abundance.

Table 3-10 shows principal species, number of species, and number of individuals of epibenthic microinvertebrates captured in otter trawls at the LA-5 disposal and reference sites, by sampling period (season) and depth of trawl station. In all, sampling at these two sites produced 98 species. Extensive trawling by SCCWRP (Moore et al., 1983) produced over 500 species. The comparatively limited results of the present study are not surprising considering the limited depth range (69 to 93 fathoms or 135 to 186 m) and duration (64 mostly 5-minute trawls) of the sampling.

The trawls were dominated by crustaceans and echinoderms in both species composition and abundance (Appendix A, Table A-30). Five species dominated the catch in terms of abundance: the sea urchins L. pictus (4,128 individuals in 31 of 64 trawls) and A. fragilis (1,280 in 38 trawls), the shrimps Crangon zacae (1,389 in 42 trawls) and S. ingentis (1,091 in 31 trawls). Together, these caught account for 86 percent of the total number of macroinvertebrates caught in the trawls.

Pleuroncodes planipes, often referred to as the "red crab," is a primarily pelagic species brought into southern California water by warm water masses moving in from the south. It is abundant only when such a water mass makes a major intrusion in the area, usually in the summer, as happened in the summer of 1983 during the "El Nino" phenomenon. During most summers, P. planipes occurs in the Southern California Bight in low numbers, but its presence in large numbers in an infrequent, somewhat anomalous condition. This is reflected by the fact that, even during "El Nino," P. planipes was abundant in only one of this study's trawls. Twenty-nine hundred (2,900) P. planipes were caught in a trawl at Station 3 (mid-depth) at the disposal site in August 1983. Although P. planipes is primarily pelagic, it also adopts a benthic existence at 2-3 years of age. Therefore, it is possible that the P. planipes in this trawl were caught on the bottom, in the water column as the trawl descended or ascended, or a combination of both. Individuals caught were not aged. Discounting this trawl, P. planipes appears to be a widely distributed but not very abundant species (263 in 36 trawls).

Discounting the 2,900 P. planipes in this one trawl, the other four species listed above represent 79% of the trawl catch by abundance during all the surveys. These four species are

Table 3-10. Dominant Epifauna of the LA-5 and Reference Sites

DISPOSAL SITE

	Principal Species	Number of Species	Number of Individuals
Shallow Station (135 m)	*Lytechinus pictus*	36	1,997
Mid-Depth Station (168 m)	*Crangon zacae* *Sicyonia ingentis* *Ophiura lutkeni* *Allocentrotus fragilis*	33	1,216
Deep Station (186 m)	*Crangon zacae*	46	838
Overall Site	*Crangon zacae* *Sicyonia ingentis* *Allocentrotus fragilis*	86	4,051

REFERENCE SITE

	Principal Species	Number of Species	Number of Individuals
Shallow Station (135 m)	*Sicyonia ingentis* *Lytechinus pictus*	23	2,769
Mid-Depth Station (168 m)	*Crangon zacae* *Lytechinus pictus*	35	547
Deep Station (186 m)	*Crangon zacae* *Sicyonia ingentis* *Lytechinus pictus*	30	375
Overall Site	*Crangon zacae* *Sicyonia ingentis* *Lytechinus pictus*	48	3,691

Appendix A, p. A-86

Fathom = 1.829 meters

common components of trawl samples from the region (SCCWRP, 1973; Moore et al., 1983), but they do not generally dominate to the extent they did in our trawls. The other abundant species in the trawls are also common benthic invertebrates of the region: the shrimp Pandalus platyceros, the brittlestar Ophiura lutkeni, and the basket star Gorgonocephalus eucnemis. Species that occurred frequently in the trawls but usually in low numbers included Octopus sp., the shrimp Crangon resima, the nudibranch Pleurobranchaea californica, the brittlestar Ophiacantha diplasia, the sea cucumber Parastichopus californicus, and the seastars Astropecten verrilli and Luidia fiololata.

There is no clear depth-related trend in number of species at either site, but there is a clear pattern of decreased abundances in trawls with depth, particularly at the reference site (Table 3-10). Many more invertebrates were caught at the shallow 69 fathoms (135 m) station than at the deeper stations. Trawl studies by SCCWRP (Word and Mearns, 1977; Moore et al., 1983) have shown increasing epibenthic invertebrates abundance and diversity with depth, but over a much larger depth range than the present study (all present stations are within the mid-depth category 25 to 110 fathoms (50-199 m), of Moore et al. (1983)). The relatively small depth range of this study limits the assessment of depth-related trends. There are no apparent depth-related patterns in the distribution of the principal species, except that the shrimp Crangon zacae was seldom abundant at the shallow stations.

There is little evidence for a difference between the disposal and reference site in abundance of invertebrates, but more species were caught at the disposal site (86) than at the LA-5 site (48) during 3 of the 4 surveys, during 11 of 12 stations samplings, and over all surveys combined. If the epibenthic macroinvertebrate infauna is in fact more diverse at the disposal site, it seems unlikely to be a result of disposal (infauna show the opposite pattern) and is most likely due to environmental factors such as heterogeneity of habitat type.

Among the principal species, C. zacae is more common at the disposal site, while Sicyonia ingentis is more common at the reference site. Since these are both shrimp, this may be an instance of niche replacement, with an unknown relation to disposal. The other principal species are approximately equally prevalent at the two sites.

For this EIS it was determined that a common benthic epifanual organism should be tested for toxic substances. Studies of tissue samples from S. ingentis were tested for the accumulation of toxic substances. There was no significant difference ($p = 0.05$) in the concentration of any heavy metals in the muscle tissues of shrimp from either the LA-5 site or the reference site. Concentrations of oil and grease were below detection limits and it is assumed that there is no significant difference between the two areas (Appendix A, p. A-37).

Similarly, there is little or no evidence of a consistent elevation of DDT isomer or PCB tissue concentrations at the disposal site relative to concentrations observed at the reference site (Appendix A, p. A-42). Tissue levels of pesticides and PCBs vary among surveys, and among samples within each survey. The significance of these variations is uncertain because of the small number of successful analyses at the reference site.

Natural variability in the tissue concentrations of chlorinated hydrocarbons may result from: (1) exposure to any of the other contaminated areas within the Southern California Bight, (2) feeding habits of individuals or (3) differential ability of individuals to metabolize contaminants (Jeff Cross, SCCWRP, personal communication, 30 September 1985). In addition, although standard analytical techniques were used, there is not adequate data to quantify analytical variability, so that no firm conclusions can be made regarding natural variability.

It should be noted that tissue levels of trace metals and chlorinated hydrocarbons at LA-5 were much lower than levels in S. ingentis from locations near the Hyperion outfall in Santa Monica Bay and the Whites Point outfalls off the Palos Verdes Peninsula near Los Angeles (Brown et al., 1984).

3.3.4 Fish

The fish fauna of the San Diego region consists of distinct vertically distributed fish communities, including species common to mainland and island shelf areas, mesopelagic deep sea or midwater species, bathypelagic demersal fishes, and various transient and resident species (Ebeling et al., 1970). Of the 554 species (representing 129 families) of coastal marine fishes known to occur off California (Miller and Lea, 1972), 481 species (87%) are found in southern California waters from Point Conception to the Mexican border. The list compiled by Miller and Lea includes only part of the deep-sea fauna. As the distance north from southern California increases, the number of species decreases. Fish abundance and biomass increase with depth to the lower portions of the coastal slope. These factors decrease in the deep-sea basin where few juveniles are found (Allen and Mearns, 1977). Below 109 and 164 fathoms (200 and 300 m) the number of species varies directly with decreasing temperature and dissolved oxygen concentrations.

Ahlstrom (1959, 1965, 1969) summarized information on the extensive CalCOFI collections of fish eggs and larvae in the California Current. The distribution of fish larvae is highly dependent upon the spawning areas of the parents and the hydrographic conditions prevailing in the area. Because most of the coastal waters are transported in either a northern or southern direction, larvae spawned in coastal areas tend to be retained there (Richardson and Pearcy, 1977). The distribution and abundance of fish larvae and eggs vary by season over the

Southern California Bight depending on the species. For some species, for example the northern anchovy (Engraulis mordax) and the several species of rockfish (Scorpaenidae spp.), larvae occur throughout the bight area during most of the year.

In the CalCOFI data, 12 larval types (species or genus) comprised 90 to 93 percent of all larvae collected (Table 3-11). The northern anchovy (E. mordax) and Pacific hake (Merluccius productus) represented 40 to 60% of the catch. Larvae of deep sea pelagic fishes composed 20 to 40% of all larvae taken in CalCOFI cruises from 1955 to 1960. Three families represented 90% of the deep sea fishes and were the most important species in offshore oceanic waters. These were the larvae of the myctophid lanternfishes, the gonostomatid lightfishes and the deep sea smelts (Bathylagidae) (Ahlstrom, 1969). Ahlstrom (1965) found larvae of subarctic species in winter and spring and those of subtropical species in the warmer summer months.

3.3.4.1. Demersal Fish

The demersal fish of the Southern California Bight have been the subject of numerous studies which have reported several basic distribution patterns (Mearns and Allen, 1973; SCCWRP, 1973; Stephens et al., 1973; Allen and Mearns, 1977; Word et al., 1977; Moore and Mearns, 1980; Moore et al., 1983). In nearshore areas between 6-50 fathoms (10-100 m), common demersal fish are speckled sanddab (Citharichthys stigmaeus), California tonguefish (Symphurus atricauda), horneyhead turbot (Pleuronichtys verticalis), white surfperch (Phanerodon furcatus), shiner surfperch (Cymatogaster aggregata), and white croaker (Genyonemus lineatus).

In deeper shelf environments between 55 to 219 fathoms (100-400 m), demersal fish tend to be dominated by flatfish (Pleuronectidae) and rockfish (Scorpaenidae). Common species include: Dover sole (Microstomus pacificus), slender sole (Lyopsetta exilis), rex sole (Glyptocephalus zachirus), Pacific sanddab (Citharichthys sordidus), stripetail rockfish (Sebastes saxicola), splitnose rockfish (Sebastes diporproa), shortspine thornyhead (Sebastolobus alascanus), pink surfperch (Zalembius rosaceus), plainfin midshipman (Porichthys notatus), and shortspine combfish (Zaniolepis frenata). These fish feed on a variety of prey species including: epifauna such as ostracods, mysid shrimp and other crustaceans, infauna such as polychaetes and bivalves; zooplankton such as copepods and tunicates; and other demersal fish.

3.3.4.2. Demersal Fish of the LA-5 Site

Otter trawl sampling within the LA-5 site produced 37 species in 14 families (Appendix A, p. A75-79). The catch was dominated by flatfish (primarily family Pleuronectidae) and rockfish (Scorpaenidae). Numerically, one species, the slender sole (Lyopsetta exilis), was particularly dominant, accounting

Table 3-11. Common Fish Larvae of the Southern California Bight

Genus Species	Common Name
Engraulis mordax	Northern anchovy
Merluccius productus	Pacific hake
Sebastes spp.	Rockfish
Citharichthys spp.	Sanddabs
Bathylagidae	Deep-sea smelts
Myctophidae	Lanternfishes
Gonostomatidae	Lightfishes
Sardinops caerulea	Pacific sardine
Trachurus symmetricus	Jack mackerel
Parophrys vetuius	English sole
Isopsetta isolepis	Butter sole
Microgadus proximus	Pacific tomcod

(BLM, 1978)

for almost half of the total individuals caught. The slender sole was also frequently encountered, occurring in 61 of the 64 trawls, indicating a widespread distribution. The Pacific sanddab (Citharichthys sordidus) was the second most abundant species. Two additional species, although not so abundant as the slender sole and the Pacific sanddab, occurred in a large number of trawls: the shortspine combfish (Zaniolepis frenata) and the Dover sole (Microstomus pacificus). These two species thus appear to be widely distributed but not generally abundant. Other commonly caught species were the stripetail rockfish (Sabastes saxicola), the halfbanded rockfish (Sebastes semicinctus), the rosethorn rockfish (Sebastes helvomaculatus), the plainfin midshipman (Porichthys notatus), and the pink surfperch (Zalembius rosaceus). All of the above species are well-known common components of the mid-depth demersal fish fauna of southern California (Horn, 1974; SCCWRP, 1973; Stephens, 1973; Moore et al., 1983). Based on the results of previous studies, the shortspine combfish and the slender sole were perhaps more abundant than would be expected, while the stripetail rockfish, the yellowchin sculpin (Icelinus quadriseriatus), and the California tonguefish (Symphurus atricauda) were perhaps underrepresented.

There is some indication that demersal fish are less abundant and less diverse at the LA-5 site, compared to the nearby reference site (Appendix A, p. A-74). More fish were caught at the reference site during 3 of the 4 surveys, and almost twice as many were caught there overall (2,267 vs. 1,205) Appendix A, Table A-29). These differences may be related to the previous disposal of dredged material, although the reason for lower catches at the disposal site is not clear.

Infaunal benthic community density was greater at the disposal site stations during all four surveys than at almost all corresponding depth reference site stations (see Appendix A, Section A.3.3). Although the infaunal community at the disposal site could be separated from that at the reference site, in many of the classification analyses there is nothing to suggest that disposal site organisms were unacceptable as prey to the fish community.

Major differences were found in trawl epibiota density between the first two and last two surveys. Since fish abundance and diversity trends did not vary similarly it is unlikely there is a direct relationship between epibiota density and fish catch. The difference in fish catch between disposal and reference sites may simply reflect avoidance of the disposal sites by some species and individuals as a response to the increased frequency of disturbance within the disposal site. Of course, it is possible that depauperate fish and invertebrate fauna at LA-5 relative to the reference site is due to natural differences between the sites.

Contaminants in demersal fish of the Southern California Bight vary according to the type of toxicant. Levels of pesticides and PCBs tend to be low in offshore areas and other areas distant from pollutant sources (SCCWRP, 1973; Kaplan, 1977). These same contaminants tend to be higher in nearshore species, particularly near sewage outfalls such as the Whites Point outfall on the Palos Verdes Peninsula near Los Angeles (BLM, 1978). Trace metal levels do not show this pattern (BLM, 1981b).

Levels of heavy metals (As, Cd, Cr, Cu, Hg, Pb, and Zn), oil and grease, and chlorinated hydrocarbons (pesticides and PCBs) were analyzed in tissue samples of L. exilis and C. sordidus collected at the LA-5 site. Tissue levels of metals at the LA-5 site were not higher than those at the reference site (Appendix A, p. A-37), and compared favorably with levels reported in the literature for the Southern California Bight (Appendix A, p. A-42). For pesticides and PCBs, there was little or no evidence of a difference in DDT isomer or PCB tissue concentrations at the LA-5 site relative to concentrations at the reference site (Appendix A, p. A-42). Levels at the LA-5 and reference site also compared well with literature values (Appendix A, p. A-42; Sherwood et al., 1980).

3.3.4.3. Pelagic Fish

Pelagic fish were not sampled as part of thé present study. Horn (1974) provided a list of 80 species from 30 families that are pelagic species found in southern California waters. Population diversity is illustrated in the list of fish presented in Table 3-12.

The Southern California Bight offers both nearshore or coastal and offshore or high seas environments and the habitat diversity is partially illustrated by this list of fishes. Some of those listed are rare, such as the Zeidae (dories), Lophotidae (crestfishes), Regalecidae (oarfishes), Trachipteridae (ribbonfishes), and Luvaridae (louvars), whereas others are common such as the Engraulidae (anchovies), Merlucciidae (hakes), and Scomberesocidae (sauries). Certain species are truly epipelagic (in surface layers of open waters) such as the Exocoetidae (flyingfishes), Hemirhamphidae (halfbeaks), Belonidae (needlefishes), and Molidae (molas), whereas others have a wider depth range such as the Bramidae (pomfrets), Xiphiidae (swordfish), Scombridae (mackerels), Centrolophidae (medusafishes) and Tetragonuridae (squaretails). Some species are coastally-oriented such as the Engraulidae (anchovies), Clupeidae (herrings), Carangidae (jacks), and Stromateidae (butterfishes), while others are more offshore or high seas fishes such as the Lamprididae (opahs), Coryphaenidae (dolphin-fishes), Trichiuridae (cutlass-fishes), Istiophoridae (billfishes), Bramidae, and Tetragonuridae.

More than 50% of the 80 species of pelagic fish are rare and almost 75% are either rare or uncommon based on an occurrence evaluation by Miller and Lea (1972), and Horn (1974).

Table 3-12. Families of Fish Inhabiting the Pelagic Environment In the Southern California Bight

RARE	COMMON
Dories (Zeidae)	Anchovies (Engraulidae)
Crestfish (Lophotidae)	Hakes (Merlucciidae)
Oarfish (Regalecidae)	Sauries (Scomberesocidae)
Ribbionfish (Trachipteridae)	
Louvars (Luvaridae)	
EPIPELAGIC	WIDE DEPTH RANGE
Flyingfish (Exocoetidae)	Pomfrets (Bramidae)
Halfbeaks (Hemirhamphidae)	Swordfish (Xiphiidae)
Needlefish (Belonidae)	Mackerels (Scombridae)
Molas (Molidae)	Medusafish (Centrolophidae)
	Squaretails (Tetragonuridae)
COASTAL	OFFSHORE
Anchovies (Engraulidae)	Opahs (Lamprididae)
Herrings (Clupeidae)	Dolphinfish (Coryphaenidae)
Jacks (Carangidae)	Cutlassfish (Trichiuridae)
Butterfish (Stromateidae)	Billfish (Istiophoridae)
	Pomfrets (Bramidae)
	Squaretails (Tetragonuridae)

(Miller and Lea, 1972)

The numerically dominant species are several of sport and commercial species include the following: Engraulis mordax, Pacific saury (Cololabis saira), jack mackerel (Trachurus symmetricus), yellowtail (Seriola dorsalis), California barracuda (Sphyraena argentea), Merluccius productus, Pacific mackerel (Scomber japonicus), Pacific bonito (Sarda chiliensis), albacore (Thunnus alalunga) and Pacific butterfish (Peprilus simillimus). These species feed primarily on zooplankton and other pelagic fish.

3.3.4.4. Deep-Sea Fish

Many deep sea fishes undergo periodic vertical migrations and, therefore, may be found in the upper 55 to 274 fathoms (100 to 500 m) layer of the ocean. However, they are members of a rather distinctive group since they live at least part of their lives in waters several hundred to thousands of meters deep. These fishes are generally small (<300 mm long), black or dark with silvery reflective sides and frequently with luminescent organs. Members of the families Myctophidae (lanternfish), Bathylagidae, and Gonostomidae are the most abundant deep sea fishes off southern California, and they occupy central positions in oceanic food webs. These families, especially the Myctophidae, appear to occupy important positions in the trophic structure of offshore waters comparable to that of the anchovy in shallow, more inshore waters (Horn, 1974). Deep-sea fish feed primarily on deep sea crustaceans such as euphausiids and copepods, chaetognaths, and other fish. In turn, the deep-sea fish serve as food for cetaceans, tunas, sharks, and billfish.

The heterogeneity and transitional nature of the southern California deep water environment produces a relatively diverse fish fauna for the region. Approximately 30 families and 93 species of deep water fishes are known in the Southern California Bight (Horn, 1974). According to Fitch and Lavenberg (1968) two deep-sea families, lanternfish (Myctophidae) and lightfish (Gonostomatidae), are the two most abundant fish groups in the world oceans.

This generalization also holds for southern California waters. The five principal deep water families for the region in terms of number of species are: Myctophidae, 16 species; bigscales (Melamphaeidae), 9 species; hatchetfish (Sternoptychidae), 7 species; Gonostomatidae, 6 species; and deep-sea smelts (Bathylagidae), 5 species. The species most frequently collected by Ebeling et al. (1970) were Leuroglossus stilbius, a mesopelagic bathylagid, and two mesopelagic myctophids, Stenobrachius leucopsarus and Triphoturus mexicanus.

3.3.5. Coastal Birds

The avifauna of the San Diego region of the Southern California Bight is extremely varied and highly transient. Birds which might occur in the LA-5 area or other offshore areas consist of pelagic or littoral species which feed on epipelagic fishes and marine invertebrates either at the surface or by shallow diving. Common offshore pelagic species include Common Loon, Arctic Loon, Red-throated Loon, Western Grebe, Horned Grebe, Eared Grebe, Pied-billed Grebe, Pink-footed Shearwater, Sooty Shearwater, Black-vented Shearwater, Black Storm-petrel, Brown Pelican, Double-crested Cormorant, Brant, Surf Scoter, Red-breasted Merganser, Glaucous-winged Gull, Western Gull, California Gull, Ring-billed Gull, Mew Gull, Bonaparte's Gull, Heerman's Gull, Forster's Tern, Elegant Tern, and Caspian Tern.

Although the Southern California Bight is not as significant a breeding locale for coastal species as is the northern portion of the State (Farallon Islands northward) it does contain the entire California breeding populations of Black Storm-Petrels, Xantus Murrelets and Brown Pelicans (Sowls et al., 1980). The breeding colonies of these three species are located on the Channel Islands at considerable distance from the LA-5 and other sites under consideration. Little effect upon the breeding efforts of these species would be expected. Preferred breeding areas for most of the other common pelagic species are either dispersed along the California coast or located at more northerly breeding colonies. The designation of the LA-5 disposal site is not likely to affect any of the avian species which occur in the San Diego region.

3.3.6. <u>Marine Mammals</u>

Within the Southern California Bight, 32 species of marine mammals have been recorded. The bight is the richest of all temperate water areas in terms of abundance and species. Most marine mammals are broadly distributed, seasonal migrants that are not dependent on the habitat that will be affected by the project. Therefore, the designation of the San Diego disposal site is not likely to affect any of the listed species.

3.3.6.1. <u>Pinnipeds</u>

The Southern California Bight supports a large number of seals and sea lions (Table 3-13A). Six species are present, although the Guadalupe fur seal (<u>Arctocephalus townsendi</u>) is considered a rare visitor to this area. Pinnipeds tend to be concentrated offshore at the northern Channel Islands, where essentially all breeding, pupping, most foraging and hauling out occurs (NOAA, 1980). The most important rookeries are on San Miguel Island. Other important pinniped areas are located on San Nicolas, San Clemente and Santa Barbara Islands.

Pinnipeds are found in smaller numbers along the mainland coast as well, where the main activity is hauling out. Feeding occurs in both nearshore and offshore waters, with some species swimming daily across the channel to feed over offshore banks

Table 3-13. Marine Mammals of the Southern California Bight

Species	Estimated North American Pacific* Population
A. PINNEPEDS	
California sea lion (*Zalophus californianus*)	157,000
Steller sea lion (*Eumetopias jubata*)	10,000
Northern elephant seal (*Mirounga angustirostris*)	100,000
Harbor seal (*Phoca vitulina*)	42,000
Northern fur seal (*Callorhinus ursinus*)	4,000
Guadalupe fur seal (*Arctocephalus townsendi*)	1,600
TOTAL PINNEPEDS	314,600
B. CETACEANS	
Common dolphin (*Delphinus delphis*)	900,000
Pacific bottlenose dolphin (*Tursiops truncatus*)	ND
White-sided dolphin (*Lagenorhynchus obliquidens*)	40,000
Northern right whale dolphin (*Lissodelphis borealis*)	ND
Dall's porpoise (*Phocoenoides dalli*)	920,000
Pacific pilot whale (*Globicephala macrorhyncus*)	ND
California gray whale (*Eschrichtius robustus*)	18,000
TOTAL CETACEANS	1,878,000

* Excluding Alaska

ND = No Data Available

(NMFS, 1986)

and ridges. The California sea lion (Zalophus californianus) and the harbor seal (Phoca vitulina) are the two most common pinniped species along the mainland coast and in the vicinity of the LA-5 site.

3.3.6.2. Cetaceans

Of the 29 species of cetaceans that have been identified in the Southern California Bight (Table 3-13B), 10 species are common (Dailey, 1974). All of these species are either transient or migratory in the area and, with the exception of the gray whale (Eschrichtius robustus) and harbor porpoise (Delphinus delphis), tend to occur offshore over the continental slope between the 175 to 1,000 fathom (300 and 2,000 meter) isobaths (Dailey, 1974). Gray whales and bottlenose dolphins (Tursiops truncatus) are common inshore, normally occurring within 8 nmi of the coast. The gray whale and six other cetacean species are listed as endangered by the U.S. National Marine Fisheries Service.

Five cetaceans which occur in California waters (California gray whale, blue whale, Sei whale, humpback whale, and sperm whale) are designated as endangered species by the federal government. All marine mammals, however, are afforded complete protection under the Marine Mammals Protection Act of 1972.

3.3.7. Rare, Threatened and Endangered Species

Table 3-14 lists rare, threatened and endangered species that occur in the offshore Southern California Bight and immediate coastal areas. Most of these species do not occur in the project vicinity, nor do they make regular use of the area. Designation of an ODMDS near the San Diego coast is not expected to affect any endangered species. Species of particular interest in the project area are discussed below.

3.3.7.1. Gray Whale (Eschrichtius robustus)

The gray whale population has shown marked recovery in recent years as a result of protection under the Endangered Species Act. In the most recent survey by the National Marine Fisheries Service (NMFS, 1985), the present population is estimated to be 17,000. These animals migrate through the Southern California Bight twice a year between their summer feeding grounds off Alaska and Canada, and their winter calving areas in the coastal lagoons of Baja California.

The San Diego region is a principal gray whale migration route. Gray whales pass near and/or through the alternative disposal sites in the San Diego region on their twice-yearly migrations. The major migratory route is between the mainland shore and the Channel Islands. The whales tend to swim closer

Table 3-14. Rare, Threatened or Endangered Species of the Southern California Bight

Species	California Distribution	Federal Status	State Status
PLANTS			
Salt marsh bird's beak (Cordylanthus martinimus spp. martimus)	Coastal marshes of Santa Barbara, Ventura, Orange and San Diego Counties.	E	E
REPTILES			
Leatherback turtle (Dermochelys coriacea sechlegeli)	Tropical and subtropical seas of west coast; some stray as far north as Vancouver Island, B.C.	E	N/A
Loggerhead sea turtle (Caretta caretta)	Offshore.	T	N/A
Green sea turtle (Chelonia mydas)	Offshore.	E	N/A
Pacific Ridley's turtle (Lepidochelys olivacea)	Rare visitors offshore.	E	N/A
BIRDS			
American peregrine falcon (Falco peregrinus anatum)	Territories along coastal California between Oregon and Mexico.	E	E
Southern bald eagle (Haliaeetus leucocephalus	Mainly in interior of state some found along the coast and on Catalina Island.	E	E
California brown pelican (Pelecanus occidentalis californicus)	Statewide along coast. Breeding only on Anacapa Island and Scorpion Rock in So. California.	E	E

(CONTINUED)

Table 3-14 (Continued). Rare, Threatened or Endangered Species of the Southern California Bight

Species	California Distribution	Federal Status	State Status
California least tern (*Sterna albifrons browni*)	Breeding from San Francisco Bay to Mexico.	E	E
Lightfooted clapper rail (*Rallus longirostris levipes*	Salt marshes of Santa Barbara, Ventura, Orange, and San Diego Counties.	E	E
California black rail (*Lateralis jamacensis carturniculus*)	Salt marshes of Santa Barbara, Ventura, Orange and San Diego Counties.	N/A	R
Belding's savannah sparrow (*Passerculus sandwichensis beldingi*)	Tidal estuaries; So. California to N. Baja.	N/A	E
MAMMALS			
Southern sea otter (*Enhydra lutris nereis*)	Santa Cruz south to Pismo Beach.	T	N/A
Guadalupe fur seal (*Arctocephalus townsendi*)	Offshore, Channel and San Nicolas Islands.	E	R
Blue whale (*Balaenoptera musculus*)	Offshore.	E	N/A
Fin whale (*Balaenoptera physalus*)	Offshore.	E	N/A
Sei whale (*Balaenoptera borealis*)	Offshore.	E	N/A
Gray whale (*Eschrichtius robustus*)	Nearshore, normally within 8 nmi of the mainland shore.	E	N/A

(CONTINUED)

Table 3-14 (Continued). Rare, Threatened or Endangered Species of the Southern California Bight

Species	California Distribution	Federal Status	State Status
Humpback whale (*Megaptera novaeenglinae*)	Nearshore.	E	N/A
Pacific right whale (*Eubalaena glacialis japonica*)	Offshore.	E	N/A
Sperm whale (*Physeter catondon*)	Offshore.	E	N/A

E = Endangered
R = Rare
T = Threatened
N/A = Not Applicable

to shore, often less than 0.5 nmi (1 km), from February to March on their northward migration when calves are present, than on the southward migration from December to January. Point Loma is a favorite whale watching location.

3.3.7.2. California Brown Pelican (Pelicanus occidentalis californicus)

The brown pelican population has shown strong recovery in recent years since the banning of the use of DDT. Due to the mobility of this species, it is difficult to estimate the total size of the California population, but breeding pairs have numbered roughly 2,000 to 3,000 in recent years (FWS, 1985). A notable exception to this estimate was that only 850 breeding pairs were observed in 1984. This was thought to be a temporary decrease, and the California pelican population is expected to grow or remain constant in the near future.

In the Southern California Bight, pelican rookeries are located on Anacapa Island, Scorpion Rock on Santa Cruz Island, Santa Barbara Island, and the Los Coronados Islands off northern Mexico. The closest of these, Los Coronados, is located approximately 10.5 nmi (19.4 km) south of the LA-5 site. During the nesting season between March and July, pelicans feed primarily in the vicinity of the rookeries. During the remainder of the year, pelicans are common throughout coastal southern California and they feed in nearshore areas, offshore waters and close to their resting places along the coast.

3.3.7.3. California Least Tern (Sterna albifrons browni)

Arriving from unknown wintering areas, California least terns nest from approximately April to August on sandy beaches from Baja California to San Francisco Bay. The California population is currently estimated at approximately 1,200 nesting pairs (California Department of Fish and Game, 1983). The endangered status of this species is partly due to encroachment on its nesting and feeding areas by development and other disturbance by humans.

Nesting sites in the vicinity of the LA-5 site are the mouths of several lagoons in northern San Diego County, Mission Bay, San Diego Airport, Coronado Naval Air Station, several sites in south San Diego Bay and the Tijuana River mouth. The closest of these, Coronado Naval Air Station, is approximately 8 nmi (15 km) north of the LA-5 site. Least terns feed in estuaries, rivers and streams, and to a lesser extent in nearshore marine waters near their nesting locations.

3.3.8. Marine Sanctuaries and Areas of Special Biological Significance

The Border Field Federal Wildlife Refuge, located at the mouth of the Tiajuana River, is the only federally administered reserve in the LA-5 region (Figure 3.5). It is located 12.3 nmi (22.8 km) east-southeast of the LA-5 site near the international border between the United States and Mexico. This estuarine habitat is an important area for many rare species of plants and birds. Prevailing longshore currents and its distance from the LA-5 preferred site effectively protect this refuge from any impact by ODMDS activities.

Two Areas of Special Biological Significance (ASBS) are located around the LA-5 site (Figure 3.5). These ASBS were designated by the California State Water Resources Control Board (CSWRCB) in 1976 to protect species or biological communities from alteration of natural water quality (CSWRCB, 1976). The San Diego-La Jolla Ecological Reserve ASBS and the San Diego Marine Life Refuge include the shores and coastal waters from a point near Point La Jolla northward to the Scripps Institute of Oceanography and the U.S. Fishery Oceanography Center. Prevailing longshore currents and their distance, 17 to 19 nmi (31 to 35 km) north-northeast of the LA-5 preferred site, effectively protect these sensitive underwater preserves from any impacts from continued use of the ODMDS.

Two additional state administered refuges located in the LA-5 region are the Torrey Pines State Reserve and the Point Loma Ecological Reserve. Within the Torrey Pines Reserve is located the Los Penasquitas Marsh Natural Preserve, one of the few remaining salt marsh and lagoon areas in southern California. It is the habitat of a number of rare and endangered bird species such as the Least Tern and the Light-footed Clapper Rail and is an important feeding and nesting place for migratory waterfowl and shorebirds. Because of its location more than 20 nmi (37 km) northwest of the LA-5 site, no impact is expected. The closest reserve, 6 nmi (11 km) east of the LA-5 site, at the southern end of Point Loma includes a small underwater preserve. Its distance from the preferred ODMDS makes any impact from disposal activities very unlikely.

The Channel Islands National Marine Sanctuary is the only established Federal marine sanctuary in the southern California area. Marine sanctuaries are ocean areas designated under the National Oceanic and Atmospheric Administration's (NOAA) authority in Title III of MPRSA. The purpose of this section of MPRSA is to preserve or restore natural areas, recreation activities and ecological and aesthetic values through conservation of unique areas. NOAA's Office of Coastal Zone Management is authorized to carry out the provisions of Title III of MPRSA. The closest part of the sanctuary to the LA-5 site is approximately 88 nmi (163 km) northwest of the LA-5 site. Movement of suspended material from the ODMDS is not expected to impact the Channel Islands National Marine Sanctuary.

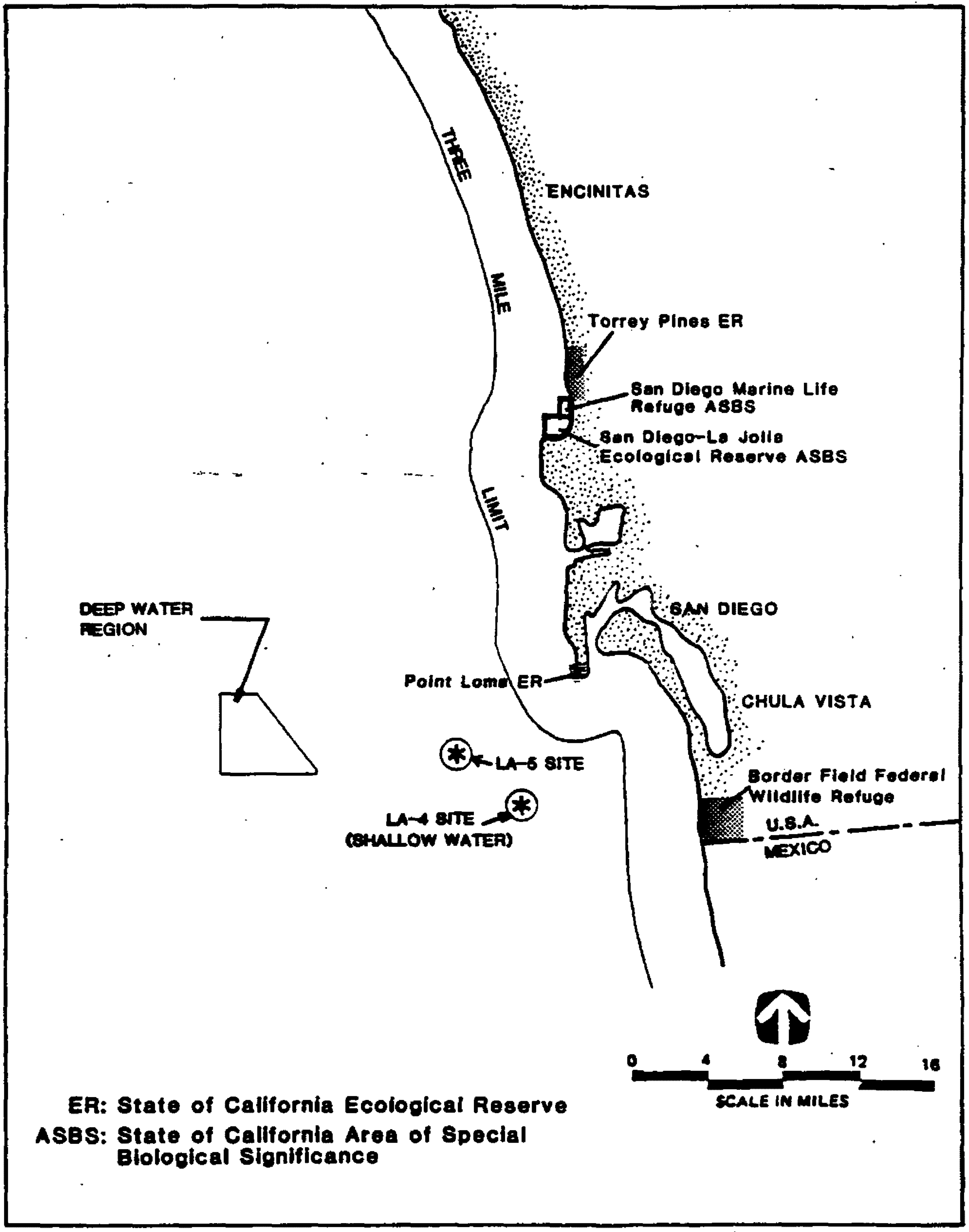


FIGURE 3-5. LOCATION OF FEDERAL AND STATE BIOLOGICAL RESERVES IN THE PROJECT AREA

The State of California has designated oil and gas sanctuaries within the three mile limit of its jurisdiction (Figure 3.5). The oil and gas sanctuaries are specifically excluded from oil and gas leasing in order to protect the scenic and wildlife values of the area. Except for those areas already leased, almost all coastal areas of San Diego County are designated as oil and gas sanctuaries administered by the State Lands Commission. The preferred LA-5 site is located within an area of Proposed Southern California Lease Offering and 3.5 nmi (6 km) west of the coastal zone deleted by the State from lease sale. Some movement of suspended material from the ODMDS could be expected to enter this area.

3.3.9. Potentiality for the Development or Recruitment of Nuisance Species in the Disposal Site 40 CFR 228.6(a)(10)

The sediments of some southern California ports and outfall discharge areas support high densities of characteristic invertebrate species that are considered indicators of polluted sediments. Common species of this type are:

Polychaetes	*Capitella capitata* *Tharyx tesselata*
Bivalve	*Parvilucinia tenuisculpta*
Amphipods	*Corophium acherusicum* *Corophium insideiosum* *Podocerus brasiliensis*

Three of these species, *C. capitata*, *Tharyx sp.*, and *P. tenuisculpta*, are common at the LA-5 site, but they are much less dominant than in highly polluted areas such as industrial ports and sewage discharge sites. These species also occur at the reference site, although in lesser numbers. It is possible that the somewhat elevated abundance of these species at the LA-5 site is due to disposal of dredged material, and continued disposal would be likely to maintain this situation. However, the present abundance of these species at the LA-5 site is not considered high enough to indicate a highly polluted or "nuisance" condition, and it is unlikely that continued disposal would result in such a condition.

Disposal is most likely to promote development of nuisance species at the shallow water site, because these species are likely to be uncommon there at present and because environmental conditions there are most similar to those of the shallow habitats in which these species are normally most abundant. At the deep water site, the potential for disposal to result in establishment of nuisance species is uncertain, but would seem to be low because of low dissolved oxygen levels, low food supply, and general conditions very different from those of the shallow habitats where the species are normally most abundant.

3.4. SOCIOECONOMIC ENVIRONMENT

3.4.1. Commercial Fishing

The San Diego area is an important center for commercial fishing. The 85 million pounds of commercial fish and invertebrates landed in 1983 at San Diego area ports were valued at $38.0 million. This represents approximately 16.5% of the total catch weight and 20.3% of the total value of all commercial landings in California (Table 3-15). Between 1981 and 1983, the value of landings at the San Diego area ports declined from about $89.0 million to $38.0 million due primarily to decline in the catch produced by the tuna fleet based in San Diego.

The annual landings of fish and invertebrates by ports in the San Diego area are shown in Table 3-16. Although landings were reported from several ports in the area, the Port of San Diego accounted for almost 99.8% of all landings in the area.

The species of fish commonly landed at San Diego include tuna (yellowfin, blue fin, skipjack, and albacore), swordfish, Pacific bonito, and rockfish, accounting for over 90% of all landings during the 1981-1983 period.

Figure 3-6 and Table 3-17 show the principal species and the average annual catch by blocks of origin in the San Diego area. This information is based on unpublished data from the California Department of Fish and Game (1984). Fish and Game Block 878 which contains the LA-5 site, has not been very productive for commercial fishing.

The total catch in Block 878 in 1981 amounted to approximately 235,000 pounds of fish and invertebrates. Even though it represented a four-fold increase over the 1976-77 catch, it still amounted to only one-fourth of the average catch per block in the San Diego area. Blocks 860 and 861, to the north of this block are, however, much more productive, partly due to the presence of rocky substrate, kelp beds and other fish habitat. In 1981, these two blocks accounted for almost 4.0 million pounds of fisheries amounting to about 23% of the total catch in the local waters of the San Diego area. In general, the productivity of most of the blocks increased over the 1976-1981 period. The annual fluctuations in the catch are more a reflection of the market demand for fish, rather than the productivity of the blocks.

3.4.2. Commercial Shipping

San Diego Bay is a major Naval, commercial and recreational center for the southwest United States. To enter the bay, ships travel north for four miles from Point Loma to the northern end of the Silver Strand, then turn east for several miles, and finally south to the central harbor areas. The Navy has

Table 3-15. Weight and Value of Landings of Commercial Fish at San Diego Area Ports and in California, 1981-1983

DESCRIPTION	1981	1982	1983
Landings (lbs)			
San Diego Area	158,768,201	112,167,526	84,773,494
California	779,966,447	687,684,354	513,200,668
San Diego as percentage of California	20.4	16.3	16.5
Value of Landings ($)			
San Diego Area	88,624,184	59,949,483	37,692,723
California	280,077,311	229,323,050	186,091,668
San Diego as percentage of California	31.6	26.1	20.3

California Department of Fish and Game, Computer Printouts of Unpublished Data, March 1984.

Table 3-16. Value of Commercial Fish Landing by Port, San Diego Area, 1981-1983

PORT	1981 Value	%	1982 Value	%	1983 Value	%
San Diego	88,454,717	99.8	59,810,489	99.8	37,546,276	99.7
Oceanside	162,188	0.2	130,629	0.2	127,993	0.3
Mission Bay	4,677	--	5,661	--	7,017	--
La Jolla	2,485	--	204	--	6,640	--
San Diego Area TOTAL	88,624,184	100.0	59,949,483	100.0	37,692,723	100.0

California Department of Fish and Game, Computer Printouts of Unpublished Data (March 1984).

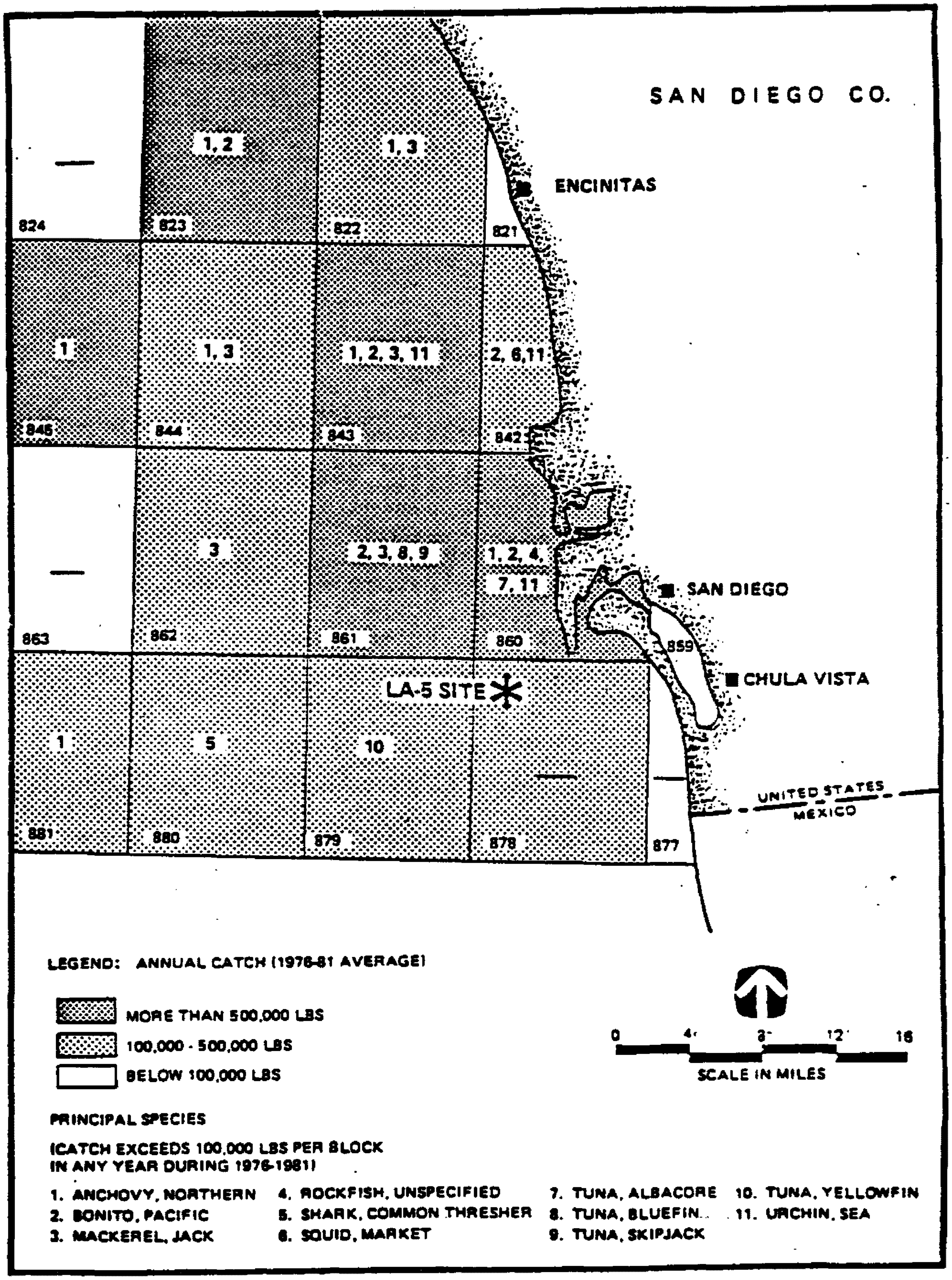


FIGURE 3-6. PRINCIPAL COMMERCIAL FISH SPECIES AND AVERAGE ANNUAL CATCH BY BLOCK IN PROJECT AREA

Table 3-17. Annual Catch in Pounds of Commercial Fish, by Blocks of Origin in the San Diego Area, 1976, 1977 and 1981

Block Number	1976	1977	1981
821	25,753	6,439	9,752
822	1,012,877	106,550	291,134
823	1,554,782	32,409	924,282
824	122,454	213,113	10,012
842	N/A	615,480	170,372
843	397,361	410,960	6,693,322
844	592,934	153,610	47,185
845	38,814	3,392	3,683,971
859	N/A	79,000	4,160
860	1,254,040	1,583,582	3,349,643
861	650,716	357,239	500,234
862	119,197	297,295	212,769
863	9,562	76,205	163,705
877	1,722	224	47,173
878	72,721	40,063	235,002
879	52,465	54,567	320,665
880	106,507	71,435	304,264
881	172,316	146,559	102,547

N/A = Not Available

California Department of Fish and Game, Computer Printouts of Unpublished Data (March 1984).

facilities at the inner north end of the San Diego Bay, about 7 miles from the harbor entrance. Commercial facilities at San Diego, National City, and Chula Vista are primarily on the east side of the bay, from 7 to 15 miles from the entrance (William J. Garrett, Manager, San Diego Unified Port District, personal communication, 1984).

The harbor serves the San Diego metropolitan area and is a major shipping point for agricultural goods from southern California, Arizona, and New Mexico. Approximately two million tons of cargo passes through the port annually. Between 1,200 and 1,400 commercial and other vessels annually called at San Diego Bay ports during the 1979-1983 period (Table 3-18). Port users anticipate future shipping and trade with China, Indonesia, Malaysia, New Zealand, Australia, Hong Kong, and Taiwan as well as coastal shipping from Alaska, Seattle, San Francisco, and Oakland.

The San Diego Unified Port District has responsibility for providing safe navigation in San Diego Bay. A maintenance dredging project involving several sites along the waterfront was carried out recently to restore a number of commercial berthing spaces and some marina areas to their authorized depths. While existing ship channel depths and widths appear adequate for the foreseeable planning period, growing ship size is expected to continue placing greater demand on the need for deeper channels and expanded terminal areas in the long term future. A second entrance to the harbor has been contemplated and studied several times by the Corps of Engineers to reduce congestion and inconvenience due to distance from the central harbor to the channel entrance, but has not been found economically feasible.

3.4.3. Oil and Gas Development

There is no oil and gas development offshore of San Diego County. The State waters within the three-mile limit have been designated by the State as oil and gas sanctuaries. This precludes any oil and gas development in these areas.

In the Federal waters, some tracts were proposed for leasing in the initial call area for lease 48 anticipated to be held in 1977. A number of issues were raised during the comment period on the call and throughout the environmental impact statement process. Subsequently, all tracts off San Diego were deleted from the final offering in June 1979. These areas were again included in the call for lease sale 68, but were dropped before the final sale offering in June 1982. For the third time, the lease sale proposed for January 1984 again included the San Diego area in its initial study and the EIS. This time, Congress put a moratorium on funding and asked the Interior Department to review the entire sale offering. Large areas including those outside San Diego have been deleted from the proposed sale as a result of this congressional action. Only about 34% of the proposed sale area studied in the December 1983 EIS was offered in Lease Sale 80, held in October 1984.

Table 3-18. San Diego Unified Port District, Vessel Traffic 1980 to 1983

YEAR	VESSEL ARRIVALS COMMERCIAL	OTHER	TOTAL	TOTAL TONNAGE HANDLED (MILLION METRIC TONS)
1979-1980	256	968	1,224	1.91
1980-1981	261	945	1,206	2.33
1981-1982	195	981	1,176	1.79
1982-1983	217	1,204	1,421	1.66

San Diego Unified Port District, Annual Reports for 1979-1980, 1980-81, 1981-82, 1982-83.

3.4.4. Military Usage

The Port of San Diego includes one of the largest Navy establishments in the country. San Diego Bay is the home base for 120 Navy ships, which constitute more than 18% of the Navy's active fleet. San Diego also is home to the Navy's Fleet Area Control and Surveillance Facility. The area offshore of San Diego is extensively used for various military operations (Figure 3-7). These include: surface and submarine fleet maneuvers and training, aircraft carrier operations, amphibious vehicle training and assault operations, and antisubmarine warfare. The area offshore of San Diego is the principal training ground for the Navy and the Marine Corps (MMS, 1983).

Most of the military operations take place far beyond the immediate coastal areas outside San Diego. It is only the military vessel traffic in and at the mouth of San Diego Bay, off Point Loma, that may be of any concern in connection with the activities related to the dredged material dumping at the LA-5 site. Annually, Navy aircraft carriers make about 50 trips, cruisers and destroyers about 1,300 trips each, amphibious fleet about 4,600 trips, and service fleets about 1,250 trips in and out of San Diego Bay (U.S. Army Corps of Engineers, 1983).

3.4.5. Recreational Activities

The major ocean-related recreational activities in the San Diego area are sightseeing, beachcombing, picnicking, swimming, wading, sunbathing, diving, surfing, sailing, and power boating. Most of the beach-related activities are confined to ocean-front areas north of San Diego Bay, particularly from Mission Bay to Oceanside, although some recreational areas do exist along the Coronado Peninsula. The shore-related activity closest to the LA-5 site is diving which occurs off Point Loma.

Table 3-19 gives the number of participation days for ocean-related recreational activities in 1980 and projected demand for 1985 and 1990. In 1980, San Diego County recorded 25.2 million participation days of ocean-related recreational activity and this demand is expected to grow by more than 14% during the 1980-1990 period (California Department of Parks and Recreation, 1984). Activities which are expected to experience highest growth between 1980 and 1990 include: sailing (25%), sportfishing (23%), powerboating (17.5%), and scuba diving (16%).

3.4.5.1. Sportfishing

Sportfishing in the San Diego area occurs out of several harbors and at a number of piers. Five fishing methods predominate in the area's ocean sportfishery: shore, pier, skiff, party boat (commercial passenger fishing vessel), and skin and SCUBA diving. Shore and pier fishing are by far the

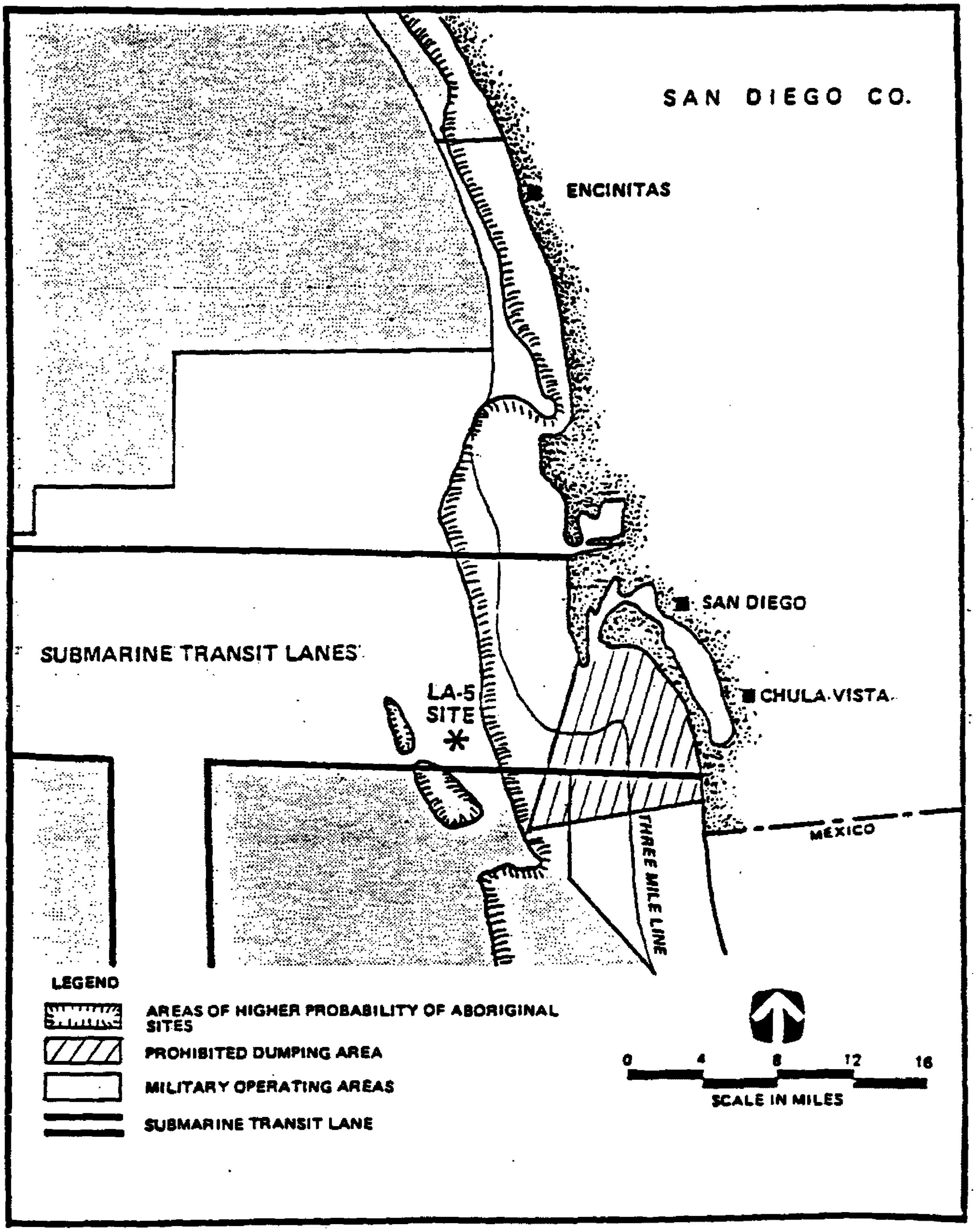


FIGURE 3-7. COMMERCIAL SHIPPING LANES, ZONES OF MILITARY OPERATION AND OTHER CULTURAL FEATURES IN THE PROJECT AREA

Table 3-19. Existing and Projected Number of Participation Days for Ocean-Related Recreational Activities in the LA-5 Area (San Diego County) 1980, 1985 and 1990

ACTIVITY CODE	ACTIVITY	NUMBER OF PARTICIPATION DAYS (IN THOUSANDS) 1980	1985	1990	PERCENT CHANGE 1980-1990
2	Power Boating	845	923	996	17.5
3	Sailing	708	824	885	25.0
6	Salt Water Fishing	1,843	2,048	2,268	23.0
19	Ocean Swimming	9,132	9,959	10,622	16.3
21	Scuba and Snorkeling	455	497	528	16.0
22	Body Surfing	4,144	4,264	4,572	10.3
23	Board Surfing	2,957	3,030	3,232	9.3
24	Sunbathing	3,175	3,418	3,591	13.1
25	Beachcombing	629	675	709	12.7
26	Beach Games	1,310	1,388	1,477	12.7
	TOTAL	25,200	27,026	28,880	14.6

California Department of Parks and Recreation, Computer Printouts of the "PARIS" model (April 1984).

most popular methods, although more fish per hour are caught from boats. Due to the location of the LA-5 site away from the shore, party boat fishing is the activity most likely to be affected by the project-related activities (Figure 3-8). The discussion below, therefore, pertains mainly to this method of sportfishing.

Party boats in the San Diego area operate mostly from Mission Bay, San Diego, and Oceanside Harbors with some activity seen in recent time from Coronado as well. Table 3-20 provides the number of fish caught and the number of anglers reported by boats operating from these harbors for 1977 and 1981. In 1977, San Diego reported almost 98,000 anglers catching more than 400,000 fish which amounted to 8.5% of the total sportfish caught in the State. Second was Mission Bay with 50,000 anglers and almost 260,000 fish caught, with Oceanside a distant third reporting a catch of 54,000 fish. By 1981, number of anglers and catch out of Oceanside increased by almost 100%, and anglers began using the Coronado Harbor (863 anglers). As a result, the number of anglers at Mission Bay and San Diego dropped somewhat from 1977 levels. These locational changes did not affect the overall activity in the area which experienced increases both in the number of anglers and fish caught. However, the area did experience a moderate decline in its share of the State catch as well as the number of anglers, partly due to increasing activity in the neighboring Los Angeles area.

Over 70 species of fish have been recorded in the San Diego area sport catch. However, only about 10 species are caught in large numbers. The commonly caught species by number and by block of origin, as defined by the California Department of Fish and Game, are shown in Table 3-21. Block 878, which contains the LA-5 site, is not a very productive block in terms of sport fisheries partly due to its distance from the shore, and partly due to the depth of water which is not suitable for sportfishing activity. In 1977, it reported a catch of only 22,000 compared to its northerly neighbor, block 860, which reported a catch almost 13 times larger.

3.4.5.2. Boating

The recreational activity most likely to be affected by the project-related activities, particularly transportation of dredged material by barges, is boating. Most recreational boating is done close to the coastline in shallow waters. Once the boats leave San Diego Bay at Point Loma, their destination usually is either to the north toward Los Angeles, or to the south along the Mexican Coast. In 1979, about 34,500 boats were registered in San Diego County and they accounted for over 40 million participation days of boat use. There are approximately 4,000 boat slips in use for privately owned recreational craft in the harbor and there is a high demand for additional slips. In addition, thousands of trailerable boats use launch facilities.

