EIR~EA

Shell OCS Beta Unit Development

December 1, 1978
Volume III

Prepared By:

United States Geological Survey
Department of the Interior
300 North Los Angeles Street
Los Angeles, California 90013

State Lands Commission
1807 13th Street
Sacramento, California 95814

Port of Long Beach
925 Harbor Plaza
Long Beach, California 90801

EIR/EA
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Technical Appendix

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1807 13th Street
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Department of the Interior
300 North Los Angeles Street
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APPENDIX

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APPENDIX I

GEOTECHNICAL MATERIALS

INCLUDING USGS ANALYSIS

AND SUPPORT MATERIALS

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Region
300 South Ferry Street
Terminal Island, California 90731

November 17, 1977

FSW33/RSH

Mr. F. J. Schambeck
Department of Interior, Geological Survey
300 N. Los Angeles Street
Los Angeles, California 90012

NOTED - SCHAMBECK

NOTED - LAVELLE

NOTED - ADAMS

Dear Mr. Schambeck:

Subject: Platforms Ellen and Elly, OCS-P 0300 and OCS-P 0301, San Pedro Bay, off Southern California

We do not feel that the proposed platforms will significantly affect those resources for which we have a responsibility. However, the location of the platforms could alter the normal migration route of the California gray whale (Eschrichtius robustus) and therefore should be considered in the environmental analysis.

Sincerely,

Gerald V. Howard
Regional Director

United States Department of the Interior
FISH AND WILDLIFE SERVICE
500 NE MULTNOMAH STREET SUITE 1692
PORTLAND OREGON 97232

NOTED - DUNAWAY

November 28, 1977

NOTED - ADAMS

File

To: Oil and Gas Supervisor, Pacific Area, USGS, Los Angeles, California

From: Regional Director, FWS, Portland, Oregon

Subject: Plan of Development, Beta Unit, OCS Leases P-0296, 0300, 0301, 0306, and Unleased Tract 0255

We have reviewed the subject Plan of Development (POD), Beta Platform Site Evaluations, and Report Pipeline Route Survey, San Pedro Shelf, California. We do not object to the concept as described in the POD.

We wish to review installation methods, pipeline corridors, and other material submitted in the future relative to the development of the subject platform(s).

We have noted that the general area is one of intense commercial fishing. Some impacts upon fish populations and fishing may occur in the event of an oil spill. Impacts upon fish and wildlife populations may be severe if an unforeseen spill reaches the few remaining lagoons and estuaries in the coastal area.

Our response has been submitted in accordance with the provisions of Section 4(f) 3 of Secretarial Order No. 2974 (revised) of January 19, 1977. Attached is the Plan of Development, site evaluation, and pipeline route survey for the Beta Unit.

Thank you for the opportunity to review this material and to provide our comments.

J. W. Teeter

Attachments

Acting Regional Director

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

7211 FEDERAL BUILDING
300 NO. LOS ANGELES STREET
LOS ANGELES, CALIFORNIA 90012

An environmental review for the following activity has been conducted in accordance with Section 402.04 of Part 402, Chapter IV, Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.):

SHELL OIL COMPANY AS OPERATOR
PLAN OF OPERATION (DEVELOPMENT)
BETA UNIT, PARCELS COVERED BY LEASES

OCS-P 0296 Block 37W, 34N
OCS-P 0300 Block 37W, 33N
OCS-P 0301 Block 36W, 33N
OCS-P 0306 Block 36W, 32N
and
Unleased Tract 255 Block 36W, 34N
SAN PEDRO BAY OFF CALIFORNIA

The following determination has been made for this activity to identify if it may jeopardize the existence of any endangered species or result in the destruction or adverse modification of critical habitat.

✓ 1. The above activity will not jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of critical habitat.

____ 2. The above activity may jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of critical habitat and a consultation is recommended with Fish and Wildlife Service and/or National Marine Fisheries Service.

F. J. Schramkock
Oil and Gas Supervisor

9/12/78
Date

3.4 ARCHEOLOGICAL AND HISTORICAL SITE CLEARANCE DETERMINATION

The Bureau of Land Management was contacted for comments initially on November 29, 1977, and subsequently on July 31, 1978. Responses appear on the following pages.

UNITED STATES GOVERNMENT

memorandum

DATE: JAN 5 1978

REPLY TO ATTN OF: Manager, Pacific OCS Office

1780.11 OCS P-0296, 0300, 0301, 0306

JAN 5 1978

SUBJECT: Beta Unit Prospect, OCS Leases P-0296, -0300, -0301, -0306, and Unleased Tract 255, San Pedro Bay

TO: Oil and Gas Supervisor, Pacific Area

We have reviewed Shell's Plan of Development Concept and our comments are:

1. No legal conflicts nor encumbrances in the leases except that the "Beta Unit" is being proposed and that the Operator has not been designated. We have no legal objection to Shell's Plan of Development Concept.

2. No comment on Oil Spill Contingency Plan. NOTED - DUNAWAY

3. No impacts on biological resources. NOTED - SCHAMBECK

4. Comments on cultural resources as follows:

a. Platform: We have reviewed the reports submitted and the remote sensing data obtained by BB&N. An archeological assessment was made by Dr. Hole for the original drill sites proposed and he found "no indication of anything of archeological interest near the proposed drill sites in Block 262". He also found, with the exception of some anomalies on the north end of OCS P-0300, "...no other anomalies in either block." Dr. Hole did, however, state that "The magnetometry is technically good, but generally ineffective at the depths over most of this survey. The sensor head was never more than about 100' deep; thus, over much of the area it was too far above the bottom to record even very large anomalies."

Our review does, however, indicate numerous anomalies based on both the magnetometry and sidescan data. The deployment of the magnetometer high in the water column and on a 305 meter grid, may have also resulted in a failure to pick up other anomalies. From the data available, in our opinion, these anomalies cannot be reliably determined to be of a non-significant cultural resource nature. For this reason and the fact that the data quality precludes an effective assessment of cultural resources potential, we question whether these blocks can be considered clear.

b. Pipeline Routes: Cursory surveys of two of the three routes proposed indicated that numerous anomalies are present. To be confident that these are not culturally related, their source should be identified as geological, as non-significant cultural resources, or avoided. To avoid them, in many cases, would require more than a single line of data to locate them accurately. Also, these pipeline routes were not evaluated

by a qualified archaeologist, therefore the necessary professional expertise was not utilized. In addition, there has been no determination as to whether the planned pipeline would be a "GS gathering line" or BLM permitted pipeline.

c. Conclusion: Due to the recent temporary BLM-GS agreement obliging us to utilize the existing cultural resources NTL for these reviews, we will not recommend withholding approval of the conceptual plan of development as it relates to platform sites and associated operations. However, we do believe you should be aware that, in our opinion, the cultural resources potential on these leases and pipeline routes has not been adequately evaluated. As to the pipeline, we are asking our Washington Office for guidance pertaining to the BLM/GS jurisdictional question. We expect to have additional opportunities to comment as more specific plans are finalized.

5. Comments on camouflage stipulation as follows:

This stipulation applies to both leases with platform proposals. Reported visibility ranges for the San Pedro Bay-Catalina Channel area exceed 10 nautical miles 22% of the time in January and 31% of the time in July. Thus, the platforms will probably be visible from shore for significant time periods. We look forward to working with you on color or pattern selections. It might be beneficial for Shell to employ the services of a professional in the design arts to aid in both the structural design and color selection to lessen visual impact.

We recommend approval of Shell's Beta Unit Plan of Development Concept.

We are returning the following information which was forwarded to us with your memorandum of November 29, 1977, and additional information which was subsequently received informally from you:

1. Beta Unit Plan of Development
2. Oil Spill Contingency Plan
3. Critical Operations and Curtailment Plans
4. Report Pipeline Route Survey
5. Geoseismic Investigation of Palos Verde Fault Zone
6. An Environmental Design Study
7. Soil Boring, Sampling 7 Testing Program Tract 261
8. Soil Boring, Sampling & Testing Program Tract 262
9. Beta Platform Site Evaluations
10. BB&N Remote Sensing Data and Report

Enclosures

/s/ William E. Grant

UNITED STATES GOVERNMENT

memorandum

DATE: AUG 07 1978

REPLY TO ATTN OF: Manager, Pacific OCS Office

1780-11
OCS P-0296, 0300, 0301, 0306

SUBJECT: Cultural Resource Survey, Proposed Beta Unit Plan of Development

TO:

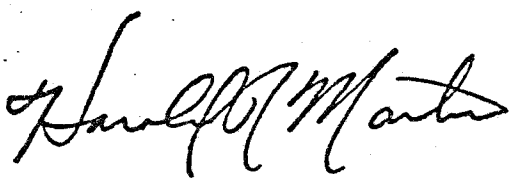
Oil and Gas Supervisor, Pacific Area

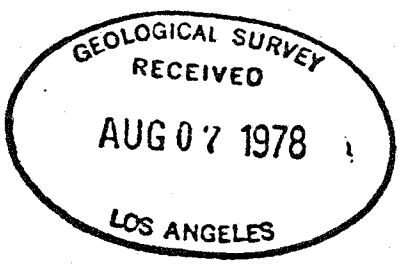
We have reviewed the enclosed Dames and Moore's report concerning the section on cultural resource surveys and our comments are:

The report indicates that the cultural survey study along the proposed pipeline route from the proposed production platform Elly to Port of Long Beach was conducted by specialists in marine archaeology and history. They have concluded that no potential sites or features of possible cultural values are located in the survey area. Based on their conclusion we recommend approval of the section on cultural survey.

We are returning the following report which was forwarded to us with your memorandum of July 31, 1978: Dames and Moore. July 1978. Report Marine Geophysical and Cultural Resource Surveys Proposed Pipeline Route Offshore Long Beach, California for Shell Oil Company.

Enclosure





OPTIONAL FORM NO. 10
(REV. 7-76)
GSA FPMR (41 CFR) 101-11.6
5010-112

3.5 REVIEW COMMENTS AND RELATED CORRESPONDENCE

Cooperative proposal review and environmental report planning has been an ongoing process with the State of California since early October 1977. Shell's Special Report to the Governor of California of September 29, 1977 was received by the Governor's office on October 3, 1977. In accordance with 30 CFR 250.34, a copy of the Plan of Development (POD) was transmitted to the Governor. Mr. Allan Lind of the Office of Planning and Research (OPR) requested an additional 20 copies for State Agency review, which was honored. By letter of January 25, 1978, Mr. Bill Press, the Director of OPR, transmitted State comments to Shell Oil Company and the USGS. Responding State Agencies were:

- OPR
- Air Resources Board
- State Lands Commission
- Department of Fish and Game
- Department of Navigation and Ocean Development
- Department of Conservation

  Division of Mines and Geology
  Division of Oil and Gas
- State Water Resources Control Board

On March 23, 1978, Mr. William F. Northrup, Executive Officer of the State Lands Commission, sent letters by certified mail to those agencies which were determined, under the provisions of the California Environmental Quality Act of 1970, as amended, and subsequent guidelines; to be "responsible agencies" in the Shell Beta Project. By this letter, the State Lands Commission and the Port of Long Beach requested, pursuant to Public Resources Code Section 21080.4(a), a written statement of the scope and content of the environmental information in connection with the proposed project which was germane to each agency's statutory responsibilities and which was to be included in the EIR. Attached were a proposed outline for the subject environmental document, and a project description. Responses were received from:

- United States Coast Guard
- California Department of Transportation
- California Regional Water Quality Control Board,
  Los Angeles Region
- California Division of Oil and Gas

- California Coastal Commission
- South Coast Air Quality Management District
- City of Huntington Beach
- State Water Quality Resources Control Board
- Los Angeles County Flood Control District
- City of Long Beach

  Department of Fire
  Department of Planning and Building

- California Air Resources Board

Additionally, comments were received from:

- Office of Historic Preservation, Department of Parks and Recreation

3.6 MAPS AND ILLUSTRATIONS

Maps and illustrations appear as appropriate throughout the document and are not segregated in a single appendix.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

7760 Federal Building
300 North Los Angeles Street
Los Angeles, California 90012

September 8, 1978

MEMORANDUM

To: Oil and Gas Supervisor, Pacific Area

From: District Geologist, Los Angeles

Subject: Geologic Hazard Evaluation for Beta Platforms Ellen and Elly

Shell's proposal to site a development drilling platform (Ellen) at x=1,428,175 y=520,220 and a production platform (Elly) at x=1,428,310 y=520,580 (California Zone 6) was reviewed by Scott Hamlin, Don Krotser, Richard Tudor, and Roger Nielson.

The site proposed for these platforms is relatively well chosen within this geologically complex area, between two surface faults and just inshore from the current and paleo shelf breaks. There is indication of slumping beyond the shelf break, but none in the more gradual gradient inshore. Possible indications of gas seeps have been identified as close as 500 feet away from the site(s) in contractor interpretations, but are not confirmable in the perhaps incomplete geophysical data profiles submitted.

Foundation stability is discussed in a report to Shell by Robert Pyke, in which reference is made to a final geotechnical report by Woodward Clyde Consultants dated April 1978. This reference was not submitted, so evaluation of Pyke's report of negligably small risk of instability is left unsubstantiated, though plausible.

Drilling from Platform Ellen will be subject to hazards of subsurface gas and faulting indicated in geophysical data and in previous drilling.

for Keith A. Yenne

KAY/DJK/sk

U.S. GEOLOGICAL SURVEY
CONSERVATION DIVISION

To: District Engineer, Ventura

From: Los Angeles District Office

Subject: Geologic Hazards Analysis of APD

Operator: Shell

Lease Number: OCS P-0300 Well Number: Platforms Ellen and Elly

Surface Location: Ellen - X = 1,428,175 Y = 520,220 (Drill)
Elly - X = 1,428,310 Y = 520,580 (Production)

Deviated Location:

Water Depth: Ellen 265 ft., Elly 255 ft. Total Well Depth:

A. Surface Hazards:

1. Slope stability

Slope at the site is 2^{o} SE. Two areas of disturbed recent sediments lie 2000 ft. SW and 1500 ft. SE of the proposed site below the paleo shelf break. Geophysical profiles show evidence of slump movement in these areas.

2. Slumping

The possibility of slumping at the site appears to be minor.

3. Surface faulting

The site lies adjacent to the Palos Verdes Fault Zone, 500 ft. NE of the Beta Fault, a NE branch of the Palos Verdes Fault.

4. Seeps

Two questionable areas of oil and/or gas seeps lie 500 ft. east and west of the site and uncertain seeps are linked with the disturbed sediments to the SE in the contracted hazard interpretation. No seeps were observed in the submitted geophysical records.

5. Seismicity

The site is located along the seismically active Palos Verdes Fault Zone. The maximum credible earthquake magnitude for this area is 7. At the site the associated bedrock acceleration would equal 0.35 g.

B. Subsurface Hazards:

1. Potential oil or gas reservoir, depth

The reservoir occupies seven subdivisions from 2,700 to 4,700 ft. subsea within the Lower Pliocene and Upper Miocene correlating to shales and sandstones of the Repetto and Monterey formations. The reservoir is composed of Delmontian sands, shales, and silts.

2. Possible shallow gas zones, depth

Shallow gas zones are expected to be encountered at various depths (see P-0300 #1 drilling record). Geophysical profiles show numerous bright spot anomalies from 25 to 500 ft. subsea.

3. Possible surface cutting faults which may be encountered in drilling, approximate depths

None seen in the geophysical profiles.

4. Possible subsurface faults which may be encountered in drilling, approximate depths

The Beta and Palos Verdes faults form updip boundaries of the reservoir between 2500 and 5000 ft. below the sea bottom. These faults are likely to be encountered at depth in subsequent development drilling for production.

Lease Number: OCS P-0300 Well Number: Platform Ellen and Elly

5. Possible fresh or salt water flows, depth

Unknown

6. Possible lost circulation zones, depth

Some of the previous wells drilled in OCS leases P-0296, 0300, and 0301 encountered temporary lost circulation. Recovery occurred spontaneously or was accomplished by increasing the drilling fluid viscosity in these wells.

7. Possible abnormal pressure zones, depth

As indicated from review of the drilling records of leases P-0300, P-0296, and 0301, no abnormal pressures are expected.

8. Remarks

Foundation conditions:

We are unable to evaluate the geotechnical character of the platform locations for the following reasons:

1. Data was not submitted for coreholes in the immediate vicinity of the platform sites.
2. The submitted geotechnical reports (Site Stability Studies and Soil Boring, Sampling, and Laboratory Testing Program) are based upon coreholes located outside of the immediate platform site area.

Date: Sept. 11, 1978 Signed: R. B. Ballantine Jr.
Acting Distr. Supt.

Initials: SNH, DJK, RBT, RGN

Rev. 3-78 Hazard Unit

APPENDIX II

MARINE BIOLOGY SPECIES LISTS

TABLE 1

SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF ALAMITOS BAY AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1971-72 (FROM ENVIRONMENTAL QUALITY ANALYSTS, INC., AND MARINE BIOLOGICAL CONSULTANTS, INC., 1973b).

Species	Stations												
	RW7	RW8	RW9	RW10	RW12	RW13	Total	RW7	RW8	RW9	RW10	RW12	RW13	Total
	October 1971							May 1972						
CARCHARHINIDAE														
Mustelus henlei												1		1
SQUALIDAE														
Squalus acanthias												1		1
RHINOBATIDAE														
Platyrhinoidis triseriata														
Rhinobatos productus	1						1					10		10
DASYATIDAE														
Urolophus halleri														
MYLIOBATIDAE														
Myliobatis californica			1				1	1				4		5
ENGRAULIDAE														
Anchoa compressa						1	1							
A. delicatissima														
Engraulis mordax	244	7			26	1	278	2		21			9	32
BATRACHOIDIDAE														
Porichthys myriaster													2	2
P. notatus								2		3	2			7
OPHIDIDAE														
Otophidium scrippsae						1	1							
O. taylori													1	1
SYNGNATHIDAE														
Syngnathus griseolineatus													1	1
Syngnathus sp.														
SERRANIDAE														
Paralabrax nebulifer					1	1	2							
POMADASYIDAE														
Anisotremus davidsoni														
SCIAENIDAE														
Genyonemus lineatus			6		2	11	19	167	14	418	38	51	210	898
Menticirrhus undulatus		8				1	9	1				9		10
Seriphus politus					1		1	61	48	113	24	741	39	1026
Umbrina roncador														
EMBIOTOCIDAE														
Amphistichus argenteus	1	6					7			2		13	5	20
Cymatogaster aggregata			12		16	12	40	106	6	371	86	6	199	774

TABLE 1 (Cont.)

SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF ALAMITOS BAY AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1971-72 (FROM ENVIRONMENTAL QUALITY ANALYSTS, INC., AND MARINE BIOLOGICAL CONSULTANTS, INC., 1973b).

Species	Stations													
	RW7	RW8	RW9	RW10	RW12	RW13	Total	RW7	RW8	RW9	RW10	RW12	RW13	Total
	October 1971							May 1972						
EMBIOTOCIDAE (Cont)														
Embiotoca jacksoni										9	1	2	2	14
Hyperprosopon argenteum		20				36	56	120	6	96	5	47	22	296
Phanerodon furcatus	1	19	20	35	28	102	205	420	24	269	172	87	135	1107
Rhacochilus vacca														
CLINIDAE														
Heterostichus rostratus														
STROMATEIDAE														
Peprilus simillimus								1					1	
COTTIDAE														
Hemilepidotus spinosus														
Leptocottus armatus	2	1					3	3					3	
BOTHIDAE														
Bothidae, unid.					2		2							
Citharichthys stigmaeus	56	16	131	13	35	145	346	13		92	67	9	16	197
Hippoglossina stomata	1						1							
Paralichthys californicus	10	28			17	2	57			2		7	1	10
PLEURONECTIDAE														
Hypsopsetta guttulata			1		2	1	4			2		2	1	5
Parophrys vetulus											2			2
Pleuronichthys decurrens										3	2			5
P. ritteri														
P. verticalis	2	1	6	4	3	15	31	6		20	30		3	59
CYNOGLOSSIDAE														
Symphurus atricauda	1	1	1	1	2	11	17			30	26		12	68
Number of Individuals	319	107	178	53	135	340	1132	908	98	1451	455	990	658	4555
Number of Species	10	10	8	4	12	14	21	13	5	15	12	15	16	26
Diversity Index	1.11	2.77	1.40	1.28	2.76	2.27		2.21	1.90	2.68	2.60	1.51	2.44	

TABLE 1 (Cont.)

SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF ALAMITOS BAY AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1971-72 (FROM ENVIRONMENTAL QUALITY ANALYSTS, INC., AND MARINE BIOLOGICAL CONSULTANTS, INC., 1973b).

Species	Stations														Grand Total
	RW7	RW8	RW9	RW10	RW12	RW13	Total	RW7	RW8	RW9	RW10	RW12	RW13	Total	
	September 1972							November 1972							
CARCHARHINIDAE															
Mustelus henlei															1
SQUALIDAE															
Squalus acanthias															1
RHINOBATIDAE															
Platyrhinoidis triseriata	1					1	2		5	1				6	8
Rhinobatos productus	11	8	6		3	11	39								50
DASYATIDAE															
Urolophus halleri					2		2					1	3	4	6
MYLIOBATIDAE															
Myliobatis californica			4			1	5						2	2	13
ENGRAULIDAE															
Anchoa compressa	16	12	19	5		10	62	8	161	79	6		52	306	369
A. delicatissima										41			3	44	44
Engraulis mordax	130	226	285	47	384	277	1349	7	73	343	1807	385	48	2663	4322
BATRACHOIDIDAE															
Porichthys myriaster		2				4	6								8
P. notatus													1	1	8
OPHIDIDAE															
Otophidium scrippsae															1
O. taylori								2			2			4	5
SYNGNATHIDAE															
Syngnathus griseolineatus															1
Syngnathus sp.			1				1		2					2	3
SERRANIDAE															
Paralabrax nebulifer			1				1								3
POMADASYIDAE															
Anisotremus davidsoni			1				1								1
SCIAENIDAE															
Genyonemus lineatus	47	30	78	147	1	77	380	69	54	93	206	4	113	539	1836
Menticirrhus undulatus	3	1	50		1	2	57		14			5		19	95
Seriphus politus	3	14		814		173	1004	9	41	240	574	2	199	1065	3096
Umbrina roncador										1				1	1
EMBIOTOCIDAE															
Amphistichus argenteus	4	11	2			1	18		17					17	62
Cymatogaster aggregata	60	12	272	9	5	1	359	3	3	3	5	1	33	48	1221

TABLE 1 (Cont.)
SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF ALAMITOS BAY AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1971-72 (FROM ENVIRONMENTAL QUALITY ANALYSTS, INC., AND MARINE BIOLOGICAL CONSULTANTS, INC., 1973b).

Species	Stations														Grand Total
	RW7	RW8	RW9	RW10	RW12	RW13	Total	RW7	RW8	RW9	RW10	RW12	RW13	Total	
	September 1972							November 1972							
EMBIOTOCIDAE (Cont)															
Embiotoca jacksoni	4	13	2	6			25				5		1	6	45
Hyperprosopon argenteum	34	24	61	16			135	2	30	4	5		23	64	551
Phanerodon furcatus			95	66	4	1	166	2	22	2	2	52	131	211	1689
Rhacochilus vacca									1					1	1
CLINIDAE															
Heterostichus rostratus									1					1	1
STROMATEIDAE															
Peprilus simillimus				22			22						7	7	30
COTTIDAE															
Hemilepidotus spinosus				1			1								1
Leptocottus armatus	2	2	1	1			6	2	1					3	15
BOTHIDAE															
Bothidae, unid.															2
Citharichthys stigmaeus	6	5	16	25		2	54		10	3	18	2	28	61	708
Hippoglossina stomata															1
Paralichthys californicus	12	3	7		14	7	43	1	4			14	2	21	131
PLEURONECTIDAE															
Hypsopsetta guttulata	1		3	1	1		6				2			2	17
Parophrys vetulus															2
Pleuronichthys decurrens													1	1	6
P. ritteri									1					1	1
P. verticalis	1	1	11	42			55		1		14	1	9	25	170
CYNOGLOSSIDAE															
Symphurus atricauda				137			137			2	81		17	100	322
Number of Individuals	335	364	915	1339	415	568	3936	105	441	812	2727	467	673	5225	14848
Number of Species	16	15	19	15	9	14	26	10	18	12	13	10	18	29	41
Diversity Index	2.75	2.20	2.72	2.08	0.56	1.90		1.89	2.91	2.11	1.48	0.99	2.89		

TABLE 2

SPECIES AND COMMON NAMES, FREQUENCY OF CAPTURE, AND RELATIVE ABUNDANCE OF FISHES CAPTURED BY TRAWLING OFFSHORE OF HUNTINGTON BEACH, 1976-78 (AFTER MARINE BIOLOGICAL CONSULTANTS, INC., 1977, 1978)

Species	Common Name	Number Captured	Frequency of Capture	Relative Abundance (%)
	August 1976			
Seriphus politus	queenfish	1822	12	42.3
Genyonemus lineatus	white croaker	1773	12	41.1
Engraulis mordax	northern anchovy	356	12	8.3
Hyperprosopon argenteum	walleye surfperch	145	9	3.4
Peprilus simillimus	Pacific butterfish	68	7	1.6
Phanerodon furcatus	white surfperch	59	9	1.4
Amphistichus argenteus	barred surfperch	18	7	0.4
Citharichthys stigmaeus	speckled sanddab	14	6	0.3
Symphurus atricauda	Pacific tonguefish	10	6	0.2
Cymatogaster aggregata	shiner surfperch	7	4	0.2
Paralichthys californicus	Pacific halibut	7	5	0.2
Embiotoca jacksoni	black surfperch	6	2	0.1
Menticirrhus undulatus	California corbina	5	4	0.1
Syngnathus leptorhynchus	bay pipefish	5	4	0.1
Pleuronichthys verticalis	hornyhead turbot	5	3	0.1
Chilara taylori	spotted cusk-eel	3	3	0.07
Rhinobatos productus	shovelnose guitarfish	2	2	0.05
Mustelus henlei	brown smoothhound	1	1	0.02
Torpedo californica	Pacific electric ray	1	1	0.02
Otophidium scrippsi	basketweave cusk-eel	1	1	0.02
Damalichthys vacca	pile surfperch	1	1	0.02
Total Number Captured		4309		
Number of Species		21		
	August 1977			
Genyonemus lineatus	white croaker	3743	12	46.4
Engraulis mordax	northern anchovy	3126	11	38.7
Phanerodon furcatus	white surfperch	275	11	3.4
Hyperprosopon argenteum	walleye surfperch	254	12	3.1
Amphistichus argenteus	barred surfperch	206	11	2.5
Seriphus politus	queenfish	134	12	1.7
Citharichthys stigmaeus	speckled sanddab	85	9	1.1
Paralichthys californicus	California halibut	80	11	1.0
Cymatogaster aggregata	shiner surfperch	62	9	0.8
Syngnathus californiensis	kelp pipefish	39	8	0.5
Symphurus atricauda	California tonguefish	11	5	0.1
Platyrhinoidis triseriata	thornback	9	2	0.1
Leptocottus armatus	staghorn sculpin	8	5	0.1
Pleuronichthys verticalis	hornyhead turbot	6	3	0.07
Synodus lucioceps	California lizardfish	5	3	0.06
Porichthys myriaster	specklefin midshipman	4	3	0.05
Mustelus henlei	brown smoothhound	3	2	0.04

TABLE 2 (Cont.)
SPECIES AND COMMON NAMES, FREQUENCY OF CAPTURE, AND RELATIVE ABUNDANCE OF FISHES CAPTURED BY TRAWLING OFFSHORE OF HUNTINGTON BEACH, 1976-78 (AFTER MARINE BIOLOGICAL CONSULTANTS, INC., 1977, 1978) (Cont)

Species	Common Name	Number Captured	Frequency of Capture	Relative Abundance (%)
	August 1977 (Cont)			
Rhinobatos productus	shovelnose guitarfish	3	2	0.04
Menticirrhus undulatus	California corbina	3	3	0.04
Xystreurys liolepis	fantail sole	3	2	0.04
Pleuronichthys ritteri	spotted turbot	2	1	0.04
Otophidium scrippsi	basketweave cusk-eel	1	1	0.01
Sebastes paucispinis	bocaccio	1	1	0.01
Girella nigricans	opaleye	1	1	0.01
Damalichthys vacca	pile surfperch	1	1	0.01
Heterostichus rostratus	giant kelpfish	1	1	0.01
Peprilus simillimus	Pacific butterfish	1	1	0.01
Hypsopsetta guttulata	diamond turbot	1	1	0.01
Total Number Captured		8068		
Number of Species		28		
	February 1978			
Genyonemus lineatus	white croaker	6030	14	74.8
Seriphus politus	queenfish	1272	13	15.8
Engraulis mordax	northern anchovy	220	13	2.7
Citharichthys stigmaeus	speckled sanddab	94	12	1.2
Anchoa compressa	deepbody anchovy	92	10	1.1
Syngnathus exilis	pipefish	70	11	0.87
Cymatogaster aggregata	shiner surfperch	58	11	0.72
Amphistichus argenteus	barred surfperch	34	4	0.42
Otophidium scrippsi	basketweave cusk-eel	32	6	0.40
Pleuronichthys verticalis	hornyhead turbot	27	7	0.34
Paralichthys californicus	California halibut	22	11	0.27
Menticirrhus undulatus	California corbina	19	7	0.24
Symphurus atricauda	California tonguefish	17	6	0.21
Phanerodon furcatus	white surfperch	14	7	0.17
Synodus lucioceps	California lizardfish	14	5	0.17
Hyperprosopon argenteum	walleye surfperch	13	3	0.16
Rhinobatos productus	shovelnose guitarfish	5	5	0.06
Xystreurys liolepis	faintail sole	5	3	0.06
Pleuronichthys ritteri	spotted turbot	4	2	0.05
Myliobatis californica	bat ray	3	3	0.04
Platyrhinoidis triseriata	thornback	3	3	0.04
Urolophus halleri	round stingray	3	3	0.04
Paralabrax nebulifer	barred sand bass	2	2	0.03
Scorpaena guttata	California scorpion	2	2	0.03
Squalus acanthias	spiny dogfish	1	1	0.01

TABLE 2 (Cont.)
SPECIES AND COMMON NAMES, FREQUENCY OF CAPTURE, AND RELATIVE ABUNDANCE OF FISHES CAPTURED BY TRAWLING OFFSHORE OF HUNTINGTON BEACH, 1976-78 (AFTER MARINE BIOLOGICAL CONSULTANTS, INC., 1977, 1978) (Cont)

Species	Common Name	Number Captured	Frequency of Capture	Relative Abundance (%)
	February 1978 (Cont)			
Atractoscion nobilis	white sea bass	1	1	0.01
Umbrina roncador	yellowfin croaker	1	1	0.01
Xenistius californiensis	salema	1	1	0.01
Lepidogobius lepidus	bay goby	1	1	0.01
Peprilus simillimus	Pacific butterfish	1	1	0.01
Sebastes serranoides	live rockfish	1	1	0.01
Total Number Captured		8062		
Number of Species		31		

TABLE 3
SPECIES AND COMMON NAMES, FREQUENCY OF CAPTURE, AND RELATIVE ABUNDANCE OF FISHES CAPTURED BY TRAWLING OFFSHORE OF ALAMITOS BAY, FEBRUARY 1978
(AFTER MARINE BIOLOGICAL CONSULTANTS, INC., 1978)

Species	Common Name	Number Captured	Frequency of Capture	Relative Abundance (%)
Genyonemus lineatus	white croaker	3782	8	70.6
Symphurus atricauda	California tonguefish	791	6	14.8
Seriphus politus	queenfish	345	8	6.4
Engraulis mordax	northern anchovy	114	7	2.1
Anchoa compressa	deepbody anchovy	98	8	1.8
Citharichthys stigmaeus	speckled sanddab	36	7	0.67
Cymatogaster aggregata	shiner surfperch	32	7	0.60
Tilapia mossambica	tilapia	31	3	0.58
Otophidium scrippsi	basketweave cusk-eel	23	4	0.43
Syngnathus exilis	pipefish	22	1	0.41
Phanerodon furcatus	white surfperch	13	6	0.24
Paralichthys californicus	California halibut	11	6	0.21
Hypsopsetta guttulata	diamond turbot	8	6	0.15
Pleuronichthys verticalis	hornyhead turbot	8	5	0.15
Menticirrhus undulatus	California corbina	7	5	0.13
Sebastes dallii	callico rockfish	6	2	0.11
Embiotoca jacksoni	black surfperch	6	3	0.11
Synodus lucioceps	California lizardfish	5	7	0.09
Syngnathus sp.	pipefish	4	2	0.07
Hyperprosopon argenteum	walleye surfperch	4	3	0.07
Porichthys myriaster	specklefin midshipman	3	2	0.06
Chilara taylori	spotted cusk-eel	3	2	0.06
Platyrhinoidis triseriata	thornback	1	1	0.02
Rhinobatos productus	shovelnose guitarfish	1	1	0.02
Atherinops affinis	topsmelt	1	1	0.02
Pleuronichthys ritteri	spotted turbot	1	1	0.02
Total Number Captured		5356		
Number of Species		26		

TABLE 4
SPECIFIC AND COMMON NAMES, NUMBER, RANKED ABUNDANCE, AND FREQUENCY OF CAPTURE OF FISHES TAKEN BY TRAWLING SEPTEMBER, 1975 (FROM LONG BEACH HARBOR CONSULTANTS, 1976)

Species	Common Name	Number Captured	Relative Abundance (%)	Frequency of Capture
Genyonemus lineatus	white croaker	3,437	55.5	21
Engraulis mordax	northern anchovy	993	16.0	18
Phanerodon furcatus	white surfperch	445	7.2	17
Symphurus atricauda	California tonguefish	353	5.7	18
Cymatogaster aggregata	shiner surfperch	282	4.6	11
Sebastes dallii	calico rockfish	261	4.2	11
Seriphus politus	queenfish	229	3.7	13
Citharichthys stigmaeus	speckled sanddab	81	1.3	8
Pleuronichthys verticalis	hornyhead turbot	38	0.6	10
Lepidogobius lepidus	bay goby	24	0.4	10
Sebastes auriculatus	brown rockfish	12	0.2	4
Embiotoca jacksoni	black surfperch	7	0.1	5
Citharichthys sordidus	Pacific sanddab	5	0.1	2
Porichthys myriaster	specklefin midshipman	4	0.1	3
Hyperprosopon argenteum	walleye surfperch	4	0.1	1
Paralichthys californicus	California halibut	3	0.1	2
Squalus acanthias	spiny dogfish	2	0.03	1
Chilara taylori	spotted cusk-eel	2	0.03	1
Otophidium scrippsi	basketweave cusk-eel	2	0.03	2
Paralabrax clathratus	kelp bass	2	0.03	2
Rhinobatos productus	shovelnose guitarfish	1	0.02	1
Torpedo californica	Pacific electric ray	1	0.02	1
Damalichthys vacca	pile surfperch	1	0.02	1
Paralabrax nebulifer	barred sandbass	1	0.02	1
Peprilus simillimus	Pacific butterfish	1	0.02	1
Sebastes paucispinis	bocaccio	1	0.02	1
Artedius lateralis	smoothhead sculpin	1	0.02	1
Leptocottus armatus	staghorn sculpin	1	0.02	1
Odontopyxis trispinosa	pygmy poacher	1	0.02	1
Lepidopsetta bilineata	rock sole	1	0.02	1
Parophrys vetulus	English sole	1	0.02	1
Total Number Captured		6,197		

TABLE 5

SPECIES, NUMBER, AND RANK OF FISHES CAPTURED BY GILL NETTING IN LONG BEACH HARBOR, 1974-78 (FROM ENVIRONMENTAL QUALITY ANALYSTS AND MARINE BIOLOGICAL CONSULTANTS, INC., 1978).

