2.4 AIR AND WATER ENVIRONMENTS

2.4.1 Historic Climatic Conditions

2.4.1.1 Introduction

For plant design purposes, and to provide an assessment of potential impacts of plant emissions on the local environment, it is necessary to explore long-term climatological records of the proposed site area. This information provides insight into expected climatic extremes, area norms, and the potential transport and dispersion of plant emissions in the ambient atmosphere. For this study effort, a variety of sources of meteorological and climatological records were examined, and data were assembled from these sources to provide a comprehensive summary of local climatic conditions.

2.4.1.2 Regional Climatology

The climate of coastal Southern California is dominated by the Pacific Ocean and the nearby mountainous terrain. The mountains restrict the inland air flow and trap local pollutants under certain meteorological conditions.

Generally, the most characteristic climatic feature of the Southern California coastal area is the persistent night and morning low cloudiness and fog, followed by sunny, pleasant afternoons. These conditions prevail most often during spring and summer and with lesser frequency during the fall and winter. Because of the nearby moderating effect of the Pacific Ocean, the coastal temperature remains comfortable all year, with very infrequent periods of temperatures above 80° or below 50° F. Rainfall is sparse, averaging around 10 inches per year, most of which occurs during the winter half of the year. Daytime winds are generally brisk and from the west, but nighttime winds are often very light, flowing toward the west and south. Severe storms, thunderstorms, and tornadoes are very rare in these areas of California; however, during the fall and winter strong, dry northeasterly winds can occur. The coastal regions are frequently subject to reduced visibilities due to fog, haze, or smoke. The greatest frequencies of lowered visiblities (40-50%) occur during the months of July through October, but poor visibility can also be expected on about one day in four or five throughout the rest of the year. Details of the local climate pertinent to the site and vicinity are discussed in the following sections.

2.4.1.3 Site Area Climate

The climate of the Southern California coast around the Port Hueneme vicinity is categorized as a subtropical mesothermal (temperate) warm climate with dry summers (Trewartha, 1954). The controlling climatic influence for this area is the Eastern Pacific high pressure system, which produces a persistent strong inversion aloft throughout most of the year, and forces cool, moist maritime air to move inland. Only occasional winter low pressure storm systems extend as far south as Port Hueneme. The combination of the permanent Pacific high pressure system, which expands and contracts from summer to winter, the mountains to the north and east, and the moderating influence of the Pacific Ocean results in mild weather throughout the year.

In order to describe the climatology of the site area, data from a number of nearby weather stations were assembled and analyzed. The weather stations selected to represent the climatology of Port Hueneme are listed in Table 2.4.1-I and are shown on Plate 2.4.1-1. The selection of these weather stations was based upon: 1) a review of numerous climatic records, and elimination of data not considered pertinent; 2) selection of stations representative of the topographic setting of Port Hueneme; 3) proximity to Port Hueneme and availability of specific meteorological records; and 4) adequacy of the period of data record. The following subsections provide detailed information on the local climate based on data from these sources.

Temperature

Southern California, in the site region, experiences a relatively uniform annual temperature distribution. Mean monthly low temperatures at Point Mugu, about 4 miles southeast of the site, range from 45° to 58° F, while mean monthly maxima range from 62° to 71°. Monthly relative humidities range from 64 to 84 percent. Table 2.4.1-II summarizes temperatures and humidity for Oxnard Air Force Base (U.S. Air Force, July 1970). Table 2.4.1-III summarizes mean monthly values of temperature and relative humidity for Point Mugu (U.S. Naval Weather Service, May 1969).

Oxnard Air Force Base, several miles inland from the shore, shows higher mean maximum temperatures, lower mean minimum temperatures, and lower relative humidities than Point Mugu, due to a somewhat reduced maritime influence. Extreme maximum and minimum temperatures at Port Hueneme are significantly more moderated by proximity to the ocean than those reported for Oxnard, and the resulting temperature extremes are less severe.

Precipitation

As is generally true throughout coastal California, the preponderance of annual precipitation in the site area occurs during the winter months. During the dry summer season, it is common for no precipitation to be recorded for extended periods of time. Severe rain showers from thunderstorms rarely occur near the coast, but showers and thunderstorms are observed over the coastal ranges at times during the summer when moist air from the south and southeast penetrates inland to higher elevations. Tables 2.4.1-IV and 2.4.1-V list precipitation data for Point Mugu and Oxnard. It is expected that values for Port Hueneme will be very similar to those reported for Point Mugu and Oxnard.

Wind

Wind data for Point Mugu were obtained from the National Oceanographic and Atmospheric Administration's National Climatic Center, Asheville, North Carolina. On an annual basis, winds ranging from westerly through northeasterly predominate, as shown in Table 2.4.1-VI. This table is a summary of 12 years of hourly wind data (NOAA (2)).

Monthly and annual wind summaries for Oxnard Air Force (U.S. Air Force, 1970) are shown in Table 2.4.1-VII. The winds show a seasonal variation in direction; westerly winds predominate from March through October, northeasterly and east-northeasterly winds from November through February.

Extreme Winds

Wind speeds in the site area seldom average more than 16 knots throughout the year, as the tables noted above indicate. However, for design purposes, the maximum expected extreme winds and their occurrence intervals are required. The probability for the occurrence of various wind speeds was calculated using a method developed by H.C.S. Thom (1968). Table 2.4.1-VIII gives the maximum instantaneous gust, along with 1-minute, 1-hour, 3-hour, and 6-hour average sustained wind speeds in miles per hour for 2-, 10-, 25-, 50-, and 100-year recurrence intervals.

Temperature Inversions and Atmospheric Stability

Under a temperature inversion (an increase in temperature with an increase in altitude), the ability of the atmosphere to dilute and diffuse contaminants becomes very restricted, since the vertical mixing of air is severely reduced. In order to assess the frequency of distribution of the various atmospheric stability (type and degree of temperature change with altitude) categories, data from Santa Monica and Santa Barbara, the closest upper air sounding stations, were obtained and summarized.

A summary of surface atmospheric stability by the Pasquill-Turner (U.S. Public Health Service, 1962) classification is presented in Table 2.4.1-IX. Pasquill A, B, and C represent unstable conditions with good atmospheric diffusion, Pasquill D is neutral, and Pasquill E and F represent surface temperature inversions with poor atmospheric diffusion. Santa Monica (NOAA (1), no date) has an annual surface temperature inversion frequency of 32.9 percent (Pasquill E and F), while Santa Barbara has a 40.9 frequency. The annual frequency of surface temperature inversions for Port Hueneme can be approximated as the average of the two weather stations, or about 37 percent.

The base height of temperature inversions aloft may be approximated by the mixing height of the atmosphere. The mixing height (or depth) is defined as the height above the surface through which relatively vigorous vertical mixing and dispersion occurs. Table 2.4.1-X (NOAA, 1966) presents the mean seasonal and annual, morning and afternoon mixing heights in meters for Santa Monica, California. The minimum morning (0400 Pacific Standard Time) mean mixing height of 422 meters occurred in the winter season; and the minimum afternoon (1400 PST) mean mixing height of 603 meters occurred in the summer.

Upper air data from Santa Monica may be considered generally representative of southern coastal locations, and thus can be considered reasonably representative of Port Hueneme conditions.

Visibility

The Port Hueneme area is often affected by restricted visibility due to fog, smoke and/or haze. Table 2.4.1-XI indicates that Oxnard experiences a significant amount of time each month with visibility reduced below 7 miles. Smoke and/or haze is the predominant restriction to visibility. The greatest number of reported low visibilities occurs during the summer months of July and August, with 51.4 and 51.7 percent restriction to visibility, respectively. These observations are made on an hourly basis.

Icing

There have been no reported occurrences of freezing rain or freezing drizzle at Oxnard. Icing is not expected to occur at Port Hueneme at any time.

Severe Weather

During the period of record 1919 through 1972, only one tropical storm has been recorded within 50 miles of Port Hueneme (San Francisco Weather Bureau, 1972). This occurred in September 1939, when a tropical storm reached the coast of Santa Barbara, causing several million dollars of damage and one fatality. Approximately a dozen tropical storms have been recorded (all in the months of July through September) within 300 miles of the Southern California coast. However, these storms were all in the final extra-tropical stages of dissipation and were rapidly losing energy and dying out.

During the period of record 1916 through 1972, 70 tornadoes were reported in the state of California (U.S. Department of Commerce, 1960; Poultney, 1973). The majority of all tornado occurrences in California are in the southern half of the state. If the estimate of mean area affected by a tornado is assumed conservatively as 1.0 square miles, then the mean probability of a tornado striking any specific point in California in any year is 7.7×10^{-6}, and the recurrence interval for a tornado striking a given point is 129,000 years (Dames & Moore, 1973).

Tornadoes in California are generally much less severe and result in less property damage than eastern state tornadoes. The months of greatest tornado occurrence are March and April. Tornadoes seldom occur in coastal areas.

2.4.1.4 Marine Climatology

Weather observations are taken at sea aboard ships of most nations and reported over a weather broadcasting network. The U.S. Naval Weather Service Command summarizes these for coastal North American marine areas. Coastal Area 24 (Point Mugu--latitude 34-36 north) (USNWSC, 1970) summarizes weather data for marine areas near Point Mugu, California (Plate 2.4.1-1).

The annual percent frequency of visibility in Coastal Area 24 is shown in Table 2.4.1-XII. The annual percent frequency of wind direction for Coastal Area 24 is presented in Table 2.4.1-XIII. As is the case with Point Mugu data, the predominant directions are west through north. The prevailing direction is from the northwest (18.6%). The mean annual speed is 11 knots for all wind directions. Monthly tables of wind speed versus wind direction are given in Table 2.4.1-XIV.

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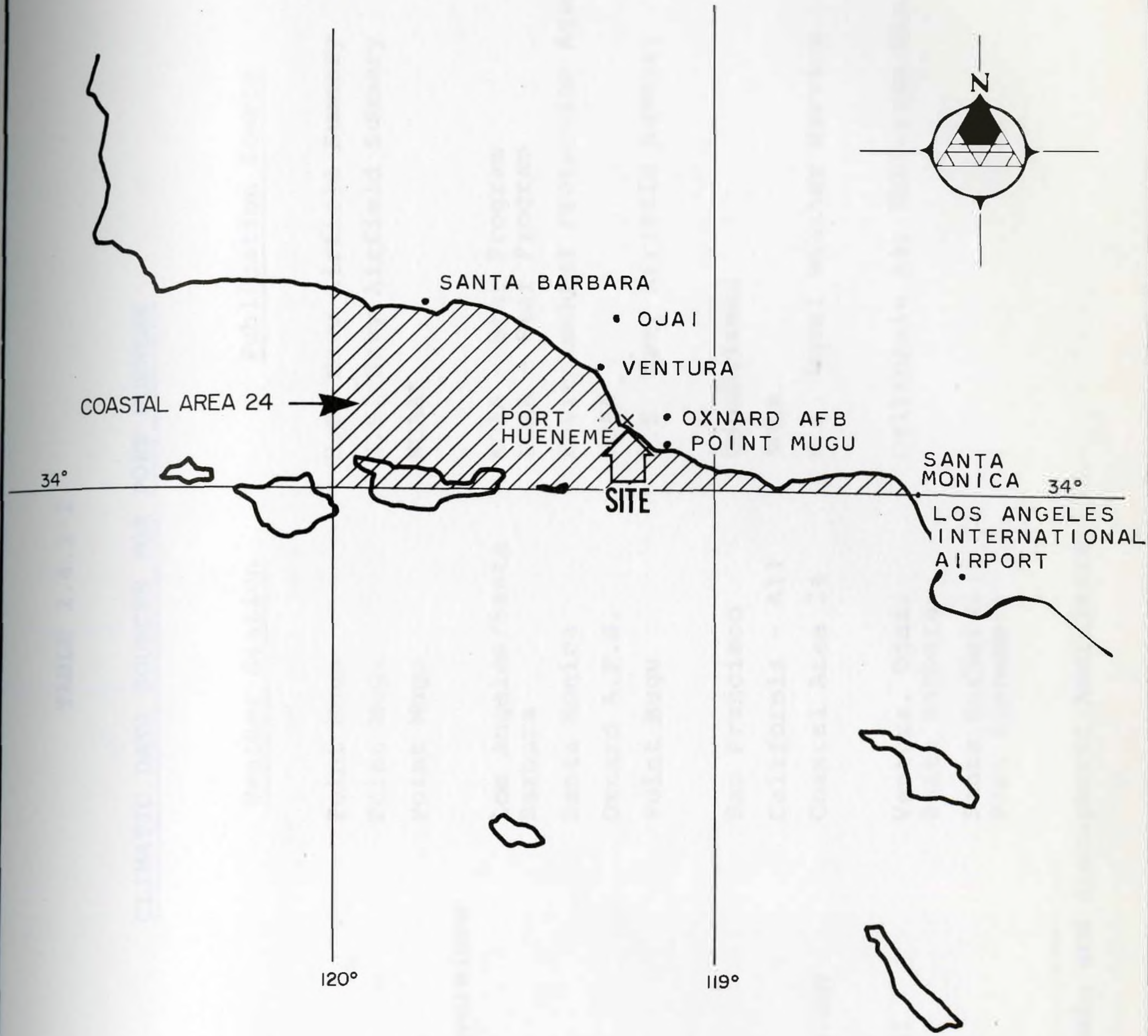

CLIMATIC DATA MONITORING STATIONS

0 10 20 30 40 50

SCALE IN STATUTE MILES

DAMES & MOORE

PLATE 2.4.1-1

TABLE 2.4.1-I

CLIMATIC DATA SOURCES FOR PORT HUENEME

Meteorological Parameter	Weather Station	Publication Source
Temperature	Point Mugu	U.S. Navy Airfield Summary
Precipitation	Point Mugu	U.S. Navy Airfield Summary
Wind	Point Mugu	NOAA*
Temperature Inversions		
Surface	Los Angeles/Santa Barbara	NOAA - Star Program NOAA - Star Program
Aloft	Santa Monica	Environmental Protection Agency
Fog/Smog	Oxnard A.F.B.	NOAA
Icing	Point Mugu	U.S. Navy Airfield Summary
Severe Weather		
Hurricanes	San Francisco	Unpublished
Tornadoes	California - All	NOAA
Marine Climatology	Coastal Area 24	U.S. Naval Weather Service
Air Quality		
Photochemical Oxidants	Ventura, Ojai, Santa Barbara	California Air Resources Board
Hydrocarbons	Santa Barbara, Port Hueneme	

*National Oceanic and Atmospheric Administration.

TABLE 2.4.1-II

OXNARD

TEMPERATURE SUMMARY - 17 YEARS OF DATA

	J	F	M	A	M	J	J	A	S	O	N	D	**ANNUAL**
Mean Temperature	53.1	54.0	54.3	56.6	59.0	62.3	65.7	66.6	65.5	62.3	57.6	53.1	59.3
Mean Maximum Temperature	64.3	65.1	65.0	66.8	68.3	71.1	74.5	75.5	76.0	73.6	69.3	66.6	69.7
Mean Minimum Temperature	41.1	42.5	43.0	46.1	49.2	52.9	56.5	57.2	54.6	50.6	45.4	43.2	48.6
Extreme Maximum Temperature	87	89	89	97	95	101	94	96	105	101	97	93	105
Extreme Minimum Temperature	25	30	30	31	36	42	45	46	43	35	31	27	25
Mean Relative Temperature	64.2	67.7	72.1	74.6	74.5	77.3	78.7	79.3	77.5	72.4	66.9	60.5	72.2

REFERENCE: U.S. AIR FORCE, 1970

TABLE 2.4.1-III

POINT MUGU

TEMPERATURE/HUMIDITY - 12 YEARS OF DATA

	J	F	M	A	M	J	J	A	S	O	N	D	ANNUAL
Mean Maximum Temperature	62	63	62	63	64	67	70	70	71	69	68	65	66
Mean Minimum Temperature	45	45	45	49	51	54	58	58	56	52	49	47	51
Mean Relative Humidity	70	70	75	79	80	83	84	84	83	79	67	64	77

REFERENCE: U.S. NAVAL WEATHER SERVICE, 1969

TABLE 2.4.1-IV

POINT MUGU - MEAN PRECIPITATION (INCHES) - 12 YEARS OF DATA

J	F	M	A	M	J	J	A	S	O	N	D	Year
3.10	1.68	1.12	1.13	0.15	0.01	0.00	0.01	0.04	0.13	1.23	1.16	9.8

REFERENCE: NOAA, 1971

Table 2.4.1-V

OXNARD - PRECIPITATION (INCHES) - 17 YEARS OF DATA

	J	F	M	A	M	J	J	A	S	O	N	D	Year
Mean Monthly	2.49	2.67	1.40	1.26	0.13	0.05	0.00	0.01	0.11	0.13	1.87	1.49	11.61
Greatest Monthly	8.00	12.97	5.78	4.46	0.66	0.69	0.02	0.09	0.88	0.56	7.22	5.32	
Least Monthly	0.30	0.00	0.00	0.00	Trace	0.00	0.00	0.00	Trace	Trace	0.00	0.05	
Percent Days with Measurable Amounts	17.1	16.1	14.3	10.6	3.8	1.7	0.4	1.3	2.2	3.4	13.8	12.3	8.1

REFERENCE: U.S. AIR FORCE, 1970

DAMES & MOORE

TABLE 2.4.1-IV, TABLE 2.4.1-V

TABLE 2.4.1-VI

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED

POINT MUGU - 1960-1972

ANNUAL

SPEED (KNTS) DIR.	1-3	4-6	7-10	11-16	17-21	22-27	28-33	34-40	41-47	48-55	≥56	%	MEAN WIND SPEED
N	3.7	3.5	.8	.1	.0							8.0	4.0
NNE	2.9	3.1	1.0	.2	.0	.0	.0	.0				7.3	4.7
NE	2.6	2.4	1.0	.9	.5	.2	.0	.0				7.7	7.0
ENE	1.3	1.0	.6	.9	.4	.2	.0	.0	.0			4.5	8.8
E	.5	.4	.2	.2	.0	.0						1.3	5.7
ESE	.2	.3	.2	.1	.0	.0						.8	6.5
SE	.3	.6	.8	.5	.1	.0	.0					2.2	8.6
SSE	.4	1.0	1.0	.5	.1	.0	.0	.0				2.9	7.5
S	.7	1.6	1.4	.4	.1	.0						4.2	6.6
SSW	.4	1.3	1.0	.1	.0	.0						2.8	6.2
SW	.5	1.4	1.2	.1	.0	.0						3.2	6.1
WSW	.6	2.0	2.1	.4	.0	.0						5.2	6.8
W	1.7	5.1	8.2	3.0	.5	.1	.0	.0				16.7	8.2
WNW	1.5	2.6	2.4	1.1	.2	.1	.0					7.8	7.1
NW	1.8	1.9	.7	.1	.0	.0						4.5	4.6
NNW	1.9	1.8	.4	.1	.0							4.1	4.1
VARBL													
CALM												14.8	
	20.9	29.9	23.0	8.7	2.0	.7	.1	.0	.0			100.0	5.6

TOTAL NUMBER OF OBSERVATIONS 109069

REFERENCE: NOAA (2) no date

TABLE 2.4.1-VII

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

JANUARY

OXNARD, CALIFORNIA

Period of Record 1945, 1953-67

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	.9	.8	.2	.0								1.8	4.0
NNE	.8	.8	.3	.1	.0	.0						1.9	4.7
NE	2.8	4.7	2.6	1.5	.6	.3	.1	.0				12.7	7.8
ENE	2.0	4.1	3.0	2.7	1.2	.4	.1					13.6	9.2
E	1.4	1.9	1.7	1.6	.5	.3	.0	.0				7.3	8.8
ESE	.4	.5	.2	.2	.0	.0						1.4	6.7
SE	.5	.3	.1	.1	.0	.0	.0					1.0	4.9
SSE	.3	.3	.1	.1	.0	.0						.7	5.5
S	.6	.6	.2	.2	.0							1.6	5.5
SSW	.5	.8	.6	.1	.0							2.1	5.7
SW	1.3	2.5	1.5	.3	.0							5.6	5.7
WSW	.8	2.2	1.9	.5	.0							5.4	6.5
W	1.4	2.5	1.9	.8	.1	.1	.0					6.7	6.9
WNW	1.2	1.6	.5	.2	.0	.0						3.6	5.0
NW	2.2	3.0	.5	.1	.0							5.7	4.2
NNW	1.1	1.1	.1	.0								2.3	3.9
VARBL													
CALM	X	X	X	X	X	X	X	X	X	X	X	26.6	
	18.2	27.5	15.3	8.4	2.6	1.1	.3	.0				100.0	5.0

TOTAL NUMBER OF OBSERVATIONS 11806

REFERENCE: U.S. AIR FORCE, 1970

TABLE 2.4.1-VII (CON'T)

PERCENTAGE FREQUENCY OF WIND
DIRECTION AND SPEED
(FROM HOURLY OBSERVATIONS)

FEBRUARY

OXNARD, CALIFORNIA

Period of Record 1945, 1953-67

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	1.0	.9	.2	.1								2.1	4.2
NNE	.9	.9	.4	.1	.1	.0	.0					2.5	6.0
NE	2.4	3.7	1.8	1.5	.4	.2	.0	.0				10.1	7.3
ENE	2.2	3.5	2.3	1.9	.7	.4	.0					11.2	8.3
E	1.6	1.7	1.2	.9	.3	.2						5.8	7.6
ESE	.6	.4	.2	.0	.0	.0						1.2	4.9
SE	.4	.3	.2	.1	.0							1.0	5.2
SSE	.5	.3	.2	.1								1.1	5.1
S	.6	.8	.6	.2	.0							2.1	5.9
SSW	.8	.9	.8	.3	.0	.0						2.8	6.2
SW	1.3	2.8	2.3	.4	.0							6.8	6.0
WSW	1.0	2.3	2.5	.6	.0	.0						6.5	6.8
W	1.7	2.6	2.5	1.7	.2	.1	.0					8.8	7.6
WNW	1.2	1.1	.7	.6	.1	.1						3.6	6.7
NW	2.0	2.1	.5	.1	.0	.1						4.8	4.4
NNW	.0	1.1	.2	.1	.0							2.4	4.4
VARBL													
CALM	X	X	X	X	X	X	X	X	X	X	X	27.4	
	19.2	25.3	16.4	8.5	2.0	1.1	.1	.0				100.0	4.9

TOTAL NUMBER OF OBSERVATIONS 10824

REFERENCE: U.S. AIR FORCE, 1970

DAMES & MOORE

TABLE 2.4.1-VIIb

TABLE 2.4.1-VII (CON'T)

PERCENTAGE FREQUENCY OF WIND
DIRECTION AND SPEED
(FROM HOURLY OBSERVATIONS)

MARCH

OXNARD, CALIFORNIA

Period of Record 1945, 1953-67

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	.9	.6	.2	.1	.0							1.8	4.4
NNE	.9	.9	.5	.1	.1							2.5	5.6
NE	2.4	2.7	1.0	.5	.3	.1	.0					7.1	6.1
ENE	2.3	3.1	1.0	.8	.3	.2						7.6	6.5
E	2.0	1.9	.7	.3	.1	.0						5.0	5.0
ESE	.8	.4	.1	.0	.0							1.3	4.2
SE	.9	.4	.1	.1								1.4	4.2
SSE	.5	.3	.2	.0								1.1	4.7
S	.8	1.1	.8	.3								3.0	5.9
SSW	.8	1.3	1.2	.3	.0							3.6	6.3
SW	1.4	2.9	3.5	.8	.1	.0						8.6	6.8
WSW	1.0	2.9	3.6	1.1	.1	.0						8.7	7.4
W	1.7	2.9	4.1	2.9	.6	.3	.1					12.5	8.8
WNW	1.2	.8	.6	.5	.1	.1	.0					3.3	6.7
NW	1.8	1.3	.3	.2	.1	.0						3.6	4.5
NNW	.8	.7	.1	.0		.0						1.7	3.7
VARBL													
CALM												27.1	
	20.3	24.1	18.0	8.1	1.7	.7	.1					100.0	4.8

TOTAL NUMBER OF OBSERVATIONS 11904

REFERENCE: U.S. AIR FORCE, 1970

TABLE 2.4.1-VII (CON'T)

PERCENTAGE FREQUENCY OF WIND
DIRECTION AND SPEED
(FROM HOURLY OBSERVATIONS)

APRIL

OXNARD, CALIFORNIA

Period of Record 1944-45, 1952-67

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	.9	.5	.0	.0								1.5	3.7
NNE	.7	.5	.1	.0	.0	.0						1.4	4.2
NE	1.4	1.5	.5	.1	.0							3.6	4.8
ENE	1.7	2.5	.8	.2	.1	.0						5.3	5.2
E	2.1	1.8	.4	.1								4.5	4.3
ESE	.7	.6	.1	.1	.0							1.5	4.2
SE	.8	.4	.2	.0								1.5	4.3
SSE	.5	.4	.1	.0								1.1	4.4
S	1.0	.8	.7	.2	.0							2.9	5.7
SSW	.8	1.4	1.2	.4	.0	.0						3.9	6.4
SW	1.7	3.5	4.4	1.5	.1	.0						11.1	7.2
WSW	1.2	3.5	4.6	1.4	.2	.0						10.9	7.5
W	2.4	4.2	5.7	3.4	1.0	.4	.1	.0				17.1	8.8
WNW	.9	.7	.5	.3	.1	.0						2.5	6.7
NW	1.7	1.2	.1	.0	.0							3.1	3.7
NNW	.8	.5	.1	.0	.0							1.5	3.7
VARBL													
CALM												26.7	
	19.4	24.1	19.6	7.9	1.6	.5	.1	.0				100.0	4.8

TOTAL NUMBER OF OBSERVATIONS 12239

REFERENCE: U.S. AIR FORCE, 1970

TABLE 2.4.1-VII (CON'T)

PERCENTAGE FREQUENCY OF WIND
DIRECTION AND SPEED
(FROM HOURLY OBSERVATIONS)

MAY

OXNARD, CALIFORNIA

Period of Record 1944-45, 1953-67

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥56	%	MEAN WIND SPEED
N	.6	.3	.0	.0								.9	3.2
NNE	.5	.3	.0		.0							.8	3.7
NE	1.1	.9	.2	.1	.0							2.2	4.2
ENE	1.6	1.6	.3	.2	.1	.1						3.9	5.2
E	1.9	1.4	.2	.1	.0	.0	.0					3.6	4.1
ESE	.8	.4	.0	.0								1.2	3.3
SE	.8	.5	.1	.0								1.3	3.4
SSE	.7	.2	.1									1.0	3.5
S	.9	1.1	.6	.1								2.8	5.2
SSW	1.1	1.5	1.6	.5								4.7	6.4
SW	2.2	3.7	5.5	1.4	.1							12.9	6.9
WSW	1.7	3.5	6.2	1.9	.2							13.5	7.6
W	2.7	4.2	6.4	3.1	.6	.3	.1					17.4	8.2
WNW	1.1	1.0	.7	.4	.1	.0						3.3	6.4
NW	1.4	.6	.1	.0								2.2	3.3
NNW	.6	.3	.0	.0								.9	3.2
VARBL													
CALM												27.5	
	19.6	21.5	22.0	7.7	1.2	.4	.1					100.0	4.7

TOTAL NUMBER OF OBSERVATIONS 12642

REFERENCE: U.S. AIR FORCE, 1970

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

JUNE

OXNARD, CALIFORNIA

Period of Record 1944-45, 1953-67

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥ 56	%	MEAN WIND SPEED
N	.8	.3										1.1	3.0
NNE	.6	.4	.0									1.0	3.5
NE	.8	.5	.0	.0	.0							1.4	3.5
ENE	1.5	1.1	.1	.0	.0							2.8	3.7
E	1.1	.9	.1									2.1	3.7
ESE	.6	.3	.0	.0								1.0	3.5
SE	.8	.2	.0									1.0	2.9
SSE	.5	.1	.0									.7	3.3
S	1.1	.9	.9	.3								3.1	5.7
SSW	1.2	1.5	1.6	.4	.0	.0						4.8	6.4
SW	2.2	4.3	5.8	1.1	.0							13.4	6.7
WSW	1.7	4.5	7.1	1.3	.1	.0						14.8	7.1
W	3.3	5.2	6.8	1.8	.1							17.4	6.8
WNW	1.2	.9	.4	.1	.0							2.7	4.8
NW	1.2	.6	.0	.0								1.8	3.1
NNW	.7	.2										.9	2.8
VARBL													
CALM												30.1	
	19.4	21.9	23.[illegible]	5.3	.3	.0						100.0	4.2

TOTAL NUMBER OF OBSERVATIONS 12227

REFERENCE: U.S. AIR FORCE, 1970

TABLE 2.4.1-VIIf

DAMES & MOORE

TABLE 2.4.1-VII (CON'T)

PERCENTAGE FREQUENCY OF WIND
DIRECTION AND SPEED
(FROM HOURLY OBSERVATIONS)

JULY

OXNARD, CALIFORNIA

Period of Record 1944-45, 1953-67

SPEED (KNTS) DIR.	1-3	4-6	7-10	11-16	17-21	22-27	28-33	34-40	41-47	48-55	≥ 56	%	MEAN WIND SPEED
N	.9	.3	.0									1.2	3.0
NNE	.5	.1										.6	3.1
NE	.8	.3										1.1	2.9
ENE	1.3	.4	.0									1.8	3.1
E	.9	.3	.0									1.3	3.0
ESE	.6	.1	.0									.7	3.0
SE	.5	.1										.6	2.6
SSE	.5	.1										.6	2.7
S	1.2	.5	.3	.1								2.0	4.1
SSW	.9	.9	1.2	.1								3.2	5.8
SW	2.3	4.0	6.1	.7								13.2	6.5
WSW	2.2	4.9	9.0	.9								17.0	6.8
W	3.7	5.5	7.1	.8								17.2	6.2
WNW	1.6	1.1	.6	.0								3.4	4.4
NW	2.0	.8	.1									2.9	3.1
NNW	.8	.4	.0									1.2	3.1
VARBL													
CALM												32.1	
	20.8	20.0	24.4	2.7								100.0	3.9

TOTAL NUMBER OF OBSERVATIONS 12643

REFERENCE: U.S. AIR FORCE, 1970

TABLE 2.4.1-VII (CON'T)

PERCENTAGE FREQUENCY OF WIND
DIRECTION AND SPEED
(FROM HOURLY OBSERVATIONS)

AUGUST

OXNARD, CALIFORNIA

Period of Record 1944-45, 1953-67

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥ 56	%	MEAN WIND SPEED
N	.8	.3	.1									1.2	3.3
NNE	.5	.2	.0									.7	3.1
NE	.9	.6	.1	.0								1.6	3.3
ENE	1.4	.8	.1									2.3	3.3
E	.9	.7	.0	.0								1.7	3.4
ESE	.4	.2	.0									.6	3.2
SE	.5	.1										.6	2.8
SSE	.4	.1	.0	.0								.5	2.9
S	.8	.5	.3	.0								1.6	4.2
SSW	.8	1.0	.9	.1	.0							2.9	5.3
SW	2.0	4.0	5.4	.7	.0							12.1	6.6
WSW	1.8	4.4	7.9	.8								14.9	6.9
W	3.0	4.9	6.9	.8	.0							15.6	6.4
WNW	1.8	1.3	.4	.1	.0							3.5	4.1
NW	1.8	1.0	.2	.0								3.0	3.4
NNW	1.0	.3	.1									1.4	3.2
VARBL													
CALM												35.9	
	18.7	20.4	22.3	2.6	.0							100.0	3.6

TOTAL NUMBER OF OBSERVATIONS 11902

REFERENCE: U.S. AIR FORCE, 1970

DAMES & MOORE

TABLE 2.4.1-VIIh

TABLE 2.4.1-VII (CON'T)

PERCENTAGE FREQUENCY OF WIND DIRECTION AND SPEED (FROM HOURLY OBSERVATIONS)

SEPTEMBER

OXNARD, CALIFORNIA

Period of Record 1944-45, 1953-67

SPEED (KNTS) DIR.	1-3	4-6	7-10	11-16	17-21	22-27	28-33	34-40	41-47	48-55	≥ 56	%	MEAN WIND SPEED
N	.9	.4	.1	.0								1.4	3.4
NNE	.5	.4	.0	.0	.0							.9	3.6
NE	1.7	.7	.1	.1	.0							2.6	3.9
ENE	1.7	1.0	.1	.1	.1	.0						3.1	4.3
E	1.6	1.0	.1	.0	.0							2.9	3.7
ESE	.6	.2	.0	.0								.9	3.5
SE	.6	.1	.0									.8	3.0
SSE	.4	.1	.1									.6	3.5
S	.7	.6	.4	.1								1.8	5.2
SSW	.9	.9	1.0	.3								3.2	6.0
SW	1.7	3.6	4.8	.6								10.8	6.5
WSW	1.8	4.1	6.2	.6								12.6	6.5
W	2.7	4.3	5.7	.9	.0							13.5	6.4
WNW	1.6	1.2	.7	.1								3.7	4.5
NW	1.9	1.0	.1									3.0	3.3
NNW	1.1	.6	.1									1.7	3.3
VARBL													
CALM												36.5	
	20.6	20.4	19.5	2.8	.2	.0						100.0	3.5

TOTAL NUMBER OF OBSERVATIONS 11518

REFERENCE: U.S. AIR FORCE, 1970

TABLE 2.4.1-VII (CON'T)

PERCENTAGE FREQUENCY OF WIND
DIRECTION AND SPEED
(FROM HOURLY OBSERVATIONS)

OCTOBER

OXNARD, CALIFORNIA

Period of Record 1944-45, 1953-67

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥ 56	%	MEAN WIND SPEED
N	.8	.8	.1	.0								1.7	3.8
NNE	.8	.6	.0	.1								1.5	4.0
NE	2.1	2.1	.7	.5	.2	.1	.0					5.7	6.1
ENE	1.9	2.0	.8	.8	.2	.1	.0					5.9	6.5
E	1.7	1.4	.4	.3	.2	.2	.0					4.1	6.1
ESE	.5	.5	.1									1.0	3.3
SE	.6	.3										.9	3.1
SSE	.4	.3	.0									.8	3.5
S	.9	.8	.4	.1								2.2	4.9
SSW	.8	1.3	.8	.2								3.1	5.7
SW	1.5	3.5	3.6	.6	.0							9.3	6.4
WSW	1.4	3.4	4.2	.7	.0							9.8	6.6
W	2.1	3.3	3.2	1.0	.1							9.7	6.5
WNW	1.3	.9	.7	.2	.0							3.2	5.2
NW	2.0	1.5	.2	.1		.0						3.8	3.7
NNW	.9	.7	.2	.0								1.8	4.0
VARBL													
CALM												35.7	
	19.8	23.4	15.4	4.6	.7	.4	.1					100.0	3.7

TOTAL NUMBER OF OBSERVATIONS 11903

REFERENCE: U.S. AIR FORCE, 1970

DAMES & MOORE

TABLE 2.4.1-VII

TABLE 2.4.1-VII (CON'T)