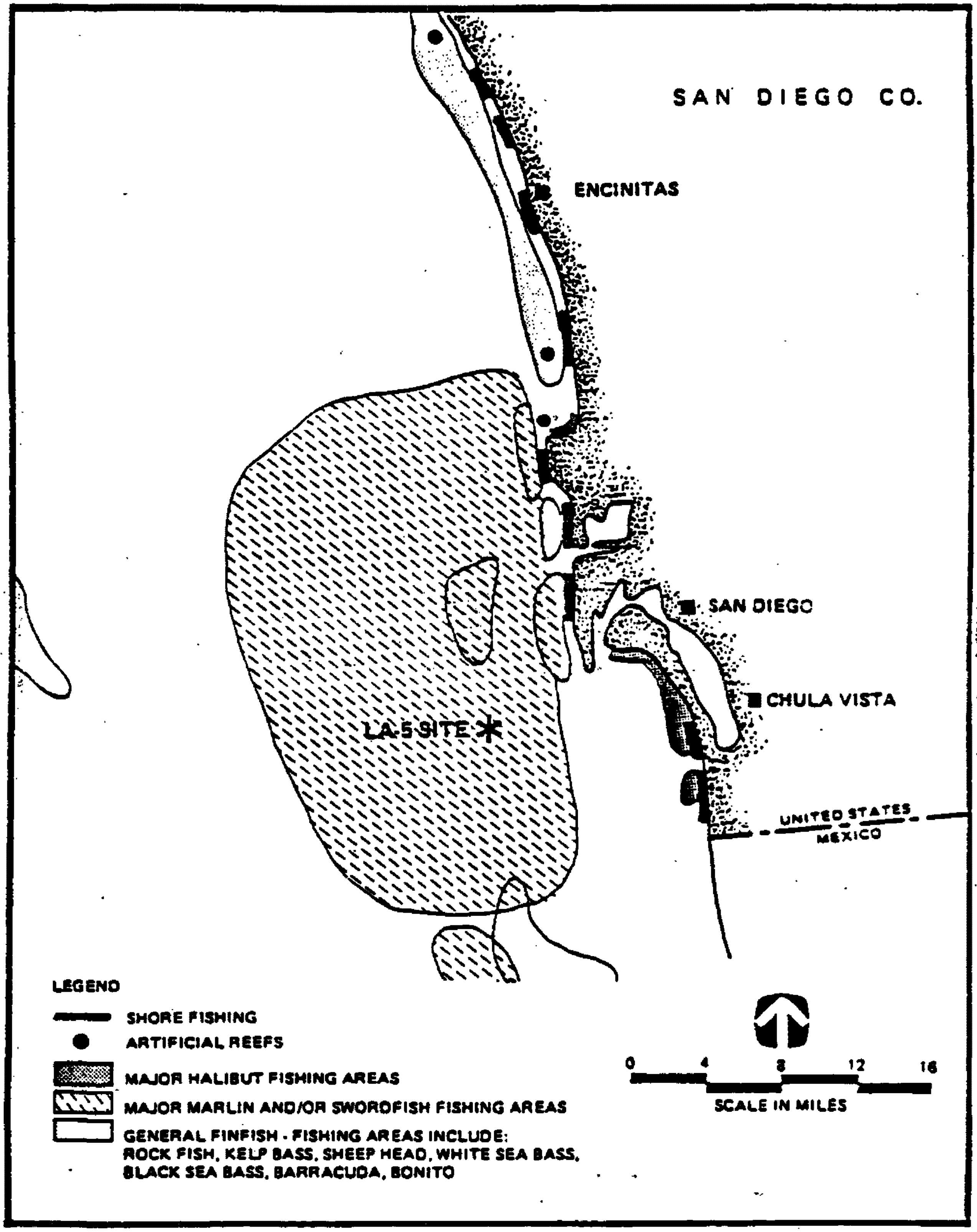


FIGURE 3-8. SPORTFISHING RESOURCES OF THE PROJECT AREA

Table 3-20. Number of Sportfish Caught and Number of Anglers on Commercial Passenger Fishing Vessels (Party Boats), by Port, in the San Diego Area, 1977 and 1981.

	Sportfish Caught			
	1977		1981	
Port	Number	% of State Total	Number	% of State Total
Mission Bay	259,628	5.4	270,284	4.3
San Diego	413,283	8.5	456,115	7.2
Oceanside	53,525	1.1	130,670	2.1
Coronado	--	--	1,840	--
State Total	4,849,472	100.0	6,314,534	100.0
	Number of Anglers			
	1977		1981	
	Number	% of State Total	Number	% of State Total
Mission Bay	50,267	7.0	48,874	5.8
San Diego	97,562	13.6	93,017	11.2
Oceanside	11,605	1.6	19,877	2.4
Coronado	--	--	863	0.1
State Total	716,536	--	830,653	100.0

California Department of Fish and Game, Computer Files of Unpublished Data (July 1984).

Table 3-21. Number of Sportfish Caught, by Block of Origin, in the Vicinity of LA-5 Site, 1977

SPECIES CODE	FISH SPECIES	FIRST TIER OF BLOCKS FROM SITE BLOCK SITE BLOCK 878	859	860	861	877	979
3	Bonito, Pacific	313	--	42,734	10,925	375	171
51	Mackerel, Pacific	4,858	--	121,164	26,932	1,161	8
130	Barracuda, California	223	--	8,888	1,286	61	12
250	Rockfish, Unspecified	1,550	--	67,985	15,200	259	92
260	Scorpion Fish, Spotted	44	--	841	233	27	--
277	Bass, Kelp	1,931	--	33,124	3,636	587	3
278	Bass Barred Sand	12,957	--	6,320	697	2,767	--
435	Croaker White	44	--	138	30	495	--
478	Halfmoon	1	--	126	47	--	--
490	Whitefish, Ocean	13	--	14	--	6	--
--	Others	465	--	5,935	1,400	46	393
	TOTAL	22,117	--	287,269	60,386	5,784	679

California Department of Fish and Game, Computer Files of Unpublished Data (July 1984).

3.4.5.3. Other Recreational Activities

Other major ocean-related recreational activities in the San Diego area are sightseeing, beachcombing, picnicking, swimming, wading, sunbathing, diving, and surfing. Sightseeing and beachcombing are enjoyed along the entire coast. Picnicking, swimming, wading, and sunbathing tend to be concentrated along public beaches where recreational facilities are easily accessible (Figure 3-9). Due to a large concentration of population in southern California, the warm climate of the region, and a worldwide reputation for beautiful beaches, coastal recreational facilities in the San Diego area are used by large numbers of people each summer day. Diving occurs along the San Digeo County coast.

Surfing is a popular sport activity along the San Diego coast to the northeast of the LA-5 site. There has been a large increase in surfing over the past few years due to the use of wet suits to protect the surfers from the cold. This allows the sport to be practiced over the entire year rather than just during the warmer season. None of these activities will be affected by designation of an ODMDS.

3.4.6. Cultural Resources

Cultural resources relevant to offshore areas are prehistoric and historic remains comprising a nonrenewable resource base that provides archaeologists and historians with information for reconstruction of past cultural systems and behaviors. The offshore region of southern California is believed to contain numerous cultural resources (Figure 3-7). Types of submerged resources are aboriginal remains, and sunken ships and aircrafts. There are over 50 recorded marine prehistoric sites in the inner basins of southern California extending from Los Angeles to San Diego. All of these sites are in State waters, close to shore and relatively shallow. The most probable resource that could be encountered near the LA-5 site is shipwrecks.

The Minerals Management Service (MMS) has compiled a list of shipwrecks with their known or suspected locations (MMS, 1984). Over 450 known historic shipwrecks have occurred in the inner banks of southern California, most of which occurred near either Los Angeles or San Diego (MMS, 1983). Based upon water depth and known cultural resource location data, MMS has also identified 16 Federal oil and gas lease tracts in the LA-5 study area having cultural resource sensitivity (MMS, 1983). There are 10 wrecks reported off Point Loma, and 4 off the San Diego area (BLM, 1979). The tract containing the LA-5 site as well as most other tracts in its immediate vicinity are highly sensitive cultural resource areas as a result of these reported wrecks.

Aboriginal sites are unlikely in the project study area except in the shallow Coronado bank area. Intertidal gathering occurred mostly near Point Loma.

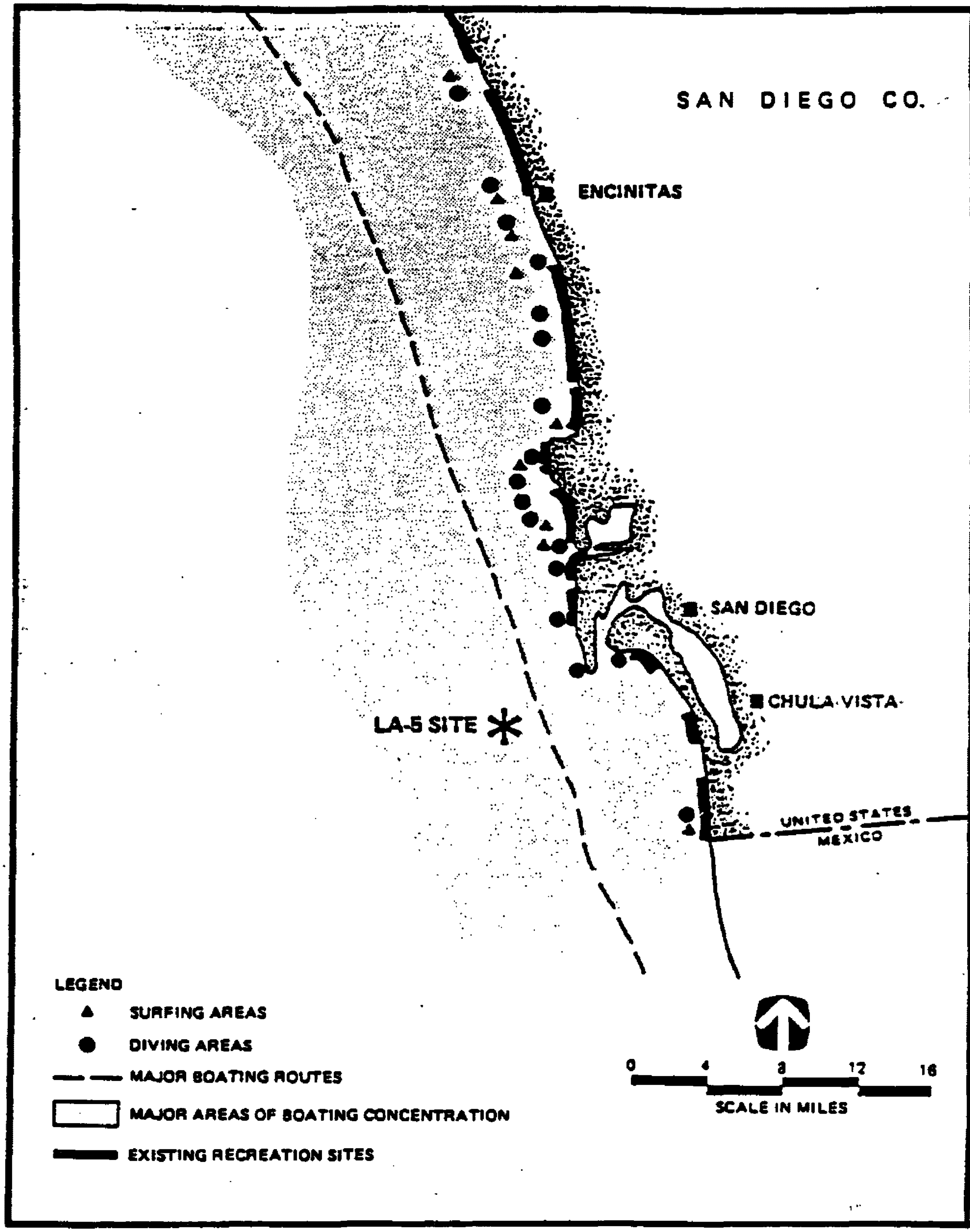


FIGURE 3-9. PRINCIPAL RECREATION AREAS IN THE PROJECT REGION

3.4.7. Public Health and Welfare

Ensuring that public health and welfare are not adversely affected by ocean disposal of dredged materials is a primary concern. Public health and welfare can be affected in a number of ways. Here only three issues, health, safety, and aesthetics, are discussed.

Health hazards may arise if the chemical nature of the materials has the potential for bioaccumulation of toxic substances in organisms. Potential impacts on human health can be inferred from bioassay and bioaccumulation tests performed on marine animals. Since the LA-5 study area provides a large amount of fish and invertebrates for human consumption, the public health issue gains added importance. (See Sections 3.4.1 and 3.4.5.1, Commercial and Sportfishing, for details on local fish and invertebrates. Refer also to Section 3.3, Biological Environment.)

The disposal of dredged material could present hazards to navigation either as a result of mounding within the disposal site, or as a result of interference of the disposal barges with shipping traffic. As described in the commercial shipping section, traffic in the LA-5 study area is fairly heavy. In addition a large number of fishing and recreational boats also use this area.

A third aspect of the public health and welfare issue is the effects of dredged material disposal on the aesthetics of the area. The LA-5 site is used by people engaged in sportfishing and recreational boating. They may encounter discoloration of normally clear water particularly at times when dumping is in operation. Potential impacts and mitigation measures related to public health will be discussed in Chapter 4, Environmental Consequences.

CHAPTER 4. ENVIRONMENTAL CONSEQUENCES

4.1. INTRODUCTION

This chapter assesses the impacts of the proposed project alternatives on the physical, biological, and socioeconomic environmental segments discussed in Chapter 3. Any site designated ODMDS is expected to have some environmental impacts on the biological community within the designated area. It is the purpose of this EIS to determine the probable or known severity of impacts expected at the site and the significance of potential impacts outside the boundaries of the ODMDS related to human health and the marine environment.

The classification system used in this EIS to determine levels of environmental impact is similar to that used by MMS (1984) to evaluate impacts for the Point Arguello Oil Field Development Plan. The environmental impacts are divided into the following classes:

- Class I - Significantly adverse impacts that cannot be mitigated to insignificance. This means that no measures could be taken to avoid or reduce these adverse effects to insignificant or negligible levels.

- Class II - Significant adverse impacts that can be mitigated to insignificance. These impacts are potentially similar in significance to Class I impacts, but the severity of the impact can be reduced or avoided by implementation of mitigation measures discussed under each heading.

- Class III - Adverse but insignificant impacts, or no effect anticipated. No mitigation measures are required for these impacts or effects.

- Class IV - Beneficial impacts. These impacts would improve conditions relative to the pre-project baseline conditions. They are further subdivided as significant or insignificant where applicable.

The term "significant" is used in this chapter to characterize the magnitude of the potential impact. For the purposes of the EIS, a significant impact is a substantial or potentially substantial change to resources in the vicinity of the ODMDS or the area adjacent to the ODMDS.

In the discussions of each subject area below, criteria used to distinguish between significant and insignificant impacts are provided. To the extent feasible, distinctions are also made between the scope of local and regional significance, and short-term versus long-term duration. Mitigation measures are discussed where appropriate. A summary of the impacts and mitigation measures is presented in Tables 4.1, 4.2, 4.3 and 4.4.

Table 4-1. Summary of Impacts and Mitigation Measures for the LA-5 Site (Refer to text in Chapter 4 for detailed explanation.)

Impacts										Potential Mitigation Measures
Description	Class I	Class II	Class III	Class IV	Scope (1) S	Scope (1) L	Scope (1) R	Term (2) S	Term (2) E	
PHYSICAL ENVIRONMENT										
Air Quality			X			X		X		
Water Quality			X			X			X	
- turbidity, DO	X					X		X		No mitigation
- trace metals,										measures proposed
DDTs, PCBs, oils										because effects
and greases	X					X		X		are short-term.
Geology										
- sediment grain size	X				X				X	
- sediment quality	X				X				X	
BIOLOGICAL ENVIRONMENT										
Plankton			X			X		X		
Kelp			X				X		X	
Benthic Infauna	X				X				X	
Benthic Epifauna	X				X				X	
Demersal Fish	X					X		X		
Pelagic Fish			X			X			X	
Coastal Birds			X				X		X	
Marine Mammals			X			X			X	
Threatened and Endangered Species			X			X			X	
Marine Sanctuaries and ASBS			X				X		X	

(CONTINUED)

(1) = Scope Definitions
S = site, 1000 yd (914 m) radius from center of designated ODMDS.
L = local, up to 1 nmi outside of site.
R = region, beyond local vicinity of ODMDS.

(2) = Term
S = short, less than or equal to 5 hours.
E = extended, greater than 5 hours.

Table 4-1 (continued). Summary of Impacts and Mitigation Measures for the LA-5 Site (Refer to text in Chapter 4 for detailed explanation.)

Impacts										Potential Mitigation Measures
	Class				Scope (1)			Term (2)		
Description	I	II	III	IV	S	L	R	S	E	
SOCIOECONOMIC ENVIRONMENT										
Commercial Fishing										
- fish stocks			X				X		X	
- fishing fleet safety			X			X			X	
Commercial Shipping				X			X		X	
- safety			X			X		X		
- mounding			X		X				X	
- port access				X			X		X	
Oil and Gas Development			X			X			X	
Military Usage										
- traffic interference			X			X	X		X	
- naval ship access				X			X		X	
Sport Fishing			X			X			X	
Other Recreational Activities			X			X			X	
Cultural Uses			X			X			X	
Public Health and Welfare										
- health			X				X		X	
- safety			X			X		X		

(1) = Scope Definitions
S = site, 1000 yd (914 m) radius from center of designated ODMDS.
L = local, up to 1 nmi outside of site.
R = region, beyond local vicinity of ODMDS.

(2) = Term
S = short, less than or equal to 5 hours.
E = extended, greater than 5 hours.

Table 4-2. Summary of Impacts and Mitigation Measures for the No Action Alternative (Refer to text in Chapter 4 for detailed explanation.)

Impacts										Potential Mitigation Measures
	Class				Scope (1)			Term (2)		
Description	I	II	III	IV	S	L	R	S	E	
PHYSICAL ENVIRONMENT				X	X				X	
BIOLOGICAL ENVIRONMENT				X	X				X	
SOCIOECONOMIC ENVIRONMENT										
Commercial Shipping and Military Use	X						X		X	
Public Health, Safety, Aesthetics				X		X			X	

(1) = Scope Definitions
S = site, 1000 yd (914 m) radius from center of designated ODMDS.
L = local, up to 1 nmi outside of site.
R = region, beyond local vicinity of ODMDS.

(2) = Term
S = short, less than or equal to 5 hours.
E = extended, greater than 5 hours.

Table 4-3. Summary of Impacts and Mitigation Measures for the Shallow Water Alternative (Refer to text in Chapter 4 for detailed explanation.)

Impacts										Potential Mitigation Measures
Description	Class I	Class II	Class III	Class IV	Scope (1) S	Scope (1) L	Scope (1) R	Term (2) S	Term (2) E	
PHYSICAL ENVIRONMENT										
Air Quality			X			X		X		
Water Quality			X			X			X	
- turbidity, DO	X					X		X		No mitigation measures proposed because effects are short-term.
- trace metals, DDTs, PCBs, oils and greases	X					X		X		
Geology										
- sediment grain size	X				X				X	
- sediment quality	X				X				X	
BIOLOGICAL ENVIRONMENT										
Plankton			X			X		X		
Kelp			X				X		X	
Benthic Infauna	X				X				X	
Benthic Epifauna	X				X				X	
Demersal Fish	X					X		X		
Pelagic Fish			X			X			X	
Coastal Birds			X				X		X	
Marine Mammals			X			X			X	
Threatened and Endangered Species			X			X			X	
Marine Sanctuaries and ASBS			X				X		X	

(CONTINUED)

(1) = Scope Definitions
S = site, 1000 yd (914 m) radius from center of designated ODMDS.
L = local, up to 1 nmi outside of site.
R = region, beyond local vicinity of ODMDS.

(2) = Term
S = short, less than or equal to 5 hours.
E = extended, greater than 5 hours.

Table 4-3 (continued). Summary of Impacts and Mitigation Measures for the Shallow Water Alternative (Refer to text in Chapter 4 for detailed explanation.)

Impacts										Potential Mitigation Measures
	Class				Scope (1)			Term (2)		
Description	I	II	III	IV	S	L	R	S	E	
SOCIOECONOMIC ENVIRONMENT										
Commercial Fishing										
- fish stocks			X				X		X	
- fishing fleet safety			X			X			X	
Commercial Shipping				X			X		X	
- safety			X			X		X		
- mounding			X		X				X	
- port access				X			X		X	
Oil and Gas Development			X			X			X	
Military Usage										
- traffic interference			X			X	X		X	
- naval ship access				X			X		X	
Sport Fishing			X			X			X	
Other Recreational Activities			X			X			X	
Cultural Uses		X			X	X			X	Close coordination with the SHPO to prevent damage.
Public Health and Welfare										
- health			X				X		X	
- safety			X			X		X		

(1) = Scope Definitions
S = site, 1000 yd (914 m) radius from center of designated ODMDS.
L = local, up to 1 nmi outside of site.
R = region, beyond local vicinity of ODMDS.

(2) = Term
S = short, less than or equal to 5 hours.
E = extended, greater than 5 hours.

Table 4-4. Summary of Impacts and Mitigation Measures for the Deep Water Alternative (Refer to text in Chapter 4 for detailed explanation.)

Impacts										Potential Mitigation Measures
	Class				Scope (1)			Term (2)		
Description	I	II	III	IV	S	L	R	S	E	
PHYSICAL ENVIRONMENT										
Air Quality			X			X		X		
Water Quality			X			X			X	
- turbidity, DO	X					X		X		
- trace metals, DDTs, PCBs, oils and greases	X					X		X		
Geology										
- sediment grain size	X				X				X	
- sediment quality	X				X				X	
BIOLOGICAL ENVIRONMENT										
Plankton			X			X		X		
Kelp			X			X			X	
Benthic Infauna	X					X			X	
Benthic Epifauna	X					X			X	
Demersal Fish	X					X		X		
Pelagic Fish			X			X			X	
Coastal Birds			X				X		X	
Marine Mammals			X			X			X	
Threatened and Endangered Species			X			X			X	
Marine Sanctuaries and ASBS			X				X		X	

(CONTINUED)

(1) = Scope Definitions
S = site, 1000 yd (914 m) radius from center of designated ODMDS.
L = local, up to 1 nmi outside of site.
R = region, beyond local vicinity of ODMDS.

(2) = Term
S = short, less than or equal to 5 hours.
E = extended, greater than 5 hours.

Table 4-4 (continued). Summary of Impacts and Mitigation Measures for the Deep Water Alternative (Refer to text in Chapter 4 for detailed explanation.)

Impacts										Potential Mitigation Measures
	Class				Scope (1)			Term (2)		
Description	I	II	III	IV	S	L	R	S	E	
SOCIOECONOMIC ENVIRONMENT										
Commercial Fishing			X			X	X		X	
Commercial Shipping										
- interference			X				X		X	
- port access				X			X		X	
Oil and Gas Development			X			X			X	
Military Usage			X			X	X		X	
Sport Fishing			X			X			X	
Other Recreational Activities			X			X			X	
Cultural Uses			X			X			X	
Public Health and Welfare										
- health			X				X		X	
- safety			X			X			X	

(1) = Scope Definitions
S = site, 1000 yd (914 m) radius from center of designated ODMDS.
L = local, up to 1 nmi outside of site.
R = region, beyond local vicinity of ODMDS.

(2) = Term
S = short, less than or equal to 5 hours.
E = extended, greater than 5 hours.

4.2. LA-5 ODMDS ALTERNATIVE (PREFERRED ALTERNATIVE)

The principal effect of disposal of dredged material at the LA-5 site is the introduction of substantial amounts of sediment and associated contaminants into a small area. It is important to note that significant impacts may be expected at any site designated as the final ODMDS by virtue of the accumulation of large amounts of disposed dredged material. Furthermore, this EIS is on designation of a permanent disposal site, while dredged material is specifically reviewed under the COEs permitting regulations. Designation of the LA-5 site is expected to maintain the observed effects of past disposal, such as fluctuations in grain size distribution and increases in concentrations of trace metals, oil and grease, pesticides, and PCBs. In turn, these factors are expected to continue affecting the benthic fauna of the site, causing less diverse infauna and less abundant epifauna and encouraging the presence of several species indicative of moderate pollution.

Other mechanisms by which disposal is expected to affect benthic fauna at the disposal site include smothering and interference with feeding processes. These effects on benthic fauna are expected to be at least partly responsible for maintaining a less diverse and reduced demersal fish fauna compared to populations that exist at the reference site. In addition, any elevation in the levels of pesticides or PCBs in the dredged materials disposed at the site may be reflected in the levels found in the tissues of invertebrates and fish at the LA-5 site.

Significant effects of disposal on the sediment and benthic fauna are likely to be limited to the immediate site vicinity, and no significant effects are expected on the sediments or benthic fauna of the area surrounding the LA-5 site or the region in general. The effects of disposal on water quality of the site are expected to be localized and transitory, so that no significant long-term effect is expected on the plankton or pelagic fish of the site or of its surroundings and no significant effects are expected on marine mammals or endangered species.

4.2.1. Effects on Physical Environment

Environmental effects on the physical environment were assessed for each alternative by identifying and/or quantifying potential sources of contamination or alteration. This approach included review of existing literature, modeling of the dredged material discharge plume, and analysis of field data collected at the LA-2 and reference sites.

Criteria for assigning impacts to aspects of the physical environment as significantly adverse under Class I or Class II, were:

A. The likelihood of a relatively large degree of change from baseline conditions as indicated by analagous situations and previous studies,

B. The persistence of adverse impacts long enough to measurably affect receiving waters or benthic environments, or

C. The relative volume of water or area of the sea floor adversely affected thereby determining whether the level of significance is local or regional.

4.2.1.1. Meteorology and Air Quality

Disposal of dredged material at the LA-5 site will not have a significant effect on the meteorology or air quality of the local area (Class III). COE does not anticipate that there will be any increase beyond the current number of disposal trips to the site, and there have not been any significant air quality impacts detected to date.

4.2.1.2. Physical Oceanography

Final designation of the LA-5 site for dredged material disposal will have no significant effect on physical oceanography (Class III). Physical oceanographic parameters such as currents, waves, and tides are important in how they determine the mixing of the water column and the transport of sediment. These forces, in turn, affect the fate of the disposed dredged material. Bottom currents and mid-water currents are especially important in determining the direction and extent of sediment transport at a disposal site. Tidal currents may also contribute to the transport of disposal material, but these currents do not usually add net directional effects. The role of these parameters in determining water column and sediment quality impacts are discussed below. It should be noted that the effect of waves mixing bottom sediments and increasing turbidity by resuspension of bottom sediments were not projected for the LA-5 site.

4.2.1.3. Water Quality

Continued disposal of dredged material at the LA-5 site is not expected to have any long-term effects on water quality in the local area or region. This conclusion is based on water quality data from the field survey that show no significant difference in water temperature, pH, turbidity, and DO between the LA-5 site which has been used for disposal for the last ten years and the reference site. These levels since 1977 are also within the range of values found for these parameters in undisturbed areas of the bight. Values for salinity were lower than has been historically reported but this variance appears to be due to errors in field measurement rather than disposal activities.

Considering the frequency of disposal, the anticipated quantities of suspended sediment, the volume and dilution capacity of the local water column and currents, and the ambient concentrations of suspended particulates and contaminants, disposal is not expected to have a significantly adverse effect on the water quality of the project area (Class III). This overall rating is supported by the fact that the water quality of the LA-5 site is indistinguishable from that of the reference site despite at least 10 years of disposal at the LA-5 site.

Short term impacts to water quality in the immediate vicinity of the LA-5 site can be expected at the time of dredged material disposal (Class I). The dredged material will be dispersed by currents in a plume cloud causing an increase in turbidity and possibly a reduction in dissolved oxygen. As discussed in more detail under Section 4.2.1.5, after the initial disposal and with a prevailing northwest current, it is predicted that the plume cloud will have a peak concentration of at least 40 mg/l but will dilute to a neglible concentration within 2 hours. Elevated suspended sediment concentrations are expected to extend approximately 2,000 feet downcurrent from the discharge site and to affect an area of approximately 27,870 m^2 (300,000 ft^2) and a volume of approximately 1.4 million m^2 (51 million ft^2).

Increased turbidity and reduced DO in the water column have been determined as a Class I impact since they cannot be mitigated. This is a local effect of short-term duration, so no mitigation measure is proposed.

Trace metals, chlorinated hydrocarbons (pesticides and PCBs), oils and greases were not detected during the field survey in the water column. Such contaminants that are associated with the dredged material sink to the bottom or are greatly diluted by currents. Impacts immediately after disposal would be of a temporary nature and in a local area (Class I); therefore, no mitigation measure is proposed. It should be noted that the levels of detection in the field survey were often above or near levels of these contaminates reported for other unpolluted areas of the bight.

4.2.1.4. Geology

The final designation of the LA-5 site for dredged material disposal will add a layer of sediment to the ocean floor. Since the LA-5 site is on a slope from the mainland shelf, cumulative sedimentation could lead to slumping of material down the slope's gradient. This is a common natural occurrence and disposal activities are not expected to add to it significantly.

4.2.1.5. Sediment Transport

To evaluate the effect of disposal on turbidity and bottom sedimentation at the LA-5 site, a model was developed simulating the dispersal of the dredged material (Appendix C). The model assumes that disposal will be from a barge with a load of 1500 yd^3 (1,147 m^3 of dredged material stored and released from either separate bin compartments or a split hull. A simulation was run at 100 fathoms (183 m) with ambient surface current to the northwest at 55 cm/s (1.8 feet/s), and a near bottom current in the same direction at 30 cm/s (1.0 feet/s).

In this simulation, most of the sand particles from the barge load will settle to the bottom of the water column within one half hour and 305 m (1,000 feet) downcurrent of the discharge point.

Within one and a half hours and 488 m (1,600 feet) downcurrent of the point of discharge, 55 to 100% of the finer particles will also be deposited on the bottom. Stratification of the water column during the summer lessens the rate at which the fine particles disperse, and it is at this time of the year when the percentages of deposition under the influence of gravity are higher.

The rest of the fine particles, silt at a suspended concentration of 10 to 100 mg/l after a period of one and a half hours, will descend in a plume cloud down the water column at a slower rate and will be transported by northwest currents to deeper waters. As these finer particles are transported by currents, they will continue to be dispersed and diluted.

This model does not include resuspension and slumping which would tend to expand the area of deposition but lessen the thickness of the deposition layer. Furthermore, this is a simulation of one disposal activity only; cumulative impacts will result from the total number of trips undertaken throughout the year. Since disposal activities are expected to be separated in most instances by several hours if not days or weeks, cumulative effects to the concentration of the plume or the total area of deposition are not expected. However, numerous disposal activities will result in a progressively thicker layer of deposition with time in the local area of the disposal site (Class I).

4.2.1.6. Sediment Quality

Sediment in the vicinity of the LA-5 disposal site is the component of the physical environment expected to be most significantly affected by disposal, because large amounts of disposed dredged material will permanently alter natural sediment conditions at the disposal site (Class I). The most significant potential effects are changes in grain size distribution, increased concentrations of contaminants, biological oxygen demand (BOD) and chemical oxygen demand (COD). There is evidence that some of these effects have already occurred at the LA-5 site due to past disposal operations. The sediments of the LA-5 site show a greater range of grain sizes than those at the reference site (see Table 3-2).

Concentrations of trace metals, chlorinated hydrocarbons, oils and grease in sediments at the LA-5 site were higher than those at the reference site and other unpolluted areas of the bight (see Tables 3-3 and 3-4 for comparative values). These differences may be due to disposal activities or natural factors, but they are probably due to both.

Assuming the worst case, that all differences between the LA-5 site and reference site have been caused by past disposal activities, grain size differences and contaminant levels in sediments can be expected to persist at the LA-5 site if final designation allows continued disposal (Class I). It is also likely that bacteria and organic matter associated with disposal sediments have caused and will continue to cause increased BOD and COD in the sediments at LA-5 (Class I).

4.2.2. Effects on Biological Environment

Potential effects on marine communities were examined for each alternative site based on the susceptibility of each community to direct or indirect impacts resulting from disposal of dredged material. Potential effects were analyzed in relation to the baseline data for the various communities described in Chapter 3.

Criteria used in this section to assign significance to a potential impact are considered:

A. Significant only to the site if impacts to biological communities are not expected to occur outside of a 1,000 yard (914 m) radius of the designated ODMDS,

B. Locally significant if judged likely to cause or substantially contribute to a measurable change in species composition or distribution in a particular habitat located within 1 nmi (1.8 km) outside of the project site, and

C. Regionally significnat if judged likely to cause or substantially contribute to measurable changes in the function or recovery of any habitat of special importance, or a change in population of any species of recognized regulatory, commercial, scientific, or recreational importance beyond the local vicinity of the ODMDS.

4.2.2.1. Plankton Community

Plankton could be adversely affected by dredged material disposal through mortality due to entrainment in the sediment plume, exposure to contaminants, reduction in photosynthetic productivity due to lowered light levels (Pequegnat, 1978; Wright, 1978), or interference with feeding processes. Sullivan and Hancock (1977) concluded that any adverse impacts on plankton would be so small as to be undetectable superimposed on large natural fluctuations in plankton populations. Any such temporary effects from the disposal of dredged material should be insignificant (Class III).

Modeling of the disposal plume at the LA-5 site (see Section 4.2.1.5) showed that the discharge is expected to sink to the bottom quickly, and that significant suspended sediment concentrations would occur well below the euphotic zone. Some small amount of fine sediment will be suspended in surface waters, but should be diluted to background levels relatively quickly by the ambient current. Decreased light transmittance, and the associated potential for reduced photosynthesis should also be temporary, localized, and not significant. Studies show that increased turbidity and reduction in light penetration from disposal of dredged materials causes short-term adverse effects on phytoplankton, but no long-term effects on primary productivity (Wright, 1978; Hirsch, et al., 1978). Mortality of phytoplankton due to entrainment should likewise be localized, temporary, and insignificant.

Zooplankton may also be entrained in the plume and killed or exposed to contaminants. In addition, suspended sediment may interfere with filter-feeding zooplankton (FWS, 1980). Because zooplankton occur throughout the water column, exposure of zooplankton to the disposed sediment, including the plume of suspended sediment at deeper depths, will be greater than that for phytoplankton. However, almost all suspended and liquid phase bioassay tests on dredged material proposed for ocean disposal from San Diego Bay have shown no significant mortality for planktonic species in the initial mixing zone.

Beyond the initial mixing zone, dilution and transport will reduce turbidity and contaminant levels quickly. Mortality due to entrainment of zooplankton in the plume will be small. The effects of disposal on zooplankton should be localized, temporary, and negligible in comparison to the reproductive capacity of zooplankton species. Sullivan and Hancock (1977) concluded that any adverse impacts of disposal on plankton would be so small as to be undetectable among the well-known large natural fluctuations in plankton populations (Class III).

4.2.2.2. Kelp Community

Disposal at the LA-5 site is not expected to have a significant effect on the nearest kelp beds off Point Loma since more than 5 nmi (9 km) separate this site from the closest kelp bed and no disposal material is expected to travel this distance toward shallow waters (Class III).

4.2.2.3. Benthic Invertebrate Community

Benthic communities are the component of the biological environment most likely to be affected by disposal. Disposal affects the benthos through smothering by deposited sediment, deposited or suspended sediment interfering with feeding mechanisms, toxic effects of contaminants, and altering sediment characteristics which change the suitability of the habitat (Class I).

During each disposal operation the sediment discharged will settle over an area centered 1,600 feet (488 m) downcurrent from the point of release from the split-hull barge. Significant mortality of benthic fauna due to smothering would occur in the areas of deepest sedimentation within the disposal site only (Class I). In surrounding areas experiencing less sediment deposition, mortality should be high only among nonmobile species (Richardson et al., 1978). Some mobile species are known to be capable of burrowing up through as much as 12.5 inches (32 cm) of overburden sediment (Mauer et al., 1978). These species and many of the epifauna species may survive the temporary inundation following each disposal event.

Modeling results indicate that disposal will cause turbidity of near bottom waters up to 5 hours after disposal (see Section 4.2.1.5). Suspended sediments will interfere with feeding processes of benthic fauna. Both smothering and interference with feeding mechanisms will persist during disposal operations, which can last up to several weeks or months. This is long enough to cause significant faunal changes in the affected areas (Class I). The intermittent scheduling of dredging projects or management of disposal operations within the site can provide sufficient time for partial recolonization and recovery of benthic fauna from disposal effects.

Some tests of materials disposed at LA-5 showed accumulation of pesticides and PCBs, but levels were not sufficient to cause significant mortality (Salazar et al., 1980; Salazar and U'Ren, 1981; Lockheed Ocean Science Laboratories, 1982; Westec, 1984; Salazar and Salazar, 1983 a, b and 1984). Levels of neither metals (Cd, Hg, Pb, Cr, Cu, As, Zn) nor chlorinated hydrocarbons (pesticides and PCBs) were consistently elevated in the shrimp Sicyonia ingentis at the LA-5 site as compared to the reference site (Appendix A, A-40). Tissue concentrations of metals and chlorinated hydrocarbons were much lower than those reported for S. ingentis from locations near sewage outfalls in the Los Angeles area (Brown et al., 1984).

Species diversity and abundance of both infauna and epifauna at the LA-5 and reference sites showed no consistent trends. Infauna at LA-5 were less diverse but approximately equally abundant, and the most abundant species were more dominant numerically. More epifaunal species were caught fairly consistently at the LA-5 site than at a nearby reference site, but there were no apparent differences between the two sites in number of individuals caught. Sediment differences between the two sites, which may be responsible for any differences in the benthos, could be due to disposal or to natural factors such as slope, currents, or location in relation to sediment sources. Both explanations, or a combination of the two, are plausible.

Resolution of this issue would require more extensive sampling and analysis of the sediments and fauna of the region than was possible for this study. EPA and COE will develop a site management program (see Section 4.6) as a mitigative measure to manage and monitor the site in an attempt to resolve these issues.

The preceding analysis indicates that measured differences between LA-5 and the reference site in benthic communities could very well be due to previous disposal activities, although natural factors could also be involved. Assuming that all of the observed differences are effects of past disposal, it is predicted that these effects will continue if the LA-5 site is designated as the ODMDS. In this case, continued disposal at levels similar to past activity may not have any additional, significant effects on benthic populations. It is quite certain that continued disposal at the site will prevent the benthic community from returning to predisposal or "normal" conditions. Because the impacts are restricted to an already affected site, no significant adverse environmental impact to the Southern California Bight is expected from continued disposal at this site (Class III).

4.2.2.4. Fish Community

a. Demersal Fish

The results of demersal fish sampling conducted for the EIS study indicate that past disposal actions may have had some effect on the fish fauna of the LA-5 site. Compared to the reference site, fewer individuals (1,205 vs. 2,267) and fewer species (30 vs. 40) were collected at the LA-5.

At this time the only known explanation which could account for the differences observed between LA-5 and the reference site is disposal at the site. There is some indication of elevated levels of PCBs and pesticides in tissues of the slender sole at the LA-5 site (Appendix A, Table A-11). Interpretation of the tissue contaminant levels is difficult because of the mobility of this species, but there is no readily apparent alternative explanation (to disposal) of the fairly consistent differences observed between LA-5 and the reference site. Despite the elevated PCB and pesticide levels observed at LA-5, the fact that dredged material disposed at the site has been shown by bioassay tests not to cause significant mortality in demersal fish (usually the speckled sanddab) argues against direct toxicological on fish. The somewhat depauperate fish fauna at the LA-5 site relative to the reference site may also be due to the depauperate benthic infauna, the principal food source for demersal fish. As described above, differences in sediment characteristics between LA-5 and the reference site appear to have caused the depauperate benthic infauna. Differences between the fish fauna of the two sites could also be related to topographic relief, currents and proximity to locally significant habitats.

If populations at the site are affected by disposal operations, or if disposal quantities increase significantly in the future, additional adverse effects (Class I) may result from continued use of the site. Assuming that future disposal quantities and actions will be similar to those in the past, and bioassay tests of demersal fish continue to allow ocean disposal of acceptable dredged material, regional effects on the Southern California Bight demersal fish population are expected to remain insignificant (Class III). Even if dredged material disposal activities increase, local impacts on the site would be greater (Class I), but regional impacts on the San Diego region and Southern California Bight are still expected to remain insignificant (Class III).

b. Pelagic Fish

Although pelagic fish were not sampled as part of the present study, there is little reason to believe that these populations, including that of the commercially important anchovy, would be adversely affected by continued disposal at the site (Class III). The northern anchovy (*Engraulis mordax*), one of the principal commercial fish species of southern California, is known to be particularly abundant in surface waters overlying the continental slope, location of the LA-5 site, and there is no reason to believe that the site waters are any exception. Anchovies are pelagic (open water/surface) species, and so are not likely to be affected by the benthic sediment regime or sediment suspended at depth.

Disposed material is expected to remain confined in the discharge plume and sink to the bottom. This will remove most of the disposed material from the surface and mid-water zones where many pelagic fish live (see Section 4.2.1.5.). Sediments and associated contaminants remaining in the water column would be diluted and transported relatively quickly by the ambient currents, so that any adverse effects on the pelagic environment would be localized and temporary (Class III).

4.2.2.5. Coastal Birds

The continued use of the LA-5 site will not adversely affect any of the coastal birds living in or immigrating through the San Diego region (Class III). The location of this site, more than 6 nmi (11 km) from the nearest shore at Point Loma, effectively eliminates any impacts on inshore species. More pelagic forms may utilize the brief supply of food provided from dredged materials (i.e., dislocated or dead marine organisms) at the time of disposal (Class IV). This additional food supply would be considered incidental in the diet of scavengers.

4.2.2.6. Marine Mammals

Disposal at the LA-5 site should not have any adverse effects on marine mammals (Class III). Their large size, mobility and intelligence minimizes the possibility of direct effects of disposal on marine mammals. These animals will avoid the disposal vessel and discharged plume, which will be very localized and temporary. The disposal site is not in or near any important marine mammal feeding or breeding areas. The naturally less productive environment of the LA-5 site, situated on the slope of the San Diego shelf minimizes its use as a preferred feeding area for most marine mammals which utilize richer areas nearer shore.

4.2.2.7. Threatened and Endangered Species

Disposal at the LA-5 site is not expected to adversely affect any threatened or endangered species (Class III). The U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) have concurred with this assessment (see Chapter 5). The rare, threatened or endangered species in the area either:

A. Conduct feeding and breeding activities in locations strictly associated with coastal land areas too far from the disposal site to be affected,

B. Occur farther offshore, to the north or are so rarely near the disposal site to have a significant potential for being affected, or

C. They use the area temporarily as a migratory route and could effectively avoid any disposal operation.

The continued use of the LA-5 site would greatly reduce potential effects on rare or endangered species which might be affected by the disposal of dredged materials in either shallow water or terrestrial alternatives nearer to refuge locations.

4.2.2.8. Marine Sanctuaries and Areas of Special Biological Significance

No state or national wildlife or marine refuge or Area of Special Biological Significance (ASBS) is in the immediate vicinity or within an area of influence of the LA-5 site (Figure 3-5). Continued disposal of dredged materials will not impact any such areas (Class III).

4.2.3. Effects on Socioeconomic Environment

In this section, potential impacts on socioeconomic resources are identified and possible mitigation measures are introduced. Each individual component of the socioeconomic environment is evaluated based the nature of potential impacts. For the purposes of the assessment, it is assumed that all resources which may be affected by the proposed action are both significant and important. This procedure gives all known resources the full benefit of consideration in NEPA planning and review process. Where possible, mitigation measures are proposed to reduce any impacts. Net beneficial impacts are considered to be those impacts that preserve or enhance any natural condition or major resources of the project area.

4.2.3.1. Commercial Fishing

The demersal fish fauna of the LA-5 site is depauperate compared to that of the reference site, and it is possible that this is an effect of disposal of dredged material at LA-5. Continued disposal operations at the site will not adversely affect commercially important demersal fish on a regional level (Class III). Other important commercial fish species caught near the LA-5 site are pelagic. Therefore, there should be no effect of disposal on the stocks of commercially harvested fish or on the viability of the commercial fishing industry of the region (Class III).

Since ocean disposal of dredged material is infrequent in San Diego Harbor and not all dredged materials are disposed at the LA-5 site, the number of barges involved in transporting dredged material varies considerably during the year. The normal time span for a dredging project is usually a few weeks to several months long (Shannon Cunniff, COE Los Angeles District, personal communication). No interference or accident between these barges and the commercial fishing fleet has been reported by USCG in the past (Class III).

4.2.3.2. Commercial Shipping

The disposal of dredged material could present two potential hazards to navigation: interference of the disposal barges with vessel traffic, and mounding within the disposal site. Mounding may temporarily occur at the LA-5 site following dumping. But due to the depth of water (80-110 fathoms) at the site, no hazard to vessel traffic is possible, and mounded material will eventually be dispersed by currents and slumping. The potential for interference does exist since the disposal barges and the ocean-going vessels would travel the same route between San Diego Bay and the LA-5 site. However, the frequency of ocean disposal is so low that the probability of interference is almost negligible. These hazards have already been considered in the existing permitting program, and actions have been taken so they no longer pose a significant impact (Class III).

A net beneficial impact of the ocean disposal of dredged material is the improvement and maintenance of shipping lanes, channels and docking areas in San Diego Bay (Class IV). Dredging associated with channel deepening projects provides access to the area for larger, more efficient commercial vessels which results in transportation savings since larger vessels can carry more goods.

4.2.3.3. Oil and Gas Development

No oil and gas development occurs offshore of San Diego County either in the State or Federal waters, and none is expected in the foreseeable future. Therefore, no impact is expected on oil and gas development as a result of the final designation of the LA-5 site for dredged material disposal (Class III). Final site designation of the LA-5 site would not impact consumption of petroleum resources (Class III).

4.2.3.4. Military Usage

Although the area off southern California is the most heavily utilized naval operating area in the nation, most of the military operations take place far beyond the immediate coastal areas outside San Diego Bay. The disposal of dredged material at the LA-5 site does not pose any danger to military activities (Class III).

Military vessels which travel in and out of San Diego Bay may face interference from the disposal barges, but the probability of interference is negligible because the frequency of ocean disposal trips is low and traffic in the precautionary area is strictly monitored. No incidents involving the disposal barges have been reported over the past eight years since the disposal site was given interim designation (Class III). A net beneficial impact of the ocean disposal of dredged material is the improvement and maintenance of shipping lanes and port facilities used by the Navy at its Fleet Area Control and Surveillance Facility.

4.2.3.5. Recreational Activities

4.2.3.5.1. Sportfishing

Because of the somewhat depauperate demersal fish fauna of the LA-5 site, bottom fishing within the site boundaries could be adversely affected by disposal. Sportfishing in this area is rare, however, due to the depth and distance from shore. The effect of disposal on demersal fish is likely to be localized, so that disposal should not affect demersal fish populations in shallower areas which support sportfishing. This includes the kelp beds off Point Loma, a popular and productive fishing area (Figure 3-8), which are approximately five miles north of the disposal site, too far to be affected by disposal. Many of the most important sportfish of the area are pelagic species, which are not expected to be affected by disposal. Therefore, disposal is not expected to significantly affect sportfishing in the general area (Class III).

Sportfishing is usually carried out in shallow waters close to the shore. The 100 fathom (183 m) line at which the LA-5 site is located forms approximately the outer boundary for sportfishing by party boats. The area close to the LA-5 site is not very productive and is not particularly frequented by sportfishing boats. A larger number of sportfishing boats, however, pass through the LA-5 vicinity on the way to fishing areas farther offshore. While the potential of accidents between dredged material barges and fishing boats exists, the probability of such incidents is extremely low due to the low level of dredging activity which requires only a small number of trips to the site per year (Class III). No incidents have been reported by USCG over the past ten years since the LA-5 site has been used on an interim basis.

4.2.3.5.2. Boating

The recreational activity most likely to be affected by the project-related activities is pleasure boating. Most of the boats turn north or south almost immediately after coming out of San Diego Bay at Point Loma. This reduces the potential of conflict with the disposal barges on the open sea. No incidents of conflict have been reported during the ten year period during which the LA-5 site has been used for disposal on an interim basis. Hence the impact on recreation is considered to be minimal and insignificant (Class III).

4.2.3.5.3. Other Recreational Activities

Most ocean-related recreational activities occur at the beaches or in nearshore areas. These include sightseeing, beachcombing, picnicking, swimming, wading, sunbathing, diving, and surfing. Disposal activities at the LA-5 site will not impact these nearshore recreational activities (Class III).

Reduced water clarity will be caused temporarily by disposal of material at the site. This may cause some short term inconvenience and lack of site appeal if some recreational boaters happen to be in the immediate area during actual disposal (Class I). However, the LA-5 site is not visible from the San Diego Bay beaches and other amenity areas except the Silver Strand area. Even from this area, the site is more than five nmi away. No impacts on the visual aesthetics of beach visitors are expected from the disposal activity (Class III).

4.2.3.6. Cultural Resources

MMS has identified 16 Federal oil and gas lease tracts in the LA-5 study area having cultural resource sensitivity. This is based on the water depth and known cultural resource location data, particularly location of shipwrecks. The tract containing the LA-5 site is one of these 16 tracts but the exact location of any shipwreck is not certain. The site has been in use for ocean dredged material disposal for more than ten years, and the remains of shipwrecks, if any, have probably been buried under the previously disposed material. No new impacts are, therefore, anticipated as a result of the proposed action (Class III). The State Historic Preservation Officer (SHPO) has concurred in this assessment. SHPO has also indicated that no National Register or eligible properties would be impacted by the proposed action (see Chapter 5, Exhibit 12).

4.2.3.7. Public Health and Welfare

Impacts on three aspects of public health and welfare, including health, safety, and aesthetics, are discussed in this section. Health hazards may arise if the chemical nature of the materials has the potential for bioaccumulation of toxic substances in organisms. Under the COE permitting system, sediment analyses, bioassays and bioaccumulation tests are conducted on all materials prior to disposal at the LA-5 site. No materials considered hazardous may be disposed of at the site. Therefore, the potential for health hazards is not considered to be significant (Class III).

Human safety could be jeopardized as a result of interference by the disposal barges with shipping traffic, commercial and sportfishing boat traffic, recreational boat traffic, and Navy vessel traffic. The LA-5 site has been used on an interim basis over the past ten years and no incidences of conflict or accidents have been reported during this period. With no anticipated increase in disposal activities in the foreseeable future and with strict monitoring of traffic by USCG in the zone of operation, impacts on human safety are considered to be very low and unavoidable (Class III).

4.3. NO ACTION ALTERNATIVE

If the No Action Alternative is selected by EPA, interim designation of LA-5 would expire and there would be no ocean site for disposal of dredged materials in the San Diego area (Class I). Discontinued use of LA-5 for disposal would lead to recovery of the ecosystem at the site from the impacts of past disposal (Class IV). The rate and extent of this recovery, and the length of time that residual effects of past disposal would persist, are not known. As normal sedimentation occurred at the site, levels of contaminants in the top layers of the sediment would decrease. Concentration of contaminants in fish and invertebrate tissues could change, and the benthic invertebrate fauna and demersal fish populations would shift toward conditions more similar to those of the surrounding areas (Class IV) given present conditions at unimpacted sites.

Interference with commercial fishing, recreation, shipping, oil and gas development would be reduced to zero (Class IV); however, cessation or significant curtailment of dredging in San Diego Bay could impair the ability of these facilities to fully support commerce and trade or the needs of the U.S. Navy base. This could have serious adverse effects on the economy of the region, state, and nation, and on the military readiness of the Navy (Class I). It is not possible to quantify these effects at this time.

As stated in the "Purpose of and Need for Action" (Section 1.2), it is the intent of this EIS to identify and designate an ODMDS that is suitable for use by COE for Federal projects and permitted projects under Section 103 of MPRSA. Selection of the No Action Alternative by EPA will force COE to designate a suitable ODMDS through their authority under Section 103 of MPRSA. Selection of the No Action Alternative is not an adequate response by EPA to the request by COE for the designation of an ODMDS through a cooperative relationship between the two Federal agencies (Class I). Therefore, EPA will seek to designate an ODMDS based on the Preferred Alternative described in this EIS.

4.4. SHALLOW WATER SITE

Disposal of dredged material at the shallow water (LA-4) site would damage an area used only occasionally in the past as a dump site. The partially or perhaps wholly recovered benthic community would be significantly degraded with continued use as an ODMDS (Class I).

Since the LA-4 site is located very near to the LA-5 preferred site (3 nmi to the southeast), the same type of San Diego shelf habitats and biotic assemblages would be present at both sites. Most, if not all, of the same impacts discussed earlier for LA-5 would be expected to develop at LA-4. This new damage at LA-4 would be somewhat offset by the gradual recovery at LA-5 but no particular gain would accrue from such a change of ODMDS siting.

4.4.1. Effects on the Physical Environment

The same impact criteria used to evaluate the physical environment under the Preferred Alternative apply to this section.

4.4.1.1. Meteorology and Air Quality

Final designation of the LA-4 shallow water site for ocean dredged material will not have a significant effect on the meteorology or air quality of the area (Class III). This is due to the similar locations of the LA-4 and LA-5 sites. The COE does not anticipate any increase beyond the current number of disposal trips and there have not been any significant air quality impacts detected to date due to dumping at the LA-5 site. Therefore, based on the air pollutant dispersion calculations which provided very similar numbers for all three sites, there will be no significant air quality impact due to disposal of dredged material at the shallow water site.

4.4.1.2. Physical Oceanography

Disposal at the shallow water site will not affect physical oceanography (Class III). Physical oceanographic parameters such as currents, waves and tides will determine the effects of disposal on water and sediment quality.

4.4.1.3. Water Quality

Less material is expected to be initially deposited on the bottom at the LA-4 shallow water site than at the LA-5 site according to the plume models discussed in Sections 4.2.1.5 and 4.4.1.5. The Class I effects of turbidity, dissolved oxygen, nutrients, and contaminants in the water column would, therefore, occur in a larger area.

4.4.1.4. Geology

Disposal at the LA-4 shallow water site would cause increased sedimentation to the ocean floor (Class I).

4.4.1.5. Sediment Transport

A plume model was developed to evaluate the effect of disposal on turbidity and bottom sedimentation at the LA-4 shallow water site. A simulation was run at 45 fathoms (82 m) with ambient surface currents at 15 cm/s (0.49 feet/s), and a near bottom current in the same direction at 5 cm/s (0.18 feet/s).

In this simulation, all of the sand particles from the barge load will settle to the bottom of the water column within 17 minutes and 305 m (1,000 feet) downcurrent of the discharge point.

Within one and a half hours and 762 m (2,500 feet) down-current of the point of discharge, 65 to 85% of the fine particles will also be deposited on the bottom. The rest of the fine particles, silt at a suspended concentration of 10 to 100 mg/l after a period of one and one half hours, will descend in a plume cloud down the water column at a slower rate and will be transported by northwest currents to deeper waters. As these finer particles are transported by currents, they will continue to be dispersed and diluted.

This model does not include resuspension and slumping which tend to expand the area of deposition but lessen the thickness of the deposition layer. Furthermore, this is a simulation of one disposal activity only; cumulative impacts will result from the total number of trips undertaken throughout the year. Since disposal activities are expected to be separated in most instances by several hours if not days or weeks, cumulative effects to the concentration of the plume cloud or the total area of deposition are not expected. However, numerous disposal activities will result in a progressively thicker layer of deposition with time at this site which has previously experienced only a limited amount of disposal (Class I).

4.4.1.6. Sediment Quality

As described above, a proportion of disposed dredged material is expected to be initially deposited at the LA-4 shallow water site and therefore affect grainsize and contaminant concentration in an area which can be expected to have lower concentrations of these contaminants due to the limited amount of previous disposal (Class I).

Compared to the LA-5 site, a smaller amount of BOD, oil and grease, trace metals, and chlorinated hydrocarbons would concentrate in the sediment at the LA-4 shallow water site based on the assumption that less material would be initially deposited on the bottom. However, the relative impact of contaminants at the LA-4 shallow water site is presumed to be greater because of the relatively degraded existing condition of the LA-5 site.

4.4.2. Effects on the Biological Environment

The same criteria used to evaluate the biological environment under the Preferred Alternative apply to this section.

4.4.2.1. Plankton Community

Effects of disposal on plankton at the LA-4 site should not be significant or substantially different from effects at the LA-5 preferred site (Class III).

4.4.2.2. Kelp Community

Disposal of dredged materials at the LA-4 site is not expected to have a significant effect on the nearest kelp beds off Point Loma since more than 6 nmi (11 km) separate this site from the closest kelp bed and no disposal material is expected to travel this far towards shallow waters (Class III).

4.4.2.3. Benthic Invertebrate Community

Disposal at LA-4 is expected to adversely affect the benthic community in a similar way to that encountered at the LA-5 site (Class I). These sediment impacts include smothering, interference with feeding, toxic effects of associated contaminants, and changes in the physical properties of the bottom sediments. In areas of the shallow water site, the benthic fauna is likely to be more diverse and abundant than that at the LA-5 site. In these areas, disposal would have a greater relative impact on benthic fauna, particularly where they have not been affected as much by past dredged material disposal.

4.4.2.4. Fish Community

Disposal of dredged material at LA-4 would have a significantly adverse effect on demersal fish (Class I). Effects would occur due to turbidity, reduced dissolved oxygen, toxic effects of contaminants, and effects on their principal benthic food sources.

In the shallow water region, the demersal fish fauna is likely to be more diverse and abundant than the naturally occurring populations found in the vicinity of the LA-5 site (Allen and Mearns, 1977). Because of the proximity of the two sites, disposal activities would be expected to have similar impacts on demersal and pelagic fish populations at both the LA-5 and LA-4 sites (Class III).

4.4.2.5. Coastal Birds

The use of the LA-4 site would not adversely affect any of the coastal birds living in or immigrating through the San Diego region (Class III). The location of this site, more than 6 nmi from the nearest shore, effectively eliminates any impacts on inshore species. More pelagic forms may utilize the brief supply of food provided from dredged materials (i.e., dislocated or dead marine organisms) at the time of disposal (Class IV). No significant impacts on bird populations are expected at the shallow water site.

4.4.2.6. Marine Mammals

Disposal at the LA-4 site would not have any adverse effects on marine mammals (Class III). Their large size, mobility and intelligence minimmizes the possibility of direct effects of disposal on marine mammals. These animals will avoid the disposal vessel and discharged plume, which will be very localized and temporary.

The naturally less productive environment of the LA-4 site, situated on the slope of the San Diego shelf, minimizes its use as a preferred feeding area for most marine mammals which utilize richer areas nearer shore. The disposal site is not in or near any important marine mammal feeding or breeding areas. As in the case of the LA-5 site, none of the activities of marine mammals are expected to be significantly impacted in this area (Class III).

4.4.2.7. Threatened and Endangered Species

Environmental impacts on endangered species are not expected if the shallow water site is designated as the ODMDS (Class III). Gray whales, equally abundant in the shallow water LA-4 site as they are near the LA-5 site, should not be affected by disposal. Disposal at LA-4 is not expected to significantly affect the pelagic fish of the region which are their principal food source. Consequently, no impacts are predicted for pelican or tern populations.

4.4.2.8. Marine Sanctuaries and Areas of Special Biological Significance

No state or national wildlife or marine refuge or Area of Special Biological Significance (ASBS) (see Figure 3-8) is in the immediate vicinity or within an area of influence of the LA-4 site. Disposal of dredged materials at the shallow water site would not impact any such areas (Class III).

4.4.3. Effects on the Socioeconomic Environment

The same impact criteria used to evaluate the socioeconomic environment under the Preferred Alternative apply to this section.

4.4.3.1. Commercial Fishing

Disposal activities at the LA-4 site will affect commercial fishing to approximately the same extent as at the LA-5 site (Class III).

4.4.3.2. Commercial Shipping

The potential for conflict between disposal vessels and commercial shipping is the same at all alternative sites. Due to the infrequent dredging activity as well as its short duration, the probability of conflict is considered to be minimal and no adverse impacts are anticipated (Class III).

4.4.3.3. Oil and Gas Development

No oil and gas development activities are planned or proposed in the shallow water region and no conflicts or impacts are anticipated (Class III). Energy consumption, associated with transport of dredged material, would decrease slightly if the shallow water site is used over the deep water site, because the distance to the shallow water site is less than the distance to the deep water site, but this effect is negligible.

4.4.3.4. Military Usage

Although the area offshore southern California is the most heavily utilized Naval operating area in the nation, most of the military operations take place far beyond the immediate coastal areas outside San Diego Bay. The disposal of dredged material at the shallow water site does not pose any danger to the military activities. Military vessels which travel in and out of the San Diego Bay may face interference from the disposal barges. However, no incidences involving the disposal barges have been reported over the past eight years since the disposal site has been used on an interim basis. With no anticipated increase in dredged material disposal activities in the foreseeable future, the impacts on military activities are considered to be negligible and insignificant (Class III).