Species Name	Number Captured	Rank
Genyonemus lineatus	1,811	1
Seriphus politus	1,102	2
Cymatogaster aggregata	901	3
Phanerodon furcatus	632	4
Engraulis mordax	554	5
Hyperprosopon argenteum	314	6
Embiotoca jacksoni	218	7
Porichthys myriaster	127	8
Atherinops affinis	108	9
Damalichthys vacca	89	10
Trachurus symmetricus	70	11
Menticirrhus undulatus	61	12
Synodus lucioceps	53	13
Cheilotrema saturnum	50	14
Paralabrax nebulifer	30	15
Mustelus henlei	26	16
Paralichthys californicus	23	17
Mustelus californicus	22	18
Sardinops sagax caeruleus	22	18
Girella nigricans	20	20
Squalus acanthias	13	21
Sphyraena argentea	13	21
Medialuna californiensis	13	21
Rhacochilus toxotes	13	21
Sebastes seranoides	12	25
S. paucispinis	11	26
Roncador sternsii	8	27
Atherinopsis californiensis	7	28
Paralabrax clathratus	7	28
Anisotremus davidsonii	7	28
Sarda chiliensis	7	28
Paralabrax maculatofasciatus	6	32
Scomber japonicus	6	32
Heterodontus francisii	5	34
Urolophus halleri	5	34
Myliobatis californica	5	34
Amphistichus argenteus	5	34
Peprilus simillimus	5	34
Symphurus atricauda	5	34
Triakis semifasciata	4	40
Paralabrax clathratus	4	40

TABLE 5 (Cont.)
SPECIES, NUMBER, AND RANK OF FISHES CAPTURED BY GILL NETTING IN LONG BEACH HARBOR, 1974-78 (FROM ENVIRONMENTAL QUALITY ANALYSTS AND MARINE BIOLOGICAL CONSULTANTS, INC., 1978) (Cont)

Species Name	Number Captured	Rank
Atractoscion nobilis	4	40
Brachyistius frenatus	4	40
Hyperprosopon anale	4	40
Atherinopsis californiensis	3	45
Scorpaena guttata	3	45
Pleuronichthys verticalis	3	45
Sebastes gordii	2	48
Heterostichus rostratus	2	48
Hypsopsetta guttulata	2	48
Anchoa compressa	1	51
Sebastes melanops	1	51
S. mystinus	1	51
S. rastrelliger	1	51
Artechius lateralis	1	51
Stereolepis gigas	1	51
Umbrina roncador	1	51
Hermosilla azurea	1	51
Hyperprosopon ellipticum	1	51
Micrometrus minimus	1	51
Chromis punctipinnis	1	51
Mugil cephalus	1	51
Acanthogobius flavimanus	1	51
Citharichthys stigmaeus	1	51
Sebastes sp.	1	
Number of Individuals	6436	
Number of Species	64	

TABLE 6

SPECIES, NUMBER, AND RANK OF FISHES CAPTURED BY TRAWLING IN LONG BEACH HARBOR, 1974-78 (FROM ENVIRONMENTAL QUALITY ANALYSTS AND MARINE BIOLOGICAL CONSULTANTS, INC., 1978)

Species Name	Number Captured	Rank
Genyonemus lineatus	68,547	1
Engraulis mordax	28,898	2
Seriphus politus	15,601	3
Lepidogobius lepidus	8,159	4
Symphurus atricauda	5,483	5
Phanerodon furcatus	3,693	6
Cymatogaster aggregata	2,756	7
Peprilus simillimus	1,869	8
Sebastes dallii	1,742	9
Anchoa compressa	748	10
Synodus lucioceps	664	11
Citharichthys stigmaeus	654	12
Porichthys myriaster	511	13
Pleuronichthys verticalis	158	14
Chilara taylori	144	15
Embiotoca jacksoni	120	16
Paralichthys californicus	68	17
Paralabrax nebulifer	56	18
Syngnathus sp.	50	19
Damalichthys vacca	50	19
Sebastes miniatus	34	21
Hyperprosopon argenteum	26	22
Otophidium scrippsi	25	23
Porichthys notatus	19	24
Sebastes auriculatus	19	24
Odontopyxis trispinosa	16	26
Sebastes paucispinis	11	27
Leptocottus armatus	9	28
Trachurus symmetricus	9	28
Citharichthys sordidus	8	30
Xystreurys liolepis	7	31
Squalus acanthias	5	32
Sebastes mystinus	4	33
Myliobatos californica	3	34
Urolophus halleri	3	34
Scorpaena guttata	3	34
Sebastes saxicola	3	34
S. serranoides	3	34
Rhacochilus toxotes	3	34
Hippoglossina stomata	3	34
Rhinobatos productus	2	41

TABLE 6 (Cont.)

SPECIES, NUMBER, AND RANK OF FISHES CAPTURED BY TRAWLING IN LONG BEACH HARBOR, 1974-78 (FROM ENVIRONMENTAL QUALITY ANALYSTS AND MARINE BIOLOGICAL CONSULTANTS, INC., 1978) (Cont)

Species Name	Number Captured	Rank
Anchoa delicatissima	2	41
Atherinops affinis	2	41
Artedius lateralis	2	41
Neoclinus uninotatus	2	41
Pleuronichthys decurrens	2	41
Mustelus henlei	1	47
Leuresthes tenuis	1	47
Sebastes semicinctus	1	47
Atroctoscion nobilis	1	47
Cheilotrema saturnum	1	47
Heterostichus rostratus	1	47
Clevelandia ios	1	47
Ilypnus gilberti	1	47
Parophrys vetulus	1	47
Engraulididae, unid.	13	
Sebastes sp.	10	
Embiotociadae, unid.	4	
Gobiidae, unid.	2	
Number of Individuals	104,235	
Number of Species	55	

TABLE 7

QUALITATIVE LIST OF THE INTERTIDAL ANIMALS COLLECTED FROM THE FOUR OFFSHORE OIL ISLANDS, SPRING 1976 (FROM SOUTHERN CALIFORNIA OCEAN STUDIES CONSORTIUM, 1977)

Species	Grissom	White	Chaffee	Freeman
PORIFERA				
Leucandra heathi			X	
Leucosolenia eleanor			X	
Xestospongia vanilla			X	
COELENTERATA				
HYDROZOA				
Obelia sp.	X		X	X
Plumularia sp.			X	X
Sertularia sp.	X			
Stauridiosarsia			X	
Syncoryne sp.	X			X
Tubularia sp.	X			
ANTHOZOA				
Anthopleura elegantissima	X	X	X	X
A. xanthogrammica	X	X	X	X
Metridium senile				X
PLATYHELMINTHES				
TURBELLARIA				
polyclads, unid.	X		X	X
NEMERTEA				
Emplectonema gracile	X	X		X
Lineus ruber				X
Nemertopsis gracilis	X			
Paranemertes peregrina				X
Nemertea, unid.	X		X	X
ANNELIDA				
POLYCHAETA				
Anaitides williamsi		X		
Arabella iricolor	X	X	X	X
A. semimaculata	X	X	X	X
Armandia brevis		X		
Autolytus sp.				X
Axiothella rubrocincta			X	
Boccardia proboscidea	X	X		X
Boccardia sp.		X	X	X
Capitella capitata		X		
Chaetozone setosa				X
Chrysopetalum occidentale				X
Cirratulus cirratus		X		
Cirriformia luxuriosa	X	X	X	X
C. spirabrancha	X	X	X	X

TABLE 7 (Cont.)

QUALITATIVE LIST OF THE INTERTIDAL ANIMALS COLLECTED FROM THE FOUR OFFSHORE OIL ISLANDS, SPRING 1976 (FROM SOUTHERN CALIFORNIA OCEAN STUDIES CONSORTIUM, 1977)

Species	Grissom	White	Chaffee	Freeman
ANNELIDA				
POLYCHAETA (Cont)				
Dodecaceria fewkesi				X
Dorvillea rudolphi			X	
Eudistylia polymorpha			X	
Eulalia quadrioculata	X	X	X	
Eulalia sp.		X	X	X
Eumida bifoliata	X	X		X
E. sanguinea				X
Eupomatus gracilis	X	X	X	X
Exogone uniformis			X	
Genetyllis castanea			X	X
Halosydna brevisetosa	X	X	X	X
Langerhansia heterochaeta			X	
Lumbrineris zonata		X		X
Naineris dendritica	X	X	X	X
Nereis grubei	X	X	X	X
N. latescens	X	X		X
Odontosyllis phosphorea			X	X
Ophiodromus pugettensis			X	X
Paleanotus bellis			X	X
Phragmatopoma californica		X	X	X
Platynereis bicanaliculata		X	X	
Polydora sp.	X	X	X	X
Polyophthalmus pictus		X	X	X
Pseudopotamilla occelata		X		X
Sabella crassicornis			X	
S. media		X	X	X
Sabellaria cementarium		X	X	
Serpula vermicularis		X		
Sigambra bassi				X
Spirobinae, unid.			X	X
Steggoa californiensis			X	
Syllis gracilis			X	
Tharyx sp.	X			X
Thelepus setosus			X	
Trypanosyllis gemmipara		X		
Typosyllis aciculata				X
T. fasciata	X	X	X	
Typosyllis sp.				X
SIPUNCULOIDEA				
Phascolosoma agassizi			X	

TABLE 7 (Cont.)

QUALITATIVE LIST OF THE INTERTIDAL ANIMALS COLLECTED FROM THE FOUR OFFSHORE OIL ISLANDS, SPRING 1976
(FROM SOUTHERN CALIFORNIA OCEAN STUDIES CONSORTIUM, 1977)

Species	Grissom	White	Chaffee	Freeman
MOLLUSCA				
POLYPLACOPHORA				
Cyanoplax dentiens			X	
C. hartwegii				X
Lepidozona cooperi			X	
L. mertensii				X
Mopalia ciliata				X
M. hindsii		X	X	X
M. lowei			X	
M. mucosa	X	X	X	X
Nuttallina fluxa	X	X	X	X
Stenoplax conspicua		X		
S. fallax		X		
GASTROPODA				
PROSOBRANCHIATA				
Acanthina spirata			X	
Amphissa versicolor			X	
Ceratostoma nuttalli			X	X
Collisella conus				X
C. digitalis	X	X	X	X
C. limatula	X	X	X	X
C. pelta				X
C. scabra	X	X	X	X
C. strigatella	X		X	X
Crepidula onyx	X	X	X	X
Crepipatella lingulata	X	X	X	X
Diodora aspera				X
Haliotis cracherodii	X	X	X	X
H. fulgens				X
Iselica fenestrata		X		
Littorina planaxis	X	X	X	X
L. scutulata	X		X	
Lottia gigantea	X	X	X	X
Megatebennus bimaculatus			X	X
Megathura crenulata		X	X	X
Mitrella carinata	X	X	X	X
M. tuberosa			X	
Nassarius mendicus		X		
N. tegula			X	
Norrisia norrisi		X		
Notoacmaea fenestrata	X			
N. insessa	X	X	X	
N. persona	X			
Ocenebra poulsoni	X	X		X
Serpulorbis squamigerous		X	X	X
Tegula brunnea			X	
T. eiseni	X	X	X	X
T. funebralis	X	X	X	X
T. gallina		X	X	X

TABLE 7 (Cont.)
QUALITATIVE LIST OF THE INTERTIDAL ANIMALS COLLECTED FROM THE FOUR OFFSHORE OIL ISLANDS, SPRING 1976
(FROM SOUTHERN CALIFORNIA OCEAN STUDIES CONSORTIUM, 1977)

Species	Grissom	White	Chaffee	Freeman
MOLLUSCA				
GASTROPODA				
OPISTHOBRANCHIATA				
Coryphella trilineata		X		X
Dendronotus frondosus		X		
D. iris		X		
Hermissenda crassicornis		X		
Navanax inermis			X	
Surilla oliviae			X	
PELECYPODA				
Chama pellucida		X	X	X
Chione undatella	X			
Chlamys hastata			X	X
Cooperella subdiaphana	X			
Cumingia californica			X	
Hiatella arctica	X	X	X	X
Hinnites multirugosus		X	X	X
Leptopecten latiauratus		X		
Modiolus demissus		X		
Mytilus californianus		X	X	X
M. edulis	X	X	X	X
Ostrea lurida	X		X	
Penitella penita		X		
Petricola californiensis			X	
Pitar newcombianus				X
Pododesmus cepio	X			X
Protothaca staminea	X	X	X	X
Saxidomus nuttalli			X	
Tresus nuttallii			X	
CEPHALOPODA				
Octopus bimaculatus	X		X	
ARTHROPODA				
CRUSTACEA				
COPEPODA				
Tigriopus californicus		X	X	
CIRRIPEDIA				
Balanus amphitrite	X			
B. crenatus	X	X	X	X
B. glandula	X	X	X	X
B. tintinnabulum	X	X	X	X
Chthamalus dalli	X	X		X
C. fissus	X	X	X	X
Pollicipes polymerus	X	X	X	X
Tetraclita squamosa rubescens	X	X	X	X

TABLE 7 (Cont.)

QUALITATIVE LIST OF THE INTERTIDAL ANIMALS COLLECTED FROM THE FOUR OFFSHORE OIL ISLANDS, SPRING 1976 (FROM SOUTHERN CALIFORNIA OCEAN STUDIES CONSORTIUM, 1977)

Species	Grissom	White	Chaffee	Freeman
ARTHROPODA				
CRUSTACEA				
MALACOSTRACA				
AMPHIPODA				
Ampithoe humeralis		X		X
A. plumulosa	X	X	X	
Caprella californica	X			
C. equilibra	X		X	
Ceradocus spinicaudus			X	
Corophium acherusicum	X	X	X	X
Elasmopus rapax	X		X	X
Ericthonius brasiliensis			X	X
Hyale anceps	X	X		
H. frequens				X
Jassa falcata	X		X	X
Najna sp.				X
Orchestia traskiana		X		X
Parallorchestes ochotensis			X	
Paramoera mohri	X			
Parapleustes nautilus	X			
Photis brevipes			X	
Podocerus brasiliensis			X	X
ISOPODA				
Cirolana hardfordi		X	X	X
Dynamenella sp.	X	X		
Ianiropsis kincaidi kincaidi			X	
I. minuta				X
Idothea sp.				X
Jaeropsis dubia paucispinis			X	
Ligia occidentalis	X	X	X	X
Limnoria tripunctata	X	X		
Paracerceis sp.	X	X		X
TANAIDACEA				
Anatanais normani		X	X	X
Leptochelia dubia		X	X	X
Pancolus californiensis	X			
CUMACEA				
Cumacean, unid.			X	
DECAPODA				
Alpheus sp.			X	
Bataeus longidactylus			X	
Cancer antennarius			X	
C. productus		X		
Hemigrapsus oregonensis	X			
Lecythorhynchus sp.		X		
Lophopanopeus bellus			X	

TABLE 7 (Cont.)
QUALITATIVE LIST OF THE INTERTIDAL ANIMALS COLLECTED FROM THE FOUR OFFSHORE OIL ISLANDS, SPRING 1976
(FROM SOUTHERN CALIFORNIA OCEAN STUDIES CONSORTIUM, 1977)

Species	Grissom	White	Chaffee	Freeman
ARTHROPODA				
CRUSTACEA				
MALACOSTRACA				
DECAPODA				
Opisthopus transverus		X		
Pachycheles rudis		X	X	X
Pachygrapsus crassipes	X	X	X	X
Pagurus hirsutiusculus			X	
P. samuelis	X	X	X	X
Pelia tumida			X	
Petrolisthes cinctipes	X	X	X	X
Pugettia producta	X		X	X
P. richii			X	
PYCNOGONIDA				
Pycnogonids, unid.		X	X	
ENTOPROCTA				
Barentsia sp.		X		X
ECTOPROCTA				
Bowerbankia gracilis	X		X	X
Bugula californica	X			X
B. neritina		X	X	X
Crisia occidentalis			X	X
Crisulipora occidentalis	X	X	X	X
Cryptosula pallasiana	X	X	X	X
Filicrisia franciscana			X	X
Membranipora membranacea	X	X	X	
M. tuberculata	X		X	
Schizoporella unicornis	X	X		X
Thalamoporella californica		X	X	
Victorella pavida				X
ECHINODERMATA				
ASTEROIDEA				
Asterometris sertulifera				X
Patiria miniata		X	X	X
Pisaster brevispinus		X	X	
P. giganteus	X	X	X	
P. ochraceus	X	X	X	X
ECHINOIDEA				
Strongylocentrotus franciscanus		X	X	X
S. purpuratus		X	X	X
OPHIUROIDEA				
Amphipholis squamata			X	
Ophiactis simplex		X	X	
Ophionereis annulata				X
HOLOTHUROIDEA				
Cucumaria miniata			X	
Stichopus californicus			X	X

TABLE 7 (Cont.)
QUALITATIVE LIST OF THE INTERTIDAL ANIMALS COLLECTED FROM THE FOUR OFFSHORE OIL ISLANDS, SPRING 1976
(FROM SOUTHERN CALIFORNIA OCEAN STUDIES CONSORTIUM, 1977)

Species	Grissom	White	Chaffee	Freeman
CHORDATA				
UROCHORDATA				
Aplidium californicum			X	
Archidistoma ritteri			X	
Ascidia ceratodes			X	X
Botrylloides diegensis			X	X
Botryllus sp.			X	X
Ciona intestinalis			X	
Diplosoma pizoni			X	
Distaplia occidentalis			X	
Perophora annectens				X
Pyura haustor			X	
Styela plicata			X	X

TABLE 8

NUMBER OF SPECIES AND INDIVIDUALS OF INTERTIDAL ORGANISMS COLLECTED FROM GRISSOM ISLAND ON JANUARY 17 THROUGH 19, 1977.
(FROM SOUTHERN CALIFORNIA OCEAN STUDIES CONSORTIUM, 1977)

Species	Station 1			Station 2			Station 3			Station 4		
	H*	M	L	H	M	L	H	M	L	H	M	L
PORIFERA												
Incerta sp.		S*	S			S					C	
Leucilla nuttingi						S						
sponge, unid.								S			S	
sponge, unid.								S				
COELENTERATA												
HYDROZOA												
Obelia sp.			S									S
Phialidium sp.			S									
Tubularia sp.			C					S	S			C
ANTHOZOA												
Anthopleura elegantissima						A						
A. xanthogrammica			S			S		S	S		S	S
PLATYHELMINTHES												
Polycladia, unid.		S				8			7		4	56
NEMERTEA												
Nemertean, unid.			156			8		22			4	
NEMATODA												
Nematode, unid.				160			4	52		4	320	
ANNELIDA												
POLYCHAETA												
Armandia bioculata			4			48						
Capitella capitata			80			112						4
Capitita ambiseta						8						
Cirriformia spirabrancha									1			
Cirriformia sp.			12									
Eulalia avioulaseta									1			
Eupomatus gracilis	S	C	4		3	C		10	A		30	14
Halosydna brevisetosa						8					4	2
H. johnsoni						40		2	S			
Lumbrineris sp.						8						
Naineris dendritica			8			8			1			12
Nereis grubea					4	16						
Nereis sp.												2
Notomasus tenuis						40						
Ophryotrocha sp.						40						
Paleonotus bellis						32			3			
Pionosyllis gigantea						16			1			
Polydora limicola						64			5		2	28
Polyophthalmus pictus						24			12			4
Sabellidae, unid.			4									2
Syllidae, unid.						8						
Tharyx spp.						56						
Typosyllis fasciata						760			64			

TABLE 8 (Cont.)
NUMBER OF SPECIES AND INDIVIDUALS OF INTERTIDAL ORGANISMS COLLECTED FROM GRISSOM ISLAND ON JANUARY 17 THROUGH 19, 1977.
(FROM SOUTHERN CALIFORNIA OCEAN STUDIES CONSORTIUM, 1977)

Species	Station 1			Station 2			Station 3			Station 4		
	H	M	L	H	M	L	H	M	L	H	M	L
ARTHROPODA												
CRUSTACEA												
OSTRACODA												
Cylindroleberis mariae			4									
COPEPODA												
Harpacticoida, unid.			C			A		A	C		C	
CIRRIPEDIA												
Balanus glandula	18	918	C	270	378	C	36	117	C	36	6	8
B. tintinnabulum								2				
Chthamalus fissus	3340	267	C	7625	792	C	1296	486	C	1332	1935	C
Tetraclita squamosa		S	C		17	C		3	C	S	3	
MALOCOSTRACA												
CUMACEA												
Cumella sp.			20			40		14				14
TANAIDACEA												
Anatanais normani			28		6				2			374
ISOPODA												
Ianiropsis tridens			136									
Ligia occidentalis										A	A	
Limnoria tripunctata											14	
Munna sp.						16						
AMPHIPODA												
Ampithoe sp.												1
Caprella equilibra			4									
C. verrucosa			4									
Corophium acherusicum								1			6	13
Elasmopus rapax			112			2		15				
Gammaropsis thompsoni											2	
Jassa falcata											6	16
Maera simiule			28					1				
Podocerus sp.												4
Stenothoe valida					2	2						
DECAPODA												
Pachygrapsus crassipes	S	A	A		A	A	C	A	2	S	A	A
Petrolithes cinctipes			C						C			
LABIATA												
INSECTA												
Coleoptera, unid.								2			2	
PYCNOGONIDA												
Pycnogonida, unid.											4	S
MOLLUSCA												
POLYPLACOPHORA												
Mopalia hindsii			1			S						
M. muscosa		S				S		S	C			S

TABLE 8 (Cont.)
NUMBER OF SPECIES AND INDIVIDUALS OF INTERTIDAL ORGANISMS COLLECTED FROM GRISSOM ISLAND ON JANUARY 17 THROUGH 19, 1977.
(FROM SOUTHERN CALIFORNIA OCEAN STUDIES CONSORTIUM, 1977)

Species	Station 1			Station 2			Station 3			Station 4		
	H	M	L	H	M	L	H	M	L	H	M	L
MOLLUSCA (Cont)												
GASTROPODA												
Acanthina spirata									S			
Bankia setacea											2	
Collisella digitalis	C				C		9			3		
C. limatula	S	C	C		17	C	S	36		S	36	
C. persona											3	
C. scabra	C	150	C	160	233	C	54	387		72	207	S
Crepidula onyx												2
Crepidula sp.			4									
Crepipatella lingulata		S	S								2	
Diodora aspera			S									
Littorina planaxis	21			20			3			A	C	
Lottia gigantea								3				
Megathura crenulata		S	S									S
Mitrella carinata								S	1			14
Norrisia norrisii		S	S									
Ocenebra poulsoni								S	S			
Serpulorbis squamigerus											S	
Tegula funebralis	S	S			S					S		
PELECYPODA												
Chama pellucida			S									
Cumingia californica						16						
Hiatella arctica		3	12			32		6	3		12	14
Kellia laperousii												14
Leptopecten sp.			S									S
Mytilus edulis	S	24	311		40	852		4	16	S	16	56
Pelecypod, unid.			4									4
Petricola sp.						40						2
Protothaca sp.						64						
ECTOPROCTA												
Bugula neritina												A
Crisulipora occidentalis											S	
Cryptosula pallasiana		A	A		A	A		A	A		A	A
Membranipora sp.			S						C			
ENTOPROCTA												
Barentsia sp.											A	A
ECHINODERMATA												
ECHINOIDEA												
Strongylocentrotus purpuratus			C			S			S			C
ASTEROIDEA												
Pisaster ochraceous			C			C		C	A			C
OPHIUROIDEA												
Amphipholis squamata			44						1			8
Ophionereis annulata											2	

TABLE 8 (Cont.)

NUMBER OF SPECIES AND INDIVIDUALS OF INTERTIDAL ORGANISMS COLLECTED FROM GRISSOM ISLAND ON JANUARY 17 THROUGH 19, 1977.
(FROM SOUTHERN CALIFORNIA OCEAN STUDIES CONSORTIUM, 1977)

Species	Station 1			Station 2			Station 3			Station 4		
	H	M	L	H	M	L	H	M	L	H	M	L
CHORDATA												
UROCHORDATA												
ASCIDIACEA												
Botryllus sp.												C
Ciona intestinalis			S								S	S
VERTEBRATA												
OSTEICHTHYS												
Gobiesox eugrammus						S						
CHLOROPHYTA												
Ulva sp.						A			A			A
PHAEOPHYTA												
Egregia sp.						C			A			S
RHODOPHYTA												
Gelidium sp.						C						
Gigartina sp.			S									A
Polysiphonia sp.												S
Total Number of Specimens	3379	1362	980	8075	1492	2528	1398	1115	172	1443	2306	988
Total Number of Species	10	17	46	4	14	50	7	29	34	11	35	46

* H = High Tide Zone M = Mid Tide Zone L = Low Tide Zone
S = Sparse (1-10) C = Common (11-500 A = Abundant (>50)

TABLE 9

SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF ORANGE COUNTY AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1975-77 (FROM CSDOC, 1975, 1976, 1977)

Species	nT0	nT1	nT2	nT3	nT4	nT5	nT6	Total	Percent of Total Catch
				Trawl Date: 2/26/75					
Chilara taylori		1		1	1	3	1	78	0.21
Chitonotus pugetensis		1	27	1	1	41	103	174	5.13
Citharichthys sordidus		20		181	3	37	121	362	10.67
C. stigmaeus	40	355	244		142	41	198	1020	30.06
C. xanthostigma					7			7	0.21
Cymatogaster aggregata	1	2						3	0.09
Embiotoca jacksoni	1							1	0.03
Genyonemus lineatus	2							2	0.06
Hippoglossina stomata		4	1	1	9	7	4	26	0.77
Hydrolagus colliei							1	1	0.03
Icelinus quadriseriatus		4	64	80	198	421	396	984	29.00
Lepidogobius lepidus			3		1			4	0.12
Microstomus pacificus		108		6		1		115	3.39
Odontopyxis trispinosa			3		2	5	4	14	0.41
Ophiodon elongatus						1		1	0.03
Paralichthys californicus	5				1			6	0.18
Parophrys vetulus	6	222		3		1		232	6.84
Phanerodon furcatus	3							3	0.09
Pleuronichthys decurrens	1	1				6		8	0.24
P. verticalis	16	6	4	3	1	12	2	44	1.30
Porichthys myriaster	1			1				2	0.06
P. notatus		2	4	36	9			51	1.50
Rathbunella hypoplecta						5		5	0.15
Scorpaena guttata		6	4		1		5	16	0.47
Sebastes dalli				1				1	0.03
S. jordani				1		9		10	0.29
S. saxicola		3	5	2		6	4	20	0.59
S. semicinctus		5				2		7	0.21
Symphurus atricauda	7	43	27	13	48	3	8	149	4.39

TABLE 9 (Cont.)
SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF ORANGE COUNTY AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1975-77 (FROM CSDOC, 1975, 1976, 1977)

Species	nT0	nT1	nT2	nT3	nT4	nT5	nT6	Total	Percent of Total Catch
				Trawl Date: 2/26/75 (Cont)					
Synodus lucioceps	3	1		2				6	0.18
Zalembius rosaceus		2	5	3		35	7	52	1.15
Zaniolepis frenata				6		15	1	22	0.65
Z. latipinnis		23	4	4	1	1	5	38	1.12
Number of Individuals	86	809	395	545	246	652	860	3393	
Percent	2.5	23.8	11.6	10.2	7.3	19.2	25.3		
				Trawl Date: 5/12/75					
Anoplopoma fimbria						3		3	0.07
Caulolatilus princeps							1	1	0.02
Chilara taylori		1		2	2	4		9	0.22
Chitonotus pugetensis		21	23	9		17	33	103	2.48
Citharichtys fragilis				12		1		13	0.31
C. sordidus		57	12	314		38	48	469	11.28
C. stigmaeus	15	113	184		88	26	28	454	10.92
C. xanthostigma			2		1		1	4	0.10
Cymatogaster aggregata					2			2	0.05
Embiotoca jacksoni	2							2	0.05
Engraulis mordax	2					4		6	0.14
Genyonemus lineatus	42		109	1	4	204	9	369	8.88
Glyptocephalus zachirus				7				7	0.17
Hippoglossina stomata			20		1	2	6	29	0.70
Icelinus quadriseriatus		52	264	45	1	49	169	580	13.95
Lepidogobius lepidus		2	1				1	4	0.10
Lycodopsis pacifica				66		6		72	1.73
Lyopsetta exilis				45				45	1.08
Microstomus pacificus	1	83	17	160	3	31	2	297	7.14
Odontopyxis trispinosa			2	2		2	2	8	0.19
Otophidium scrippsae	2							2	0.05
Paralichthys californicus	2					1		3	0.07
Parophrys vetulus		8	2	4	4	2	9	29	0.70
Phanerodon furcatus	1							1	0.02

