2.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

2.1 LAND FEATURES AND USES

In this section baseline land use information is presented to define the local setting and the regional characteristics of land use in the area where the proposed site is located. The area described comprises the principal interactive environment in which the proposed LNG facility will have a direct effect on land use conditions. The general area was examined for the years 1959, 1971, and 1973 (dates for which high quality aerial photography were available) in order to establish the direction and magnitude of trends in land use changes. During this time the land use of the proposed LNG facilities site has remained agricultural. Plate 2.1.1-1 illustrates graphically the distribution patterns of land use for the year 1973, while three tables (2.1.1-I, -II, -III) provide quantitative data for assessing the trends in land use for the three time frames. Data for the maps and tables are presented in the following categories: undeveloped open space, pasture, cultivated land; residential; service/government (schools, parks, hospitals, golf courses, military installations, etc.); commercial; and extractive mining and/or industrial.

2.1.1 Land Uses

2.1.1.1 Local Land Use

The immediate area in which the site is located is bounded on the south-southeast by Mugu Lagoon, on the east-northeast by State Highway 1 and U.S. Highway 101, on the north by the Santa Clara River, and on the west-southwest by the coastline (see Section 1.2). The berthing facility site adjoins an existing industrial/government services harbor. The vaporization plant site adjoins an industrial area, and is planned for long-range industrial use by the Oxnard City Planning Department. The present major industrial neighbors at both locations are described in Section 2.3.2. The follow discussion examines land use characteristics for the years 1959, 1971, and 1973, and documents changes that have occurre over this total time span.

1959

The principal land use in the area was cultivated la including row, field, and orchard crops, with scattered concen tions of other types of usage. Southeast of the proposed site the majority of land was agricultural; the major exception was the U.S. Navy Point Mugu Pacific Missile Range. Similarly, the area to the east-northeast was predominantly agricultural. The area to the north-northwest presented a contrasting environment the two expanding cities of Port Hueneme and Oxnard. Scattere areas of open space and cultivated land existed between and within the city boundaries. The majority of urbanized land was developed as residential, with scattered concentrations of commercial (particularly along Highway 1), service (schools and parks), and industrial areas (southern part of Port Hueneme). Ventura County Airport had been constructed west of Oxnard, while the Naval Construction Battalion (Seabee) Center was located northwest of Port Hueneme. Along a one-half mile stretch of shoreline extending from Port Hueneme Harbor to the

Santa Clara River floodplain, the land was primarily open space with small areas of oil extraction, industrial, and residential developments. The remaining land in the northwest portion of the area, up to the Santa Clara River floodplain, was in agricultural use.

1971

During the 12-year time period from 1959 to 1971, land use mix had changed significantly from agricultural use to a low density urban development. Land use to the south and southeast of the site had changed from agricultural to industrial, and miscellaneous open space uses. In the northeast, outlying pockets of residential development were established in proximity to the Port Hueneme-Oxnard area. The cities of Port Hueneme and Oxnard had grown together into a loosely contiguous urbanized unit; the primary change was from agricultural and open space to residential and commercial uses. As Oxnard expanded northward, agricultural land was converted into single-family residential usage. Residential expansion occurred northward from, and adjacent to, the Naval Construction Battalion Center. The 1/2-mile stretch of shoreline developed into a mix of residential and recreational land uses. The remaining land to the northwest remained in agricultural use, with the exception of an area adjacent to the Santa Clara River floodplain which was converted into open space (land which has not been developed for use by man).

1973

From 1971 to 1973, less perceptible changes occurred in the area. The land use pattern for 1973 is shown on Plate

2.1.1-1. A small area of residential usage developed east of Port Hueneme, while Oxnard expanded further northward with residential/commercial development. Land use patterns in the local area for this time period may be characterized in the following manner: 1) the Pacific Missile Range to the south; 2) an agricultural "buffer zone" between the Pacific Missile Range and the Port Hueneme-Oxnard urban area; 3) the southeast-northwest expanding urbanized area of Port Hueneme-Oxnard (residential, commercial, industrial, and service/government land uses, including the Naval Construction Battalion Center) encompassing the central portion of the area; 4) an agricultural zone extending from Port Hueneme-Oxnard to the Santa Clara River floodplain; and 5) a residential/recreational stretch of shoreline, extending northwest from Port Hueneme Harbor to the Santa Clara River floodplain.

Local Trends

As indicated above, land use patterns underwent significant changes over the 14-year time period from 1959 to 1973 (Table 2.1.1-I). In 1959, agricultural land occupied almost 55 percent of the local area and open space about 10 percent; in total, approximately 65 percent of the land was in a relatively low density usage. Higher density usage--residential, 8+ percent; commercial, 1+ percent; service/government, 23 percent; industrial, 2+ percent--accounted for about 35 percent of the land area. By 1971, the percentage relationship between low and high density land usage had almost reversed itself. Agriculture and open space had declined in total percentage area to slightly over 40 percent. The higher economic intensity uses

--residential, 20+ percent; commercial, 2+ percent; service/ government, 33+ percent; industrial, 2+ percent--had increased to the point where they comprised almost 60 percent of the total area. In particular, residential and commercial uses had more than doubled in area, primarily within the Port Hueneme-Oxnard city boundaries. In the 2-year period from 1971 to 1973, 0.5 percent of land in agricultural usage was converted to residential/commercial uses. Analysis of the data indicates that the local land use pattern is changing in the direction of the higher density uses associated with urban growth, primarily to residential and commercial developments.

2.1.1.2 Regional Land Use

The region in which the site is located is bounded on the south-southeast by Mugu Lagoon; on the east by Calleguas Creek/Arroyo Las Posas; on the northeast by a line extending from below Somis northwest to approximately Wheeler Canyon; on the north generally by Foothill Road; and on the west-southwest by the coastline.

1959

Agriculture was the major land use in the region at this time. In the area bounded by Highways 1 and 101, the only non-agricultural uses were residential and commercial (Camarillo); military (Oxnard Air Force Base); industrial activities on the eastern side of Oxnard and adjacent to Highway 1; and small areas of residential, commercial, and industrial uses along Highway 1. The area between Highway 1 and the Santa Clara River floodplain was pasture and cultivated land. Major exceptions to this were residential areas south of the Camarillo Hills, El Rio, and a sand and gravel mining operation along the Santa Clara River floodplain (Kaiser Cement Works). West of this location and north of the Santa Clara River floodplain, two-thirds of the land was under cultivation or in open space, while the remainder was primarily occupied by the cities of Ventura and Montalvo.

<u>1971</u>

By 1971, the region outside of the immediate site area had changed in a manner similar to that of the immediate site area. Little change had occurred on the land bounded by Highway 1 and 101. The majority of development involved residential expansion of the towns of Camarillo, El Rio, and Oxnard. Between Highway 101 and the Santa Clara River floodplain, considerable change had occurred. Camarillo Hills was transformed into low-density residential developments and orchards. Nyeland Acres was developed along Highway 101 east of El Rio, and the Saticoy Country Club was developed near South Mountain. Water storage facilities were located at two sites: adjacent to, and northeast of, El Rio; and along the Santa Clara River floodplain, west of South Mountain. North of the Santa Clara River floodplain development also took place on a large scale. Northeast of Ventura and along Highway 126, large areas of agricultural land were converted into residential usage (particularly the built-up area of Saticoy), involving approximately 15 percent of the land. The city of Ventura expanded to the east; cultivated land was transformed into residential, commercial, and service uses. Montalvo doubled in size, growing towards Highway 126. The Ventura Marina was constructed, as well as the Olivas Park Golf Course, along the Santa Clara River floodplain.

1973

Relatively minor changes occurred in the area from 1971 to 1973, involving conversion of cultivated land into residential developments. The areas most affected were the Camarillo Hills, El Rio, and Saticoy. The pattern of land use in 1973 (Plate 2.1.1-1), exclusive of the immediate site area, may be summarized as follows: 1) The area bounded by Highways 1 and 101 is largely agricultural, but includes the deactivated Oxnard Air Force Base and urban developments along the highways (southern Camarillo, southern El Rio, and eastern Oxnard). 2) The area between Highway 101 and the Santa Clara River floodplain is predominantly agricultural (the only area containing cultivated land and pasture), with the exception of extensive low density housing in the Camarillo Hills, the northern portion of Camarillo, the major part of El Rio, and Nyeland Acres. 3) North of the Santa Clara River floodplain, the area is in a process of urbanization, with the centers of Ventura, Montalvo, and Saticoy growing towards each other. (The major exception is the agricultural area approximately 2 miles to the east of Saticoy.)

Regional Trends

Exclusive of the immediate site area, the regional setting in 1959 was primarily agricultural/open space (Table 2.1.1-II). This usage occupied over 90 percent of the area: cultivated land, 78+ percent; pasture, 11+ percent; open space, 2+ percent. High economic intensity usage was confined to relatively small areas and included residential, commercial, service/government, and industrial activities. By 1971, there were significant increases in residential and commercial land at the expense of agriculture. Residential usage more than tripled in area, while commercial areas doubled in extent. Agricultural land declined to less than 80 percent of the total area. Service/government and industrial usages experienced very little change. By 1973, this situation had changed only slightly; about 1 percent of the land had been converted from agricultural to residential use. Review of the data indicates that the region excluding the immediate site area is experiencing a change toward increased urban-type uses, but at a less intense rate than the immediate site area.

When the region is considered as a whole, including the immediate site area, agriculture/open space was the predominant use in 1959 (Table 2.1.1-III). Cultivated land (70+%), pasture (8+%), and open space (4+%) encompassed more than 80 percent of the land area. High economic intensity uses, such as commercial and industrial, occupied less than 20 percent of the total area; a high percentage was in service/government activities (almost 8%), the majority related to the Pacific Missile Range and Naval Construction Battalion Center. By 1971, agriculture/open space land had declined to less than 70 percent of the total area. Residential usage had more than tripled to 16 percent, while of the total area commercial usage had expanded to almost 12 percent (approximately a 50% increase). By 1973, this pattern had changed only to a limited degree; less than 1 percent of the land had been converted from cultivated, residential, and commercial uses. The trend in land use conversion for the region represents a slow change from a rural setting to a low density suburban environment.

The immediate site area is experiencing a more accelerated rate of change to an urban environment than the region as a whole. The proposed LNG facilities are consistent with these land use changes and the General Plan (Gruen Associates, 1969, 1970; Plate 2.1.1-2) for development in the vicinity of the site.

2.1.1.3 Cultural/Educational Facilities

Baseline data for cultural and educational facilities located in proximity to the proposed LNG site are provided in Table 2.1.1-IV. The table indicates the location of the specific facility and the approximate distance in miles from the proposed LNG storage and vaporization site.

2.1.1.4 Transportation Facilities

Baseline data for transportation facilities include the following elements: roads and highways, airline service, railroad service, and ship facilities. These elements are discussed with respect to present use and planned capacity, as appropriate.

The major roads and highways that would provide access to the proposed LNG site are listed in Table 2.1.1-V. In order to establish baseline conditions for these transportation networks, figures are also provided in the table for peak-hour traffic and average daily traffic.

Commuter air carrier service is provided to the area by Golden West Airlines at Ventura County Airport. Direct air service is available only to Los Angeles and Santa Barbara.

Approximately 70 round trips to Los Angeles and 56 round trips to Santa Barbara are made each week. Table 2.1.1-VI presents operating statistics for Ventura County Airport (Ventura County 1972). The proposed plant site is not within the established overflight patterns utilized by the Ventura County Airport or Point Mugu Missile Base.

Ventura County Railway Company provides railroad service in the Oxnard-Port Hueneme area. The company is engaged exclusively in freight service and operates on a 6-day work-week, 8 hours per day (morning to night). The company has an interchange track with Southern Pacific Railroad (SPRR) which runs along 5th Street in Oxnard (SPRR tracks run north of 5th Street; Ventura County Railway Company tracks run south). There is no fixed time schedule, but the company can deliver materials the same day as received from local areas to the site vicinity. There is a railroad dock facility adjacent to the site for unloading railroad cars at Perkins Road.

Port Hueneme Harbor (Oxnard Harbor District) maintains the following facilities for ship activities:

1. Six deep draft concrete wharfs (one for commercial use) with ten deep draft berths 600 feet long (a maximum of three may be used for commercial purposes).
2. Two shallow draft wharfs (one for commercial use) with six shallow draft berths (three for commercial use).

Deep draft facilities are dredged to a depth of 36 feet below mean lower low water (MLLW); shallow draft facilities are dredged to a depth of 14 feet below MLLW. Table 2.1.1-VII shows ship movements for 1972, and projected movements for 1973 and 1974. Table 2.1.1-VIII shows import and export tonnage at Port Hueneme Harbor for calendar years 1947-1971.

The Oxnard Municipal Transit Line provides bus service to the cities of Oxnard and Port Hueneme, as well as to Ventura College in the city of Ventura. The Port Hueneme Loop (Line #6) of the system serves the area in which the LNG plant is to be located. This line's closest proximity to the plant site is the corner of Perkins Road and Hueneme Road, less than one-fourth mile from the site. Service frequency is at 30-minute intervals.

BIBLIOGRAPHY 2.1.1

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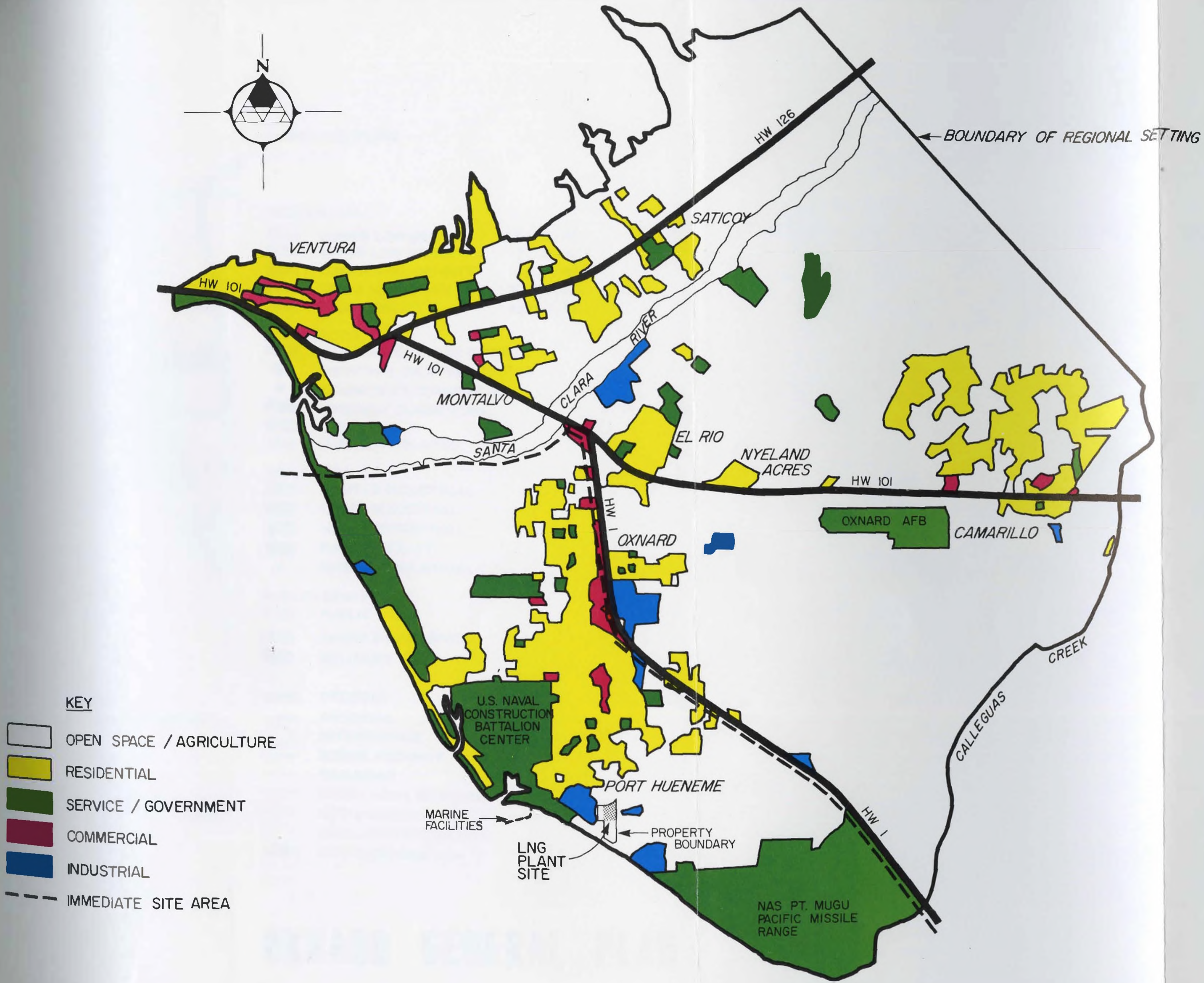
*Ventura County, 1973a, County Traffic Engineer's Office, personal communication.

*Ventura County, 1973b, Commissioner of Airports and Harbors, personal communication.

*Ventura County County, 1972-1973, Director of Public Schools, personal communication.



REGIONAL LAND USE 1973

5000 0 5000 10,000 15,000

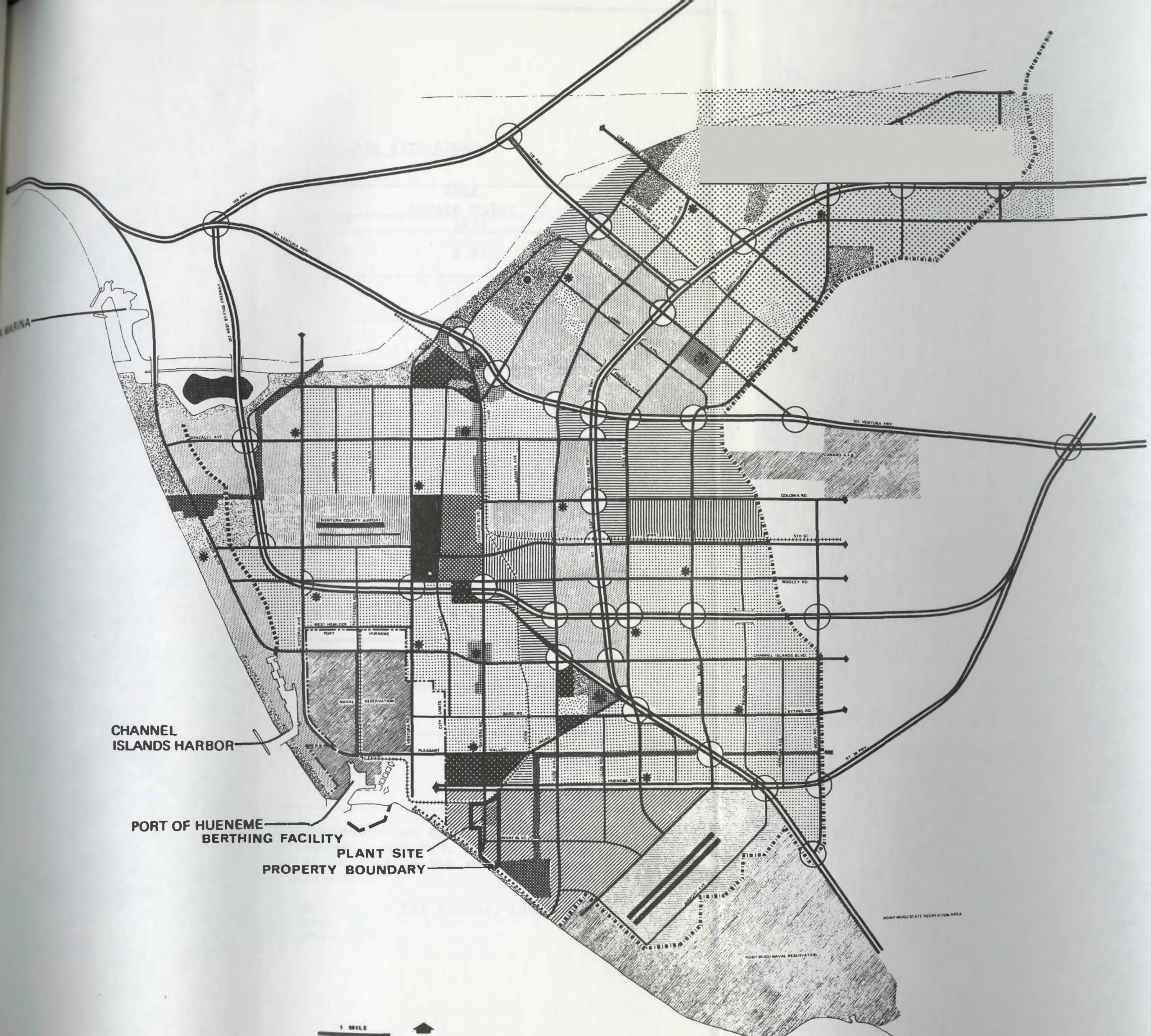
SCALE IN FEET

NOTE: 1" = 10,000 FEET

SOURCE: NASA AERIAL PHOTOGRAPH, 1973

DAMES & MOORE

PLATE 2.1.1-1



REFERENCE: GRUEN ASSOCIATES, 1970

LAND USE PLAN

RESIDENTIAL

- LOWER LOW DENSITY 2.5 D.U./AC.
- UPPER LOW DENSITY 7 D.U./AC.
- LOWER MED. DENSITY 13 D.U./AC.
- UPPER MED. DENSITY 20 D.U./AC.
- HIGH DENSITY 42 D.U./AC.

COMMERCIAL

- CENTRAL BUSINESS DISTRICT
- REGIONAL SHOPPING CENTER
- COMMUNITY COMMERCIAL
- HIGHWAY COMMERCIAL
- SPECIAL
- AIRPORT RELATED

INDUSTRIAL

- LIMITED INDUSTRIAL
- LIGHT INDUSTRIAL
- HEAVY INDUSTRIAL
- PUBLIC UTILITY
- INTERIM INDUSTRIAL

PUBLIC–SEMI PUBLIC

- PUBLIC
- PARKS & OPEN SPACE
- MILITARY

- FREEWAY
- ARTERIAL
- INTERCHANGE
- SCENIC HIGHWAY
- RAILROAD
- STUDY AREA BOUNDARY
- CITY LIMITS BOUNDARY
- PARTIAL INTERCHANGE
- GRADE SEPARATION

OXNARD GENERAL PLAN

PLATE 2.1.1–2

TABLE 2.1.1-I

LAND USE CHANGES FOR IMMEDIATE SITE AREA*

Category	AREA Square Miles 1959	1971	1973
Undeveloped Open Space	3.58	0.81	0.81
Pasture	0.00	0.00	0.00
Cultivated Land	20.51	14.70	14.56
Subtotal Low Density Use	24.09	15.51	15.37
Residential	3.29	7.57	7.66
Service/Government	8.62	12.47	12.47
Commercial	0.53	1.02	1.07
Extractive Mining	0.10	0.00	0.00
Industrial	0.75	0.81	0.81
Subtotal High Density Use	13.29	21.87	22.01
TOTAL	37.38	37.38	37.38
Percent Low Density Use	64.4%	41.5%	41.1%
Percent High Density Use	35.6%	58.5%	58.9%

*The area is bounded on the south-southeast by Mugu Lagoon, on the east-northeast by State Highway 1 and U.S. Highway 101, on the north by the Santa Clara River, and on the west-southwest by the coastline (see Plate 2.1.1-1).

Reference: U.S. Department of Agriculture Air Photos, 1959
NASA Aerial Photography, 1971
NASA Aerial Photography, 1973.

TABLE 2.1.1-II

REGIONAL LAND USE CHANGES EXCLUSIVE OF IMMEDIATE SITE AREA *

Category	1959	AREA Square Miles 1971	197
Undeveloped Open Space	2.23	1.22	1.22
Pasture	11.53	7.01	7.01
Cultivated Land	80.39	74.53	73.65
Residential	4.13	13.56	14.44
Service/Government	2.05	4.25	4.25
Commercial	1.12	1.18	1.18
Extractive Mining	0.16	0.33	0.33
Industrial	1.03	0.56	0.56
TOTAL	102.64	102.64	102.64

*The region is bounded on the south-southeast by Mugu Lagoon, on the east by Calleguas Creek/Arroyo Las Posas, on the northeast by a line extending from below Somis northwest to approximately Wheeler Canyon, on the north generally by Foothill Road, and on the west-southwest by the coastline (see Plate 2.1.1-1).

Reference: U.S. Department of Agriculture Air Photos, 1959
NASA Aerial Photography, 1971
NASA Aerial Photography, 1973

TABLE 2.1.1-III

LAND USE CHANGES FOR REGIONAL SETTING,*
INCLUDING LOCAL SITE AREA

	AREA Square Miles		
Category	1959	1971	1973
Undeveloped Open Space	5.81	2.03	2.03
Pasture	11.53	7.01	7.01
Cultivated Land	100.90	89.23	88.21
Residential	7.42	21.13	22.10
Service/Government	10.67	16.72	16.72
Commercial	1.65	2.20	2.25
Extractive Mining	0.26	0.33	0.33
Industrial	1.78	1.37	1.37
TOTAL	140.02	140.02	140.02

Reference: U.S. Department of Agriculture Air Photos, 1959
NASA Aerial Photography, 1971
NASA Aerial Photography, 1973

* Regional boundarys shown on Plate 2.1.1-I

TABLE 2.1.1-IV

LISTING OF CULTURAL AND EDUCATIONAL FACILITIES

Category	Name	Location	Approx. Distance From Site (Miles)
CULTURAL FACILITIES & COLLEGES	Oxnard Community Center	800 Hobson Way, Oxnard	4.1
	Pioneer Museum	77 N. California St., Ventura	12.7
	Seabee Museum	Naval Construction Batallion, Port Hueneme	2.2
	Ventura College	4667 Telegraph Rd., Ventura	10.8
HIGH SCHOOLS	Public Schools		
	Buena H. S.	5670 Telegraph Rd., Ventura	10.4
	Channel Islands H. S.	1400 E. Boise Way, Oxnard	2.2
	Hueneme H. S.	500 Bard Rd., Oxnard	1.1
	Mar Vista H. S.	2607 Ocean Ave., Ventura	11.1
	Oxnard H. S.	937 W. Fifth St., Oxnard	4.4
	Rio Mesa H. S.	545 Central Ave., Oxnard	9.3
	Ventura H. S.	2155 E. Main St., Ventura	12.4
JUNIOR HIGH AND ELEMENTARY SCHOOLS	Public Schools		
	Anacapa J. H. S.	100 S. Mills Rd., Ventura	11.1
	Balboa J. H. S.	247 Hill St., Ventura	10.8
	Richard Bard	620 E. Pleasant Valley, Port Hueneme	1.5
	*Charles Blackstock	701 Johnson Rd., Oxnard	1.8
	Brittell	150 North "G" St., Oxnard	4.8
	Cabrillo J. H. S.	1426 E. Santa Clara St., Ventura	12.8
	Caarillo Heights	35 Catalina Dr., Camarillo	11.5
	Bernice Curren	1101 North "F" St., Oxnard	5.4
	Dos Caminos	3635 Appian Way, Camarillo	12.0
	Driffill	910 South "E" St., Oxnard	3.7
	El Camino	501 College Dr., Ventura	10.8
	El Descanso	1099 N. Bedford St., Camarillo	10.8
	Elm Street	450 E. Elm St., Oxnard	3.0
	Elmhurst	5080 Elmhurst St., Ventura	10.4
	El Rancho	550 Temple Ave., Camarillo	11.5
	El Rio	2714 Vineyard Ave., El Rio	7.2
	John Charles Fremont J. H. S.	1130 North "M" St., Oxnard	5.4
	*E. O. Green	3739 South "C" St., Oxnard	1.8
	Norma Harrington	2501 S. Gisler Ave., Oxnard	2.6
	Julien G. Hathaway	405 E. Dollie St., Oxnard	1.1
	Art Haycox	5400 Perkins Rd., Oxnard	0.7
	Richard Barrett Haydock J. H. S.	647 W. Hill St., Oxnard	3.3
	Hollywood Beach	Sunset & Channel Is. Rd., Oxnard	4.4
	Hueneme	344 N. Third St., Port Hueneme	1.4
	Juana Maria	100 S. Crocker Ave., Ventura	10.8
	Juanita	244 N. Juanita Ave., Oxnard	4.8
	Kamala	634 W. Kamala Dr., Oxnard	3.3
	Laguna Vista	5084 Etting Rd., Oxnard	3.7
	Ansgar Larsen	E. Thomas Ave., Oxnard	2.2
	Las Posas	75 Calle La Cumbre, Camarillo	9.7
	Lincoln	1107 E. Santa Clara, Ventura	12.8
	Loma Vista	300 Lynn Dr., Ventura	12.0
	**Los Altos Intermediate	700 Temple Ave., Camarillo	11.5
	Los Nogales	1555 N. Kendall Ave., Camarillo	12.4
	Marina West	2501 Carob St., Oxnard	3.7
	Mar Vista	2382 Etting Rd., Oxnard	3.3
	Dennis McKinna	1611 South "J" St., Oxnard	3.0
	Montalvo	2050 Grand Ave., Ventura	9.0

TABLE 2.1.1-IV continued

LISTING OF CULTURAL AND EDUCATIONAL FACILITIES

	Name	Location	Approx. Distance From Site (Miles)
	Public Schools - continued		
JUNIOR HIGH AND ELEMENTARY SCHOOLS	**Monte Vista Intermediate	888 N. Lantana St., Camarillo	10.1
	Mound	455 S. Hill Rd., Ventura	10.8
	Ocean View J. H. S.	4300 Olds Rd., Oxnard	2.6
	Parkview	1416 Sixth Pl., Port Hueneme	1.4
	Pierpoint	Martha's Vineyard Ct., Ventura	10.8
	Pleasant Valley	2222 Ventura Blvd., Camarillo	10.1
	Poinsetta	350 N. Victoria Ave., Ventura	11.1
	Ramona	804 Cooper Rd., Ventura	4.4
	Blanche Reynolds	450 Valmore Ave., Ventura	10.8
	**Rio del Valle	3100 Rose Ave., El Rio	7.6
	Rio Lindo	2131 Snow Ave., Oxnard	6.3
	Rio Plaza	600 Simon Way, El Rio	7.9
	Rio Real	1140 Kenney St., El Rio	7.2
	Will Rogers	316 Howard St., Ventura	11.1
	Rose Avenue	220 S. Driskell St., Oxnard	4.8
	Saticoy	760 Jazmin St., Saticoy	11.1
	Junipero Serra	8880 Halifax St., Ventura	10.1
	Sierra Linda	2201 Jasmine St., Oxnard	6.3
	Sunkist	1400 Teakwood St., Oxnard	2.2
	Tierra Vista	2001 Sanford St., Oxnard	1.5
	Valle Lindo	777 Aileen St., Camarillo	10.4
	Washington	96 S. MacMillan Ave., Ventura	12.8
	Fred Williams	4300 Anchorage St., Oxnard	1.8

*Grades 6-8 only
**Grades 7-8 only

	Name	Location	Approx. Distance From Site (Miles)
	Private Schools		
	St. Bonaventure H. S.	3167 Telegraph Rd., Ventura	11.1
	Santa Clara H. S.	2121 Saviers Rd., Oxnard	3.0
JUNIOR HIGH AND ELEMENTARY SCHOOLS	Camarillo Christian Elementary	579 Anacapa Dr., Camarillo	10.8
	Hueneme Christian Elem.	312 N. Ventura Rd., Port Hueneme	1.8
	Linda Vista Jr. Academy	5050 Perry Way, Oxnard	5.4
	Mary Law Private School	2931 Albany Drive, Oxnard	2.2
	Our Lady of Assumption School	3169 Telegraph, Ventura	11.1
	Our Lady of Guadalupe School	530 N. Juanita, Oxnard	4.8
	St. Anthony's School	2421 South "C" St., Oxnard	2.6
	St. John's Lutheran School	1500 North "C" St., Oxnard	5.8
	St. Mary Magdalen School	2532 E. Ventura, Camarillo	10.1
	St. Paul's Episcopal Church School	3290 Loma Vista Rd., Ventura	11.1
	St. Thomas Aquinas School	210 La Canada St., Oxnard	1.8
	Santa Clara Elem.	324 South "E" St., Oxnard	4.4
	Ventura Christian School	346 N. Kimball Dr., Ventura	10.1

Reference: Ventura County 1972-1973
and various city directories.

TABLE 2.1.1-V

ROAD AND HIGHWAY TRAFFIC

Location	Peak Traffic (Vehicles per Hour)	Average Daily Traffic
Hueneme Road (west of Arcturus Rd.)	1,360	8,330
Saviers Road (north of Hueneme Rd.)	940	7,670
Ventura Road (north of Channel Islands Rd.)	2,100	20,680
State Highway 1 (north of Hueneme Rd.)	1,600	13,400
State Highway 1 (north of Pleasant Valley Rd.)	1,750	14,700
State Highway 34 (east of Pleasant Valley Rd.)	900	6,100
State Highway 126 (west of Victoria Rd.)	1,900	18,000
U.S. Highway 101 (west of Lewis Rd.)	3,850	41,000
U.S. Highway 101 (west of State Highway 1)	6,200	66,000

Reference: County of Ventura, 1973a
City of Oxnard,1973

TABLE 2.1.1-VI

1972 OPERATING STATISTICS
VENTURA COUNTY AIRPORT

Total Aircraft Operations	$159,763
IFR Operations	$ 8,908
Air Carriers	
Flights (takeoff and landings)	5,426
Passengers - Inbound	19,299
- Outbound	18,300
Cargo Handled	90,635 lbs.
Visitors	582,294
Based Aircraft	
Tiedowns	67
Hangered	114

Reference: County of Ventura, 1973b

TABLE 2.1.1-VII

SHIP MOVEMENTS - PORT HUENEME HARBOR

	Commercial		Military	
Year	Vessels Calling	Tonnage Shipped (short tons)	Vessels Calling	Tonnage Shipped (short tons)
1972	38	48,000	170	64,205
1973*	96	800,000	140	75,000
1974*	102	1,000,000	140	80,000

* projected figures.