4.4.3.5. Recreational Activities

4.4.3.5.1. Sportfishing

Sportfishing is usually carried out in shallow waters close to the shore. The potential for impacts on sportfishing is the same at the LA-4 site, the LA-5 or deep water sites. No unique areas for sportfishing occur in the LA-4 area and disposal operations would not cause significant infringements on present sportfishing efforts (Class III).

4.4.3.5.2. Boating

The potential for impact on boating from disposal at the LA-4 site is similar to the impact expected from disposal of the LA-5 site (Class III).

4.4.3.5.3. Other Recreational Activities

Similar to sportfishing, recreational activities (excluding boating) are usually carried out closer to the shore. Potential impacts on nearshore activities are the same at the shallow water site, the LA-5 or deep water sites (Class III).

4.4.3.6. Cultural Resources

The shallow water site lies closer to the areas of higher probability of aboriginal sites. Disposal at this site also has a greater potential for impacting shipwrecks since most of them have been known to occur in shallow water regions of up to 50 fathoms (91 m) depth. In order to mitigate these potential impacts close coordination with the SHPO will be maintained to avoid locating the disposal site in an area that would affect cultural resources (Class II).

4.4.3.7. Public Health and Welfare

Impacts on the public health, safety and aesthetics, discussed earlier for the LA-5 preferred site (Section 4.2.3.7.) are expected to be similar for the shallow water site.

4.5. DEEP WATER SITE

Any significant impacts predicted for the deep water site would be new and classified as Class I impacts. Impacts from disposal activities on the physical and biological environments of the deep water site should be approximately the same as the impacts observed at the LA-5 site. This is based on the assumption that disposal at the two sites will have similar adverse effects on sediment quality, benthic invertebrates and demersal fish. Impacts on water quality, pelagic fish, marine mammals, threatened and endangered species are expected to be insignificant.

Disposal at the deep water site would have less immediate impact on the benthic environment and a greater impact on the pelagic environment because more disposed material would be suspended and dispersed in the water column. In addition, the benthic invertebrate and demersal fish fauna of the deep water site are less diverse and less abundant than those of the LA-5 site. However, a counterbalancing consideration is that the sediments, benthos, and fish population of the deep water site are in an undisturbed condition, while these resources at the LA-5 site have already been affected by past disposal. Recognition of the undisturbed nature of the deep water site was instrumental in the selection of the LA-5 site as the preferred alternative. No significant adverse impacts to the Southern California Bight ecosystem are expected from ocean disposal at the deep water site.

4.5.1. Effects on the Physical Environment

The same impact criteria used to evaluate the physical environment under the Preferred Alternative apply to this section.

4.5.1.1. Meteorology and Air Quality

Final designation of the deep water site for ocean dredged material will not have a significant effect on the meteorology or air quality of the area (Class III). The COE does not anticipate any increase beyond the current number of disposal trips and there have not been any significant air quality impacts detected to date due to dumping at the LA-5 site. Therefore, based on the air pollutant dispersion calculations which provided very similar numbers for all three sites, there will be no significant air quality impact due to disposal of dredged material at the deep water site.

4.5.1.2. Physical Oceanography

Disposal at the deep water site would not affect physical oceanography (Class III). Physical oceanographic parameters such as currents and waves will determine the extent of disposal impacts on water quality and sediment quality.

4.5.1.3. Water Quality

At the deep water site, more material is expected to remain in suspension in the water column than at the LA-5 site due to the greater depth and the presence of a permanent thermocline, although the suspended material will be diluted in a much greater volume of water than at the LA-5 site. Therefore, the effects on turbidity, dissolved oxygen, nutrients, and contaminant levels on water quality would be more widespread than at the LA-5 site but the effect would be temporary and concentrations would quickly become dilute (Class I).

4.5.1.4. Geology

Disposal of dredged material at the deep water site would not affect the geological parameters of the area (Class III).

4.5.1.5. Sediment Quality

Deposition of dredged material at the deep water site would be spread out over a wider area compared to the LA-5 site due to the deeper depths and the movement of fine material by deep currents along the thermocline. Sediment grain size distribution, biological oxygen demand, and concentrations of trace metals, chlorinated hydrocarbons, oils and greases would be affected by disposal but the effect would be more widespread and at lower levels. However, the existing sediment quality in the deep water region is undisturbed compared to that of the LA-5 and LA-4 site.

The overall impact on sediments of the deep water site is adverse because the environmental effects are new; however, the significance of the impact will be spread out over a larger area (Class I). The regional environmental impact of these effects to the Southern California Bight should be equivalent to the observed impact of past disposal at the LA-5 site.

4.5.2. Effects on the Biological Environment

The same criteria used to evaluate the biological environment under the Preferred Alternative apply to this section.

4.5.2.1. Plankton Community

Effects of disposal on plankton at the deep water site should not be significant or substantially different from effects at the LA-5 site (Class III).

4.5.2.2. Kelp Community

Disposal at the deep water site is not expected to have a significant effect on the nearest kelp beds off Point Loma since the designated site would be at least 17 nmi (31 km) from the closest kelp bed and no disposal material is expected to travel this far toward shallow waters (Class III).

4.5.2.3. Benthic Invertebrate Community

The effect of disposal on the benthos of the deep water site is expected to be approximately the same as that observed at the LA-5 preferred site (Class I). Less sediment and associated contaminants will reach the bottom at the deep water site. The benthic populations of the deep basins are known to be less diverse and less abundant than the shelf or slope fauna (BLM, 1978). This is true for benthic fauna at the deep water site even taking into account the disturbed nature of the LA-5 site.

In addition, the deep water benthic invertebrates are tolerant of low DO levels (Hartman and Barnard, 1958; Fauchald and Jones, 1978c) and may be less affected by altered DO than species inhabiting the LA-5 site. Benthic populations in the deep water site have not been subjected to significant impacts related to disposal of dredged material. Designation of the deep water site would cause environmental impacts of a significant nature which could alter the benthic invertebrate populations in the area (Class I).

4.5.2.4. <u>Fish Community</u>

Fish populations of the deep basins are known to be more depauperate than those of the shelf and slope environments (Allen and Mearns, 1977). Therefore, the fish fauna of the deep water site is naturally less diverse and less abundant than that of the LA-5 site.

If the deep water site is designated as the ODMDS for the San Diego area, the effects associated with dredged material disposal could significantly impact the demersal fish fauna in a manner similar to that observed at the LA-5 site (Class I). The impact may be diminished because less dredged material and associated contaminants would reach the bottom at the deep water site, thus the potential for toxicological effects on fish and effects on primary food sources would be somewhat reduced. Disposal operations at the deep water site should not have any impact on pelagic fish (Class III).

4.5.2.5. <u>Coastal Birds</u>

Because of the location more than 13 nmi offshore, disposal of dredged material at the deep water site will not have a significant effect on coastal bird populations (Class III).

4.5.2.6. <u>Marine Mammals</u>

Because of the location more than 13 nmi offshore, disposal at the deep water site is not expected to have significant impacts on marine mammals (Class III).

4.5.2.7. <u>Threatened and Endangered Species</u>

Because of the location more than 13 nmi offshore, disposal at the deep water site is not expected to impact threatened or endangered species (Class III).

4.5.2.8. Marine Sanctuaries and Special Resource Areas

Because of the more than 13 nmi offshore location, disposal of dredged material at the deep water site is not expected to affect marine sanctuaries or areas of special biological significance (Class III).

4.5.3. Effects on the Socioeconomic Environment

The criteria used to evaluate the socioeconomic environment of the deep water site are the same as the criteria described for the preferred alternative.

4.5.3.1. Commercial Fishing

Commercially important fish are more abundant in the deep water site area than at the LA-5 or LA-4 sites. This area of the coastal sea does not contain any exclusive or unique stocks of fisheries resources and the impacts on commercial fishing would be no greater than at the LA-5 site. Due to the infrequent disposal needs and the short duration of the disposal activity, the actual interference of disposal with fishing will be minimal, no significant impacts on commercial fishing are anticipated (Class III).

4.5.3.2. Commercial Shipping

The potential for interference of the disposal barges with commercial vessels is the same whether the dredged material disposal takes place at the deep water site or at the LA-5 site. The probability of conflict is, however, minimal due to infrequent use of disposal sites (Class III).

4.5.3.3. Oil and Gas Development

Since no oil and gas development activity is presently proposed or planned off the San Diego Coast, no impacts are anticipated (Class III). Energy consumption associated with transport of dredged material to the site is likely to double as the distance to the deep water site is approximately twice that to the LA-5 site.

4.5.3.4. Military Usage

No military operations take place in the deep water region. Military vessels which travel in and out of San Diego Bay may face interference with the disposal barges, but the probability of such interference is negligible (Class III). Impacts at the deep water site will be comparable to those at the LA-5 site and the LA-4 shallow water site.

4.5.3.5. Recreational Activities

4.5.3.5.1. Sportfishing

Little, if any, sportfishing occurs in water depths greater than 100 fathoms. No impacts on sportfishing are anticipated if dredged material disposal occurs in the deep water site area (Class III).

4.5.3.5.2. Other Recreational Activities

Impacts of disposal activity on recreational boating in the deep water site area will be similar to those at the LA-5 site and the LA-4 site. Potential for conflict between the disposal vessels and recreational boats exists but the frequency of ocean disposal is expected to be so low that the probability of conflict will be insignificant (Class III).

4.5.3.6. Cultural Resources

No known aboriginal cultural resource sites will be impacted by the disposal activities at the deep water site. The potential for impacting a shipwreck is much lower at the deep water site compared to the LA-5 site or shallow water site (Class III).

4.5.3.7. Public Health and Welfare

Impact on the public health and safety discussed earlier for the LA-5 preferred site (Section 4.2.3.7) are expected to be similar for the deep water site. The greater distance from shore of this alternate site could reduce, to some extent, the already low potential for significant effects on the public health and welfare.

4.6. MANAGEMENT OF THE DISPOSAL SITE

Existing COE and EPA procedures, including bulk sediment analyses, acute and chronic toxicity tests, and bioaccumulation tests will continue to be required for MPRSA Section 103 permits and Federal dredging projects to evaluate the suitability of the material to be disposed at the designated ODMDS. These requirements will ensure that significant environmental impacts are prevented from developing at the site.

For more effective site management, the COE, Los Angeles District, has imposed special conditions as discussed below on permits to dispose of dredged material at the designated site. The purpose of Condition 1 is to minimize interference with commercial shipping and the purposes of Conditions 2 and 3 are to facilitate surveillance and monitoring, documenting amounts and characteristics of disposed material, and assessing impacts of disposal.

COE 103 Permit Conditions

A. All ocean dumping permits shall be sent to the Captain of the Port. The permittee shall notify the U.S. Coast Guard, Captain of the Port 48 hours prior to dumping of dredged material at the disposal site at the following address:

Commanding Officer
Marine Safety Office
San Diego, California 92101
(619) 577-5877

B. For every calendar year in which ocean disposal of dredged material occurs, the permittee shall submit the following information to COE Los Angeles District before February 1 of the next year:

1. Permit number,
2. Mode of dredging,
3. Mode of transportation,
4. Form of dredged material,
5. Frequency of dumping,
6. Start date of dumping,
7. Completion date of dumping,
8. Chemical composition of dredged material,
9. Solubility of dredged material,
10. Density of dredged material,
11. pH of dredged material,
12. Percent sand silt and clay of dredged material,
13. Method of packaging,
14. Method of release,
15. Procedure and method for tank washing, and
16. Total cubic yards dumped.

A further condition that may be imposed on some permits will be a requirement to monitor effects of the disposal operation on water quality and ecology at the time of disposal. The need to implement a long-term management and monitoring program to improve understanding of the environmental impacts of all disposal at the site will be addressed in a supplementary Site Management Program and Site Monitoring Plan to be issued after final designation of the ODMDS.

The plan will include long-term management and monitoring of the site. The broad list of management areas listed below identifies general considerations pertinent to site management. Major elements of the site management program will include:

A. Evaluation of sediment movement towards important biological resources outside of or in close proximity to the site boundaries,

B. Periodic evaluation of trace metal and/or chlorinated hydrocarbon levels in tissues of selected organisms at the site, and

C. Evaluation of sediment quality at the site and adjacent to the area.

4.7. RELATIONSHIP BETWEEN SHORT-TERM USE AND LONG-TERM RESOURCE USES

The proposed action is not expected to affect biological resources of the region. Certain components of the biological environment of the immediate site, such as benthic invertebrates and demersal fish, may be adversely affected. Impacts will persist as long as the site continues to be used for disposal. Cessation of disposal would permit a gradual recovery of the benthic communities to normal levels over time.

The LA-5 site has been used for 10 years and disposal activities have not interfered, nor are they expected to interfere, with the long-term use of any resources at the site. Commercial fishing and sportfishing have not been impaired to any measurable extent because the site constitutes a very small percentage of the total fishing grounds near San Diego Bay.

No oil and gas development occurs offshore of San Diego County either in the State or Federal waters, and none is expected in the foreseeable future. Therefore, no impact is expected on oil and gas development as a result of the final designation of the LA-5 site for dredged material disposal. Final site designation of the LA-5 site would not impact consumption of petroleum resources.

In conclusion, the only effect on site resources that is expected to result from the proposed action is a relatively minor decrease in the biological productivity of the immediate site, which is a dynamic effect. The loss of some biological resources at the site is offset by the significant benefit to commercial, military and recreational traffic from the future dredging of San Diego Harbor and the subsequent disposal of this dredged material at an environmentally suitable location. Lack of a fully designated ocean disposal site capable of accepting large quantities of dredged material would have serious adverse effects on the economic productivity of the San Diego area.

4.8. IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

The irreversible or irretrievable resources committed to the proposed action of final designation of the LA-5 site will remain the same as those committed to the interim site. These include:

A. Commitment of energy resources used as fuel for dredges, pumps, and disposal vessels,

B. Commitment of economic resources incurred as costs associated with ocean disposal, and

C. Commitment or dedication of the benthic environment of the immediate disposal site in the form of degradation of sediment quality, benthos, and demersal fish fauna for the duration of disposal at the site.

These commitments, however, are less significant than the economic advantages of disposing of dredged material at the LA-5 site and the effect of new environmental impacts on resources described in alternative disposal schemes.

CHAPTER 5. COORDINATION

5.1 PUBLIC INVOLVEMENT

A Notice of Intent (NOI) to prepare an environmental impact statement was published in the Federal Register on November 17, 1983 (Exhibit 1). This NOI was published concurrently with COE Publication 84-LA5-S(HB) (Exhibit 2). Public and regulatory agency comments were accepted regarding the of the EIS for the designation of the LA-5 site as an ODMDS for continued use. Several Federal, State and local agencies, and interested public groups submitted comments by the closing date of January 16, 1984. These comments are summarized in Table 5.1, and individual letters follow as Exhibits 3 through 8.

Most of the comments identified in the letters were later repeated in an interagency workshop held on June 26, 1984. The responses to these comments appear in the discussion related to the interagency workshop. A note to that effect is made under each comment letter. Responses not covered in the interagency workshop are given directly following the comment letter.

5.2 INTERAGENCY WORKSHOP

An interagency workshop on the designation of the LA-5 ODMDS as a final site was held on June 26, 1984 and a list of attendees is provided in Table 5.2. The purpose of the workshop was to:

A. Disseminate detailed information about site surveys,

B. Obtain feedback from other agencies on the results of these studies, and

C. Solicit comments from other agencies on the designation issues prior to the actual preparation of the EIS.

The workshop participants reviewed the respective roles of the EPA and the COE with regard to the site designation process and monitoring studies. The study plan was discussed and some preliminary results were displayed. All attendees were given a booklet covering the information presented in the oral briefing. Comments recorded during the workshop are presented below.

5.2.1. Issue 1

USCG was concerned that the LA-2 site is located too close to vessel traffic lanes and that there is a potential for vessel incidents to occur. They requested that the site be moved farther offshore. Harvey Beverly (Regulatory Branch, COE Los Angeles District) outlined the history of discussions between

EXHIBIT 1

52348 Federal Register / Vol. 48, No. 223 / Thursday, November 17, 1983 / Notices

Department of the Air Force

Public Information Collection Requirement Submitted to OMB for Review

The Department of Defense has submitted to OMB for review the following proposal for the collection of information under the provisions of the Paperwork Reduction Act (44 U.S.C. Chapter 35). Each entry contains the following information: (1) Type of submission; (2) Title of information collection and form number, if applicable; (3) Abstract statement of the need for and the uses to be made of the information collected; (4) Type of respondent; (5) An estimate of the number of responses; (6) An estimate of the total number of hours needed to provide the information; (7) To whom comments regarding the information collection are to be forwarded; (8) The point of contact from whom a copy of the information proposal may be obtained.

Revision of a Currently Approved Collection

Proposal for an Advertising Copy Evaluation Survey

The purpose of this collection is to develop a quantitative testing technique for Air Force advertising. A pretesting system is needed to evaluate prefinished print ads prior to final production, discriminate between alternatives and provide diagnotic information to fine tune the execution prior to final production. This copy testing system has as its evaluative criteria both a pre and post exposure measurement of interest in the Air Force versus other military services.

Individuals, men and women, ages 17–28 years: 800 responses, 335 hours.

Forward comments to Edward Springer, OMB Desk Officer, Room 3235, NEOB, Washington, DC 20503, and John Wenderoth, DOD Clearance Officer, WHS/DIOR, Room 1C335, Pentagon, Washington, DC 20301, telephone (202) 694-0187.

A copy of the information collection proposal may be obtained from Mr. O. F. Stumbaugh, USAFRS/RSAAS, Randolph AFB TX 78150, telephone (512) 652-4701 or AUTOVON 487-4701.

M. S. Healy,

OSD Federal Register Liaison Officer, Department of Defense.

November 10, 1983.

[FR Doc. 83-30887 Filed 11-16-83; 8:45 am]

BILLING CODE 3910-01-M

Public Information Collection Requirement Submitted to OMB for Review

The Department of Defense has submitted to OMB for review the following proposal for the collection of information under the provisions of the Paperwork Reduction Act (44 U.S.C. Chapter 35). Each entry contains the following information: (1) Type of submission; (2) Title of information collection and form number, if applicable; (3) Abstract statement of the need for and the uses to be made of the information collected; (4) Type of respondent; (5) An estimate of the number of responses; (6) An estimate of the total number of hours needed to provide the information; (7) To whom comments regarding the information collection are to be forwarded; (8) The point of contact from whom a copy of the information proposal may be obtained.

Revision of a Currently Approved Collection

Proposal for a Proprietary Tracking Study of Air Force Advertising

The purpose of the research study is to gather proprietary data with which to develop the most effective Air Force advertising and marketing program. Current Air Force imagery must be discernable at a point in time which is most reflective of Air Force advertising efforts. Study will be conducted among a nationally representative sample of young men and women, ages 17–28 years.

Individuals, men and women, ages 17–28; 610 responses, 255 hours.

Forward comments to Edward Springer, OMB Desk Officer, Room 3235, NEOB, Washington, DC 20503, and John Wenderoth, DOD Clearance Officer, WHS/DIOR, Room 1C335, Pentagon, Washington, DC 20301, telephone (202) 694-0187.

A copy of the information collection proposal may be obtained from Mr. O. F. Stumbaugh, USAFRS/RSAAS, Randolph AFB TX 78150, telephone (512) 652-4701 or AUTOVON 487-4701.

Dated: November 10, 1983.

M. S. Healy,

OSD Federal Register Liaison Officer, Department of Defense.

[FR Doc. 83-30886 Filed 11-16-83; 8:45 am]

BILLING CODE 3910-01-M

Department of the Army

Draft Environmental Impact Statement (DEIS) for a Proposed Final Designation of LA 5 Interim Oceaning Dumping Site, Offshore of San Diego County, California; Intent To Prepare

AGENCY: U.S. Army Corps of Engineers, DOD.

ACTION: Notice of intent to prepare a draft environmental impact statement (DEIS).

SUMMARY: 1. Proposed Action. The Los Angeles District (LAD) of the U.S. Army Corps of Engineers will prepare a Draft Environmental Impact Statement to identify the impacts associated with the final designation of an ocean disposal site for dredge material off of San Diego (Site No. LA 5). The LA 5 dumpsite consists of the area within 1000 yards of a center point of 32° 36′ 48″ N, 117° 20′ 32″ W.

Preparation of the DEIS regarding the final designation of the disposal site will be accomplished by the U.S. Army Corps of Engineers at the request of the Environmental Protection Agency (EPA). Since documentation in support of final designation must have EPA approval (EPA is responsible for final disposal site designation), the U.S. Army Corps of Engineers will be coordinating closely with the EPA.

To establish baseline data for the site, LAD began comprehensive field sampling began in summer 1983 which will repeat for three consecutive seasons. The sampling plan includes 5 sampling stations at the dumpsite: one station is located at the center of the dumpsite and the other 4 are spaced at 90° intervals around the outer edge of the dumpsite, 1000 yards from the center.

Three sample stations will be located at the adjacent Reference (control) site. These stations represent similar depths as those stations located at the dumpsite's center, shallowest and deepest sampling stations.

The center coordinates of the LA 5 reference site is:

32° 34′ 44″ N, 117° 19′ 17″ W

Project tasks are focused primarily on benthic resources, although other biological, physical, cultural and socio-economic aspects will be considered. The DEIS will analyze the need for the ocean disposal site by addressing the present and potential future use of the site for disposal of uncontaminated dredge spoil and by addressing the availability of land disposal sites.

2. Alternatives. Alternatives to the proposed project include (a) no action, (b) utilization of land disposal sites, or (c) designation of alternative ocean disposal sites. Other alternatives may be identified through the scoping process.

3. Scoping Process.

a. Public Involvement. An extensive mailing list has been prepared which includes affected Federal, State, and local agencies and other interested private organizations and parties. Each entity on the mailing list will receive a copy of the scoping public notice which will have details of the proposed studies.

b. Significant Issues. Significant issues to be analyzed in depth in the DEIS will include: The need for the project, alternatives to the project, impacts to benthic habitats and biota (including endangered species); water quality and circulation, water use, aesthetics, socio-economics, and transportation. Tissue and sediment chemistry will be analyzed and bioaccumulation potential addressed as part of assessing the impacts to benthic habitat and biota. Other potentially significant issues may be identified through the scoping process.

4. Scoping Meetings. The Corps of Engineers will circulate a public notice soliciting comments regarding the scope of the DEIS rather than holding a scoping meeting.

5. Publication of the DEIS. The Draft Environmental Impact Statement is expected to be available to concerned agencies and the interested public for review and comment in November 1984.

Paul W. Taylor,

Colonel, Corps of Engineers, District Engineer.

[FR Doc. 83-31020 Filed 11-16-83; 8:45 am]

BILLING CODE 3710-KF-M

DEPARTMENT OF EDUCATION

National Center for Research in Vocational Education Advisory Council; Meeting

AGENCY: National Center for Research in Vocational Education Advisory Council, Ed.

ACTION: Notice of meeting.

SUMMARY: This notice sets forth the schedule and proposed agenda of a forthcoming meeting of the National Center for Research in Vocational Education Advisory Council. This notice also describes the functions of the Council. Notice of this meeting is required under Section 10(a)(2) of the Federal Advisory Committee Act. This document is intended to notify the general public of their opportunity to attend.

DATE: December 12, 1983.

ADDRESS: The National Center for Research in Vocational Education, Ohio State University, 1960 Kenny Road, Columbus, Ohio 43210.

FOR FURTHER INFORMATION CONTACT: Dr. Howard F. Hjelm, Director, Division of Innovation and Development, 400 Maryland Avenue SW., Rm. 5044, ROB 3, Washington, D.C. 20202, (202) 245-2278.

SUPPLEMENTARY INFORMATION: The National Center for Research in Vocational Education Advisory Council is established under Section 171 of the Vocational Educational Act of 1963 as amended by the Education Amendments of 1976 (P.L. 94-482) (20 U.S.C. 2401). The primary purpose of the Council is to advise the National Center Director on the operation of the National Center and the Secretary on regional centers. In addition to advising the Director, the Council, at the request of the Secretary, may be consulted on current issues in vocational education as they affect the National Center. Meetings held at the request of the Secretary are conducted in accordance with the Federal Advisory Committee Act (FACA).

That portion of the meeting of the Council under FACA is open to the public on December 12, 1983 from 1:00 p.m. to 4:30 p.m. The proposed agenda includes:

1:00–1:45—Report back to Advisory Council:
Resolution No. 1 (Technassociates, Inc. Evaluation Report)
Resolution No. 2 (NCRVE Scope of Work)
1:45–3:00—Review of the National Academy of Science Report and discussion of implementation strategies
3:00–4:00—Recommendations for Option letter for year III
4:00–4:30—Other.

Records are kept of all Council proceedings and are available for public inspection at the office of Glenn Boerrigter, Program Improvement Systems Branch, 400 Maryland Avenue SW., Rm. 5018, ROB 3, Washington, D.C. 20202; telephone: (202) 245-2617.

Dated: November 10, 1983.

Robert M. Worthington,

Assistant Secretary for Vocational and Adult Education.

[FR Doc. 83-31030 Filed 11-16-83; 8:45 am]

BILLING CODE 4000-01-M

DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission

[Docket Nos. CP73-184-000, CI73-485-000]

Colorado Interstate Gas Co., et al.; Informal Conference

November 10, 1983.

In the matter of Colorado Interstate Gas Company, a division of Colorado Interstate Corporation and CIG Exploration, Inc.; CIG Exploration, Inc.

Take notice that on Wednesday, December 7, 1983, an informal conference will be held in the above-captioned dockets. The subject of the informal conference is the offer of settlement submitted by Colorado Interstate Gas Company in these dockets on March 11, 1983. The informal conference will convene at 2:00 p.m. in a conference room at the offices of the Federal Energy Regulatory Commission, 825 North Capitol Street, NE., Washington, D.C. 20426. All interested persons are invited to attend. For further information contact: P.J. Roidakis (202) 357-8307 or R.D. Long, (202) 357-8307.

Lois D. Cashell,

Acting Secretary.

[FR Doc. 83-31008 Filed 11-16-83; 8:45 am]

BILLING CODE 6717-01-M

[Docket Nos. RP82-81-001 and PR82-104-001]

Inter-City Minnesota Pipelines Ltd., Inc.; Filing of Tariff Sheet

November 10, 1983.

Take notice that on November 4, 1983, Inter-City Minnesota Pipelines Ltd., Inc. (MPL) tendered for filing Second Substitute Twentieth Revised Sheet No. 4 to Original Volume No. 1 of Minnesota Pipelines' FERC Gas Tariff.

MPL represents that the tendered sheet effects the base rate approved by the Commission in its order of October 5, 1983, and cumulates that base rate to the PGA filings made by the Company in the interim since the settlement offer was made on May 13, 1983. Since the rate effects no new application but only the approved base rate and PGA adjustments already in effect, MPL requests that it be made effective November 1, 1983. MPL requests all necessary waivers of notice and all suspension policies to allow the requested date. MPL further represents that approval of the tariff sheet so tendered will allow MPL to calculate the refund owed its customers in this docket

Public Notice

US Army Corps
of Engineers
Los Angeles District
P.O. Box 2711
Los Angeles, CA 90053

EXHIBIT 2

SPLCO-R (84-LA5-S(HB))

Date NOV 3 0 1983 Comment Deadline: JAN 1 6 1984

To Whom It May Concern:

Your comments are invited on the scope of an Environmental Impact Statement (EIS) on the proposed Final Designation of the LA 5 Interim Ocean Dumping Site, offshore of San Diego County, California (figures 1 and 2).

SCOPING

In the scoping process, public comment helps determine the scope of an EIS, i.e., the plan of study, the impacts and possible alternatives to be considered. Through the scoping process the significant issues which should be addressed in depth by the EIS are identified.

PROPOSED PROJECT AND STUDY PLAN

The LA 5 dumpsite is a 100 fathom (600 foot) deep circular disposal site with a radius of 1000 yards and a center located at 32^{o} 36' 50" N, 117^{o} 20' 40" W. This dumpsite was given Interim status by the Environmental Protection Agency in 1977. Final designation, pursuant to the Marine Protection Research, and Sanctuaries Act of 1972, as amended, is necessary if its use as a dumpsite for dredge spoil is to be continued. The EPA requested that the U.S. Army Corps of Engineers (USACE) prepare the EIS required prior to final disposal site designation by the EPA. Therefore, the U.S. Army Corps of Engineers will prepare a Draft Environmental Impact Statement (DEIS) for the Proposed Final Designation of LA 5 Interim Ocean Dumping Site pursuant to: the National Environmental Policy Act (NEPA) of 1969; the Council On Environmental Quality Regulations on Implementing NEPA Procedures (40 Code of Federal Regulations (CFR) 1505-1508); and the Corps of Engineers regulations: Policy and Procedures For Implementing NEPA (33 CFR 230). The U.S. Army Corps of Engineers has filed a Notice of Intent to prepare this document. (Concurrently, USACE is preparing an EIS for the Final Designation of LA 2 Interim Ocean Dumpsite located off of Los Angeles.)

USACE is undertaking a comprehensive field sampling and data analysis program to: 1) obtain the information necessary for accurate ecological assessment, and 2) create a scientifically sound baseline of existing conditions. The project tasks primarily focus upon benthic resources, although other biological, physical, cultural, and socio-economic aspects will be considered.

Historic data on biological, physical, and chemical oceanography, transportation networks, and disposal events will be obtained from the private and public sector. Data will be obtained from a literature search, published and unpublished government data, and interviews with local experts. Data will be used to establish a historic baseline which can be compared to existing conditions.

SUBJECT: The Scope of an Environmental Impact Statement on the Proposed Final Designation of the LA 5 Interim Ocean Dumping Site

Four seasonal field surveys will be conducted with sufficient detail to adequately assess existing conditions and trends. Sampling is designed to be statistically justifiable, repeatable, and utilizes technically appropriate methods. Field surveys will include sampling of the infauna, epifauna, fish, sediment, chemical and physical oceanography at the dumpsite and the adjacent reference site. Field surveys will include:

1) ORGANISMAL SAMPLING. Quantitative seasonal inventory of benthic marine fish and invertebrates will be sampled via otter trawls. Infauna sampling will be made with a 0.1 m^2 bottom grab. Otter trawl stations will correspond to infaunal sampling stations. Voucher specimens will be fixed and stored at the Los Angeles District office of the Corps of Engineers.

2) PHYSICAL OCEANOGRAPHIC SAMPLING. Water column profiles of temperature, salinity, pH, dissolved oxygen, and water transmissivity will be performed at two stations at each site (dumpsite and reference site). Replicate profiles will be made. Vertical spacing of sampled depths will be sufficient to define the major pycnoclines in the water column and to satisfy any requirements of biological or physical modeling analyses.

3) CHEMICAL OCEANOGRAPHIC SAMPLING. Water bottles will collect samples for analysis of concentration of suspended solids, heavy metals (Cadmium (Cd), Chromium (Cr), Copper (Cu), Mercury (Hg), Lead (Pb), Arsenic (As), Zinc (Zn), PCBs, petroleum hydrocarbons, and total organohalogens. Samples will be collected approximately 4 meters above the bottom and 5 meters below the surface.

4) SEDIMENT SAMPLING. A vertical core sample will be taken from the 0.1 m^2 bottom grab. Grain size distribution of each sample will be determined. Laboratory analysis of sediment chemistry and tissue chemistry will also be performed. Analysis will be for Cd, Cr, Cu, Hg, Pb, As, Zn pesticides (including chlorinated hydrocarbons), total organohalogens, PCBs, and petroleum hydrocarbons. Standard methods and Environmental Protection Agency testing procedures will be followed. Target species for tissue chemistry will be 1) a benthic-feeding flat fish, the Pacific Sanddab (Citharichthys sordidus) and 2) the filter-feeding shrimp, Sicyonia spp..

Speed, direction and vertical structure of water body movement at each site will be derived from historical data and not measured directly.

This data will in part be used to describe the biotic and oceanographic conditions of the project environment. Data will also be used to assess the differences between the dumpsite and reference (control) site; these differences may indicate the impacts of ocean disposal of dredged material at the dumpsite. The socio-economic setting of the project will be addressed via discussion of those aspects of the project area most likely to be affected by the final designation of the dumpsites. These include: commercial and sport fisheries, coastal recreation, cultural resources, offshore oil development, marine transportation, dredge and disposal operations, and sewage outfalls.

SUBJECT: The Scope of an Environmental Impact Statement on the Proposed Final Designation of the LA 5 Interim Ocean Dumping Site

CONTENT AND STRUCTURE OF THE EIS

The EIS will be structured in accordance with the following outline:

1. Summary
   - a. Major Conclusions
   - b. Areas of Controversy
   - c. Issues to be Resolved
2. Purpose and Need for Action
   - a. Proposed Action
     - (1) Route description
     - (2) Barge description
     - (3) Dredging type
     - (4) Scope of disposal
       - (a) A need for action
       - (b) Stages of implementation
       - (c) Life of the project
       - (d) Historic
   - b. Interrelationship With Other Policies, Plans, and Projects
     - (1) Federal Government: Outer Continental Shelf
     - (2) State: California
     - (3) Local Ports
     - (4) Private industry (proposed projects and ongoing studies)
3. Alternatives Including Proposed Action
   - a. The Environmental Impacts of the Proposed action
     - (1) Introduction
     - (2) Existing environment (direct and indirect impacts of operation).
     - (3) Water resources and quality: Marine
     - (4) Biota: Marine

(5) Use plans - (coastal and ocean route)

b. Alternatives to the Proposed Action

(1) No action

(2) Delayed action

(3) Land disposal

(4) Alternative ocean disposal sites

c. Comparative Impacts of Alternatives

d. Mitigating Measures Not Included in the Proposed Action

(1) Methodology for determining mitigating measures

(2) Mitigating measures

(3) Measures required by Federal agencies

(4) Measures required by State of California and other entities

4. Affected Environment

a. Environmental Conditions

(1) Southern Pacific Coastal Climatic Region, emphasizing Ports and Disposal Sites.

(2) Identification of marine ecosystem components in the area:

(a) Abiotic

(b) Biotic

(3) Physical setting of disposal site and its reference site

(a) Physiography

(b) Geology

(c) Sedimentology

(4) Water resources, quality, and uses: ocean

(5) Water quality standards:

(a) Federal

(b) State

(c) Local

SUBJECT: The Scope of an Environmental Impact Statement on the Proposed Final Designation of the LA 5 Interim Ocean Dumping Site

(6) Water use (how the proposed action conforms or conflicts with the objectives and specific terms of existing or proposed Federal, State, and local land/water use plans, policies, and controls, if any, for the area affected).

(7) Recreation and recreational values

(a) Historic trends

(b) Present trends

(8) Use plans, controls, and constraints:

(a) Coastal and ocean transportation routes

(b) Existing policies

(c) Trends of conflicts

b. Significant Resources

(1) Resources identified as significant in laws, regulations, and guidelines

(2) Critical resources

(3) Species of concern such as: unique, threatened, rare, and Endangered species, and ecologically important species.

5. Environmental Consequences

a. The Environmental Impacts of the Proposed Actions

(1) Introduction

(a) Methodology of impacts analysis

(b) Existing impacts

(c) Potential for impacts

(2) Existing environment (direct and indirect impacts of operation)

(a) Physical and chemical oceanography

(b) Marine ecosystem

(c) Sedimentology

(3) Water resources and quality: marine

(4) Biota: marine

(5) Use plans - (coastal and ocean route)

SUBJECT: The Scope of an Environmental Impact Statement on the Proposed Final Designation of the LA 5 Interim Ocean Dumping Site

(a) Transportation (marine)

(b) Socioeconomic characteristics

b. Alternatives to the Proposed Action:

(1) No Action

(2) Delayed action

(3) Land disposal

(4) Alternative ocean disposal sites

c. Mitigating Measures Not Included in the Proposed Action

(1) Methodology for determining mitigating measures

(2) Mitigating measures

(3) Measures required by Federal agencies

(4) Measures required by State of California and other entities

6. List of Preparers

COMMENTS

Your written comments will help us to identify public concerns over the final designation of the disposal site and focus the EIS on significant issues. Please send your comments to:

U.S. Army Engineer District
ATTN: SPLCO-R (84-LA2-6(HB))
P.O. Box 2711
Los Angeles, California 90053

For further information, call Harvey Beverly, Regulatory Branch, (213) 688-5606.

for Paul W. Taylor
Colonel, Corps of Engineers
District Engineer

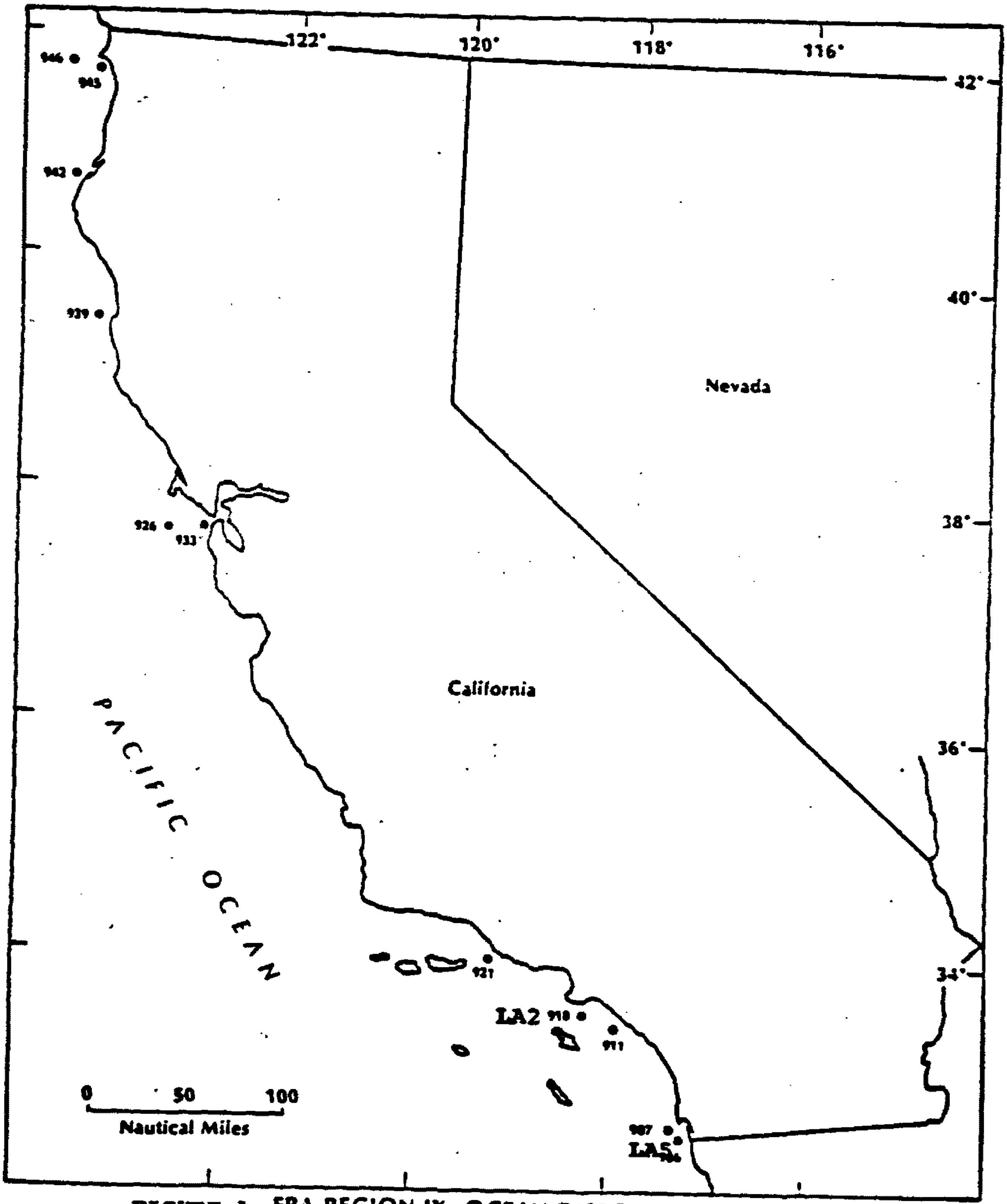
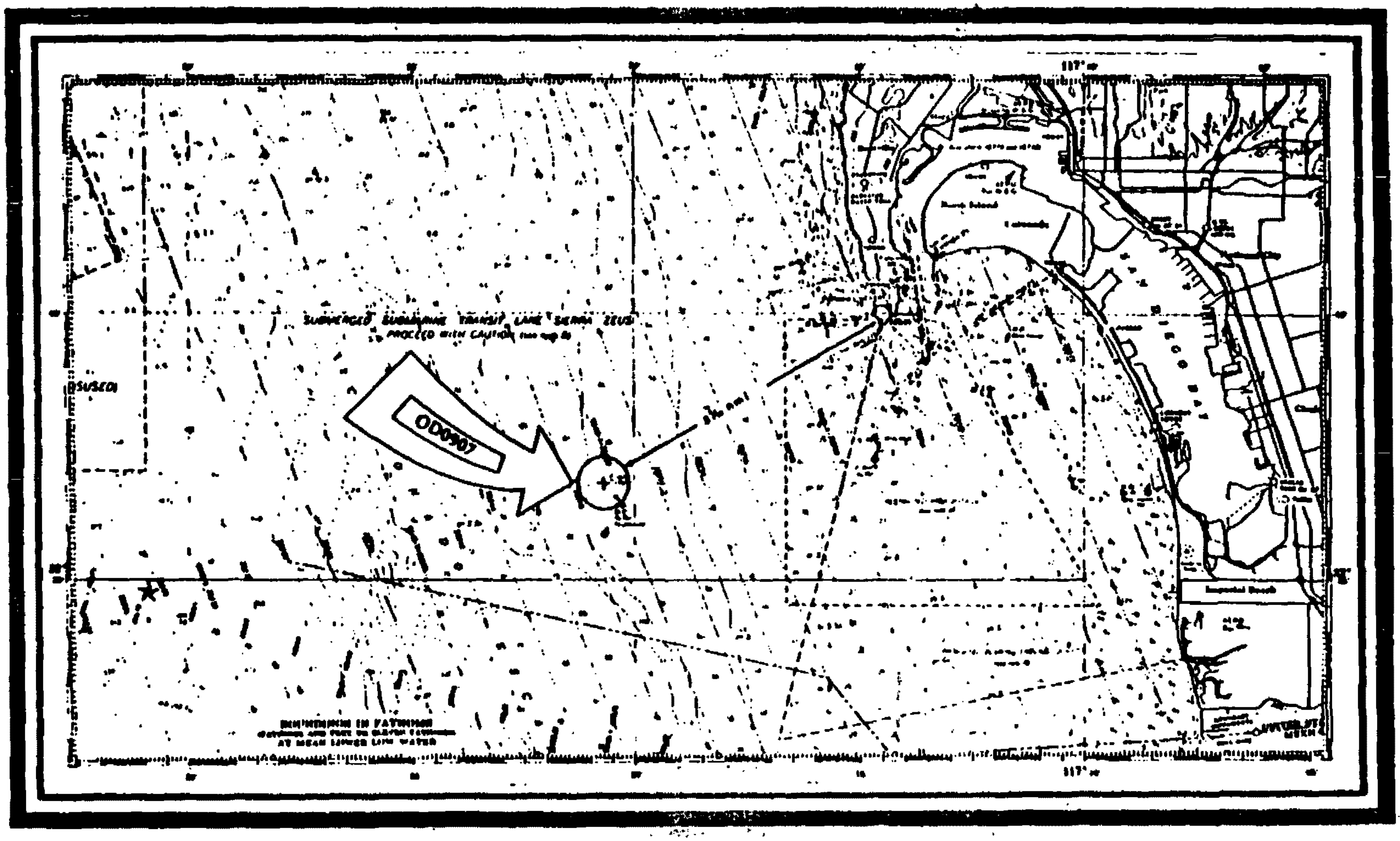


FIGURE 1: EPA REGION IX OCEAN DISPOSAL SITES



Boundary Coordinates .... 1,000-Yard Radius
Center Coordinates .... 32°36'50"N., 117°20'40"W.

Navigation Chart No. .... NOS 18765
Area .... 0.76 Square Nautical Mile
Local Navigational Aids .... Loran A & C, Omega, RDF, Radar
Material Type .... Dredged Material

OD0907
San Diego, CA – 100 Fathom

September 1980

FIGURE 2: LA5 OCEAN DUMP SITE

Table 5-1. Issues Identified During the Scoping Process

AGENCY	ISSUES AND COMMENTS
National Oceanic and Atmospheric Administration	Recommend that topics of commercial and recreational fishing be highlighted in the EIS.
U.S. Fish and Wildlife Service	Suggest use of a beam trawl in place of otter trawl fish sampler. Also suggest midwater trawl samples.
The Resources Agency of California (representing nine other state agencies)	No comments now. Would like to review DEIS. Conveyed California Coastal Commission comment that a Federal consistency certification will be required. This was later retracted by the Commission. (See Section 5.4, Formal Consultation.)
Regional Water Quality Control Board (San Diego Region	Suggest analyzing water column samples and vertical core samples for tin.
City of San Diego	EIS should clearly state the source of the dredge material.
Sunset Beach Community Association	Do not wish to comment.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southwest Region
300 South Ferry Street
Terminal Island, California 90731

EXHIBIT 3

December 20, 1983

F/SWR33:JJS
1503-01.d

Colonel Paul W. Taylor
District Engineer
Corps of Engineers
P.O. Box 2711
Los Angeles, CA 90053

Dear Colonel Taylor:

We have reviewed Public Notices Nos. 84-LA2-S and 84-LA5-S requesting comments on the scope of environmental impact statements (EIS) for the proposed final designations of the LA-2 and LA-5 Interim Ocean Dumping Sites off Los Angeles and San Diego respectively. In general, the content and structure proposed for each EIS thoroughly covers those areas of concern to the National Marine Fisheries Service.

The only apparent deficiency we can see concerns the subjects of commercial and recreational fishing. The texts of both Public Notices state that these topics will be covered in the discussions involving socio-economic settings. Because of the importance of thoroughly considering the implications of long-term dumping at each of the interim sites on fishing, we recommend that the topics of commercial and recreational fishing be specifically highlighted in the content section of each EIS.

Sincerely yours,

Floyd S. Anders, Jr.
Acting Regional Director

cc:
CDFG, Long Beach
FWS, Laguna Niguel

RESPONSE: See Sections 3.4.1, 3.4.5.1, 4.2.3.1, 4.2.3.5.1

United States Department of the Interior

FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
24000 Avila Road
Laguna Niguel, California 92677

EXHIBIT 4

January 5, 1984

Commander
Los Angeles District
Corps of Engineers
P.O. Box 2711
Los Angeles, California 90053

Attention: Regulatory Branch

Re: PN 84-LA2-S and PN 84-LA5-S EIS Scoping Notices
for Ocean Dump Site Designation

Dear Colonel Taylor:

The Fish and Wildlife Service (FWS) has examined the referenced public notices and finds that no significant topic within our purview has been overlooked.

With regard to the field sampling program, we suggest that the FWS be given the opportunity to review and comment on the biological study plan prior to its implementation. Further, we suggest that the proposed otter trawl fish sampler be replaced with a beam trawl which includes a device for measuring the actual bottom area swept by the trawl. Often, a significant failing of otter trawl sampling is that bottom time and area swept by the net is only estimated, rather than actually determined, thus introducing considerable error. The addition of midwater trawl samples should also be considered, in order to assess the presence of fishes normally associated with the water column, as well as the bottom.

Please contact Mr. Jack Fancher on this matter, should the need arise, at FTS 796-4270.

Sincerely yours,

Dale A. Pierce
Acting Field Supervisor

cc: CDFG, MRR, Long Beach, CA
NMFS, Terminal Island, CA
EPA, Reg. IX, San Francisco, CA

RESPONSE: See Section 5.2.2

Resources Building
1416 Ninth Street
95814

(916) 445-5656

Department of Conservation
Department of Fish and Game
Department of Forestry
Department of Boating and Waterways
Department of Parks and Recreation
Department of Water Resources

GEORGE DEUKMEJIAN
GOVERNOR OF
CALIFORNIA

Air Resources Board
California Coastal Commission
California Conservation Corps
Colorado River Board
Energy Resources Conservation and Development Commission
Regional Water Quality Control Boards
San Francisco Bay Conservation and Development Commission
Solid Waste Management Board
State Coastal Conservancy
State Lands Commission
State Reclamation Board
State Water Resources Control Board

THE RESOURCES AGENCY OF CALIFORNIA
SACRAMENTO, CALIFORNIA

EXHIBIT 5

Colonel Paul W. Taylor
Army Corps of Engineers
Post Office Box 2711
Los Angeles, CA 90053

January 13, 1984

Public Notice 84-LA2S (Interim Ocean Dumping Site)

Dear Colonel Taylor:

The State agencies listed below have reviewed the subject public notice and have provided comments used in writing this response. The Resources Agency concurs in these findings.

The Coastal Commission comments that it will provide comments regarding this proposed action for: (1) EPA's DEIS on Designation of an Ocean Dumping Site in the San Pedro Basin for the Ocean Disposal of Drilling Fluids and Cuttings (August 1983) and (2) the U.S. Army's DEIS for the Proposed Final Designation of LA 2 Interim Ocean Dumping Site.

In addition, the Commission comments that a federal consistency certification will be required for EPA's final disposal site designation action.

Because we have received no adverse comments, the State will not object to issuance of the Corps permit.

Sincerely,

Gordon F. Snow

GORDON F. SNOW, Ph.D
Assistant Secretary for Resources

cc: Department of Boating and Waterways
Department of Parks and Recreation
State Water Resources Control Board
Department of Fish and Game
Wildlife Conservation Board
Department of Water Resources
State Lands Commission
Coastal Commission
Department of Health Services

RESPONSE: See Section 5.3

STATE OF CALIFORNIA

GEORGE DEUKMEJIAN, Governor

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

6154 Mission Gorge Road
(Mail: Suite 205. Enter: Suite 106)
San Diego, California 92120-1939
Telephone: (619) 265-5114

EXHIBIT 6

December 16, 1983

U.S. Army Engineer District
Attn: SPLCO-R(84-LA5-S(HB)
P. O. Box 2711
Los Angeles, California 90053

Dear Sirs:

Re: LA 5 Dumping Site

Thank you for providing the opportunity to comment on the Public Notice for a draft environmental impact statement for final designation of the LA 5 dumping site off San Diego. Although my staff understands LA 5 lies more than three miles off the coast of California, there are potential impacts on state waters; therefore, I offer the following suggestions for the Corps' baseline sampling program.

> Chemical Oceanographic Sampling: analyze water column samples for tin.
>
> Sediment Sampling: analyze vertical core samples for tin.

Presumably, most of the material dumped at the LA 5 site will be dredge spoil taken from San Diego Bay. The bay supports three steam generation power plants and is home port to approximately one-fourth of the U.S. Navy's ships as well as a large fleet of commercial and recreational vessels. In the future, I anticipate a much greater use of organo tin anti-fouling paints, such as tributyl tin oxide (TBTO) from these sources. It would, therefore, be appropriate to establish baseline concentrations for appropriate species of organo tins in both bottom sediments and in the water which overlies the bottom at the disposal site.

Since laboratory procedures for these analyses are still being refined by various research teams, analysis and data interpretation would be difficult and expensive. Possible alternatives to quantification of species of organo tins might be to analyze for total tin and to preserve samples for later analysis.

U.S. Army Engineer District December 16, 1983

Although it would require a major effort to establish baseline concentrations of organo tins, I believe such an effort is warranted for protection of waters of the Pacific Ocean off San Diego. As the use of TBTO coatings increases, it will soon be impossible to obtain valid baseline data for the LA 5 dumping site.

Again, thank you for allowing me to comment on this issue. Should your staff have any questions, they may call Mr. Pete Michael at (619)265-5114.

Very truly yours,

ARTHUR L. COE
Supervising Engineer

PM:ej

cc: Mr. Jim Anderson, Executive Officer, Region 8, Santa Ana
Mr. Bob Ghirelli, Executive Officer, Region 4, Los Angeles
Mr. Roger James, Executive Officer, Region 2, Oakland
Mr. Dave Cohen, Program Manager, Special Projects, State Water Resources Control Board, Sacramento
Mr. John Ladd, DFG, Technical Services, State Water Resources Control Board, Sacramento

RESPONSE: No response needed.

EXHIBIT 6-Page 3

TELEPHONE OR VERBAL CONVERSATION RECORD

For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office.

DATE: 19 January 1984

SUBJECT OF CONVERSATION: Clarification of Comment on LA 5 Ocean Disposal Site Public Notice

INCOMING CALL

PERSON CALLING	ADDRESS	PHONE NUMBER AND EXTENSION
PERSON CALLED	**OFFICE**	**PHONE NUMBER AND EXTENSION**

OUTGOING CALL

PERSON CALLING	OFFICE	PHONE NUMBER AND EXTENSION
SHANNON CUNNIFF	SPLPD-RQ	x2934
PERSON CALLED	**ADDRESS**	**PHONE NUMBER AND EXTENSION**
MR. PETE MICHAEL	San Diego Regional Water Quality Control Board	(619) 265-5114

SUMMARY OF CONVERSATION

Pete Michael of San Diego Regional Water Quality Control Board (SDRWQC) informed me that organo-tin compounds are being used by the Navy in their anti-fouling paints. It is probably that by 1991 the entire Naval fleet will be coated with this organo-tin containing anti-fouling paint. The paint is available to the public. Its use is increasing at a rate of 20% per year. Organo-tins are toxic at 1 ppB, are attracted and persistent in sediments, and have a half life on the order of months. At present there are no standards for analysis, in short, different analytical techniques produce different results. Normal handling and analytical techniques used for metals are not applicable due to organo-tin's ability to rapidly degrade.

The purpose of SDRWQCB's letter was to inform the Corps of Engineers that organo-tins were likely to be on the increase in the sediment and water column. The letter was not meant to be a State of California demand that we include organo-tin in our water and sediment sampling plan.

I mentioned to Mr. Michael that we, the Corps, could:

1) investigate the possibility of including organo-tin in our Bioassay Procedure Manual; and
2) suggest that testing for organo-tins be included in the Disposal Site Monitoring Plan.

Until a standard for organo-tin (including a standard analytical procedure) are determined, results of organo-tin surveys would be close to useless.

Mr. Michael gave me a list of persons to contact for further information on organo-tin and the U.S. Navy's Environmental Assessment on its conversion to organo-tin based anti-fouling paints. The best contact appears to be:

TELEPHONE OR VERBAL CONVERSATION RECORD For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office.		DATE 19 January 1984
SUBJECT OF CONVERSATION Clarification of Comment on LA 5 Ocean Disposal Site Public Notice continued		
INCOMING CALL		
PERSON CALLING	ADDRESS	PHONE NUMBER AND EXTENSION
PERSON CALLED	OFFICE	PHONE NUMBER AND EXTENSION
OUTGOING CALL		
PERSON CALLING SHANNON CUNNIFF	OFFICE SPLPD-RQ	PHONE NUMBER AND EXTENSION x2934
PERSON CALLED MR. PETE MICHAEL	ADDRESS San Diego Regional Water Quality Control Board	PHONE NUMBER AND EXTENSION (619) 265-5114

SUMMARY OF CONVERSATION

Mr. Bill Bailey
SRA Corporation
Arlington, VA
(703) 486-0600

Mr. Michael suggested that if the Corps had any concerns concerning the Navy's use of these paints, that we contact Mr. Baily.

I thanked Mr. Micheal for the information and his comments on the LA 5 Public Notice and informed him that we desired to cooperate with the State agencies as much as possible.

DA FORM 1 APR 66 751 REPLACES EDITION OF 1 FEB 58 WHICH WILL BE USED.

EXHIBIT 7

THE CITY OF
SAN DIEGO
CITY ADMINISTRATION BUILDING • 202 C STREET • SAN DIEGO, CALIF. 92101

ENVIRONMENTAL
QUALITY DIVISION
PLANNING
DEPARTMENT
236-5775

January 10, 1984

U. S. Army Engineer District
ATTN: SPLCO-R (84-LA5-S(HB))
P. O. Box 2711
Los Angeles, CA 90053

SUBJECT: LA 5 INTERIM OCEAN DUMPING SITE

Thank you for sending the public notice regarding the scope of a draft environmental impact study that your office will be preparing on the proposed final designation of the LA 5 Interim Ocean Dumping site located offshore of San Diego.

The Environmental Quality Division has reviewed the scope of work for the project and believes that it adequately identifies the potential issues which should be addressed in the environmental impact study. The environmental impact study should clearly state the source of the dredge material. The scoping notice was not clear in this regard.

Thank you for the opportunity to comment on the scope of work for the project, and please send a copy of the draft environmental impact study for our review and comment.

Sincerely,

Allen M. Jones, Deputy Director
City Planning Department

GW:AMJ:ms

RESPONSE: No response needed.

Sunset Beach Community Association

P. O. Box 215 - Sunset Beach - California 90742

EXHIBIT 8

December 12, 1983

Department ofthe Army
Los Angeles District
Corps of Engineers
Box 2711
Los Angeles, CA 90053

Gentlemen:

The Sunset Beach Community Ass. does not wish to comment on the following public notices :

83-144-RA (Amend. 1)
84 - LA5-S(HB)(EIS)
83-130-RA
83-144-RA

Sincerely,

George Tuck

George Tuck, Chairman
Engineering Advisory Committee

GT/nb

RESPONSE: No response needed.

Table 5-2. Attendees at the Interagency Workshop on Ocean Disposal at the LA-2 and LA-5 Sites

NAME	ORGANIZATION
Eric Yunker	EPA Region 9, Ocean Dumping Coordinator
Harvey Beverly	COE Los Angeles District, Regulatory Branch
Terry Breyman	COE Los Angeles District, Environmental Section
Shannon Cunniff	COE Los Angeles District, Environmental Section
William Van Peeters	COE Los Angeles District, Environmental Section
Jack Fancher	U.S. Fish and Wildlife Service
Martin J. Kenney	U.S. Fish and Wildlife Service
James E. Mahoney	U.S. Coast Guard
Lewis A. Schinazi	California Regional Water Quality Control Board, Los Angeles Region (4)
Jim Steele	California Department of Fish and Game
Pete Xander	California Coastal Commission
Don Cadien	MBC Applied Environmental Sciences
Michael Sowby	MBC Applied Environmental Sciences
Rick Ware	MBC Applied Environmental Sciences
Tom Grieb	Tetra Tech, Inc.
Raj Mathur	Tetra Tech, Inc.
Ted Turk	Tetra Tech, Inc.

USCG, EPA and COE. USCG did not pursue their request further after learning what was involved in the site designation process. Jack Fancher (U.S. Fish and Wildlife Service) opposed moving the site because this would cause impacts to an as yet undisturbed location. Shannon Cunniff (Environmental Section, COE Los Angeles District) agreed with this point and noted that the LA-2 interim site had been used since 1977. It was generally agreed that the site should not be moved to another location.

5.2.2. Issue 2

Jim Steele of the California Department of Fish and Game and Jack Fancher of the U.S. Fish and Wildlife Service stated that site designation studies should address impacts to pelagic and mid water fish. Jim Steele specifically mentioned that the effects of suspended fine sediment on anchovies should be studied. Jack Fancher suggested that mid-water trawls should be made to sample the pelagic fish population in the area. Shannon Cunniff explained that field studies had already been initiated and that these studies were focused on benthic resources because this portion of the biological environment would be the most significantly affected resource of the area. She noted that monitoring studies included in the site management program could include a study of mid water fish and other means of assessing the impacts of suspended fine sediment.