PERCENTAGE FREQUENCY OF WIND
DIRECTION AND SPEED
(FROM HOURLY OBSERVATIONS)

NOVEMBER

OXNARD, CALIFORNIA

Period of Record 1944-45, 1953-67

SPEED (KNTS) DIR.	1-3	4-6	7-10	11-16	17-21	22-27	28-33	34-40	41-47	48-55	≥ 56	%	MEAN WIND SPEED
N	1.2	.9	.1		.0	.0						2.3	4.0
NNE	.9	.7	.2	.1	.0	.0	.0					2.0	5.0
NE	2.6	3.9	1.8	1.1	.4	.2	.0	.0				10.0	6.9
ENE	2.1	2.9	2.2	2.4	.9	.4	.0	.0				10.9	9.0
E	1.4	2.2	1.5	1.1	.3	.2						6.7	7.7
ESE	.6	.4	.2	.2	.0	.0						1.3	6.2
SE	.5	.3	.1	.0								1.0	4.5
SSE	.3	.3	.2	.0								.9	4.8
S	.6	.5	.4	.1	.0							1.7	5.5
SSW	.7	.9	.8	.2	.0	.0						2.5	6.1
SW	1.3	3.0	2.4	.3	.0	.0						7.0	6.0
WSW	.9	2.3	2.3	.3	.0							5.9	6.4
W	1.5	2.6	2.7	.9	.2	.0						8.0	6.9
WNW	1.1	1.4	.6	.3	.1		.0					3.3	5.6
NW	2.2	2.3	.4	.1	.0							5.0	4.1
NNW	1.4	1.1	.1	.0								2.6	3.6
VARBL													
CALM												28.8	
	19.3	25.6	16.1	7.2	2.1	.8	.1	.0				100.0	4.6

TOTAL NUMBER OF OBSERVATIONS 11516

TABLE 2.4.1-VII (CON'T)

PERCENTAGE FREQUENCY OF WIND
DIRECTION AND SPEED
(FROM HOURLY OBSERVATIONS)

DECEMBER

OXNARD, CALIFORNIA

Period of Record 1944-45, 1952-67

SPEED (KNTS) DIR.	1-3	4-6	7-10	11-16	17-21	22-27	28-33	34-40	41-47	48-55	≥ 56	%	MEAN WIND SPEED
N	1.1	.7	.2	.0								2.0	3.5
NNE	.8	.7	.3	.1	.0							1.9	4.8
NE	2.6	3.7	2.4	1.6	.9	.4	.1	.0				11.8	8.3
ENE	1.9	3.3	3.0	3.6	1.8	.7	.1	.0				14.3	10.3
E	1.3	1.8	1.9	2.2	1.1	.3						8.6	5.9
ESE	.5	.5	.4	.5	.2	.0	.0					2.1	5.7
SE	.4	.3	.1	.0	.0							.8	4.6
SSE	.2	.1	.0	.0	.0							.4	4.4
S	.4	.5	.2	.2	.0	.0						1.4	6.1
SSW	.6	.7	.5	.1	.0							2.0	5.6
SW	1.2	2.4	1.4	.2	.0							5.2	5.5
WSW	.9	1.9	1.3	.3								4.5	5.3
W	1.5	2.4	2.0	.6	.2	.0						6.7	6.7
WNW	1.2	1.4	.6	.2	.1	.0						3.5	5.3
NW	2.4	2.7	.6	.1	.1	.0	.0					5.9	4.5
NNW	1.4	1.3	.3	.0	.0							3.1	4.1
VARBL													
CALM												25.8	
	18.5	24.5	15.2	9.9	4.5	1.4	.1	.0				100.0	5.5

TOTAL NUMBER OF OBSERVATIONS 12156

REFERENCE: U.S. AIR FORCE, 1970

TABLE 2.4.1-VIII

TABLE 2.4.1-VII (CON'T)

PERCENTAGE FREQUENCY OF WIND
DIRECTION AND SPEED
(FROM HOURLY OBSERVATIONS)

ANNUAL

OXNARD, CALIFORNIA

Period of Record 1944-45, 1952-67

SPEED (KNTS) DIR.	1 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22 - 27	28 - 33	34 - 40	41 - 47	48 - 55	≥ 56	%	MEAN WIND SPEED
N	.9	.6	.1	.0	.0	.0						1.6	3.7
NNE	.7	.5	.2	.0	.0	.0	.0					1.5	4.6
NE	1.8	2.1	.9	.6	.2	.1	.0	.0				5.7	6.6
ENE	1.8	2.2	1.1	1.0	.5	.2	.0	.0				6.8	7.7
E	1.5	1.4	.7	.5	.2	.1	.0	.0				4.4	6.5
ESE	.6	.4	.1	.1	.0	.0	.0					1.2	5.1
SE	.6	.3	.1	.0	.0	.0	.0					1.0	3.9
SSE	.4	.2	.1	.0	.0	.0						.8	4.1
S	.8	.7	.5	.2	.0	.0						2.2	5.4
SSW	.6	1.1	1.0	.3	.0	.0						3.2	6.1
SW	1.7	3.3	3.9	.7	.0	.0						9.7	6.5
WSW	1.4	3.4	4.8	.9	.1	.0						10.4	7.0
W	2.3	3.7	4.6	1.6	.3	.1	.0	.0				12.6	7.2
WNW	1.3	1.1	.6	.3	.0	.0	.0					3.3	5.4
NW	1.9	1.5	.3	.0	.0	.0	.0					3.7	3.9
NNW	1.0	.7	.1	.0	.0	.0						1.8	3.7
VARBL													
CALM												30.0	
	19.5	23.2	19.0	6.3	1.4	.5	.1	.0				100.0	4.4

TOTAL NUMBER OF OBSERVATIONS 143200

REFERENCE: U.S. AIR FORCE, 1970

TABLE 2.4.1-VIII

SITE EXTREME WINDS (ESTIMATED)

Recurrence Interval	Maximum Instantaneous Gust	AVERAGE SUSTAINED WIND 1 Min.	1 Hr.	3 Hr.	6 Hr.
2 yr.	46	35	27	24	23
10 yr	**73**	**56**	**44**	**39**	**37**
25 yr.	68	52	40	36	34
50 yr.	101	78	60	55	51
100 yr.	104	80	62	59	52

REFERENCE: (THOM, 1968)

TABLE 2.4.1-IX

SURFACE ATMOSPHERIC STABILITY

Period of Record

Los Angeles: May 1964 - April 1969

Santa Barbara: January 1960 - December 1964

Pasquill Classification	Percent Annual Los Angeles	Percent Annual Santa Barbara	
A	0.09	0.46	
B	4.08	8.22	
C	14.79	15.65	
D	48.19	34.81	
E	13.36	8.41	Temperature Inversions (E, F)
F	19.49	32.44	

REFERENCE: NOAA (1) no date

TABLE 2.4.1-X

MEAN SEASONAL AND ANNUAL, MORNING AND AFTERNOON MIXING HEIGHTS (METERS)

(Santa Monica, California 1960-1964)

Season-Months	Morning	Afternoon
Winter (D,J,F)	422	893
Spring (M,A,M)	676	963
Summer (J,J,A)	562	603
Fall (S,O,N)	510	798
Annual	542	814

TABLE 2.4.1-XI

PERCENTAGE FREQUENCY OF OCCURRENCE OF REDUCED VISIBILITY*

OXNARD, CALIFORNIA

PERIOD OF RECORD: 44-45, 52-67

MONTH	FOG	SMOKE AND/OR HAZE	DUST AND/OR SAND	% OF OBS WITH OBST TO VISION	TOTAL NO. OF OBS.
JAN	11.5	9.6	.1	20.2	1180
FEB	12.4	10.2	.0	20.6	1252
MAR	9.0	11.0	.0	18.5	1190
APR	12.5	13.1	.1	24.5	1224
MAY	10.9	17.5	.0	26.5	1254
JUN	16.6	25.1		38.9	1223
JUL	21.7	33.2		51.4	1254
AUG	23.6	32.7	.0	51.7	1190
SEP	22.8	27.3	.0	46.8	1151
OCT	21.7	25.4	.1	43.3	1190
NOV	13.3	17.4	.2	29.0	1151
DEC	11.5	12.0	.1	21.6	1215
TOTALS	15.7	19.7	.1	32.5	14329

* %OBS with OBST to vision - percent frequency of time when visibility is reduced to below seven miles

Reference: U.S. Air Force, 1970

TABLE 2.4.1-XII

PERCENT FREQUENCY VISIBILITY (NM) BY HOUR

COASTAL AREA 24*

HOUR (GMT)	<1/2	1/2<1	1<2	2<5	5<10	10+	TOTAL OBS
00&03	.5	.4	.7	2.5	9.4	14.4	7543
06&09	.7	.3	.6	2.0	7.1	10.9	5851
12&15	1.0	.7	.9	2.2	6.7	10.6	5968
18&21	.5	.5	1.4	3.3	9.0	13.9	7744
TOT	703	520	971	2698	8703	13511	27106
PCT	2.6	1.9	3.6	10.0	32.1	49.8	100.0

* Coastal Area 24 = Area from coast to 120° west longituude
between 34° and 36° north latitude

Reference: U.S. Naval Weather Service, 1970

TABLE 2.4.1-XIII

PERCENT FREQUENCY OF WIND DIRECTION

COASTAL AREA 24

ANNUAL

PERIOD: (PRIMARY) 1935-1968
(OVER-ALL) 1854-1968

WND DIR	WIND SPEED (KNOTS) 0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
N	.9	2.4	3.0	.9	.1	*	3091	7.3	12.8
NNE	.7	1.0	.5	.1	*	*	961	2.3	8.0
NE	.8	1.2	.4	.1	*	.0	1046	2.5	6.7
ENE	.6	.8	.4	.1	*	.0	789	1.9	7.7
E	.6	.9	.3	*	*	.0	758	1.8	7.2
ESE	.3	.7	.2	*	*	.0	505	1.2	8.0
SE	.4	1.1	.4	.1	*	.0	884	2.1	8.7
SSE	.3	1.0	.5	.1	*	*	819	1.9	9.5
S	.6	1.4	.6	.1	*	*	1183	2.8	8.5
SSW	.4	1.3	.4	.1	*	.0	921	2.2	8.2
SW	.6	2.6	2.3	.1	.0	.0	2428	5.7	10.1
WSW	.5	2.7	3.8	.3	*	.0	3103	7.3	11.7
W	1.3	6.0	3.9	.5	*	*	5002	11.8	10.0
WNW	1.0	5.0	3.6	.7	*	*	4369	10.3	10.9
NW	1.0	6.2	8.5	2.7	.2	*	7854	18.6	13.9
NNW	.6	3.4	6.9	3.1	.2	*	5967	14.1	15.9
VAR	*	*	.0	.0	.0	.0	21	*	2.9
CALM	6.2						2643	6.2	.0
TOT	7171	15928	15135	3839	252	9	42334	100.0	11.0
PCT	16.9	37.6	35.8	9.1	.6	*	100.0		

Reference: U.S. Naval Weather Service, 1970

TABLE 2.4.1-XIV

PERCENT FREQUENCY OF WIND DIRECTION

COASTAL AREA 24

JANUARY

PERIOD: (PRIMARY) 1936-1968
(OVER-ALL) 1863-1968

WND DIR	0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
	WIND SPEED (KNOTS)								
N	.8	4.2	3.1	.5	*	.0	267	8.6	10.9
NNE	1.5	2.7	1.1	.2	*	*	172	5.5	7.8
NE	1.3	2.4	1.0	.2	.0	.0	153	4.9	8.0
ENE	.5	1.5	1.2	.2	*	.0	106	3.4	10.4
E	.8	1.4	1.0	*	.0	.0	101	3.3	8.3
ESE	.3	1.2	.4	.1	*	.0	61	2.0	9.0
SE	.5	1.7	.5	.3	*	.0	93	3.0	9.9
SSE	.7	1.4	.8	.3	.1	.0	101	3.3	11.0
S	.7	2.4	1.1	.5	.1	.0	148	4.8	10.4
SSW	.4	2.3	.6	.2	.0	.0	108	3.5	8.6
SW	.7	3.1	1.6	.2	.0	.0	171	5.5	9.1
WSW	.6	3.2	2.6	.2	*	.0	204	6.6	10.3
W	1.0	4.2	3.3	.5	.0	.0	279	9.0	10.4
WNW	.6	3.8	2.7	.4	*	.0	235	7.6	10.7
NW	.6	5.7	5.2	1.3	*	.0	399	12.9	12.4
NNW	.7	3.5	5.9	1.5	.1	.0	360	11.6	13.9
VAR	.0	.1	.0	.0	.0	.0	2	.1	5.0
CALM	4.6						144	4.6	.0
TOT	507	1387	993	200	16	1	3104	100.0	10.2
PCT	16.3	44.7	32.0	6.4	.5	*	100.0		

FEBRUARY

PERIOD: (PRIMARY) 1937-1968
(OVER-ALL) 1876-1968

WND DIR	0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
	WIND SPEED (KNOTS)								
N	1.4	3.1	3.1	.8	.1	.0	265	8.5	11.5
NNE	1.5	2.4	.8	.2	.0	.0	152	4.9	7.2
NE	1.3	2.1	.6	.1	.0	.0	129	4.1	6.7
ENE	.5	1.4	1.2	.2	.0	.0	103	3.3	10.2
E	.6	2.0	.6	.1	*	.0	104	3.3	8.3
ESE	.2	1.4	.5	.1	.0	.0	69	2.2	9.1
SE	.5	2.0	1.2	.3	.0	.0	120	3.9	10.1
SSE	.4	1.3	1.1	.3	.0	*	94	3.0	11.4
S	.4	2.1	.9	.3	.0	.0	117	3.8	9.9
SSW	.4	1.5	.9	.1	.0	.0	91	2.9	9.7
SW	.5	2.7	1.7	.2	.0	.0	159	5.1	9.9
WSW	.3	2.7	2.8	.1	*	.0	186	6.0	10.5
W	.8	3.7	3.0	.5	.0	.0	250	8.0	10.9
WNW	.5	3.7	3.0	.9	.1	.0	254	8.2	12.3
NW	1.1	6.0	6.5	2.0	.1	.0	485	15.6	12.7
NNW	.7	3.5	5.0	2.1	.4	.0	365	11.7	14.7
VAR	*	.0	.0	.0	.0	.0	1	*	2.0
CALM	5.5						170	5.5	.0
TOT	518	1295	1025	255	20	1	3114	100.0	10.5
PCT	16.6	41.6	32.9	8.2	.6	*	100.0		

Reference: U.S. Naval Weather Service, 1970

PERCENT FREQUENCY OF WIND DIRECTION

COASTAL AREA 24

MARCH

PERIOD: (PRIMARY) 1937-1968
(OVER-ALL) 1878-1968

WND DIR	0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
	WIND SPEED (KNOTS)								
N	1.0	2.1	2.9	1.1	.1	.0	275	7.2	13.7
NNE	.7	1.4	.4	.1	.0	.0	93	2.6	7.0
NE	.9	1.7	.3	.1	.0	.0	116	3.1	5.9
ENE	.8	1.2	.3	.2	.0	.0	91	2.4	6.9
E	.5	.9	.4	.0	.0	.0	69	1.8	6.7
ESE	.2	.8	.5	.2	.0	.0	63	1.7	10.2
SE	.4	1.1	.5	.2	.1	.0	86	2.3	10.5
SSE	.3	1.1	.4	.1	.0	.0	76	2.0	9.6
S	.7	1.5	1.1	.2	.0	.0	131	3.4	9.5
SSW	.4	1.1	.5	.1	.0	.0	80	2.1	8.9
SW	.6	2.6	2.5	.2	.0	.0	222	5.8	10.5
WSW	.6	2.9	4.4	.3	*	.0	311	8.2	11.9
W	1.0	5.7	5.6	1.1	.1	.0	512	13.5	12.0
WNW	.8	3.9	4.3	1.4	.1	.0	397	10.5	13.1
NW	.8	4.9	7.6	3.2	.2	.0	633	16.7	14.9
NNW	.5	2.9	5.8	3.1	.2	.0	475	12.5	16.3
VAR	.0	.0	.0	.0	.0	.0	0	.0	.0
CALM	4.3						163	4.3	.0
TOT	547	1359	1432	427	33	0	3798	100.0	11.8
PCT	14.4	35.8	37.7	11.2	.9	.0	100.0		

APRIL

PERIOD: (PRIMARY) 1936-1968
(OVER-ALL) 1875-1968

WND DIR	0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
	WIND SPEED (KNOTS)								
N	.7	1.6	2.6	1.0	.2	.0	230	6.1	14.5
NNE	.4	.6	.3	.0	.0	.0	50	1.3	6.7
NE	.6	.7	.1	.1	.0	.0	59	1.6	5.8
ENE	.8	.7	.1	.1	.0	.0	63	1.7	5.2
E	.6	.6	.3	.1	.0	.0	56	1.5	6.9
ESE	.2	.7	.3	.0	.0	.0	46	1.2	7.2
SE	.7	1.5	.5	*	.0	.0	103	2.8	7.7
SSE	.5	1.1	.5	.2	.0	.0	86	2.3	9.2
S	.9	1.5	.7	.1	.0	.0	117	3.1	7.9
SSW	.6	1.2	.7	.1	.0	.0	99	2.6	8.8
SW	.7	2.6	2.6	.1	.0	.0	226	6.0	9.7
WSW	.6	2.7	3.8	.3	.0	.0	278	7.4	11.6
W	1.3	6.6	5.8	.8	.1	.0	545	14.6	11.2
WNW	1.0	4.9	4.8	1.1	*	*	444	11.9	11.7
NW	.7	5.6	9.1	3.0	.4	.0	699	18.7	14.9
NNW	.6	2.5	6.3	3.3	.4	.0	491	13.1	17.1
VAR	.1	.0	.0	.0	.0	.0	2	.1	2.0
CALM	3.9						146	3.9	.0
TOT	558	1315	1442	382	42	1	3740	100.0	11.8
PCT	14.9	35.2	38.6	10.2	1.1	*	100.0		

PERCENT FREQUENCY OF WIND DIRECTION
COASTAL AREA 24

MAY

PERIOD: (PRIMARY) 1938-1968
(OVER-ALL) 1880-1968

WND DIR	0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
			WIND SPEED (KNOTS)						
N	.7	1.1	2.2	.9	.0	.0	177	4.9	14.2
NNE	.4	.5	.2	*	.0	.0	41	1.1	7.1
NE	.5	.6	.1	.0	.0	.0	43	1.2	5.4
ENE	.6	.2	.1	.0	.0	.0	35	1.0	4.9
E	.4	.5	.1	*	.0	.0	37	1.0	5.9
ESE	.3	.4	.1	.0	.0	.0	32	.9	5.6
SE	.4	.9	.1	*	.0	.0	51	1.4	6.5
SSE	.4	1.1	.2	.0	.0	.0	63	1.7	6.4
S	.9	1.1	.3	*	.0	*	87	2.4	6.5
SSW	.5	.8	.2	.0	.0	.0	56	1.6	6.1
SW	.8	2.4	2.2	.2	.0	.0	203	5.6	10.1
WSW	.4	3.1	3.5	.4	.0	.0	269	7.4	12.0
W	1.5	8.3	4.7	.9	.1	.0	558	15.5	10.1
WNW	1.1	5.3	4.8	1.1	.1	.0	446	12.4	11.7
NW	.7	5.4	10.8	4.1	.5	.0	779	21.6	15.8
NNW	.4	2.2	6.6	4.8	.1	.0	506	14.0	18.4
VAR	.1	.0	.0	.0	.0	.0	2	.1	1.5
CALM	6.3						226	6.3	.0
TOT	595	1223	1312	452	28	1	3611	100.0	11.9
PCT	16.5	33.9	36.3	12.5	.8	*	100.0		

JUNE

PERIOD: (PRIMARY) 1937-1968
(OVER-ALL) 1879-1968

WND DIR	0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
			WIND SPEED (KNOTS)						
N	.4	1.4	2.8	1.4	.2	.0	239	6.1	16.2
NNE	.2	.3	.3	.1	.0	.0	32	.8	11.8
NE	.4	.4	.2	.0	.0	.0	38	1.0	6.5
ENE	.4	.3	.0	.0	.0	.0	25	.6	3.8
E	.2	.3	.1	.0	.0	.0	22	.6	5.4
ESE	.4	.4	*	.0	.0	.0	29	.7	4.7
SE	.3	1.0	.2	.0	.0	.0	60	1.5	6.5
SSE	.4	.9	.2	.0	.0	.0	56	1.4	6.1
S	.7	1.1	.3	.0	.0	.0	83	2.1	6.0
SSW	.3	1.3	.4	.0	.0	.0	80	2.0	7.1
SW	.7	2.2	4.0	.2	.0	.0	278	7.1	11.7
WSW	.5	2.0	5.6	.6	.0	.0	340	8.6	13.9
W	1.6	7.9	4.2	.4	*	.0	559	14.2	9.5
WNW	.8	4.9	3.4	1.0	*	.0	399	10.1	11.3
NW	.6	4.4	10.2	4.8	.4	*	802	20.4	16.8
NNW	.3	2.8	7.6	4.8	.3	.0	620	15.6	18.1
VAR	.0	.0	.0	.0	.0	.0	0	.0	.0
CALM	6.9						273	6.9	.0
TOT	596	1228	1555	520	35	1	3935	100.0	12.5
PCT	15.1	31.2	39.5	13.2	.9	*	100.0		

TABLE 2.4.1-XIV (CON'T)

PERCENT FREQUENCY OF WIND DIRECTION
COASTAL AREA 24

JULY

PERIOD: (PRIMARY) 1937-1967
(OVER-ALL) 1884-1967

WND DIR	WIND SPEED (KNOTS) 0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
N	.3	1.2	3.2	.9	.0	.0	208	5.6	14.9
NNE	.1	.2	.2	*	.0	.0	22	.6	9.5
NE	.4	.2	.1	.0	.0	.0	27	.7	5.3
ENE	.4	.2	*	.0	.0	.0	21	.6	3.9
E	.2	.3	*	.0	.0	.0	22	.6	5.2
ESE	.1	.3	.1	.0	.0	.0	19	.5	6.1
SE	.4	.8	.2	.0	.0	.0	53	1.4	6.3
SSE	.3	.5	.2	.0	.0	.0	34	.9	6.1
S	.8	1.1	.2	.0	.0	.0	78	2.1	5.8
SSW	.6	1.2	.3	.0	.0	.0	77	2.1	6.6
SW	.6	2.6	2.3	.2	.0	.0	211	5.7	10.4
WSW	.6	2.2	3.6	.4	.0	.0	254	6.8	12.1
W	2.0	6.8	2.8	.4	.0	.0	447	12.0	8.7
WNW	1,5	6.8	4.1	.6	*	.0	487	13.1	10.0
NW	1.3	7.0	11.5	3.4	.1	*	867	23.3	14.2
NNW	.5	3.2	8.7	4.8	.1	.0	643	17.3	17.1
VAR	.0	.0	.0	.0	.0	.0	0	.0	.0
CALM	6.9						256	6.9	.0
TOT	634	1287	1399	395	10	1	3726	100.0	11.4
PCT	17.0	34.5	37.5	10.6	.3	*	100.0		

AUGUST

PERIOD: (PRIMARY) 1937-1967
(OVER-ALL) 1869-1967

WND DIR	WIND SPEED (KNOTS) 0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
N	.5	1.7	3.6	1.0	*	.0	235	6.8	14.1
NNE	.3	.4	.4	*	.0	.0	40	1.2	9.0
NE	.3	.5	.1	.1	.0	.0	33	1.0	8.0
ENE	.3	.2	.0	.0	.0	.0	18	.5	3.6
E	.5	.3	*	.0	.0	.0	29	.8	4.0
ESE	.1	.4	.0	.0	.0	.0	16	.5	5.6
SE	.2	.5	.1	.0	.0	.0	28	.8	5.7
SSE	.2	.4	.1	.1	.0	.0	24	.7	7.4
S	.1	.8	.1	.0	.0	.0	37	1.1	6.3
SSW	.3	.8	.3	.0	.0	.0	47	1.4	7.7
SW	.6	1.7	2.7	.1	.0	.0	178	5.1	11.0
WSW	.4	2.1	4.4	.3	.0	.0	253	7.3	13.0
W	1.9	6.5	3.5	.5	.0	.0	431	12.4	9.1
WNW	1.0	6.1	4.6	.5	*	.0	424	12.2	10.5
NW	1.6	6.6	11.4	2.7	*	.0	771	22.3	13.5
NNW	.4	3.4	10.3	3.3	.1	*	606	17.5	16.4
VAR	.1	.1	.0	.0	.0	.0	5	.1	3.0
CALM	8.3						287	8.3	.0
TOT	591	1128	1441	295	6	1	3462	100.0	11.3
PCT	17.1	32.6	41.6	8.5	.2	*	100.0		

PERCENT FREQUENCY OF WIND DIRECTION

COASTAL AREA 24

SEPTEMBER

PERIOD: (PRIMARY) 1936-1967
(OVER-ALL) 1864-1967

WND DIR	WIND SPEED (KNOTS) 0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
N	.8	2.5	2.5	.5	*	*	231	6.4	11.6
NNE	.5	.3	.3	.1	.0	.0	42	1.2	7.7
NE	.6	.4	.1	*	.0	.0	43	1.2	5.4
ENE	.4	.4	*	.0	.0	.0	27	.8	4.0
E	.7	.7	.1	.0	.0	.0	50	1.4	4.3
ESE	.2	.2	.1	*	*	.0	19	.5	8.7
SE	.4	.5	.1	.0	.1	.0	43	1.2	8.3
SSE	.1	.7	.2	.0	.0	.0	39	1.1	7.3
S	.4	1.1	.2	.0	.0	.0	58	1.6	5.8
SSW	.2	.8	.2	*	.0	.0	47	1.3	7.9
SW	.6	2.4	3.1	.1	.0	.0	222	6.2	10.9
WSW	.6	2.7	5.1	.3	.0	.0	309	8.6	12.6
W	1.5	6.2	4.1	.3	.0	.0	432	12.0	9.6
WNW	1.4	6.9	3.6	.4	.0	.0	444	12.4	9.3
NW	1.5	8.1	9.4	2.0	*	.0	758	21.1	12.3
NNW	.8	4.5	8.3	2.1	*	.0	563	15.7	14.2
VAR	.1	*	.0	.0	.0	.0	3	.1	3.0
CALM	7.3						263	7.3	.0
TOT	654	1379	1341	210	8	1	3593	100.0	10.3
PCT	18.2	38.4	37.3	5.8	.2	*	100.0		

OCTOBER

PERIOD: (PRIMARY) 1936-1967
(OVER-ALL) 1873-1967

WND DIR	WIND SPEED (KNOTS) 0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
N	1.2	3.6	3.0	1.0	.1	.0	327	8.9	11.8
NNE	.8	.8	.4	.1	*	.0	77	2.1	8.6
NE	1.2	1.0	.3	.0	.0	.0	92	2.5	5.3
ENE	1.0	.9	.6	.0	*	.0	91	2.5	6.8
E	.6	.8	.4	.1	*	.0	72	2.0	7.9
ESE	.3	.7	.2	.0	.0	.0	44	1.2	6.9
SE	.5	1.0	.3	.0	.0	.0	68	1.8	6.4
SSE	.2	1.0	.4	.1	*	.0	63	1.7	9.7
S	.7	1.4	.5	.1	*	.0	100	2.7	7.2
SSW	.6	1.2	.3	.1	*	.0	82	2.2	7.6
SW	.6	2.6	1.6	.1	.0	.0	178	4.8	9.4
WSW	.6	2.8	4.2	.1	.0	.0	285	7.7	11.1
W	1.4	6.1	3.4	.4	.0	*	415	11.3	9.2
WNW	1.0	5.5	2.0	.3	.1	.0	326	8.9	8.9
NW	1.4	7.4	7.3	2.0	.1	.0	670	18.2	12.4
NNW	1.0	4.4	6.6	2.3	.3	.0	536	14.6	14.6
VAR	*	.0	.0	.0	.0	.0	1	*	2.0
CALM	6.9						255	6.9	.0
TOT	732	1518	1166	243	23	1	3683	100.0	9.9
PCT	19.9	41.2	31.7	6.6	.6	*	100.0		

PERCENT FREQUENCY OF WIND DIRECTION

COASTAL AREA 24

NOVEMBER

PERIOD: (PRIMARY) 1936-1967
(OVER-ALL) 1854-1967

WND DIR	WIND SPEED (KNOTS) 0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
N	1.4	3.9	3.5	.9	*	.0	351	9.7	11.0
NNE	.8	1.5	.8	.1	*	.0	115	3.2	8.2
NE	1.4	2.0	.9	.2	*	.0	161	4.5	7.8
ENE	.9	1.4	.7	.2	.0	.0	114	3.2	8.4
E	.9	1.3	.2	.1	.0	.0	91	2.5	6.4
ESE	.3	.6	.4	.1	.0	.0	49	1.4	8.5
SE	.6	1.1	.5	.2	*	.0	83	2.3	9.7
SSE	.4	1.2	.7	.2	*	.0	94	2.6	11.0
S	.6	1.4	1.1	.1	.0	.0	116	3.2	9.9
SSW	.2	1.4	.4	.1	.0	.0	73	2.0	9.1
SW	.4	3.2	1.6	.1	.0	.0	190	5.3	9.1
WSW	.4	2.7	2.7	*	.0	.0	212	5.9	10.2
W	.9	4.4	3.0	.3	.0	.0	309	8.6	9.8
WNW	.8	3.6	3.2	.5	.0	.0	293	8.1	11.1
NW	.9	7.6	6.6	1.5	.1	.0	603	16.7	12.2
NNW	.6	4.1	6.2	2.1	.2	.0	475	13.2	14.5
VAR	.1	*	.0	.0	.0	.0	3	.1	3.0
CALM	7.5						271	7.5	.0
TOT	688	1492	1165	241	17	0	3603	100.0	10.0
PCT	19.1	41.4	32.3	6.7	.5	.0	100.0		

DECEMBER

PERIOD: (PRIMARY) 1935-1967
(OVER-ALL) 1872-1967

WND DIR	WIND SPEED (KNOTS) 0-3	4-10	11-21	22-33	34-47	48+	TOTAL OBS	PCT FREQ	MEAN SPD
N	1.2	3.6	3.4	1.0	.1	.0	276	9.3	11.7
NNE	1.0	1.9	1.0	.2	.0	.0	120	4.0	8.7
NE	1.5	2.5	1.0	.1	.0	.0	152	5.1	7.2
ENE	.6	1.6	.8	.2	.0	.0	95	3.2	9.3
E	.8	1.7	.8	.2	.0	.0	105	3.5	9.0
ESE	.4	1.1	.4	.1	.0	.0	58	2.0	8.6
SE	.3	1.6	1.1	.1	.1	.0	96	3.2	11.2
SSE	.3	1.4	1.0	.2	*	.0	89	3.0	11.3
S	.6	1.7	.9	.5	.1	.0	111	3.7	11.2
SSW	.5	1.5	.5	.1	.0	.0	81	2.7	8.7
SW	.8	4.1	1.3	.2	.0	.0	190	6.4	8.4
WSW	.6	3.8	2.2	.2	.0	.0	202	6.8	9.7
W	1.0	4.5	2.9	.4	*	.0	264	8.9	9.8
WNW	.7	3.7	2.4	.5	*	.0	220	7.4	10.6
NW	1.1	5.6	5.0	1.3	*	.0	338	13.1	11.9
NNW	.7	4.0	4.4	1.9	*	.0	327	11.0	13.6
VAR	*	*	.0	.0	.0	.0	2	.1	3.0
CALM	6.4						189	6.4	.0
TOT	551	1317	864	219	14	0	2965	100.0	9.9
PCT	18.6	44.4	29.1	7.4	.5	.0	100.0		

2.4.2 Hydrology and Hydrography

2.4.2.1 Introduction

The property is situated in a low-lying area on the coast. Principal streams do not flow near or affect the property. Aquifers are at great depth, isolated from the land surface by impervious formations. Water requirements for the project are supplied by others from groundwater aquifers in the Oxnard Plain.

2.4.2.2 Surface Water Hydrology

The property is located in the Oxnard plain, a featureless coastal valley floor. Precipitation is seasonal, occurring in the December-March period. Annual rainfall averages 10 inches (Section 2.4.1).

The area was originally intensely cultivated for row crops, but is becoming partially urbanized (see Section 2.1.1). Drainage is generally poor. Drainage features of the property are shown on Plate 2.4.2-1. The gradient is less than 15 feet per mile, sufficiently flat that artificial drains are constructed for the purpose of relieving ponded water conditions. One of these drains (Oxnard Industrial Drain) is located west of the operating facility site and essentially drains the Oxnard urban area. The drain is apparently not entirely adequate for handling runoff and occasionally overflows onto the property during some wet seasons (Ventura County Department of Public Works, 1973).

The property varies between 5 and 10 feet above sea level and is less than one-half mile from the coast. Drainage and flooding are therefore influenced more by tidal conditions than overland flows following storms.

The Santa Clara River, a major stream, empties into the ocean 8 miles north of the property. This distance is sufficiently far that flooding conditions on this river will not affect the site.

Chemical quality of the surface waters draining the site and surrounding areas is not monitored. It is concluded (California Department of Water Resources, 1959) that the water is highly mineralized owing to discharges from surrounding agricultural and urban areas which use groundwater. During wet seasons runoff into the drains would dilute the stream waters. It is concluded that surface waters in the Oxnard plain area are not used for water supply principally because of inadequate runoff and storage potential.

2.4.2.3 Groundwater Hydrology

Intensive groundwater pumping for irrigation and the resulting sea water intrusion into aquifers beneath Oxnard Plain has prompted detailed investigation of groundwater conditions by the California Department of Water Resources. Their reports, which form the basis for this discussion, are listed in the Bibliography.

Occurrence

Aquifers beneath the Oxnard plain are Pleistocene and Recent granular sedimentary units associated with the development of the Santa Clara River, its floodplain, delta, and estuary. The aquifers dip gently toward the coast and are present to depths of 3,000 feet or more. Six principal water-bearing units are defined (Table 2.1.2-I). The aquifer units are confined under artesian pressure and are separated from one another by more or less continuous layers of silt or clay. The aquifers merge northeast of Oxnard, where they receive recharge from floodplain deposits of the Santa Clara River.

Groundwater movement is normally toward the coast, and natural discharge is offshore through submerged outcrop areas. The offshore locations of the submarine outcrop are shown on Plate 2.1.2-12.

The uppermost aquifers, the Oxnard and the Mugu, are capable of producing large quantities of water. They have been developed extensively by large-capacity irrigation wells. Consequently, a substantial amount of data is available on them. Because there has not been a need to obtain water from deeper aquifers, the information available for these deeper aquifers is limited to results of a few test wells.