TABLE 9 (Cont.)
SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF ORANGE COUNTY AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1975-77 (FROM CSDOC, 1975, 1976, 1977)

Species	nT0	nT1	nT2	nT3	nT4	nT5	nT6	Total	Percent of Total Catch
				Trawl Date: 5/12/75 (Cont)					
Pleuronichthys decurrens				1				1	0.02
P. verticalis	2		19	3	10		3	37	0.89
Porichthys notatus		9	9	157	1	7	3	186	4.47
Scorpaena guttata						3	5	8	0.19
Sebastes crameri				1				1	0.02
S. dalli			1	1				2	0.05
S. goodei	1		3			4	15	23	0.55
S. jordani	1		1	1		2	3	8	0.19
S. levis				10		1		11	0.26
S. miniatus	2	2	23		3		8	38	0.91
S. rosenblatti		1						1	0.02
S. rubrivinctus						1		1	0.02
S. saxicola	1	296	111	282	3	187	74	954	22.95
S. semicinctus		5		6		14		25	0.60
Seriphus politus						1		1	0.02
Symphurus atricauda	9	36	35	14	39		6	139	3.34
Zalembius rosaceus		5	89	6		16	13	129	3.10
Zaniolepis frenata				11		1		12	0.29
Z. latipinnis		21	13	22		6	6	68	1.63
Number of Individuals	83	712	940	1182	162	633	445	4157	
				Trawl Date: 7/9/75					
Anoplopoma fimbria		1		1				2	0.04
Chilara taylori		4	1	2				7	0.15
Chitonotus pugetensis		7	4	7		21	24	63	1.31
Citharichthys sordidus		89	16	258		165	173	701	14.35
C. stigmaeus	22	265	102		67	72	74	602	12.48
C. xanthostigma							1	1	0.02
Coryphopterus nicholsi							1	1	0.02
Cymatogaster aggregata	2		4		27			33	0.68
Embiotoca jacksoni	3							3	0.06
Engraulis mordax	34					2		36	0.75

TABLE 9 (Cont.)
SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF ORANGE COUNTY AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1975-77 (FROM CSDOC, 1975, 1976, 1977)

Species	nT0	nT1	nT2	nT3	nT4	nT5	nT6	Total	Percent of Total Catch
				Trawl Date: 7/9/75 (Cont)					
Genyonemus lineatus	126		106		42	12	102	388	8.04
Hippoglossina stomata		1	3	3		2	1	10	0.21
Hydrolagus colliei							2	2	0.04
Hyperprosopon argenteum	1							1	0.02
Hyperprosopon argenteum	1							1	0.02
Icelinus quadriseriatus		25	149	111		117	54	456	9.45
Lepidogobius lepidus							1	1	0.02
Lycodopsis pacifica				9				9	0.19
Microstomus pacificus	1	45	8	42	1			97	2.01
Odontopyxis trispinosa		2	3	3		4		12	0.25
Otophidium scrippsae	1							1	0.02
Paralabrax nebulifer			1					1	0.02
Paralichthys californicus	4						1	5	0.10
Parophrys vetulus		29	1	7	21	3	3	64	1.33
Phanerodon furcatus	17		1		4			22	0.46
Pleuronichthys verticalis	13		12		6		1	32	0.66
Porichthys notatus		11	2	23			1	37	0.77
Rathbunella sp. A		1		1				2	0.04
Scorpaena guttata							1	1	0.02
Sebastes dalli	67	744	289	219	96	212	349	1976	40.96
S. goodei				1				1	0.02
S. hopkinsi					1			1	0.02
S. miniatus			1				1	2	0.04
S. rosenblatti				1				1	0.02
S. saxicola		16		3		1		20	0.41
S. semicinctus				23				23	0.48
S. umbrosus		2						2	0.04
Seriphus politus	2		1					3	0.06
Symphurus atricauda	22	45	27	15	20	1	5	135	2.80
Syngnathus californiensis	1							1	0.02
Synodus lucioceps						1	1	2	0.04

TABLE 9 (Cont.)
SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF ORANGE COUNTY AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1975-77 (FROM CSDOC, 1975, 1976, 1977)

Species	nT0	nT1	nT2	nT3	nT4	nT5	nT6	Total	Percent of Total Catch
				Trawl Date: 7/9/75 (Cont)					
Torpedo californica				1				1	0.02
Zalembius rosaceus			10	8				18	0.37
Zaniolepis frenata				1				1	0.02
Z. latipinnis		23		24				47	0.97
Number of Individuals	316	1310	741	763	285	613	796	4824	
Percent	6.6	27.2	15.4	15.8	5.9	12.7	16.5		
				Trawl Date: 10/8/75					
Chilara taylori		4			**	* 4		8	0.19
Chitonotus pugetensis		45	10	18		30	82	185	4.41
Citharichthys sordidus		63		336	54	219	231	903	21.56
C. stigmaeus	8	182	210	58	68	177	27	38	700	16.71
Engraulis mordax	71							71	1.69
Genyonemus lineatus	250			1		2		1	254	6.06
Hippoglossina stomata		5	1				2	8	16	0.38
Hyperprosopon argenteum	6								6	0.14
Icelinus quadriseriatus		186	59	399		12	209	100	965	23.04
Lepidogobius lepidus				1		2			3	0.07
Microstomus pacificus		28		8				2	38	0.90
Odontopyxia trispinosa		1	6	4		11	5	7	34	0.81
Paralichthys californicus	3								3	0.07
Parophrys vetulus		16	1	8	3	7		1	33	0.79
Phanerodon furcatus	5					3			8	0.19
Pleuronichthys decurrens							2	4	6	0.14
P. verticalis	17	1	3		4	6	2	2	31	0.74
Porichthys notatus		19	5	11		2	1		38	0.90
Scorpaena guttata			1			1	1	5	8	0.19

* Retrawled station nT4 (10-13-75) numbers are included in total and % total catch because large piece of wire may have fouled trawl and resulted in low numbers on 10-8-75 that was not representative of station.

**Station nT4 (10-8-75) numbers not represented in total or % total catch.

TABLE 9 (Cont.)

SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF ORANGE COUNTY AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1975-77 (FROM CSDOC, 1975, 1976, 1977)

Species	nT0	nT1	nT2	nT3	nT4	nT5	nT6	Total	Percent of Total Catch
				Trawl Date: 10/8/75 (Cont)					
Sebastes crameri		1						1	0.02
S. dalli		79	1	72	1	120	103	376	8.98
S. jordani		1						1	0.02
S. miniatus		10						10	0.24
S. rubrivinctus						1		1	0.02
S. saxicola		25						25	0.60
S. semicinctus		6						6	0.14
S. (Sebastomus) sp. UI						1		1	0.02
Seriphus politus	31							31	0.74
Symphurus atricauda	35	41	45	27	94	3	46	291	6.95
Syngnathus californiensis					1	1		2	0.05
S. exilus					2				
Xeneretmus triacanthus		2						2	0.05
Zalembius rosaceus		14		3	14		10	41	0.98
Zaniolepis latipinnis		55		16	14		5	90	2.15
Number of Individuals	426	784	342	962	77	401	628	645	4188
				Trawl Date: 1/14/76					
Cheilotrema saturnum	1							1	0.03
Chilara taylori		1		1				2	0.06
Chitonotus pugetensis		5	17	2	1	9	18	52	1.50
Citharichthys fragilis				2				2	0.06
C. sordidus		45	18	328	49	82	104	626	18.11
C. stigmaeus	11	114	100	1	111	4	34	375	10.85
C. xanthostigma			8		3	1		12	0.35
Cymatogaster aggregata		18		4				22	0.64
Engraulis mordax	1							1	0.03
Genyonemus lineatus	45			36				81	2.34
Hippoglossina stomata		1	1	1		4	6	13	0.38
Hyperprosopon argenteum	1							1	0.03
Hypsopsetta guttulata	1							1	0.03
Icelinus quadriseriatus		95	22	239		345	215	916	26.50
Lepidogobius lepidus			1			1		2	0.0

TABLE 9 (Cont.)
SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF ORANGE COUNTY AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1975-77 (FROM CSDOC, 1975, 1976, 1977)

Species	nT0	nT1	nT2	nT3	nT4	nT5	nT6	Total	Percent of Total Catch
				Trawl Date: 1/14/76 (Cont)					
Lycodopsis pacifica						1		1	0.03
Lyopsetta exilis						1		1	0.03
Menticirrhus undulatus	3							3	0.09
Microstomus pacificus		17		2		2		21	0.61
Odontopyxis trispinosa		1		2		1		4	0.12
Paralichthys californicus	4		1	1				6	0.17
Parophrys vetulus		22		16	6		1	45	1.30
Phanerodon furcatus	7							7	0.20
Pleuronichthys verticalis	9	1	8	9	3		4	34	0.98
Porichthys myriaster	1							1	0.03
P. notatus				183		1		184	5.32
Rhacochilus vacca		1						1	0.03
Scorpaena guttata		209	37	126		51	53	476	13.77
Sebastes saxicola		5				5		10	0.29
S. semicinctus		5						5	0.14
Seriphus politus	35			28				63	1.82
Symphurus atricauda		70	25	20	47	38	10	210	6.07
Syngnathus californiensis						1		1	0.03
Zalembius rosaceus		192				2		194	5.61
Zaniolepis frenata						1		1	0.03
Z. latipinnis		40	2	24		2	5	73	2.11
Number of Individuals	119	842	243	1026	221	553	453	3457	
Percent	3.4	24.4	7.0	29.7	6.4	16.0	13.1		
				Trawl Date: 4/7/76					
Argentia sialis						1		1	0.04
Chilara taylori				1				1	0.04
Chitonotus pugetensis			11	3		4	23	41	1.82
Citharichthys sordidus		14	26	279	11	14	46	390	17.33
C. stigmaeus	10	142	82	5	40	3	10	292	12.97
C. xanthostigma			7		2			9	0.40
Cymatogaster aggregata	4				3		11	18	0.80

TABLE 9 (Cont.)
SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF ORANGE COUNTY AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1975-77 (FROM CSDOC, 1975, 1976, 1977)

Species	nT0	nT1	nT2	nT3	nT4	nT5	nT6	Total	Percent of Total Catch
				Trawl Date: 4/7/76 (Cont)					
Embiotoca jacksoni	3							3	0.13
Genyonemus lineatus	63			40	1		1	105	4.67
Hippoglossina stomata		2	4	1			6	13	0.58
Icelinus quadriseriatus	2	8	99	47	1	67	103	327	14.53
Microstomus pacificus		215	3	12		3	2	235	10.44
Odontopyxis trispinosa			2	1				3	0.13
Paralichthys californicus	3							3	0.13
Parophrys vetulus		64	7	11	7	3	2	94	4.18
Phanerodon furcatus					2			2	0.09
Pleuronichthys verticalis	8		9	3	6	1		27	1.20
Porichthys notatus		1		10	4	1	1	17	0.76
Rhacochilus vacca					1	1		2	0.09
Scorpaena guttata		1	1			1	5	8	0.36
Sebastes dalli		44	15	209		128	7	403	17.91
S. miniatus						1		1	0.04
S. saxicola			6			15	7	28	1.24
S. semicinctus		1		2				3	0.13
Sebastes sp.					1			1	0.04
Seriphus politus	5							5	0.22
Symphurus atricauda	10	5	27	6	11	8	9	76	3.38
Syngnathus californiensis	1			1				2	0.09
Zalembius rosaceus		27	1	8	4	18	15	73	3.24
Zaniolepis latipinnis		13		19		6	29	67	2.98
Number of Individuals	109	537	300	658	94	275	277	2250	
Percent	4.8	23.9	13.3	29.2	4.2	12.2	12.3		
				Trawl Date: 7/28/76					
Agonopsis sterletus							1	1	0.03
Argentina sialis				1				1	0.03
Chilara taylori		1		4				5	0.16
Chitonotus pugetensis		19	15	6		6	15	61	1.93

TABLE 9 (Cont.)

SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF ORANGE COUNTY AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1975-77 (FROM CSDOC, 1975, 1976, 1977)

Species	nT0	nT1	nT2	nT3	nT4	nT5	nT6	Total	Percent of Total Catch
				Trawl Date: 7/28/76 (Cont)					
Citharichthys fragilis				3				3	0.09
C. sordidus		57	2	136		82	104	381	12.06
C. stigmaeus	2	83	102		67		67	321	10.16
Coryphopterus nicholsi				1				1	0.03
Cymatogaster aggregata	10							10	0.32
Engraulis mordax	79							79	2.50
Genyonemus lineatus	692		103					795	25.17
Hippoglossina stomata			5	3	1	1	6	16	0.51
Hyperprosopon argenteum	14							14	0.44
Icelinus quadriseriatus		136	152	86		24	15	413	13.07
Icichthys lockingtoni		1						1	0.03
Lepidogobius lepidus			2					2	0.06
Menticirrhus undulatus	1							1	0.03
Microstomus pacificus		26	2	11		1		40	1.27
Odontopyxis trispinosa		5	3	3		2	4	17	0.54
Paralichthys californicus	6							6	0.19
Parophrys vetulus		7	1	16	2	2	2	30	0.95
Peprilus simillimus		1	1					2	0.06
Phanerodon furcatus	20							20	0.63
Pleuronichthys decurrens				1				1	0.03
P. verticalis	7		1	6	10		1	25	0.79
Porichthys myriaster	1				1			2	0.06
P. notatus		66		102		4	2	174	5.51
Sebastes dalli		25		349				374	11.84
S. diploproa		1						1	0.03
S. goodei				1				1	0.03
S. rubrivinctus				1				1	0.03
S. saxicola		4		1				5	0.16
S. semicinctus				42				42	1.33
S. ?paucispinis						1		1	0.03
Seriphus politus	98		1					99	3.13

TABLE 9 (Cont.)
SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF ORANGE COUNTY AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1975-77 (FROM CSDOC, 1975, 1976, 1977)

Species	nT0	nT1	nT2	nT3	nT4	nT5	nT6	Total	Percent of Total Catch
				Trawl Date: 7/28/76 (Cont)					
Symphurus atricauda	34	30	1	10	12	1	21	109	3.45
Synodus lucioceps					3		1	4	0.13
Zalembius rosareus		11		3			3	17	0.54
Zaniolepis frenata				1				1	0.03
Z. latipinnis		68		14				82	2.60
Number of Individuals	964	541	391	801	96	124	242	3159	
Percentage	30.5	17.1	12.4	25.4	3.0	3.9	7.7		
				Trawl Date 10/6/76					
Argentina sialis						3		3	0.19
Chilara taylori		1				1		2	0.13
Chitonotus pugetensis		32		3		5		40	2.54
Citharichthys sordidus		84	2	286		188	29	589	37.37
C. stigmaeus	1	130	73		1	20	136	361	22.91
C. xanthostigma			5			1	11	17	1.08
Embiotoca jacksoni	10							10	1.08
Genyonemus lineatus					2			2	0.13
Hippoglossina stomata		4	4	1		4		13	0.82
Icelinus quadriseriatus		76		210		57	1	344	21.83
Microstomus pacificus		2		2				4	0.25
Odontopyxis trispinosa				2				2	0.13
Oxylebius pictus	1							1	0.06
Parophrys vetulus		50	2	4	7	2		65	4.12
Phanerodon furcatus	2							2	0.13
Pleuronichthys verticalis	1		5	4		5	2	17	1.08
Porichthys notatus		2	4			1		7	0.44
Scorpaena guttata			7	1				8	0.51
Sebastes serranoides	1							1	0.06
Symphurus atricauda		56	3	1		22		82	5.20
Syngnathus exilis							1	1	0.06

TABLE 9 (Cont.)
SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF ORANGE COUNTY AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1975-77 (FROM CSDOC, 1975, 1976, 1977)

Species	nT0	nT1	nT2	nT3	nT4	nT5	nT6	Total	Percent of Total Catch
				Trawl Date: 10/6/76 (Cont)					
Synodus lucioceps				1	1		1	3	0.19
Xystreurys liolepis						2		2	0.13
Number of Individuals	16	437	105	515	11	311	181	1576	
Percent	1.0	27.7	6.7	32.7	0.7	19.7	11.5		
				Trawl Date: 1/5/77					
Chitonotus pugetensis		3		2		16		21	1.30
Citharichthys fragilis		4	4	1		13		22	1.36
Citharichthys sordidus		13		115		47	2	177	10.98
C. stigmaeus	14	92	175	16	37	5	111	450	27.92
C. xanthostigma			5	33			5	43	2.67
Embiotoca jacksoni							1	1	0.06
Genyonemus lineatus					1			1	0.06
Hyppoglossina stomata			4	1		4	2	11	0.68
Icelinus tenuis						1		1	0.06
I. quadriseriatus		227	4	121		308	1	661	41.00
Lepidogobius lepidus						1		1	0.06
Lyopsetta exilis							1	1	0.06
Odontopyxis trispinosa				1		1		2	0.12
Paralichthys californicus	3				2			5	0.31
Parophrys vetulus				5				5	0.31
Pleuronichthys decurrens						1		1	0.06
P. verticalis	2	2	9	2	1	2	2	20	1.24
Porichthys notatus		4	1	17		20		42	2.61
Scorpaena guttata		1		2		4		7	0.43
Sebastes dalli						3	4	7	0.43
S. miniatus							1	1	0.06
S. rubrivinctus							1	1	0.06
S. vexillaris						1		1	0.06
Symphurus atricauda	1	38	21	8	17	25	3	113	7.01
Syngnathus exilis					2		1	3	0.19

TABLE 9 (Cont.)
SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF ORANGE COUNTY AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1975-77 (FROM CSDOC, 1975, 1976, 1977)

Species	nT0	nT1	nT2	nT3	nT4	nT5	nT6	Total	Percent of Total Catch
				Trawl Date: 1/5/77 (Cont)					
Synodus lucioceps		2		5			1	8	0.50
Xystreurys liolepis			3		1		1	5	0.31
Zalembius rosaceus						1		1	0.06
Number of Individuals	20	386	226	329	61	453	137	1612	
				Trawl Date: 5/2/77					
Chilara taylori	1		1	1	1	4		8	0.32
Chitonotus pugetensis			8	2		6	4	20	0.79
Citharichthys fragilis		1	14	20		3	1	39	1.54
C. sordidus		31	2	286	4	22	19	364	14.40
C. stigmaeus	8	102	279	63	102	387	91	1032	40.84
C. xanthostigma			14	11	13	6	3	47	1.86
Genyonemus lineatus	7						4	11	0.44
Hippoglossina stomata				3		1	1	5	0.20
Icelinus quadriseriatus		12	67	127	29	64	4	303	11.99
Lepidogobius lepidus			1					1	0.04
Microstomus pacificus		7	1	29				37	1.46
Odonotopyxis trispinosa		1	1	4	1	2		9	0.36
Paralichthys californicus	1						1	2	0.08
Parophrys vetulus		29		15	4		4	52	2.06
Phanerodon furcatus	3							3	0.19
Pleuronichthys decurrens							1	1	0.04
P. verticalis	2		9	2	2			15	0.59
Porichthys notatus		12	1	275	20			308	12.19
Scorpaena guttata			4		1	6	1	12	0.47
Scorpaenichthys marmoratus					1			1	0.04
Sebastes dalli		5		48		1	1	55	2.18
S. goodei						1		1	0.04
S. miniatus			3		1			4	0.16
S. saxicola		7	21	2	4	5	14	53	2.08
S. serranoides						1		1	0.04

TABLE 9 (Cont.)

SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF ORANGE COUNTY AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1975-77 (FROM CSDOC, 1975, 1976, 1977

Species	nT0	nT1	nT2	nT3	nT4	nT5	nT6	Total	Percent of Total Catch
				Trawl Date: 5/2/77 (Cont)					
Symphurus atricauda	2	16	12	9	21	7		67	2.65
Synodus lucioceps	1	2	26				2	31	1.23
Zalembius rosaceus			6	11	3		5	25	0.99
Zaniolepis latipinnis		6	1	11		2		20	0.79
Number of Individuals	25	231	471	919	207	518	156	2527	

TABLE 10

SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF HUNTINGTON BEACH AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1971-72 (FROM ENVIRONMENTAL QUALITY ANALYSTS, INC., AND MARINE BIOLOGICAL CONSULTANTS, INC., 1973a).

Species	Stations																			
	A	B	C	D	E	F	G	H	O	Total	A	B	C	D	E	F	G	H	O	Total
	October 1971										May 1972									
Galeorhinus zyopterus																				
Triakis semifasciata																				
Squalus acanthias																				
Platyrhinoidis triseriata																				
Rhinobatos productus							1			1										
Torpedo californica																		1		1
Myliobatis californica																				
Anchoa compressa	1						1			2										
Engraulis mordax								1		1										
Porichthys myriaster																				
P. notatus																				
Otophidium scrippsae																				
O. taylori																				
Syngnathus californiensis													1			1		2		4
Paralabrax maculatofasciatus																				
P. nebulifer																				
Chellotrema saturnum																				
Cynoscion nobilis													1							1
Genyonemus lineatus	19			3	2		2	20	14	60	1	9			10				18	38
Menticirrhus undulatus							2			2										
Seriphus politus	102			1	1			36	794	934	1				7					8
Amphistichus argenteus							34	1		35	1	2	1				12	7	1	24
Cymatogaster aggregata	13	1	40	24	65		21	1		165		9	4	2	12	3	61	3	23	17
Embiotoca jacksoni																				
Hyperprosopon argenteum	18	2		7			4	11	1	43					1		1			2
Phanerodon furcatus	23	4	33	35	50		5			150	4	11	8		38	1	6		40	108
Rhacochilus toxotes																				
Zalembius rosaceus															2					2
Heterostichus rostratus																				
Peprilus simillimus								1		1										
Scorpaena guttata															2	1				3
Leptocottus armatus	2		1							3		1					1			2
Citharichthys sordidus					5		10	1		16					2					2
C. stigmaeus	26	1	33	3	93	9	8	1		174	20	29	31	46	70	20	114	14	28	372

TABLE 10 (Cont.)

SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF HUNTINGTON BEACH AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1971-72 (FROM ENVIRONMENTAL QUALITY ANALYSTS, INC., AND MARINE BIOLOGICAL CONSULTANTS, INC., 1973a).

Species	Stations																			
	A	B	C	D	E	F	G	H	O	Total	A	B	C	D	E	F	G	H	O	Total
	October 1971										May 1972									
Hippoglossina stomata							3	2		5				1	4					5
Paralichthys californicus			1	1			2			4		1			2		1	1		5
Hypsopsetta guttulata																	1	1		2
Microstomus pacificus														2	2					4
Parophrys vetulus					1					1	2	2		7	6	4				21
Pleuronichthys decurrens																1	1	1		3
P. verticalis	3		3		11	1				18		2	2	4	8	2	1		1	20
Symphurus atricauda	1		1	1	7	1	1			12		3		5	11			1		20
Number of Individuals	208	8	112	75	235	11	94	75	809	1627	29	69	48	67	177	33	199	31	111	764
Number of Species	10	4	7	8	9	3	13	10	3	19	6	10	7	7	15	8	10	9	6	22
Diversity Index	1.69	1.12	1.48	1.62	1.47	0.83	2.64	2.08	0.30		1.53	2.53	1.68	1.97	2.82	2.35	1.61	2.75	2.05	

Species	A	B	C	D	E	F	G	H	O	Total	A	B	C	D	E	F	G	H	O	Total	Grand Total
	September 1972										December 1972										
Galeorhinus zyopterus							1			1											1
Triakis semifasciata								2		2											2
Squalus acanthias		1								1											1
Platyrhinoidis triseriata							3	1		4	2							3		5	9
Rhinobatos productus	3		1				3	2		9		1								1	11
Torpedo californica																					1
Myliobatis californica													1							1	1
Anchoa compressa	3						3	16		22	3	2	2							7	31
Engraulis mordax	69	85		208	126	72	48	62	124	794	21	50	24		4				46	145	940
Porichthys myriaster					2					2											2
P. notatus								2		2											2

TABLE 10 (Cont.)

SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF HUNTINGTON BEACH AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1971-72 (FROM ENVIRONMENTAL QUALITY ANALYSTS, INC., AND MARINE BIOLOGICAL CONSULTANTS, INC., 1973a).

Species	A	B	C	D	E	F	G	H	O	Total	A	B	C	D	E	F	G	H	O	Total	Grand Total
				September 1972										December 1972							
Otophidium scrippsae				1		13				14		3								3	17
O. taylori					6					6											6
Syngnathus californiensis								1		1					1	2			1	4	9
Paralabrax maculatofasciatus							2			2											2
P. nebulifer																1				1	1
Cheilotrema saturnum			1							1											1
Cynoscion nobilis																					1
Genyonemus lineatus	26	127	10	30	394	197	7	160	7	958	19	76	17		5				6	123	1179
Menticirrhus undulatus	1		3				2	4		10	2	1	2					3		8	20
Seriphus politus	73	137		203	116	217	126	84	30	986	136	349	68		3				88	644	2572
Amphistichus argenteus	6	4	10		1		41	34	1	97	31	1	7					20	1	60	216
Cymatogaster aggregata	8	11	12	9	43	16	62	39	4	204	1	4	6		7				3	21	507
Embiotoca jacksoni		4	10							14											14
Hyperprosopon argenteum	19	16	2	11	10		21	13	4	96	6	3	44						16	69	210
Phanerodon furcatus	39	25	27	9	26		9	18	1	154	5	3	8	2	4				1	23	435
Rhacochilus toxotes		2								2											2
Zalembius rosaceus																					2
Heterostichus rostratus								2		2		1		2						3	5
Peprilus simillimus	21	3	1			2	6	3	3	39											40
Scorpaena guttata																					3
Leptocottus armatus							2	10		12											17
Citharichthys sordidus																					18
C. stigmaeus	19	19	41	18	67	57	15	70		306		3	11	5	29	19		7	1	75	927
Hippoglossina stomata																					10

TABLE 10 (Cont.)

SPECIES AND NUMBER OF FISHES CAPTURED OFFSHORE OF HUNTINGTON BEACH AT EACH STATION DURING QUARTERLY TRAWLING SURVEYS, 1971-72 (FROM ENVIRONMENTAL QUALITY ANALYSTS, INC., AND MARINE BIOLOGICAL CONSULTANTS, INC., 1973a).

Species	A	B	C	D	E	F	G	H	O	Total	A	B	C	D	E	F	G	H	O	Total	Grand Total
	September 1972										December 1972										
Paralichthys californicus			2		1		2	4		9				2				1		3	21
Hypsopsetta guttulata							1	1		2		1						1		2	6
Microstomus pacificus																					4
Parophrys vetulus						1				1				2	2					4	27
Pleuronichthys decurrens								1		1								1		1	5
P. verticalis	1	2	2	5	14	39	1	3		67		1	2		13	1				17	122
Symphurus atricauda	1	3	1	7	45	44				101	2	22	4	1	16	2				47	180
Number of Individuals	289	439	123	501	851	658	355	532	174	3922	228	521	196	14	84	25		36	163	1267	
Number of Species	14	14	14	10	13	10	19	22	8	33	11	16	13	6	10	5		7	9	23	
Diversity Index	2.97	2.55	2.87	1.97	2.47	2.49	2.91	3.15	1.41		1.92	1.67	2.79	2.41	2.74	1.26		1.96	1.79		

APPENDIX III

NAVIGATION AIDS

AND

MARINE TRAFFIC

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
COMMANDER (oan)
ELEVENTH COAST GUARD DISTRICT
UNION BANK BLDG.
400 OCEANGATE
LONG BEACH, CA. 90822

16575/PF
Ser: oan 264-78
AUG 08 1978

Mr. W. M. Marshall
Division Production Manager
Western Division
Shell Oil Company
P. O. Box 831
Houston, Texas 77001

Dear Mr. Marshall:

Enclosed is the approved application for Private Aids to Navigation for the proposed platforms Ellen and Elly. Your attention is directed to the comment in Block 11.

Approval of this application does not constitute Coast Guard approval of the platforms or the proposed site. The Coast Guard's position on the proposal is that it is unacceptable without the institution of the shipping safety fairways as described in the Eleventh Coast Guard District Commander's letter of 31 March 1978 to the District Engineer, Los Angeles District, Corps of Engineers.

If I can be of any further assistance please contact me at (213) 590-2222.

Sincerely yours,

M. J. DANKO
Lieutenant Commander, U. S. Coast Guard
Chief, Aids to Navigation Branch
By direction of the District Commander

Copy to:
Corps of Engineers, Los Angeles District

SHELL OIL COMPANY

P.O BOX 831

HOUSTON, TEXAS 77001

July 14, 1978

Department of Transportation
United States Coast Guard
Eleventh Coast Guard District
400 Oceangate
Long Beach, California 90822

Attention Chief, Aids to Navigation Branch

Attached is our revised "Application for Class I Private Aids to Navigation" for our planned platforms Ellen and Elly located in OCS waters about eight miles southwest of Huntington Beach, California.

This application has been revised to comply with the requirements outlined in your letter 16575/PF, Ser: oan 205-78. The eight lanterns, all of which will be located 40 feet above mean high water, will each produce at least 6,500 candela. The two two-mile fog signal emitters, mounted at the same elevation on opposite corners of the complex, are directional and are synchronized. The HALS 15 lighting system for the top of the derrick remains unchanged. The entire navigational aid system will be connected to the emergency stand-by generator buss.

If you have any questions or need additional information, please let me know.

Yours very truly,

R. C. Visser

BLF:DC

For: W. M. Marshall
Division Production Manager
Western Division

Attachment

cc - United States Geological Survey
Los Angeles, California

Governor's Office of Planning & Research
Sacramento, California

Port of Long Beach
Long Beach, California

State Lands Commission
Sacramento, California

TREASURY DEPARTMENT
U. S. COAST GUARD
CG-4143 (5-62)

APPLICATION FOR CLASS 1 PRIVATE AIDS TO NAVIGATION ON ARTIFICIAL ISLANDS AND FIXED STRUCTURES

(Please read instructions on reverse)

Form Approved Budget Bureau No. 48-R383

1. NAME AND ADDRESS OF CORPORATION OR PERSON MAKING APPLICATION

Shell Oil Company
1200 Milam St.
Houston, Texas 77002
Attn; Mr. R.C. Visser

2. ACTION REQUESTED FOR PRIVATE AIDS TO NAVIGATION

A. [X] ESTABLISH AND MAINTAIN
B. [ ] CHANGE OWNERSHIP
C. [ ] CHANGE EQUIPMENT
D. [ ] MOVE
E. [ ] DISCONTINUE
F. DATE OF ACTION .....

3. POSITION

A. GENERAL LOCALITY AND GRID AREA	B. LATITUDE	C. LONGITUDE
OCS San Pedro Bay, Ca. Zone 6	33° 34' 56.2867"N	118° 07' 39.2990"

D. BLOCK NUMBER	E. SIGN	F. LEASE NUMBER	G. WELL NUMBER
261	Ellen and Elly	OCS-P-0300	N/A

4. LIGHT

A. CHARACTERISTICS — COLOR WHITE [ ] RED [ ]
FLASH 0.4 SECONDS ECLIPSE 0.6 SECONDS

B. NUMBER INSTALLED: 9

C. ILLUMINANT (Check): [X] ELECTRICITY [ ] GAS [ ] OIL [ ] OTHER (Specify) .....

D. HEIGHT ABOVE MEAN HIGH WATER	E. VOLTS	F. AMPERES	G. INSIDE DIAMETER LENS	G. INSIDE DIAMETER GLOBE	H. CANDLEPOWER (If known)
+40 (8)	120 (8)	4.17 (8)	250MM	G-40	6,700 (8) EFI
+236 (1)	120 (1)	8.34 (1)			14,000 (1)

5. FOG SIGNAL *(Characteristic will be one two-second blast every twenty seconds)*

A. CLASS	B. MANUFACTURED BY	C. MODEL NUMBER
[X] A (2-Mile) [ ] B (½-Mile)	Automatic Power, Inc. Houston, Texas	ELG-500/02 (2)

6. STRUCTURE

A. COLOR	B. HEIGHT ABOVE MEAN HIGH WATER	C. DEPTH OF WATER BELOW MEAN LOW WATER
To be determined	Platform +39 Derrick +236)	-258

7. AUTHORIZED BY CORPS OF ENGINEERS, U. S. ARMY, PERMIT NO.

8. PERSON IN DIRECT CHARGE OF AID

A. NAME	C. ADDRESS
Mr. R. F. Honer	196 S. Fir St.
B. TELEPHONE NUMBER	Ventura, calif. 93001
805-648-2751 Home 805-642-1665	

9. The applicant agrees to save the Coast Guard harmless with respect to any claim or claims that may result arising from the alleged negligence of the operation of the approved aids.

