DEPARTMENT OF GENERAL PLANNING
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

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MAYOR

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CHIEF PLANNING OFFICER

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DEPUTY CHIEF PLANNING OFFICER

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October 3, 1991

Mr. Brian Choy, Director
Office of Environmental Quality Control
Central Pacific Plaza
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Mr. Choy:

Acceptance Notice for the Proposed
Campbell Drainage Channel
Supplemental to Kapolei Business-Industrial Park
Environmental Impact Statement (EIS)

We are notifying you of our acceptance of the Final EIS for the proposed Campbell Drainage Channel. Pursuant to Section 11-200-23(e), Chapter 200, Title 11 ("Environmental Impact Statement Rules") of the Hawaii Administrative Rules, this acceptance notice should be published in the October 8, 1991 OEQC BULLETIN.

We have attached our Acceptance Report of the Final EIS for the Campbell Drainage Channel and the "DOCUMENT FOR PUBLICATION IN THE OEQC BULLETIN". Should you have any questions, please contact Matthew Higashida of our staff at 527-6056.

Sincerely,

BENJAMIN B. LEE
Chief Planning Officer

BBL:ft

Attachments

cc: Susan Sublett, The Estate of James Campbell
Kenneth Ishizaki, Engineering Concepts, Inc.
Department of Land Utilization

OEQC LIBRARY

FINAL ENVIRONMENTAL IMPACT STATEMENT

FOR THE

CAMPBELL DRAINAGE CHANNEL

SUPPLEMENTAL TO KAPOLEI BUSINESS - INDUSTRIAL PARK EIS

EWA, OAHU, HAWAII

TAX MAP KEY: 9-1-14:4(POR)

This document is prepared pursuant to Chapter 343, HRS.

APPLICANT: The Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, Hawaii 96813

Prepared by:

Engineering Concepts, Inc.
250 Ward Avenue, Suite 206
Honolulu, Hawaii 96814

August 1991

FINAL ENVIRONMENTAL IMPACT STATEMENT

FOR THE

CAMPBELL DRAINAGE CHANNEL

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828 Fort Street Mall, Suite 500
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Honolulu, Hawaii 96814

Kenneth Ishizaki, Vice President

For Submittal to:

City and County of Honolulu, Department of General Planning

August 1991

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I. SUMMARY

A. DEVELOPMENT SUMMARY

Applicant:	The Estate of James Campbell 828 Fort Street Mall, Suite 500 Honolulu, Hawaii 96813
Property Owner:	Same as Applicant
EIS Consultant:	Engineering Concepts, Inc. 250 Ward Avenue, Suite 206 Honolulu, Hawaii 96814
Accepting Authority:	Department of General Planning City and County of Honolulu Municipal Office Building, 8th Fl. 650 South King Street Honolulu, Hawaii 96813
Proposed Action:	Construct Drainage Channel
Project Name:	Campbell Drainage Channel
Project Location:	Ewa, Oahu, Hawaii
Tax Map Key:	9-1-14: 4(portion)
Project Area:	6 Acres
Existing Uses:	Open space
Proposed Uses:	Drainage Channel
State Land Use District:	Urban
Development Plan Designation:	Industrial
Zoning:	I-2 (General Industrial)

B. DESCRIPTION OF THE ENTIRE PROJECT

The Estate of James Campbell is proposing the expansion of the existing James Campbell Industrial Park (JCIP) in Ewa, Oahu. The expansion, known as Kapolei Business-Industrial Park (KBIP), will occupy an area of approximately 931 acres. The Kapolei Business-Industrial Park is bordered by Malakole Road to the south and the OR & L railroad right-of-way to the north. The Barbers Point Naval Air Station is located to the east (see Figure 1).

A Final Environmental Impact Statement (EIS) in support of a Development Plan amendment for KBIP was prepared by William E. Wanket, Inc., in April 1990. This EIS addressed the environmental impacts associated with the KBIP site. Included in this EIS was a description of the proposed drainage channel that will traverse the KBIP site and convey storm runoff from the drainage basin to the Pacific Ocean. The EIS was accepted by the City and County of Honolulu, Department of General Planning, on May 25, 1990.

C. PURPOSE OF THIS SUPPLEMENTAL EIS

A major drainage channel is proposed to relieve the increase in runoff due to the urbanization of the KBIP site. Approximately 554 acres of the proposed KBIP development are within of the 2400 acre drainage channel watershed.

This Supplemental Environmental Impact Statement (SEIS) will address the section of the proposed drainage channel extending from the KBIP development boundary at Malakole Road to its terminus at the coastal shoreline, and the resulting potential environmental impacts on coastal water conditions, marine life, and the nearshore environment.

This SEIS has been prepared in accordance with Chapter 343, HRS, Environmental Impact Statement Regulations. It will be submitted to the City and County of

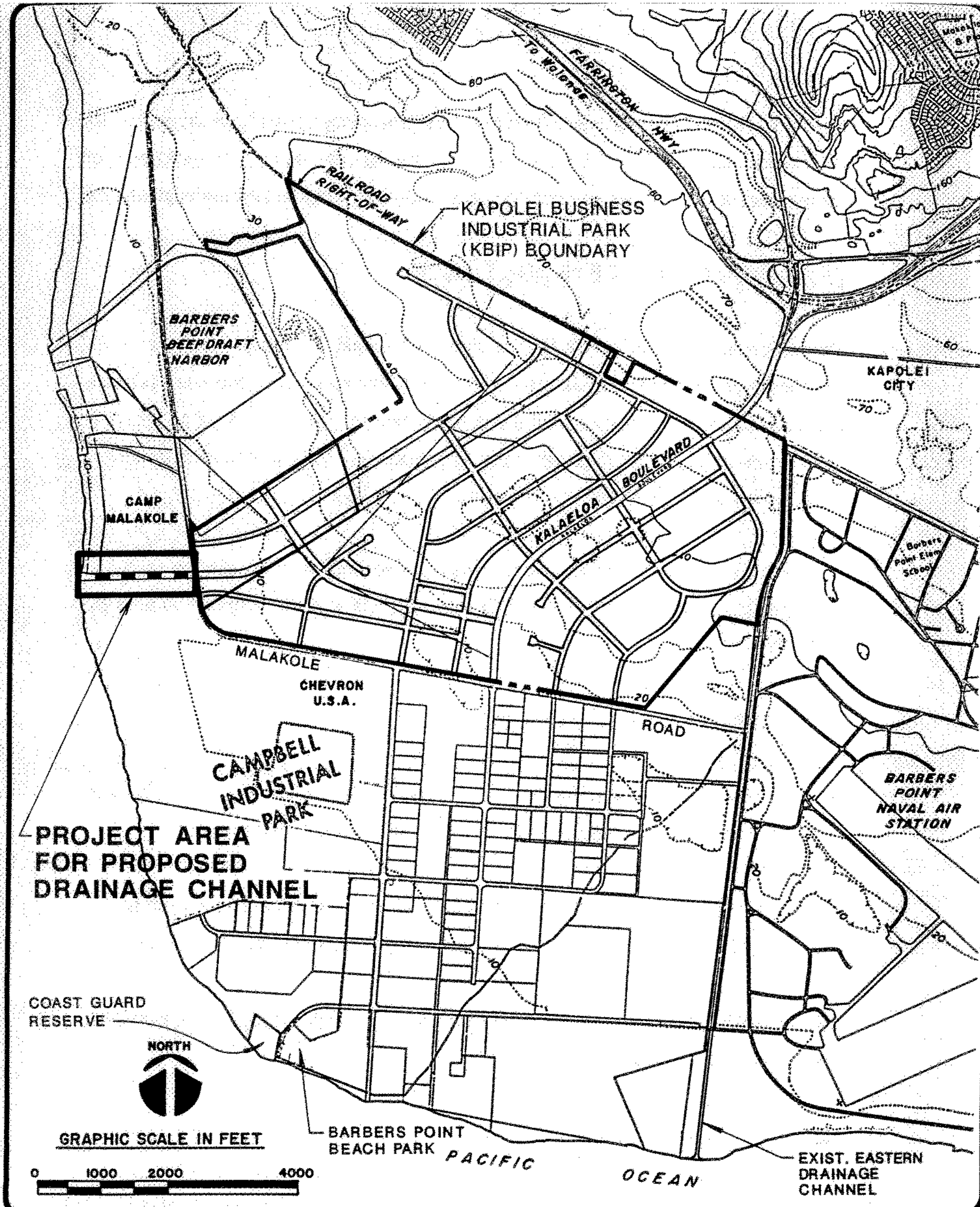

fig. 1 Location Map

CAMPBELL DRAINAGE CHANNEL

EWA, OAHU, HAWAII

Prepared By: ENGINEERING CONCEPTS, INC.

Honolulu, Department of General Planning, the "accepting agency", in support of the DP amendment for KBIP. This document will also be submitted in conjunction with various permit applications required for construction of the proposed drainage channel.

D. BRIEF DESCRIPTION OF PROJECT AREA

The project area covered in this SEIS is shown on Figure 1. The project area stretches over approximately six acres of open, undeveloped space between Malakole Road and the ocean. The proposed drainage channel is expected to have an approximate bottom width of 100 feet and extend approximately 1750 feet in an east-west direction from Malakole Road to the ocean.

As mentioned above, the environmental impacts associated with the portion of the drainage channel located within the KBIP site were addressed in conjunction with the KBIP EIS.

E. SUMMARY OF BENEFICIAL IMPACTS

KBIP Development: The proposed drainage channel is expected to mitigate flooding problems due to increased storm water runoff from the KBIP development.

Future Development: The proposed drainage channel will accommodate future developments as delineated in the State and County General Plans. This infrastructure

will serve the 2400 acre drainage basin by conveying storm runoff from future land developments to the ocean.

Existing Flooding Problem: The proposed drainage channel will provide an engineered route for storm water runoff to reach the ocean, eliminating flooding that currently occurs at low lying areas near the Kalaeloa Boulevard/Malakole Road intersection and on the northwest corner of the Chevron USA refinery, adjacent to Malakole Road.

Fishing Habitat: The effects of the storm runoff discharge into the Pacific Ocean are expected to change the nearshore environment, with brackish waters at the mouth of the proposed drainage channel encouraging a habitat for a variety of reef fishes and demersal fishes characteristic of harbors and shoreline inlets. The presence of brackish water would not hinder habitat potential, as evidenced by a channel built in 1970 to drain the eastern side of the industrial park.

Littoral Process: No adverse effects to the littoral process are expected to occur as a result of the proposed drainage channel.

Flora/Fauna: No endangered species of flora or fauna are expected to be affected by the construction of the proposed drainage channel.

F. SUMMARY OF POTENTIAL ADVERSE IMPACTS

Water Quality: Receiving water quality will be temporarily affected by intermittent stormwater discharges from the proposed drainage channel. Depressed salinity and increased turbidity are potential impacts to receiving waters due to storm water runoff.

Mitigative Measures: These potential impacts are considered to be periodic and infrequent, occurring only during heavy rainstorms. Development within the watershed will be required to implement approved erosion control measures during construction and comply with applicable City and County grading ordinances. These measures will reduce the potential sediment concentration in the storm runoff during construction. Development of upstream areas is expected to ultimately reduce soil erosion and sediment concentration in storm water discharge from the proposed drainage channel. Detention basins incorporated within the proposed Makaiwa Hills development will settle sediment prior to entrance of storm runoff into the drainage channel. Construction of sediment traps within the drainage channel is under consideration, pending acceptance by the Department of Public Works for maintenance.

Recreation: Recreational activities, such as diving, may be affected due to turbid waters.

Mitigative Measure: Periods of increased turbidity in the nearshore waters are associated with periods of inclement weather. Recreational activities are expected to be low during these periods of inclement weather, resulting in minimal impacts.

Shoreline Access: The drainage channel will limit the access to the entire length of the shoreline.

Mitigative Measure: A pedestrian bridge near the mouth of the drainage channel is under consideration to provide lateral access to the shoreline, provided that a public agency accepts dedication of the bridge.

Aquatic Resources: The excavation of the channel will require the removal of the marine bench along the shoreline. Although no endangered species will be affected, Pterocladia, a common algae food source for the endangered sea turtle may be lost in the disturbed marine bench.

Mitigative Measure: The impact on the turtles due to the loss of Pterocladia is small considering the abundance of this algae along the entire coast. Studies have indicated that even when disturbed, Pterocladia growth recovered where suitable substrata conditions emerged at the channel cuts.

Archaeological Resources: Although no existing archaeological and paleontological sites will be directly impacted, the excavation of the proposed drainage channel could result in destruction of subsurface archaeological remains.

Mitigative Measure: Before construction commences, dune deposits on the makai end of the project site will be tested for the presence or absence of cultural material. An evaluation of the findings will be reported to the Department of Land and Natural Resources, Historic Preservation Division and appropriate mitigation measures will follow.

The project site will be monitored for potential significant remains during the excavation of the drainage channel.

Construction: Temporary dust, noise and traffic disruptions may result from the construction of the proposed project.

The construction of the proposed drainage channel may also temporarily affect the coastal water quality.

Mitigative Measures: The developer and its contractor will comply with local grading and subdivision ordinances and regulations of the State Department of Health. Traffic plans and erosion, dust and noise control measures will be implemented during periods of construction.

Potential impacts to coastal water quality during construction will be minimized by constructing a substantial portion of the channel in the "dry" prior to opening to the ocean.

G. ALTERNATIVES CONSIDERED

Four alternatives were considered for the proposed drainage channel. The no action alternative assumed that the land would remain in current uses, and storm runoff would continue in existing patterns. A second alternative examined routing a box culvert to discharge into Barbers Point Harbor. The third alternative was to route the storm water runoff to the existing eastern drainage channel in Campbell Industrial

Park, located east of the KBIP site, between the existing industrial park and Barbers Point Naval Air Station. The fourth alternative was to contain the storm runoff in a retention basin.

Upon consideration of all the alternatives, construction of a new drainage channel was selected. The proposed drainage channel was the most viable and beneficial alternative to serve the 2400 acre drainage basin, including the KBIP site.

H. COMPATIBILITY WITH LAND USE PLANS AND POLICIES

The proposed project is compatible with the applicable State, City and Federal plans and policies.

I. UNRESOLVED ISSUES

Pedestrian Bridge: The developer is willing to construct a pedestrian bridge near the mouth of the channel for lateral access to the shoreline, provided a public agency agrees to accept the dedication of the bridge. Details regarding the specific location, design features, and dedication of the bridge will need to be coordinated with government agencies. If a public agency is not willing to accept dedication of the pedestrian bridge, an alternative to provide public access along both sides of the channel will be considered.

Potential Archaeological Deposits in Beach Dune: Significant subsurface artifacts may exist beneath the layer of aeolean sand deposits forming a beach berm. An archaeological survey at that specific locality will be undertaken. The results of the archaeological survey will be reported to the Department of Land and Natural Resources, Historic Preservation Division, for review and approval. If the survey uncovers significant findings, an appropriate mitigation plan will be reported and implemented prior to construction. However, if no significant sites are present, then no further archaeological concern need be addressed.

J. NECESSARY PERMITS AND APPROVALS

A number of permits and approvals must be secured before construction of the proposed drainage channel can begin. Major approvals include:

U.S. Department of the Army: The Army Permit, issued by the Corps of Engineers pursuant to Section 10 of the Rivers and Harbor Act of 1899 is required to authorize activities in or affecting navigable waters.

Conservation District Use Application Permit: The CDUA Permit is required by the State of Hawaii, Department of Land and Natural Resources, for development within lands designated as Conservation Districts. Coastal waters of the state are designated as Conservation Districts.

Special Management Area Use Permit: An SMA Permit is required by the City and County of Honolulu, Department of Land Utilization for construction activities located within the Special Management Area.

Shoreline Setback Variance: A shoreline setback variance is required for activities within 40 feet of the shoreline from the Department of Land Utilization, City and County of Honolulu.

National Pollutant Discharge Elimination System Permit: The NPDES permit is required by the State of Hawaii, Department of Health, for construction activities involving clearing, grading and excavation of more than five (5) acres of total land area. A separate NPDES permit for storm water discharge from a municipal system will be required upon dedication of the drainage channel to the City and County.

Antidegredation Analysis: An Antidegredation Analysis is required for the proposed stormwater discharge, pursuant to the State Department of Health Administrative

Rules, Chapter 11-5401.1 and the Code of Federal Regulations, Title 40, Part 131, Section 131.12.

Acquire Easement within State-Owned Land: An easement is required by the Department of Land and Natural Resources, Division of Land Management, for the portion of the drainage channel built on state-owned land, makai of the high tide mark.

II. PROJECT DESCRIPTION

A. LOCATION

The location of the proposed drainage channel is illustrated on Figure 1. The portion of the drainage channel addressed in this SEIS extends approximately 1,750 feet in an east-west alignment from Malakole Road to the Pacific Ocean. A 150-foot wide parcel has been set aside for this project. Camp Malakole borders the channel to the north and the Chevron refinery is located to the south.

B. PROJECT DESCRIPTION

The proposed drainage channel is a major drainage improvement planned for the 2400 acre drainage basin, including the KBIP development. The proposed drainage channel will be designed based on a 100-year storm with a peak runoff capacity of 5200 cubic feet per second (cfs). The proposed channel will have vertical sides, with an average bottom width of approximately 100 feet and varying depth. It is anticipated that the entire length of the channel will be lined with concrete. The channel excavation at the coast will daylight at an approximate elevation of (-)5 feet mean sea level (MSL). Tidal influence will extend 2000 to 2500 feet inland from the channel mouth. A typical channel cross-section is shown on Figure 2 and the proposed drainage channel profile is shown on Figure 3.

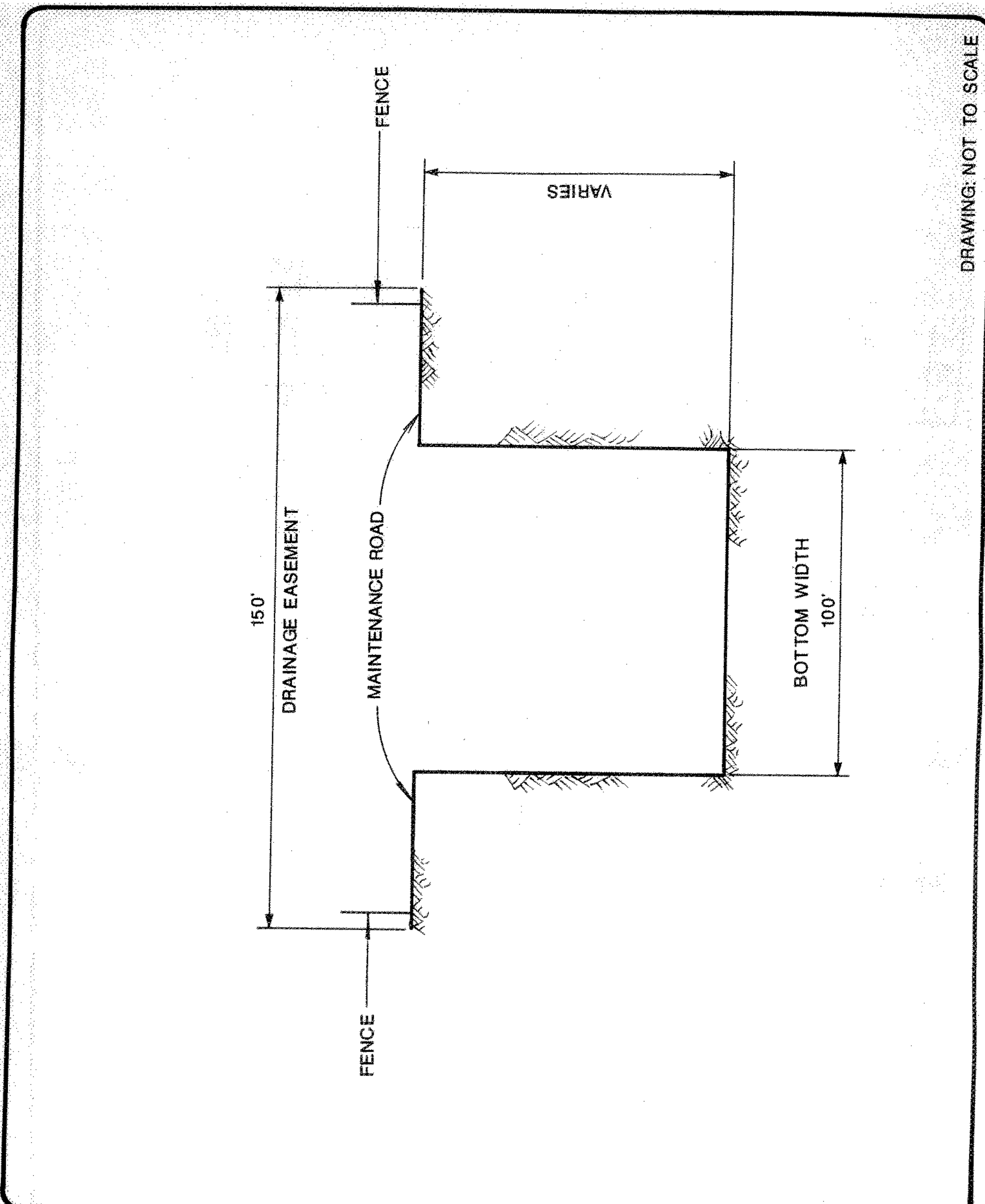

fig. 2 Drainage Channel Cross-Section

CAMPBELL DRAINAGE CHANNEL

EWA, OAHU, HAWAII

Prepared by: ENGINEERING CONCEPTS, INC.

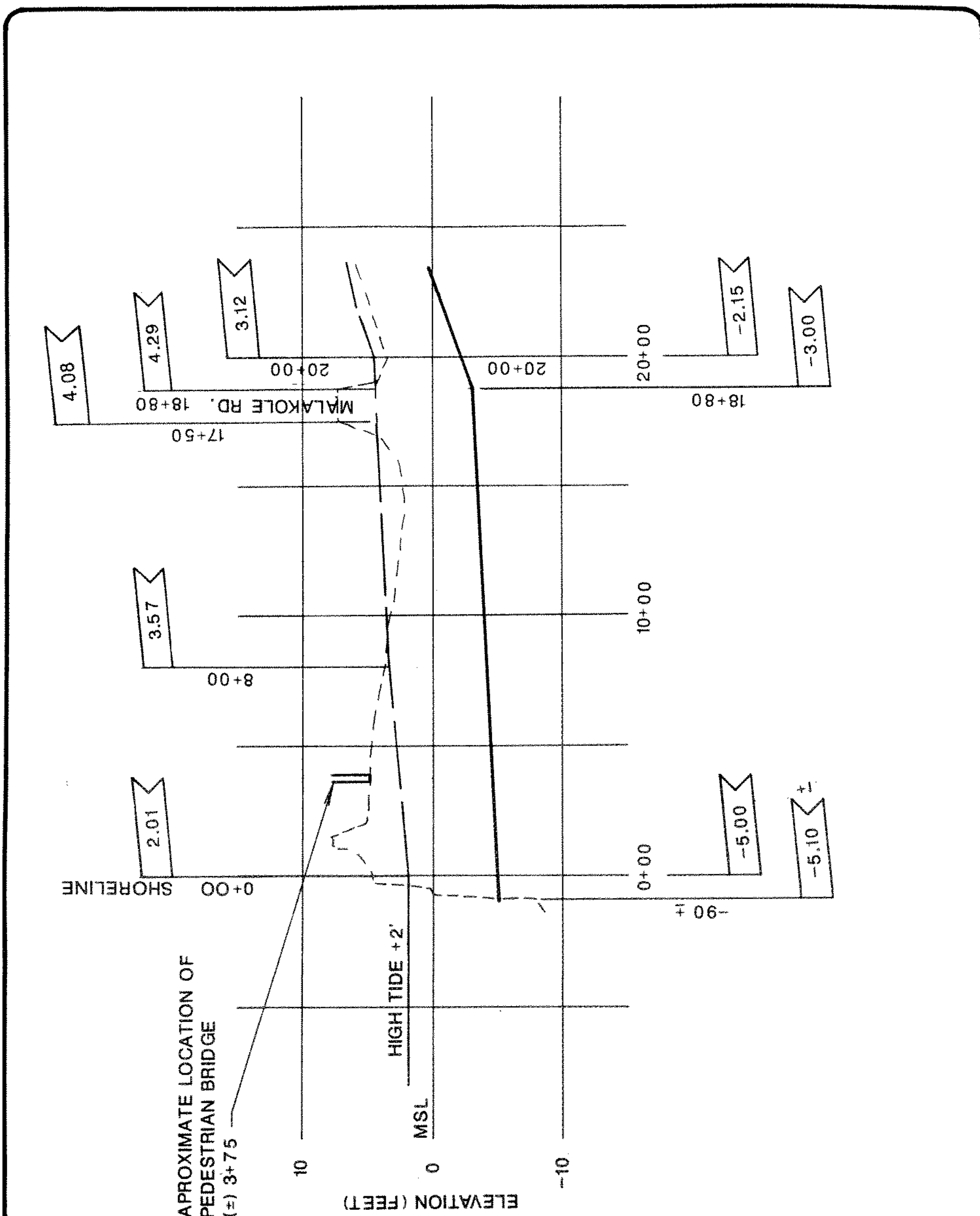

fig. 3 Drainage Channel Profile

CAMPBELL DRAINAGE CHANNEL
EWA, OAHU, HAWAII

Prepared by: ENGINEERING CONCEPTS, INC.

Maintenance roads and chain link fencing/gates will be located along both banks of the proposed drainage channel for the length of the channel to the ocean. Access to the maintenance roads will be off of Malakole Road. A box culvert structure will traverse below Malakole Road and connect with the drainage channel running through the KBIP site.

A pedestrian bridge is proposed to provide lateral access along the shoreline near the mouth of the channel, provided that a public agency accepts dedication of the bridge. An approximate location of the pedestrian bridge is shown on the channel plan view, Figure 4. In the event dedication of the bridge cannot be coordinated, public access to the shoreline will be provided along both sides of the drainage channel. A fenced pedestrian walk will parallel the maintenance roads from Malakole Road to the ocean.

C. NEED/PURPOSE OF THE PROPOSED PROJECT

The proposed drainage channel will serve two main purposes: (1) The channel will support the KBIP development and future developments within the 2400 acre drainage basin, and (2) the channel will mitigate existing flooding within the proposed KBIP site and neighboring properties.

Development of KBIP and future development of the areas north of KBIP will alter runoff characteristics of the drainage basin. Existing vegetative cover will be replaced by buildings, paved surfaces, formal landscaped areas, and other improvements normally associated with industrial park developments. Peak storm runoff rate and volume generated within the KBIP site will increase as a result of the development.

Flooding occurs in low lying areas near the Kalaeloa Boulevard/Malakole Road intersection and near the northwest corner of the Chevron refinery, adjacent to Malakole Road. Development of the industrial park will increase the rate and amount of storm runoff and exacerbate flooding problems. The extent of flooding may reach

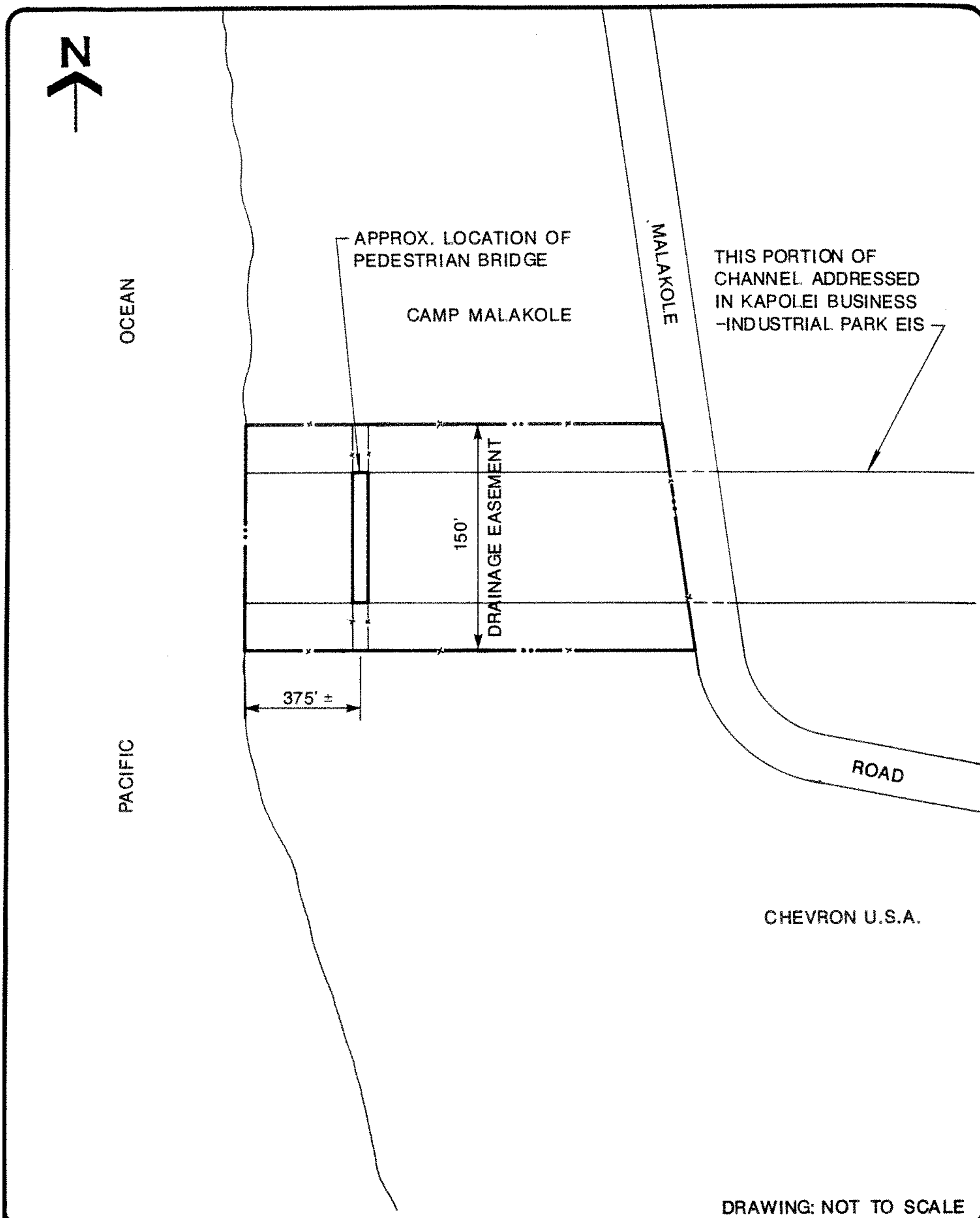

fig. 4 Drainage Channel Plan View

CAMPBELL DRAINAGE CHANNEL

EWA, OAHU, HAWAII

Prepared by: ENGINEERING CONCEPTS, INC.

neighboring properties in the event proper drainage facilities are not constructed to cope with the increased runoff.

The proposed drainage channel is necessary to mitigate the effects of additional storm runoff due to urbanization of the drainage basin, including the KBIP development. The flood control channel will provide a well defined engineered route for storm runoff to be discharged into the ocean.

D. TIME TABLE/COST ESTIMATE

All permits are anticipated to be obtained by March 1992. Construction is anticipated to begin during the summer of 1992 and is expected to be completed in a year. The estimated project cost is anticipated to be $5,000,000.

III. EXISTING ENVIRONMENTAL SETTING

A. GEOGRAPHIC CHARACTERISTICS

Topography: The project site is generally level except for localized topographic depressions near Malakole Road. A natural drainage way already exists along the project route up to the coastline. However, several feet of sand and coral debris, form a beach berm at the seaward end of the natural drainage way, impeding the flow of storm runoff to the ocean.

Two existing 36-inch pipe culverts cross Malakole Road with invert elevations of 1.5 feet at the downstream end.

Geology/Soils: Dames and Moore (1990) performed a geological reconnaissance along the project site. The report, attached as Appendix A, is summarized below.