The aquifers beneath the plant site are shown in the cross-section on Plate 2.4.2-2; the location of the cross section is shown on Plate 2.4.2-3. In the property area the three principal aquifers are the Oxnard, Mugu, and Fox Canyon. The Hueneme aquifer is apparently not present below the property. The existence of the Grimes Canyon aquifer beneath the property has not been definitely established. The property is isolated from the aquifer system by a clay layer and is downstream from the recharge areas.

In the property area, groundwater elevations have been measured since 1915. Prior to 1920, the aquifers were confined under sufficient artesian pressure to cause wells to flow naturally. Pumping from subsequent irrigation caused water levels to decline gradually to a low of 40 feet below sea level in the 1960's. Water levels have recently begun to rise; the groundwater elevation in the site area is now approximately at sea level.

Water Quality

Groundwater in the Oxnard plain is predominantly a calcium-sodium sulphate type. Dissolved solids are about 1,000 mg/l. Chemical analysis of water sampled from a well in 1971 on the eastern edge of Oxnard follows (California Department of Water Resources, 1972).

Well No. 1N/22W-3F4

Calcium	146 mg/l	Bicarbonate	277 mg/l
Magnesium	50	Sulphate	443
Sodium	96	Chloride	52
Potassium	5.5	Nitrate	14

Total Hardness	571 ppm
Dissolved Solids	1,024 ppm

The water is suitable for most irrigation uses. It is highly mineralized and very hard according to most public health standards, but with treatment for hardness can be made satisfactory for domestic use. The populations of both Oxnard and Port Hueneme, as well as irrigators, use local groundwater.

A chemical analysis of near-surface groundwater pumped from a 20-foot deep boring was obtained from the proposed vaporization plant site and is listed in Table 2.4.2-I (Agri-Science Laboratories, Inc., 1973).

This sample should represent the type of water that will be pumped in the first 10 minutes during construction dewatering, should it be necessary. Disposal of this water will conform to requirements issued by the California Regional Water Quality Control Board.

The water level drawdown caused by pumping has resulted in a reversal in gradient, such that beginning in the late 1940's sea water has invaded aquifers near the coast. The principal intrusion has occurred at Port Hueneme. The map on Plate 2.4.2-4 illustrates the position of the salt water-fresh water interface as defined in California Department of Water Resources Bulletin 63-1 (1965). The advance of sea water has been stemmed since the late 1960's due to decreased irrigation pumpage resulting from urbanization of farmland in the Oxnard-Port Hueneme area. The seawater intrusion is believed to exist only in the shallow aquifers, Oxnard and Mugu. The 500 ppm chloride line shown on Plate 2.4.2-4 was chosen because "waters with concentrations exceeding 500 ppm chloride ion are marginal for all uses" (California Department of Water Resources Bulletin 63-1, 1965, page 48).

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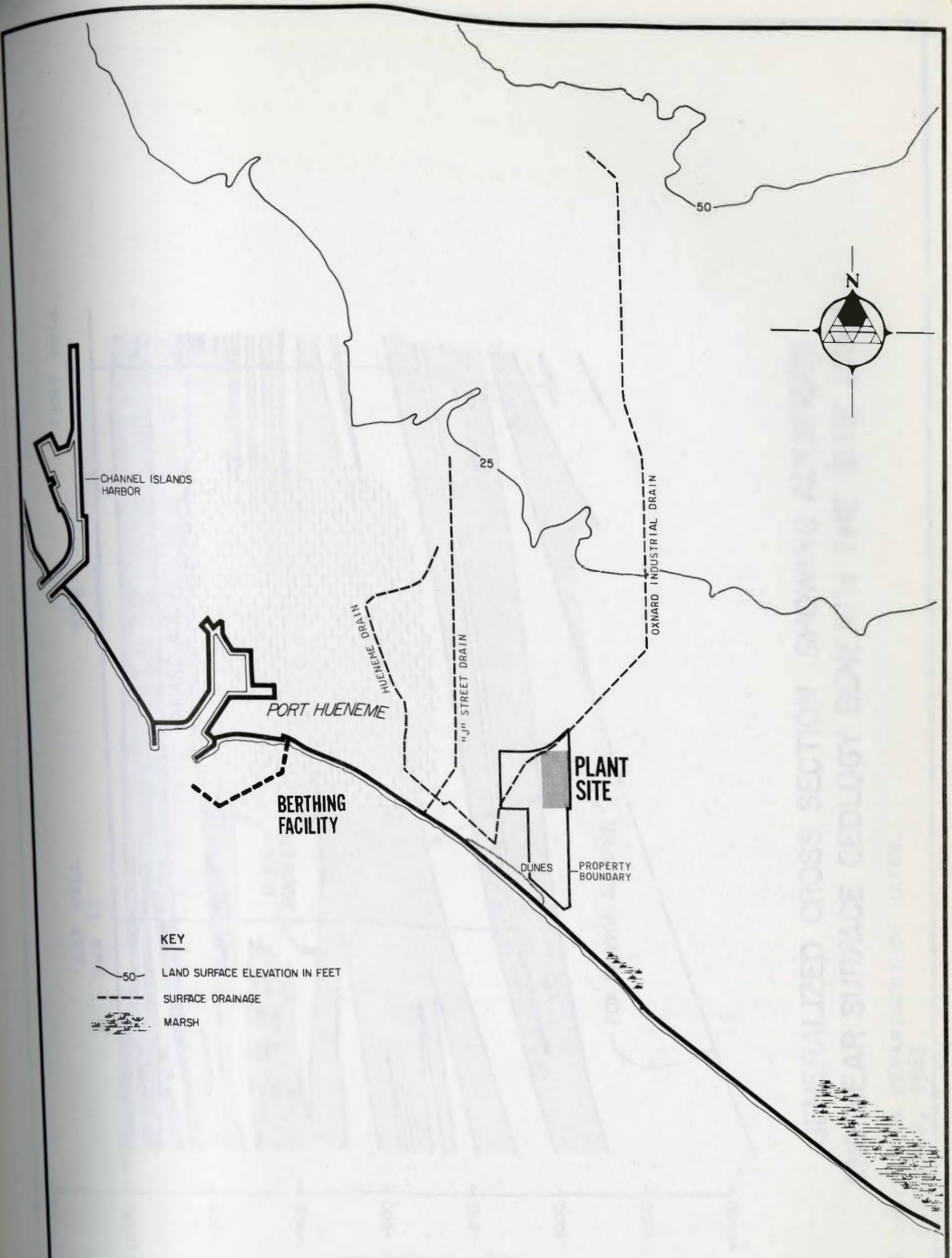
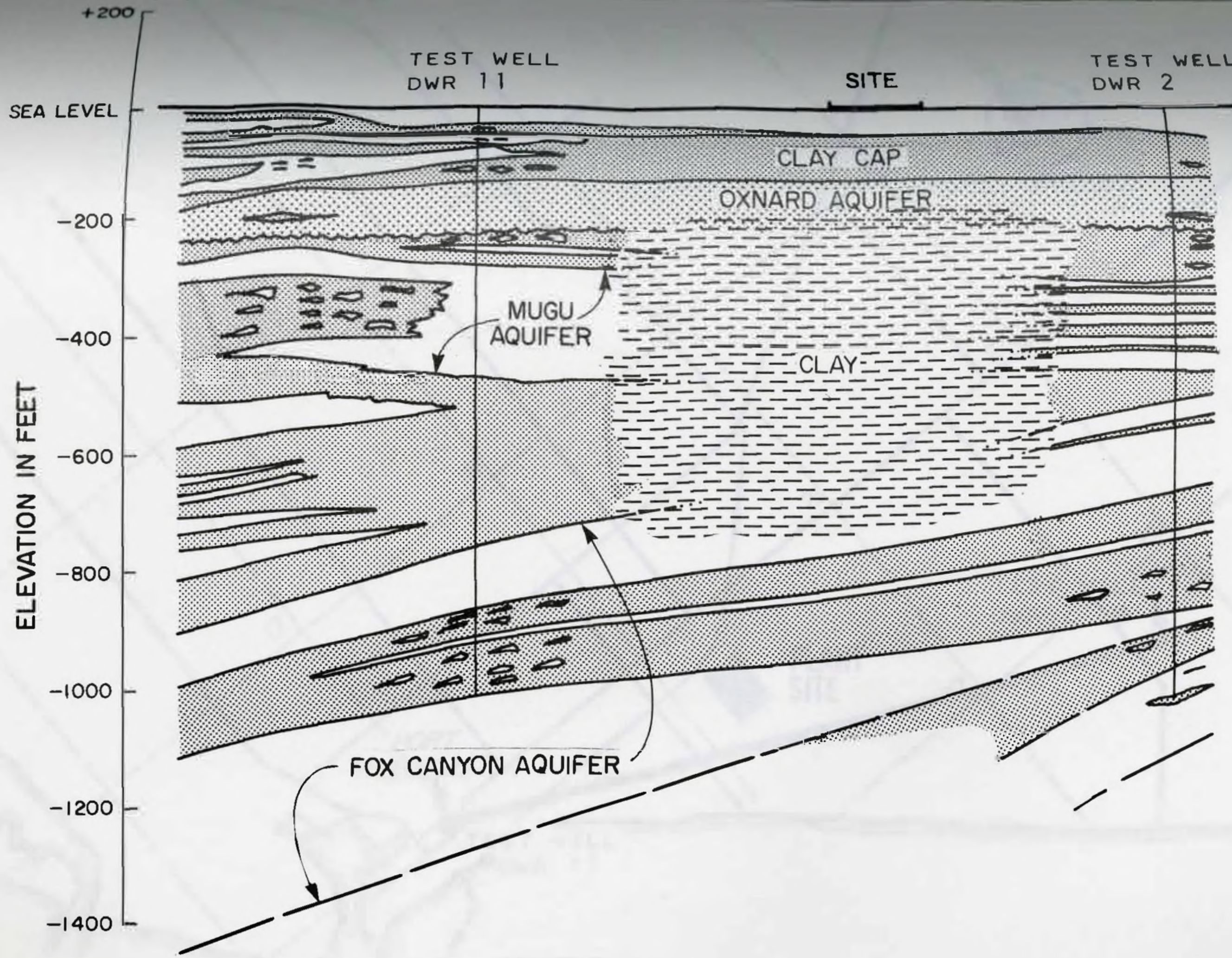


SITE DRAINAGE MAP

REFERENCE: CALIFORNIA DEPARTMENT OF WATER RESOURCES, 1965 BULL. 63-1

DAMES & MOORE

PLATE 2.4.2-1

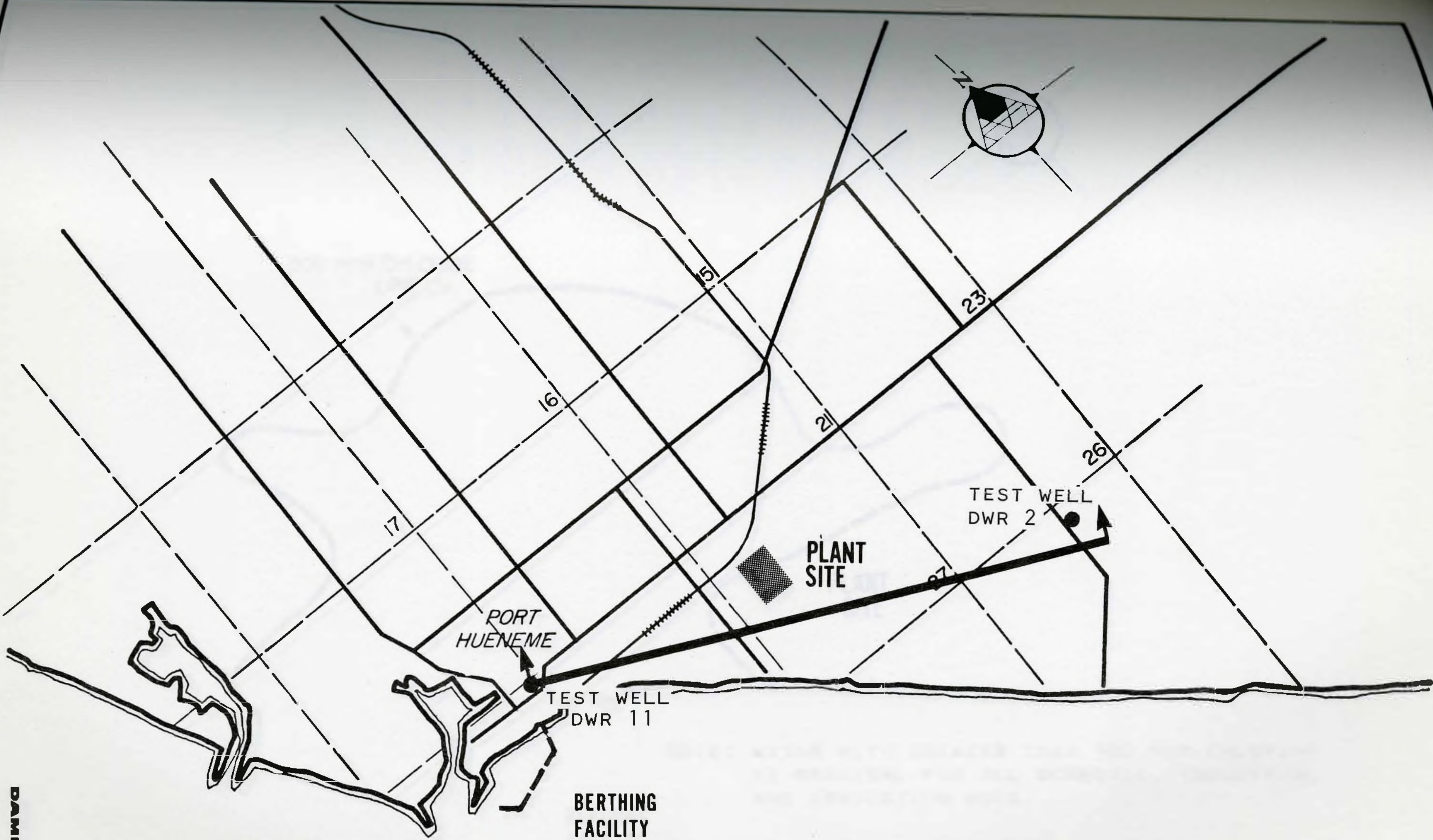


GENERALIZED CROSS SECTION SHOWING AQUIFERS AND NEAR SURFACE GEOLOGY BENEATH THE SITE AREA

REFERENCE: CALIFORNIA DEPARTMENT OF WATER RESOURCES, 1965

DAMES & MOORE

PLATE 2.4.2-2



MAP OF SITE AREA SHOWING LOCATION OF CROSS SECTION

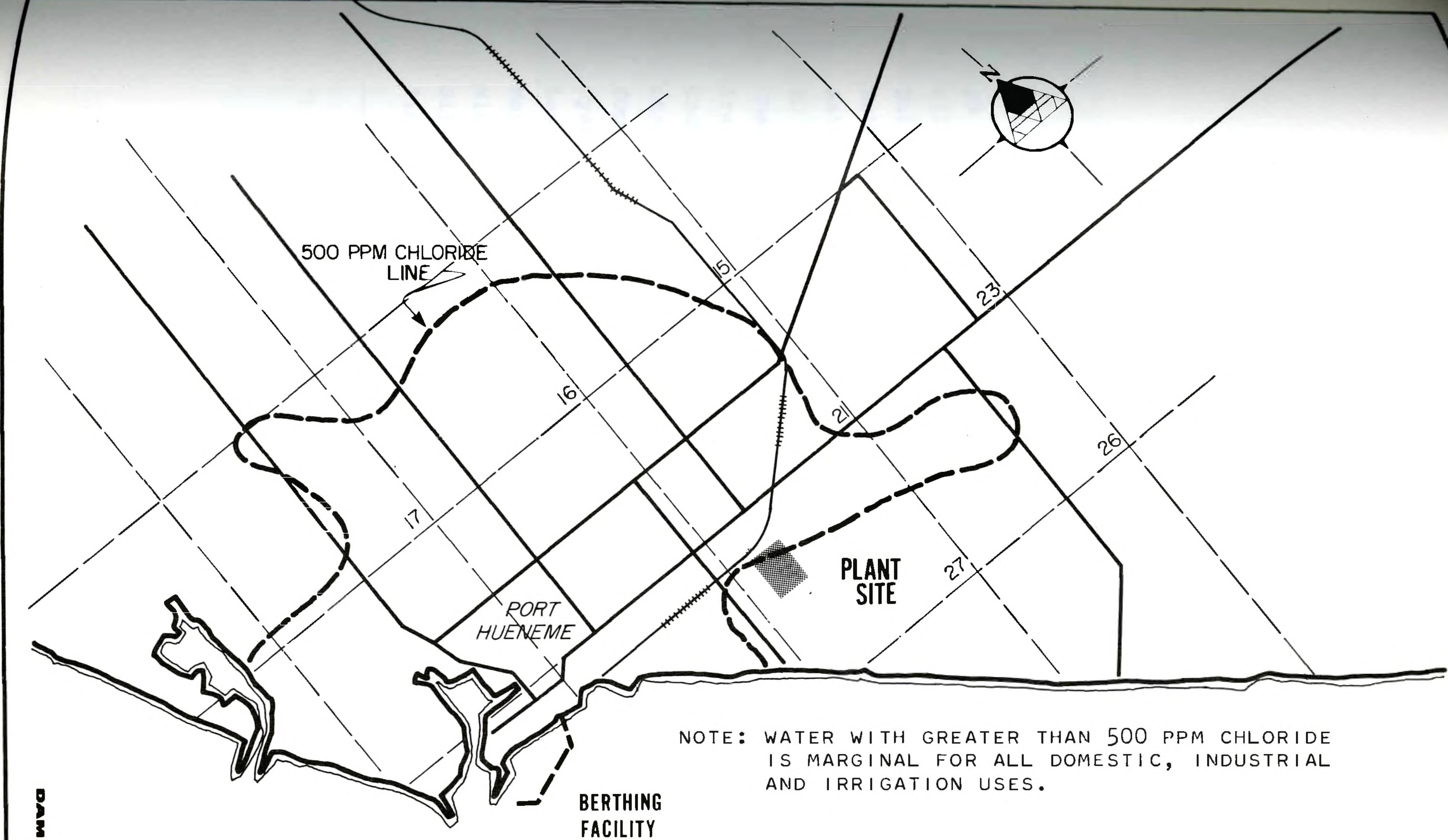
0

SCALE IN MILES

REFERENCE: CALIF. DEPT. OF WATER RESOURCES, 1965

DAMES & MOORE

PLATE 2.4.2-3



SEA WATER INTRUSION INTO THE OXNARD PLAIN, 1969

1 0 1
SCALE IN MILES

REFERENCE: UNITED WATER CONSERVATION DISTRICT, 1973

DAMES & MOORE

PLATE 2.4.2-4

TABLE 2.4.2-I

CHEMICAL ANALYSIS OF NEAR-SURFACE GROUNDWATER FROM LNG PLANT SITE

Characteristic	Concentration
pH	7.8
Oil & Grease	2.0 mg/l
Sulfide	0.16 mg/l
Settleable Solids	45 mg/l
Salinity (equivalents as NaCl)	1,792 mg/l
EC (micromhos/cm^2)	2.8
Chemical Oxygen Demand (COD)	27.1 mg/l
Arsenic (As)	0.004 mg/l
Cadmium (Cd)	0.0021 mg/l
Chromium (Cr)	0.008 mg/l
Copper (Cu)	0.0084 mg/l
Cyanide	N.D.[1]
Lead (Pb)	0.0094 mg/l
Mercury (Hg)	0.008 mg/l
Nickel (Ni)	0.015 mg/l
Silver (Ag)	0.07 mg/l
Zinc (Zn)	0.011 mg/l

[1]None detected, detection limit = .003 mg/l.

2.4.3 Air, Noise, and Water Quality

2.4.3.1 Air Quality

It is the responsibility of federal, state, and local air pollution control agencies to prevent further deterioration of ambient air quality, and to abate existing air pollution levels. The State of California Implementation Plan for Achieving and Maintaining National Ambient Air Quality Standards has been approved by the Environmental Protection Agency (Federal Register, May 1972). Port Hueneme is in an area of the coastal zone where ambient air quality standards for some air contaminants are periodically exceeded.

Despite increasing population and greater energy usage, the trend in air pollution has stabilized in many areas, and in most cases has even shown a definite trend toward lower levels for most air contaminants. One aspect of these control efforts is the substitution of cleaner burning fuels (e.g., low-sulfur oil for high-sulfur oil, natural gas for coal and oil) wherever possible.

Air Quality Standards and Criteria

The ambient air quality standards for California and the Federal Government are shown in Table 2.4.3-I. These standards, particularly the federal, are established whenever possible by determining the concentrations of each specific pollutant to which there is a physiological response by the most sensitive segment of the population (generally the aged and the very young). This threshold level is established as a Primary Standard, the level to which, or below which, the ambient concentrations of the specific pollutant need to be reduced. The Secondary Standard is a longer-term goal, with a safety margin below the threshold level to provide further protection to the population and the environment.

Background Air Quality

Near Port Hueneme, there are several air quality monitoring stations in the South Coast Basin, namely, Ventura, Santa Barbara, Oxnard, and Ojai. The results of local air quality sampling are shown in Tables 2.4.3-II and 2.4.3-III (State of California, 1972) for gaseous pollutants and for total suspended particulates, respectively. All of the reported stations (Plate 2.4.1-1) are within 35 miles of Port Hueneme. The reported gaseous measurements shown in Table 2.4.3-II include oxidants, carbon monoxide (CO), nitrogen dioxide (NO_2), nitric oxide (NO_3), and nitrogen oxides (NO_x), along with hydrocarbons for Santa Barbara. Hydrocarbons are not measured at Ojai, and only nitrogen oxides are reported for Point Mugu. These 1972 data reflect the averages of the maximum hourly average (first figure) and the monthly peak concentration (second figure).

For the gaseous sampling, it can be seen from Table 2.4.3-II that oxidant levels at all sampling stations exceeded state or federal standards at some time during almost every month of the year (peak concentration values), while carbon monoxide and nitrogen dioxide levels seldom exceeded the standards. A notable exception was at Point Mugu during January, November, and December, when levels of nitrogen dioxide greater than 0.25 parts per million were reached at least once during each month. Hydrocarbon levels at Santa Barbara frequently exceeded the 0.24 parts per million federal standard.

For the suspended particulate sampling, the 1972 results show that all of the stations in the vicinity of the proposed project exceeded the state standard for annual mean value (60 micrograms per cubic meter), and frequently exceeded the 24-hour state standard (100 micrograms per cubic meter) and the federal secondary standard (150 micrograms per cubic meter).

Table 2.4.3-III shows the results of high-volume air sampling for 1972 for stations at Santa Barbara, Ventura, Ojai, Oxnard, and Port Hueneme. Approximately 6 months of data are available for the Port Hueneme station. The remaining sampling locations are represented by a full year of data taken on a random sampling basis. These sampling data show the frequency of occurrence of individual 24-hour samples above 260, 150, and 100 micrograms per cubic meter, the maximum reported value for the year, and the annual geometric mean value, by station.

BIBLIOGRAPHY 2.4.3.1

(Reference cited denoted by asterisk)

*State of California, 1972, Air Resources Board, California Air Quality Data, October-December 1972.

TABLE 2.4.3-I

AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Standards: Concentration[2]	California Standards: Method[3]	National Standards[1]: Primary[2, 4]	National Standards[1]: Secondary[2,5]	National Standards[1]: Method[6]
Photochemical Oxidants (Corrected for NO_2)	1 hour	0.10 ppm (200 $\mu g/m^3$)	Neutral Buffered Potassium Iodide	160 $\mu g/m^3$(7) (0.08 ppm)	Same as Primary Std.	Chemiluminescent Method
Carbon Monoxide	12 hour	10 ppm (11 mg/m^3)	Non-Dispersive Infrared Spectroscopy	-	Same as Primary Standards	Non-Dispersive Infrared Spectroscopy
	8 hour	-		10 mg/m^3 (9 ppm)		
	1 hour	40 ppm (46 mg/m^3)		40 mg/m^3 (35 ppm)		
Nitrogen Dioxide	Annual Average	-	Saltzman Method	100 $\mu g/m^3$ (0.05 ppm)	Same as Primary Standards	Colorimetric Method Using NaOH
	1 hour	0.25 ppm (470 $\mu g/m^3$)		-		
Sulfur Dioxide	Annual Average	-	Conductimetric Method	80 $\mu g/m^3$ (0.03 ppm)	60 $\mu g/m^3$ (0.02 ppm)	Pararosaniline Method
	24 hour	0.04 ppm (105 $\mu g/m^3$)		365 $\mu g/m^3$ (0.14 ppm)	260 $\mu g/m^3$ (0.10 ppm)	
	3 hour	-		-	1300 $\mu g/m^3$ (0.5 ppm)	
	1 hour	0.5 ppm (1310 $\mu g/m^3$)		-	-	
Suspended Particulate Matter	Annual Geometric Mean	60 $\mu g/m^3$	High Volume Sampling	75 $\mu g/m^3$	60 $\mu g/m^3$	High Volume Sampling
	24 hour	100 $\mu g/m^3$		260 $\mu g/m^3$	150 $\mu g/m^3$	
Lead	30 Day Average	1.5 $\mu g/m^3$	High Volume Sampling, Dithizone Method	-	-	-
Hydrogen Sulfide	1 hour	0.03 ppm (42 $\mu g/m^3$)	Cadmium Hydroxide Stractan Method	-	-	-
Hydrocarbons (Corrected for Methane)	3 hour (6-9 a.m.)	-	-	160 $\mu g/m^3$ (0.24 ppm)	Same as Primary Standards	Flame Ionization Detection Using Gas Chromatography
Ethylene	8 hour	0.1 ppm	-	-	-	-
	1 hour	0.5 ppm				
Visibility Reducing Particles	1 observation	In sufficient amount to reduce the prevailing visibility to less than 10 miles when the relative humidity is less than 70% (8)		-	-	-

NOTES:

1. National standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than once per year.
2. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 mm of mercury. All measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of Hg (1,013.2 millibar); ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.
3. Any equivalent procedure which can be shown to the satisfaction of the Air Resources Board to give equivalent results at or near the level of the air quality standard may be used.
4. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each state must attain the primary standards no later than three years after that state's implementation plan is approved by the Environmental Protection Agency (EPA).
5. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after implementation plan is approved by the EPA.
6. Reference method as described by the EPA. An "equivalent method" of measurement may be used but must have a "consistent relationship to the reference method" to be approved by the EPA.
7. Corrected for SO_2 in addition to NO_2.
8. Prevailing visibility is defined as the greatest visibility which is attained or surpassed around at least half of the horizon circle, but not necessarily in continuous sectors.

MARCH 1973

Reference: State of California, 1972

TABLE 2.4.3-II

AIR QUALITY DATA - 1972
(parts per million)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Santa Barbara												
Oxidant	.03/.08	.03/.10	.06/.16	.05/.20	.05/.15	.04/.12	.04/.19	.05/.11	.04/.13	.04/.24	.03/.11	.02/.08
CO	5/18	4/17	2/10	2/8	2/6	1/6	2/7	2/12	3/16	4/16	4/16	5/20
NO_2	.06/.16	.06/.16	.06/.14	.07/.14	.05/.12	.04/.14	.05/.10	.05/.14	.05/.13	.05/.09	.06/.12	.04/.09
NO_3	.22/.66	.19/.77	.12/.65	.09/.33	.09/.34	.08/.31	.09/.25	.06/.41	.14/.95	.23/.92	.30/.92	.30/.97
NO_x	.27/.80	.23/.82	.18/.70	.15/.39	.14/.37	.12/.36	.14/.31	.11/.51	.19/1.05	.27/1.00	.35/.98	.35/1.05
Hydrocarbon	12/50	13/50	6/11	8/18	9/50	5/37	4/12	5/14	5/50	7/25	7/42	8/26
Ojai												
Oxidant	.05/.12	.08/.19	.08/.16	.08/.16	.09/.21	.10/.16	.11/.21	.14/.26	.14/.25	.04/.10	MSG	.03/.09
CO	7/16	5/14	2/6	3/6	3/9	3/6	2/8	2/5	3/8	2/5	2/5	2/10
NO_2	.06/.23	.04/.09	.04/.10	.04/.10	.01/.08	.01/.02	.01/.04	.03/.14	.03/.06	.01/.04	.02/.06	.02/.05
NO_3	--/.41	--/--	.02/.06	.00/.05	.00/.06	.01/.04	.00/.04	.00/.04	.01/.04	.00/.04	.03/.09	.06/.20
NO_x	--/.45	--/.21	.06/.12	.04/.10	.02/.08	.02/.05	.02/.06	.04/.15	.04/.07	.02/.08	.05/.10	.08/.20
Point Mugu												
NO_2	.07/.28	.05/.21	.04/.13	.06/.16	.03/.06	.02/.06	.03/.09	.05/.13	.04/.12	.06/.14	.09/.27	.07/.29
NO_3	.05/--	.05/--	.03/--	.03/--	.01/--	.01/--	.04/--	.02/--	.04/--	.09/--	.06/--	.06/--
NO_x	.10/.30	.09/.26	.07/.20	.08/.18	.04/.11	.03/.13	.06/.33	.06/.16	.07/.26	.13/1.40	.13/.28	.12/.32

First figure is average of maximum hourly average.
Second figure is monthly peak concentration.

Reference: State of California, 1972

1972 ANNUAL SUMMARY FOR SUSPENDED PARTICLES

		Number of Samples			Maximum	Annual Geometric
Station	Total Samples	>260 $\mu g/m^3$	>150 $\mu g/m^3$	>100 $\mu g/m^3$	$\mu g/m^3$	Mean $\mu g/m^3$
Santa Barbara	54	0	1	7	222	66.02
Ventura	59	0	1	5	218	64.87
Ojai	57	0	2	10	169	66.40
Oxnard	58	0	2	16	166	77.21
Port Hueneme*	21	0	7	12	212	-

*Summarized by Dames & Moore, partial year sampling data.

Reference: State of California,1972

2.4.3.2 Noise Survey

Purpose

The purpose of this noise survey was to measure the present ambient noise levels in the vicinity of the proposed project. These noise levels will be used to develop a noise criterion for consideration during plant design to minimize the noise impact of the plant on the surrounding communities.

Description of Site and Measurement Stations

Site. The location and general description of the proposed storage and vaporization plant site have been presented earlier in this report (Section 1.0). Important features of the area which affect the ambient noise levels are:

1. Generally flat topography.
2. Predominance of residential land use north of the site, across Hueneme Road.
3. Proximity of the Point Mugu Naval Air Station.
4. Several industrial facilities adjacent to and near the site.

Measurement Stations. Nine measurement stations (Plate 2.4.5-1) were selected in order to evaluate the existing noise environment within the community and the noise levels at the Ormond Beach Generating Station (a 24-hour operation). Station 1 was selected to measure the noise levels near the Generating Station. Station 2 was selected in a remote area to aid in determining the attenuation characteristics of the Edison plant noise. The remaining seven community locations were selected to represent areas potentially sensitive to noise. Most are near schools. Location 7 is in a sensitive area because it is near a school and one block from Belinda Hospital. Within 2 miles of the LNG plant site, most of the land use is residential or open. Commercial enterprises in this area are limited to the main roads and are predominantly daytime operations. The nine stations and the approximate distance from each to the proposed LNG plant site is shown on Plate 2.4.3-1. With the exceptions noted for Stations 2, 7, and 8, the Ormond Beach Generating Station is the predominant nighttime noise source. The measurement stations and the noise sources affecting them during our survey are described below.

Station 1 is 4,700 feet from the proposed site and approximately 1,500 feet north of the Generating Station, just beyond the main gate, on a direct line-of-sight with the LNG facility. The Generating Station is the major daytime and nighttime noise source at Station 1.

Station 2 is approximately 8,600 feet southeast of the proposed LNG facility with clear line-of-sight to the project location and the Generating Station, and downwind of both. It is in a remote area with little traffic. It is under the flight path for aircraft making right turns on takeoff out of Point Mugu Naval Air Station. Except during periods of flight operations, the Generating Station remains the major noise source for this location.

Station 3 is 7,500 feet northeast of the LNG plant site at the northwest corner of Sanford Street and Webster Drive. Major noise sources during daytime hours are aircraft, light traffic, and human noises.

Station 4 is 3,300 feet from the plant site at the southwest corner of Courtland and Clara Streets, about 25 feet off the corner in an open field. This location has a clear line-of-sight to the proposed facility. It is at the edge of a residential area. Daytime noise is governed by children and traffic.

Station 5 is 5,700 feet north of the LNG plant site at the intersection of Dollie Street and Squires Drive. This is in a rapidly developing residential area. Most homes are only several years old, and many new ones are presently under construction. Daytime noise was mainly from children and moderate traffic. No construction noise was heard during the survey. There is a clear line-of-sight to both the Generating Station and the proposed LNG facility.

Station 6 is 9,900 feet north of the proposed facility in a residential area, at 3311 Fournier Street. Main daytime noise sources were children and light traffic.

Station 7 is 7,000 feet west of the LNG plant site at the southwest corner of Pearl and 3rd Streets. Belinda Hospital is one block north of this location. Daytime noise is governed by local traffic and U.S. Navy reservation activities. At night, operations at the Northrop Plant are audible. Under light winds, the Generating Station is audible, but at wind velocities above about 5 miles per hour, the wind creates an acoustic shadow for this noise source.

Station 8 is 6,300 feet northwest of the plant site at the southeast corner of Forest Loop Drive, off Evergreen Lane, in a quiet residential area. Cars and human sounds dominate during the day. The Generating Station and Northrop were audible at night; however, neither was dominant.

Station 9 is 9,500 feet northwest of the plant site at the intersection of 7th Street and 7th Place, about 200 feet south of Pearson Road. The area is residential. Daytime noise sources are mainly children and traffic. Nighttime noise is a mixture of many sounds.

Description of Field Noise Measurement Procedures

The ambient noise survey was conducted from August 21 through August 23, 1973. Daytime hours are considered to be 7 a.m. to 7 p.m., and nighttime from 7 p.m. to 7 a.m. The measurements were obtained from 10 a.m. to 4 p.m. and from 10 p.m. to 4 a.m. At each station two types of data were obtained:

1. Twelve 10-minute samples (one each hour) of the A-weighted noise levels covering daytime and nighttime periods.
2. Four octave band sound level spectra at each location, two during the day and two at night.

The A scale is an electrical frequency weighting network which discriminates against low and high frequencies (below 500 Hertz and over 10,000 Hertz) approximately as does the human ear. The use of this description of environmental noise has been found to correlate well with subjective human response to noise (Beranek, 1971; Brock, 1971).

The measuring system consisted of a General Radio Corporation Precision Sound Level Meter and Analyzer, Type 1933, with a one-inch electret-condenser microphone (Peterson and

Gross, 1972; Beranek, 1971). A Type 1562 Sound Level Calibrator was used to calibrate the system.