Jack Fancher noted that the FWS comment letter on the Notice of Intent recommended that a beam trawl with a device to measure bottom time be used in lieu of an otter trawl. Tom Grieb (Tetra Tech, Inc.) and Shannon Cunniff noted that quantitative abundance estimates were not the objective of the trawl survey and that it is not necessary to know the exact bottom distance traversed. Furthermore, it was explained that tow speed, cable angle, cable length and cable vibration are monitored carefully to ensure uniform bottom time for the trawls. Sample of a questionable nature, such as those trawls that bounce along the bottom, are discarded and the trawl is made again.

5.2.3. Issue 3

Jim Steele suggested that histopathological studies be performed in lieu of or in addition to muscle tissue contaminant analyses of selected organisms. Shannon Cunniff pointed out that COE has limited funding and that this is a preliminary baseline type of survey. There does not appear to be a precedent for this level of detail in a study of this nature. Materials disposed of at the site have already been subjected to bioassay tests to determine the suitability of the material for ocean disposal. Therefore, it is assumed that the material is relatively clean. Tom Grieb added that histopathological analyses are not yet a standard technique and the proper protocols would require research and development. If this study or future monitoring studies indicate a need for such studies, then the requirement for histopathological analyses could be included in the scope of work for site characterization.

5.2.4. Issue 4

Jim Steele recommended that the ice cream cone worm, *Pectinaria* sp., be used for tissue burden studies. Don Cadien (MBC Applied Environmental Sciences) noted that the small size of this polychaete requires that an unacceptably large number of bottom samples would have to be taken in order to obtain sufficient numbers of the organisms. Furthermore, analysis of whole *Pectinaria* sp. would measure toxics in the gut, including ingested sediment, as well as the tissues.

5.2.5. Issue 5

The problem of short dumping was discussed. USCG is responsible for monitoring proper disposal positions. Jim Steele and Bill Van Peeters (Environmental Section, COE Los Angeles District) suggested that a radar target could be placed on the disposal barge to allow verificaiton of the dump location by USCG personnel. Harvey Beverly noted that the COE Regulatory Branch would consider adding this condition to COE Section 103 permits. Dumping on the way to the site still remains a concern.

5.2.6. Issue 6

Robert Hoffman of National Marine Fisheries Service asked if there was any feasible alternative to the designation of LA-2, since land disposal was not feasible alternative. Shannon Cunniff noted that several alternative ocean sites and land alternatives would be considered in the EIS. Alternative ocean disposal site include a shallow water site and a deep water site.

5.2.7. Issue 7

Jack Fancher asked why COE had not coordinated better with concerned agencies prior to initiation of the field studies. Harvey Beverly and Shannon Cunniff explained that the scheduling and funding of the project made extensive coordination impossible and that Russ Bellmer, formerly COE's District Senior Ecologist and responsible for the scope of work, reported coordination on an informal basis with agencies prior to development of the work plan.

5.2.8. Issue 8

At several points, the site monitoring program was referred to as a means of incorporating other agencies' recommendations for site studies. Eric Yunker (EPA) noted that a detailed site monitoring program would probably not be incorporated into the

EIS, but that it could be part of EPA's Record of Decision on the EIS that is published concurrently with the final designation package.

5.3 FORMAL CONSULTATIONS

Formal consultation required by the Endangered Species Act was initiated with the U.S. Fish and Wildlife Service on January 4, 1984 and with the National Marine Fisheries Service on January 11, 1984 and November 11, 1984. The responses to consultation report letters are shown as Exhibits 9, 10 and 11.

Coordination with the California State Historic Preservation Officer, as required by the National Historic Preservation Act, was initiated and a response was received on December 7, 1984. This response is shown as Exhibit 12.

Consultation with the California Coastal Commission regarding coastal zone consistency review was initiated. In the Commission's letter, dated November 9, 1984, they indicated that a consistency determination was not required for final designation of the dredged material site (Exhibit 13). The Commission will continue to review all permit actions under Section 103 of MPRSA to determine consistency.

National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southwest Region
300 South Ferry Street
Terminal Island, California 90731

EXHIBIT 9-Page 1

February 2, 1984

F/SWR31:DJS
1514-05

Mr. Carl F. Enson
Chief, Planning Division
Los Angeles District
Army Corps of Engineers
P.O. Box 2711
Los Angeles, CA 90053

Dear Mr. Enson:

This responds to your January 11, 1984 information requests concerning endangered, threatened, or candidate species that may be affected by the proposed designation of the LA2 and LA5 ocean disposal sites.

The enclosed list indicates those species which may be present in the project area. The gray whale is most likely of these species to be found in these areas. As this species would occur only transiently in these small areas as it migrates along the west coast, we believe that conducting an informal consultation may satisfy the requirements of Section 7(c) of the Endangered Species Act. We would appreciate receiving a copy of the DEIS for these projects and believe these documents may be used in place of submitting formal Biological Assessments.

We have received another request from the Corps of Engineers (COE) for a similar project in the Humboldt Bay, California region. We recommend that all three documents address the cumulative effects of these projects to listed or candidate species. In addition, if the COE concludes in the DEIS that the projects may affect populations of any listed or candidate species, the COE should initiate the formal consultation process.

If you have any further questions please contact Mr. Dana J. Seagars of our Marine Mammal Program at (FTS) 796-2518 or (213) 548-2518.

Sincerely yours,

Rodney R. McInnis
Acting Regional Director

Enclosure

EXHIBIT 9-Page 2

Enclosure
Species Which May Be Present in Project Areas

Common Name	Scientific Name	Status
Gray whale	(*Eschrichtius robustus*)	Endangered
Right whale	(*Eubalaena glacialis*)	Endangered
Blue whale	(*Balaenoptera musculus*)	Endangered
Fin whale	(*B. physalus*)	Endangered
Sei whale	(*B. borealis*)	Endangered
Humpback whale	(*Megaptera novaengliae*)	Endangered
Sperm whale	(*Physeter macrocephalus*) [*catodon*]	Endangered
Green sea turtle	(*Chelonia mydas*)	Endangered
Leatherback sea turtle	(*Dermochelys coriacea*)	Endangered
Pacific Ridley sea turtle	(*Lepidochelys olivacea*)	Endangered
Loggerhead sea turtle	(*Caretta caretta*)	Threatened
Guadalupe fur seal	(*Arctocephalus townsendi*)	Candidate

RESPONSE: No Response Needed.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southwest Region
300 South Ferry Street
Terminal Island, California 90731

EXHIBIT 10

November 26, 1984

F/SWR33:DJS
1514-05

Mr. Carl F. Enson
Chief, Planning Division
Los Angeles District
Army Corps of Engineers
P.O. Box 2711
Los Angeles, CA 90033

Dear Mr. Enson:

We have reviewed your November 11, 1984 determination that populations of listed endangered, threatened or candidate species will not be affected adversely by the proposed final designation of the LA2 and LA5 ocean disposal sites for dredged materials. We concur with your conclusion. We see no need to proceed further with the consultation process prescribed in Section 7 of the Endangered Species Act.

Sincerely yours,

E. C. Fullerton
Regional Director

RESPONSE: No response needed.

EXHIBIT 11

United States Department of the Interior

FISH AND WILDLIFE SERVICE

SACRAMENTO ENDANGERED SPECIES OFFICE
1230 "N" Street, 14th Floor
Sacramento, California 95814

FEB 17 1984
In reply refer to: SESO
#1-1-84-SP-117

Mr. Carl F. Enson
Chief, Planning Division
Department of the Army
Los Angeles District
Corps of Engineers
P.O. Box 2711
Los Angeles, California 90053

Subject: Request for List of Endangered and Threatened Species in the Area of LA 5 Ocean Disposal Site, offshore San Diego County, California

Dear Mr. Enson:

This is in reply to your letter of December 30, 1983, requesting a list of listed and proposed endangered and threatened species that may occur within the area of the subject project. Your request and this response are made pursuant to Section 7(c) of the Endangered Species Act of 1973 as amended (PL 95-632).

We have reviewed the most recent information and to the best of our knowledge there are no listed or proposed species within the area of the project. We appreciate your concern for endangered species and look forward to continued coordination. If you have further questions, please contact Mr. Ralph Swanson of our office at (FTS) 448-2791 or (916) 440-2791.

Sincerely,

Gail C. Kobetich

Project Leader

EXHIBIT 12

State of California — The Resources Agency
OFFICE OF HISTORIC PRESERVATION
DEPARTMENT OF PARKS AND RECREATION
P.O. Box 2390
Sacramento, CA 95811
(916) 445-8006

Date: 7 December 1984

Project No.: CoE 841024 B
and CoE 841024 C

TITLE: LA 2 and LA 5 DUMP SITES

The item cited above was received in this office on ______.
Thank you for consulting us pursuant to 36 CFR 800.

We concur in your determination that this undertaking:

- [X] does not involve National Register or eligible properties.
- [ ] will not affect National Register or eligible properties.

The provisions of 36 CFR 800.7 apply if previously unidentified National Register or eligible resources are discovered during construction.

Contact: Nicholas Del Cioppo of our staff if you have any questions.

Marion Mitchell-Wilson

Marion Mitchell-Wilson, Deputy State Historic Preservation Officer
Acting Chief, Office of Historic Preservation

RESPONSE: No response needed.

State of California, George Deukmejian, Governor

California Coastal Commission
SOUTH COAST DISTRICT
245 West Broadway, Suite 380
P.O. Box 1450
Long Beach, California 90801-1450
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November 9, 1984

Shannon Cunniff
Environmental Section
Department of the Army
L. A. District, Corps of Engineers
P.O. Box 2711
Los Angeles, CA 90053

Re: LA 2 and LA 5 Ocean Disposal Site Selection

Dear Shannon,

Thank you for your coordination with the Coastal Commission regarding the COE ocean disposal site studies for dredged material placement at disposal sites LA 2 and LA 5. As you are aware, on January 11, 1984, the U. S. Supreme Court issued a decision in Watt vs. California concerning consistency determinations by the State of California for federal activities which may affect the coastal zone. The 5-4 ruling reversed two lower court rulings and determined that an administrative action, such as an Outer Continental Shelf oil and gas lease sale, is not subject to review by the State under Section 307(c)(1) of the Coastal Zone Management Act. While a bill was introduced a few weeks later to change the CZMA to permit such state review of these federal agency decisions, the Bill -- HR 4589 -- died in committee. It is expected that it will be reintroduced when the 99th Congress convenes early next year.

In the meantime, the Coastal Commission would continue to have consistency review and permit authority over dredging projects and the shipment of materials through the coastal zone that may adversely affect coastal resources. We appreciate the level of involvement that you have afforded the Commission, and I am confident that the "unofficial" review of the potential impacts

RESPONSE: No response needed.

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of the designation of two disposal sites for further placement of dredged materials by our agency and other State agencies concerned with resource protection and management will ensure that the projects and monitoring programs will be thorough and helpful.

Again, thank you for your effort to keep the Coastal Commission involved and informed. I am looking forward to assisting you in any way I can in the future on this and other projects by the COE.

Sincerely yours,

Peter F. Xander

Peter F. Xander
Staff Planner

PFX/sws

cc: Tom Tobin
Liz Fuchs
Mary Hudson

5.4. REQUESTED REVIEWERS

Comments were requested from the following organizations:

5.4.1. Federal Agencies and Offices

Council on Environmental Quality
Department of Commerce
  National Oceanic and Atmospheric Administration
  National Marine Fisheries Service
  Maritime Administration
Department of Defense
  Army Corps of Engineers
  Navy
Department of Health and Human Services
Department of the Interior
  Fish and Wildlife Service
  Minerals Management Service
Department of Transportation
  Coast Guard
National Science Foundation

5.4.2. State and Municipal Offices

State of California
  State Resources Agency
  Department of Fish and Game
  State Historic Preservation Office
County of Los Angeles
City of Los Angeles
City of Long Beach
Port of Los Angeles
Port of Long Beach

5.4.3. Private Organizations

American Cetacean Society
Audubon Society
Cousteau Society
National Wildlife Federation
Oceanic Society
Sierra Club

5.4.4. Academic/Research Institutions

California State University, Long Beach
Scripps Institute of Oceanography, La Jolla
University of California, Los Angeles
University of California, Santa Cruz

CHAPTER 6. LIST OF PREPARERS

NAME	EXPERTISE	EXPERIENCE	RESPONSIBILITY
<u>U.S. Environmental Protection Agency</u>			
Patrick J. Cotter, M.Sc.	Ocean Disposal Program, EIS preparation and Oceanography	Three years as EIS Reviewer and Regional Ocean Disposal Program Contact	Review and editing of EIS
Philip Oshida, M.Sc.	Ocean Disposal Program, Bioassay Evaluation, and Oceanography	Two years in Oceans and Estuaries Section, Seven Bioassay Lab Manager SCCWRP	Review and editing of EIS
Eric Yunker, M.Sc.	Ocean Disposal Program	Four years as Regional Ocean Dumping Coordinator	Review of work plan and coordination on EIS content
<u>U.S. Army Corps of Engineers</u>			
Harvey W. Beverly	Ocean Disposal Regulations	Seven years as Permit Manager, seven years as Hydrographic Surveyor	Technical review of regulatory concerns

NAME	EXPERTISE	EXPERIENCE	RESPONSIBILITY
Terrance L. Breyman, M.S.	Ecology	Six years as COE Ecologist and 13 years as Biologist with Federal government and consulting firms	Technical review of EIS
Shannon E. Cunniff, M.A.	Ecosystems Analysis and Impact Analysis	Four years as Environmental Coordinator and Ecologist for COE, seven years environmental education	Project Environmental Coordinator
John H. Kennedy, M.A.	Environmental and Community Planning	Six years as Environmental Section Chief, seven years as Geographer and Community Planner for COE	Review of EIS
Gloria Lauter, M.A.	Archaeology and Cultural Resources	Three years as COE Archaeologist and five years as Consulting Archaeologist	Project Cultural Resources Coordinator
Patricia Martz, Ph.D.	Archaeology and Cultural Resources	Eight years as COE Archaeologist	Technical review of archaeology and cultural resources

NAME	EXPERTISE	EXPERIENCE	RESPONSIBILITY
Contractor: Tetra Tech, Inc.			
Arthur Babcock, M.S.	Physical Oceanography	Ten years environmental consulting and research	Physical oceanography and water quality assessment
Robert Barrick, B.S.	Chemistry	Six years environmental consulting and research	Analysis and interpretation of chemical data
Dale Brandon, Ph.D.	Marine Geology	Twenty years environmental consulting and research	Physical oceanography and sediment quality assessment
Thomas M. Grieb, M.A.	Marine Biology and Biostatistics	Ten years environmental consulting and benthic fauna assessment	Statistical analysis of all data
Thomas Leung	Ocean Engineering	Ten years environmental consulting and research	Numerical modeling of fate of disposal material
Raj Mathur, Ph.D	Socioeconomic and Cultural Resource	Eight years environmental consulting and 20 years research and teaching	Socioeconomic and cultural resource assessment
Jeffery Stern, B.S.	Oceanography	Five years environmental consulting and research	Analysis and interpretation of chemical data

NAME	EXPERTISE	EXPERIENCE	RESPONSIBILITY
Ted R. Turk, Ph.D.	Marine Ecology	Six years environmental consulting and five years environmental research and teaching	Contractor Project and Document Manager and Biological Assessment
Frank Wu, Ph.D.	Ocean Engineering	Fifteen years environmental consulting and research	Numerical modeling of fate of disposal material
<u>Contractor: MBC Applied Environmental Sciences</u>			
Donald B. Cadien, Ph.D.	Invertebrate Taxonomy and Ecology	Twenty years environmental consulting and research in invertebrate taxonomy and consulting	Director of taxonomy laboratory. Invertebrate taxonomist.
John N. Bonfiglio, Ph.D.	Chemistry	Eight years biochemistry and organic chemistry	Director of chemical laboratory analyses
David W. Connally, M.Sc.	Oceanography	Ten years physical oceanography and plankton ecology	MBC Project Manager physical oceanographic data collection

NAME	EXPERTISE	EXPERIENCE	RESPONSIBILITY
Michael L. Sowby, M.A.	Biological Oceanography	Fifteen years toxicity studies and fish and plankton ecology	Fish data collection and laboratory chemical analysis
Robert R. Ware, M.A.	Marine Biology	Twelve years benthic ecology and sediment processes	MBC Project Manager and invertebrate taxonomy
R. Craig Wingert, Ph.D.	Fisheries Biology	Fifteen years fish ecology and taxonomy	Director of fish data collection
<u>Contractor: Earth Metrics Incorporated</u>			
C. Michael Hogan, Ph.D.	Physics	Twenty years of experience in water chemistry	Principal in Charge
Gary Deghi, M.S.	Ecology	Eleven years environmental analysis and consulting	Project coordinator responsible for project management and ecological analyses
David A. Mullen, Ph.D.	Environmental Biology	Twenty years environmental research and consulting	Preparation of Biological and general sections, Project Manager

NAME	EXPERTISE	EXPERIENCE	RESPONSIBILITY
Cindy A. Roessler, B.A.	Biology	Four years coastal zone management	Preparation of Physical Environment and Oceanographic sections
Sepehr Haddad, M.S.	Economic Analysis	Four years economic analysis and consulting	Preparation of Socio-economic sections
Jane Staten, B.S.	Environmental Engineering	Analyses of air quality assessments	Preparation of Air Quality sections

CHAPTER 7. LITERATURE CITED

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DRAFT
ENVIRONMENTAL IMPACT STATEMENT

FINAL DESIGNATION OF A
DREDGED MATERIAL DISPOSAL SITE
OFF OF SAN DIEGO, CALIFORNIA

San Diego County, California

APPENDIX A
REPORT OF FIELD SURVEY

U.S. ENVIRONMENTAL PROTECTION AGENCY

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APPENDIX A - REPORT OF FIELD SURVEY

A.1 INTRODUCTION

A.1.1 A field survey was conducted to collect site-specific biological, sedimentological, physical and chemical data for the LA 5 (San Diego) interim dredged material disposal site, and at a nearby reference site, between August 1983 and May 1984. The purpose of the survey was to provide data with which to assess the effects of past disposal at the site, and to provide a baseline for comparison with results of future site monitoring to assess the effects of continued use of the site. Field sample collection and laboratory analyses were conducted by MBC Applied Environmental Sciences. Data analysis and interpretation were performed by Tetra Tech, Inc.

A.1.2 The biological aspects of the survey focused on benthic resources - benthic infauna, demersal fishes, and epibenthic macroinvertebrates. Demersal fishes and epibenthic organisms were collected primarily to obtain selected species for tissue chemical analysis, and secondarily to provide a general characterization of the fish and macroinvertebrate communities. To characterize the physical and chemical environment, samples were taken to determine the grain size of bottom sediments and suspended particle loads in the water column. In addition, vertical profiles of water temperature, salinity, dissolved oxygen, hydrogen ion concentration (pH), and transmissivity were gathered. Chemical analyses included trace metals, chlorinated hdyrocarbons, and petroleum hydrocarbons in the water column, sediments, and fish and invertebrate tissues.

A.2 METHODS

A.2.1 FIELD METHODS

The LA 5 interim dumpsite (Figure A-1) is located approximately six miles offshore Point Loma, San Diego. Field surveys were conducted during August and December 1983, February/March and April/May 1984. Dates of sampling for each task are given in Table A-1, and the number and arrangement of stations are presented in Figure A-1. All sampling was performed aboard the R/V Westwind, a 48 ft. vessel equipped with a Raynav 6000 LORAN C navigation system which electronically interfaces with the autopilot and an EPSCO navigational plotter. Sampling gear was deployed and retrieved with a stern-mounted "A" frame.

A.2.1.1 Benthic Infauna

A.2.1.1.1 Infaunal samples were taken at five (5) stations at the disposal site at three (3) stations at the reference site (Fig. A-1). At the disposal site, three stations were located across the bathymetric gradient (one at the center of the site, one 1,000 yds (914 meters) inshore, and one 1,000 yds (914 m) offshore from the center) to characterize changes in the benthic fauna over the depth range encompassed in the site boundaries (1,000 yd (914 m) radius from center). Two additional stations were located at the upcoast and downcoast boundaries of the site, a the same depth as the center station, to characterize spatial variation within the site at a constant depth. The three

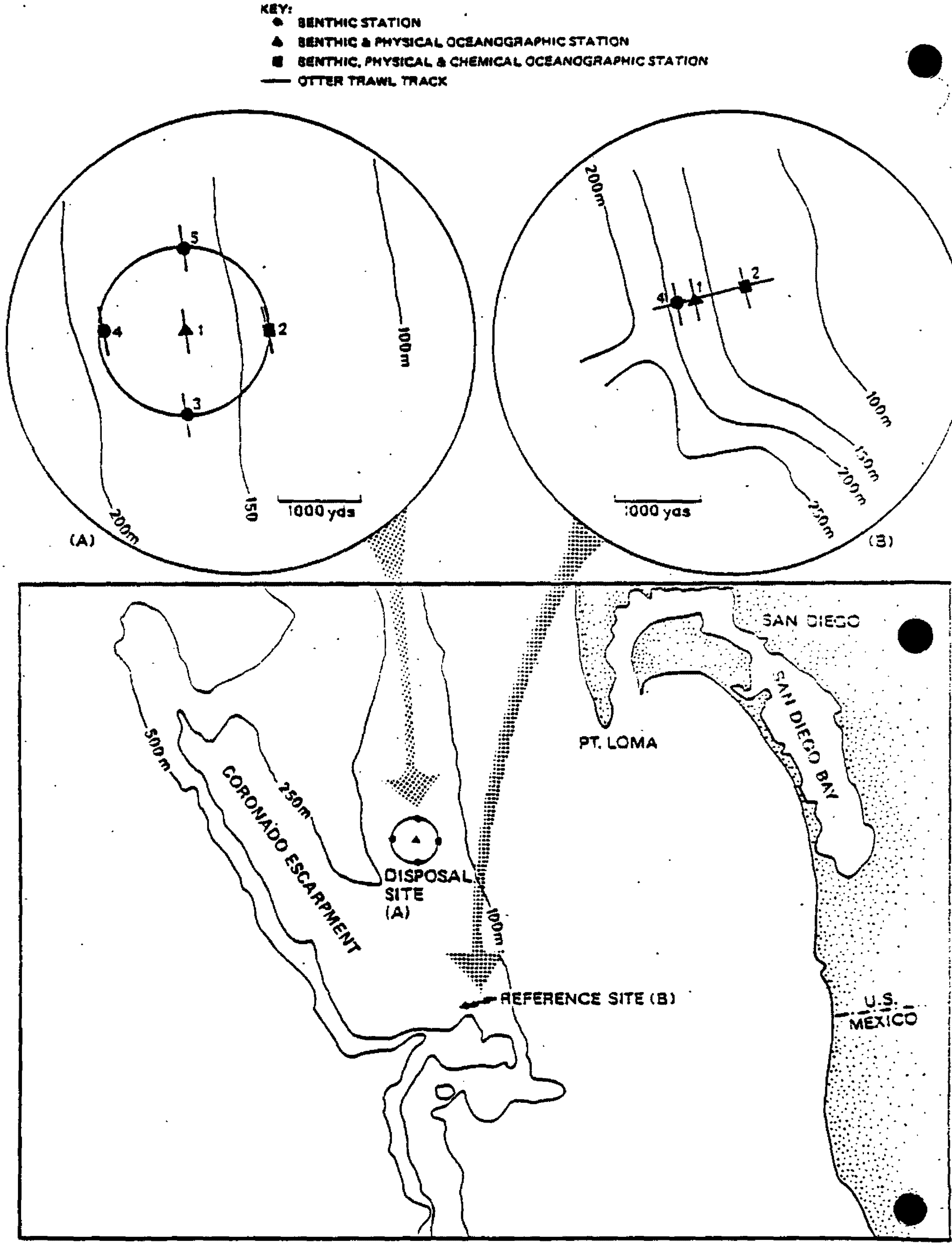


FIGURE A–1 SAMPLING STATIONS AT DISPOSAL AND REFERENCE SITES

TABLE A-1. SAMPLING AND COLLECTION DATES[1]

	Benthic Infauna Sediment, and Sediment Chemistry	Fish and Macro-invertebrates and Tissue Chemistry	Physical Oceanographic and Water Column Chemistry
		August Survey	
LA5	22-27 August 1983	24-25 August 1983	23 August 1983
		December Survey	
LA5	12-14 December 1983	8 December 1983	13 December 1983
		February/March Survey	
LA5	27 February, 1-2 March 1984	28-29 February 1984	1 March 1984
		April/May Survey	
LA5	2-3 May 1984	30 April 1984	4 May 1984

[1]Every means possible (see A.2.1) was used to locate the sampling stations, however, it is highly improbable to relocate exactly bottom grabs and trawl stations due to extreme depth of the site and relocation techniques. Therefore it is highly likely that performance of trawls prior to grab samples had no effect on grab sample data.

stations at the reference site, were located across the bathymetric gradient at the same depths as the three cross-gradient stations at the disposal site. Four replicate grab samples were taken at each station during each of the four sampling episodes.

A.2.1.1.2 Infaunal samples were collected with a Van Veen grab. The gear used was chain-rigged, as recommended by Word (1976), and sampled a 0.1 m^2 surface area. In order to obtain paired biological and sediment samples, grabs were deployed in tandem at opposite ends of a 1 m bar when weather and sea state permitted.

A.2.1.1.3 Collected sediments were screened in running seawater through a sequence of screens (5.0 mm, 1.0 mm, and 0.5 mm) on a high volume, low pressure wash box developed by Dr. A.G. Carey of Oregon State University. Retained sediments and organisms were rinsed into shallow plastic pans and anesthetized in 6 percent magnesium chloride solution for 1/2 to 3/4 hour, then bagged, labeled, and fixed in 10 percent seawater formalin solution.

A.2.1.2 Demersal Fishes and Macroinvertebrates/Tissue Collections

A.2.1.2.1 Demersal fishes and epibenthic macroinvertebrates were sampled at the same intervals as infauna. Sampling dates and the location of sampling stations are presented in Table A-1 and Figure A-1.

A.2.1.2.2 Five (5) stations were established at both the disposal site, with three (3) stations at each of the corresponding reference site. Otter trawl stations were located along isobaths that corresponded to the depths of infaunal sampling stations (Table A-2).

A.2.1.2.3 Sampling was conducted using a 7.6 m semi-balloon otter trawl net. All tows were made in the daytime between 0800-1800 hours. Gear deployment, towing scope (i.e., cable to depth ratio) and gear retrieval were rigorously standardized to ensure that all samples were obtained in an identical manner. All tows were made at a vessel speed of 2.0-2.5 knots for a duration of 5 minutes except during the initial survey when 10 minute tows were conducted. These initial 10 minute trawl periods resulted in the loss of five otter trawl nets. Subsequently, the tow time was reduced to 5 minutes to minimize survey interruptions and costs. The purpose and quality of the program remained relatively unchanged by the decreased trawl periods because the primary purpose was to collect tissue for chemical analysis; the number of shrimp and fish collected was, however, probably lower than would have been collected in 10 minute tows. (The lack of tissue data reported from some surveys results from discovering faulty chemical analyses and having insufficient tissue remaining for reanalysis). Towing speeds were monitored by means of a deck readout flowmeter. Towing distances were estimated by determining the distance between the starting and ending point of each trawl track using LORAN C coordinates for these points.

A.2.1.2.3.1 The 7.6 m semi-balloon otter trawl is a standard sized net used in southern California benthic fish surveys. Its dimensions are very similar to those used by Moore et al. (1982) to sample fish populations in the Bight between 1977 and 1982. A comparison of net dimensions indicate that similar segments of the demersal fish and epibenthic populations would be collected.

TABLE A-2. ISOBATHS (IN METERS) OF OTTER TRAWL SAMPLING STATIONS AT THE LA5 DISPOSAL AND REFERENCE SITES

Site	Station	Isobath (m)
Disposal	1	168
	2	135
	3	168
	4	186
	5	168
Reference	1	168
	2	135
	4	186

TABLE A-3. SUMMARY OF THE NUMBER OF OTTER TRAWL COLLECTIONS OBTAINED AT EACH STATION FOR EACH SITE

		Season				
Site	Station	W1	Sp2	Su3	F4	Total
Disposal	1	2	2	2	2	8
	2	2	2	2	2	8
	3	2	2	2	2	8
	4	2	2	2	2	8
	5	2	2	2	2	8
		10	10	10	10	40
Reference	1	2	2	2	2	8
	2	2	2	2	2	8
	4	2	2	2	2	8
		6	6	6	6	24
Total		16	16	16	16	64

1 = Winter, 2= Spring, 3 = Summer, 4 = Fall

A.2.1.2.4 Two replicate samples were obtained at each station during each sampling period, which resulted in the quarterly collection of 16 otter trawl samples. A total of 64 otter trawl collections were obtained over the one year study period. A summary of the number of otter trawl collections obtained at each site and station is presented in Table A-3.

A.2.1.2.5 All other trawl stations were processed in the field. All collected fishes ad macroinvertebrates were identified and enumerated by species. Identification of fishes was based on Miller and Lea (1972). Standard lengths were obtained for 125 individuals per fish species in each replicate sample. Aggregate weights were also obtained for each fish species in each replicate sample. Macroinvertebrates were identified using current taxonomic information. Fish or invertebrates whose field identification was uncertain were returned to the laboratory for further examination. Voucher specimens for all fish and macroinvertebrate species were retained, and preserved for delivery to the Corps of Engineers.

A.2.1.2.5 Target fish and macroinvertebrate species for tissue contaminant analysis were selected on the basis of having sufficient tissue from the desired species and the close association of those species with the dumpsite and reference areas. During the August 1983 survey, a sanddab (Citharichythys sordidus), the slender sole (Lyopsetta exilis), and a shrimp (Sicyonia ingentis) satisfied these requirements. Pacific sanddab (Citharichthys sordidus) and the ridgeback prawn (Sicyonia ingentis) were selected at this time by the COE and the contractors with verbal approval of EPA - Region IX. During subsequent surveys, Citharichthys sordidus was not captured in sufficient quantities for analysis, and the slender sole (Lyopsetta exilis) was substituted for tissue analysis. The slender sole was selected because it shares a common habitat with the Pacific sanddab, and because it was one of the few fish caught in sufficient quantities to perform tissue analyses. Feeding data are not available for the slender sole. Other soles from the area have been shown to have diets similar to that of the sanddab in that they are both benthic feeders preying primarily on polychaetes and crustaceans (Manzanilla and Cross, 1982). The soles' diets differ from that of the sanddab in containing a slightly higher percentage of burrowing and tubiculous forms, and somewhat varying proportions of polychaetes and crustaceans. Overall, the substitution of slender sole for Pacific sanddab is reasonable.

A.2.1.2.7 Tissue Preparation. Flatfish (i.e., slender sole and Pacific sanddab) and shrimp were removed from the otter trawl collections and composited by species. Approximately 50 grams of tissue from each species were obtained when sufficient tissue was available. The composite technique was required, as neither individual flatfish nor shrimp provided sufficient tissue to perform all required analyses. The fish were wrapped in labeled, hexane-rinsed, oven-dried aluminum foil and immediately frozen. At dockside, the frozen samples were transferred into insulated 60 liter ice chests with the frozen commercial coolant "Blue Ice" to prevent thawing during transport to the laboratory.

A.2.1.3 Sedimentological and Chemical Collections

Four replicate sediment samples were collected at each of the infaunal stations (Fig. A-1). Each replicate was collected independently using a 0.1 m^2 modified Van Veen sampler. Geological and sediment chemistry samples were taken within the same sediment grab. A vertical core was taken in the grab centerline for grain size analysis, transferred to a pre-labeled bag, and stored at ambient temperature until return to the laboratory. Samples for both organic and inorganic chemistry analyses were collected through the access panels of the grab and from the upper 5 cm of the middle of the grab sample to reduce disturbance and the possibility of sample contamination. Samples were collected in glass jars and preserved, when necessary, following the procedures outlined in Plumb (1981). Collected samples were placed under refrigeration and returned to the laboratory where they were stored at 4°C until analysis.

A.2.1.4 Physical and Chemical Oceanographic Sampling

A.2.1.4.1 The oceanographic sampling plan was divided into physical oceanographic and chemical oceanographic components. Physical oceanographic sampling included water column profiles of temperature (°C), salinity (°/oo), hydrogen ion concentration (pH), dissolved oxygen (mg/l), and water transmissivity (%). The sampling profile was designed to be sufficient to define the major pycnoclines in the water column and to satisfy requirements of biological and physical modeling analyses. Physical oceanographic measurements were conducted at two stations at each of the two sampling sites. Profiles were recorded at the center station at the dumpsite as well as the innermost (closest to shore) station. All parameters were recorded on descending and ascending phases of the profile. A Martek Mark VI Water Quality Profiler, coupled with a Martek Mark VIII XMS Transmissometer with a 0.25 m light path-length was used to collect the data. Physical oceanographic data were recorded onto data sheets in the field. Instruments were calibrated versus factory standards prior to and on return from each sampling cruise.

A.2.1.4.2 Chemical oceanographic collections included suspended solids (mg/l), heavy metals (ppm), total chlorinated hydrocarbons (ppm), polychlorinated biphenyls (ppm), pecticides (ppm), and petroleum hydrocarbons (oil and grease; ppm). Three replicate samples were collected from a depth of 5 m below the surface and 5 m above the bottom at the center of the dumpsite and reference site using an array of Van Dorn water bottles. Collection, storage, and preservation of water samples followed EPA (1979a,b) and Plumb (1981) procedures.

A.2.2 LABORATORY METHODS

A.2.2.1 Benthic Infauna

A.2.2.1.1 After return to the laboratory and within four days of collection, samples were logged in, rinsed with tap water on a 0.5 mm screen to remove residual formalin, and transferred to 70 pecent isopropyl alcohol for preservation. Each of the three sample fractions from each replicate was separately sorted under a low-power dissecting microscope to recover organisms from retained sediments and debris. If the replicate was one pre-selected at random for quality control re-sort, sediments and debris from each fraction were saved for examination by the sorting supervisor. Organisms removed from each fraction were separated into categories to facilitate later identification. Specimens from the 5.0 mm and 1.0 mm fractions were combined prior to identification.

A.2.2.1.2 Sorted sample fractions were signed out by systematists and analyzed under dissecting and compound microscopes to identify and count the organisms they contained. Specimens of all phyla other than Protista and Nematoda were identified to lowest possible taxon (usually species) and recorded on laboratory bench sheets. Samples of species which could not be identified with certainty by MBC staff were submitted to outside specialists for identification or confirmation. Species for which no description could be found in existing literature were given provisional names (i.e., Bruzelia sp. B). Specimens of all specific level taxa were removed from the samples, labeled, and placed in a voucher museum to be maintained at the COE Los Angeles District office.

A.2.2.1.3 Data on the bench sheets was reviewed by the supervising systematist for completeness and accuracy. A backup file copy of each corrected sheet was made and the original forwarded for data analysis.

A.2.2.1.4 Fishes and Macroinvertebrates. Fishes and macroinvertebrate specimens which were not field identifiable were returned to the laboratory for positive identification. Samples of species which could not be identified with certainty by MBC staff were submitted to outside specialists for identification or confirmation. Field data were reviewed by supervising fish and invertebrate systematists for completeness and accuracy, copied, and the original forwarded for data analysis.

A.2.2.1.5 Sedimentology. Sand grain size distributions of each sediment sample were determined using a settling tube similar to that described by Gibbs (1974). The device used a differential transformer to sense the load exerted by sediment as it settled and accumulated in a pan near the base of the settling column. The strip chart output from the load sensor was converted to a cumulative frequency plot of the sizes of the particles constituting the samples. The results of the modified settling tube are the same as would be expected from Gibbs' (1974) technique. The silt-clay distribution was determined by hydrometer method based on the settling rates of different sized particles and fluid density (ASTM, 1963). Gravel fraction grain size distribution was determined on standard sieves using a shaker table.

A.2.2.1.6 Grain sizes were reported in phi units (phi = $\log_2$ diameter in millimeters). The range of phi sizes examined were approximately -5 phi to 15 phi. Grain size data were converted to the cumulative frequency of the occurrence of grain size classes. Statistical parameters (mean grain size, sorting, skewness, and kurtosis) of each grain size distribution were determined using moment measures (Krumbein and Pettijohn 1938, Sharp and Fan 1973).

A.2.2.1.7 Sedimentological data were reviewed by the sediment laboratory supervisor and project manager, copied, and sent through data processing and computer analysis. Hard copy and computer tapes were forwarded for data analysis.

A.2.2.2 Sediment Chemistry

A.2.2.2.1 Inorganic Chemistry. Sediment samples were analyzed for arsenic, cadmium, chromium, copper, mercury, lead, and zinc. Metals other than arsenic and mercury were digested using the HNO_2 digestion procedure described by Plumb (1981). Samples were filtered to remove mineral residue the final volume adjusted to a convenient size, which eased handling but did not effect results. The sample was subsequently analyzed on a Varian 875 atomic absorption spectrophotometer.

A.2.2.2.2 Sediment samples for mercury analyses were analyzed using a cold vapor technique. Digestion of the sediment was accomplished using the protocol described by Plumb (1981). The procedure consisted of an initial digestion using concentrated H_2SO_4 and HNO_3 followed by the addition of potassium permanganate and potassium persulfate. Analyses were performed on a Varian 875 atomic absorption spectrophotometer fitted with a mercury vapor generator.

A.2.2.2.3 Arsenic samples were also prepared according to the procedure of Plumb (1981). Weighed sediment samples were fused with potassium pyrosulfate at 320°C for 15 minutes. The cooled sample was dissolved in deionized distilled water and concentrated HCl. Analysis was performed on a Varian 875 atomic absorption spectrophotometer fitted with an arsenic generator.

A.2.2.2.4 Organic Chemistry. Sediment samples were analyzed for petroleum hydrocarbons (grease and oils), total chlorinated hydrocarbons, polychlorinated biphenyls (PCBs), and pesticides (including chlorinated hydrocarbons). Petroleum hydrocarbons were analyzed in sediment samples according to Method 403E in Standard Methods for Examination of Water and Wastewater (APHA, 1980). Weighed samples were extracted with trichlorotrifluorethane and the extract removed. Extracts were then treated with silica gel to remove biogenic material, filtered into tared flasks and the halogenated solvent removed *in vacuo*. The residue was determined by weight difference.

A.2.2.2.5 Sediment samples for chlorinated hydrocarbons were analyzed according to the protocol described in Plumb (1981). Weighed sediment samples were extracted for 18 hours in Soxhlet apparatus with acetone/hexane. The resultant extract was reduced to 30 ml *in vacuo*. The extract was then subjected to Florisil partitioning. Fraction I was eluted from the Florisil column using 6 percent diethal ether/hexane while fraction II was eluted with 15 percent diethal ether/hexane. Analysis was performed on a Varian Series 6000 gas chromatograph.

A.2.2.2.6 An interference peak was recorded near the retention time of Arochlor 1242 in all sediment analyses, so that it was not possible to quantify the exact amount of this compound present. All values for Arochlor 1242 were therefore reported as maximum concentrations.

A.2.2.2.6.1 The interference peak was found when running Arochlor 1242 analyses. The interference is caused by a contaminant that is found in extraction thimbles and other apparatus used in the extraction. It was corrected by running a blank and subtracting it out. Because the interference falls on the largest peak produced by Arochlor 1242, another correction method can be to use a smaller Arochlor 1242 peak; however, this is often more difficult because the smaller peaks overlap with other Arochlors.

A.2.2.3 Tissue Chemistry

A.2.2.3.1 Tissue Preparation. Upon arrival at the laboratory, tissue samples were logged in and held at a constant -18°C until analysis was begun.

A.2.2.3.2 All dissections were performed in a clean environment on tempered plate glass, measuring 50 x 30 x 0.3 cm, to prevent contamination of the tissue samples. Utensils and working surfaces were initially washed with detergent, rinsed at least three times with tap water and once with distilled water, and re-rinsed with a 20 percent nitric acid solution, tap water and distilled water prior to each dissection. To minimize possible contamination during muscle tissue dissections, laboratory personnel wore surgical latex gloves when handling samples.

A.2.2.3.3 Standard length measurements for the fish and carapace length measurements for the shrimp were taken to the nearest millimeter prior to dissection of the muscle tissue. Whole body weights to the nearest hundredth of a gram for both the fish and shrimp were also recorded. All specimens were then scrubbed and rinsed in deionized water to remove any sediment particles that may have been attached to the tissue surface.

A.2.2.3.4 Fish dissection was initiated with a cross-cut incision using a stainless steel scalpel with a carbon steel blade. The incision penetrated 1 to 2 mm through the skin beginning at a point approximately in line with the end of the operculum at the base of the dorsal fin and extended posteriorly past the pectoral fin, terminating at the base of the anal fin. For larger fish in the sample, a second incision was made along the vertebral column adjacent to the lateral line. The skin layer was then peeled away from the underlying muscle tissue using stainless steel forceps and the exposed tissue was scraped away using plain glass microscope slides. The procedure was repeated on the underside of the fish and the total tissue amount from each fish was combined and weighed to the nearest hundredth (0.01) of a gram. Between 10 and 20 fish were needed from each station to obtain sufficient tissue for analysis.

A.2.2.3.5 Shrimp (Sicyonia ingentis) muscle tissue dissections were initiated by removing the tail section from the thorax. The surrounding carapace was peeled away from the muscle tissue, and the digestive gut was removed by making an incision along the dorsal surface with a glass microscope slide. The gut and its contents were washed away with deionized water. Prepared tissue was weighed to the nearest hundredth of a gram. The procedure was repeated with sufficient shrimp to form a composite sample of approximately 50 grams per station.

A.2.2.3.6 After the fish and shrimp tissues were composited, each sample was divided into approximately two equal parts. One-half was placed in labeled plastic "Whirl-pak" bags for heavy metal analysis, while the other half was wrapped in hexane-rinsed, oven-dried aluminum foil for hydrocarbon anlysis. Both samples were then immediately frozen for later chemical analyses.

A.2.2.3.7 Inorganic Chemistry. Tissue samples for trace metal analyses (arsenic, cadmium, copper, chromium, mercury, lead, zinc) were homogenized, weighed, and subjected to digestion procedures outlined for sediments. Samples for all analyses but arsenic were subjected to nitric acid digestion. Samples for mercury analyses were subjected to further digestion using the potassium permanganate/hydroxylamine-sulfate procedure, while samples for arsenic analysis were fused with potassium pyrosulfate and then dissolved in deionized distilled water and concentrated HCl. Analyses were performed on a Varian 875 atomic absorption spectrophotometer following the procedures outlined for sediments. In cases where sufficient tissue for separate digestion and analyses of arsenic, mercury, and the remaining heavy metals were not available, the priority for analyses was: (1) the suite of metals Cu, Cd, Cr, Pb, and Zn; (2) Hg; and (3) As.

A.2.2.3.8 Organic Chemistry. Tissue samples for petroleum hydrocarbons were analyzed according to the method of Warner (1976). The sample was first homogenized, weighed, and subjected to a sodium-hydroxide digestion to saponify any biogenic lipids. The sample was subsequently extracted with ether several times. The ether layers were combined, dried with magnesium sulfate, and concentrated to 1.0 ml. The concentrated ether extract was then subjected to column chromatography using silica gel as described in the procedure. The fractions were then concentrated to 1 ml, charged with an internal standard (nonane), and analyzed on a Varian 6000 gas chromatograph.

A.2.2.3.9 Tissue samples were analyzed for total chlorinated hydrocarbons (including pesticides and PCBs) according to the methods described by the EPA (1980). The micro-method consisted of homogenizing a 0.5 g sample of tissue and extracting with acetonitrile several times. The acetonitrile extracts were combined, diluted with water and extracted with hexane (3 x 50 ml). The hexane extracts were combined, dried, and concentrated to a final volume of 2 ml. The concentrated extract was further purified by elution through a small Florisil column with 1 percent methanol in hexane. Two fractions were collected, concentrated to 1 ml and injected into the gas chromatography unit for analysis.

A.2.2.4 Physical and Chemical Oceanographic Analysis

A.2.2.4.1 Physical oceanographic parameters (dissolved oxygen, pH, temperature, salinity, and transmissivity) were recorded onto computer coding sheets in the field. Chemical oceanographic water samples were analyzed for total suspended solids, heavy metals, chlorinated hydrocarbons, total chlorinated hydrocarbons, PCBs, and petroleum hydrocarbons (grease and oils).

A.2.2.4.2 Total suspended solids in the seawater were determined using Method 290C in Standard Methods for Examination of Water and Wastewater (APHA, 1980). One liter of seawater was filtered through a standard glass-fiber filter. The retained material and the filter were dried at 103 to 105°C. The weight of the suspended material was then determined and expressed as mg/l.

A.2.2.4.3 Analyses of seawater for heavy metals were performed following the methods described in Plumb (1981). For all metals except mercury and arsenic, a chelation-extraction procedure was performed on 100 ml of water samples. The extract was then analyzed on a Varian 875 instrument.

A.2.2.4.4 Arsenic levels in the seawater samples were determined using the arsine generation method. Samples were treated with concentrated nitric dacid and the resultant solution analyzed on a Varian 875 instrument fitted with an arsine generator.

A.2.2.4.5 Chlorinated hydrocarbons in seawater samples were extracted using the methylene chloride/hexane (MC/hexane) procedures outlined in Plumb (1981). One liter of seawater was extracted using MC/hexane. The extract was concentrated and subjected to partitioning using a Florisil column. Fraction I was eluted with 6 percent in petroleum ether. Fraction II was eluted with 15 percent diethylether in petroleum ether.

A.2.2.4.6 Petroleum hydrocarbon (grease and oil) levels in seawater were determined following Method 503A of Methods of Examination of Water and Wastewater (APHA, 1980). Oil and grease were extracted from 1 liter water samples using trichlorotrifluoroethane. The weight of the grease and oil was then determined and the results reported in ppm (mg/l).

A.2.3 QUALITY CONTROL

A.2.3.1 Benthic Infauna

A.2.3.1.1 Quality control procedures start with appropriate design and execution of field sampling, including appropriate station location and relocation.

A.2.3.1.2 Rationale for location of reference ("control") site was selection of a site as far as possible from the disposal site in a direction opposite the general net bottom current flow. This flow was expected to be northwesterly (Hendricks, 1979) and so the reference site was selected to the southeast of the disposal sites (Fig. A-1). Two factors required selection of a reference site nearer the LA 5 site than desired. Only a limited distance southeastward from the LA 5 site, the head of the Coronado Submarine Canyon intersects the Coronado Escarpment. Faunas of canyons tend to be modified from those at equivalent slope depths by inshore displacement of organisms more typical of deeper water (Hartman, 1963) and are not well-suited to act as references for disposal site biotas. A very short distance beyond the canyon lie Mexican waters. The alternative of selecting a reference site to the northwest was similarly constrained by input of the Point Loma Sanitation District wastefield which flows primarily northward along the coast (Hendricks, 1979), and by the La Jolla Submarine Canyon.

A.2.3.1.3 The accuracy of station location with the LORAN C system in use on the sampling vessel is estimated at ±150 ft. or better. Repeatability (station relocation) is estimated at a minimum of ±50 ft. In practice, accuracy and repeatability of station location were increased by application of a maximum acceptable depth variation of ±3 m about the station mean depth. Data on sample depth variability are provided in Table A-4. Loran C coordinates were established during the initial August survey. During subsequent surveys, the position of the sampling station was reestablished according to the known coordinates. Tidal variation was accounted for in the selection of each station during each survey, given the tidal condition at the time of sampling.

A.2.3.1.4 Criteria for acceptance of a grab sample as adequate were: (1) penetration depth of at least 6 cm a the shallowest part of the sample; and, (2) lack of evidence of "washing" or selective removal of fine materials from the grab during retrieval. Although samples of 6 cm penetration were taken and used, they were only kept where grab success was low and greater penetration could not be achieved without excessive effort. Average penetration depth was 11.3±2.5 cm. Penetration depth measurements were made from the grab top to the sediment surface using a pre-calibrated rule prepared to read distance to grab bottom. Readings were taken along grab center prior to removal of the sample from the grab.

A.2.3.1.5 Acceptance or rejection of grab samples was performed by the deck supervisor for each watch. Data relating to each gear drop were recorded on a benthic grab collection record. Acquisition of other samples for sediment chemistry, organic carbon, and grain size was also supervised and verified by the deck watch supervisor.

A.2.3.1.6 All samples were checked in when they arrived at the laboratory immediately following field surveys. All samples were inventoried for damge or abnormalities, and checked for proper fixation and storage. A pre-selected random 15 percent of the sorted sample residue were examined by a sorting supervisor for animals passed over during sorting, and a running efficiency percentage for each sorter maintained. Sorters having efficiencies of less than 95 percent were replaced. Any additional specimens recovered during re-sort were combined with those from the first sort prior to identification. All identifications were double-checked by the supervising systematist. Questionable or uncertain identifications were confirmed or corrected by the following outside specialists: M. Bergen- Holothuroidea, J. Ljubenkov - Cnidaria, B. Myers - Ostracoda, P. Scott - Bivalvia, J. Shrake - Aplachophora, B. Thompson - Echiura and Sipuncula, S. Williams - Polychaeta.

A.2.3.1.7 The supervising systematist checked the identifications for accuracy, consistency and spelling. Voucher type specimens of undescribed species were prepared for reference to ensure consistency throughout the entire program.

TABLE A-4. DEPTH VARIATION (M) OF SAMPLING STATIONS*

Station	Sampling Month Aug	Dec	Feb/Mar	Apr/May	±
DISPOSAL					
1	169-172	169-171	166-171	168-171	169±1.8 m
2	137-139	130-137	134-138	133-137	136±2.4 m
3	167-171	162-170	167-168	168-171	168±1.8 m
4	185-188	187-188	183-185	183-187	186±1.6 m
5	168-170	165-167	165-168	166-169	167±1.8 m
REFERENCE					
1	169-174	165-172	165-168	165-168	168±2.5 m
2	134-137	129-133	132-138	132-138	134±2.9 m
4	186-187	184-189	183-188	183-188	186±1.8 m

* Unadjusted for tidal variations.

A.2.3.2 Fishes

Quality Control of the deployment and retrieval phase of each otter trawl sample was the responsibility of the field team leader. He verified proper otter trawl deployment at the beginning of each tow. The retrieval phase was also closely scrutinized by the field team leader to determine if any twists in the otter boards had occurred during the descent. If incorrectly deployed, the sample was discarded and the station resampled. Presence of net tears or large debris which reduced the efficiency of the trawl also resulted in station resampling.

A.2.3.3 Chemistry

A.2.3.3.1 All collection and handling procedures were performed in the field in accordance with Army Corps/EPA recommended procedures (Plumb, 1981; EPA, 1979a,b; 1980). Collected samples were stored in the appropriate containers and marked with an identification number. These numbers were recorded on field collection sheets and returned to the laboratory with the samples. During the initial storage and transport to the laboratory, water and sediment samples were stored at approximately 4°C and tissue samples were frozen.

A.2.3.3.2 Upon receipt at the laboratory, all samples were separated by type and catalogued against an enclosed packing list and the field data sheets. Containers were inspected for integrity and numbers or labels for clarity and any deviations noted. A systematic custodianship of samples was undertaken to ensure the samples were not lost or misplaced. Samples were then stored in accordance with Army Corps/EPA procedures (EPA, 1979a,b; 1980) until analysis.

A.2.3.3.3 A checkout-from-storage procedure was instituted to track all samples during the various inhouse analysis procedures or when samples were shipped to outside contractors. Inhouse analysts signed for all samples on removal from storage and noted all procedures used for individual samples during that analysis. Samples delivered to outside contractors were signed for on an individual basis.

A.2.3.3.4 Sample preparation for each analysis was performed following the methods outlined in Plumb (1981), EPA (1971a,b; 1980) or Standard Methods for the Examination of Water and Wastewater (APHA, 1980). All sample preparation was conducted with clean glassware that was: (1) washed in Alkonox and rinsed in distilled water; (2) rinsed with methanol and then acetone before storage at 100°C overnight; (3) capped with kiln-fired and solvent-rinsed aluminum foil during storage; and (4) rinsed with additional solvent immediately before use. The highest grade solvents were used in sample preparation to reduce the possibility of contamination. The precision of sample preparation procedures was checked by analyzing spiked samples and sample preparation blanks. All sample containers were properly marked with an identification number during all preparation procedures to ensure that sample contamination or loss did not occur.

A.2.3.3.5 All analyses were performed following accepted methods outlined in the publications previously cited. Detection limits for each analysis are presented in Table A-5. All analyses were performed within the prescribed the limits. Randomly selected samples were sent to an outside laboratory for inter-laboratory comparison of results.

Table A-5. DETECTABILITY LIMITS FOR THE VARIOUS HEAVY METALS AND ORGANIC COMPOUNDS ANALYZED

Metals	Detectability Limits (ppm)	Organics	Detectability Limits (ppm)
Arsenic	0.002	O'P-DDE	0.001
Cadium	0.002	O'P-DDE	0.002
Chromium	0.02	O'P-DDD	0.001
Copper	0.01	O'P-DDD	0.002
Lead	0.05	O'P-DDT	0.001
Mercury	0.0002	P'P-DDT	0.002
Zinc	0.005	PCB 1242	0.007
		PCB 1254	0.013
		PCB 1260	0.034
		A-BCH	0.001
		Lindane	0.001
		B-BHC	0.001
		Heptachlor	0.001
		Epoxide	0.001
		Petroleum Hydrocarbons*	0.1

* Oil and grease.

A.2.3.3.6 The reliability and precision of all instrumentation was checked daily. Both analytical blanks and standards were analyzed with actual samples were under normal operating conditions. The results of all analyses were recorded in a project log and maintained in a fireproof file.

A.2.3.3.7 All stock standards were prepared on a bi-yearly basis using the highest grade solvents, metals, and organics. Standards for chlorinated hydrocarbon analysis were permanently sealed. All standards were stored under refrigeration and protected from ultraviolet light.

A.2.3.3.8 Data developed from the various analyses were examined by both inhouse personnel and outside consultants. Any data point or group of data points were questionable were re-analyzed to ensure their accuracy.

A.2.4 DATA ANALYSIS

A.2.4.1 Study Design

The sampling stations at LA 5 are shown in Figure A-1. Five sampling locations were selected from within the disposal site. Three stations were located on the bathymetric centerline of the site and a single station was positioned on both the inshore and offshore nominal edges of the site. This configuration forms a cross pattern with a station located in the center of the site and transect of three stations both longshore and across the bathymetric gradient. Three stations were selected within the reference site. These were located across the bathymetric gradient at the same depth as the stations within the disposal site. This sampling layout provided reference stations for comparison of physical-chemical and biological variables at three depths within the disposal site. The three stations located along the same isobath within the disposal site provided data for making similar comparisons within the disposal area.

A.2.4.2 Statistical Analysis

Statistical comparisons of sediment chemistry and biological variables were conducted with the data from individual surveys. The analysis of variance (ANOVA) was used to test for statistical significance of observed differences in selected variables both between sites and within the disposal site. Three ANOVA models were used. First, the fixed-effects one-way ANOVA was used to make comparisons among stations from both the reference and disposal sites. Second, the one-way design was used to test for differences in selected variables at the three longshore stations (station 1, 3, and 5) within the disposal site. Third, a two-way ANOVA was used to test simultaneously for differences due to depth and for differences between the reference and disposal sites.

A.2.4.2.1 The underlying assumptions of the ANOVA can be stated as follows:

1. The measures of the dependent variable at each station are normally distributed;

2. The distribution of these measures in each treatment population has the same variance (i.e., variances are homogeneous), and

3. The errors associated with all measurements are statistically independent (i.e., no spatial or temporal correlation among samples).

However, simulation studies have shown that the effects of moderate heterogeneity and deviations from normality have a minimal effect on Type I error probabilities (Glass et al., 1972; Grieb, 1984). For all analysis presented in this report tests for homogeneity of variance were conducted. In those data sets which violated the assumption of homogeneity of variance, transformations were applied to reduce the degree of heterogeneity. All statistical comparisons were made with data collected during a single survey, and based on the sampling procedures spatial correlation was assumed to be minimal.

A.2.4.2.2 In all one-way analyses in which a signficant test result was obtained, an a posteriori multiple-range test was performed to identify where differences were located among group means. The Statistical Package for the Social Sciences (SPSS; Nie et al., 1975) was used for all ANOVA tests.

A.2.4.2.3 Numerical classification methods (Clifford and Stephenson, 1975) were used in the analysis of the benthic infauna data (Section A.3.3). Numerical classification encompasses a wide variety of techniques that can be used to distinguish groups of entities (e.g., sample sites) according to similarity of attributes (e.g., species). Using these techniques, the similarity of group attributes is expressed using a variety of resemblance measures, including commonly used similarity coefficients such as Jaccard, Bray-Curtis, Canberra metric, and Euclidean distance. Classification begins with the compilation of a matrix of similarity coefficients (index scores) between all possible pairs of entities. One of a variety of available clustering methods is then used to form association among entities and to graphically display groups of entities with similar attributes.

A.2.4.2.4 For all numberical classification analyses presented in this report the Bray-Curtis Dissimilarity Index (Boesch, 1977) was used to develop the initial matrix of similarity, and the unweighted pair-groupd method using arithmetic averages (Sneath and Sokal, 1973) was used as the clustering strategy. The numerical classification analysis were conducted using a computer program developed by Tetra Tech, Inc. Many of the programs in this package are modified versions of those presented by Andenberg (1972).

A.3 RESULTS AND DISCUSSION

A.3.1 PHYSICAL OCEANOGRAPHY

This section describes the results of the vertical profiles taken at each station measuring temperature, dissolved oxygen, (salinity) conductivity, pH, and transparency (transmissivity). All water profile data are compiled in Table B-1 in Appendix B.

A.3.1.1 Temperature

A.3.1.1.1 Historical data sources indicate that the sea surface temperature in the Southern California Bight normally ranges from 12.5°C to 19.5°C (Maloney and Chain, 1974) with extreme ranges from 11°C to 23°C (BLM, 1978). These extreme temperatures are normally attributable to the local climate (SCCWRP, 1973). Maximum sea surface temperatures are experienced during the summer and fall (August - September) with minimum temperatures during the winter (December to February). Data collected during this survey agree well with these historical sources.

A.3.1.1.2 Table A-6 presents the profiling data for the surface, 100 meters, and bottom at each station for the four surveys. Maximum sea surface temperatures were recorded during Survey 1 (August 1983) and ranged from 21.6°C to 22.5°C. Minimum surface temperatures occurred during Survey 3 (March) and ranged from 14.9°C to 15.6°C. The yearly range in surface temperatures was between 6.6°C and 7.4°C, depending on the station, which compares favorably with that expected normally.

A.3.1.1.3 The temperatures at 100 m showed a much smaller range, as expected (BLM, 1978), with temperatures from 9.8°C to 13.2°C. Maximum temperatures were again found in August (Survey 1) but, minimum temperatures at 100 m were found during Survey 4 (May 1984). Bottom temperatures showed a wider range between stations due to the differences in depth of each station. Yearly fluctuations at each station compared with those experienced at the 100 m depth (2-4°C). Maximum bottom temperatures were experienced during Survey 1 (August) while minimum temperatures were found during survey 4, the same as the 100 m depths. These data indicate that the fluctuations in temperature at depths in excess of 100 m are controlled to a greater extent by water mass movements and seasonal currents than by the climatic heating and cooling which control temperatures in the upper 100 m (Chan, 1974).

A.3.1.1.4 Figure A-2 shows the temperature profiles for each survey collected at the Disposal Site, Station 1. These profiles are typical of those collected at all stations for both items. The seasonal thermocline between 10 and 50 meters created by summertime heating of the surface layer (Allan Hancock Foundation, 1965) is well developed during Survey 1. Surveys 2 and 3 show the absence of the any thermocline with steady decrease in temperature from surface to bottom. Survey 4 (May 1984) taken at the beginning of the warm season, shows the initial stages of development of the seasonal thermocline.