The geological reconnaissance identified three different regions of ground surface types within the proposed project site. Local areas of ponding, and soft deposits, characterize the segment adjacent to Malakole Road which extends seaward for approximately 600 feet. The surface material along the middle segment is primarily silty sand and gravel, and the segment (approximately 650 feet) adjacent to the ocean is primarily coralline sand and gravel, locally cemented.

Two boring samples taken by Dames and Moore along the route of the proposed drainage channel, provide data on subsurface and groundwater conditions.

The first boring, drilled near the shoreline, encountered primarily coralline sand and gravel, varying from loose to locally cemented. Beach rock deposits were also encountered at about 10 to 15 feet below the existing ground surface.

The second boring, drilled at the shoulder of Malakole Road where the proposed channel crosses under that road, encountered a medium stiff, gravelly, sandy silt layer (probably fill) at depths of about one to six feet. Below this surface layer, a layer of olive gray to brown, very soft, clayey silt material containing organic matter was encountered to a depth of approximately 14 feet. Below this very soft and highly compressible deposit was approximately six feet of very stiff clayey silt overlying medium dense sandy gravel.

Between these borings, shallow probings performed during the site reconnaissance indicated that most of the low lying areas are underlain by very soft silty deposits, to depths of greater than four feet.

Groundwater was encountered at about five feet below existing ground surface. High groundwater elevation is estimated at +4 MSL. Higher groundwater levels may result from a combination of ground water input due to high rainfall and extreme tides or storm surge conditions.

B. LAND USE

The property (Tax Map Key 9-1-14:4(portion)) is presently designated Urban by the State Land Use Commission and Industrial by the City and County Development Plan. The land is presently zoned I-2 or General Industrial.

C. ATMOSPHERIC CONDITIONS

The climate in the project vicinity is relatively warm and dry, typical of the climate throughout the Ewa Plains. Tradewinds from the northeast occur much of the time, with occasional Kona winds. The normal temperature range for the area is from the high 60's to the low 90's (degrees Fahrenheit). Rainfall is light, with an average annual rainfall of about 20 inches.

The State Department of Health maintains an air quality monitoring station at the Chevron Refinery site, located within half a mile of the proposed drainage channel, south of Malakole Road. Recent data indicated that total suspended particulates (TSP) and sulphur dioxide ($SO2$) standards are being met. Carbon monoxide (CO) levels are also below state standards most of the time with only occasional exceedences.

D. COASTAL SETTING

The coastline at the proposed project site is characterized by calcareous reef rock and hard coral limestone shelves with rubble material and sand collected only in small pockets along the shore and nearshore region.

The nearshore bottom slopes about one foot vertically for every four feet of horizontal distance seaward, to a depth of 20 feet. A flat limestone shelf then extends seaward to a depth of 50 feet, at a distance of 3000 feet from shore. Beyond the shelf, depths of 300 and 600 feet are attained at distance of 5000 and 6500 feet from shore, respectively.

With the scarcity of sandy material, littoral transport processes are extremely limited and the shoreline configuration is therefore stable throughout the year.

E. WINDS AND WAVES

Ewa, Oahu typically experiences tradewinds 75 to 85 percent of the year with wind speeds varying from 10 to 25 knots. The coastline is exposed to wave energy from north-northwesterly ocean swell during the winter season and southerly swell during the summer season. These swells, however, undergo considerable refraction effects prior to reaching the shore.

Scrips Institution of Oceanography, under a U.S. Army Corps of Engineers contract, maintains and operates the Waverider buoy which is a wave measuring station. The deep water wave condition offshore of the proposed drainage channel can be characterized from available data recorded at a buoy located 600 feet off the shore of the deep draft harbor at Barbers Point. From data recorded between December 1986 and September 1988, a maximum wave height of 10 feet with 14 to 16 second periods was experienced during the winter season. Maximum southern swell heights of four to six feet at intervals of 14 to 18 seconds were recorded during the summer season.

The typical offshore wave climate is characterized by wave heights of two to four feet at periods of 16 seconds. With the absence of shallow fringing coral reefs, significant wave energy reaches the shoreline at the project site especially during large swell and westerly Kona storm conditions.

F. CURRENTS AND CIRCULATION

Currents offshore of the project site are dominated by semi-diurnal tidal forces. Flood tide currents generally set southeastward, while ebb tide currents generally flow northeastward, parallel to bottom contours.

Measurements in waters off of the Barbers Point Harbor entrance channel show currents to be strongest offshore, generally reaching speeds two times higher than inshore currents. The boundary between the two current regimes is approximately the 50-foot depth contour where the bottom drops off steeply about 4000 feet from shore. Offshore current speeds (current meter located 5200 feet offshore) equalled or exceeded 50 centimeters per second (cm/sec) (approximately 1 knot) five percent of the time. The average speed was about 24 cm/sec, with maximum measured speed of 84 cm/sec (approximately 1.7 knots) during a 7.5 minute recording interval.

Inshore currents (current meter located 1800 feet offshore) averaged 12 to 15 cm/sec, with maximum measured speed of 42 cm/sec. At times, weak inshore currents were found to flow in a direction counter to the strong offshore currents.

G. WATER QUALITY

AECOS (1990) conducted a study of the existing water quality in the vicinity of the proposed drainage channel. The report is attached as Appendix B and is summarized below.

Water samples collected off the project site on May 21, 1990 were analyzed for water quality parameters designated for open coastal waters by the State of Hawaii, Department of Health (DOH). The results of these analyses are presented in Table 1. Stations 1 to 3 are shoreline samples taken at the proposed channel outlet, 500 feet north of the outlet, and 500 feet south of the outlet. Stations 4 and 5 are located immediately west of and 500 feet west of the existing eastern drainage channel.

Also measured were salinity (by refractive index) and temperature. Salinity varied between 35.5 and 36.5 parts per thousand (o/oo) and the temperature ranged from 26 to 26.5 degrees Celsius.

TABLE 1

RESULTS OF WATER QUALITY SAMPLING FROM SELECTED COASTAL SITES IN THE VICINITY OF BARBERS POINT, OAHU.

Station	pH	Turbidity (ntu)	NO_2+NO_3 ($mgNO_2+NO_3$-N/L)	NH_4 (mg NH_4-N/L)	Total N (mg N/L)	Total P (mg P/L)	Chlorophyll-a (ug/L)
Project Site							
1	8.34	1.78	0.003	0.012	0.37	0.03	0.56
2	8.34	0.99	0.002	0.004	0.19	0.01	0.47
3	8.32	1.10	0.003	0.001	0.20	0.01	0.44
Vicinity of Existing Eastern Drainage Channel							
4	8.38	3.24	0.019	0.002	0.34	0.01	4.34
5	8.35	2.05	0.052	0.006	0.20	0.01	2.03

Notes:

1. Stations 1,2, and 3 are nearshore samples taken at the proposed drainage channel outlet, 500 feet north of the outlet and 500 feet south of the outlet.
2. Stations 4 and 5 are nearshore samples taken immediately west and 500 feet west of the existing eastern drainage channel which empties on the south shore near Barbers Point.
3. Samples were collected on 5/21/90 from the seaward edge of the marine bench.

Source: AECOS, Inc. (1990)

Comparing the results presented in Table 1, the coastal water off the existing eastern drainage channel is characterized as higher in turbidity, higher nitrate plus nitrite (NO2 + NO3) nitrogen, and higher chlorophyll a value than the waters off the project site.

The geometric mean for each parameter, derived from the results at stations 1 to 3 of Table 1, is summarized in Table 2. The geometric mean of the turbidity value, 1.24 NTU, is somewhat consistent with historical data (see Tables 4 and 5 of Appendix B) for the same area. Bienfang and Brock (1980) reported lower turbidity values ranging from 0.17 to 0.6 NTU for the waters north of Barbers Point Harbor.

The geometric mean of chlorophyll a value, 0.49 micrograms per liter (ug/l), for the coastal waters off the project site is slightly lower than historical data for the Barbers Point coastal zone after construction of the deep draft harbor in 1985 (Appendix B). Bienfang and Brock (1980) reported values ranging from 0.11 to 0.31 ug/L from waters north of Barbers Point Harbor, with higher values occurring near shore.

Higher nitrate plus nitrite (0.006 to 0.026 ppm) and ammonia (0.002 to 0.017 ppm) values were measured by Bienfang and Brock (1980), considering only nearshore samples, at waters north of Barbers Point Harbor.

The geometric mean of total nitrogen, ammonia, chlorophyll a, and turbidity for waters off the project site exceeds the water quality criteria established by the State Department of Health (see Table 2). Historical data also indicate the same parameters tend to exceed their respective water quality criteria. However, the water quality criteria is intended to compare the geometric mean of many samples taken at different times of the day, under varying tidal conditions and rainfall events. The value compared to the water quality criteria in this case is the geometric mean of single samples taken on the same day at three different locations. The relationship of the existing water quality and the state water quality standards can only be inferred due to the spatial, not temporal, data.

TABLE 2

COASTAL WATER QUALITY AT THE PROJECT SITE IN COMPARISON TO STATE WATER QUALITY CRITERIA

Water Quality Parameter	Site Geometric	Mean Not To Exceed	10% Not To Exceed	2% Not To Exceed
Total Nitrogen (mg N/L)	0.240	**0.110**	**0.180**	**0.250**
Ammonia Nitrogen (mg NH_4-N/L)	0.004	**0.002**	**0.005**	**0.009**
Nitrate+Nitrite (mg NO_3+NO_2-N/L)	0.003	0.0035	0.010	0.020
Total Phosphorus (mg P/L)	0.01	0.016	0.030	0.045
Light Extinction Coef. (k units)	--	0.10	0.30	0.55
Chlorophyll a (ug/L)	0.49	**0.15**	**0.50**	1.00
Turbidity (ntu)	1.24	**0.20**	**0.50**	**1.00**

Notes:

1. Criteria in bold print are those exceeded by the project site values from a single sampling event at three locations.

2. Based on State of Hawaii Water Quality Standards, 1989.

Source: AECOS, Inc. (1990)

Additional site specific water quality data will be obtained as part of the process of permitting for the discharge under the new NPDES regulations covering storm drains.

H. DRAINAGE/FLOODING

The outlet of the proposed drainage channel is located in an area designated as Zone AE on the Flood Insurance Rate Map (FIRM) (see Figure 5). This zone is designated as an area inundated by the 100-year flood with a base flood elevation of eight feet above MSL. This area is also exposed to potential tsunami inundation extending up to Malakole Road.

The watershed to be served by the proposed drainage channel encompasses approximately 2400 acres and extends nearly six miles inland from the coast (see Figure 6).

Presently, runoff from the area above Interstate Route H-1 is collected by three gulches: Awanui Gulch, Palailai Gulch and an unnamed gulch. The three gulches converge at a point just mauka of the H-1 freeway. After crossing the H-1, the drainage way continues on a course parallel to the freeway for a short distance before veering makai into the proposed KBIP site and toward Malakole Road.

There are no existing drainage improvements within the KBIP site. Runoff generated on the KBIP site and from adjacent areas drains overland via sheet flow and small ditches to the depressions on the site. With the exception of major storms, very little runoff is generated under existing conditions due to the agricultural use and infiltration characteristic of the soil. Runoff from major storms flows into the depression near the Kalaeloa Boulevard/Malakole Road intersection, flooding low-lying areas. Two 36-inch pipe culverts traverse under Malakole Road to relieve ponding of runoff.

The proposed drainage channel is an extension of the drainage channel described in the KBIP EIS. The proposed channel is approximately 100 feet wide, between Malakole Road and the ocean. The project will improve the present drainage way that

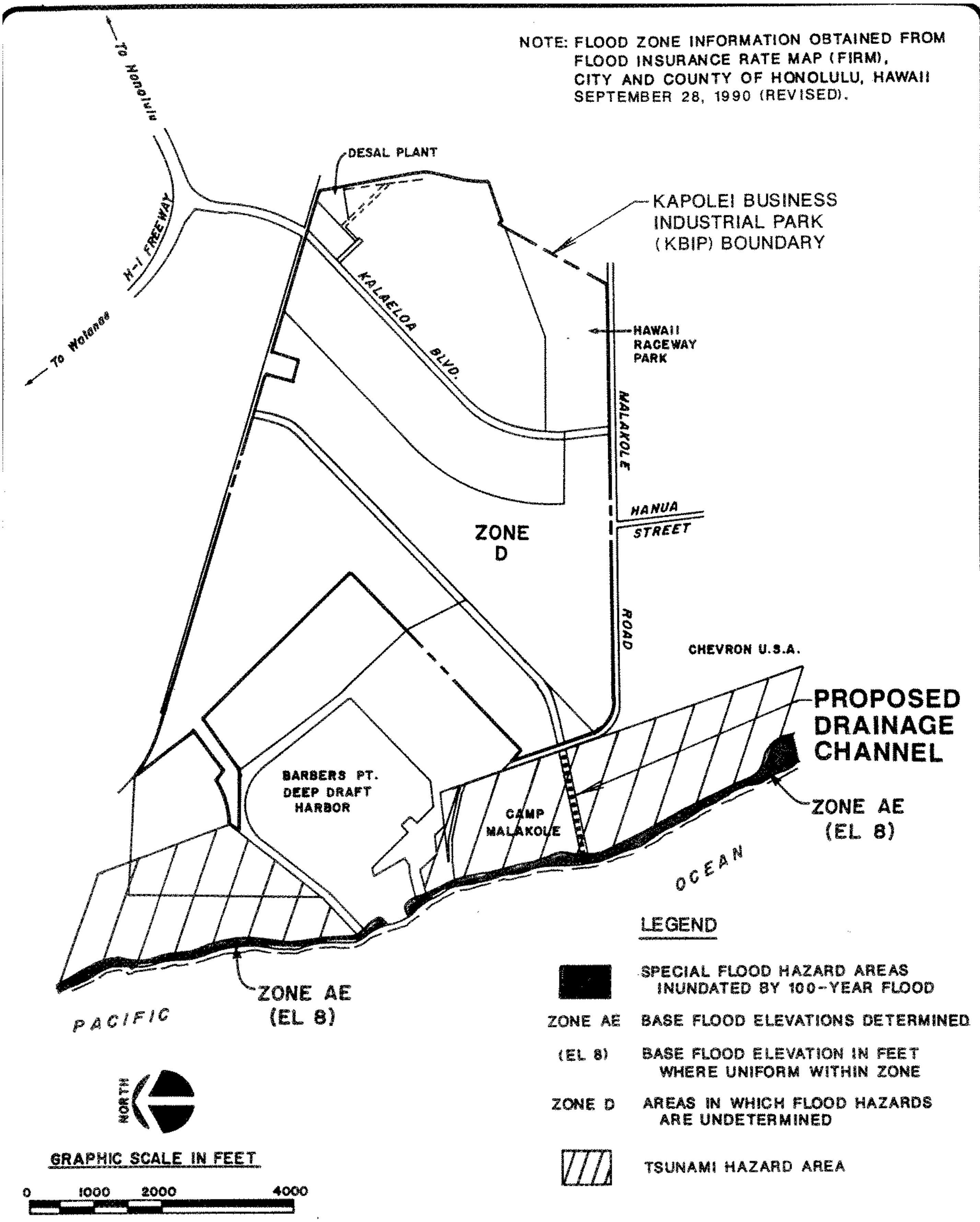

fig. 5 Flood Map

CAMPBELL DRAINAGE CHANNEL
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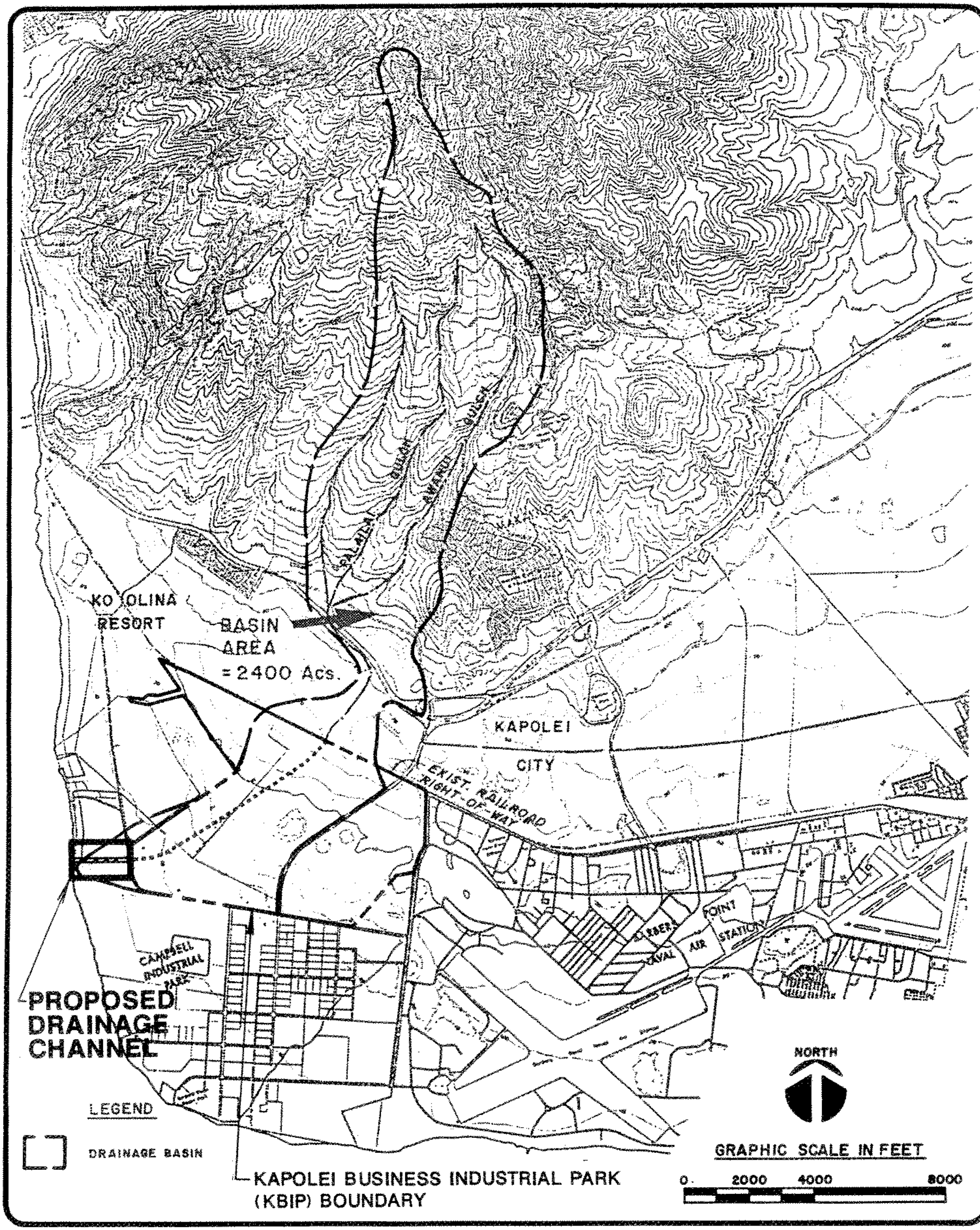

fig. 6 Watershed

CAMPBELL DRAINAGE CHANNEL
EWA, OAHU, HAWAII

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is not well defined in the vicinity of Malakole Road. At the downstream end of the drainage way near the shoreline, a man-made cut made through the limestone outcropping acts as an existing outlet to convey storm runoff to the ocean. However, several feet of sand fill the drainage way near the northwest corner of the Chevron refinery impeding the flow of storm runoff to the ocean causing runoff from major storms to pond. Also, this sandfill now causes runoff from major storms to pond in depressions near Malakole Road and Kalaeloa Boulevard.

IV. EXISTING ARCHAEOLOGICAL RESOURCES

Cultural Surveys Hawaii (1990) conducted an archaeological reconnaissance for the portion of the proposed drainage channel located between Malakole Road and the shoreline (Appendix D). No archaeological remains were found within the project site during the reconnaissance survey. However, the potential for archaeological resources exists and can best be explained by describing the findings in adjacent properties.

The Camp Malakole site located just north of the proposed drainage channel and west of Malakole Road (see Figure 1) contains historical remains of the former camp structures and sinkholes in the limestone bedrock.

Ten to fifteen sinkholes were found, situated near the southwest corner of the Camp Malakole parcel. A majority of the sinkholes were filled with rocks and chunks of old mortar from a brick wall. Two sinkholes were already excavated by others and one of these was marked with an aluminum tag "52". Aluminum tags marked "54" and "SH-53" were found on the two other sinkholes in the field.

The sinkholes were apparently the subject of a previous reconnaissance conducted by Paul Rosendahl (1988). Rosendahl concluded that those sinkholes bear no significant paleontological remains.

The Camp Malakole property has about 1,853 feet of beach frontage extending from the existing Chevron refinery at the south end to the Barbers Point deep draft harbor at the north end. Along the shoreline, a ridge composed of beach sand, overlain by aeolean dune sand, extends the entire length of the Camp Malakole property. This feature is considerably larger and less disturbed at the north end. Although, this beach berm is less prominent and heavily disturbed at the south end, in the vicinity of the proposed drainage channel, the potential for subsurface cultural layers is still present.

V. EXISTING RECREATIONAL RESOURCES

The State Recreation Plan (September, 1980) indicated that the recreational use intensity of the beach area extending north from Barbers Point Harbor to Maipalaoa Beach Park is high. In contrast, the south shoreline recreational use intensity of the area extending south from Barbers Point Harbor to Barbers Point Coast Guard Station, including the area of the drainage channel outlet, is only medium to moderate. This is probably attributable to the rocky nature of the shoreline in the southern sector of the coast which makes this stretch unattractive for swimming.

Fishing activity is light to moderate along most of the coast, except near the entrance channel at Barbers Point Harbor where fishing is relatively heavy (AECOS, 1979). Coastal recreational opportunities in the vicinity of the proposed drainage channel may be limited, due to the strong currents along this coastline as described in Section III. Also, since open flames are prohibited near the Chevron refinery, picnicking activities may also be limited.

Spear fishing and net fishing are infrequent in these waters. Certain offshore areas are noted for its fishing, commercial trapping for lobsters, diving for octopus and collecting shells.

Public access to the shoreline area can be made through the existing drainageway located along the project site, which is presently open space. However, access is difficult during the winter months and after periods of rainfall due to wet and muddy ground conditions.

VI. EXISTING BIOLOGICAL RESOURCES

A. FLORA

Char & Associates (1989) surveyed the vegetation in the general area of the proposed project. The report is attached as Appendix E and is summarized below.

An open kiawe forest borders the north side of the proposed drainage channel, while the ground cover is dominated by tangled mats of pickleweed (Batis maitima). Pickleweed is a salt water tolerant plant and is found in areas that are subjected to periodic inundation by sea water and in areas where salinity of the soil is high. Three species of Pluchea shrubs, three to six feet high, are common along the project area. 'Akulikuli (Sesuvium portulacastrum) and swollen finger grass (Cloris barbata) are abundant. Besides the 'akulikuli, other native plants found along the project site include kipukai (Heliotropium curassavicum), 'ilima (Sida fallax), and a few shrubs of false sandalwood or naio (Myoporum sandwicense).

No officially listed threatened or endangered plants occur along the proposed drainage channel alignment. Achyranthes rotundata, an officially listed endangered species, has been found on the adjacent Camp Malakole property; however, it does not occur on or near the channel site. Achyranthes is found in exposed coralline substrate. The wet, highly saline soil around the channel site would not provide suitable habitat for the Achyranthes.

B. FAUNA

Phillip L. Bruner conducted an Avifauna and Feral Mammal Survey along the proposed drainage channel site in July and August 1989. The report is attached as Appendix F and is summarized below.

No endemic (native only to the Hawaiian Islands) land birds were recorded during the course of the field survey. The only likely endemic species which might occasionally forage the area are the Hawaiian Owl or Pueo (Asio flammeus sandwichensis) and the Hawaiian Stilt (Himantopus mexicanus knudseni). Fossil evidence recovered from the sink-holes located on the makai portion of the neighboring KBIP property may be an indication that a variety of endemic birds may have inhabited the area in the past.

No resident indigenous birds (native to the islands and also to one or more geographic area(s)) were recorded. The only potential species is the Black-crowned Night Heron (Nycticorax nycticorax). This species is opportunistic and may forage in flooded ditches and other temporary wet areas when such are available on the property. No resident indigenous seabirds were found during the survey and it is unlikely any would nest at this site due to an abundance of predators. Seabirds such as the Great Frigate (Fregata minor) may be seen overhead.

A total of ten Pacific Golden Plover (Pluvialis fulva) were recorded on the final day of the survey. No other species of migratory shorebird was found. Plovers are probably the most common migratory species in Hawaii. They prefer open areas such as mud flats, fields and lawns. The only other likely migratory species that may occur on the property is the Ruddy Turnstone (Arenaria interpres).

A total of seventeen species of exotic (introduced) birds were found during this field survey. The most abundant species were Zebra Dove (Geoelie striata), Red-vented Bulbul (Pycnonotus cafer), Japanese White-eye Mannikin (Lonchura punctulata). Exotic species not recorded on the actual survey but which potentially could occur at this locality include: Japanese Bushwarble (Cettia diphone) and Ring-necked Pheasant (Phasianus colchicus). The habitat is probably too dry for the White-rumped Shama (Copsychus malabricis) and too open for the Melodious Laughing-thrush (Garrulax canorus).

The only feral mammals observed during the survey were cats and Small Indian Mongoose (Herpestes auropunctatus). Without a trapping program, it is difficult to conclude much about relative abundance of rats, mice, cats and mongooses at this site. It is likely, however, that their numbers are typical of what one would find elsewhere in a similar habitat on Oahu.

C. MARINE BIOLOGY

On May 14, 1990, AECOS conducted a survey of marine life present in the coastal waters off of the outlet of the proposed channel. The studied area and reference to previous surveys extended from the shore and intertidal area to the offshore area to depths over 50 feet. The results of the survey are summarized below:

Shore and Intertidal Areas: Along the entire coast from Kahe Point to Barbers Point Beach Park, erosion along the emergent reef that comprises the Ewa Plain has formed a marine bench. This bench varies considerably in form from place to place, but its essential feature is a leveled surface of variable width positioned near mean sea level on which grows a diverse assemblage of algae. Algal species are often arranged in distinct bands parallel to the shoreline depending on such physical factors as width and slope of the bench surface, elevation of the surface relative to tide factors, and exposure to wave energies.

Along the inner part of the bench, near the shoreline, a small subtidal inlet extends inward across the bench providing habitat for small tide pool and juvenile reef fish. Two damsel fishes (kupipi--Abudefduf sordidus and Chromis ovalis) are common. The most conspicuous algal growth in this area is Padina japonica.

Along the outer part of the bench where wave wash is constant, there is a band of Sargassum, limu kohu (Asparagopsis taxiformis) and Pterocladia arranged consecutively toward the edge of the bench. The Pterocladia and a colorful variety of calcarious species (Corallina, Porolithon, and Amphiroa) and deep green Dictyosphaeria versluysi extend down the vertical face of the outer edge of the bench.

Near Shore Subtidal Zone: Directly offshore of the project area, the bottom is an irregular surface of projecting limestone pinnacles separated by grooves and holes. The bottom drops away to depths between six and eight feet fairly quickly off the bench, then descends more gradually to depths of nine to ten feet. Within the area closest to shore, the coastline receives the full force of the waves. AECOS reported no observations were possible due to the rough wave condition.

Low Relief Limestone Bottom: Between depths of 6 to 20 feet, species of sea urchin that bore into calcium carbonate surfaces and occupy depressions within the reef platform are very abundant (Echinometra mathaei and E. oblonga). Coral growth reaches 20 percent cover with Porites lobata, Montipora patula, Pocillopora meandrina, Montipora verrucosa and Leptastrea all present. A variety of macrothallic algae, including Asparagopisis taxiformis, Hydrolython neinboldi, Amansia glomerata, Neomeris annulata, Halimeda opuntia, and Mertensia are also present.

High Relief Limestone: Another survey conducted in 1985 by AECOS, Inc., reported a relatively high coral coverage of 34 percent, approximately 1300 feet offshore of the project site, at a depth of 30 feet. The bottom consists of limestone with scattered Porites compressa mounds and Porites lobata heads to 6 feet in diameter. Six coral species were recorded. A total of 24 fishes were encountered in the fish transect area.

Deep Offshore Sand and Rubble Bottom: Seaward of about the 40 to 50 foot isobaths, the ocean floor descends gradually and consists of featureless sand and rubble. There are a few areas of large boulders, up to 6 feet in diameter. The overall substratum is 60 to 70 percent sand and vertical relief is very low.

Coral cover is very low, about 0.1 percent near the edges of rubble areas and 2 to 15 percent in the center of these patches. Porites lobata dominates and is characterized by small colony size.

Numerous commercially imported fishes were seen at a depth of 52 feet, including uku (Aprion virescens), kea (Parupeneus chryserydros), papio (Gnathanodon speciosus, Caranx melampygus), opelu (Decapterus pinnulatus), uhu (Scarus perspicilatus) and weke (Mulloidichthys flavolineatus) (Bienfang and Brock, 1980).

VII. POTENTIAL LONG TERM IMPACTS AND MITIGATING MEASURES

A. WATER QUALITY

Storm Water Runoff: Receiving water quality may be potentially impacted by the quality of the storm water runoff. Until the drainage channel is constructed, actual runoff quantity and quality are not measurable. However, runoff quantities can be predicted using hydrological formulas; the quality of storm water runoff generated in this drainage area can be compared to literature values for urban areas; and the impact of runoff on receiving waters can be simulated by computer models.

Runoff Quantity: In an attempt to quantify storm water runoff relative to various rainfall intensities for the specified drainage area, a flood hydrograph was developed using the United States Soil Conservation Services computer program entitled "TR-20 Project Formulation Hydrology." The program estimated runoff quantities for the developed watershed using the Rational Formula where:

$Q = CIA$, Q = discharge (cfs)

I = rainfall intensity (in/hr)

A = area (acres)

In general, runoff from a watershed area depends on the intensity of rainfall, duration of rainfall, antecedent moisture conditions of soil, extent of the watershed contributing to runoff, infiltration/percolation characteristics and any other mechanical/hydrometeorological factors peculiar to the watershed (slope, land treatment, etc.). For the purpose of predicting the future runoff from this drainage area, appropriate parameters based on the drainage subarea size, land uses, soil types, and other factors critical to estimating the runoff potential for a given rainfall were identified.

The resulting runoff volumes and flow rates for a series of rainfall intensities are summarized in Table 3. These results are considered conservative since a rainfall duration of 6 hours was used in deriving the runoff values. The analysis indicates that runoff will be discharged from the proposed drainage channel if rainfall exceeds 0.10 inch per day. The relationship between daily rainfall and the runoff volume generated by the rainfall is graphically presented in Figure 7.

Analysis of runoff volume and its relationship to rainfall frequency was performed. Daily rainfall and the frequency at which it occurs was analyzed, based on 57 years of historical daily rainfall records published by the National Oceanic and Atmospheric Administration (NOAA), spanning from 1905 to 1987 (non-consecutive years). The frequency for a range of rainfall intensities was determined. Based on this analysis, rainfall producing runoff (greater than 0.10 inch per day) is likely to occur 4.7 percent of the time (17 days per year). The relationship between the critical rainfall and the percentage of time rainfall less than critical rainfall is likely to occur over an unspecific time period is reflected in the graph in Figure 8.