The field procedures were as follows: At the start of each 6-hour measurement period, the microphone was set up on a tripod and connected to a 60-foot extension cable which was attached to the sound level meter. The sound level meter was switched on, and the batteries and internal electronics were checked according to manufacturer's recommended procedures. Any necessary adjustments were made.

Following this, the calibrator was placed over the microphone and the system calibrated at 2,000, 1,000, 500, 250, and 125 Hertz.

At each station the microphone was placed at least [illegible] feet away from walls, houses, or other reflective objects, and at a height of 5 feet above the ground. At this height, the microphone was receiving noise that is representative of that which humans hear.

After setting up the microphone, the sound level meter was turned on, A-weighting and slow meter response were selected, and an appropriate meter setting was chosen to best bracket the ambient noise levels. The meter was observed continuously. At 5-second intervals the noise levels were observed and recorded. In this way, a histogram of 120 points was developed in the field from which the median (L_{50}) and intrusive (L_{10}) levels could be determined.

At the end of each 6-hour period, the calibration procedure was repeated. In addition, battery checks were made every 2 hours, and random checks were made on calibration during each measurement period.

To obtain the octave band sound pressure level spectra, the same calibration procedures were followed. The slow response was again used, and at each of the band center frequencies, the meter was observed for about 10 to 20 seconds and the median level estimated. In most cases where the noise varied considerably the meter was observed for a longer period.

Description of Analytic Procedures

Characterizing Community Noise. One approach to the problem of characterizing community noise is to determine a statistical distribution of the noise levels over a specified time period. To acquire the community noise data, 10-minute noise samples were collected once an hour over the course of each measurement period. Implicit in this procedure is the assumption that the statistical distribution obtained from a 10-minute sample is fairly representative of the distribution that would be obtained by sampling continuously for 60 minutes. The data is then analyzed to determine the L_{50} or median levels (the noise level that is exceeded 50% of the time). The accuracy of the L_{50} level was shown in a recent study (Schultz, 1972) to be ±1.0 dB under normal community noise situations. The intrusive or L_{10} levels were determined in a similar manner.

There are two main reasons why a statistical approach is necessary. The first is the variation in the sensitivity of the human ear with different frequency components of noise. This problem is often solved by using the A-weighting network described earlier. This single-number rating has been found to correlate well with individuals' subjective judgments of the annoyance of many types of noise. It has been used for many years as a measure of both urban and vehicle noise and is used in this report.

The second and primary reason for a statistical descriptor when evaluating an urban noise environment is the fact that the ambient noise levels can vary considerably with time. Except in rare instances, the noise observed at a particular location in an urban community is continually changing. The passing of a vehicle, an aircraft flyover, or the barking of a dog are just a few of the many noise sources that result in a pattern of fluctuating noise levels. It is this variability that does not lend itself to a brief description of community noise.

Data Analysis. The data which were developed in the field were analyzed in the following manner to determine the L_{50} and L_{10} levels. First, all field notes were reviewed for record of any unusual conditions during the measurement periods. Next, for each set of measurements, the data were counted to obtain the number of samples at each level. The cumulative distribution was then determined. The level which contained half or more of the counts is the L_{50} level. The level which contained the upper 10 percent of the counts is the L_{10} level. Plates 2.4.3-2 and 2.4.3-3 show several samples. In obtaining the data, "high" and "low" categories were allowed for to cover readings beyond the 20 dB range of the sound level meter scale. Several values of L_{10} exceeded the meter reading. These are indicated on the plates discussed below under Results.

Results

Hourly Data. The results of the hourly data analysis for the L_{50} and L_{10} levels for all stations are presented on Plates 2.4.3-4 through 2.4.3-12. Small perturbations of several dBA in the levels are normal and are indicative of the unsteady nature of the community noise. Large changes (5 dBA or more) generally indicate a change in the background levels. The L_{10} levels are an indication of single events which intrude on the overall noise environment.

As human activity decreases through the evening hours, the ambient noise levels in a community will be lower than daytime levels. This was the case for Stations 2 through 9. Station 1, near the Generating Station, which was a constant noise source, had the same L_{50} noise levels for daytime and nighttime hours.

Generally, there was very little human activity after midnight, and the ambient noise levels decreased. Changes in ambient noise levels at some locations were caused by increased traffic on some main roads and changes in operation at either the Edison or Northrop facilities.

Octave Band Spectra. Octave band sound pressure levels were measured for the nine measurement stations and correspond to the times indicated on Plates 2.4.3-13 through 2.4.3-21. The equivalent A-levels are shown in the key on each plate. These spectra will be used as a basis for determining an octave band criterion for limiting the plant-generated noise spectra. Whereas the A-scale sound level meter reading weights and combines the noise signal to a single number descriptor, octave band sound pressure level measurements retain the frequency information of the noise signal. The need for two different approaches in describing and quantifying the noise environment is twofold. First, the single-value descriptors are required in order to relate the noise levels to subjective human response and are thus used to develop criteria and community impact. Second, the spectra are needed for the assessment of the source (plant), with the objective of developing specific noise reduction requirements for equipment noise problems.

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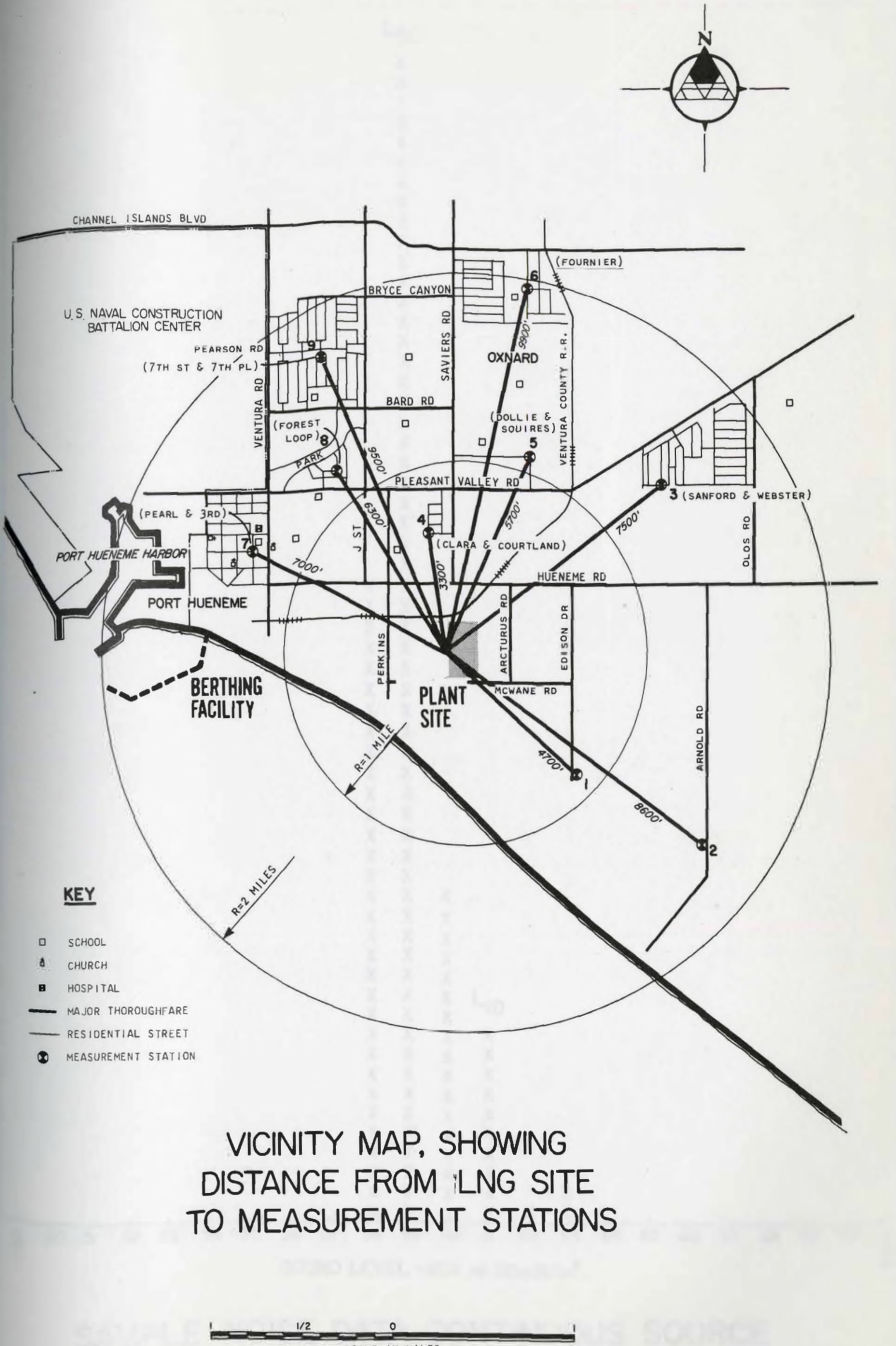
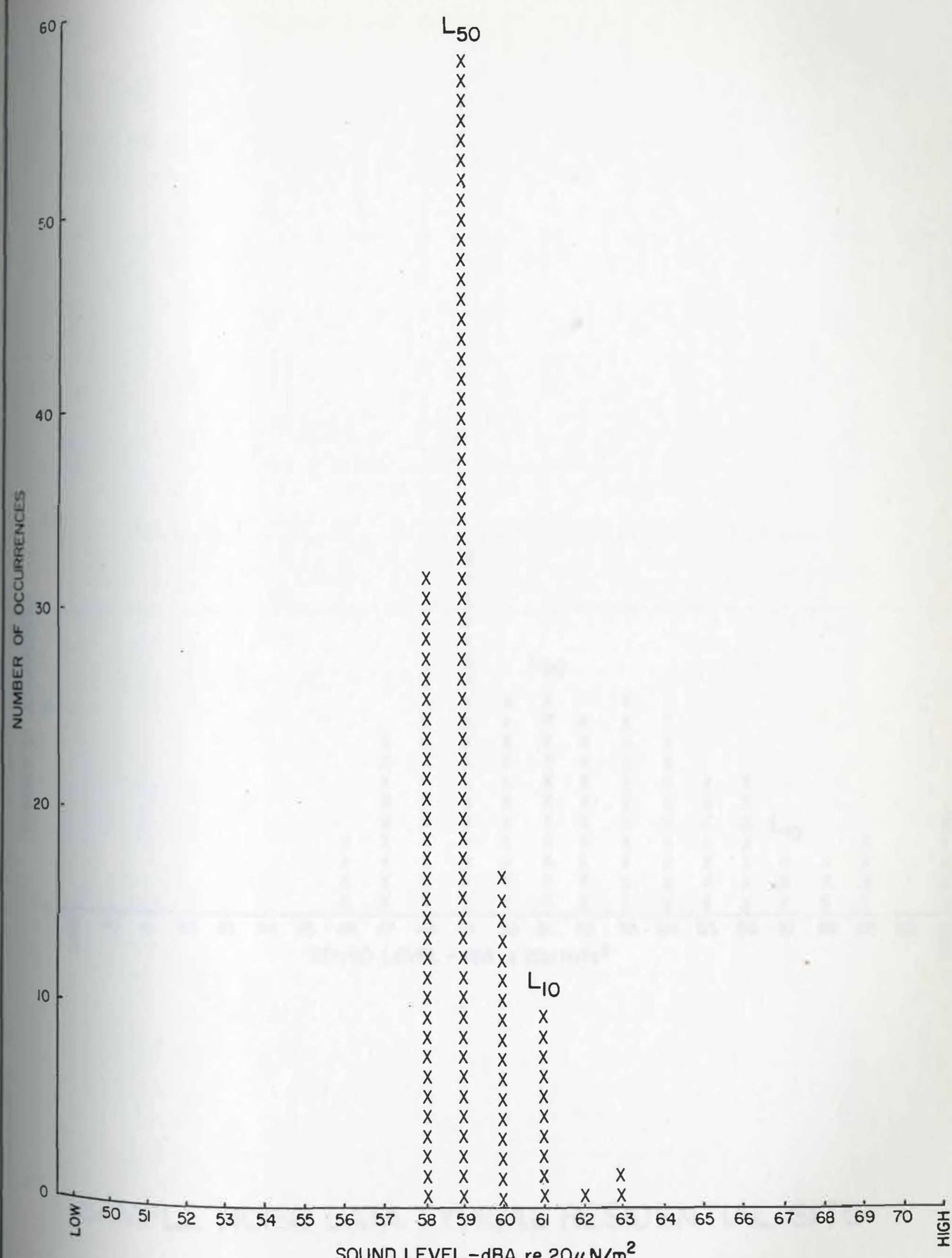


VICINITY MAP, SHOWING DISTANCE FROM LNG SITE TO MEASUREMENT STATIONS

REFERENCE: MAP DRAWN FROM U.S.G.S. QUADRANGLE MAP - OXNARD, CALIF. 1949

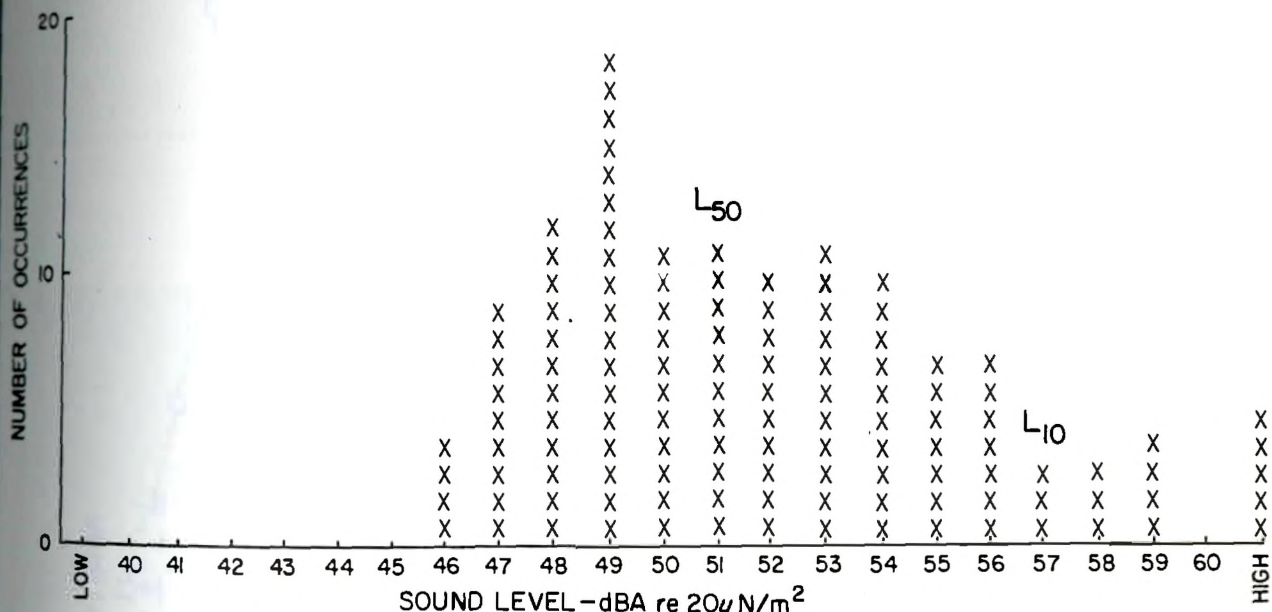
DAMES & MOORE

PLATE 2.4.3-1



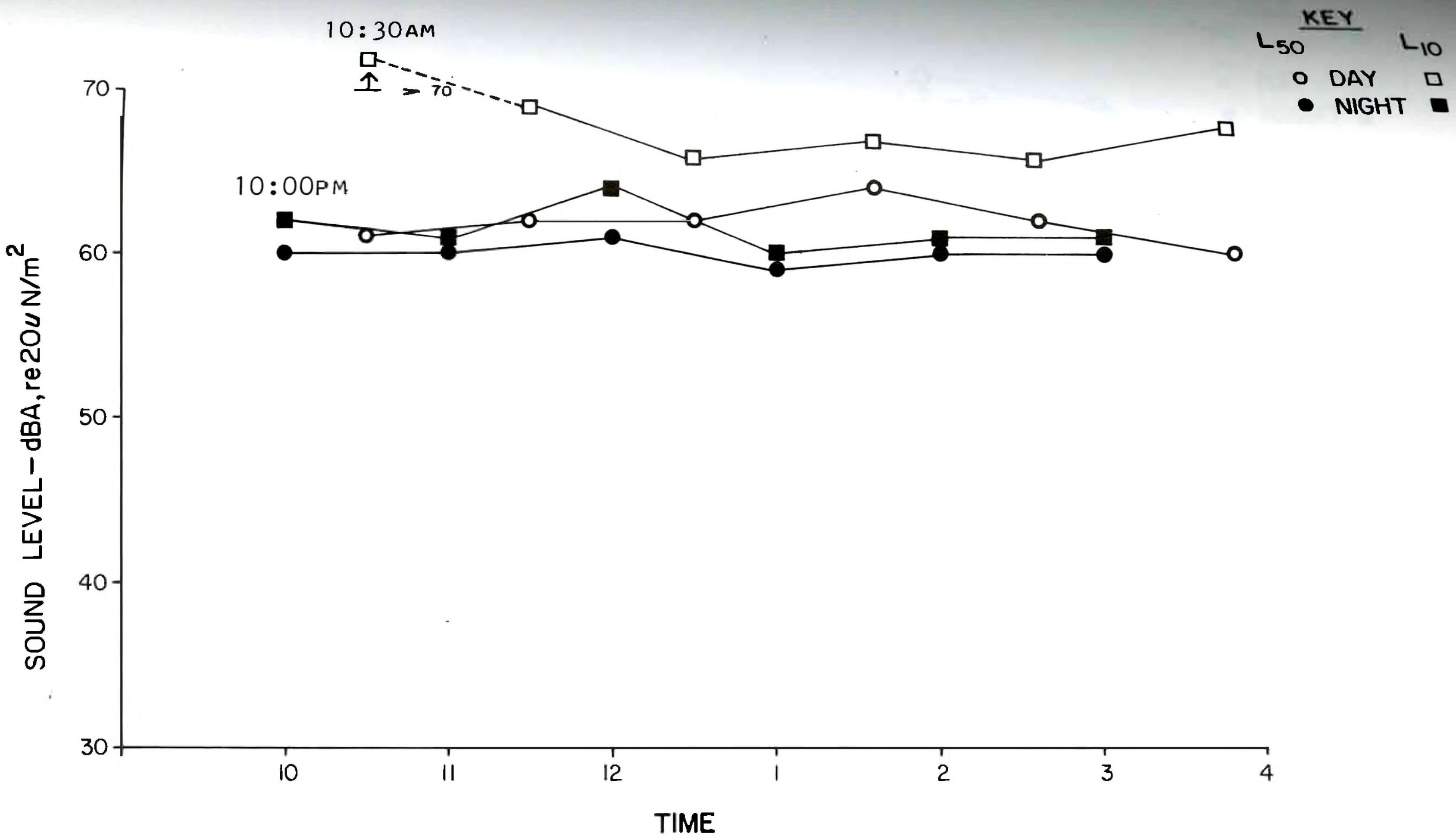
SAMPLE NOISE DATA CONTINUOUS SOURCE

DAMES & MOORE



SAMPLE NOISE DATA TYPICAL RESIDENTIAL SITE

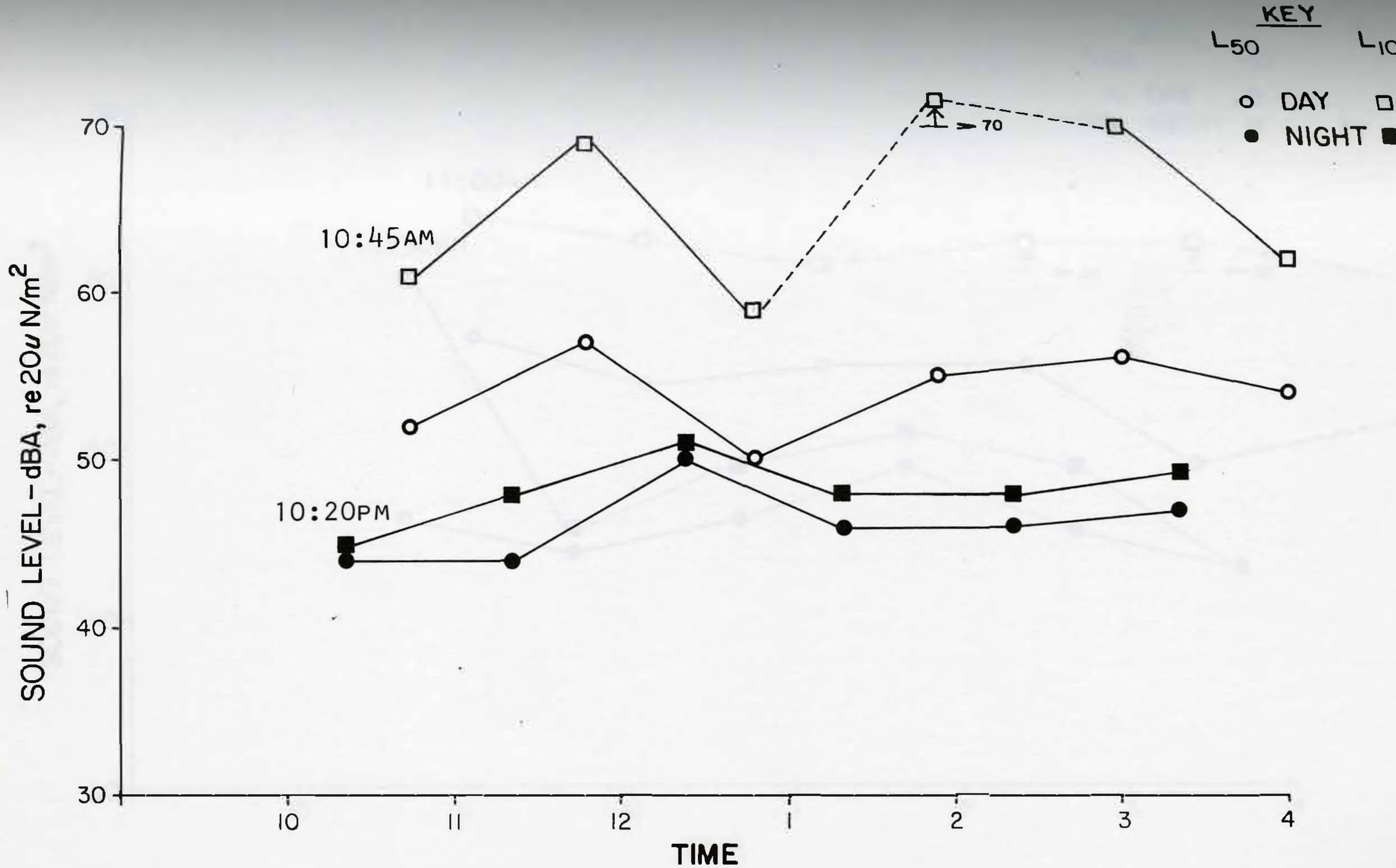
DAMES & MOORE



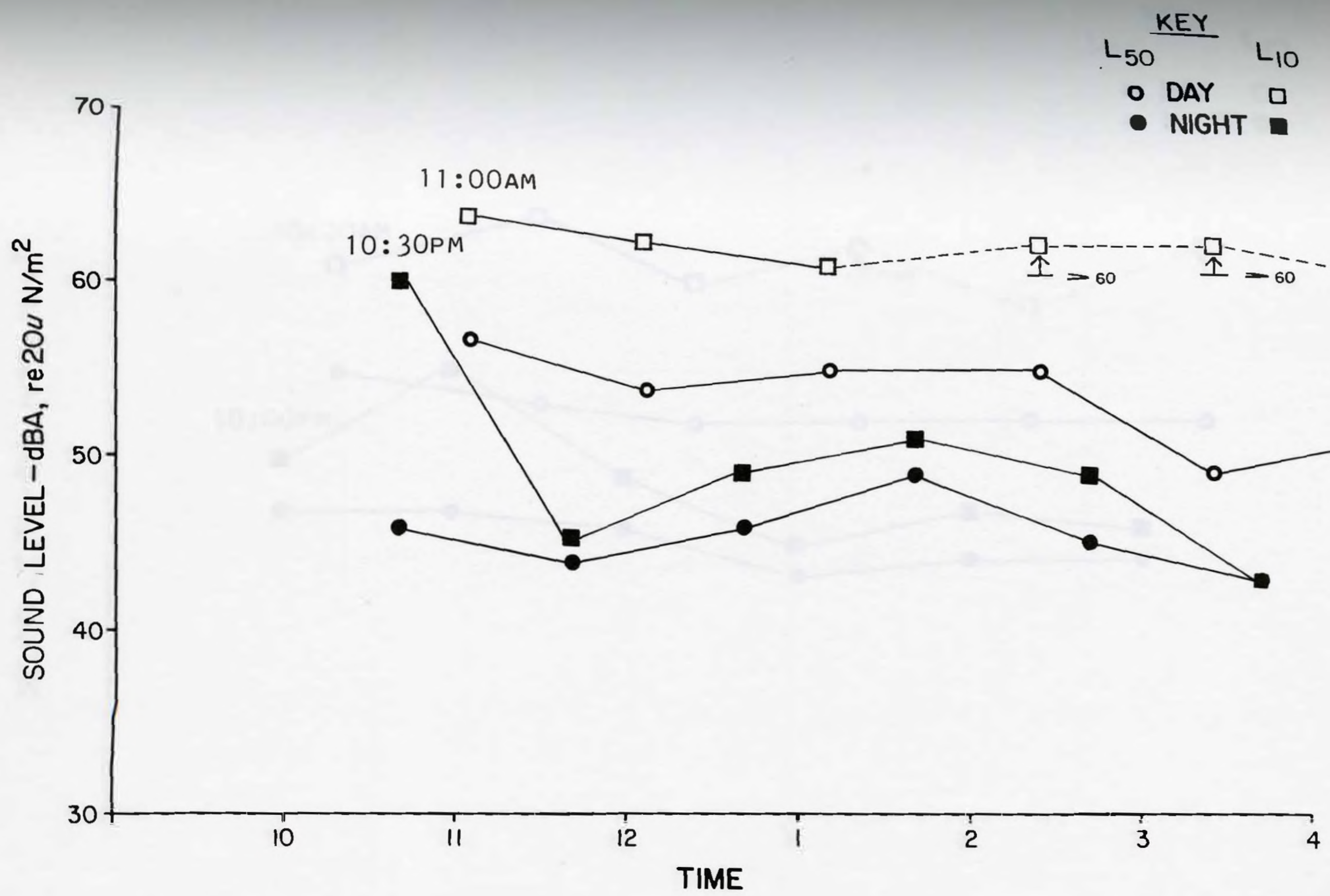
AMBIENT NOISE LEVELS, OXNARD, CALIFORNIA – STATION 1

DAMES & MOORE

PLATE 2.4.3-4



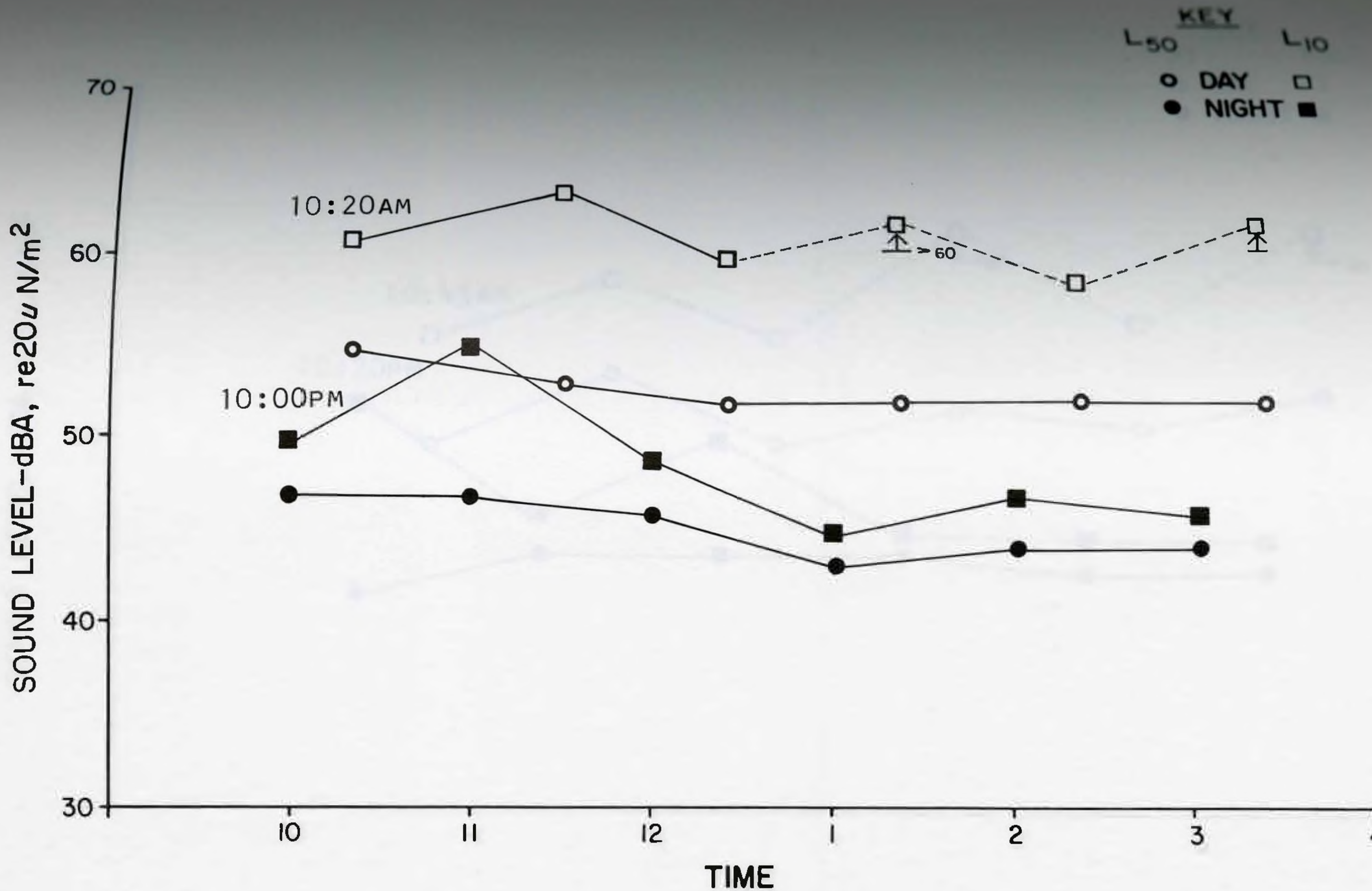
AMBIENT NOISE LEVELS, OXNARD, CALIFORNIA-STATION 2