Reference: Oxnard Harbor District, 1973.

TABLE 2.1.1-VIII

IMPORT AND EXPORT TONNAGE FOR CALENDAR YEARS
1947-1971
PORT HUENEME HARBOR
(short tons)

Year	Imports	Exports	Total
1947	0	11,000	11,000
1948	0	3,296	3,296
1949	0	26,699	26,699
1950	0	1,532	1,532
1951	1,922	24,479	26,401
1952	0	30,749	30,749
1953	3,335	31,442	34,777
1954	4,528	18,948	23,476
1955	8,177	24,109	32,286
1956	4,619	7,010	11,629
1957	23,207	21,152	44,359
1958	42,054	13,931	55,985
1959	10,425	35,729	46,154
1960	37,291	38,191	75,482
1961	77,153	27,209	104,362
1962	58,896	36,840	95,736
1963	63,933	30,089	94,022
1964	77,221	27,797	105,018
1965	65,132	38,035	103,167
1966(1)	42,711	30,743	73,454
1967(2)	30,282	37,633	67,815
1968	56,473	85,993	142,466
1969	34,793	115,133	149,926
1970	58,600	37,300	95,900
1971(3)	112,046	24,120	136,166

(1) The years 1947 through 1966 are based upon statistics taken from Port Hueneme Harbor Officials and were lifted from the 1 April 1968 "Review Report for Navigation, Port Hueneme Harbor."

(2) The years 1967 through 1970 are waterborne commerce figures and include offshore oil supplies and equipment tonnage from port statistics.

(3) The 1971 figures are based upon statistics obtained from Port Hueneme Officials and include offshore oil supplies.

Reference: U.S. Army Corps of Engineers, 1973

2.1.2 Topography, Physiography, and Geology

2.1.2.1 Terrestrial Geology

Introduction

In this section, the local and regional terrestrial geologic setting of the Port Hueneme area is described. The majority of the information which is presented was obtained by researching available published and unpublished literature and by a reconnaissance of the site.

Physiographic Setting

The site is located on the Oxnard Plain of the Ventura Basin within the Transverse Ranges Province of Southern California as shown on Plate 2.1.2-1. The Transverse Ranges Province is a geologically complex, east-west trending geomorphic unit which cuts across the general northwest trend of Southern California. The province consists of east-west trending hills and mountains separated by narrow to moderately broad valleys.

The Ventura Basin is a folded and faulted synclinorium bounded on the north by the Santa Ynez and Topatopa Mountains, bounded on the south by the Santa Monica Mountains, and containing several intra-basin chains of hills and mountains. Two of these chains, Oak Ridge and Camarillo Hills, slope to the west into the flat, alluviated Oxnard Plain, the most extensive lowland in the Ventura Basin. The plain slopes southwesterly at 12 to 15 feet per mile toward the Pacific Ocean.

The highest elevations in the Ventura Basin are about 2,500 feet in the mountains to the north and east of Port Hueneme. The site elevation ranges from 5 to 10 feet above sea level.

Stratigraphy

The Ventura Basin is an east-west trending structure which has been downwarped during the past 60 to 75 million years. Cretaceous, Tertiary, and Quaternary sediments, with locally interbedded volcanic rocks, have accumulated to thicknesses in excess of 6,000 feet on a pre-Cretaceous basement of igneous and metamorphic rocks. The sediments are dominantly marine and were deformed and uplifted during a period of crustal instability in the mid-Pleistocene epoch.

The Oxnard Plain represents the ancient delta of the Santa Clara River, formed at the end of the last glacial epoch when the Santa Clara was part of a much more extensive river system. Nonmarine sediments consisting of sand, silt, and clay were deposited on the deformed rocks of lower Pleistocene and older ages.

An idealized geologic section (Holman, 1958), which shows the general relationship of the formations in southern Ventura County before Pleistocene deformation occurred, is presented on Plate 2.1.2-2. Table 2.1.2-I gives detailed information regarding the near-surface stratigraphy in the vicinity of the site.

Structure

Structural features in the region primarily resulted from mid-Pleistocene crustal instability (Ventura County Department of Public Works, 1973). During this deformation, the sediments which had been accumulating in the slowly subsiding Ventura Basin were uplifted, folded, and faulted along east-west trends in response to north-to-south compression. This folding and faulting has continued, with lessened intensity, to the present. The Red Mountain, San Cayetano, Oak Ridge, Simi-Santa Rosa, and other fault zones resulted from this mid-Pleistocene tectonism.

Subsurface relationships of geological formations in the coastal area of Ventura County are shown on Plate 2.1.2-3. The folding at the north end of the cross section lessens in intensity to the south where the proposed site is located. The beds underlying the site area are fairly flat-lying to a depth of approximately 2,000 feet.

A larger-scale cross section of the area between Port Hueneme and Saticoy is presented on Plate 2.1.2-4 (California Department of Water Resources, 1958). The lower Pleistocene to Holocene formations are the only sediments shown. Aquifers significant in the Oxnard Plain are also indicated. These aquifers are important in this discussion since they reflect the lack of deformation by past tectonic movement.

Faults in Region of the Site

References reviewed for this evaluation do not report any faults beneath the site or its immediate vicinity. Active or potentially active faults in the Ventura County area include the San Cayetano, McGrath, Oak Ridge, Camarillo Hills, Sycamore, Red Mountain, Simi-Santa Rosa, and Malibu faults (Ventura County Department of Public Works, 1973). These faults are shown on Plate 2.1.2-5. The seismicity of the proposed site area is discussed in the following section.

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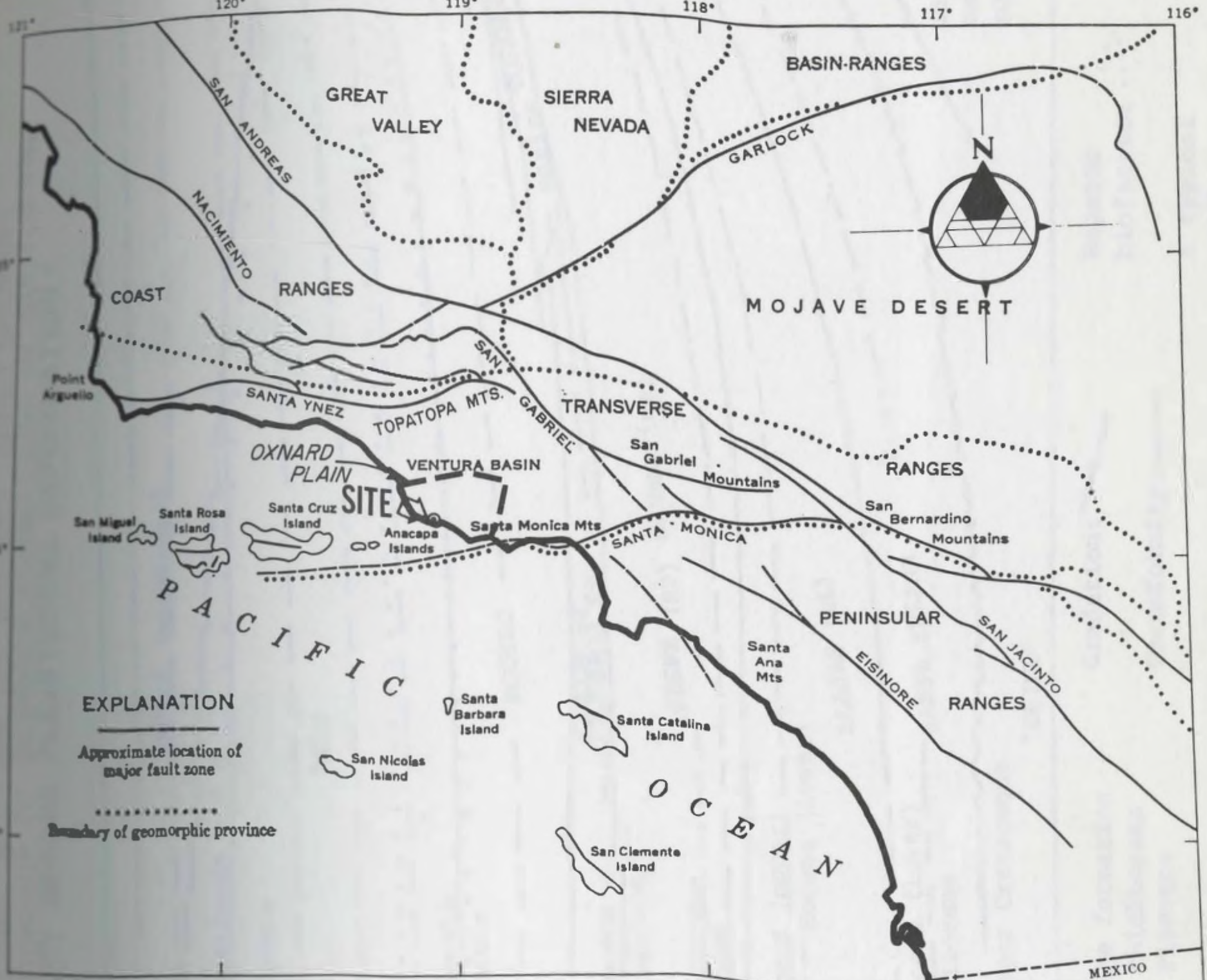


PHYSIOGRAPHIC SETTING OF SITE

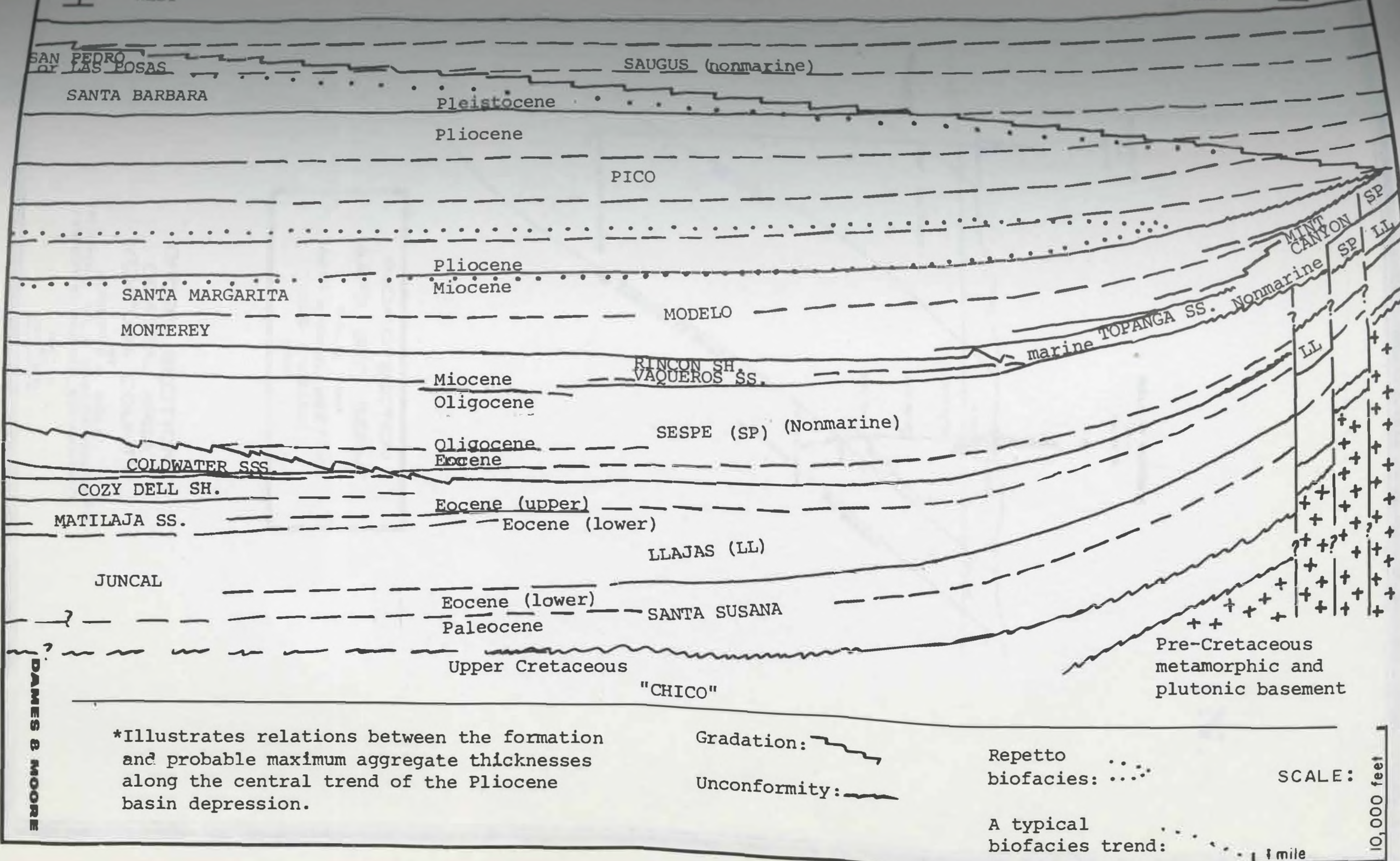
40 0 40 80
SCALE IN STATUTE MILES

REFERENCE: YERKS, ET. AL., 1965

DAMES & MOORE

PLATE 2.1.2-1

IDEALIZED GEOLOGIC SECTION BY HOLMAN (1958,) SHOWING GENERAL RELATIONSHIP OF BEDROCK FORMATIONS IN SOUTHERN VENTURA COUNTY BEFORE PLEISTOCENE DEFORMATION*



*Illustrates relations between the formation and probable maximum aggregate thicknesses along the central trend of the Pliocene basin depression.

DAMES & MOORE

PLATE 2.1.2-2

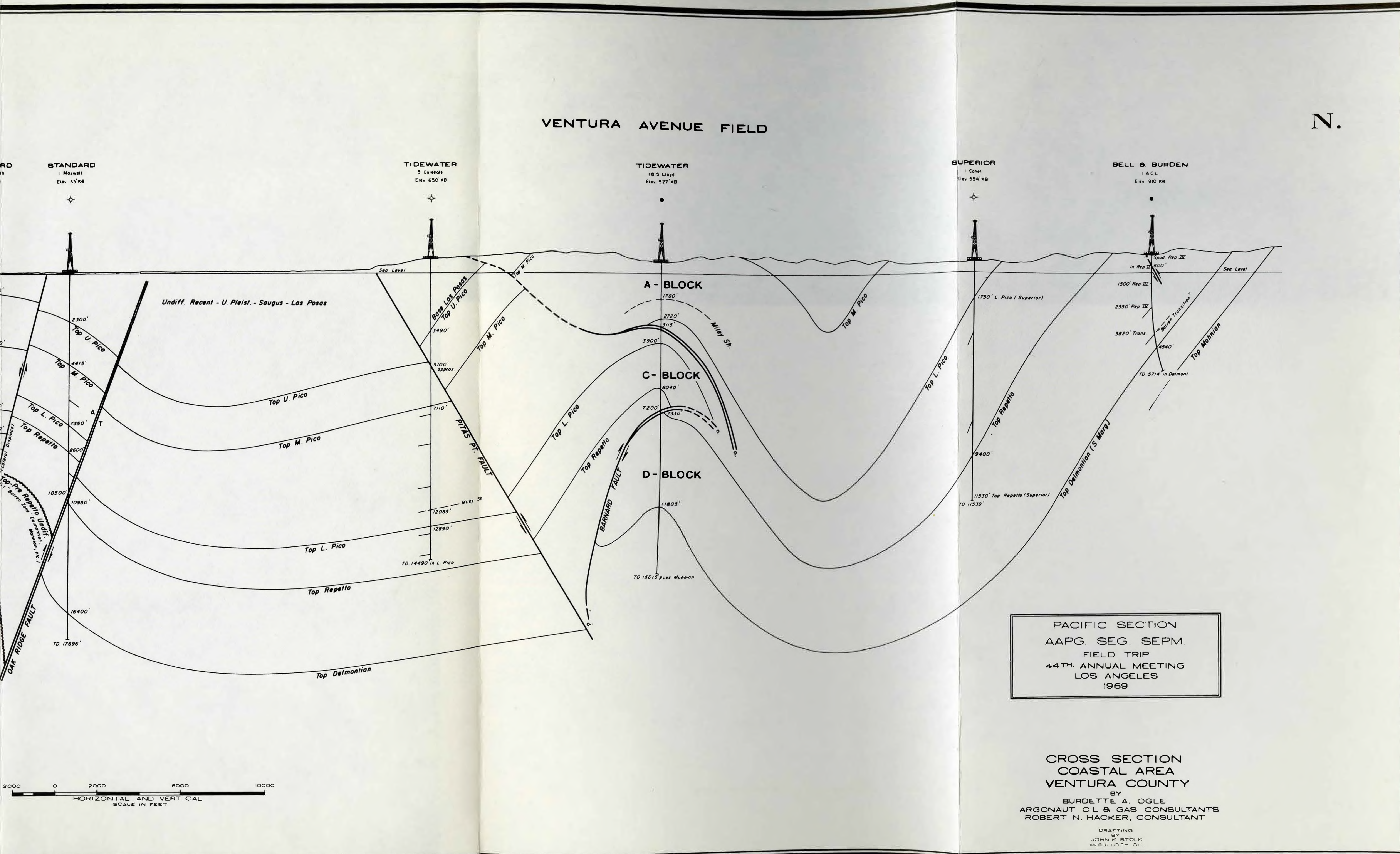
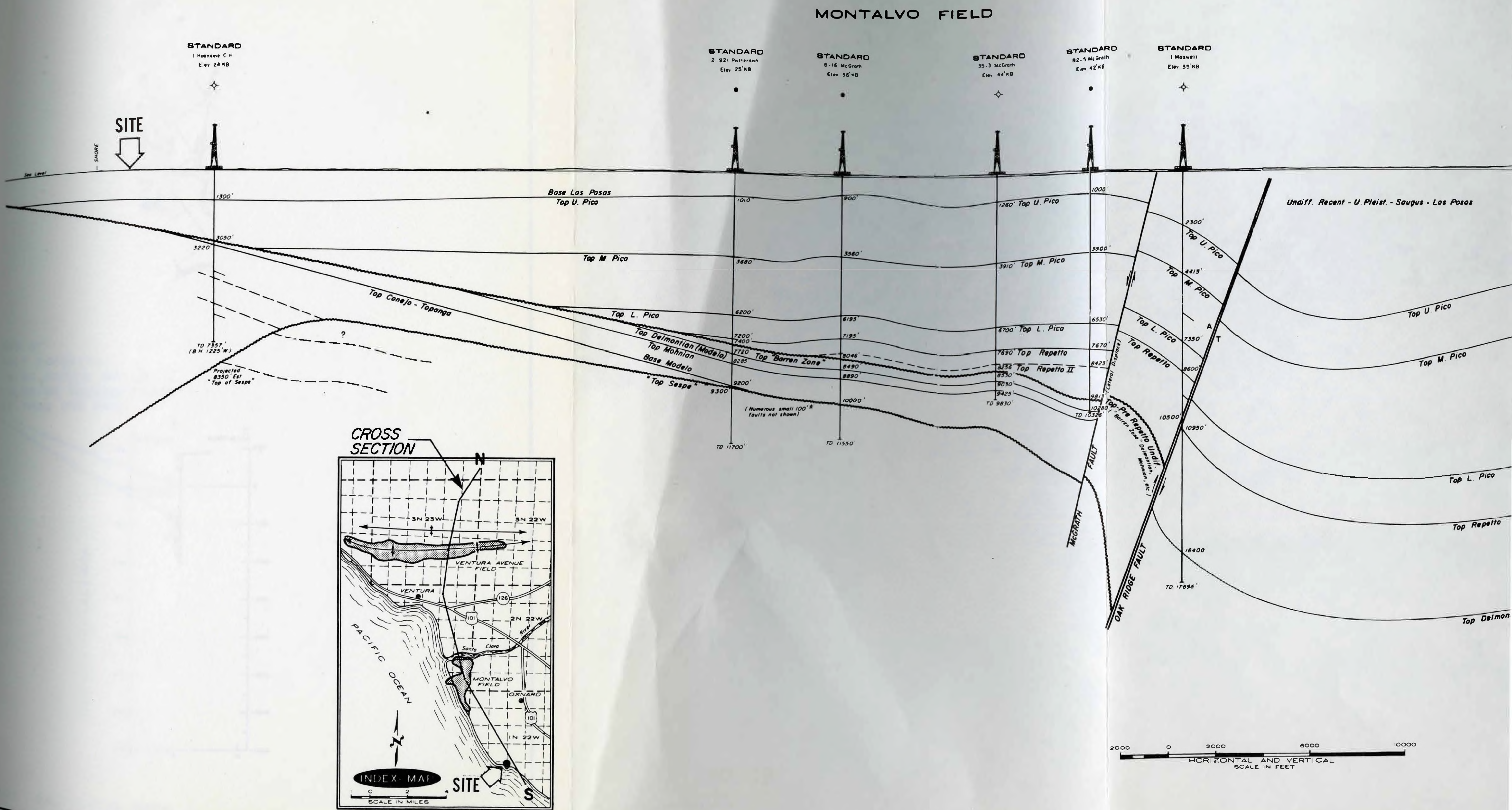
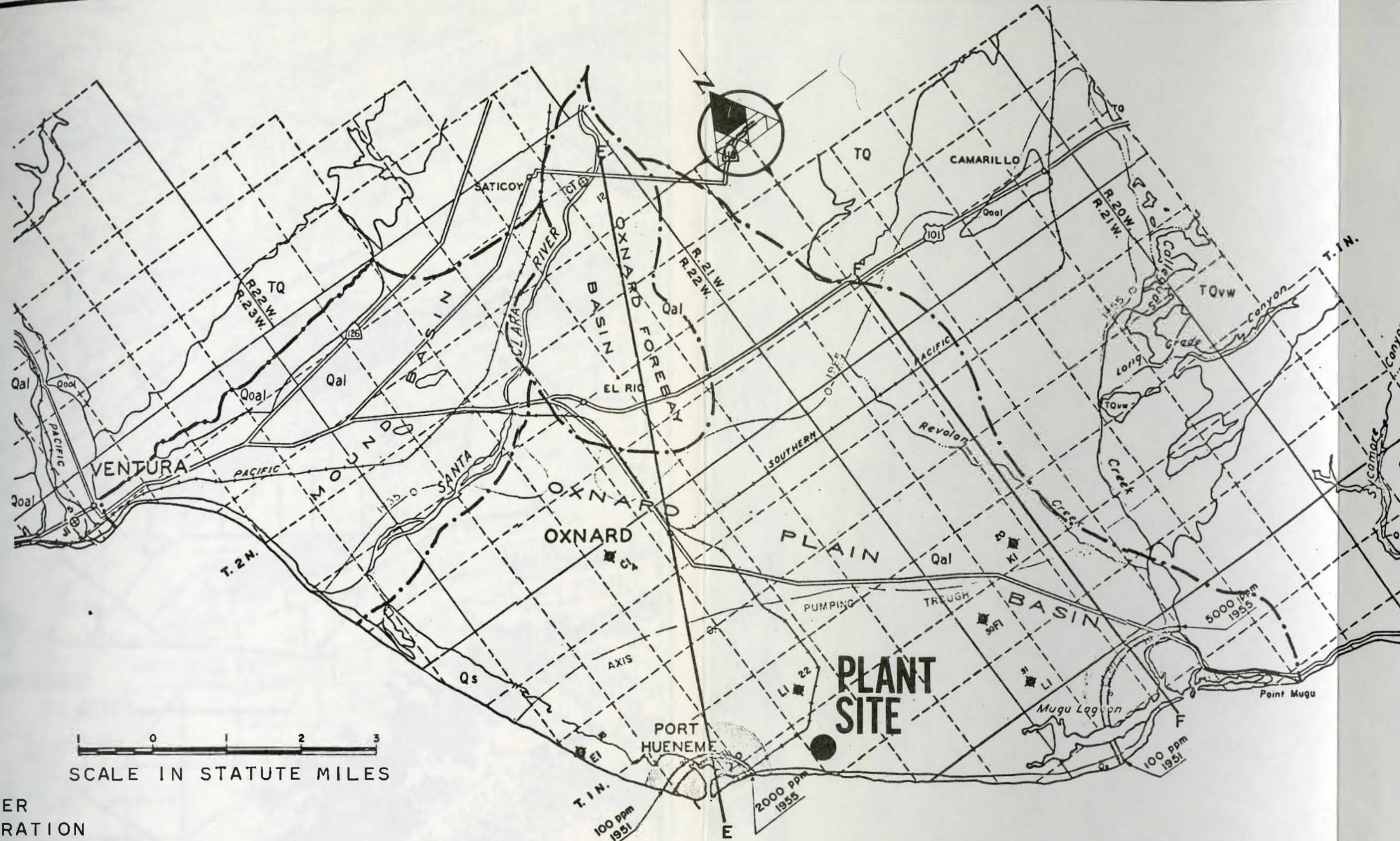

VENTURA AVENUE FIELD
N.
STANDARD
1 Maxwell
Elev. 35' KB
TIDEWATER
5 Corehole
Elev. 650' KB
TIDEWATER
18 5 Lloyd
Elev. 527' KB
SUPERIOR
1 Conet
Elev. 554' KB
BELL & BURDEN
1 ACL
Elev. 910' KB
Sea Level
Undiff. Recent - U. Pleist. - Saugus - Las Posas
Base Los Posas
Top U. Pico
Top M. Pico
Top L. Pico
Top Repetto
Top Delmontian
Top Delmontian (S. Marg.)
Top Mohnian
Top-Pre Repetto Undif.
OAK RIDGE FAULT
PITAS PT. FAULT
BARNARD FAULT
Miley Sh.
A - BLOCK
C - BLOCK
D - BLOCK
2300'
4415'
7350'
8600'
10500'
10950'
16400'
TD 17696'
3490'
5100' approx
7110'
12085'
12890'
TD 14490' in L. Pico
1780'
2720'
3115'
3900'
6040'
7200'
7330'
11805'
TD 15015' poss. Mohnian
1750' L. Pico (Superior)
9400'
11530' Top Repetto (Superior)
TD 11539'
Spud Rep III
In Rep II 600'
1500' Rep III
2550' Rep IV
3820' Trans
"Barren Transition"
4540'
TD 5714' in Delmont
PACIFIC SECTION
AAPG. SEG. SEPM.
FIELD TRIP
44TH. ANNUAL MEETING
LOS ANGELES
1969
CROSS SECTION
COASTAL AREA
VENTURA COUNTY
BY
BURDETTE A. OGLE
ARGONAUT OIL & GAS CONSULTANTS
ROBERT N. HACKER, CONSULTANT
DRAFTING
BY
JOHN K. STOLK
McCULLOCH OIL
2000 0 2000 6000 10000
HORIZONTAL AND VERTICAL
SCALE IN FEET

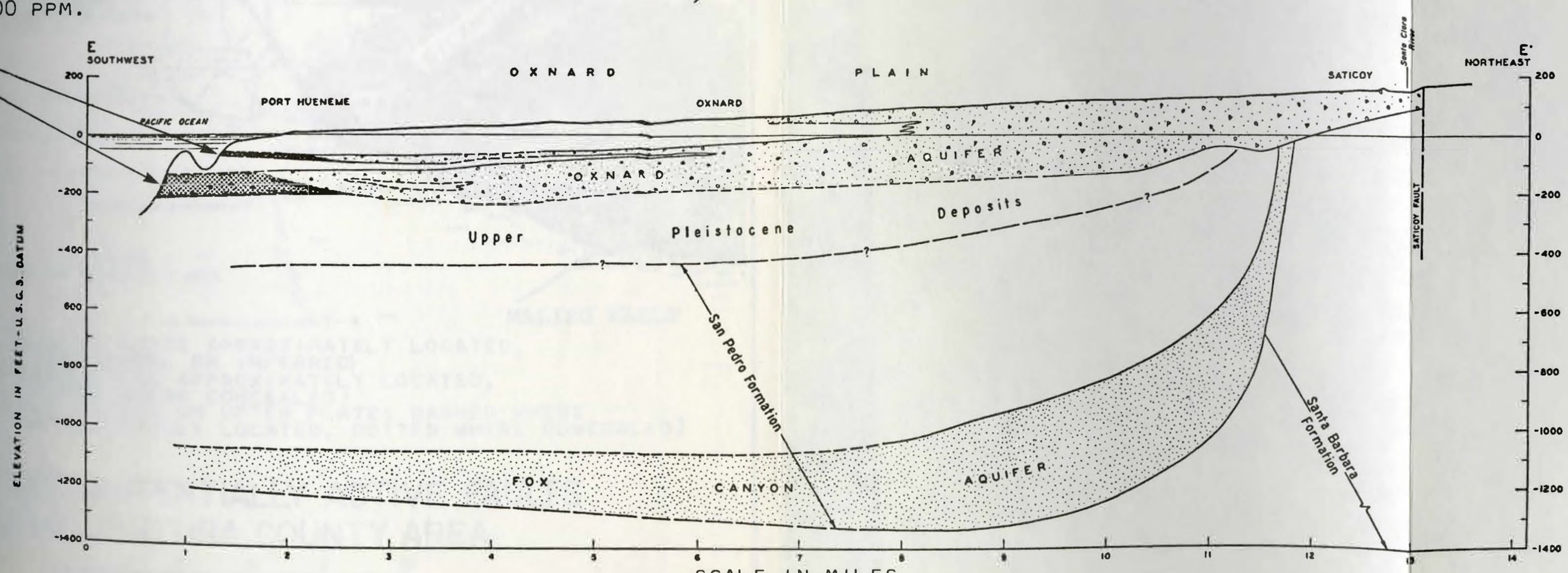
Plate 2.1.2-3

S.


MONTALVO FIELD
STANDARD
1 Hueneme C H
Elev 24' KB
STANDARD
2-921 Patterson
Elev 25' KB
STANDARD
6-16 McGrath
Elev 36' KB
STANDARD
35-3 McGrath
Elev 44' KB
STANDARD
82-5 McGrath
Elev 42' KB
STANDARD
1 Maxwell
Elev 35' KB
SITE
SHORE
Sea Level
Base Los Posas
Top U. Pico
Top M. Pico
Top L. Pico
Top Conejo - Topanga
Top Delmontian (Modelo)
Top Mohnian
Base Modelo
"Top Sespe"
Top "Barren Zone"
Top Repetto
Top Repetto II
Projected
8350' Est
"Top of Sespe"
TD 7357'
(B H 1225' W)
(Numerous small 100'± faults not shown)
TD 11700'
TD 11550'
TD 9830'
TD 10326'
TD 17696'
Undiff. Recent - U. Pleist. - Saugus - Los Posas
Top-Pre Repetto Undif.
("Barren Zone" Delmontian, Mohnian, etc.)
(Lateral Displace)
MCGRATH FAULT
OAK RIDGE FAULT
Top Delmon
CROSS SECTION
N
3N 23W
3N 22W
VENTURA AVENUE FIELD
VENTURA
126
101
2N 22W
PACIFIC OCEAN
Santa Clara River
MONTALVO FIELD
OXNARD
1N 22W
INDEX MAP
SCALE IN MILES
SITE
S
HORIZONTAL AND VERTICAL
SCALE IN FEET
2000 0 2000 6000 10000



PORTIONS OF PERMEABLE DEPOSITS CONTAINING GROUND WATER WITH CHLORIDE CONCENTRATION GREATER THAN 100 PPM.