Runoff Quality: Assessing whether the proposed drainage will or will not meet water quality standards is far more complex than simply comparing probable concentrations of constituents in the drainage effluent with appropriate water quality criteria. Most properties of the discharge water will not be within acceptable ranges for marine water quality criteria. The result of the discharge of this terrestrial runoff water will impact

TABLE 3
RAINFALL AND ASSOCIATED RUNOFF CALCULATIONS

Rainfall (IN./DAY)	Percent of time less rainfall will occur [a]	RUNOFF VOLUME @ DISCHARGE POINT (ACRE-FT)	RUNOFF VOLUME @ DISCHARGE POINT (CF X 1000)	PEAK RUNOFF (CFS)
O/T[b]	83.7	0	0	0
< 0.10	93.1	0	0	0.8
0.11 - 0.20	95.3	2	97	9.6
0.21 - 0.30	96.2	9	389	31
0.31 - 0.40	96.9	16	681	63
0.41 - 0.50	97.4			
0.51 - 0.60	97.7	36	1,548	151
0.61 - 0.70	97.9			
0.71 - 0.80	98.1	63	2,726	258
0.81 - 0.90	98.3			
0.91 - 1.00	98.5	94	4,088	385
> 1.00 - 1.20	98.7	125	5,451	546
> 1.20 - 1.50	99.0	179	7,787	842
> 1.50 - 2.50	99.5	373	16,255	2,165
> 2.50 - 3.50	99.8	579	25,210	3,522
> 3.50 - 4.50	99.9	793	34,554	4,862
> 4.50 - 6.50	99.9	1,227	53,438	7,573
> 6.50	100.0	-	-	-

a Source: National Oceanic and Atmospheric Administration (NOAA), 1905 to 1987. Fifty seven non-consecutive years of daily rainfall readings from US Magnetic Observatory station 702, Hokuloa station 725.2 and Campbell Industrial Park station 702.5.

b O/T = no rainfall/trace rainfall

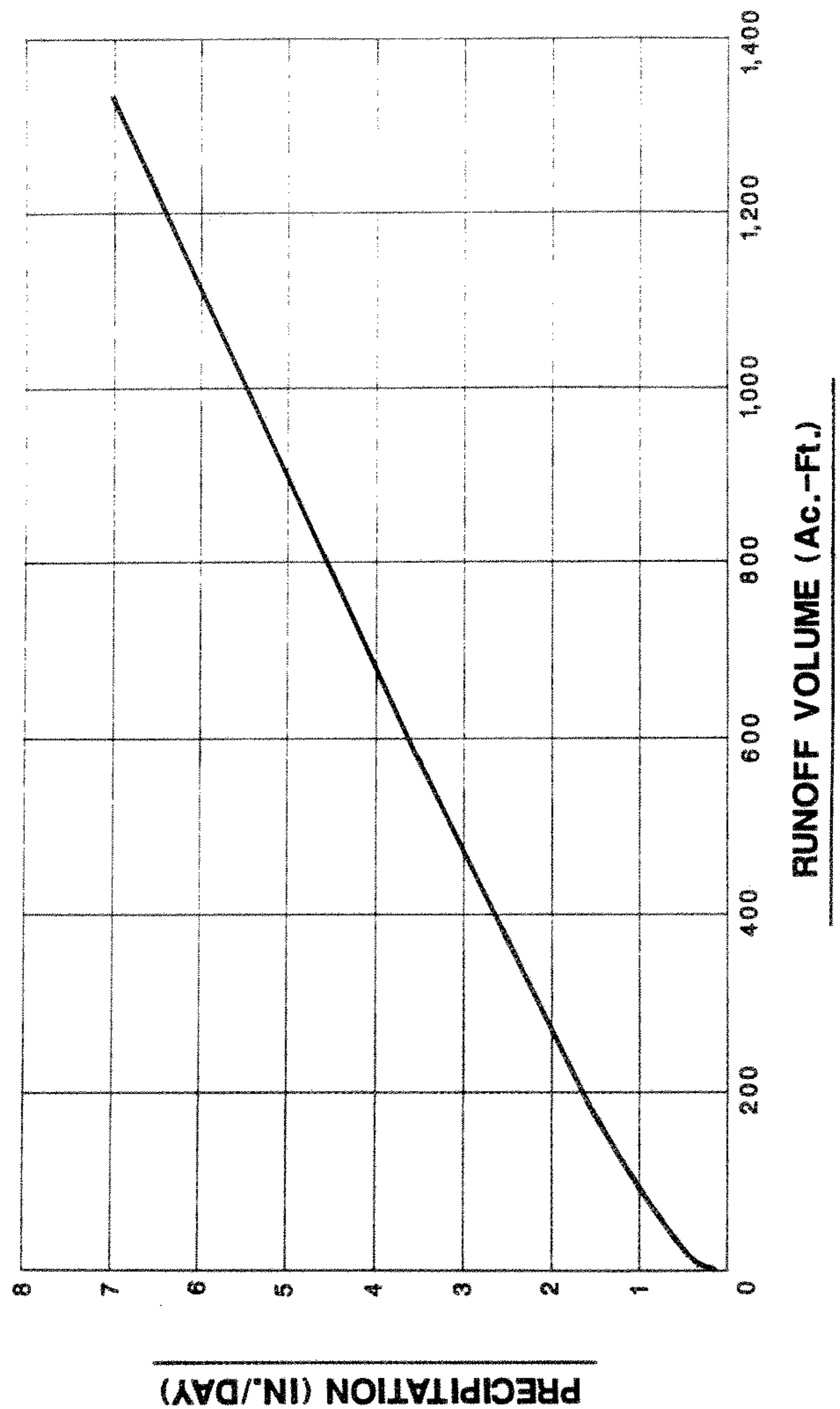

fig. 7 Precipitation vs. Runoff

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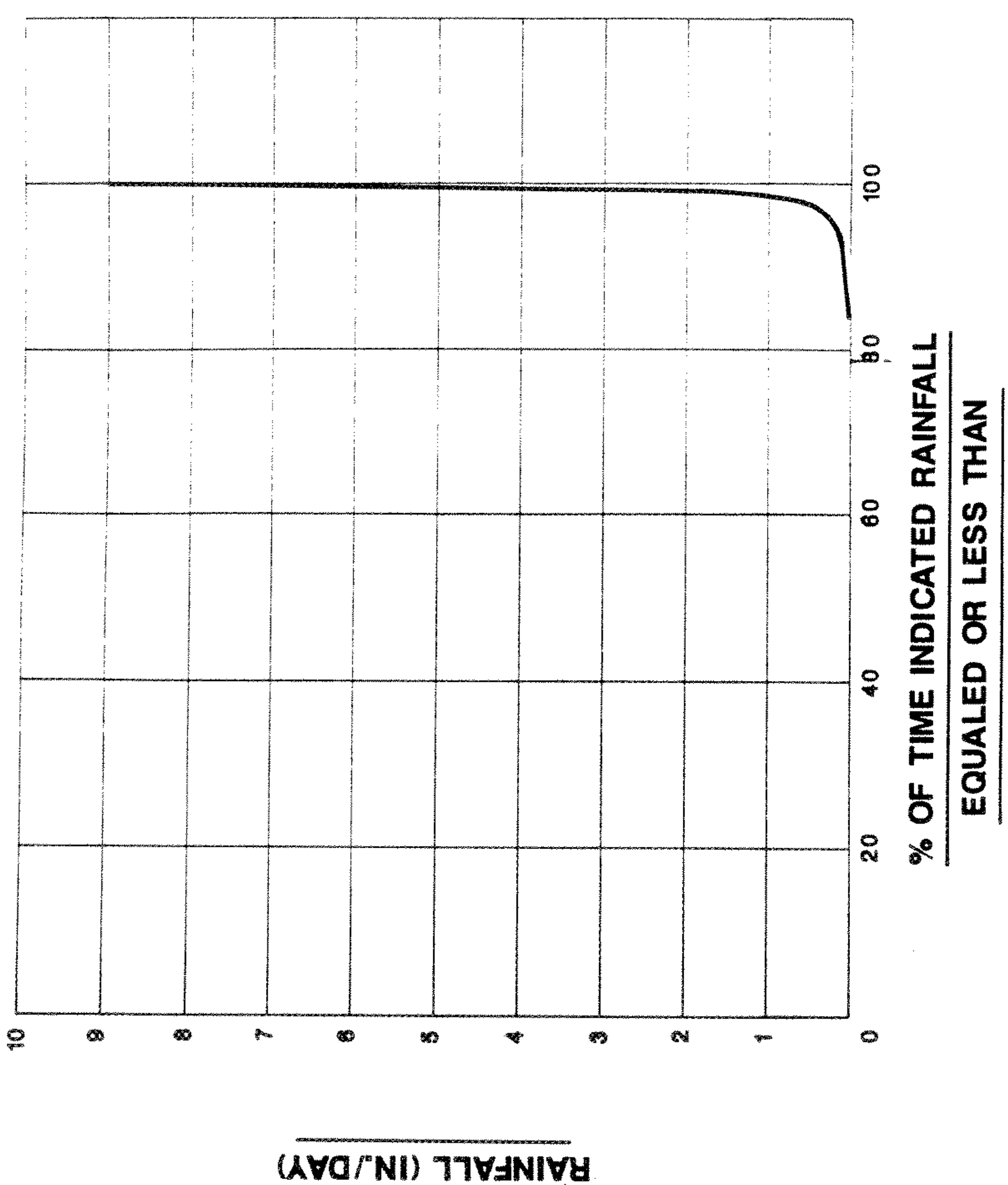

fig. 8 Rainfall Frequency Data

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the nearshore water quality over an area and for a period of time that will depend upon the volume and the duration of discharge. These factors will depend upon the nature of the storm(s) generating the discharge.

The discharge process has been modeled for the proposed outlet in Appendix C assuming various storm intensities. In order to predict whether the discharge from the proposed outlet will violate any of the water quality criteria, the duration at any given location is more important than the distribution of concentrations of non-toxic substances. The water quality criteria require establishing the probability of occurrence of certain concentrations. For example, the turbidity of the near shore water will exceed the criterion of 1.0 ntu following a storm discharge. So long as this turbidity is not exceeded more than 2 percent of the time (one week per year), the criterion is not violated.

Water sample analysis for this project and historical data indicate total nitrogen, ammonia nitrogen, chlorophyll a, and turbidity in the existing coastal waters may exceed the water quality criteria established by DOH. It is conceivable that any amount of runoff discharged into the ocean will potentially exceed the state water quality criteria at the point of discharge over a short term period.

Based on the historical rainfall data summarized in Table 3, it is probable that rainfall producing runoff is likely to occur about 5 percent of the time. Consequently, the receiving water over some minimal area, will potentially exceed the state standards. In an attempt to improve and prevent further degradation to the existing coastal water quality, mitigation measures to reduce potential sediment loads and potential urban pollutants in the runoff are necessary. These mitigation measures are discussed below.

Suspended Sediment: The existing coastal water condition may be attributed to the long term effects of erosion since the majority of the drainage area is presently undeveloped. The sediment load is expected to decrease substantially after the watershed is developed, due to replacement of erodible surfaces with pavement and other impermeable surfaces. Studies (see Appendix B) have indicated that the sediment load is measurably low in developed watersheds in comparison to watersheds with broad areas of exposed soils.

The most significant source of suspended material of potential harm to the marine environment is likely to originate in the gulches draining into the system from the Waianae Range, mauka of the H-1 freeway. As a mitigative measure, the proposed Makaiwa Hills development mauka of the freeway has proposed to incorporate detention basins to dampen the effects of storm runoff from these gulches. By detaining storm runoff, the basins will also promote sedimentation and are expected to alleviate a significant amount of the sediment load which would have ultimately been deposited into the ocean.

Construction of sediment traps within the drainage channel will also be considered providing the City and County Department of Public Works accepts the maintenance responsibilities. The number of sediment traps, location, size, and design will be coordinated with the Department of Public Works.

Urban Pollutants: The chronic impacts on marine reef environments by the many substances contributed by urban runoff are not at all understood. Certainly a variety of potentially harmful pollutants may find their way into the new channel as the watershed becomes urbanized. The long-term effects of these chemicals on extant marine resources cannot be predicted in any rational way. An observed decline in resources following urbanization in other parts of the island may as easily be attributed to other factors (increased fishing pressure and human activities in general) as to a general rise in streamborne and storm water runoff pollutants.

Assessing impacts of storm water contaminants is complicated by the manner in which constituents are delivered to the receiving water. The discharge of water from a storm drainage system is an intermittent occurrence. In many parts of Hawaii the relatively frequent, short-duration, and high intensity rain storms reduce the accumulation of contaminants on streets and other impermeable surfaces (DOH, 1980). Under these conditions, the concentrations of contaminants in the discharge, particularly any constituents which show a pattern of decreasing concentration with increasing storm duration, should be relatively low.

Pollutant loadings (the total amount of a substance delivered into the receiving waters over a period of time) may not be related to rainfall frequency, only the amount that is delivered with each storm. Fujiwara (1973) has suggested that the actual intermittent impact upon receiving waters is far more critical than the total loading. Certainly, for many of the potentially toxic substances that could be found in storm-water runoff, the peaks in concentration may be more significant for a receiving water such as the coastal environment off Barbers Point because the potential for accumulation in the nearshore environment is not great. Studies have shown that the more toxic compounds associated with urban street runoff are associated with the fine solids fraction (Sartor and Boyd, 1972), which will enjoy greater dilution and dispersion upon discharge from the channel. Sediment traps within the channel are not expected to remove this fine solids fraction.

The Campbell Industrial Park area is typified by infrequent rains; therefore significant time periods for accumulation of contaminants on impermeable surfaces will occur. Mitigation of potential pollution impacts can possibly be achieved by street cleaning and maintenance.

Recognizing that runoff from certain urban and industrial areas can produce significant pollutant loadings into the nation's aquatic environments has prompted the Environmental Protection Agency to promulgate regulations governing storm water discharges under the NPDES program (55 FR 47990 et seq; 56 FR 12098 et seq). The new regulations are to be implemented in 1991/1992. The proposed drainage channel will service an area with facilities that fit the definition of industrial activity and therefore require facility permits. Permits will have to be obtained by each industrial facility that contributes runoff to the channel. However, wholesale, retail, service, and commercial operations are excluded from the facility permit requirements. Upon dedication and acceptance by the City and County Department of Public Works, the channel will presumably come under the program for municipal storm sewers, requiring the filing of a permit application and development of a variety of programs to control the discharge of pollutants into the channel.

Requirements under the permits issued will focus on "pollution prevention measures" rather than "end-of-pipe" technological controls (McCubbin, Becker, and Hill, 1991). EPA will use the application process to determine what control and pollution prevention measures are currently used by industries, and later incorporate the successful techniques into permits.

Filing requirements are detailed and include site drainage mapping, listing of significant materials used or stored on the site, control measures used to reduce pollutants in runoff, and testing of the discharge. Samples must be collected from the discharge resulting from a storm event that is greater than 0.1 inch. Further, the sampled event must occur at least 72 hours after a previously measurable storm event of more than 0.1 inch of rainfall. Analytical testing requirements include (1) any pollutant limited in an effluent guideline to which the facility is subject; (2) any pollutant listed in a facility's NPDES permit for process wastewater; (3) all of the following: oil & grease, pH, BOD_5, COD, NFR, total phosphorus, TKN, and nitrate plus nitrite nitrogen, and (4) any toxic that the applicant knows or has reason to believe may be present at the facility or may have been present in the past (Tarbert, 1991).

Implementation of the new regulations is expected to begin the process of bringing under control discharges into streams or the ocean from drainage systems that are typically intermittent and represent non-point sources of pollution. Application of the State of Hawaii water quality standards (which are based on averaged values over unspecified time periods) has been difficult in such cases because of the intermittent nature of the discharge.

Storm Water Discharge "Plume" Analysis: Salinity depression, siltation and turbidity are potential effects on the quality of nearshore waters resulting from storm water runoff into the ocean at the channel outlet. In order to evaluate these impacts, a numerical modeling for various discharge flows was performed by Edward K. Noda and Associates (1990). Details of the model and results are attached as Appendix C and summarized below.

Near-Field Plume Model: The Prych-Davis-Shirazi (PDS) model was used to best characterize the plume in the near-shore region, which extends from the channel outlet to 3200 feet from the shoreline. The model analyzed the physical characteristics of the "mixing plume", i.e. the interaction of the storm water discharge and the ocean receiving waters. Factors used in developing the model included characteristics of the ambient receiving waters and the storm water discharge, and the configuration of the channel outlet. Available data on ambient near-field ocean conditions as used in the model are an average temperature of 24 degrees Celsius, a salinity of 34.6 parts per thousand (o/oo) and current speed of 1.31 feet per second (fps). The storm water runoff characteristics for the extremes of a 1-year and 100-year recurrence interval storm are shown in Table 4. Predicted characteristics of the near-field plume for four different conditions of zero current speed (worst condition) and ambient current speed (normal conditions) are listed in Table 5.

In addition to suspended sediment concentrations, the model also evaluated salinity concentrations in the discharge plume. Corals are salinity-sensitive with salinity values below 21 to 23 o/oo being harmful. A salinity depression to 22.5 o/oo, a level which is 65 percent of ambient salinity, is considered the limit below which the reduced salinity may be potentially harmful to benthic organisms. Table 6 summarizes the effect on salinity as the stormwater discharge mixes nearshore in the ocean. The degree to which salinity is reduced is largely dependent on the rate of

TABLE 4
STORMWATER FLOW CHARACTERISTICS AND PDS MODEL INPUT

Description	Case 1 (1A)	Case 2 (2A)	Case 3 (3A)	Case 4 (4A)
STORM CHARACTERISTICS				
Storm Recurrence Interval (yr)	100	100	1	1
Rainfall Duration (hrs)	24	1	24	1
Time To Peak Runoff (hrs)	9.69	1.21	9.93	1.38
Total Runoff Duration (hrs)	27.70	4.80	27.60	4.95
Total Runoff Volume (acre-ft)	2,484	413	327	93
Peak Runoff (cfs)	5,956	5,200	1,285	868
Total Sediment Yield (tons)	7,577	2,571	1,034	409
Total Sediment Concentration (lbs/cf)[1]	0.17	0.35	0.18	0.24
PDS MODEL INPUT VARIABLES				
Exit Channel Width (ft)	107.8	107.8	107.6	107.5
Exit Channel Water Depth (ft)	7.37	7.09	6.22	6.19
Exit Ave. Flow Velocity (ft/sec)	7.50	6.81	1.92	1.30
Discharge Angle (degrees)	90	90	90	90
Ambient Current Velocity (ft/sec)[2]	0 (1.31)	0 (1.31)	0 (1.31)	0 (1.31)
Suspended Sediment Concentration (lbs/cf)[3]	0.14	0.29	0.20	0.14
Ambient Water Temperature (degrees C)[4]	24	24	24	24
Ambient Water Salinity (o/oo)	35.1	35.1	35.1	35.1

Notes:
1. Total Sediment Concentration = (Total Sediment Yield) / (Total Runoff Volume).
2. Ambient Velocity = 0 for Cases 1, 2, 3 & 4.
   Ambient Velocity = 1.31 fps for Cases 1A, 2A, 3A and 4A.
3. Suspended Sediment Concentration = 84% of Total Sediment Concentration.
4. Ambient Water conditions represent winter season conditions.

Source: Edward K. Noda & Associates, Inc. (1990)

TABLE 5
NEAR-FIELD PLUME SOLUTIONS FOR THE CASES SHOWN IN TABLE 3

PLUME CHARACTERISTICS	Case 1	Case 1A	Case 2	Case 2A	Case 3	Case 3A	Case 4	Case 4A
At Maximum Plume Depth:								
Maximum Depth (ft)	15.4	14.1	47.7	33.0	7.5	6.3	9.2	6.5
Y-Distance (ft)	478	391	1,814	1,005	411	423	628	157
X-Distance (ft)	0	121	0	1,661	0	747	0	309
Plume Width (ft)	528	437	1,558	804	553	472	675	261
Average Dilution	3.50	3.37	10.72	11.30	2.43	4.22	2.95	3.63
Average Suspended Sediment								
Concentration (lbs/cf)	0.044	0.045	0.029	0.028	0.091	0.052	0.054	0.044
Concentration (ppm)	264	273	176	167	550	317	324	263
Excess Speed (ft/sec)	3.27	2.95	0.96	0.27	0.96	-0.17	0.52	-0.16
Time (minutes)	1.7	1.4	19.4	17.4	5.0	11.8	13.5	4.9
At 3,200 ft Travel Distance:								
Plume Depth (ft)	13.4	12.2	45.5	36.5	5.3	11.9	7.0	15.3
Y-Distance (ft)	3,200	2,135	3,200	1,284	3,200	724	3,200	391
X-Distance (ft)	0	2,240	0	2.740	0	3,051	0	3,133
Plume Width (ft)	2,349	1,481	2,664	1,020	2,043	815	2,087	572
Average Dilution	5.20	6.89	13.04	15.32	3.24	14.80	3.76	20.31
Average Suspended Sediment								
Concentration (lbs/cf)	0.029	0.022	0.024	0.020	0.068	0.015	0.042	0.0078
Concentration (ppm)	178	134	145	123	413	90	254	47
Excess Speed (ft/sec)	1.26	0.57	0.71	0.15	0.49	-0.12	0.28	-0.07
Time (minutes)	29.2	23.0	47.9	29.8	84.5	46.1	137.3	44.7

Note:
Case 1 and 1A: 100 Yr Frequency, 24 hr Rainfall Duration, 0 and 1.31 fps current.
Case 2 and 2A: 100 Yr Frequency, 1 hr Rainfall Duration, 0 and 1.31 fps current.
Case 3 and 3A: 1 Yr Frequency, 24 hr Rainfall Duration, 0 and 1.31 fps current.
Case 4 and 4A: 1 Yr Frequency, 1 hr Rainfall Duration, 0 and 1.31 fps current.
ppm = parts per million

Source: Edward K. Noda & Associates, Inc. (1990)

TABLE 6
DISTANCE FROM THE SHORELINE DISCHARGE LOCATION ALONG THE PLUME CENTERLINE, S, FOR A GIVEN SALINITY CONTOUR VALUE

Case No.	Salinity: 20 o/oo S (ft)	22.5 o/oo S (ft)	25 o/oo S (ft)	30 o/oo S(ft)
1	166		469	>10,000
1C	165		465	>10,000
1B	165		465	4,781
1A	165		459	3,184
2	112		218	707
2C	112		218	712
2B	112		218	728
2A	112		218	811
3	270	1,344	4,664	>10,000
3C	256	697	1,810	>10,000
3B	225	537	1,352	5,240
3A	192	291	553	1,681
4	193	437	2,047	>10,000
4C	189	381	921	5,246
4B	179	285	582	2,034
4A	170	221	325	961

For n = 1, 2, 3 and 4

Case n : No Current Conditions

Case nC: 0.33 ft/sec Current Speed

Case nB: 0.65 ft/sec Current Speed

Case nA: 1.31 ft/sec Current Speed

Source: Edward K. Noda & Associates, Inc. (1990)

stormwater discharge and the speed of ocean currents. For cases 1 to 4, for both zero and ambient currents, it can be seen that the spread of the plume is greatly affected by the amount of stormwater discharged and that as current speeds increases, the plume effects are significantly dispersed; i.e., salinity recovery is closer to shore.

Graphical representations of the results of the plume calculations for cases 1 to 4, are shown in Figures 9 to 12, respectively. To account for the time element, the 1 hour and 1.5 hour dilution time contour lines are also shown.

The largest suspended sediment concentrations in the near-field are given by case 3 (1-year storm interval, 24-hour duration), Figure 11, where the suspended sediment concentrations immediately offshore of the channel outlet exceeds 400 ppm for the zero ambient current condition. As the current is imposed, the suspended sediment concentration decreases significantly, with concentrations approximately 50 to 75 ppm, at distances of about 3,000 feet from the channel outlet in the direction of current flow, towards the north. The suspended sediment concentration contour lines should be mirror imaged about the channel centerline to provide plume conditions for ambient flow towards the south.

In case 2 (100-year storm interval, 1-hour duration) Figure 10, suspended sediment concentration of about 100 to 125 ppm are predicted in the nearshore water out to about 3,000 feet down current from the channel outlet.

The salinity contours shown in Figures 9 to 12 indicate that case 3 provides the "worst case" receiving water impacts for salinities less than and equal to 25 o/oo. In general, all the cases indicate that the limiting 22.5 o/oo salinity contour extends a maximum distance of about 200 to 400 feet along on either side of the channel outlet for flood and ebb tide current flow conditions, and extends a maximum of about 1,300 feet, to a depth of 15 feet, directly offshore for the no current condition. Growth of coral in this zone may be retarded in the long term due to reduced salinity during occasions of storm runoff into the ocean from the channel.

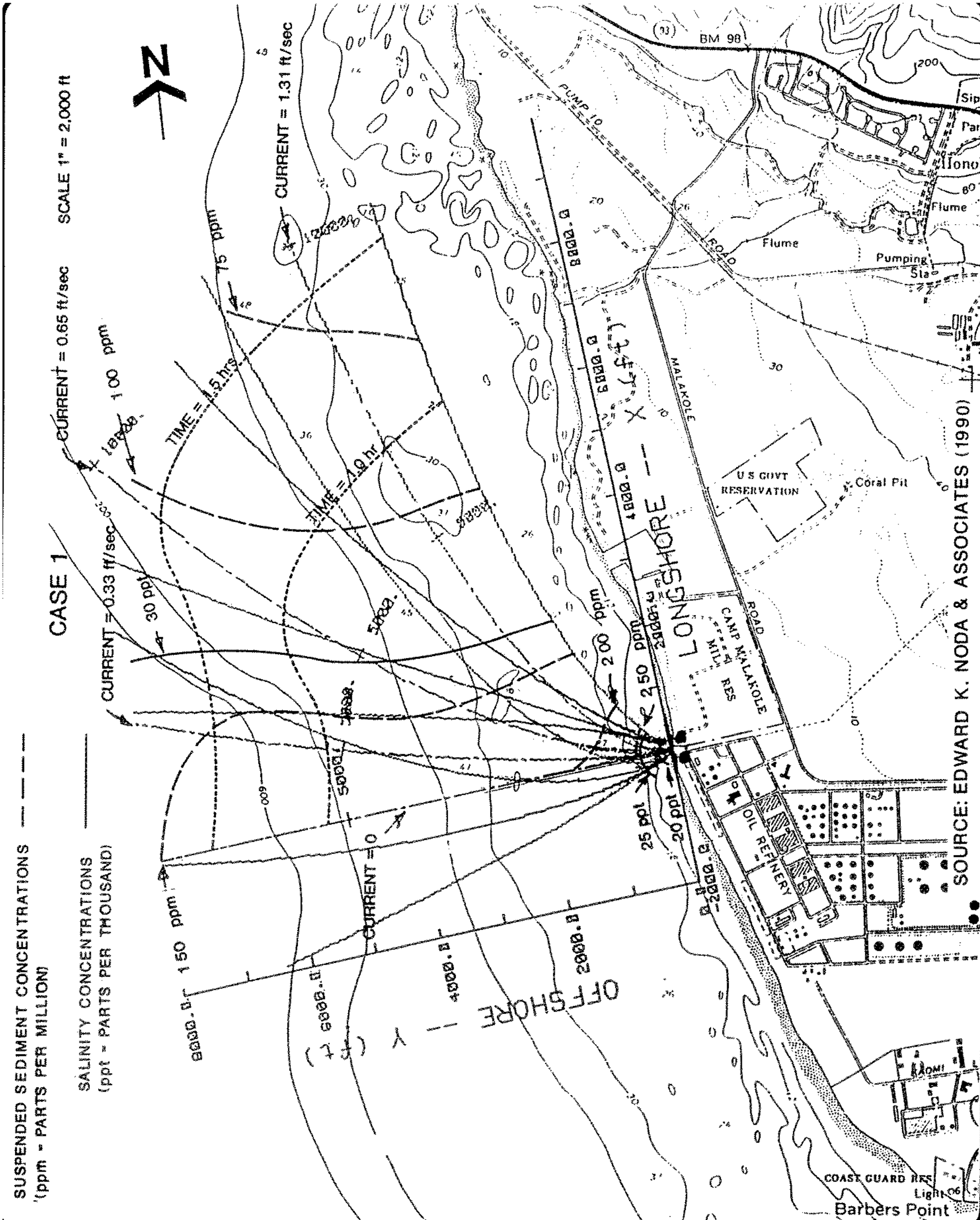


fig. 9 OVERPLOT OF PLUME PLAN VIEWS FOR AMBIENT CURRENT SPEEDS OF 0, 0.33, 0.65, AND 1.31 ft/sec. FOR CASE 1.

CAMPBELL DRAINAGE CHANNEL

EWA, OAHU, HAWAII

Prepared by: ENGINEERING CONCEPTS, INC.

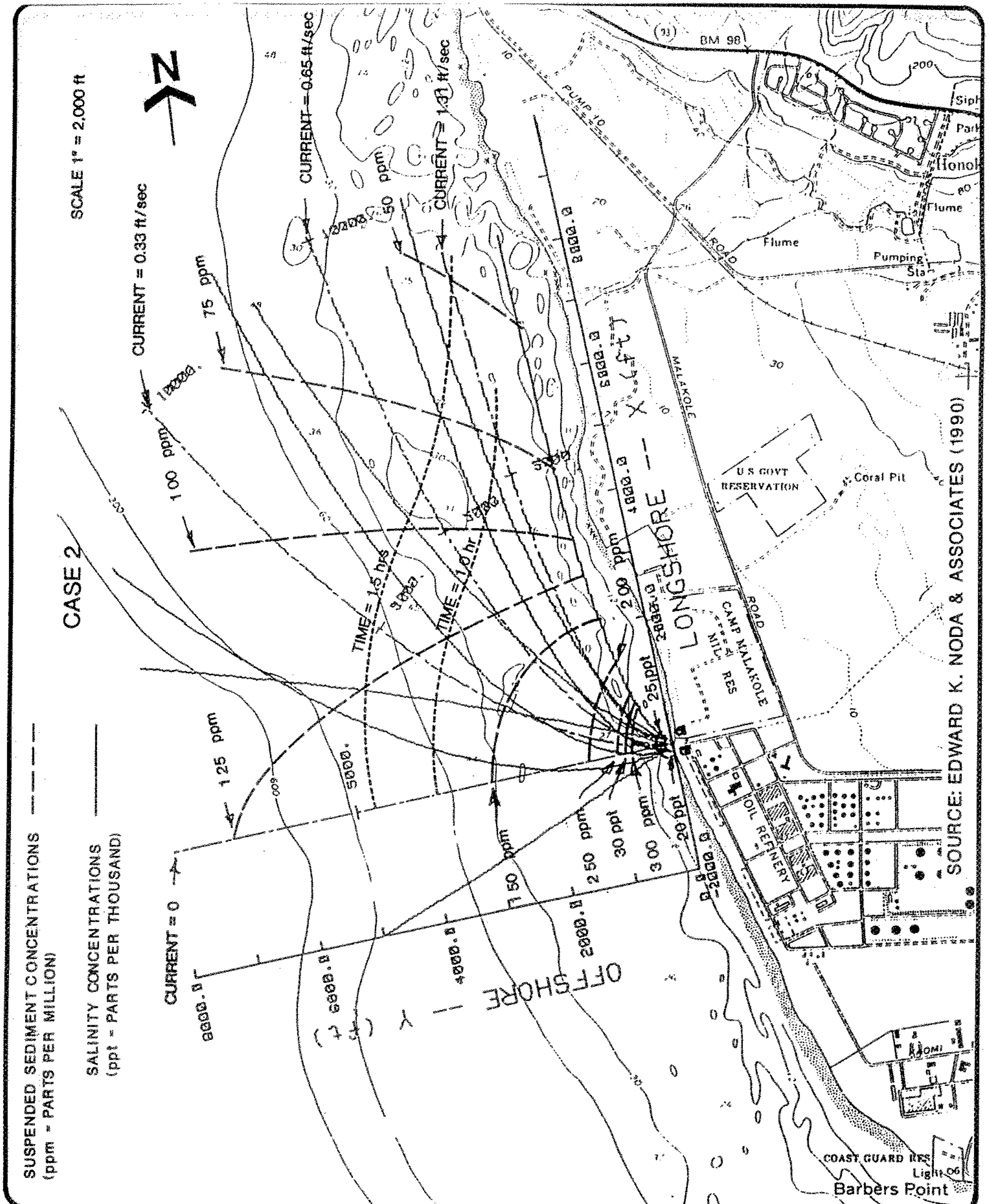


fig. 10 OVERPLOT OF PLUME PLAN VIEWS FOR AMBIENT CURRENT SPEEDS OF 0, 0.33, 0.65, AND 1.31 ft/sec. FOR CASE 2.