AMBIENT NOISE LEVELS, OXNARD, CALIFORNIA -STATION 3

DAMES & MOORE

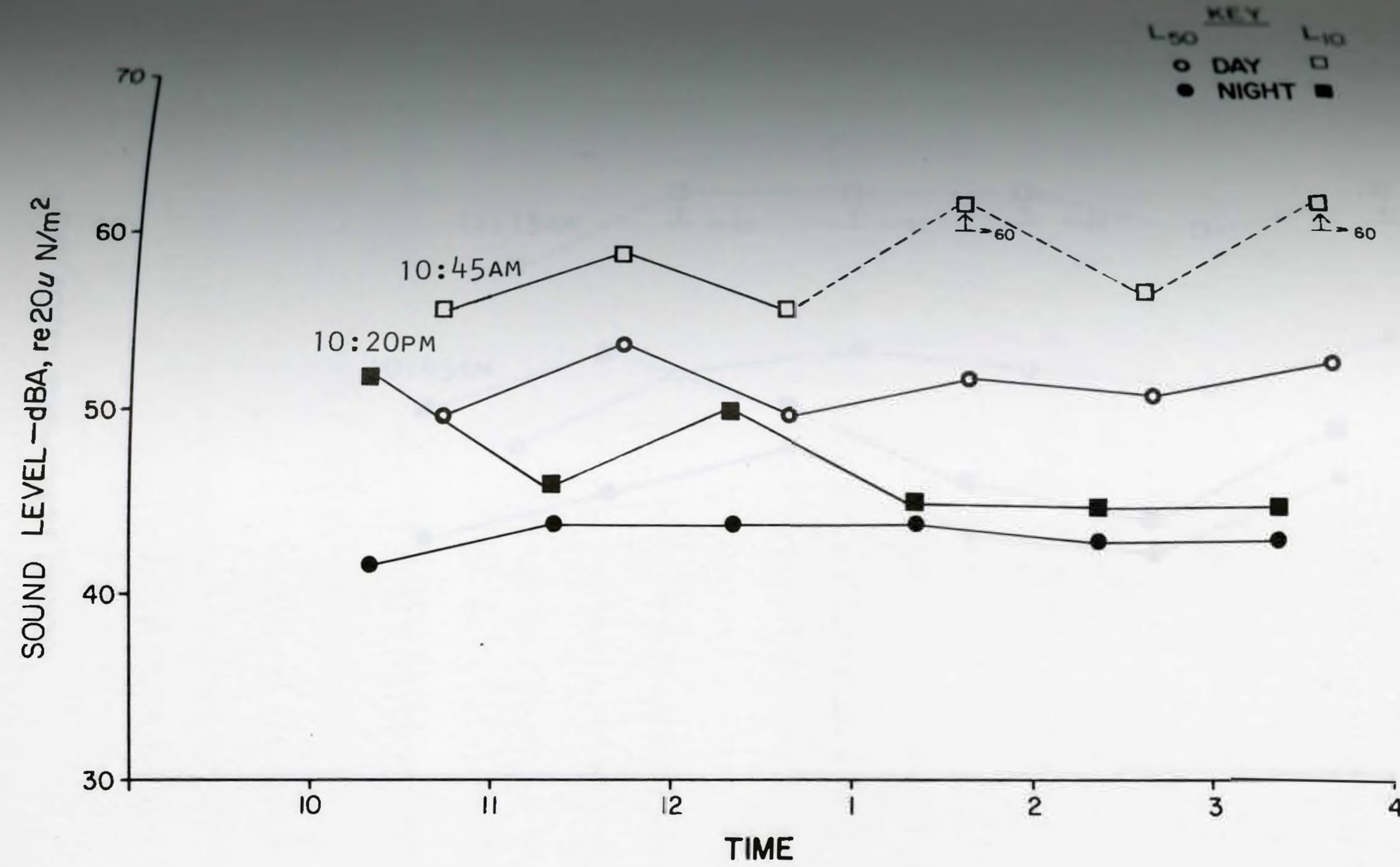
PLATE 2.4.3-6



AMBIENT NOISE LEVELS, OXNARD, CALIFORNIA — STATION 4

PLATE 2.4.3-7

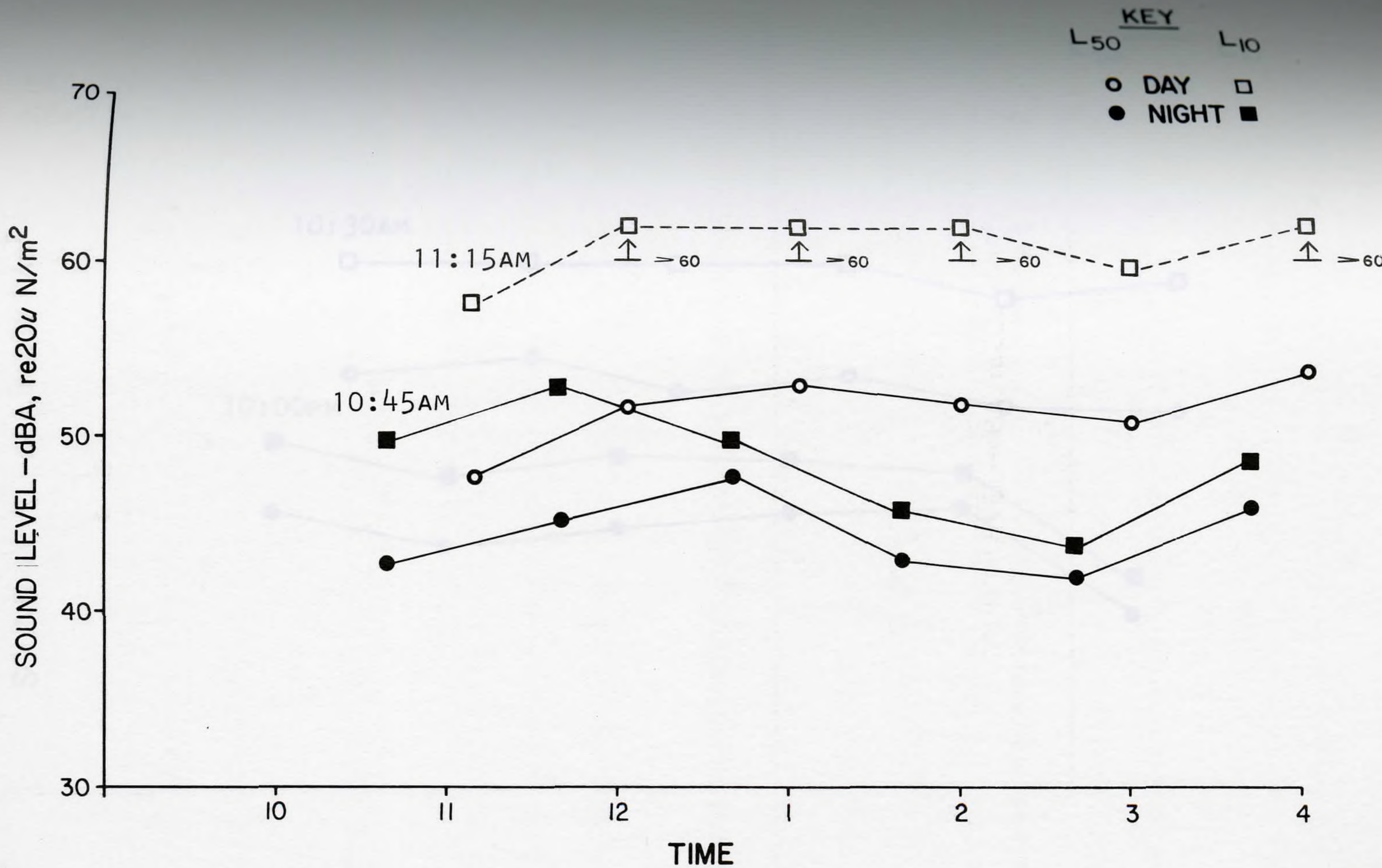
DAMES & MOORE



AMBIENT NOISE LEVELS, OXNARD, CALIFORNIA —STATION 5

DAMES & MOORE

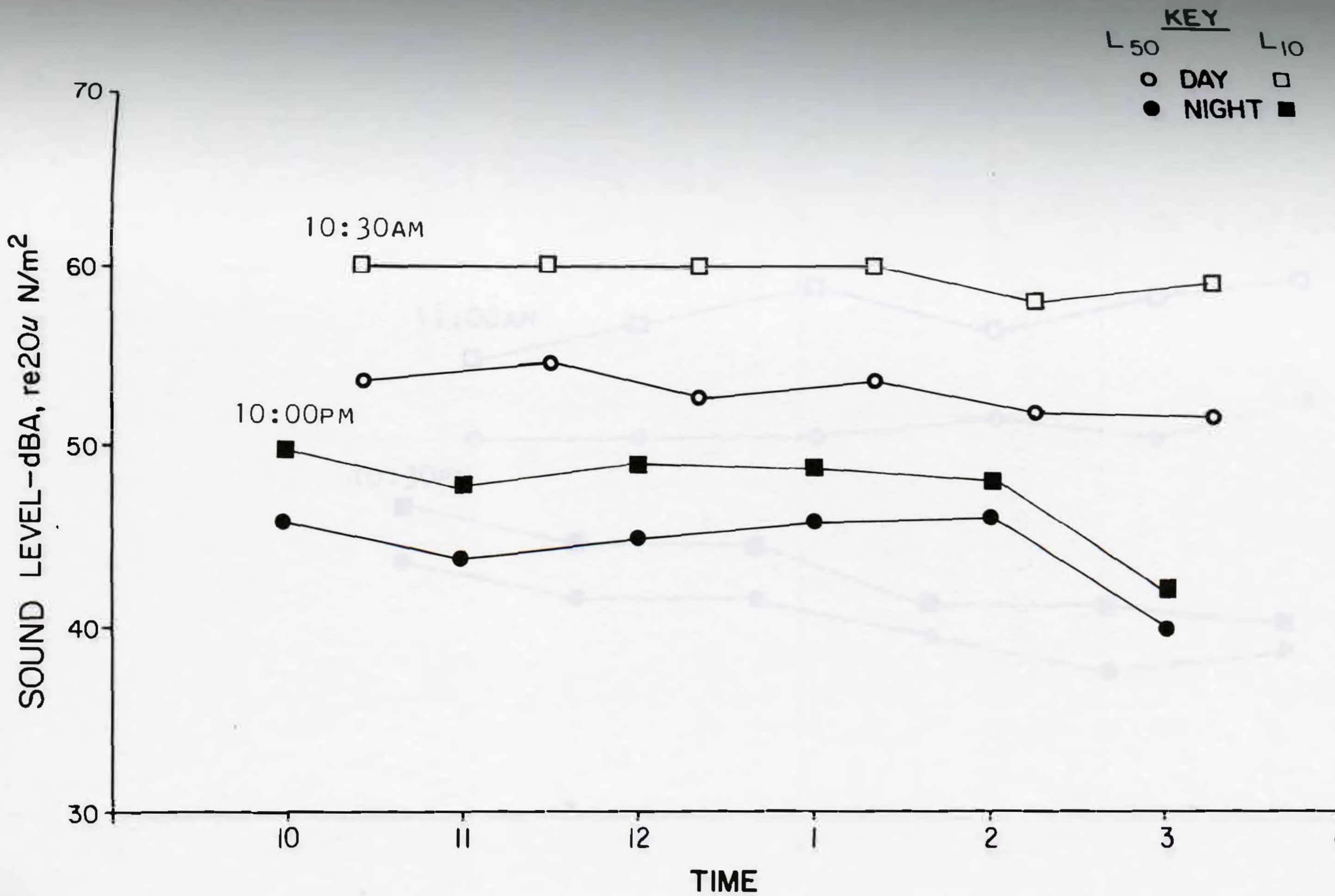
PLATE 2.4.3-8



AMBIENT NOISE LEVELS, OXNARD, CALIFORNIA - STATION 6

DAMES & MOORE

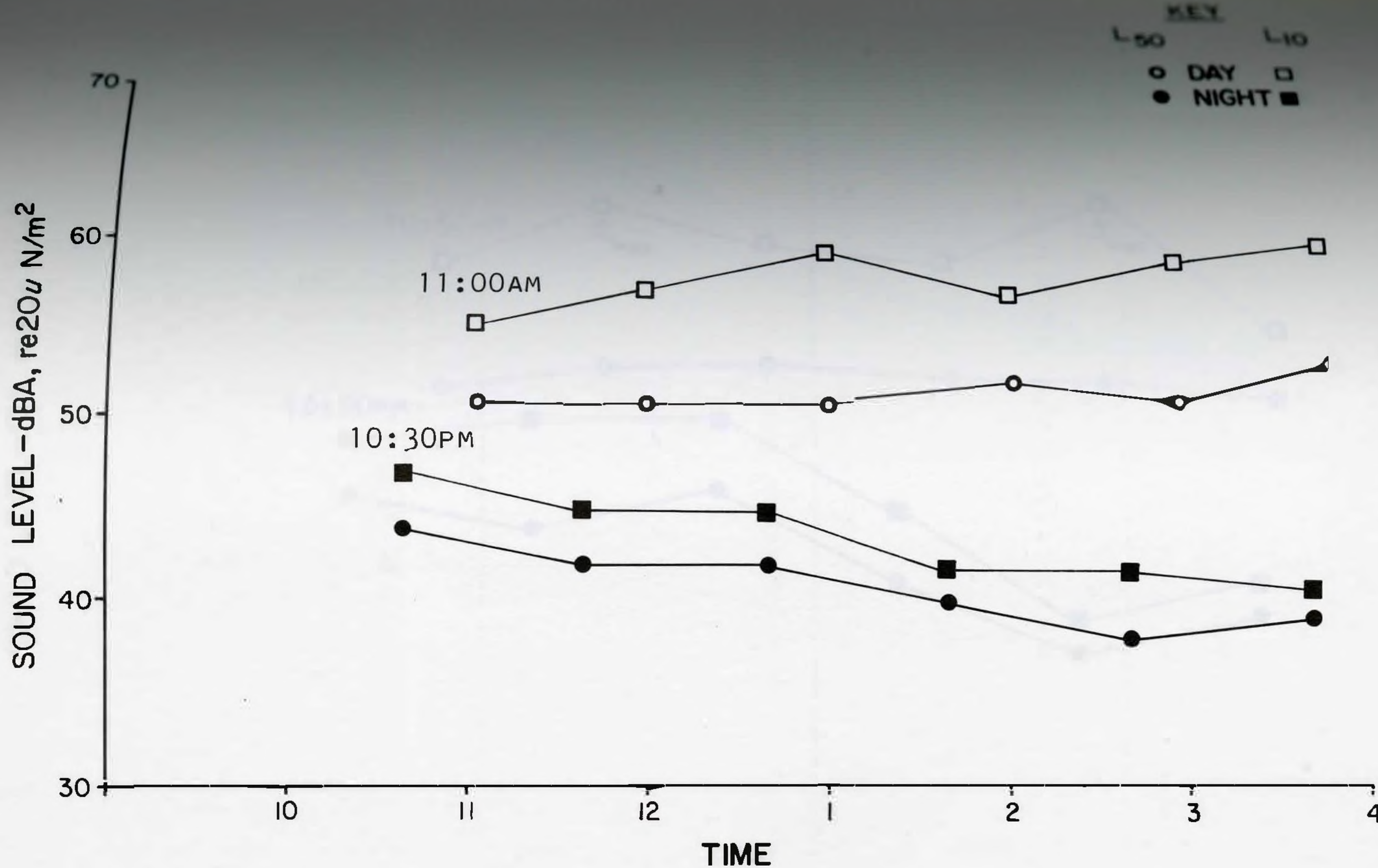
PLATE 2.4.3-9



AMBIENT NOISE LEVELS, PORT HUENEME, CALIFORNIA – STATION 7

DAMES & MOORE

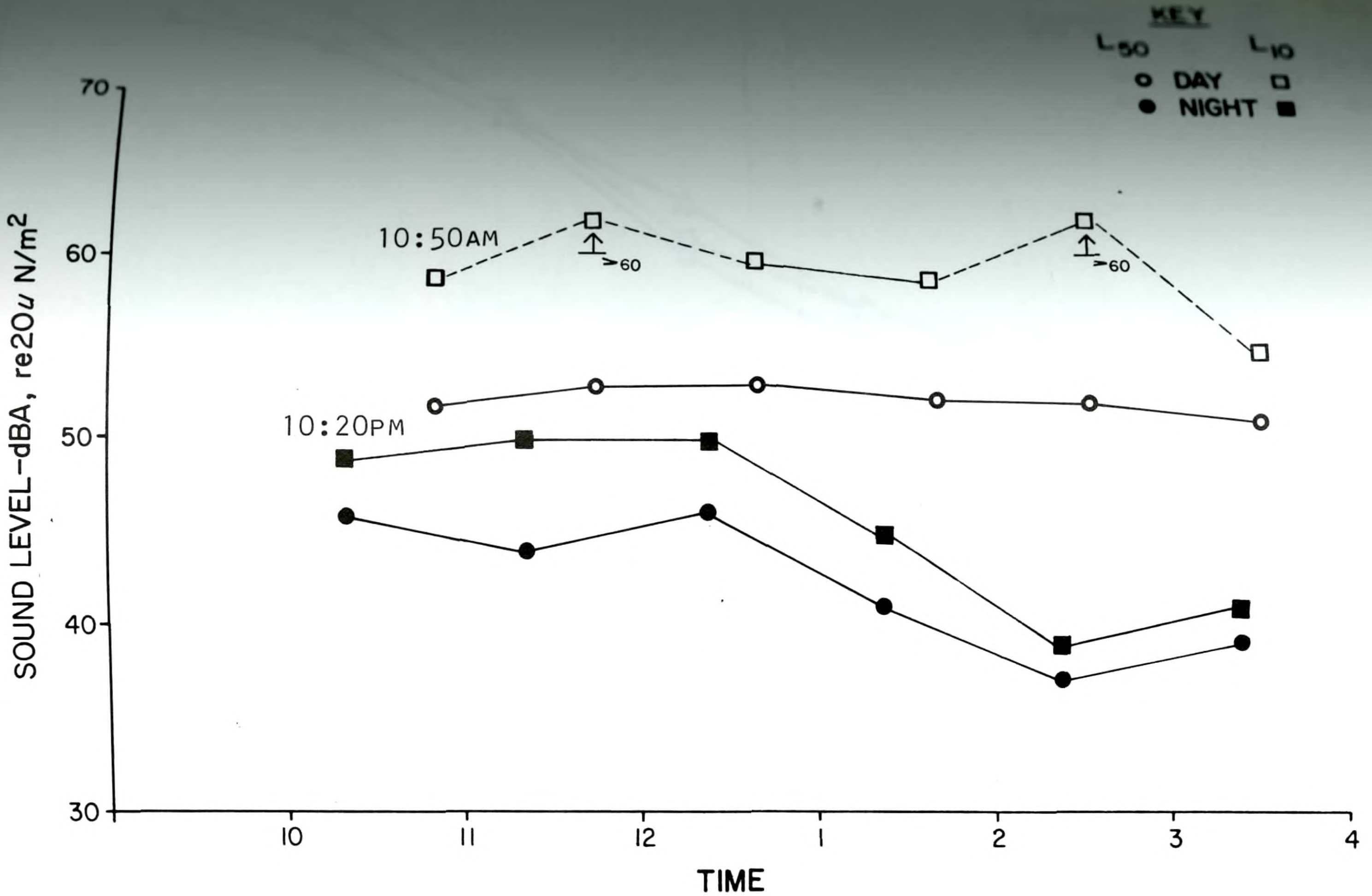
PLATE 2.4.3-10



AMBIENT NOISE LEVELS, OXNARD, CALIFORNIA - STATION 8

DAMES & MOORE

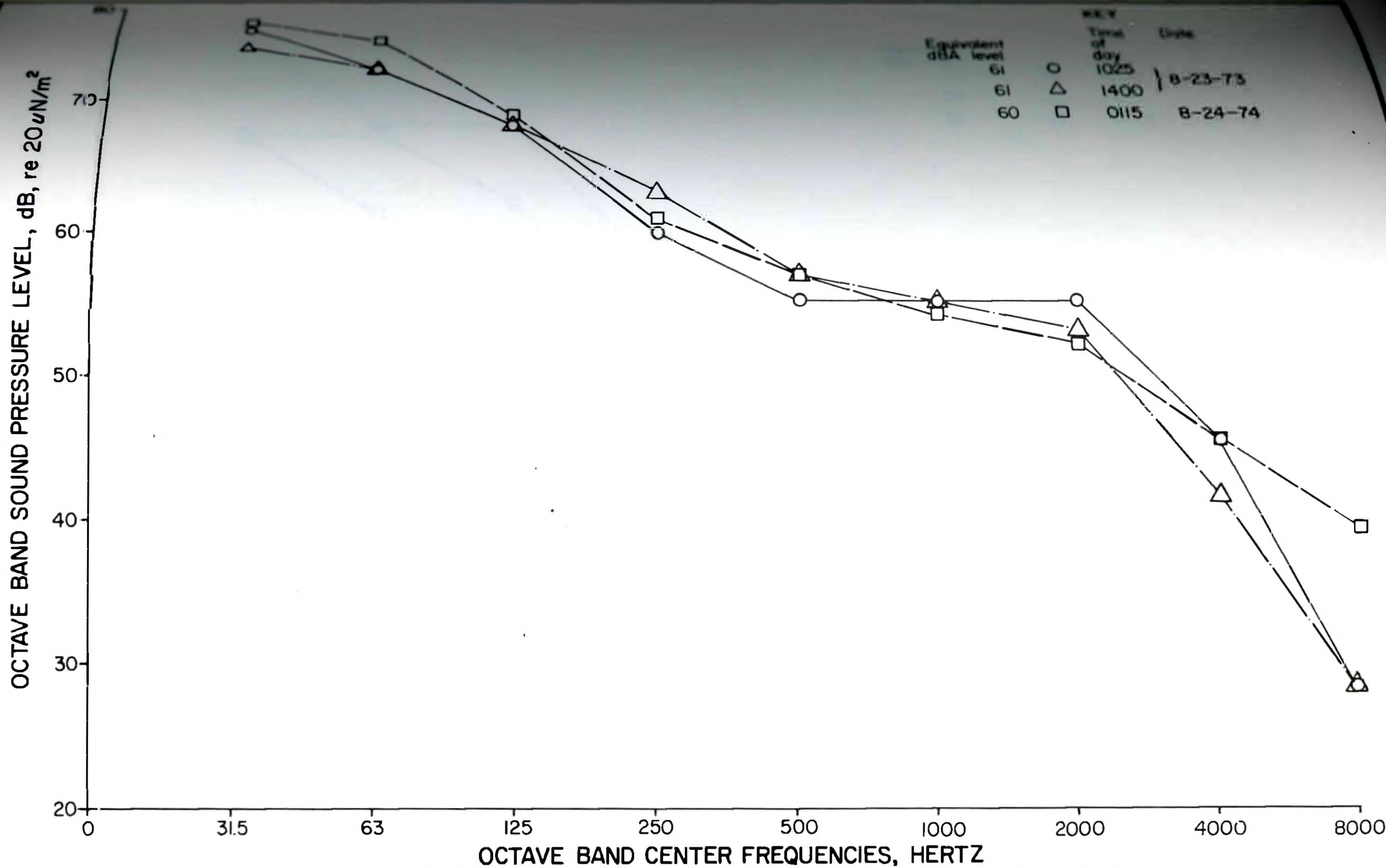
PLATE 2.4.3-11



AMBIENT NOISE LEVELS, OXNARD, CALIFORNIA -STATION 9

DAMES & MOORE

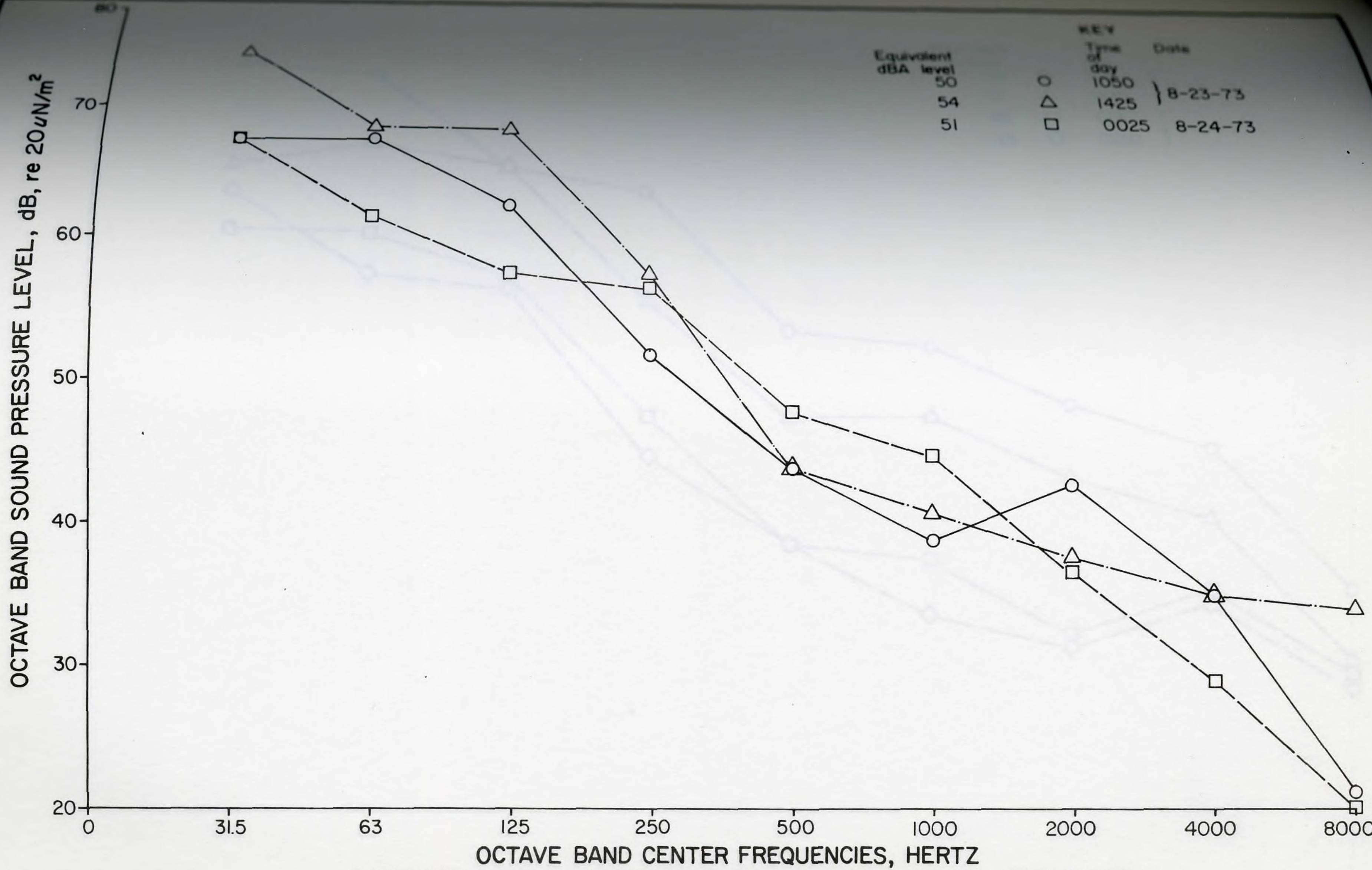
PLATE 2.4.3-12



OCTAVE BAND SOUND PRESSURE LEVEL SPECTRA
AT STATION I – OXNARD, CALIF.

DAMES & MOORE

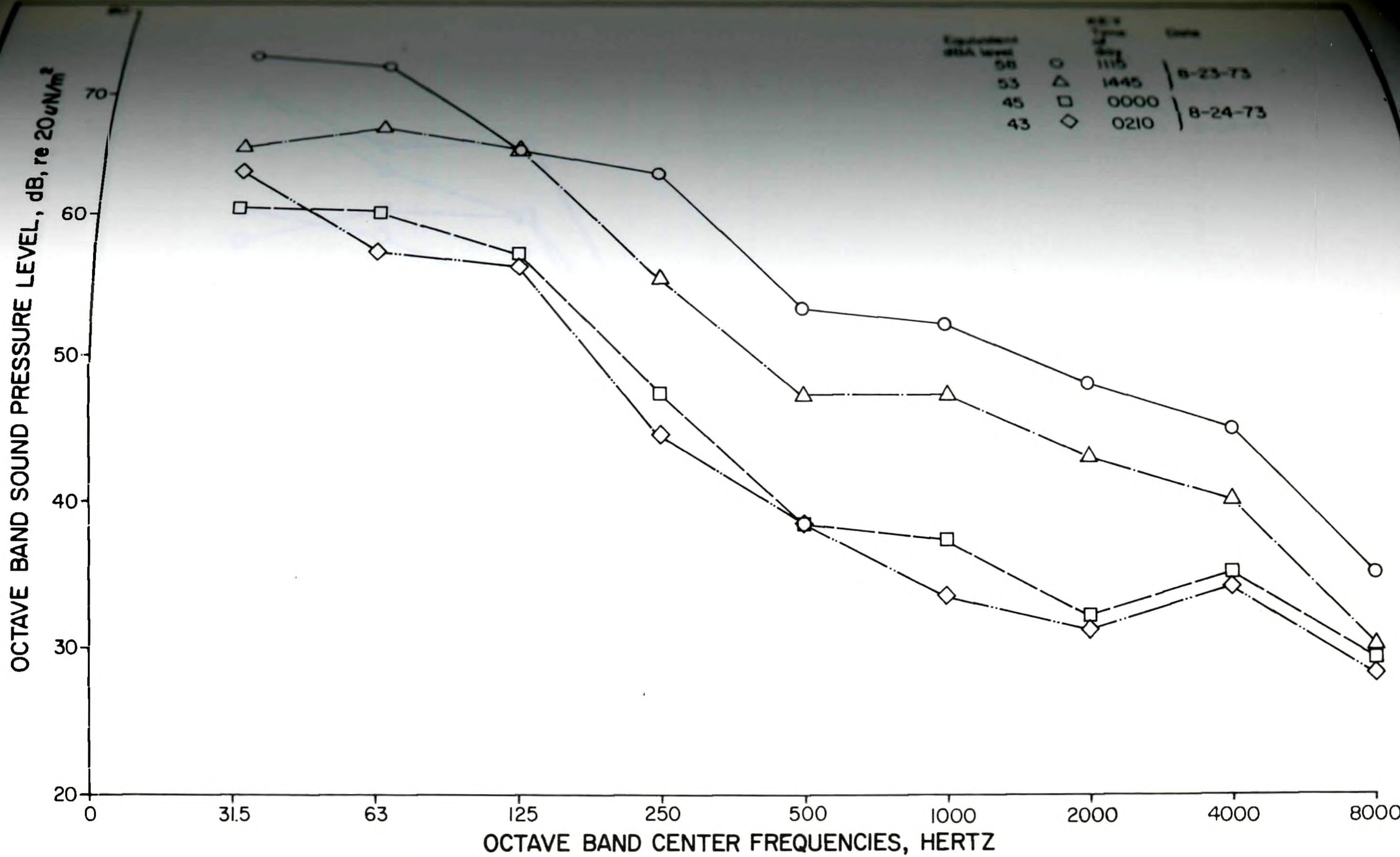
PLATE 2.4.3-13



OCTAVE BAND SOUND PRESSURE LEVEL SPECTRA
AT STATION 2– OXNARD, CALIF.

DAMES & MOORE

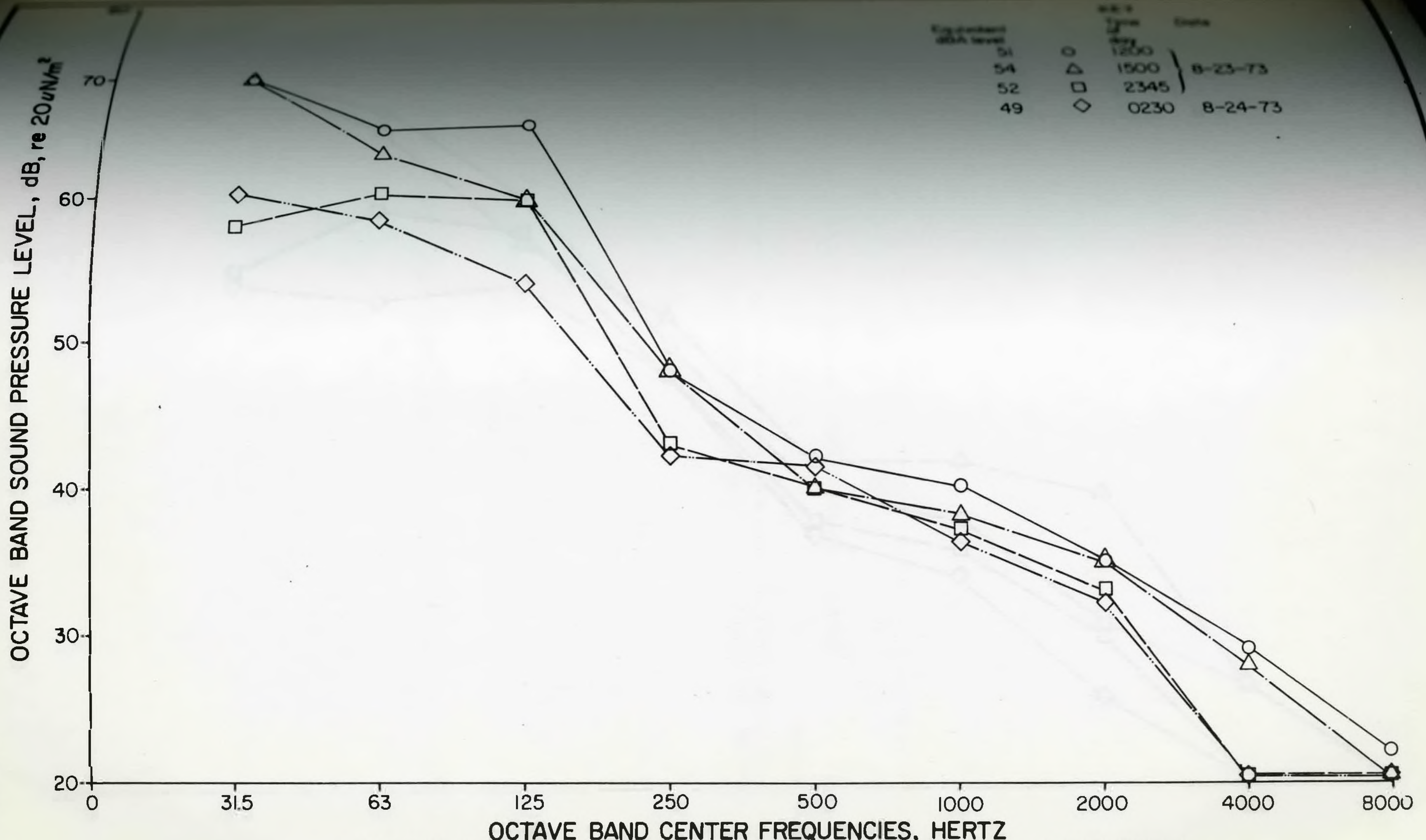
PLATE 2.4.3-14



OCTAVE BAND SOUND PRESSURE LEVEL SPECTRA AT STATION 3–OXNARD, CALIF.

PLATE 2.4.3-15

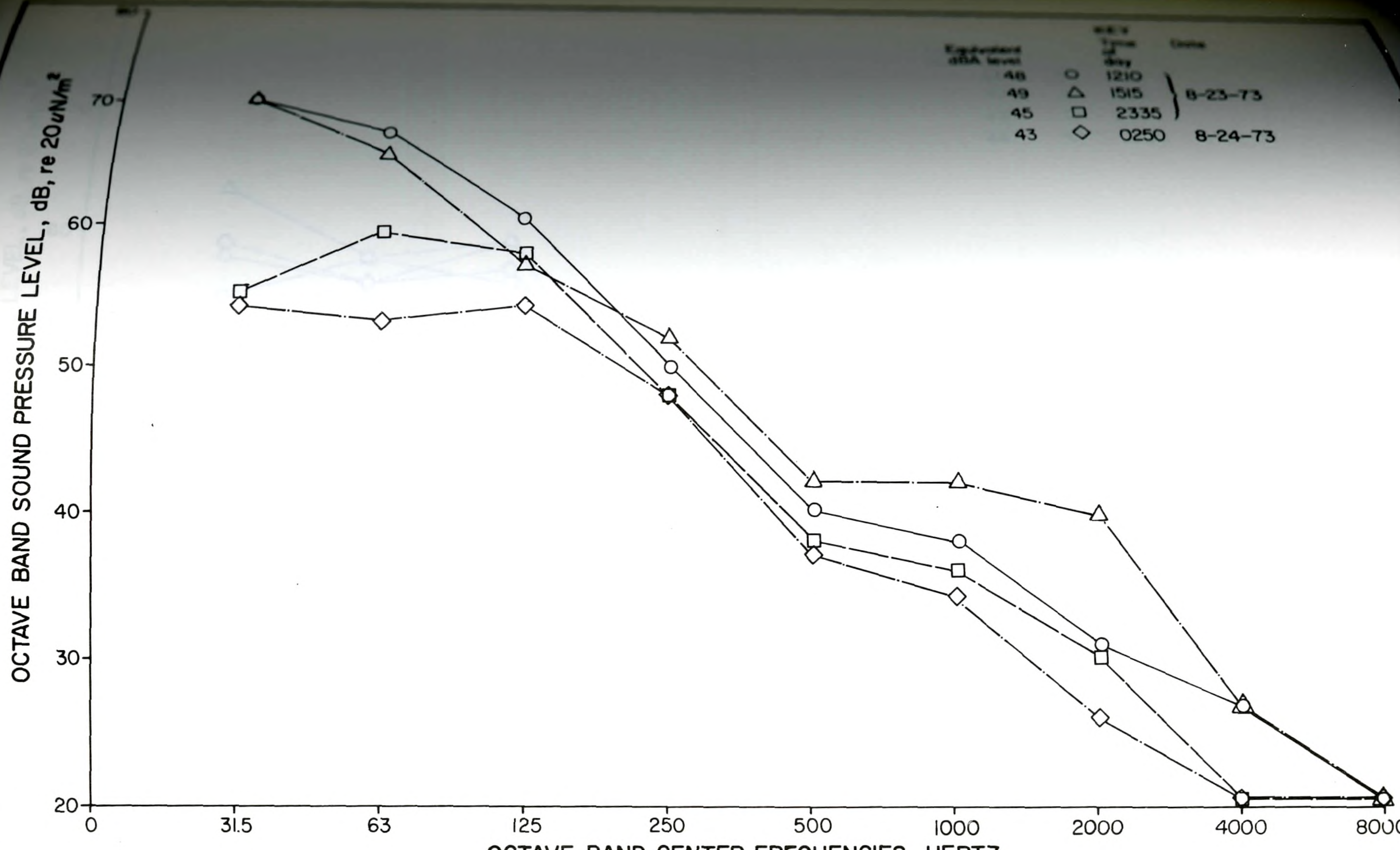
DAMES & MOORE



OCTAVE BAND SOUND PRESSURE LEVEL SPECTRA
AT STATION 4-OXNARD, CALIF.