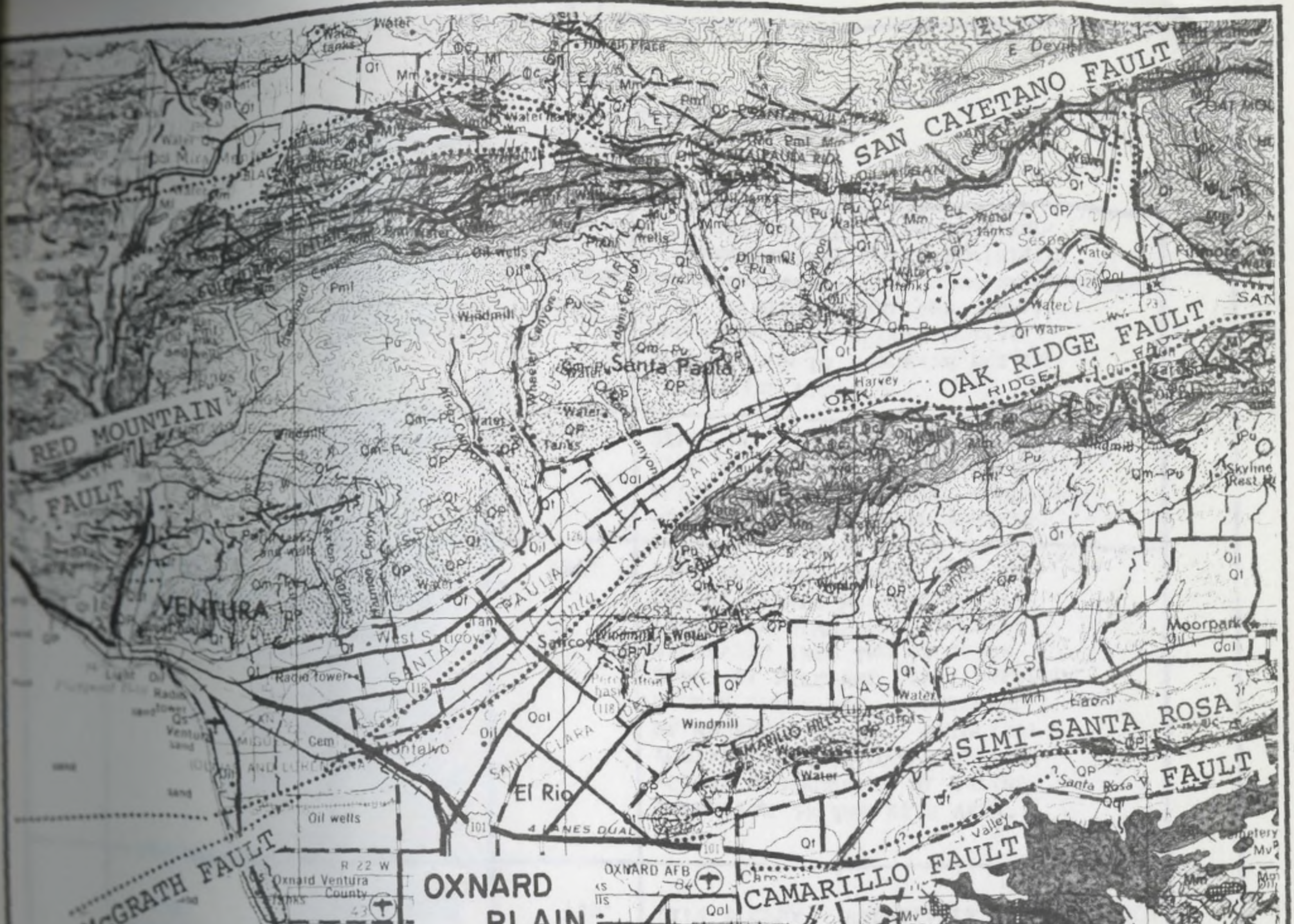
REFERENCE: CALIFORNIA DEPARTMENT OF WATER RESOURCES, 1958, BULLETIN 63

GEOLOGIC SECTION

PORT HUENEME TO SATICOY

DAMES & MOORE

PLATE 2.1.2-4



CONTACT (DASHED WHERE APPROXIMATELY LOCATED, GRADATIONAL OR INFERRED)

FAULT (DASHED WHERE APPROXIMATELY LOCATED, DOTTED WHERE CONCEALED)

THRUST FAULT (BARBS ON UPPER PLATE; DASHED WHERE APPROXIMATELY LOCATED, DOTTED WHERE CONCEALED)

ACTIVE AND POTENTIALLY ACTIVE FAULTS IN THE VENTURA COUNTY AREA

0 2 4 6 8 10

SCALE IN MILES

REFERENCE: JENNINGS AND STRAND, 1969
VENTURA COUNTY DPW, 1973

DAMES & MOORE

PLATE 2.1.2-5

TABLE 2.1.2-I

GENERALIZED STRATIGRAPHIC COLUMN
OF WATER BEARING FORMATIONS,
COASTAL OXNARD PLAIN

AGE	FORMATION	AQUIFER & AQUICLUDE	MAXIMUM THICKNESS	GENERALIZED LITHOLOGY AND GROUNDWATER CHARACTERISTICS
RECENT	CHANNEL DEPOSITS DUNE SAND ALLUVIUM	SEMIPERCHED AQUIFER	160'	FINE TO MEDIUM SAND AND GRAVEL. UNDEVELOPED BY WELLS. ACTIVE DEGRADATION BY BRACKISH RETURN IRRIGATION WATER
		"CLAY CAP"	160'	SILT AND CLAY WITH LENTICULAR FINE TO MEDIUM SAND INTERBEDS. RELATIVELY IMPERMEABLE. CONFINING MATERIAL ABOVE OXNARD AQUIFER.
	ALLUVIAL FLOOD PLAIN DEPOSITS	OXNARD AQUIFER	225'	FINE TO COARSE SAND, FINE TO COARSE GRAVEL RANGING TO SIX INCHES IN DIAMETER. LOCALLY SEPARATED INTO TWO OR THREE ZONES BY SILT AND CLAY INTERBEDS. HIGHLY PERMEABLE. DEVELOPED BY NUMEROUS WELLS. PRINCIPAL AQUIFER BENEATH OXNARD PLAIN. ACTIVE DEGRADATION BY SALINE INTRUSION IN THE SITE AREA.
	— DISCONFORMITY —			
UPPER PLEISTOCENE	UPPER PLEISTOCENE ALLUVIAL FLOOD PLAIN DEPOSITS	AQUICLUDE	130'	SILT & CLAY. RELATIVELY IMPERMEABLE.
		MUGU AQUIFER	240'	FINE TO COARSE SAND AND FINE GRAVEL. INTERBEDDED SILT & CLAY. MODERATE TO HIGH PERMEABILITY. LOCALLY DEVELOPED BY WELLS.
		AQUICLUDE	190'	SILT & CLAY. RELATIVELY IMPERMEABLE.
	— UNCONFORMITY —			
LOWER PLEISTOCENE	SAN PEDRO FORMATION	HUENEME AQUIFER	380'	IRREGULARLY INTERBEDDED FINE TO COARSE SAND, SILT, & CLAY, NOT PRESENT SOUTH OF HUENEME ROAD. LOW TO MODERATE PERMEABILITY. DEVELOPED BY FEW WELLS. NOT PRESENT IN SITE VICINITY.
		AQUICLUDE	220'	SILT & CLAY. RELATIVELY IMPERMEABLE.
		FOX CANYON AQUIFER	580'	FINE TO MEDIUM SAND & THIN GRAVEL STRINGERS. INTERBEDDED SILT & CLAY: MODERATE TO HIGH PERMEABILITY. DEVELOPED BY DEEP WELLS. PRINCIPAL LOWER PLEISTOCENE AQUIFER.
		AQUICLUDE	40'	SILT & CLAY. RELATIVELY IMPERMEABLE
LOWER PLEISTOCENE	SANTA BARBARA FORMATION	GRIMES CANYON AQUIFER	1530'	FINE TO COARSE SAND & GRAVEL. UPPERMOST MEMBERS OF THE FINE GRAINED SANTA BARBARA FORMATION. MODERATE TO HIGH PERMEABILITY. DEVELOPED BY FEW DEEP WELLS.

Reference: California Department of Water Resources, 1965

2.1.2.2 Seismicity

Earthquake History

California is located within the circum-Pacific earthquake zone and is the most seismically active of the 48 contiguous states. All of California experiences earthquake activity to some degree. In recent years the site area has experienced several seismic events per year, although most were quite small and detected only by instruments.

The major earthquakes which have occurred in Southern California during the years 1912 to 1971 are listed in Table 2.1.2-II, and the most important of these are shown on Plate 2.1.2-6.

The Magnitude of an earthquake is a function of its energy release as measured on a standard seismograph (Richter, 1935). Intensity refers to subjective evaluation of the physical effects of ground motion at a specific location. The Modified Mercalli Scale places these observations into a ranking scale (Wood and Neumann, 1931), as shown in Table 2.1.2-III.

Earthquake epicenters of all magnitudes located within about 60 miles of the site from 1932-1972 (California Institute of Technology, 1973) are shown on Plate 2.1.2-7. There is a large amount of activity in the general region, but by comparison, it is not intensive in the coastal Oxnard Plain. Study of Plate 2.1.2-7 indicates four major concentrations of epicenters: (1) to the southeast in the Los Angeles-Long Beach area; (2) to the east in the northern San Fernando Valley; (3) to the north in Kern County; and (4) to the west in the Santa Barbara Channel.

A list of earthquakes that have been perceptible near the site is presented in Table 2.1.2-IV. The term "site intensity" is equivalent to the Modified Mercalli Intensity at or near the site. In some of the older events, the earthquake was presumed perceptible but no intensity was estimated due to a lack of information.

There have been 91 earthquakes reportedly felt near the site since 1769. There have been a total of 18 felt with Intensity VI or greater, including at least three with Intensity VIII. Even the highest intensities felt in this region in the past would cause only slight damage to modern structures.

Recurrence intervals can be developed from the historical data. A recurrence interval gives an indication of how many times per century an earthquake of a certain intensity might occur. This is merely a statistical calculation derived from historical probabilities. The following intervals have been calculated with this in mind:

Intensity	Occurrences per Century
VIII	2.2
VII	4.0
VI	6.7

Intensities have been held to be related to ground accelerations. Use of such accelerations for design purposes has been reasonably successful in the past when applied to ordinary construction of moderate size. For large construction and for special units such as tanks, it is necessary to consider expected ground motions in detail by the design earthquake method. Such a correlation between intensity and acceleration is difficult and different researchers have developed different values. However, for general purposes, Intensity VIII ground motion can be assigned a maximum horizontal acceleration of 0.30g (Leeds, 1973) and Intensity VII, 0.10g (derived from information obtained from Duke and Leeds, 1962; Hamilton, 1969; Housner and Hudson, 1958; and Matthiesen, 1973). Recurrence intervals for the accelerations would be the same as for their corresponding intensities.

Relation of Earthquakes to Tectonic Structure

Southern California exhibits a high degree of seismicity, most of which can be related to known fault systems. Plate 2.1.2-6 shows the location of major earthquakes and their association with faults and ground breakage along those faults.

The four areas of earthquake epicenter concentration exhibited on Plate 2.1.2-7 can be related to tectonic structures. The area south of Los Angeles is related to activity on the Newport-Inglewood and associated faults. Activity here is primarily associated with the 1933 Long Beach earthquake and its aftershocks. The activity in the San Fernando Valley is related to the Sierra Madre faults and is primarily due to aftershocks of the San Fernando earthquake of 1971. The Kern County earthquakes are due to activity on the White Wolf and related faults, and are primarily aftershocks of the Arvin-Tehachapi earthquake of 1952. The activity in the Santa Barbara Channel is due to continuing movement on several offshore faults and an earthquake swarm in 1968. This last major area affects the site most due to its proximity and continuing activity. Many of the events perceptible at the site have originated here, including one of Intensity VIII. This was also the probable epicentral ar[illegible] of the great earthquake of 1812.

Also shown on Plate 2.1.2-7 are the San Andreas, B[illegible] Pine, Santa Ynez, and other faults. Little activity appears [illegible] be directly associated with these faults, but they have pote[illegible] to generate large earthquakes. A great earthquake originat[illegible] on this part of the San Andreas Fault in 1857; and one in 18[illegible] probably centered on the Big Pine Fault.

Several recent earthquakes have occurred in the of[illegible] shore area adjacent to the site. Two of these occurred in 19[illegible] the Point Mugu earthquake, southeast of the site; and the An[illegible] earthquake, southwest of the site. These earthquakes suggest continuing moderate seismic activity near the Oxnard Plain. Most of them appear to have had a thrusting mechanism charac-terized by a high momentary acceleration, but only small effective acceleration. These events have had a source on f[illegible] associated with the Malibu and Sycamore faults. There is al[illegible] some indication of minor activity on the Oak Ridge fault bet[illegible] Oxnard and Ventura.

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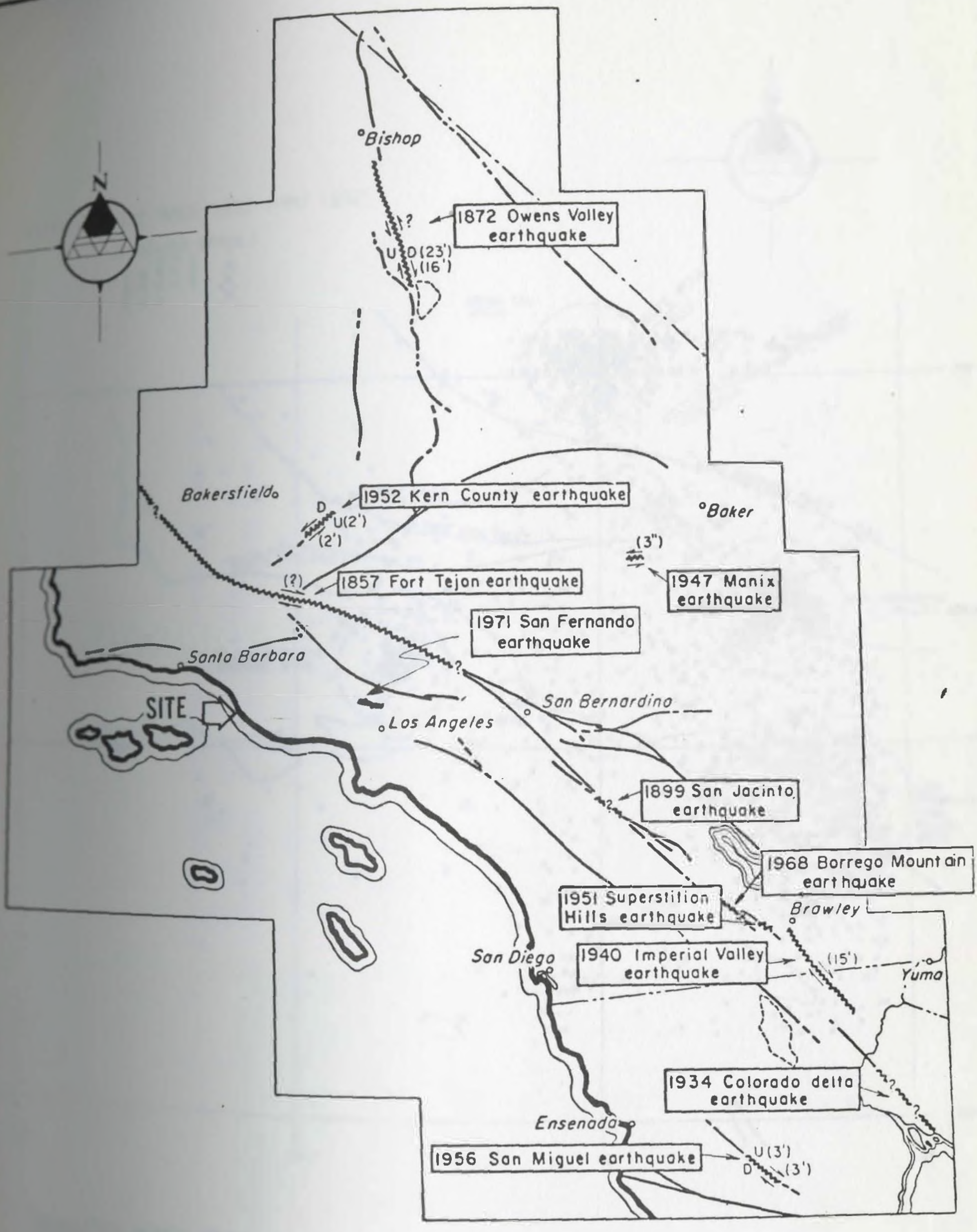


HISTORIC FAULT BREAKS
SOUTHERN CALIFORNIA REGION

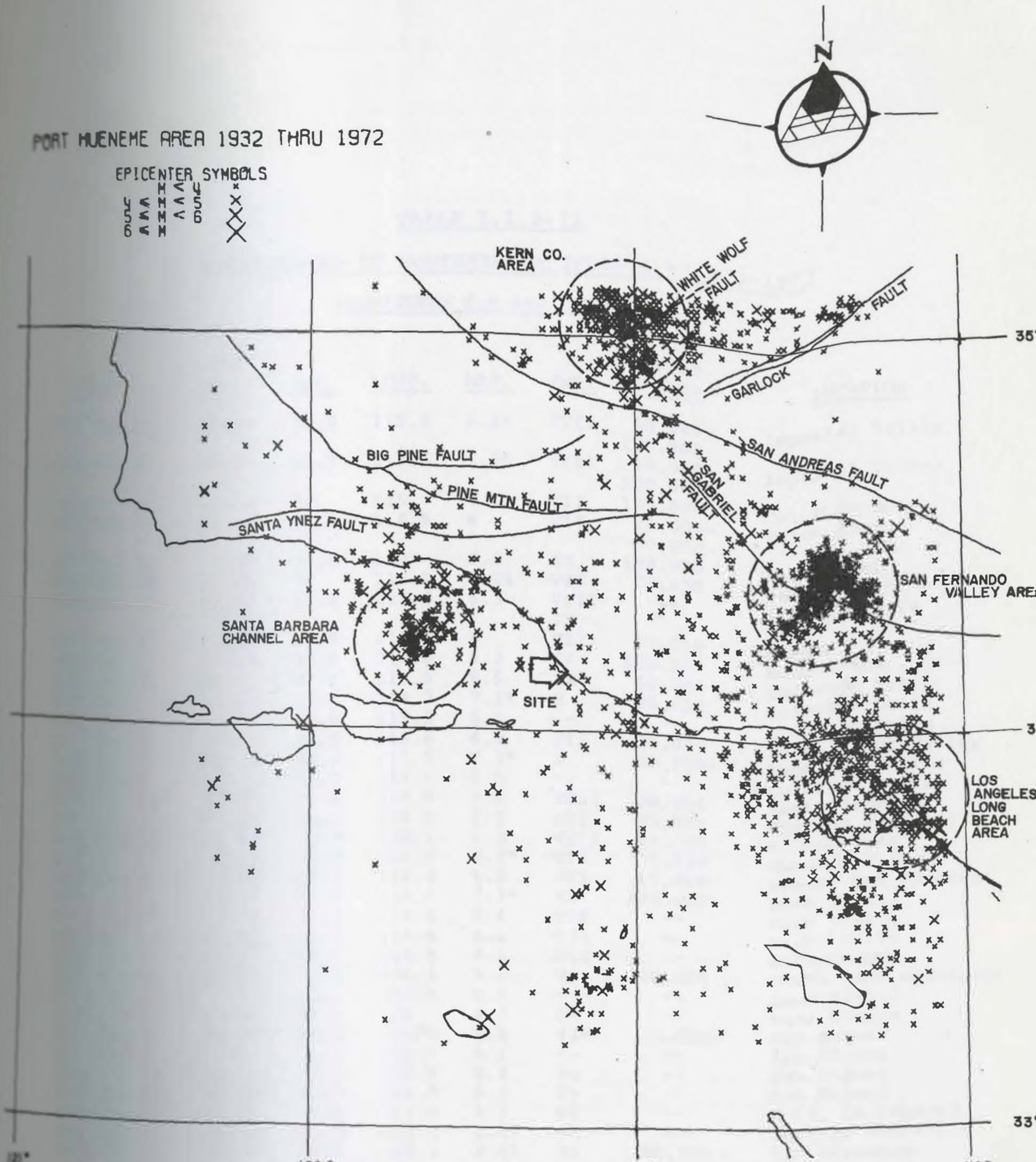
0 50 100

SCALE IN STATUTE MILES

REFERENCE: ALLEN, ET. AL., 1965
UPDATED 1971 BY DAMES AND MOORE

DAMES & MOORE

PLATE 2.1.2-6



INSTRUMENTAL LOCATIONS OF EARTHQUAKE EPICENTERS IN SITE AREA, 1932–1972

0 10 20 30 40 50

SCALE IN STATUTE MILES

REFERENCE: CALIF. INST. OF TECHNOLOGY, 1973

DAMES & MOORE

PLATE 2.1.2-7

TABLE 2.1.2-II

EARTHQUAKES OF SOUTHERN CALIFORNIA - 1912-1973

MAGNITUDES 6.0 AND GREATER

DATE	TIME (PST)	LAT.	LONG.	MAG.	INT.	FELT AREA +	LOCATION
1915 Jun 22	19:59	32.8	115.5	6.25	VIII	50,000-100,000	Imperial Valley
1915 Jun 22	20:56	32.8	115.5	6.25	VIII	50,000-100,000	Imperial Valley
1915 Nov 20	16:14	32	115	7.1	VII	120,000	Colorado Delta
1916 Oct 22	18:44	34.9	118.9	6	VII	25,000-50,000	Tejon Pass
1918 Apr 21	14:32	33.7	117	6.8	IX	130,000	San Jacinto
1923 Jul 22	23:30	34	117.2	6.25	VII	70,000	San Bernardino
1925 Jun 29	06:42	34.3	119.8	6.3	VIII-IX	--	Santa Barbara
1927 Sep 17	18:07	37.5	118.7	6	VII	75,000	Bishop
1933 Mar 10	17:54	33.6	118.0	6.3	IX	100,000	Long Beach
1934 Dec 30	05:52	32.2	115.5	6.5	IX	60,000	Colorado Delta
1934 Dec 31	10:45	32	114.7	7.1*	X	80,000	Colorado Delta
1935 Feb 24	--	32.0	115.2	6.0	--	--	Colorado Delta
1937 Mar 25	08:49	33.5	116.6	6.0	VII	30,000	Terwilliger Valley
1940 May 18	20:36	32.7	115.5	7.1*	X	60,000+	Imperial Valley
1940 Dec 8	--	31.7	115.1	6.0	--	--	Colorado Delta
1941 Jun 30	23:51	34.4	119.6	6.0	VIII	20,000	Santa Barbara
1942 Oct 21	08:22	33.0	116.0	6.5	VII	35,000	Borrego Valley
1946 Mar 15	05:49	35.7	118.1	6.3	VIII	65,000	Walker Pass
1947 Apr 10	07:58	35.0	116.6	6.2*	VII	75,000	Manix
1948 Dec 4	15:43	39.9	116.4	6.5	VII	65,000	Desert Hot Springs
1952 Jul 21	03:52	35.0	119.0	7.7*	XI	160,000	Kern County
1952 Jul 22	23:53	35.0	118.8	6.4	VII	--	Kern County
1952 Jul 23	05:17	35.2	118.8	6.1	VII	--	Kern County
1952 Jul 28	23:03	35.4	118.9	6.1	VII	--	Kern County
1954 Mar 19	01:54	33.3	116.2	6.2	VI	40,000	Santa Rosa Mountains
1954 Oct 24	--	31.5	116.0	6.0	--	--	Agua Blanca
1954 Nov 12	04:26	31.5	116	6.3	V+	--	Agua Blanca
1956 Feb 9	06:32	31.8	115.9	6.8	VI+	30,000+	San Miguel
1956 Feb 9	--	31.7	115.9	6.1	--	--	San Miguel
1956 Feb 14	10:33	31.5	115.9	6.3	V+	--	San Miguel
1956 Feb 14	17:20	31.5	115.9	6.4	V+	--	San Miguel
1966 Aug 7	09:36	31.8	114.5	6.3	VI	--	Gulf, California
1968 Apr 8	18:29	33.1	116.1	6.5*	--	--	Borrego Mountains
1971 Feb 9	06:01	34.4	118.4	6.6*	XI	80,000	San Fernando

*Surface faulting

+ FELT AREA IN SQUARE MILES

Reference: Eppley, 1966; U.S. Department of Commerce, various years, (U.S. Earthquakes)

TABLE 2.1.2-III

MODIFIED MERCALLI INTENSITY (DAMAGE) SCALE OF 1931 (ABRIDGED)

I. Not felt except by a very few under especially favorable circumstances. (I Rossi-Forel Scale.)

II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing. (I to II Rossi-Forel Scale.)

III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibration like passing of truck. Duration estimated. (III Rossi-Forel Scale.)

IV. During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably. (IV to V Rossi-Forel Scale.)

V. Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop. (V to VI Rossi-Forel Scale.)

VI. Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight. (VI to VII Rossi-Forel Scale.)

VII. Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motorcars. (VIII Rossi-Forel Scale.)

VIII. Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motorcars disturbed. (VIII+ to IX- Rossi-Forel Scale.)

IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken. (IX+ Rossi-Forel Scale.)

X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks. (X Rossi-Forel Scale.)

XI. Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.

XII. Damage total. Waves seen on ground surface. Lines of sight and level distorted. Objects thrown upward into the air.

Reference: Modified from Wood and Newman, 1931,

TABLE 2.1.2-IV

EARTHQUAKES SIGNIFICANT TO SITE

Year	Month	Day	Location	NLAT	WLON	MMI	SI	M	Area
1769	7	28	Los Angeles area	34	118				
1800	11	22	S. California			VII			
			Santa Barbara	34.5	119.5	VI			
1806	3	24	Santa Barbara	34.5					
1812	12	8	Los Angeles area			VIII-IX			
	12	21	Santa Barbara Channel	34	120	X	VIII(?)		
1852	10	26	S. California						
	11	27-30	S. California	34.5	119	IX-X	VI-VII(?)		
1857	1	9	Fort Tejon	35	119	X-XI	VIII(?)		
1872	3	26	Owens Valley	36.5	118	X-XI	I-III		
1880	4	12	Ventura County			V	I-III(?)		
1883	9	5	Ventura	34	119	VI	V(?)		
1893	5	18	Off Ventura	34	119	VII(?)	V-VI(?)		
	6	1	Santa Barbara	34.5	119.5	VII	I-III		
1894	7	29	S. California	35	118	VII	I-III(?)		
1902	7	27,31	Santa Barbara County	34.5	120.5	IX	I-III(?)		
1906	4	18	San Francisco	38	123	XI	I-III(?)	8.3	375,000
1910	5	15	Riverside County			VII	I-III		
1911	5	10	Oxnard	34	119	IV	IV		
1912	12	14	Oxnard	34	119	VI-VII	VI-VII		
1915	10	2	Pleasant Valley, NV	40.5	117.5	X	I-II(?)	7.6	500,000
1918	4	21	Riverside County	33.8	117	IX	I-III(?)	6.8	150,000
1919	1	25	Tejon Pass	35	119	V	I-II(?)		
1920	6	20	Inglewood	33.6	118	IX	I-II(?)		
1925	6	29	Santa Barbara	34.3	119.8	VIII-IX	VII-VIII?	6.3	
1926	2	18	Off Ventura	34	119.5	VI	V-VI(?)		
	5	3	Off Point Hueneme	34	119	VI	V-VI		
	6	29	Santa Barbara	34.5	119.5	VII	IV-V(?)		30,000
1927	5	15	Off Point Hueneme	34	119	V	IV-V(?)		
	11	4	Off Point Arguello			IX-X	IV-V(?)	7.5	
1928	3	10	Ventura	34	119				
	4	18	Santa Cruz Island				I-III(?)		
1930	1	15	San Bernardino Mtns	34.2	116.9	VI	I-III		50,000
	8	5	Santa Barbara	34.5	119.5	VII	V-VI		9,000
	8	30	Santa Monica	33.9	118.6	VII-VIII	III		11,500
1932	2	4	Santa Barbara & Ventura	34.6	119.7	I-III	I-III		
	12	20	Western Nevada	38.7	117.8	X-XI	I-III		500,000
1933	3	10	Long Beach	33.6	118	IX	VI	6.3	75,000
	6	25	Off Point Conception			V	I-III		4,000
	10	2	Los Angeles	33.8	118.1	VI	IV		6,000
1934	6	7	Parkfield	35.9	120.5	VIII	I-III		34,000
1935	7	13	Los Angeles	34.2	117.9	V	III		14,000
1936	2	23	Colton	34.1	117.4	V	I-III		11,000
1937	3	25	Riverside County	33.5	116.6	VI	I-III		30,000
1938	5	31	Santa Ana Mtns	33.7	117.5	VI	IV		30,000
1940	10	10	Santa Monica Bay	33.8	118.4	VI	V		7,000
1941	6	30	Santa Barbara Channel	34.3	119.6	VIII	VI	5.9	20,000
	9	1	New Santa Barbara	34.3	119.6	V	I-II		1,500
	10	22	Gardena	33.8	118.2	VI	I-III		

TABLE 2.1.2-IV - continued

EARTHQUAKES SIGNIFICANT TO SITE

Year	Month	Day	Location	NLAT	WLON	MMI	SI	M	Area
1944	6	12	Cabazon	34.0	116.8	VI	IV		16,000
1945	4	1	Santa Rosa Is.	34.0	120.0	IV	III-IV(IV*)	5.4	1,000
1946	3	15	Walker Pass	35.7	118.1	VIII	V*		65,000
1947	4	10	Manix	35.0	116.5	VII	V*		75,000
1948	4	16	Off Point Mugu	34.0	119.0	VI	IV(VI*)		1,400
	12	4	Desert Hot Springs	33.9	116.3	VII	IV(V*)		65,000
1950	2	25	Sespe Hot Springs	34.6	119.1	VI	IV(VI*)		2,500
1952	7	21	Kern County	35.0	119.0	X	VI(VII*)	7.7	160,000
	8	22	Bakersfield	35.3	118.9	VIII	IV*		40,000
		23	Acton	34.5	118.2	VI	VI*		35,000
	11	5-6	Oxnard				I-II(?)		
		21	Bryson	35.8	121.2	VII	IV*		20,000
1953	10	21	Santa Barbara	34.3	119.7	V	I-III		
1954	1	12	Wheeler Ridge	35.0	119.0	VII-VIII	V*		35,000
	3	19	Santa Rosa Mtns	33.3	116.2	VI	IV*		49,000
	8	26	Anacapa Is.	33.9	119.5	VI	IV*		
	11	17	Ventura	34.5	119.1	IV	IV*		
1956	2	9	Baja California	31.8	115.9	VI*	I-III	6.8	30,000
	10	9	Oxnard			IV	IV		
1957	3	18	S. of Oxnard	34.1	119.2	VI	VI	5	3,000
1958	7	13	Off Carpinteria	34.4	119.5	VI	V	4.7	5,000
1959	9	30	Point Conception	34.4	120.6	VI	I-III	4.5	
1961	11	14	Wheeler Ridge	34.9	119.0	VI	I-III(IV*)	5.0	10,000
	12	27	Oxnard	34.1	119.1			2.3	
1962	1	15	S.E. of Oxnard	34.2	119.1			3.0	
	2	18	S.E. of Oxnard	34.2	119.1			2.9	
1963	2	28	Fort Tejon	34.9	119.0	VI	I-III*	5.0	8,000
	5	17	Ventura County			V	IV(I-III*)		300
1965	7	29	Off Ventura County	33.5	119.7	V	V	4.3	600
1966	6	27	Parkfield	35.9	120.9	VII	III(IV*)	5.3	20,000
1968	4	8	Borrego Mt.	33.2	116.1	VII	IV+	6.5	60,000
	6	26	Off Santa Barbara	34.2	119.7	V	I-III	4.0	800
	7	4	Off Santa Barbara	34.1	119.7	VI	V	5.2	8,000
1969	3	11	Off Ventura	34.1	119.2	I-III	I-III*	2.5	
	4	28	Borrego Springs	33.4	116.4	VII	I-III(?)	5.9	30,000
	10	24	Off S. Calif Coast	33.3	119.2	V	V*		
1970	8	25	Off S. Calif Coast	34.2	119.2	V	I-IV(V*)	3.6	
	9	12	Lytle Creek	34.3	117.5	VII	V*	5.4	65,000
1971	2	9	San Fernando	34.4	118.4	VIII-IX	VI	6.5	80,000
	2	21	San Fernando Aftershock	34.4	118.5	III+	III		
1973	2	21	Off Point Mugu	34.1	119.0		V+	5.7	
	8	6	Off Point Mugu	34.0	119.2		IV	4.3	

NOTES:
MMI=Modified Mercalli Intensity
M=Richter Magnitude
?=Estimated
SI=Site intensity in MMI
Area=Felt Area (in square miles)

1) Before 1900 site intensity was derived from Ventura.
2) Between 1900 and 1945 site intensity was derived from Oxnard.
3) After 1945, site intensities are derived from Port Hueneme.
*Oxnard intensities are also listed and denoted by asterik.

Reference: Cal. Inst. of Technology, 1973; Eppley, 1966; Siesmological Society Of America Bulletin, various issues 1971-1973 and Los Angeles Times, 1973

2.1.2.3 Marine Geology

In this section, the marine geological setting of the Port Hueneme coastal area is described as it relates to the proposed marine facilities site. This information has been developed from a detailed investigation of available published and unpublished literature, augmented by site visits and an underwater reconnaissance of the proposed ship berthing area. In addition, the marine geology of the area has been discussed in detail with staff members of the Office of Marine Geology, U.S. Geological Survey.

Sea-Floor and Coastal Morphology

The site of the proposed LNG marine terminal is located on the northern edge of the California continental borderland, a structurally complex offshore region of basins and troughs separated by ridges which often emerge as offshore islands (Plate 2.1.2-8). Port Hueneme is situated near the intersection of one such major submarine ridge and the mainland coastline. The eastern end of the ridge forms a sill separating two depositional basins: the Santa Barbara Basin to the northwest and the Santa Monica Basin to the southeast.

The mainland shelf off Port Hueneme is approximately 3 miles in width and slopes to the southwest at approximately 40 feet per mile (less than one degree). At a depth of approximately 120 feet, the slope increases to about 5°. From this point, it descends to the floor of the Santa Monica Basin, which is at a depth of about 2,000 feet. The shelf is incised by two major submarine canyons, Hueneme Canyon and Mugu Canyon, with three smaller, unnamed canyons lying between them (Plate 2.1.2-9).

The 120-foot depth contour in both Hueneme and Mugu Canyons approaches within 1,000 feet of the shoreline. The head of Hueneme Canyon lies approximately in the center of the Santa Clara River floodplain (Oxnard Plain); Mugu Canyon lies off the southeastern edge of the plain. Both canyons exhibit branching canyon heads and meandering courses, suggesting that at least the upper parts of the canyons may have been originally cut by rivers during the lower sea level of the past glacial epochs.