TABLE A-6. TEMPERATURE PROFILING DATA AT LAS

	Disposal Station 1	Disposal Station 2	Reference Station 1	Reference Station 2
Survey 1 (Aug)				
Surface	22.3°C	22.2°C	21.6°C	22.5°C
100 m	12.7	12.8	12.7	13.2
Bottom	10.3	11.2	12.1	13.1
Survey 2 (Dec)				
Surface	15.8	15.7	16.0	15.8
100 m	11.2	10.9	11.6	11.0
Bottom	9.2	9.5	8.7	9.7
Survey 3 (Mar)				
Surface	14.9	14.9	15.0	15.6
100 m	10.9	10.8	10.5	10.3
Bottom	9.1	10.3	9.3	9.8
Survey 4 (May)				
Surface	17.3	17.3	17.6	17.5
100 m	9.8	9.8	9.9	9.8
Bottom	9.0	9.2	9.0	9.4

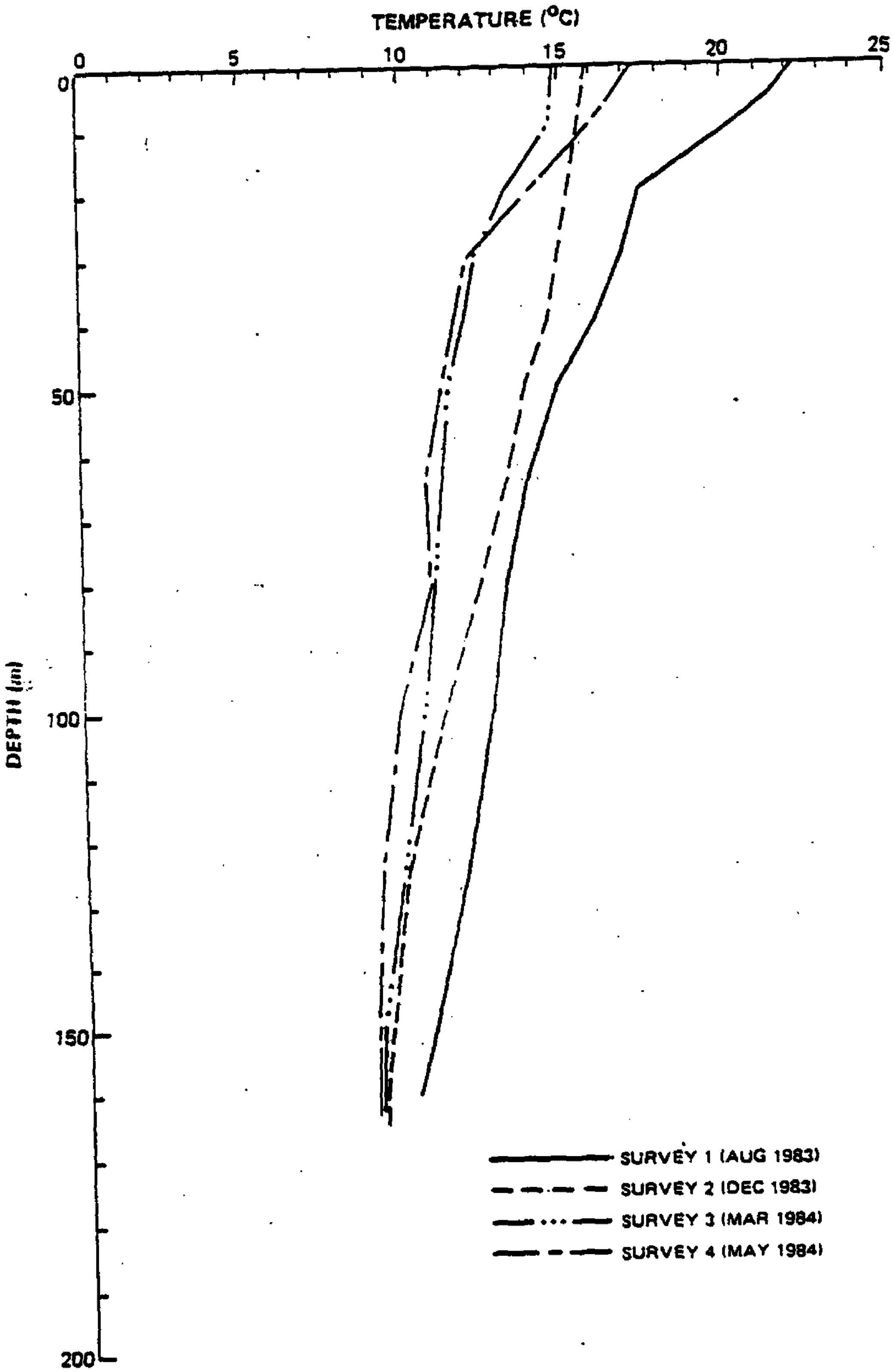


FIGURE A–2 TEMPERATURE PROFILES AT LA 5 DISPOSAL SITE, STATION 1

A.3.1.1.5 No significant differences between the disposal or reference sites or between stations at each site in either temperatures, temperature ranges, or seasonal fluctuations were noted.

A.3.1.2 Dissolved Oxygen

A.3.1.2.1 The Allan Hancock Foundation (1965) found that dissolved oxygen levels in the California Bight are dependent on temperature, salinity, and biological processes such as respiration, photosynthesis, and oxidation. Dissolved oxygen values are normally near or at saturation levels at the surface with generally declining values with depth.

A.3.1.2.2 Table A-7 shows the dissolved oxygen levels at the surface, 100 m, and bottom for the four surveys in this study. Surface values ranged from 8.4 ppm to 10.0 ppm. Values at 100 m depths showed the concentration decline mentioned above with values ranging from 4.7 ppm to 7.5 ppm. At the bottom values showed a wider range (3.6 to 7.4 ppm) due to the variance in water depth at each station, but continued to show declining concentration with depth.

A.3.1.2.3 Figure A-3 shows the dissolved oxygen profiles at the LA2 Disposal Site, Station 1, for each of the four surveys. Once again, the decline of concentration with depth can be noted, as can a subsurface maximum between 10 m and 50 m for Surveys 1 (August 1983) and 4 (May 1984). Reid (1962) found that this subsurface maximum developed in the late spring and continued through the fall. He concluded that this maximum was tied to the seasonal variation in temperature in the upper layers and was found when the seasonal thermocline was present. This seasonal subsurface maximum is a phenomenon found throughout much of the Pacific Ocean and is though to be associated with entrapment of oxygen by the seasonal thermocline and not with increased photosynthetic activity.

As with the temperature data, no significant differences in dissolved oxygen concentrations were found between sites or between stations at each site. Values recorded fell within those described by historical sources. (Maloney and Chan, 1974; Chan, 1974; AHF, 1965.)

A.3.1.3 Salinity

Salinity measurements were taken through the use of a conductivity probe which measures the electrical resistivity of the water. Salinity values were then calculated from the conductivity and temperature values using a standard conversion algorithm.

Salinity values in the Southern California Bight normally range from approximately 32.9^{o}/oo to 34.5^{o}/oo (AHF, 1965). Seasonal salinity variations are generally small with highest salinities recorded during the summer and fall. This has been attributed to the increased precipitation during the winter and the greater evaporation during the summer.

TABLE A-7. DISSOLVED OXYGEN PROFILING DATA AT LA5
Dashes indicate no data.

	Disposal		Reference	
	Station 1	Station 2	Station 1	Station 2
Survey 1 (Aug)				
Surface	10.0	9.2	8.4	8.5
100 m	6.8	6.8	6.8	7.5
Bottom	4.4	5.0	6.1	7.4
Survey 2 (Dec)				
Surface	8.9	9.4	7.8	-
100 m	-	-	-	-
Bottom	3.4	-	-	-
Survey 3 (Mar)				
Surface	9.7	10.0	8.9	8.8
100 m	5.1	5.2	4.7	4.5
Bottom	3.9	5.2	3.9	4.0
Survey 4 (May)				
Surface	8.4	8.6	9.1	8.7
100 m	4.8	4.7	4.8	5.1
Bottom	3.6	4.1	4.2	5.4

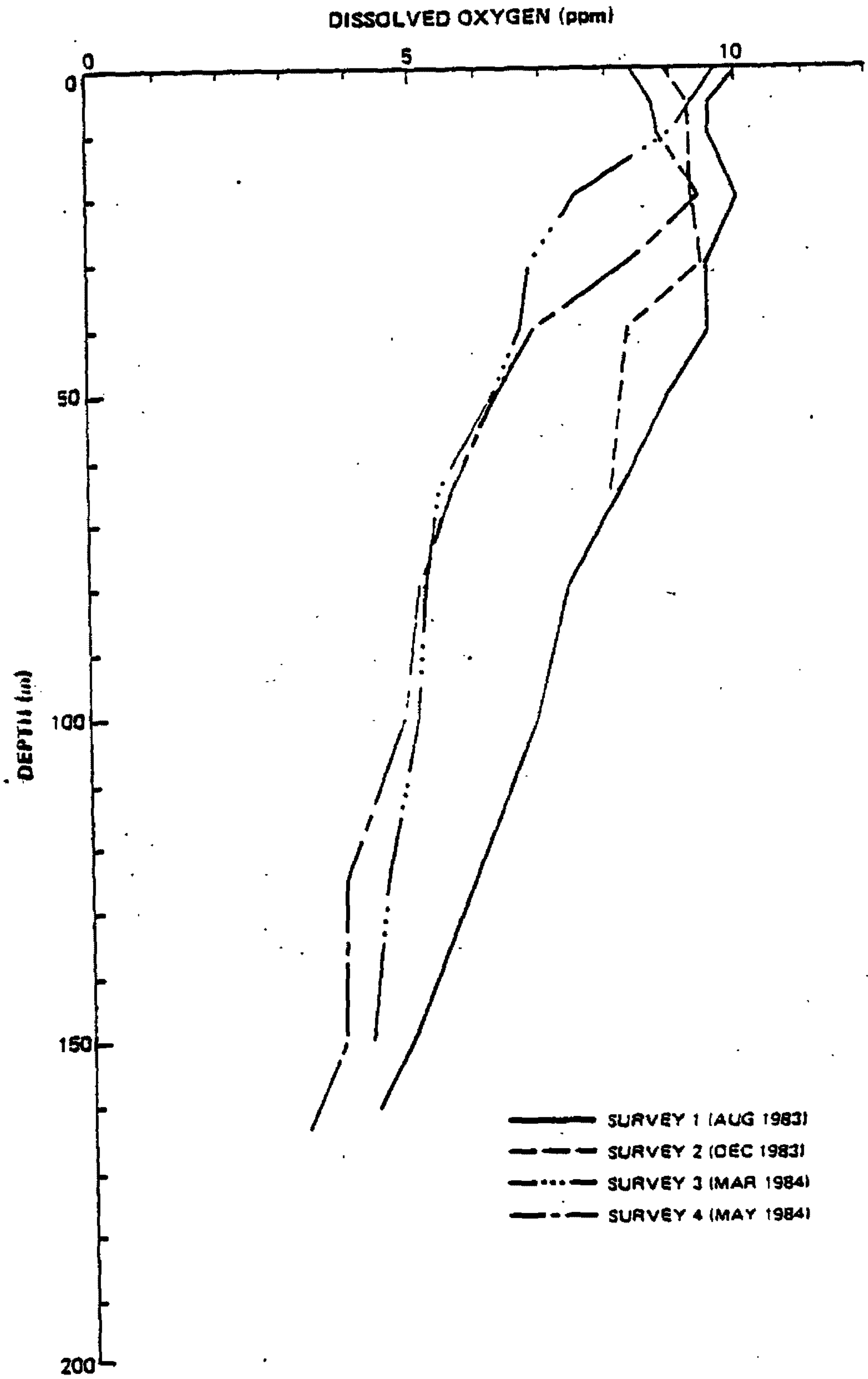


FIGURE A–3 DISSOLVED OXYGEN PROFILES AT LA 5 DISPOSAL SITE, STATION 1

Figure A-4 presents representative salinity profiles for the LA 5 Disposal and Reference Sites. Additional salinity data are presented in Table B-1 in Appendix B. Wider range in salinity was recorded during these four surveys than has been historically reported. In particular, salinities calculated for Surveys 2 and 4 are unexpectedly low, raising some question about the reliability of these values. Questionable data have not been presented in the profile plots but all but the most questionable data have been included in Table B-1. Coastal waters are generally susceptible to salinity fluctuations in the surface layer caused by excessive runoff, and the particularly wet November and December experienced during 1983 may explain the decreased salinity values experienced during Survey 2. However, this effect cannot explain the Survey 4 results, and moreover is not normally seen below the upper 10-20 m. Very small errors in calibrating or reading the conductivity sensor can lead to calculated salinity fluctuations of 1-2 ppt and is a more likely explanation for the decreased salinities experienced throughout the water column on some surveys.

Figure A-4 shows a slight salinity increase with depth and is due to the mixing or more saline bottom waters with the surface water (Maloney and Chan, 1974).

No significant salinity differences were noted between sites or between stations at each site.

A.3.1.4 Hydrogen Ion Concentration (pH)

All values of pH at the LA5 site fell within the range of 7.1 to 8.6. This compares favorably with the range of 7.5 to 8.6 described by the Allan Hancock Foundation report (1965). A slight decrease in pH with depth was noted.

Table A-8 shows the pH profile data at the Disposal and Reference Sites for each survey. These data show the pH decrease with depth and the lack of significant pH differences between sites or stations at each site.

Because the ocean is a buffered solution, a very narrow range of pH is to be expected. Large transient shifts in pH are usually associated with regions with sewage disposal or with transient events such as ocean disposal.

A.3.1.5 Transparency

Transparency measurements were made using a standard transmissometer. Percent transmissivity was recorded and values for the surface, 100 m, and bottom are presented in Table A-9. Values averages 94.8 percent and showed little variation with depth. No significant differences between the disposal or reference sites or between stations at each site were noted.

A.3.2 CHEMISTRY

Results from the analyses of sediments, tissues, and the water column are tabulated at the end of this section (Table B-2). These analyses include metals, oil and grease, pesticides, and PCBs from the LA5 disposal site and the reference site. Detection limits are included for each parameter

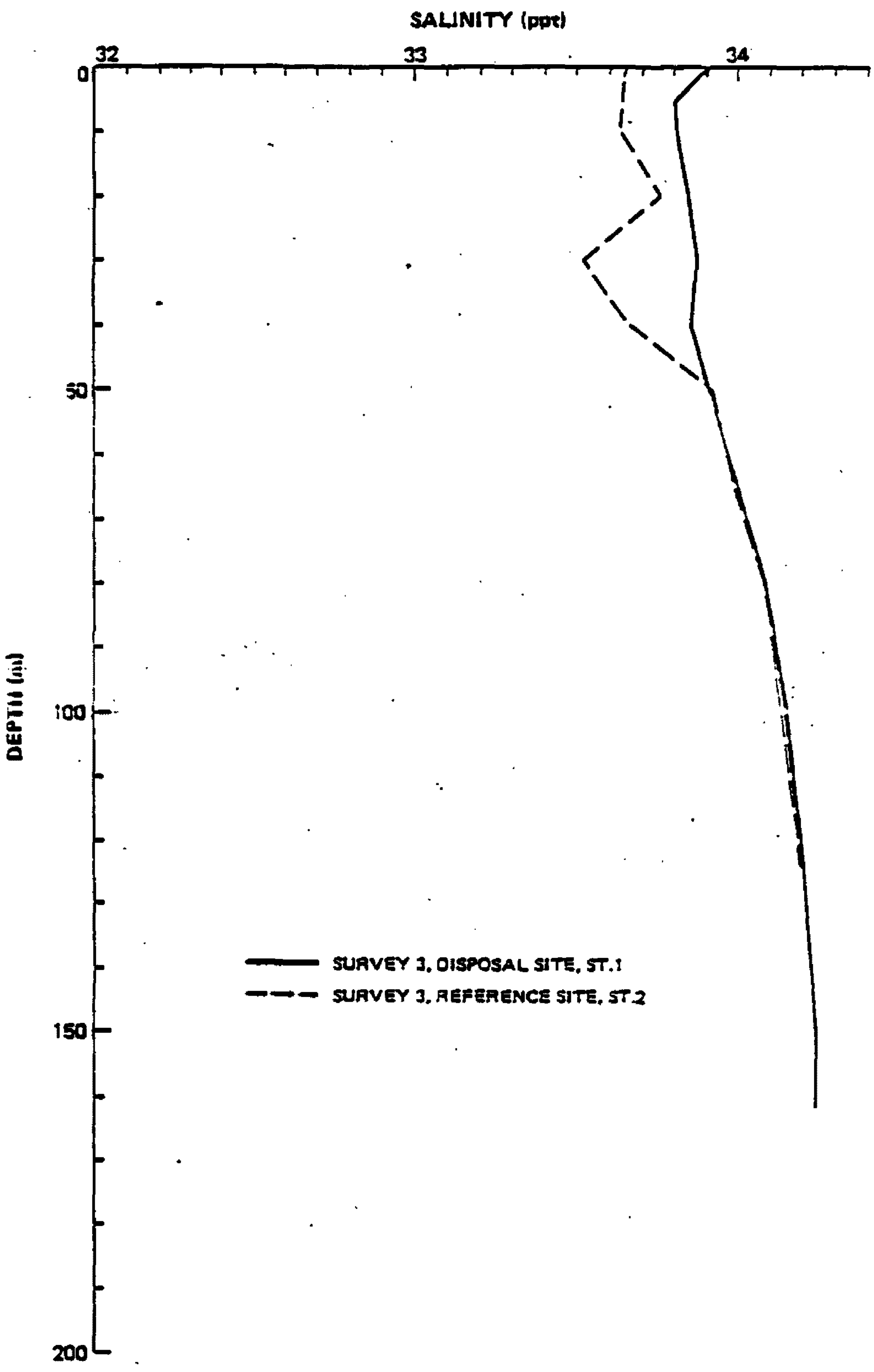


FIGURE A—4 SALINITY PROFILES AT LA 5 DISPOSAL AND REFERENCE SITES

TABLE A-8. pH PROFILES AT LA 5
Dash indicates no data due to equipment malfunction realized after return from study sites.

	Disposal		Reference	
	Station 1	Station 2	Station 1	Station 2
Survey 1 (Aug)				
Surface	8.3	8.3	8.2	8.4
100 m	7.8	7.9	7.8	8.0
Bottom	7.9	7.6	7.8	8.0
Survey 2 (Dec)				
Surface	8.3	8.3	8.2	8.2
100 m	8.1	7.5	7.3	7.9
Bottom	8.1	7.1	7.1	7.5
Survey 3 (Mar)				
Surface	8.5	8.4	8.5	8.1
100 m	8.1	8.1	7.8	7.6
Bottom	7.9	8.1	7.6	-
Survey 4 (May)				
Surface	8.2	8.2	8.2	8.2
100 m	7.6	7.6	7.4	-
Bottom	-	-	7.6	-

TABLE A-9. TRANSMISSIVITY PROFILE AT LA 5

	Disposal		Reference	
	Station 1	Station 2	Station 1	Station 2
Survey 1 (Aug)				
Surface	96.3%	95.1%	96.5%	95.7%
100 m	96.7	97.7	95.5	95.9
Bottom	97.2	97.7	95.6	96.4
Survey 3 (Mar)				
Surface	93.6	100.0	99.1	96.3
100 m	98.1	100.0	96.6	99.2
Bottom	95.5	100.0	96.3	93.2
Survey 4 (May)				
Surface	98.3	96.9	96.0	100.0
100 m	100.0	96.9	88.9	86.2
Bottom	89.0	91.1	90.2	81.3

analyzed. Statistical analyses were conducted on at least one survey from each site, for each parameter, to test significance of the results when obvious trends existed. Analyses were performed as needed on selected surveys when no trends were obvious to facilitate interpretation. Three types of ANOVA were conducted on the chemistry data:

1. One-way ANOVA with all stations from a selected site included.

2. One-way ANOVA with only stations 1, 3, and 5 from the disposal location.

3. Two-way ANOVA with stations 1, 2, and 4 from both the disposal location and the reference location. The two factors are station and type (reference or disposal).

Multiple Range Tests were conducted for those one-way analyses with significant (α =0.05) test results. A test for homogeneity of variance was run for each analysis. The purpose of these tests is described in the data analysis section (A.2.4). Interpretation of these results is presented below.

A.3.2.1 Metals

A.3.2.1.1 Sediments. Sediment acid-extractable metals concentrations for all four surveys are compared in Figure A-5 for the disposal and reference site. Inspection of Figure A-5 indicates for each metal that levels at the disposal site are elevated over levels at the reference stations. Significant ANOVA results (α =0.05) for heterogeneity among stations and between the disposal and reference site support this conclusion. The increase in the variance among replicates at disposal site stations over the reference stations suggests spotty concentrations of the metals at the dump site. Significant differences among dump site stations 1, 3, and 5 along the 170 m isobath (to remove depth trends) is additional evidence of the spotty contamination of metals at the dump site. There are no depth trends in the metal concentrations at either site. Station 3 approaches reference levels for each metal. This is the upcurrent station for most of the year and appears not to receive much input from dumping in comparison to natural input.

A.3.2.1.2 Water Column. Metals were undetected in the water column analyses at the detection limits listed in Table A-5. Therefore, a comparison of disposal and reference site water quality conditions cannot be made.

A.3.2.1.3 Tissues. One epibenthic macrinvertebrate and two demersal fish species were used for tissue analyses. The ridgeback prawn (*Sicyonia ingentis*) was sampled during all four surveys. The Pacific sanddab (*Citharichthys sordidus*) was collected during the first two surveys, but was replaced with the slender sole (*Lyopsetta exilis*) for the final two surveys because low catches of the former did not yield enough tissue for analyses. Figures A-6, A-7, and A-8 are representative plots of metal concentrations for all three species. All tissue metal data are not plotted to conserve space. Complete metals analyses were not possible for all surveys due to lack of sufficient tissue. The lack of sufficient tissue results in many cases from discovering faulty analytical techniques; insufficient tissue remained to

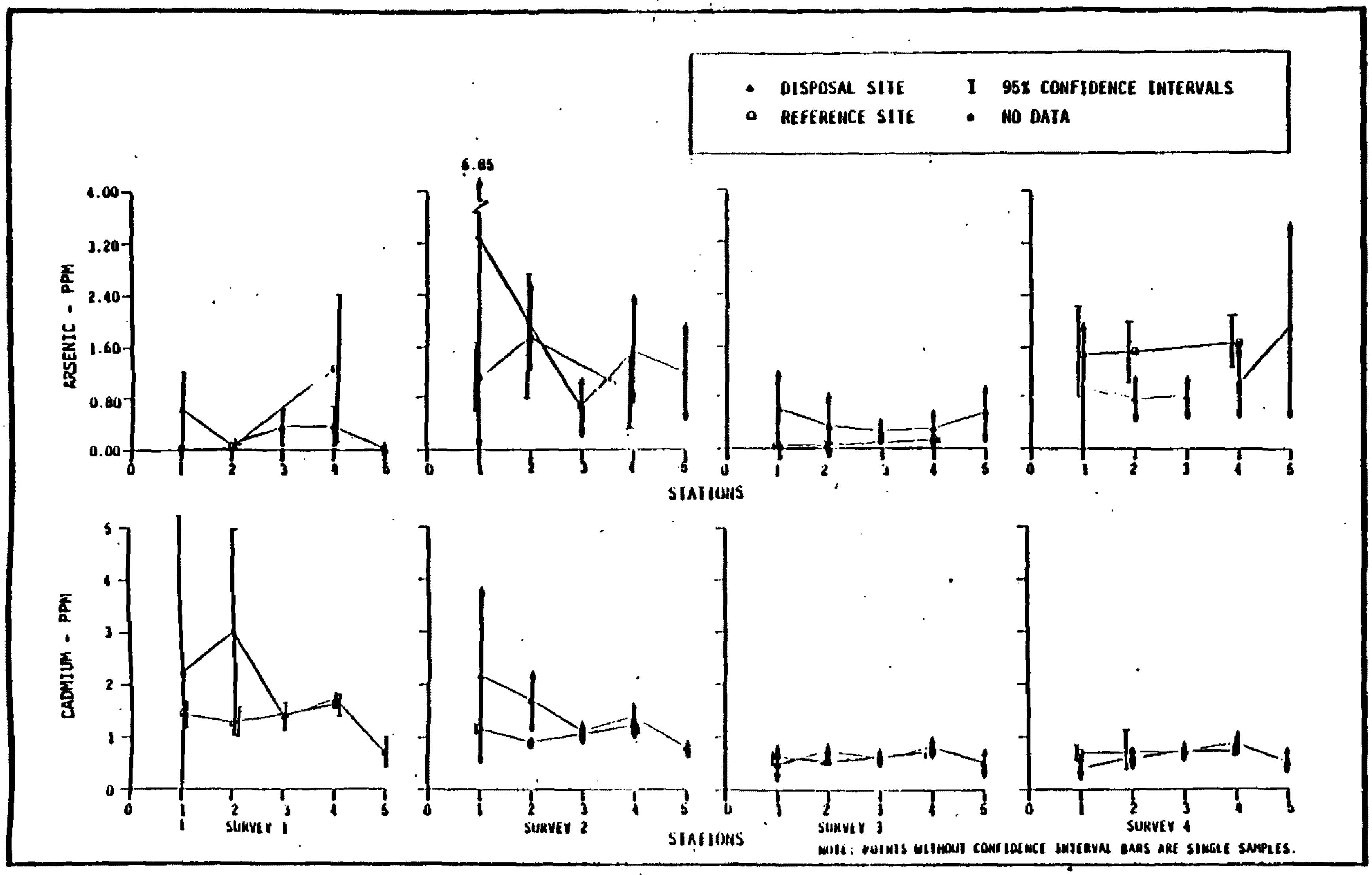


FIGURE A6. MEAN AND 95% CONFIDENCE INTERVALS FOR TRACE METALS SEDIMENT CONCENTRATIONS (DRY WT) AT LA 6 SITE. CONNECTING LINES ARE TO ENHANCE READABILITY AND DO NOT INDICATE TRENDS.

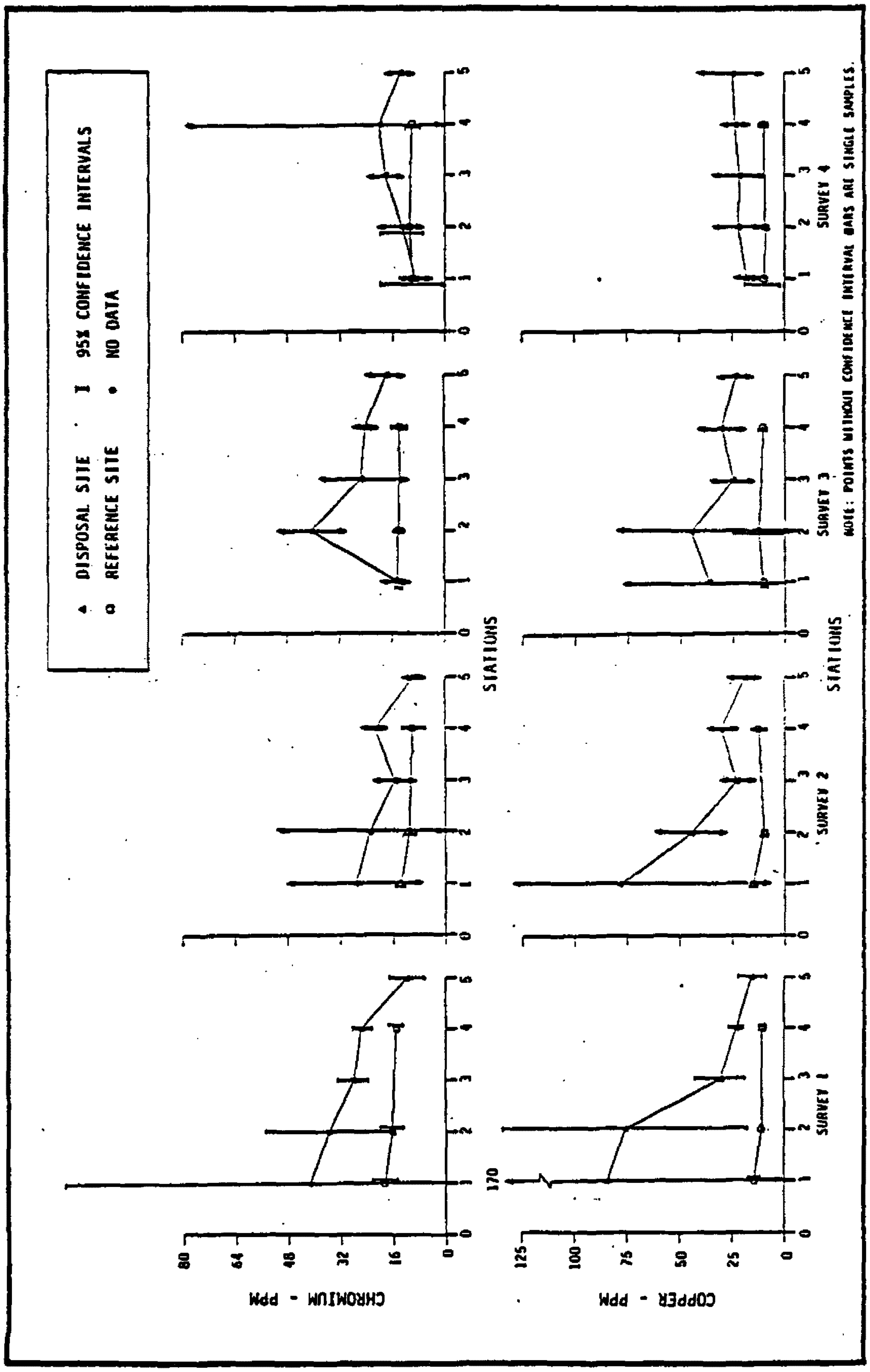


FIGURE A6 (CONTINUED)

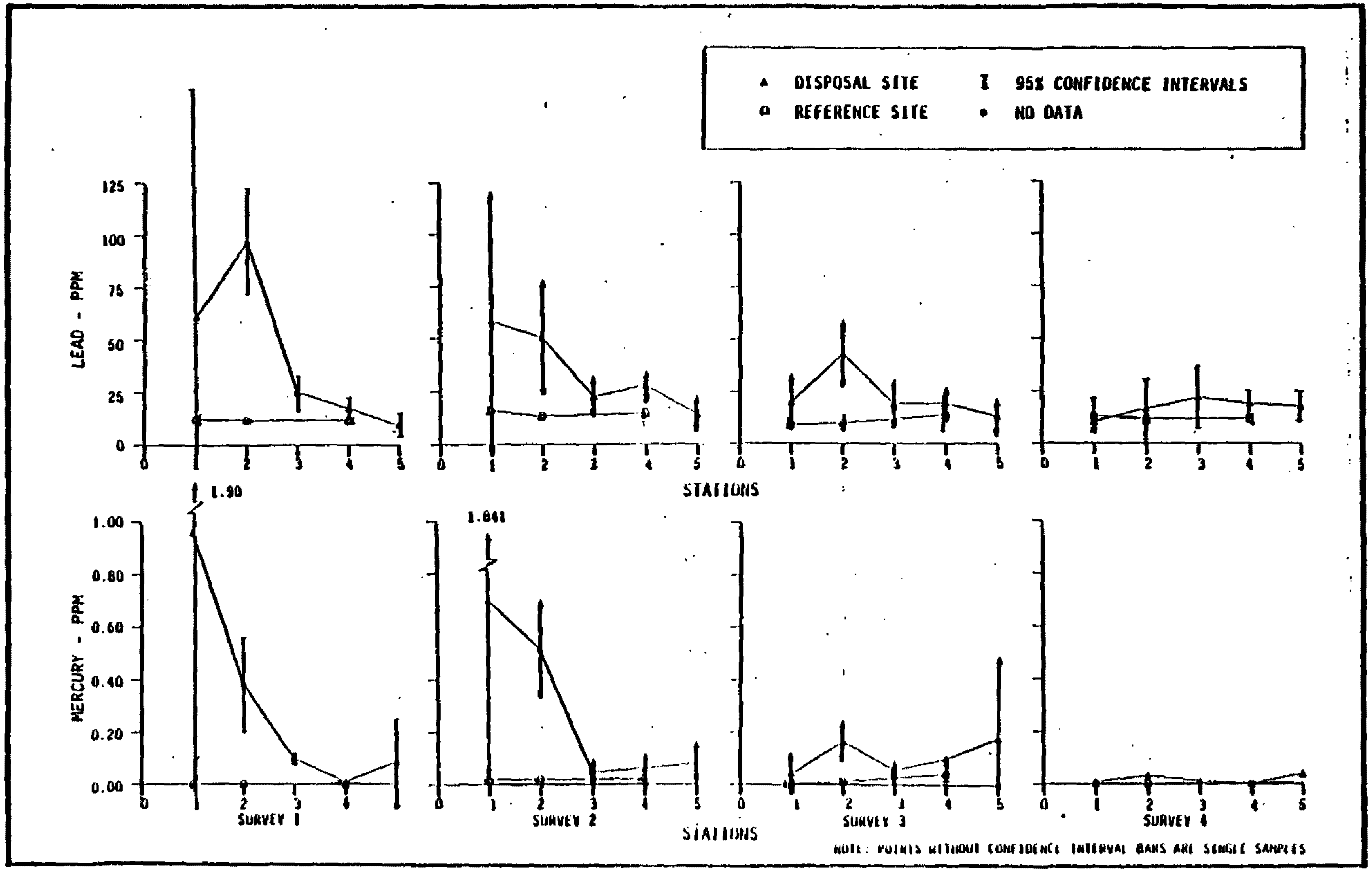


FIGURE A5 (CONTINUED)

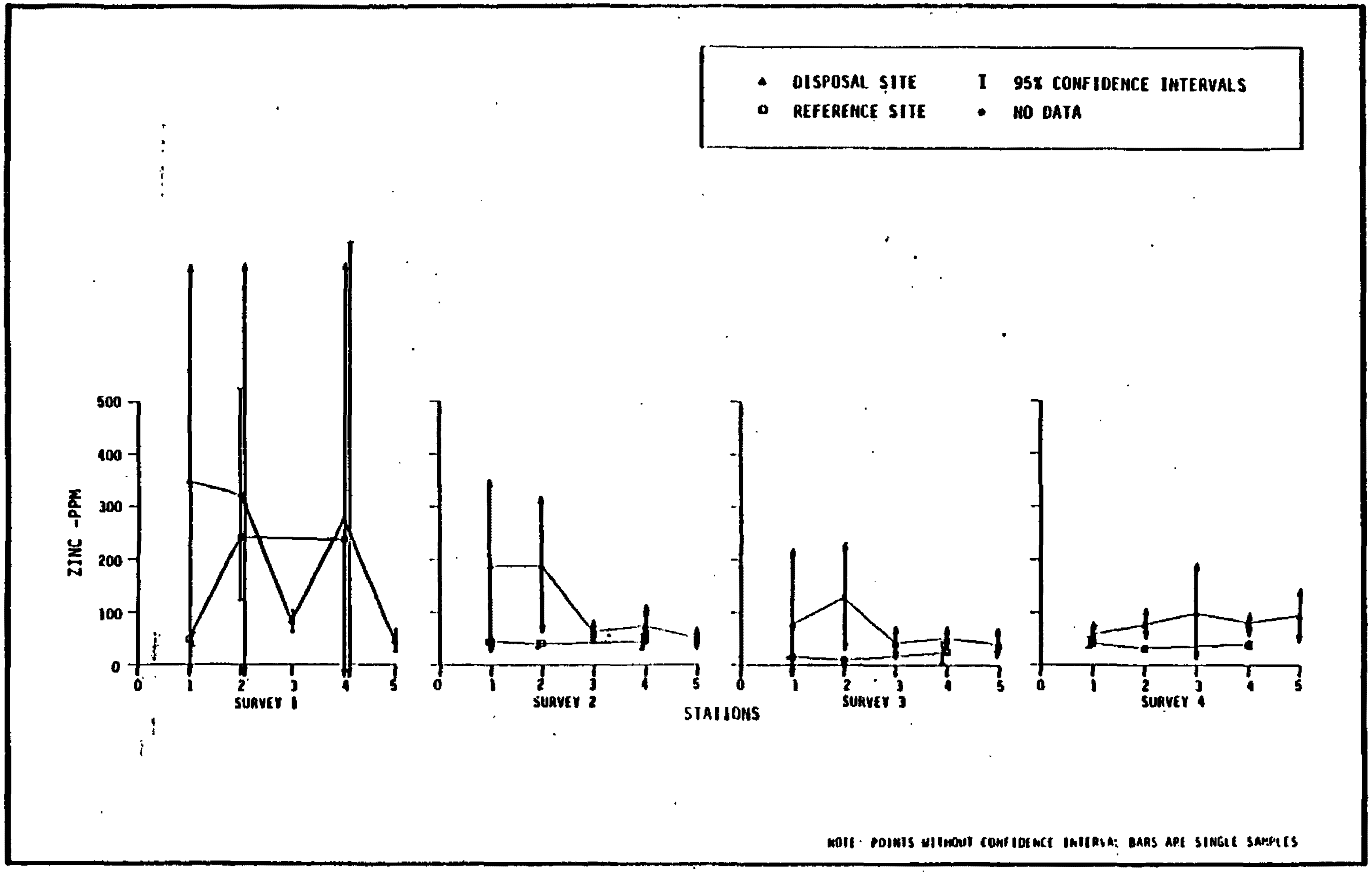


FIGURE A6 (CONTINUED)

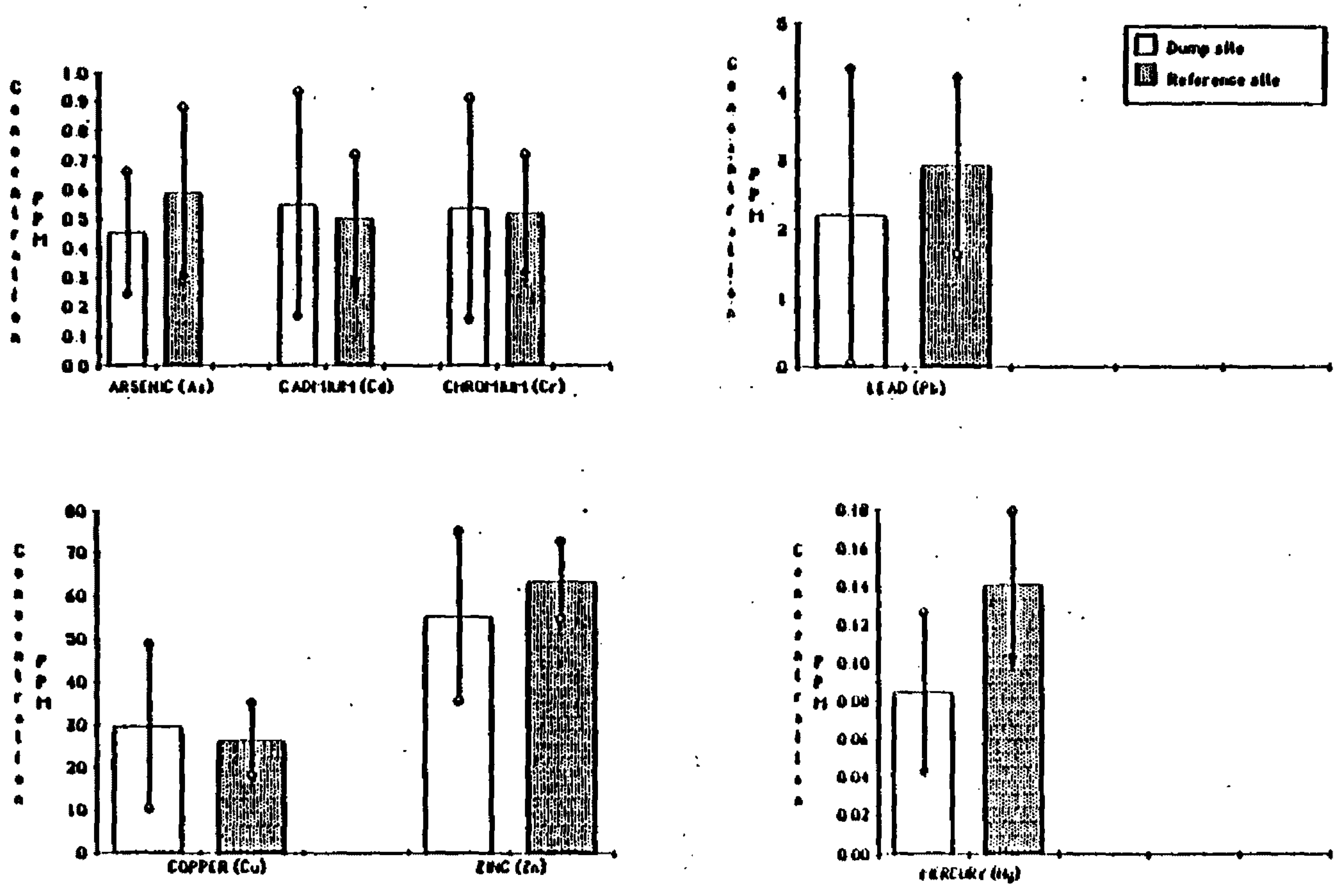


FIGURE A6. MEAN AND 95% CONFIDENCE INTERVALS FOR TISSUE TRACE METAL CONCENTRATIONS (DRY WT). *SICYONIA INGENTIS*. SURVEY 1 LA 5.

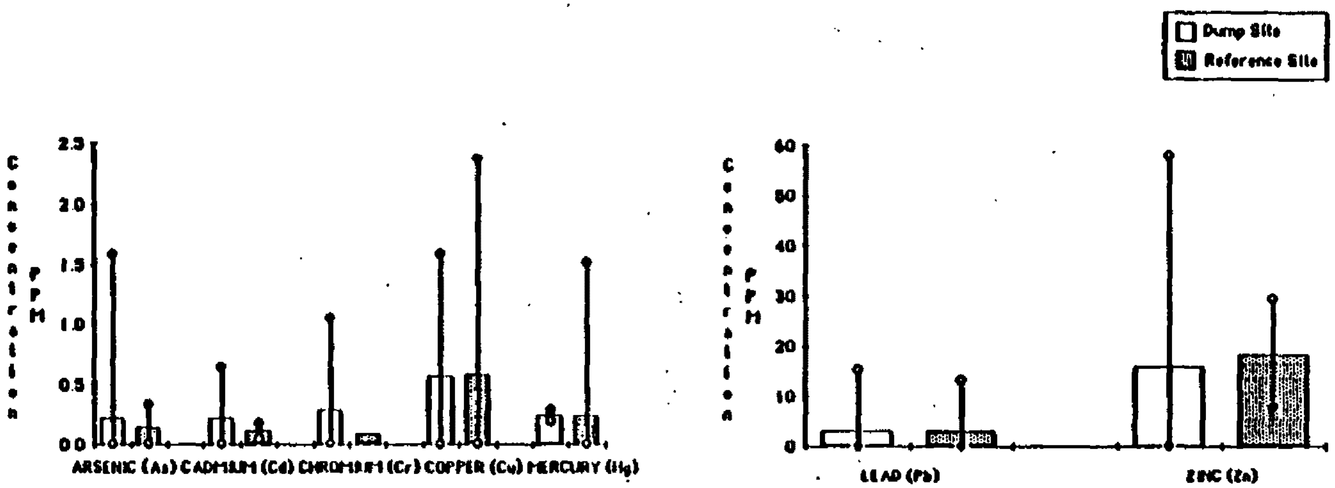


FIGURE A7. MEAN AND 95% CONFIDENCE INTERVALS FOR TISSUE TRACE METAL CONCENTRATIONS (DRY WT). *CITHARICHTHYS SORDIDUS.* SURVEY 2 LA 5.

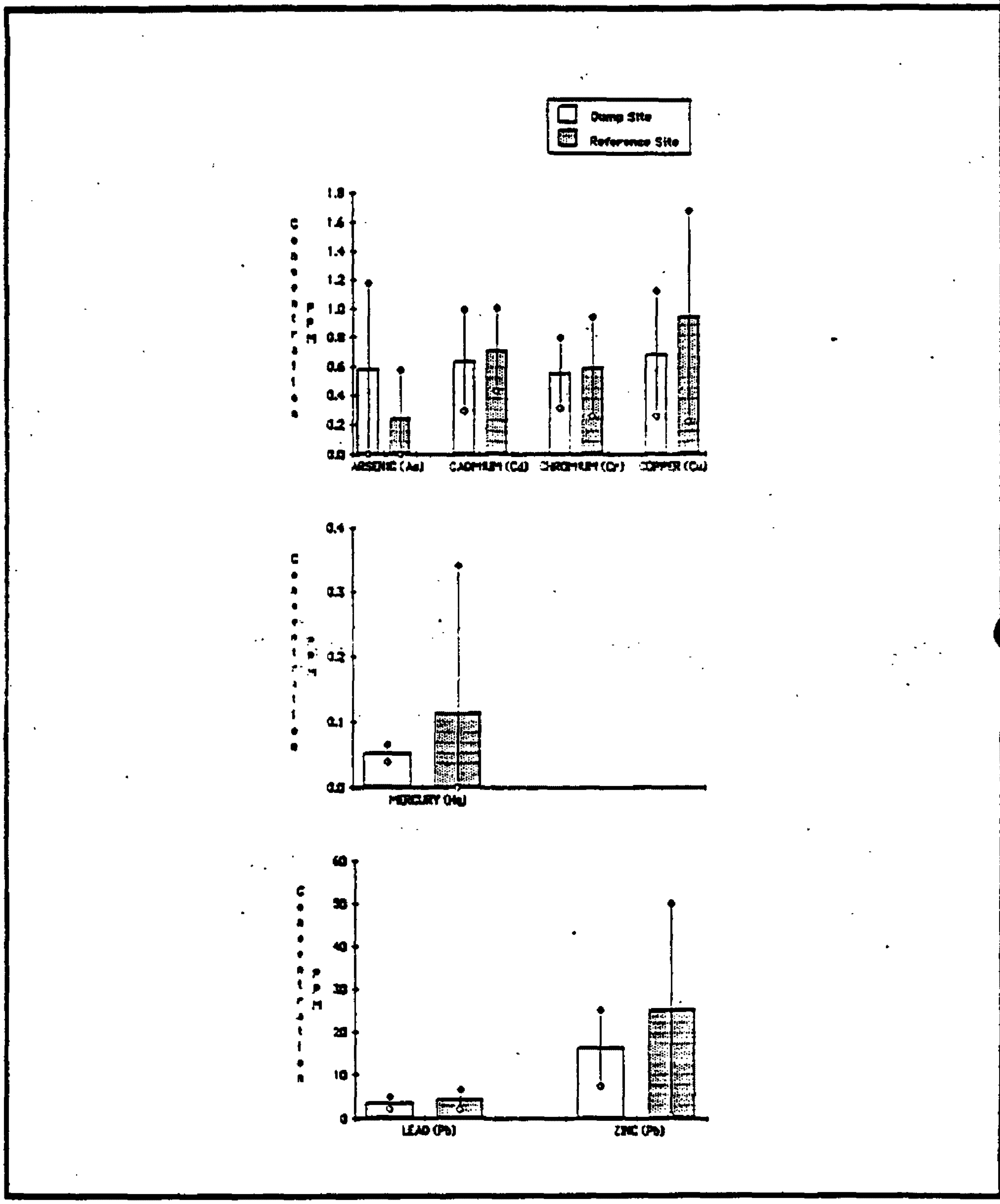


FIGURE A8. MEAN AND 95% CONFIDENCE INTERVALS FOR TISSUE TRACE METAL CONCENTRATIONS (DRY WT). *LYOPSETTA EXILIS.* SURVEY 3 LA 5.

allow complete reanalysis for chlorinated hydrocarbons, PCBs and metals. All tissue metals data are presented in Table B-2. There is no significant difference (α =0.05) in the concentration of any metal in the muscle tissue between disposal and reference sites. The slender sole had higher tissue concentrations of some metals than the Pacific sanddab (Figs. A-7 and A-9, Table B-2). This may be due to dietary or physiological differences between the species.

A.3.2.2 Oil and Grease

A.3.2.2.1 Sediments. Oil and grease analyses were conducted on sediment samples from Surveys 2 through 4. Samples were not collected for analyses during the first survey. Results of these analyses for the disposal site and reference site are plotted in Figure A-9. Mean values of the control sites were compared in a one-way ANOVA test and the values for Survey 2 are significantly different (α =0.05) from Surveys 3 and 4. Therefore, Survey 2 will not be included in the interpretation of the results.

A.3.2.2.2 Oil and grease concentrations at the disposal site are not significantly elevated (α=0.05) over the reference values. The homogeneity among stations (α =0.05) supports the interpretation that elevated levels are not exhibited at the disposal site. The high mean values shown in Figure A-9 for Station 5 from Survey 3, and Station 3 from Survey 4, are the result of single high values that could be explained by sample or analytical variability as well as by spot contamination at the disposal site. Because of the lack of repetition of these values at other stations in the LA5 disposal site the former explanation appears more plausible.

A.3.2.2.3 Water Column. Oil and grease concentrations in the water column are below the detection limit of 0.1 mg/l for all samples. Therefore a comparison of dump and reference site water quality conditions cannot be made.

A.3.2.2.4 Tissues. Oil and grease analyses were not conducted on all tissue samples because of limited sample size. Concentrations were below the detection limit of 1 mg/kg for those samples analyzed, and the data are not included in the tables accompanying this section. Therefore a comparison of dump and reference site tissue oil and grease concentrations cannot be made.

A.3.2.3 Chlorinated Hydrocarbons

A.3.2.3.1 Sediments. Pesticides and PCBs were analyzed at all sediment stations. All pesticides other than DDTs were undetected at a detection limit of 1 ug/kg (dry weight) in all samples. Ranges and median concentrations of selected DDTs and PCBs at the disposal site are compared with the reference site in Table A-10. DDT isomers that are excluded do not exhibit any significant elevation over reference values. Surveys 1 and 2 are not included in Table A-10 because an analytical fraction of the sample extract sometimes containing DDTs and PCBs was not analyzed and added into the totals in Surveys 1 and 2. The procedural error involved the extraction of four different chlorinated hydrocarbon fractions: (1) hexane fraction, (2) 6 percent ether in hexane, (3) 15 percent in hexane and (4) chloroform. Compounds in fractions 1 and 2 do not clearly separate and the chemical technician

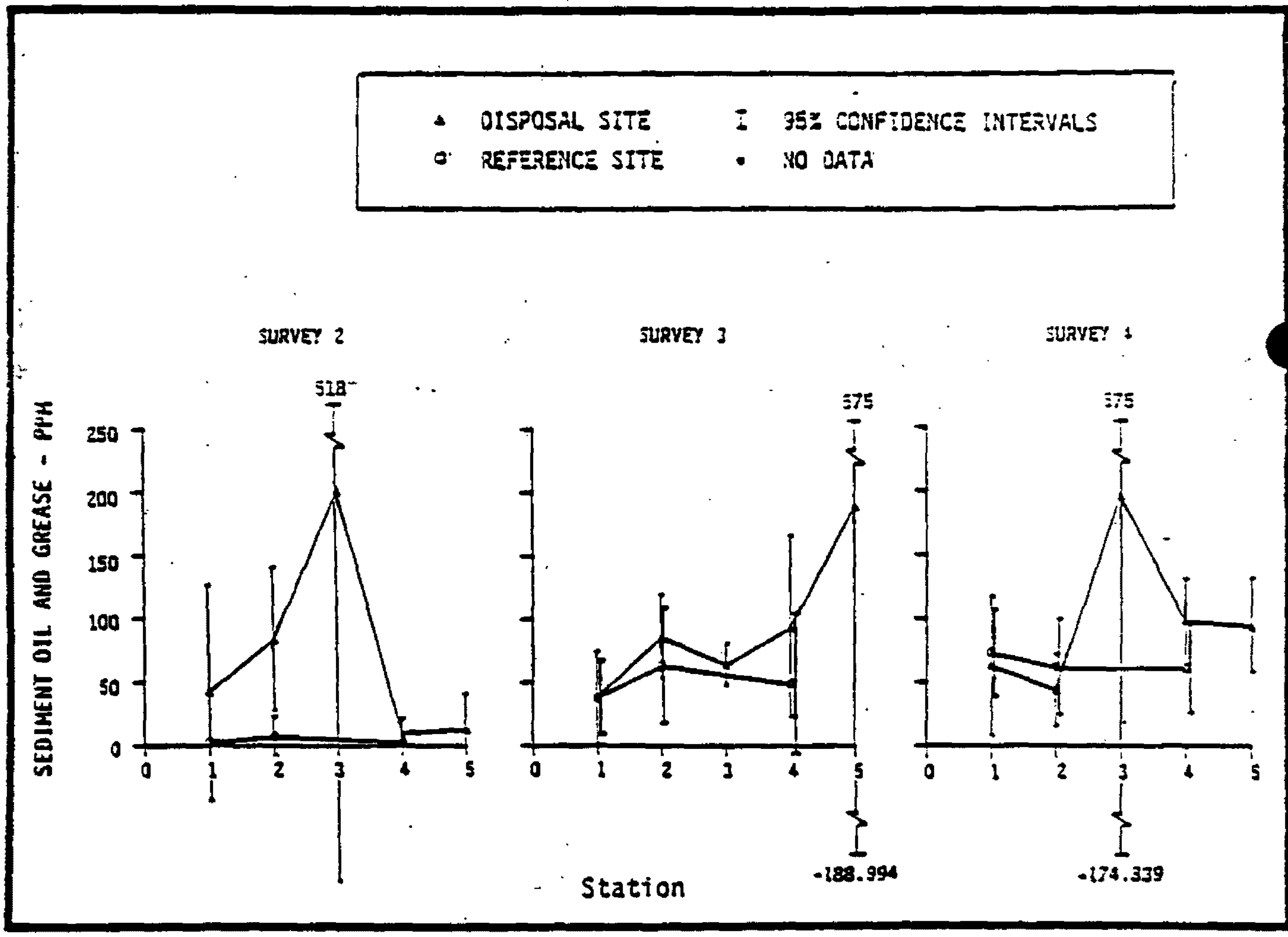


FIGURE A9. MEAN AND 95% CONFIDENCE INTERVALS FOR OIL AND GREASE SEDIMENT CONCENTRATION (DRY WT) AT LA 5 DISPOSAL AND REFERENCE SITES. CONNECTING LINES ARE TO ENHANCE READABILITY AND DO NOT SHOW TRENDS.

TABLE A-10. COMPARISON OF THE RANGE AND MEDIAN OF SELECTED PESTICIDE AND PCB CONCENTRATIONS IN SEDIMENTS[a]

Parameter (ug/kg dry wt)	Site	Survey 3	Survey 4
p,p'-DDE	D	2-13 (2)[b]	2-46 (2)
	Ref	2-5 (4)	2-7 (4)
p,p'-DDD	D	2-13 (2)	2-54 (2)
	Ref	2-7 (2)	2 (2)
p,p'-DDT	D	2-22 (3)	2-75 (2)
	Ref	2 (2)	2 (2)
PCB 1242	D	7-180 (45)	7-300 (14)
	Ref	7-39 (7)	7-33 (7)
PCB 1254	D	13-170 (43)	13-120 (18)
	Ref	13 (13)	13 (13)
PCB 1260	D	34-320 (34)	34-340 (34)
	Ref	34-130 (76)	34 (34)

[a] Data for surveys 1 and 2 are excluded because of analytical procedure differences (see text for discussion).

[b] Median values given in parentheses.

D = Disposal site

Ref = Reference site

misidentified the compounds based on their respective retention time This likely resulted in an underestimation of values for the first two surveys. After the second survey, it was discovered that adding in this additional fraction resulted in a more reliable analysis for these contaminants, and this procedure was followed for Surveys 3 and 4. Limiting the discussion to the data from Surveys 3 and 4 results in a clearer picture of the pattern chlorinated hydrocarbon levels in the study sites. Chlorinated hydrocarbon data from Surveys 1 and 2 are included in Table B-2.

A.3.2.3.2 The disposal site exhibits significantly elevated (α=0.05) levels only of p,p'-DDT in the sediments. High values of p,p'-DDD and p,p'-DDE reported in Survey 4 occurred in a limited number of replicates at a single station. Multiple range tests produced significant elevation (α=0.05) of only p,p'-DDD at Station 1 in Survey 4. No depth trends are exhibited for any isomer.

A.3.2.3.3 Table A-10 also compares PCB levels at the disposal and reference sites. PCB 1260 concentrations are not statistically elevated over reference values at the disposal site based on Survey 3 results. Survey 4 PCB 1260 results are significantly different (α=0.05) between the LA5 disposal site and the reference area, but PCB 1260 was undetected in all reference area samples from Survey 4 resulting in zero variance. This fact, coupled with the considerable variability in PCB 1260 concentrations observed among dump site stations and among replicates at stations, likely accounts for the significant difference found in Survey 4. Based on these results and the comparison of median values presented in Table A-10, there appears to be no justification to conclude that PCB 1260 is statistically elevated at the disposal site relative to reference conditions. There is no depth trend in the distribution of PCB 1260.

A.3.2.3.4 The increased in the ranges and median values of PCB 1242 and 1254 at LA5 dump site over reference levels suggest possible elevation of both Arochlor mixtures at the dump site. However, these data must be interpreted with caution because of the considerable interference observed in the chromatographic region used to quantitate these Arochlors (particulary in the region used for PCB 142). These interferences result from elemental sulfur and from additional coeluting organic residues. No statistical tests were conducted with PCB 1242 or 1254.

A.3.2.3.5 Water Column. All pesticides and PCBs were undetected in the water column at the detection limits stated in Table A-5, so that comparisons cannot be made of the disposal and reference sites water quality conditions.

A.3.2.3.6 Tissues. Interpretation of DDT and PCB results in tissues is limited to the last two surveys for the same reasons as those stated above in the sediments section. The limited amount of tissue resulting in few duplicates per site, combined with the high variability of the results, is expected to result in no significant separation of these parameters from reference levels. A more detailed analysis than was possible under the limitations of this study may be able to determine trends. Table A-11 lists the range of selected pesticides and PCB concentrations in tissues from the disposal and reference sites. Median values were not calculated because of the limited number of samples at each site.

TABLE A-11. COMPARISON OF THE RANGE OF SELECTED PESTICIDE AND PCB CONCENTRATIONS IN TISSUES[a]

Parameter (ug/kg dry wt)	Species	Site	Survey 3	Survey 4
p,p'-DDE	S	D	17-27	14
		Ref	13-14	19-23
	L	D	66-100	27-34
		Ref	72-190	46-70
o,p'-DDT	S	D	3-9	13
		Ref	9-15	9-25
	L	D	57-110	19-33
		Ref	1-50	1-12
p,p'-DDT	S	D	5-15	17
		Ref	4-12	3-8
	L	D	22-44	6-13
		Ref	2-17	2-6
PCB 1242	S	D	12-22	3
		Ref	7-18	3-40
	L	D	3-49	3-72
		Ref	3-17	3
PCB 1254	S	D	130-240	6
		Ref	82-140	6
	L	D	240-450	6-290
		Ref	6-200	6-54

[a] Survey 1 and 2 are excluded because of analytical procedure differences (see text for discussion). PCB 1260 was undetected at 34 ug/kg in all samples.

S = Sicyonia ingentis.

L = Lyopsetta exilis.

D = Disposal site

Ref = Reference site

A.3.2.3.7 There is little or no evidence of a consistent elevation of DDT isomer or PCB tissue concentrations at the disposal site relative to the reference site. Based on the tissue data summarized in Table A-11, there are no readily apparent trends in concentrations. Apparent elevations of pesticides and PCBs vary among surveys, and among samples within each survey. The highest values in individual tissue samples are often, but not always, observed at the disposal site. The significance of these apparent elevations is uncertain because of the small number of samples at the reference site (1 to at most 3 samples per survey).

A.3.2.3.8 Natural variability in the tissue concentrations of chlorinated hydrocarbons may result from (1) exposure to any of the other contaminated areas within the southern California Bight (discussed in the body of the EIS) or (2) feeding habits of individuals (for example a marked preference of sediment-ingesting polychaetes over mysid shrimp) or (3) differential ability of individuals to metabolize contaminants (Jeff Cross, SCCWRP, pers. comm. 30 Sept. 1985). Although standard analytical techniques were used, insufficient data on analytical variability are available to make an appropriate evaluation of the potential natural and analytical variability at these sites.