DAMES & MOORE

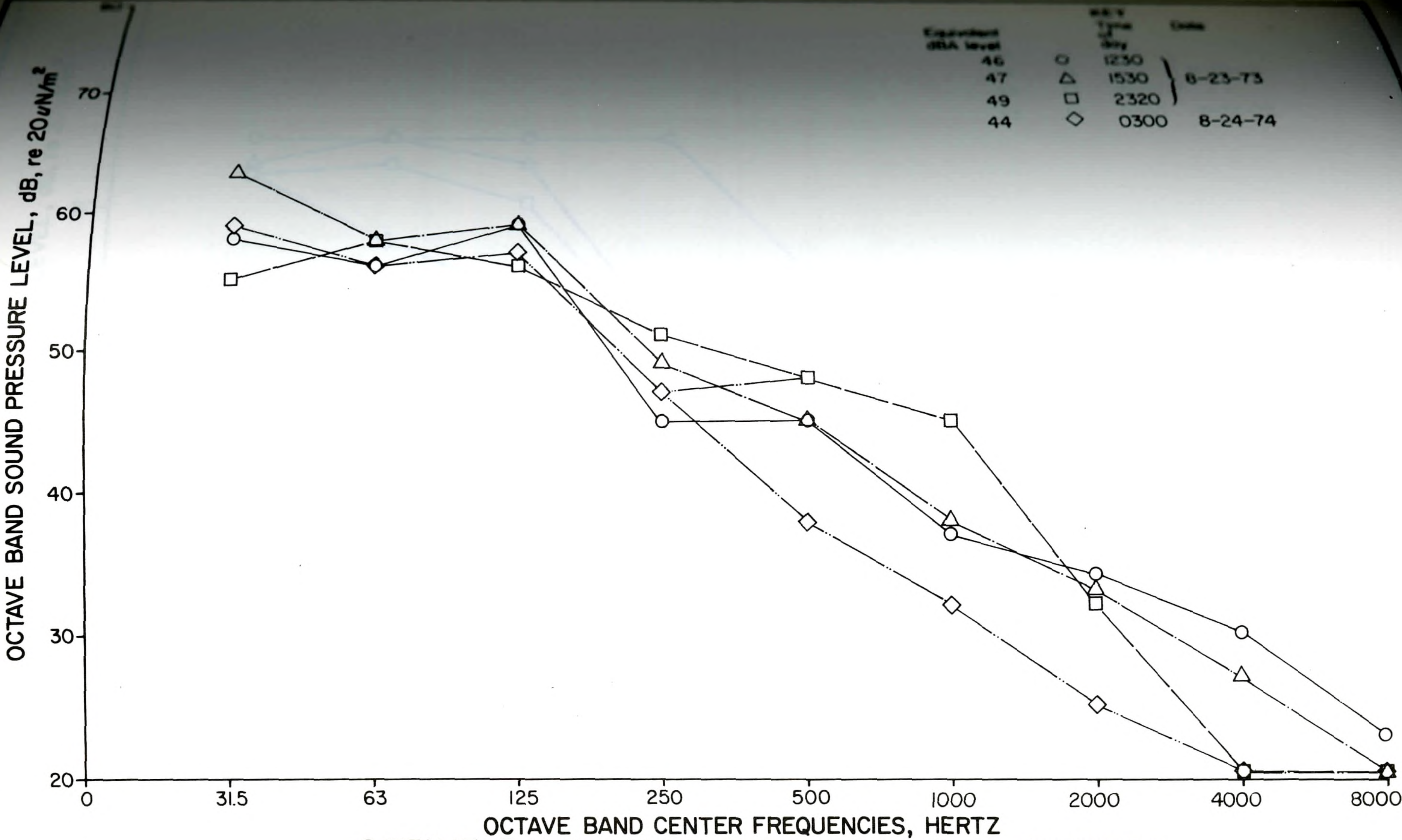
PLATE 2.4.3-16



OCTAVE BAND SOUND PRESSURE LEVEL SPECTRA AT STATION 5-OXNARD, CALIF.

DAMES & MOORE

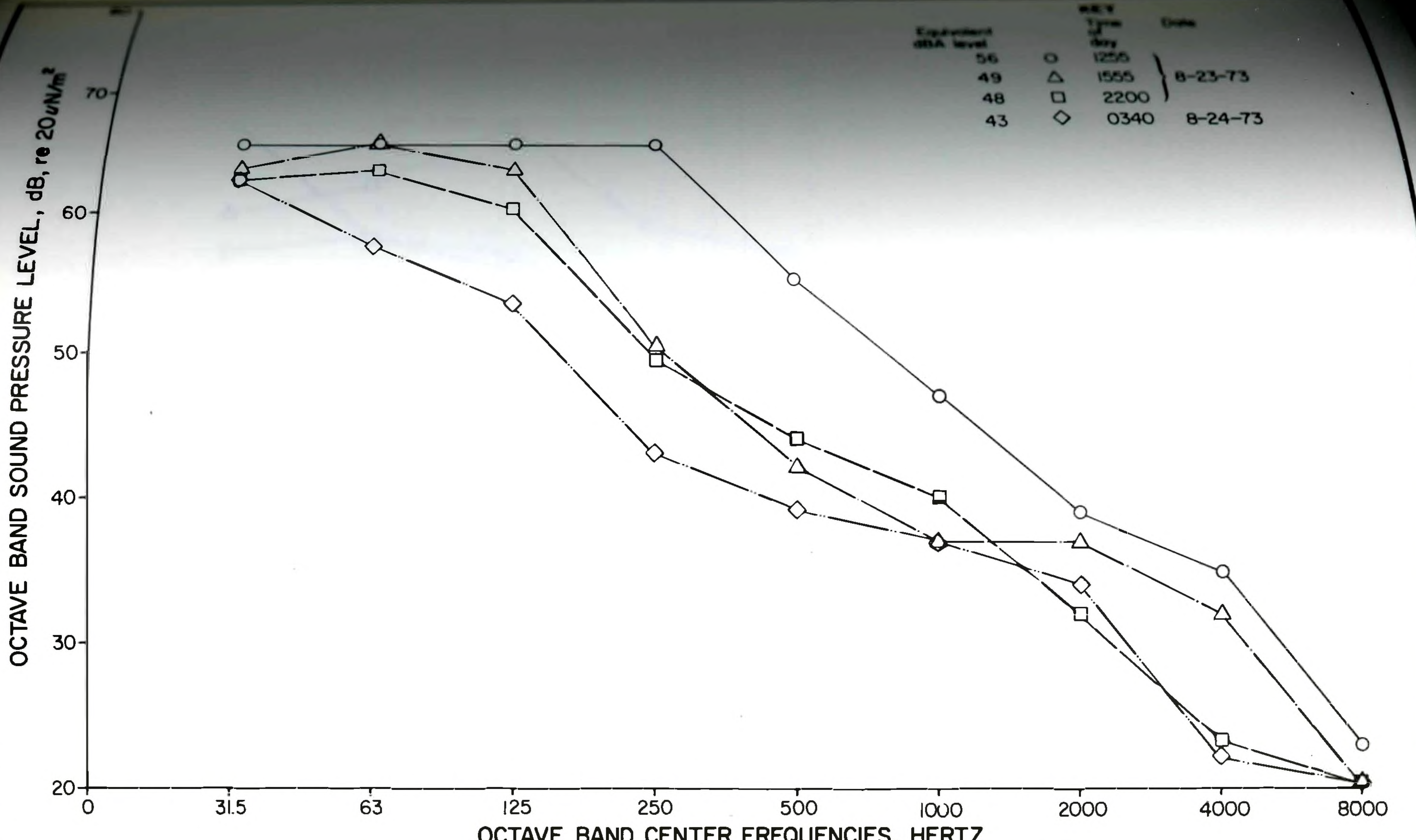
PLATE 2.4.3-17



OCTAVE BAND SOUND PRESSURE LEVEL SPECTRA
AT STATION 6-OXNARD, CALIF.

DAMES & MOORE

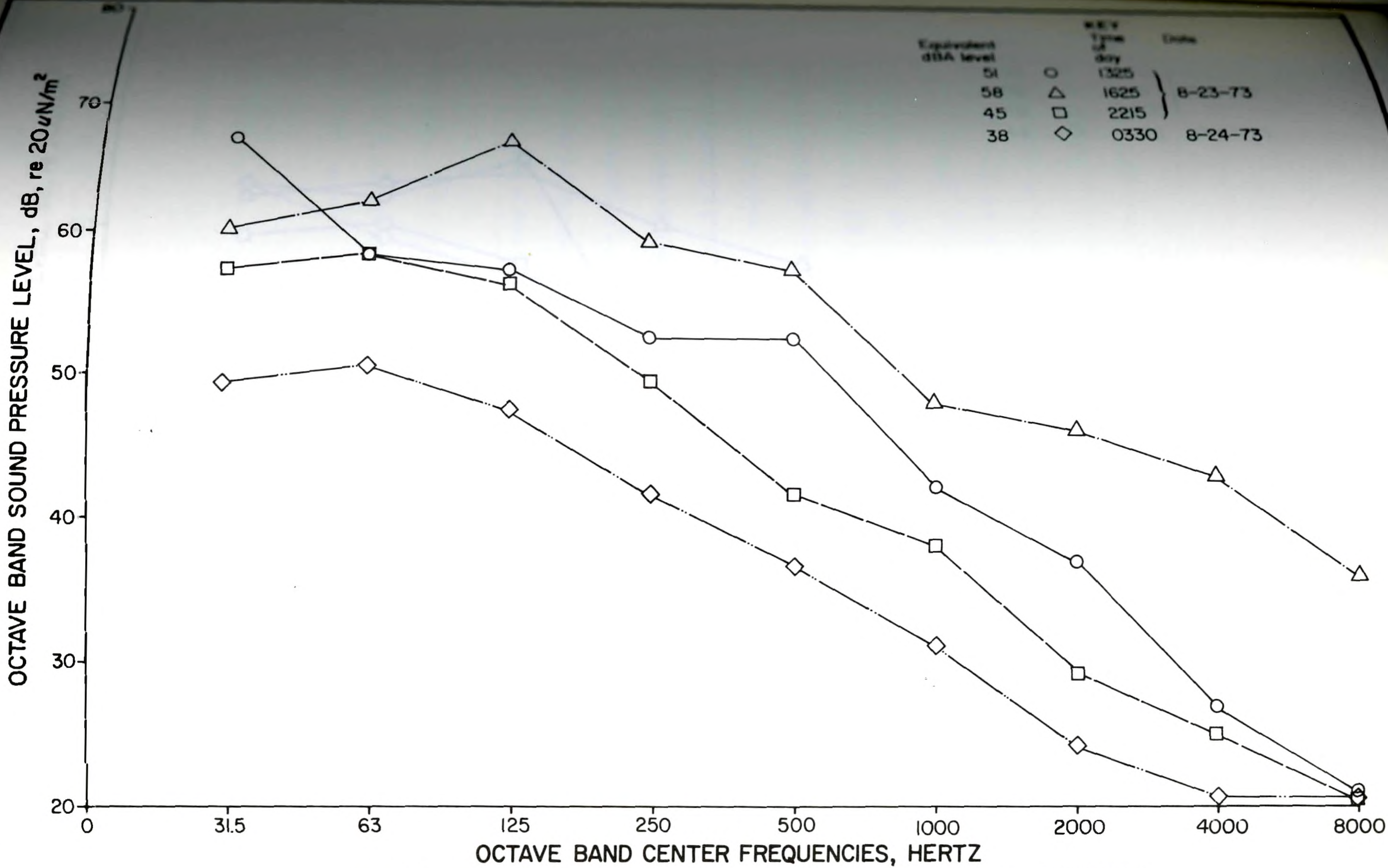
PLATE 2.4.3-18



OCTAVE BAND SOUND PRESSURE LEVEL SPECTRA
AT STATION 7– PORT HUENEME, CALIF.

DAMES & MOORE

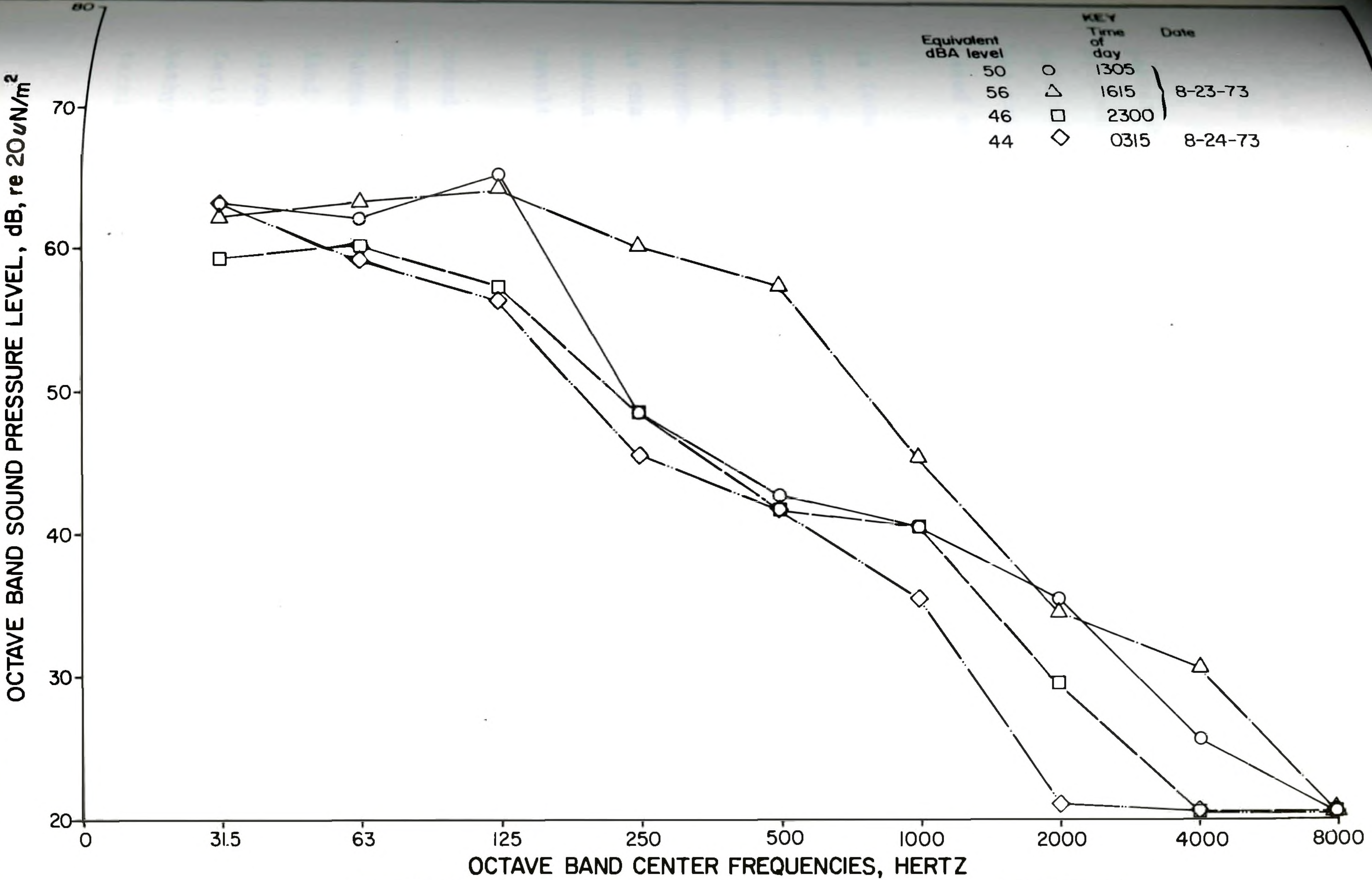
PLATE 2.4.3-19



OCTAVE BAND SOUND PRESSURE LEVEL SPECTRA
AT STATION 8 - OXNARD, CALIF.

DAMES & MOORE

PLATE 2.4.3-20



OCTAVE BAND SOUND PRESSURE LEVEL SPECTRA AT STATION 9—OXNARD, CALIF.

DAMES & MOORE

PLATE 2.4.3-21

2.4.3.3 Physical Oceanography

Introduction

This section presents a review of available literature pertaining to physical oceanography in the vicinity of the proposed LNG marine terminal at Port Hueneme. Included in this section are discussions of tides, wave climate, current patterns, and tsunami occurrence in the area. The information given is based on actual field measurements in the area.

The proposed LNG ship-berthing site at Port Hueneme is located on the south central coast of California within an area commonly known as the Southern California Bight. This region, extending from Point Conception to Baja California, is an open embayment of the Pacific Ocean with highly irregular bathymetric features (Plate 2.4.3-22; also Plate 2.1.2-8). It is characterized by a wide range of wind and sea conditions, several major ocean currents, and groups of offshore islands, resulting in a complex circulation system.

The region offshore of Port Hueneme at the eastern boundary of the Santa Barbara Channel has water depths approaching 1,000 feet within a few miles of shore. Two major submarine canyons (Hueneme and Mugu) cut deeply into the mainland shelf and are important features affecting the nearshore circulation. The marine terminal for the proposed LNG facility is located near the head of Hueneme Canyon. The bathymetry in the immediate vicinity of the proposed marine terminal is shown on Plate 2.4.3-23.

Tides

Variations in sea level in the Port Hueneme area are primarily the result of two dominant driving mechanisms: astronomical tides and fluctuating meteorological conditions. These relatively long-period variations in water level are discussed under this heading while the relatively short-period variations produced by wave action and tsunamis will be discussed under subsequent headings.

Astronomical tides in the area result from the passage of two harmonic tide waves, one with a period of 12.5 hours and the other of 25 hours. There are usually two high and two low waters in a day. The semi-diurnal tide of 12.5 hours predominates over the diurnal tide of 25 hours, producing the chief characteristic of the tides in this area--the diurnal inequality (the difference in heights of successive high waters or low waters). Because of the diurnal inequality, there may be a difference of only a few tenths of a foot between one high water and low water of a day, but a marked difference in height between the other high water and low water. Additional information on the tides can be found in the following publications: Allan Hancock Foundation (1965); Southern California Coastal Water Research Project (1973); and National Ocean Survey (1973a and b).

Port Hueneme is a subordinate station on the National Ocean Survey Network of Tide Prediction Stations. The reference station for the Port Hueneme area is Los Angeles, for which daily predictions of the high and low waters are available (National Ocean Survey, 1973a).

The datum from which the tidal heights are reckoned is the same as that used for the nautical charts of the area, namely, the 19-year mean of the lower of the two low waters occurring each day. The present mean lower low water (MLLW) datum at Port Hueneme is 2.57 feet below the reference sea level datum of 1929 (National Ocean Survey, 1973b), while it is 2.8 feet below the predicted mean tide level for 1973 (National Ocean Survey, 1973a). (The difference between the reference sea level datum and the mean tide level at Port Hueneme could result from long-term trends in sea level or departure of the local sea level from the level at the location where the reference was defined.)

The predicted mean tidal range (the difference between the mean high water and the mean low water) at Port Hueneme is 3.7 feet. The predicted diurnal range (the difference between the mean lower low water and the mean higher high water) is 5.4 feet (National Ocean Survey, 1973a). The highest tide predicted at Port Hueneme is 7.1 feet above MLLW (National Ocean Survey, 1973a). The maximum range of the astronomical tide is therefore close to 9 feet.

The astronomical tides in the area may be altered by meteorological tides, which are caused by daily or seasonal variations in local wind and barometric pressure. In general, both onshore winds and low barometric pressure will tend to cause higher water levels than those produced by the tides acting alone. Conversely, offshore winds and high barometric pressure will result in lower water levels. However, water level variations due to fluctuating meteorological conditions are not considered to be significant in the Port Hueneme area when compared to variations produced by the astronomical tides. The changes in sea level produced by seasonal weather patterns in the region are probably less than half a foot (National Ocean Survey, 1973a). A report on the Santa Barbara Harbor Navigation Project (U.S. Army Corps of Engineers, 1961) adopted a maximum increase in water level due to storm conditions of one foot for design purposes (Santa Barbara lies approximately 30 nautical miles northwest of the proposed marine terminal).

The data given above are based on continuous records of water levels at Port Hueneme taken during the period from 1940 to 1961. The extreme high water recorded during that period was 7.6 feet above MLLW, and the extreme low water recorded was 2.5 feet below MLLW (National Ocean Survey, 1973b). However, other factors, such as tsunamis and harbor oscillations, in addition to the astronomical and meteorological tides, could have caused these extreme water levels.

Waves

Wave climate is composed of two elements: sea and swell. Sea refers to waves in a storm area generated by the local winds of the storm. Swell denotes waves of longer and more regular periods that have moved out of their generating area. A basic difference between sea and swell is that sea wave heights are highly irregular while swell wave heights are more uniform. Both sea and swell can occur simultaneously in any given area, resulting in a complex sea surface.

Sea and swell conditions at seven stations in deep water off the California coast have been hindcast for a three-year period (1956-1958) from synoptic meteorological charts of the Pacific Ocean (National Marine Consultants, 1960). Station 6, located in the Santa Barbara Channel at laLatitude 34.2° North and Longitude 120.0° West, and Station 7, located in the Santa Cruz basin at Latitude 33.5° North and Longitude 119.9° West, best represent the deepwater wave climate in the area. The average annual wave roses for Stations 6 and 7 are presented on Plates 2.4.3-24 and 2.4.3-25, respectively. The roses show frequency distributions of wave direction. The histograms surrounding the roses give frequency distributions of wave heights for each direction. Two roses are presented for each station, one each for sea and swell. The dominant direction of swell approach is from the west at Station 6 and from the northwest at Station 7. Both stations demonstrate the effectiveness of the Channel Islands and the configuration of the shoreline in limiting the directions of wave approach. Although the highest swell hindcast at Station 6 was 17 to 19 feet, with a period of 12 to 14 seconds, the dominant westerly swell was less than 5 feet high about 78 percent of the time.

The dominant direction of sea approach is from the northwest at both Station 6 and Station 7, apparently in response to the prevailing wind conditions in the area. The Channel Islands and the configuration of the shoreline effectively limit the available wind fetch for the generation of waves. The highest sea hindcast at Station 6 was 11 to 13 feet, with a period of 8 to 10 seconds, approaching from the west rather than the northwest due to the limited northwest fetch. The dominant northwest-to-west sea was less than [illegible] feet high about 85 percent of the time.

The hindcast wave statistics provide an indication of the sheltering effect of the offshore islands on the wave climate at Port Hueneme. Another hindcast study which considered the effects of wave refraction and shoaling within the Santa Barbara Channel (Oceanographic Services, 1969) concluded that west-northwest sea and swell would be reduced to about 70 percent of their deep-water height as they approached Port Hueneme. Similarly, westerly swell would be reduced to between about [illegible] and 90 percent of its deep-water height as it approached Port Hueneme. The relative wave heights in the Santa Barbara Channel for the dominant westerly direction of swell approach are shown on Plate 2.4.3-26.

As a supplement to the hindcast statistics, wave observations have been compiled from routine marine weather logs by the National Weather Service Environmental Detachment (1971). These shipboard observations are available for the area bounded by latitude 34.0° north, longitude 119.5° west, and the coastline and are presented in Table 2.4.3-IV. The data indicate that waves less than 6 feet high occur about [illegible] percent of the time, while waves less than 2 feet high occur about 58 percent of the time. As ships in passage generally attempt to avoid storm conditions, it should be noted that the ship observations may be biased toward good weather conditions.

The wave statistics given above are for deep-water waves and do not describe conditions that would be expected in the shallow waters close to shore. The effects of refraction and shoaling as the waves pass over Hueneme Canyon would significantly modify the wave directions and heights. Wave refraction studies over Mugu Canyon (Inman, 1950), which is 7 miles to the southeast, demonstrate the strong refraction effects that could also occur over Hueneme Canyon. These effects include wave convergences which may increase wave heights, as well as divergences in which the wave height is decreased. Refraction diagrams available for Ormond Beach indicate that it is probably a zone of wave divergence under prevailing conditions (Bechtel Corporation, 1970).

Hindcast wave statistics are available for Ormond Beach in 50 feet of water (Oceanographic Services, 1971). The directions of wave approach considered are west-northwest, west, west-southwest, and southeast. The data indicate that the prevailing directions of wave approach throughout the year are from west-northwest and west, especially during the summer and early fall. The largest waves approaching from the southerly directions occur during the winter months and have heights of 15 to 18 feet. The largest waves from the westerly direction also occur during the winter months and have heights of 12 to 15 feet. The greatest occurrence of wave heights in excess of 6 feet is about 100 hours during the month of February, and the least occurrence is about 15 hours during the month of August. The hindcast wave statistics for Ormond Beach are summarized in seasonal wave roses on Plate 2.4.3-27.

Currents

The principal offshore current in the Port Hueneme area is related to the general circulation pattern of the Pacific

Ocean. As water flows eastward from Japan across the North Pacific and impinges upon the west coast of North America, it divides into two streams. That portion of the current flowing southward along the Oregon and California coast is called the California Current. The California Current is a slow, wide, meandering current that is enhanced by the dominant northwesterly winds along the coast (Jones, 1971).

As the California Current flows southward past Point Conception, it departs from the abrupt eastward turn of the coastline and continues to a region off northern Baja California. There the main portion of the current turns toward land and divides into two branches. One branch, the Southern California Countercurrent, moves northward again and flows through the Channel Islands, becoming the inshore side of the Southern California Eddy (Jones, 1971). The dominant features of the offshore circulation pattern in the upper 100 meters of the ocean are shown on Plate 2.4.3-28. Estimates of the current speed in the Southern California Countercurrent are comparable to that observed in the California Current itself: 0.2 to 0.4 knot (Jones, 1971).

Surface currents flowing over the Santa Barbara-Oxnard Shelf are the result of that part of the northwestward-flowing Southern California Countercurrent that enters the Santa Barbara Channel through the passage between Point Mugu and Anacapa Island (Kolpack, 1971). Surface currents over the inner shelf north of Point Mugu are characterized by a series of eddies which break off the Southern California Countercurrent (Kolpack and Straughan, 1972). Recent studies have indicated that there may the two dominant eddies over the Mugu-Hueneme shelf. The northerly eddy appears to have a net offshore (or southwest) component over Hueneme Canyon. The southerly eddy is located north of Mugu Lagoon. The interaction of the two produces a convergence zone in the area off Ormond Beach (Kolpack and Straughan, 1972).

Wind conditions play an important role in modifying the surface water movements described above. The prevailing northwesterly winds reinforce the southward-flowing California Current during the period of March through October. However, during the period from November through February frequent southeasterly winds strengthen the Southern California Countercurrent and cause the California Current to move further offshore. A shift in local wind direction may be sufficient to change the surface water drift and cause short-term reversals in water movement.

Astronomical tides are an additional factor complicating the water movements on the mainland shelf. Offshore, the tidal current changes its direction continually and never comes to a slack, so that in a tidal cycle of about 12.5 hours it will have set in all directions of the compass. The deep-water tidal currents of the region rarely exceed 0.4 knot (Intersea Research Corporation, 1973). However, near shore the tidal currents are confined by the submarine topography to directions essentially parallel to the bottom contours. Thus, the nearshore tidal currents are largely oscillatory, rather than rotary, and 180° reversals in direction occur in one-half a tidal cycle of about 6 hours.

Surface currents in the area off Ormond Beach were investigated with the aid of current drogues (Intersea Research Corporation, 1973). The results of nine one-day drogue studies conducted between August 1969 and October 1971 indicated that the surface currents were moving at a speed of about 4 percent of the wind speed and in a direction approximately 30° to the right of the wind direction. The drogues drifted parallel to the coastline for about 50 percent of the observations at an average speed of about 0.2 knot. For the remaining 50 percent of the observations, the surface currents flowed with an onshore-offshore component at an average speed of less than 0.2 knot. The generalized surface water circulation in the area off Ormond Beach is shown on Plate 2.4.3-29, for a typical 10-month period in 1971-72.

Subsurface and bottom current measurements made with recording current meters in the area off Port Hueneme indicated that the direction of current flow was controlled primarily by the tides. In the Santa Barbara Channel, current speeds ranged from 0.2 knot to 1.0 knot with a mean velocity of 0.5 knot (Drake, Kolpack, and Fischer, 1972).

Currents were measured at a depth of 10 feet in 30 feet of water off Ormond Beach during two 1-month surveys (April 1968 and August 1970). The maximum observed speeds were between 1.8 and 2.0 knots to the southeast, while the average current speed for the period was about 0.3 knot. The current direction fluctuated between upcoast on a rising tide and downcoast on the falling tide (Intersea Research Corporation, 1973).

Bottom currents were measured in 50 feet of water off Ormond Beach for a 22-day period (May 1970) and produced a maximum current speed of 0.45 knot directed southeast (Bechtel, 1970). Additional bottom current measurements for a 12-day period (February 1972) yielded a maximum current speed of 0.75 knot, with the dominant speeds between 0.25 and 0.50 knot (Kolpack and Straughan, 1972). The direction of current flow was controlled primarily by the tidal cycle as shown on Plate 2.4.3-30.

Surface, mid-depth, and bottom currents were measured for 25-hour periods at 2-month intervals from December 1971 to October 1972 (Engineering Science, Inc., 1972). Five stations were occupied in the vicinity of Ormond Beach to depths of about 200 feet. The results of this study can be summarized as follows:

1. The surface water movements followed a complex, not easily defined pattern. The complexity of the water movements in the area was accentuated by the fact that a multilayer system appeared to exist, with mid-depth and bottom current speeds often exceeding those measured at the surface and varying considerably in direction.
2. Currents over the inner shelf were predominantly directed parallel to shore. During the late fall and early winter months the water movements were directed alongshore toward the northwest, probably representing a strong manifestation of the Southern California Counter-

current. In the early spring, the water movements veered toward shore, possibly as a result of mild upwelling at the head of the canyon. The onshore currents were usually prevalent over the canyon. In the late spring, when upwelling apparently ceased, the pattern broke down into a number of eddies.

3. Current speeds during the winter were fairly high, particularly along the rim of the canyon, while summer water movements were relatively sluggish. A summary of diurnal resultant current speed and direction for each of the 25-hour surveys is presented in Table 2.4.3-V. The locations of the measurement station numbers 1, 2, 4, 5, and 8 are shown on Plate 2.4.3-31 in Section 2.4.3.4.

The description of nearshore circulation given above does not apply to currents in the surf zone. Waves that break at an angle to the shoreline will generate currents within the surf zone that set parallel to shore and are termed littoral currents. The direction and magnitude of the littoral current is dependent upon the angle between the breaking wave and the shoreline, which is in turn dependent upon the direction of deepwater wave approach and the location of points of wave convergence. This principle was used by the Corps of Engineers (1948) to determine that the coastline between the Santa Clara River and Point Mugu is subject to a prevailing southeastward littoral current. However, wave refraction, e.g., over canyons, may cause currents that at some points are opposed to the prevailing direction along the coast. A study of drift west of Point Mugu (Inman, 1950) noted that the dominant littoral currents flowed to the southeast. Local reversals in the direction of the littoral drift were observed and attributed either to the effects of wave refraction over Mugu Canyon or to the approach of waves from the southerly direction. A similar situation may exist in the vicinity of Hueneme Canyon.

Tsunamis

Tsunamis are water waves with periods of 5 to 60 minutes or longer. The major cause of catastrophic tsunamis is the rapid tectonic displacement of the sea floor often associated with an earthquake, although there are also other causes (Weigel, 1970).

Tsunamis in the Port Hueneme area can result from either local or distant generating mechanisms. Although reports of tsunamis generated by seismic events in the Southern California area in 1812 and 1927 exist (Hamilton, et al., 1969), they do not provide information regarding tsunami damage in the Port Hueneme area.

The U.S. Coast and Geodetic Survey has published reports based on tide recordings of five major tsunamis of recent years, all generated by distant events (Berkman and Symons, 1964; Spaeth and Berkman, 1967). The data available for Port Hueneme, including the date of the tsunami, the location of the earthquake epicenter and its magnitude, and the amplitude of the greatest wave recorded for each are summarized in Table 2.4.3-VI.

The largest tsunami wave amplitude recorded at Port Hueneme was 8.8 feet, associated with the Chilean earthquake of 1960. The height of the initial rise in water level for that tsunami was 1.9 feet, with a period of about 20 minutes between the first and second crests (Berkman and Symons, 1964).

A refraction analysis of long wave propagation over the continental shelf near Port Hueneme has been published (Jen, 1969). The analysis showed that Port Hueneme is somewhat sheltered from tsunamis generated in the North Pacific. On the other hand, the Channel Islands offer only minimal sheltering from tsunamis generated in the South Pacific.

In enclosed harbors the damage resulting from strong currents induced by the long period oscillations of the harbors can outweigh the damage due to inundation by the tsunami itself. These currents can inflict damage by tearing loose moorings and vessels berthed in the harbor, and from scour around structures. Maximum current speeds of about 10 feet per second are not uncommon in enclosed basins where tsunami-induced oscillations have been recorded.

Reports of the tsunamis of November 4, 1952 (O'Brien, 1952), and March 9, 1957 (O'Brien and Kuchenruether, 1957), have indicated that no damage was sustained by the Mugu-Hueneme beaches, the Port Hueneme harbor structures, or vessels berthed in the harbor. A study of the effects of the tsunami of March 28, 1964 (Wilson, 1971) at representative tide stations along the west coast of the United States did not indicate any damage at Port Hueneme. No other reports have been found which describe or discuss tsunami-induced damage in or near Port Hueneme.

The Port Hueneme area does not appear to have been subject to any damage during tsunamis which have occurred since 1946.