Hueneme Canyon has an average gradient of approximately 3 percent, but that gradient increases to greater than 20 percent near the head of the canyon. The canyon is approximately 13 miles long and terminates in water depths exceeding 2,400 feet.

The coastline in the Port Hueneme area is arcuate and generally trends northwest-southeast between the Santa Monica and Santa Ynez Mountains (Plate 2.1.2-9). There is a wide beach backed by large sand dunes along the coast north of Port Hueneme and a somewhat narrower beach with small sand dunes to the south. The shoreline of the Oxnard Plain between the Santa Clara River and Point Mugu is broken by two man-made harbors and one natural lagoon. These are, from north to south, Channel Islands Harbor, Port Hueneme Harbor, and Mugu Lagoon; Channel Islands Harbor lies one mile upcoast (northwest) of Port Hueneme, while Mugu Lagoon lies 8 miles downcoast (southeast).

Bedrock Geology

Known and postulated areas of exposed bedrock within the Southern California continental borderland are shown on Plate 2.1.2-10. No rock bottom is shown within a radius of several miles from the proposed site.

The bedrock surface beneath the site is a broad downwarped basin underlain by Pliocene and older sedimentary and volcanic rocks, and overlain by up to 2,000 feet of Pleistocene and Holocene sediments introduced by the ancestral Santa Clara River (California Division of Mines and Geology, in press). The bedrock geology is discussed further in Section 2.1.2.1, Terrestrial Geology.

Available information about the geologic structure of the bedrock in the immediate site area has been reviewed. Seismic profiling records run by the U.S. Geological Survey (Greene, Wolf, and Blom, in press) show only a few small faults offshore of Port Hueneme. One of these is a possible fault which has been inferred to extend from the shoreline down the axis of Hueneme Canyon for a distance of about 3 miles, but apparently it does not displace post-Pliocene materials and can therefore be considered inactive.

Sedimentary Deposits

A study of the Southern California mainland shelf by the Allan Hancock Foundation (1965) established that shelf sediments off Port Hueneme generally consist of sandy silts, silty sands, and relatively well-sorted sands (Plate 2.1.2-11). The surficial sediments presently found in the area have been transported downcoast (southeasterly) from the Santa Clara and Ventura River mouths.

The Hueneme submarine canyon cuts through unconsolidated and semiconsolidated alluvial deposits which comprise the present Santa Clara River floodplain. Although these deposits include lenses of gravel and cobbles, no such material has yet been obtained from the sea floor at the head of the canyon. A jet-probing operation at the head of the canyon (Shepard and Emery, 1941) encountered a hard substratum beneath 26 feet of overburden at a water depth of approximately 40 feet. Farther down the canyon, at depths of 442, 484, and 1,238 feet, gravel was found along with sand and mud in sediment cores (Shepard and Emery, 1941). The Hueneme Canyon fill material is predominantly sand in the upper reaches of the canyon, grading down canyon into sand and silt mixtures.

The alluvial deposits directly underlying the Port Hueneme area consist of approximately 1,800 feet of interbedded marine and nonmarine clays, silts, sands, and gravels (Green, Wolf, and Blom, in press). These deposits comprise the lower Pleistocene Santa Barbara and San Pedro formations, and the unnamed upper Pleistocene and Holocene floodplain deposits, all of which form an extensive groundwater basin. Because of its value as a water resource, the alluvial sequence has been the subject of intensive study by several investigators (California Department of Water Resources, 1953, 1958, 1965; Gorsline, 197[illegible]; Green, Wolf, and Blom, in press) and has been described in Terrestrial Geology, Section 2.1.2.1.

The water-bearing deposits (aquifers) beneath the Oxnard Plain extend offshore and crop out on the basin slopes and the walls of Hueneme Canyon; they are assumed to be in hydraulic continuity with the ocean waters. Plate 2.1.2-12 illustrates the probable outcrops of two upper Pleistocene and Recent age aquifers on the sea floor. Gravel reported in the floor of Hueneme Canyon by Shepard and Emery (1941) and Gorsl[illegible]

1970) probably represents exposures of the stream channel deposits.

Sedimentary Processes

The primary source of the sediments now found on the Ventura-Oxnard shelf is the Santa Clara River, which enters the ocean approximately 7 miles north of Port Hueneme. The greatest volume of sediment is delivered to the coast during the winter and spring rains. The finer fractions are carried offshore in suspension, while the coarser fractions of the sediments are transported away from the river mouth throughout the year by littoral drift. A much smaller source of sediment is littoral material that reaches the area from the coast north of the Santa Clara River mouth.

Studies of littoral drift along the Ventura-Oxnard coast (Johnson, 1956; U.S. Army Corps of Engineers, 1948, 1957, and 1970; Savage, 1957) have shown that the direction of movement is predominantly from north to south (downcoast), although temporary reversals do occasionally occur during summer and fall. The rate of littoral drift in this area has been estimated to be on the order of 350,000 to 500,000 cubic yards per year.

Prior to the construction of Port Hueneme Harbor in 1938-40, much of the bottom material transported by longshore currents was trapped in the head of Hueneme Canyon and from there was transported down the canyon to the floor of the Santa Monica Basin. The construction of the North Jetty at Port Hueneme directed an even greater amount of sediment into the canyon, resulting in severe erosion of the beaches downcoast of the harbor mouth (Savage, 1957). A sand-bypassing project was initiated in 1953 to mechanically transfer sand past the harbor mouth.

The construction of Channel Islands Harbor in 196] one mile upcoast (northwest) of Port Hueneme, included a sanc from behind which sand is dredged biennially (once every 2 ye and deposited downcoast of Port Hueneme. The width of the be south of Port Hueneme is directly related to the amount of sa artificially delivered to it from the Channel Islands Harbor sandtrap. Comparative surveys taken at the Port Hueneme Sout Jetty show no beach in November 1966, a 200-foot-wide beach i March 1968, no beach in June 1969, and a 100-foot-wide beach June 1970 (U.S. Army Corps of Engineers, 1970). At the time this writing (October 1973), no beach existed adjacent to the South Jetty.

Sediment Geochemistry

Available data concerning the chemical properties of sea floor sediments in the Port Hueneme area, particularly wi regard to pollutants, are limited. Therefore, these data have been supplemented by studies conducted for this project. The Allan Hancock Foundation (1965) examined nitrogen and calcium carbonate concentrations in sediment samples obtained as part a comprehensive study of the entire Southern California mainl shelf. Results of the Allan Hancock Foundation study are pre- sented diagrammatically in Plates 2.1.2-13 and 2.1.2-14. The values for nitrogen are generally low, resulting from dilutio of the organic material by the large quantities of detrital sediments received from upcoast beaches (Allan Hancock Foundat 1965). The amount of calcium carbonate in the sediments, der- mainly from the shells of marine organisms, is also low.

Kolpack, et al. (1971), reported oil concentrations in surface sediments from bottom samples obtained off Port Hueneme in February 1970. The analyses were done as part of a comprehensive study of hydrocarbon content of sediments in the Santa Barbara Channel, designed to elucidate the impact of the Santa Barbara oil spill of January 1969. Of the eight samples taken within a 6-nautical-mile radius of Port Hueneme, seven showed no detectable oil content, and one showed a concentration of 0.22 percent of the total sample. The latter sample station was located in 867 feet of water approximately 3 1/2 nautical miles south of the proposed location of the LNG marine terminal.

Kolpack and Straughan (1972) presented data on total carbon, organic carbon, and calcium carbonate for surface sediments in the vicinity of Port Hueneme. Distribution maps showing these three parameters are presented on Plates 2.1.2-15 through 2.1.2-17. Total carbon values are relatively low and are typical of inner shelf concentrations for Southern California (Emery, 1960). Carbonate and organic carbon values are also low. These low values, according to Kolpack and Straughan, reflect the active sedimentation and corresponding dilution of chemical constitutents as also found previously by the Allan Hancock Foundation (1965). In addition, the trends reflect a well-oxygenated sediment-water interface where organic material is oxidized and not readily preserved.

Bottom sediment samples from inside Port Hueneme Harbor have been analyzed for volatile solids, chemical oxygen demand, total Kjeldahl nitrogen, mercury, lead, zinc, manganese, and oil and grease (U.S. Army Corps of Engineers, 1973b). Da from this study of Port Hueneme Harbor are listed in Table 2.1.2-V for the stations illustrated on Plate 2.1.2-18. Nitr concentrations are comparable to those found offshore on the shelf by the Allan Hancock Foundation (1965). Zinc, and oil a grease concentrations at Station 1 exceed the limits for open water disposal of dredge spoil proposed for these substances by Region IX of the Environmental Protection Agency (EPA) (197 Concentrations for all other parameters fall within the limits set by the EPA. These criteria are discussed further below.

The Southern California Coastal Water Research Proje (1973) analyzed surface sediment samples from near the Oxnard Municipal Treatment Plant outfall, within 1 1/2 nautical mil the proposed LNG marine terminal site (see Plate 2.4.6-1). Th sediments were examined for the trace metals silver, cadmium, chromium, copper, lead, zinc, and mercury, and for total DDT and polychlorinated biphenyls (PCB) concentrations. The resul of those analyses are presented in part on Plates 2.1.2-19 and 2.1.2-20, and are listed in Table 2.1.2-VI. Mercury concentrations tend to be higher outside the 300-foot-depth contour and to the southeast of the Oxnard sewage outfall; no discern patterns appear to exist for the distributions of the other parameters. All values fall well within both the proposed EPA Region IX standards set for dredge spoil disposal (EPA, 1973a) and the national criteria (EPA, 1973b).

Predredging Investigation

In order to accommodate LNG ships of the envisioned size, dredging to a depth of water 48 feet below mean lower lo water (MLLW) is proposed. This would require the removal of approximately 2 million cubic yards of sediments from the proposed berthing facilities (Plate 1.3-1). A detailed predredging investigation was carried out in the area proposed to be dredged to determine the geochemical nature of the sediments. The purpose of the study was to provide sufficient data for an assessment of the potential impact of the dredging and spoil disposal.

Results of this investigation indicate that the sediments which are proposed to be dredged are unpolluted according to applicable EPA criteria (1973a, 1973b). Approximately 70 percent of the sediments which were tested are sand size or larger. The proposed berthing facility is located on a shallow water open coast site, and as far as can be determined, the area has never been dredged, nor has polluted dredge material ever been deposited there. No EPA Region IX (1973a) limits for trace metals or oil and grease in bottom sediments were exceeded. The sediments will not be acutely toxic nor overstimulate algal growth. Sediment-seawater elutriation experiments indicate that trace metal or organohalogen concentrations are not substantially increased in seawater after elutriation.

The predredging investigation performed for this project exceeds all presently applicable local, state, and federal requirements. The data are presented in this section; the impact will be addressed in Section 3.1.4-4.

<u>Applicable Standards and Criteria</u>. Dredging projects in California are subject to a number of expressed and implied criteria from the following agencies: the Environmental

Protection Agency (EPA), the Bureau of Sport Fisheries and Wildlife, the California State Water Resources Control Board, the California Regional Water Quality Control Boards, the California Department of Fish and Game, the California Coastal Zone Commission, and the Regional California Coastal Zone Commissions. The U.S. Army Corps of Engineers is ultimately responsible for issuing dredging permits and in so doing must take into consideration recommendations from other agencies and individuals. Recommendations published by the EPA are generally accepted by other agencies.

The EPA (1973b) has published Final Regulations and criteria for ocean dumping, which apply to "waters of the territorial sea, the contiguous zone, and the oceans." Under these national regulations:

> "Dredged material may be classified as unpolluted based on the known primary source(s) of the sediments, the history of its exposure to pollutants, and its physical composition. If the sediments cannot be classified as unpolluted according to the following criteria, laboratory analyses will be required. Dredged material will be considered unpolluted if it meets one of the following conditions:
>
> "(a) The dredged material is composed essentially of sand and/or gravel, or of any other naturally occurring sedimentary materials with particle sizes larger than silts and clays, generally found in inlet channels, ocean bars, ocean entrance channels to sounds and estuaries, and other areas

of normally high wave energy such as predominates at open coastlines.

"(b) If the water quality at and near the dredging site is adequate, according to the applicable State water quality standards, for the propagation of fish, shellfish, and wildlife, and if the biota associated with the material to be dredged are typical of a healthy ecosystem, taking into account the normal frequency of dredging, the sediments can be reasonably classified as unpolluted.

"(c) If it produces a standard elutriate in which the concentration of no major constitutent is more than 1.5 times the concentration of the same constituent in the water from the proposed disposal site used for the testing. The standard elutriate is the supernatant resulting from the vigorous 30-minute shaking of one part bottom sediment with four parts water from the proposed disposal site followed by one hour of letting the mixture settle and appropriate filtration or centrifugation. Major constituents are those water quality parameters deemed critical for the proposed dredging and disposal sites taking into account known point or areal source discharges in the area."

The Region IX Office (San Francisco) of the EPA which has jurisdiction over the site subsequently issued Dredge Spoil Disposal Criteria (DSDC) (Environmental Protection Agency, 1973a), which are the regional office interpretation and implementation of the national criteria. These interpretive criteria specify the following analyses and limits, above and beyond the national criteria.

Elutriate Analysis. The following tests on the elutriate and on the water from the disposal site are required for all projects:

(1) Immediate Oxygen Demand (prior to settling, on elutriate only)

(2) Biochemical Oxygen Demand (5-day, 20° C)

(3) Suspended Solids

(4) Organohalogens

Bottom Sediment Analyses. The bottom sediment analyses required (dry weight basis) and proposed limits of acceptability for open water disposal are as follows:

Parameter	Limit
(1) Mercury	1 ppm
(2) Cadmium	2 ppm
(3) Lead	50 ppm
(4) Zinc	130 ppm
(5) Oil and Grease	1,500 ppm

Field Methods. The sediments in the immediate vicinity of the proposed berthing area were sampled at the nine locations shown on Plate 2.1.2-21. The samples designated C-1 through C-6 were obtained using 5-foot-long acrylic-vinyl core tubes a diver-operated underwater coring device. The samples designated B-1 through B-3 are continuous cores obtained using a rotary-wash drill rig mounted on a moveable platform. They extended from the sediment-water interface to depths of approximately 48 feet below MLLW and were collected in 25-inch, noncontaminating plastic liners.

The sediments collected by using the diver-operated corer were extruded into acid-washed glass sample jars immediately after collection, stored in dry ice, and delivered to the chemical laboratory within approximately 10 hours of collection. The incremental samples comprising the deeper, continuous cores were inspected and logged immediately after retrieval, after which the ends of the plastic liners were capped and the samples stored on ice until delivery to the laboratory within approximately 10 hours of collection. The individual cores were combined into 4- to 10-foot intervals for laboratory analysis. Every effort was taken to insure that the samples were not contaminated during the sample collection, handling, and storage procedures.

Seawater from the proposed area was obtained from beneath the surface by submerging polyethylene containers and allowing water to displace the entrapped air. More than 350 gallons were collected for use in the elutriate analyses and for determining baseline water chemistry. Seawater from the vicinity of the proposed dredging and disposal area was transported in polyethylene containers on dry ice and then stored at 4° C until analyzed.

Laboratory Procedures. The sediment samples were homogenized upon receipt. The bacteriological assays were made at once; the remaining samples were frozen for later testing. Analyses were made on:

1) Sediment-parameters determined and reported on the total sample, on an as-is basis.

2) Seawater-parameters determined variously on one or a combination of the following three fractions.

   a) The total sample.

   b) The dissolved fraction, defined by water passing a 0.45-micron Millipore filter.

   c) The residue fraction, defined by substance retained on the 0.45-micron Millipore filter.

3) Elutriates-sediments were elutriated in 3 kg subsamples per 12 liters of receiving water. These were added together in 5-gallon polyethylene bottles and mixed for 30 minutes on a shaker. Following shaking, the samples were left quiescent for 60 minutes to settle, after which the entire supernatant was siphoned off. Settleable solid content was determined at that moment. Turbidity measurements were made at that time and after 60 more minutes of settling time in an Imhoff cone. Immediate oxygen demand (IOD) was determined at once after the first 60-minute settling period, and bacteriological assays were initiated. Aliquots were preserved for subsequent testing. The elutriates were variously partitioned into three fractions following the protocol for the seawater itself, namely:

a) Total elutriate
b) Dissolved fraction
c) Residue

Chemical Tests. Procedures used for analysis generally followed Standard Methods (American Public Health Association, 1971), and where applicable, Environmental Protection Agency (1971) methods. Procedures for each of these tests are referenced below:

1. Metals by atomic absorption spectrophotometry on wet digested total sample: cadmium, lead, zinc, copper, total chromium, nickel, beryllium, vanadium (American Public Health Association, 1971). Elutriates concentrated by ion exchange (Riley and Taylor, 1966).
2. Mercury by flameless atomic absorption spectrophotometry (Environmental Protection Agency, 1971).
3. Arsenic (Environmental Protection Agency, 1971).
4. Phosphates, silicates, phenols, sulfide, dry matter, suspended solids, total solids, total volatile solids, ammonia, nitrate, nitrite, Kjeldahl, and organic nitrogen, oil and grease, chemical oxygen demand, biochemical oxygen demand, immediate oxygen demand, and total organic carbon ((American Public Health Associtio, 1971).
5. Selenium (Olson, 1969).
6. Sulfur (Chen, et al., 1973).
7. Organochlorine pesticides and polychlorinated biphenyls by electron capture gas chromatography

(U.S. Food and Drug Administration, 1971, modified by Dr. R.H. T. Mattoni).

8. Fish bioassays (Environmental Protection Agency, 1972).

9. Algal bioassays (Environmental Protection Agency 1972).

Physical Tests. Grain-size analyses were performed by the Dames & Moore Soils Testing Laboratory in Los Angeles to determine the applicability of criterion (a) of the Environmental Protection Agency (1973b) regulations and criteria for ocean dumping. Each sample was wet sieved using the procedures required by Section D-422 of the American Society of Testing Materials Standards (1973). Grain-size distributions and the percent material passing a #200 sieve were determined. Also, several hydrometer analyses were performed to determine the size distribution of the sediment fraction passing the #200 seive.

Bioassays. The fish bioassays were conducted using three-spine sticklebacks (Gasterosteus aculeatus) obtained from Marineland of the Pacific. Fish were acclimated to filtered seawater prior to initiation of testing.

The tests consisted of preparing a seawater solution of 10 percent (by wet weight) of the sediments to be tested. Seawater for these experiments was obtained from the vicinity of the proposed dredging and disposal site. Three liters of the resulting solution were placed in each of four or five replicate 4-liter aquaria.

The test fish were placed in these aquaria which were continuously aerated for the first 24 hours to maintain a minimum dissolved oxygen (DO) concentration of 4 parts per million (ppm). If the DO dropped below 4 ppm during the ensuing 96-hour period, the mixture was again aerated. Aquaria were periodically checked for the presence of dead fish or low DO. Tested fish were discarded at the end of each experiment.

A minimum of 90 percent survival at the conclusion of the tests is required to meet EPA proposed standards (1972). The toxicity concentration (Tc) of the sediment can be estimated by:

$$Tc = \frac{\log (100 - \text{percent survival})}{1.7}$$

Algal bioassays are more complex than fish bioassays. The methods which were employed are summarized below.

Fifty grams (wet weight) of sediment were added to 300 ml of unfiltered seawater. The mixture was agitated for 15 minutes and allowed to settle. The supernatant was filtered and made up into three aliquots.

Three replicate control blanks were prepared as above, omitting the sediment. Positive controls were also prepared as above, but using a PAAP medium (Weiss and Helms, 1971) in a 3.5 percent NaCl solution in place of the filtered seawater. Concentrations of nutrient salts were adjusted to yield correct concentrations in the final solutions.

Samples were cultured for a 3-week period at 22° C under CW fluorescent lights which yield 350 foot-candles. After incubation the cultures were filtered, and the filters were ground with 2 to 3 ml of 90 percent spectrographic grade acetone (in water) in a glass tissue homogenizer. The homogenates were made up to 10 ml and transferred to the original culture flasks. Four to five glass beads were added, and the flasks shaken on a reciprocating shaker for 20 minutes in total darkness. This last step was taken to include periphyton in the chlorophyll a estimates. The resulting solutions were then individually transferred to graduated centrifuge tubes and allowed to settle in the dark for 10 minutes. They were then shaken thoroughly, made up to 10 ml and centrifuged at 2,500 revolutions per minute for 5 minutes.

The extracted supernatant from each centrifuge tube was transferred to a 1 cm cuvette and read at 750 nanometers (nm). The solution was then read at 665 nm 2 minutes after the addition of two drops of NaCl. The blank was also read at 665 nm with 90 percent acetone.

Data obtained from the algal bioassays are reported in micrograms per liter (μg/l) chlorophyll a as calculated by the formula:

$$\mu g/l \text{ chlorophyll } \underline{a} = \frac{11.9 \times 2.43\,(A665b - A665a)\,V_1}{V_2 \times L}$$

where A665b = Absorbance chlorophyll a, extract

A665a = Absorbance phaeophytin a, acid-treated extract

V_1 = Volume acetone

V_2 = Volume of seawater sediment extract

L = Cuvette path length

A maximum increase of 25 µg/l chlorophyll a over the control water value is permitted under EPA Region IX proposed criteria (Environmental Protection Agency, 1972).

Comparison of Results and Criteria

Physical Tests. Descriptive logs for the shallow sediment cores obtained using the diver-operated corer are shown on Plates 2.1.2-22 through 2.1.2-28; those for the deeper sediment samples obtained by rotary wash drilling are presented on Plates 2.1.2-29 through 2.1.2-31. Grain-size characteristics of the homogenized samples are given in Table 2.1.2-XII.

The sediments are predominantly fine sands, with varying amounts of silts. The median grain diameter of 20 of the samples fell in the fine-sand size classification. One of these samples was classified as coarse silt. The combined percentages of silt and clay size material ranged from 4 to 52 percent and averaged approximately 29 percent. Hydrometer analyses of six of the 21 sediment samples (C-1 through C-6) were made in order to determine the size distribution of the fine fractions and showed that no more than 4 percent of the material in each of those six samples were clays. The field logging of the sediment cores similarly showed only very low percentages of clay sized material from the sediment surface to the planned depth of dredging. Finely divided micas and heavy minerals were locally abundant throughout the sediments; localized concentrations of shell fragments (mainly sand dollars and clam shells) and coarse gravel and pebbles (up to 2 1/2 inches in diameter) were also found scattered throughout the sediment column.

Trask Sorting Coefficients were calculated (or estimated for some of the samples for which hydrometer analyses were not done) for each of the 21 homogenized sediment samples. Coefficients ranged from approximately 1.4 to 2.2, indicating high degree of uniformity of grain sizes. By comparison, dune and beach sands typically have Trask Sorting Coefficients of about 1.2, and marsh sediments of 4.2 (Emery, 1960). No distributional patterns, either areally or vertically, appear to exist in the grain size or sorting characteristics.

Under criterion "a" of the EPA Final Regulations and Criteria for Ocean Dumping (1973b) and EPA Region IX DSDC (197-) the sediments now within the proposed LNG ship berthing area should be considered as unpolluted based on the following:

1) Grain Size. Approximately 79 percent of the sediments which were analyzed are sand grain size or larger (Table 2.1.2-XII). The mean grain size for all stations is within the range classified as sands. The Trask Sorting Coefficient is low, indicating a narrow distribution of grain sizes.

2) Wave Energy. The proposed berthing facility is located on a shallow-water open-coast site. Most of the clays and silts remain in suspension in high wave energy environments such as this one and are carried into deeper, calmer waters before being deposited. Clays and silts can adsorb many types of toxic pollutants from the water (Munson, 1972; Gustafson, 1972). Because clays and silts

are present in small proportions in the sediments proposed to be dredged, there is less likelihood for pollution.

3) Past History of Sediments. As far as can be determined, the proposed berthing area has never been dredged, nor has polluted dredge material ever been deposited there. Sand replenishment within this area has taken place on a biennial basis since 1961 (Fuquay, 1973) (Table 2.4.3-XVIV).

Baseline data collected for this investigation suggest that this area does not differ from other similar localities along the coast of Southern California.

These data indicate that Port Hueneme and the immediate surrounding areas are apparently not considered polluted (Section 3.1.4.4), although they have been extensively altered (Fay, 1972).

Chemical Tests. The chemical characteristics of the sediments collected from the proposed berthing area are given on Table 2.1.2-VII for cores C-1 through C-6 and on Plates 2.1.2-29 through 2.1.2-31 for cores B-1, -2, and -3. Of the 21 samples analyzed, none exceeded any of the limits for the five parameters (mercury, cadmium, lead, zinc, and oil and grease) established by the EPA Region IX Dredge Spoil Disposal Criteria (1973a). The values in most cases are comparable to those found in the earlier investigations by others. They are generally less than the corresponding parameters determined from sediments around the Oxnard outfall (Southern California

Coastal Water Research Project, 1973) and sediments inside Port Hueneme Harbor (U.S. Army Corps of Engineers, 1973b). Mean concentrations in sediments of some trace metals found this study contrasted against sediment concentrations from other localities are presented in Table 2.1.2-VIII. The ra of values reported in the present study are generally within the normal variability which can be expected in natural sedi

The sediments exhibit very low concentrations of agricultural pesticides. Other than those listed, no additi pesticides, such as aldrin, dieldrin, lindane, and toxaphene, were found in any of the sediments analyzed.

Seawater was collected from the vicinity of the pro- posed dredging and disposal area for use in the elutriation experiments (Table 2.4.3-X). Seawater collected on Septembe 1973, was used to elutriate samples C-1 through C-6, and sea- water collected on December 11, 1973, was used for the remain of the samples.

The sediment-seawater elutriation experiments showe that of the four tests required by the EPA Region IX DSDC (1973a) (immediate oxygen demand, biochemical oxygen demand, suspended solids, and organohalogen concentrations) only the organohalogen concentrations (i.e., chlorinated hydrocarbons fell within the limits defined by 1.5 times the concentratio of the same constituent in seawater from the proposed dispos site (criterion "c") (Tables 2.1.2-IX and 2.1.2-X). The immediate oxygen demand (IOD) increased from a nondetectable amount (less than 0.2 mg/l) in seawater from the site to an average of 0.29 mg/l. The biochemical oxygen demand (BOD) increased from an average of 1.5 mg/l in the seawater before elutriation, to an average of about 3.2 mg/l in the total sample after mixing with the bottom sediments. However, after elutriation the BOD in the dissolved fraction of the sample was reduced to an average of only 1.1 mg/l (Table 2.1.2-X). Suspended solids increased to an average of 148.4 mg/l after elutriation from 25.8 mg/l in seawater. Chlorinated hydrocarbon concentrations were below detection limits both before and after mixing seawater and bottom sediments.

Concentrations of trace metals which were dissolved in the seawater following elutriation were in the low parts per billion range and were very close to the initial concentrations in the control seawater (Table 2.1.2-X). Trace metal concentrations in the residue fraction were higher but were generally not substantially increased over values in the control seawater (Table 2.1.2-XI). By comparison, the concentrations of trace metals in the bottom sediments were as high as 32 mg/l, or several orders of magnitude greater than the same trace metals in the elutriates.

Comparison of the results from the sediment-seawater elutration studies and the effluent quality requirements for waste discharges set by the California State Water Resources Control Board (1972) shows that the spoil from the proposed dredging project will not violate their minimum (most stringent) limits set for the following parameters:

Oil and Grease
pH
Phenolic Compounds

Ammonia Nitrogen
Total Identifiable Chlorinated Hydrocarbons
Toxicity Concentration
Arsenic
Cadmium
Chromium
Copper
Lead
Mercury
Nickel
Silver
Zinc

The only limits which will be exceeded are those inherently higher in dredging projects, namely, suspended and settleable solids, and turbidity. It must be emphasized that these requirements do not apply specifically to the disposal of dredge spoil.

Biological Tests. The sediments were examined for three important biological properties: 1) acute fish toxicity, 2) algal growth stimulation, and 3) bacteria, the presence of which may indicate human waste pollution. Results of all three testing procedures are given in Table 2.1.2-XIII.

Over the 96-hour fish bioassay tests, only one sample had less than 100 percent survival. This was for C-3, which was collected outside the proposed dredging area (see Plate 2.1.2-21). The calculated toxicity concentration was 0.41 for this core and was due to the death of one fish.

Results of the fish bioassay tests run on all of the samples show that the sediment proposed to be dredged are not toxic (see Section 3.1.2.2). In addition, literature search and a diving survey has indicated that the water and sediments at and near the dredging site support healthy populations of fish and shellfish and that the biota associated with the material to be dredged are typical of a healthy ecosystem (see Section 2.2.2). Therefore, the sediments proposed to be dredged are unpolluted according to criterion "b" of the EPA Final Regulations and Criteria for Ocean Dumping (1973b) and the EPA Region IX Dredge Spoil Disposal Criteria (1973a).

Stimulation of chlorophyll *a* production by algae was negligible in the first six samples analyzed (C-1 through C-6). The lowest recorded value was zero, the highest 0.014 µg/l. In view of the very low chlorophyll *a* production found in the near surface samples and the similarity to the deeper sediments, no greater concentration of biostimulants in the remaining samples is expected.

Concentrations of coliform bacteria, which are indicators of human waste, are generally very low, and are either very near or below the detection limits. A single exception is core sample C-5, which exhibited a higher coliform count. Although no explanation can be offered for the single anomalous value, it is still very low in an absolute sense and represents no health hazard. *Salmonella* was not detected in any of the samples.