A.3.2.4 Comparison to Literature Values

A.3.2.4.1 One check on the quality of the data is to compare reference site values with those in the literature. Table A-12 lists metals concentrations for sediments, water column, and tissues at control sites from various studies in the southern California Bight. Metals concentrations in sediments from both reference sites are within the range of literature values. Water column analyses detection limits are all above reported metals concentrations in the literature and it follows that no metals would be detected. Tissue concentrations corrected to wet weight for Lyopsetta (17.1% solids) and Citharichthys (19.0% solids) also compare favorably with published values; both range from the less than, to slightly greater than, the values listed in Table A-12. There are no reported values in the literature for Sicyonia or other panaeid shrimp.

A.3.2.4.2 Information on pesticide and PCB concentrations for control sties in the southern California Bight is scarce. However, the limited published values do compare with reference values in this study. Sediment concentrations of 3 to 70 and 2 to 40 ug/kg for the same DDTs and PCBs, respectively (Young and Gossett, 1980; Word and Mearns, 1979) bracket the median sediment values for those parameters listed in Table A-10. Meaningful values for total PCBs cannot be calculated because PCBs were undetected in many samples and detection limits were relatively high. Ranges of 11 to 101 and 3 to 37 ug/kg wet weight for the sums of DDTs and PCBs, respectively, were calculated for the slender sole (Lyopsetta exilis) tissue concentrations reported in Surveys 3 and 4 based on an average 17.1 percent solid. These ranges are included in the ranges of 6 to 20 and 13 to 43 ug/kg wet weight for the sum of DDTs and PCBs respectively, reported by Sherwood et al. (1980) for the Dover sole (Citharchthys sordidus) at a California Bight control station. Literature data for the slender sole are not available for direct comparison. There are no reported values in the literature for the ridgeback prawn (Sicyonia ingentis). Values for Pacific sanddab are not compared because of questions about the pesticide and PCB from Surveys 1 and 3 (A.3.2.3.1).

TABLE A-12. METALS CONCENTRATIONS AT CONTROL SITES IN THE SOUTHERN CALIFORNIA BIGHT

Source	Metals						
	As	Cd	Cr	Cu	Pb	Hg	Zn
Surface Sediments (ug/g dry wt.)							
Sherwood (1982)	-	-	13-19	8.1-9.4	3-5	-	44-46
Hershalman et. al. (1981)	-	0.26-1.3	24-50	6.4-19	5.2-29	-	32-71
Word & Mearns (1979)	-	0.1-1.4	6.5-43	2.8-31	2.7-12	-	9.8-62
Hershalman et. al. (1977)	-	0.2-0.5	34-62	13-21	6.2-12	0.02-0.05	54-75
Chen & Lu (1974)	-	1.4-2.1	26-60	11-18	20-78	0.04-0.09	32-65
Bruland et. al. (1974)	-	1.0-2.0	90-150	28-35	5-30	-	85-100
Water Column (ug/l)							
DOI (1983)	-	0.0005	-	<0.0034	0.0018	-	0.008
Garrison (1981)	-	0.004	0.1	0.08	0.005	0.001	0.01
Morel et. al. (1975)	-	0.1	0.2	3.0	0.04	0.03	10
Tissues (ug/g wet wt)							
Sherwood (1982) Dover sole	-	-	0.01	0.07	<0.09	-	1.9
Young et. al. (1981	-						
Pacific sanddab	-	-	0.03-0.08	0.09-0.37	<0.24	0.05-0.16	2.7-6.1

A.3.3 BENTHIC FAUNA

All infaunal data collected at the LA 5 interim disposal site and the corresponding reference area are presented in Appendix Tables B-3A, B-3B, B-3C and B-3D. Each table summarizes the data collected in one of the four field surveys. The abundance of individual taxa is presented for each replicate sample. Additionally, calculated summary information such as indices of diversity, the total number of taxa and total number of individuals is presented for each replicate sample and for combined samples within a station. A complete list of taxa identified in all four surveys is presented in Appendix Table B-3E.

A.3.3.1 Data Analysis

The infaunal data were analyzed to provide information on existing biological conditions and to determine the effect of the disposal of dredged material on benthic communities at this interim disposal site. Three sets of analyses were conducted. First, biological community indices such as diversity, number of taxa and number of individuals were compared among sampling stations. Second, numerical classification methods were used to examine the relationship among sampling stations in terms of biological community structure. Third, the correlation between biological and physical-chemical variables was evaluated. The focus of these analyses was on the comparison of spatial differences within the disposal site and between the disposal site and the reference stations. The results of these analyses are provide below.

A.3.3.1.1 Community Indices - Four community indices were calculated for each infaunal sample: Shannon-Weaver Diversity (Shannon and Weaver, 1944), Margalef's Species Richness (Margalef, 1957), the total number of taxa and the total number of individuals. Shannon-Weaver Diversity (H') and Species Richness (D) were calculated as:

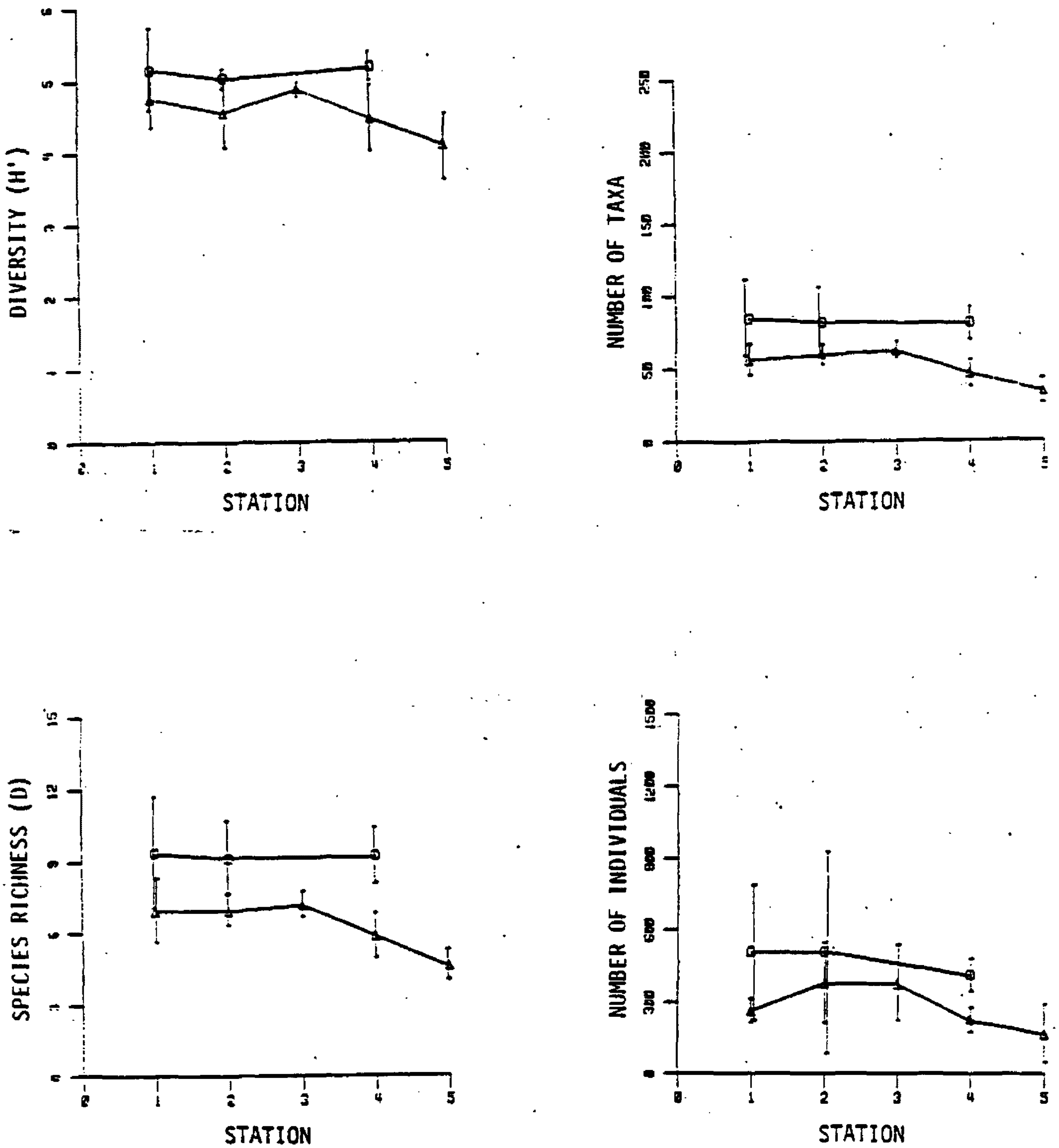
$$H' = -\sum \frac{n_i}{N} \log \frac{n_i}{N}$$

$$D = \frac{S-1}{\ln N}$$

where:

S = number of taxa
N = number of individuals
n_i = number of individuals in the i^{th} taxon

A.3.3.1.2 The mean value of these indices, calculated for each sampling station, is plotted by survey in Figures A-10 - A-13. The mean values and 95 percent confidence intervals for each station were calculated from four replicate samples. These graphical summaries provide a useful means for making comparisons of the selected biological variables among collection areas (disposal site versus reference site) and between stations. For example,



□ Reference Site Station
△ Disposal Site Station

FIGURE A10. MEAN VALUES AND 95% CONFIDENCE INTERVALS FOR INFAUNAL COMMUNITY INDICES. SURVEY 1. CONNECTING LINES ARE TO ENHANCE READABILITY AND DO NOT INDICATE TRENDS.

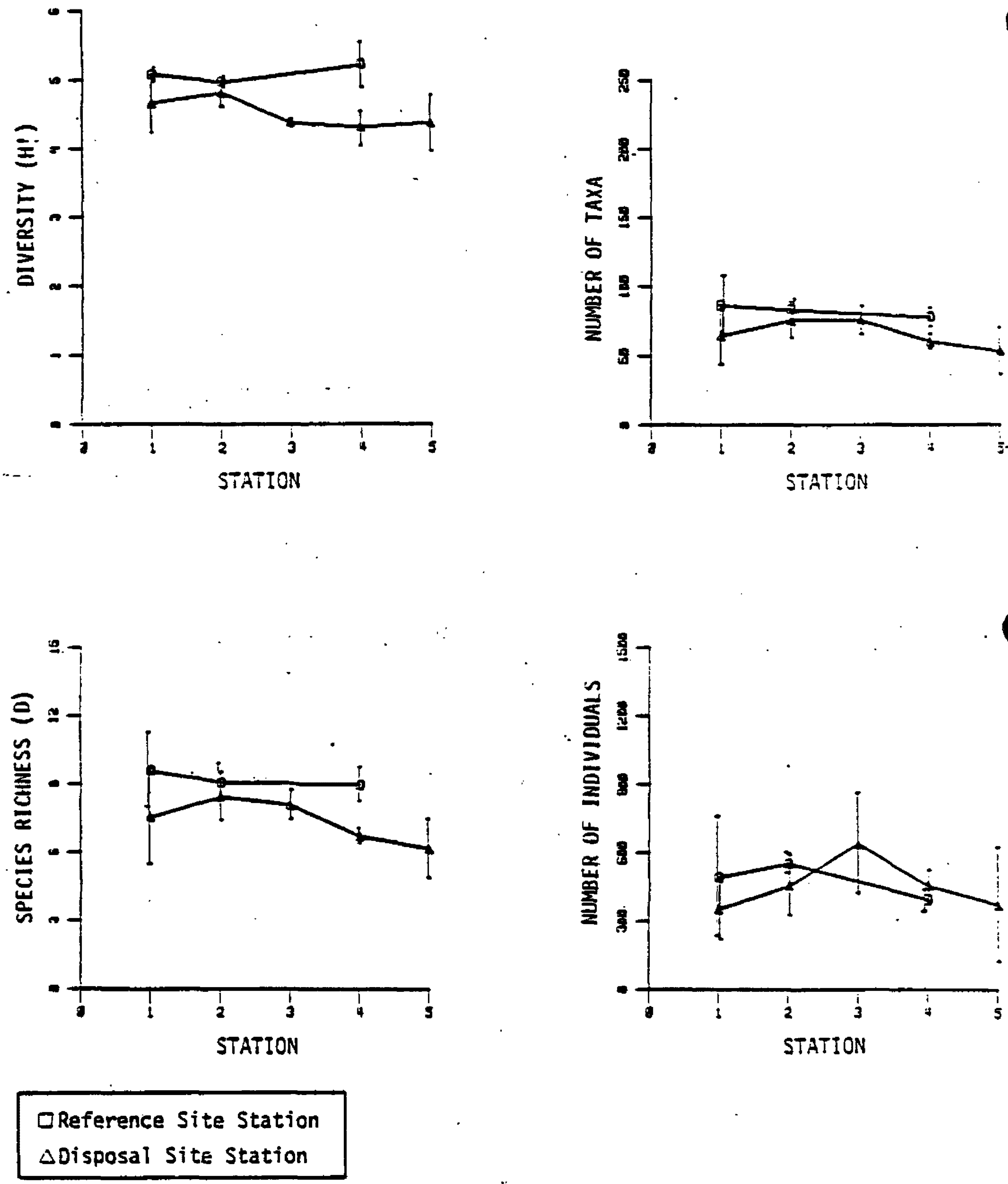


FIGURE A11. MEAN VALUES AND 95% CONFIDENCE INTERVALS AT EACH SAMPLING STATION FOR INFAUNAL COMMUNITY INDICES. SURVEY 2. CONNECTING LINES ARE TO ENHANCE READABILITY AND DO NOT INDICATE TRENDS.

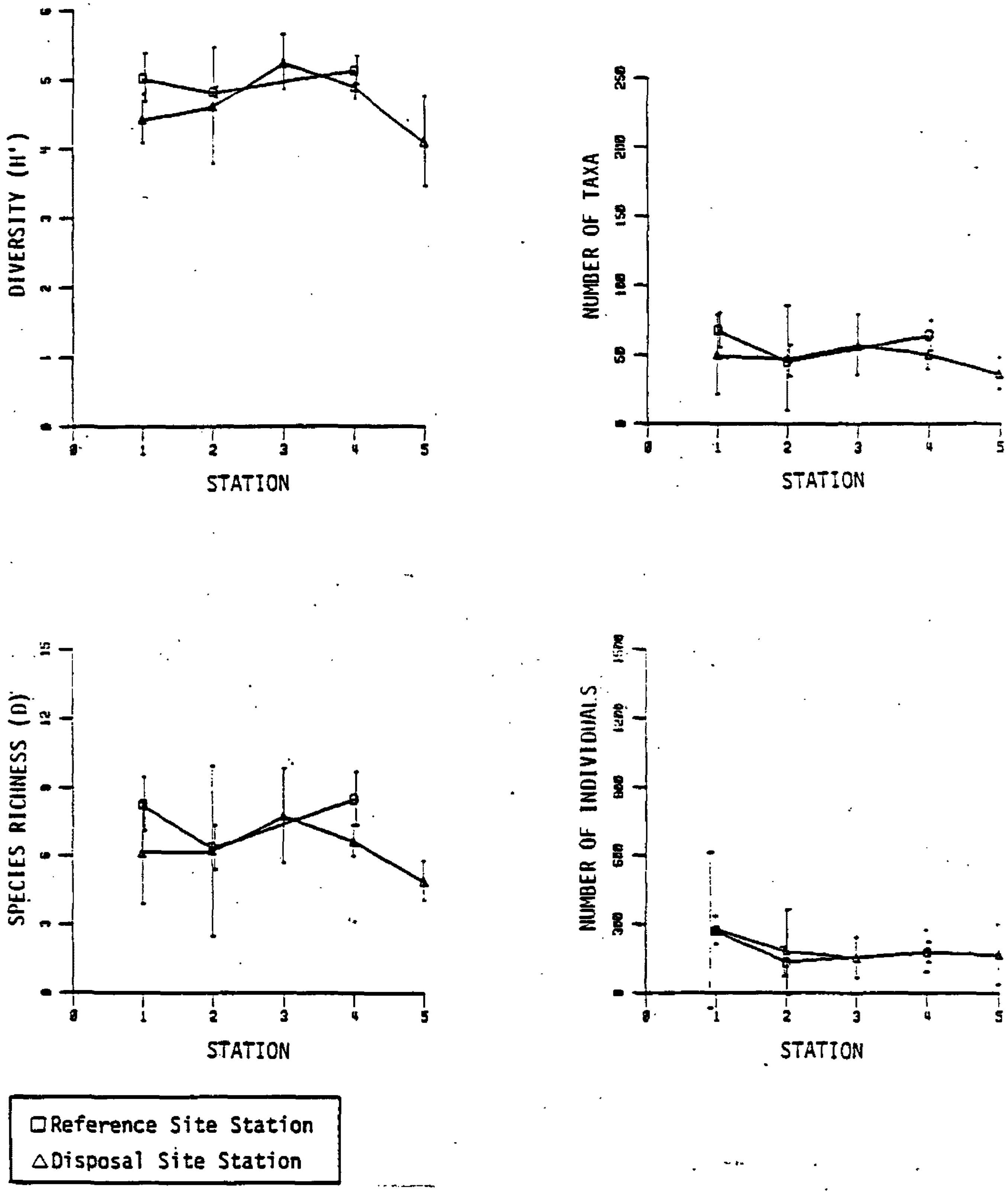


FIGURE A12. MEAN VALUES AND 95% CONFIDENCE INTERVALS AT EACH SAMPLING STATION FOR INFAUNAL COMMUNITY INDICES. SURVEY 3. CONNECTING LINES ARE TO ENHANCE READABILITY AND DO NOT INDICATE TRENDS.

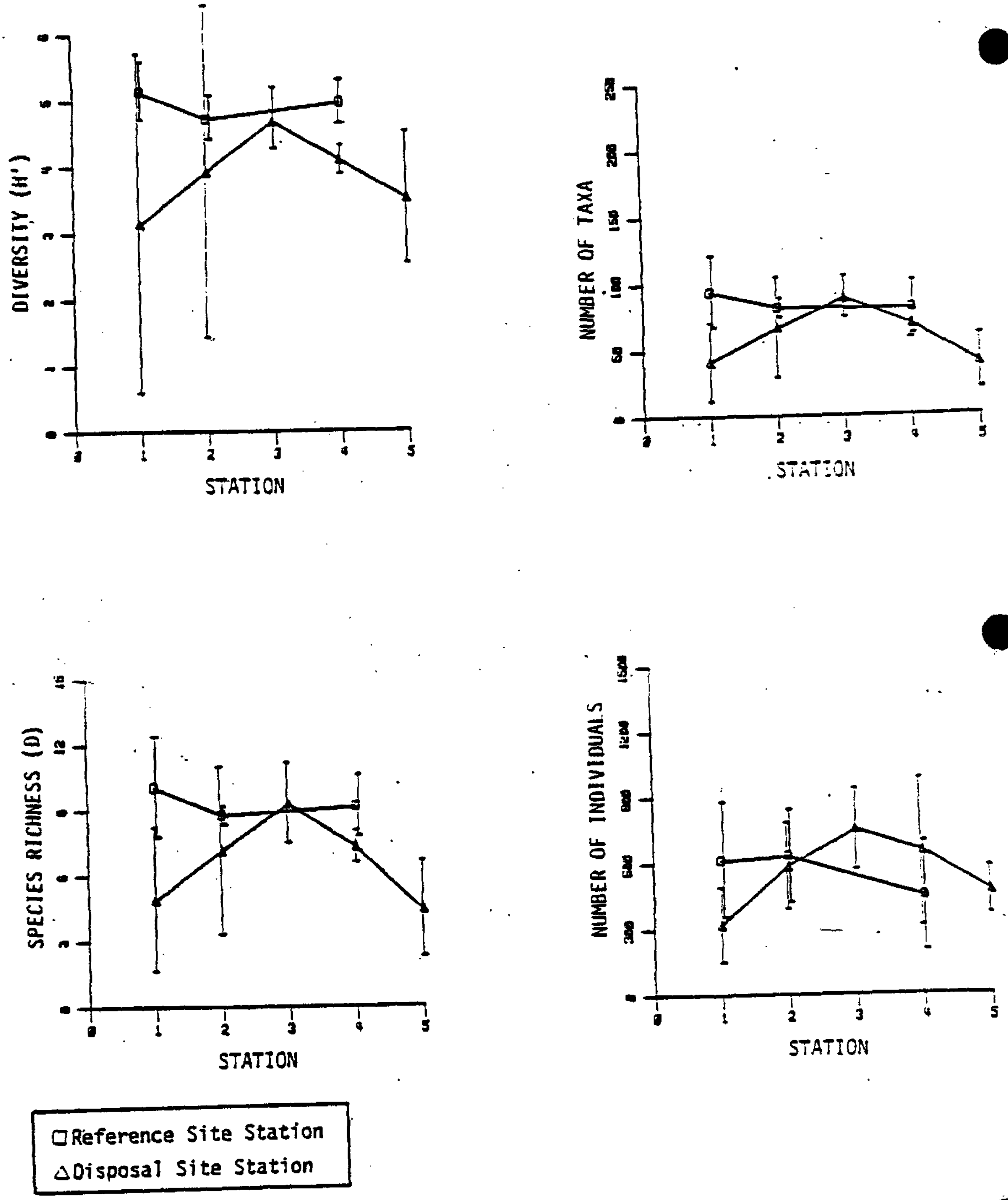


FIGURE A13. MEAN VALUES AT EACH SAMPLING STATION FOR INFAUNAL COMMUNITY INDICES. SURVEY 4. CONNECTING LINES ARE TO ENHANCE READABILITY AND DO NOT INDICATE TRENDS.

Stations 1, 2 and 4 are located at different depths, but each station is at the same approximate depth at both the disposal and reference sites (see Fig. A-1).

A.3.3.1.3 As indicated in Figures A-10 - A-13, the mean values for all four biological variables at reference-site Stations 1, 2 and 4 were greater than or equal to the reported values at the corresponding disposal site stations in all but two cases. These differences were not pronounced in the first two surveys. For example, the mean number of taxa at the reference site in Survey 1 was approximately 50 percent greater than report values at the disposal site (Fig. A-10).

A.3.3.1.4 Examination of these plots also indicates consistent differences in the mean values of all variables between Stations 1, 3 and 5 within the disposal site. These stations are all located on the bathymetric centerline of the site (Fig. A-1) at a depth of approximately 170 m. Reported values for all variables were always lowest at Station 5 which is located at the northern edge of the site, and in all but one survey the maximum values were observed at the southern edge of the site (Fig. A-1). Thus, an increasing gradient in species richness, number of taxa and number of individuals was observed along the north-south centerline of the disposal site.

A.3.3.1.5 Observed differences in the four community indices were tested for statistical significance. The results of two sets of analyses are described below. First, the observed differences in community indices between Stations 1, 3 and 5 within the disposal site were tested with the one-way ANOVA. Second, a two-way ANOVA was used to test simultaneously for differences due to depth within sites and for differences in the mean value of community indices between the reference and disposal sites. The results of these analyses are summarized in Table A-13.

A.3.3.1.6 The results of the one-way ANOVAs presented in Table A-13 indicate the statistical significance of observed differences in the values of all four community variables at Stations 1, 3 and 5 within the disposal site area. Observed differences in both number of taxa and number of individuals were statistically significant in all but one survey, and species diversity among the three stations was significantly different in two of the four surveys.

A.3.3.1.7 In those cses in which a significant ANOVA test result was obtained, on a posteriori multiple-range test was performed to identify where differences were located among the group means. The results of these tests for differences in the mean number of taxa and number of individuals among disposal Stations 1, 3 and 5 are presented in Table A-14. As indicated in this table, the mean number of taxa at Station 3 was significantly higher than at Station 5 in each of the three surveys compared. The number of taxa at Station 1 was always intermediate between Stations 1 and 5, and the mean value at this station formed a significant subset with one of these stations or both. Similar results were obtained for the comparison of mean values for number of individuals among the three stations (Table A-14). The abundance of organisms was always greatest at Station 3, and the differences between the Stations 5 and 3 were always statistically significant.

TABLE A-13. RESULTS OF ANOVA TESTS FOR DIFFERENCES IN THE MEAN VALUE OF BIOLOGICAL-COMMUNITY VARIABLES

SURVEY	VARIABLE	ONE-WAY ANOVA (Location within Dumpsite)	TWO-WAY ANOVA (Source of Variation)		
			Depth	Type	Depth x Type
1	Diversity (H')	*[1]	n.s.	*	n.s.
	Species Richness (D)	*	n.s.	*	n.s.
	No. of Taxa	*	n.s.	*	n.s.
	No. of Individuals	*	n.s.	*	n.s.
2	Diversity (H')	n.s.[2]	n.s.	*	n.s.
	Species Richness (D)	*	n.s.	*	n.s.
	No. of Taxa	*	n.s.	*	n.s.
	No. of Individuals	*	n.s.	n.s.	n.s.
3	Diversity (H')	*	n.s.	*	n.s.
	Species Richness (D)	*	n.s.	*	n.s.
	No. of Taxa	n.s.	n.s.	*	n.s.
	No. of Individuals	n.s.	n.s.	n.s.	n.s.
4	Diversity (H')	n.s.	n.s.	*	n.s.
	Species Richness (D)	*	n.s.	*	n.s.
	No. of Taxa	*	n.s.	*	*
	No. of Individuals	*	n.s.	n.s.	*

1 Statistical test results significant at $p = 0.05$
2 Statistical test results not significant at $p = 0.05$

TABLE A-14. ONE-WAY ANOVA RESULTS FOR COMPARISON OF THE MEAN NUMBER OF TAXA AND NUMBER OF INDIVIDUALS AMONG DISPOSAL SITE STATIONS 1, 3 AND 5. Values enclosed in the same symbol (circle or square) are not significantly different by a multiple-range test.

Survey	Mean Number of Taxa/0.1 m^2 Station 5	1	3
1	34.0	56.7	62.2
2	53.5	65.0	76.2
4	39.7	41.75	89.2

Survey	Mean Number of Individuals/0.1 m^2 Station 5	1	3
1	164.7	262.7	375.5
2	354.2	373.0	638.2
4	320	469.2	752.5

A.3.3.1.8 The results of two-way ANOVA tests for differences in the community indices due to depth and type of station (reference of disposal site) are presented in Table A-13. These results reflect the differences observed in the plots of these data (figs. A-10 - A-13). Mean values of these variables did not differ significantly over the range of sampling depth (140 to 190 M), but the values of three of these variables (Diversity, Species Richness and Number of Taxa) showed significant differences associated with sampling location. The values of these three community indices at the reference site were significantly higher than the reported values at the disposal site sampling locations. In general, there was a lack of evidence for depth X sample-type interaction, and it appears as if the effects of sampling location (reference or disposal site) are not influenced by sample depth.

A.3.3.1.9 An example of the observed effects of sampling location indicated in the two-way ANOVA is presented in Table A-15. The mean number of taxa per replicate sample at Stations 1, 2 and 4 within the reference site is compared with the mean value observed at the corresponding stations within the disposal area. The mean number of taxa at the reference site was on the average approximately 38 percent greater than the number of taxa observed at the stations within the disposal site.

A.3.3.1.10 As shown in Table A-13, significant differences between the reference and disposal sites for the number of individuals per replicate sample were observed only in Survey 1. The mean values for this variable which were compared in the two-way ANOVAs are presented in Table A-16. Large differences were observed between the reference and disposal sites in the first survey. However, in the remaining surveys the difference in the mean number of individuals between the reference and disposal sites was reduced and for five of the samples the values recorded at the disposal site exceeded those at the corresponding reference location.

A.3.3.1.11 Numerical Classification - Numerical classification methods (described in Section A.2.4) were used to define groups of sampling stations (entities) based on similarities in the abundance of infaunal organisms (attributes). These analyses were conducted for each survey with replicate samples combined at each station.

A.3.3.1.12 The results of the numerical classifications conducted for each survey with sampling stations as entities are presented in Figure A-14. For each survey, the similarity in infaunal species composition among eight stations (five disposal-site and three reference-site stations) is depicted in dendrograms. For each survey, these stations can be partitioned into three groups. These group selections were made by drawing a line across the dendrogram at a selected level of similarity and defining as a station-group each branch of the dendrogram crossing that level of similarity (Fig. A-14). Using this criterion, the same three groups of stations, designated A, B and C, were identified in each survey. Group A consisted of the three stations located within the reference site. Group B consisted of disposal-site Stations 3 and 4, and the third group (Group C) consisted of Stations 1, 2 and 5 within the disposal site. The location of each of these eight stations are depicted in Figure A-1.

TABLE A-15. COMPARISON OF THE MEAN NUMBER OF TAXA PER REPLICATE SAMPLE AT THE REFERENCE- AND DISPOSAL-SITE SAMPLING LOCATIONS

SURVEY	STATION	MEAN NUMBER OF TAXA/0.1m^2 REFERENCE SITE	DISPOSAL SITE
1	1	84.75 (57.61-111.89)*	56.75 (46.74-66.76)
	2	82.25 (58.93-105.57)	60.25 (53.58-66.92)
	4	81.00 (69.31-92.69)	46.75 (37.62-55.88)
2	1	86.75 (65.24-108.26)	65.00 (44.09-85.91)
	2	83.75 (76.59-90.91)	75.75 (62.93-88.57)
	4	78.50 (71.45-85.55)	60.50 (56.71-64.29)
3	1	67.75 (55.61-79.89)	50.25 (21.69-78.81)
	2	45.75 (34.93-56.57)	47.75 (10.46-85.04)
	4	64.50 (53.74-75.26)	50.75 (40.25-61.25)
4	1	93.50 (67.31-119.69)	41.75 (11.52-71.98)
	2	82.25 (74.85-89.65)	67.00 (29.39-104.61)
	4	81.00 (61.18-100.82)	68.75 (57.85-79.65)

*95% Confidence Interval

TABLE A-16. COMPARISON OF THE MEAN NUMBER OF INDIVIDUAL ORGANISMS PER REPLICATE SAMPLE AT THE REFERENCE- AND DISPOSAL-SITE SAMPLING STATIONS

SURVEY	STATION	MEAN NUMBER OF INDIVIDUALS/$0.1m^2$ REFERENCE SITE	DISPOSAL SITE
1	1	505.75 (226.75-784.75)*	262.75 (215.18-310.32)
	2	509.25 (91.10-927.40)	379.75 (214.95-544.55)
	4	411.25 (342.14-480.36)	225.75 (172.61-278.89)
2	1	492.75 (233.32-752.18)	354.25 (219.94-488.56)
	2	553.25 (509.37-597.13)	456.25 (322.32-590.18)
	4	394.75 (346.73-442.77)	456.75 (386.44-527.06)
3	1	271.50 (208.21-334.79)	277.75 (-63.60-619.10)
	2	133.25 (73.06-193.44)	181.75 (-3.41-366.91)
	4	177.75 (133.47-222.03)	180.50 (87.73-273.27)
4	1	605.00 (349.33-860.67)	320.00 (149.76-490.24)
	2	631.25 (420.54-841.96)	585.00 (386.55-783.45)
	4	446.25 (200.87-691.63)	648.25 (313.42-983.08)

*95% Confidence Interval

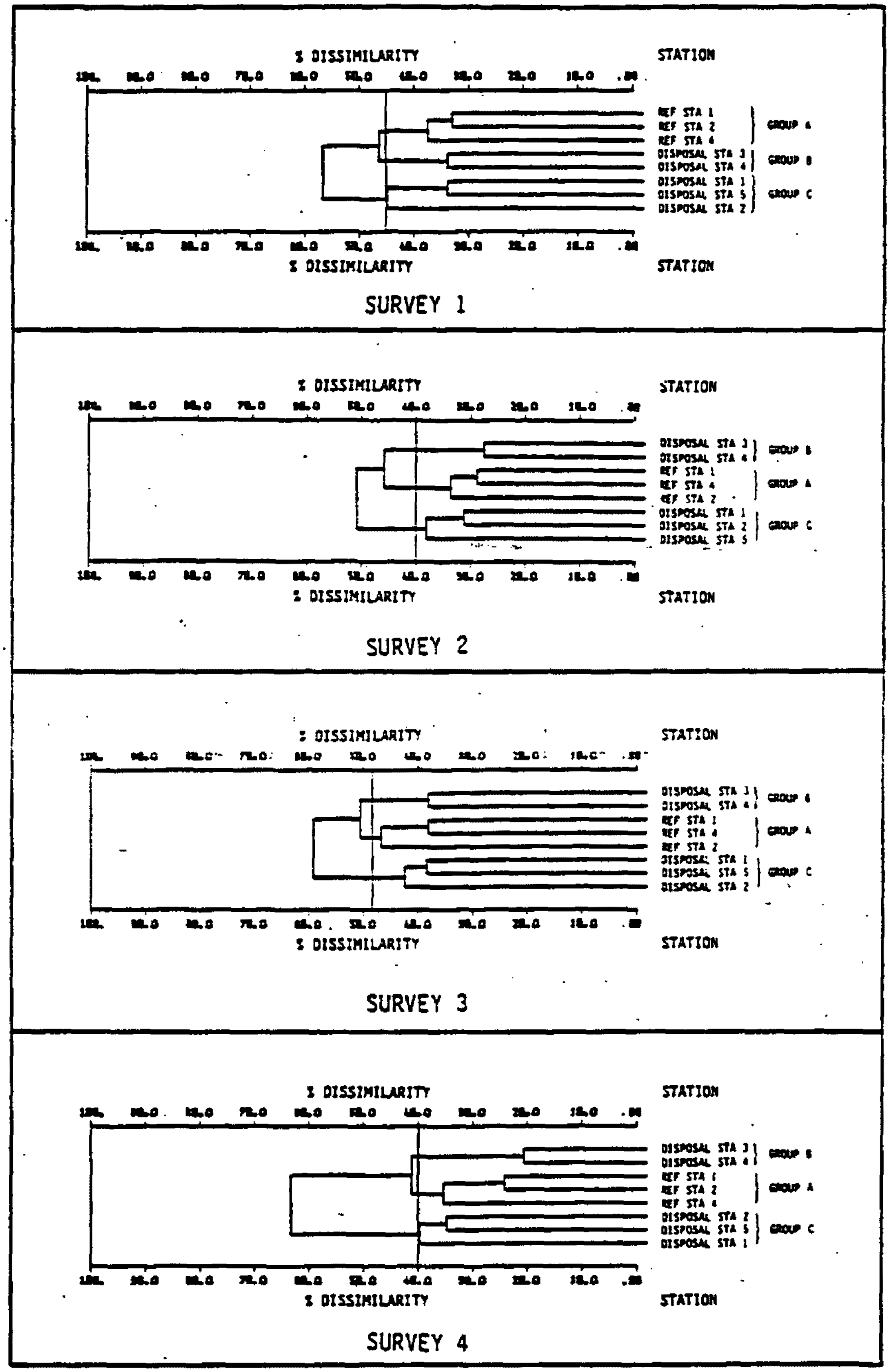


FIGURE A14. NUMERICAL CLASSIFICATION RESULTS. DENDROGRAMS DEPICT THE SIMILARITY IN INFAUNAL COMMUNITY STRUCTURE AMONG EIGHT STATIONS.

A.3.3.1.13 These numerical classification results indicate the existence of consistent differences between reference and disposal-site benthic infaunal communities. These results also point to differences in infaunal community structure between Stations 3 and 4 (Group B) and Stations 1, 2 and 5 (Group C) within the disposal site. In an effort to account for these differences, values of the previously defined community indices as well as the physical (i.e., sediment) characteristics of the habitats within each of the three defined groups were compared. The data from Survey 1 were also used in an inverse numerical classification analysis, i.e., with individual taxa as entities and the abundance at stations as attributes. Nodal analyses were then used with these data to describe differences among groups of stations on the basis of the occurrence and abundanace of members of the defined groups of taxa.

A.3.3.1.14 Consistent differences in the values of computed community indices (see A.3.3.1) were evidence among station Groups A, B and C (Fig. A-14). In Table A-17, the mean values of Shannon-Weave Diversity, Number of Taxa and Number of Individuals are presented by individual stations within these three groups. Additionally, the rank of these stations based on the computed values are shown for each survey. In most surveys, the largest values for each infaunal community index usually occurred in station Group A. In half the survey-index rankings presented in Table A-17, the stations within the reference site were ranked 1, 2 and 3. Additionally, large values for these variables were consistently observed at Stations 3 and 4 within the disposal site (Group B). These two stations also showed close associations with the reference stations in the numerical classifications (Fig. A-14). The lowest values for these computed indices were almost always found in Group C consisting of Stations 1, 2 and 5 within the disposal site. In particular, the lowest values for number of taxa, number of individuals and diversity were most frequently found at Station 5 within Group C.

A.3.3.1.15 The sediment grain size characteristics at the sampling stations (Fig. A-1) are presented in Tables A-18 - A-25. Similarities were observed between disposal- and reference-site sediment characteristics based on the percentage of material in the gravel, sand, silt and clay components. Generally, sediments at all stations exhibited large proportions of both sand and silt. However, based on the sediment grain size distribution in one-unit phi intervals over the range -1 to +13 (Tables A-22 - A-25), distinct differences were observed between reference-site ad disposal-site stations. Characteristically, the reference-site sediments were composed primarily of very fine sand to coarse silt (phi intervals 2-5). The larger sediments (phi intervals greater than 2) represented less than 2 percent of the total in all but four reference-site samples. Likewise, a consistent pattern was observed in the small contribution of very fine sediments to the total. At the disposal-site stations, sediments were generally well distributed over the different phi interals, and both the coarse and fine sediment intervals were well represented at all stations. Differences in the distribution of sediments, however, were also observed among the disposal site stations. Stations 3 and 4 consisted primarily of coarse silt and exhibited a greater similarity to the reference-site stations than to disposal-site stations 1, 2 and 5, which consisted primarily of medium to fine sand.

TABLE A-17. MEAN VALUES OF NUMBER OF TAXA, NUMBER OF INDIVIDUALS AND SHANNON-WEINER DIVERSITY FOR INDIVIDUAL REPLICATE SAMPLES (0.1 M^2)

Survey	Group[1]	A			B		C		
	Station[2]	R1	R2	R4	D3	D4	D1	D2	D5
					Number of Taxa (rank[3])				
1		84.7 (1)	82.2 (2)	81.0 (3)	62.5 (4)	46.7 (7)	56.7 (6)	60.2 (5)	34.0 (8)
2		86.7 (1)	83.7 (2)	78.5 (3)	76.2 (4)	60.5 (7)	65.0 (6)	75.7 (5)	53.5 (8)
3		67.7 (1)	45.7 (7)	64.5 (2)	57.5 (3)	50.7 (4)	50.2 (5)	47.7 (6)	36.7 (8)
4		93.5 (1)	82.5 (3)	81.0 (4)	89.2 (2)	68.7 (5)	41.7 (7)	67.0 (6)	39.1 (8)
					Number of Individuals (rank)				
1		505.7 (2)	509.2 (1)	411.2 (3)	375.5 (5)	225.7 (7)	262.7 (6)	379.7 (4)	164.7 (8)
2		492.7 (3)	553.2 (2)	394.7 (6)	638.2 (1)	456.7 (4)	354.2 (8)	456.2 (5)	373.0 (7)
3		271.5 (2)	133.2 (8)	177.7 (5)	155.5 (7)	180.5 (4)	277.7 (1)	181.7 (3)	166.7 (6)
4		605.0 (4)	631.2 (3)	446.2 (7)	752.5 (1)	648.2 (2)	320.0 (8)	585.0 (5)	469.0 (6)
					Diversity (rank)				
1		5.16 (1)	5.04 (2)	5.19 (3)	4.89 (4)	4.48 (7)	4.76 (5)	4.57 (6)	4.10 (8)
2		5.08 (2)	4.97 (3)	5.23 (1)	4.39 (6)	4.31 (8)	4.66 (5)	4.81 (4)	4.38 (7)
3		5.02 (3)	4.81 (5)	5.13 (2)	5.24 (1)	4.90 (4)	4.44 (7)	4.61 (6)	4.10 (8)
4		5.13 (1)	4.73 (3)	4.95 (2)	4.68 (4)	4.08 (5)	3.14 (8)	3.93 (6)	3.49 (7)

[1]Station groups defined on the basis of numerical classification results (Figure A-14).

[2]Station designation: R = Reference site; D = Disposal site.

[3]Stations are ranked within each survey on the basis of computed values of the indicated community index.

TABLE A-18. SUMMARY OF SEDIMENT GRAIN-SIZE ANALYSIS. SURVEY 1

TYPE STATION	STATION	REPLICATE	SAMPLING DEPTH (M)	MEAN GRAIN SIZE	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT	PERCENT CLAY
DISPOSAL								
	1	1	149	3.74	0.00	73.54	17.73	7.56
	1	2	170	3.10	0.00	76.48	16.86	5.71
	1	3	170	2.29	25.23	41.52	23.31	8.77
	1	4	170	3.87	0.47	70.09	16.78	10.70
	2	1	138	3.28	0.33	75.62	15.76	7.16
	2	2	139	4.11	0.00	68.83	17.97	11.49
	2	3	138	4.41	0.23	48.10	40.23	11.21
	2	4	138	4.78	0.53	56.78	23.48	16.30
	3	1	170	5.00	0.00	36.52	53.33	8.76
	3	2	170	5.14	0.00	43.83	40.84	13.47
	3	3	171	4.49	0.00	30.72	64.43	4.68
	3	4	170	4.67	0.00	41.67	48.58	9.52
	4	1	185	5.10	0.00	20.64	70.59	7.54
	4	2	187	4.99	0.00	21.20	72.71	5.31
	4	3	187	6.22	0.00	11.63	67.89	17.48
	4	4	186	5.79	0.00	12.21	73.41	12.44
	5	1	170	2.17	3.27	82.53	11.81	2.65
	5	2	148	2.89	2.33	74.88	18.79	3.87
	5	3	170	2.91	6.98	67.50	17.52	6.80
	5	4	170	2.95	2.82	72.82	20.25	4.26
REFERENCE								
	1	1	169	3.94	0.00	56.65	40.36	2.95
	1	2	170	4.37	0.00	45.79	50.24	3.85
	1	3	174	4.32	0.00	56.02	38.68	4.50
	1	4	169	4.94	0.00	31.68	60.27	7.48
	2	1	136	4.21	0.00	49.86	46.62	3.46
	2	2	133	4.28	0.00	47.37	49.41	3.18
	2	3	137	4.32	0.00	46.02	50.23	3.68
	2	4	136	3.94	0.00	54.37	44.24	1.36
	4	1	187	3.93	0.00	63.09	32.62	4.16
	4	2	186	3.73	0.00	66.57	30.49	2.91
	4	3	186	3.70	0.00	67.04	28.54	4.30
	4	4	187	3.70	0.00	65.95	31.53	2.51

TABLE A-19. SUMMARY OF SEDIMENT GRAIN-SIZE ANALYSIS. SURVEY 2

TYPE STATION	STATION	REPLICATE	SAMPLING DEPTH (M)	MEAN GRAIN SIZE	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT	PERCENT CLAY
DISPOSAL								
	1	1	169	5.74	0.00	40.66	30.74	24.88
	1	2	170	4.17	2.66	66.57	14.75	13.58
	1	3	171	3.31	6.45	68.66	16.35	7.17
	1	4	171	5.82	0.00	44.45	27.98	23.23
	2	1	130	3.13	9.82	60.62	17.46	10.43
	2	2	136	5.20	1.35	50.07	24.97	20.16
	2	3	133	4.50	2.04	59.01	21.34	14.07
	2	4	137	4.27	4.34	34.20	25.47	13.33
	3	1	176	4.88	0.00	41.12	46.38	10.05
	3	2	162	4.98	0.00	40.25	48.51	9.84
	3	3	168	5.40	0.00	31.75	52.82	13.15
	3	4	168	4.79	0.00	43.95	43.34	11.02
	4	1	187	5.49	0.00	27.87	54.95	15.27
	4	2	188	5.75	0.00	17.90	65.61	16.08
	4	3	188	4.76	0.00	25.35	65.08	8.01
	4	4	188	3.16	0.00	35.74	49.28	13.28
	5	1	166	3.16	2.89	74.40	15.43	7.11
	5	2	167	3.24	1.06	75.17	17.24	6.34
	5	3	165	4.05	0.00	67.12	19.88	11.01
	5	4	165	4.62	1.89	52.68	29.61	13.62
REFERENCE								
	1	1	168	4.98	0.00	52.91	34.20	11.21
	1	2	165	5.21	0.00	38.47	47.28	12.60
	1	3	168	5.26	0.00	41.10	45.72	11.46
	1	4	167	5.06	0.00	44.61	42.20	12.88
	2	1	133	4.13	0.00	64.88	31.09	4.03
	2	2	130	4.48	0.00	62.47	28.27	8.64
	2	3	133	4.34	0.00	65.09	27.49	7.18
	2	4	130	4.27	0.00	60.43	33.83	5.63
	4	1	185	5.05	0.04	50.83	35.48	11.95
	4	2	188	4.44	0.04	60.07	30.31	9.45
	4	3	187	5.64	0.04	59.12	18.38	19.05
	4	4	184	4.48	0.04	57.58	34.43	7.00

TABLE A-20. SUMMARY OF SEDIMENT GRAIN-SIZE ANALYSIS. SURVEY 3

TYPE STATION	STATION	REPLICATE	SAMPLING DEPTH (M)	MEAN GRAIN SIZE	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT	PERCENT CLAY
DISPOSAL								
	1	1	170	3.33	2.80	69.05	19.36	7.14
	1	2	166	3.62	5.51	66.00	17.24	9.46
	1	3	167	4.24	0.00	68.89	18.36	10.66
	1	4	168	4.17	1.17	65.34	19.47	13.58
	2	1	138	4.30	4.47	51.87	23.12	10.33
	2	2	138	4.06	3.00	61.35	20.77	12.80
	2	3	135	3.44	3.83	65.44	20.74	8.06
	2	4	136	3.25	0.18	63.08	16.07	10.01
	3	1	168	5.30	0.00	31.04	50.40	15.14
	3	2	148	5.08	0.00	32.06	54.84	12.63
	3	3	147	5.22	0.29	45.74	34.63	16.54
	3	4	147	5.15	2.15	41.06	37.35	16.90
	4	1	183	5.53	0.00	32.41	48.45	16.55
	4	2	183	5.67	2.43	25.43	51.23	17.94
	4	3	184	5.76	0.00	21.81	58.97	18.68
	4	4	181	5.85	0.00	24.34	53.18	18.98
	5	1	168	4.33	0.00	65.17	19.16	13.34
	5	2	168	3.26	1.79	72.16	18.51	6.72
	5	3	168	5.82	0.00	49.67	23.74	23.30
	5	4	165	3.39	1.75	70.96	19.45	6.71
REFERENCE								
	1	1	128	4.44	0.00	55.40	34.65	8.63
	1	2	165	4.90	0.00	49.66	38.15	10.40
	1	3	166	5.08	0.00	47.70	38.76	11.76
	1	4	168	4.83	0.00	52.50	36.13	11.04
	2	1	135	4.72	0.00	52.20	38.52	7.92
	2	2	138	4.46	0.00	58.87	33.12	6.70
	2	3	133	4.66	0.00	52.68	38.48	8.59
	2	4	136	4.71	0.00	53.99	36.54	8.29
	4	1	186	4.62	0.00	59.45	29.20	10.52
	4	2	188	4.47	0.00	61.13	29.08	9.05
	4	3	186	4.73	0.00	53.04	36.12	9.39
	4	4	187	4.68	0.00	58.27	30.37	10.48

TABLE A-21. SUMMARY OF SEDIMENT GRAIN-SIZE ANALYSIS. SURVEY 4

TYPE STATION	STATION	REPLICATE	SAMPLING DEPTH (M)	MEAN GRAIN SIZE	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT	PERCENT CLAY
DISPOSAL								
	1	1	171	1.86	13.10	72.86	7.62	5.56
	1	2	168	3.78	7.97	60.80	14.92	14.45
	1	3	169	2.81	13.15	65.86	10.31	9.03
	1	4	169	3.20	9.93	63.40	12.73	11.07
	2	1	137	2.76	12.83	51.65	18.50	14.72
	2	2	136	3.53	11.36	52.89	17.76	15.35
	2	3	136	3.32	5.25	68.50	11.84	12.24
	2	4	137	2.76	3.57	68.71	15.15	10.64
	3	1	168	4.87	0.00	53.47	35.11	9.99
	3	2	167	4.61	0.00	56.25	29.49	12.19
	3	3	167	4.95	0.00	44.59	43.28	10.59
	3	4	168	4.93	0.00	35.66	55.57	8.58
	4	1	183	6.60	0.00	19.25	66.20	12.92
	4	2	183	4.28	4.09	39.76	43.78	11.30
	4	3	186	5.24	0.00	40.49	45.78	12.82
	4	4	186	5.26	0.00	25.22	61.88	12.59
	5	1	167	0.28	7.74	66.05	14.54	9.94
	5	2	166	3.36	9.87	59.07	16.46	13.12
	5	3	166	4.32	1.58	58.65	25.86	12.02
	5	4	168	3.07	13.97	55.05	15.01	13.64
REFERENCE								
	1	1	165	4.63	0.00	56.77	34.19	7.85
	1	2	165	4.72	0.00	55.99	33.06	9.59
	1	3	168	4.33	0.00	64.79	27.55	6.67
	1	4	168	4.44	0.00	64.18	27.28	7.47
	2	1	138	4.45	0.00	61.75	29.85	7.32
	2	2	138	4.36	0.00	66.71	24.97	7.28
	2	3	132	4.24	0.00	68.75	24.87	5.66
	2	4	138	4.37	0.00	62.68	30.02	6.50
	4	1	103	4.67	0.00	54.07	35.76	9.47
	4	2	103	4.37	0.00	61.24	30.16	8.03
	4	3	103	4.39	0.00	65.47	25.51	7.96
	4	4	108	4.49	0.00	62.59	26.76	9.44

TABLE A-22. GRAIN SIZE ANALYSIS - SEDIMENT WEIGHT DISTRIBUTION BY PHI INTERVAL
Survey 1

TYPE STATION	STATION	REPLICATE	PHI-1 to PHI00	PHI00 to PHI01	PHI01 to PHI02	PHI02 to PHI03	PHI03 to PHI04	PHI04 to PHI05	PHI05 to PHI06	PHI06 to PHI07	PHI07 to PHI08	PHI08 to PHI09	PHI09 to PHI10	PHI10 to PHI11	PHI11 to PHI12	PHI12 to PHI13	PHI13 to PHI14	PHI14 to PHI15
DISPOSAL																		
	1	1	1.20	2.20	6.72	46.70	13.01	9.84	3.81	3.29	2.41	1.60	0.91	2.32	0.71	1.37	0.43	0.00
	1	2	1.36	12.26	18.20	33.66	10.70	6.67	4.66	2.29	1.04	1.80	0.69	1.49	0.44	1.01	0.28	0.00
	1	3	0.46	8.33	4.98	64.80	9.17	11.36	4.06	4.39	2.83	2.65	0.96	2.36	0.74	1.29	0.47	0.00
	1	4	1.00	6.48	14.70	38.83	9.30	7.70	4.26	3.83	1.01	1.18	0.66	2.96	1.23	2.40	0.80	0.00
	2	1	1.73	9.97	20.39	34.43	8.88	7.07	3.70	3.43	1.36	1.74	0.42	2.29	0.70	1.34	0.46	0.00
	2	2	1.20	4.30	13.04	33.73	13.96	6.61	4.24	4.17	3.73	1.95	0.62	4.02	1.33	0.72	0.65	0.00
	2	3	2.46	3.32	12.44	21.94	7.76	14.99	10.62	8.43	3.96	2.78	1.82	4.03	1.09	1.49	0.00	0.00
	2	4	0.00	2.00	10.82	39.71	11.24	10.31	3.98	4.19	2.37	2.41	0.93	3.69	2.07	2.86	1.32	0.00
	3	1	0.00	0.12	0.97	9.62	23.81	31.81	12.34	5.63	3.13	1.97	0.61	2.02	0.89	1.90	0.37	0.00
	3	2	0.00	0.66	1.04	12.99	28.34	21.42	10.42	5.50	3.50	2.92	1.21	3.78	1.22	2.36	0.78	0.00
	3	3	0.06	0.00	1.44	9.06	19.40	30.23	8.98	3.97	2.27	0.47	1.93	0.21	1.29	0.13	0.63	0.00
	3	4	0.00	0.43	3.37	19.77	18.08	27.77	12.69	8.42	4.71	2.44	1.33	2.90	0.85	1.55	0.37	0.00
	4	1	0.07	0.71	2.49	6.69	10.60	42.73	18.71	6.49	8.64	1.58	0.58	2.44	0.77	1.66	0.49	0.00
	4	2	0.00	0.21	1.35	8.73	10.91	40.81	19.84	7.32	4.74	1.47	0.41	1.39	0.47	1.07	0.20	0.00
	4	3	0.00	0.00	0.24	1.74	9.63	36.09	20.93	8.13	3.92	2.69	1.43	6.01	1.99	4.07	1.27	0.00
	4	4	0.11	0.05	0.32	1.42	10.31	40.93	17.66	10.42	4.40	2.60	1.14	3.91	1.26	2.63	0.80	0.00
	5	1	0.42	16.29	24.67	23.10	11.72	8.40	2.06	1.08	0.27	1.20	0.12	0.01	0.08	0.41	0.03	0.00
	5	2	3.00	10.32	17.12	27.24	16.40	11.04	3.97	1.68	1.78	0.12	1.71	0.19	1.13	0.12	0.38	0.00
	5	3	6.32	11.73	22.20	20.39	6.86	5.65	4.47	1.21	2.19	0.92	0.38	2.42	0.76	1.44	0.40	0.00
	5	4	2.48	6.90	18.74	29.01	15.21	12.19	4.20	2.18	1.48	0.11	1.09	0.21	1.27	0.14	0.64	0.00
REFERENCE																		
	1	1	0.00	0.94	1.64	14.31	39.36	21.74	7.77	4.26	0.41	2.06	0.18	0.71	0.00	0.00	0.00	0.00
	1	2	0.00	0.21	1.47	8.04	39.07	33.59	11.07	4.10	1.48	0.30	1.63	0.17	1.09	0.11	0.35	0.00
	1	3	0.00	0.00	0.38	10.67	46.97	25.35	8.40	4.29	0.66	0.48	0.47	1.63	0.30	1.10	0.22	0.00
	1	4	0.00	0.00	0.30	1.10	30.20	37.19	13.38	6.40	3.10	2.04	0.96	2.13	0.63	1.32	0.36	0.00
	2	1	0.00	0.00	0.46	8.46	46.98	35.13	6.47	3.40	1.22	0.71	1.07	0.49	0.66	0.87	0.26	0.00
	2	2	0.00	0.00	0.35	8.27	44.83	35.96	8.02	3.36	1.31	0.63	0.98	0.43	0.61	0.23	0.24	0.00
	2	3	0.00	0.00	0.44	1.73	43.83	37.28	7.84	4.03	1.08	0.76	1.13	0.33	0.70	0.29	0.27	0.00
	2	4	0.00	0.78	1.76	5.28	46.33	34.29	6.17	2.48	1.10	0.39	0.54	0.22	0.21	0.00	0.00	0.00
	4	1	0.00	0.43	3.66	27.22	31.98	20.04	6.89	4.26	1.43	0.32	1.76	0.18	1.18	0.62	0.60	0.00
	4	2	0.00	0.47	3.33	29.69	32.93	20.43	5.57	3.27	1.22	0.59	0.90	0.41	0.36	0.23	0.22	0.00
	4	3	0.00	2.09	6.73	33.63	24.59	18.63	5.35	3.74	0.82	0.33	1.82	0.19	1.22	0.12	0.62	0.00
	4	4	0.22	0.63	2.93	34.17	24.99	19.42	6.64	2.35	1.92	0.88	1.07	0.30	0.18	0.00	0.00	0.00

TABLE A-23. GRAIN SIZE ANALYSIS - SEDIMENT WEIGHT DISTRIBUTION BY PHI INTERVAL
Survey 2.

TYPE STATION	STATION	REPLICATE	PHI-1 to PHI00	PHI00 to PHI01	PHI01 to PHI02	PHI02 to PHI03	PHI03 to PHI04	PHI04 to PHI05	PHI05 to PHI06	PHI06 to PHI07	PHI07 to PHI08	PHI08 to PHI09	PHI09 to PHI10	PHI10 to PHI11	PHI11 to PHI12	PHI12 to PHI13	PHI13 to PHI14	PHI14 to PHI15
DISPOSAL																		
	1	1	1.03	3.88	10.63	14.93	10.33	12.86	7.34	6.66	4.28	6.43	1.93	7.70	2.20	3.22	1.40	0.00
	1	2	0.33	6.02	12.73	33.93	14.92	3.10	4.52	2.63	2.30	1.83	0.94	3.09	1.39	3.44	0.89	0.00
	1	3	0.40	9.23	12.93	24.10	20.48	6.33	4.52	1.76	1.34	0.79	0.32	2.90	0.74	1.95	0.47	0.00
	1	4	0.00	2.14	9.27	24.72	8.33	8.01	8.36	6.35	4.86	3.04	0.84	8.79	2.02	3.94	1.80	0.00
	2	1	4.13	12.38	13.99	19.61	9.31	8.74	4.47	2.01	2.31	2.66	0.39	3.47	0.96	2.34	0.61	0.00
	2	2	0.74	1.47	10.06	25.77	12.03	10.93	6.23	4.71	3.09	3.29	1.61	7.14	2.03	4.82	1.30	0.00
	2	3	0.33	3.67	14.69	27.80	18.33	9.26	5.86	3.90	2.93	8.14	0.33	5.60	1.73	3.78	1.10	0.00
	2	4	0.39	6.55	17.71	30.03	9.63	9.86	6.97	4.36	4.48	1.43	0.30	5.24	1.39	3.39	1.01	0.00
	3	1	0.00	0.67	5.36	20.34	14.73	24.96	13.66	4.07	2.67	2.92	0.39	3.48	0.93	2.33	0.59	0.00
	3	2	0.00	0.00	1.17	12.94	26.34	27.37	13.94	4.99	3.01	2.61	0.47	3.00	0.75	2.03	0.48	0.00
	3	3	0.00	0.23	1.98	12.33	17.20	28.77	14.12	4.78	3.19	2.33	0.70	4.74	1.33	3.20	0.85	0.00
	3	4	0.32	2.63	5.52	20.32	15.24	22.62	13.76	4.01	2.97	2.46	0.99	3.62	0.92	2.44	0.39	0.00
	4	1	0.00	0.66	2.16	11.43	13.60	27.66	16.77	7.18	3.36	2.13	1.39	4.03	1.10	2.72	0.70	0.00
	4	2	0.00	0.12	0.62	5.47	11.69	29.39	22.20	8.79	3.03	4.08	2.18	5.29	1.26	2.73	0.54	0.00
	4	3	0.00	0.29	2.19	9.88	13.03	36.07	9.23	1.63	2.13	0.91	0.19	3.28	0.90	2.21	0.37	0.00
	4	4	0.18	0.74	3.87	15.11	15.84	23.19	13.90	7.39	2.80	4.39	1.39	3.37	0.93	2.41	0.39	0.00
	5	1	0.88	3.08	19.81	34.78	19.83	6.29	4.78	1.93	0.41	3.29	0.27	3.20	0.17	1.11	0.07	0.00
	5	2	0.81	8.89	15.36	20.69	21.43	11.72	3.83	0.76	0.93	0.13	3.89	0.33	1.93	0.16	0.98	0.00
	5	3	3.96	9.33	11.36	26.22	20.43	11.36	4.35	1.69	8.28	1.44	0.63	4.19	1.16	2.83	0.74	0.00
	5	4	1.19	4.46	9.23	21.43	16.37	11.96	8.46	4.73	4.46	2.83	0.99	4.64	1.23	3.13	0.78	0.00
REFERENCE																		
	1	1	0.00	0.00	0.00	1.83	31.00	30.01	9.49	2.60	8.10	8.32	1.27	3.31	0.94	2.37	0.60	0.00
	1	2	0.00	0.00	0.00	1.06	37.41	30.71	9.90	5.03	1.64	4.18	1.09	3.87	0.93	2.34	0.39	0.00
	1	3	0.00	0.00	0.00	1.60	39.30	23.03	12.42	4.18	4.07	2.69	1.13	3.60	0.98	2.43	0.63	0.00
	1	4	0.00	0.00	0.28	1.41	42.93	22.98	11.03	4.39	3.80	4.10	1.47	3.91	0.96	2.03	0.41	0.00
	2	1	0.00	0.00	0.36	3.28	61.24	22.27	9.01	0.48	3.37	0.23	2.26	0.16	1.14	0.07	0.13	0.00
	2	2	0.00	0.00	0.00	2.63	59.81	19.31	6.33	1.89	0.33	2.40	1.21	2.30	0.84	1.42	0.47	0.00
	2	3	0.00	0.00	0.00	2.13	62.96	20.00	4.17	1.87	1.43	0.16	3.26	0.29	2.18	0.19	1.10	0.00
	2	4	0.00	0.00	0.00	1.69	38.74	24.87	3.46	2.20	1.32	1.10	1.80	0.76	1.12	0.42	0.43	0.00
	4	1	0.00	0.00	0.00	1.44	49.31	19.74	9.80	3.48	2.46	2.98	1.39	3.39	0.96	2.42	0.61	0.00
	4	2	0.00	0.00	0.33	12.73	47.01	18.34	7.29	2.32	3.16	2.05	1.60	3.65	0.82	1.33	0.00	0.00
	4	3	0.00	0.00	0.37	16.07	42.48	0.04	4.19	8.99	9.16	3.90	0.68	7.12	2.14	4.81	1.38	0.00
	4	4	0.00	0.00	0.33	4.31	33.73	22.84	7.62	2.14	1.83	0.93	3.38	0.30	2.36	0.19	1.13	0.00

TABLE A-24. GRAIN SIZE ANALYSIS - SEDIMENT WEIGHT DISTRIBUTION BY PHI INTERVAL
Survey 3.