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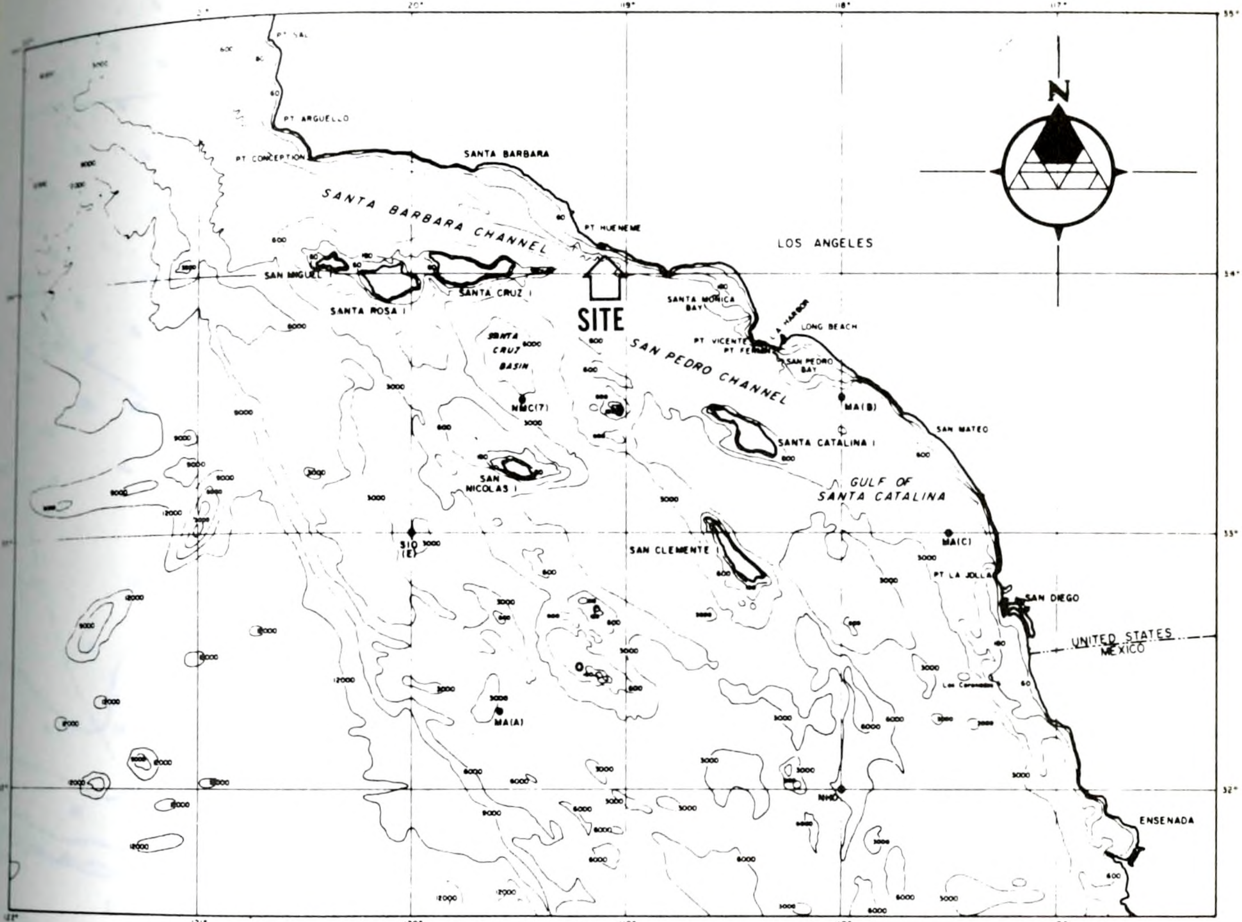


BATHYMETRY OF THE CONTINENTAL SHELF OFF SOUTHERN CALIFORNIA

0 50 100

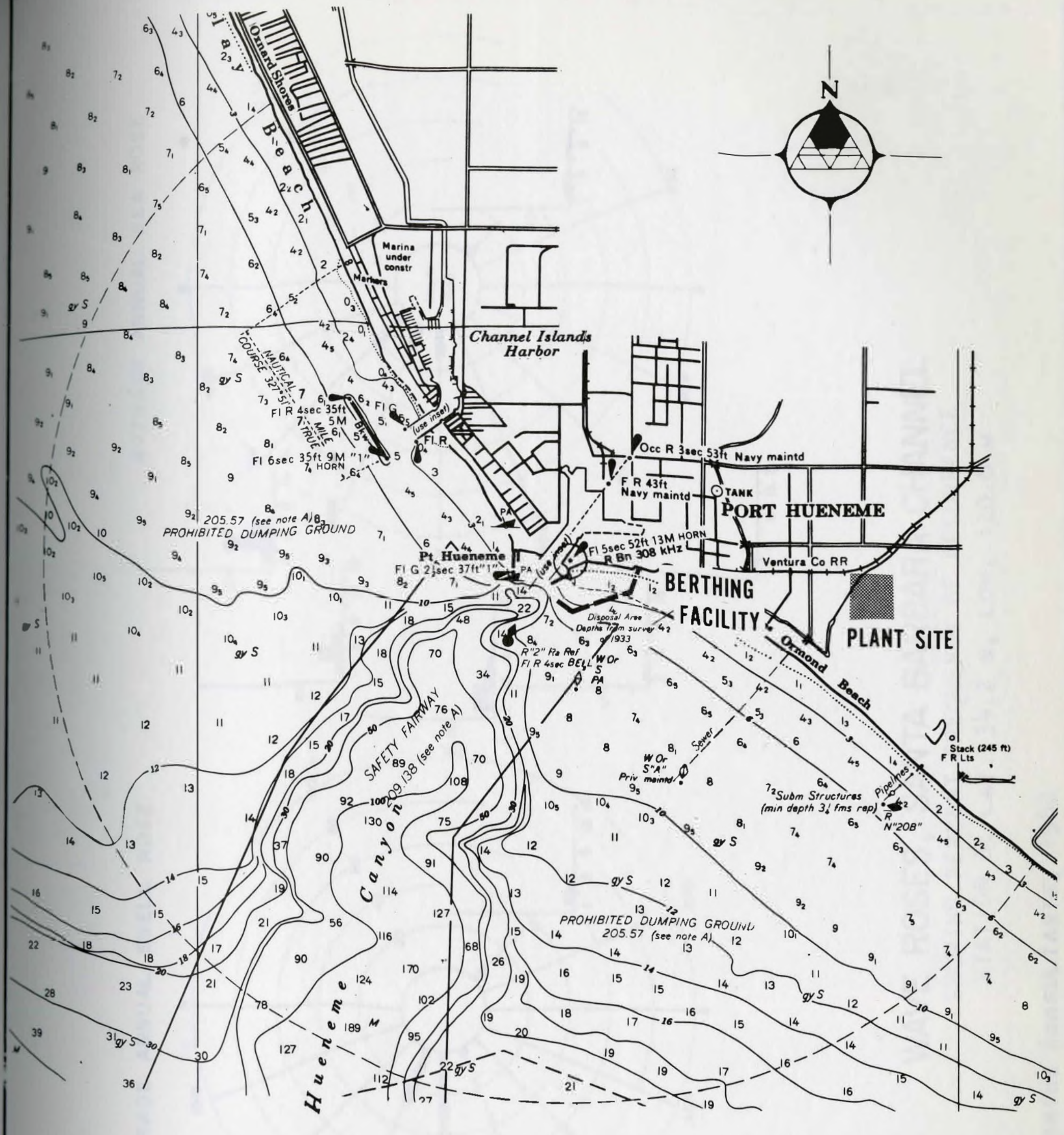
SCALE IN NAUTICAL MILES

DEPTH CONTOURS IN FEET

REFERENCE: JEN, 1969

DAMES & MOORE

PLATE 2.4.3-22



DETAIL BATHYMETRY OF THE VICINITY OF THE PROPOSED MARINE TERMINAL

0 1 2

SCALE IN NAUTICAL MILES

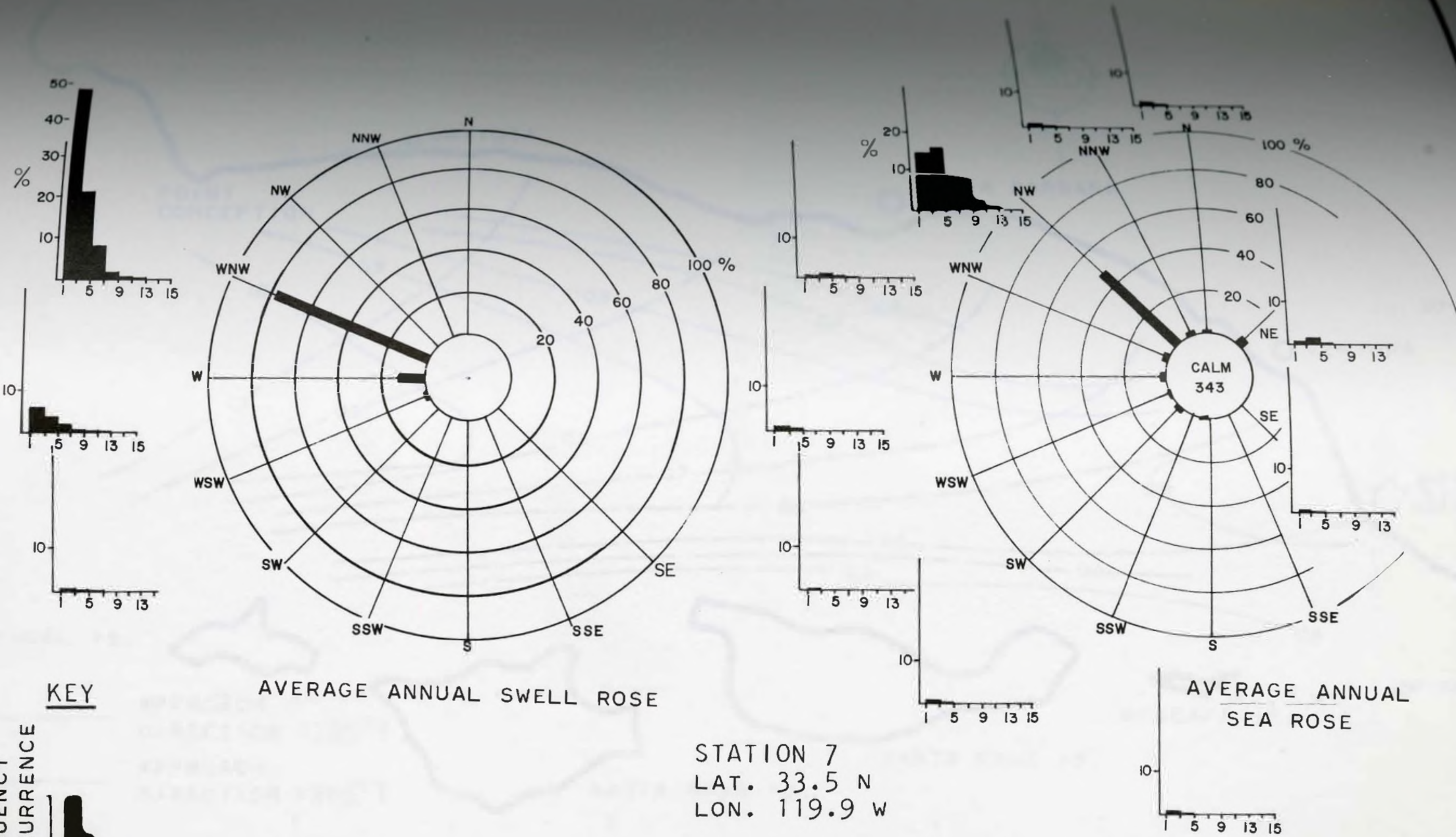
SOUNDINGS IN FATHOMS

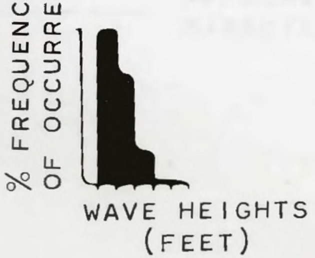
(FATHOMS AND FEET TO 11 FATHOMS)

REFERENCE: U.S. DEPARTMENT OF COMMERCE, 1973

DAMES & MOORE

PLATE 2.4.3-23



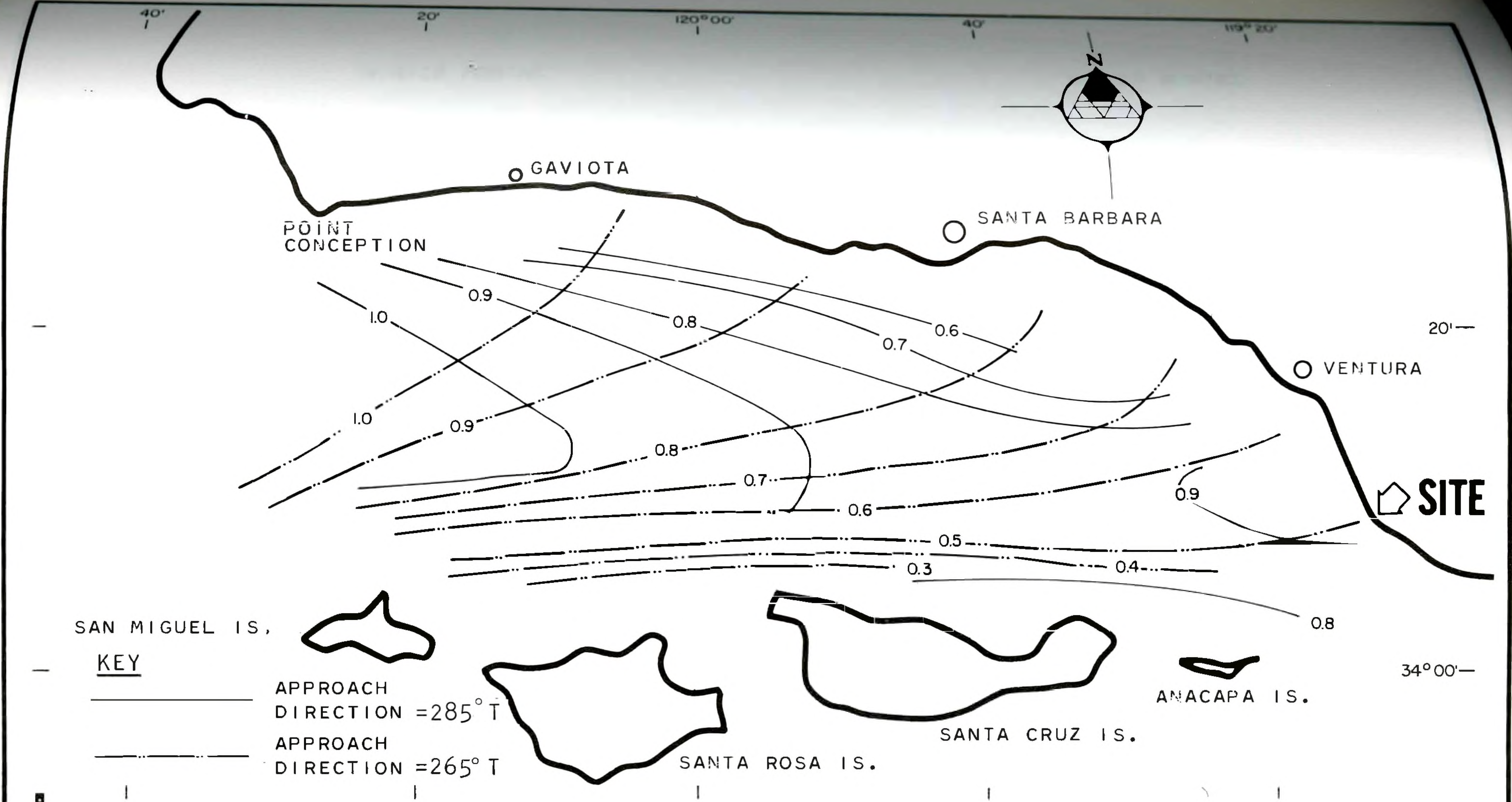


WAVE ROSES, SANTA CRUZ BASIN

SHOWING PERCENT FREQUENCY OF OCCURRENCE

STATION 7: LAT. 33.5 N, LON. 119.9 W

REFERENCE: NATIONAL MARINE CONSULTANTS, 1960



RELATIVE WAVE HEIGHTS FOR WESTERLY SWELL

IN SANTA BARBARA CHANNEL

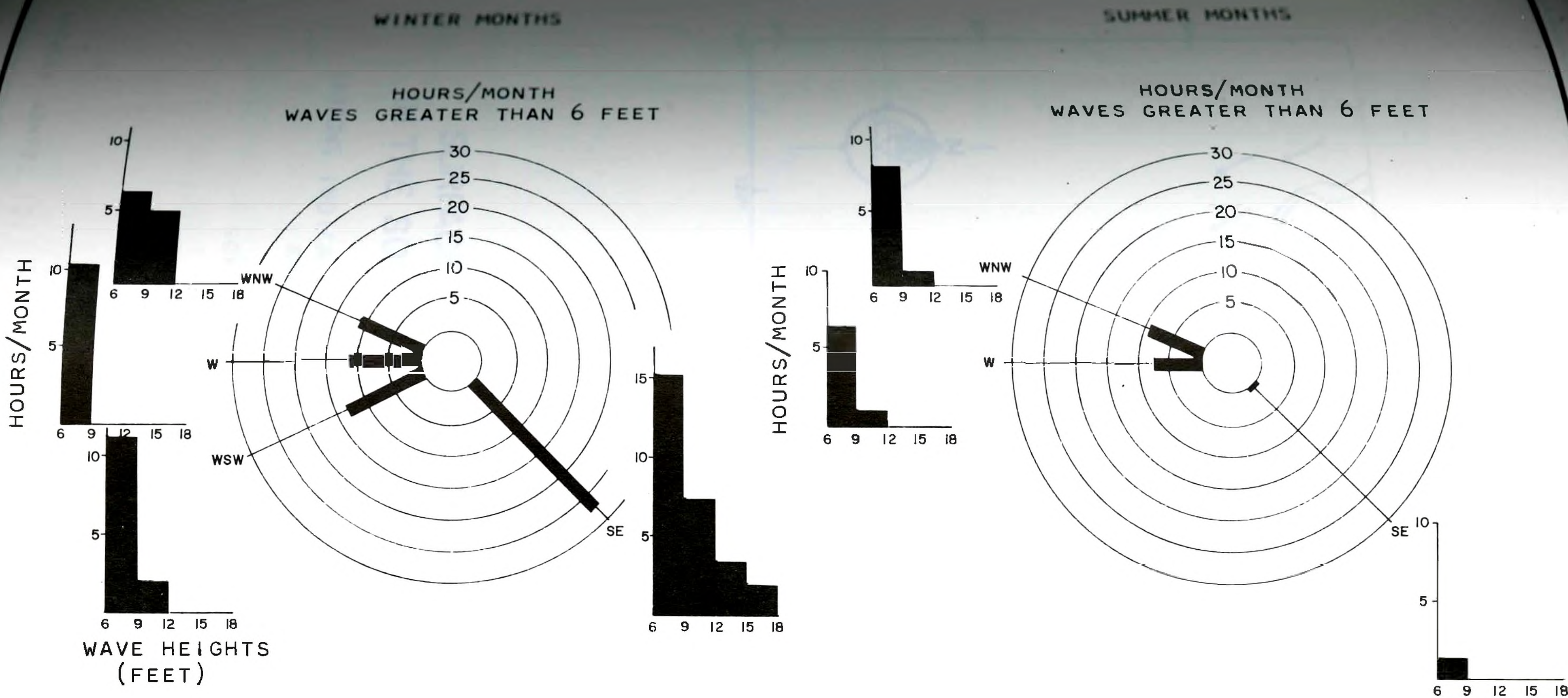
0 10 20 30

SCALE IN STATUTE MILES

REFERENCE: OCEANOGRAPHIC SERVICES INC., 1969

DAMES & MOORE

PLATE 2.4.3-26



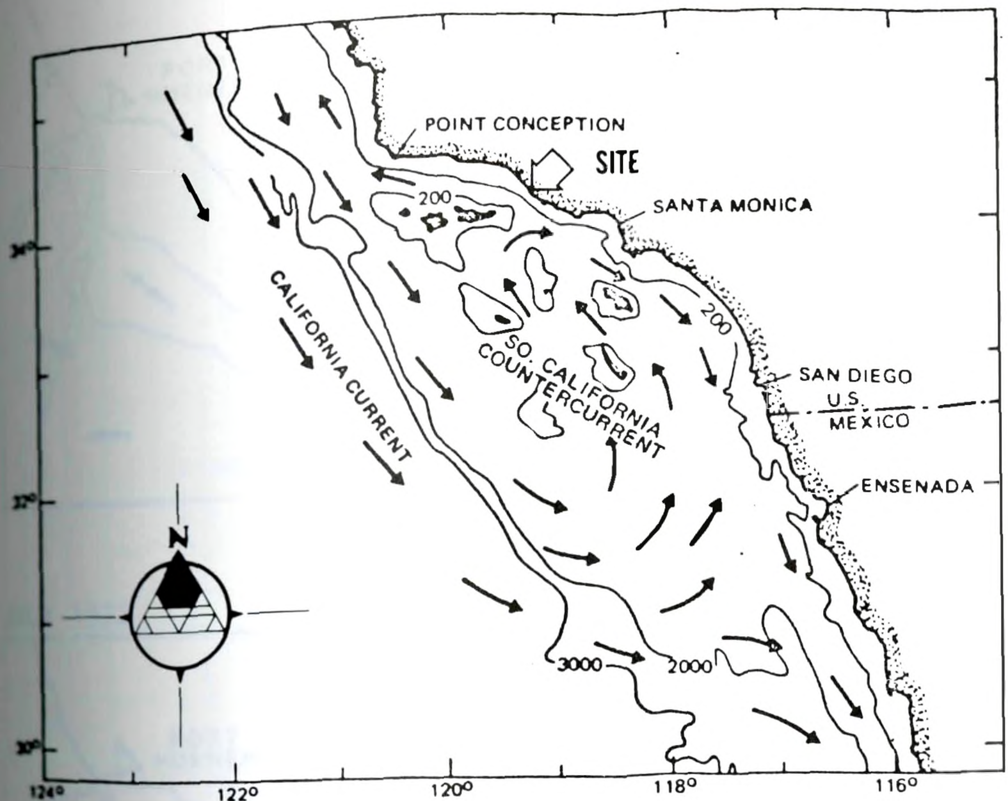
WAVE ROSES, ORMOND BEACH

SHOWING AVERAGE DURATION IN HOURS/MONTH

REFERENCE: OCEANOGRAPHIC SERVICES, INC., 1971

DAMES & MOORE

PLATE 2.4.3-27



SURFACE CIRCULATION (0-100m) IN THE SOUTHERN CALIFORNIA BIGHT

(ARROWS INDICATE APPROXIMATE DIRECTION OF FLOW)

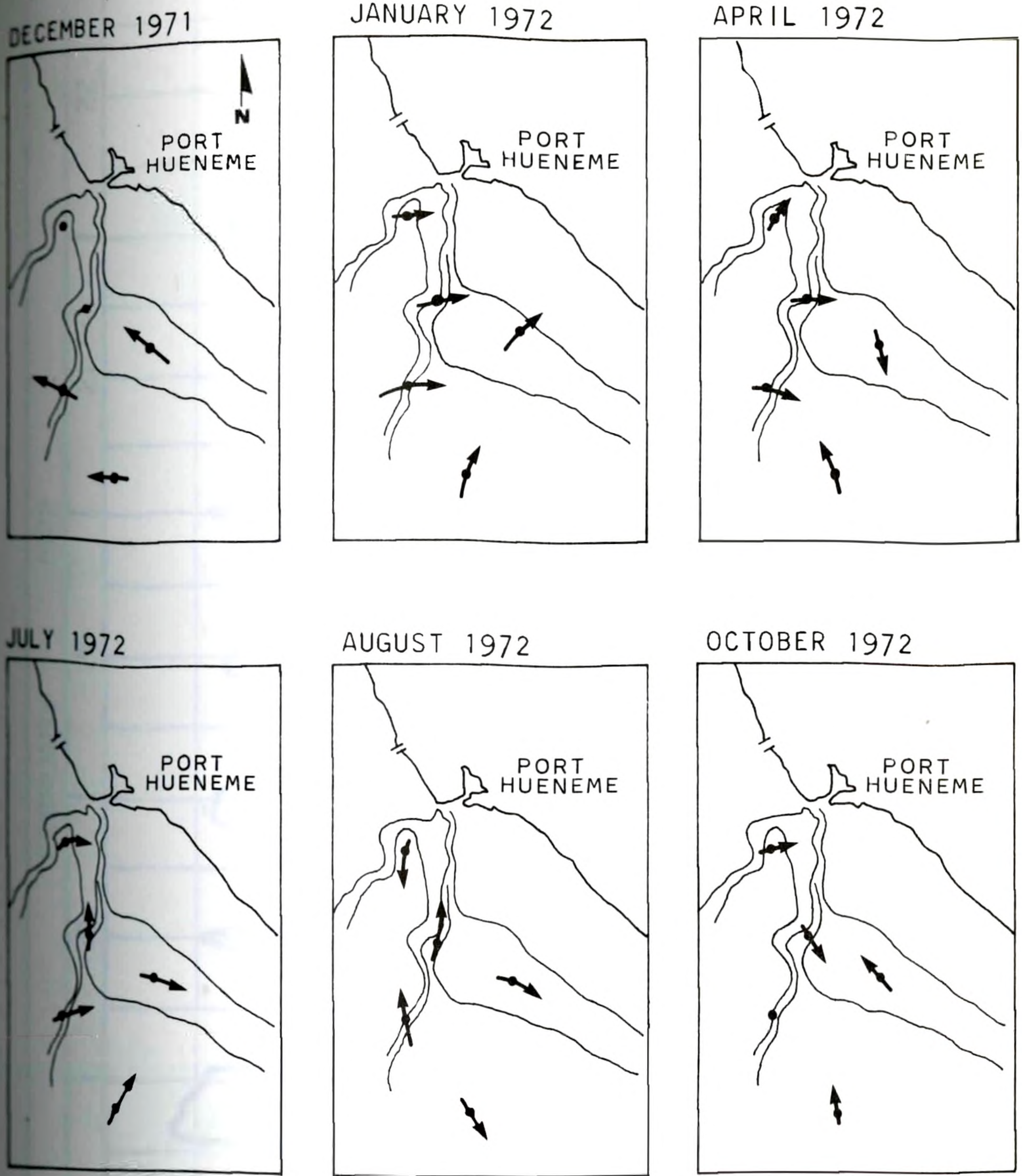
DEPTH IN METERS

0 100 200

SCALE IN KILOMETERS

REFERENCE: JONES, 1971

DAMES & MOORE



KEY

• NO MEASURABLE CURRENT

⟶ DIRECTION OF MEASURED CURRENT

GENERALIZED SURFACE WATER CIRCULATION
OXNARD OCEANOGRAPHIC SURVEY

REFERENCE: ENGINEERING SCIENCE, INC., 1972

BOTTOM CURRENTS AND ASTRONOMICAL TIDE

REFERENCE: KOLPACK AND STRAUGHAN, 1972

TABLE 2.4.3-IV

WAVE OBSERVATIONS

SANTA BARBARA CHANNEL-PORT HUENEME

(34° to 34.5° N, 119° to 119.50 W)

Month	Percent of Wave Height Greater Than		
	2 ft	6 ft	9 ft
Jan	40	6	<5
Feb	35	5	-
Mar	55	10	6
Apr	45	5	-
May	55	14	7
Jun	45	<5	-
Jul	40	-	-
Aug	40	<5	-
Sep	41	<5	-
Oct	41	<5	-
Nov	37	5	-
Dec	39	<5	-

Reference: National Weather Service Environmental Detachment, 1971.

TABLE 2.4.3-V

DIURNAL RESULTANT CURRENTS - PORT HUENEME

		December 1971		February 1972		April 1972		July 1972		August 1972		October 1972	
Station*	Depth (ft)	Speed (ft/sec)	Direction (°MN)	Speed (ft/sec)	Direction (°MN)	Speed (ft/sec)	Direction (°MN)	Speed (ft/sec)	Direction (°MN)	Speed (ft/sec)	Direction (°MN)	Speed (ft/sec)	Direction (°MN)
1	3.3			0.17	68	0.12	353	0.12	76	0.16	146	0.05	71
	224.0			0.09	133	0.32	210	0.05	325	0.03	287	0.03	173
	436.0			0.15	20	0.18	194	0.01	16	0.02	354	0.04	274
2	3.3			0.38	61	0.19	54	0.14	322	0.53	341	0.10	152
	56.0			0.24	357	0.34	312	0.04	339	0.03	221	0.01	14
	120.0			0.19	318	0.13	351	0.02	316	0.04	235	0.03	46
4	3.3	0.22	277	0.60	59	0.15	104	0.21	41	0.17	304	0.01	130
	139.0	0.22	143	0.28	56	0.13	279	0.08	70	0.05	261	0.01	271
	289.0	0.40	178	0.43	342	-	-	0.02	179	0.03	260	0.05	271
5	3.3	0.55	298	0.19	357	0.22	160	0.42	98	0.17	84	0.19	321
	34.2	0.35	300	0.14	333	0.12	138	0.45	112	0.25	137	0.21	269
	65.6	0.27	238	0.22	345	0.09	139	0.30	134	0.27	119	0.27	237
8	3.3	0.13	243	0.23	353	0.61	333	0.74	2	0.47	147	0.33	337
	83.7	0.20	271	0.85	342	0.11	282	0.10	325	0.25	127	0.32	302
	170.5	0.16	176	0.38	283	0.09	200	0.05	286	0.18	107	0.24	283

*Stations shown on Plate 2.4.3-31

Reference: Engineering Science, Inc., 1972.

TABLE 2.4.3-VI

MAJOR TSUNAMIS AT PORT HUENEME FOR THE PERIOD 1946-1964

Date	Earthquake Epicenter Location	Earthquake Magnitude (Richter Scale)	Tsunami Amplitude (feet)
4-1-46	Aleutian Islands	7.25	5.5
11-4-52	Kamchatka	8.50	4.7
3-9-57	Aleutian Islands	8.50	3.5
5-22-60	Chilean Coast	8.50	8.8
3-28-64	Prince William Sound	8.33	5.9*

*Recorded at Rincon Island, guage limit exceeded

Reference: Berkman and Symons, 1964; Spaeth and Berkman, 1967.

TABLE 2.4.3-VI

2.4.3.4 Ocean Water Quality

Introduction

A number of previous studies have been conducted on the chemical and physical properties of the coastal waters in the vicinity of the proposed project. The discussion here draws upon the findings of these studies. Pertinent data have been obtained from the following sources:

1. Sea surface temperature records which have been measured daily for the past 34 years by the U.S. Coast Guard at the Port Hueneme Light Station (U.S. Coast and Geodetic Survey, 1967).

2. Six quarterly oceanographic surveys from August 1969 through October 1971 at 20 stations in depths of 10 to 40 feet (Intersea Research Corp., 1972).

3. Six bimonthly oceanographic surveys from December 1971 through November 1972 at eight stations in depths of 75 to 900 feet (Engineering-Science, Inc., 1972).

4. Monthly monitoring surveys from January 1972 through August 1973 (Oxnard Municipal Treatment Plant, 1973).

5. Monthly monitoring surveys from January 1972 through August 1973 (Port Hueneme Municipal Treatment Plant, 1973).

The locations of the survey stations and transects for these investigations are shown on Plate 2.4.3-31, with the exception of the U.S. Coast Guard temperature measurements, which are taken near the present south jetty of Port Hueneme Harbor. Data for Station P, one of the four observation sites utilized by the Oxnard Municipal Treatment Plant 1972 survey, and Station 5, one of the monitoring stations of the Engineering-Science, Inc. survey (Plate 2.4.3-31) are presented in this section in more detail because they lie directly offshore of the storage and vaporization site.

In addition to these earlier investigations, two samples of seawater from the vicinity of the proposed dredging and disposal site were collected during this investigation and have been analyzed for many water quality parameters.

Water Characteristics

Temperature. Ambient temperatures of the coastal waters adjacent to the Port Hueneme and Oxnard area are a function of seasonal changes in hydrographic climate of the Southern California Bight, as well as fluctuations in solar heating, nocturnal radiation, evaporation, and the mixing effect of wind and waves.

Temperature data collected by the U.S. Coast Guard (U.S. Coast Geodetic Survey, 1967) over a 34-year period at Port Hueneme are summarized on Plate 2.4.3-32. Average monthly surface temperatures are typically at a minimum in February and are approximately 56° F; maximum average monthly surface temperatures reach approximately 62° F in September.

The available data indicate that there is little surface variation of temperature (less than 4° F) for both the nearshore and offshore waters during the winter months. Vertical temperature profiles during winter months are characterized by small gradients (Plate 2.4.3-33).

Early spring is marked by the inflow of colder bottom water into the canyon with the water column becoming moderately stratified. Thermoclines in the nearshore waters ordinarily occur between 10- and 30-foot depths (Intersea Research

Corporation, 1972). During the February-March 1972 survey, Engineering-Science, Inc. (1972), measured colder water (approximately 42° F) in the bottom of Hueneme Canyon while the mean surface water temperature was about 54° F over the adjacent shelf.

Areal differences in surface temperatures become more pronounced during the summer, with temperature differences as large as 9° F (Engineering-Science, Inc., 1972). The warmest waters during the summer have been recorded in August and September. Mean surface temperatures measured by Marine Advisers, Inc. in August 1969 and July 1970 were approximately 64° F and 60° F, respectively (Intersea Research Corp., 1972). A strong thermocline also develops during the summer months between the 20- and 50-foot depths in the nearshore waters (Plate 2.4.3-33).

During the fall months there is a transition period during which the water temperatures gradually decrease to winter levels.

Sea surface temperatures recorded during the recent surveys are within the historical monthly ranges recorded by the U.S. Coast Guard (Plate 2.4.3-32). Temperature data from Stations P and 5, as studied by the Oxnard Municipal Treatment Plant personnel and by Engineering-Science, Inc., respectively, have been linearly interpolated in Table 2.4.3-VII to show the average temperature differences between a depth of 15 feet at Station P and a depth of 50 feet at Station 5.

Salinity. The salinity of the Port Hueneme-Oxnard nearshore waters is potentially influenced by 1) stream and storm water runoff, 2) mixing with waters from the open ocean,

3) evaporation, and 4) waste discharges. The ocean waters offshore of Port Hueneme and Oxnard are not significantly influenced by these factors and are consequently relatively constant, averaging 33.6 parts per thousand (ppt) (Allan Hancock Foundation, 1965; Southern California Coastal Water Research Project, 1973).

Salinities measured during an 8-year period at the Port Hueneme Harbor Light Station averaged between 32.93 and 33.58 ppt (as reported by Intersea Research Corporation, 1972). The nearshore waters are essentially isohaline (having uniform salinity) during the winter months. Average salinities are also relatively constant in the spring, increasing slightly with increasing depth. Haloclines (marked increase in salinity with a small increase in depth) appear during the summer at depths corresponding to the thermoclines, and the bottom waters in the canyon exhibit a sharp increase in salinity. During the fall, the water column returns to a normal isohaline condition (Engineering-Science, Inc., 1972).

pH. Data on pH were collected in the nearshore waters during 1971 and 1972 (Engineering-Science, Inc., 1972). The values recorded range from 7.7 to 9.1. During fall and winter the pH generally decreases with depth. The data also indicate that during the spring and summer the waters in the canyon have lower pH values than on the adjacent shelf. The highest pH values have been recorded near the Oxnard Municipal Treatment Plant outfall. The values in the open ocean generally range from about 8.3 at the surface to 7.7 in deeper subsurface waters.

Dissolved Oxygen (DO). Dissolved oxygen is a principal indicator of water quality. DO levels in the water column are influenced by 1) mixing with open ocean water, 2) rates of diffusion across the air-water interface, 3) rates of oxygen consumption and production by living organisms, and 4) absorption and generation rates associated with other chemical reactions. The amount of DO which can be contained in any given body of water varies with the temperature, salinity, impurities, and barometric pressure.

The shallow coastal waters in the vicinity of Port Hueneme and Oxnard are similar to the open ocean in that both are normally at or near saturation and occasionally become supersaturated with dissolved oxygen. In general, higher DO concentrations exist in water depths of less than 50 feet than in the deeper canyon waters.