CAMPBELL DRAINAGE CHANNEL

EWA, OAHU, HAWAII

Prepared by: ENGINEERING CONCEPTS, INC.

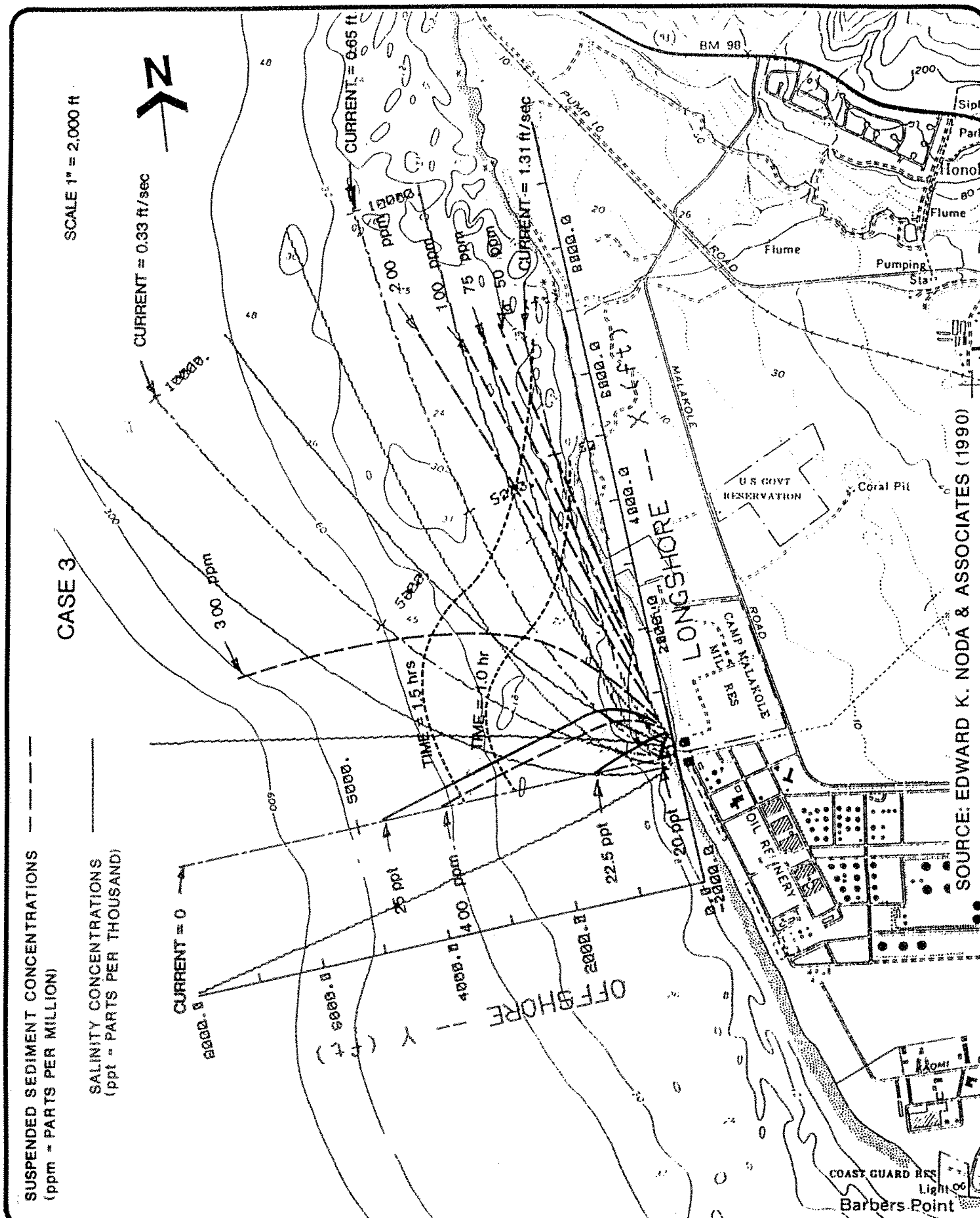


fig. 11 OVERPLOT OF PLUME PLAN VIEWS FOR AMBIENT CURRENT SPEEDS OF 0, 0.33, 0.65, AND 1.31 ft/sec. FOR CASE 3.

CAMPBELL DRAINAGE CHANNEL
EWA, OAHU, HAWAII

Prepared by: ENGINEERING CONCEPTS, INC.

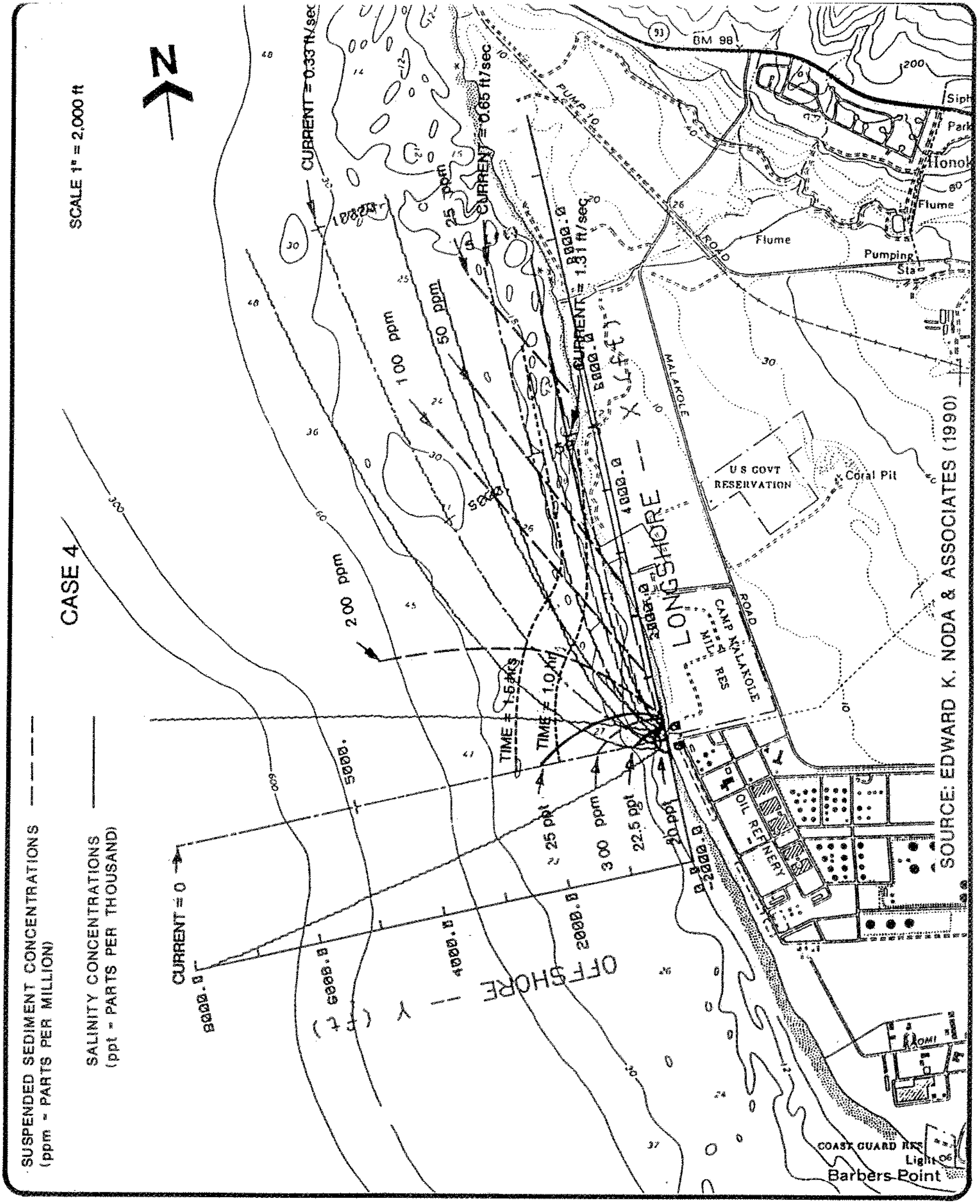


fig. 12 OVERPLOT OF PLUME PLAN VIEWS FOR AMBIENT CURRENT SPEEDS OF 0, 0.33, 0.65, AND 1.31 ft/sec. FOR CASE 4.

CAMPBELL DRAINAGE CHANNEL
EWA, OAHU, HAWAII

Prepared by: ENGINEERING CONCEPTS, INC.

Far-Field Plume Model: Following the initial near-field mixing, the diluted plume would be dynamically passive, being transported and dispersed by ocean currents. The Monte Carlo simulation model of the plume transport process is applied to characterize the behavior of the plume offshore. This model incorporates current meter data obtained at the site.

The far-field extends beyond 3200 feet from the shoreline. Parameters used in the model are similar to those of the near-field model. Based on available data, current speed of 2.44 fps, temperature of 24 degrees Celsius and salinity of 34.6 o/oo were used.

The far-field model was run for time periods of 3, 6, 9, 12, 24, 36 and 48 hours after the start of discharge into the far-field for the four near-field cases. The results (Appendix C) indicate that case 1 (100-year recurrence interval, 24-hour duration storm) provides the "worst case" offshore impacts, with regard to total volume of suspended sediment discharge. Figures 13 and 14 illustrate the far-field simulation results for time intervals of 3, 6, 9, 12, 24, 36 and 48 hours respectively. The far-field results for the other three cases are shown in Appendix C. In general, as the plume gradually grows in overall size with passing time, the maximum suspended sediment concentrations correspondingly decrease. In the model, "worst case" sediment concentrations reached a peak value of about 2.9 ppm 3 hours after discharge.

The modeling findings demonstrate that, turbidity is likely to increase as stormwater empties into the ocean at the channel outlet, thereby temporarily degrading the aesthetic quality of the nearshore waters. However, depending on the ocean currents prevailing during that time, the fine sediments in the runoff will be carried a considerable distance away from the outlet before settling out in the water column. Thus, siltation effects are not likely to be significant.

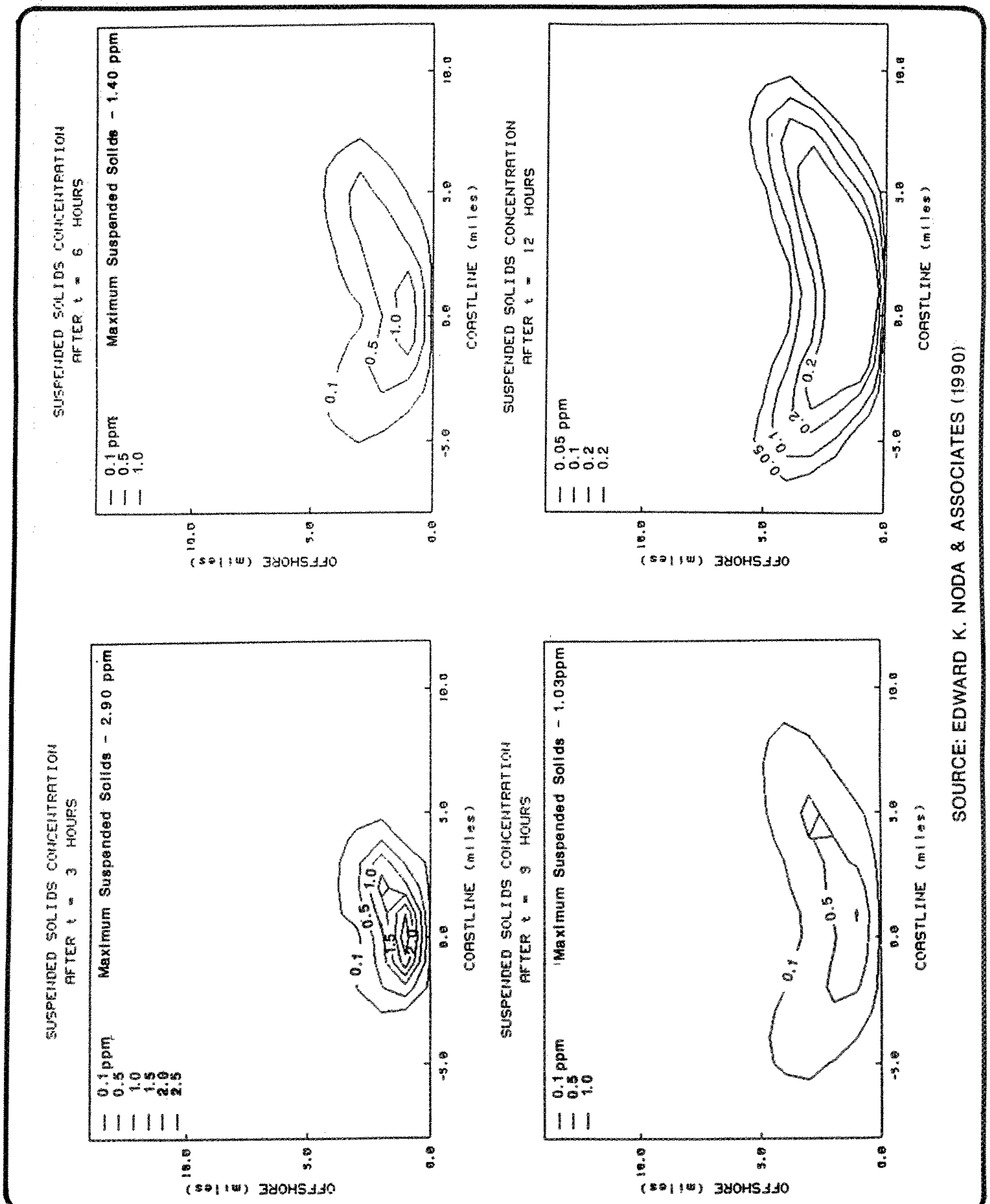
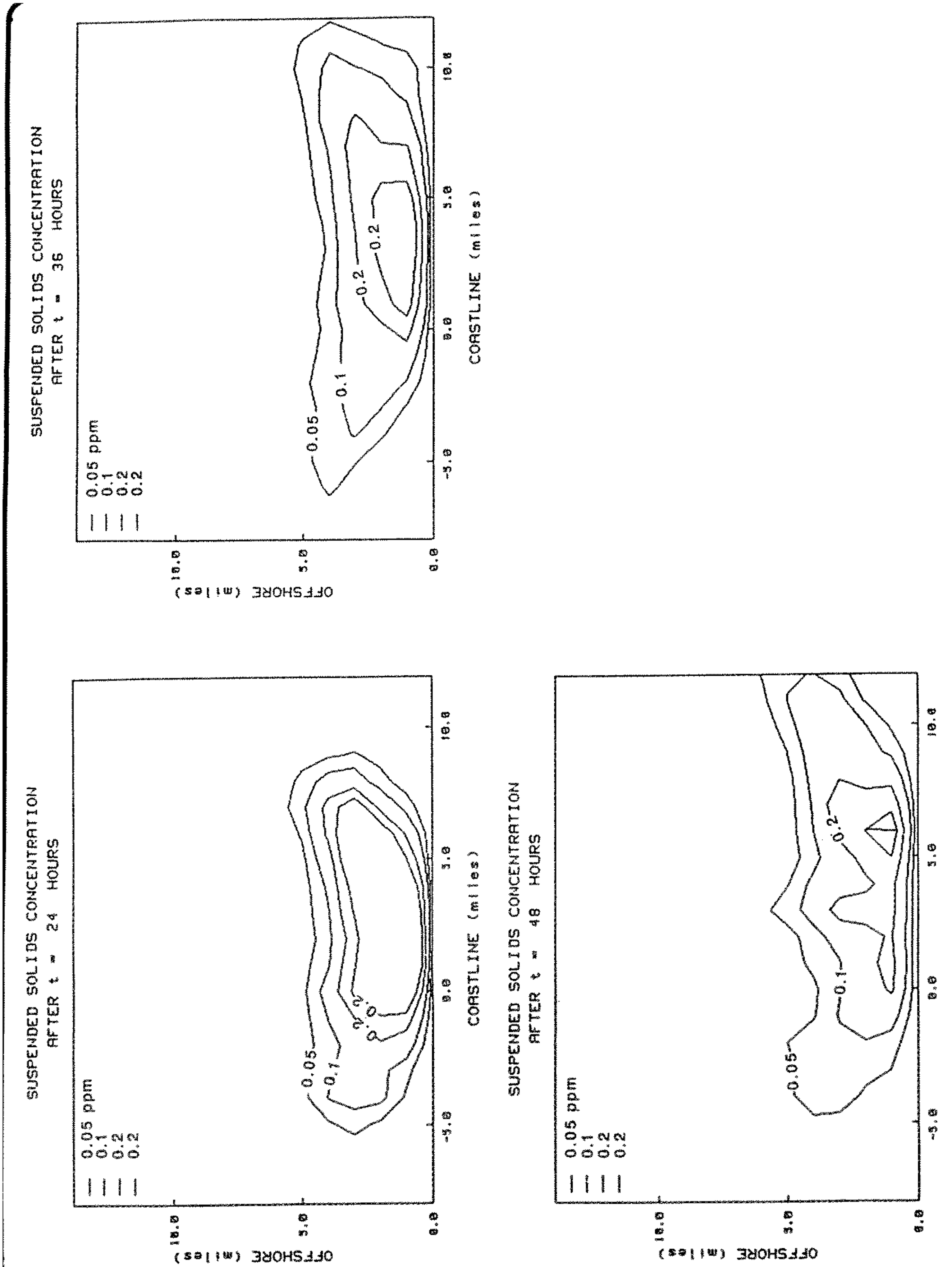


fig. 13 FAR-FIELD PLUME RESULTS FOR CASE 1 SHOWING SUSPENDED SEDIMENT CONCENTRATIONS AFTER VARIOUS TIMES AFTER DISCHARGE.

CAMPBELL DRAINAGE CHANNEL

EWA, OAHU, HAWAII

Prepared by: ENGINEERING CONCEPTS, INC.



SOURCE: EDWARD K. NODA & ASSOCIATES (1990)

fig. 14 FAR-FIELD PLUME RESULTS FOR CASE 1 SHOWING SUSPENDED SEDIMENT CONCENTRATIONS AFTER VARIOUS TIMES AFTER DISCHARGE.

CAMPBELL DRAINAGE CHANNEL

EWA, OAHU, HAWAII

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Salinity depression and turbidity effects from freshwater runoff containing soil sediments are considered to be temporary impacts, occurring only during heavy rainstorms. Due to the rapid dispersion of the plume in the ocean, it is expected that the discharge plume may be discernible in the receiving water for only a few hours.

B. LITTORAL PROCESS

The proposed drainage channel will have no significant impact on the existing littoral processes. The channel will daylight about 50 feet seaward of the mean sea level (MSL) elevation at the shoreline at an invert 5 feet below MSL. Wave erosion or the potential for channel blockage due to infilling by longshore sediment transport are not expected to be a problem, because the existing shoreline is comprised of beachrock and coral limestone material with hardly any sand or sediments. Sand and coral rubble material in the backshore region have been deposited by storm wave action, where the rocky limestone shoreline traps the material after it is carried inland by the large overtopping waves. Typical wave energy is sufficiently high to keep the shoreline scoured of sediment. Therefore, structural measures are not necessary to protect and maintain the channel opening.

C. DRAINAGE/FLOODING

The proposed channel will improve drainage within the watershed. The channel will be designed to accommodate the stormwater runoff resulting from the KBIP development as well as future developments within the watershed. The increase in runoff, after development is presented in Table 7.

The proposed channel will eliminate the existing drainage problems in the flood-prone low-lying area near the Kalaeloa Boulevard/Malakole Road intersection as well as other such areas of the watershed. Further, the proposed drainage infrastructure will handle the additional runoff from planned developments within the service area.

TABLE 7

RUNOFF QUANTITIES FOR 2400 ACRE WATERSHED

DESCRIPTION	* Tm (RECURRENCE INTERVAL) 10 YR. STORM	50 YR. STORM	100 YR. STORM
EXISTING CONDITION (CFS)	2000	3018	3661
DEVELOPED CONDITION (CFS)	2639	3772	5200
PERCENT INCREASE (%)	33	25	42

* 1 - HOUR DURATION

SOURCE: KAPOLEI BUSINESS-INDUSTRIAL PARK FINAL EIS, 1990

D. ARCHAEOLOGICAL RESOURCES

No known existing archaeological or paleontological sites will be directly impacted by the construction of the drainage channel. However, the potential exists to unearth significant subsurface archaeological remains, specifically within the undisturbed beach dune area at the west end of the proposed drainage channel.

Mitigative measures include archaeological subsurface testing to locate archaeological deposits within the beach dune area. The results of this test will be reported to the Historic Preservation Division of the Department of Land and Natural Resources for review and approval. If significant subsurface findings are uncovered, an appropriate mitigation plan will be executed. However, if the findings have no significant archaeological value, no further action is required.

E. RECREATIONAL RESOURCES

The aesthetic quality of the nearshore waters may be impacted by soil sediments carried in the storm water runoff and discharged from the drainage channel. Turbidity in the receiving waters may interfere with diving and other recreational activities, but such periods will not be of long duration, will occur only after storm events, and will not linger after the discharge ceases. During inclement weather, recreational activities should be minimal, allowing turbidity impacts on water quality to subside greatly before public recreational use of the shoreline resume.

In reference to the letter from the Department of Parks and Recreation, City and County of Honolulu, dated May 16, 1991: public parking and public access to the shoreline will be provided at Malakole Industrial Subdivision immediately north of the proposed drainage channel.

A pedestrian bridge has been proposed to provide lateral access to the shoreline, provided a public agency accepts dedication of the bridge. As an alternative, public access to the shoreline will parallel the maintenance roads along both sides of the channel between Malakole Road and the ocean. Improvement of public access will result in either case, especially during wet weather conditions.

F. BIOLOGICAL RESOURCES

Flora and Fauna: Based on available information, no unusual or distinctive flora or fauna were identified along the drainage channel alignment.

Marine Biology: The primary concerns discussed in this section are potential impacts on the marine environment as a result of the salinity depression and increased turbidity.

The depressed salinity associated with major floods may affect benthic organisms, such as corals, within 300 to 500 feet from shore and located in waters 15 feet or shallower. However, AECOS, Inc. (1990) indicated that very few benthic organisms exist within this particular zone along the coast (approximately less than one percent coral cover). Significant coral covers tend to occur at greater depths.

Increased receiving water turbidity will be the immediate impact of suspended solids in the storm water discharge. Harmful effects to the growth of coral and algae, due to the decrease in light energy is not likely to be a serious problem. As fine materials settle, this material may cover the bottom and temporarily impair benthic organisms. However, siltation effects are not likely to occur at any distance from the discharge point because of prevailing high energy waves and currents along this coast.

A potential long term impact on the marine environment due to coastal excavation is loss of the algal species, Pterocladia. Construction of the 100-foot wide channel will require the removal of a portion of the limestone outcrop and marine bench along the shoreline. As a result, some Pterocladia, a common food source for the endangered turtles, may be lost in this immediate nearshore zone. The impact on turtles due to the loss of this resource is small considering that Pterocladia is available on marine benches along the entire coast. Also, studies indicate Pterocladia growth has recovered where suitable substrata conditions at a proper elevation relative to tidal factors remained after channel cuts were made.

The completed drainage channel will become a long, narrow inlet to the sea, with invert below sea level up to a point beyond Malakole Road. Therefore, an intertidal bottom will be created between 2,000 and 2,500 feet inland from the channel mouth, as well as along the channel walls. The proposed channel can be expected to develop a sand or silty-sand bottom at the inlet. Salinity may be slightly depressed much of the time due to normal brackish ground water seepage. The presence of brackish water would not be a hindrance to habitation potential, but would define the character of the biological assemblage. Potential habitants include: tilapia (Orepchromis mossambica), aholehole (Kuhlai sandvicensis), mullet (Mugil cephalus), gobies (Gobiidae), and goatfishes (Mullidae). Also, suitable habitat may exist for a variety of juvenile fishes and non-demersal fishes characteristic of harbors and similar inlets.

VIII. POTENTIAL SHORT TERM IMPACTS AND MITIGATING MEASURES

A. NOISE

Noise due to construction related activities will cause short-term impacts. These impacts should be minimal, because neighboring areas are mostly industrial use. Noise sensitive areas are distant and should not be impacted. However, if necessary, mitigative measures will include limiting hours of noisy construction and complying with Department of Health administrative rules on noise control.

B. AIR QUALITY

Construction activities will have short term impacts on local air quality due to construction vehicle activities and fugitive dust from excavation and grading.

Mitigative measures include dust control measures employed during the construction period. Dust control could be accomplished through frequent watering of unpaved roads and areas of exposed soil.

C. TRAFFIC

Construction activities will have a short term impact on the traffic. Motorists may be inconvenienced by the rerouting of traffic and the movement of construction vehicles. Construction vehicles traveling to and from the project site may disrupt local traffic.

Development and adherence to an approved traffic control plan matching local traffic patterns should mitigate any adverse effects of construction.

D. COASTAL WATER QUALITY

The impacts to the coastal water quality during the excavation along the shoreline will be minimal. Construction of the channel will be performed in the "dry". Only after the channel has been substantially constructed, will it be opened to the ocean.

The effects of erosion generated from construction occurring upstream of the drainage channel may consequently affect the coastal water quality. Therefore, all such construction activities will be required to employ appropriate methods of erosion control.

An erosion control plan will be developed specifically for conditions at the project site.

IX. ALTERNATIVES TO THE PROPOSED PROJECT

This project goal is to mitigate the effects of increased runoff resulting from the development of the watershed. Four alternative measures were considered in addition to the proposed project:

A. NO ACTION

In the no action scenario, major flooding will result due to increase in runoff after development. Flooding will not be limited to the project area; it will also reach the adjacent industrial park and have a compound effect in areas currently experiencing flood problems.

This alternative is not acceptable because it may create conditions that jeopardize public safety and may damage property.

B. DIVERT RUNOFF INTO BARBERS POINT HARBOR

Using a box culvert, the runoff generated within the watershed could be diverted into Barbers Point Harbor. Although this alternative may appear to have minimal environmental effects, it will likely create a safety hazard and impose operational difficulties within the harbor. The velocity of discharge would affect maneuvering ships and may displace ships from moorings. Also, a box culvert designed large enough to handle the volume of runoff may not be feasible.

For these reasons, this alternative is not acceptable. The State Department of Transportation, Harbors Division, indicated that its assessment also finds this alternative unacceptable. (See letter attached as Appendix G.)

C. USE EXISTING EASTERN DRAINAGE CHANNEL

In this scenario, the runoff generated within the watershed would be routed into the existing eastern drainage channel, located east of the KBIP site, between the existing industrial park and Barbers Point Naval Air Station (see Figure 1). More than one pump station would probably be required to convey runoff to the existing eastern channel. Although this alternative appears to have minimal environmental effects, it is not a feasible alternative. The existing eastern drainage channel serves a separate drainage basin of 2500 acres with 7500 cfs peak runoff and does not have adequate capacity to handle runoff generated from the additional 2400 acre drainage basin. Increasing the capacity of the existing eastern drainage channel would require either increasing its width or depth to twice its present dimension. Increasing the channel width is not possible due to development on both sides of the channel. Increasing the channel depth is not hydraulically feasible.

D. CONTAIN STORM RUNOFF ON LAND

Storm runoff from the watershed could be collected in one or more retention basin(s), preventing runoff from flowing overland into coastal waters. The retention basin(s) would be designed to contain runoff generated within the 2400 acre drainage basin during the 100-year storm. In conjunction with the retention basin(s), a series of injection wells would allow percolation of the collected runoff. Although this alternative would have minimal impact on the coastal water quality and marine environment, the land requirement for the retention basin(s) makes it impractical.

E. NEW DRAINAGE CHANNEL

The proposed drainage channel is considered the best feasible measure which will mitigate flooding hazards. Although runoff discharged into receiving waters may affect water quality, the safety and the well being of the public outweighs the potential impacts to the coastal water quality. Considering that such impacts are temporary and occur only periodically with severe storms, the benefits realized offset the water quality impacts. Water quality impacts due to stormwater runoff are unavoidable, no matter where such discharges occur.

X. RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Short-term uses of man's environment are associated with the urbanization process and include clearing, grubbing, grading and construction of the drainage channel structure and its appurtenant facilities. Maintenance and enhancement of long-term productivity relates to the contribution of the drainage channel to society and the general well-being of its residents.

Short-Term: Construction-related activities may result in short-term adverse environmental impacts including generation of dust and noise, and traffic disruption. The potential for onsite soil erosion may also increase during grading operations. Completion of the project in accordance with appropriate State and City and County Standards will mitigate those temporary construction-related conditions.

Positive short-term impacts on the economy and employment are expected as a result of the project due to purchasing of construction materials and generation of jobs during the construction period.

Long-Term: Construction of the drainage channel commits the present open space and eliminates other alternative uses including industrialization. The drainage channel is an essential infrastructure requirement to serve the proposed KBIP development and other proposed developments within the watershed, which in turn are essential components to the success of the Secondary Urban Center concept.

XI. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Development of the drainage channel will result in an irreversible commitment of approximately 6 acres of land currently in open space. Construction materials will be irretrievably committed with a limited salvage value expected. Funds, human resources, time and energy will also be irretrievably committed to the project. The City and County will have a long-term public and financial commitment to maintain the channel upon dedication and acceptance.

The excavation of the proposed drainage channel will require removal of a portion of the shoreline and marine bench. This will result in irreversible commitment of coastal water resources and irretrievable loss of shoreline and marine bench.

The marine environment at the point of discharge will likely change and may be potentially suitable for a new marine habitat attracting fishes that seek quiet and brackish waters (AECOS, 1990)

Lateral shoreline access may be irreversibly eliminated. However, construction of a pedestrian bridge over the channel near the shore is currently being studied. Construction of the bridge would allow continued lateral shoreline access.

XII. RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS, POLICIES AND CONTROL

This section discusses the relationship of the project to the objectives and policies of the Hawaii State Plan, the City and County of Honolulu General Plan, The Coastal Zone Management Program, and the Special Management Rules and Regulations of the City and County of Honolulu.

A. HAWAII STATE PLAN

The goals, objectives and policies of the Hawaii State Plan, Chapter 226, HRS, and applicable priority guidelines and functional plan policies are:

Section 11(a): Objectives for the physical environment - land-based, shoreline, and marine resources:

(2) Effective protection of Hawaii's unique and fragile environmental resource.

Section 11(b): Applicable Policies:

(6) Encourage the protection of rare or endangered plant and animal species and habitat native to Hawaii.

Discussion: There were no endemic plants and birds identified in the project area. Unusual or distinctive habitat or fauna are not present.

Section 13(a): Objectives for physical environment - land, air, water quality:

(1) Maintenance and pursuit of improved quality in Hawaii's land, air and water resources.

Section 13(b): Applicable policies:

(2) Promote the proper management of Hawaii's land, air and water resources.

(3) Promote effective measures to achieve desired quality in Hawaii's surface, ground, and coastal waters.

Discussion: The applicant will be in compliance with applicable state, federal and county regulations relating to land, air and water resources in development of the project.

(5) Reduce the threat to life and property from erosion, flooding, tsunamis, hurricanes, earthquakes, volcanic eruptions and other natural or man-induced hazards and disasters.

Discussion: The proposed drainage channel is expected to reduce existing flooding problems occurring along the project site and elsewhere in the planned KBIP development. The drainage channel will serve the master-planned developments within the watershed, channelizing stormwater runoff into the ocean to prevent undesirable flooding and soil erosion.

Land Resource Priority Guidelines:

Section 104 (b)(6): Seek participation from the private sector for the cost of building infrastructure and utilities, and maintaining open spaces.

Discussion: The applicant will build the proposed drainage channel and maintenance/shoreline access roadways on both sides of the drainage channel.