TYPE STATION	STATION	REPLICATE	PHI-1 to PHI00	PHI00 to PHI01	PHI01 to PHI02	PHI02 to PHI03	PHI03 to PHI04	PHI04 to PHI05	PHI05 to PHI06	PHI06 to PHI07	PHI07 to PHI08	PHI08 to PHI09	PHI09 to PHI10	PHI10 to PHI11	PHI11 to PHI12	PHI12 to PHI13	PHI13 to PHI14	PHI14 to PHI15
DISPOSAL																		
	1	1	4.22	11.42	14.41	26.33	18.67	10.60	4.38	2.24	2.14	0.26	0.14	3.05	0.81	2.06	0.32	0.00
	1	2	0.93	3.49	12.38	32.05	17.13	9.99	3.76	1.99	1.30	2.03	0.37	3.38	0.84	2.28	0.54	0.00
	1	3	0.00	1.35	5.93	41.71	19.41	9.90	4.86	1.26	2.36	1.86	0.60	3.93	1.09	2.67	0.69	0.00
	1	4	1.02	4.60	12.29	28.67	19.46	9.49	4.66	2.70	2.62	0.80	3.73	1.37	3.62	0.95	2.21	0.00
	2	1	0.60	6.60	13.19	22.49	11.69	10.83	6.42	2.93	5.94	8.98	1.27	5.83	1.42	3.33	0.90	0.00
	2	2	1.38	3.94	14.74	25.41	18.61	9.19	5.36	3.87	2.33	3.38	0.54	4.47	1.34	3.02	0.85	0.00
	2	3	0.93	5.61	13.66	28.98	14.26	10.48	4.53	3.25	3.28	0.28	2.13	1.08	2.87	0.75	1.72	0.00
	2	4	3.54	11.93	22.35	17.71	7.33	8.13	3.12	2.19	2.64	1.89	0.61	3.84	1.13	2.39	0.73	0.00
	3	1	0.00	0.83	2.49	12.87	47.83	26.16	14.74	3.60	3.92	2.54	3.01	0.00	6.38	0.02	3.19	0.00
	3	2	0.71	0.47	2.13	9.90	18.86	33.66	14.50	4.51	3.39	3.47	2.36	3.21	2.24	1.37	0.00	0.00
	3	3	0.00	1.10	3.77	24.45	16.42	17.33	9.27	3.24	2.80	2.88	1.14	5.77	1.74	3.90	1.11	0.00
	3	4	0.00	1.10	5.74	22.73	11.49	17.84	8.70	6.70	4.11	3.47	2.15	5.26	1.51	3.35	0.96	0.00
	4	1	0.66	1.16	4.13	13.90	13.36	23.42	14.68	6.75	3.60	3.19	1.93	3.41	1.45	3.63	0.93	0.00
	4	2	0.13	3.51	3.08	8.66	9.27	23.48	16.43	7.90	4.42	3.67	1.11	6.06	1.86	4.08	1.18	0.00
	4	3	0.93	8.46	2.32	8.12	9.98	29.68	17.37	7.17	4.55	3.32	3.39	0.00	7.79	0.08	3.90	0.00
	4	4	0.16	1.26	3.00	8.38	11.54	25.37	17.60	7.67	4.46	3.61	3.56	0.00	7.34	0.06	4.41	0.00
	5	1	0.00	4.13	14.62	33.38	13.84	9.21	4.66	2.40	2.83	2.33	0.61	4.93	1.29	3.34	0.82	0.00
	5	2	2.09	6.62	18.98	30.45	13.02	10.74	5.73	1.78	0.36	0.00	2.13	0.73	3.06	0.52	1.26	0.00
	5	3	0.00	0.29	4.97	21.25	50.16	8.48	7.03	4.01	3.22	2.14	2.11	8.62	2.81	5.83	1.79	0.00
	5	4	1.70	10.87	15.98	26.85	15.56	9.72	5.26	2.30	1.97	1.22	0.46	3.41	0.61	1.62	0.39	0.00
REFERENCE																		
	1	1	0.00	0.00	0.49	7.42	47.49	22.69	6.86	2.66	2.44	1.69	1.16	2.71	0.76	1.83	0.48	0.00
	1	2	0.00	0.00	0.43	4.73	44.46	23.14	7.37	2.99	2.43	1.93	0.69	3.79	0.98	2.36	0.63	0.00
	1	3	0.00	0.00	0.00	4.24	43.36	23.97	9.03	3.27	2.47	2.29	1.60	0.00	4.71	0.02	2.14	0.00
	1	4	0.00	0.00	0.30	3.04	47.66	21.90	7.91	3.63	2.69	1.84	2.07	2.80	2.13	1.36	0.92	0.00
	2	1	0.00	0.00	0.00	3.06	50.13	28.11	3.99	2.22	3.20	1.37	0.46	2.93	0.72	1.98	0.46	0.00
	2	2	0.00	0.33	1.00	3.33	51.21	23.35	4.94	1.14	1.49	0.67	0.16	2.80	0.73	1.09	0.46	0.00
	2	3	0.00	0.00	0.00	3.26	30.42	26.99	6.49	3.22	2.78	1.39	1.39	2.13	1.61	1.18	0.69	0.60
	2	4	0.00	0.00	0.00	3.06	50.93	23.84	9.17	2.91	0.62	1.76	1.26	1.73	1.43	1.30	0.91	0.00
	4	1	0.00	0.00	0.44	13.83	43.48	18.13	6.70	2.47	1.90	1.94	1.98	0.00	4.12	0.01	2.47	0.00
	4	2	0.00	0.00	0.40	18.91	41.84	18.33	6.66	2.06	2.17	2.01	1.47	1.92	1.56	1.22	0.87	0.00
	4	3	0.00	0.00	0.00	8.76	44.28	22.20	6.94	3.63	2.33	1.80	1.09	3.04	0.86	2.05	0.55	0.00
	4	4	0.00	0.00	0.47	12.79	43.01	18.67	6.81	2.62	2.27	1.67	1.84	2.40	1.95	1.33	1.09	0.00

TABLE A-25. GRAIN SIZE ANALYSIS - SEDIMENT WEIGHT DISTRIBUTION BY PHI INTERVAL
Survey 4.

TYPE STATION	STATION	REPLICATE	PHI-1 to PHI00	PHI00 to PHI01	PHI01 to PHI02	PHI02 to PHI03	PHI03 to PHI04	PHI04 to PHI05	PHI05 to PHI06	PHI06 to PHI07	PHI07 to PHI08	PHI08 to PHI09	PHI09 to PHI10	PHI10 to PHI11	PHI11 to PHI12	PHI12 to PHI13	PHI13 to PHI14	PHI14 to PHI15
DISPOSAL																		
	1	1	11.74	10.63	20.37	13.19	6.91	3.73	3.47	0.31	1.06	1.23	0.94	1.74	0.52	1.18	0.33	0.00
	1	2	0.63	4.33	16.60	27.01	11.81	8.11	3.13	2.01	1.63	0.70	3.62	1.96	4.22	1.36	2.39	0.00
	1	3	1.79	7.37	17.19	29.91	9.60	3.67	2.51	0.78	1.33	1.16	0.64	3.30	1.04	2.23	0.66	0.00
	1	4	1.23	7.39	19.00	27.00	8.62	9.43	3.51	1.23	2.54	1.94	0.70	4.31	1.33	2.05	0.84	0.00
	2	1	1.41	4.83	10.45	23.91	11.66	6.92	4.54	3.56	3.46	2.71	1.66	4.39	1.62	3.11	1.03	0.00
	2	2	5.60	8.67	13.99	17.63	7.00	7.00	4.33	3.33	3.10	0.69	0.94	5.21	1.02	3.53	1.16	0.00
	2	3	8.55	17.27	20.66	19.53	8.49	6.36	3.76	1.78	0.94	1.70	0.84	4.38	1.44	2.96	0.92	0.00
	2	4	0.00	8.46	13.64	20.97	15.64	6.12	4.34	2.40	2.09	1.30	0.74	3.09	1.27	2.63	0.81	0.00
	3	1	0.00	0.00	0.36	3.08	50.13	19.43	8.17	4.63	2.00	2.31	1.34	2.93	0.88	1.90	0.36	0.00
	3	2	0.76	2.64	7.93	26.93	18.07	14.03	9.00	3.36	3.11	2.13	0.90	4.16	1.32	2.02	0.84	0.00
	3	3	0.00	0.64	2.22	14.33	27.39	23.23	10.93	4.64	4.40	2.44	1.40	3.08	0.96	2.08	0.61	0.00
	3	4	0.00	0.00	0.42	3.80	31.44	32.80	13.92	4.30	4.35	2.69	1.16	2.47	0.68	1.29	0.39	0.00
	4	1	0.00	0.67	1.03	4.01	13.53	36.34	17.91	6.93	5.03	4.26	1.90	3.29	1.01	2.22	0.64	0.00
	4	2	5.10	7.82	7.64	10.36	9.34	21.30	12.76	5.77	3.87	3.09	1.45	3.36	0.99	2.06	0.53	0.00
	4	3	0.33	1.63	5.53	17.07	15.93	11.53	8.99	0.00	23.26	3.90	1.32	3.53	1.04	2.17	0.58	0.00
	4	4	0.10	1.00	2.50	9.31	13.31	32.60	17.23	6.62	5.43	3.80	1.65	3.70	1.06	1.93	0.43	0.00
	5	1	3.82	8.32	16.30	27.12	11.01	5.02	8.33	1.46	2.71	1.96	0.60	3.31	1.11	8.37	0.71	0.00
	5	2	4.42	8.30	13.80	23.74	8.83	6.19	4.12	1.63	4.22	2.87	0.71	1.31	3.46	1.05	2.12	0.00
	5	3	1.08	6.71	14.72	22.07	14.07	7.17	8.74	5.02	4.13	2.06	1.58	3.81	1.22	2.58	0.77	0.00
	5	4	5.92	11.84	16.13	15.51	5.62	5.21	5.29	2.53	1.90	1.66	1.59	4.60	1.55	3.17	0.99	0.00
REFERENCE																		
	1	1	0.00	0.00	0.79	3.97	52.01	20.16	8.02	2.62	3.37	1.90	0.67	2.44	0.73	1.65	0.46	0.00
	1	2	0.00	0.00	0.36	5.38	50.85	22.16	4.25	3.23	3.44	2.48	1.06	2.80	0.86	1.90	0.55	0.00
	1	3	0.00	0.00	0.46	18.51	45.82	16.70	6.04	2.94	2.89	1.43	0.84	2.04	0.60	1.38	0.38	0.00
	1	4	0.00	0.00	0.75	8.58	54.85	15.16	9.83	1.86	3.63	1.90	0.80	2.22	0.64	1.30	0.41	0.00
	2	1	0.00	0.00	1.61	9.28	50.86	18.25	6.83	2.43	2.34	1.93	0.61	2.22	0.65	1.50	0.41	0.00
	2	2	0.00	1.75	1.40	9.08	51.48	14.17	6.29	2.64	1.92	1.95	0.60	2.16	0.63	1.46	0.40	0.00
	2	3	0.00	0.00	0.33	4.30	61.13	13.76	5.85	1.45	1.81	1.82	0.63	1.30	0.43	1.01	0.27	0.00
	2	4	0.00	0.00	0.33	3.29	59.16	20.43	5.75	1.63	2.19	2.05	0.80	1.70	0.49	1.13	0.31	0.00
	4	1	0.00	0.00	0.30	8.63	43.19	21.10	9.04	2.48	3.14	2.84	1.19	2.64	0.76	1.62	0.42	0.00
	4	2	0.00	0.53	1.06	19.87	40.36	16.90	7.85	2.28	3.12	2.42	0.94	2.27	0.65	1.39	0.36	0.00
	4	3	0.00	0.00	0.93	24.26	40.76	13.89	6.73	2.82	2.07	2.41	0.81	2.20	0.65	1.48	0.41	0.00
	4	4	0.00	0.31	0.63	21.59	40.06	14.53	7.60	2.89	1.75	2.86	1.13	2.51	0.75	1.69	0.48	0.00

A.3.3.1.16 To demonstrate the observed differences in infaunal community structure among the three groups of stations, the data from Survey 1 was used to compare the occurrence and abundance of individual taxa among the identified groups of stations. Three analyses were conducted. First, an inverse numerical classification was performed to identify groups of taxa with similar distributional characteristics among the sampling areas (stations). Second, nodal analyses were conducted to identify those assemblages of organisms which showed the most consistent differences in their distribution among the stations. Third, the abundance of these groups of organisms was tabulated for the three groups of stations (A, B and C, see Fig. A-14) previously defined.

A.3.3.1.17 The seventy-two most abundant infaunal taxa were selected for the inverse classification analysis from the 298 taxa identified in Survey 1. These taxa represented over 90 percent of all the individuals enumerated in this survey and included all taxa present in at least 12 of the 32 individual replicate samples. A listing of these taxa, their abundance, the proportion of the total number of individuals enumerated in the survey represented by these taxa, and their frequency of occurrence in individual replicate samples is presented in Table A-26.

A.3.3.1.18 The results of the inverse numerical classification for Survey 1 are presented in Figure A-15. The selected taxa were partitioned into 7 Species Groups by drawing a line across the dendrogram at the indicated level of similarity. The use of this method for defining species groups excluded six taxa which joined these groups at lower levels of similarity. The seven species-groups defined in Figure A-15 were used in nodal analyses (Boesch, 1977) to demonstrate differences in infaunal assemblages among the three previously defined groups of stations (Groups A, B and C, Fig. A-14). The index of constancy was used to express the degree of station-group and species-group coincidences for each species-group and station-group pair. The degree of constancy of taxa in particular station groups is expressed as:

$$C_{ij} = \frac{a_{ij}}{n_i n_j}$$

where a_{ij} = number of occurrences of members of species group i in collection group j

n_i = number of taxa in species group i

n_j = number of stations in station group j

A.3.3.1.19 The nodal constancy diagram for this analysis is presented in Figure A-16. The value of the constancy index is arbitrarily graded as very high, high, moderate, low and very low based on the proportion of the number of occurrences of taxa in the station group to the total possible number of such occurrences. The dimensions (width and height) of each cell in the constancy diagram are drawn proportional to the number of taxa in the species group and the number of stations in each station group.

TABLE A-25. MOST ABUNDANT BENTHIC INFAUNAL TAXA. SURVEY 1

TAXON	NUMBER OF INDIVIDUALS	RANK	PROPORTION OF TOTAL INDIVIDUALS	CUMULATIVE PROPORTION	FREQUENCY OF OCCURRENCE	RANK BY FREQUENCY
MEDIOMASTUS AMBISETA	1444	1	0.127	0.13	1.000	1
TAUBERIA GRACILIS	789	2	0.070	0.20	0.969	4
OPHIUROIDEA UNID.	774	3	0.068	0.27	1.000	2
SPIOPHANES BERKELEYORUM	683	4	0.060	0.33	0.969	5
ALLIA RAMOSA	530	5	0.047	0.37	0.781	18
THARYX SP.	484	6	0.043	0.41	1.000	3
EUPHILOMEDES PRODUCTA	471	7	0.042	0.46	0.781	16
AMPHIODIA URTICA	349	8	0.031	0.49	0.719	20
DECAMASTUS GRACILIS	342	9	0.030	0.52	0.969	6
ADONTORHINA CYCLIA	211	10	0.019	0.54	0.781	15
MINUSPIO CIRRIFERA	208	11	0.018	0.55	0.688	22
PECTINARIA CALIFORNIENSIS	182	12	0.016	0.57	0.719	19
LUMBRINERIS SP.	181	13	0.016	0.59	0.781	17
COSSURA SP.	152	14	0.013	0.60	0.875	10
AXIOTHELLA RUBROCINCTA	143	15	0.013	0.61	0.500	45
AMPHIURA ARCYSTATA	134	16	0.012	0.62	0.625	28
CIRROPHORUS BRANCHIATUS	127	17	0.011	0.64	0.688	21
LAONICE CIRRATA	126	18	0.011	0.65	0.844	14
PARVILUCINA TENUISCULPTA	119	19	0.010	0.66	0.844	13
CAPITELLA CAPITATA	117	20	0.010	0.67	0.688	23
MONOBRACHIUM PARASITUM	113	21	0.010	0.68	0.656	27
EXOGONE LOUREI	108	22	0.010	0.69	0.875	9
METAPHOXUS FREQUENS	106	23	0.009	0.70	0.531	39
RUTIDERMA LOMAE	98	24	0.009	0.70	0.625	29
PRIONOSPIO SP. A OF SCAMIT	96	25	0.008	0.71	0.875	8
PHOLOE GLABRA	92	26	0.008	0.72	0.906	7
NEPHTYS CORNUTA FRANCISCANA	90	27	0.008	0.73	0.656	25
CHAETODERMA/FALCIDENS SP.	84	28	0.007	0.74	0.844	12
NEMERTEA UNID.	84	29	0.007	0.74	0.875	11
TUBIFICOIDES SP. B OF MBC	82	30	0.007	0.75	0.469	48
TOMBURCHUS REDONDOENSIS	81	31	0.007	0.76	0.594	31
LYSIPPE LABIATA	79	32	0.007	0.77	0.625	30
ACESTA CATHARINAE	74	33	0.007	0.77	0.563	35
NOTOMASTUS HEMIPODUS	70	34	0.006	0.78	0.469	47
?LYCERA SP.	70	35	0.006	0.78	0.656	26
?PTOGNATHIA SP. A OF MBC	67	36	0.006	0.79	0.406	56
?RIOCHELE GRACILIS	66	37	0.006	0.80	0.500	44
AMPELISCA UNSOCALAE	65	38	0.006	0.80	0.563	33
PRAXILLELLA AFFINIS PACIFICA	62	39	0.005	0.81	0.469	49
SPIOPHANES MISSIONENSIS	56	40	0.005	0.81	0.406	57
AXINOPSIDA SERRICATA	54	41	0.005	0.82	0.531	37
TELLINA CARPENTERI	50	42	0.004	0.82	0.375	61
NEMATODA UNID.	50	43	0.004	0.83	0.500	46
RHEPOXYNIUS BICUSPIDATUS	47	44	0.004	0.83	0.344	66
CADULUS QUADRIFISSATUS	45	45	0.004	0.83	0.375	60
DOUGALOPLUS AMPHACANTHA	42	46	0.004	0.84	0.375	62
AMPHICHONDRIUS GRANULOSUS	42	47	0.004	0.84	0.656	24
SPHAEROSYLLIS BRANDHORSTI	42	48	0.004	0.84	0.313	75
LEPTOGNATHIA SP. B OF MBC	37	49	0.003	0.85	0.406	55
SCLEROCONCHA TRITUBERCULATA	37	50	0.003	0.85	0.344	70
ONUPHIS SP.	36	51	0.003	0.85	0.500	41
GNATHIA SP.	35	52	0.003	0.86	0.406	54
PHOXOCEPHALUS HOMILIS	35	53	0.003	0.86	0.344	69
LEPTOSTYLIS SP. E OF MBC	34	54	0.003	0.86	0.531	38
AMYGDALUM PALLIDULUM	33	55	0.003	0.87	0.563	32
ACESTA SIMPLEX	33	56	0.003	0.87	0.438	53
EUCHONE INCOLOR	32	57	0.003	0.87	0.531	40
PRAXILLELLA GRACILIS	27	58	0.002	0.87	0.563	34
CHAETOZONE SETOSA	26	59	0.002	0.88	0.219	90
AMPHIODIA PSARA	26	60	0.002	0.88	0.031	289
SARSONUPHIS PARVA	26	61	0.002	0.88	0.406	58
PISTA DISJUNCTA	25	62	0.002	0.88	0.531	36
TEREBELLIDES STROEMI	25	63	0.002	0.89	0.438	51
SILOPHASMA GEMINATUM	25	64	0.002	0.89	0.375	63
EUDORELLA PACIFICA	25	65	0.002	0.89	0.438	52
HETEROPHOXUS OCULATUS	25	66	0.002	0.89	0.500	43
PARAPRIONOSPIO PINNATA	25	67	0.002	0.89	0.344	71
NEPHTYS SP.	24	68	0.002	0.90	0.344	72
GLYCERA CAPITATA	24	69	0.002	0.90	0.406	59
AMPHIPHOLIS SQUAMATA	23	70	0.002	0.90	0.250	82
MONOCULODES EMARGINATUS	22	71	0.002	0.90	0.500	42
BATHYLEBERIS CALIFORNICA	22	72	0.002	0.91	0.469	50

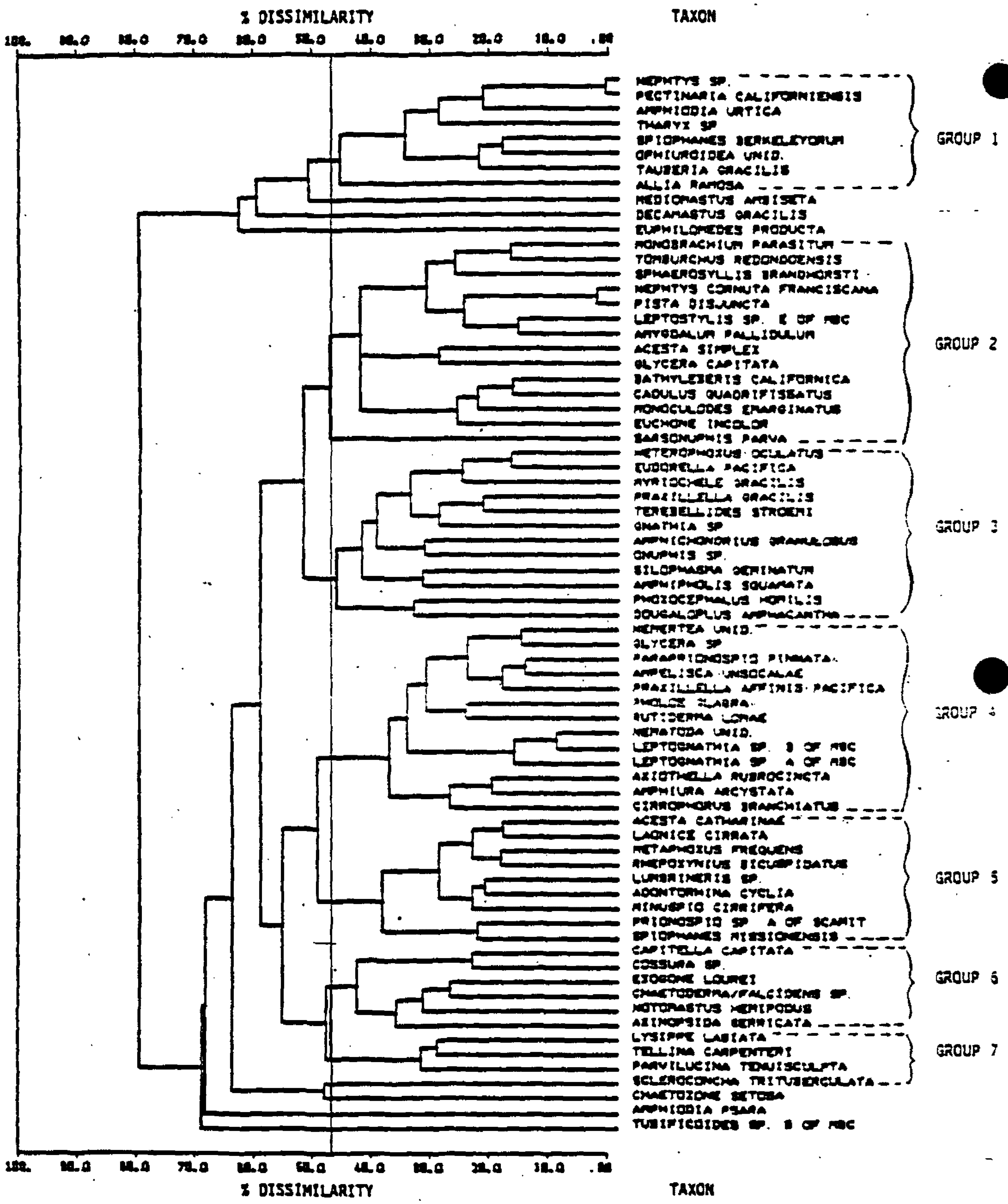


FIGURE A–15 INVERSE CLASSIFICATION RESULTS

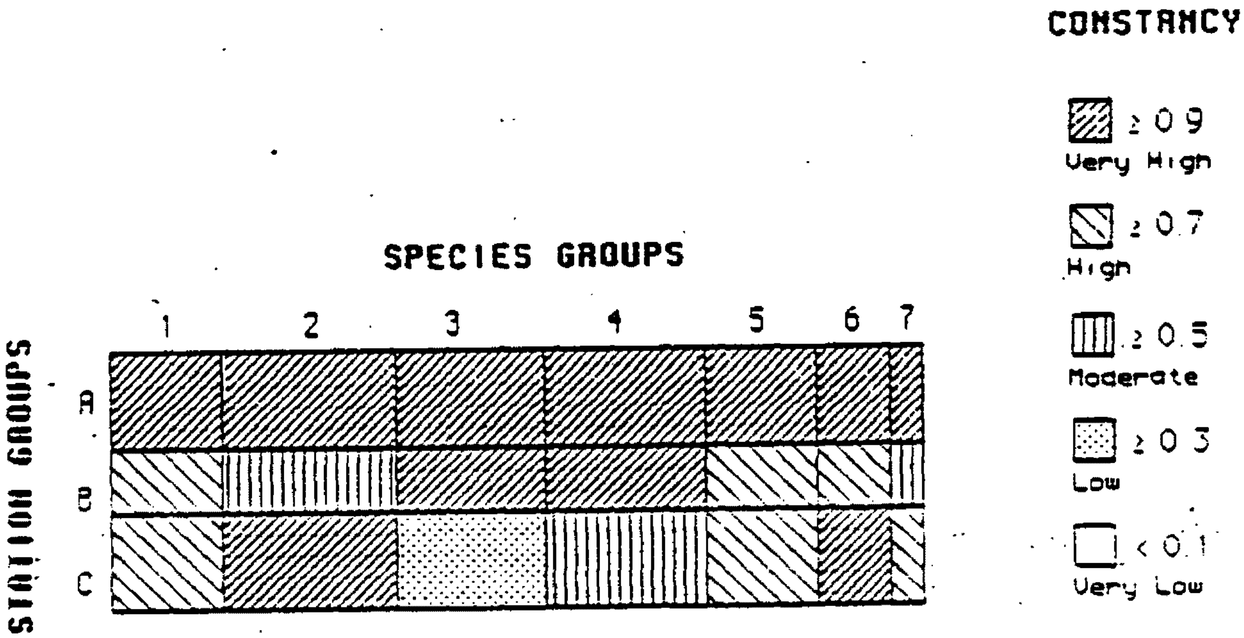


FIGURE A16. NODAL CONSTANCY DIAGRAM SURVEY 1.

A.3.3.1.20 The results of the nodal analysis summarized in Figure A-16 demonstrate infaunal community differences between the three station groups. All seven species groups were well represented in samples collected at the reference site (station Group A). Therefore, none of the three station groups were characterized by taxa which are well represented within a particular group and not elsewhere. The major difference between the disposal site (Group A) and the reference sites (Groups B and C) was the occurrence of taxa from Species Groups 2, 3 and 4. Differences in the occurrence of these taxa were also evident among stations within the disposal site (Groups B and C).

A.3.3.1.21 The nodal constancy diagram provides information on the patterns of presence or absence of taxa among the station groups. Quantitative data on the abundance of taxa from Species Groups 2, 3 and 4 at individual stations within Site Groups A, B and C are presented in Table A-27. As indicated, large differences between the reference and disposal sites were found in the abundance of taxa from Species Groups 2, 3 and 4. Large differences in the abundance of the taxa from Species Groups 3 and 4 were also found between station Groups A and B even though the frequency of occurrence of these taxa was similar.

A.3.3.1.22 Correlation Analysis - Special sampling gear was used in these field surveys which allowed infaunal samples and sediment samples for physical-chemical analyses to be collected in tandem. Fifty-three of the 128 samples (41 percent) collected in the four surveys represent paired infauna/sediment samples. The data from these 53 samples were used to determine the correlation between biological and environmental variables.

A.3.3.1.23 A summary of the correlations that existed between the infaunal community indices and environmental variables measured during this study is presented in Table A-28. Statistically significant correlations were observed between infaunal community indices and the proportion of medium, fine, and very fine sand in the sediments. Species Richness, Number of Taxa and Number of Individuals were negatively correlated with the proportion of very fine sand in the sediments. These results generally support the previous observations concerning the effects of station location on these infaunal community indices. Both the number of taxa and number of individuals were highest at stations within the reference site where sediments had a large component of very fine sand. The lowest values for these community indices were found at Stations 1, 2 and 5 within the disposal site where the sediments were primarily medium sand (phi interval 1-2).

A.3.3.1.24 The results of the sediment chemistry analyses presented in Section A.3.2 indicated that sediment metal concentrations within the disposal area were significantly elevated above the reference-site. However, the results presented in Table A-28 do not indicate that the elevated metal concentrations have affected the benthic infaunal community. The only statistically significant correlations between sediment metal concentrations and infaunal community indices were the positive correlations between arsenic concentrations and Species Richness, Number of Taxa and Number of Individuals. However, other results not presented in Table A-24 indicate that arsenic

TABLE A-27. ABUNDANCE OF TAXA FROM SPECIES GROUPS 2, 3 AND 4 AT STATIONS WITHIN SITE GROUPS A, B AND C

Species Group / Station Group[1] / Station[2]	A R1	A R2	A R4	B D3	B D4	C D1	C D2	C D5
2								
Monobrachium parasitum	49	37	6	17	1	10	6	2
Tomburchus redondoensis	39	19	3	14	1	4	6	-
Sphaerosyllis brandhorsti	56	17	1	-	-	1	4	-
Nephtys cornuta franciscana	137	61	175	13	21	27	8	2
Pista disjuncta	33	13	4	3	2	3	1	-
Leptostylis sp. E of MBC	19	15	5	-	1	3	9	2
Amygdalum pallidulum	19	14	5	8	2	4	4	1
Acesta simplex	9	16	1	2	-	5	2	1
Glycera capitata	4	9	2	3	-	9	2	2
Bathyleberis californica	10	30	8	-	1	2	2	2
Cadulus quadrifissatus	16	26	5	-	1	1	1	-
Monoculodes emarginatus	23	33	4	1	-	4	4	4
Euchone incolor	10	26	2	2	2	7	9	5
Sarsonuphis parva	13	5	2	-	-	1	6	1
3								
Heterophoxus oculatus	13	2	19	8	3	-	-	-
Eudorella pacifica	14	7	14	6	3	1	1	-
Myriochele gracilis	16	21	19	6	1	1	3	-
Praxillella gracilis	17	7	5	6	2	7	-	-
Terebellides stroemi	15	6	5	3	7	1	-	-
Gnathia sp.	17	5	11	-	8	4	3	4
Amphichondrius granulosus	13	1	9	6	1	4	9	1
Onuphis sp.	3	4	13	9	-	5	5	1
Silophasma geminatum	8	1	11	5	9	-	1	1
Amphipholis squamata	3	2	7	8	5	-	-	-
Phoxocephalus homilis	20	-	6	15	3	-	-	-
Dougaloplus amphacantha	12	11	-	19	3	-	-	-
4								
Nemertea unid.	49	24	19	15	9	4	5	7
Glycera sp.	50	35	25	6	6	11	8	8
Paraprionospio pinnata	34	36	22	4	1	-	2	-
Ampelisca unsocalae	30	35	36	5	9	-	-	-
Praxillella affinis pacifica	37	23	23	12	6	-	-	-
Pholoe glabra	28	12	13	17	7	5	16	2
Rutiderma lomae	36	14	36	8	2	3	18	1
Nematoda unid.	60	11	42	-	1	4	3	6
Leptognathia sp. B of MBC	60	10	45	3	-	-	-	-
Leptognathia sp. A of MBC	73	17	33	4	1	-	-	-
Axiothella rubrocincta	33	34	58	-	2	2	34	1
Amphiura arcystata	30	19	39	28	7	9	2	-
Cirrophorus branchiatus	25	-	52	33	29	6	1	6

[1]Station groups defined on the basis of numerical classification results (Figure A-14).

[2]Station designation: R = Reference site; D = Disposal site.

TABLE A-28. PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENTS BETWEEN SELECTED INFAUNAL COMMUNITY INDICES AND PHYSICAL-CHEMICAL VARIABLES. Correlations based on 53 samples.

Grain-Size Characteristics (phi Intervals)	Species Diversity	Species Richness	Number of Taxa	Number of Individuals
Medium Sand (01-02)	-0.1739 P=0.106	-0.3960 P=0.002	-0.4034 P=0.001	-0.3493 P=0.005
Fine Sand (02-03)	0.0800 P=0.285	-0.1193 P=0.197	-0.1652 P=0.119	-0.2532 P=0.034
Very Fine Sand (03-04)	0.0371 P=0.396	0.4101 P=0.001	0.4723 P=0.000	0.4857 P=0.000
Coarse Silt (04-05)	0.1285 P=0.180	0.1659 P=0.118	0.1766 P=0.103	0.1750 P=0.105
Medium Silt (05-06)	-0.0016 P=0.496	-0.0373 P=0.395	-0.0572 P=0.342	-0.0464 P=0.371
Sediment Metal Concentration				
Cu	0.0073 P=0.479	-0.0944 P=0.251	-0.1150 P=0.206	-0.1471 P=0.147
Pb	0.0565 P=0.344	0.0019 P=0.495	-0.0156 P=0.456	-0.0718 P=0.305
Hg	0.0829 P=0.299	0.0111 P=0.472	-0.0056 P=0.486	-0.0740 P=0.319
Zn	0.0180 P=0.449	-0.0196 P=0.445	-0.0037 P=0.490	0.0476 P=0.368
As	-0.0484 P=0.373	0.3175 P=0.015	0.3947 P=0.003	0.4415 P=0.001
Cd	0.1287 P=0.179	0.1036 P=0.230	0.0946 P=0.250	0.0177 P=0.450
Cr	0.1043 P=0.229	-0.0397 P=0.389	-0.0844 P=0.274	-0.1746 P=0.106
Sample Depth	0.0718 P=0.305	-0.1632 P=0.122	-0.2097 P=0.066	-0.2547 P=0.033

concentrations are highly correlated with the percentage of silt in the sediment. Previously, it was shown that these infaunal indices are also positively correlated with silty sediments.

A.3.3.1.25 A statistically significant negative correlation was also observed between station depth and number of individuals. This result supports the information presented in Figures A-10 through A-13 on the relationship between depth and number of individuals within the disposal site.

A.3.3.2 Summary

The results presented in this section indicate the existence of differences in the benthic infaunal commuity between the reference- and disposal-area sampling sites and between sampling sites within the disposal area. Graphical and statistical methods were used to demonstrate the existence of elevated values at the reference site for three community indices (Diversity, Species Richness and Number of Taxa). Statistically, significant differences in both number of taxa and number of individuals were also identified between stations within the disposal site. Numerical classification analysis was used to identify consistent differences in the infaunal community characteristics between the reference and disposal sites. These differences were related to both the occurrence and abundance of dominant infaunal taxa.

A.3.3.2.1 These observed biological differences were attributed to differences in sediment grain-size characteristics and sampling depth. There was no evidence that the observed biological differences were related to the accumulation of toxics (i.e., metals) within the sediment. The major difference in the sediment characteristics between the reference and disposal sites was the greater percentage of sand in the disposal-site sediments. Based on the modling results of the dredge-spoil plume during dumping (Appendix C), the deposition of sand sediments within the disposal site is possible. However, given the differences of sediment grain-size characteristics within the disposal site and the lack of information on the specific location of dumping activities there is insufficient evidence to attribute observed biological differences to dredge-spoil dumping.

A.3.4 DEMERSAL FISH AND EPIBENTHIC MACROINVERTEBRATES

A complete list, enumerated by species, of fish and invertebrates captured in otter trawls at the LA 5 disposal and reference sites during each of the four sampling periods is provided in Appendix B, Table B-4. The following sections summarize the discuss these data in a manner commensurate with the non-quantitative nature of the sampling. Because the primary purpose of the trawling was to collect animals for tissue contaminant analysis, we did not attempt to sample in a rigorous quantitative manner (by carefully measuring the area swept by each trawl, for example). Therefore, the data cannot support detailed quantitative analysis of density, diversity, biomass, etc. The data can be used, however, to characterize in general the fish and epibenthic macrinvertebrate fauna of the sites by assessing major trends and patterns in principal species present, number of species, and overall abundance.

A.3.4.1 Demersal Fish

A.3.4.1.1 Overall Characterization. Table A-29 shows principal species, number of species and total number of individuals of demersal fish captured in otter trawls at the LA 5 disposal and reference sites, broken down by sampling period (season) and depth of trawl station. In all, sampling at these two sites produced 45 species representng 19 families. Miller and Lea (1972) list 481 species in 129 families as occurring in southern California (Pt. Conception to Mexican border). Earlier, more extensive studies of demersal fish have reported 213 species in 66 families (Horn, 1974 and 121 species in 41 families (SCCWRP, 1973). The present study, therefore, represents a minority of the southern California demersal fish fauna, which is not surprising considering the limited depth range (135-186m) and duration (64 mostly 5-minute trawls) of the sampling.

A.3.4.1.2 In terms of species composition, the trawl catch was dominated by flatfish (primarily family Pleuronectidae) and rockfish (Scorpaenidae) (Table B-4). Numerically, one species, the slender sole (Lyopsetta exilis) was particularly dominant, accounting for almost half of the total individuals caught (2,176 of 4,2525). The slender sole was also very frequently encountered, occurring in 61 of the 64 trawls, indicating a widespread distribution. The Pacific sanddab (Citharichthys sordidus) was the second most abundant species (680 in 29 trawls). Two additional species, although not so abundant as the slender sole and the Pacific sanddab, occurred in a large number of trawls: the shortspine combfish (Zaniolepis frenata) (177 in 53 trawls); and the Dover sole (Mircostomus pacificus) (199 in 47 trawls). These two species thus appear to be widely distributed but not generally abundant. Other commonly caught species were the stripetail rockfish (Sebastes saxicola), the halfbanded rockfish (Sebastes semicintus), the rosethorn rockfish (Sebastes helvomaculatus), the plain-fin midshipman (Porichthys notatus), and the pink seaperch (Zalembius rosaceus). All of the above species are well-known common components of the mid-depth demersal fish fauna of southern California (Horn, 1974; SCCWRP, 1973; Stephens, 1973; Moore et al., 1983). Based on the results of previous studies, the shortspine combfish and the slender sole were perhaps more abundant than would be expected, while the striptail rockfish, the yellowchin sculpin (Icelinus quadriseriatus), and the California tonguefish (Symphurus atricauda) are perhaps under-represented (Table B-4).

A.3.4.1.3 Variations with Depth. There appears to be no depth-related trend in number of species caught at either site, and there is no trend in total abundance at the disposal site (Table A-29). At the reference site, however, there is some evidence for greater abundance at the shallow station (135 m) that the other stations: the greatest number of fish were caught at the shallow station during each of the four surveys. The lack of any strong depth-related trends in the data is not surprising considering the relatively small depth range (135-186 m) involved.

A.3.4.1.4 Regarding principal species, the slender sole tends to be most dominant at the deep stations (186 m). This is largely due to a generally decreasing abundance of other principal species, although the Pacific sanddab

TABLE A-29. SUMMARY OF FISH CAUGHT IN OTTER TRAWLS AT LA 5 DISPOSAL AND REFERENCE SITES. Two replicate trawls are combined for each station. Numbers in parentheses are for all three mid-depth stations combined.

AUGUST 1983

	DISPOSAL SITE			REFERENCE SITE		
	Principal Species	Number of Species	Number of Individuals	Principal Species	Number of Species	Number of Individuals
Shallow Station (135 m)	Citharichthys sordidus Pacific sanddab Sebastes semicinctus Halfbanded rockfish	12	96	Citharichthys sordidus Pacific sanddab Sebastes saxicola Stripetail rockfish Zalembius rosaceus pink surfperch	20	407
Mid-Depth Station (168 m)	Lyopsetta exilis Slender sole Zaniolepis frenata Shortspine combfish Sebastes saxicola Stripetail rockfish	10 (23)	90 (210)	Citharichthys sordidus Pacific sanddab Lyopsetta exilis Slender sole	15	330
Deep Station (186 m)	Lyopsetta exilis slender sole	12	363	Citharichthys sordidus Pacific sanddab	16	246
Overall Site	Lyopsetta exilis Slender sole Sebastes saxicola Stripetail rockfish	18 (24)	549 (669)	Citharichthys sordidus Pacific sanddab Lyopsetta exilis Slender sole	23	983

TABLE A-29, Cont'd.

DECEMBER 1903

	DISPOSAL SITE Principal Species	Number of Species	Number of Individuals	REFERENCE SITE Principal Species	Number of Species	Number of Individuals
Shallow Station (135 m)	*Lyopsetta exilis* Slender sole	12	73	*Lyopsetta exilis* Slender sole *Citharichthys sordidus* Pacific sanddab	16	752
Mid-Depth Station (168 m)	*Lyopsetta exilis* Slender sole	14 (17)	172 (640)	*Citharichthys sordidus* Pacific sanddab *Lyopsetta exilis* Slender sole	19	79
Deep Station (186 m)	*Lyopsetta exilis* Slender sole	14	74	*Citharichthys sordidus* Pacific sanddab *Lyopsetta exilis* Slender sole	11	98
Overall Site	*Lyopsetta exilis* Slender sole	18 (20)	319 (787)	*Citharichthys sordidus* Pacific sanddab *Lyopsetta exilis* Slender sole	24	929

TABLE A-29, Cont'd.

MARCH 1984

	DISPOSAL SITE Principal Species	Number of Species	Number of Individuals	REFERENCE SITE Principal Species	Number of Species	Number of Individuals
Shallow Station (135 m)	Lyopsetta exilis Slender sole	11	89	Lyopsetta exilis Slender sole Citharichthys sordidus Pacific sanddab	11	115
Mid-Depth Station (168 m)	Lyopsetta exilis Slender sole Lycodopsis pacifica Blackbelly eelpout	10 (12)	55 (220)	Lyopsetta exilis Slender sole Sebastes helvomaculatus Rosethorn rockfish Microstomus pacificus Dover sole	13	102
Deep Station (186 m)	Lyopsetta exilis Slender sole	9	59	Lyopsetta exilis Slender sole	10	56
Overall Site	Lyopsetta exilis Slender sole	15 (15)	203 (360)	Lyopsetta exilis Slender sole	18	273

TABLE A-29, Cont'd.

MAY 1984

	DISPOSAL SITE Principal Species	Number of Species	Number of Individuals	REFERENCE SITE Principal Species	Number of Species	Number of Individuals
Shallow Station (135 m)	*Lyopsetta exilis* Slender sole *Microstomus pacificus* Dover sole	7	79	*Lyopsetta exilis* Slender sole *Citharichthys sordidus* Pacific sanddab	7	37
Mid-Depth Station (165 m)	*Lyopsetta exilis* Slender sole *Sebastes semicinctus* Halfbanded rockfish	4 (8)	56 (301)	*Lyopsetta exilis* Slender sole	6	19
Deep Station (186 m)	*Lyopsetta exilis* Slender sole	9	54	*Lyopsetta exilis* Slender sole	6	26
Overall Site	*Lyopsetta exilis* Slender sole	11 (11)	189 (434)	*Lyopsetta exilis* Slender sole	10	82

TABLE A-29, Cont'd.

ALL SURVEYS COMBINED

	DISPOSAL SITE Principal Species	Number of Species	Number of Individuals	REFERENCE SITE Principal Species	Number of Species	Number of Individuals
Shallow Station (135 m)	*Lyopsetta exilis* Slender sole	21	337	*Lyopsetta exilis* Slender sole *Citharichthys sordidus* Pacific sanddab	23	1,311
Mid-Depth Station (168 m)	*Lyopsetta exilis* Slender sole *Zaniolepis frenata* Shortspine combfish	19 (26)	318 (1,371)	*Lyopsetta exilis* Slender sole *Citharichthys sordidus* Pacific sanddab	29	530
Deep Station (186 m)	*Lyopsetta exilis* Slender sole	20	550	*Lyopsetta exilis* Slender sole *Citharichthys sordidus* Pacific sanddab	23	426
Overall Site	*Lyopsetta exilis* Slender sole	34 (37)	1,205 (2,258)	*Lyopsetta exilis* Slender sole *Citharichthys sordidus* Pacific sanddab	40	2,267

is frequently abundant in the trawls at the deep stations. No other depth-related trend in the distribution of the most common species is apparent.

A.3.4.1.5 Differences Between Disposal and Reference Sites. There is evidence that demersal fish are less abundant and diverse at the disposal site than at the reference site. More fish were caught at the reference site during 3 of the 4 surveys, and almost twice as many were caught there overall (2,267 vs. 1,205) (Table A-29).

These differences may be related to the disposal of dredged material, although the reason for lower catches at the disposal site is not clear. Infaunal benthic community density was greater at the disposal site stations during all four surveys than at almost all corresponding depth reference site stations (see Section A.3.3). Although the infaunal community at the disposal site could be separated from that at the reference site in many of the classification analyses there is nothing to support that disposal site organisms were unacceptable as prey to the fish community. Major differences were found in trawl epibiota density between the first two and last two surveys. Since fish abundance and diversity trends did not very similarly is it unlikely there is a direct relationship between epibiota density and fish catch. The difference in fish catch between disposal and reference sites may simply reflect avoidance of the disposal sites by some species and individuals as a response to the increased frequency of disturbance within the disposal site.

A.3.4.1.6 Regarding principal species, the Pacific sanddab (*Citharchthys sordidus*) is less abundant at the disposal site than at the reference site (Tables A-29 and B-4). The relation of this to disposal is not known, although the differences between the sites in benthic fauna could result in there being less suitable food for this species at the disposal site. No other differences between the two sites in abundance of principal species are apparent.

A.3.4.1.7 Seasonal Variation. In assessing seasonal differences, the inclusion of the August data is problematic because this survey employed 10-minute trawls, whie 5-minute trawls were used in the other surveys. Over the last three surveys, there is evidence of a decline in the number of species and number of fish caught at the both sites. This may indicate that demersal fish are more abundant at the sites in the fall than in the winter and spring, or may be the result of variation in the effectiveness of the trawls, which is known to be sensitive to small changes in operating procedures.

A.3.4.1.8 The slender sole (*Lyopsetta exilis*) is more dominant in the December 1983 trawls than in the following two surveys, primarily due to an increase in its abundance rather than lower abundance of other species (Table B-4). This may indicate movement by the slender sole into this site in the fall, and movement out by February-March.

A.3.4.2 Epibenthic Macroinvertebrates

The two most commonly used methods of sampling benthic fauna are grab/core samplers, and trawls. Grabs and cores are used primarily to sample infauna, while trawls are used to sample demersal fish and, somewhat incidentally, epibenthic fauna. The two methods produce vary different results, as can be seen by comparing species lists from grab/core studies in the Southern California Bight such as Fauchald and Jones (1979) and Jones (1979) to those from trawl studies such as those conducted by the Southern California Coastal Water Research Project (SCCWRP, 1973; Moore et al., 1983). Therefore, it is not worthwhile to compare the present data to results from grab/core studies, and these data will be compared only to results from previous trawl studies in the region.

A.3.4.2.1 Overall Characteristization. Table A-30 shows principal species, number of species, and number of individuals of epibenthic micrinvertebrates captured in otter trawls at the LA 5 disposal and reference sites, broken down by sampling period (season) and depth of trawl station. In all, sampling at these two sites produced 98 species. Extensive trawling by SCCWRP (Moore et al., 1983) produced over 500 species. The comparatively limited results of the present study are not surprising considering the limited depth range (135-186 m) and duration (64 most of which were 5-minute trawls) of the sampling.

A.3.4.2.2 The trawls were dominated by crustaceans and echinoderms in both species composition and abundance (Table A-30). Five species dominated the catch in terms of abundance. The sea urchins Lytechinus pictus (4,128 individuals in 31 of 64 trawls) and Allocentrotus fragilis (1,280 in 38 trawls), the shrimps Crangon zacae (1,389 in 42 trawls) and Sicyonia ingentis (1,091 in 31 trawls), and the decapod crustacean Pleuroncodes planipes (3,163 in 37 trawls). Together, these caught account for 86 percent of the total number of macroinvertebrates caught in the trawls.

A.3.4.2.3 Pleuroncodes planipes, often referred to as the "red crab," is a primarily pelagic species brought into southern California water by warm water masses moving in from the south. It is abundant only when such a water mass makes a major intrusion in the area, usually in the summer, as happened in the summer of 1983 during the "El Nino" phenomenon. During most summers, P. planipes occurs in the Southern California Bight in low numbers, but its presence in large numbers in an infrequent, somewhat anomalous condition. This is reflected by the fact that, even during "El Nino", P. planipes was abundant in only one of this study's trawls. Twenty-nine hundred (2,900) P. planipes were caught in a trawl at Station 3 (mid-depth) at the disposal site in August 1983. Although P. planipes is primarily pelagic, it also adopts a benthic existence at 2-3 years of age. Therefore, it is possible that the P. planipes in this trawl were caught on the bottom, in the water column as the trawl descended or ascended, or a combination of both. (Individuals caught were not aged.) Discounting this trawl, P. planipes appears to be a widely distributed but not very abundant species (263 in 36 trawls).

A.3.4.2.4 Discounting the 2,900 P. planipes in this one trawl, the other four species listed above represent 79 percent of the trawl catch by abundance during all the surveys. These four species are common components of trawl

TABLE A-30. SUMMARY OF MACROINVERTEBRATES IN OTTER TRAWLS FROM LA 5 DISPOSAL AND REFERENCE SITES.
Two trawls at each station are combined.
Numbers in parentheses are for all three mid-depth stations combined.

AUGUST 1983

DISPOSAL SITE

	Principal Species	Number of Species	Number of Individuals
Shallow Station (135 m)	*Lytechinus pictus* sea urchin	24	1,307
Mid-Depth Station (168 m)	*Pleuroncodes planipes* crab *Sicyonia ingentis* shrimp *Crangon zacae* shrimp *Ophiura lutkeni* brittlestar	19 (24)	614 (4,020)
Deep Station (186 m)	*Crangon zacae* shirmp *Sicyonia ingentis* shrimp	20	363
Overall Site	*Crangon zacae* shrimp *Sicyonia ingentis* shrimp *Lytechinus pictus* sea urchin	36 (38)	2,284 (5,690)

REFERENCE SITE

	Principal Species	Number of Species	Number of Individuals
Shallow Station (135 m)	*Lytechinus pictus* sea urchin *Sicyonia ingentis* shrimp	5	1,259
Mid-Depth Station (168 m)	*Sicyonia ingentis* shrimp *Pleuroncodes planipes* crab *Lytechinus pictus* sea urchin	11	251
Deep Station (186 m)	*Sicyonia ingentis* shrimp *Astropecten verrilli* seastar *Pandalus platyceros* shrimp *Gorgonocephalus eucnemis* basket star	14	178
Overall Site	*Sicyonia ingentis* shrimp *Lytechinus pictus* sea urchin	20	1,688

TABLE A-30, Cont'd.

DECEMBER 1983

	DISPOSAL SITE Principal Species	Number of Species	Number of Individuals	REFERENCE SITE Principal Species	Number of Species	Number of Individuals
Shallow Station (135 m)	*Lytechinus pictus* sea urchin	23	548	*Allocentrotus fragilis* sea urchin *Sicyonia ingentis* shrimp *Crangon zacae* shrimp	16	955
Mid-Depth Station (168 m)	*Allocentrotus fragilis* sea urchin *Crangon zacae* shrimp	20 (30)	215 (828)	*Allocentrotus fragilis* sea urchin	18	60
Deep Station (186 m)	*Crangon zacae* shrimp *Ophiura lutkeni* brittlestar	22	260	*Lytechinus pictus* sea urchin *Crangon zacae* shrimp	19	92
Overall Site	*Crangon zacae* shrimp	41 (46)	1,023 (1,636)	*Allocentrotus fragilis* sea urchin *Crangon zacae* shrimp	34	1,107

TABLE A-30, Cont'd.

MARCH 1984

	DISPOSAL SITE			REFERENCE SITE		
	Principal Species	Number of Species	Number of Individuals	Principal Species	Number of Species	Number of Individuals
Shallow Station (135 m)	*Parastichopus californicus* sea cucumber *Sicyonia ingentis* shrimp	13	25	*Lytechinus pictus* sea urchin *Sicyonia ingentis* shrimp	11	354
Mid-Depth Station (168 m)	*Sicyonia ingentis* shrimp *Allocentrotus fragilis* sea urchin *Crangon zacae* Shrimp	16(23)	337(1,184)	*Crangon zacae* Shrimp	17	62
Deep Station (186 m)	*Allocentrotus fragilis* sea urchin	11	152	*Lytechinus pictus* sea urchin *Crangon zacae* shrimp	10	54
Overall Site	*Allocentratus fragilis* sea urchin *Sicyonia ingentis* shrimp	25 (31)	614(1,361)	*Lytechinus pictus* Sea urchin *Crangon zacae* Shrimp	26	470

TABLE A-30, Cont'd.

MAY 1984

	DISPOSAL SITE			REFERENCE SITE		
	Principal Species	Number of Species	Number of Individuals	Principal Species	Number of Species	Number of Individuals
Shallow Station (135 m)	Lytechinus pictus sea urchin	9	117	Lytechinus pictus sea urchin Sicyonia ingentis shrimp	6	201
Mid-Depth Station (168 m)	Ophiura lutkeni brittlestar Crangon zacae shrimp Allocentrotus fragilis sea urchin	12 (23)	50 (334)	Crangon zacae shrimp Lytechinus pictus sea urchin	10	174
Deep Station (186 m)	Crangon zacae shrimp	15	63	Sicyonia ingentis shrimp	4	51
Overall Site	Crangon zacae shrimp	22 (27)	230 (514)	Lytechinus pictus sea urchin Sicyonia ingentis shrimp Crangon zacae shrimp	13	426

TABLE A-30, Cont'd.

ALL SURVEYS COMBINED

	DISPOSAL SITE Principal Species	Number of Species	Number of Individuals	REFERENCE SITE Principal Species	Number of Species	Number of Individuals
Shallow Station (135 m)	Lytechinus pictus sea urchin	36	1,997	Sicyonia ingentis shrimp Lytechinus pictus sea urchin	23	2,769
Mid-Depth Station (168 m)	Crangon zacae shrimp Allocentrotus fragilis sea urchin Sicyonia ingentis shrimp Ophiura lutkeni brittlestar	33 (44)	1,216 (6,366)	Lytechinus pictus sea urchin Crangon zacae shrimp	35	547
Deep Station (186 m)	Crangon zacae Shrimp	46	838	Lytechinus pictus sea urchin Crangon zacae shrimp Sicyonia ingentis shrimp	30	375
Overall Site	Crangon zacae Shrimp Sicyonia ingentis Shrimp Allocentrotus fragilis Sea urchin	86	4,051 (9,201)	Lytechinus pictus sea urchin Crangon zacae shrimp Sicyonia ingentis shrimp	48	3,691

samples from the region (SCCWRP, 1973; Moore et al., 1983), but they do not generally dominate to the extent they did in our trawls. The other abundant species in the trawls are also common benthic invertebrates of the region: the shrimp Pandalus platyceros, the brittlestar Ophiura lutkeni, and the basket star Gorgonocephalus eucnemis. Species that occured frequently in the trawls but usually in low numbers included Octopus sp., the shrimp Crangon resima, the nudibranch Pleurobranchaea californica, the brittlestar Ophiacantha diplasia, the sea cucumber Parastichopus californicus, and the seastars Astropecten verrilli and Luidia fiololata.

A.3.4.2.5 Variation with Depth. There is no clear depth-related trend in number of species at either site, but there is a clear pattern of decreased abundances in trawls with depth, particularly at the reference site (Table A-30). Many more invertebrates were caught at the shallow (135 m) station than at the deeper stations. Trawl studies by SCCWRP (Word and Mearns, 1977; Moore et al., 1983) have shown increasing epibenthic invertebrates abundance and diversity with depth, but over a much larger depth range than the present study (all present stations are within the mid-depth category, 50-199 m, of Moore et al. (1983)). The relatively small depth range encompassed by the present study limits the assessment of depth-related trends. There are no apparent depth-related patterns in the distribution of the principal species, except that the shrimp Crangon zacae was seldom abundant at the shallow stations.

A.3.4.2.6 Differences Between Disposal and Reference Sites. There is little evidence for a difference between the disposal and reference site in abundance of invertebrates, but more species were caught at the disposal site during 3 of the 4 surveys, during 11 of 12 stations samplings, and over all surveys combined (86 vs. 48). If the epibenthic macroinvertebrate infauna is in fact more diverse at the disposal site, it seems unlikely to be a result of disposal (infauna show the opposite pattern) and is most likely due to environmental factors (heterogeneity of habitat type, for example) not related to disposal.

A.3.4.2.7 Among the principal species, Crangon zacae is more common at the disposal site, while Sicyonia ingentis is more common at the reference site (Table A-30). Since these are both shrimp, this may be an instance of niche replacement, with unknown relation to disposal. The other principal species are approximately equally prevalent at the two sites.

A.3.4.2.8 Seasonal Variation. In assessing seasonal trends, the inclusion of the August survey data is problematical because this was the only survey which employed 10-minute trawls. As with the fish data, there is evidence for declining abundance and number of species over the last three surveys. This may indicate epibenthic invertebrates are more abundant at these sites during the fall than the winter and spring, although such a rapid change in abundance seems less plausible for invertebrates than for the more mobile fish. Because the demersal fish at these sites feed on epibenthic fauna as well as infauna, a decrease in abundance of epifauna could be at least part of the cause for decrease in fish abundance. Another explanation for concomitant decrease in fish and and invertebrates caught is variation in trawl effectiveness, as discusssed in A.3.4.1.7. All four of the most abundant species also decrease in abundance in the trawls over the last three surveys.