Monthly surface DO concentrations over an annual cycle vary from 6.1 to 10.3 mg/l in the inshore waters (Oxnard Municipal Treatment Plant, 1973) while the surface waters further offshore and in the canyon area averaged 7.8 to 8.9 mg/l (Engineering-Science, Inc., 1972). The values fall within the range measured during the 2-year study of the inshore waters by Intersea Research Corporation (1972). The values recorded during the study varied from 4.2 to 11.1 mg/l with averages from 7.3 to 9.6 mg/l. The bottom waters in the canyon have average values ranging from 4.1 to 6.0 mg/l, which are less than the bottom water DO concentrations of 5.6 to 7.8 mg/l for the adjacent shelf (Engineering-Science, Inc., 1972).

Dissolved oxygen data from Station P and Station 5, monitored by Oxnard Municipal Treatment Plant personnel and Engineering-Science, Inc., respectively, have been summarized in Table 2.4.3-VIII to show the average differences between a depth of 15 feet at Station P and a depth of 50 feet at Station 5.

Inorganic Nutrients. The common inorganic nutrients considered to be necessary for organic productivity are nitrogen, phosphorus, and dissolved silica. The biologically available forms of nitrogenous nutrients are nitrate, nitrite, and ammonia.

A biological and oceanographic survey of the Santa Barbara Channel was conducted in 1969 and 1970 (Kolpack, 1971). The surface water nutrient concentrations of certain nutrients were measured, and it was found that the highest values occurred in May and the lowest in December. Also, the distribution of nutrients is related to circulation patterns in the area.

Two subsequent oceanographic surveys conducted offshore of Port Hueneme in the winter of 1971-72 (Kolpack and Straughan, 1972) also measured surface nutrients and obtained values comparable to those of the 1969 surveys. The results of all of these surveys are presented in Table 2.4.3-IX. The 1969 surveys were obtained after an oil spill which affected almost the entire Santa Barbara Channel and may not, therefore, be representative of natural nutrient concentrations. Substantial seasonal changes in nutrient concentrations can be expected as a result of seasonal variations in upwelling.

Trace Metals. An analysis of metals and certain refractory materials in the waste waters coming from the Port

Hueneme and Oxnard Municipal Treatment Plant is given below in Ocean Discharges. Data which are available for the "J" Street drain are also presented below in Ocean Discharges.

Trace metals found in the sediments of the area are discussed in Section 2.1.2.3.

Transparency. The transparency of the water is an indication of the amount of particulate matter in suspension. The greater the amount of suspended material the lower the transparency. The transparency of the nearshore waters in the vicinity of Port Hueneme and Oxnard is affected by the Oxnard and Port Hueneme outfalls and the biennial sand-bypassing operations at the harbor, as well as naturally induced particulate suspension of material due to wave action, runoff, currents, upwelling, and biological activity.

Secchi disc readings taken during the Oxnard and the Port Hueneme monitoring programs of 1972 indicate that the transparency of the nearshore waters can vary between 2.5 and 10.0 meters (Oxnard Municipal Treatment Plant, 1973; Port Hueneme Municipal Treatment Plant, 1973). These waters are generally more turbid than ocean waters of the Southern California Bight which vary in transparency from 6 to 15 meters (Allan Hancock Foundation, 1965).

Transmissometer measurements taken during 1972 indicated that during the fall and winter, transparency of the water column is fairly constant along this section of coast, with the light transmission being generally greater than 50 to 60 percent (Engineering-Science, Inc., 1972). During the spring and summer the transparency of the water column is less uniform. Light transmission measurements tend to show an increase in transparency with increasing depth.

Ocean Discharges

There are five effluent discharges into the Pacific Ocean in the Port Hueneme-Oxnard area. They are from: 1) the Port Hueneme Municipal Treatment Plant; 2) the Oxnard Municipal Treatment Plant; 3) the Ormond Beach Generating Station; 4) the "J" Street drain; and 5) the Channel Islands Harbor biennial maintenance dredging program. The treatment plant and generating station discharges are continuous, while the "J" Street drain is seasonal.

Port Hueneme Municipal Treatment Plant. The Port Hueneme facility is a primary treatment plant which serves the community of Port Hueneme and the U.S. Naval Construction Battalion Center. The outfall from the facility is located approximately one nautical mile south of the Port Hueneme Harbor south jetty. It is a gravity-fed outfall, 5,200 feet long, terminating at a depth of approximately 50 feet below mean lower low water with a multi-port diffuser (Plate 2.4.3-31).

The outfall discharges 3 to 4 million gallons per day (mgd) of wastewaters. Due to an equipment failure, the waste sludge has been trucked to a sanitary landfill for the past year (Finnigan, 1973). The Port Hueneme plant is scheduled to be linked with the Oxnard plant in the near future. Table 2.4.3-XI shows a monthly analysis of the effluent from the plant, and Table 2.4.3-XII shows the results of an analysis of metals and certain refractory materials in the effluent. The Port Hueneme Municipal Treatment Plant discharged an average of 7,400 pounds per day of biochemical oxygen demand (BOD-5 day), and 2,750 pounds per day of suspended solids during 1972.

Oxnard Municipal Treatment Plant. The Oxnard facility is a primary treatment plant which serves the community of Oxnard. The outfall from the facility is located approximately 1.5 nautical miles downcoast of the Port Hueneme Harbor south jetty. It is a gravity-fed outfall, extending a distance of 6,000 feet from the shore to a depth of 50 feet (MLLW), terminating in a 400-foot multiport diffuser (Ciango, 1973).

The treatment plant processes between 11 and 12 mgd of waste water. Table 2.4.3-XIII shows a monthly analysis of the effluent from the plant, and Table 2.4.3-XIV shows the results of an analysis of the effluent. The Oxnard plant discharged an average of 11,600 pounds per day of BOD (5 day) and 7,800 pounds per day of suspended solids in 1972.

Ormond Beach Generating Station. There are two electrical generating units at the Ormond Beach facility, each of which is rated at 850 megawatts. These units are presently operating at a peak output of 650 megawatts each.

The cooling system at the Generating Station presently utilizes approximately 476,000 gallons per minute of sea water. Under full operating load the temperature of the cooling water would be raised 30° F. Presently, with both units operating at an output of 650 megawatts, the cooling water temperatures are increased by a maximum of 23° F (Ricket, 1973). Temperatures decrease proportionately with decreases in power output.

The cooling water intake pipe extends approximately 2,600 feet from shore to a depth of 37 feet (MLLW) (Plate 2.4.3-31).

An intake structure rises vertically from the point on the ocean bottom to a depth of 23 feet (MLLW) and is covered with a velocity cap. The discharge pipe extends approximately 2,000 feet from shore to a depth of 32 feet (MLLW) and rises vertically to a depth of 15 feet (MLLW) (Ricket, 1973).

Drainage Channels

The three major drainage channels in the Port Hueneme-Oxnard area are the Hueneme drain, the "J" Street drain, and the Oxnard Industrial Drain (see Plate 2.4.3-31 for locations). These drains convey storm water runoff from urban and agricultural areas and groundwater from a perched water table. The three drains meet at Ormond Beach where the Port Hueneme drain and the Oxnard Industrial Drain are pumped into the "J" Street drain. The "J" Street drain then discharges across the beach into the surf zone (Workman, 1973).

Neither the volume of water carried by these drains nor the water's quality are monitored on a regular basis. The available data describing the quality of the waters carried in the Hueneme drain and Oxnard Industrial Drain are presented in Tables 2.4.3-XV and 2.4.3-XVI, respectively. Measurements, taken after storms, of the flow in the "J" Street drain at the Pacific Ocean are shown in Table 2.4.3-XVII (Quinn, 1973).

Channel Islands Harbor Maintenance Dredging Program. The Channel Island Harbor sand trap, which was constructed in 1961, is dredged biennially (every 2 years) in order to replenish sand on the beaches downcoast of the Port Hueneme Harbor. The sand is dredged using a hydraulic dredge and is pumped through a submerged pipeline, across both the Channel Islands Harbor and Port Hueneme Harbor mouths, and is discharged over approximately 1.5 miles of beach beginning at the south jetty of Port Hueneme Harbor. The discharge is composed of dredged sediment and seawater in a ratio of approximately 1 to 5. The discharge pipe is located on the beach with the discharge itself occurring in the surf zone to a depth of approximately 15 feet (MLLW).

Approximately 2.5 million cubic yards of sand are scheduled to be removed from the Channel Island Harbor sand trap early in 1974. The approximate volumes of sand which have been dredged since the maintenance program began are shown in Table 2.4.3-XVIII (Fuquay, 1973).

Present Study

Seawater samples were collected from the site of the proposed berthing facility on September 18 and December 11, 1973. The samples were chemically analyzed and served as a control for sediment and seawater elutriation experiments, the results of which will be presented in Section 3.1.2. The water quality parameters determined on the seawater itself represent baseline conditions at the time they were collected and are presented in Table 2.4.3-X.

The results of these analyses are compatible with earlier findings where similar parameters were estimated. The levels of phosphate and nitrate compare well with those found by Kolpack (1971) and Kolpack and Straughan (1972), as shown in Table 2.4.3-IX. Other parameters, including trace metal levels are generally within limits found in seawater samples from other regions.

Results of the seawater analyses indicate that the existing quality of the water is normal. There are no obvious signs of pollution such as abnormally high concentrations of organic materials, nutrients, or metals.

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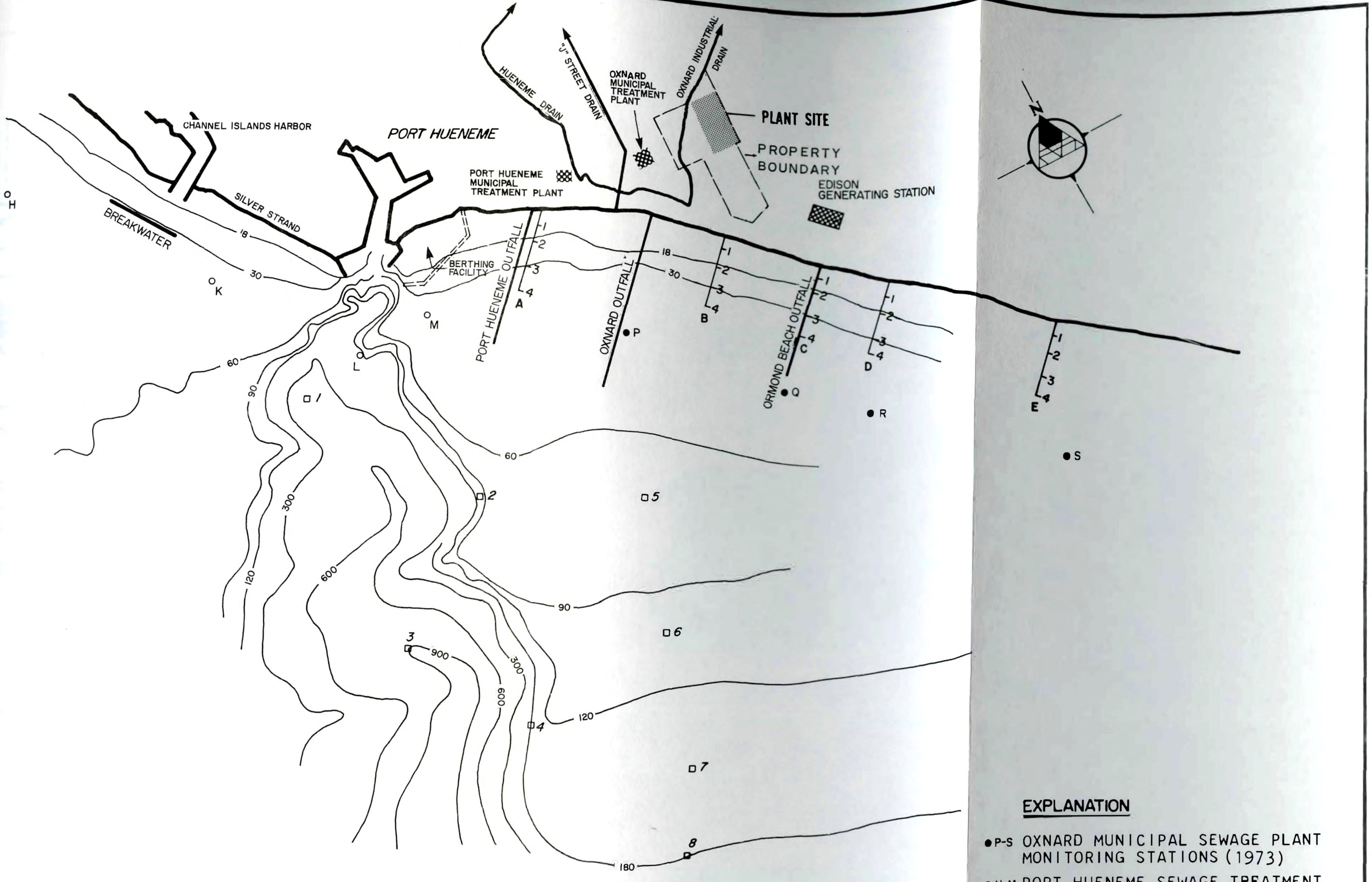


OCEANOGRAPHIC MONITORING STATIONS

DEPTH IN FEET

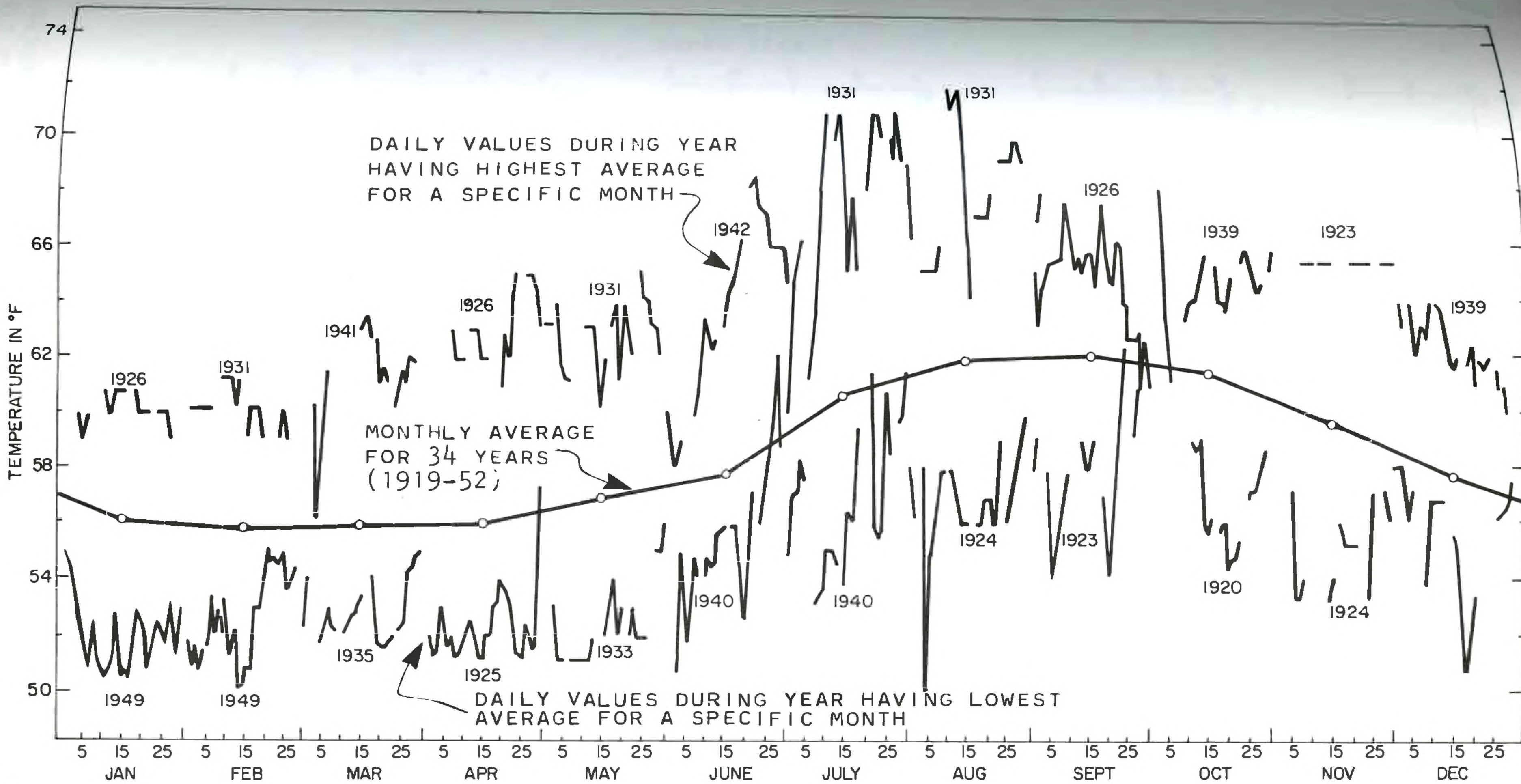
0 1/2 1

SCALE IN NAUTICAL MILES

EXPLANATION

- ● P-S OXNARD MUNICIPAL SEWAGE PLANT MONITORING STATIONS (1973)
- ○ H-M PORT HUENEME SEWAGE TREATMENT PLANT MONITORING STATIONS (1973)
- □ 1-8 ENGINEERING-SCIENCE INC. MONITORING STATIONS (1972)
- 1-4, A-E MARINE ADVISERS INC. MONITORING STATIONS (INTERSEA RESEARCH, 1972)

DAMES & MOORE

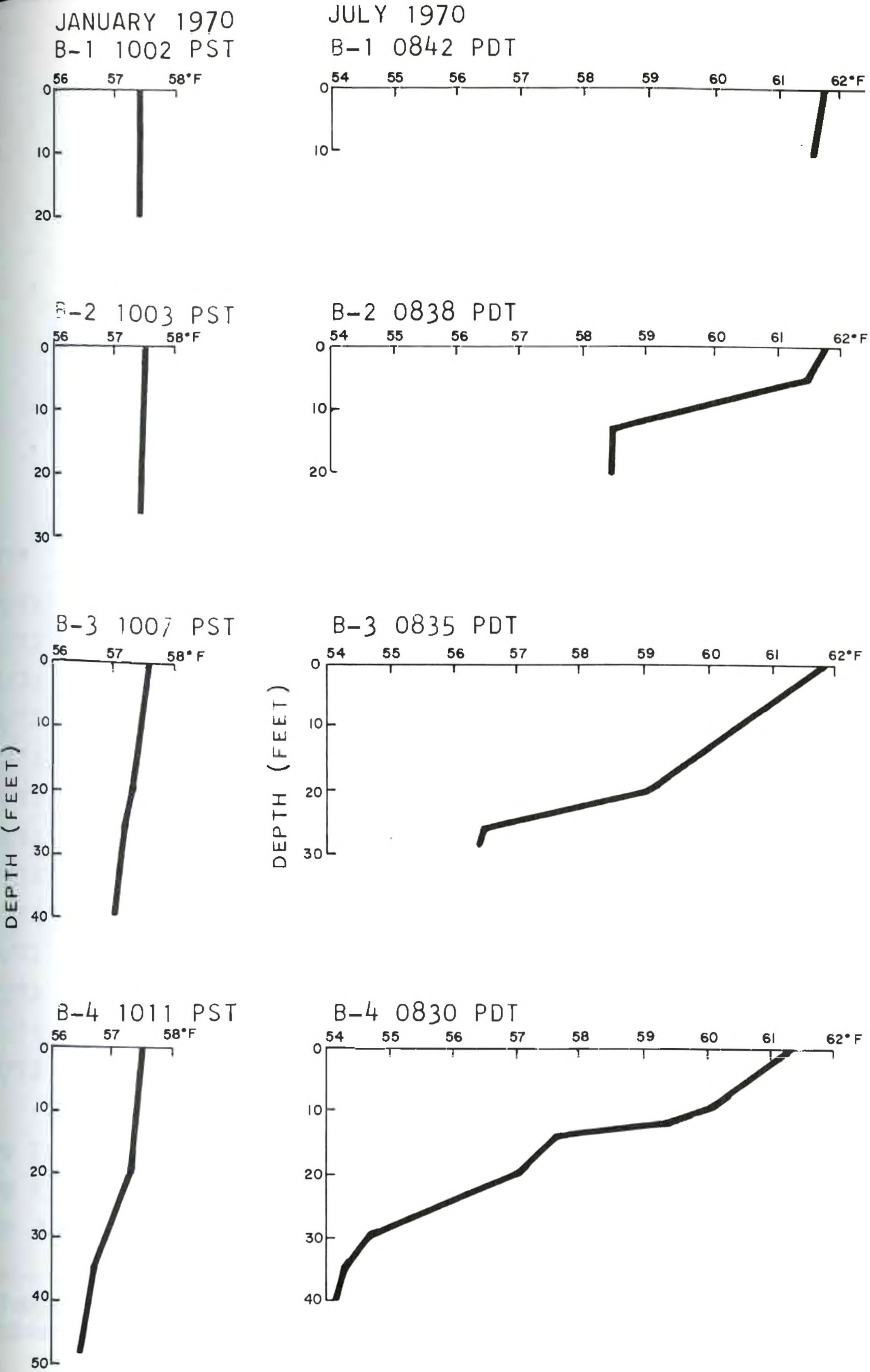


SEA SURFACE TEMPERATURES AT PORT HUENEME PIER

REFERENCE: INTERSEA RESEARCH, 1972

DAMES & MOORE

PLATE 2.4.3-32



TYPICAL WINTER AND SUMMER TEMPERATURE PROFILES

REFERENCE: INTERSEA RESEARCH, 1972
(SEE PLATE 2.4.6-1 FOR STATION LOCATIONS)

TABLE 2.4.3-VII

MONTHLY AVERAGE OCEAN WATER TEMPERATURES

Date	Temperature Degrees F Station P[1]	Temperature Degrees F Station 5[2]	Temperature Difference
12/71		52.2	
1/72	54.1		
2/72	55.0	53.6	1.4
3/72	57.5		
4/72	52.8	51.8	1.0
5/72	59.0		
6/72	55.4		
7/72	61.4	58.5	2.9
8/72	60.8	56.7	5.1
9/72	60.1		
10/72	58.4		
11/72	61.4	60.3	1.1
12/72	61.0		

Avg T, Sta P = 58.1 degrees F

Avg T, Sta 5 = 55.4 degrees F

Avg Δ T, = 2.7 degrees F

[1]Temperature at 15-foot depth, Reference Oxnard Municipal Treatment Plant, 1973.

[2]Temperature at 50-foot depth, Reference Engineering-Science, Inc., 1972.

(see Plate 2.4.3-31 for station locations)

TABLE 2.4.3-VIII

MONTHLY AVERAGE DISSOLVED OXYGEN CONCENTRATIONS

Date	D.O.[1] at 15 ft.	D.O.[2] at 50 ft.
12/71		8.1
1/72	10.2	
2/72	8.9	6.9
3/72	9.5	
4/72	7.3	5.8
5/72	9.0	
6/72	6.0	
7/72	7.0	7.0
8/72	7.5	7.8
9/72	8.1	
10/72	7.4	
11/72	7.9	7.8
12/72	8.1	

[1] Station P, Reference: Oxnard Municipal Treatment Plant, 1973.
[2] Station 5, Reference: Engineering-Science, Inc. 1972.

(see Plate 2.4.3-31 for station locations)

TABLE 2.4.3-IX

SURFACE WATER NUTRIENTS

	Silicate mg/l	Phosphate mg/l	Nitrite mg/l	Nitrate mg/l
May 1969				
Offshore Port Hueneme	0.42	0.09	0.01	0.25
Range for Santa Barbara Channel	0.12-0.96	0.05-0.12	0.01-0.04	0.06-0.74
August 1969				
Offshore Port Hueneme	0.03	0.02	0	0
Range for Santa Barbara Channel	0.03-0.42	0.02-0.07	0-0.02	0-0.43
December 1969				
Offshore Port Hueneme	0.15	0.04	0	0.02
Range for Santa Barbara Channel	0.12-0.21	0.03-0.04	0-0.02	0.02-0.12
December 1971				
Offshore Port Hueneme	0.37	0.07	0.03	
January 1972				
Offshore Port Hueneme	0.23	0.05	0.03	

Reference: Kolpack, 1971 (May, August, and December, 1969 surveys).
Kolpack and Straughan, 1972 (December 1971 and January 1972 surveys).

TABLE 2.4.3-X

CHEMICAL PROPERTIES OF SEAWATER FROM VICINITY OF PROPOSED DREDGING AND DISPOSAL AREA

	Seawater Collected 9/18/73	Seawater Collected 12/11/73	Mean
Suspended Solids (mg/l)	32.5	19.0	25.8
Settleable Solids (mg/l)	N.D.[1]	N.D.[1]	N.D.[1]
Total Solids (%)	3.45	3.93	3.69
Total Volatile Solids (%)	0.41	0.74	0.58
Oil and Grease (mg/l)	0.9	0.1	0.5
Turbidity (JTU)	0.75	1.00	0.88
pH	8.13	8.09	8.11
Sulfur (mg/l)	N.D.[1]	N.D.[1]	N.D.[1]
Sulfide (mg/l)	N.D.[2]	0.24	0.12
Total Phosphates (mg/l)	0.027	0.045	0.036
Orthophosphates (mg/l)	*	N.D.[1]	-
Silicates (mg/l)	*	0.54	-
Total Organic Carbon (mg/l)	20	6	13
Ammonia Nitrogen (mg/l)	N.D.[3]	N.D.[3]	N.D.[3]
Organic Nitrogen (mg/l)	0.04	N.D.[3]	0.02
Nitrate Nitrogen (mg/l)	0.26	0.14	0.20
Nitrite Nitrogen (mg/l)	*	0.001	-
Total Kjeldahl Nitrogen (mg/l)	0.04	N.D.[3]	0.02
Immediate Oxygen Demand (mg/l)	N.D.[4]	N.D.[4]	N.D.[4]
Biochemical Oxygen Demand (mg/l)	1.0	2.0	1.5
Chlorinated Hydrocarbons (mg/l)	N.D.[5]	N.D.[5]	N.D.[5]
Total Phenols (mg/l)	N.D.[6]	N.D.[6]	N.D.[6]
Arsenic (μg/l)	N.D.[7]	N.D.[7]	N.D.[7]
Beryllium (μg/l)	0.2	0.1	0.2
Cadmium (μg/l)	0.45	0.03	0.24
Chromium (μg/l)	4	3.0	3.5
Copper (μg/l)	7	3.0	5.0
Lead (μg/l)	9	0.3	4.7
Mercury (μg/l)	N.D.[8]	N.D.[8]	N.D.[8]
Nickel (μg/l)	6	1.9	4.0
Selenium (μg/l)	4	2.9	3.5
Silver (μg/l)	3.8	2.7	3.3
Vanadium (μg/l)	N.D.[9]	N.D.[9]	N.D.[9]
Zinc (μg/l)	30	13.9	22.0

*Not analyzed.

N.D.[1]: None detected, <0.01 mg/l
N.D.[2]: None detected, <0.08 mg/l
N.D.[3]: None detected, <0.035 mg/l
N.D.[4]: None detected, <0.2 mg/l
N.D.[5]: None detected, <0.0005 mg/l (p,p'-DDE)
<0.001 mg/l (p,p'-DDT)
<0.001 mg/l (o,p'-DDT)
<0.005 mg/l (PCB)

N.D.[6]: None detected, <0.8 mg/l
N.D.[7]: None detected, <4.0 μg/l
N.D.[8]: None detected, <0.05 μg/l
N.D.[9]: None detected, <2.5 μg/l

TABLE 2.4.3-XI

MONTHLY SUMMARY OF PORT HUENEME MUNICIPAL TREATMENT PLANT

EFFLUENT CHARACTERISTICS 1972

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ocean Effluent												
BOD-5 day 20°C mg/l	200	300	295	252	400	400	165	250	360	240	300	400
SUSPENDED SOLIDS mg/l	54	97	92	74	38	185	170	65	111	85	95	205
SETTLEABLE SOLIDS ml/l	0.10	0.50	0.20	-	-	0.17	0.75	0.50	0.4	0.4	0.6	0.50
pH	6.98	6.98	6.95	7.17	7.10	7.20	7.20	7.10	7.1	7.1	7.3	7.05
OIL & GREASE mg/l	26	25	18	12	10	13	26	28	45	45	45	33
MBAS mg/l	1.00	4.20	2.60	4.60	3.50	4.80	4.85	5.50	3.9	3.9	4.5	3.50
PHENOL gm/l	0.12	0.50	0.20	0.50	0.20	1.30	0.33	-	0.2	0.2	0.2	-
	-	-	-	-	-	-	-	-	-	-	-	-
VOLUME MGD	3.10	2.86	3.00	3.00	2.85	3.00	4.00	3.20	4.00	2.45	2.5	2.55

Reference: Port Hueneme Municipal Treatment Plant, 1973.

TABLE 2.4.3-XII

PORT HUENEME MUNICIPAL TREATMENT PLANT EFFLUENT

REFRACTORY CHARACTERISTICS

JULY 1972

Characteristic	Concentration
Arsenic	<1.00 μg/l
Cadmium	0.004 mg/l
Copper	0.072 mg/l
Cyanide	3.30 μg/l
Iron	0.45 mg/l
Lead	0.09 mg/l
Manganese	0.22 mg/l
Polychlorinated Biphenyls	<1.000 μg/l
Selenium	6.00 μg/l
Silver	0.017 mg/l
Zinc	0.21 mg/l

Reference: Port Hueneme Municipal Treatment Plant, 1973.

TABLE 2.4.3-XIII

MONTHLY SUMMARY OF OXNARD MUNICIPAL TREATMENT PLANT EFFLUENT CHARACTERISTICS 1972

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ocean Effluent												
BOD-5 day 20°C mg/l	228	155	92	112	109	100	99	145	98	162	228	195
SUSPENDED SOLIDS mg/l	82	79	60	76	73	110	65	87	137	89	87	107
SETTLEABLE SOLIDS ml/l	0.10	0.10	0.1	0.1	0.10	0.90	0.20	0.60	0.30	0.60	0.50	0.10
pH	6.90	7.10	7.3	7.2	7.10	7.20	7.40	7.20	7.10	7.00	6.80	6.80
OIL & GREASE mg/l	19.50	19.90	8.8	8.7	9.90	11.37	9.01	10.70	18.80	21.40	15.70	13.53
MBAS mg/l	0.90	1.40	0.5	0.5	1.54	0.94	0.78	1.85	1.56	1.21	1.87	0.58
PHENOL mg/l	0.06	0.30	0.1	0.1	0.37	0.50	0.14	0.37	0.23	0.11	0.71	0.09
CL2 RESIDUAL mg/l	0.40	0.70	1.2	1.0	0.53	0.20	0.53	0.15	0.11	0.15	0.00	0.95
VOLUME MGD	9.985	8.996	10.372	9.568	8.778	9.022	8.070	10.80	11.021	10.142	9.692	9.279

Reference: Oxnard Municipal Treatment Plant, 1973.

TABLE 2.4.3-XIV

OXNARD MUNICIPAL TREATMENT PLANT

EFFLUENT REFRACTORY CHARACTERISTICS

MAY 1972

Characteristic	Concentration (mg/l)
Aluminum	4.20
Arsenic	<0.01
Barium	0.39
Cadmium	0.016
Chromium	0.081
Copper	0.083
Cyanide	0.007
Iron	0.33
Lead	0.10
Manganese	0.12
Mercury	<0.001
Nickel	0.052
Selenium	0.003
Silica	33.00
Silver	0.014
TICH	<0.001
Zinc	0.36

Reference: Oxnard Municipal Treatment Plant, 1973.

TABLE 2.4.3-XV

HUENEME DRAIN WATER SAMPLE ANALYSIS

Characteristic	August 1952 mg/l	October 1960 mg/l
Calcium (Ca)	262.0	307.0
Magnesium (Mg)	68.0	103.0
Sodium (Na)	162.0	322.0
Potassium (K)	5.0	1.2
Carbonate (CO3)	0.0	0.0
Bicarbonate (HCO3)	335.0	384.0
Sulfate (SO4)	846.0	940.0
Chloride (Cl)	94.0	425.0
Nitrate (NO3)	12.4	8.7
Boron (B)	0.9	0.52
Fluoride (F)		1.6
Total Dissolved Solids	1,760.0	2,469.0
Hardness (CaCO3)	936.0	1,190.0
pH, units	7.6	7.7
Electrical Conductance, units	2,218.0	3,300.0
Temperature, °F	64.0	69.0

Reference: Hassan, 1973.

TABLE 2.4.3-XVI

OXNARD INDUSTRIAL DRAIN WATER SAMPLE ANALYSIS

Characteristic	June 1952 mg/l	Aug 1952 mg/l	Jan 1953 mg/l	Feb 1953 mg/l	Nov 1960 mg/l
Calcium (Ca)	280.0	320.0	377.0	301.0	364.0
Magnesium (Mg)	202.0	149.0	187.0	138.0	147.0
Sodium (Na)	474.0	370.0	620.0	390.0	434.0
Potassium (K)		4.1	7.8	37.0	3.9
Carbonate (CO3)	0.0	0.0	0.0	0.0	0.0
Bicarbonate (HCO3)	332.0	322.0	337.0	308.0	293.0
Sulfate (SO4)	1,930.0	1,575.0	2,150.0	1,605.0	1,918.0
Chloride (Cl)	204.0	180.0	247.0	160.0	134.0
Nitrate (NO3)	49.6	56.0	59.0	37.2	53.0
Boron (B)	1.8	1.86	2.72	2.1	2.6
Fluoride (F)					
Total Dissolved Solids	3,500.0	3,010.0	3,816.0*	2,822.0*	3,430.0 (3,221.0*)
Hardness (CaCO3)	1,530.0	1,412.0	1,711.0	1,320.0	1,511.0
pH, units	7.6	7.1	7.8	7.8	7.6
Electrical conductance, units	4,110.0	2,994.0	4,149.0	3,490.0	4,040.0
Temperature, °F	66.0	65.0		57.0	68.0

Reference: Hassan, 1973.

*Milliequivalents per liter.

TABLE 2.4.3-XVII

"J" STREET DRAIN ESTIMATED FLOWS

Date	Gage Height Feet	Estimated Flow Cu. Ft. per Sec.
11/13/69	4.6	580
1/2/70	1.2	70
2/11/70	1.7	169
3/2/70	1.5	130
12/2/70	3.5	390
12/28/70	5.3	495

Reference: Quinn, 1973.

TABLE 2.4.3-XVIII

CHANNEL ISLANDS HARBOR MAINTENANCE
PROGRAM DREDGED VOLUMES

Date Completed	Total Cubic Yardage
June 1961 (original project)	5,390,000
September 1963 (maintenance)	1,986,000
September 1965 (maintenance)	3,527,000
February 1968 (maintenance)	1,672,000
January 1970 (maintenance)	2,824,000
December 1971 (maintenance)	2,500,000

Reference: Fuquay, 1973.