Attached to this application are:

A. [X] LOCATION PLAT B. [X] PRINT OF STRUCTURE C. [XX] AIDS TO NAVIGATION EQUIPMENT LIST
D. [ ] CERTIFICATE REQUIRED BY 33 CFR 67.10-1(4)

DATE	SIGNATURE
July 13, 1978	R. C. Visser
	TITLE: Project Manager, Western Division Productio

FOR COAST GUARD USE

10. FROM: Commander Eleventh Coast Guard District (oan)

A. THE ACTION DESCRIBED ABOVE IS	B. NOTICE TO MARINERS
[XX] APPROVED [XX] APPROVED SUBJECT TO THE COMMENTS IN BLOCK 11 ON REVERSE	[XX] WILL BE ISSUED [ ] WILL NOT BE ISSUED

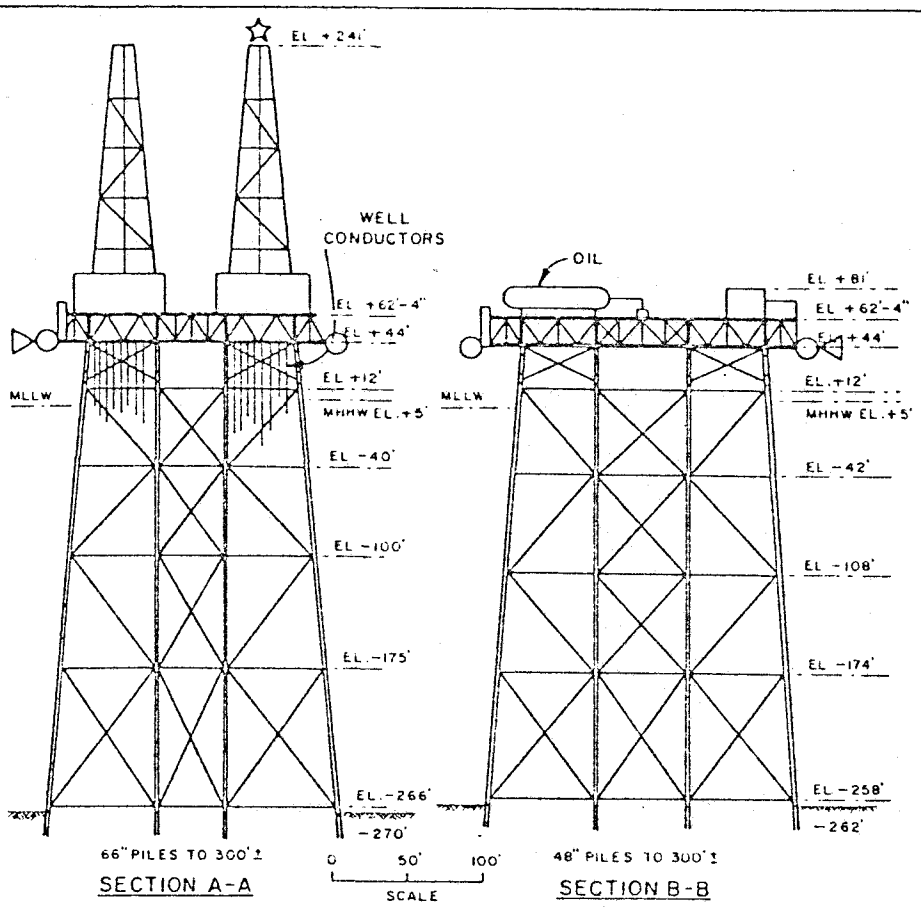
C. CHARTS AFFECTED	D. NAME OF AID(S)
18746 (C&GS 5142) 18747 (C&GS 5142-SC)	Ellen and Elly Structure

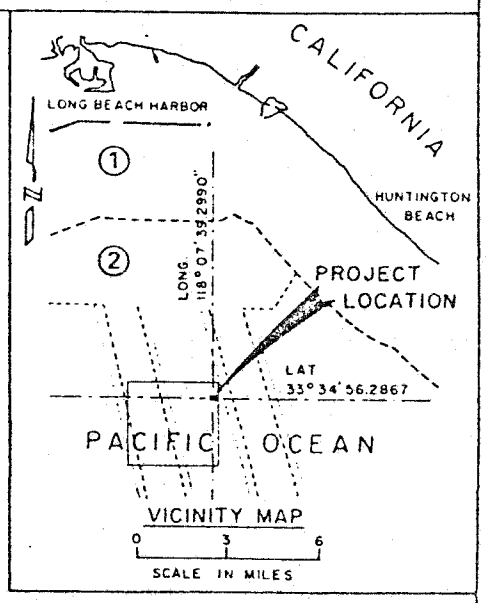
E. DATE	F. SIGNATURE (By direction in accordance with 33 CFR 67)
24 July 1978	M. J. DANKO, LCDR, USCG

25791 TREAS. COHQ. WASH., D.C.

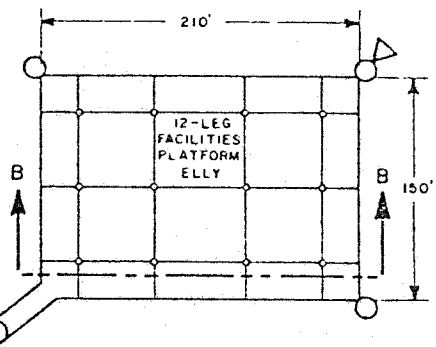
Block 11:

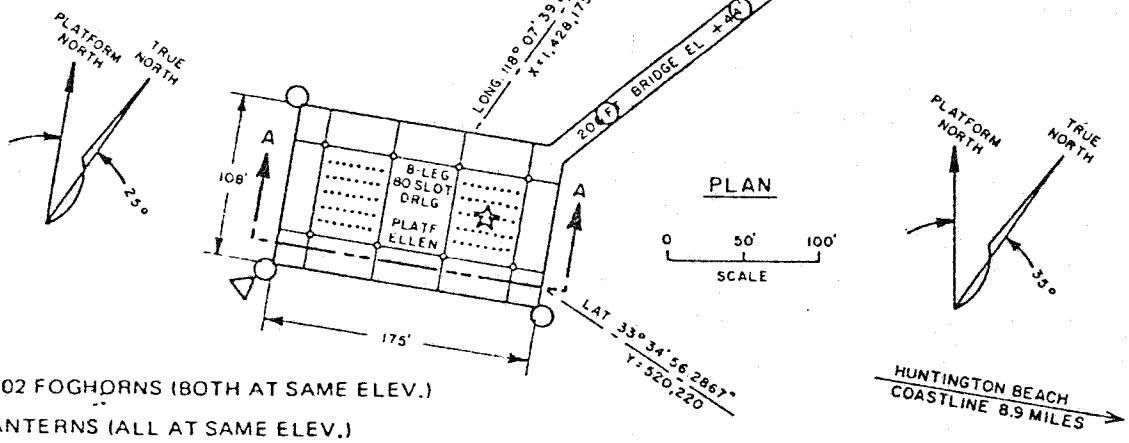
All obstruction lights shall be operated to flash in unison (33 CFR 67.05-5)





FROM: N.O.A.A. 18746





▷ ELG 500-02 FOGHORNS (BOTH AT SAME ELEV.)

○ FA 250 LANTERNS (ALL AT SAME ELEV.)

☆ HALS-15, 15 MILE LIGHTING SYSTEM

DATUM: MLLW

ADJACENT PROPERTY OWNERS:

① STATE OF CALIFORNIA

② U. S. DEPT. OF THE INTERIOR, OCS

LOCATION OF NAVIGATION AIDS ON PROPOSED DRILLING PLATFORM AND PRODUCTION PLATFORM

ON OCS LEASE P-0300
SAN PEDRO BAY, CALIF.

APPLICATION BY SHELL OIL CO. OPERATOR OF THE BETA UNIT PARCELS COVERED BY LEASES OCS P-0296, 0300, 0301, 0306 AND UNLEASED TRACT 255

SHEET 1 OF 1 DATE 12/1/77

ZF-2790

EQUIPMENT LIST

for

PLATFORMS ELLY AND ELLEN

(OCS LEASE P-0300)

SAN PEDRO BAY, CALIFORNIA

QUANTITY	DESCRIPTION
1	CG-1000 Fog Signal inverter with remote control switch and two ELG-500/02 emitters. Blast characteristic is 2 sec. ON and 18 sec. OFF 120/240 VAC 60Hz power source required.
1	SF-4000 Light Controller and Monitor with photocell 120 VAC, 60Hz power source required.
8	Dual Ventilated FA-250 Lanterns with 120 volt AC, 500 watt lamp with mounting stand to operate as a master and standby system. Flash characteristic is 0.4 sec. ON, 0.6 sec. OFF, 7000 effective candelas, 120 VAC, 60Hz power source required.
1	HALS 15, 15 Mile Derrick Light. Dual ventilated FA-250 lantern with mounting stand and both lanterns operating simultaneously 15,000 effective candelas. Flash characteristic 1.0 sec. ON, 2.0 sec. OFF, 220 volt AC, 60Hz, power source required.

REFERENCE EQUIPMENT LAYOUT PER DRAWING L-1205-C

INTER-GOVERNMENTAL MARITIME
CONSULTATIVE ORGANIZATION

ASSEMBLY - 10th session
Agenda item 8(b)

Distr.
GENERAL

A X/Res.379
15 December 1977

Original: ENGLISH

IMCO

RESOLUTION A.379(X)
adopted on 14 November 1977

ESTABLISHMENT OF SAFETY ZONES AND FAIRWAYS OR ROUTEING SYSTEMS IN OFF-SHORE EXPLORATION AREAS

THE ASSEMBLY,

NOTING Article 16(i) of the Convention on the Inter-Governmental Maritime Consultative Organization concerning the functions of the Assembly,

RECOGNIZING the need for ensuring unencumbered exploitation of sea-bed resources as well as safety at sea,

RECOGNIZING FURTHER that the congestion of navigable waters by off-shore platforms or other similar structures could result in ships colliding with such structures thereby causing loss of life, pollution of the marine environment and economic loss,

RECALLING Resolution A.340(IX) by which it adopted a Recommendation on Establishment of fairways through off-shore exploration areas,

NOTING that in accordance with Article 5 of the 1958 Convention on the Continental Shelf, Governments may establish safety zones, extending to a maximum distance of 500 m around continental shelf installations or other devices, which should be respected by ships of all nationalities,

BEING INFORMED of the frequent infringements of safety zones by ships,

HAVING CONSIDERED the Recommendation adopted by the Maritime Safety Committee at its thirty-sixth session,

RECOMMENDS that Governments:

(a) ensure that the exploitation of sea-bed resources does not seriously obstruct sea approaches and shipping routes;

(b) study the pattern of shipping traffic through off-shore resource exploration areas at an early stage so as to be able to assess potential interference with marine traffic passing close to or through such areas at all stages of exploitation;

(c) where proliferation of oil installations or changes of traffic pattern warrants it, consider as appropriate the designation of safety zones around off-shore platforms and other similar structures or the establishment and charting of fairways or routeing systems through exploration areas,

URGES Governments:

(a) to take all necessary steps to ensure that ships under their flags, unless specifically authorized, do not enter or pass through duly designated safety zones;

(b) to promulgate by all appropriate means details of designated safety zones and established fairways or routeing systems, taking into account Resolution A.341(IX) on the Dissemination of Information, Charting and Manning of Drilling Rigs, Production Platforms and Other Similar Structures,

REVOKES Resolution A.340(IX).

APPENDIX IV

OFFSHORE STRUCTURE COLLISION DATA

TABLE 11

RAMMING INCIDENTS INVOLVING VESSELS IN EXCESS OF 500 GROSS TONS AND ARTIFICIAL ISLANDS, GULF OF MEXICO JULY 1, 1962 - JUNE 30, 1977

CASE	DATE TIME OF DAY	VES. TYPE G. TONNAGE	VISIBILITY WIND SPEED	PRINCIPAL CAUSE	DAMAGE - STRUCTURE DAMAGE - VESSEL
1.	11/9/63 Night	Cargo 5 - 10,000	8 mi 30 kts	Failure to make proper allowance for leeway in high wind.	300,000 5,000
2.	5/4/64 Day	Tug & Tow 1 - 5,000	2 mi 20 kts	Personnel error - unlicensed/uncertified crew member - passed too close to windward.	180,000 <1,000
3.	10/4/65 Night	Cargo 5 - 10,000	1 - 3 mi 20 kts	Lack of proper look out in reduced visibility (fog).	50,000 191,000
4.	12/15/65 Day	Cargo 1 - 5,000	Unknown Unknown	Unknown/insufficient information.	200,000 <1,000

TABLE 11 (Cont.)

CASE	DATE TIME OF DAY	VES. TYPE G. TONNAGE	VISIBILITY WIND SPEED	PRINCIPAL CAUSE	DAMAGE - STRUCTURE DAMAGE - VESSEL
5.	9/12/67 Night	Unknown Unknown	Unknown Unknown	Damaged by collision with unidentified vessel.	100,000 Unknown
6.	10/30/67 Night	Cargo 10 - 15,000	Poor in heavy rain 45 kts	Use of uncorrected charts. Platform not identified on radar - sea return.	1,100,000 12,000
7.	8/27/69 Night	Cargo 10 - 15,000	18 mi 5 kts	Failed to identify platform lights.	500,000 10,000
8.	10/10/70 Night	Tanker >15,000	5 mi 7 kts	Lack of proper lookout.	865,000 60,000

TABLE 11 (Cont.)

CASE	DATE TIME OF DAY	VES. TYPE G. TONNAGE	VISIBILITY WIND SPEED	PRINCIPAL CAUSE	DAMAGE - STRUCTURE DAMAGE - VESSEL
9.	May '74 Night	Cargo 1,5000	2+ miles slight	Vessel operator carelessness/ inattention.	850,000 500,000
10.	August '75 Night	Tanker >15,000	2+ miles 4 - 10 kts	Failed to post lookout.	(total > 10,000,000 loss) >10,000,000(total loss)

Source: References 3, 4.

APPENDIX V

OIL SPILL SIMULATION EQUATIONS

APPENDIX B

SIMULATED OIL SPILL EQUATIONS

Oil Spreading Equations

(1) gravity-inertia regime:

$$r_i(t)=K_{2i}(\Delta g V t^2)^{1/4} \text{ for } 0 \leq t \leq t_{iv}$$

$$\text{where } t_{iv}=(K_{2v}/K_{2i})^4 (V/\Delta g \nu_w)^{1/3}$$

and in particular,

$$r_i(t)=1.192V^{1/4}t^{1/2} \text{ for } 0 \leq t \leq 243.4V^{1/3}$$

(2) gravity-viscous regime:

$$r_v(t)=K_{2v}(\Delta g V^2 t^{3/2}/\nu_w^{1/2})^{1/6} \text{ for } t_{iv} < t \leq t_{vt}$$

$$\text{where } t_{vt}=(K_{2v}/K_{2t})^2 (\rho_w/\sigma)(\Delta g \nu_w)^{1/3} V^{2/3}$$

and in particular,

$$r_v(t)=4.709V^{1/3}t^{1/4} \text{ for } 243.4V^{1/3} < t \leq 175.2V^{2/3}$$

(3) surface tension-viscous regime:

$$r_t(t)=K_{2t}(\sigma^2 t^3/\rho_w^2 \nu_w)^{1/4} \text{ for } t_{vt} < t \leq t_f$$

$$\text{where } t_f=((10^5/\pi)^{1/2}(\sigma^2/\rho_w^2 \nu_w)^{-1/4}/K_{2t})^{4/3} V^{1/2}$$

and in particular,

$$r_t(t)=.35569t^{3/4} \text{ for } 175.2V^{2/3} < t \leq 3985V^{1/2}$$

$r(t)$ = radius of slick in meters (m) at time t in seconds (sec)

K_{2i} = 1.14; K_{2v} = 1.45; K_{2t} = 2.30

ρ_o = density of oil = 900 Kg/m^3

ρ_w = density of water = 1025 Kg/m^3

$\Delta = \frac{\rho_w - \rho_o}{\rho_o} = 0.12195$ (dimensionless)

g = acceleration of gravity = 9.80665 m/sec^2

V = initial spill volume (m^3)

ν_w = kinematic viscosity of water = $1.04 \times 10^{-6} m^2/sec$

σ = spreading coefficient due to surface tension = .025 Kg/sec^2 (N/m)

Vector Equations for Wind and Current Induced Drift

Calculate components of the wind velocity parallel and perpendicular to the surface current velocity:

$$W_p = W \cos \theta$$

$$Wv = W \sin \theta$$

where W = wind speed,

W_p = speed component parallel to $\vec{C}$,

Wv = speed component perpendicular to $\vec{C}$,

θ = angle between $\vec{W}$ and $\vec{C}$,

and $\vec{C}$ = surface current velocity

If the wind is producing co-current drift, i.e., $W_p C > 0$, and $W_p > 20$ C where C is the current speed, then a current drift-factor of 96.7% and a wind drift-factor of 3.3% can be used to give the total slick speed parallel to the surface current:

$$T_p = 0.967\ C + 0.033 W_p$$

If the wind-induced drift is co-current ($W_p C > 0$) but $W_p \leq 20C$, then Tsahalis showed that:

$$T_p = C + C\left[-.00011 + 0.0015\left(\frac{W_p}{C}\right) - 0.00229\left(\frac{W_p}{C}\right)^2 + 0.0011\left(\frac{W_p}{C}\right)^3 - 0.000102\left(\frac{W_p}{C}\right)^4 + 0.00000426\left(\frac{W_p}{C}\right)^5 - \left(4.26 \times 10^{-6}\right)\left(\frac{W_p}{C}\right)^6 + \left(6.78 \times 10^{-10}\right)\left(\frac{W_p}{C}\right)^7\right]$$

If the wind is producing counter-current drift ($W_p C < 0$) and if $W_p < -35C$, i.e., W_p larger in absolute value than 35 C, the current and wind drift-factors of 96.7% and 3.3%, respectively, can be used:

$$T_p = 0.967\ C + 0.033\ W_p$$

If the wind-induced drift is counter-current ($W_p C < 0$) but if $W_p \geq 35\ C$, i.e., W_p is smaller in absolute value than 35 C, the total slick speed parallel to the surface current is:

$$T_p = C + C\left[-.0027 + 0.0071\left(\frac{W_p}{C}\right) - 0.00391\left(\frac{W_p}{C}\right)^2 - 0.000551\left(\frac{W_p}{C}\right)^3 - 0.0000379\left(\frac{W_p}{C}\right)^4 - 0.00000122\left(\frac{W_p}{C}\right)^5 - \left(1.85 \times 10^{-8}\right)\left(\frac{W_p}{C}\right)^6 - \left(1.06 \times 10^{-10}\right)\left(\frac{W_p}{C}\right)^7\right]$$

In both the co-current and counter-current wind-induced drift cases, the total slick speed perpendicular to the surface current is given by a wind drift-factor of 3.3% applied to the wind-speed component perpendicular to the surface current:

$$T_v = 0.033\ W_v$$

The resultant slick speed is then:

$T = \sqrt{T_p^2 + T_v^2}$, with direction in degrees relative to the surface current direction:

$$\beta = \tan^{-1} \frac{T_v}{T_p}$$

References:

Fay, James A. "Physical Processes in the Spread of Oil on a Water Surface". Proceedings of Joint Conference on Prevention and Control of Oil Spills. (1971), pp. 463-467.

Premack, Joel and George A. Brown. "Prediction of Oil Slick Motions in Narragansett Bay". Proc Joint Conf. Prevention and Control of Oil Spills. (1973), pp. 531-540.

Tsahalis, D. T. "Theoretical and Experimental Study of Wind and Wave Induced Drift". preprint from J. Phys. Ocean.

APPENDIX VI

LIST OF COASTAL

BEACHES AND PARKS

APPENDIX VI

COASTAL BEACH AND PARK FACILITIES
(Long Beach to San Clemente, inclusive)

State

Bolsa Chica
Huntington
Doheny
San Onofre
San Clemente
Corona del Mar (State owned, but maintained by Newport Beach)

County

Los Angeles
- Santa Ana River

Orange
- Sunset
- Sunset Aquatic
- Newport Harbor
- Laguna Niguel
- Dana Point Harbor
- Aliso Beach
- Dana Cove (maintained but not owned by County)

City

Huntington
- City Beach
- Huntington Harbor (joint jurisdiction - patrolled by County, maintained by City)

Laguna Beach
- Crescent Way Bay Beach
- Shaw Cove Beach
- Boat Canyon Beach
- Diver's Cove Beach
- Picnic Beach
- Rock Pile Beach
- Heisler Park
- Main Beach
- Sleepy Hollow Beach
- Saint Ann Beach
- Thalia Street Beach
- Oak Street Beach

Laguna Beach, continued
- Mountain Road Beach
- Bluebird Street Beach
- Pearl Street Beach
- Wood's Cove Beach
- Moss Street Beach
- Victoria Street Beach
- * Blue Lagoon
- * Aliso Beach and Pier
- * Camille
- * Laguna Niguel Royal
- * West Street
- ** Irvine Cove
- ** Emerald Bay
- ** Three Arch Bay

Long Beach
- Alamitos Park
- Bixby Park
- Bluff Park
- Marine Park
- Overlook Park
- Bay Shore Beach (swim)
- Dana Place to 68th Place (swim and boat)
- Peninsula Bay Beach (swim and boat)
- Alamitos Bay (boat)
- Marine Stadium (motor boats)
- 1st Place to 72nd Place (swim)
- Colorado Lagoon (swim)
- Long Beach Marina
- Long Beach Harbor
- Los Cerritor Channel
- San Gabriel River
- Los Angeles River Channel
- Shoreline Aquatic Park (proposed)

Newport Beach
- Newport Pier
- Newport Beach
- Newport Dunes Aquatic Park
- Newport Bay Wildlife Preserve
- West Newport Park
- North Star Beach
- Bluffs Parks
- Cliff Drive View Park
- Balboa Pier
- Balboa Peninsula Park
- Balboa Island Beaches
- West Jetty Park
- Las Arenas Park
- Lido Park
- Lido Isle Beaches

---

* Owned by County but guarded by Laguna Beach
** Privately owned and maintained; guarded by City

San Clemente
- City Beach
- San Clemente Pier

Seal Beach
- Eisenhower Park
- Seal Beach Municipal Pier

Commercial Recreational Facilities Privately Run

Sportsfishing
- Seal Beach Sportsfishing
- Davey's Locker (Newport Beach)
- Art's Landing (Balboa)
- Dana Wharf (Dana Point)

Boating
- Alamitos Bay Yacht Club (Long Beach
- Long Beach Yacht Club
- Basin Marina
- Newport Dunes Aquatic Park
- Art's Landing
- Embarcadero Marina (Dana Point)

APPENDIX VII

UTILITY/SERVICE AGREEMENTS

POLICE DEPARTMENT
City of Huntington Beach

P.O. BOX 70 • 2000 MAIN STREET, HUNTINGTON BEACH, CA. 92648 • TEL: (714) 536-5311

EARLE ROBITAILLE
Chief of Police

September 20, 1978

WESTEC SERVICES, INC.
Applied Sciences
180 East Main Street
Tustin, California 92680

Attention: Nina Gruver

Dear Ms. Gruver:

A number of your organizations telephoned us about ten days ago and a discussion was held regarding the project "Shell OCS Beta Unit Development". To reiterate that discussion, and answer the questions in your letter, we consider the police service we provide to be among the best and most technically advanced in the nation.

We do not anticipate any adverse effect your project will have upon our level of service under normal operations. There may be some concern regarding the protection of automobiles which may be parked for extended periods. Because of the transient population using the beaches in our city, there may be a temptation for auto theft, auto burglary, theft from autos or malicious mischief in your parking lots.

The traffic problem appears to be insignificant at this time. However, the one area of concern regarding our service is major disasters such as major oil leaks flooding our beaches, aircraft or vessel collisions, or accidents and personal accidents requiring immediate or emergency services.

It is difficult to project the additional personnel needed to service the area as a result of your project. It will definitely create a need for some additional police man hours, however, the number cannot be anticipated now.

The response time for emergency service averages under five minutes and for non-emergency calls, the average time is approximately twenty two minutes with the average overall time at below thirteen minutes.

We are pleased to respond to your request. If you have further questions, please contact us.

Sincerely,

EARLE W. ROBITAILLE
Chief of Police

ROBERT E. FICKLE, Sergeant
Special Operations Division

EWR:REF:skd

September 18, 1978

Nina Gruver
Environmental Analyst
Westec Services, Inc.
180 East Main Street
Tustin, CA 92680

Dear Ms. Gruver:

This is in response to your September 11, 1978 correspondence concerning a proposed Shell Beta Project and the use of the Shell Oil marine fueling facility for crew boats. We will answer your questions in the same order as presented.

1. We consider the current level of service for the community in relation to fire protection as "good."

2. We do not at this time contemplate any adverse effects upon the level of service should the project being researched be approved. We do, however, have one question, and that would be concerning any rupture of the underwater petroleum line between the proposed platforms and Pier J in the Port of Long Beach. A rupture of this pipeline could result in some problems relating to beach pollution, water pollution, and what could be combustible petroleum products in the water and on the sand.

3. We do not anticipate any additional personnel or cost to the Fire Department as a result of this project.

4. The only special services that we could forecast would be in relation to a rupture of the underwater pipe.

5. The Fire Department has an average response time of approximately five minutes to an emergency and five to ten minutes for non-emergency calls.

I hope that this response will assist you in preparation of the environmental impact necessary for the Shell Beta Project.

Yours truly,

R. E. Adams

R. E. Adams, Fire Chief
SEAL BEACH FIRE DEPARTMENT

REA:mc
cc: City Manager
Planning Department

The Port of Long Beach
"America's most Modern Port"
P. O. BOX 570 · LONG BEACH, CALIFORNIA 90801 · TELEPHONES: (213) 437-0041 · (213) 775-3469 · TELEX: 65-6452 PORTOBEACH LGB

September 15, 1978

Ms. Nina Gruver
Enviornmental Analyst
Westec Services, Inc.
180 East Main St.
Tustin, Calif. 92680

Dear Ms. Gruver:

This is in reply to your letter of September 11, 1978, requesting written response to certain specified security aspects of the proposed Shell Beta Project. This will also confirm our responses to verbal inquiry tendered earlier.

Our current level of manned security services in the Port of Long Beach is considered to be good. Harbor Department civil service Security Officers maintain 24-hour days, every day in the year, continual harbor patrol. Security officers use black and white police type vehicles with two-way radio communication to command base. Security guard service for individual facilities, if required, must be furnished by the facility operator.

There is no presently recognized adverse effect the Shell Beta project might have on Port security service, and no additional port security personnel are contemplated as a result of the project.

No special security services on the part of the Port are anticipated. Project design and construction should provide any specific physical security measures considered appropriate.

Harbor Department Security force response time to an emergency averages two to five minutes, depending upon the nature of the emergency and its physical location relative to Port Security headquarters. Response time in non-emergency calls normally would vary from ten to thirty minutes-again depending upon the nature of the problem.

J. H. McJunkin
General Manager

H. H. Harnagel
Director of Operations

HHH:njc

PACIFIC HOSPITAL OF LONG BEACH
A NON-PROFIT CORPORATION
2776 PACIFIC AVENUE P.O. BOX 1268
LONG BEACH, CALIF. 90801 (213) 595-1911

C. JOSEPH HEINZ
Administrator

September 20, 1978

Ms. Nina Gruver
Environmental Analyst
Westec Services, Inc.
Applied Sciences
180 East Main Street
Tustin, CA 92680

Dear Ms. Gruver:

We are in receipt of your letter of September 11th, outlining the proposed Shell Beta Project.

From the information submitted for our review, this product should have no adverse affect upon the level or quality of services provided by the Hospital, and we would be most willing to provide services if needed to employees and their families.

Sincerely,

C. Joseph Heinz

CJH:jl

LONG BEACH COMMUNITY HOSPITAL
OFFICE OF THE PRESIDENT

September 18, 1978

Ms. Nina Gruver
Environmental Analyst
Westec Services, Inc.
Applied Sciences
180 East Main Street
Tustin, CA 92680

RE: Shell OCS Beta Unit Development

Dear Ms. Gruver:

In response to your September 11, 1978 letter, I cannot see that the proposed project would have any direct measurable effect on Long Beach Community Hospital.

Very truly yours,

Bruce R. Sanderson
President

BRS/ep

1720 Termino Avenue • P.O. Box 2587 • Long Beach, California 90801 • (213) 597-6655

CITY OF LONG BEACH
DEPARTMENT OF FIRE
400 WEST BROADWAY, ROOM 261 • LONG BEACH, CALIFORNIA 90802

ADMINISTRATION
436-2219
FIRE PREVENTION
435-2458
FIRE TRAINING CENTER
597-5488
TECHNICAL SERVICES
599-3679
EMERGENCY PREPAREDNESS
595-1751

September 15, 1978

Nina Gruver, Environmental Analyst
Westec Services, Inc.
Applied Sciences
180 East Main Street
Tustin, CA. 92680

Dear Ms. Gruver:

This is in reply to your letter of September 11, 1978 requesting information from our Department regarding our concerns about the Shell OCS Beta Unit development.

One of the problems in responding to your letter is that yours is one of several proposals involving the Harbor District. While individually a project may not adversely impact the level of service provided, collectively they are almost certain to do so.

However, we will predicate our resonse on the basis of no additional projects.

1. Our current level of service provided is excellent. Long Beach received a Class I rating for it's Fire Department when rated in 1972 by the Insurance Services Office.

2. This project would not have significant impact on the level of service currently provided, but additional inspection responsibilities would be placed on our Fire Prevention Bureau.

3. No additional personnel would be required.

4. S pecial services required would consist of inspections by the Fire Prevention Bureau.

5. Response time to an emergency call would be somewhere between three and four minutes, under normal conditions. Non-emergency response time would depend on the time of day and traffic conditions.

Should any additional information be required, please call me at (213) 436-2219.

Sincerely,

JB Souders

J. B. Souders, Deputy Chief - Administration
Department of Fire

JBS:kd

APPENDIX VIII

OCEANOGRAPHIC SURVEY RESULTS

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INTRODUCTION

This report presents the results of a physical-chemical oceanographic field study conducted by the Environmental Sciences Division of Brown and Caldwell (B and C) in conjunction with the OCS Beta Unit EIR/EA for Shell Oil Company. This introductory section of the report describes the objectives and scope of the study, while the following sections present a description of the equipment and procedures used during the field effort, the data processing techniques, and the results of the survey.

Objectives and Scope

The Shell Beta Unit Plan of Development envisions the construction of a 265 foot drilling platform (Ellen) and a 255 foot production platform (Elly). Future plans include a 700 foot drilling platform (Eureka) to produce the deep portions of the reservoir. A 16 inch pipeline will connect the production platform to a land site within Long Beach Harbor.

The estimated peak oil production rate from the 265 foot platform will be approximately 16,000 barrels per day (B/D) in 1982. The estimated peak oil rate from both the 265 and 700 foot platforms will be 26,000 B/D in 1984.

The purpose of this study was to gather supportive site specific data for the proposed Shell Beta platform site, the proposed pipeline corridor between the production platform and the Long Beach breakwater, and the proposed pipeline terminus corridor within Long Beach Harbor (Figure 1).

The primary objective of the study was to substantiate the validity of existing background information. A secondary objective of increasing the established data base was also accomplished. The scope of work included a single comprehensive examination of representative physical and chemical oceanographic parameters within the study area.

Characteristics of the Study Area

The area of planned development is located within the Southern California Bight on the northeast shelf and slope of the San Pedro Basin, approximately nine miles offshore of Huntington Beach (Figure 1). The Beta accumulation (petroleum reservoir) is located at a structurally high position along the east side of the Palos Verdes Fault, extending along the fault approximately five miles. The beds dip generally to the northeast from 10 to 30 degrees. Oil-water contacts limit the width of the accumulation to approximately one mile.