B. STATE FUNCTIONAL PLANS

The State Functional Plans translate the broad goals and objectives of the Hawaii State Plan into detailed courses of action. The relationship of the proposed actions within the project site to the relevant State Functional Plan objectives is described below.

Recreation

Objective III-A: Prevent the loss of access to shoreline and mauka recreation areas due to new development.

Objective III-D: Acquire, develop, and manage additional public accessways.

Policy III-D(2): Provide adequate improvements at public accessways.

Discussion: The developer has proposed to provide a pedestrian bridge which will facilitate lateral access to the shoreline.

C. GENERAL PLAN FOR THE CITY AND COUNTY OF HONOLULU

The following discussion provides an assessment of how the proposed project conforms to and implements the General Plan.

Natural Environment

Objective B, Policy 4: Provide opportunities for recreational and educational use and physical contact with Oahu's natural environment.

Discussion: The shoreline area will be accessible to the public via a proposed pedestrian bridge to be located near the mouth of the drainage channel.

Objective B, Policy 8: Protect plants, birds, and other animals that are unique to the State of Hawaii and the island of Oahu.

Discussion: Unusual or distinctive flora or fauna is not present within the project area.

Culture and Recreation

Objective B: To protect Oahu's cultural, historic, architectural and archaeological resources.

Objective B, Policy 1: Encourage the restoration and preservation of early Hawaiian structures, artifacts and landmarks.

Discussion: During the excavation of the drainage channel, the site will be monitored for potential archaeological findings.

D. HAWAII COASTAL ZONE MANAGEMENT PROGRAM

The objectives of the Hawaii Coastal Zone Management Program, Section 205-2, HRS, are to protect valuable and vulnerable coastal resources such as coastal ecosystems, special scenic and cultural values, and recreational opportunities. The objectives of the program are also to reduce coastal hazards and to improve the review process for activities proposed within the coastal zone.

The following are applicable objectives of the Hawaii Coastal Zone Management Program and an assessment of how the proposed project relates to them.

Recreational Resources Objective: Lateral access along the shoreline area will be facilitated by a pedestrian bridge near the mouth of the channel.

Historic Resources Objective: Protect, preserve and where desirable, restore those natural and man made historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

Discussion: During the excavation of the drainage channel, the site will be monitored for potential archaeological resources.

Scenic and Open Space Resources Objective: Protect, preserve and, where desirable, restore or improve the quality of coastal scenic and open space resources.

Discussion: The drainage channel is not expected to affect the littoral process of this coastline.

Coastal Ecosystem Objective: Protect valuable coastal ecosystem from disruption and minimize adverse impacts on all coastal ecosystem.

Discussion: No unusual aquatic habitat is present within the project area. The discharge of stormwater runoff may alter this coastal ecosystems and encourage a new fishing habitat at the mouth of the proposed channel.

E. SPECIAL MANAGEMENT RULES AND REGULATIONS OF THE CITY AND COUNTY OF HONOLULU

The guidelines of Section 33-3.2 of the Revised Ordinance of Honolulu are used by the Department of Land Utilization and the City Council for the review of developments proposed in the Special Management Area. Figure 15 illustrates the location of the proposed drainage channel that lies within the Special Management Area. These guidelines are derived from Section 205A-26, HRS. The conformity of the proposed project with the guidelines are discussed below.

(1) All development in the Special Management Area shall be subject to reasonable terms and conditions set by the Council to insure that:

(A) Adequate access, by dedication or other means, to publicly owned or used beaches, recreation areas, and natural reserves is provided to the extent consistent with sound conservation principles;

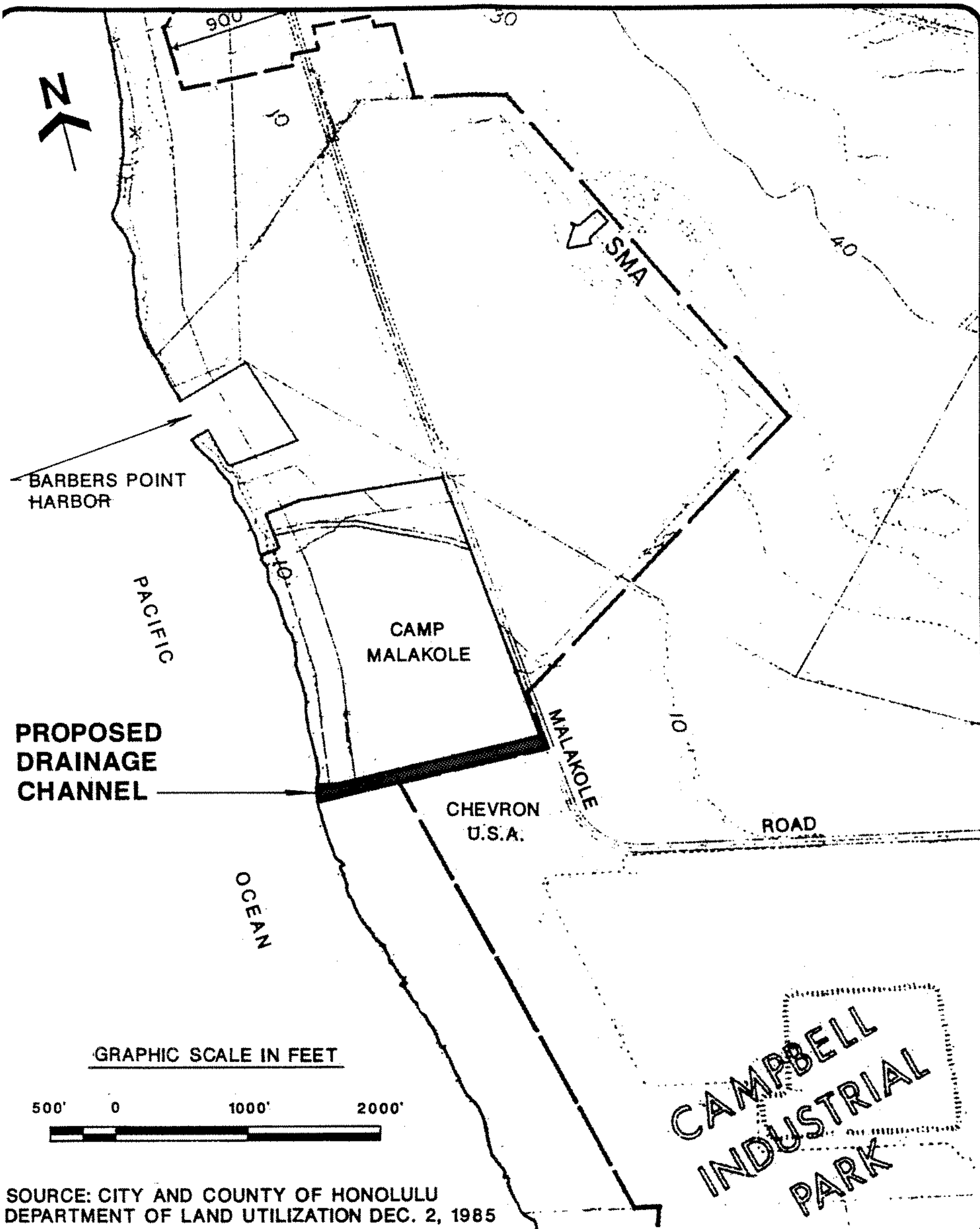

fig. 15 SMA Map

CAMPBELL DRAINAGE CHANNEL
EWA, OAHU, HAWAII

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(D) Alteration to existing land forms and vegetation except crops, and construction of structures shall cause minimum adverse effects to water resources and scenic and recreational amenities and minimum danger to floods, landslides, erosion, siltation, or failure in the event of earthquakes.

(2) No development shall be approved unless the Council has first found that:

(A) The development will not have any substantial, adverse environmental or ecological effect except such as adverse effect is minimized to the extent practicable and clearly outweighed by public health and safety, or compelling public interests. Such adverse effect shall include, but not be limited to, the potential cumulative impact of individual developments, each one of which taken in itself might not have a substantial adverse effect, and the elimination of planning options;

(B) The development is consistent with the objectives and policies set forth in Section 33-3.1 and area guidelines contained in Section 205A-26, Hawaii Revised Statutes; and

(C) The development is consistent with the County General Plan, development plans, zoning and subdivision codes and other applicable ordinances.

(3) The Council shall seek to minimize, where reasonable:

(B) Any development which would reduce the size of any beach or other area usable for public recreation;

(C) Any development which would reduce or impose restrictions upon public access to tidal and submerged lands, beaches, portions of rivers and streams within special management areas and the mean high tide line where there is no beach;

(E) Any development which would adversely affect the water quality, existing areas of open water free of visible structures, existing and potential fisheries and fishing grounds, wildlife habitats, or potential or existing agricultural uses of land.

Discussion: (1)(A) and (3)(C): The proposed drainage channel will occupy the open space area presently used for access to the beach. With this project, lateral access to the beach will be by a proposed pedestrian, bridge located near the makai end of the channel.

(1)(D), (2)(A), (3)(B) and (3)(E): The proposed drainage channel must encroach onto the beach. However, this drainage improvement is necessary to protect the public from potential flood hazards. The need for this drainage channel, for the purpose of public safety, clearly outweighs potential impacts to coastal water quality. Substantial adverse impacts are not expected, since impacts to the water quality, such as turbidity and salinity depression, are considered periodic and infrequent occurrences, occurring only during severe storms.

The discharge from the drainage channel is not likely to severely affect the marine environment. Brackish water at the mouth of the drainage channel may attract a new fish community.

No endangered biological resource or archaeological sites are known to exist in the affected area.

(2)(B) and (2)(C): Construction of the proposed drainage channel appears to be consistent with the objectives and policies set forth in section 33-3.1 and area guidelines contained in section 205A-26 of the Hawaii Revised Statutes and the applicable County General Plan.

XIII. PERMITS AND APPROVALS

PERMITS/APPROVALS	APPROVING AUTHORITY	STATUS
Army Permit	Army Corps of Engineers, Pacific Division	Will be filed following approval of SEIS
CDUA Permit	State of Hawaii Department of Land and Natural Resources	Will be filed following approval of SEIS
SMA Permit	City and County of Honolulu Department of Land Utilization	Will be filed following approval of SEIS
Shoreline Setback Variance	City and County of Honolulu Department of Land Utilization	Will be filed following approval of SEIS
NPDES Permit	State of Hawaii Department of Health	Will be filed following approval of SEIS
Antidegradation Analysis	State of Hawaii Department of Health	Will be filed in conjunction with the NPDES Permit
Easement Aquisition	State of Hawaii DLNR Division of Land Management	Will be filed prior to construction

XIV. LIST OF CONSULTANTS INVOLVED IN PREPARATION OF EIS

This report was prepared for the Estate of James Campbell by Engineering Concepts, Inc. The following list identifies the consultants involved in the preparation of their respective contributions.

FIRM	TASK	INDIVIDUAL
Engineering Concepts, Inc.	Primary Author/ Consultant Coordinator	Craig Arakaki
Dames and Moore	Geotechnical Investigation	Masanobu R. Fujioka
AECOS, Inc.	Survey of Marine Biology/ Water Quality	Rick Guinther
Edward K. Noda and Associates, Inc.	Littoral Impacts/Plume Modeling	Edward K. Noda
Char & Associates	Botanical Survey	Winona P. Char
Dr. Phillip L. Bruner	Survey of Avifauna and Feral Mammals	Dr. Phillip L. Bruner
Cultural Surveys Hawaii	Archaeological Reconnaissance	Dr. Hallet H. Hammatt

XV. CONSULTED PARTIES, COMMENTS AND RESPONSES RECEIVED DURING PREPARATION OF THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

The notice of availability of EIS Preparation Notice (EISPN) was officially published in the Office of Environmental Quality Control (OEQC) Bulletin on November 8, 1990. The deadline for submitting comments was established as December 12, 1990.

One agency comment letter was received during the comment period. The agency is identified by an asterisk (*). A copy of the letter and the response are included following the list of consulted parties.

Federal Agencies:

- Department of Agriculture, Soil Conservation Service
- Department of the Army, U.S. Army Engineer District, Honolulu
  - Construction - Operations Division
  - Engineering Division
- Department of the Navy
  - Pearl Harbor Naval Base
  - Barbers Point Naval Air Station
- Department of the Interior
  - Fish and Wildlife Service
  - Geological Survey

State Agencies:

- Department of Agriculture
- Department of Business & Economic Development
- Department of Health

Department of Land and Natural Resources

Board of Land and Natural Resources

Division of State Parks, Outdoor Recreation & Historic Sites

Historic Preservation Program

Department of Transportation

Hawaii State Coastal Zone Management Program

Office of Environmental Quality Control

University of Hawaii, Environmental Center

City and County Agencies:

Department of General Planning

Department of Land Utilization

* Department of Parks and Recreation

Department of Public Works

Department of Transportation Services

Public Utilities:

GASCO, Inc.

GTE Hawaiian Telephone Company, Inc.

Hawaiian Electric Company, Inc.

Other:

Chevron USA, Inc.

Cook Inlet Region, Inc.

Oahu Sugar Company, Ltd.

DEPARTMENT OF PARKS AND RECREATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

WALTER M. OZAWA
DIRECTOR

ALVIN K.C. AU
DEPUTY DIRECTOR

RECEIVED
DEC 17 1990

December 13, 1990

TO: BENJAMIN B. LEE, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

FROM: ALVIN K. C. AU, ACTING DIRECTOR

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)
FOR THE PROPOSED CAMPBELL DRAINAGE CHANNEL, EWA, OAHU
TAX MAP KEY 9-1-14: PORTION 4

We have reviewed the EISPN for the proposed drainage channel and make the following comments and recommendations.

The project should be modified to include a bridge over the proposed channel and along the shoreline. The bridge is needed to maintain a continuous pedestrian lateral access now extending from Barber's Point Harbor to Barber's Point Naval Air Station.

Public parking and a public beach right-of-way will be provided immediately north of the proposed drainage channel at Camp Malakole. There is no public parking and no public beach right-of-way for 1.5 miles of shoreline between Camp Malakole and Barber's Point Beach Park. By comparison the City's Development Plan guideline is to establish public access to the shoreline and adequate space for parking at intervals of not more than every one-half mile in rural areas.

Thank you for the opportunity to comment. Should you have any questions, please contact Doug Meller of our Advance Planning Branch at extension 4884.

ALVIN K. C. AU, Acting Director

AKCA:sl

cc: Department of Land Utilization
Campbell Estate

ENGINEERING CONCEPTS, INC.
CONSULTING ENGINEERS

March 19, 1991

Mr. Alvin K.C. Au, Acting Director
Dept. of Parks and Recreation
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Subject: Environmental Impact Statement Preparation Notice (EISPN) for the Campbell Drainage Channel Supplemental to Kapolei Business-Industrial Park EIS TMK: 9-1-14:4 (portion)

Thank you for your letter of December 13, 1990 with comments and recommendations for the subject project. We have reviewed your comments and are providing the following information in response:

1. Pedestrian bridge: The feasibility of including a pedestrian bridge over the proposed channel along the shoreline is currently being evaluated by the Estate of James Campbell. Public access to the shoreline has been considered with the provision of maintenance roads along both banks of the proposed channel between Malakole Road and the shore. The intent of the bridge, to maintain a continuous pedestrian lateral access from Barbers Point Harbor to Barbers Point Naval Air Station is a valid concern.

2. Public parking and public beach right-of-way: There is insufficient room for public parking within the boundary of proposed channel at the shoreline. The proposed location of public parking and a public beach right-of-way immediately north of the proposed drainage channel at Camp Malakole should serve the public interested in accessing the coastal region around the drainage channel.

We will continue to coordinate the issue of public shoreline access with your office.

Very truly yours,

Kenneth Ishizaki, P.E.
Vice President

js

250 Ward Avenue, Suite 206 • Honolulu, Hawaii 96814 • Tel: (808) 538-0920 • FAX: (808) 538-3463

XVI. CONSULTED PARTIES, COMMENTS AND RESPONSES RECEIVED DURING PREPARATION OF THE FINAL EIS

Sixty five (65) copies of the Draft EIS were delivered to OEQC on March 22, 1991 for distribution. In addition, six (6) copies of the Draft EIS and six (6) copies of the Draft EIS Summary were mailed to parties not included on the OEQC distribution list. The City and County of Honolulu Department of General Planning, the "accepting agency", received five (5) copies of the Draft EIS for their review. A complete listing of these consulted parties follows.

The Draft EIS notice was published in the April 8, 1991 edition of the OEQC Bulletin. A total of 26 comment letters were received during the 45-day public review period ending on May 23, 1991. Organizations/agencies who responded to the request for comments are marked with an asterisk (*). Response letters were only sent to those commenting parties requiring further discussion or clarification regarding specific subject matters. Copies of the comment and response letters follow the list of consulted parties.

Federal:

Department of Agriculture, Soil Conservation Service
Department of the Army, U.S. Army Engineer District, Honolulu
  Construction - Operations Division
* Engineering Division
Department of the Navy
* Pearl Harbor Naval Base
  Barbers Point Naval Air Station
Department of the Interior
  Fish and Wildlife Service
  Geological Survey

State Agencies:

- * Department of Accounting General Services
- Department of Agriculture
- * Department of Budget and Finance, Housing Finance and Development Corp.
- Department of Business, Economic Development & Tourism
  - * Energy Division
  - * Land Use Commission
- * Department of Defense, Hawaii Air National Guard
- * Department of Health
- * Department of Land and Natural Resources
  - Board of Land and Natural Resources
  - Division of State Parks, Outdoor Recreation & Historic Sites
  - Historic Preservation Program
- * Department of Transportation
- Hawaii State Coastal Zone Management Program
- * Office of Environmental Quality Control
- * Office of State Planning
- * University of Hawaii, Environmental Center

City and County Agencies:

- * Board of Water Supply
- * Building Department
- * Fire Department
- * Police Department
- * Department of General Planning
- * Department of Housing and Community Development
- * Department of Land Utilization
- * Department of Parks and Recreation
- * Department of Public Works

* Department of Transportation Services

Public Utilities:

GASCO, Inc.
* GTE Hawaiian Telephone Company, Inc.
* Hawaiian Electric Company, Inc.

Other:

Chevron USA, Inc.
Cook Inlet Region, Inc.
The Honorable John DeSoto, District Councilman
Ewa Beach Community Association
Ewa Beach Neighborhood Board #23
Honokai Hale Community Association
Makakilo Community Association
* Na Ala Hele, Hawaii Trail and Access System
Oahu Sugar Company, Ltd.

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
BUILDING 230
FT. SHAFTER, HAWAII 96858-5440

REPLY TO ATTENTION OF:

May 16, 1991

RECEIVED
MAY 17 1991
ENGINEERING CONCEPTS

Planning Division

Mr. Matthew Higashida
Department of General Planning
City and County of Honolulu
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Dear Mr. Higashida:

We have reviewed the Draft Environmental Impact Statement for the Campbell Drainage Channel, Ewa, Oahu (supplemental to the Kapolei Business-Industrial Park EIS). The following comments are offered:

a. As noted on page 10 of the document, a Department of the Army permit will be required for this project. For more information about permit requirements, please contact Operations Division at 438-9258 and refer to file number PO90-017.

b. The latest Flood Insurance Rate Map (FIRM), dated September 28, 1990, should be referenced on page 20 of the document. According to the 1990 FIRM (copy of relevant portion enclosed), the project parcel is in Zone AE (areas inundated by the 100-year flood, with a base flood elevation of 8 feet above mean sea level) and Zone D (areas in which flood hazards are undetermined).

Sincerely,

/s/ Pelowski

Kisuk Cheung
Director of Engineering

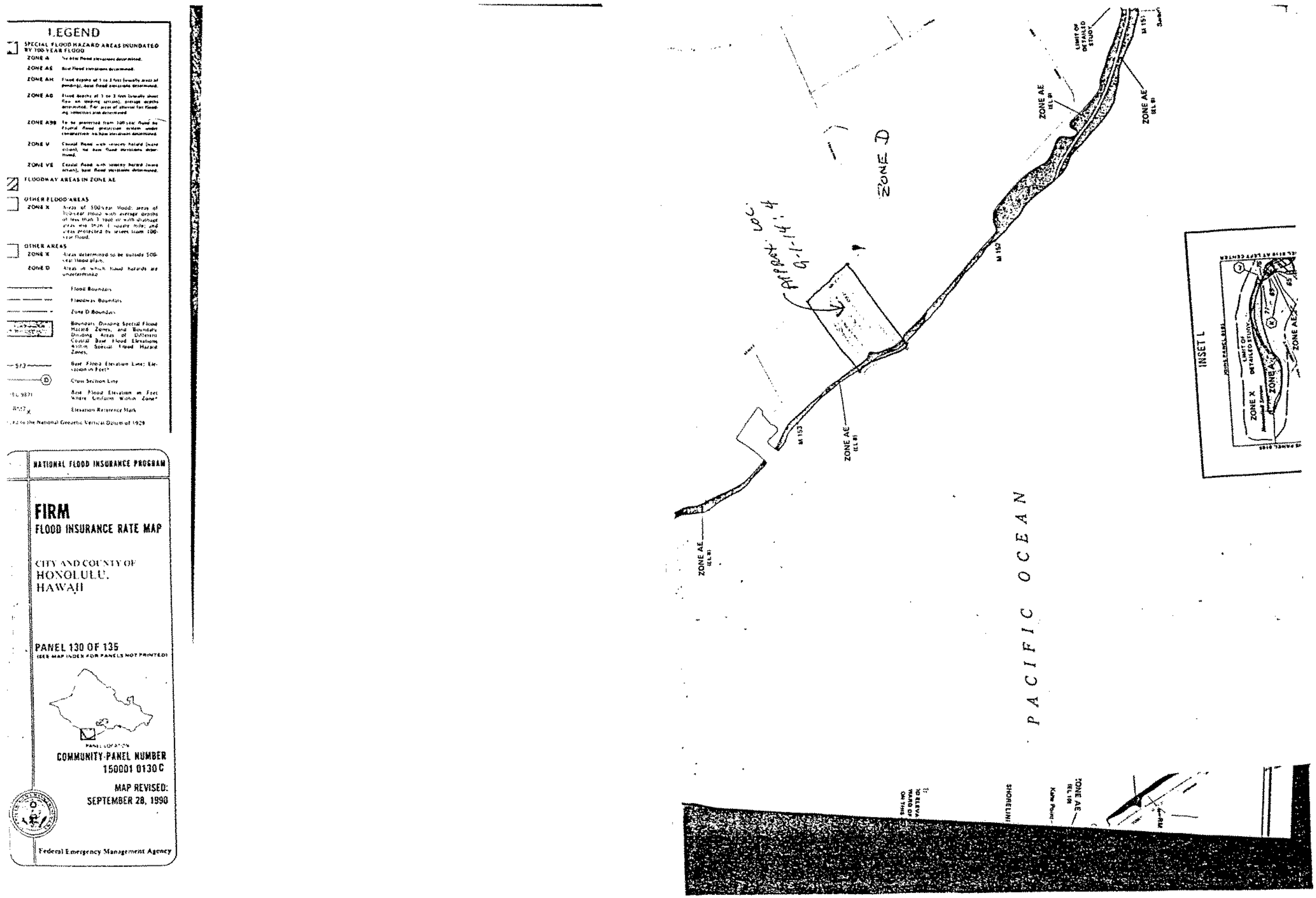
Enclosure

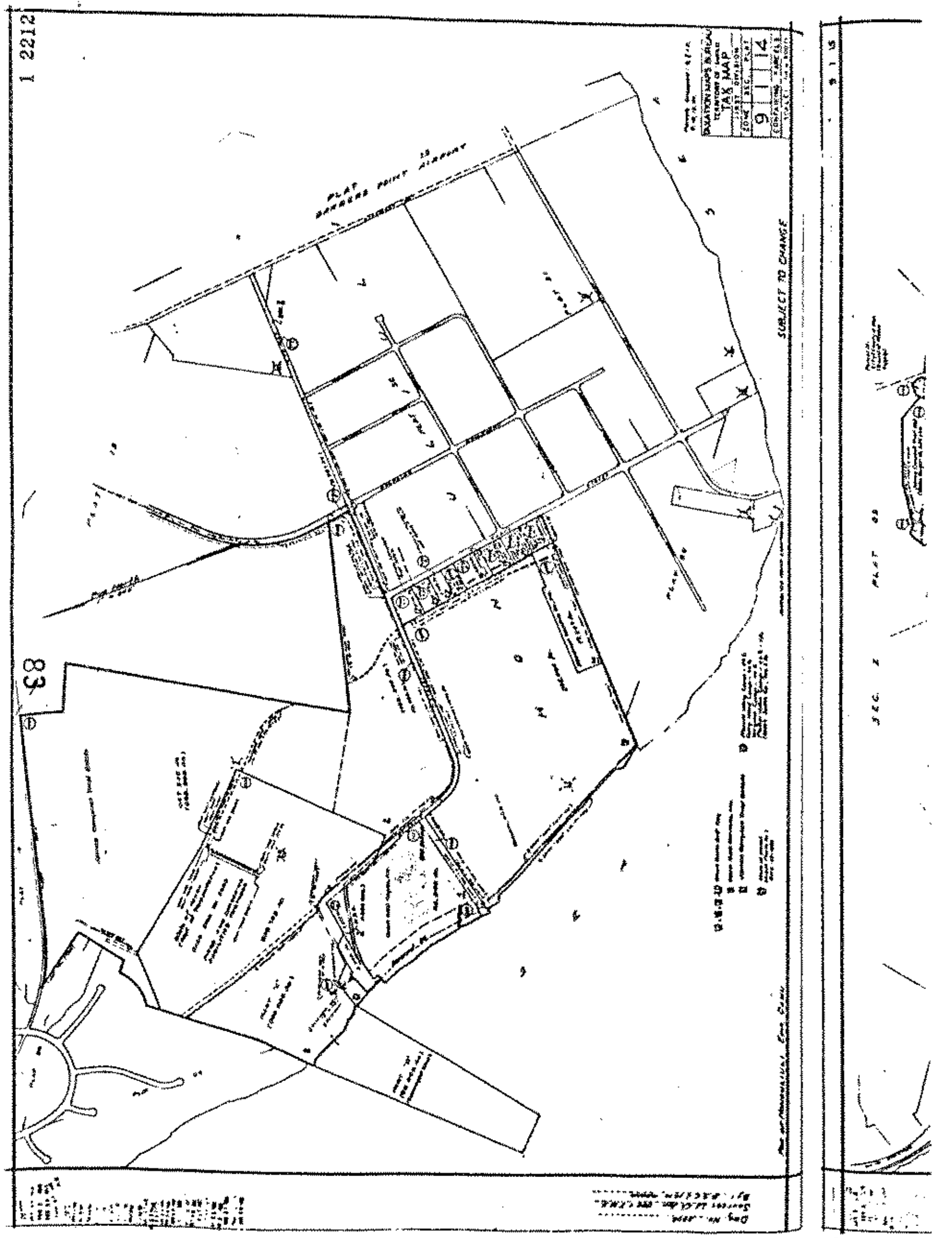
Copies Furnished:

Ms. Susan Sublett
The Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, Hawaii 96813

✓Mr. Kenneth Ishizaki
Engineering Concepts, Inc.
250 Ward Avenue, Suite 206
Honolulu, Hawaii 96814

Office of Environmental Quality Control
State of Hawaii
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813


LEGEND
SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD
ZONE A
ZONE AE
ZONE AH
ZONE AO
ZONE A99
ZONE V
ZONE VE
FLOODWAY AREAS IN ZONE AE
OTHER FLOOD AREAS
ZONE X
OTHER AREAS
ZONE X
ZONE D
Flood Boundary
Floodway Boundary
Zone D Boundary
Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.
Base Flood Elevation Line; Elevation in Feet*
Cross Section Line
Base Flood Elevation in Feet Where Uniform Within Zone*
Elevation Reference Mark
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
CITY AND COUNTY OF
HONOLULU,
HAWAII
PANEL 130 OF 135
(SEE MAP INDEX FOR PANELS NOT PRINTED)
COMMUNITY-PANEL NUMBER
150001 0130 C
MAP REVISED:
SEPTEMBER 28, 1990
Federal Emergency Management Agency
ZONE AE
ZONE D
APPROX. LOC.
9-1-14:4
M 153
M 152
M 151
LIMIT OF DETAILED STUDY
PACIFIC OCEAN
SHORELINE
ZONE AE
INSET L
ZONE X
ZONE A
ZONE AE
LIMIT OF DETAILED STUDY



ENGINEERING CONCEPTS, INC.

July 2, 1991

Mr. Kisuk Cheung
Director of Engineering
Department of the Army
U.S. Army Engineer District, Honolulu
Building 230
Fort Shafter, Hawaii 96858-5440

Subject: Campbell Drainage Channel Draft Environmental Impact Statement Supplemental to Kapolei Business-Industrial Park EIS
Ewa, Oahu, Hawaii; TMK: 9-1-14:4 (portion)

Thank you for your letter of May 16, 1991 regarding the draft environmental impact statement for the subject project. The following is offered in response to your comments.

1. We will contact Operations Division regarding information about permit requirements.

2. The revised EIS will reflect information from the latest Flood Insurance Rate Map, dated September 28, 1990.

Thank you again for your comments. Please feel free to call if you have any questions or require additional information.

Very truly yours,

Kenneth Ishizaki, P.E.
Vice President

KI/js

cc: OEQC
Ms. Susan Sublett
Mr. Michael Warren
Mr. Bill Wanket
Mr. Matthew Higashida, DGP

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

IN REPLY REFER TO:
11000
Ser 00F(238)/0993
10 MAY 1991

RECEIVED
MAY 18 1991
ENGINEERING CONCEPTS

Mr. Matthew Higashida
Department of General Planning
City and County of Honolulu
650 South King Street
Honolulu, HI 96813

Dear Mr. Higashida:

SUPPLEMENTAL TO KAPOLEI BUSINESS-INDUSTRIAL PARK DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) CAMPBELL DRAINAGE CHANNEL

We have reviewed the subject DEIS forwarded by the Office of Environmental Quality Control and the following comment is provided:

a. Section I.F. SUMMARY OF POTENTIAL ADVERSE IMPACTS, Water Quality. Mitigative Measures, page 6, fourth line, "Development of upstream areas is expected to ultimately reduce soil erosion and sediment concentration in storm water discharge from the proposed drainage channel."

Comment: Upstream development and further channelization may increase vice reduce concentrations of sedimentation downstream. The natural erosion deposits from the mountains will be allowed to discharge more rapidly into the receiving waters via the drainage channel. Mitigative measures such as installing sediment traps should be considered in the design of the subject drainage channel. The DEIS should address the cumulative affects of channelization on the receiving waters. While this project itself may not significantly impact on the coastal resources, other developments and associated channelization increases may cause the discharge from the channel systems to become significant.

We appreciate the opportunity to review and comment on the supplemental DEIS for the subject development, and request that we be provided three copies of the final document. The Navy point of contact is Mr. Bill Liu, telephone 471-3324.

Sincerely,

W. K. LIU
Assistant Base Civil Engineer
By direction of
the Commander

Copy to:
Department of Housing and Community Development (Ms. E. Mark)
The Estate of James Campbell (Ms. S. Sublett)
Engineering Concepts, Inc. (Mr. K. Ishizaki)
QEQC

ENGINEERING CONCEPTS, INC.
CONSULTING ENGINEERS

July 30, 1991

Mr. William K. Liu
Assistant Base Civil Engineer
Department of the Navy
Naval Base Pearl Harbor
P.O. Box 110
Pearl Harbor, Hawaii 96860-5020

Subject: Campbell Drainage Channel Draft Environmental Impact Statement Supplemental to Kapolei Business-Industrial Park EIS
Ewa, Oahu, Hawaii; TMK: 9-1-14:4 (portion)

Dear Mr. Liu:

Thank you for your May 10, 1991 letter concerning the Draft Environmental Impact Statement for the subject project. The following is offered in response to your comments.