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DRAFT
ENVIRONMENTAL IMPACT STATEMENT

FINAL DESIGNATION OF A
DREDGED MATERIAL DISPOSAL SITE
OFF OF SAN DIEGO, CALIFORNIA

San Diego County, California

APPENDIX B
DETAILED FIELD SURVEY DATA

AVAILABLE UPON REQUEST

U.S. ENVIRONMENTAL PROTECTION AGENCY

DRAFT
ENVIRONMENTAL IMPACT STATEMENT

FINAL DESIGNATION OF A
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APPENDIX C
NUMERICAL SIMULATION
OF
DREDGED MATERIAL DISPOSAL

U.S. ENVIRONMENTAL PROTECTION AGENCY

APPLICATION OF THE INSTANTANEOUS DUMP DREDGED MATERIAL DISPOSAL MODEL TO THE DISPOSAL OF SAN DIEGO HARBOR MATERIAL AT THE 45 FATHOM (LA 4) AND 100 FATHOM (LA 5) DISPOSAL SITES

By
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DISCUSSION OF DREDGED MATERIAL DISPOSAL MODELS AND THEIR APPLICATION FOR THE LOS ANGELES DISTRICT

PART I: INTRODUCTION

1. In August 1979, the Los Angeles District of the U.S. Army Corps of Engineers (LAD) requested that the Waterways Experiment Station (WES) provide assistance in determining the fate of dredged material after open water disposal at the San Diego 45 and 100 fathom disposal sites shown in Figure 1.

2. Under the Dredged Material Research Program (DMRP) of the U.S. Army Corps of Engineers, two numerical models have been developed by Tetra Tech, Inc. to provide the DMRP with tools to predict the short-term fate of dredged material discharged in the estuarine environment.[1] One model is for an instantaneous dump disposal and the other is for a continuous fixed (pipeline) or moving discharge. The development of these models was based upon the Environmental Protection Agency's Koh-Chang model for the barged ocean disposal of wastes.[2]

3. A major assumption in the models is that once material is deposited on the bottom, it remains there; i.e., neither erosion nor bed load movement of material is allowed. This is the primary theoretical limitation of the models that restricts their usefulness to the study of the short-term fate of discharged material, other than computer-related operational constraints.

4. The models have been applied to data collected by Gordon during a barge disposal operation in the Duwamish Waterway in the State of Washington and a hopper dredge disposal operation in Lake Ontario.[3] Although the models have not undergone sufficient calibration of the many coefficients contained within and a subsequent verification using these data to warrant confidence in a quantitative sense, the limited calibration and in-depth evaluation presented in reference 4 do justify confidence in a qualitative sense, especially if the material is properly characterized, and the models are judiciously applied to adequately represent a real disposal operation. A brief discussion of

the theoretical structure of the models along with the input data required and output provided are presented below.

PART II: THEORETICAL DEVELOPMENTS

5. In both models, the behavior of the dumped material is assumed to be separated into three phases: convective descent, during which the dump cloud or discharge jet falls under the influence of gravity; dynamic collapse, occurring when the descending cloud either impacts the bottom or arrives at the level of neutral buoyancy at which descent is retarded and horizontal spreading dominates; and long-term passive dispersion, commencing when the material transport and spreading is determined more by ambient currents and turbulence than the dynamics of the disposal operation. Figure 2 illustrates these phases for the instantaneous dump model.

Convective Descent

6. In the instantaneous dump model, a single cloud is assumed to be released which maintains a hemispherical shape during convective descent. Since the solids concentration in dredged material is usually low, the cloud is expected to behave as a dense liquid and thus a basic assumption is that a bouyant thermal analysis is appropriate. The equations governing the motion are those for conservation of mass, momentum, buoyancy, solid particles, and vorticity. These equations are straightforward statements of conservation principles and will not be presented here. In the continuous discharge model, the flow phenomenon near the discharge opening is that of a sinking momentum jet in a cross current. Basic assumptions in the formulation of the conservation equations for the jet convection phase are that the jet cross section remains circular and that velocity, density, and material concentration distributions may be approximated by "top-hat" profiles.

Dynamic Collapse

7. During convective descent, the dumped material cloud or jet grows as a

result of entrainment and eventually either the bottom is encountered or the density difference between the discharged material and the ambient becomes small enough for a position of neutral buoyancy to be assumed. In either case, the vertical motion is arrested and a dynamic spreading in the horizontal occurs. With the exception of vorticity, which is assumed to have been dissipated by the stratified ambient, the same conservation equations used in convective descent but now written for the particular shapes assumed in dynamic collapse are applicable. For the case of collapse on the bottom, the only difference is the inclusion of a frictional force between the bottom and the collapsing cloud.

Passive Dispersion

8. When the rate of horizontal spreading in the dynamic collapse phase becomes less than an estimated rate of spreading due to turbulent diffusion, the collapse phase is terminated. During collapse, solid particles can settle as a result of their fall velocity. As these particles leave the main body of material, they are stored in small clouds which are characterized by a uniform concentration, thickness, and position in the water column. these small clouds are then allowed to settle and disperse until they become large enough to be inserted into the long-term two-dimensional passive dispersion grid positioned in the horizontal plane. Once small clouds are inserted at particular net points, those net points then have a concentration, thickness, and top position associated with them. This is the manner in which the three-dimensional (3-D) nature of the problem is handled on a 2-D grid. Figure 3 illustrates a typical concentration profile at a net point. Computations on the passive dispersion grid are made using Fisher's backward convection concept rather than attempting a numerical solution of the governing convection-diffusion equation. In the backward convection solution technique, a massless particle at each net point at the present time level is moved backward in time by the ambient current to the position it occupied one time step before. The concentration at the net point it presently occupied is then taken as a five-point average of the points surrounding its old position (see Figure 3).

9. In addition to the horizontal convection and diffusion of material, settling of the suspended solids also occurs. Therefore, in addition to computing a concentration profile at each net point, the amount of solid material deposited on the bottom and a corresponding thickness is also determined. A basic assumption in the models is that once material is deposited on the bottom it remains there, i.e., neither erosion nor bed load movement of material is allowed. This is the primary theoretical limitation of the models that restricts their usefulness to the study of the short-term fate of discharged material.

Model Input Requirements

10. Input data required for the operation of the model can be grouped into (a) a description of the ambient environment at the disposal site, (b) characterization of the dredged material, (c) data describing the disposal operation, and (d) model coefficients. Each is discussed in the following paragraphs.

11. The first task to be accomplished when applying the models is that of constructing a horizontal long-term grid over the disposal site. The number of grid points should be kept as small as possible but large enough to extend the grid beyond the area of interest at the level of spatial detail desired. Quite often, it may be desirable to change the horizontal grid after a few preliminary runs. Water depths and horizontal components of the ambient current must be input at each net point. Either of the three options of velocity input illustrated in Figure 4 may be selected, with the simplest case being velocities at a constant depth disposal site. The ambient density profile at the deepest point in the disposal site must also be input. This profile may vary with time but is assumed to be the same at each net point of the grid.

12. The dredged material can be composed of up to 12 solid fractions, a fluid component, and a conservative chemical constituent, if desired. For each solid type, its concentration by volume, density, fall velocity, voids ratio and an indicator as to whether or not it is cohesive must be input. Proper material characterization is extremely

important in obtaining realistic predictions from the models. For example, field observations have shown that the majority of the solids settle to the bottom of the hoppers in the case of a hopper dredge disposal with the resulting density of the upper portion of the hopper being almost that of the ambient water. If a conservative chemical constituent is to be traced, its initial concentration and a background concentration must be given. In addition, the bulk density and aggregate voids ratio of the dredged material must be prescribed.

13. For the bottom dump model, the position of the disposing vessel on the horizontal grid, the radius of the initial hemispherical cloud, the depth below the water surface at which the material is released, and the initial velocity of the cloud are required. Normally, the initial cloud radius is computed from the known volume of material. However, in some cases, it may be desirable to set the radius from geometrical considerations, e.g., the vessel width. If this is the case, the bulk density must be adjusted to reflect the initial dilution making sure the resulting cloud contains the exact amount of solid material contained within the vessel. For the continuous discharge model, the initial position of the discharge, the vessel's course and speed if moving, the orientation and depth below the water surface of the discharge, the radius and flow rate of the initial discharge and the total discharge time must be input.

14. The models contain suggested average values for the many coefficients involved but the user may input other values, if desired. A brief sensitivity analysis of the more important coefficients in the instantaneous dump model is discussed later.

Model Output

15. As previously noted, the discharged material is traced through three phases: convective descent, during which the dump cloud or discharge jet falls under the influence of gravity; dynamic collapse, occurring when the descending cloud either impacts the bottom or arrives at the level of neutral buoyancy at which descent is retarded and horizontal spreading dominates; and long-term passive dispersion, commencing when

the material transport and spreading is determined more by ambient currents and turbulence than the dynamics of the disposal operation. Output from the models in both tabular and plotted form describing the movement of the material through each of these phases is provided.

16. The time history position in the water column, velocity, and size of the cloud or jet plume is provided at the end of both the convective descent and collapse phases. In addition, the volume of solids and their corresponding concentrations as well as the density difference between the discharged material and the ambient are provided. As a guide in determining dilution rates, the time history of the conservative chemical constituent concentrations is also furnished.

PART III: INPUT DATA FOR MODEL APPLICATIONS AT THE SAN DIEGO DISPOSAL SITES

The Disposal Operations

17. A major problem when attempting to apply the numerical disposal models to actual disposal operations is that of representing the "real world" operation by the idealized conditions assumed in the models. Disposal operations can be approximated in one of three ways within the current structure of the instantaneous dump model. First, the model can be applied to a single bin of a disposal vessel with the model output multiplied by the number of bins, i.e., the assumption is made that the separate dumps do not influence each other. The second method is to model the complete load as a single instantaneous dump. As a third way of modeling a disposal operation, material from one bin is modeled as a single instantaneous dump with material from the remaining bins "feeding" the bottom collapse of the cloud. This is accomplished by allowing the collapsing cloud to entrain material possessing the bulk density of the cloud from a single bin at the moment of bottom encounter. This is a modification which was made in order to handle the disposal from a stationary hopper dredge in Lake Ontario and is discussed in more detail in reference 4.

18. The disposal operation at both the 45 and 100 fathom sites is accomplished from a vessel with a total capacity of 1,500 yd^3. There are six separate bins of 250 yd^3 each. The disposal vessel is essentially stationary during the disposal operation with disposal alternating between forward and rear bins. Each bin contains a pair of bottom doors that are each 20 ft long and 5 ft wide. With such a bottom opening for the 250 yd^3 of material to pass through, the assumption of an instantaneous dump from each bin is probably a good assumption. In addition, since the entire load appears to be a sequence of six individual dumps as opposed to a more continuous operation in which the latter bins "feed" the bottom surge, it seems reasonable to assume that superposition holds. Thus, the disposal operation is modeled by considering the disposal of a single bin and assuming that the computed results can be multiplied by the number of bins to yield approximate results for the complete operation. In addition, since the LA District has indicated that a newer type of disposal vessel called a "split hull" barge might be used for future disposal operations, the complete load has also been modeled as a single instantaneous dump.

Disposal Site Information

19. The instantaneous dump model has been applied at both the 45 and the 100 fathom sites for both a summer and a winter ambient density profile (see Figures 5 and 6). The ambient current is represented by simple orthogonal velocity profiles for a constant depth (See Figure 4.a). The coordinate system has been oriented such that the X-coordinate lies along the direction of the current, i.e., 300° magnetic direction, therefore, the Z-velocity component is set to zero. These data, along with other input data, are presented in Tables 1 and 2 for the 45 and 100 fathom sites, respectively.

San Diego Harbor Material

20. Dredged material from North San Diego Bay is disposed at the 45 fathom site; whereas, the more polluted material from South San Diego Bay is

disposed at the 100 fathom site. Material dumped at the 45 fathom site is primarily sandy material. From information provided by the LA District, it was determined that the material to be disposed possesses a bulk density of 1.88 gm/cc and is composed of 46 percent sand and 12 percent silt by volume. Material from the South Bay was determined to have a bulk density of 1.30 gm/cc and is composed of 3 percent sand and 15 percent silt.

Model Coefficients

21. Only a limited calibration of the dredged material disposal models based upon a comparison of computed results and field data has been conducted (reference 4). Since the ambient conditions in that study are quite different from those at the present disposal sites, it is not believed the values for the coefficients as determined in reference 4 are applicable here.

22. To provide some insight into the sensitivity of model results to various coefficients, a series of runs were made for an instantaneous dump of one bin of material at the 45 fathom site. It should be realized that the characteristics of the material being dumped as well as the depth of the disposal site have a great influence upon such sensitivity analyses.

23. The entrainment, drag and apparent mass coefficients in the convective descent phase, as well as the entrainment, drag and friction coefficients in the collapse phase, have been varied. In a series of tank tests, JBF Scientific[5] found that the three convective descent coefficients above are dependent upon the multiple of the liquid limit (MLL) of the material being dumped where the MLL increases as the cloud of material falls through the water column. In those tests, the entrainment coefficient α_0, was found to rapidly increase to a value of 0.285, corresponding to a MLL of 3. A much more gradual increase up to a value of 0.310 at a MLL of 10 was then observed. As indicated in Table 3, the model default value is 0.235. The convective descent drag coefficient was found from the tank tests to decrease from a value of about 1.0 at a MLL of 1 to a value of 0.25 as the MLL

increased to 3. Similarly, the apparent mass coefficient decreased from a value of 1.7 at a MLL of 1 to a value of about 0.40 as the MLL increased to 3. The default values of the convective descent drag coefficient, CD, and the apparent mass coefficient, CM, are 0.5 and 1.0, respectively (see Table 3).

24. As can be seen from Table 4, the computed results are fairly sensitive to α_0. The default value of 0.235 is probably okay at the moment of dump but should be increased as the cloud moves downward through the water column entraining ambient fluid with a corresponding increase of the MLL. Increasing α_0 above its default value results in the collapsing cloud rising from the bottom. Physically, it does not seem that such a phenomena should be allowed. Of course, one could adjust other coefficients to force the cloud to remain on the bottom with the higher values of α_0.

25. Decreasing the drag coefficient (CD) to 0.30 resulted in an execution mode error; whereas, increasing its value to 1.0 resulted in an initial rising of the cloud and a corresponding termination of the computations. Thus, it can be seen that for particular disposal operations the model does not operate over unlimited ranges of individual coefficients.

26. Several runs were made in which the entrainmnt (α_C), drag (C_{DRAG}) and friction (FRICTN) coefficients in the collapse phase were varied. Results from these runs are also presented in Table 4.

27. In summary, model results are of course dependent upon the values assumed for the coefficients. However, as demonstrated by the results presented in Table 4, model computations are not overly sensitive to any of the coefficients, i.e., relatively small changes in individual coefficients do not produce an order of magnitude change in the computed results. In addition, since there is no real justification for selecting values other than the default values, the default values presented in Table 3 were used for the modeling of the disposal operations discussed herein.

PART IV: MODEL RESULTS

28. As previously noted, the instantaneous dump model has been applied at each disposal site for both a single bin as well as a complete instantaneous dump for both a summer and a winter ambient density profile. As can be seen from Table 5, approximately 30 sec is required for a small dump to reach the ocean bottom at the 45 fathom site and about 4 minutes at the 100 fathom site. The corresponding times for the large dump are 16 sec and almost 2 minutes, respectively for the 45 and 100 fathom sites. As can be seen, the ambient density profile has little influence on the movement of the cloud through the water column. The major influence of the ambient density shows up through its influence on the vertical diffusion of the top of the concentration profile in the long-term diffusion phase. A very small density gradient will prohibit vertical diffusion; whereas, if the density gradient is zero, the position of the cloud top moves upward by an amount given by $2\sqrt{2K_y \Delta t}$, where K_y is the vertical diffusion coefficient and Δt is the long-term time step.

29. At both the 45 and 100 fathom sites, essentially all of the sand is deposited within 1,000 ft downstream of the dump. This is true for both small and large dumps under both summer and winter conditions (see Table 6).

30. From an inspection of Table 7, it can be seen that at the 45 fathom site 85 percent of the silt from a small dump will be deposited within about 2,200 ft downstream of the dump site for both a summer and a winter dump. Approximately the same results are obtained for a large dump under winter conditions. However, only about 65 percent is deposited within the same distance for a large summer dump. It appears this is because the top of the cloud has moved above the ambient stratification over the bottom 30 ft into the constant density regime (see Figure 5). The model now allows for a vertical growth which results in a larger distance for the silt particles to fall before deposition and thus less deposition within a given time frame.

31. At the 100 fathom site, all of the silt is deposited within a relatively short distance for both small and large dumps with the summer profile. This is because the stratification over the bottom 60 ft prohibits vertical growth and rapid deposition of the silt occurs. However, under the winter profile presented in Figure 6, vertical diffusion is allowed which results in only about 54 percent of the silt from a small dump being deposited within 1,600 ft downstream of the dumping point within 5,000 sec after the dump and about 85 percent from a large dump within the same spatial distance and time frame.

32. As indicated in Table 8, suspended silt concentrations are in the neighborhood of 10^{-5} to 10^{-6} gm/cc after 5,000 sec. It should be remembered that with superposition assumed, the concentrations presented for a small dump should be multiplied by six to reflect approximate results of the complete disposal operation. The suspended silt concentrations extend from the ocean floor upward as high as 150-170 ft, depending upon the ambient stratification near the bottom. After 5,000 sec, the leading edge of the suspended silt cloud at the 45 fathom site is about 3,600 ft from the dump point, except for the large summer dump where the distance is 5,400 ft. In this case, the cloud top has moved 150 ft into the water column which results in the centroid of the cloud being advected by a larger ambient velocity with a corresponding greater movement of the cloud in the direction of the current. Due to a much smaller ambient current at the 100 fathom site, the maximum extent of the leading edge of the cloud is only about 2,100 ft, after 5,000 sec.

33. As a final note, it should be remembered that particle fall velocities were used for both the sand and silt fractions. If the material had been assumed to contain clumps of cohesive material with much larger fall velocities, a corresponding larger percent of the solids would have been deposited within the time frame tested.

PART V: LIMITATIONS OF MODEL RESULTS

34. Two different disposal operations have been modeled. The first in essence consists of six individual dumps and is modeled by neglecting

the interaction of the separate dumps and assuming superposition applies. The other is a disposal from a "split hull" barge and is modeled by assuming the complete load is discharged essentially instantaneously. It should again be emphasized that a major problem in the use of the dredged material models is the representation of the actual disposal operation by the idealized conditions assumed in the models. Proper characterization of the material and specification of ambient conditions are also extremely important. For example, if a significant portion of the material had been composed of "clumps" with a fall velocity of perhaps 1.0 to 2.0 fps, the results would have been quite different as far as the percent of material deposited within a small distance from the dump. In addition, the ambient density gradient near the bottom is very important in determining the vertical diffusion of suspended sediment. A zero gradient allows for a rapid diffusion upward which in turn increases the probability of the suspended material being swept from the disposal site if the ambient current is significant. It is important to stress that quantitative reliance should not be placed in model predictions due to uncertainties associated with the specification of appropriate model coefficients, the ambient density profile, the characterization of the dredged material and the approximate method employed for representing the disposal operation. However, it is believed that model predictions do provide a qualitative picture of reality and should be useful in helping to assess the environmental impact of a disposal operation.

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2. Koh, R.C.Y. and Chang, Y.C., "Mathematical Model for Barged Ocean Disposal of Waste," Environmental Protection Technology Series EPA 660/2-73-029, December 1973, U.S. EPA, Washington, D.C.

3. Bokunierwicz, H.J. et al., "Field Study of the Mechanics of the Placement of Dredged Material at Open Water Disposal Sites," Technical Report D-78-7, U.S. Army Engineer Waterways Experiment Station, April 1978.

4. Johnson, B.H. and Holliday, B.W., "Evaluation and Calibration of the Tetra Tech Dredged Material Disposal Models Based on Field Data," Technical Report D-78-47, U.S. Army Engineer Waterways Experiment Station, August 1978.

5. Study by JFF Scientific Corporation, Wilmington, Massachusetts, for EPA at Corvallis, Oregon.

TABLE 1. INPUT DATA FOR 45 FATHOM SITE (LA4)

Number of grid points in Z-direction = 30

Number of grid points in X-direction = 30

Grid spacing = 50 ft and 300 ft (2 runs)

Water depth = 270 ft

Depth of discharge = 20 ft

Bulk density = 1.88 gm/cc

Long term time step = 1000 sec

Dump size = 250 yd^3 and 1500 yd^3 (2 runs)

Characterization of Material

Description	Density gm/cc	Concentration ft^3/ft^3	Fall Velocity ft/sec
Sand	2.6	0.46	0.07
Silt	2.6	0.12	0.01

Ambient Conditions

Depth ft	Density gm/cc Summer	Density gm/cc Winter	X-Velocity ft/sec	Z-Velocity ft/sec
0.0	1.025	1.025	1.8	0.0
60.0	1.025	1.025		
120.0	1.026	1.025	1.8	0.0
180.0	1.026	1.025		
240.0	1.026	1.026	1.0	0.0
270.0	1.027	1.026	0.0	0.0

TABLE 2. INPUT DATA FOR 100 FATHOM SITE (LA 5)

Number of grid points in Z-direction = 30

Number of grid points in X-direction = 30

Grid spacing = 50 ft and 300 ft (2 runs)

Water depth = 600 ft

Depth of discharge = 20 ft

Bulk density = 1.30 gm/cc

Long term time step = 1000 sec

Dump size = 250 yd^3 and 1500 yd^3 (2 runs)

Characterization of Material

Description	Density gm/cc	Concentration ft^3/ft^3	Fall Velocity ft/sec
Sand	2.6	0.03	0.07
Silt	2.6	0.15	0.01

Ambient Conditions

Depth ft	Density gm/cc		X-Velocity ft/sec	Z-Velocity ft/sec
	Summer	Winter		
0.0	1.025	1.025	0.49	0.0
60.0	1.025	1.025		
120.0	1.026	1.025		
180.0	1.026	1.025		
240.0			0.49	0.0
300.0		1.026		
540.0	1.026		0.18	0.0
600.0	1.027	1.026	0.0	0.0

TABLE 3. DEFAULT VALUES OF INSTANTANEOUS DUMP MODEL COEFFICIENTS

Coefficient	Default Value
α_o	0.235
β	0.0
Cm	1.0
CD	0.50
γ	0.25
CDRAG	1.0
CRFIC	0.01
CD_3	0.10
CD_4	1.0
α_c	0.001
FRICTN	0.01
FL	0.10
λ_H	0.005
λ_v	0.005

TABLE 4. SENSITIVITY ANALYSIS

Coefficients Varied						Computed Results							
α_o	C_M	C_D	α_c	C_{DRAG}	FRICTN	t_{CD}	R_{CD}	V_{CD}	t_{COll}	A_{COll}	b_{COll}	SV_{COll}	*
0.235	1.0	0.50	0.001	1.0	0.010	26.0	60.7	4.86	340	1.26	916	50	**
0.30	-	-	-	-	-	31.3	72.2	3.79	470	1.52	1082	34	***
0.40	-	-	-	-	-	39.5	88.9	2.78	572	1.98	1296	52	***
0.50	-	-	-	-	-	48.0	105.0	2.15	689	2.49	1479	65	***
-	-	0.30	-	-	-				Execution Error				
-	-	1.0	-	-	-				Rises Initially				
-	0.80	-	-	-	-				Rises Initially				
-	1.7	1.0	-	-	-	35.2	60.8	3.58	358	1.29	908	50	
-	-	-	0.0025	-	-	26.0	60.7	4.86	381	1.36	994	39	
-	-	-	0.005	-	-	"	"	"	443	1.52	1120	29	
-	-	-	0.010	-	-	"	"	"	585	1.82	1369	15	
-	-	-	0.020	-	-	"	"	"	769	2.36	1813	12	***
-	-	-	0.040	-	-	"	"	"	1134	3.36	2615	7	***
-	-	-	-	5.0	-	"	"	"	610	2.48	618	60	
-	-	-	-	-	0.10	"	"	"	343	1.32	891	54	
-	-	-	-	5.0	0.10	"	"	"	577	2.78	580	86	
-	-	-	0.040	5.0	0.10	"	"	"	1151	4.07	1128	21	****
-	-	-	0.040	5.0	0.075	"	"	"	1151	4.12	1088	22	****
-	-	-	0.040	5.0	0.005	"	"	"	1083	3.20	3371	7	***

*

α_o - Convective descent entrainment coeff

C_M - Apparent mass coeff

C_D - Convective descent drag coeff

α_c - Collapse entrainment coeff

C_{DRAG} - Collapse drag coeff.

FRICTN - Bottom friction coeff

t_{CD} - Time to bottom encounter, sec

R_{CD} - Radius of cloud at bottom, ft

V_{CD} - Velocity of cloud at bottom, fps

t_{COll} - Time to end of collapse, sec

A_{COll} - Max thickness at end of collapse, ft

b_{COll} - Cloud diameter at end of collapse, ft

SV_{COll} - Volume of solids in cloud at end of collapse, ft^3

** - Default values of coefficients
*** - Collapsing cloud has risen off bottom
**** - Collapse phase has not terminated and cloud is off bottom

TABLE 5. BOTTOM ENCOUNTER INFORMATION

Time (sec)	Radius (ft)	Velocity (ft/sec)	Site	Dump Type	Season
29.87	67.57	4.71	45 (LA 4)	Small	Summer
29.87	67.61	4.64	"	"	Winter
16.12	78.68	10.00	"	Large	Summer
16.00	78.45	10.02	"	"	Winter
230.00	139.29	1.26	100 (LA 5)	Small	Summer
258.40	138.89	1.06	"	"	Winter
107.33	150.43	2.93	"	Large	Summer
108.87	149.80	2.83	"	"	Winter

TABLE 6. DEPOSITION OF SAND*

Time (sec)	Radius (ft)	Centroid (ft)	% of Total	Site	Dump Type	Season
1000	465	165	100	45 (LA 4)	Small	Summer
1000	465	160	100	"	"	Winter
1000	650	123	100	"	Large	Summer
1000	650	131	100	"	"	Winter
1000	550	113	100	100 (LA 5)	Small	Summer
1010	450	180	80	"	"	Winter
2020	770	260	98	"	"	Winter
1000	775	85	100	"	Large	Summer
1000	775	80	98	"	"	Winter

* See Figure 7.

TABLE 7. DEPOSITION OF SILT*

Time (sec)	Radius (ft)	Centroid (ft)	% of Total	Site	Dump Type	Season
1000	495	150	24	45 (LA 4)	Small	Summer
2000	865	450	53	"	"	"
3000	1015	600	68	"	"	"
4000	1150	725	78	"	"	"
5000	1350	825	84	"	"	"
1000	520	150	24	45 (LA 4)	Small	Winter
2000	865	440	55	"	"	"
3000	1015	580	68	"	"	"
4000	1200	710	78	"	"	"
5000	1380	820	85	"	"	"
1000	845	70	38	45 (LA 4)	Large	Summer
2000	1220	210	53	"	"	"
3000	1445	315	59	"	"	"
4000	1665	420	62	"	"	"
5000	1870	520	65	"	"	"
1000	845	140	26	45 (LA 4)	Large	Winter
2000	1135	370	53	"	"	"
3000	1375	530	67	"	"	"
4000	1585	675	77	"	"	"
5000	1725	800	84	"	"	"
1000	585	175	60	100 (LA 5)	Small	Summer
2000	865	175	100	"	"	"
1010	500	190	6	100 (LA 5)	Small	Winter
2020	865	295	35	"	"	"
3030	985	320	45	"	"	"
4040	1110	350	50	"	"	"
5050	1210	365	54	"	"	"
1000	1095	115	91	100 (LA 5)	Large	Summer
2000	1395	115	100	"	"	"
1000	1095	145	65	100 (LA 5)	Large	Winter
2000	1395	150	79	"	"	"
3000	1405	155	82	"	"	"
4000	1405	160	84	"	"	"
5000	1405	160	85	"	"	"

* See Figure 7.

TABLE 8. SUSPENDED SILT INFORMATION*

Time (sec)	C_{MAX} (gm/cc)	D_{MAX} (ft)	T_{MAX}** (ft)	C_{MIN} (gm/cc)	D_{MIN} (ft)	T_{MIN}** (ft)	Site	Dump Type	Season
2000	4.7×10^{-5}	600	32	0.13×10^{-5}	1500	32	45 (LA 4)	Small	Summer
3000	2.6×10^{-5}	1200	33	0.08×10^{-6}	2400	33	"	"	"
4000	1.5×10^{-5}	1800	34	0.10×10^{-6}	3000	34	"	"	"
5000	9.6×10^{-6}	2400	32	0.13×10^{-6}	3600	32	"	"	"
2000	4.2×10^{-5}	600	33	0.10×10^{-5}	1500	33	45 (LA 4)	Small	Winter
3000	2.6×10^{-5}	1200	32	0.10×10^{-5}	2100	32	"	"	"
4000	1.5×10^{-5}	1800	31	0.10×10^{-6}	3000	31	"	"	"
5000	7.8×10^{-6}	2400	34	0.08×10^{-6}	3600	34	"	"	"
2000	6.8×10^{-5}	1200	31	0.08×10^{-5}	1800	31	45 (LA 4)	Large	Summer
3000	2.9×10^{-5}	1500	131	0.08×10^{-5}	2700	33	"	"	"
4000	2.2×10^{-5}	2400	152	0.03×10^{-6}	4200	33	"	"	"
5000	1.8×10^{-6}	3600	151	0.05×10^{-6}	5400	33	"	"	"
2000	14.3×10^{-5}	600	31	0.05×10^{-5}	1800	34	45 (LA 4)	Large	Winter
3000	9.1×10^{-5}	1200	33	0.10×10^{-5}	2400	33	"	"	"
4000	6.0×10^{-5}	1800	32	0.10×10^{-5}	3000	32	"	"	"
5000	3.9×10^{-5}	2100	32	0.08×10^{-5}	3600	31	"	"	"
725	18.1×10^{-5}	225	8.2	-	-	-	100 (LA 5)	Small	Summer
2000	0.0	-	-	-	-	-	"	"	"
2020	3.4×10^{-5}	300	64	0.03×10^{-5}	1200	58	100 (LA 5)	Small	Winter
3030	1.7×10^{-5}	300	94	0.18×10^{-6}	1500	102	"	"	"
4040	9.9×10^{-6}	600	129	0.10×10^{-6}	1800	137	"	"	"
5050	5.7×10^{-6}	900	167	0.08×10^{-6}	2100	172	"	"	"
891	15.6×10^{-5}	160	3.44	-	-	-	100 (LA 5)	Large	Summer
2000	0.0	-	-	-	-	-	"	"	"
2000	1.9×10^{-5}	0.0	63	0.10×10^{-6}	1500	52	100 (LA 5)	Large	Winter
3000	10.4×10^{-6}	300	93	0.03×10^{-6}	1800	87	"	"	"
4000	6.8×10^{-6}	300	126	0.03×10^{-6}	2100	133	"	"	"
5000	4.7×10^{-6}	600	162	0.16×10^{-6}	2100	167	"	"	"

* See Figure 8.

** T_{MAX} and T_{MIN} are the thickness of the maximum and minimum concentrations, respectively.

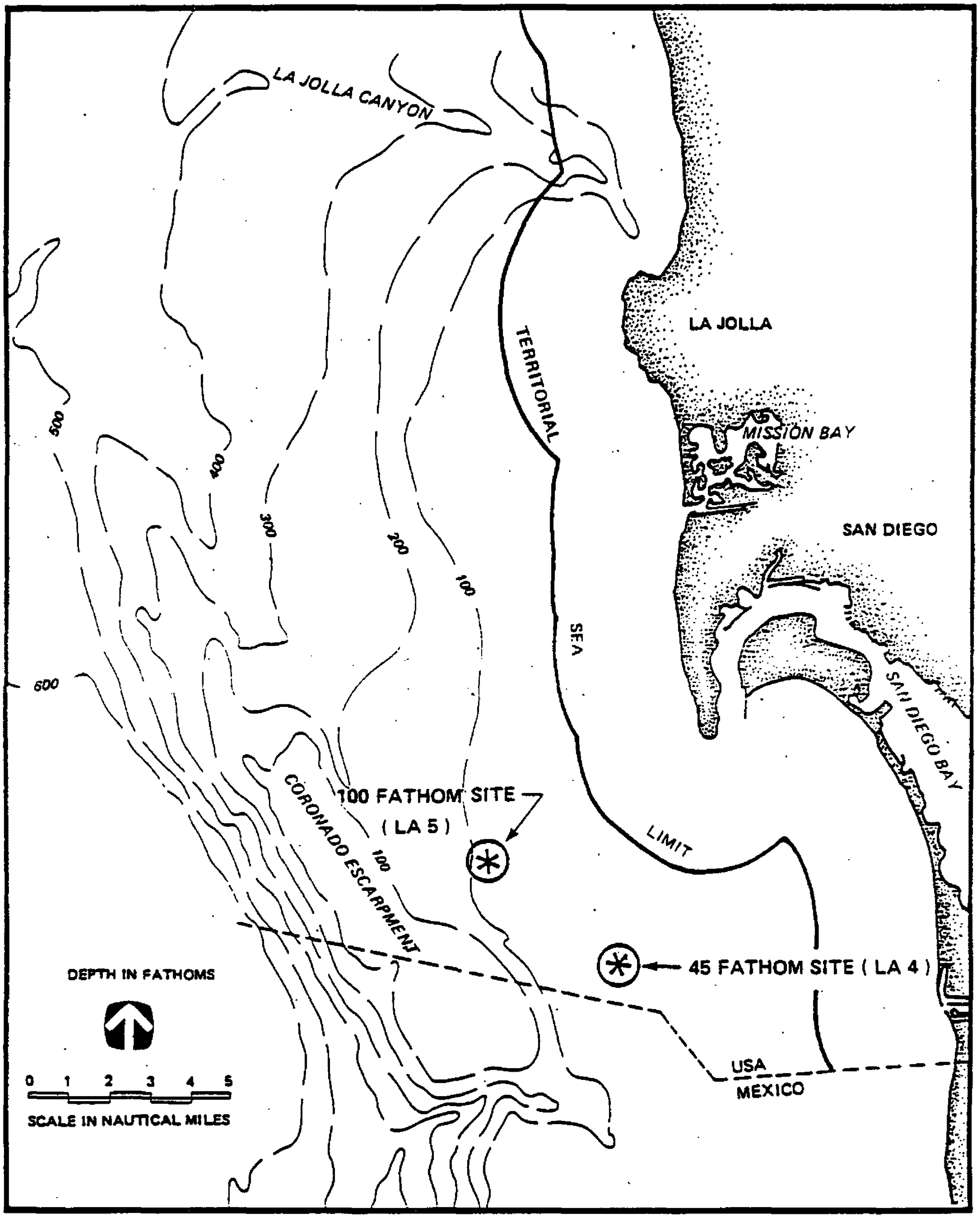


FIGURE 1 DISPOSAL SITES MODELLED

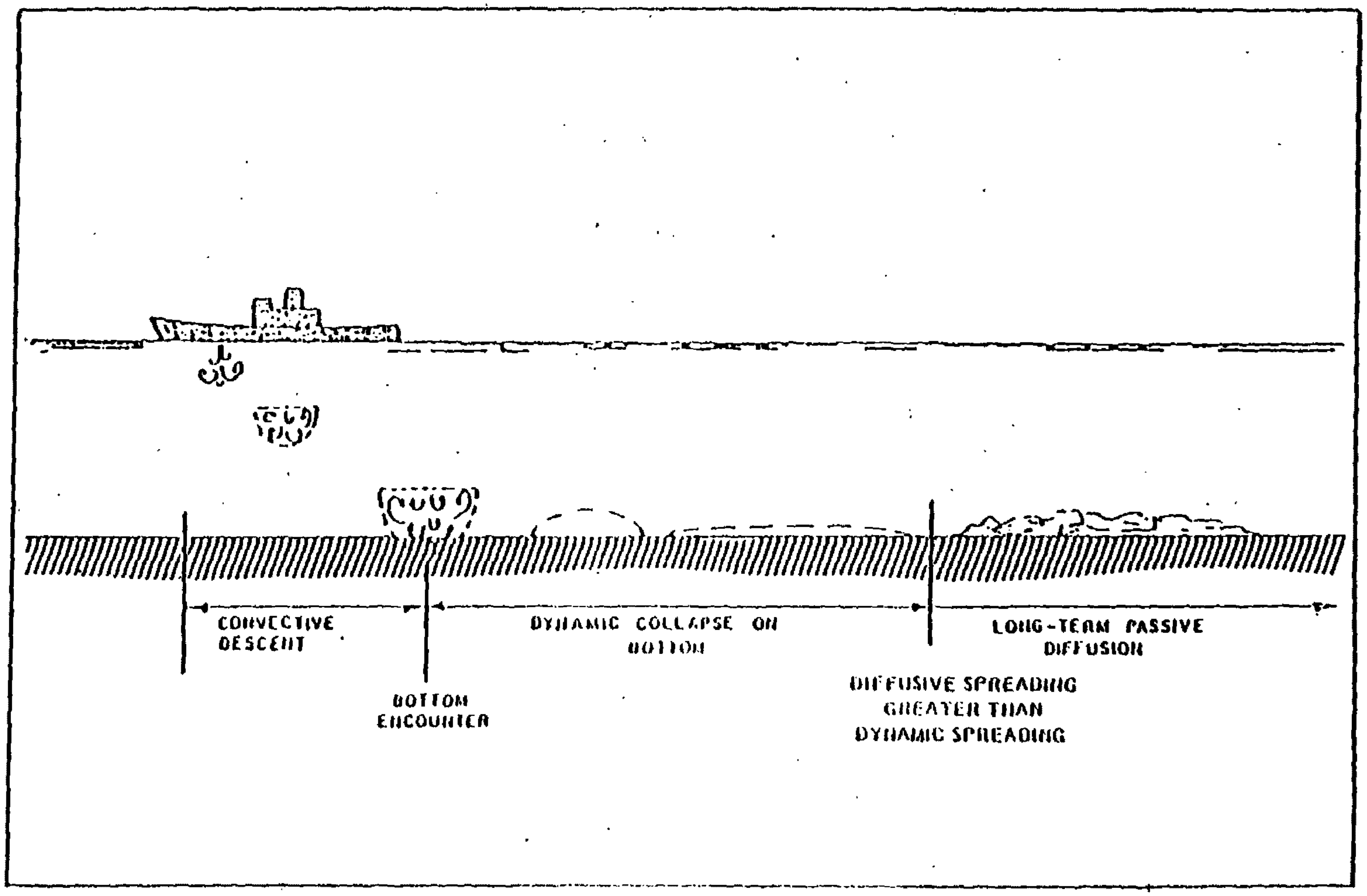


Figure 2. Illustration of idealized bottom encounter after instantaneous dump of dredged material (from Brandsma and Divoky[1])

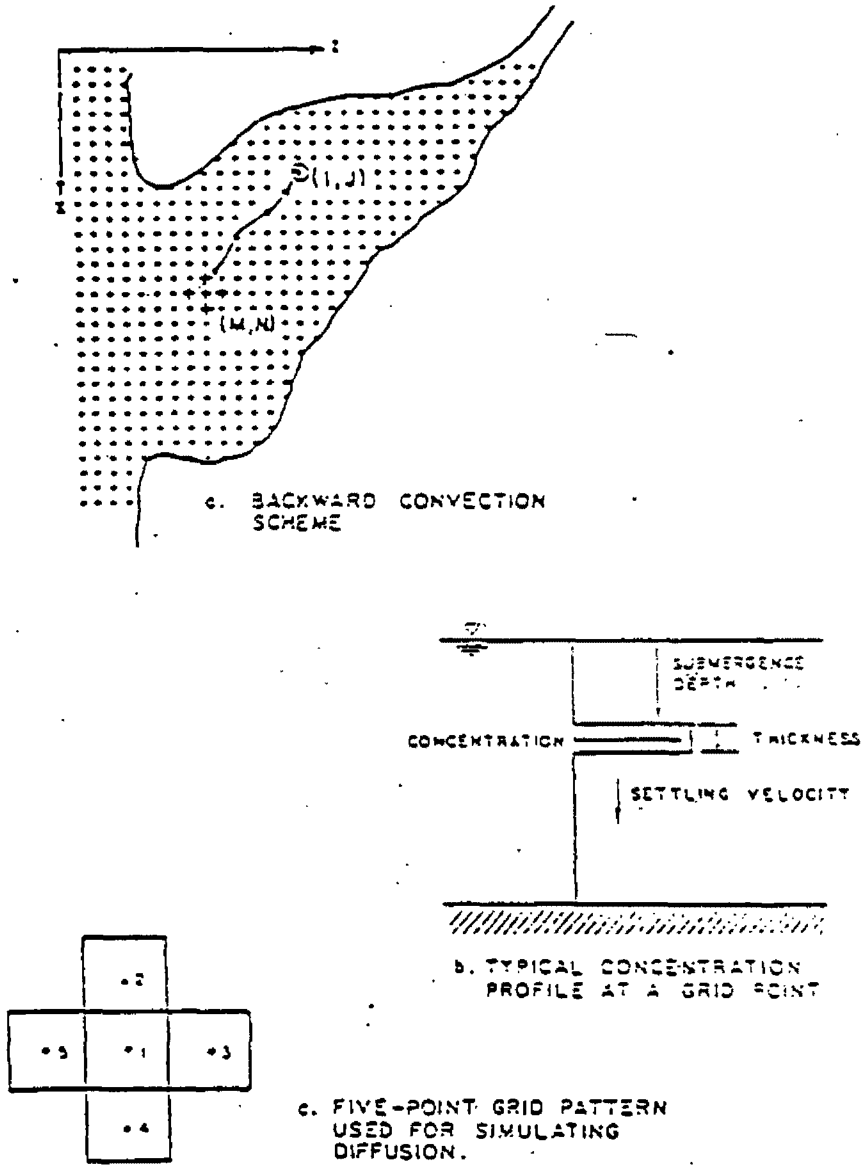
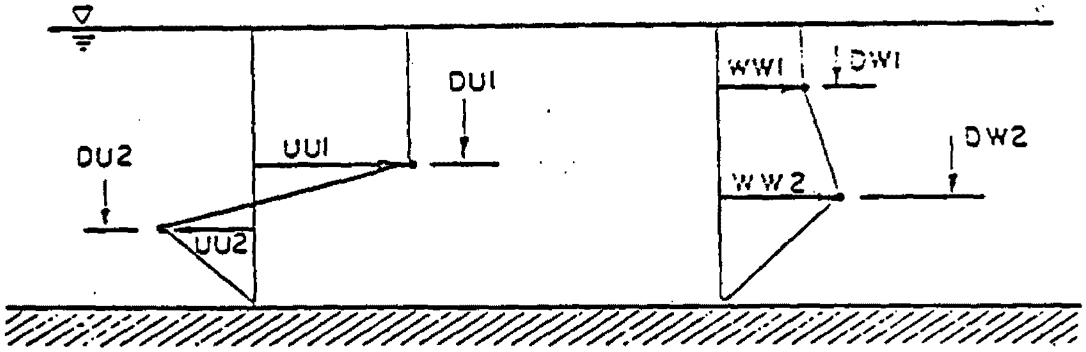
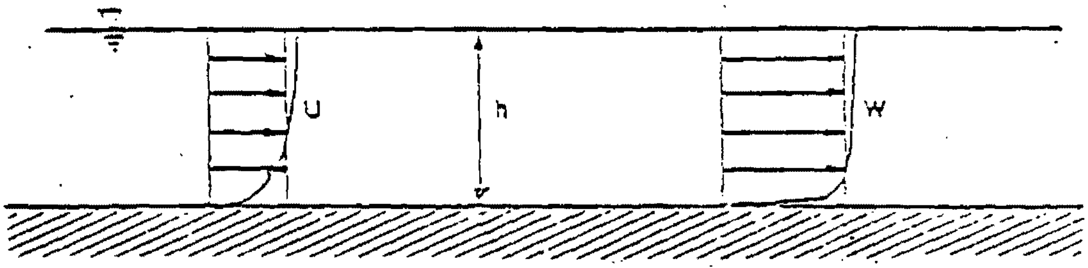


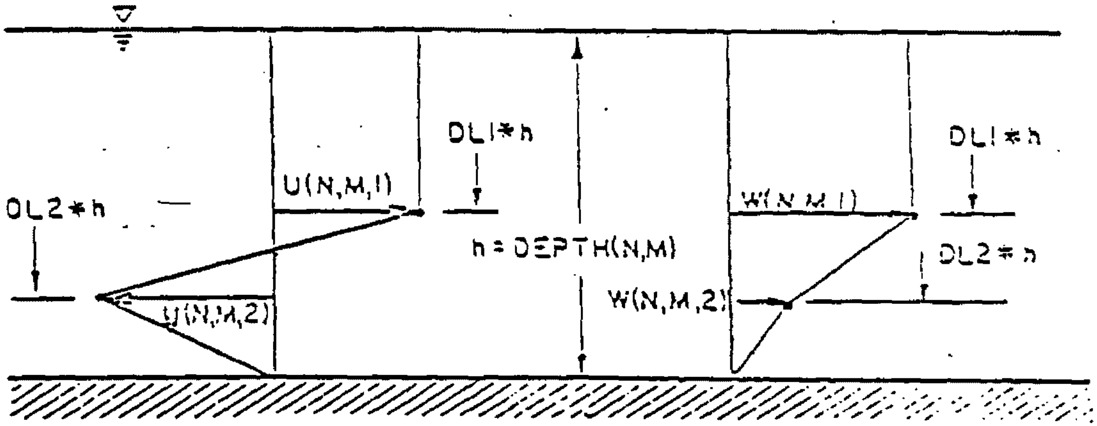
Figure 3. Aspects of passive diffusion (from Brandsma and Divoky[1])



a. SIMPLE ORTHOGONAL VELOCITY PROFILES FOR CONSTANT DEPTH. APPLIED EVERYWHERE IN FIELD.



b. VERTICALLY AVERAGED VELOCITY PROFILES FOR VARIABLE DEPTHS WITH EQUIVALENT LOGARITHMIC PROFILES SUPERIMPOSED.



c. TWO-LAYER PROFILES FOR VARIABLE DEPTH.

Figure 4. Illustration of the various velocity profiles available for use in models (from Brandsma and Divoky[1])

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AMBIENT DENSITY PROFILE AT 45 FATHOM SITE

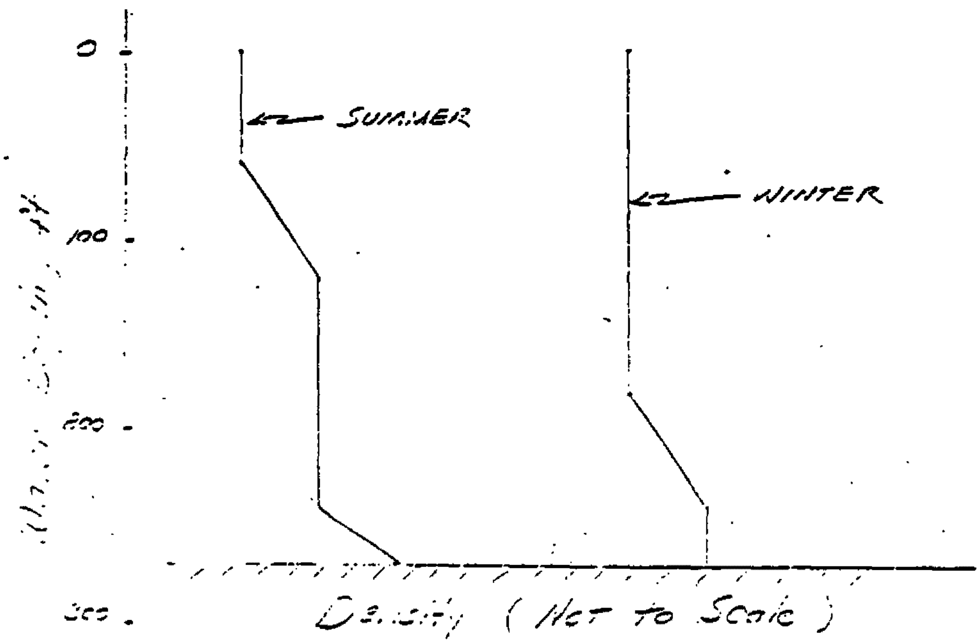

FIG. 5

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AMBIENT DENSITY PROFILE AT 100 FATHOM SITE

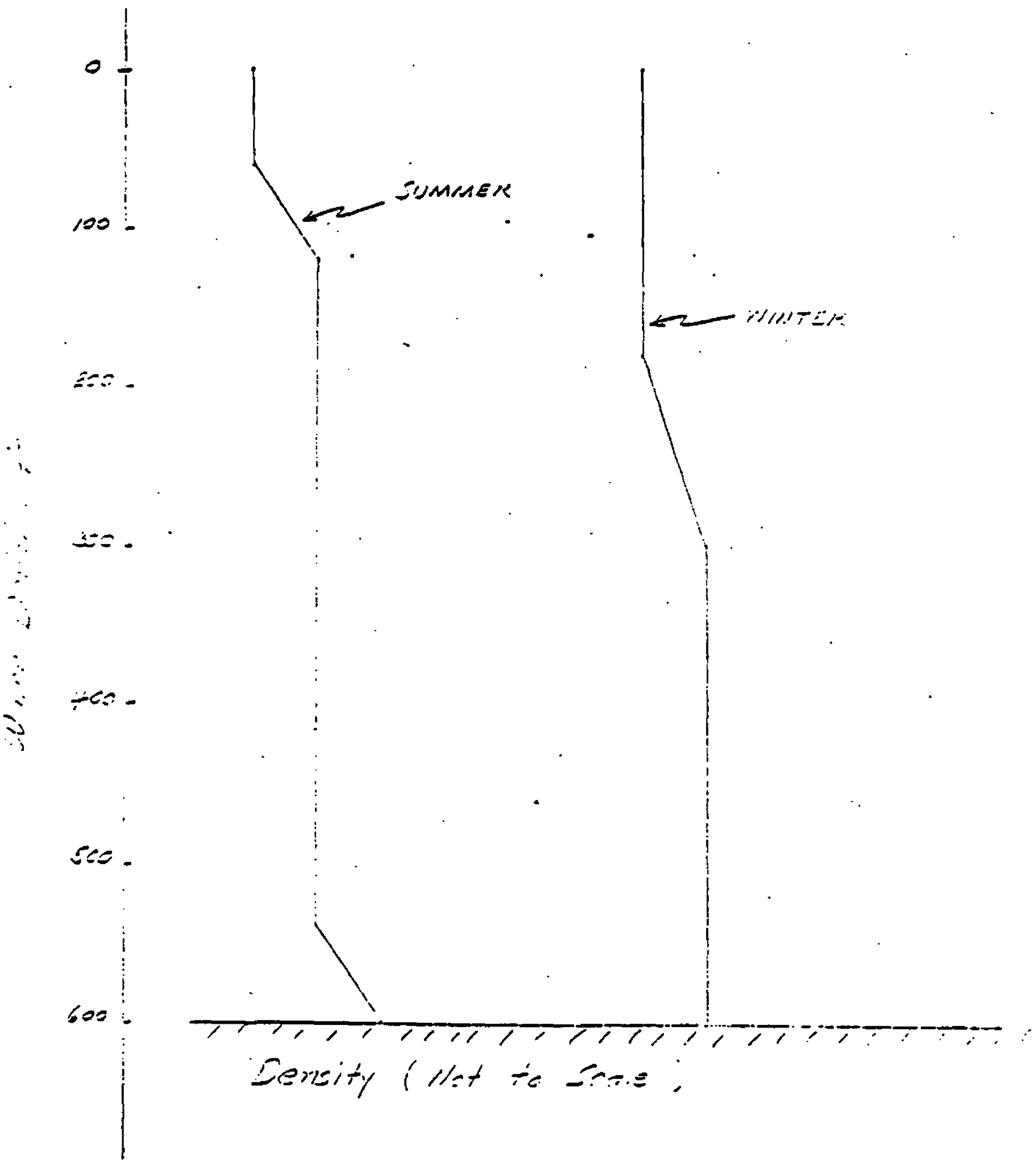

FIG. 6

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FIG. 1

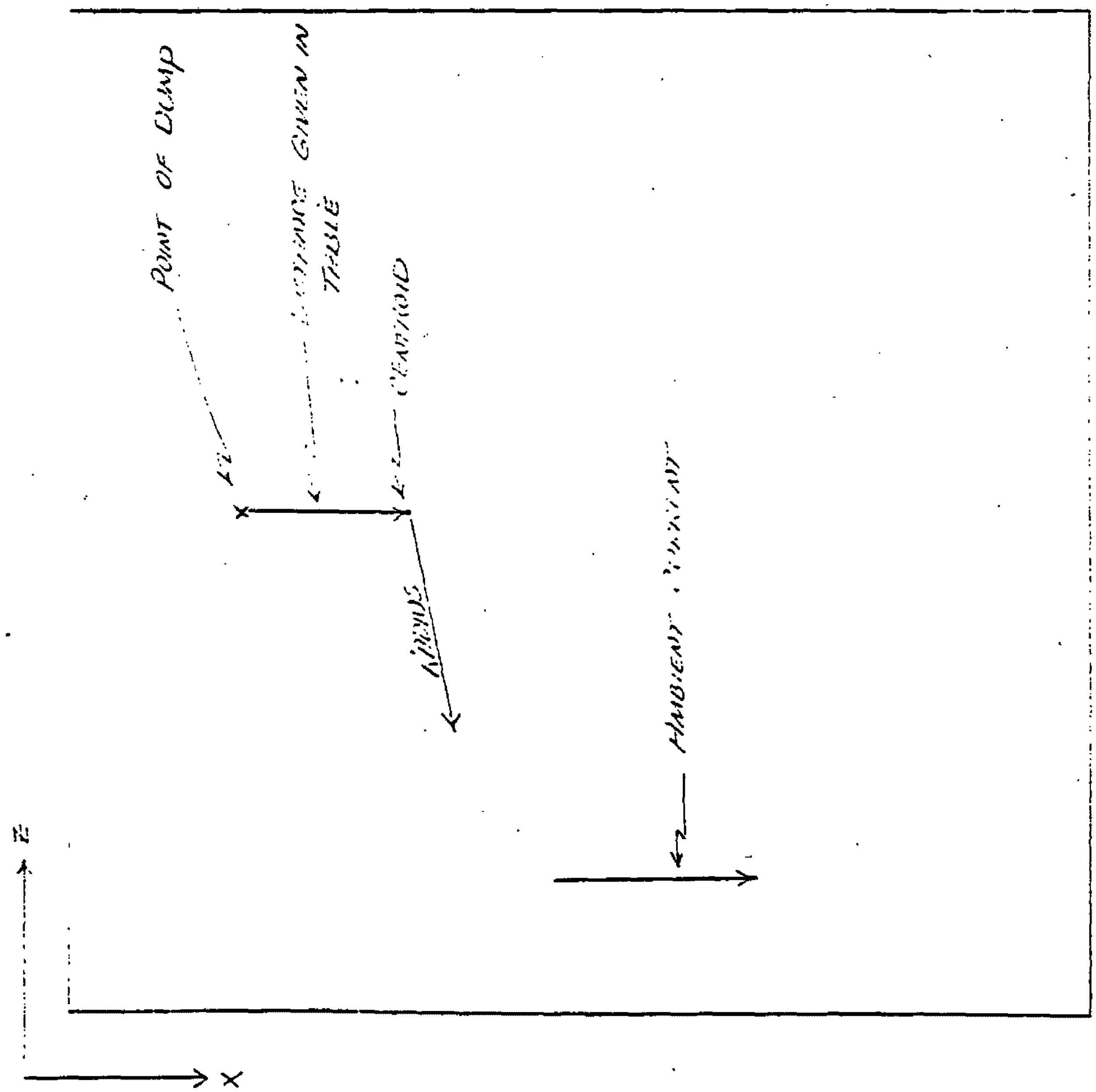

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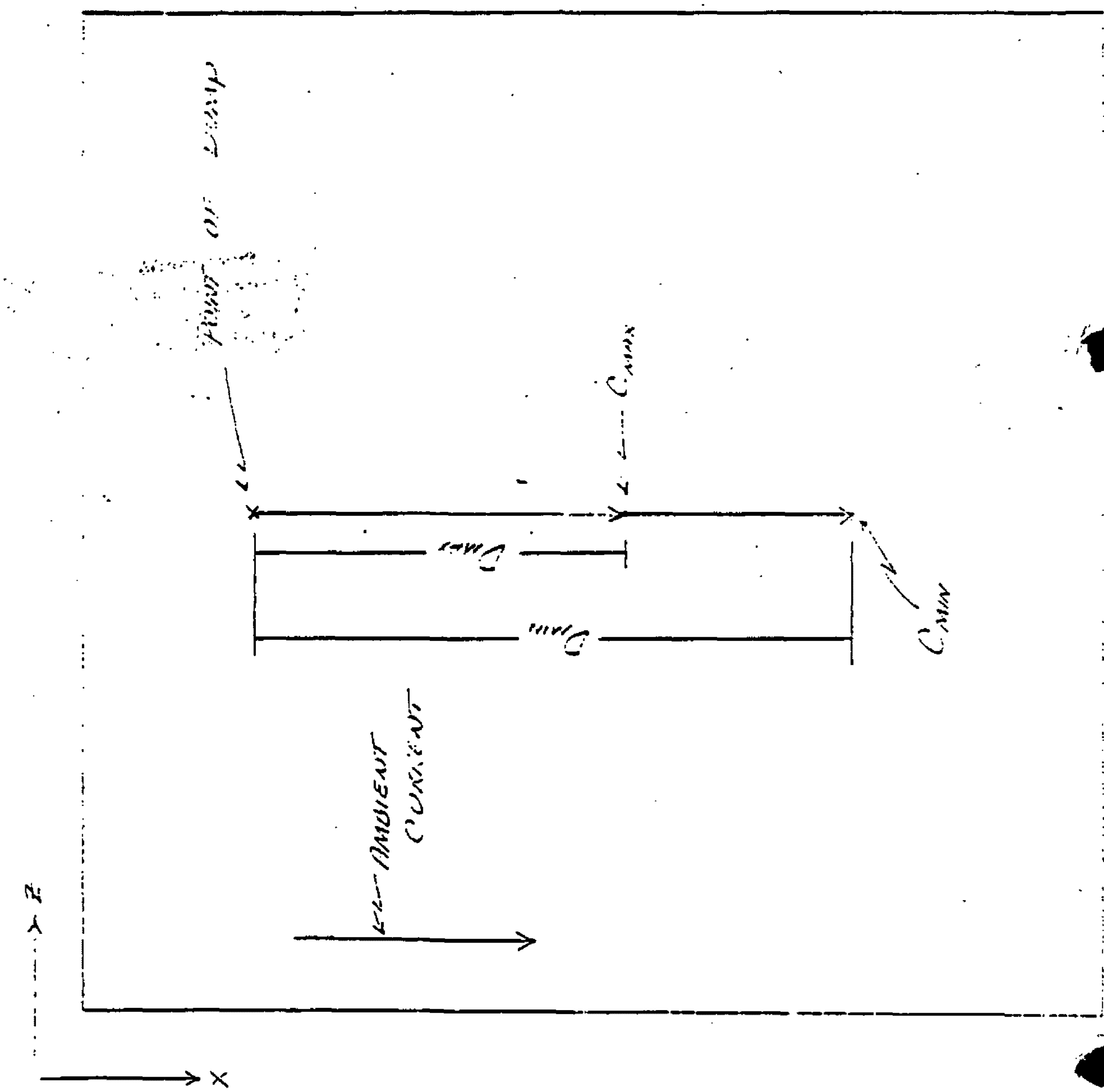
FIG. 8



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