Oil is currently produced from accumulations in folded structures associated with the Palos Verdes and Newport-Inglewood fault zones onshore and offshore in San Pedro Bay. There were no measureable quantities of H_2S in any of the

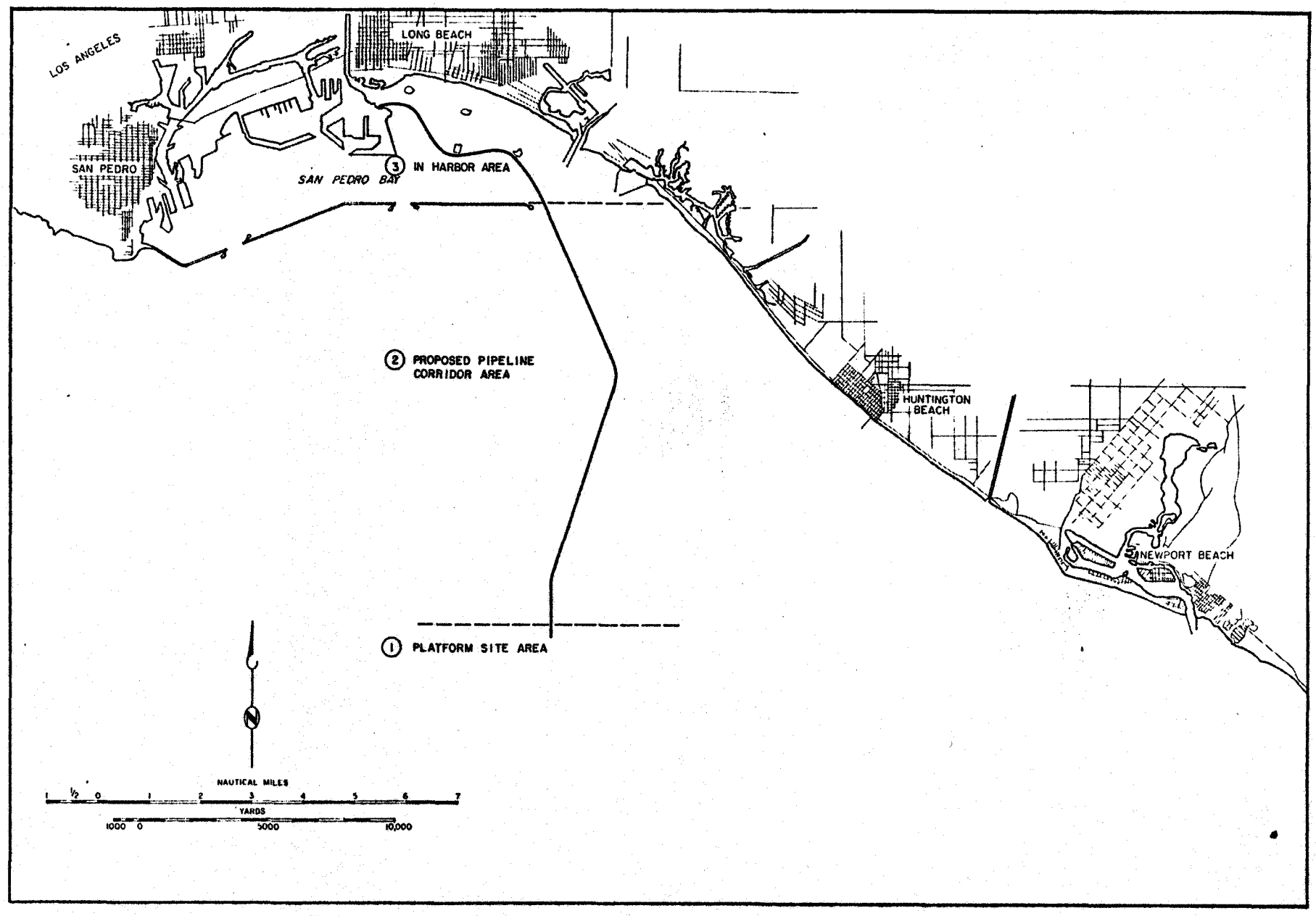


Figure 1. Shell Beta Study Area

produced gas samples from exploratory drilling. The sulfur content of the crude ranges from 3 to 4 percent with the estimated average produced gravity for both sites to be between 14 - 16° API.

EQUIPMENT AND PROCEDURES

This section of the report describes sampling areas and sampling stations monitored, the survey equipment used, methodology employed, and the data reduction procedures followed during the Shell Beta field survey.

Study Areas and Sampling Locations

Field surveys were conducted throughout the study area between July 18 and July 26, 1978. The Shell Beta study area was divided into three subareas as shown on Figure 1. The location of each of the 18 stations, including the positions from which drogues and current meters were deployed, are shown on Figure 2.

Table 1 presents a list of all parameters measured and the total number of samples taken at each site. Individual stations outside the breakwater were located using a Motorola miniranger electronic positioning system. Stations within the Long Beach breakwater were located by sextant and visual observation using landmarks and existing oil producing islands.

Water Quality Measurements

Continuous vertical profile measurements of water quality parameters were measured during the July survey using Brown and Caldwell's water quality data acquisition system shown in Figure 3. The water quality data acquisition system consists of a Martek Mark III water quality analyzer and transmissometer and Brown and Caldwell's data processor. This system was used to record vertical profile measurements of temperature, conductivity, dissolved oxygen, pH, and light transmittance. As the underwater sensors were lowered from the surface to the bottom of each station, the analog signal produced by each sensor was converted to digital, displayed, and recorded at one-second intervals. The digital data processor recorded water quality profile information by printing the information on paper and also punching the information on mylar computer tape. The printed output was used as a hard copy for field check of the accuracy of parameters measured. The punched tape was used for computerized data reduction.

The survey procedure was the same at each water quality station. A label containing B and C's internal job number, date, station code, and time of the profile was recorded on punched tape by the digital data processor, and the station number was written directly on the printed output. The underwater sensors of the water quality data acquisition system were lowered over the side and held

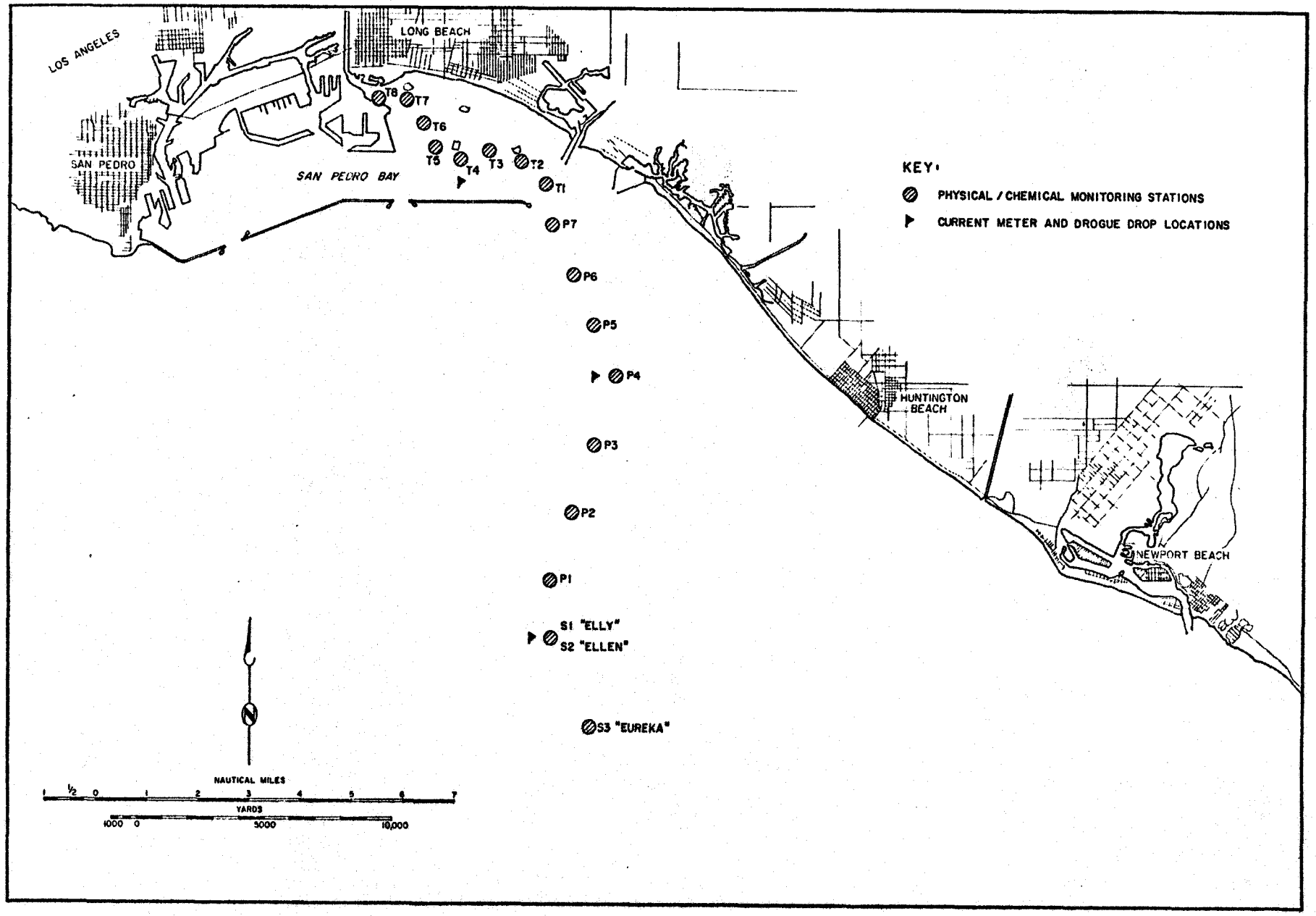
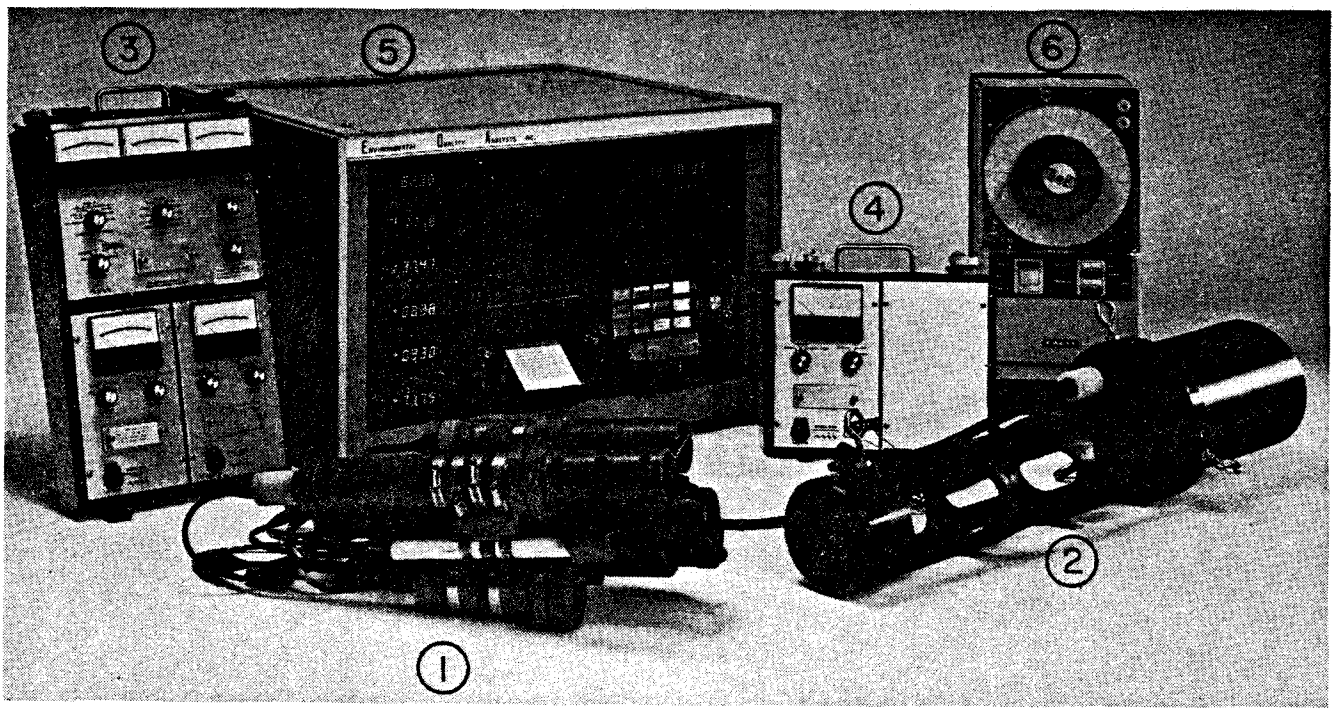


Figure 2. Oceanographic Station Locations



OCEANOGRAPHIC WATER QUALITY DATA ACQUISITION SYSTEM

1. Martek Mark III Underwater Sensors
2. Martek XMS Transmissometer
3. Martek Mark III Water Quality Analyzer
4. Martek Transmissometer Deck Unit
5. Digital Data Processor
6. Facit Paper Tape Punch

Parameter	Method of Measurement	Accuracy	Indicating and Recording Methods[c]
Depth	Pressure transducer	± 1% full scale, ± 1 foot	Digital, printed paper tape, ASCII format mylar tape.
Temperature[a]	Transistor probe	± 0.1C 0.01 C resolution	Digital, printed paper tape ASCII format mylar tape.
Specific electrical conductivity	Five-electrode guarded Kelvin cell	± 0.02 Millimho/cm	Digital, printed paper tape, ASCII format mylar tape.
pH	Glass and silver/ silver chloride	± 0.1 pH unit, ± 0.01 unit resolution	Digital, printed paper tape, ASCII format mylar tape.
Dissolved oxygen[b]	Auto-temperature compensated polarographic gold/silver electrode	± 1% full scale, ± 0.2 part per million	Digital, printed paper tape ASCII format mylar tape.
Turbidity, light transmittance	Transmissometer, feedback-balanced photodiode detector	± 1% full scale	Digital, printed paper tape, ASCII format mylar tape.

[a] Temperature measuring systems are checked for accuracy with N.B.S. calibrated thermometers.
[b] Calibrated during the survey using the Winkler titration procedure.
[c] Accuracies listed are manufacturers specifications and are based on using analog meter outputs. Laboratory and field calibration indicates, however, that greater accuracy is achieved using digital recording outputs instead.

Table 1. Summary of Physical and Chemical Field Study Sampling Frequency

PHYSICAL-CHEMICAL FIELD STUDIES

Parameters	Receiving Water			Sediment		
	Site Area	Pipeline Area	Terminus Area	Site Area	Pipeline Area	Terminus Area
Temperature	10[a]	24	24			
Salinity	10	24	24			
Dissolved Oxygen	10	24	24			
Hydrogen Ion Concentration	10	24				
Transmissivity	10	24	24			
Submarine Photometer	10	24	8			
Nitrate/Nitrite	3	7	8			
Phosphate	3	7	8			
Silicate	3	7	8			
Phenols				3		8
Coliform Bacteria	3					
Ammonia	3					
Grease and Oil	3	7	8	3	7	8
Cadmium				3		8
Copper				3		8
Lead				3		8
Silver				3		8
Zinc		7		3	7	8
Cobalt				3	3	8
Manganese				3		8
Arsenic				3		8
Boron				3		8
Nickel				3		8
Mercury				3		8
Total Chromium	3			3		8
Barium	3			3		8
Lead	3			3		8
Aluminum	3			3	4	3
Iron	3			3		8
BOD	3			3	7	8

[a] Numbers indicate total samples taken per area.

at the water's surface until they had equilibrated. The underwater sensors were then lowered manually by the electronic cable connecting the sensors to their readouts at approximately one-half foot per second as the digital data processor recorded all parameters simultaneously. After the sensors had been lowered all the way to the bottom (or to a depth of 280 feet) the digital data processor was turned off, and the sensors were retrieved. Each sensor was calibrated before and after each survey, and calibration checks were performed several times during each survey.

Light intensity was measured at all stations during daylight hours. A submarine photometer, measuring light within blue-green spectrum, was used to measure downwelling light intensity in milliamps at depths of surface, 6.5, 20, and 40 feet (surface, 2, 6, and 12 m). From these measurements, the percent of incident light remaining was calculated and converted to Langleys per second (ergs/cm^2/sec).

Current Measurements

The speed and direction of currents during the study period were determined by the use of both current meters and drogues.

Current Meters. Current measurements were taken at Stations S1 and P4 for a period of 25 hours. Three EG&G CT/3 electromagnetic current meters were moored using a dual string arrangement as shown in Figure 4. The meters were moored at near-surface (1 m depth), mid-depth, and within three meters of the bottom, moving vertically with the tide. Each assembly was moored with one danforth anchor on short scope to limit horizontal movement.

The EG&G meters are self-contained, in-situ recording instruments which orient themselves in the direction of the current flow by means of a large vane. Speed is detected using electromagnetic sensors. Direction is referenced to magnetic north by means of a flux gate compass. An internal program controlled by a crystal clock governs the rate of data recorded on a magnetic cassette tape recorder.

The meters have an accuracy of $\pm$ 0.015 m/sec in the speed range of 0.03 to 3.0 m/sec and a directional accuracy of $\pm$ 5 degrees. The three meters were programmed to record every six seconds over a two-minute period every fifteen minutes.

Current measurements within the Long Beach breakwater were obtained hourly at Station T4. A Bendix Model Q-15 ducted current meter was utilized to record both speed and direction at depths of 3, 6, 10, 15, 25, 30, and 40 feet. This current meter compensates for oscillatory wave motions so that only the net current speed is recorded. The current meter is oriented in the direction of the net current flow by a 10 foot long vane. Direction is referenced to magnetic north by a compass contained within the current meter housing. The ducted current meter system has an accuracy of $\pm$ 0.03 knots in the speed range of 0 to 1 knot and a directional accuracy of $\pm$ 5 degrees.

Drogues. Drogue releases were made during slack water between both flooding and ebbing tidal phases. The drogues were released twice at each station (S1, P4, and T4) and followed for a period of approximately six hours. Due to a positioning equipment malfunction, the data from Station P4 was determined unreliable and has not been included.

A typical drogue is shown in Figure 5. Each drogue consists of two 5' x 5' polyethylene panels attached at right angles to a frame of PVC pipe. The frame is rigid in the water but can be collapsed and rolled for ease of handling and storage. The drogue is attached to a surface float which in turn is tethered to a surface buoy. The drogue itself is weighted to maintain proper vertical orientation within five feet of the surface. The effective surface area ratios of drogue to marker buoy is approximately 100 to 1.

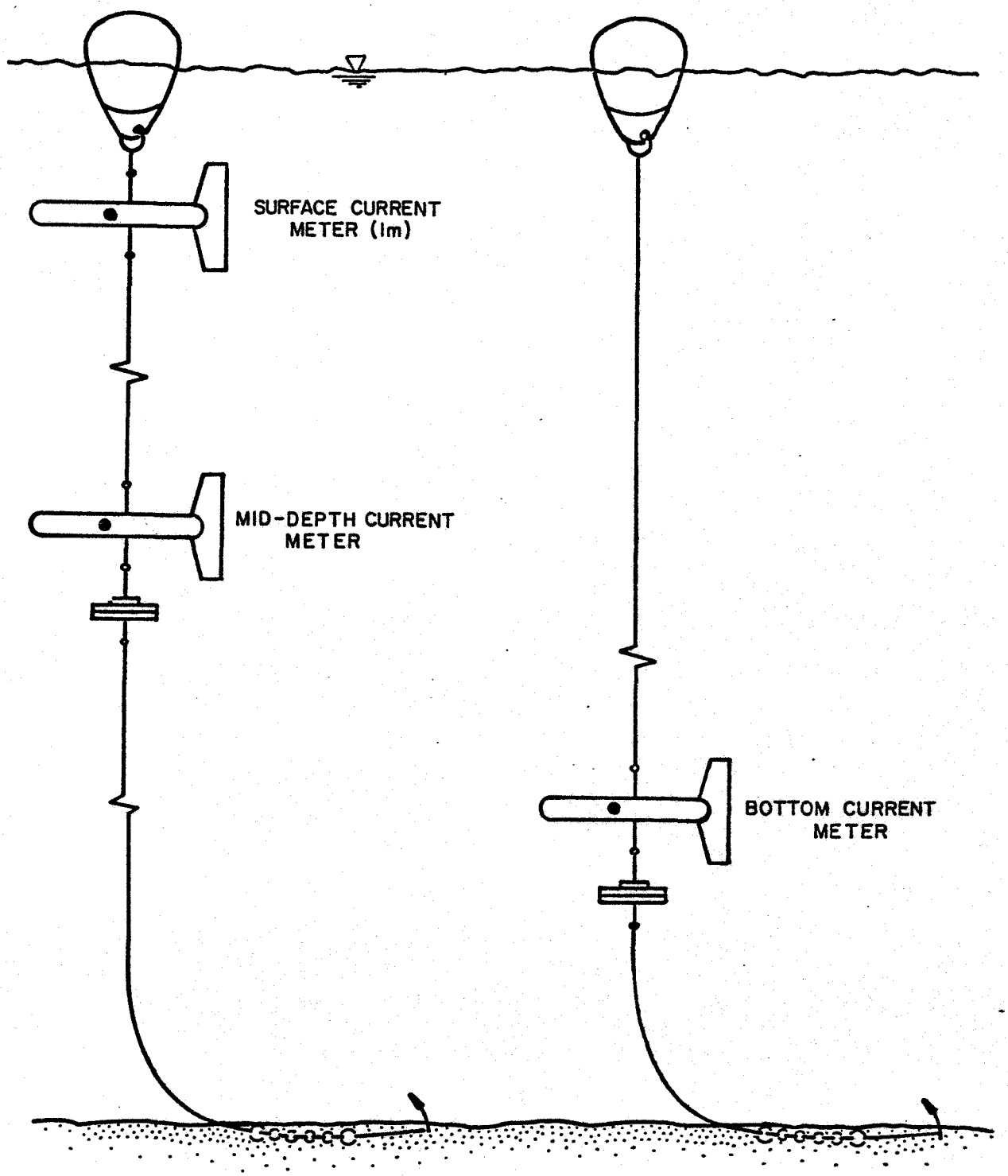


Figure 4. Current Meter Mooring Arrangement

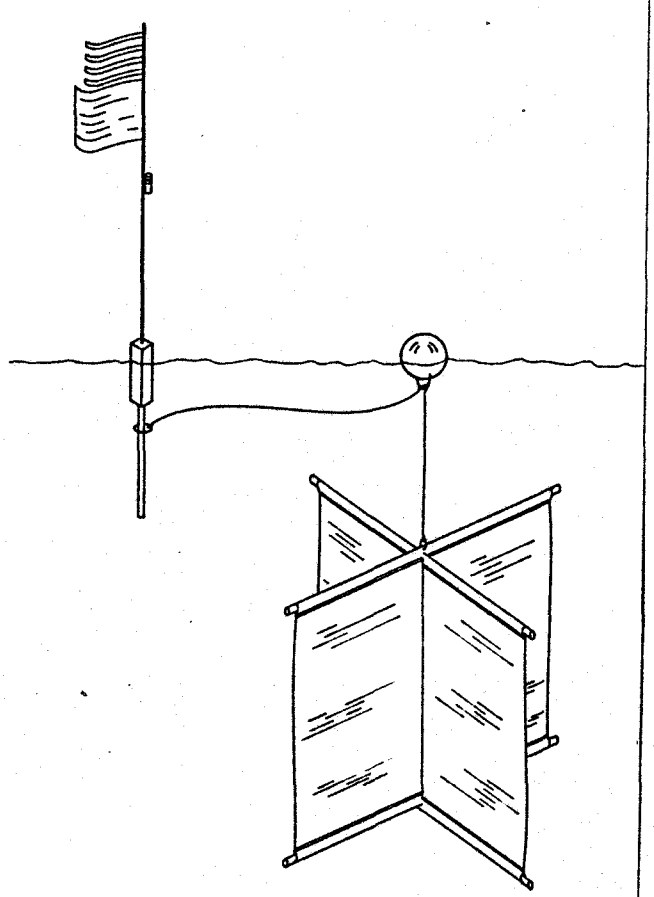


Figure 5. Biplane Drogue and Tethered Float

Receiving Water Chemistry

Receiving water samples were collected throughout the study area for subsequent laboratory analyses for nutrients, grease and oil, trace metals, and coliform organisms.

Nutrients. Two water samples were collected at each station and analyzed for ammonia, nitrate, nitrite, phosphate, and silica. The samples were taken from just below the water surface. One sample was filtered in the field through a 0.45μ membrane filter, then both the filtered and unfiltered samples were frozen to ensure preservation prior to laboratory analysis.

A Technicon Autoanalyzer was used to measure the ammonia by the automated Bertholet method (Standard Methods, 14th Edition, p. 616, 1975). Using this method, a blue-colored compound believed to be related to indophenol was formed when the sample was treated with sodium phenoxide, followed by the addition of sodium hypochlorite. Potassium sodium tartrate and sodium citrate were added to prevent the precipitation of calcium and magnesium. Absorbance caused by the blue indophenol complex was measured at 630 mm and related to ammonia concentration by comparison with calibration standards.

Nitrite was measured using a Technicon Autoanalyzer by reaction with acidic sulfanilamide to form a diazo-complex. This complex was then coupled with N-1-naphthylenediamine dihydrochloride to form a reddish purple azo-dye which absorbs strongest at 550 nm. Standards and blanks were analyzed to relate absorbance to the nitrite concentration and correct for seawater matrix interference. This procedure is an adaptation of the nitrate nitrogen procedure (Standard Methods, 14th Edition, p. 620, 1975). In this case, the cadmium reduction column is eliminated.

Nitrates were reduced to nitrite using a cadmium reduction column (Standard Methods, 14th Edition, p. 620, 1975). Then total nitrite nitrogen (the sum of the original nitrite plus the reduce nitrate) was determined by the procedure described in the previous paragraph. The difference between this total nitrite nitrogen concentration and the nitrite nitrogen measured without the use of the reduction column provided the nitrate nitrogen concentration.

The automated determination of orthophosphate depends on the formation of a phosphomolybdenum blue-complex which absorbs strongly at 880 nm (Standard Methods, 14th Edition, p. 624, 1975). A reagent solution containing sulfuric acid, ammonium molybdate, ascorbic acid and antimony mixed with standards and samples and heated to 99.5 F (37.5 C) formed the colored complexes which allowed calculation of orthophosphate.

The automated procedure for the determination of soluble silicates is based on the reduction by ascorbic acid of an acidic silicomolybdate complex to molybdenum blue. Oxalic acid is introduced to prevent orthophosphate interference. The colored complexes produced from standards and samples were measured at 660 nm, allowing the calculation of the silicate concentrations (A Practical Handbook of Seawater Analysis, Strickland and Parsons, p. 65, 1968).

Grease and Oil. Water samples for grease and oil determinations were collected once at each station in 1-liter wide mouth glass containers and preserved by acidification. In the laboratory, dissolved or emulsified grease and oil was extracted from the water samples quantitatively with freon using the partition-gravimetric method (Standard Methods, 14th Edition, p. 515, 1975). Freon dissolves not only oil but also other organic substances. As no solvent can selectively dissolve only grease, the reported value is actually a measure of nonvolatile freon extractable material which is predominently grease and oil. Each sample was transferred to a 2-liter separatory funnel, and the container was rinsed with 30 to 50 ml of freon, which was then transferred to the funnel. This mixture was shaken vigorously for several minutes and allowed to sit until layers of the solution separated. The organic layer containing grease was drained into a dried and tared boiling flask through freon moistened filter paper filled with anhydrous sodium sulfate. This extraction was repeated twice. The freon was then removed by vacuum evaporation, thus leaving the extracted material. The flask was dried at 221 F (105 C), cooled and weighed, and the freon extractable material was determined by weight difference.

Trace Metals. A one pint water sample was collected at each of the platform stations for laboratory analysis of total chromium, barium, lead, aluminum, and iron. The samples were fixed in the field with HNO_3, cooled, and returned to the laboratory for analysis. All non-volative metals samples were prepared for analysis by the digesting of 250 ml of sample to dryness after acidification with nitric acid. The sample was then redissolved into a matrix of nitric acid, hydrochloric acid and ammonium chloride, and filtered and diluted to 250 ml. The actual analyses by atomic absorption spectroscopy will be described in detail in the sediment metals section.

Coliform Bacteria. Receiving water was sampled for total coliform organisms at one foot below the surface at the three platform stations. Fermentation tubes containing sterile lactose broth were inoculated in the field with serial dilutions of 10, 1, 0.1, and 0.01 ml of sample and kept cool until returned to the laboratory for incubation at 95 F (35 C).

Tubes showing gas production at 24 or 48 hours were submitted to the confirmed test by aseptic transfer to fermentation tubes containing brilliant green bile lactose broth (BGB). Gas production within 48 hours of incubation at 95 F (35 C) in BGB constitutes a positive confirmed test for total coliform bacteria. Statistical tables allow determination of total coliform density as the most probable number (MPN) of organisms per 100 ml of sample.

Sediment Chemistry

Sediment samples were collected at all the specified stations using a modified Shipek bottom sampler (Figure 6) and a one meter phlegar corer. The type of sampling device used depended primarily on the composition of the substratum being sampled. Approximately 14 ounces of sample were collected in glass jars for each station, the excess water was drained off, and the samples were cooled for transfer to the laboratory.

Analysis of sediment samples followed accepted procedures set forth by the Environmental Protection Agency, Chemistry Laboratory Manual, Bottom Sediments, Great Lakes Region Committee on Analytical Methods, 1969 (EPA, 1969). In the laboratory, portions of each sediment sample were dried at 22 F (105 C) to determine the percentage of solids so as to express all results on a dry weight basis.

Grease and Oil. Sediment grease and oil is determined by the soxhlet extraction method (EPA, 1969, p. 42). Samples for oil and grease determinations were acidified with hydrochloric acid and dried by mixing with anhydrous magnesium sulfate. Dried samples were transferred to cellulose thimbles and covered with glass beads to prevent the carrying over of solid sample into the extraction system. The freon soluble grease and oil was then determined gravimetrically using a soxhlet extraction apparatus. Following the four hour extraction period, the solvent was removed from the tared boiling flasks using a rotary evaporator. The flasks were dried to constant weight at 22 F (105 C) and then weighed to determine weight-gain, allowing calculation of the grease and oil concentration. Blanks were run to check for impurities in the solvents used.

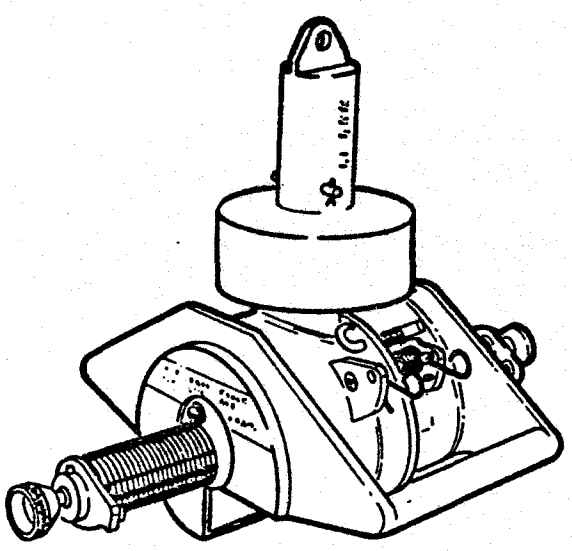


Figure 6. Shipek Bottom Grab Sampler

Phenols. Phenols, defined as the hydroxy derivatives of benzene were analyzed by the 4-aminoantripyrine colorimetric method (EPA, 1969, p. 77). Fifty gram samples were placed in one liter distillation flasks. Following addition of distilled water, copper sulfate and phosphoric acid, the samples were distilled to produce 500 mls of

aqueous phenols solution that was free of sediments. The phenolics were then treated at pH 10 with 4-aminoantipyrine in the presence of ferrycyanide to form the colored antipyrine dye. This dye was concentrated by solvent extraction into chloroform and light absorbance measured at 460 nm. Standards and blanks were also distilled and analyzed to provide standard curves for the calculation of the initial phenolic contents of the sediments.