Your comment that further channelization may increase sediment load is correct in the context stated in your letter: channelizing the segment across the Ewa plain will increase the delivery of sediments to the ocean from the upland drainage areas (mauka of the freeway). The potential increase in sediment delivery would be substantial since without the proposed drainage channel this runoff may not reach the sea directly.

The statement on page 6 of the DEIS refers to the anticipated conversion of agriculture fields and undeveloped lands on the Ewa plain into an urban/industrial setting and development of the upland drainage area into an urban/residential setting. The result of this conversion would be a reduction in sediment load in the runoff from the developed areas.

The Final EIS for the proposed Makaiwa Hills development (April 1991) has identified detention basins as a means of mitigating the impacts of storm runoff. These basins will also act as settling basins, removing silt from runoff waters prior to their entrance into the drainage channel. Sediment traps will be considered in the channel design pending acceptance by the City and County Department of Public Works for maintenance.

The DEIS does address the "cumulative affects of channelization" to the extent that the entire drainage system is considered and not just the final segment which connects the drainage area to the sea. For example, the discharge volumes used in the models represent outflows

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Campbell Drainage Channel Draft Environmental
Impact Statement Supplemental to Kapolei
Business-Industrial Park EIS
Ewa, Oahu, Hawaii; TMK: 9-1-14:4 (Portion)
July 30, 1991
Page 2

generated from "other developments and associated channelization" that will feed into the proposed Kapolei Business-Industrial Park drainage system as presented.

The water quality implications of each and every facility or development that might be later constructed within the drainage area cannot be addressed at this time because these developments are not known at this time. Runoff from any facility into the storm drain system constitutes a non-point source contribution, for which no or minimal regulation presently exists even though such runoff may constitute a source of pollution to the nearshore environment. This situation will soon change. On November 16, 1990, the U.S. Environmental Protection Agency promulgated final regulations governing storm water discharges from industrial and municipal systems. The regulations require permits, issued as part of the NPDES program (the existing point-source regulation permitting scheme under the federal Clean Water Act), for storm water discharges associated with industrial activity. These regulatory mechanisms constitute the means by which significant adverse impacts from pollutants in the discharge will be avoided.

Again, thank you for your comments. Please feel free to call me if you have any questions.

Very truly yours,

Kenneth Ishizaki, P.E.
Vice President

KI/js

cc: OEQC
Ms. Susan Sublett
Mr. Michael Warren
Mr. Bill Wanket
Mr. Matthew Higashida

(P)1440.1

APR 24 1991

APR 26 1991
ENGINEERING CONCEPTS

Department of General Planning
City and County of Honolulu
Municipal Office Building, 8th Floor
650 South King Street
Honolulu, Hawaii 96813

Attention: Mr. Matthew Higashida

Gentlemen::

Subject: Kapolei Business-Industrial Park
Campbell Drainage Channel
Draft EIS

Thank you for the opportunity to review the subject document. We have no comments to offer.

Should there be any questions, please have your staff contact Mr. Ralph Yukumoto of the Planning Branch at 548-7192.

Very truly yours,

T. Tominaga
TEUANE TOMINAGA
State Public Works Engineer

RY:jk
cc: The Estate of James Campbell
✓Engineering Concepts, Inc.
OEQC

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
SEVEN WATERFRONT PLAZA, SUITE 300
500 ALA MOANA BOULEVARD
HONOLULU, HAWAII 96813
FAX (808) 543-6841

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

IN REPLY REFER TO:
91:PLNG/2415 jt

RECEIVED
MAY 23 1991
ENGINEERING CONCEPTS

May 21, 1991

TO: Mr. Matthew Higashida
Dept. of General Planning
City & County of Honolulu

FROM: Joseph K. Conant
Executive Director

SUBJECT: Supplemental EIS for the Campbell Drainage Channel

Thank you for the opportunity to review the subject supplemental EIS. We have no comments to offer.

JT:eks

c: Ms. Susan Sublett
Mr. Kenneth Ishizaki
Office of Environmental Quality Control

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813
Telephone: 548-4611

ESTHER UEDA
EXECUTIVE OFFICER

RECEIVED
APR 1 7 1991
ENGINEERING CONCEPTS

April 16, 1991

Mr. Matthew Higashida
Department of General Planning
City & County of Honolulu
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Dear Mr. Higashida:

Subject: DEIS for the Campbell Drainage Channel, Supplemental to Kapolei Business - Industrial Park EIS, Ewa, Oahu, TMK No. 9-1-14:4 (Por.)

We have reviewed the subject DEIS and have no comments except to confirm that the subject parcel is designated within the State Land Use Urban District.

We appreciate the opportunity to comment on this matter. If you have any questions, please call me or my staff at 548-4611.

Sincerely,

ESTHER UEDA
Executive Officer

EU:to

cc: The Estate of James Campbell
ATTN: Susan Sublett
Engineering Concepts, Inc.
ATTN: Kenneth Ishizaki
OEQC

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 PHONE: (808) 548-4080 FAX: (808) 531-5243

JOHN WAIHEE, GOVERNOR
MURRAY E. TOWILL, DIRECTOR
BARBARA KIM STANTON, DEPUTY DIRECTOR

April 4, 1991

RECEIVED
APR 8 1991
ENGINEERING CONCEPTS

Department of General Planning
City & County of Honolulu
Municipal Office Building, 8th Floor
650 South King Street
Honolulu, Hawaii 96813
Attention: Matthew Higashida

Dear Sir:

Subject: Supplemental to Kapolei Business-Industrial Park EIS
Campbell Drainage Channel, Ewa, Oahu
TMK: 9-1-14:4

We wish to inform you that we have no comments to offer on the subject environmental impact statement.

Thank you for the opportunity to review the document.

Sincerely,

[signature]
Maurice H. Kaya
Energy Program Administrator

MHK:hkeis30

cc: The Estate of James Campbell
✓Engineering Concepts, Inc.
Office of Environmental Quality Control

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE ADJUTANT GENERAL
3949 DIAMOND HEAD ROAD, HONOLULU, HAWAII 96816-4495

RECEIVED
APR 9 1991
ENGINEERING CONCEPTS

April 5, 1991

Engineering Office

Department of General Planning
City & County of Honolulu
Municipal Office Building
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Dear Mr. Higashida:

Supplemental to Kapolei Business Industrial Park
Campbell Drainage Channel

Thank you for providing us the opportunity to review the above subject project.

We have no comments to offer at this time regarding this project.

Sincerely,

[signed]

Jerry M. Matsuda
Lieutenant Colonel
Hawaii Air National Guard
Contracting & Engineering Officer

cc: The Estate of James Campbell
Susan Sublett
✓Engineering Concepts, Inc.
Kenneth Ishizaki
OEQC

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

RECEIVED
MAY 16 1991
ENGINEERING CONCEPTS

In reply, please refer to:
File: EMD/CWB

Ref. No. 91-2-109X

May 8, 1991

P0514MT

Mr. Matthew Higashida
Department of General Planning
City & County of Honolulu
Municipal Office Building, 8th Floor
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Higashida:

Subject: Draft Environmental Impact Statement
Campbell Drainage Channel
Supplemental To Kapolei Business - Industrial Park EIS
Ewa, Oahu, Hawaii
March 1991

The Department of Health has reviewed the subject Draft Environmental Impact Statement and provides the following comments:

1. For construction activities involving clearing, grading and excavation of more than five (5) acres of total land area, a stormwater National Pollutant Discharge Elimination System (NPDES) permit application must be submitted. This application should be submitted to the Director of Health at least 90 days before the date on which construction is to commence.

2. Pursuant to Department of Health Administrative Rules, Chapter 11-54-09.1, a Water Quality Certification is required for the construction of the drainage canal. This application should be submitted to the Director of Health at least 180 days before the date on which construction is to commence.

3. Pursuant to Department of Health Administrative Rules, Chapter 11-54-01.1 and Code of Federal Regulations, Title 40, Part 131, Section 131.12, an Antidegradation Analysis is required for the proposed stormwater discharge. The Antidegradation Analysis should be submitted to the Director of Health at least 180 days before the date on which construction is to commence.

Should you have any questions, please call Mr. Mark Tomomitsu of the Engineering Section, Clean Water Branch, at telephone 543-8309.

Very truly yours,

for JOHN C. LEWIN, M.D.
Director of Health

cc: The Estate of James Campbell
Engineering Concepts, Inc.
Office of Environmental
Quality Control

ENGINEERING CONCEPTS, INC.
CONSULTING ENGINEERS

July 5, 1991

Dr. John C. Lewin, M.D.
Director of Health
State of Hawaii
Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801

Subject: Campbell Drainage Channel Draft Environmental Impact Statement Supplemental to Kapolei Business-Industrial Park EIS
Ewa, Oahu, Hawaii; TMK: 9-1-14:4 (portion)

Thank you for your May 8, 1991 letter concerning the draft environmental impact statement for the subject project. The following is offered in response to your comments.

We have met with your staff and were provided information regarding the requirements of the various regulations. We will continue to maintain contact with your staff to ensure compliance of these regulations.

Again, thank you for your comments. Please feel free to call me if you have any questions.

Very truly yours,

Kenneth Ishizaki, P.E.
Vice President

KI/js

cc: OEQC
Ms. Susan Sublett
Mr. Michael Warren
Mr. Bill Wanket
Mr. Matthew Higashida

250 Ward Avenue, Suite 206 • Honolulu, Hawaii 96814 • Tel: (808) 538-0920 • FAX: (808) 538-3463

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
KEITH W. AHUE
MANABU TAGOMORI
Dan T. Kochi

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION PROGRAM
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

REF:OCEA:JN

MAY 7 1991

File No.: 91-412
Doc. No.: 0672E

RECEIVED
MAY 9 1991
ENGINEERING CONCEPTS

The Honorable Benjamin Lee
Department of General Planning
City and County of Honolulu
Municipal Office Building, 8th Floor
650 South King Street
Honolulu, Hawaii 96813
Attn: Matthew Higashida

Dear Mr. Lee:

Subject: Draft EIS Supplemental to Kapolei Business-Industrial Park EIS Campbell Drainage Channel-Honouliuli, 'Ewa, Oahu TMK: 9-1-14: 4

Thank you for giving our Department the opportunity to comment on this matter. We have reviewed the materials you submitted and have the following comments.

Our Department's Historic Preservation Division comments that most of the area of the proposed drainage channel has been extensively modified and historic sites inventory found no surface sites. The Draft EIS notes the possibility of significant subsurface deposits in the beach dune at the west end of the proposed drainage channel and makes a commitment to carry out archaeological monitoring during excavation. We find this arrangement unacceptable, because sites are found during monitoring only after having sustained significant damage. If there is the probability of sites being present, then archaeological testing as part of the inventory survey process is needed. Thus, we ask that subsurface archaeological testing be completed and a report of results be submitted. If significant historic sites are present, then an acceptable mitigation plan will need to be worked out in consultation with our office and be executed prior to construction. If no significant sites are present, then historic preservation review concludes with no further work needed.

The Division of Land Management indicates that the applicant will be required to obtain an easement for that portion of the drainage channel built on State-owned lands makai of the private property. Also, the applicant must insure that lateral shoreline access is provided at the mouth of the channel.

Finally, Page 25 of the EIS indicates that access to the shoreline area can be made through Camp Malakole and the existing drainage way. Both sites are privately owned and we know of no formal public access (right-of-way) across the property. As such, we would recommend that if the drainage channel is approved, the applicant be required to construct a public beach right-of-way with parking to the beach from Malakole Road and if possible, the right-of-way be dedicated to the City and County of Honolulu.

Thank you for your cooperation in this matter. Please feel free to call me or Roy Schaefer at our Office of Conservation and Environmental Affairs, at 548-7837, if you have questions.

Very truly yours,

Keith W. Ahue
for William W. Paty

cc: The Estate of James Campbell
Engineering Concepts, Inc.
OEQC

ENGINEERING CONCEPTS, INC.
CONSULTING ENGINEERS

July 2, 1991

Mr. William W. Paty
Director
Department of Land and Natural Resource
P.O. Box 621
Honolulu, Hawaii 96809

Subject: Campbell Drainage Channel Draft Environmental
Impact Statement Supplement to Kapolei
Business-Industrial Park EIS
Ewa, Oahu, Hawaii; TMK: 9-1-14:4 (portion)

Thank you for your May 7, 1991 letter concerning the draft environmental impact statement for the subject project. The following is offered in response to your comments.

The Historical Preservation Division comments that archaeological monitoring during construction is unacceptable as a mitigative measure and recommends subsurface testing to locate and evaluate archaeological deposits before construction. We will comply with this requirement. The relevant sections of the report have been revised to include a recommendation for subsurface testing before construction. The results of this testing will be detailed in a report which will be submitted to DLNR for review and approval. If significant subsurface findings are located, an appropriate mitigation plan will be reported.

In response to the comment by the Division of Land Management, the applicant will obtain an easement for the portion of the drainage channel built on State-owned land, makai of the high-tide mark. Also, the applicant is willing to consider construction of a pedestrian bridge near the mouth of the channel to provide lateral shoreline access, provided a public agency accepts dedication of the bridge. Details regarding the specific location, design features, and the dedication of the bridge will need to be coordinated with government agencies.

In response to your final comment, public parking and shoreline access is being provided by the adjacent Camp Malakole development.

250 Ward Avenue, Suite 206 • Honolulu, Hawaii 96814 • Tel: (808) 538-0920 • FAX: (808) 538-3463

Again, thank you for your comments. Please feel free to call me if you have any questions.

Very truly yours,

Kenneth Ishizaki, P.E.
Vice President

KI/js

cc: OEQC
Ms. Susan Sublett
Mr. Michael Warren
Mr. Bill Wanket
Mr. Matthew Higashida

Attn: Lori/Cory — send copies to appropriate parties

JOHN WAIHEE
GOVERNOR

5/91-1478

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
AL PANG
JOYCE T. OMINE
JEANNE K. SCHULTZ
CALVIN M. TSUDA

IN REPLY REFER TO
HWY-PS
2.6780

RECEIVED '91 MAY -7 A10:27
OFC. OF ENVIRON. QUALITY CONTROL

May 6, 1991

MEMORANDUM

TO: Brian Choy, Director
Office of Environmental Quality Control

FROM: Edward Y. Hirata, Director
Department of Transportation

SUBJECT: DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT TO KAPOLEI BUSINESS-INDUSTRIAL PARK EIS, CAMPBELL DRAINAGE CHANNEL, EWA, OAHU, TMK: 9-1-14: POR. 4

Thank you for your transmittal requesting our comments on the subject supplemental DEIS.

We have the following comments:

1. The applicant should consider constructing a bridge over the proposed drainage channel instead of using a box culvert structure. The bridge must conform to current State highway design standards.

2. Plans for construction work within the State right-of-way shall be submitted to the Highways Division for our review and approval. A permit will be needed from the Highways Division Construction and Maintenance Branch.

RECEIVED
'91 MAY 14 AM 10:55
DEPT. OF GENERAL PLANNING
C & C HONOLULU

ENGINEERING CONCEPTS, INC.
CONSULTING ENGINEERS

June 6, 1991

Mr. Edward Y. Hirata, Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Subject: Campbell Drainage Channel Draft Environmental Impact Statement Supplemental to Kapolei Business-Industrial Park EIS
Ewa, Oahu, Hawaii; TMK: 9-1-14:4 (portion)

Thank you for your letter of May 6, 1991 concerning the subject project.

Construction plans for all work within the State right-of-way will be submitted for your department's review. The contractor for the project will be required to obtain a permit from the Highways Division, Construction and Maintenance Branch.

We will evaluate the feasibility of a bridge across the drainage channel and will remain in contact with your staff during the design phase of the project to ensure the concerns of your department are addressed.

Thank you again for your comments. If you have any questions or require additional information, please feel free to call me at 538-0920.

Very truly yours,

Kenneth Ishizaki, P.E.
Vice President

KI/js

cc: Ms. Susan Sublett
Mr. Michael Warren
Mr. Bill Wanket

250 Ward Avenue, Suite 206 • Honolulu, Hawaii 96814 • Tel: (808) 538-0920 • FAX: (808) 538-3463

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
220 SOUTH KING STREET
FOURTH FLOOR
HONOLULU, HAWAII 96813

BRIAN J. J. CHOY
Director

RECEIVED
MAY 24 1991
ENGINEERING CONCEPTS

May 23, 1991

Mr. Matthew Higashida
Department of General Planning
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Dear Mr. Higashida:

SUBJECT: Campbell Drainage Channel, Supplemental to Kapolei Business Industrial Park, Draft Environmental Impact Statement

We have reviewed the document listed above and have no comments to offer on the contents of this document. However, we were unable to find a section in the DEIS which listed "Unresolved Issues." We remind you that such a section is necessary to fulfill the requirements of Title 11, Department of Health Administrative Rules, Chapter 200-17, 18. We recommend that you include " Unresolved Issues" in your Final EIS.

Thank you for the opportunity to submit comments on this project.

Sincerely,

fa Brian J.J. Choy

cc: ✓The Estate of James Campbell
Engineering Concepts

ENGINEERING CONCEPTS, INC.

July 2, 1991

Mr. Brian J.J. Choy, Director
Office of Environmental Quality Control
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

Subject: Campbell Drainage Channel Draft Environmental Impact Statement Supplemental to Kapolei Business-Industrial Park EIS
Ewa, Oahu, Hawaii; TMK: 9-1-14:4 (portion)

Thank you for your letter of May 23, 1991 concerning the draft environmental impact statement for the subject project.

We will include a section regarding "Unresolved Issues" in the final environmental impact statement in compliance with Title 11, Department of Health Administrative Rules, Chapter 200-17, 18.

Please call me if any questions arise.

Very truly yours,

Kenneth Ishizaki, P.E.
Vice President

KI/js

cc: OEQC
Ms. Susan Sublett
Mr. Michael Warren
Mr. Bill Wanket
Mr. Matthew Higashida, DGP

5/91- 1767

OFFICE OF STATE PLANNING
Office of the Governor
STATE CAPITOL, HONOLULU, HAWAII 96813 TELEPHONE (808) 548-5893
JOHN WAIHEE, Governor

Ref. No. P-1956

May 16, 1991

RECEIVED
'91 MAY 20 AM 7:30
DEPT. OF GENERAL PLANNING
C & C HONOLULU

The Honorable Benjamin Lee
Chief Planning Officer
Department of General Planning
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Lee:

Subject: Supplemental to Kapolei Industrial Park EIS, Campbell Drainage Channel, Ewa, Oahu

We have reviewed the referenced document and have the following comments to offer for your consideration. A Coastal Zone Management (CZM) objective is to protect coastal ecosystems from disruption and minimize adverse impacts on all coastal ecosystems. This objective also states that land and water uses which violate State water quality standards should be prohibited. Pages 19 and 48 indicate that the coastal water quality already exceeds the Department of Health's water quality standards, and that this project will also have an adverse impact on water quality by increasing turbidity in the nearshore vicinity. The EIS should discuss mitigation measures that would decrease these impacts, such as sedimentation traps, etc. The impacts of the project should be mitigated so that the proposal does not adversely impact water quality.

We also note on pages 47-48, Alternatives to the Proposed Project, that an alternative to contain the runoff on land, as opposed to depositing it into the ocean, was not discussed. This alternative and a discussion on the feasibility of that alternative should be incorporated into the EIS.

Another CZM objective is to provide coastal recreational opportunities accessible to the public. We note that page 53 of the DEIS states that public access will be provided by the access/maintenance roads along both sides of the channel. A discussion on the arrangements for keeping this roadway open to the public should be included. Also, the EIS should indicate lateral public access across the channel. A preliminary site plan should be included in the EIS to illustrate public access along and across the channel.

Thank you for allowing us the opportunity of reviewing this DEIS. If you have any questions, please contact Lorene Maki of the Coastal Zone Management Program at 548-3961.

Sincerely,

for Harold S. Masumoto
Director

ENGINEERING CONCEPTS, INC.
CONSULTING ENGINEERS

July 30, 1991

Mr. Harold Masumoto
Director, Office of State Planning
Office of the Governor
State Capitol
Honolulu, Hawaii 96813

Subject: Campbell Drainage Channel Draft Environmental Impact Statement Supplemental to Kapolei Business-Industrial Park EIS
Ewa, Oahu, Hawaii, TMK: 9-1-14:4 (Portion)

Dear Mr. Masumoto:

Thank you for your May 16, 1991 letter concerning the Draft Environmental Impact Statement for the subject project.

Table 2 (DEIS, pg. 19) will be clarified. Violation of State Water Quality Criteria cannot be ascertained based on the data gathered. The water quality standards are based on many samples taken over a period of time. A discussion of the State Water Quality Standards and comparison to the anticipated discharge parameters will be included in the Final EIS.

The upland (mauka) portion of the watershed is expected to be the primary source of sediment in runoff waters. Impacts on receiving water quality due to sediment in storm runoff will be mitigated by construction of detention basins within the proposed Makaiwa Hills development, a project encompassing the mauka portion of the drainage channel watershed. These detention basins have been identified in the Final EIS for Makaiwa Hills (April 1991) as a means of mitigating storm runoff. The basins will also act as sedimentation basins, removing silt from runoff waters prior to entrance into the drainage channel. Sediment traps will be considered in the channel design, pending acceptance by the City and County Department of Public Works for maintenance.

The water quality implications of each and every facility or development that might be later constructed within the drainage area cannot be addressed at this time because these developments are not known at this time. Runoff from any facility into the storm drain system constitutes a non-point source contribution, for which no or minimal regulation presently exists even though such runoff may constitute a source of pollution to the nearshore environment. This situation will soon change. On November 16,

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1990, the U.S. Environmental Protection Agency promulgated final regulations governing storm water discharges from industrial and municipal systems. The regulations require permits, issued as part of the NPDES program (the existing point-source regulation permitting scheme under the federal Clean Water Act), for storm water discharges associated with industrial activity. These regulatory mechanisms constitute the means by which significant adverse impacts from pollutants in the discharge will be avoided.

The Final EIS will include a discussion on the feasibility of an alternative to contain stormwater runoff on land instead of allowing discharge into the ocean.

Other agencies have also expressed concerns that public access at the shoreline will be interrupted by the drainage channel. Consequently, the developer is willing to consider construction of a pedestrian bridge near the mouth of the channel to provide lateral shoreline access, provided a public agency accepts dedication of the bridge. Details regarding the specific location, design features, and the dedication of the bridge will still need to be coordinated with government agencies.

Again, thank you for your comments. Please feel free to call me if you have any questions.

Very truly yours,

Kenneth Ishizaki, P.E.
Vice President

KI/js

cc: OEQC
Ms. Susan Sublett
Mr. Michael Warren
Mr. Bill Wanket
Mr. Matthew Higashida

University of Hawaii at Manoa

Environmental Center
A Unit of Water Resources Research Center
Crawford 317 • 2550 Campus Road • Honolulu, Hawaii 96822
Telephone: (808) 956-7361

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MAY 24 1991
ENGINEERING CONCEPTS

May 23, 1991
RE:0581

Mr. Matthew Higashida
Department of General Planning
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Higashida:

Draft Environmental Impact Statement (DEIS)
Campbell Drainage Channel
(Supplement to Kapolei Business Industrial EIS)
Ewa, Oahu

The above referenced document proposes construction of a drainage channel which will occupy an area of approximately 6 acres and serve a 2400 acre watershed area which includes a portion of Campbell Industrial Park. The proposed channel is expected to have a bottom width of 100 feet and extend approximately 1750 feet in an east-west direction to the ocean. Excavation is anticipated to be from hard coral, therefore concrete lining will not be used.

This review was prepared with the assistance of Hans-Jurgen Krock, Ocean Engineering; Yu-Si Fok, Water Resources Research Center; and Alex Buttaro of the Environmental Center.

Water Quality

Our reviewers suggest that more site specific data in addition to computer modeling should be included in the analysis of plume discharge in the consultants report (Appendix C).

A comparison of the anticipated discharge parameters to the State water quality standards should be made, and this information should be included in the water quality impact section (section 4.A) with a statement as to whether or not the State standards will be met. With the exception of suspended solid concentrations, no other parameters are mentioned in the impacts section. Our reviewers note that ground water and surface water are

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affected by past and present agricultural practices in the area. Mention of nutrient, biochemical oxygen demand (BOD) and metals loading of drainage waters, and the resultant plume characteristics should be included in the appropriate sections of the EIS in order to meet the content requirements pursuant to the EIS Rules, Sections 11-200-16, and 11-200-17(b) and (i). Our reviewers suggest that these parameters be incorporated into the survey design and findings of the consultant's report in Appendix C.

Marine Biology

Suggestions from our reviewers indicate that in addition to the literature review in the consultant's report, there is a need for substantial studies with respect to marine biota, due to considerable changes in the vicinity over the past few years. Subtidal studies should be conducted, and the impacts of the channel on the coral communities must be adequately addressed in the appropriate sections pursuant to EIS Rules Sections 11-200-16, and 11-200-17(b) and (i).

Also, any substantive reliance on data from the eastern drainage channel as indicative of potential impacts from the new channel is probably not warranted. The nearshore and offshore subtidal communities in the region of the eastern channel differ significantly (see Appendix B, page 37). Thus, water quality and discharge related impacts are likely to be of greater concern North of Barber's Point where marine benthic communities are more fully developed.

Coastal Sedimentation

Our reviewers suggest that the EIS needs to adequately address coastal sediment movement. We are concerned that drift sand and gravel may be deposited at the project canal outlet and render it useless for flood water discharge into the ocean.

Threatened and Endangered Species

According to the consultants report, no officially listed or endangered plants occur along the drianage site (Appendix E, page 4). Yet, the Federal EIS for Barber's Point Harbor lists five species located in the drainage channel area (Appendix B-2, page 2): *Capparis sandwichiana* DC. var. *sandwichiana*; *Euphorbia skottsbergii* var. *kalaeloana* Sherff; *Euphorbia skottsbergii* Sherff var. *skottsbergii*; *Eragrostis paupera* Jedw.; and *Achyranthes splendens* var. *rotundata* Hbd., which was said by the consultant to be absent from the project site. With the exception of *Achyranthes*, why are these species absent from this report's survey, yet documented to be present in the area, in the survey for the 1976 Barber's Point EIS?

Pedestrian Bridge

Our reviewers strongly suggest that the project be modified to include the pedestrian bridge recommended by the City and County of Honolulu, Department of Parks and Recreation (page 62), to maintain the continuous pedestrian access that presently extends from Barber's Point Harbor to

Barber's Point Naval Air Station, or at a minimum, propose an alternative mitigative measure that will be implemented.

General Summary

Serious concern over the lack of information collected on the specific site was expressed by our reviewers. Due to the considerable changes that have occurred in the area over the last few years, additional current studies lending insight into the impacts of the specific aforementioned water quality parameters upon marine biota and plume should be included pursuant to EIS Rules previously cited.

Thank you for the opportunity to comment on this document and we hope you will find our comments helpful.

Sincerely,

John T. Harrison, Ph.D.
Environmental Coordinator

cc: OEQC
Susan Sublett, The Estate of James Cambell
✓Kenneth Ishizaki, Engineering Concepts
Roger Fujioka, WRRC
Hans-Jurgen Krock, Ocean Engineering
Yu-Si Fok, Water Resources Research Center
Alex Buttaro

ENGINEERING CONCEPTS, INC.
CONSULTING ENGINEERS

August 14, 1991

Mr. John T. Harrison, Ph.D,
Environmental Center
University of Hawaii at Manoa
Crawford 317
2550 Campus Road
Honolulu, Hawaii 96822

Subject: Campbell Drainage Channel Draft Environmental Impact Statement Supplemental to Kapolei Business-Industrial Park EIS
Ewa, Oahu, Hawaii; TMK: 9-1-14:4 (Portion)

Thank you for your May 23, 1991 letter concerning the Draft Environmental Impact Statement for the subject project. The following is offered in response to your comments.

Water Quality

Additional site specific data will be obtained as part of the process of permitting for the discharge under the new NPDES regulations covering storm drains. Considerable data have been collected for the Ko Olina Resort monitoring, encompassing the coastline north of the deep draft harbor. Only portions of these data sets have been summarized in reports. The area covered begins some 4000 feet north of the proposed drainage channel outlet. The most recent survey, involving 12 stations, was conducted on April 7 and 8, 1990. Results reported by OI Consultants (1990) suggested that only mean phosphate exceeded state water quality criteria at this time. In an earlier study (OI Consultants, 1987), mean levels of turbidity, chlorophyll a, ammonium, total nitrogen, and total phosphorus exceeded water quality criteria. Unfortunately, the calculated "means" in both cases are based on spatial, not temporal, data. Thus the relationship of the existing water quality and the state water quality standards can only be inferred.

Assessing whether the proposed drainage will or will not meet water quality standards is far more complex than simply comparing probable concentrations of constituents in the drainage effluent with appropriate water quality criteria. Most properties of the discharge water will not be within acceptable ranges for marine water quality criteria. The result of the discharge of this terrestrial runoff water will impact the nearshore water quality over an area and for a period of time that will depend upon the volume and the duration of discharge. These factors will depend upon the nature of the storm(s) generating the discharge.

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The discharge process has been modeled for the proposed outlet in Appendix C assuming various storm intensities. In order to predict whether the discharge from the proposed outlet will violate any of the water quality criteria, the duration of the impact at any given location is more important than the distribution of concentrations of non-toxic substances. The water quality criteria require establishing the probability of occurrence of certain concentrations. For example, the turbidity of the nearshore waters will exceed the criterion of 1.0 ntu following a storm discharge. So long as this turbidity is not exceeded more than 2 percent of the time (one week per year), the criterion is not violated.

Based on a rainfall frequency analysis of 57 non-consecutive years of daily rainfall data, it is anticipated that rainfall producing runoff will occur about 5 percent of the time. Therefore, water quality criteria may be exceeded about 3 percent of the time.

Marine Biology

We presume that the "considerable changes in the vicinity [of the project] over the past few years" referenced by the reviewers alludes to changes on the land (i.e., harbor construction, Ko Olina Lagoons) and not changes in the benthic communities offshore. The results of the literature review and the reconnaissance survey in 1990 provide no evidence of such changes in the marine communities offshore of the project during the period covered by these studies. Although Brock (AECOS, 1985) described damage to corals on this reef flat attributed to waves generated by Hurricane Iwa, it seems unlikely that the abundance and diversity of reef inhabitants has improved since the several referenced studies were conducted (1975, 1985). Thus, additional surveys will not reveal a more sensitive biota or otherwise alter the assessment of impacts on the coral community as presented in the DEIS and Appendix B.

Although the area off the eastern drainage channel was briefly surveyed, little or no reliance was placed on any marine biological observations made on the reef. Data from the eastern drainage channel served to provide (1) a characterization of the environment that probably would develop within the new channel, and (2) some water quality characterization from this environment.

Differences between the shoreline, nearshore, and reef environments can be found west from Barbers Point as compared with comparable areas north from Barbers Point. Although definitive, site specific data are lacking (as pointed out in Appendix B), it is an oversimplification to imply that any area north along the coast from the lighthouse is significantly different from any area east along the coast from the lighthouse. What is known is that marine communities well north from Barbers Point (and generally north of the deep draft harbor) are significantly different from marine communities well east from Barbers Point.

Coastal Sedimentation

Page 15 of the DEIS describes the coastline as characterized by calcareous beachrock and hard coral limestone shelves with a paucity of sandy material, thus littoral transport processes are extremely limited. Sand and coral rubble material in the backshore region have been deposited by storm wave action, where the rocky limestone shoreline traps the material after it is carried inland by the large overtopping waves. Typical wave energy is sufficiently high to keep the shoreline scoured of sediment. As stated on page 39 of the DEIS, the potential for channel blockage due to infilling by sediment transport is not expected to be a problem.

Threatened and Endangered Species

Char and Associates did not find any threatened and endangered plants on the site of the proposed drainage channel during their field survey. Also, during the U.S. Fish and Wildlife Service sponsored 'Ewa Plains Botanical Survey in 1979, no rare, threatened or endangered plants were mapped from the subject project area.