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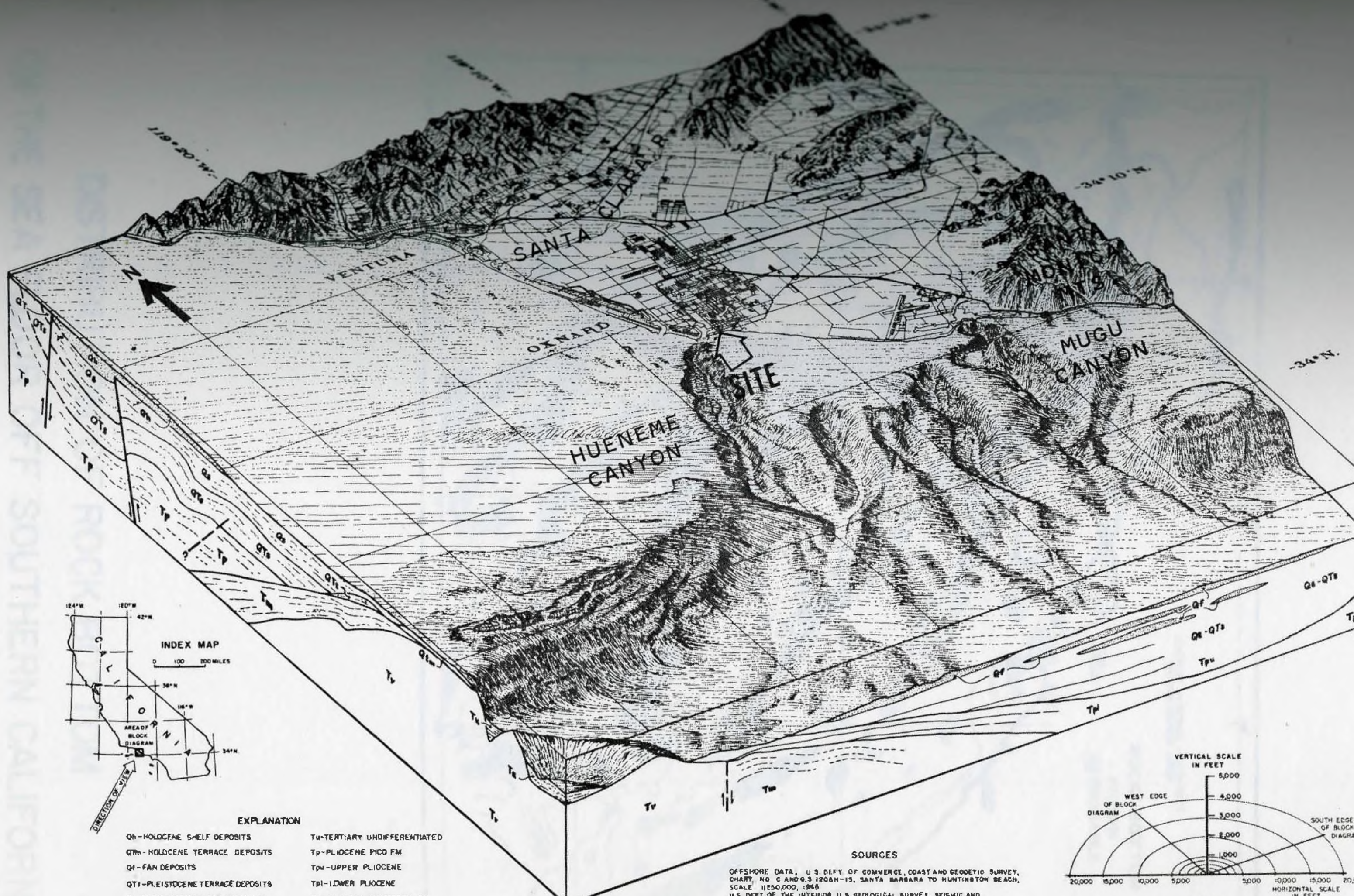
SOUTHERN CALIFORNIA BORDERLAND

REFERENCE: BATHYMETRY BASED ON U.S. COAST AND GEODETIC SURVEY BATHYMETRIC MAPS 1206N-15, 1206N-16, 1306N-19, AND 1306N-20 AT THE SCALE OF 1:250,000 (1967)

TOPOGRAPHY BASED ON U.S. GEOLOGICAL SURVEY STATE OF CALIFORNIA BASE MAP, AT THE SCALE OF 1:500,000 (1963)

DAMES & MOORE

PLATE 2.1.2-8



EXPLANATION

Qh-HOLOCENE SHELF DEPOSITS
QTm-HOLOCENE TERRACE DEPOSITS
Qf-FAN DEPOSITS
QTt-PLEISTOCENE TERRACE DEPOSITS
Qs-PLEISTOCENE? SAN PEDRO FM
QTs-PLEISTOCENE SANTA BARBARA FM
Tu-TERTIARY UNDIFFERENTIATED
Tp-PLIOCENE PICO FM
Tpu-UPPER PLIOCENE
Tpl-LOWER PLIOCENE
Tm-MIOCENE MONTEREY FM
Tv-MIOCENE CONEJO VOLCANICS

GEOLOGICAL INTERPRETATION BY H. GARY GREENE AND ARNE JUNGER

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OFFSHORE DATA, U.S. DEPT. OF COMMERCE, COAST AND GEODETIC SURVEY, CHART, NO. C AND G.S 1206N-15, SANTA BARBARA TO HUNTINGTON BEACH, SCALE 1:250,000, 1966
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ONSHORE DATA, U.S. DEPT OF THE INTERIOR, U.S. GEOLOGICAL SURVEY, 7.5 MINUTE QUADRANGLE SERIES, MAPS 1:24,000, CAMARILLO 1950, OXNARD 1950, PITAS POINT 1950, POINT MUGU 1949, SANTA PAULA 1951, SATICOY 1951, VENTURA 1951
U.S. DEPT OF COMMERCE, COAST AND GEODETIC SURVEY, CHART, NO. C AND G.S. 5114, ANACAPA PASSAGE, 1967

SCALE

VERTICAL EXAGGERATION 3:1

ORTHOGRAPHIC DRAWING BY TAU RHO ALPHA

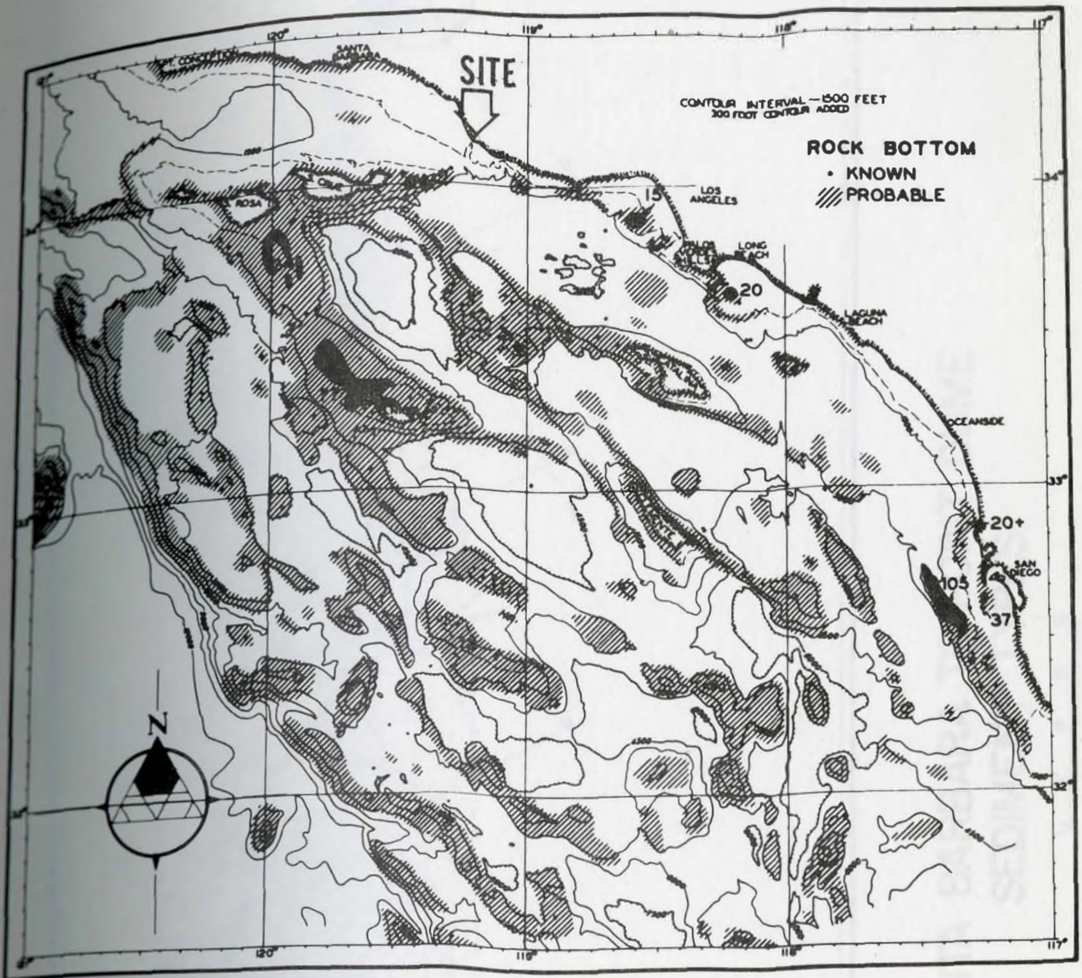
THIS MAP IS PRELIMINARY AND HAS NOT BEEN REVIEWED FOR CONFORMITY WITH U. S. GEOLOGICAL SURVEY STANDARDS AND NOMENCLATURE.

VENTURA-OXNARD OFFSHORE

U. S. GEOLOGICAL SURVEY

DAMES & MOORE

PLATE 2.1.2-9



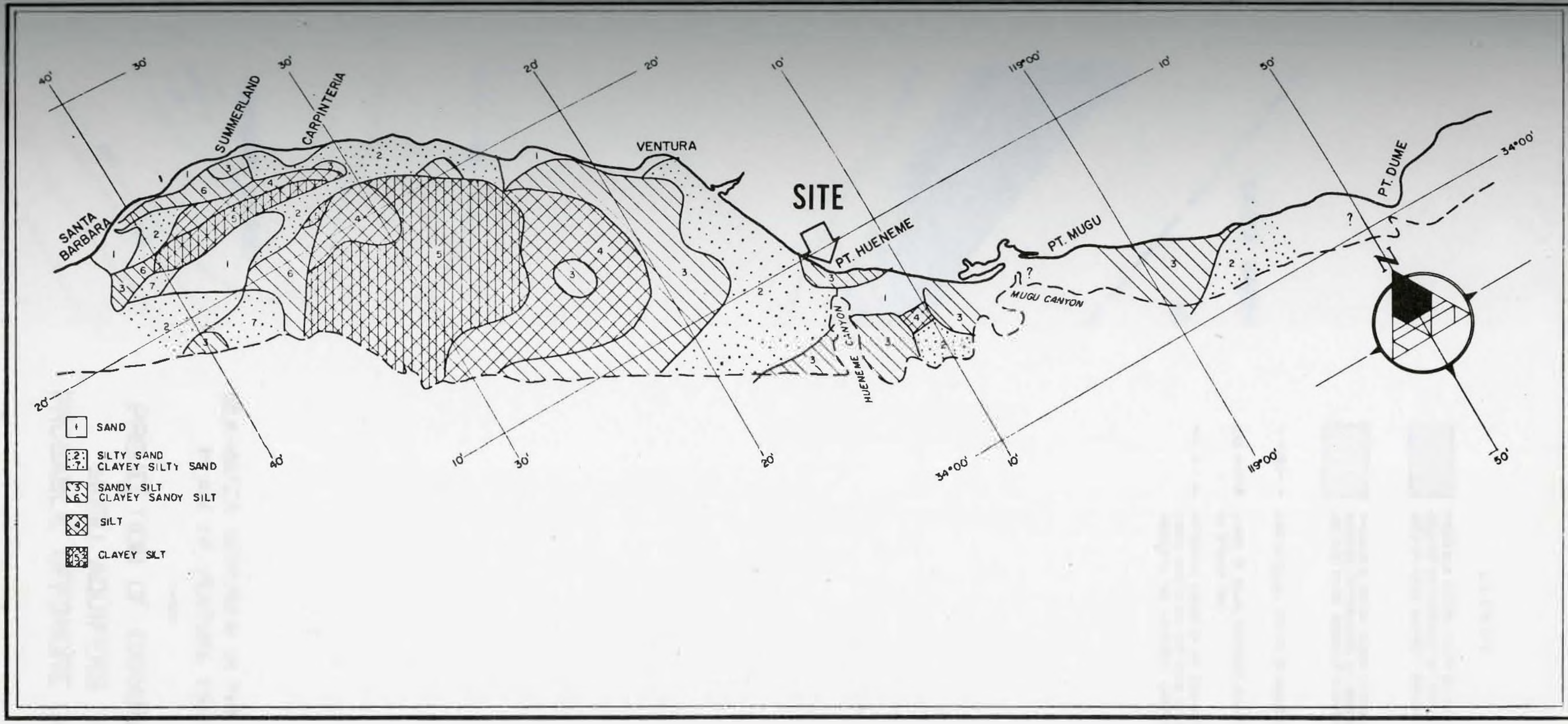
DISTRIBUTION OF ROCK BOTTOM ON THE SEA FLOOR OFF SOUTHERN CALIFORNIA

0 10 20 30 40 50
SCALE IN STATUTE MILES

REFERENCE: EMERY, 1960

DAMES & MOORE

PLATE 2.1.2-10

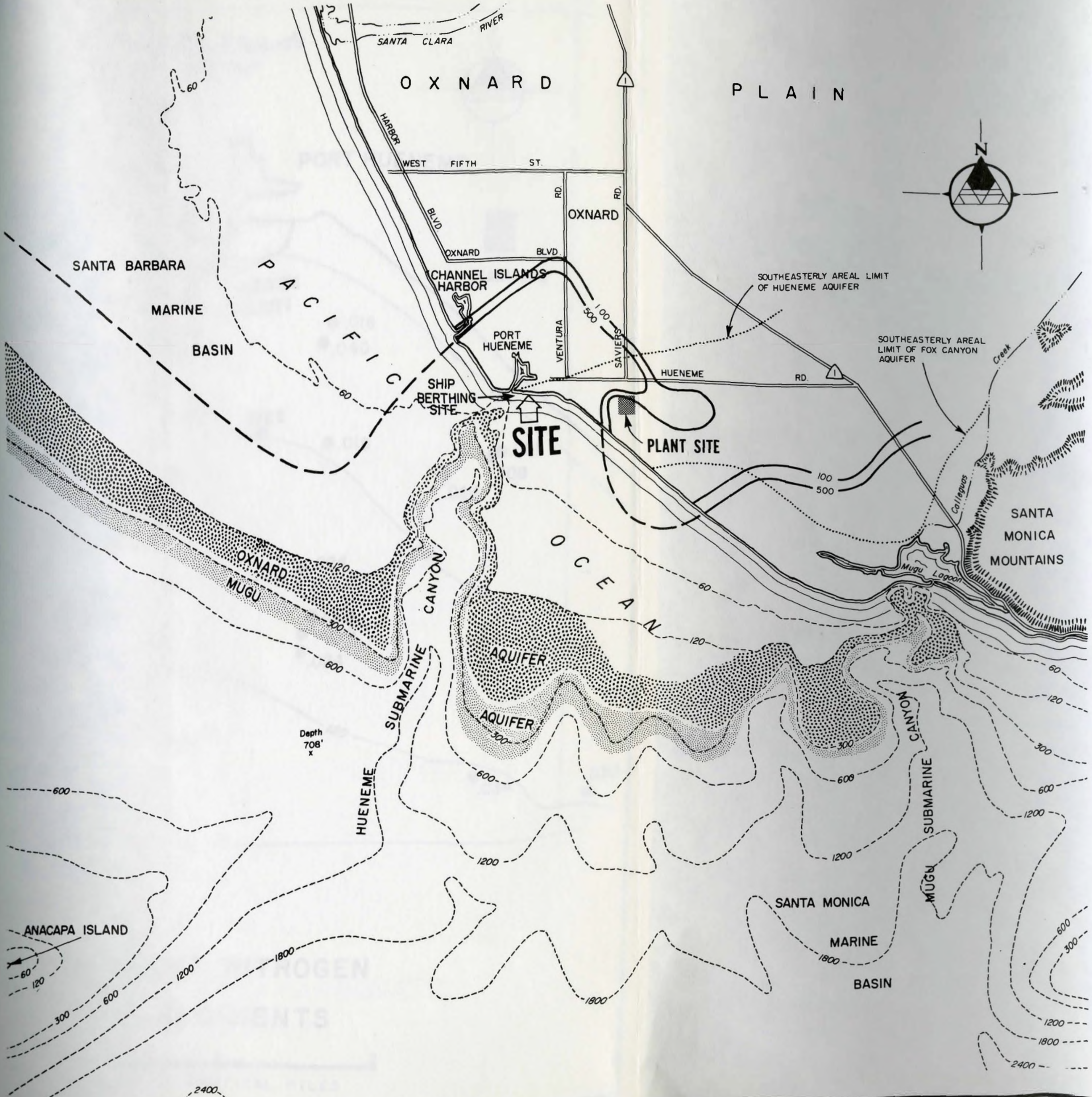


SANTA BARBARA TO POINT DUME
SEDIMENT TYPES

0 2 4 6 8

SCALE IN STATUTE MILES

REFERENCE: ALLAN HANCOCK FOUNDATION, 1965



LEGEND

PROBABLE OCEAN FLOOR OUTCROP OF OXNARD AQUIFER DETERMINED BY HORIZONTAL PROJECTION FROM NEAREST ONSHORE CONTROL

PROBABLE OCEAN FLOOR OUTCROP OF MUGU AQUIFER DETERMINED BY HORIZONTAL PROJECTION FROM NEAREST ONSHORE CONTROL

--60-- LINE OF EQUAL DEPTH OF OCEAN FLOOR IN FEET

100 —— LINES OF EQUAL CHLORIDE ION CONCENTRATION IN SPRING 1963

— — — OFFSHORE LOCATION OF SEA-WATER INTRUSION FRONT BASED ON THE RATE OF INTRUSION BENEATH THE ADJACENT LAND AREA

SEA-WATER INTRUSION IN THE OXNARD PLAIN OF VENTURA COUNTY

PROJECTION OF OXNARD AND MUGU AQUIFERS TO PROBABLE OFFSHORE OUTCROP

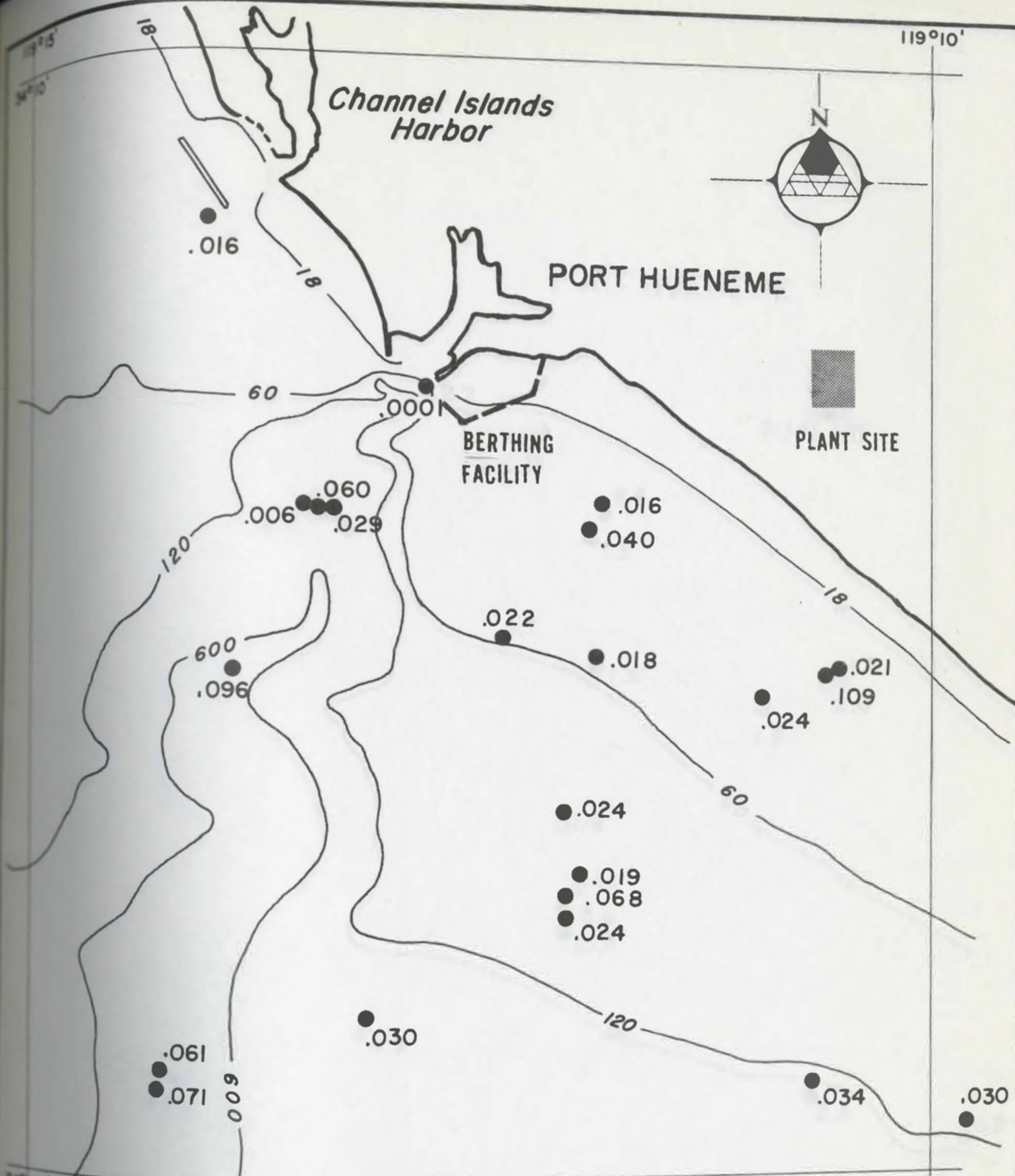
0 1 2 3 4

SCALE IN STATUTE MILES

DAMES & MOORE

REFERENCE: CALIFORNIA DEPARTMENT OF WATER RESOURCES 1965

PLATE 2.1.2-12



PERCENT NITROGEN IN SEDIMENTS

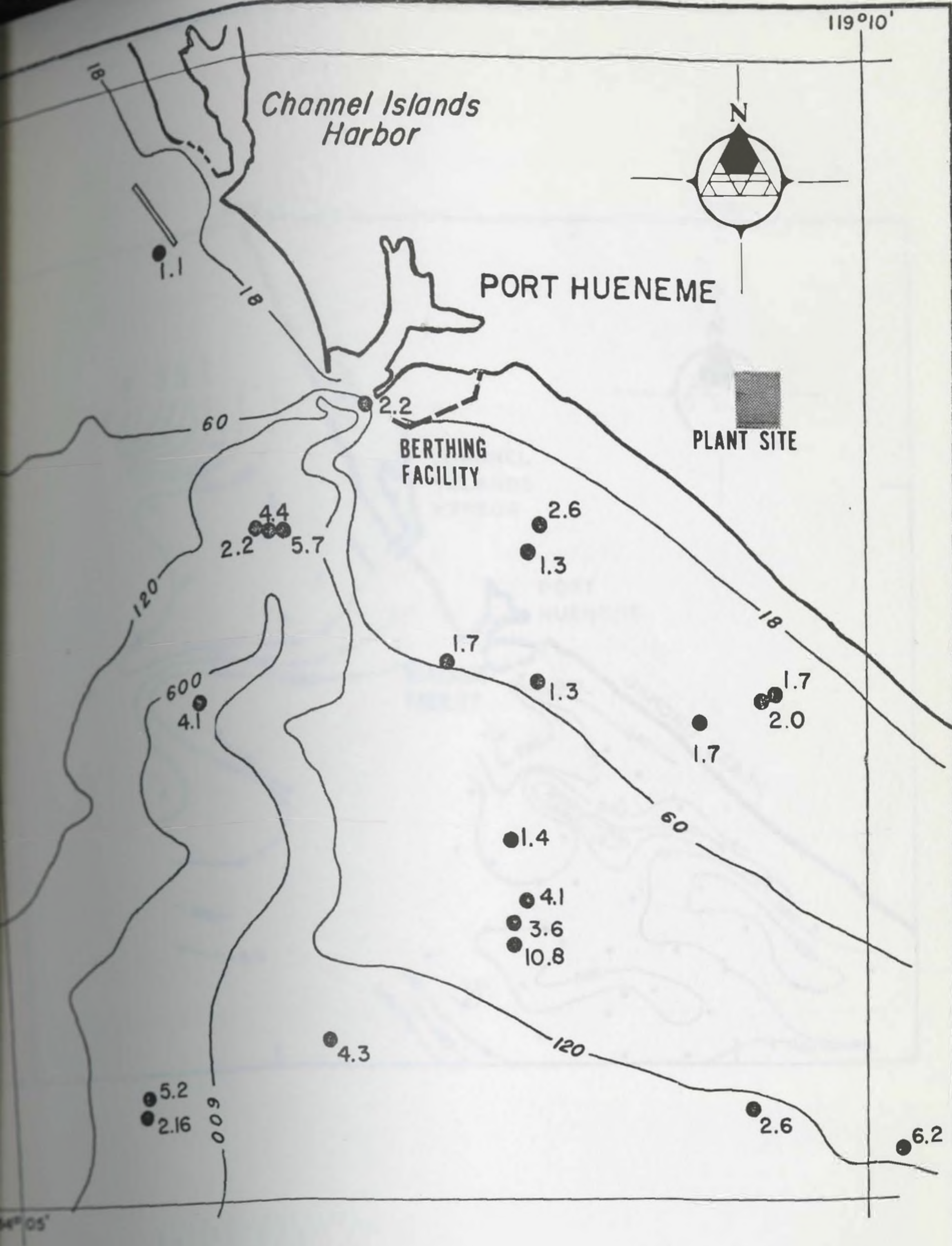
0 1/2 1 2

SCALE IN NAUTICAL MILES

REFERENCE: ALLAN HANCOCK FOUNDATION (1965)

DAMES & MOORE

PLATE 2.1-213



PERCENT CALCIUM CARBONATE
IN SEDIMENTS

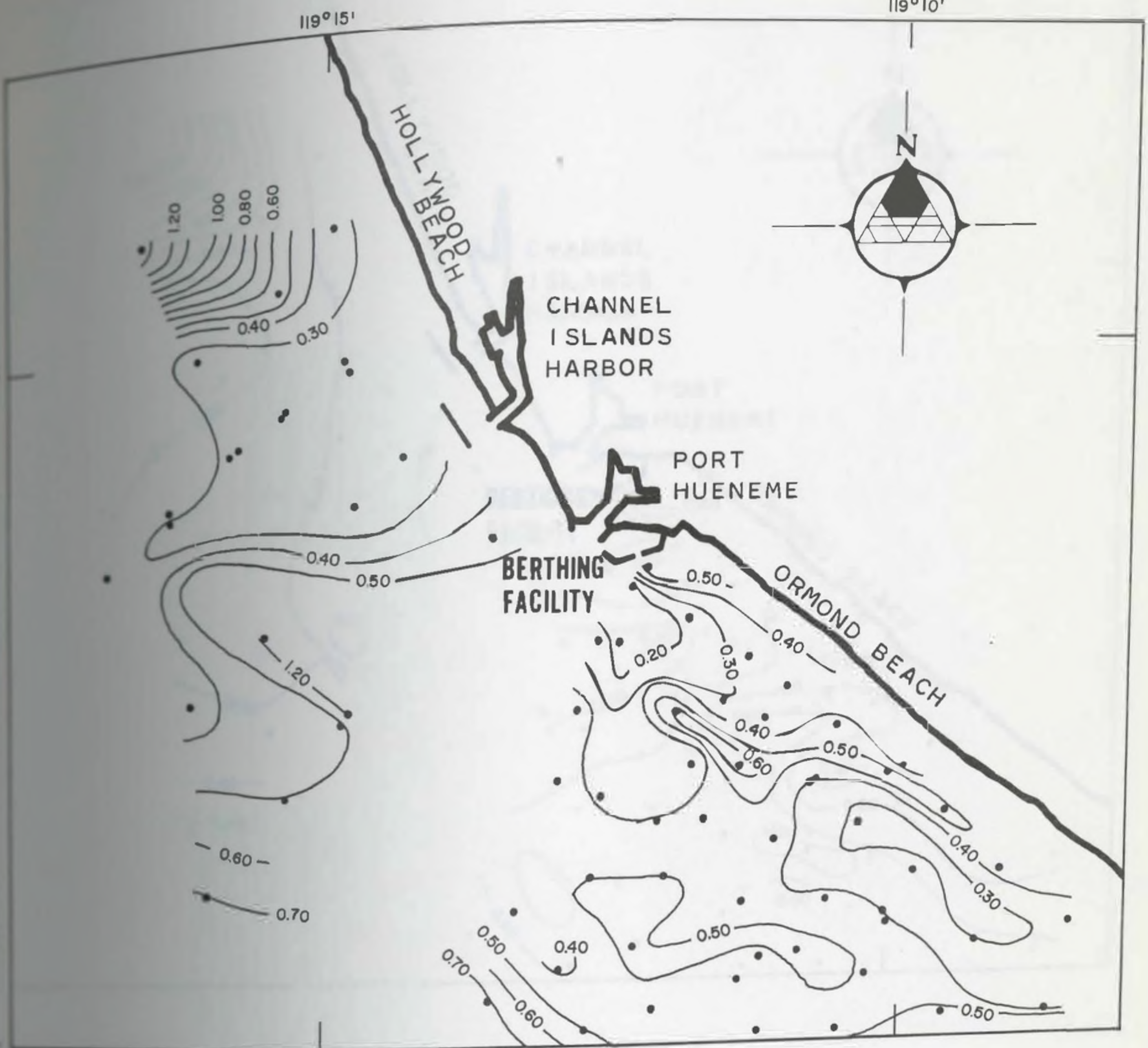
0 1/2 1 2

SCALE IN NAUTICAL MILES

REFERENCE: ALLAN HANCOCK FOUNDATION (1965)