Trace Metals. All non-volatile metals were analyzed after the sediments had been suitably digested. Duplicate 15-gram aliquots of each sediment sample were digested to dryness in redistilled nitric acid and 20% hydrogen peroxide, mildly ashed and redissolved in a nitric acid-hydrochloric acid-ammonium chloride-calcium matrix. The supernatant and residue were filtered and washed into a volumetric flask and diluted to 250 ml. Each metal was analyzed by atomic absorption spectrometry (AAS) using a Jarrel-Ash Model 810 spectrometer. Background correction using a non-absorbing line or a hydrogen continuum lamp, was used to minimize error due to flame and sample matrix interferences. Matrix-matched standards were analyzed to provide suitable calibration curves. The procedures used were in accordance with EPA procedures (EPA, 1969). When concentrations approached the flame detection limits a flameless atomizer was used in place of the air-acetylene flame. In these cases, replicate analyses were performed and averages determined to minimize error.

Analysis of arsenic was also performed by flameless atomic absorption spectroscopy. Each sample was prepared in a 1000 ppm nickel matrix for the purpose of creating a nickel-arsenic alloy. This provided stabilization of the arsenic so that interferences could be removed through an ashing step prior to atomization.

Mercury concentration was determined from triplicate 1 to 3 g aliquots of each sediment sample which were mildly digested using nitric acid and potassium permanganate in an autoclave at 239 F (115 C) and 15 atomospheres of pressure for 15 minutes. Each digestate was treated with hydroxylamine hydrochloride to reduce any remaining permanganate and manganese dioxide to manganese ion. The amount of mercury in each aliquot was measured by means of the cold vapor AAS technique using a Jarrel-Ash trace metal accessory. Each sample was treated with acidic stannous chloride and stripped of the atomic mercury with air by means of an air stone. This air, containing traces of mercury was passed through a quartz cell where atomic absorption occurred. The peak area gas then related to the quantity of mercury present.

Biochemical Oxygen Demand. Tests for biochemical oxygen demand (BOD) were performed in accordance with interim procedures (EPA, 1969, p. 44), that are still in the process of being revised. This method commonly produces variable results that are dependent upon sample size. A procedural modification recommended by the laboratory group of EPA, Region IX, 1974, was used to lessen the BOD dependency on sample size. Approximately 5-g samples were mixed with 100 ml of dilution water, and the resultant slurry used as the sample. Aliquots of the slurry were transferred to 300-ml BOD bottles, and the bottles were filled

with dilution water (distilled water plus trace nutrients). The dissolved oxygen was measured in the bottles before and after a five-day, 68F (20C) inculation. The BOD was then calculated as milligrams of oxygen uptake per kilogram of sediment.

Data Reduction

Water quality data recorded during the field surveys on mylar punched tape were returned to the office and transferred to diskette using a tape reader and minicomputer. Data were then edited and processed by the minicomputer system, wherein salinity and density were computed from measured values of temperature and specific conductivity.

Current meter data recorded on magnetic cassette tapes were processed using a minicomputer. Oscillatory wave motion was filtered out and vectors were averaged to produce hourly values of current speed and direction.

Drogue positions were plotted from miniranger and sextant observations. Mean speed and direction were computed for each drogue release over the tracking period.

RESULTS

This section of the report presents both a written and graphical representation of the results of the field effort. The physical oceanographic measurement results are presented first, followed by the results of the chemical oceanographic analyses. All physical and chemical parameters measured around the Shell Beta development and pipeline sites were typical of waters within the Southern California Bight and all concentrations and measurements were in agreement with background research data collected by other agencies within the area.

Physical Oceanographic Measurements

Physical oceanographic measurements included sampling and data collection at 18 stations as shown on Figure 2. One measurement was taken at each of the three proposed platform sites, seven along the pipeline corridor between platform "Elly" and the Long Beach breakwater, and eight within the Long Beach harbor area.

Physical parameters measured during the field effort included: temperature, salinity, density, dissolved oxygen, hydrogen ion concentration (pH), light transmittance, solar irradiance, and current measurements.

Temperature. Temperature profiles were taken at each station during the study period to provide background data for the proposed construction and production operations. All profile data are presented in Table 2 at the end of this section.

Water temperatures at the platform sites ranged from 65.5 F (18.6 C) at the surface to 49.6 F (9.8 C) at a depth of 280 feet (85 m). A thermocline was observed above 80 feet (24 m) with the maximum temperature change (0.25 F/foot) occurring between 33 and 50 feet (10 and 15 m) at Station S2. Surface temperatures showed a diurnal trend with warmest temperatures occurring during late afternoon and coolest temperatures occurring during the early morning hours. Platform area surface temperatures varied 2 to 5 F (1 to 3 C) during the study period.

Temperatures along the proposed pipeline corridor varied between 61.0 and 69.8 F (16.1 and 21.0 C) at the surface and between 50.4 and 56.7 F (10.2 to 13.7 C) at the bottom. Bottom temperature variations were largely a function of fluctuating station depth, while both surface and bottom temperature ranges were influenced by spatial distribution. The observed thermocline was variable and also a function of station depth. Diurnal variation ranged from 2 to 4 F (1 to 2 C).

Temperatures within the harbor area varied between 64.6 and 70.2 F (18.1 and 21.2 C) at the surface and between 57.7 and 62.4 F (14.3 and 16.9 C) at the bottom. Recorded temperatures were generally warmer at Stations T1 and T2 and cooler at Stations T4 and T5.

Salinity. Salinity values during summer months normally exhibit relatively small variations except in the surface waters. Evaporation can cause an increase in surface salinity while rainfall and subsequent stormwater runoff can lower values. Salinity measured throughout the proposed development area was calculated from temperature and conductivity measurements and are presented in Table 2.

The proposed platform site area exhibited salinity values between 32.59 and 33.57 ppt. Lowest salinity values were observed below the surface between 50 and 65 feet (15 and 20 m) of depth, the same depth at which the observed maximum temperature change was observed. Salinity values along the proposed pipeline corridor varied between 32.41 and 34.19 ppt, while values within the harbor area varied between 32.52 and 33.49 ppt. Observed salinity values were slightly lower than average for the Pacific Ocean at local latitudes (34.24 ppt, SCCRWP, 1973), but were within the normal range for oceanic waters.

Density. Density, although not measured directly, was derived using temperature and salinity profile data. Density, an indicator of water column stability, has been reported as sigma-T units in Table 2.

Density values measured at the proposed platform site area varied between 23.72 and 24.08 at the surface and between 25.59 and 25.83 at the bottom. All density profile values increased with depth at all platform and pipeline stations. Values along the proposed pipeline corridor varied between 23.13 and 24.45 at the surface and between 25.06 and 25.88 at the bottom.

Within the harbor area, density values increased with depth at most stations. Several stations, however, exhibited weak density structure, probably

the result of turbulent mixing from strong winds and tidal currents. Density values varied between 22.23 and 23.75 for surface waters and between 24.17 and 24.90 for bottom waters.

Dissolved Oxygen. Dissolved oxygen (DO) concentrations were measured throughout the study area as an indicator of plankton productivity and chemical or biochemical oxygen demand. Generally, dissolved oxygen values were highest at the surface and decreased with depth. All DO values measured during the field study are presented in Table 2.

Concentrations of dissolved oxygen at the proposed platform site varied between 6.7 and 10.3 mg/l at the surface and between 3.5 and 6.3 mg/l at the bottom. Along the proposed pipeline corridor, values varied between 5.7 and 9.1 mg/l at the surface and between 3.3 and 8.9 mg/l at the bottom. Again, the difference observed among bottom DO values was partially due to fluctuating station depth. Values within the harbor area varied between 5.8 and 10.4 mg/l for surface waters and between 4.8 and 8.8 mg/l for bottom waters.

Surface dissolved oxygen concentrations were generally higher during daylight hours than during periods of darkness, while maximum DO values at night were observed 10 to 20 feet (3 to 6 m) below the water's surface. This observation is typical of conditions off southern California where plankton activity plays a dominant role in the spatial distribution of oxygen concentrations.

Hydrogen Ion Concentrations. Hydrogen ion concentrations in seawater are affected by numerous physical and chemical parameters including: temperature and salinity, photosynthesis and respiration, and carbon dioxide concentration and gas exchange in a carbonate/bicarbonate buffer system. Changes in phytoplankton populations are often reflected in pH concentrations. Results of hydrogen ion concentration data collected during the field study are presented as pH units in Table 2.

The pH within the Southern California Bight normally varies between 7.5 and 8.6, with an average of 8.1 (Hancock, 1965). Values measured at the proposed platform site and along the proposed pipeline corridor varied between 7.67 and 8.09, while values within the harbor area were slightly higher than normal, varying between 7.92 and 8.62. Similar high pH values were reported by Hancock (1974) for measurements within Long Beach Harbor.

Light Transmittance. Light transmittance, as a measure of turbidity, may be affected at the proposed platform site area by the discharge of drilling muds and cuttings and along the proposed pipeline corridor within the Long Beach Harbor by dredging operations during construction. Measurements collected during the field study are presented in Table 2 as percent light transmittance.

Light transmittance values at the proposed platform site were generally high, varying between 58 and 76 percent for surface waters. Bottom values usually approached zero percent transmittance prior to reaching the ocean floor.

Maximum values were generally observed just below the thermocline, beyond the productive surface layer. Along the proposed pipeline corridor, transmittance values were lower than those recorded for the platform site. Surface values varied between 04 and 76 percent and were progressively lower with decreasing distance from shore. Maximum values were recorded below the surface layer at most stations. Light transmittance within the harbor area varied between 07 and 23 percent with maximum values occurring most frequently at Stations T5 through T8 at the surface and at Stations T1 and T4 between 10 and 15 feet (3 and 5 m).

Solar Irradiance. Solar irradiance was measured at each station during daylight hours to record the amount of light penetration available for photosynthesis within the water column. Values were recorded at the surface and at 6.5, 20, and 40 feet (2, 6, and 12 m). The amount of initial surface solar irradiance is only important as a reference to calculate the percent of penetration at depth. The greater the percent penetration, the greater the amount of energy available for photosynthesis. Measurement results presented in Table 3 were recorded in the field as millamps then converted to Langeleys per second for the purpose of this report.

The greatest initial surface irrandiance (8.9 Langeleys) was measured at Station P2 at 1513 on July 21 while the greatest percent penetration (88%) was measured at Station P1 at 1337 on July 19. The area around the proposed platform development exhibited the greatest percent irradiance penetration with average values ranging from 23 to 43 percent. At stations progressively closer to shore, sunlight penetration decreased dramatically along the proposed pipeline corridor. While the average sunlight penetration at Station P1 was 43 percent, the average near the Long Beach breakwater (P7) was only 04 percent. Although initial surface solar irradiance values recorded within the harbor area were similar to those measured at the platform site, percent penetration was dramatically reduced. The average percent penetration within the harbor area varied between < 1 and 02 percent.

Patterns observed through solar irradiance measurements coincide with the results of the light transmittance measurements, indicating the presence of an increasing turbidity field with decreased distance from shore. The source of turbidity in this area is most probably due to a combination of suspended sediment from wave action and upwelling, and the presence of phytoplankton in the near surface waters.

Current Measurements. Current measurements were determined using both current meters and current drogues.

Current meter measurements for speed and direction were collected at the proposed platform site, midway along the pipeline route (P4), and within the harbor area (T4) as shown on Figure 2. Measurements at the proposed platform site were taken midway between Stations S1 (Elly) and S2 (Ellen) using three electromagnetic current meters. The meters were moored at depths of 3, 120,

Table 2. Water Quality Profile Data

July 18, 1978				July 19, 1978							
STATION	P2	P1	S1	P4	P7	P6	P5	P4	P3	P2	P1
TIME	1422	1527	1545	1620	911	1040	1152	1212	1246	1301	1337
DEPTH (METERS)	TEMPERATURE (C)										
0	19.82	20.11	19.66	19.72	20.98	20.13	20.42	20.42	18.41	18.69	18.29
5	18.53	19.46	18.97	19.51	19.72	19.80	19.93	19.84	18.37	18.23	18.30
10	16.43	16.15	16.08	17.90	16.06	17.33	16.65	16.52	16.95	17.00	18.14
15	14.66	13.45	13.88	14.99	13.49	14.35	14.38	14.71	14.11	14.82	16.84
20	12.86	12.68	12.99	13.70	13.36	13.52	13.46	13.46	12.72	13.12	14.42
25	12.38	12.07	12.09				13.46	13.30	11.92	12.10	12.52
30	12.23	11.60	11.42						11.57	11.66	11.90
35		11.39	11.14						11.19	11.26	11.25
40		11.05	10.83						11.01	11.06	11.09
45		10.98	10.65							10.97	11.01
50			10.61							10.76	10.93
55			10.46							10.69	10.78
60			10.25								10.51
65			10.21								10.37
70			10.18								10.29
75			10.15								10.25
80			10.15								10.23
85											10.22
	SALINITY (PPT)										
0	33.15	33.31	33.23	33.21	32.94	33.19	33.08	33.18	33.22	31.11	33.38
5	32.80	32.97	32.96	33.16	32.81	33.00	32.98	32.83	33.19	33.02	33.24
10	33.30	33.30	33.22	33.48	33.12	32.67	33.26	33.32	32.97	33.20	33.25
15	33.68	34.19	33.47	33.28	33.37	33.23	33.55	33.81	33.06	33.11	33.20
20	33.43	33.94	33.42	33.26	33.64	33.46	33.25	33.42	33.08	33.19	33.27
25	33.45	33.77	33.58				33.22	33.38	33.18	33.45	33.58
30	33.39	33.60	33.52						33.18	33.51	33.59
35		33.61	33.41						33.21	33.52	33.46
40		33.54	33.39						33.31	33.51	33.69
45		33.43	33.42							33.33	33.72
50			33.47							33.35	33.67
55			33.47							33.42	33.69
60			33.55								33.58
65			33.55								33.61
70			33.58								33.56
75			33.57								33.57
80			33.56								33.58
85											33.56
	DENSITY (SIGMAT)										
0	23.42	23.46	23.53	23.49	22.96	23.37	23.21	23.28	23.83	22.15	23.98
5	23.48	23.38	23.49	23.51	23.19	23.31	23.26	23.18	23.82	23.72	23.87
10	24.37	24.42	24.38	24.15	24.31	23.67	24.28	24.36	23.99	24.16	23.92
15	25.05	25.69	25.05	24.67	25.05	24.77	25.01	25.14	24.69	24.57	24.19
20	25.22	25.66	25.19	24.93	25.29	25.12	24.97	25.10	24.99	24.99	24.78
25	25.34	25.64	25.49				24.94	25.10	25.21	25.39	25.41
30	25.31	25.60	25.57						25.28	25.52	25.54
35		25.64	25.53						25.37	25.60	25.56
40		25.65	25.57						25.48	25.62	25.76
45		25.58	25.62							25.50	25.80
50			25.67							25.56	25.77
55			25.70							25.62	25.81
60			25.80								25.78
65			25.81								25.82
70			25.83								25.80
75			25.83								25.81
80			25.82								25.83
85											25.81

Table 2. Water Quality Profile Data (Cont'd)

July 18, 1978					July 19, 1978						
STATION	P2	P1	S1	P4	P7	P6	P5	P4	P3	P2	P1
TIME	1422	1527	1545	1620	911	1040	1152	1212	1246	1301	1337
DISSOLVED OXYGEN (MG/L)											
0	8.59	7.08	6.84	6.93	9.13	7.01	7.13	7.04	6.82	6.80	6.84
5	8.56	7.07	6.85	7.08	9.03	7.10	7.12	7.02	6.93	6.80	6.89
10	9.01	7.31	7.14	7.18	9.02	7.11	7.27	7.23	6.97	6.93	6.92
15	8.94	7.50	7.42	7.50	9.10	7.28	7.25	7.33	8.45	7.14	6.85
20	18.26	7.38	7.27	7.49	8.94	6.99	7.01	7.23	8.00	7.12	6.99
25	8.74	7.15	6.96				7.00	7.16	7.51	6.79	6.87
30	8.47	6.81	6.54						6.97	6.44	6.61
35		6.52	6.04						6.40	6.01	6.16
40		6.17	5.52						6.11	5.51	5.73
45		6.05	5.10							5.23	5.40
50			4.75							4.91	5.10
55			4.39							4.70	4.83
60			3.99								4.53
65			3.84								4.24
70			3.71								3.98
75			3.62								3.73
80			3.61								3.61
85											3.59
HYDROGEN ION CONCENTRATION (PH)											
0	8.07	8.02	8.01	8.03	8.03	8.09	8.07	8.07	8.01	8.02	8.02
5	8.05	8.00	8.00	8.03	8.01	8.05	8.03	8.04	8.01	8.00	8.01
10	8.04	7.96	7.97	8.03	7.93	7.98	7.96	7.97	7.98	7.99	8.01
15	7.98	7.90	7.94	7.98	7.81	7.86	7.88	7.94	7.98	7.96	8.00
20	7.92	7.87	7.90	7.90	7.79	7.82	7.85	7.85	7.91	7.90	7.94
25	7.87	7.84	7.86				7.85	7.84	7.87	7.85	7.87
30	7.85	7.82	7.81						7.84	7.82	7.83
35		7.81	7.78						7.79	7.75	7.76
40		7.77	7.75						7.77	7.75	7.74
45		7.77	7.74							7.76	7.73
50			7.73							7.73	7.71
55			7.72							7.72	7.70
60			7.71								7.70
65			7.71								7.70
70			7.70								7.69
75			7.70								7.69
80			7.70								7.69
85											7.69
LIGHT TRANSMITTANCE (%)											
0	56	66	76	46	4	6	9	11	73	76	73
5	86	84	82	51	39	39	46	52	73	84	75
10	72	86	85	42	73	62	59	69	75	83	75
15	63	91	89	37	0	1	15	26	79	79	71
20	56	93	94	1	0	0	0	0	78	83	76
25	21	96	10				0	0	73	86	78
30	2	81	3						60	81	83
35		74	34						34	70	84
40		22	79						0	67	85
45		0	90							71	85
50			92							53	86
55			82							0	81
60			96								81
65			87								84
70			85								76
75			17								75
80			0								81
85											82

Table 2. Water Quality Profile Data (Cont'd)

July 19, 1978 July 21, 1978

STATION	S1	S2	S3	S3	S2	S1	P1	P2	P3	P4	P5
TIME	1405	1545	1647	855	927	937	951	1007	1025	1042	1053
DEPTH (METERS)	TEMPERATURE (C)										
0	18.63	18.64	18.64	17.31	16.30	16.30	16.15	16.11	15.78	18.70	18.91
5	18.60	18.57	18.63	17.29	16.24	16.18	16.08	15.85	15.54	15.83	16.86
10	17.34	17.13	17.97	17.09	16.10	16.07	15.92	15.67	14.93	14.60	14.76
15	14.67	14.56	15.57	16.37	15.38	15.43	15.18	14.53	13.32	12.70	13.05
20	13.87	13.58	13.96	14.74	12.85	12.89	12.68	12.70	12.23	12.13	12.20
25	13.20	12.72	12.70	12.76	12.02	11.91	11.69	11.86	11.72	12.04	
30	12.65	12.26	11.91	12.05	11.57	11.50	11.24	11.41	11.32		
35	11.94	11.67	11.37	11.76	11.21	11.19	11.07	11.10	11.27		
40	11.57	11.29	11.18	11.46	11.06	11.01	10.98	11.03			
45	11.22	11.05	11.14	11.28	10.88	10.88	10.80				
50	10.94	10.92	11.03	11.03	10.69	10.63	10.64				
55	10.63	10.44	10.71	10.89	10.58	10.51	10.55				
60	10.34	10.29	10.68	10.75	10.56	10.48	10.54				
65	10.25	10.23	10.27	10.64	10.50	10.45					
70	10.22	10.21	10.04	10.61	10.47	10.42					
75	10.15	10.20	9.94	10.52	10.40	10.41					
80		10.20	9.88	10.49	10.31						
85			9.84	10.49	10.31						
		SALINITY (PPT)									
0	33.17	33.18	33.15	32.84	32.88	32.71	32.81	32.82	32.89	32.67	32.77
5	33.19	33.14	33.14	32.83	32.84	32.73	32.79	32.84	32.85	32.80	32.20
10	32.92	33.03	33.08	32.84	32.82	32.75	32.77	32.83	32.93	33.20	32.90
15	33.16	33.31	32.97	32.66	32.59	32.68	32.65	32.41	32.92	33.42	33.03
20	33.29	33.24	33.07	32.59	32.78	33.17	32.74	32.68	33.09	33.29	33.85
25	33.23	33.29	33.20	32.86	33.08	33.47	32.93	32.94	33.09	33.30	
30	33.24	33.24	33.31	33.03	33.07	33.47	33.11	32.96	33.13		
35	33.25	33.20	33.28	33.00	33.06	33.24	33.07	33.13	33.13		
40	33.26	33.25	33.39	33.05	33.08	33.30	33.15	33.27			
45	33.32	33.44	33.43	33.11	33.11	33.41	33.27				
50	33.45	33.46	33.46	33.10	33.13	33.32	33.28				
55	33.44	33.47	33.38	33.17	33.12	33.30	33.27				
60	33.49	33.52	33.41	33.18	33.16	33.28	33.31				
65	33.52	33.53	33.32	33.23	33.23	33.31					
70	33.52	33.52	33.43	33.22	33.23	33.36					
75	33.55	33.52	33.53	33.26	33.24	33.52					
80		33.52	33.46	33.25	33.30						
85			33.45	33.28	33.29						
		DENSITY (SIGMAT)									
0	23.74	23.75	23.72	23.81	24.08	23.94	24.05	24.07	24.20	23.34	23.36
5	23.76	23.73	23.71	23.81	24.06	23.99	24.05	24.14	24.22	24.12	23.42
10	23.86	24.00	23.83	23.86	24.07	24.03	24.08	24.17	24.42	24.69	24.43
15	24.65	24.79	24.30	23.89	24.05	24.11	24.14	24.10	24.74	25.25	24.88
20	24.91	24.93	24.73	24.19	24.73	25.02	24.73	24.68	25.09	25.26	25.06
25	25.00	25.14	25.08	24.81	25.11	25.44	25.06	25.04	25.18	25.29	
30	25.12	25.20	25.31	25.07	25.19	25.51	25.28	25.14	25.29		
35	25.26	25.28	25.39	25.10	25.25	25.40	25.28	25.32	25.29		
40	25.34	25.38	25.51	25.20	25.29	25.47	25.36	25.44			
45	25.45	25.57	25.55	25.28	25.35	25.58	25.49				
50	25.60	25.61	25.59	25.31	25.39	25.55	25.52				
55	25.65	25.70	25.59	25.39	25.41	25.56	25.53				
60	25.74	25.77	25.61	25.43	25.44	25.55	25.56				
65	25.77	25.79	25.62	25.48	25.51	25.58					
70	25.78	25.79	25.74	25.48	25.51	25.63					
75	25.82	25.78	25.84	25.53	25.53	25.75					
80		25.79	25.79	25.53	25.59						
85			25.79	25.55	25.59						

Table 2. Water Quality Profile Data (Cont'd)

	July 19, 1978			July 21, 1978							
STATION	S1	S2	S3	S3	S2	S1	P1	P2	P3	P4	P5
TIME	1405	1545	1647	855	927	937	951	1007	1025	1042	1053
				DISSOLVED OXYGEN (MG/L)							
0	6.67	6.78	6.82	8.38	7.74	7.74	6.64	6.16	5.99	5.80	5.73
5	6.73	6.83	6.91	8.52	7.81	7.80	6.78	6.29	6.13	5.98	5.68
10	6.82	6.93	6.85	8.60	7.89	7.92	6.87	6.50	6.17	5.84	5.83
15	7.07	7.17	6.96	8.61	7.84	7.81	6.74	6.50	6.01	5.69	5.69
20	7.14	7.16	7.20	8.59	7.67	7.62	6.54	6.47	5.76	5.60	5.48
25	7.07	6.97	7.34	8.47	7.30	7.32	5.95	5.54	5.44	5.50	
30	6.94	6.76	7.02	8.12	6.89	6.91	5.25	5.47	4.98		
35	6.70	6.42	6.44	7.72	6.44	6.49	4.72	4.85	4.75		
40	6.35	5.99	6.00	7.28	6.09	6.14	4.35	4.23			
45	5.90	5.55	5.67	6.96	5.65	5.73	3.99				
50	5.22	5.00	5.38	6.61	5.27	5.36	3.64				
55	4.76	4.56	5.11	6.22	5.08	5.14	3.37				
60	4.38	4.14	4.85	5.87	4.97	4.89	3.34				
65	4.00	3.84	4.73	5.57	4.71	4.63					
70	3.88	3.65	4.65	5.43	4.49	4.39					
75	3.66	3.51	4.52	5.32	4.35	4.12					
80		3.47	4.38	5.27	4.23						
85			4.32	5.28	4.23						
				HYDROGEN ION CONCENTRATION (PH)							
0	7.98	7.99	7.99	8.00	7.98	8.00	8.01	7.99	7.99	8.04	8.03
5	7.98	7.99	7.99	8.00	7.98	8.01	8.01	7.99	7.98	7.95	7.97
10	7.98	7.98	7.99	8.00	7.98	8.00	8.00	7.99	7.96	7.93	7.93
15	7.94	7.95	7.96	7.97	7.95	7.97	7.97	7.94	7.90	7.85	7.86
20	7.93	7.92	7.95	7.92	7.86	7.87	7.87	7.87	7.85	7.83	7.83
25	7.91	7.89	7.91	7.84	7.81	7.81	7.78	5.00	7.79	7.84	
30	7.89	7.87	7.84	7.79	7.76	7.77	7.73	7.75	7.74		
35	7.85	7.82	7.77	7.76	7.74	7.74	7.72	7.71	7.74		
40	7.82	7.78	7.77	7.74	7.72	7.73	7.71	7.71			
45	7.77	7.73	7.75	7.73	7.70	7.70	7.69				
50	7.72	7.71	7.75	7.70	7.70	7.70	7.68				
55	7.72	7.69	7.73	7.69	7.71	7.70	7.67				
60	7.69	7.68	7.72	7.68	7.70	7.69	7.67				
65	7.69	7.68	7.74	7.67	7.68	7.68					
70	7.69	7.68	7.73	7.67	7.68	7.68					
75	7.68	7.68	7.73	7.67	7.68	7.68					
80		7.68	7.73	7.68	7.68						
85			7.72	7.68	7.68						
				LIGHT TRANSMITTANCE (%)							
0	76	74	71	58	59	59	57	54	44	22	9
5	76	74	72	60	61	64	57	56	55	34	30
10	72	70	69	61	68	69	68	65	66	55	42
15	73	71	64	69	73	75	75	75	43	33	15
20	75	72	66	73	75	78	74	80	50	36	1
25	75	72	69	75	78	77	63	62	61	18	
30	79	78	76	76	72	66	57	68	19		
35	81	80	80	78	78	76	54	68	0		
40	83	80	80	80	68	66	67	17			
45	85	84	82	82	64	71	68				
50	83	81	82	80	69	75	68				
55	80	68	83	83	72	73	16				
60	74	74	83	83	68	70	0				
65	75	71	84	83	67	69					
70	74	62	86	83	68	46					
75	71	58	86	84	70	15					
80		59	86	85	31						
85			87	85	0						

Table 2. Water Quality Profile Data (Cont'd)

July 21, 1978

STATION	P6	P7	S3	S1	P1	P2	P3	P4	P5	P6	P7
TIME	1108	1122	1418	1433	1501	1513	1530	1543	1557	1609	1620
DEPTH (METERS)	TEMPERATURE (C)										
0	18.39	19.66	18.08	18.05	17.47	17.44	16.74	16.80	16.08	16.46	19.21
5	16.19	16.62	17.25	17.40	16.91	16.66	16.09	15.59	15.32	15.52	17.26
10	14.50	13.38	16.72	16.77	16.27	16.00	15.22	14.56	14.91	14.65	14.21
15	13.14	12.52	15.86	16.14	15.81	15.81	13.87	12.61	13.33	13.37	12.63
20	12.39	12.47	14.28	14.71	14.40	15.45	12.21	12.06	12.27	12:39	
25			12.61	12.06	12.14	14.02	11.78	11.99			
30			11.77	11.28	11.34	12.03	11.20				
35			11.35	10.95	11.03	11.20	11.14				
40			11.14	10.74	10.89	11.02					
45			11.00	10.57	10.84						
55			10.85	10.42	10.70						
60			10.70	10.41	10.66						
65			10.53	10.40							
70			10.41	10.37							
75			10.29	10.25							
80			10.22	10.20							
85			10.21								
	SALINITY (PPT)										
0	32.95	32.72	33.08	33.01	33.20	33.17	33.26	33.29	33.31	33.03	33.05
5	32.44	32.75	32.93	33.10	32.98	33.16	33.05	33.46	33.21	32.98	32.95
10	33.00	33.62	33.17	33.08	33.16	33.20	33.22	33.22	33.35	33.05	33.16
15	33.37	33.74	33.13	33.04	33.13	33.20	33.04	33.33	33.19	33.17	34.22
20	33.44	33.83	32.92	32.78	32.95	33.10	33.24	33.44	33.55	33.41	
25			33.04	33.04	33.11	32.94	33.35	33.36			
30			33.20	33.48	33.19	33.27	33.40				
35			33.34	33.35	33.39	33.42	33.33				
40			33.35	33.45	33.68	33.61					
45			33.35	33.51	33.48						
50			33.38	33.44	33.46						
55			33.39	33.39	33.50						
60			33.49	33.39	33.42						
65			33.50	33.40							
70			33.46	33.40							
75			33.55	33.43							
80			33.56	33.46							
85			33.57								
	DENSITY (SIGMAT)										
0	23.63	23.13	23.80	23.76	24.05	24.03	24.26	24.27	24.45	24.15	23.50
5	23.76	23.89	23.89	23.98	24.01	24.20	24.25	24.67	24.54	24.32	23.90
10	24.56	25.27	24.20	24.12	24.30	24.39	24.58	24.72	24.74	24.57	24.74
15	25.13	25.53	24.36	24.23	24.38	24.43	24.72	25.20	24.94	24.92	25.88
20	25.33	25.61	24.54	24.35	24.54	24.43	25.21	25.39	25.43	25.30	
25			24.97	25.08	25.11	24.61	25.37	25.34			
30			25.25	25.56	25.33	25.26	25.51				
35			25.44	25.52	25.54	25.53	25.47				
40			25.49	25.64	25.78	25.71					
45			25.51	25.71	25.64						
50			25.55	25.66	25.64						
55			25.57	25.65	25.68						
60			25.67	25.65	25.63						
65			25.71	25.66							
70			25.70	25.66							
75			25.79	25.70							
80			25.81	25.74							
85			25.83								

Table 2. Water Quality Profile Data (Cont'd)