The five species listed in the EIS for the Barbers Point Harbor were collected or were known to occur on the 'Ewa Plains area, in general. Of the five, only Achyranthes splendens var. rotundata, an officially listed endangered species, occurs nearby (northeast portion of Camp Malakole near the powerline and Malakole Road). Capparis sandwichiana or maiapilo. the native caper, is no longer considered for endangered species status as the population is more extensive than previously known (Federal Register 55(35): 6184-6229). In the most recent treatment of the Hawaiian flora, Wagner et al.,1990, Manual of the flowering plants of Hawai'i, Eragrostis paupera is considered indigenous and not a candidate for endangered species status. Also in the flora, Euphorbia skottsbergii var. kalaeloana has been lumped with var. skottsbergii and the genus changed to Chamaesyce. Chamaesyce skottsbergii is an officially listed endangered species. The plants were found around the old quarry, now the site of the deep draft harbor.

Pedestrian Bridge

Other agencies have also expressed concerns that public access at the shoreline will be interrupted by the proposed drainage channel. Consequently, the developer is willing to consider construction of a pedestrian bridge near the mouth of the channel to provide lateral shoreline access, provided a public agency accepts dedication of the bridge. Details regarding the specific location, design and dedication of the bridge will still need to be coordinated with government agencies. If a government agency is not willing to accept the dedication of the pedestrian bridge, the developer will provide public access along both sides of the channel as an alternative.

Again, thank you for your comments. Please feel free to call me if you have any questions.

Very truly yours,

Kenneth Ishizaki, P.E.
Vice President

KI/js

cc: OEQC
Ms. Susan Sublett
Mr. Mike Warren
Mr. Bill Wanket
Mr. Matthew Higashida

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU

COPY

RECEIVED
MAY 23 1991
ENGINEERING CONCEPTS

May 21, 1991

TO: BENJAMIN B. LEE, DIRECTOR
DEPARTMENT OF GENERAL PLANNING

FROM: KAZU HAYASHIDA, MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT DATED MARCH 1991 FOR THE PROPOSED CAMPBELL DRAINAGE CHANNEL, SUPPLEMENTAL TO KAPOLEI BUSINESS INDUSTRIAL PARK DEVELOPMENT, TMK: 9-1-14: POR. 4

We have no objections to the proposed drainage project. We request that construction drawings be submitted for our review and approval if the drainage project will affect our water main along Malakole Road.

If you have any questions, please contact Bert Kuioka at 527-5235.

cc: The Estate of James Campbell
Engineering Concepts, Inc.
Office of Environmental Quality Control

ENGINEERING CONCEPTS, INC.

July 2, 1991

Mr. Kazu Hayashida
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96813

Subject: Campbell Drainage Channel Draft Environmental Impact Statement Supplemental to Kapolei Business-Industrial Park EIS
Ewa, Oahu, Hawaii; TMK: 9-1-14:4 (portion)

Thank you for your letter of May 21, 1991 concerning the draft environmental impact statement for the subject project.

Construction plans will be submitted for your department's review and approval. We will remain in contact with your staff during the design phase of the project to ensure the concerns of your organization are addressed.

Thank you again for your comments. If you have any questions or require additional information, please feel free to call me at 538-0920.

Very truly yours,

Kenneth Ishizaki, P.E.
Vice President

KI/js

cc: OEQC
Ms. Susan Sublett
Mr. Michael Warren
Mr. Bill Wanket
Mr. Matthew Higashida, DGP

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APR 1 0 1991
ENGINEERING CONCEPTS

PB 91-449

April 5, 1991

MEMO TO: BENJAMIN LEE, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

ATTN: MATTHEW HIGASHIDA

FROM: HERBERT K. MURAOKA
DIRECTOR AND BUILDING SUPERINTENDENT

SUBJECT: CAMPBELL DRAINAGE CHANNEL - SUPPLEMENTAL TO KAPOLEI BUSINESS-INDUSTRIAL PARK EIS DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)

We have reviewed the DEIS for the subject project and have no comments to offer.

HERBERT K. MURAOKA
Director and Building Superintendent

JH:jo
cc: J. Harada
Campbell Estate (Susan Sublett)
Engineering Concepts (Kenneth Ishizaki)
Office of Environmental Quality Control

FIRE DEPARTMENT
CITY AND COUNTY OF HONOLULU
1455 SOUTH BERETANIA STREET, ROOM 305
HONOLULU, HAWAII 96814

FRANK F. FASI
MAYOR

LIONEL E. CAMARA
FIRE CHIEF

DONALD S.M. CHANG
DEPUTY FIRE CHIEF

RECEIVED
APR 1 6 1991
ENGINEERING CONCEPTS

April 12, 1991

TO: BENJAMIN B. LEE, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

ATTN: MATTHEW HIGASHIDA

FROM: LIONEL E. CAMARA, FIRE CHIEF

SUBJECT: SUPPLEMENTAL TO KAPOLEI BUSINESS-INDUSTRIAL PARK EIS CAMPBELL DRAINAGE CHANNEL - EWA, OAHU, TMK 9-1-14:4

We have reviewed the application for the above subject request and have no objections or comments to the proposal.

Should you have any questions, please contact Acting Assistant Chief Attilio Leonardi of our Administrative Services Bureau at 943-3838.

LIONEL E. CAMARA
Fire Chief

AKL:ny

Copy to: Estate of James Campbell
Engineering Concepts, Inc.
Office of Environmental Quality Control (OEQC)

POLICE DEPARTMENT
CITY AND COUNTY OF HONOLULU
1455 SOUTH BERETANIA STREET
HONOLULU, HAWAII 96814 - AREA CODE (808) 943-3111

FRANK F. FASI
MAYOR

MICHAEL S. NAKAMURA
CHIEF

HAROLD M. KAWASAKI
DEPUTY CHIEF

RECEIVED
MAY 1 8 1991
ENGINEERING CONCEPTS

OUR REFERENCE KN-LK

May 15, 1991

TO: BENJAMIN B. LEE, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

FROM: MICHAEL S. NAKAMURA, CHIEF OF POLICE
HONOLULU POLICE DEPARTMENT

SUBJECT: SUPPLEMENT TO KAPOLEI BUSINESS-INDUSTRIAL PARK EIS
CAMPBELL DRAINAGE CHANNEL

We have reviewed the draft environmental impact statement for the proposed drainage channel. Implementing the mitigative measures mentioned in section VIII C should minimize the project's impact on our department.

Thank you for the opportunity to comment.

MICHAEL S. NAKAMURA
Chief of Police

By CHESTER E. HUGHES
Assistant Chief of Police
Support Services Bureau

cc: Estate of James Campbell
Engineering Concepts, Inc.
OEQC

DEPARTMENT OF GENERAL PLANNING
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

BENJAMIN B. LEE
CHIEF PLANNING OFFICER

ROLAND D. LIBBY, JR.
DEPUTY CHIEF PLANNING OFFICER

RECEIVED
JUL 3 1991
ENGINEERING CONCEPTS

MH 3/91-1029

June 25, 1991

Mr. Kenneth Ishizaki, P.E.
Engineering Concepts, Inc.
250 Ward Avenue, Suite 206
Honolulu, Hawaii 96814

Dear Mr. Ishizaki:

Draft Environmental Impact Statement (DEIS) for the Proposed Campbell Drainage Channel, Supplemental to Kapolei Business Industrial Park EIS, TMK 9-1-14: 04

Thank you for the opportunity to review and comment on the subject DEIS. We have the following comments to offer for your consideration.

1. A summary of unresolved issues does not appear in the DEIS and should be included in the Final EIS.

2. Section II.B. PROJECT DESCRIPTION, page 9, states that ". . . A 1-foot horizontal to 4-foot vertical (1H:4V) slope ratio will be used for the channel side slope."

However, according to APPENDIX A (GEOTECHNICAL ENGINEERING INVESTIGATION, PROPOSED DRAINAGE CHANNEL, JAMES CAMPBELL INDUSTRIAL PARK, BARBERS POINT, OAHU, HAWAII by DAMES & MOORE), page 5, the consultant is recommending that a 2 Horizontal to 1 Vertical (2H:1V) slope ratio be used for channel side slopes.

The obvious difference between the proposed and recommended slope ratios for channel side slopes should be consistent and clarified in the Final EIS.

3. Section VII.E. RECREATIONAL RESOURCES, page 44, states that "Maintenance roads located on both banks along the entire length of the drainage channel will facilitate shoreline access by the public." In addition, Section IX.B. STATE FUNCTIONAL PLANS, page 51, mentions that access to the shoreline will be facilitated by access/maintenance roads, located on both banks along the entire length of the drainage channel.

The applicant should consider providing lateral shoreline access via a pedestrian bridge, which crosses over the proposed drainage channel. This information should be appropriately included in Sections VII.E. RECREATIONAL RESOURCES and XI.B. STATE FUNCTIONAL PLANS, respectively.

4. We recommend an alternate design approach be investigated which would have a less negative visual impact and could provide landscaping to screen the channel. Rather than building a large concrete channel to accommodate a 100-year storm, the lined portion of the channel could be designed to carry a nominal volume of water in this low rainfall area. The channel could be stepped to a landscaped bank on each side capable of containing the 100-year storm peak capacity, while offering a visual amenity. Refer to the attached sketch.

We hope these comments are helpful in preparing the Final EIS. Should there be any questions regarding our comments, please contact Mathew Higashida of our staff at 527-6056.

Sincerely,

BENJAMIN B. LEE
Chief Planning Officer

BBL:ak

Attachment
cc: The Estate of James Campbell
Office of Environmental Quality Control
Department of Public Works

ENGINEERING CONCEPTS, INC.
CONSULTING ENGINEERS

July 15, 1991

Mr. Benjamin B. Lee
Chief Planning Office
Department of General Planning
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Subject: Campbell Drainage Channel Draft Environmental Impact Statement Supplemental to Kapolei Business-Industrial Park EIS
Ewa, Oahu, Hawaii; TMK: 9-1-14:4 (portion)

Thank you for your June 25, 1991 letter concerning the Draft Environmental Impact Statement (DEIS) for the subject project. The following is offered in response to your comments.

A summary of the unresolved issues will be included in the Final EIS.

As stated in the DEIS, it had been anticipated that most of the proposed drainage channel was to be unlined. However, the City and County of Honolulu, Department of Public Works agreed to accept the drainage channel on the condition that the channel be fully lined. Therefore, the proposed drainage channel will be fully concrete lined with vertical sides.

The developer is willing to consider construction of a pedestrian bridge near the mouth of the channel to provide lateral shoreline access, provided a public agency accepts dedication of the bridge. Details regarding the specific location, design features, and the dedication of the bridge will still need to be coordinated with government agencies.

Public access along both sides of the channel is an alternative the developer will consider, if a public agency is not willing to accept the dedication of the pedestrian bridge.

Page 9, section B of the DEIS states "Tidal influence will extend 2000 to 2500 ft. inland from the channel mouth." For this reason the alternate design suggested in your letter is not possible. Further, the Department of Public Works requires that the channel be lined. This would also make the alternate design not possible.

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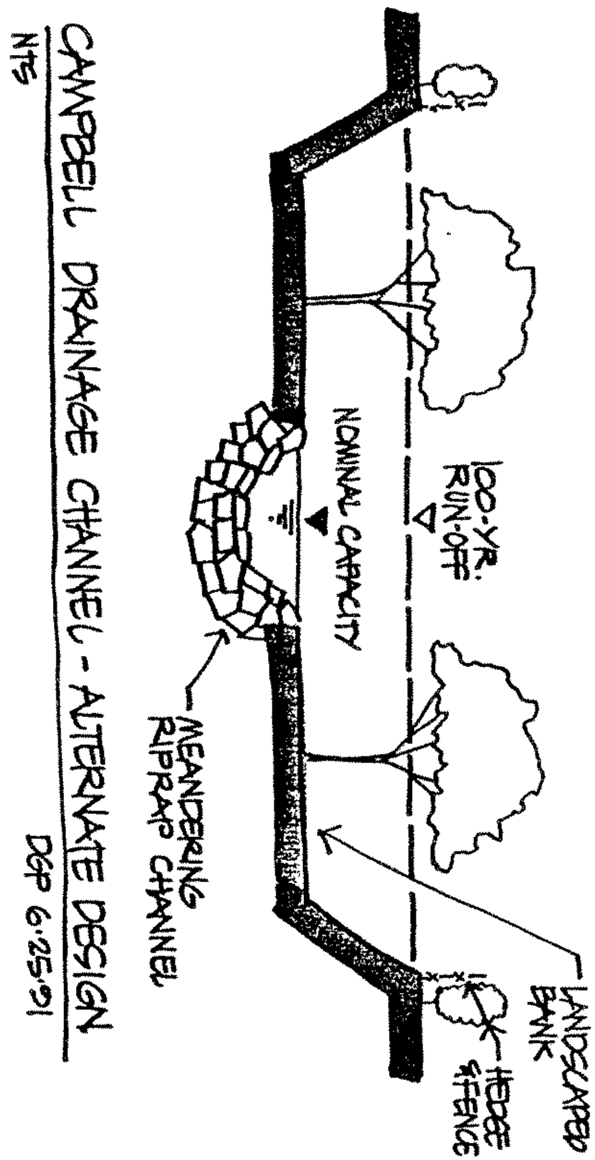

Campbell Drainage Channel Draft Environmental
Impact Statement Supplemental to Kapolei
Business-Industrial Park EIS
Ewa, Oahu, Hawaii; TMK: 9-1-14:4 (portion)
July 15, 1991
Page 2

Again, thank you for your comments. Please feel free to call me if you have any questions.

Very truly yours,

Kenneth Ishizaki, P.E.
Vice President

KI/js

cc: OEQC
Ms. Susan Sublett
Mr. Michael Warren
Mr. Bill Wanket

DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 5TH FLOOR
HONOLULU, HAWAII 96813
PHONE: 523-4427 • FAX 527-5498

FRANK F. FASI
MAYOR

MIKE N. SCARFONE
DIRECTOR

GAIL M. KAITO
DEPUTY DIRECTOR

RECEIVED
MAY 25 1991
ENGINEERING CONCEPTS

May 23, 1991

MEMORANDUM

TO: Benjamin B. Lee, Chief Planning Officer
Department of General Planning

FROM: Michael N. Scarfone

SUBJECT: Draft Environmental Impact Statement (EIS) for the Campbell Drainage Canal

Thank you for the opportunity to review the subject draft EIS, which is a supplement to the Kapolei Business - Industrial Park EIS. The Department has no comments to offer at this time.

MICHAEL N. SCARFONE
Director

cc: Susan Sublett, The Estate of James Campbell
✓Kenneth Ishizaki, Engineering Concepts, Inc.

5/91-1960

DEPARTMENT OF LAND UTILIZATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813 • (808) 523-4432

FRANK F. FASI
MAYOR

DONALD A. CLEGG
DIRECTOR

LORETTA K.C. CHEE
DEPUTY DIRECTOR

RECEIVED
JUN 1 9 1991
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(DJK)

May 30, 1991

MEMORANDUM

TO: BENJAMIN B. LEE, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

FROM: DONALD A. CLEGG, DIRECTOR

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) FOR THE CAMPBELL DRAINAGE CHANNEL, EWA, OAHU
TAX MAP KEY: 9-1-14: POR. 4

Thank you for the opportunity to comment on the above project. We have reviewed the DEIS and offer the following comments:

1. Fauna Concerns

The development area may be a foraging site for the Hawaiian Owl (the Pueo) and the Hawaiian Stilt, which are endangered species. Because of this, comments on this specific issue should be solicited from either the United States Fish and Wildlife Service or the Department of Land and Natural Resources' Forestry and Wildlife Division. This will provide an assessment of the impact of the proposed development on these endangered species.

2. Marine Life

a. The belt (or zone) of Pterocladia present along the seaward margin of the bench is a significant food source for marine turtles and a portion would be lost and not replaced after construction. The loss must be viewed as contributory to a cumulative destruction of marine bench habitat that has and may occur (for example, Barbers Point Harbor and Ko Olina Lagoons). Therefore, a discussion of mitigative measures should be included.

b. If blasting with explosives is required to remove the limestone bench, how will you ascertain that there are no sea turtles in the area at the time of the blasting? These species are protected under Federal Law and a major concern would be the death or injury of them.

c. The proposed drainage channel will most likely affect fish populations and other marine life (sea urchins, coral, algae) in the area. Mitigative measures to prevent their destruction should be discussed.

3. Water Quality

a. The amount of storm water runoff should be discussed.

b. Would there be inclusion of siltation basins between the proposed channel and more mauka areas to reduce the quantity of soil runoff finding its way into the discharge? The most significant source of suspended material of potential harm to the marine environment is likely to be the gulches feeding into the system from the Waianae Range in the vicinity of Makakilo.

c. What will be the depth of the plume relative to the bottom? This affects the salinity of the water in the area, which can cause potential harm to benthic organisms, such as coral.

4. Shoreline Access

Lateral access will be blocked with the construction of the 100-foot drainage channel. Will a structure be built, such as a bridge so that the public will be able to cross the channel?

5. Alternatives

One alternative mentioned in the DEIS was to route runoff to an existing drainage channel, located east of the Kapolei Business Industrial Park (KBIP) site, between the existing industrial park and Barbers Point Naval Air Station. The DEIS stated that the existing drainage channel does not have adequate capacity to handle additional runoff. What would be the possibility of increasing the size of the existing channel?

6. **Time Table**

What length of time is anticipated for construction? The DEIS only mentions that construction will begin the first quarter of 1992.

If you have any questions, please contact Dana Kohama of our staff at 527-5038.

DONALD A. CLEGG
Director of Land Utilization

DAC:lg

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'91 MAY 30 PM 3:51

ENGINEERING CONCEPTS, INC.
CONSULTING ENGINEERS

July 30, 1991

Mr. Donald A. Clegg
Director, Department of Land Utilization
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Subject: Campbell Drainage Channel Draft Environmental Impact Statement Supplemental to Kapolei Business-Industrial Park EIS
Ewa, Oahu, Hawaii; TMK: 9-1-14:4 (Portion)

Dear Mr. Clegg:

Thank you for your May 30, 1991 letter concerning the Draft Environmental Impact Statement for the subject project. The following is offered in response to your comments.

1. Fauna Concerns

The Fauna consultant for the project has contacted the United States Fish and Wildlife Service (John Engbring and Andy Yuen) and the State Department of Land and Natural Resources Forestry and Wildlife Division (Carol Terry) regarding the likely use of the project site by the Hawaiian Stilt and the Hawaiian Owl. It is their opinion that this particular site is not of importance to the birds in question. The Hawaiian Stilt and Hawaiian Owl may be seen in the project area on occasion, but this particular site is probably not critical to their long term success.

2. Marina Life

a. The *Pterocladia* found along the front of the marine bench is probably utilized to some extent by marine turtles as a foraging resource. A portion of the substratum supporting *Pterocladia* will be removed by the construction of the channel and mitigating this loss will be difficult. However, the loss must be viewed in the context of the amount of suitable habitat remaining, which would be substantial along this coast. The potential exists for a foraging habitat to be created along the walls of the proposed channel near the mouth, although *Pterocladia* specifically might not grow there.

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b. Blasting with explosives is not expected to occur during the construction of the drainage channel.

c. Some destruction of marine life will occur during construction, particularly because substratum is being removed. Fishes will be least impacted by this process; attached flora and fauna will be most impacted. No rare or endangered species are involved. Recovery of benthic populations is expected, although the nature of the assemblages that recolonize the new substrata resulting from the construction might differ from those that inhabited the area prior to construction.

3. <u>Water Quality</u>

a. The amount of storm water discharged by storms of different magnitudes was included in Table 6 of the DEIS. The Final EIS will include a discussion of the storm water runoff quantity and its association with various rainfall intensities and rainfall frequencies.

b. Due to the lack of available land space it is not possible to include sedimentation basins within the project site. However, the proposed Makaiwa Hills development, located in the upland drainage area mauka of the freeway, has identified detention basins as a means to mitigate storm runoff (Makaiwa Hills Final EIS, April 1991). These detention basins will settle sediment and debris prior to entrance into the drainage channel.

c. The depth of the plume generated by different outflow volumes is included in the plume modeling studies (Appendix C and DEIS Section VII) and was used to assess impacts on the offshore benthic communities (Appendix B and DEIS Section VII.F).

As discussed in DEIS section VII.A, the salinity concentration depressed to a level which may be potentially harmful to benthic organisms is expected to extend 1,300 feet to a depth of (-) 15 feet for the worst case condition. Salinity depression is not

likely to adversely impact the coral population, because the significant coral coverage is found outside the affected area.

4. <u>Shoreline Access</u>

The developer is considering construction of a pedestrian bridge near the mouth of the channel to provide lateral shoreline access, provided a public agency accepts dedication of the bridge. Details regarding the specific location, design features, and dedication of the bridge will still need to be coordinated with government agencies.

5. <u>Alternatives</u>

Routing storm runoff to the existing drainage channel would require an increase in the existing channel capacity. A capacity increase may be achieved by increasing the channel width to two times (2x) its present width or increasing the depth to 2x its present depth. Widening the channel is not possible due to the existing developments along both sides and increasing the depth of the channel is not hydraulically feasible.

6. <u>Time Table</u>

Construction of the proposed drainage channel is anticipated to begin in the summer of 1992. The length of time anticipated for construction is one year.

Very truly yours,

Kenneth Ishizaki, P.E.,
Vice President

KI/js

cc: OEQC
Ms. Susan Sublett
Mr. Michael Warren
Mr. Bill Wanket

DEPARTMENT OF PARKS AND RECREATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

WALTER M. OZAWA
DIRECTOR

ALVIN K.C. AU
DEPUTY DIRECTOR

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MAY 1 8 1991
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May 16, 1991

TO: BENJAMIN B. LEE, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

FROM: WALTER M. OZAWA, DIRECTOR

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) FOR THE CAMPBELL DRAINAGE CHANNEL SUPPLEMENT TO KAPOLEI BUSINESS-INDUSTRIAL PARK ENVIRONMENTAL IMPACT STATEMENT
TAX MAP KEY 9-1-14:4 (POR.)

We have reviewed the DEIS for the proposed Campbell drainage channel and make the following comments and recommendations.

Public parking and a public beach right-of-way will be provided at Malakole Industrial Sudivision immediately north of the proposed drainage channel. The proposed channel will deny continuous lateral shoreline access from this beach right-of-way.

The report also indicates that both sides of the proposed channel will be fenced and gated, further restricting public access to and along the shoreline. We recommend that the applicant contact Jason Yuen of our Advance Planning Branch at 527-6315 to discuss our recreational concerns to the proposed channel project.

Thank you for the opportunity to comment. We would appreciate receiving a copy of the final EIS when it is prepared.

Steven [signature]
For WALTER M. OZAWA, Director

WMO:el

Attachment

cc: Department of Land Utilization
Campbell Estates
✓Engineering Concepts, Inc.

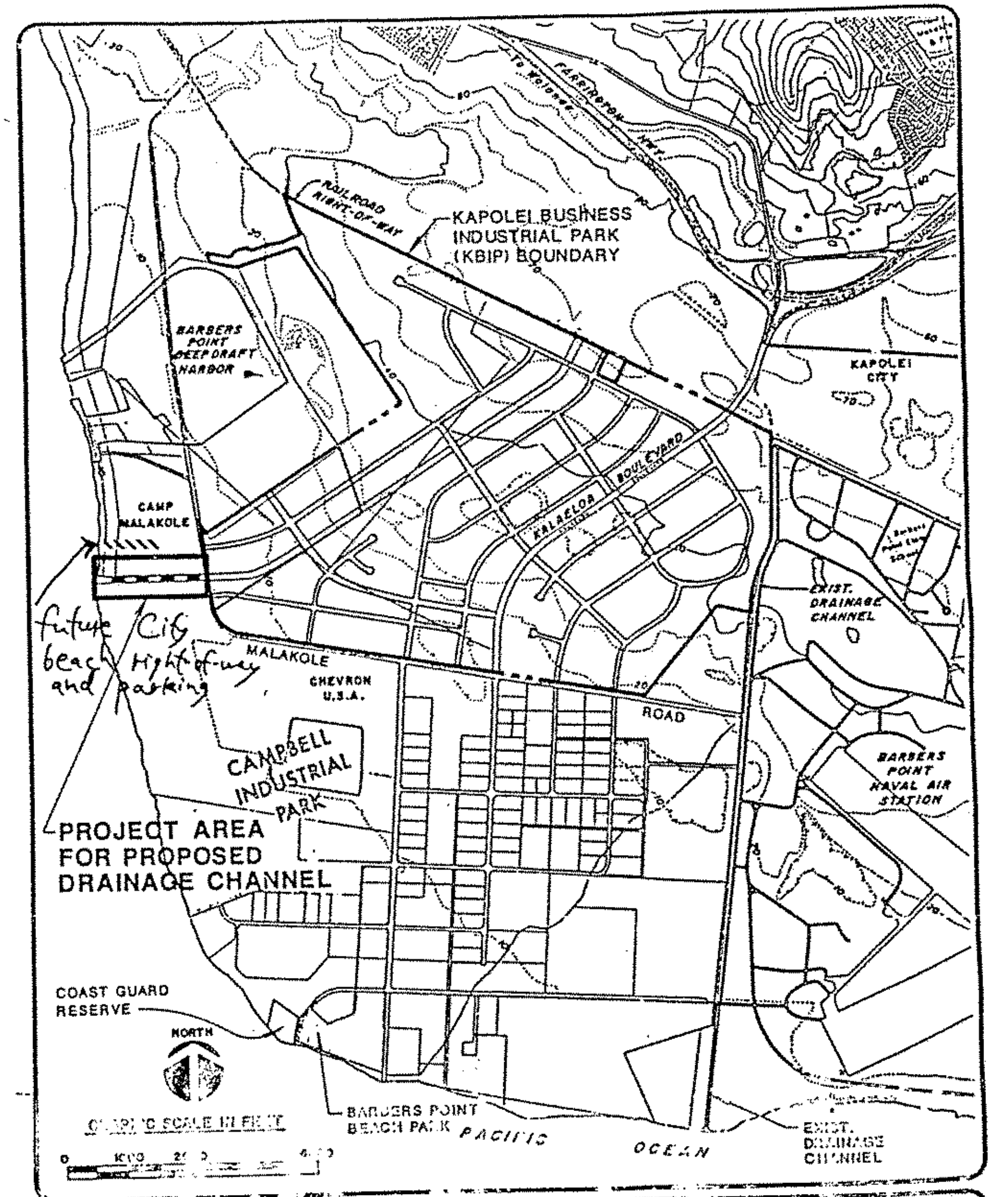

Fig. Location Map 1

CAMPBELL DRAINAGE CHANNEL
EWA, OAHU, HAWAII

Prepared by: ENGINEERING CONCEPTS, INC.

ENGINEERING CONCEPTS, INC.
CONSULTING ENGINEERS

July 5, 1991

Mr. Walter M. Ozawa
Director
Department of Parks and Recreation
City and County of Honolulu
650 South Street
Honolulu, Hawaii 96813

Subject: Campbell Drainage Channel Draft Environmental Impact Statement Supplemental to Kapolei Business-Industrial Park EIS
Ewa, Oahu, Hawaii; TMK: 9-1-14:4 (portion)

Thank you for your May 17, 1991 letter concerning the draft environmental impact statement for the subject project. The following is offered in response to your comments.

As discussed with your staff, the developer is willing to consider construction of a pedestrian bridge near the mouth of the channel to provide lateral shoreline access, provided a public agency accepts dedication of the bridge. Details regarding the specific location, design features, and the dedication of the bridge will still need to be coordinated with government agencies.

Again, thank you for your comments. Please feel free to call me if you have any questions.

Very truly yours,

Kenneth Ishizaki, P.E.
Vice President

KI/js

cc: OEQC
Ms. Susan Sublett
Mr. Michael Warren
Mr. Bill Wanket
Mr. Matthew Higashida

250 Ward Avenue, Suite 206 • Honolulu, Hawaii 96814 • Tel: (808) 538-0920 • FAX: (808) 538-3463

DEPARTMENT OF PUBLIC WORKS

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

SAM CALLEJO
DIRECTOR AND CHIEF ENGINEER

C. MICHAEL STREET
DEPUTY DIRECTOR

In reply refer to:
ENV 91-82(449)

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April 16, 1991

MEMORANDUM

TO: BENJAMIN B. LEE, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

FROM: SAM CALLEJO, DIRECTOR AND CHIEF ENGINEER

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)
CAMPBELL DRAINAGE CHANNEL
SUPPLEMENTAL TO KAPOLEI BUSINESS - INDUSTRIAL PARK EIS
TAX MAP KEY: 9-1-14: 4 (POR.)

We have reviewed the subject DEIS and have the following comment:

1. Will the channel be maintained by the City and County of Honolulu? If so, the channel should be fully lined.

Sam Callejo
SAM CALLEJO
Director and Chief Engineer

cc: The Estate of James Campbell
Engineering Concepts, Inc.
OEQC

ENGINEERING CONCEPTS, INC.
CONSULTING ENGINEERS

May 7, 1991

Mr. Sam Callejo
Director and Chief Engineer
Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Subject: Campbell Drainage Channel
Draft Environmental Impact
Statement Supplemental to Kapolei
Business-Industrial Park EIS
Ewa, Oahu, Hawaii
TMK: 9-1-14:4 (portion)

Dear Mr. Callejo:

Thank you for your letter of April 16, 1991 concerning the subject project.

Construction plans will be submitted for your department's review as it is the intent of Campbell Estate to dedicate the proposed facility to the City and County of Honolulu.

We will remain in contact with your staff during the design phase of the project to ensure the concerns of your organization are addressed.

Thank you again for your comments. If you have any questions or require additional information, please feel free to call me at 538-0920.

Very truly yours,

Kenneth Ishizaki, P.E.
Vice President

KI/js

cc: Susan Sublett
Mike Warren
Bill Wanket

250 Ward Avenue, Suite 206 • Honolulu, Hawaii 96814 • Tel: (808) 538-0920 • FAX: (808) 538-3463

DEPARTMENT OF TRANSPORTATION SERVICES

CITY AND COUNTY OF HONOLULU

HONOLULU MUNICIPAL BUILDING
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

JOSEPH M. MAGALDI, JR.
DIRECTOR

AMAR SAPPAL
DEPUTY DIRECTOR

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APR 2 3 1991
ENGINEERING CONCEPTS

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PL91.1.115

April 22, 1991

MEMORANDUM

TO: BENJAMIN B. LEE, CHIEF PLANNING OFFICER
DEPARTMENT OF GENERAL PLANNING

FROM: JOSEPH M. MAGALDI, JR., DIRECTOR

SUBJECT: KAPOLEI BUSINESS INDUSTRIAL PARK, CAMPBELL DRAINAGE CHANNEL, DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)
TAX MAP KEY: 9-1-14: 4

This is in response to the DEIS submitted to us for review on April 2, 1991 by the Office of Environmental Quality Control.

Construction plans for all work within the City's proposed right-of-way should be submitted to our department for review. A traffic control plan showing temporary detours should be included in this plan for all roadways which have been open to the public.

Should you have any questions, please contact Lance Watanabe of my staff at local 4199.

JOSEPH M. MAGALDI, JR.

cc: The Estate of James Campbell
Engineering Concepts, Inc.
Office of Environmental Quality Control

ENGINEERING CONCEPTS, INC.
CONSULTING ENGINEERS

April 25, 1991

Mr. Joseph M. Magaldi, Jr.
Director, Department of Transportation Services
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Subject: Campbell Drainage Channel
Draft Environmental Impact
Statement Supplemental to Kapolei
Business-Industrial Park EIS
Ewa, Oahu, Hawaii
TMK: 9-1-14:4 (portion)

Dear Mr. Magaldi:

Thank you for your letter of April 22, 1991 concerning the subject project.

Construction plans for all work within the City's right-of-way will be submitted for your department's review. A traffic control plan will be included in the construction drawings showing temporary detours for public roadways.