DAMES & MOORE

PLATE 2.1.2-14



PERCENT TOTAL CARBON

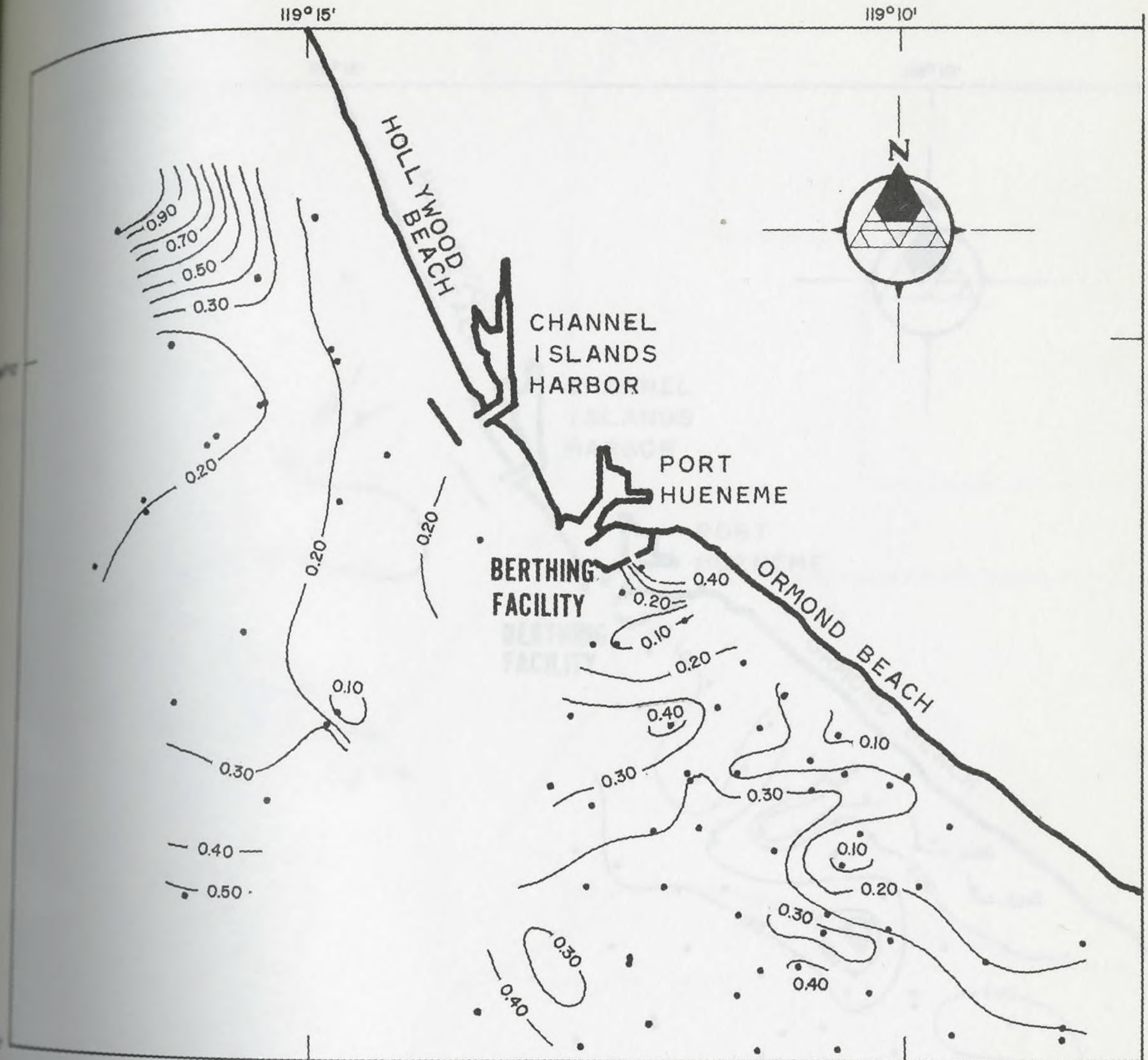
0 1 2 3 4

SCALE IN NAUTICAL MILES

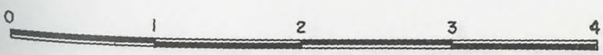
REFERENCE: KOLPACK AND STRAUGHAN, 1972

DAMES & MOORE

PLATE 2.1.2-15



PERCENT ORGANIC CARBON

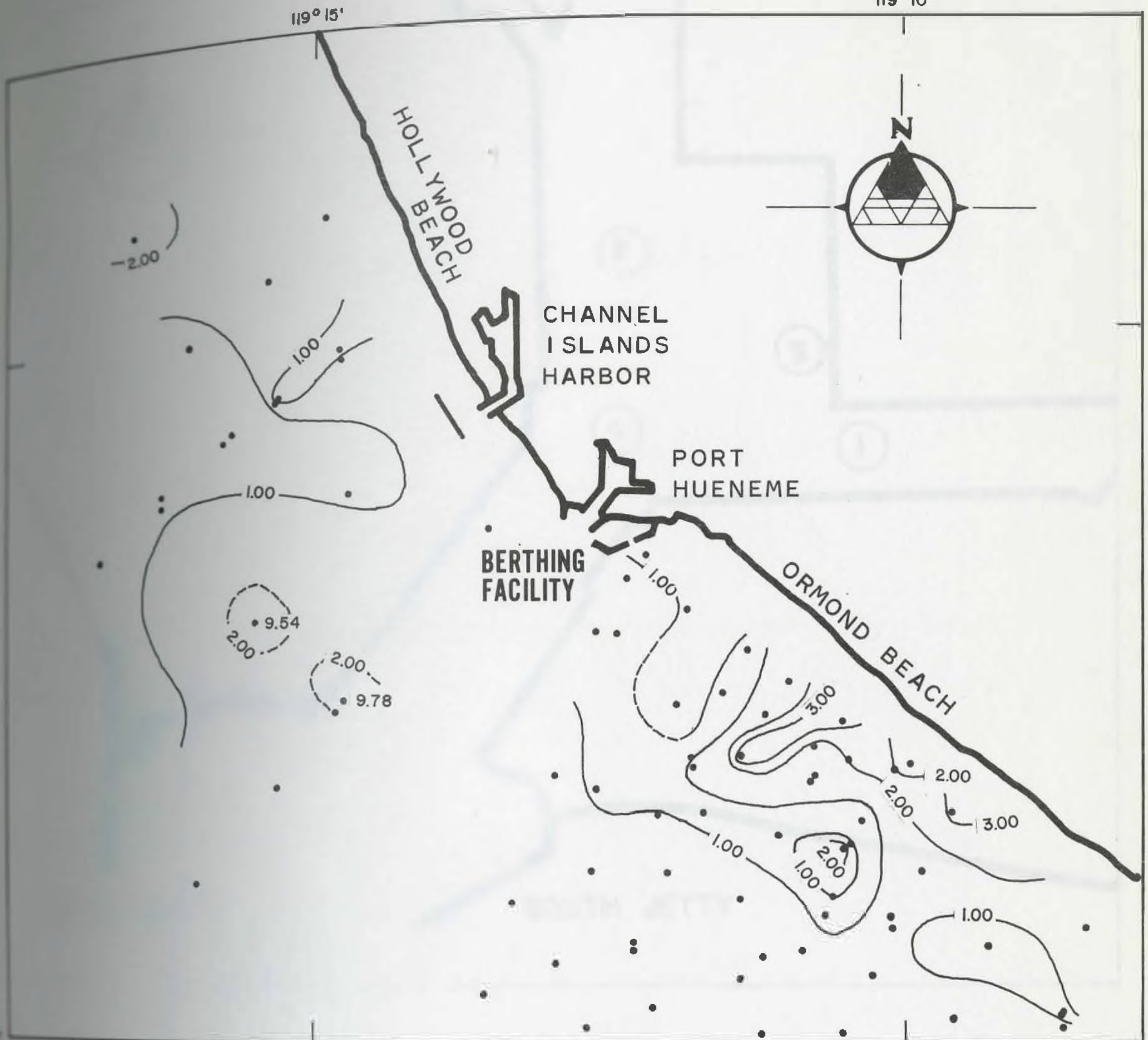


SCALE IN NAUTICAL MILES

REFERENCE: KOLPACK AND STRAUGHAN, 1972

DAMES & MOORE

PLATE 2.1.2-16



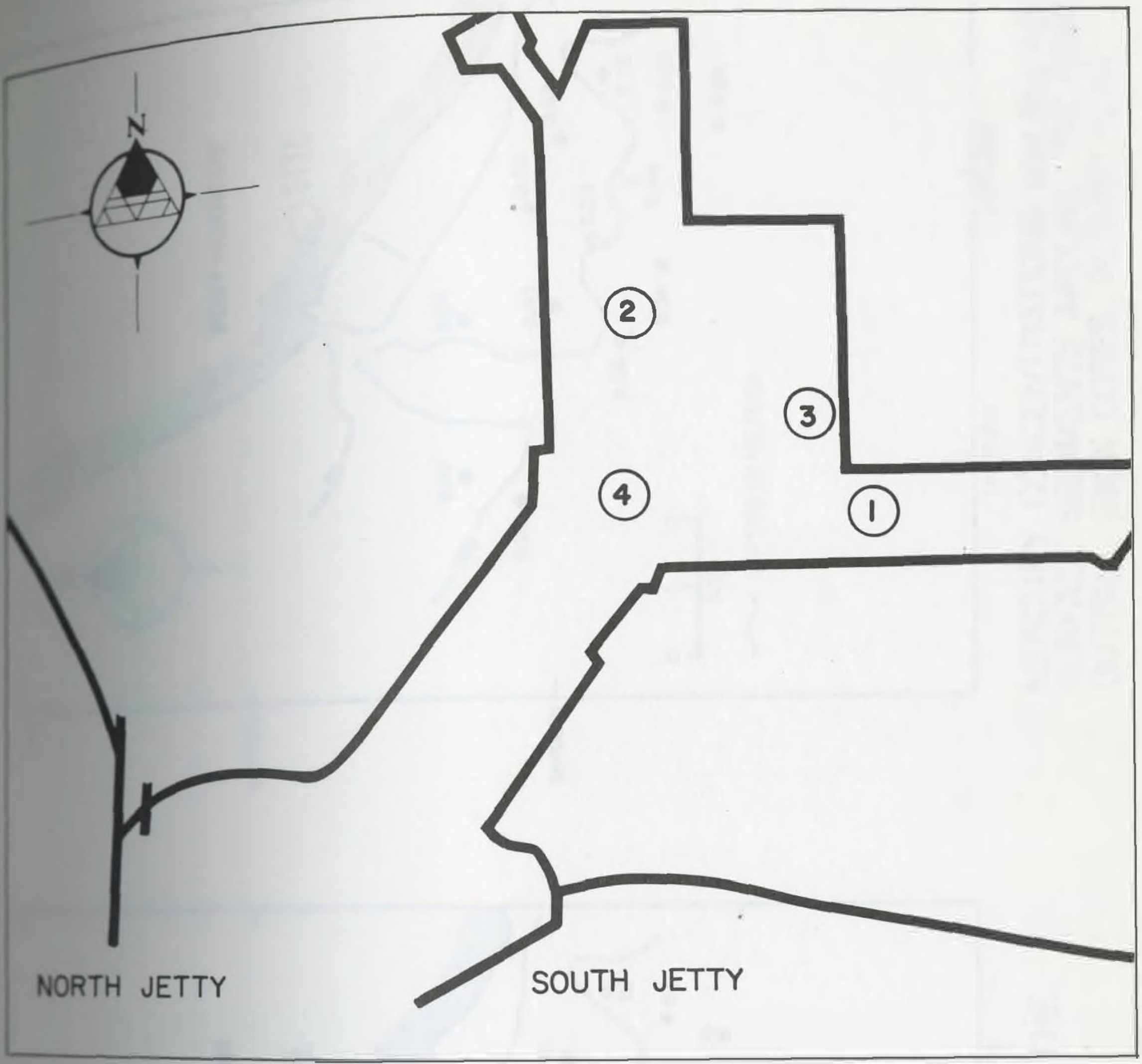
PERCENT CALCIUM CARBONATE

0 1 2 3 4

SCALE IN NAUTICAL MILES

REFERENCE: KOLPACK AND STRAUGHAN, 1972

DAMES & MOORE

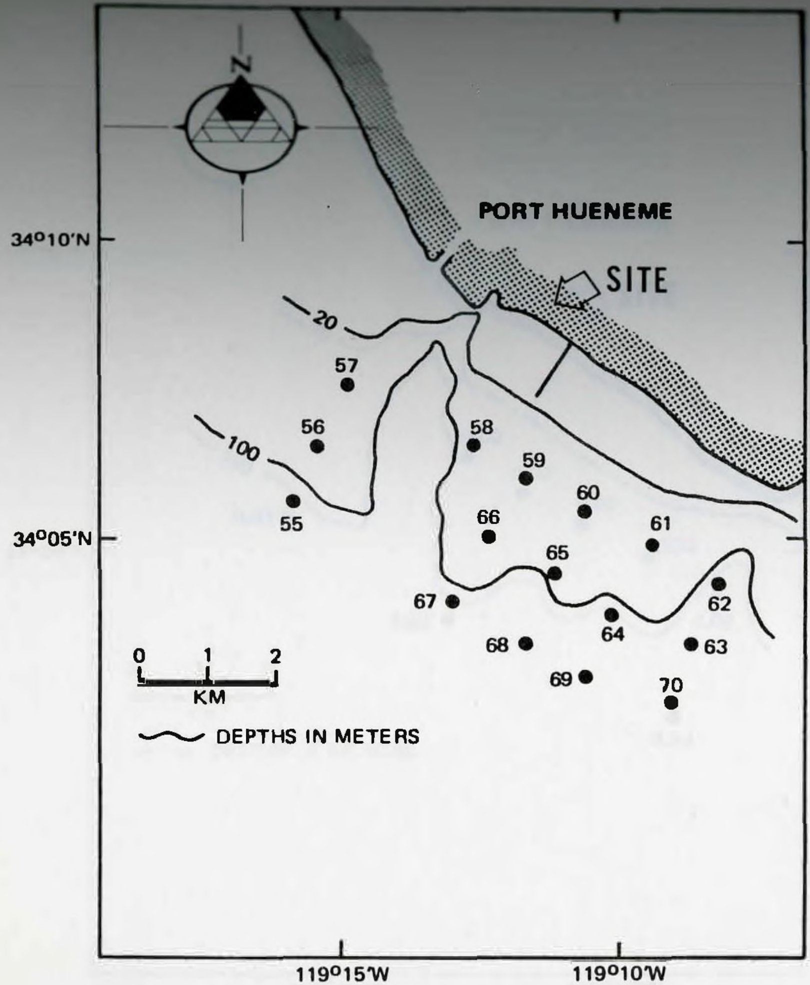


LOCATION OF BOTTOM SEDIMENT STATIONS IN PORT HUENEME HARBOR

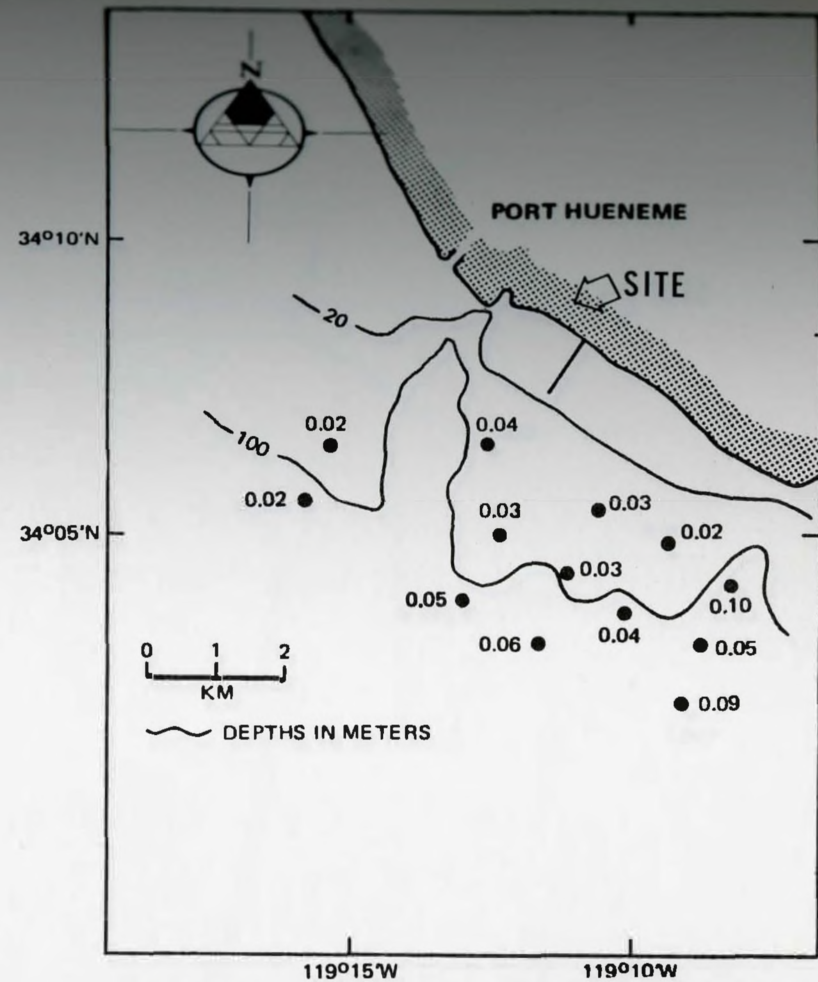
REFERENCE: U.S. ARMY CORPS OF ENGINEERS (1973B)

DAMES & MOORE

PLATE 2.1.2-18

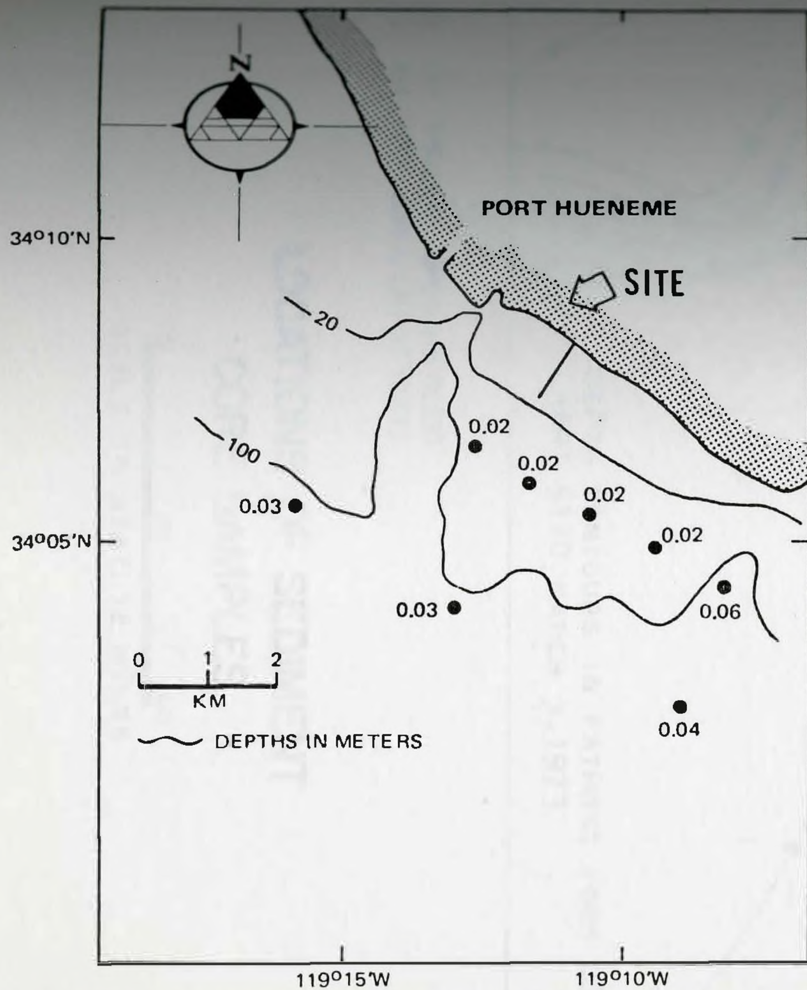


BOX CORE LOCATIONS AROUND THE OXNARD OUTFALL

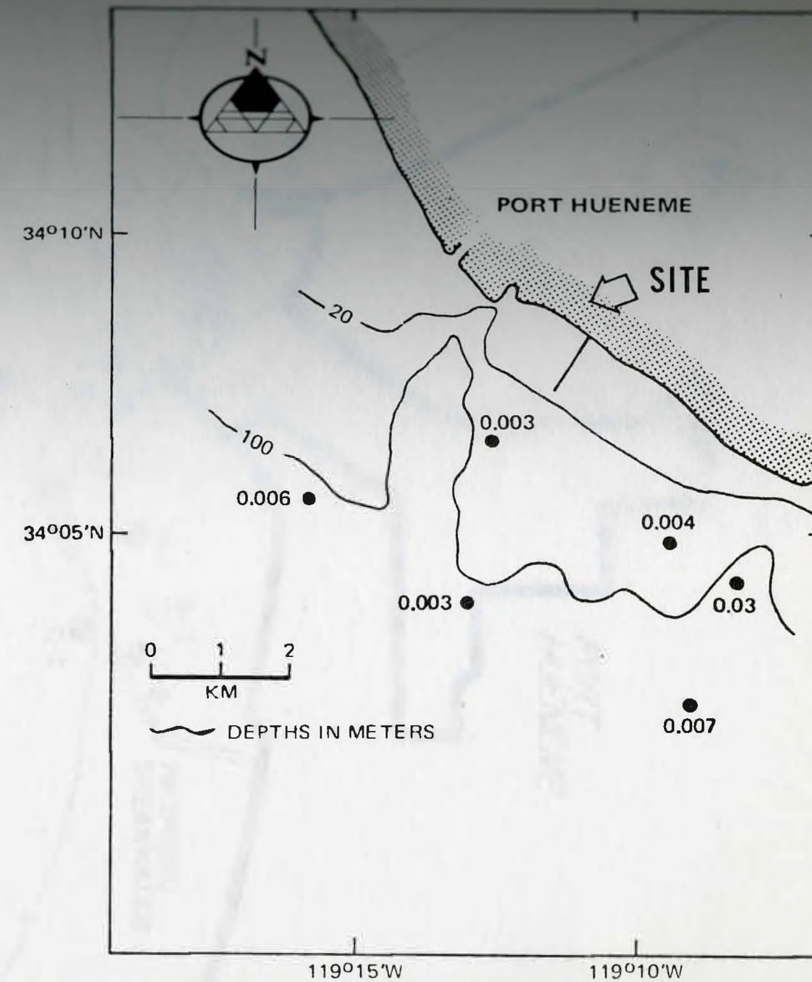


MERCURY CONCENTRATIONS (mg/dry kg) IN SURFACE SEDIMENTS AROUND THE OXNARD OUTFALL (BOX CORES, AUGUST 1971)

REFERENCE: SOUTHERN CALIFORNIA COASTAL WATER RESEARCH PROJECT, 1973



TOTAL DDT CONCENTRATIONS (mg/dry kg) IN SURFACE SEDIMENTS AROUND THE OXNARD OUTFALL (BOX CORES, SEPTEMBER 1971)

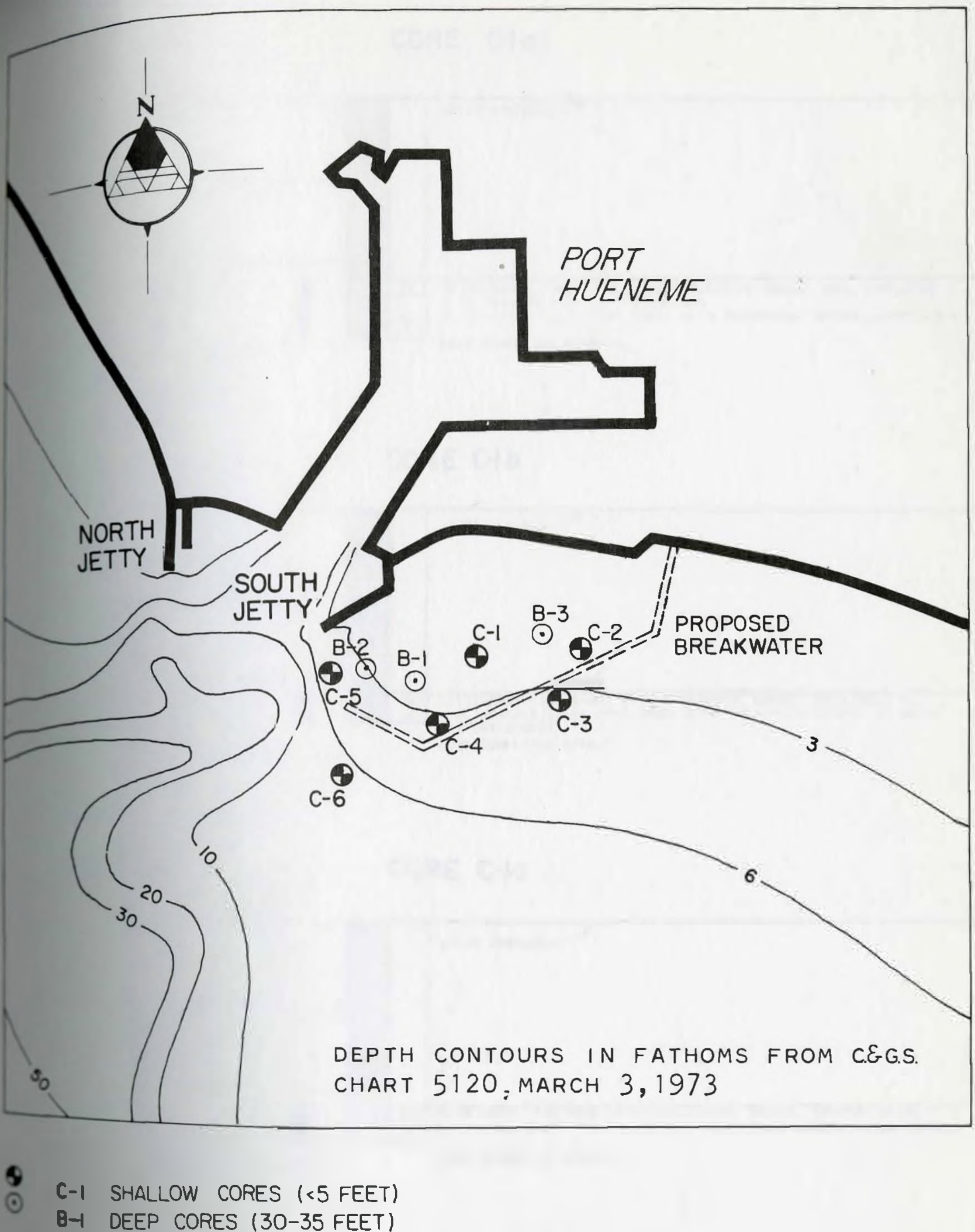


TOTAL PCB CONCENTRATIONS (mg/dry kg) IN SURFACE SEDIMENTS AROUND THE OXNARD OUTFALL (BOX CORES, SEPTEMBER 1971)

REFERENCE: SOUTHERN CALIFORNIA COASTAL WATER RESEARCH PROJECT, 1973

DAMES & MOORE

PLATE 2.1.2-20

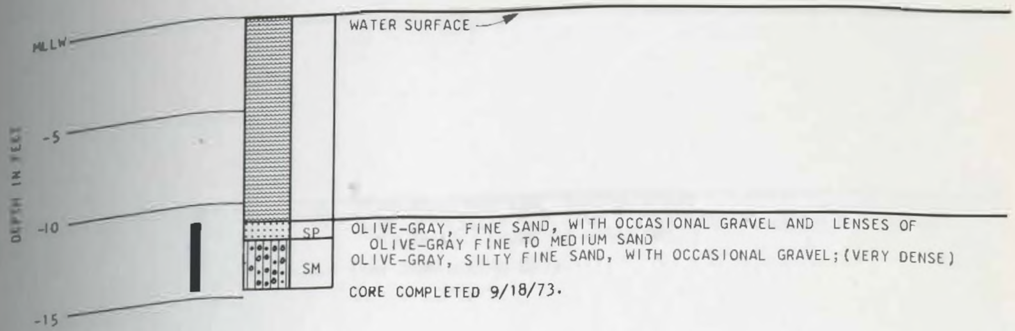


LOCATIONS OF SEDIMENT CORE SAMPLES

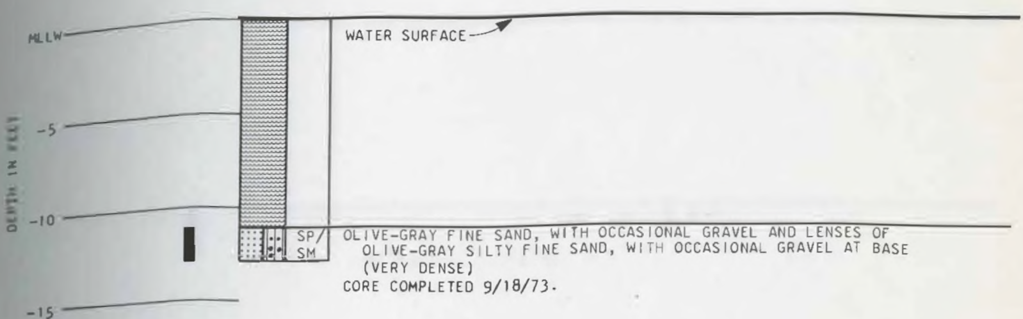
0 1/4 1/2

SCALE IN STATUTE MILES

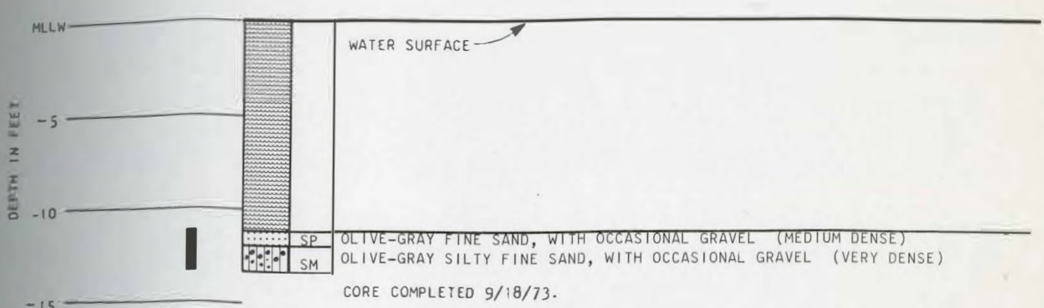
CORE C-1a



CORE C-1b



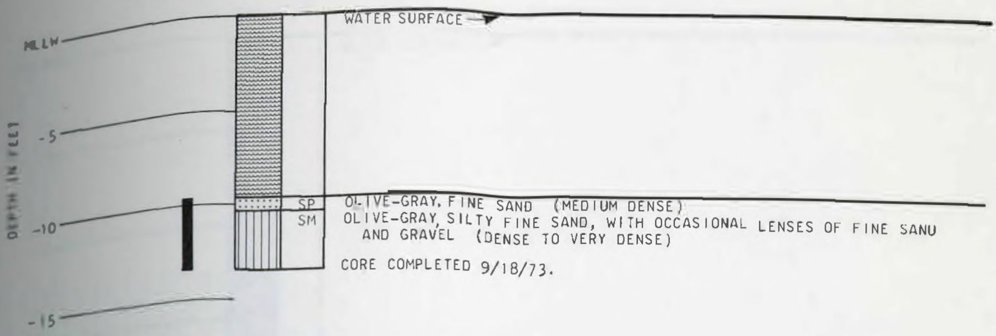
CORE C-1c



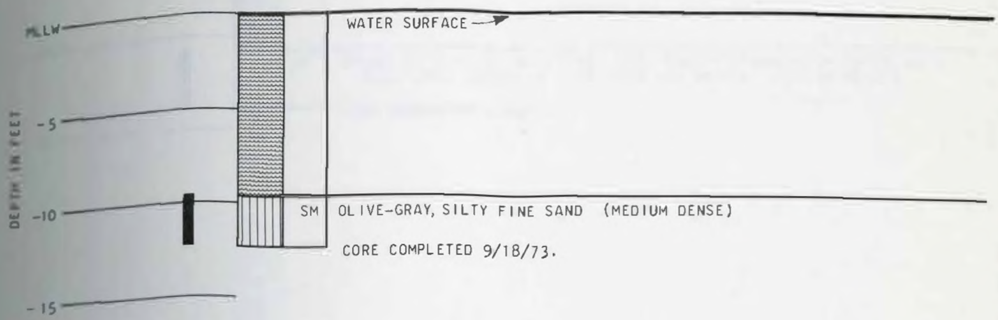
LOGS OF SEDIMENT CORES FROM PROPOSED BERTHING AREA

DAMES & MOORE

CORE C-2a



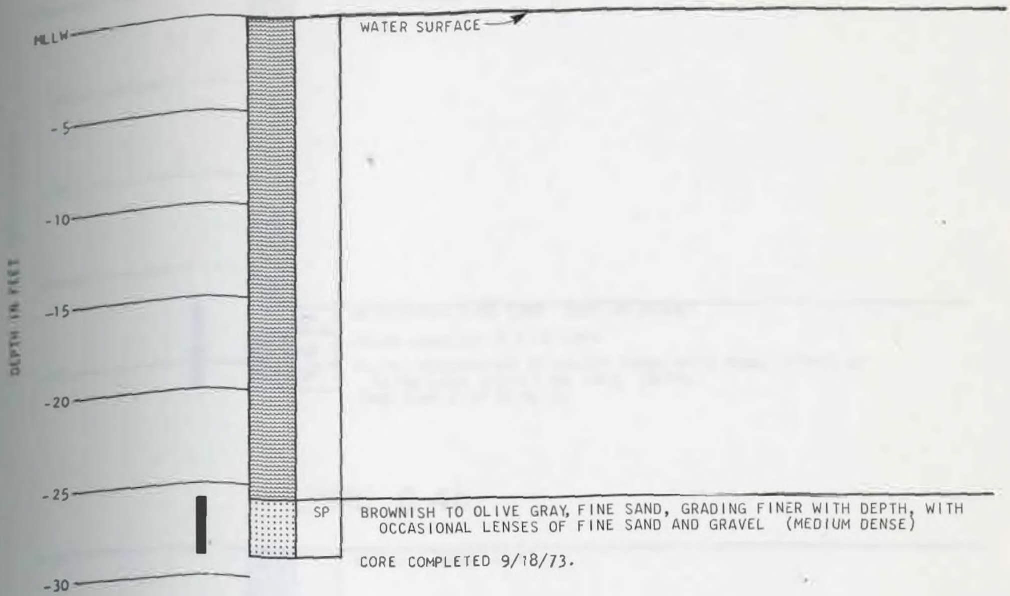
CORE C-2b



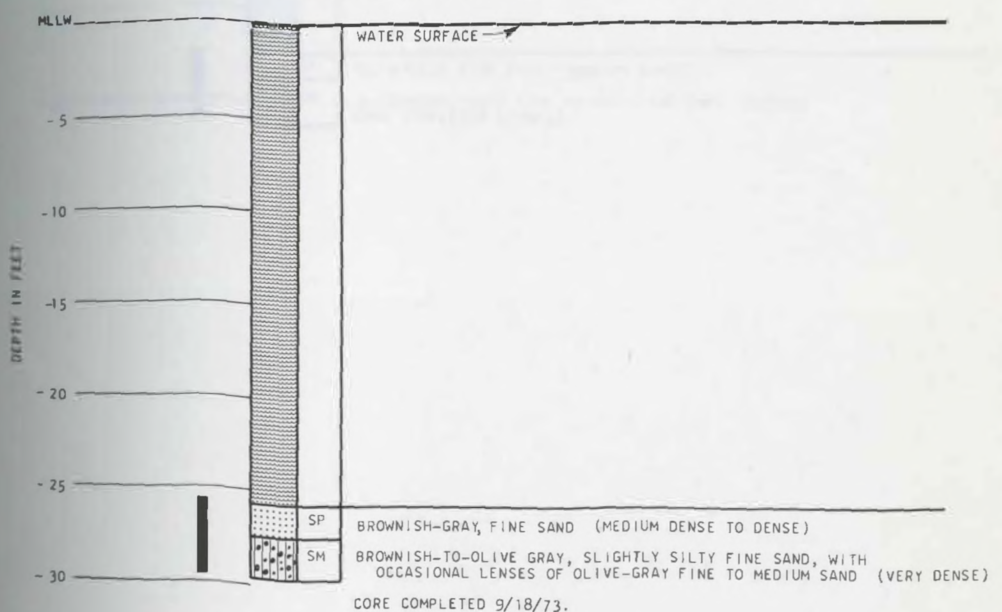
LOGS OF SEDIMENT CORES FROM PROPOSED BERTHING AREA

DAMES & MOORE

CORE C-3a



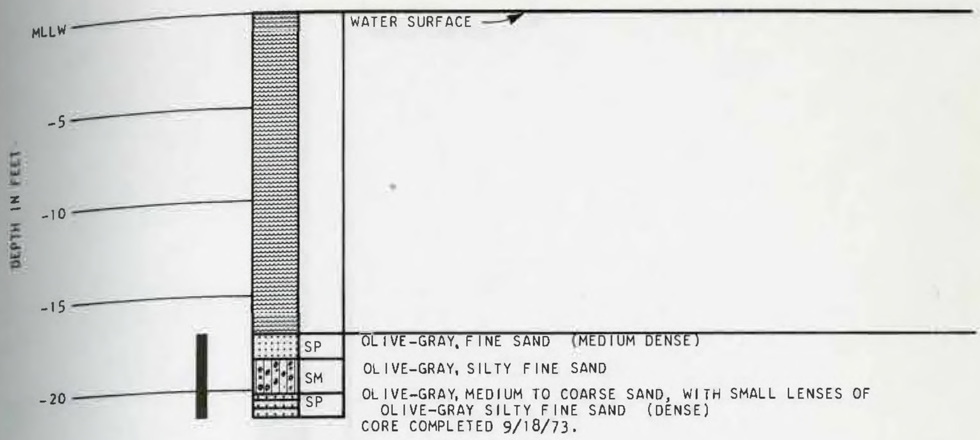
CORE C-3b



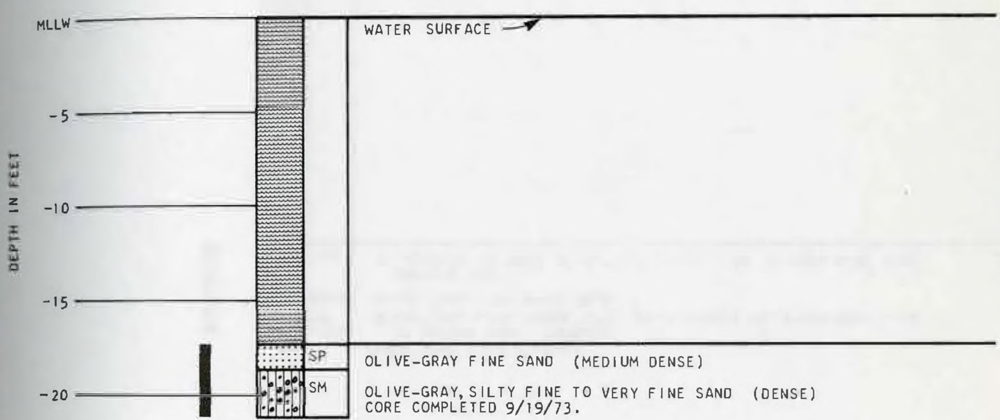
LOGS OF SEDIMENT CORES FROM PROPOSED BERTHING AREA