July 21, 1978

STATION	P6	P7	S3	S1	P1	P2	P3	P4	P5	P6	P7
TIME	1108	1122	1418	1433	1501	1513	1530	1543	1557	1609	1620
DISSOLVED OXYGEN (MG/L)											
0	6.08	5.75	10.34	8.07	7.11	7.05	6.56	6.54	6.43	6.37	6.26
5	6.17	5.76	10.46	8.25	7.33	7.13	6.72	6.76	6.72	6.44	6.46
10	6.39	5.71	10.57	8.48	7.69	7.26	6.80	6.65	6.74	6.60	6.05
15	6.18	5.42	10.44	8.64	7.86	7.35	6.60	6.05	6.34	6.28	5.03
20	5.94	5.31	10.10	8.46	7.87	7.33	6.35	5.70	5.66	5.96	
25			9.80	8.16	7.78	7.13	6.09	5.60			
30			9.29	7.51	7.40	6.81	5.58				
35			8.81	6.91	6.97	6.15	5.48				
40			8.43	6.46	6.60	5.72					
45			8.10	6.21	6.26						
50			7.84	5.98	5.91						
55			7.52	5.66	5.59						
60			7.24	5.48	5.30						
65			7.01	5.40							
70			6.71	5.31							
75			6.53	5.21							
80			6.30	5.18							
85			6.28								
HYDROGEN ION CONCENTRATION (PH)											
0	8.04	8.03	8.00	8.03	7.97	8.01	7.97	7.97	7.97	7.96	8.05
5	7.94	7.95	7.99	8.02	7.97	8.00	7.97	7.96	7.97	7.96	7.99
10	7.92	7.83	7.98	8.01	7.97	8.00	7.95	7.92	7.95	7.94	7.86
15	7.84	7.81	7.96	8.00	7.96	8.00	7.89	7.83	7.86	7.87	7.83
20	7.81	7.81	7.89	7.94	7.90	7.99	7.82	7.82	7.83	7.82	
25			7.82	7.82	7.77	7.93	7.80	7.82			
30			7.75	7.75	7.73	7.83	7.73				
35			7.73	7.73	7.71	7.74	7.73				
40			7.73	7.71	7.71	7.73					
45			7.73	7.73	7.70						
50			7.72	7.72	7.70						
55			7.71	7.70	7.70						
60			7.70	7.70	7.70						
65			7.70	7.70							
70			7.68	7.70							
75			7.67	7.69							
80			7.67	7.68							
85			7.67								
LIGHT TRANSMITTANCE (%)											
0	13	9	67	62	66	62	62	58	58	47	18
5	36	32	61	64	60	59	61	40	53	44	14
10	50	6	66	62	54	59	54	34	42	31	2
15	5	0	69	59	69	63	47	27	4	7	0
20	0	0	69	74	71	64	39	26	4	0	
25			78	67	62	54	54	0			
30			80	58	57	69	17				
35			81	56	63	59	0				
40			82	70	64	0					
45			84	77	62						
50			86	68	61						
55			86	63	25						
60			87	63	0						
65			86	63							
70			88	64							
75			67	24							
80			68	0							
85			69								

Table 2. Water Quality Profile Data (Cont'd)

July 25, 1978							July 26, 1978					
Station	T1	T2	T3	T4	T5	T6	T7	T8	T8	T7	T6	T5
Time	2115	2122	2132	2146	2212	2222	2228	2237	0044	0052	0059	0106
Depth (meters)	TEMPERATURE (C)											
0	20.04	20.49	20.00	18.98	19.59	20.01	19.76	19.66	18.10	19.51	19.39	18.69
1	20.05	20.43	20.01	18.97	19.59	20.02	19.73	19.58	18.07	19.49	19.41	18.62
2	19.89	20.18	20.00	18.83	19.35	19.78	19.22	18.66	17.94	19.13	19.46	18.39
3	19.51	19.68	19.88	18.57	18.68	18.66	18.47	17.71	17.62	18.07	19.07	18.22
4	18.97	18.92	19.41	18.11	17.80	17.10	17.66	17.16	17.16	17.09	17.77	17.97
5	18.46	18.07	18.65	17.44	17.04	16.11	16.99	16.86	16.68	16.47	16.48	17.28
6	17.97	17.26	17.63	16.73	16.39	15.72	16.56	16.63	16.25	16.06	15.92	16.27
7	17.33	16.65	16.67	16.14	15.82	15.55	16.23	16.40	15.88	15.82	15.62	15.55
8	16.58	16.17	15.91	15.76	15.33	15.41	15.90	16.21	15.68	15.70	15.38	15.20
9	15.96	15.93	15.44	15.46	14.99	15.26	15.62			15.63	15.13	15.04
10	15.55		15.20	15.15	14.72	15.11					14.89	14.94
11	15.48		15.11	14.82	14.57							14.81
12				14.64	14.49							14.71
13					14.44							
14					14.39							
15					14.34							
16					14.34							
	SALINITY (ppt)											
0	32.82	32.99	32.95	32.96	32.86	32.74	32.81	31.59	33.02	31.56	31.96	32.76
1	32.86	33.03	33.02	33.00	32.90	32.69	32.87	31.80	33.04	31.93	32.37	33.00
2	32.84	32.95	33.06	32.95	32.79	32.67	32.69	32.39	33.03	32.56	32.85	33.09
3	32.78	32.75	32.96	32.84	32.68	32.62	32.57	32.70	33.01	32.77	32.78	33.12
4	32.77	32.62	32.77	32.71	32.68	32.76	32.60	32.89	33.00	32.89	32.63	33.03
5	32.74	32.56	32.62	32.58	32.76	32.96	32.75	33.01	33.04	33.08	32.82	32.90
6	32.69	32.65	32.50	32.62	32.80	33.12	32.92	33.06	33.08	33.18	33.07	32.88
7	32.62	32.78	32.61	32.70	32.87	33.15	33.02	33.09	33.16	33.21	33.17	32.99
8	32.69	32.89	32.73	32.85	32.95	33.11	33.12	33.17	33.22	33.26	33.19	33.14
9	32.86	33.02	32.90	32.85	32.99	33.14	33.32			33.23	33.18	33.19
10	33.09		33.02	32.86	33.05	33.16					33.22	33.21
11	33.24		32.97	32.90	33.10							33.23
12				32.97	33.11							33.35
13					33.11							
14					33.14							
15					33.19							
16					33.26							
	DENSITY (Sigma-t)											
0	23.12	23.12	23.22	23.49	23.26	23.06	23.18	22.27	23.75	22.29	22.63	23.41
1	23.14	23.17	23.27	23.52	23.29	23.02	23.23	22.46	23.78	22.58	22.93	23.61
2	23.16	23.17	23.31	23.52	23.27	23.07	23.23	23.13	23.80	23.15	23.29	23.74
3	23.22	23.15	23.26	23.50	23.35	23.31	23.32	23.61	23.86	23.57	23.33	23.80
4	23.35	23.25	23.23	23.52	23.57	23.79	23.54	23.88	23.97	23.90	23.53	23.79
5	23.45	23.41	23.31	23.58	23.81	24.18	23.81	24.05	24.11	24.18	23.99	23.85
6	23.54	23.67	23.47	23.78	23.99	24.39	24.04	24.13	24.23	24.36	24.31	24.07
7	23.63	23.92	23.78	23.97	24.17	24.44	24.19	24.21	24.38	24.43	24.45	24.33
8	23.87	24.11	24.04	24.17	24.35	24.45	24.35	24.31	24.47	24.50	24.52	24.51
9	24.13	24.27	24.28	24.24	24.45	24.50	24.56			24.49	24.56	24.59
10	24.40		24.42	24.31	24.55	24.55					24.65	24.63
11	24.53		24.40	24.42	24.62							24.67
12				24.51	24.65							24.78
13					24.66							
14					24.69							
15					24.74							
16					24.80							

Table 2. Water Quality Profile Data (Cont'd)

July 25, 1978								July 26, 1978			
Station	T1	T2	T3	T4	T5	T6	T7	T8	T8	T7	T6	T5
Time	2115	2122	2132	2146	2212	2222	2228	2237	0044	0052	0059	0106
Depth (meters)	DISSOLVED OXYGEN (mg/l)											
0	10.44	10.20	10.17	10.45	9.89	9.33	9.44	7.34	7.75	7.68	8.31	9.90
1	10.44	10.23	10.25	10.46	9.93	9.38	9.42	7.26	7.73	7.72	8.36	9.94
2	10.43	10.18	10.42	10.40	9.99	9.57	9.29	7.25	7.90	8.03	8.82	9.91
3	10.43	10.06	10.56	10.26	10.01	9.78	9.22	7.48	8.16	8.74	9.27	9.78
4	10.57	9.93	10.59	10.07	10.03	9.94	9.16	7.90	8.39	9.08	9.13	9.58
5	10.74	9.71	10.56	9.79	10.07	9.92	9.07	8.32	8.31	8.76	8.57	9.30
6	10.82	9.40	10.36	9.43	10.01	9.81	8.78	8.49	7.56	8.01	7.95	8.90
7	10.67	9.00	10.08	9.01	9.79	9.77	8.31	8.24	6.11	7.25	7.36	8.38
8	10.24	8.54	9.63	8.58	9.47	9.76	7.69	7.72	4.85	6.72	6.76	7.83
9	9.61	8.28	9.21	8.19	9.16	9.67	7.13			6.36	6.38	7.43
10	8.88		8.82	7.86	8.92	9.54					6.46	7.16
11	8.73		8.63	7.57	8.73							6.97
12				7.38	8.58							6.88
13					8.46							
14					8.34							
15					8.20							
16					8.16							
	LIGHT TRANSMITTANCE (percent)											
0	12	11	14	20	19	17	15	7	11	16	19	23
1	12	9	14	14	20	17	15	8	11	16	19	24
2	15	10	15	13	20	15	14	11	11	16	19	23
3	17	12	16	13	20	10	11	11	10	12	15	21
4	18	14	17	18	19	7	9	10	6	9	13	20
5	18	13	14	18	17	7	7	6	3	7	10	18
6	17	11	10	19	11	5	2	3	1	6	7	14
7	13	4	7	18	4	2	0	0	0	5	5	11
8	8	0	5	16	1	0	0	0	0	0	4	8
9	2	0	2	13	0	0	0			0	0	6
10	0		0	6	0	0					0	2
11	0		0	0	0							0
12				0	0							0
13					0							
14					0							
15					0							
16					0							

Table 2. Water Quality Profile Data (Cont'd)

July 26, 1978

Station	T4	T3	T2	T1	T8	T7	T6	T5	T4	T3	T2	T1
Time	0113	0119	0124	0132	0805	0821	0828	0835	0843	0852	0859	0906
Depth (meters)	TEMPERATURE (C)											
0	18.90	19.77	19.81	19.32	18.82	19.31	20.13	19.59	19.12	19.70	21.24	21.00
1	18.90	19.77	19.76	19.33	18.86	19.40	20.10	19.51	19.17	19.70	21.13	20.92
2	18.77	19.44	19.36	19.19	18.85	19.50	19.88	19.12	18.82	19.36	20.57	20.36
3	18.49	18.80	18.73	18.77	18.61	19.21	19.28	18.47	18.25	18.36	19.71	19.37
4	17.95	17.98	17.97	18.21	18.12	18.41	18.35	17.80	17.62	17.49	18.57	18.31
5	17.28	17.36	17.24	17.68	17.59	17.55	17.38	17.21	17.13	17.06	17.42	17.53
6	16.61	16.82	16.58	17.29	17.22	17.01	16.67	16.56	16.66	16.68	16.59	17.01
7	16.00	16.34	16.02	16.91	16.96	16.70	16.16	15.86	16.15	16.11	16.08	16.53
8	15.50	15.91	15.69	16.51	16.88	16.25	15.78	15.35	15.63	15.53	15.81	16.05
9	15.15	15.62	15.50	16.02		15.80	15.45	15.02	15.25	15.11	15.61	15.69
10	14.90	15.40	15.43	15.54			15.26	14.85	14.99	14.88	15.44	15.41
11	14.73	15.22		15.06				14.68	14.82	14.75		15.25
12	14.56	15.15		14.89				14.66	14.68	14.72		
13	14.52								14.67			
	SALINITY (ppt)											
0	32.85	33.16	32.74	33.11	31.26	32.31	33.16	33.29	32.97	33.16	33.02	33.19
1	33.03	33.16	32.96	33.19	32.11	32.58	33.17	33.21	33.01	33.22	33.02	33.19
2	32.98	32.97	32.94	33.03	32.69	32.94	33.10	33.09	32.78	33.00	32.87	33.02
3	32.83	32.82	32.79	32.89	32.95	33.01	32.95	32.99	32.68	32.87	32.76	32.90
4	32.70	32.78	32.78	32.86	32.92	32.94	32.88	33.04	32.71	33.03	32.79	32.97
5	32.69	32.86	32.79	32.94	33.01	33.01	33.03	33.08	32.79	33.13	32.96	33.13
6	32.67	32.88	32.86	33.04	33.10	33.18	33.12	33.10	32.80	33.06	33.11	33.18
7	32.72	32.92	32.95	33.02	33.16	33.25	33.19	33.12	32.78	33.02	33.26	33.18
8	32.80	32.99	33.08	32.98	33.19	33.17	33.31	33.13	32.83	33.03	33.34	33.15
9	32.90	33.08	33.16	32.94		33.28	33.35	33.26	32.93	33.19	33.40	33.18
10	33.00	33.13	33.22	32.91			33.47	33.33	33.01	33.26	33.43	33.27
11	33.06	33.15		32.95				33.43	33.06	33.25		33.33
12	33.08	33.17		32.88				33.49	33.07	33.18		
13	33.09								33.01			
	DENSITY (Sigma-t)											
0	23.43	23.44	23.11	23.52	22.23	22.91	23.35	23.59	23.46	23.46	22.94	23.14
1	23.56	23.44	23.29	23.57	22.87	23.10	23.37	23.55	23.48	23.51	22.97	23.16
2	23.56	23.38	23.38	23.49	23.32	23.34	23.37	23.55	23.40	23.43	23.01	23.18
3	23.52	23.43	23.42	23.49	23.58	23.47	23.41	23.64	23.46	23.58	23.15	23.34
4	23.55	23.60	23.60	23.61	23.67	23.61	23.59	23.84	23.64	23.91	23.46	23.66
5	23.70	23.81	23.79	23.80	23.87	23.88	23.93	24.02	23.81	24.09	23.87	23.97
6	23.84	23.95	23.99	23.96	24.03	24.14	24.17	24.18	23.93	24.12	24.18	24.14
7	24.02	24.09	24.19	24.04	24.14	24.26	24.34	24.35	24.03	24.22	24.41	24.25
8	24.19	24.24	24.36	24.10	24.17	24.31	24.52	24.48	24.19	24.36	24.53	24.33
9	24.35	24.38	24.47	24.18		24.49	24.62	24.65	24.35	24.57	24.62	24.44
10	24.47	24.46	24.53	24.27			24.76	24.74	24.46	24.67	24.69	24.57
11	24.56	24.52		24.40				24.85	24.54	24.70		24.65
12	24.61	24.55		24.38				24.90	24.57	24.65		
13	24.63								24.53			

Table 2. Water Quality Profile Data (Cont'd)

July 26, 1978

Station Time	T4 0113	T3 0119	T2 0124	T1 0132	T8 0805	T7 0821	T6 0828	T5 0835	T4 0843	T3 0852	T2 0859	T1 0906
Depth (meters)	DISSOLVED OXYGEN (mg/l)											
0	9.85	9.62	9.63	9.86	5.75	8.04	9.26	9.23	9.42	9.49	8.03	8.37
1	9.90	9.68	9.65	9.89	5.84	8.06	9.28	9.28	9.46	9.49	8.04	8.39
2	9.99	9.77	9.60	9.85	6.25	8.28	9.30	9.42	9.53	9.38	8.11	8.47
3	10.09	9.88	9.56	9.75	6.76	8.60	9.26	9.56	9.67	9.17	8.32	8.63
4	10.15	9.93	9.48	9.61	7.25	8.86	9.16	9.64	9.84	8.98	8.69	8.89
5	10.08	9.86	9.28	9.44	7.56	9.06	9.01	9.53	10.01	8.79	9.05	9.08
6	9.89	9.62	8.93	9.26	7.70	9.10	8.64	9.20	10.08	8.52	9.10	9.13
7	9.61	9.25	8.50	9.01	7.68	8.90	7.94	8.74	10.03	8.17	8.94	9.04
8	9.30	8.83	8.04	8.68	7.52	8.26	7.21	8.26	9.86	7.74	8.70	8.91
9	8.97	8.44	7.61	8.25		7.40	6.43	7.81	9.60	7.32	8.44	8.74
10	8.67	8.11	7.33	7.77			5.89	7.45	9.32	6.93	8.24	8.54
11	8.41	7.83		7.31				7.16	9.04	6.64		8.32
12	8.21	7.73		7.18				7.13	8.81	6.55		
13	8.17								8.80			
	LIGHT TRANSMITTANCE (percent)											
0	14	16	13	19	12	11	11	7	16	13	9	5
1	12	14	11	19	13	11	13	11	17	16	12	6
2	10	13	10	19	13	11	15	18	18	17	15	12
3	8	13	11	20	14	13	16	19	17	15	17	16
4	6	11	11	21	11	15	15	18	16	13	18	16
5	8	8	8	21	5	17	11	16	17	12	18	18
6	8	11	5	19	0	8	8	14	15	13	14	23
7	8	8	2	16	0	1	6	13	10	12	9	25
8	7	5	2	13	0	0	2	12	6	8	4	19
9	4	1	0	10		0	0	8	4	4	0	6
10	2	0	0	3			0	1	2	0	0	0
11	0	0		0				0	0	0		0
12	0	0		0				0	0	0		
13	0								0			

Table 3. Solar Irradiance Data

7/18	Station	P2	P1	S1	P4					
	Time	1422	1527	1545	1620					
	Depth (meters)									
	0	7.63	8.27	8.27	6.05					
	2	5.88	5.58	7.00	4.14					
	6	4.13	3.81	3.50	2.23					
	12	2.86	2.39	2.07	0.95					
	Percent Penetration	37	29	25	16					
7/19	Station	P7	P6	P5	P4	P3	P2	P1	S1	S2	S3
	Time	0911	1040	1152	1212	1246	1301	1337	1405	1534	1647
	Depth (meters)										
	0	1.08	1.91	2.79	3.50	3.50	3.81	2.52	7.32	5.09	6.36
	2	0.34	0.73	1.75	1.75	2.23	2.07	2.07	5.58	5.09	4.45
	6	0.15	0.34	0.98	1.08	1.83	1.91	1.91	4.61	3.83	3.02
	12	0.07	0.18	0.57	0.64	1.46	1.60	2.23	3.18	2.55	1.60
	Percent Penetration	06	09	20	18	42	42	88	43	50	25
7/21	Station	S3	S2	S1	P1	P2	P3	P4	P5	P6	P7
	Time	0855	0927	0937	0951	1007	1025	1042	1053	1108	1122
	Depth (meters)										
	0	1.60	1.91	1.83	2.55	2.47	3.34	2.79	4.13	5.24	3.18
	2	1.12	1.30	1.40	1.46	1.68	1.36	1.52	1.75	2.07	1.44
	6	0.92	1.02	0.98	1.20	1.27	1.03	0.84	0.78	0.89	0.95
	12	0.53	0.62	0.62	0.72	0.79	0.64	0.35	0.28	0.37	0.20
	Percent Penetration	33	32	34	28	32	19	12	07	07	06
7/21	Station	S3	S2/S1		P1	P2	P3	P4	P5	P6	P7
	Time	1418	1433		1501	1513	1530	1543	1557	1609	1620
	Depth (meters)										
	0	2.79	4.14		8.26	8.90	8.26	7.00	7.00	7.00	5.57
	2	1.60	3.50		5.72	6.51	6.27	5.64	5.56	5.40	3.18
	6	1.30	2.07		4.45	4.61	3.66	3.34	3.81	3.34	1.11
	12	0.35	1.24		2.23	2.23	1.91	1.37	1.68	1.06	0.07
	Percent Penetration	12	30		27	25	23	20	24	15	01
7/26	Station	T8	T7	T6	T5	T4	T3	T2	T1		
	Time	0805	0821	0828	0835	0843	0852	0859	0906		
	Depth (meters)										
	0	4.46	4.45	5.40	5.58	6.36	6.05	6.36	6.36		
	2	1.08	0.83	1.60	1.91	2.07	2.23	2.07	1.91		
	6	0.21	0.30	0.35	0.46	0.48	0.48	0.48	0.38		
	12	0.07	0.03	0.05	0.05	0.02	0.02	0.12	0.08		
	Percent Penetration	02	01	01	01	<01	< 01	02	01		

and 250 feet (1, 37, and 76 m) to measure surface, mid-depth, and bottom currents. The meters were installed on July 21 for a period of 24 hours. Results of these measurements are presented in Figure 7(a). Due to a malfunction of the bottom current meter, no bottom current data were collected during this period. However, bottom current measurements were obtained on July 25-26 when a new current meter was installed at the site. Results of these measurements are presented in Figure 7(b).

Surface currents at the proposed platform site exhibited a strong tidal influence. Current direction advanced progressively clockwise over the 24-hour recording period, reflecting a progressive tidal wave with a 24 hour period. The selected sampling date coincided with the largest tidal extreme of the year. Current speed varied between 0.34 and 0.64 knots and averaged 0.51 knots.

Tidal influences at mid-depth were weaker with more of an alternating directional pattern. Predominant current direction was toward the northwest during flood tide and toward the southwest during ebb tide. Current speeds varied between 0.12 and 0.46 knots and averaged 0.27 knots.

Bottom currents showed a tidal influence with predominant current direction toward the southwest. During flood tide the current flowed predominantly toward the west, while during ebb tide it shifted toward the south-southwest. Current speeds varied between 0.15 and 0.49 knots and averaged 0.28 knots.

These results are similar to those reported by SCCWRP (1973) for San Pedro Channel, where the tidal current was described as rotary (direction changes progressively clockwise with time) with net resultant current speed of 0.26 to 0.38 knots. However, they do not directly coincide with other sources (OSI, 1978, Hancock, 1965) for net surface current flow during summer months (toward the east or northwest at 0.30 knots). This difference may be due to a combination of reduced wind influence and extreme tidal variation during the survey period, thus allowing for the development of a strong tidal eddy.

Current measurements along the pipeline corridor at Station P4 were collected in a similar manner to those collected at the platform site. Current meters were moored at 3, 36, and 50 foot (1, 11, and 15 m) depths for a period of 25 hours on July 18. Results of these measurements are presented in Figure 8. The bottom current meter was the same one which malfunctioned at the platform site and consequently no bottom data was recovered for this station.

Surface currents were tidally influenced and followed a pattern similar to the one recorded at Station S1. Tidal currents were rotary with a 24-hour period and the current speed varied between 0.12 and 0.43 knots. The predominant current direction for mid-depth currents varied between south and southeast with speed registering between 0.09 and 0.46 knots. The average current speed at this depth was 0.21 knots.

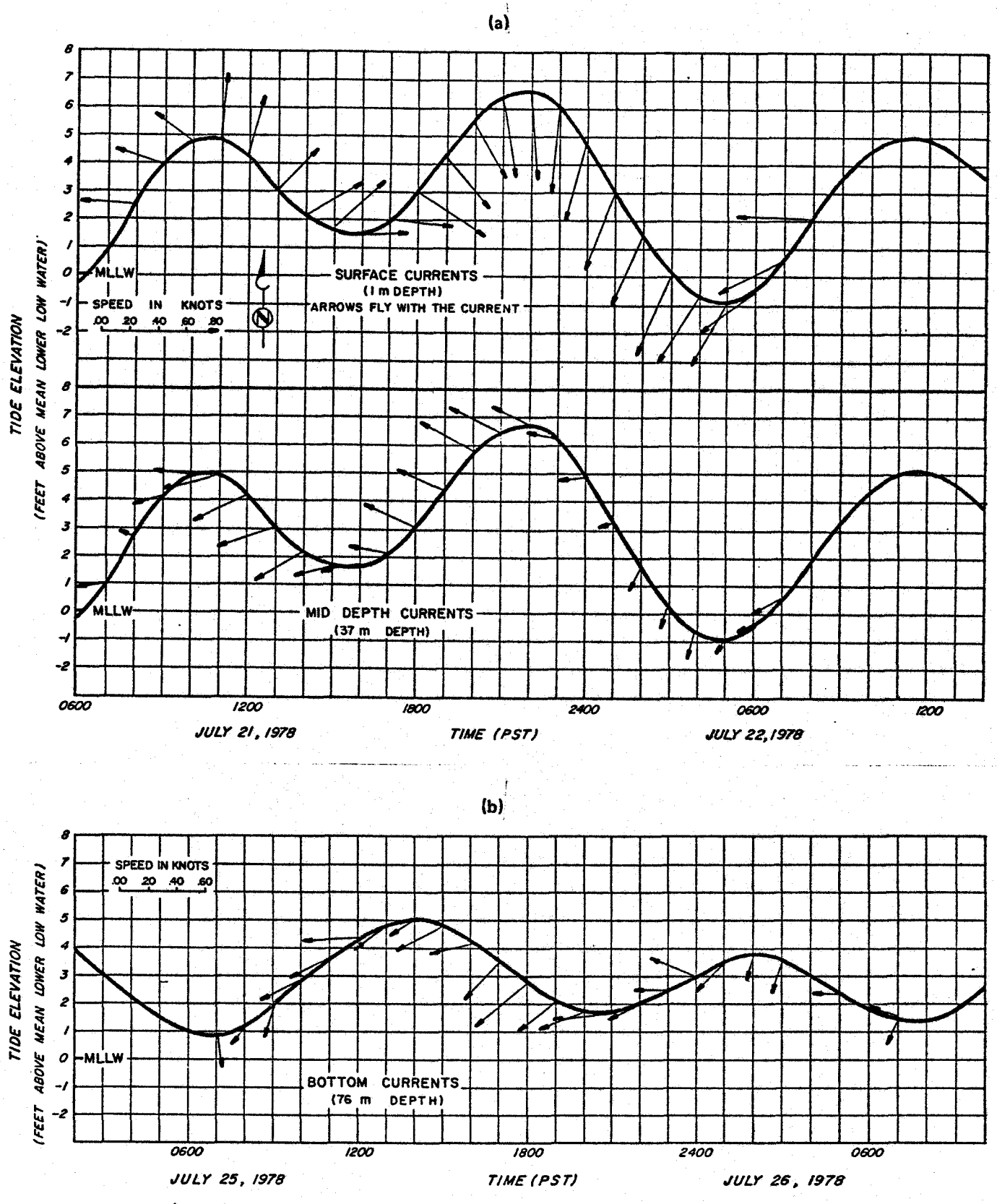


Figure 7. Surface, Mid-Depth, and Bottom Current Data for the Proposed Platform Site Station

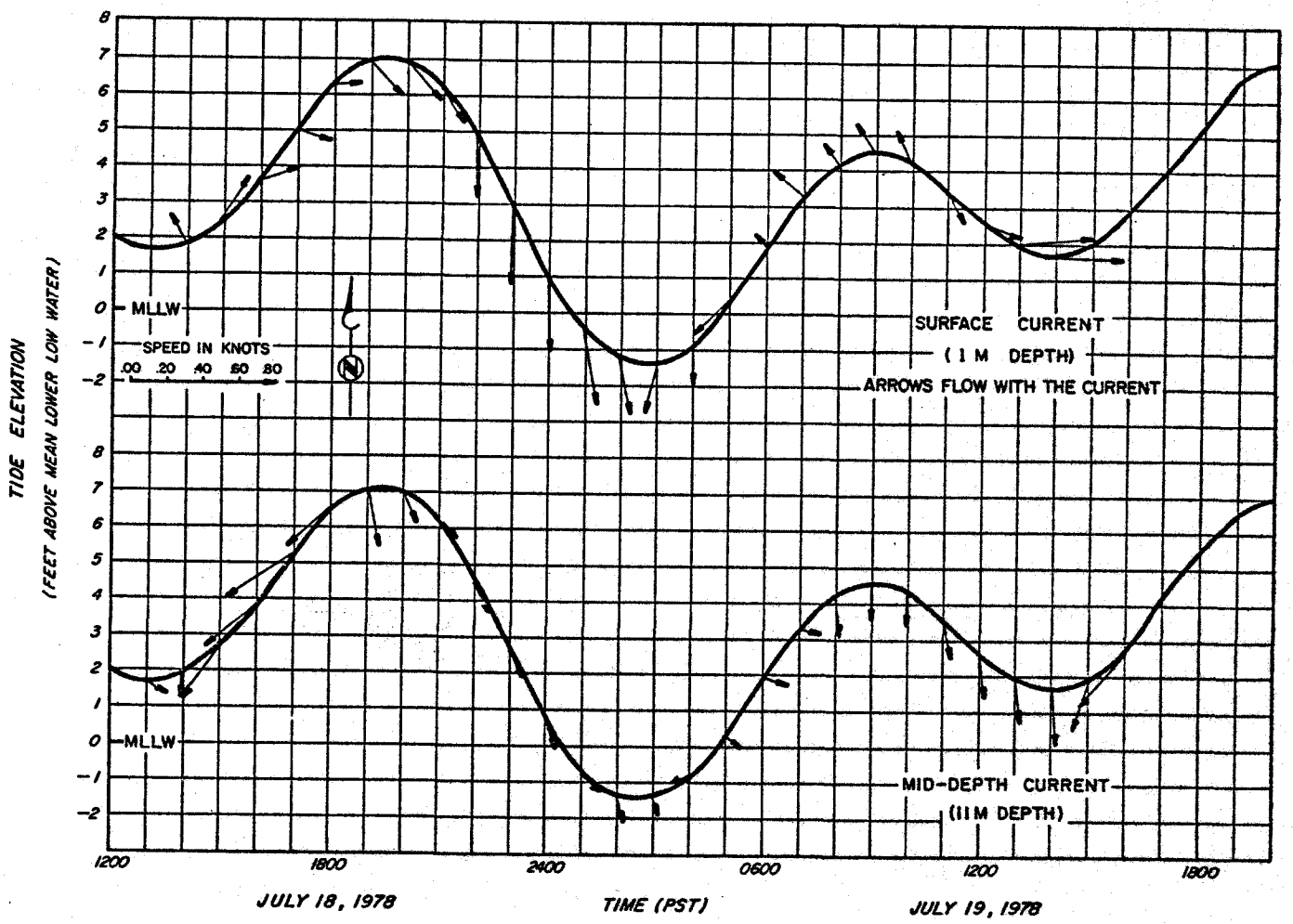


Figure 8. Surface and Mid-Depth Current Data for Station P4

In-harbor current measurements were conducted at Station T4, just off the southeast tip of oil island Freeman. A Bendix Q-15 ducted current meter recorded current speed and direction hourly at depths of 3, 5, 10, 15, 20, 30, and 40 feet. Measurements were taken on July 25 and 26 for a 25-hour period and the results are presented on Figure 9.

The in-harbor currents were strongly influenced by tide at all depths. Maximum current velocities occurred during mid-tide and minimum current velocities occurred during slack tide. Current direction was not uniform over the entire water column.

Surface currents were strongly influenced by diurnal northeast winds during daylight hours (0600 to 1800 hours). Winds were averaging from 10 to 15 knots from the southwest and surface currents flowed toward the east-northeast (to the right of the wind) at an average of 0.14 knots. Between 1800 and 0600 hours, winds were calm and surface currents flowed predominantly toward the southwest at an average speed of 0.12 knots.