DAMES & MOORE

CORE C-4a



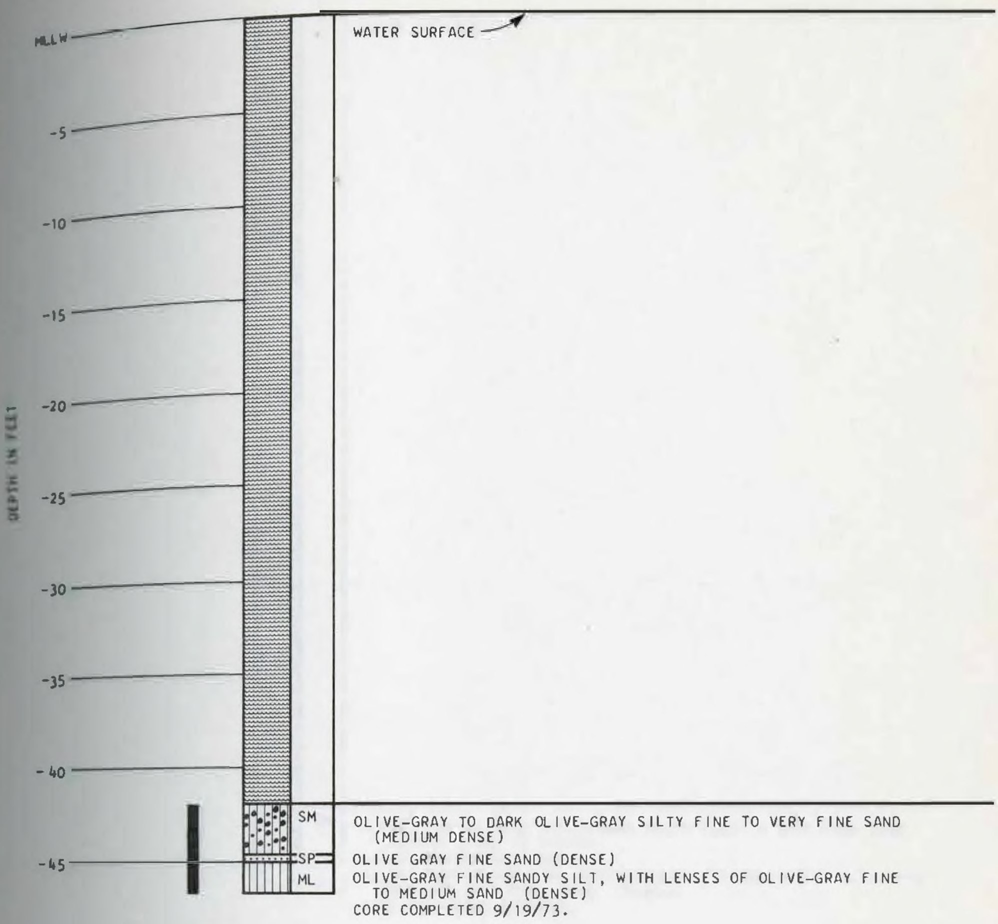
CORE C-4b



LOGS OF SEDIMENT CORES FROM PROPOSED BERTHING AREA

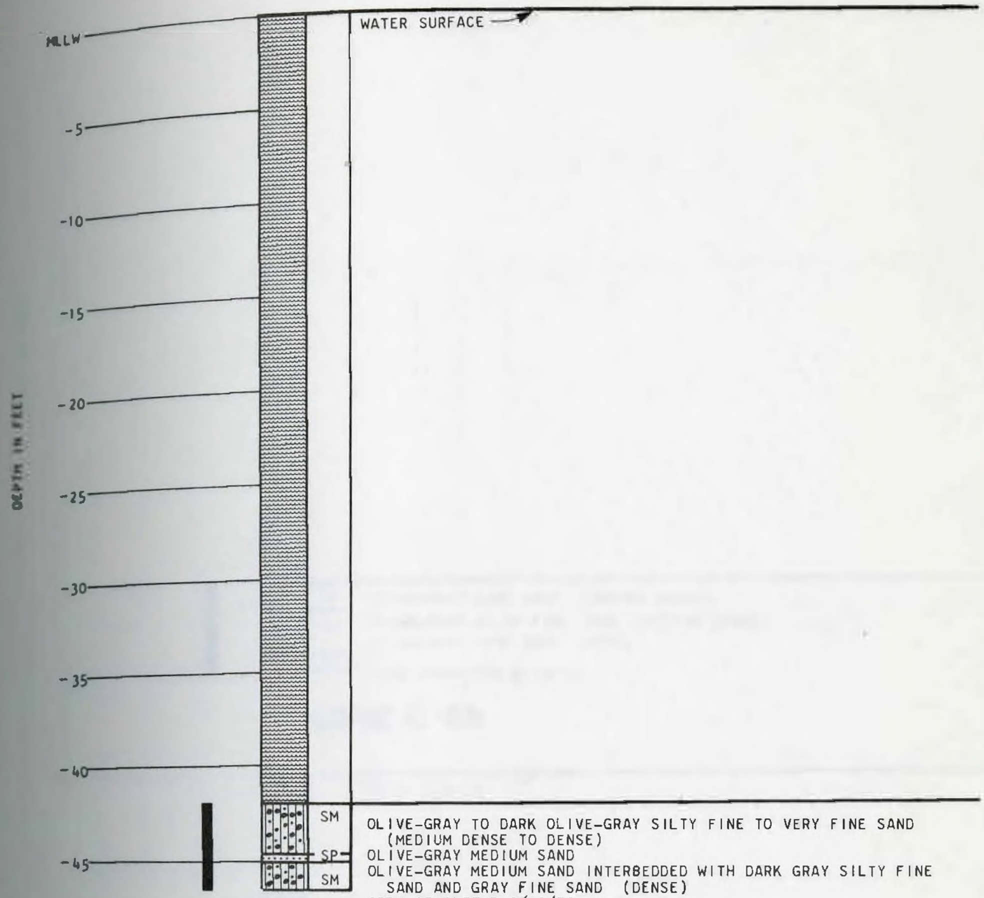
DAMES & MOORE

CORE C-5a



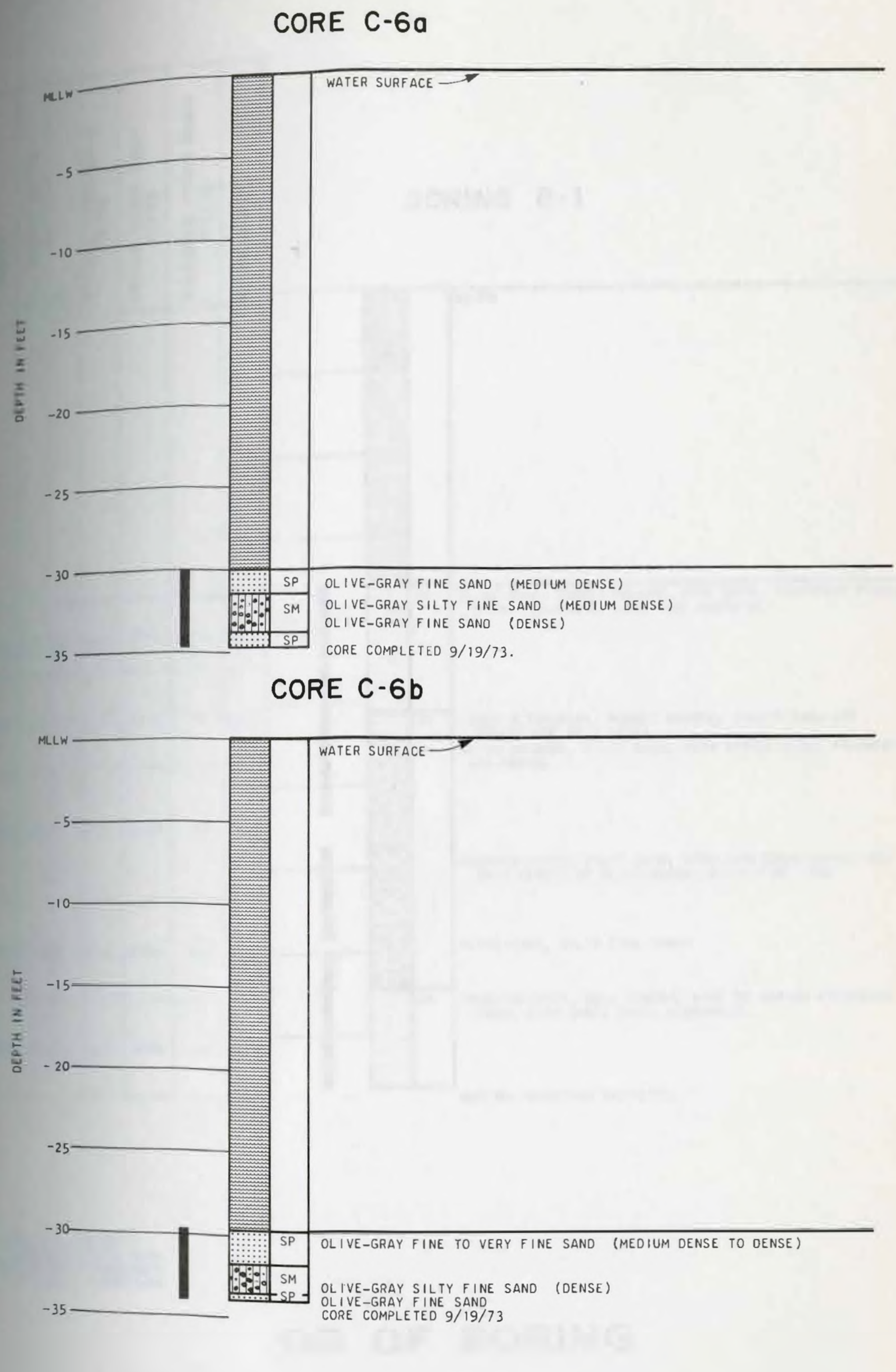
LOG OF SEDIMENT CORE FROM PROPOSED BERTHING AREA

CORE C-5b



LOG OF SEDIMENT CORE FROM PROPOSED BERTHING AREA

DAMES & MOORE



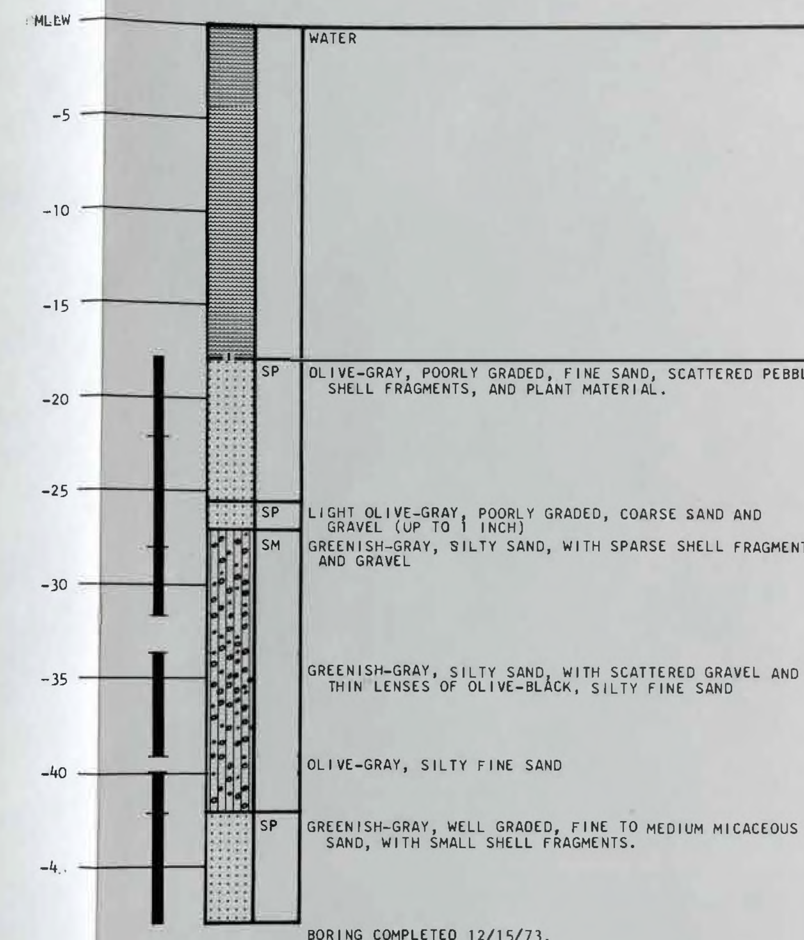
LOGS OF SEDIMENT CORES
FROM PROPOSED BERTHING AREA

DAMES & MOORE

SAMPLE ELEVATION	SAMPLE NUMBER	DRY MATTER %	TOTAL VOLATILE SOLIDS %	OIL AND GREASE mg/kg	TOTAL PHENOLS mg/kg	pH	IMMEDIATE OXYGEN DEMAND mg/kg	CHEMICAL OXYGEN DEMAND mg/kg	BIOCHEMICAL OXYGEN DEMAND mg/kg	SILICATES %	PHOSPHATES mg/kg	TOTAL ORGANIC CARBON mg/kg	AMMONIA NITROGEN mg/kg	ORGANIC NITROGEN mg/kg	SULFUR mg/kg	SULFIDE mg/kg	POLYCHLORINATED BIPHENYLS	ARSENIC mg/kg	BERYLLIUM mg/kg	CADMIUM mg/kg	CHROMIUM mg/kg	COPPER mg/kg	LEAD mg/kg	MERCURY mg/kg	NICKEL mg/kg	SELENIUM mg/kg	SILVER mg/kg	VANADIUM mg/kg	ZINC mg/kg	ORGANOCHLORINE PESTICIDES DETECTED: p,p' DDE mg/kg	p,p' DDT mg/kg	o,p' DDT mg/kg	TOTAL DDT
[illegible]	B-1-1	82.3	1.2	135	0.20	8.1	N.D.[1]	3864	111	63.2	675	3400	N.D.[2]	13.0	10.47	48.0	N.D.[2]	1.26	1.7	1.1	13	9	13	0.055	15	0.38	3	10	25	N.D.[3]	N.D.[4]	N.D.[4]	N.D.[3]
[illegible]	B-1-2	80.1	1.5	195	0.17	7.8	N.D.[1]	6348	141	72.1	712	3140	N.D.[2]	11.5	32.41	16.0	N.D.[2]	1.44	1.7	1.1	16	9	11	0.062	19	1.25	3	11	26	N.D.[3]	N.D.[4]	N.D.[4]	N.D.[3]
[illegible]	B-1-3	82.5	1.2	109	0.26	8.2	N.D.[1]	2728	87	76.2	637	3280	0.4	11.1	9.30	44.0	N.D.[2]	0.85	1.7	1.1	10	10	9	0.040	12	0.59	2	9	23	N.D.[3]	N.D.[4]	N.D.[4]	N.D.[3]
[illegible]	B-1-4	79.7	1.4	271	0.16	8.0	N.D.[1]	6160	254	72.1	887	4860	0.6	10.9	3.24	72.0	N.D.[2]	1.71	1.9	1.1	13	12	9	0.062	15	0.71	2	10	31	N.D.[3]	N.D.[4]	N.D.[4]	N.D.[3]
[illegible]	B-1-5	81.0	1.0	206	0.37	8.1	N.D.[1]	3784	329	74.8	800	3590	0.4	11.1	10.65	20.0	N.D.[2]	1.56	2.1	0.7	16	9	7	0.062	14	0.17	2	10	24	N.D.	N.D.	N.D.	N.D.

N.D.[1] : NONE DETECTED, <15 mg/kg
N.D.[2] : NONE DETECTED, < 0.02 mg/kg
N.D.[3] : NONE DETECTED, < 0.002 mg/kg
N.D.[4] : NONE DETECTED, <0.004 mg/kg

BORING B-1



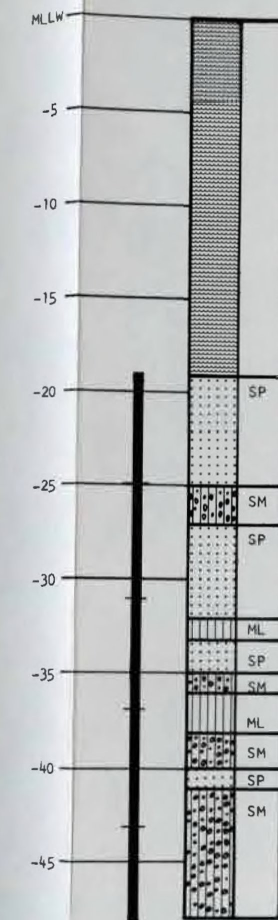
LOG OF BORING

DAMES & MOORE

SAMPLE NUMBER	DRY MATTER %	TOTAL VOLATILE SOLIDS %	OIL AND GREASE mg/kg	TOTAL PHENOLS mg/kg	pH	IMMEDIATE OXYGEN DEMAND mg/kg	CHEMICAL OXYGEN DEMAND mg/kg	BIOCHEMICAL OXYGEN DEMAND mg/kg	SILICATES %	PHOSPHATES mg/kg	TOTAL ORGANIC CARBON mg/kg	AMMONIA NITROGEN mg/kg	ORGANIC NITROGEN mg/kg	SULFUR mg/kg	SULFIDE mg/kg	POLYCHLORINATED BIPHENYLS	ARSENIC mg/kg	BERYLLIUM mg/kg	CADMIUM mg/kg	CHROMIUM mg/kg	COPPER mg/kg	LEAD mg/kg	MERCURY mg/kg	NICKEL mg/kg	SELENIUM mg/kg	SILVER mg/kg	VANADIUM mg/kg	ZINC mg/kg	ORGANOCHLORINE PESTICIDES DETECTED: p,p' DDE mg/kg	p,p' DDT mg/kg	o,p' DDT mg/kg	TOTAL DDT
B-2-1	79.0	1.2	241	0.63	8.3	N.D.[1]	1242	101	71.2	925	3260	0.4	17.1	16.50	8.0	N.D.[2]	1.48	2.1	1.0	15	10	9	0.065	14	0.25	2	10	24	N.D.[3]	N.D.[4]	N.D.[4]	N.D.[3]
B-2-2	79.8	1.3	175	0.47	7.9	N.D.	2162	150	72.0	700	3080	0.3	10.5	11.00	4.0	N.D.[2]	1.12	1.7	1.0	11	10	8	0.040	14	0.42	1	10	26	N.D.[3]	N.D.[4]	N.D.[4]	N.D.[3]
B-2-3	80.3	1.3	167	0.43	8.0	N.D.	5336	102	72.1	862	4800	1.3	16.5	66.25	32.0	N.D.[2]	1.12	2.0	1.1	11	12	7	0.034	19	0.30	2	11	34	N.D.[3]	N.D.[4]	N.D.[4]	N.D.[3]
B-2-4	78.5	1.2	152	0.63	8.1	N.D.	3444	99	71.6	762	3540	0.9	10.3	6.50	16.0	N.D.[2]	1.91	1.9	0.6	13	11	10	0.061	15	0.80	2	9	26	N.D.[3]	N.D.[4]	N.D.[4]	N.D.[3]
B-2-5	80.1	1.5	180	0.32	8.3	N.D.	2432	75	72.9	887	2470	1.3	10.4	5.10	64.0	N.D.[2]	1.46	1.9	0.7	13	11	11	0.050	11	0.28	2	10	28	N.D.[3]	N.D.[4]	N.D.[4]	N.D.[3]

N.D.[1] : NONE DETECTED, <15 mg/kg
N.D.[2] : NONE DETECTED, < 0.02 mg/kg
N.D.[3] : NONE DETECTED, < 0.002 mg/kg
N.D.[4] : NONE DETECTED, < 0.004 mg/kg

BORING B-2



WATER

GREENISH-GRAY, POORLY GRADED , FINETO MEDIUM SAND, WITH SCATTERED SHELL FRAGMENTS AND PEBBLES OF GRANITIC ROCK.

GREENISH-GRAY, SILTY SAND, WITH SPARSE SHELL FRAGMENTS AND PLANT MATERIAL; SCATTERED PEBBLES

GREENISH-GRAY, POORLY GRADED, FINE TO COARSE SAND, WITH SCATTERED SHELL FRAGMENTS AND PEBBLES, AND THIN LENSES OF OLIVE-BLACK SILT

OLIVE-GRAY, MICACEOUS, SILTY FINE SAND

GREENISH-GRAY, POORLY GRADED, FINE TO MEDIUM SAND, WITH SCATTERED SHELL FRAGMENTS

GREENISH-GRAY, MICACEOUS, SILTY SAND, WITH SPARSE SHELL FRAGMENTS

OLIVE-GRAY,SILT, WITH LENSES OF CLAYEY SILT

OLIVE-GRAY, SILTY FINE SAND

DARK GREENISH-GRAY, POORLY GRADED, MEDIUM SAND, WITH SHELL FRAGMENTS

GREENISH-GRAY, POORLY GRADED, SILTY SAND, WITH THIN (½ INCH) LAYERS OF OLIVE-GRAY SILTY CLAY; SCATTERED SHELL FRAGMENTS

BORING COMPLETED 12/16/73.

LOG OF BORING

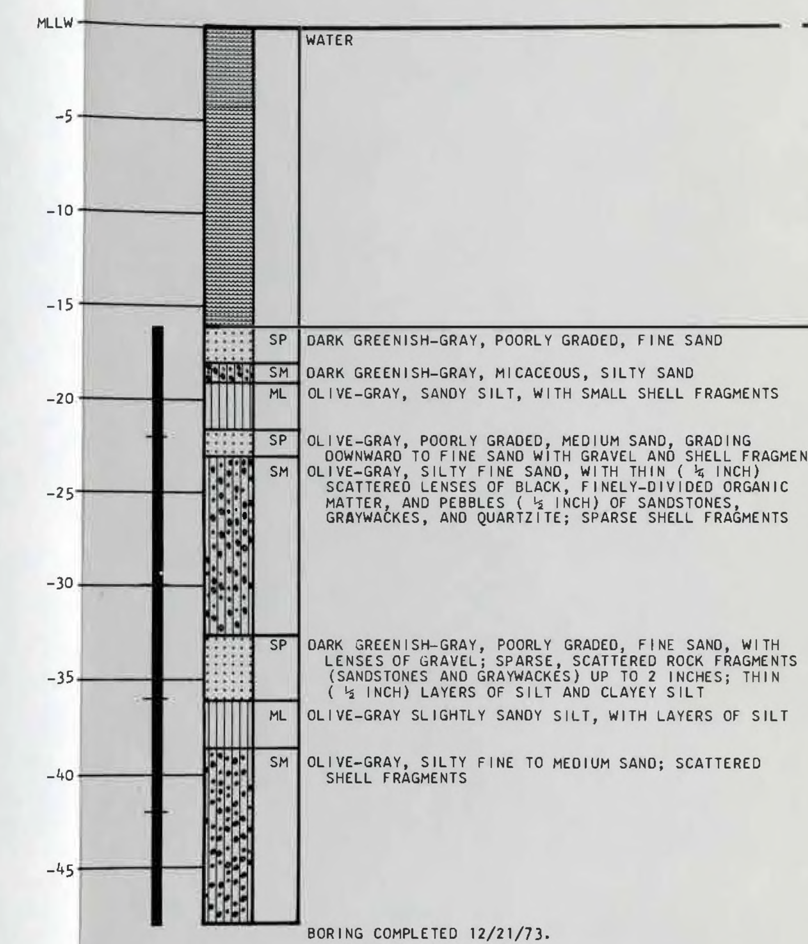
DAMES & MOORE

PLATE 2.1.2-30

SAMPLE ELEVATION (FEET BELOW MLLW)	SAMPLE NUMBER	DRY MATTER %	TOTAL VOLITILE SOLIDS %	OIL AND GREASE mg/kg	TOTAL PHENOLS	pH	IMMEDIATE OXYGEN DEMAND mg/kg	CHEMICAL OXYGEN DEMAND mg/kg	BIOCHEMICAL OXYGEN DEMAND mg/kg	SILICATES %	PHOSPHATES mg/kg	TOTAL ORGANIC CARBON mg/kg	AMMONIA NITROGEN mg/kg	ORGANIC NITROGEN mg/kg	SULFUR mg/kg	SULFIDE mg/kg	POLYCHLORINATED BIPHENYLS	ARSENIC mg/kg	BERYLLIUM mg/kg	CADMIUM mg/kg	CHROMIUM mg/kg	COPPER mg/kg	LEAD mg/kg	MERCURY mg/kg	NICKEL mg/kg	SELENIUM mg/kg	SILVER mg/kg	VANADIUM mg/kg	ZINC mg/kg	ORGANOCHLORINE PESTICIDES DETECTED: p, p' DDE mg/kg	p, p' DDT mg/kg	o, p' DDT mg/kg	TOTAL DDT
	B-3-1	82.3	0.9	389	0.12	8.4	N.D.[1]	3414	78	72.3	700	1830	1.0	5.4	22.50	4.0	N.D.[2]	0.78	1.5	0.7	11	8	21	0.077	7	0.32	3	9	23	N.D.[3]	N.D.[4]	N.D.[4]	N.D.[3]
	B-3-2	78.3	0.9	290	0.26	7.8	N.D.[1]	4300	84	72.9	462	2690	1.1	22.4	16.00	40.0	N.D.[2]	1.28	1.1	0.6	5	7	5	0.078	18	0.82	2	6	18	N.D.[3]	N.D.[4]	N.D.[4]	N.D.[3]
	B-3-3	79.0	1.2	313	0.16	8.1	N.D.[1]	2918	81	72.8	712	2860	1.0	12.9	52.30	68.0	N.D.[2]	1.32	2.1	1.5	13	11	12	0.024	6	0.30	2	10	32	N.D.[3]	N.D.[4]	N.D.[4]	N.D.[3]
	B-3-4	77.4	1.8	355	0.21	7.7	N.D.[1]	3072	108	68.7	762	5220	0.9	7.6	37.90	104.0	N.D.[2]	2.04	2.2	1.5	18	16	16	0.024	21	0.61	2	12	40	N.D.[3]	N.D.[4]	N.D.[4]	N.D.[3]
	B-3-5	81.3	1.1	195	0.21	8.1	N.D.[1]	2765	78	75.5	575	1270	0.7	8.5	10.40	68.0	N.D.[2]	2.08	2.1	1.5	11	14	18	0.047	19	0.45	2	9	25	N.D.[3]	N.D.[4]	N.D.[4]	N.D.[3]

N.D.[1] : NONE DETECTED, <15 mg/kg
N.D.[2] : NONE DETECTED, < 0.02 mg/kg
N.D.[3] : NONE DETECTED, < 0.002 mg/kg
N.D.[4] : NONE DETECTED, < 0.004 mg/kg

BORING B-3



LOG OF BORING

DAMES & MOORE

TABLE 2.1.2-V

TEST RESULTS OF BOTTOM SEDIMENTS COLLECTED WITHIN PORT HUENEME HARBOR

EPA LAB Number	Corps of Engineers Sample Description	Volatile Solids %	COD %	Total Kjeldahl Nitrogen %	Oil and Grease %	Mercury ppm	Lead ppm	Zinc ppm	Manganese ppm
238FA081	Station 1, Sample 1	3.0	2.8	0.046	0.13	0.20	30	154	228
239FA081	Station 1, Sample 2	3.1	2.8	0.048	0.19	0.23	32	92	221
240FA081	Station 3	2.0	1.3	0.029	0.07	0.06	13	62	153
241FA081	Station 4	1.8	0.94	0.021	0.01	0.06	12	49	152

Note: Station Locations shown on Plate 2.1.2-18.
The sample, if any, from Station 2 was not presented in the source table. Neither the Los Angeles Office of the Army Corps of Engineers, nor the Alameda (Calif.) Office of the Environmental Protection Agency, is now able to explain the omission.

Reference: U.S. Army Corps of Engineers, 1973a.

TABLE 2.1.2-VI

CONCENTRATIONS (mg/dry kg) OF METALS IN THE SURFACE LAYER (0-1cm) OF SEDIMENTS FROM BOX CORES COLLECTED OFF THE OXNARD SEWAGE OUTFALL DURING AUGUST 1971

Station	Silver	Cadmium	Chromium	Copper	Lead	Zinc	Mercury
55	-	-	-	-	-	-	0.02
56	-	-	-	-	-	-	0.02
58	1.6	0.35	33	14	20	50	0.04
59	1.2	0.17	35	13	12	37	0.03
61	-	-	-	-	-	-	0.02
62	-	-	-	-	-	-	0.10
63	-	-	-	-	-	-	0.05
64	-	-	-	-	-	-	0.04
65	-	-	-	-	-	-	0.03
66	-	0.27	39	16	19	49	0.03
67	-	-	-	-	-	-	0.05
68	-	-	-	-	-	-	0.06
70	1.9	0.25	70	30	11	76	0.09

Note: Station Locations shown on Plate 2.1.2-18.

Reference: Southern California Coastal Water Research Project, 1973.

TABLE 2.1.2-VII

GEOCHEMICAL PROPERTIES OF SURFACE SEDIMENTS (CORES C-1 THROUGH C-6)
FROM PROPOSED BERTHING AREA

Core Number	C-1	C-2	C-3	C-4	C-5	C-6	Mean
Dry Matter %	80.9	77.6	80.2	80.6	76.5	80.0	79.3
Total Volatile Solids %	1.2	1.3	1.1	1.3	2.2	1.1	1.4
Oil and Grease mg/kg	117.8	518.6	335.5	439.4	424.9	710.3	424.4
Phenolics mg/kg	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	N.D.
pH	8.0	7.9	8.0	8.1	7.9	8.1	8.0
Silicates %	80.6	72.3	75.3	73.1	70.6	75.1	74.5
Phosphates mg/kg	835.0	847.0	685.0	785.0	770.0	790.0	785.0
Total Organic Carbon mg/kg	1540.0	1800.0	2360.0	1280.0	3850.0	2220.0	2175.0
Ammonia Nitrogen mg/kg	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.
Organic Nitrogen mg/kg	11.10	13.25	7.47	4.58	6.02	5.42	7.97
Sulfur mg/kg	19.94	16.56	25.64	7.09	65.36	21.53	26.02
Sulfide mg/kg	*	28	20	8	124	32	42
Immediate Oxygen Demand mg/kg	8.7	8.7	8.7	8.7	8.5	8.6	8.7
Chemical Oxygen Demand mg/kg	1415.7	1989.6	1946.6	884.8	9201.9	1605.1	2940.7
Biochemical Oxygen Demand mg/kg	191.6	203.6	131.7	107.8	323.4	166.7	187.5
p,p'-DDE mg/kg	0.002	N.D.[4]	0.001	N.D.[4]	0.006	0.001	0.002
p,p'-DDT mg/kg	0.008	0.006	0.001	N.D.[5]	N.D.[5]	0.005	0.003
o,p'-DDT mg/kg	0.001	0.001	N.D.[6]	N.D.[6]	N.D.[6]	N.D.[6]	0.0
Total DDT mg/kg	0.011	0.007	0.002	N.D.	0.006	0.006	0.005
Polychlorinated Biphenyls mg/kg	N.D.[7]	N.D.[7]	N.D.[7]	N.D.[7]	N.D.[7]	N.D.[7]	N.D.
Arsenic mg/kg	1.8	1.4	2.7	1.6	1.2	0.7	1.6
Beryllium mg/kg	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Cadmium mg/kg	2.0	1.8	1.8	1.5	2.0	1.6	1.8
Chromium mg/kg	18.0	19.0	14.0	17.0	20.0	14.0	17.0
Copper mg/kg	8.3	8.7	6.2	7.5	11.0	6.2	8.0
Lead mg/kg	19.0	49.0	15.0	35.0	39.0	32.0	32.0
Mercury mg/kg	0.018	0.010	0.012	0.010	0.017	0.003	0.012
Nickel mg/kg	25.0	30.0	36.0	22.0	32.0	22.0	28.0
Selenium mg/kg	0.50	0.61	0.45	0.54	0.18	0.14	0.41
Silver mg/kg	4.0	3.0	2.0	4.0	5.0	3.0	4.0
Vanadium mg/kg	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.
Zinc mg/kg	24.0	31.0	21.0	23.0	37.0	19.0	26.0

*Not analyzed.

N.D. = None Detected

[1]Detection Limit: 0.15 mg/kg

[2]Detection Limit: 3.12 mg/kg

[3]Detection Limit: 1.5 mg/kg

[4]Detection Limit: 0.0005 mg/kg

[5]Detection Limit: 0.001 mg/kg

[6]Detection Limit: 0.001 mg/kg

[7]Detection Limit: 0.01 mg/kg

[8]Detection Limit: 5.00 mg/kg

TABLE 2.1.2-VIII

SELECTED TRACE METAL CONCENTRATIONS IN PORT HUENEME SEDIMENTS COMPARED TO NATURAL TRACE METAL CONCENTRATIONS IN SURFACE SEDIMENTS

Data in mg/kg Dry Weight

Metal	Present Study[1]	Southern California[2]	Other Nearshore	Earth's Crust
Cadmium	1.2	0.4	2[3]	0.15
Chromium	13.9	46	30[4]	200
Copper	9.8	16	7[5], 48[6]	70
Lead	16.9	8.0	15[5], 20[6]	16
Mercury	0.041	0.06	0.04[7]	0.5
Nickel	18.4	14.0	15[5], 65[6]	80
Silver	2.5	1.0	---	
Zinc	26.6	63	95[6]	132

[1]Mean of all samples
[2]Southern California Coastal Water Research Project, 1973
[3]Forster, et al., 1972; Caribbean sediments station 50
[4]Ishibashi, et al., 1964; Japanese Islands
[5]Hirst, 1962a; Caribbean sediments
[6]Wedepohl, 1960; Atlantic nearshore
[7]Carpenter, 1972; Washington shelf, N.E. Pacific
[8]Mason, 1952

TABLE 2.1.2-IX

SEAWATER AND SEDIMENT ELUTRIATE ANALYSES OF PROPOSED DREDGED MATERIALS

Total Sample

C-5	C-6	B-1-1	B-1-2	B-1-3	B-1-4	B-1-5	B-2-1	B-2-2	B-2-3	B-2-4	B-2-5	B-3-1	B-3-2	B-3-3	B-3-4	B-3-5	Sample Means
03.5	218.0	195.2	174.8	134.1	113.3	124.7	73.9	75.7	153.9	283.5	43.9	169.8	52.3	35.4	144.4	121.7	148.4
.D.[1]	N.D.[1]	0.10	1.04	0.01	4.50	1.70	N.D.[1]	0.01	0.02	0.06	N.D.[1]	0.01	0.02	N.D.[1]	N.D.[1]	N.D.[1]	0.43
3.63	3.57	5.53	3.89	3.62	3.73	3.60	3.38	3.69	3.61	3.89	3.64	3.60	3.73	3.57	3.56	3.49	3.77
0.47	0.47	2.41	0.67	0.63	0.54	0.30	0.55	0.53	0.49	0.69	0.67	0.41	0.58	0.42	0.46	0.49	0.69
7.2	1.4	0.2	0.7	0.3	0.9	0.2	1.5	0.6	0.1	0.1	0.2	0.4	0.6	0.2	0.1	0.3	0.7
39	80	95	51	65	130	240	42	69	72	119	45	55	64	27	58	45	79
*	*	56	47	56	65	75	41	67	68	70	45	50	46	26	54	43	54
7.90	8.10	7.95	8.00	7.95	7.70	7.75	7.75	7.79	7.80	7.75	7.70	7.65	7.60	7.70	7.65	7.65	7.82
0.027	0.024	0.018	0.020	0.015	0.015	0.019	N.D.[1]	N.D.[1]	0.020	N.D.[1]	0.019	0.025	0.010	0.020	0.020	0.019	0.016
0.24	N.D.[3]	0.72	0.32	0.40	N.D.[3]	N.D.[3]	0.24	0.36	0.28	0.36	0.48	0.44	0.40	0.32	0.68	0.36	0.27
.D.[4]	N.D.[4]	N.D.[5]	4.2	0.8	3.2	6.2	0.8	8.4	3.2	3.2	4.4	1.0	4.4	2.0	4.4	3.4	2.4
0.87	1.06	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	0.29
14.0	5.6	*	0.4	4.0	2.4	1.0	N.D.[2]	N.D.[2]	N.D.[2]	4.5	3.1	0.4	0.2	N.D.[2]	0.9	0.7	3.2
52	39	33	37	30	46	25	32	25	32	21	19	31	22	30	29	29	35
0.045	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	0.002
0.07	0.04	0.09	0.20	0.08	0.18	0.15	0.15	0.20	0.09	0.19	0.15	0.17	0.14	0.16	0.18	0.14	0.13
0.08	0.10	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	0.08
0.52	0.04	0.09	0.20	0.08	0.18	0.15	0.15	0.20	0.09	0.19	0.15	0.17	0.14	0.16	0.18	0.14	0.14
*	*	1.34	1.31	1.72	2.34	1.26	1.34	1.26	1.56	1.26	1.64	1.37	1.51	1.68	1.31	1.39	1.49
0.024	0.050	N.D.[6]	N.D.[6]	N.D.[6]	N.D.[6]	N.D.[6]	N.D.[6]	N.D.[6]	N.D.[6]	N.D.[6]	N.D.[6]	N.D.[6]	N.D.[6]	N.D.[6]	N.D.[6]	N.D.[6]	0.018
.D.[7]	N.D.[7]	N.D.[8]	N.D [8]	0.08	0.08	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	0.08	0.08	N.D.[8]	N.D.[8]	N.D.[8]	0.02

.8 μg/l
.0 μg/l
.7 μg/l
.05 μg/l

DAMES & MOORE

SEAWATER AND SEDIMENT ELUTRIA

	Seawater Control 9/18/73	Seawater Control 12/11/73	C-1	C-2	C-3	C-4	C-5	C-6	B-1-1	B-1-2
Suspended Solids (mg/l)	32.5	19.0	189.7	162.2	226.9	220.0	203.5	218.0	195.2	174.8
Settleable Solids (mg/l)	N.D.[1]	N.D.[1]	0.10	1.50	0.10	N.D.[1]	N.D.[1]	N.D.[1]	0.10	1.04
Total Solids (%)	3.45	3.93	3.87	4.19	3.80	3.64	3.63	3.57	5.53	3.89
Total Volatile Solids (%)	0.41	0.74	0.74	0.63	0.65	0.49	0.47	0.47	2.41	0.67
Oil and Grease (mg/l)	0.9	0.1	4.8	N.D.[2]	N.D.[2]	N.D.[2]	7.2	1.4	0.2	0.7
Turbidity (JTU)										
At once:	0.75	1.00	85	145	62	68	39	80	95	51
After 60 minutes:	-	-	*	*	*	*	*	*	56	47
pH	8.13	8.09	8.00	7.90	7.95	8.05	7.90	8.10	7.95	8.00
Sulfur (mg/l)	N.D.[1]	N.D.[1]	0.015	0.018	0.022	0.020	0.027	0.024	0.018	0.020
Sulfide (mg/l)	N.D.[3]	0.24	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	0.24	N.D.[3]	0.72	0.32
Total Phenols (μg/l)	N.D.[4]	N.D.[5]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[5]	4.2
Immediate Oxygen Demand (mg/l)	N.D.[2]	N.D.[2]	0.98	0.98	1.07	1.06	0.87	1.06	N.D.[2]	N.D.[2]
Biochemical Oxygen Demand (mg/l)	1.0	2.0	6.4	7.6	9.4	6.4	14.0	5.6	*	0.4
Total Organic Carbon (mg/l)	20	6	45	42	63	65	52	39	33	37
Ammonia Nitrogen (mg/l)	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	0.045	N.D.[4]	N.D.[4]	N.D.[4]
Organic Nitrogen (mg/l)	0.04	N.D.[4]	0.11	0.07	0.06	0.07	0.07	0.04	0.09	0.20
Nitrate Nitrogen (mg/l)	0.26	*	0.09	0.10	0.08	0.08	0.08	0.10	*	*
Total Kjeldahl Nitrogen (mg/l)	0.04	N.D.[4]	0.11	0.07	0.06	0.07	0.52	0.04	0.09	0.20
Silicates (mg/l)	*	0.54	*	*	*	*	*	*	1.34	1.31
Arsenic (mg/l)	N.D.[6]	N.D.[6]	0.004	0.018	0.006	0.006	0.024	0.050	N.D.[6]	N.D.[6]
Mercury (mg/l)	N.D.[7]	N.D.[8]	N.D.[7]	N.D.[7]	N.D.[7]	N.D.[7]	N.D.[7]	N.D.[7]	N.D.[8]	N.D[8]

*Not analyzed.
N.D.[1]: None detected, <0.01 mg/l
N.D.[2]: None detected, <0.2 mg/l
N.D.[3]: None detected, <0.08 mg/l
N.D.[4]: None detected, <0.03 mg/l
N.D.[5]: None detected, <0.8 μg/l
N.D.[6]: None detected, <4.0 μg/l
N.D.[7]: None detected, <0.7 μg/l
N.D.[8]: None detected, <0.05 μg/l

TABLE 2.1.2-X

SEAWATER AND SEDIMENT ELUTRIATE ANALYSES OF PROPOSED DREDGED

Dissolved Fraction (<0.45 micron)

	Seawater 9/18/73	Seawater 12/11/73	C-1	C-2	C-3	C-4	C-5	C-6	B-1-1	B-1-2	B-1-3	B-1-4
Biochemical Oxygen Demand (mg/l)	1.0	2.0	1.8	3.8	2.9	1.6	4.5	2.2	*	0.3	N.D.[1]	N.D.[1]
Total Organic Carbon (mg/l)	20	6	28	35	51	46	42	26	29	33	14	7
Total Kjeldahl Nitrogen (mg/l)	0.04	N.D.[2]	0.07	0.04	N.D.[2]	0.03	0.09	N.D.[2]	0.10	0.09	0.07	0.08
Ammonia Nitrogen (mg/l)	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]
Nitrate Nitrogen (mg/l)	0.026	0.14	0.12	0.16	0.12	0.10	0.08	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]
Nitrite Nitrogen (mg/l)	*	0.001	*	*	*	*	*	*	0.003	0.003	0.003	0.002
Organic Nitrogen (mg/l)	0.04	N.D.[2]	0.07	0.04	N.D.[2]	0.03	0.09	N.D.[2]	0.10	0.09	0.07	0.08
Total Phosphates (mg/l)	0.027	0.045	0.080	0.092	0.106	0.126	0.087	0.153	0.085	0.055	0.065	0.065
Orthophosphates (mg/l)	*	N.D.[3]	*	*	*	*	*	*	0.025	0.025	0.045	0.035
Sulfur (mg/l)	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]
Arsenic (µg/l)	N.D.[4]	N.D.[4]	0.004	N.D.[4]	N.D.[4]	0.005	0.010	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]
Beryllium (µg/l)	0.2	0.01	N.D.[5]	N.D.[5]	N.D.[5]	N.D.[5]	N.D.[5]	N.D.[5]	0.01	0.01	N.D.[6]	0.01
Cadmium (µg/l)	0.45	0.03	0.2	0.3	0.2	0.3	0.4	0.2	0.07	0.06	0.07	0.06
Chromium (µg/l)	4	3.0	N.D.[7]	N.D.[7]	N.D.[7]	N.D.[7]	N.D.[7]	N.D.[7]	0.5	0.4	0.4	0.3
Copper (µg/l)	7	3.0	13	13	7	7	7	9	2.0	2.1	2.0	1.5
Lead (µg/l)	9	0.3	10	12	10	10	9	10	1.4	0.7	0.9	0.6
Mercury (µg/l)	N.D.[8]	N.D.[9]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[9]	N.D.[9]	N.D.[9]	N.D.[9]
Nickel (µg/l)	6	1.9	9	11	14	11	8	10	4.6	3.1	2.7	2.9
Selenium (µg/l)	4.6	0.3	*	*	*	*	*	*	0.4	0.6	0.3	0.4
Silver (µg/l)	3.8	2.7	0.8	0.9	0.9	0.9	0.9	0.9	0.8	0.7	0.5	0.7
Vanadium (µg/l)	N.D.[10]	N.D.[11]	N.D.[10]	N.D.[10]	N.D.[10]	N.D.[10]	N.D.[10]	N.D.[10]	N.D.[11]	N.D.[11]	N.D.[11]	N.D.[11]
Zinc (µg/l)	30	13.9	17	16	31	19	15	14	9	11	2	11
Chlorinated Hydrocarbons (mg/l)	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]

*Not analyzed.

N.D.[1]: None detected, <0.2 mg/l
N.D.[2]: None detected, <0.035 mg/l
N.D.[3]: None detected, <0.01 mg/l
N.D.[4]: None detected, <4.0 µg/l
N.D.[5]: None detected, <0.1 µg/l
N.D.[6]: None detected, <0.01 µg/l
N.D.[7]: None detected, <2.0 µg/l

N.D.[8] : None detected, <0.05 µg/l
N.D.[9] : None detected, <0.03 µg/l
N.D.[10]: None detected, <8.0 µg/l
N.D.[11]: None detected, <2.5 µg/l
N.D.[12]: None detected, <0.005 mg/l (p,'p-DDE)
<0.001 mg/l (p,p'-DDT)
<0.001 mg/l (o,p'-DDT)
<0.005 mg/l (PCB)

TABLE 2.1.2-X

TRIATE ANALYSES OF PROPOSED DREDGED MATERIALS

ved Fraction (<0.45 micron)

-1-1	B-1-2	B-1-3	B-1-4	B-1-5	B-2-1	B-2-2	B-2-3	B-2-4	B-2-5	B-3-1	B-3-2	B-3-3	B-3-4	B-3-5	Sample Means
*	0.3	N.D.[1]	N.D.[1]	0.4	N.D.[1]	1.3	0.2	1.0	0.9	0.4	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	1.1
	33	14	7	31	25	35	30	49	26	22	14	28	26	27	30
10	0.09	0.07	0.08	0.20	0.10	0.11	0.07	0.11	0.15	0.09	0.10	0.05	0.07	0.07	0.08
D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	N.D.[2]	0.035
D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	N.D.[1]	0.03
003	0.003	0.003	0.002	0.005	0.003	0.005	0.005	0.008	0.007	0.006	0.005	0.006	0.004	0.004	0.005
10	0.09	0.07	0.08	0.20	0.10	0.11	0.07	0.11	0.15	0.09	0.10	0.05	0.07	0.07	0.08
085	0.055	0.065	0.065	0.075	0.065	0.055	0.075	0.065	0.085	0.085	0.150	0.160	0.055	0.045	0.087
025	0.025	0.045	0.035	0.025	0.035	0.035	0.045	0.035	0.035	0.045	0.085	0.045	0.035	0.025	0.038
D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	N.D.[3]	0.01
D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	0.006
01	0.01	N.D.[6]	0.01	N.D.[6]	0.01	0.01	N.D.[6]	0.01	0.01	N.D.[6]	0.01	N.D.[6]	N.D.[6]	N.D.[6]	0.01
07	0.06	0.07	0.06	0.06	0.09	0.10	0.09	0.10	0.06	0.12	0.05	0.07	0.06	0.07	0.13
5	0.4	0.4	0.3	0.4	0.5	0.7	0.8	0.8	0.8	0.7	0.9	0.7	0.8	0.6	0.4
0	2.1	2.0	1.5	1.9	1.3	1.4	1.3	1.3	2.2	1.3	8.8	2.0	1.7	2.1	4.2
4	0.7	0.9	0.6	1.2	1.2	N.D.[5]	1.2	1.2	3.0	1.2	0.9	1.7	1.2	0.9	3.7
D.[9]	N.D.[9]	N.D.[9]	N.D.[9]	N.D.[9]	N.D.[9]	N.D.[9]	N.D.[9]	N.D.[9]	N.D.[9]	N.D.[9]	N.D.[9]	N.D.[9]	N.D.[9]	N.D.[9]	0.03
6	3.1	2.7	2.9	3.0	1.8	2.9	4.0	2.5	4.6	2.7	4.5	3.2	4.0	3.7	5.4
4	0.6	0.3	0.4	0.3	0.4	0.5	0.8	0.3	0.4	0.4	0.5	0.3	0.4	0.4	0.4
8	0.7	0.5	0.7	0.6	0.5	0.2	0.5	0.7	0.4	0.4	0.6	0.8	0.6	0.5	0.7
D.[11]	N.D.[11]	N.D.[11]	N.D.[11]	N.D.[11]	N.D.[11]	N.D.[11]	N.D.[11]	N.D.[11]	N.D.[11]	N.D.[11]	N.D.[11]	N.D.[11]	N.D.[11]	N.D.[11]	2.5
	11	2	11	2	5	2	2	14	5	7	9	4	2	4	10
D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	N.D.[12]	0.001

DE)
DT)
DT)

DAMES & MOORE

TABLE 2.1.2-XI

SEAWATER AND SEDIMENT ELUTRIATE ANALYSES OF PROPOSED DREDGED M

Residue Fraction (>0.45 micron)

	Seawater 9/18/73	Seawater 12/11/73	C-1	C-2	C-3	C-4	C-5	C-6	B-1-1	B-1-2	B-1-3	B-1-4	B-1-5
Beryllium (μg/l)	0.2	N.D.[1]	0.2	0.2	0.4	0.2	0.2	0.2	0.3	0.3	N.D.[2]	1.5	1.2
Cadmium (μg/l)	0.3	N.D.[1]	0.3	0.3	0.5	0.6	0.4	0.3	0.5	0.5	0.5	1.2	0.2
Chromium (μg/l)	8	2.6	8	6	12	9	5	6	8	9	8	7	7
Copper (μg/l)	4	1.1	11	6	15	9	8	8	10	15	15	37	37
Lead (μg/l)	6	N.D.[3]	6	10	6	7	6	6	5	5	5	16	6
Nickel (μg/l)	4	0.5	4	20	14	17	4	13	5	7	2	22	17
Selenium (μg/l)	4.0	2.6	6.5	6.0	5.2	6.1	6.6	4.1	2.4	2.6	2.3	2.4	2.3
Silver (μg/l)	3	2.2	5	8	6	4	8	7	9	12	7	13	7
Vanadium (μg/l)	N.D.[6]	N.D.[7]	N.D.[6]	N.D.[6]	N.D.[6]	N.D.[6]	N.D.[6]	N.D.[6]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]
Zinc (μg/l)	16	2.9	16	18	23	35	14	20	23	31	20	87	75
Total Phosphates (μg/l)	0.02	2.5	0.76	1.04	1.44	0.92	0.82	1.19	9.5	11.5	9.5	24.0	22.0

N.D.[1]: None detected, <0.06 μg/l
N.D.[2]: None detected, <0.25 μg/l
N.D.[3]: None detected, <0.3 μg/l
N.D.[4]: None detected, <1.2 μg/l
N.D.[5]: None detected, <1.0 μg/l
N.D.[6]: None detected, <20 μg/l
N.D.[7]: None detected, <5 μg/l
N.D.[8]: None detected, <25 μg/l

TABLE 2.1.2-XI

SEAWATER AND SEDIMENT ELUTRIATE ANALYSES OF PROPOSED DREDGED MATERIALS

Residue Fraction (>0.45 micron)

C-5	C-6	B-1-1	B-1-2	B-1-3	B-1-4	B-1-5	B-2-1	B-2-2	B-2-3	B-2-4	B-2-5	B-3-1	B-3-2	B-3-3	B-3-4	B-3-5	Sample Means
0.2	0.2	0.3	0.3	N.D.[2]	1.5	1.2	0.5	0.5	0.3	1.0	0.3	1.0	0.5	0.3	0.3	0.3	0.5
0.4	0.3	0.5	0.5	0.5	1.2	0.2	0.2	0.5	0.2	0.5	0.7	0.2	0.2	0.5	0.2	0.5	0.8
5	6	8	9	8	7	7	6	8	6	7	7	11	5	6	8	7	7
8	8	10	15	15	37	37	17	21	12	15	10	29	14	14	19	10	15
6	6	5	5	5	16	6	3	5	3	3	1	N.D.[4]	7	N.D.[4]	1	13	5
4	13	5	7	2	22	17	N.D.[5]	3	2	3	N.D.[5]	15	N.D.[5]	2	3	N.D.[5]	7
6.6	4.1	2.4	2.6	2.3	2.4	2.3	2.8	2.5	2.7	2.0	2.1	2.4	2.5	2.0	1.8	1.9	3.3
8	7	9	12	7	13	7	7	6	5	6	12	13	7	24	7	8	9
N.D.[6]	N.D.[6]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[8]	N.D.[6]
14	20	23	31	20	87	75	22	92	27	60	80	77	46	92	30	27	44
0.82	1.19	9.5	11.5	9.5	24.0	22.0	5.5	9.5	7.5	7.5	6.0	6.5	19.0	5.5	8.0	2.2	7.6

detected, <1.0 µg/l

detected, <20 µg/l

detected, <5 µg/l

detected, <25 µg/l

TABLE 2.1.2-XII

GRAIN SIZE CHARACTERISTICS OF SEDIMENTS FROM THE PROPOSED BERTHING FACILITY AREA

Station Number	Sample Number	Depth Interval Below Bottom (feet)	% Gravel (4.8-78.0mm)	% Sand (0.07-4.8mm)	% Silt (0.003-0.074mm)	% Clay (<0.03mm)	Median[1] Diameter (mm)	Trask[2] Sorting Coefficient
C-1	C-1	0-3½	4.1	82.9	12.0	<1.0	0.14	1.46
C-2	C-2	0-3½	2.8	54.6	40.6	2.0	0.09	1.67
C-3	C-3	0-4	1.7	78.4	18.9	<1.0	0.13	1.50
C-4	C-4	0-5	3.0	82.6	8.4	<1.0	0.15	1.43
C-5	C-5	0-4½	0	57.0	39.0	4.0	0.09	1.92
C-6	C-6	0-5	0	96.0	4.0	0	0.15	1.39
B-1	B-1-1	0-4	0	59.3	40.7		0.09	1.89[3]
	-2	4-10	0	72.3	27.8		0.10	1.52[3]
	-3	10-18	0	83.4	16.6		0.18	1.71
	-4	18-24	0	58.0	42.0		0.08	1.73[3]
	-5	24-30	0	79.6	20.4		0.14	1.65
B-2	B-2-1	0-6	0	67.7	32.3		0.09	1.48[3]
	-2	6-12	0	77.3	22.7		0.14	1.62
	-3	12-18	0	51.3	48.7		0.08	1.94[3]
	-4	18-24	0	74.0	26.0		0.12	1.69[3]
	-5	24-29	0	55.0	45.0		0.08	1.61[3]
B-3	B-3-1	0-6	0	69.4	30.6		0.11	1.73[3]
	-2	6-14	0	69.6	30.4		0.13	2.08[3]
	-3	14-20	0	69.4	30.6		0.10	1.73[3]
	-4	20-26	0	48.0	52.0		0.07	2.15[3]
	-5	26-32	0	82.9	17.1		0.18	1.70
Average			0.6	69.9	29.3		0.12	1.70

[1] The median diameter corresponds to the 50th percentile on the cumulative grain size distribution curve.

[2] The Trask Sorting Coefficient = $\sqrt{D25/D75}$, where D25 and D75 are the diameters corresponding to the 25th and 75th percentiles on a cumulative grain size distribution curve.

[3] Sorting coefficient determined using estimated D25.

TABLE 2.1.2-XIII

BIOLOGICAL ANALYSES OF SEDIMENTS FROM THE PROPOSED PORT HUENEME BERTHING AREA

	C-1	C-2	C-3	C-4	C-5	C-6	B-1-1	B-1-2
Fish Bioassay Toxicity Concentration[1]	0	0	0.41	0	0	0	0	0
Chlorophyll Production Algae Growth (μg/l chlorophyll a)	0.011	0.014	0.007	0.007	0.002	0.007	*	*
Bacteriology (cells/gram) Total Plate Count	2050	550	2150	240	550	1700	[2]	[2]
Coliform (MPN)	N.D.[4]	N.D.[4]	0.6	1.3	24.0	2.3	[2]	[2]
Salmonella (1/g limit test)	–[3]	–[3]	–[3]	–[3]	–[3]	–[3]	[2]	[2]

	B-1-3	B-1-4	B-1-5	B-2-1	B-2-2	B-2-3	B-2-4	B-
Fish Bioassay Toxicity Concentration[1]	0	0	0	0	0	0	0	
Chlorophyll Production Algae Growth (μg/l chlorophyll a)	*	*	*	*	*	*	*	
Bacteriology (cells/gram) Total Plate Count	370	220	800	220	50	70	270	1
Coliform (MPN)	0.6	N.D.[4]	0.6	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N
Salmonella (1/g limit test)	–[3]	–[3]	–[3]	–[3]	–[3]	–[3]	–[3]	

[1]Toxicity Concentration (Tc) = log $\frac{(100 - \text{percent survival})}{1.7}$

[2]Non-determinable; cores frozen prior to analysis.

[3]Negative.

N.D.[4]: None detected, <0.45 cells/gram.

*Not analyzed.

TABLE 2.1.2-XIII

IMENTS FROM THE PROPOSED PORT HUENEME BERTHING AREA

B-1-2	B-1-3	B-1-4	B-1-5	B-2-1	B-2-2	B-2-3	B-2-4	B-2-5	B-3-1	B-3-2	B-3-3	B-3-4	B-3-5	Sample Means
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*	*	*	*	*	*	*	*	*	*	*	*	*	*	0.008
[2]	370	220	800	220	50	70	270	150	560	2600	740	90	760	744
[2]	0.6	N.D.[4]	0.6	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	N.D.[4]	1.5
[2]	–[3]	–[3]	–[3]	–[3]	–[3]	–[3]	–[3]	–[3]	–[3]	–[3]	–[3]	–[3]	–[3]	Negative

2.1.3 Soils

2.1.3.1 Introduction

This section contains a general review of available literature concerning the surface and subsurface soil conditions in the vicinity of the proposed storage and vaporization site. A foundation investigation of the plant site is presently underway; the field investigation has been completed and the laboratory testing is currently being performed. The results of the soils investigation will be presented in a separate report.

2.1.3.2 Surface Conditions

The plant site is essentially flat except for a sand beach berm at the south end of the property which rises above the general site grades. Site elevations range from about 5 feet in the south to slightly over 9 feet in the northeast.

Drainage is relatively good in the northern half of the site due to the surface elevation and surface gradient of about 0.5 percent toward the southeast. This area is leased on a year-to-year basis and is presently planted in Lima beans which are not irrigated. The southern half is low lying and poorly drained. It is presently covered with natural low vegetation. The northern half is traversed by the Oxnard Industrial Drain.

The surface soils in the area are of the Camarillo-Hueneme-Pacheco association. These soils are silty sands to silty clays and, from an agricultural standpoint, are some of the most productive in the Ventura area (USDA, 1970). They are used primarily for growing irrigated vegetables, field crops, lemons, and strawberries.

Most of the agriculturally developed areas are ar ficially drained. In undrained areas, the water table is generally within 2 feet of the ground surface during the irrigation season. Ground water levels were observed in Oct 1973 beneath the cultivated portions of the site at Elevati 1.5 to 2.0 feet (about 7 feet below grade). However, this w not during the irrigation season. The soils generally conta soluble salts, with greater concentrations in the poorly dra portions of the site. The silty near-surface soils may exhi moderate shrink-swell properties.

One alternate route for the buried portion of the LNG transfer system is along the railroad right-of-way from the mooring facility to the vaporization site with a total length of approximately 6,500 feet. Starting from the berth facility, beach sand will be encountered for about half the distance; miscellaneous fill will be encountered for approxi- mately 1,000 feet. Soils of the Camarillo-Hueneme-Pacheco association and underlying alluvial deposits will be encount over the remainder of the route.

Another alternate route under consideration is alo dedicated streets parallel to the beach from the berthing facility to Alton Avenue, then inland along the McWane Boulev alignment to the vaporization site. This route would encou beach sands until it turned inland where a small stretch of associated with pits and dumps from industry are found. The remainder of the distance is covered by alluvial deposits o lying soils of the Camarillo-Hueneme-Pacheco association.

The seawater exchange pipeline from the Ormond Beach Generating Station will encounter the Camarillo-Hueneme-Pacheco association along the entire route.

2.1.3.3 Subsurface Conditions

Subsurface conditions vary somewhat across the site. At the LNG storage tank locations, the subsurface conditions can be described generally as follows (Dames & Moore, 1973):

Soil Layer 1. From the surface to about 14 to 20 of alternating layers of loose silty fine sand and soft to medium stiff clayey and sandy silt.

Soil Layer 2. The next 60 feet of dense to very dense clean and silty fine sand with occasional layers of stiff to very stiff clayey silt up to 5 feet thick.

Soil Layer 3. The next 50 feet of alternating layers of stiff to very stiff clayey silt and dense clean and silty sand.

Soil Layer 4. Finally, very dense clean and silty sand with some gravel to the depths explored (maximum depth = 220 feet). This layer constitutes what is known hydrologically as the Oxnard Aquifer.

2.1.3.4 Seismic Stability

Based on empirical correlations of soil penetration resistance to relative density, preliminary opinion is that liquefaction or seismic mobility would occur in near surface soils (Soil Layer 1) under the design earthquake conditions. Preliminary opinion is that soils below Elevation -5 to -11 feet (Soil Layer 2 and below) will not liquefy under design earthquake conditions.

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2.1.4 Geologic Hazards

2.1.4.1 Introduction

Geologic hazards which might possibly have impact on the proposed berthing, storage, and vaporization facilities must be considered. To provide guidance for protection and improvement of the facility design, a number of such geologic hazards have been assessed. These include earthquake ground motion, landslides, subsidence, fault displacement, flooding, erosion, expansive soils, tsunamis, volcanic activity, loss of mineral resources, and soil liquefaction.

2.1.4.2 Earthquake Ground Motion

The historical seismicity and probability of future earthquakes is discussed in Section 2.1.2.2. The maximum probable surface ground motion has been estimated to be 0.30g horizontal acceleration, corresponding to Intensity VIII ground motion on the Modified Mercalli Scale (Table 2.1.2-III). Earthquakes of this intensity have been generated in the Santa Barbara Channel (1812 and 1925) and on the San Andreas fault near Fort Tejon (1857). The site could experience Intensity VIII ground motion during a recurrence of these events. Based on a statistical analysis of historical earthquake data, it is calculated that such ground motion may occur about two times per century.

In addition to such shaking of the ground itself, earthquake ground motion may also contribute to landslides, subsidence, and soil liquefaction, which are discussed below.

2.1.4.3 Landslides

A number of landslides have occurred in the region; the nearest is within about 6 miles of the plant site (Ventura

County Department of Public Works, 1973). Almost all of the landslides have occurred in the mountain ranges surrounding the Oxnard Plain. There is also evidence that submarine landslides have occurred on the sides of Hueneme and Point Mugu submarine canyons. However, there is no evidence of any onshore landslides in the vicinity of the plant site, or on the whole Oxnard Plain.

Many of the regional landslides have been triggered by earthquake ground motion. However, some slides may have been caused merely by saturation with water and the force of gravity.

2.1.4.4 Subsidence

Subsidence is sinking of the ground surface caused by lowering of the ground water table or removal of fluids (oil or water) from subsurface strata.

County records indicate several incidents of subsidence on the Oxnard Plain, but most have been in man-made fill or in loose material (Jones, 1973; Castle, 1973). The nearest area of reported subsidence is about one mile east of the site and south of Hueneme Road (Ventura County Department of Public Works, 1973). There are no records of subsidence at the site. There was considerable subsidence in the Santa Clara River flood plain associated with the Fort Tejon earthquake of 1857, and to a much smaller extent with the Point Mugu earthquake of 1973 (Castle, 1973).

At present, the Southern California Cooperative Leveling Program is working in this area. Any new areas of subsidence will be discovered by this resurveying (Jones, 1973).

2.1.4.5 Soil Liquefaction

Soil liquefaction has occurred during earthquakes in stream beds which traverse the Oxnard Plain. Cracking and probable liquefaction in the bed of the Santa Clara River was reported during the Fort Tejon earthquake of 1857 (see Section 2.1.4.4). The U.S. Geological Survey has observed liquefaction along stream beds in the Oxnard Plain caused by the 1973 Point Mugu earthquake (U.S. Geological Survey, 1973). Sand boils and fissures were observed in the Santa Clara River sands following these earthquakes.

The Oxnard Plain has a high ground water table and is underlain by several saturated aquifers. A general potential for liquefaction exists throughout the entire area. Based on empirical correlations of soil penetration resistance to relative density, preliminary opinion is that liquefaction or seismic mobility would occur in near-surface soils (Soil Layer 1 in Section 2.1.3.3) under the design earthquake conditions. Preliminary opinion also is that soils below Elevation -5 to -11 feet (Soil Layer 2 and below in Section 2.1.3.3) will not liquefy under design earthquake conditions.

2.1.4.6 Fault Displacement

There are no positively identified faults within the immediate area of the berthing or plant sites. Study of geologic maps, gravity, and aeromagnetic profiles identify no additional faults. The nearest probable fault is located offshore in Hueneme Canyon striking north-northeast toward Port Hueneme Harbor; at its closest approach, this possible fault is about 2 miles west of the site (Ventura County Department of Public

Works, 1973). This fault apparently cuts the late Pleistocene San Pedro formation but not the more recent material above it (Ventura County Department of Public Works, 1973; U.S. Geological Survey, 1973).

2.1.4.7 Flooding

Flooding from rivers in this area is unlikely (see Plate 2.4.2-1, Site Drainage Map, in Section 2.4.2). The major drainages are not near the plant site area, and the region of the site is presently drained by irrigation and urban runoff channels. However, drainage near the beach is not good; there is potential for backup of flowing runoff water in former lagoonal areas inland from the beach, especially to the immediate southwest of the site.

Flooding from the ocean is also unlikely but could occur as a result of major wave erosion or tsunamis, which are discussed below.

2.1.4.8 Erosion

As discussed above, there are no major natural drainages through the site area which could cause stream-type erosion. Due to the flatness of the site, small-scale surface sheet and rill wash may carry fine-grained sediments into the man-made channels during periods of heavy rains.

There have been some occasions of beach erosion in the general area, as discussed in the Sedimentary Processes section of Marine Geology, Section 2.1.2.3. The site area, however, has not been subjected to this erosion and is not expected to be.

2.1.4.9 Expansive Soils

Generalized soil maps of the site region show considerable expansive soil areas well to the east of the site. The surface soils at the site area itself exhibit only moderate shrink-swell potential (U.S. Department Agriculture, 1970). Allowances for this soil condition will be made in foundation design based on the results of the soil investigation.

2.1.4.10 Tsunamis

Tsunamis, or seismic sea waves (often erroneously referred to as "tidal waves"), are generated by undersea seismic movement. The Ventura County coast has a low tsunami damage potential but may be unsafe during one (California Division of Mines and Geology, 1973). These waves are not common and have not been destructive in the site area.

Tsunamis associated with Alaskan earthquakes come from the northwest; those associated with South American earthquakes from the south. Although they are not frequent, there have been tsunamis associated with earthquakes occurring in the Santa Barbara Channel. These events are not well known or documented but could generate waves several times higher than those associated with distant earthquakes (California Division of Mines and Geology, 1973).

In addition to the mechanical force and flooding potential of these waves, strong sea currents could be created which could affect shipping. Tsunamis are discussed in detail in Section 2.4.3.5.

2.1.4.11 Volcanic Activity

The most recent volcanic rocks in the vicinity of the Oxnard Plain are of Miocene age. Probable volcanic activity is not significant to the site.

2.1.4.12 Loss of Mineral Resources

Mineral resources being extracted from the Oxnard Plain within about 10 miles of the site are oil and gas, water and sand and gravel. No other commercial quantities of mineral resources in the area are known. None of these resources are being extracted from the immediate site area.

BIBLIOGRAPHY 2.1.4

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