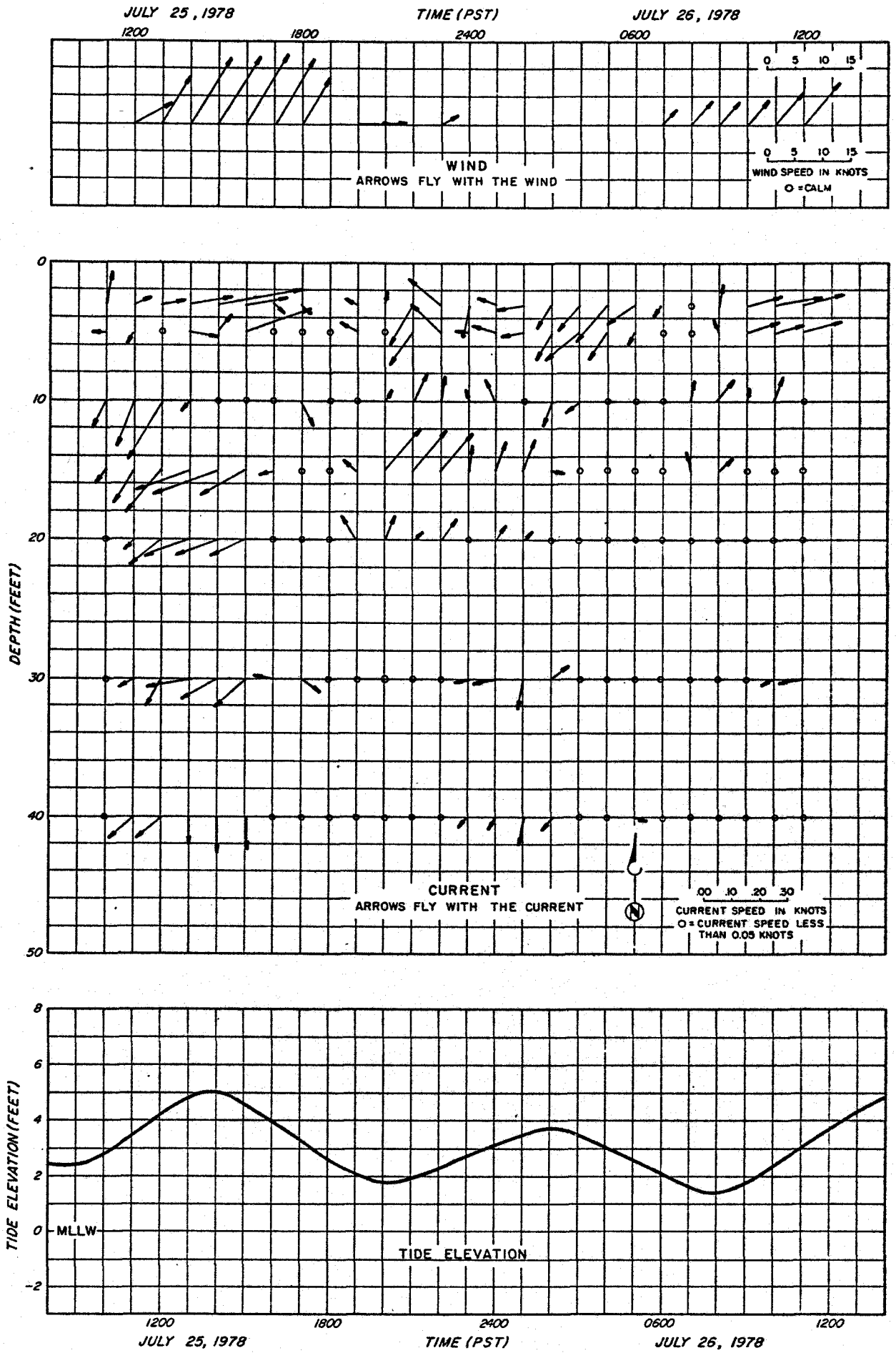


Figure 9. Wind, Current, and Tide Data for Station T4

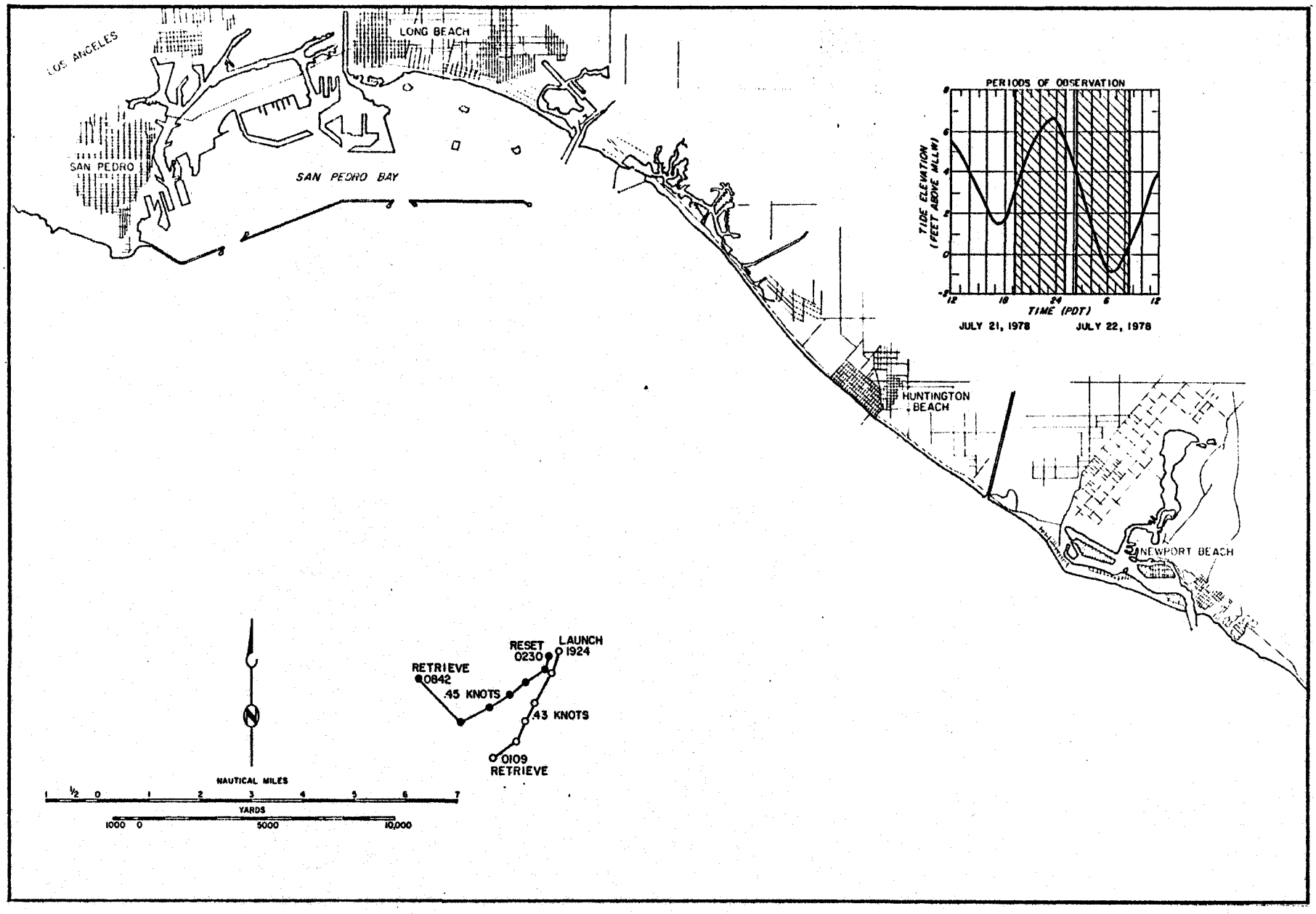


Figure 10. Surface Drogue Tracks for Station S1

Current measurements between the 10 and 20 foot (3 and 6 m) depths were considered to represent mid-depth currents and appeared to follow a clockwise rotary pattern corresponding to the 25-hour tidal cycle. Current speeds ranged from less than 0.05 to 0.23 knots.

Bottom currents (those between 30 and 40 feet) (9 and 12 m) flowed predominantly toward the south-southwest and tidal periodicity was evident. Maximun speeds were measured during high slack tide (0.13 knots) with minimum speeds occurring at mid-tide.

Drogue tracks for the July 21 and 22 releases at Station S1 are shown on Figure 10. The nine drogues released during slack tide before higher-high water (July 21) and during slack tide before lower-low water (July 22) moved in a southwesterly direction (between 220° T and 240° T) at speeds of 0.43 and 0.45 knots, respectively. During both drogue releases, winds were calm, minimizing possible wind-induced transport and maximizing both tidal and regional current influences.

The drogues released at 0230 on July 22 appeared to shift toward the northwest five hours after release. This shift in direction may have been the result of the tidal influence. The drogue results for Station S1 correspond to the current meter measurements taken during the same period (Figure 7(a)).

Although an equipment malfunction precluded the exact positioning of the P4 station drogue release, visual observations were recorded during each tracking. The first release was made at 1645 hours on July 18, during a period of slack tide before higher-high water. Winds at the time of release were from the west (265° T) at 11 knots. All drogues traveled in a west-southwesterly direction and were retrieved approximately six hours later just inshore of oil platform "Eva". The calculated net current speed was approximately 0.30 knots.

A second drogue release was made during slack tide before lower-low water (0100 hours) on July 19. Drogues released during this period followed a similar course to those previously discussed. An exact visual retrieval location was not recorded for the second drop, so no attempt was made at estimating the speed of transport.

Two drogue releases were made at Station T4, inside Long Beach Harbor, on July 25. Five drogues were released per drop, once during slack tide before higher-high water and once during slack tide before lower-low water. Results of these releases are presented on Figure 11.

Drogues released at 1200 hours moved predominantly toward the southwest at 0.18 to 0.20 knots between 1200 and 1400 hours. Then, between 1400 and 1600 hours, four of the five drogues altered course and moved toward the southeast at 0.07 to 0.20 knots. The remaining drogue continued to travel southwesterly.

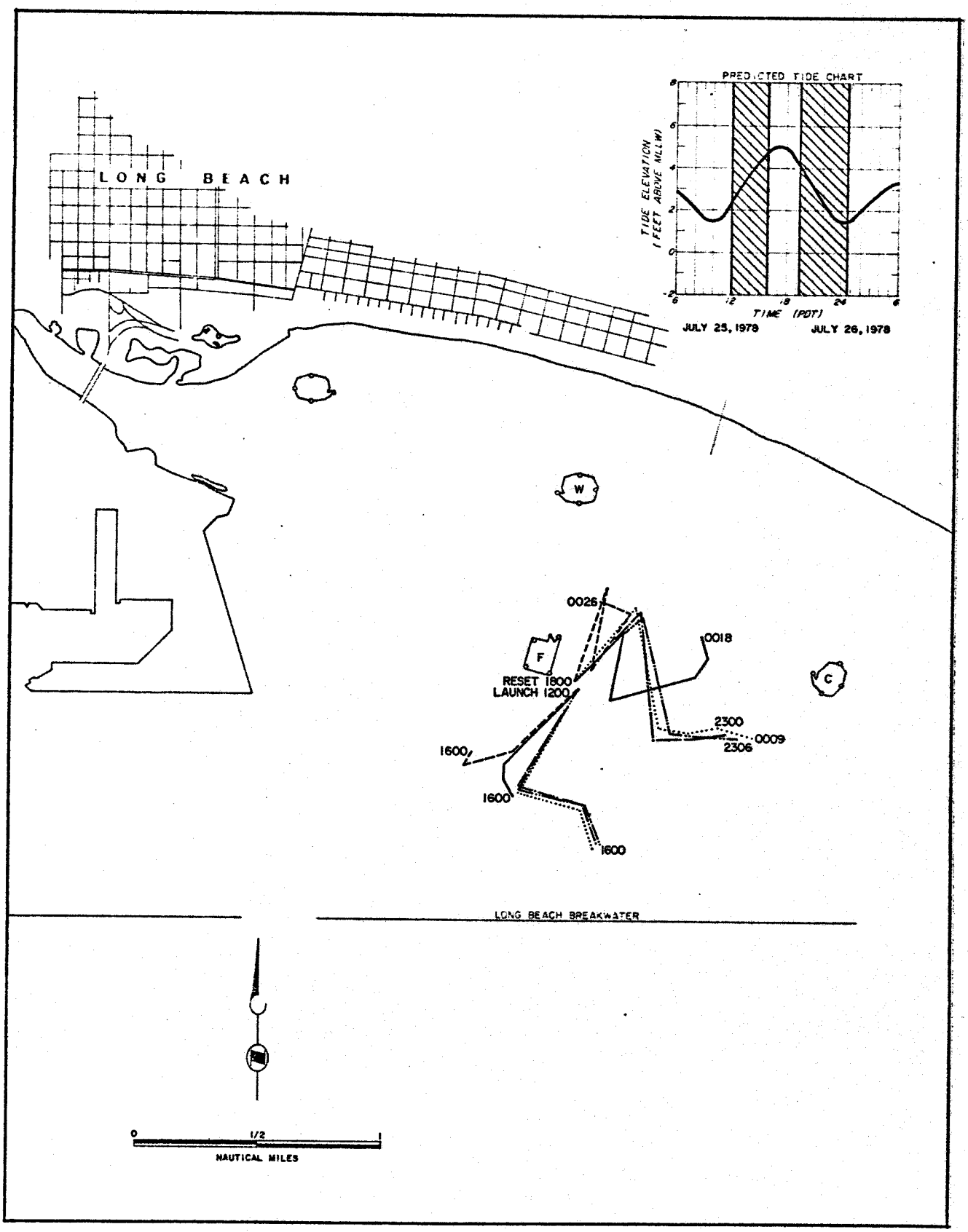


Figure 11. Surface Drogue Tracks for Station T1

Three of the five drogues released at 1800 hours moved toward the northwest at 0.30 to 0.40 knots for one hour, altered course toward the southwest at 0.30 knots for two hours, then headed almost due west at 0.12 to 0.16 knots. Net movement was toward the southwest at 0.13 knots. The remaining two drogues followed similar patterns, but net movement was toward the north and northwest.

This complex movement pattern, demonstrated by the in-harbor drogues, was consistent with current meter results previously discussed, and is indicative of the complex tidal and eddy patterns within the harbor area. Similar results have been reported by both the Allan Hancock Foundation (1972) and the U. S. Army Engineers (1975) for this area.

Chemical Oceanographic Analyses

Chemical oceanographic studies included sampling and analyses of receiving waters and sediments from 18 stations; 1 at each of the 3 platform sites, 7 along the pipeline, and 8 in the terminus area. Surface receiving water chemical parameters measured included: 1) nutrients; ammonia, nitrate, phosphate, and silicate, 2) grease and oil, 3) trace metals; total chromium, barium, iron, lead, aluminum, and zinc, and 4) coliform bacteria. Sediment chemical parameters measured included: 1) organic content; biochemical oxygen demand, grease and oil, and phenol, 2) trace metals; cadium, copper, lead, silver, zinc, cobalt manganese, arsenic, boron, nickel, mercury, total chromium, barium, iron, and aluminum, and 3) sediment description.

Surface Receiving Waters. All surface receiving water chemical analysis results are presented in Table 4. Nutrients measured are as follows: ammonia nitrogen at the platform sites only and nitrate, phosphate, and silicate at all 18 stations. Samples collected at all stations were analyzed for grease and oil. Samples collected at the 3 platform site stations were analyzed for total chromium, barium, iron, lead, and aluminum. Samples collected at the 7 pipeline stations were analyzed for zinc. Samples were collected at the 3 platform site stations and analyzed for coliform organisms and results are presented in Table 5.

Table 4. Receiving Water Chemical Analysis Results (mg/l)

Station No.	Ammonia Nitrogen	Nitrate Nitrogen	Phosphate Phosphorus	Silicate (Si)	Grease and Oil	Total Chromium	Barium	Iron	Lead	Aluminum	Zinc
S1	0.003	0.029	0.036	0.11	<5	<0.0005	<0.1	0.0028	0.0065	0.0016	-
S2	0.006	0.032	0.027	0.11	<5	<0.0005	<0.1	0.0057	0.0069	0.0010	-
S3	0.003	0.050	0.022	0.099	<5	<0.0005	<0.1	0.0052	0.0048	0.0024	-
P1	-	0.020	0.030	0.12	<5	-	-	-	-	-	0.0012
P2	-	0.025	0.032	0.13	<5	-	-	-	-	-	0.0015
P3	-	0.026	0.025	0.092	<5	-	-	-	-	-	0.0040
P4	-	0.021	0.030	0.12	<5	-	-	-	-	-	0.0019
P5	-	0.022	0.030	0.16	<5	-	-	-	-	-	0.0008
P6	-	0.019	0.032	0.16	<5	-	-	-	-	-	0.0009
P7	-	0.020	0.025	0.22	<5	-	-	-	-	-	0.0017
T1	-	0.047	0.035	0.31	<5	-	-	-	-	-	-
T2	-	0.048	0.021	0.34	<5	-	-	-	-	-	-
T3	-	0.037	0.035	0.26	<5	-	-	-	-	-	-
T4	-	0.024	0.030	0.24	<5	-	-	-	-	-	-
T5	-	0.034	0.030	0.18	<5	-	-	-	-	-	-
T6	-	0.034	0.031	0.26	<5	-	-	-	-	-	-
T7	-	0.030	0.032	0.26	<5	-	-	-	-	-	-
T8	-	0.045	0.030	0.47	<5	-	-	-	-	-	-

Table 5. Receiving Water Examination for Coliform Organisms

Station No.	Portions Examined		Presumptive Lactose Broth		Confirmed B.G.B.		Coliform Organisms Most Probable Number per 100 ml
	Volume	No.	24 hr.	48 hr.	24 hr.	48 hr.	
S1	10	3	0	0	0	0	<3
	1.0	3	0	0	0	0	
	0.1	3	0	0	0	0	
	0.01	3	0	0	0	0	
S2	10	3	0	0	0	0	<3
	1.0	3	0	0	0	0	
	0.1	3	0	0	0	0	
	0.01	3	0	0	0	0	
S3	10	3	0	0	0	0	<3
	1.0	3	0	0	0	0	
	0.1	3	0	0	0	0	
	0.01	3	0	0	0	0	

Nutrients. Surface receiving water nutrients were measured in order to gain a data base prior to the construction of the platforms and pipeline and to correlate them with the plankton dynamics of the study area.

Ammonia is normally present only in small concentrations in natural waters (SCCWRP, 1973). Samples collected at the 3 platform site stations were analyzed for ammonia in order to obtain the "natural" concentration found in the study area for later comparison with concentrations present after the proposed sanitary waste disposal from the platform. The ammonia concentrations measured ranged from 0.003 to 0.006 mg/l with a mean of 0.004 mg/l and a standard deviation of $\pm$ 0.002 mg/l.

Nitrate is the dominant inorganic nitrogenous nutrient found in natural open ocean waters. Nitrate concentrations at the platform station ranged from 0.029 to 0.050 mg/l with a mean of 0.037 mg/l and a standard deviation of $\pm$ 0.011. Nitrate concentrations along the pipeline stations ranged from 0.019 to 0.026 mg/l with a mean of 0.022 mg/l and a standard deviation of $\pm$ 0.003 mg/l. Nitrate concentrations in the terminus area stations ranged from 0.024 mg/l to 0.045 mg/l with a mean of 0.037 mg/l and a standard deviation of $\pm$ 0.009 mg/l. The Hancock Foundation found nitrate concentrations in surface waters of the Southern California Bight ranged from 0.01 to 0.16 mg/l (SCCWRP, 1973). Nitrate concentrations observed during the B and C survey are in agreement with concentrations reported by SCCWRP.

Phosphate is considered to be the second most important nutrient next to nitrogen for phytoplankton metabolism. Phosphate concentrations at the platform site stations ranged from 0.022 to 0.036 mg/l with a mean of 0.283 mg/l and a standard deviation of $\pm$ 0.007 mg/l. Along the pipeline stations phosphate concentrations ranged from 0.025 to 0.032 mg/l with a mean of 0.029 mg/l and a

standard deviation of ± 0.003 mg/l. Phosphate concentrations in the terminus area stations ranged from 0.021 to 0.035 mg/l with a mean of 0.031 mg/l and a standard deviation of ± 0.004 mg/l. Surface phosphate concentrations of the southern California mainland shelf reported by the Hancock Foundation, 1965, agree with the concentrations observed during the B and C survey.

Silicate is an essential nutrient to diatoms. Diatoms comprise a great deal of the phytoplankton population found in the study area. Silicate concentrations at the platform site station ranged from 0.099 to 0.110 mg/l with a mean of 0.106 mg/l and a standard deviation of ± 0.006 mg/l. Silicate concentrations along the pipeline stations ranged from 092 to 0.220 mg/l with a mean of 0.143 mg/l and a standard deviation of ± 0.042 mg/l. Silicate concentrations observed in the terminus area stations ranged from 0.180 to 0.470 mg/l with a mean of 0.290 mg/l and a standard deviation of ± 0.087 mg/l. The surface silicate concentrations observed during the B and C survey were lower than those reported by the Hancock Foundation, 1965. Silicate concentrations are greatly dependent upon upwelling and phytoplankton assimilation. During the B and C survey phytoplankton uptake of silicate, without replenishment from upwelling, lowered concentrations below those reported by the Hancock Foundation, 1965.

Grease and Oil. Grease and oil samples were analyzed because of their close association to potential oil seepage and spills. Throughout the entire study area, platform site stations, pipeline stations, and terminus area, <5 mg/l of grease and oil was detected in the surface receiving waters.

Trace Metals. Total chromium, barium, iron, and lead were analyzed because of their importance during construction and production as components of suspended compounds at the platform site stations. Analysis for aluminum was included because aluminum will be used as a sacrificial anode on the proposed platforms. Zinc was analyzed in surface receiving waters along the pipeline stations because it will be used as anodes on the pipeline. All measured total chromium concentrations were <0.1 mg/l. Iron concentrations ranged from 0.0028 to 0.0057 mg/l with a mean of 0.0046 mg/l and a standard deviation of ± 0.0016 mg/l. Lead concentrations ranged from 0.0048 to 0.0069 mg/l with a mean of 0.0061 mg/l and a standard deviation of ± 0.0011 mg/l. Aluminum concentrations ranged from 0.0010 to 0.0024 mg/l with a mean of 0.0017 mg/l and a standard deviation of ± 0.0007 mg/l. Surface zinc concentrations along the pipeline stations ranged from 0.0008 to 0.0040 mg/l with a mean of 0.0017 mg/l and a standard deviation of ± 0.0011 mg/l.

Coliform Organisms. Most probable number of coliform organisms per 100 ml were analyzed in surface receiving waters at the platform site stations as background information for the proposed sanitary waste disposal from the platform. At the 3 platform site stations <3 most probable number of coliform bacteria per 100 ml were observed.

Sediment Chemistry. The sediment chemistry analysis results are presented in Table 6. There are three areas of interest in the sediment analysis: 1) organic content; biochemical oxygen demand (BOD), grease and oil, and phenolic compunds

Table 6. Sediment Chemical Analysis Results (mg/kg)

Station No.	Biochemical Oxygen Demand (BOD_5)	Grease and Oil	Phenol (C_6H_5OH)	Cadmium	Copper	Lead	Silver	Zinc	Cobalt	Manganese
S1	54	<50	0.87	0.30	14	8.7	0.47	77	53	150
S2	660	<50	5.5	0.22	12	8.2	0.37	67	53	150
S3	740	<50	0.13	0.38	15	2.2	0.35	76	57	150
P1	900	1300	-	-	-	-	-	71	-	-
P2	510	220	-	-	-	-	-	47	40	-
P3	220	<50	-	-	-	-	-	30	-	-
P4	210	<50	-	-	-	-	-	21	19	-
P5	57	<50	-	-	-	-	-	15	-	-
P6	180	<50	-	-	-	-	-	14	16	-
P7	140	<50	-	-	-	-	-	46	-	-
T1	390	390	0.62	0.40	22	52	0.43	95	69	160
T2	380	540	4.4	0.34	25	44	0.54	94	74	180
T3	450	490	1.4	1.2	40	80	0.59	140	95	210
T4	480	90	0.23	1.1	41	100	0.62	150	100	190
T5	330	<50	0.24	1.2	31	83	0.46	130	90	180
T6	340	<50	0.26	1.3	33	55	0.99	110	100	190
T7	340	76	0.004	1.0	42	68	0.56	130	110	240
T8	700	340	0.26	0.79	40	100	0.46	140	100	260

Station No.	Arsenic	Boron	Nickel	Mercury	Total Chromium	Barium	Iron	Aluminum	Sediment Description
S1	47	45	20	0.28	35	1.8	21,000	68	coarse silt
S2	51	40	20	0.33	34	1.8	20,000	63	coarse silt
S3	30	42	23	0.22	41	2.0	22,000	82	coarse silt
P1	-	-	-	-	-	-	-	-	very fine sand
P2	-	-	-	-	-	-	-	33	fine sand
P3	-	-	-	-	-	-	-	-	medium sand
P4	-	-	-	-	-	-	-	18	medium sand
P5	-	-	-	-	-	-	-	-	coarse sand
P6	-	-	-	-	-	-	-	12	coarse sand
P7	-	-	-	-	-	-	-	37	fine sand
T1	24	63	20	0.23	24	2.0	23,000	-	coarse silt
T2	33	70	22	0.24	26	1.8	24,000	-	coarse silt
T3	78	52	32	0.35	35	2.3	31,000	110	coarse silt
T4	110	58	32	0.40	34	2.2	33,000	-	medium silt
T5	67	53	30	0.23	28	1.9	29,000	110	coarse silt
T6	77	50	31	0.44	30	2.3	32,000	-	coarse silt
T7	79	53	33	0.41	30	2.2	36,000	140	medium silt
T8	100	60	29	0.30	28	2.2	33,000	-	coarse silt

were analyzed because of their close association to potential oil seepage, spills, and refinery processes, 2) trace metals; cadmium, copper, lead, silver, zinc, arsenic, boron, nickel, and mercury samples were analyzed because of their importance during construction and drilling as components of the suspended sediment. Cobalt and manganese were included because of their inclusion and discussion on other oil platform EIRs. Total chrmium, barium, and iron were analyzed because they are major components in drilling muds. Aluminum and zinc were analyzed because they will be used as anodes on the platforms and along the pipeline, respectively, 3) sediment description as grain size was analyzed to complement all other sediment characteristics and to provide an indication of the indigenous benthic biota.

Organic Content. Biochemical oxygen demand (BOD), grease and oil, and phenol were analyzed as a representative of some of the organic content of the sediments. Sediment samples were collected at all the stations and analyzed for biochemical oxygen demand (BOD) and grease and oil. Samples were collected at the platform site stations and at the terminus area stations and analyzed for phenol content.

Concentrations of biochemical oxygen demand (BOD) at the platform site stations ranged from 54 to 740 mg/kg with a mean of 485 mg/kg and a standard deviation of $\pm$ 573 mg/kg. BOD concentrations along the pipeline stations ranged from 57 to 900 mg/kg with a mean of 317 mg/kg and a standard deviation of $\pm$ 293 mg/kg. BOD concentrations in the terminus area stations ranged from 330 to 700 mg/kg with a mean of 426 mg/kg and a standard deviation of $\pm$ 123 mg/kg. Sediment concentrations of grease and oil at the platform site stations were $<$ 50 mg/kg. Sediment concentrations of grease and oil along the pipeline were all $<$50 mg/kg except at Stations P1 and P2 where concentrations were 1300 and 220 mg/kg respectively. Stations P1 and P2 were located along the proposed pipeline route near the platform sites and near an exploratory drilling platform. Concentrations observed at these two stations may have been due to the drilling platform or possible natural seepage within the area. Grease and oil concentrations varied greatly among the terminus area stations. In this area sediment grease and oil concentration patterns are the result of shipping traffic and industrial discharges. In the terminus area grease and oil ranged from $<$ 50 to 540 mg/kg.

Phenol concentrations at the platform site stations ranged from 0.13 to 5.50 mg/kg with a mean of 2.17 mg/kg and a standard deviation of $\pm$ 2.91 mg/kg. Phenol concentrations in the terminus area stations ranged from 0.004 to 4.40 mg/kg with a mean of 0.927 mg/kg and a standard deviation of $\pm$ 1.47 mg/kg.

Trace Metals. Trace metals sediment analyses included cadmium, copper, lead, silver, zinc, cobalt, manganese, arsenic, boron, nickel, mercury, chromium, barium, iron, and aluminum. Samples collected throughout the study area were analyzed for zinc, cobalt, and aluminum. Samples collected at the platform site stations and the terminus stations were analyzed for all trace metals.

Cadmium concentrations at the platform site stations ranged from 0.22 to 0.38 mg/kg with a mean of 0.30 mg/kg and a standard deviation of + 0.08 mg/kg. In the terminus area sediment concentrations of cadmium ranged from 0.34 to 1.30 mg/kg with a mean of 0.92 mg/kg and a standard deviation of ± 0.37 mg/kg.

Copper concentrations at the platform site stations ranged from 12.0 to 15.0 mg/kg with a mean of 13.6 mg/kg and a standard deviation of ± 1.53 mg/kg. In the terminus area sediment copper concentrations ranged from 22.0 to 42.0 mg/kg with a mean of 34.3 mg/kg and a standard deviation of ± 7.74 mg/kg.

Lead concentrations at the platform site stations ranged from 2.2 to 8.7 mg/kg with a mean of 6.4 mg/kg and a standard deviation of ± 3.6 mg/kg. Lead concentrations in the terminus area stations ranged from 44.0 to 100 mg/kg with a mean of 72.8 and a standard deviation of ± 21.5 mg/kg.

Silver concentrations at the platform site stations ranged from 0.35 to 0.47 mg/kg with a mean of 0.40 mg/kg and a standard deviation of ± 0.06 mg/kg. In the terminus area silver concentrations ranged from 0.43 to 0.99 mg/kg with a mean of 0.58 mg/kg and a standard deviation of ± 0.18 mg/kg.

Zinc concentrations at the platform site stations ranged from 67.0 to 77.0 mg/kg with a mean of 73.3 mg/kg and a standard deviation of ± 5.51 mg/kg. Along the pipeline stations concentrations of zinc ranged from 14.0 to 71.0 mg/kg with a mean of 34.9 mg/kg and a standard deviation of ± 20.9 mg/kg. Zinc concentrations in the terminus area ranged from 94.0 to 150 mg/kg with a mean of 123 mg/kg and a standard deviation of ± 21.3 mg/kg.

Cobalt concentrations at the platform site stations ranged from 53 to 57 mg/kg with a mean of 54 mg/kg and a standard deviation of ± 2.3 mg/kg. Measured cobalt concentrations along the pipeline stations ranged from 26 to 40 mg/kg with a mean of 25 mg/kg and a standard deviation of ± 13 mg/kg. Cobalt concentrations in the terminus area ranged from 69 to 110 mg/kg with a mean of 92 mg/kg and a standard deviation of ± 14 mg/kg.

Manganese concentrations at the platform site stations were all 150 mg/kg. In the terminus area manganese concentrations ranged from 160 to 260 mg/kg with a mean of 201 mg/kg and a standard deviation of ± 34 mg/kg.

Arsenic concentrations at the platform site stations ranged from 30 to 51 mg/kg with a mean of 43 mg/kg and a standard deviation of ± 11 mg/kg. Arsenic concentrations in the terminus area ranged from 24 to 110 mg/kg with a mean of 71 mg/kg and a standard deviation of ± 29 mg/kg.

Boron concentrations at the platform site stations ranged from 40 to 45 mg/kg with a mean of 42 mg/kg and a standard deviation of ± 2.5 mg/kg. In the terminus area boron concentrations ranged from 50 to 70 mg/kg with a mean of 46 mg/kg and a standard deviation of ± 7 mg/kg.

Nickel concentrations at the platform site stations ranged from 20 to 23 mg/kg with a mean of 21 mg/kg and a standard deviation of ± 1.7 mg/kg. In the terminus area nickel concentrations ranged from 20 to 33 mg/kg with a mean of 29 mg/kg and a standard deviation of ± 4.8 mg/kg.

Mercury concentrations at the platform site stations ranged from 0.22 to 0.33 mg/kg with a mean of 0.28 mg/kg and a standard deviation of ± 0.055 mg/kg. In the terminus area mercury concentrations ranged from 0.23 to 0.44 mg/kg with a mean of 0.33 mg/kg and a standard deviation of ± 0.09 mg/kg.

Total chromium concentrations at the platform site stations ranged from 34 to 41 mg/kg with a mean of 37 mg/kg and a standard deviation of ± 3.8 mg/kg. In the terminus area chromium concentrations ranged from 24 to 35 mg/kg with a mean of 29 mg/kg and a standard deviation of ± 3.7 mg/kg.

Barium concentrations at the platform site stations ranged from 1.8 to 2.0 mg/kg with a mean of 1.9 mg/kg and a standard deviation of ± 0.1 mg/kg. In the terminus area barium concentrations ranged from 1.8 to 2.3 mg/kg with a mean of 2.1 mg/kg and a standard deviation of ± 0.2 mg/kg.

Iron concentrations at the platform site stations ranged from 20,000 to 22,000 mg/kg with a mean of 21,000 mg/kg and a standard deviation of ± 1,000 mg/kg. In the terminus area iron concentrations ranged from 23,000 to 36,000 mg/kg with a mean of 30,000 mg/kg and a standard deviation of ± 4,500 mg/kg.

Aluminum concentrations at the platform site stations ranged from 63 to 82 mg/kg with a mean of 71 mg/kg and a standard deviation of ± 9.8 mg/kg. Measured aluminum concentrations at pipeline stations ranged from 12 to 37 mg/kg with a mean of 25 mg/kg and a standard deviation of ± 12 mg/kg. In the terminus area measured aluminum concentrations ranged from 110 to 140 mg/kg with a mean of 120 mg/kg and a standard deviation of ± 17 mg/kg.

Sediment Description. The sediment at all platform site stations was observed to be coarse silt. Along the pipeline, sediments ranged from very fine sand to coarse sand. Very fine sand was found at the pipeline stations farthest offshore near the platform site stations, medium to coarse sands were found at stations along the middle of the proposed pipeline (outside the terminus area), and fine sand was found at the station closest to the Long Beach Breakwater. In the harbor area, medium and coarse silt sediments were observed with no apparent spatial patterns.