We will remain in contact with your staff during the design phase of the project to ensure the concerns of your organization are addressed.

Thank you again for your comments. If you have any questions or require additional information, please feel free to call me at 538-0920.

Very truly yours,

Kenneth Ishizaki, P.E.
Vice President

KI/js

cc: Susan Sublett
Mike Warren
Bill Wanket

250 Ward Avenue, Suite 206 • Honolulu, Hawaii 96814 • Tel: (808) 538-0920 • FAX: (808) 538-3463

GTE Hawaiian Tel
Beyond the call

GTE Hawaiian Telephone Company Incorporated
P.O. Box 2200 · Honolulu, HI 96841 · (808) 546-4511

April 11, 1991

APR 1 6 1991
ENGINEERING CONCEPTS

Kenneth Ishizaki, P.E.
Vice President
Engineering Concepts, Inc.
250 Ward Avenue, Suite 206
Honolulu, Hawaii 96814

Subject: Campbell Drainage Channel Draft
Environmental Impact Statement
(DEIS) Supplemental to Kapolei
Business Industrial Park EIS
Ewa, Oahu, Hawaii
TMK: 9-1-14:4 (portion)

Dear Mr. Ishizaki:

We are in receipt of your April 2, 1991 correspondence along with the exerpt from the DEIS concerning the above-referenced subject.

The only comment we have regarding the proposed Drainage Channel Project concerns existing aerial cables on joint poles (used and owned jointly by Hawaiian Electric and GTE Hawaiian Tel) situated on the makai side of Malakole Road, which crosses over a portion of the proposed project area. Also, in conjunction with another project, the proposed Malakole Industrial Lot Subdivision, we plan to reinforce the above mentioned facilities sometime in 1992.

Hopefully the aerial facilities will not pose a problem for the Drainage Channel Project. However, should the facilities be affected in any way, please contact Nelson Yrizarry, Outside Plant Supervising Engineer at 834-6222.

We will not require a complete copy of the DEIS since our main concern is the existing and proposed communication facilities over the project area. The excerpt from the DEIS adequately outlines the project area for our purposes.

We thank you for the opportunity to comment on the project. Again, should you have any questions or need to discuss the matter further, please call Nelson Yrizarry at 834-6222.

Sincerely,

Walter M. Matsumoto
Operations Manager
OSP Engineering

WMM:gn

ENGINEERING CONCEPTS, INC.
CONSULTING ENGINEERS

April 24, 1991

Mr. Walter M. Matsumoto
GTE Hawaiian Telephone Company Incorporated
Operation Manager
P.O. Box 2200
Honolulu, Hawaii 96841

Subject: Campbell Drainage Channel
Draft Environmental Impact
Statement Supplemental to Kapolei
Business-Industrial Park EIS
Ewa, Oahu, Hawaii
TMK: 9-1-14:4 (portion)

Dear Mr. Matsumoto:

Thank you for your letter of April 11, 1991 concerning the subject project.

Preliminary investigations indicate that the existing utility poles and aerial cables situated on the makai side of Malakole Road should not be affected by this project. The proposed channel will traverse between the existing poles and construction activities should not encroach on your facilities.

We will remain in contact with your staff during the design phase of the project to ensure the concerns of your organization are addressed.

Thank you again for your comments. If you have any questions or require additional information, please feel free to call me at 538-0920.

Very truly yours,

Kenneth Ishizaki, P.E.
Vice President

KI/js

cc: Susan Sublett
Mike Warren
Bill Wanket

250 Ward Avenue, Suite 206 • Honolulu, Hawaii 96814 • Tel: (808) 538-0920 • FAX: (808) 538-3463

Hawaiian Electric Company, Inc. • PO Box 2750 • Honolulu, HI 96840-0001

William A. Bonnet
Manager
Environmental Department

ENV 2-1
EIS
JA/G

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APR 2 4 1991
ENGINEERING CONCEPTS

April 23, 1991

Mr. Matthew Higashida
Department of General Planning
City & County of Honolulu
Municipal Office Building, 8th Floor
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Higashida:

Subject: Draft Environmental Impact Statement (DEIS) for Campbell Drainage Channel Supplemental to Kapolei Business - Industrial Park EIS

We have reviewed the subject DEIS, and have no comments at this time on the proposed project. HECO shall reserve comments pertaining to the protection of existing power lines bordering the project area until construction plans are finalized.

Sincerely,

William A. Bonnet

cc: Susan Sublett, The Estate of James Campbell
Kenneth Ishizaki, Engineering Concepts, Inc.

An HEI Company

NA ALA HELE
Hawai'i Trail & Access System

May 17, 1991

RECEIVED
MAY 21 1991
ENGINEERING CONCEPTS

City and County of Honolulu
Department of General Planning
650 South King Street
Honolulu, HI 96813

Attention: Mr. Matthew Higashida

Dear Mr. Higashida:

Campbell Drainage Channel - Supplement to
Kapolei Business Industrial Park EIS

Na Ala Hele is the statewide trail and access program in the Department of Land and Natural Resources, Division of Forestry and Wildlife. Advisory councils have been established on six islands to assist DLNR with the program. We are concerned with all matters relating to trails and access--in the mountains, to and along the shoreline, and in other areas. A fact sheet on Na Ala Hele is enclosed for your information.

The Oahu Advisory Council of Na Ala Hele would like to comment on the proposed Campbell Drainage Channel which will extend from the proposed Kapolei Business Industrial Park site to the ocean. According to the description in the OEQC Bulletin, the channel will be excavated 100 feet wide and 5 feet deep. The project will also include maintenance roads and chain link fencing on both banks.

Although provision would be made for public access to the shoreline from inland areas via the maintenance roads, we would like to point out that the channel will effectively terminate lateral access along the shoreline. The Oahu Advisory Council believes that provisions should be made to retain the existing lateral shoreline access and recommends that the developer, The Estate of James Campbell, construct a concrete pedestrian bridge over the mouth of the channel. This bridge would further enhance the recreational value of the area by providing an additional shoreline site for fishing and crabbing.

Given the significant growth taking place on the Ewa plain, our Oahu Advisory Council is concerned that the recreational needs of this new population center be taken into account in planning for the region. We have discussed the possibility of establishing a shoreline trail from the Barbers Point Harbor to the west boundary of the Barbers Point Naval Air Station. In the interest of protecting the potential of a proposed trail, we wish

Division of Forestry & Wildlife • Dept. of Land & Natural Resources • 1151 Punchbowl Street • Honolulu, Hawaii 96813

to assure continuous lateral shoreline access and believe that a pedestrian bridge over the channel would help to accomplish this objective.

Thank you for considering our concerns and our recommendation. If you have any questions, please feel free to contact me ~~at~~ 521-5351.

Sincerely,

for Verna I. Nakamoto
Susan S. Rutka, Chair
Oahu Advisory Council

Enclosure: Na Ala Hele Fact Sheet

cc: Susan Sublett, The Estate of James Campbell
Kenneth Ishizaki, Engineering Concepts, Inc.
Michael Buck, DOFAW

ENGINEERING CONCEPTS, INC.
CONSULTING ENGINEERS

June 6, 1991

Na Ala Hele
Hawaii Trail & Access System
c/o Department of Land and Natural Resources
Division of Forestry and Wildlife
1151 Punchbowl Street
Honolulu, Hawaii 96813

Subject: Campbell Drainage Channel Draft Environmental Impact Statement Supplemental to Kapolei Business-Industrial Park EIS
Ewa, Oahu, Hawaii; TMK: 9-1-14:4 (portion)

Thank you for your May 17, 1991 letter concerning the draft environmental impact statement for the subject project. The following is offered in response to your comments.

The developer is willing to consider construction of a pedestrian bridge near the mouth of the channel to provide lateral shoreline access, provided a public agency accepts dedication of the bridge. Details regarding the specific location, design features, and the dedication of the bridge will still need to be coordinated with government agencies.

Again, thank you for your comments. Please feel free to call me if you have any questions.

Very truly yours,

Kenneth Ishizaki, P.E.
Vice President

KI/js

cc: Ms. Susan Sublett
Mr. Michael Warren
Mr. Bill Wanket

250 Ward Avenue, Suite 206 • Honolulu, Hawaii 96814 • Tel: (808) 538-0920 • FAX: (808) 538-3463

XV. LIST OF REFERENCES

AECOS, Inc., 1979, Oahu Coral Reef Inventory, Part B - Sectional Map Description, prepared for the Army Corps of Engineers, Pacific Region, Fort Shafter, Hawaii, pg. 370.

AECOS, Inc., 1990, A Marine Environmental Impact Assessment for the Kapolei Business - Industrial Park Drainage Channel at Barbers Point, Oahu.

Bruner, Phillip L., 1989, Survey of the Avifauna and Feral Mammals at the Proposed Campbell Commercial - Industrial Site, Ewa, Oahu, prepared for William E. Wanket, Inc.

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Cultural Surveys Hawaii, 1990, Archaeological Reconnaissance of a Proposed Drainage Channel: Supplement to an Archaeological Assessment for the Proposed Kapolei Business / Industrial Park, Honouliuli, Ewa, Oahu.

Dames and Moore, 1990, Geotechnical Engineering Investigation, Proposed Drainage Channel, James Campbell Industrial Park, Barbers Point, Oahu, Hawaii.

Edward K. Noda and Associates, Inc., 1990, Oceanographic Input to SEIS for Drainage Channel at Kapolei Business - Industrial Park.

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William E. Wanket, Inc., 1990, Final EIS Kapolei Business - Industrial Park, prepared for the Estate of James Campbell.

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A. GEOTECHNICAL ENGINEERING INVESTIGATION, PROPOSED DRAINAGE CHANNEL, JAMES CAMPBELL INDUSTRIAL PARK, BARBERS POINT, OAHU, HAWAII, by DAMES & MOORE.

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APPENDIX A

GEOTECHNICAL ENGINEERING INVESTIGATION,

PROPOSED DRAINAGE CHANNEL,

JAMES CAMPBELL INDUSTRIAL PARK

BARBERS POINT, OAHU, HAWAII

by

DAMES & MOORE

REPORT
GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED DRAINAGE CHANNEL
JAMES CAMPBELL INDUSTRIAL PARK
BARBERS POINT, OAHU, HAWAII

DAMES & MOORE JOB NO. 07597-022-011

DAMES & MOORE

DAMES & MOORE A PROFESSIONAL LIMITED PARTNERSHIP
1144 10TH AVENUE, SUITE 200, HONOLULU, HAWAII 96816-2497 (808) 735-3585
D&M Facsimile Number: (808) 732-6077

April 6, 1990
07597-022-011

The Estate of James Campbell
c/o Engineering Concepts, Inc.
250 Ward Avenue, Suite 206
Honolulu, Hawaii 96814

Attention: Mr. Craig Arakaki

Gentlemen:

Six copies of our report entitled "Geotechnical Engineering Investigation, Propsed Drainage Channel, James Campbell Industrial Park, Barbers Point, Oahu, Hawaii," are submitted herewith.

Our work was performed in accordance with the scope of work outlined in our proposal dated July 5, 1989. Our findings and recommendations are presented in the body of this report.

Selected soil samples were used in laboratory testing and the remaining ones were kept for a period of time for possible examination. Unless requested otherwise, they will be discarded three months from this date.

It has been a pleasure performing this assignment for you. If you have any questions regarding this report, please feel free to contact us for clarification.

Yours very truly,

DAMES & MOORE
A Professional Limited Partnership

Masanobu R. Fujioka, P.E.
Consultant

MRF/JPK:ob(6970A/450A:07597-022-011)
(Six copies submitted)

REPORT

GEOTECHNICAL ENGINEERING INVESTIGATION

PROPOSED DRAINAGE CHANNEL

JAMES CAMPBELL INDUSTRIAL PARK

BARBERS POINT, OAHU, HAWAII

1.0 INTRODUCTION

This report presents the results of a geotechnical investigation performed for the proposed drainage channel and outlet at James Campbell Industrial Park, Barbers Point, Oahu, Hawaii.

Our services were provided in general accordance with our proposal dated July 5, 1989.

2.0 PROJECT CONSIDERATIONS

The proposed drainage channel alignment is located between the old railway right-of-way, through Malakole Road, to the shoreline at the James Campbell Industrial Park. Between the proposed drainage channel outlet at the shoreline to Malakole Road (approximately 1,800 feet) the proposed drainage channel alignment runs between the Chevron Oil Refinery on the south and the former Camp Malakole Military Reserve on the north. We understand that the alignment of the drainage channel and the railroad right-of-way and Malakole Road has not yet been finalized, and has not been included in this study.

We understand that the proposed drainage channel would be approximately 130 feet wide at the top and on each side of the channel there will be two service dirt roads running along the flanks of the channel. Based on our discussion with the project civil engineer, the invert of the proposed drainage outlet would be at approximately -5 feet elevation MSL (Mean Sea Level, all elevations in this report refer to this datum).

3.0 PURPOSE AND SCOPE OF WORK

The purpose of our geotechnical engineering evaluation was to explore the subsurface and groundwater conditions at the project site, and to provide pertinent design and construction recommendations for the proposed drainage channel and outfall.

To accomplish this purpose, two borings were drilled to depths of approximately 27 feet and 31 feet, and a surface reconnaissance was performed along the channel alignment. Laboratory tests and engineering analyses were performed, and we have developed conclusions and recommendations regarding:

1. Site preparation
2. Excavation conditions
3. Allowable cut slopes, and
4. Channel lining considerations.

4.0 FIELD EXPLORATION AND LABORATORY TESTING

4.1 FIELD EXPLORATION

An engineering geological reconnaissance was performed along the proposed drainage channel alignment, and site surface characteristics were noted and summarized on Plate 2. During the course of the reconnaissance, soft surface soils were noted along part of the alignment. To check the depth of the soft surface soils, shallow probing using a hand probe and hand auger were carried out at selected locations (Plate 2). A summary of the probing results is presented in Appendix A.

We explored the subsurface conditions by drilling two test borings at the locations shown on the Plot Plan, Plate 2. Our field engineer supervised the drilling work, logged the borings and collected disturbed and undisturbed samples for examination and laboratory testing. A description of our field exploration program and log of test borings are contained in Appendix A.

4.2 LABORATORY TESTING

Selected samples were tested to evaluate pertinent classification and engineering properties. Tests include moisture content and dry density determinations, and Atterberg limits. Results of the laboratory tests and a description of the test procedures are presented in Appendix B.

5.0 SURFACE AND SUBSURFACE CONDITIONS

5.1 SURFACE CONDITIONS

The project site is generally level except for local topographic depressions, near the Malakole Road end of the drainage easement. Ground surface elevations vary from approximately sea level at the shoreline, to approximately +5 feet near the makai corner of the Chevron Refinery. Ground surface elevations then decrease gradually landward, towards the east, to approximately +1 foot about 300 feet seaward (west) of Malakole road.

During our site reconnaissance, we observed that the ground surface along the seaward two-thirds of the drainage channel alignment is covered primarily by coralline sand and gravel. Beach rock (cemented coralline deposits) outcrops were observed at the shoreline to about 300 feet landward of the proposed drainage channel outlet. The remaining portion of the alignment is generally lowlying, with locally ponded water. Some of the lowlying areas are covered by marsh vegetation.

5.2 SUBSURFACE CONDITIONS

Near the shoreline, Boring 1 encountered primarily coralline sand and gravel, varying from loose to locally cemented. The boring encountered a beach rock deposit at about 10 to 15 feet below the existing ground surface.

Boring 2, which was drilled off Malakole road, encountered a medium stiff gravelly sandy silt layer (probably fill) at about 1 foot to 6 feet below the existing ground surface. Below this surficial fill layer, a layer of olive gray to brown, very soft, clayey silt material containing organic matter was encountered to a depth of approximately 14 feet below the existing ground surface. Below this very soft and highly compressible deposit was approximately 6 feet of very stiff clayey silt overlying medium dense sandy coralline gravel.

Shallow probings performed during our site reconnaissance indicated that most of the lowlying areas are underlain by very soft silty deposits, to depths of greater than 4 feet (the maximum penetration depth of our probe).

Ground water was encountered at about 5 feet below existing ground surface during the course of our field investigation. Higher groundwater levels may result from a combination of high ground water input due to high rainfall and extreme tides or storm surge conditions. We recommend a high groundwater elevation of +4 feet MSL.

6.0 DISCUSSION AND RECOMMENDATIONS

6.1 CHANNEL WALL STABILITY

Approximately 650 feet of the proposed drainage channel is located in a topographic depression near Malakole Road. Based on our site reconnaissance and exploratory borings, this lowlying area is below the groundwater table in places and, in many locations, is underlain by very soft, highly compressible, silty deposits.

For the remaining portion of the drainageway alignment, we anticipate that the subsurface will consist primarily of cemented to uncemented coralline sand and gravel deposits.

The nearsurface soft soils has very low shear strength, and would adversely affect the stability of the proposed channel wall. Further, new fill may be placed in areas adjoining the channel wall, for service road construction, and as part of future mass site grading operations in the adjoining properties. These surrounding new fills may overstress the soft soils and may cause some bulging, sloughing, and other outward movement of the channel slope.

To protect against erosion and to minimize the potential of channel wall instability, we recommend that soft soils encountered along the proposed drainage channel alignment be removed and replaced with boulder fill or riprap. Should extensive areas of soft soil be encountered, we recommend tht these areas be handled on a case by case basis, as field conditions are revealed.

We recommend that a 2 Horizontal to 1 Vertical (2H:1V) slope ratio be used for channel side slopes.

We anticipate that with remedial work on areas of soft soil, the remaining channel alignment can generally be left unlined, except at the channel outlet. However, the exploratory borings and our field observations indicate that local uncemented zones may occur within the coralline deposits. These areas of loose sand and gravel may be susceptible to erosion along the unlined channel, particularly at the channel outlet where the channel walls and invert would also be exposed to wave action. Localized erosion and dislodgement of undermined rocks may occur, and periodic maintenance will be required. Construction of revetment protection at the channel outlet, for side slopes above the beach rock is recommended.

During excavation of channel slopes, close monitoring is recommended to check for the presence of loose zones in the coralline deposits and, in particular, the extent of the soft soil deposits. If these conditions are encountered, remedial action should be taken. Loose or weak zones exposed on the channel side slopes may need to be excavated and replaced, or buttressed by rip-rap.

6.2 SITE PREPARATION AND EXCAVATION

The site should be cleared of vegetation and other miscellaneous debris prior to commencement of excavation or filling. Material from the clearing and grubbing operation should be properly disposed off site.

We anticipate that the majority of the soil at the site may be excavated with conventional earthmoving equipment. Occasional hard coralline ledges may be encountered and may require the use of hoe ram equipment.

The nearsurface soft soils had a strong organic (hydrogen sulfide) odor. An environmental assessment and chemical testing is recommended to check for possible contamination prior to excavation and/or disposal of these soils.

6.3 FILL MATERIALS, PLACEMENT, AND COMPACTION

On site granular soils free of organic materials and rock, or lumps greater than 3 inches in maximum dimension, can be used for fill. Imported materials, if used, should consist of predominantly granular material having no rocks greater than 3 inches in maximum dimension. All imported materials should be reviewed, tested as necessary, and approved by the soils engineer prior to use.

Fill materials should be placed in 8-inch loose lifts and compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM Test Procedure D-1557.

Fill slopes should not be steeper than 2H:1V, and should be overfilled, and then trimmed back to expose the compacted surface.

7.0 DESIGN REVIEW AND CONSTRUCTION INSPECTION

We recommend that we review the final structural and civil plans and specifications to see that the intent of our recommendations and design considerations are properly reflected in the completed design.

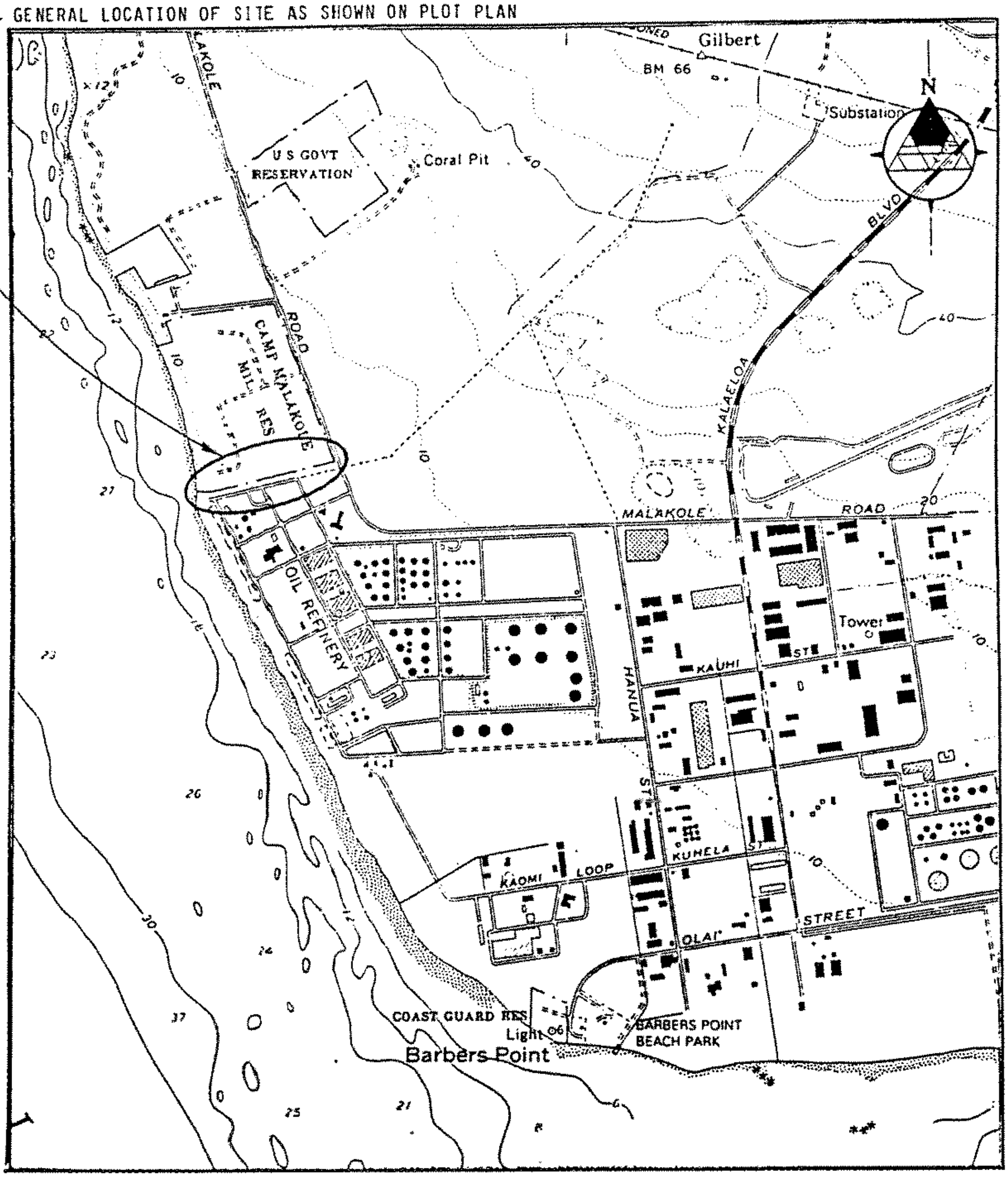
Channel excavation work should be monitored on a full-time basis by the soils engineer so that areas requiring remedial work can be identified. Remedial work (boulder fill, riprap, outlet revetment, etc.) and fill placement should be monitored and tested by the soils engineer.

8.0 LIMITATIONS

We have prepared this report for use of the Estate of James Campbell, and their designated engineers, in accordance with generally accepted geotechnical engineering practices. No other warranty expressed or implied, is made to the professional recommendations contained in this report. This report has not been prepared for other parties, and may not contain sufficient information for other purposes or for other uses.

- o0o -

GENERAL LOCATION OF SITE AS SHOWN ON PLOT PLAN



MAP OF AREA

SCALE 1:24000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

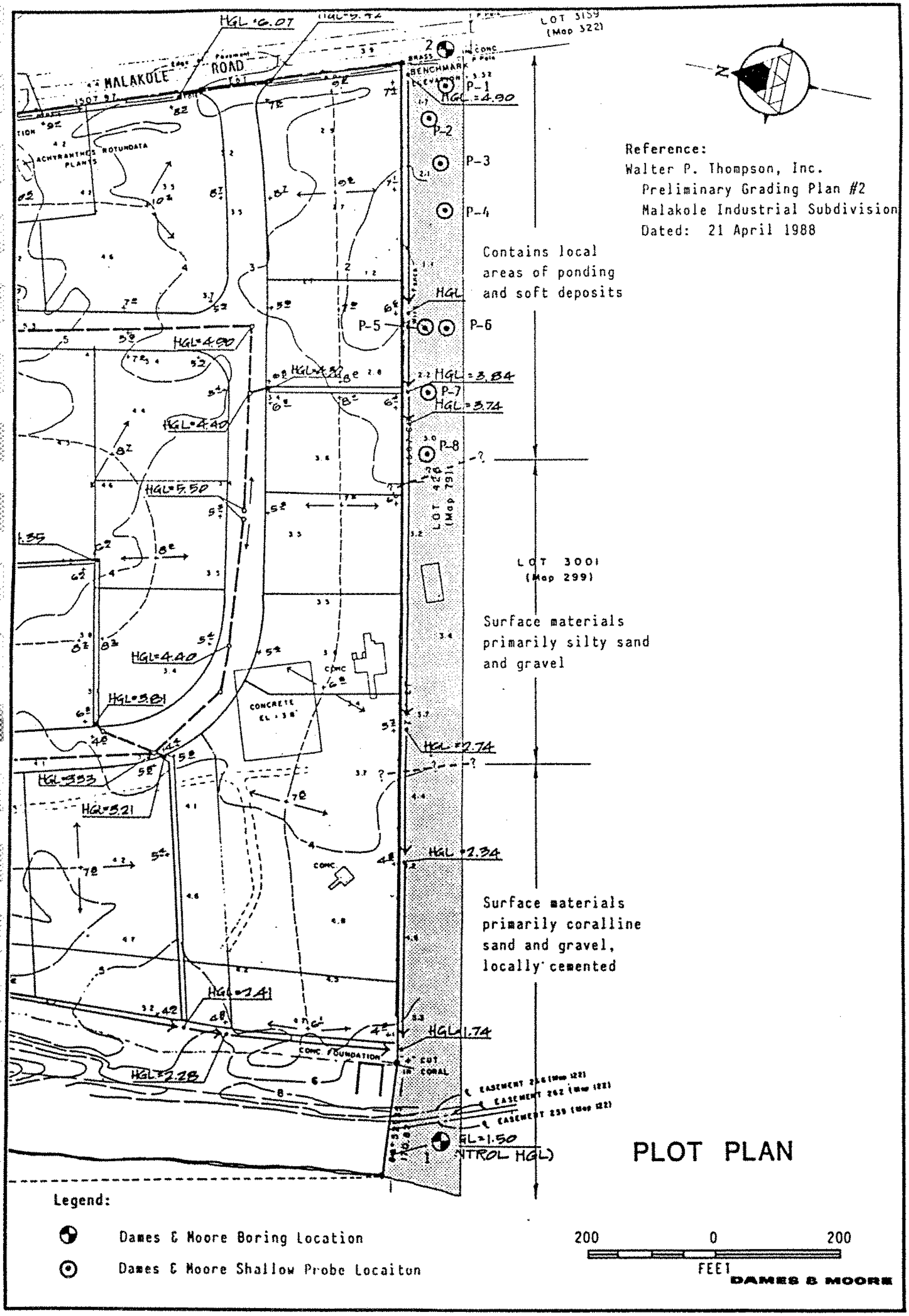
1 .5 0 1 KILOMETER

CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 20-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

Reference:
U.S.G.S. Topographic Map
Ewa, Oahu, Hawaii (1983)

DAMES & MOORE

PLATE 1



Reference:
Walter P. Thompson, Inc.
Preliminary Grading Plan #2
Malakole Industrial Subdivision
Dated: 21 April 1988
Contains local
areas of ponding
and soft deposits
Surface materials
primarily silty sand
and gravel
Surface materials
primarily coralline
sand and gravel,
locally cemented
MALAKOLE ROAD
LOT 3159 (Map 322)
LOT 3001 (Map 299)
LOT 420 (Map 791)
BENCHMARK
ACHYRANTHES ROTUNDATA PLANTS
CONCRETE EL 3.8'
CONC. FOUNDATION
CUT IN CORAL
P-1
P-2
P-3
P-4
P-5
P-6
P-7
P-8
HGL=6.07
HGL=4.90
HGL=4.90
HGL=4.40
HGL=5.50
HGL=4.40
HGL=3.81
HGL=3.84
HGL=3.74
HGL=2.74
HGL=3.33
HGL=3.21
HGL=2.34
HGL=2.41
HGL=1.74
HGL=2.28
PLOT PLAN
Legend:
Dames & Moore Boring Location
Dames & Moore Shallow Probe Locaiton
200
0
200
FEET
DAMES & MOORE

PLATE 2

APPENDIX B

A MARINE ENVIRONMENTAL IMPACT ASSESSMENT FOR THE KAPOLEI BUSINESS-INDUSTRIAL PARK DRAINAGE CHANNEL AT BARBERS POINT, OAHU

by

AECOS, INC.

AECOS No. 583

A MARINE ENVIRONMENTAL IMPACT ASSESSMENT FOR THE KAPOLEI BUSINESS-INDUSTRIAL PARK DRAINAGE CHANNEL AT BARBERS POINT, OAHU

Prepared For:

Engineering Concepts, Inc.
250 Ward Avenue, Suite 206
Honolulu, Hawaii 96814

Prepared By:

AECOS, Inc.
970 N. Kalaheo Avenue, Suite C311
Kailua, Hawaii 96734

July 1990
revised July 1991

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Section A. Introduction

Section B. Description of the Marine Environment

Section C. Environmental Impacts

Section A. INTRODUCTION

A.1 Project Description

This report assesses the impacts on the marine environment of a proposed storm drainage system for the Kapolei Business-Industrial Park located at 'Ewa, O'ahu. The drainage area for this channel includes lands located east of Barbers Point Deep Draft Harbor and north of Campbell Industrial Park (Figure 1). Most of the drainage basin for the proposed channel was undeveloped land as recently as the 1950s (Land Study Bureau, 1963). These lands are presently in sugar cane or are abandoned agriculture fields. Developments planned for the drainage area include light industrial and commercial activities as part of the urbanization of this part of O'ahu (Kapolei).

The outlet for the channel would be located along the west side of the 'Ewa Plain between the Chevron U.S.A. refinery and the property formerly known as Camp Malakole. In this area, the proposed channel follows an essentially non-functional, existing drainage. A portion of the area adjacent to Malakole Road is an intermittent wetland and a man-made cut exists through the limestone outcropping at the shoreline. Remnants of a concrete drain structure are present at the shore. However, water flow in this old channel is probably infrequent because of the relatively high base elevation (about +1.5 feet) of the channel and the several more feet of sand which presently fills its seaward end.

A.2 General Description of the Environment

The 'Ewa Plain is a low-sloping, emergent reef; that is, a fossilized limestone and sediment formation which formed as a reef when sea level stood some 25 feet higher than at present. Some alluvial material of volcanic origin is found in the higher, inland segment of the proposed drainage channel (Foote, et al., 1972). Presumably, the channel would also receive run-off from the Waianae Range because several gulches west of Makakilo drain towards the head of the proposed channel. The "ultimate drainage plan" for Campbell Industrial Park as presented in R.M. Towill Corp. (1975) shows the channel extended to collect run-off from these gulches and gives a total catchment area of 2580 acres, about two-thirds of which is uplands (volcanic) terrain.

Rainfall on the 'Ewa Plain is sparse (about 20 inches annually) and the substratum very permeable. Consequently, major rain storms can produce localized flooding because the ground is low sloping, but little direct flow into the sea except where runoff is gathered and funnelled by man-made sur-

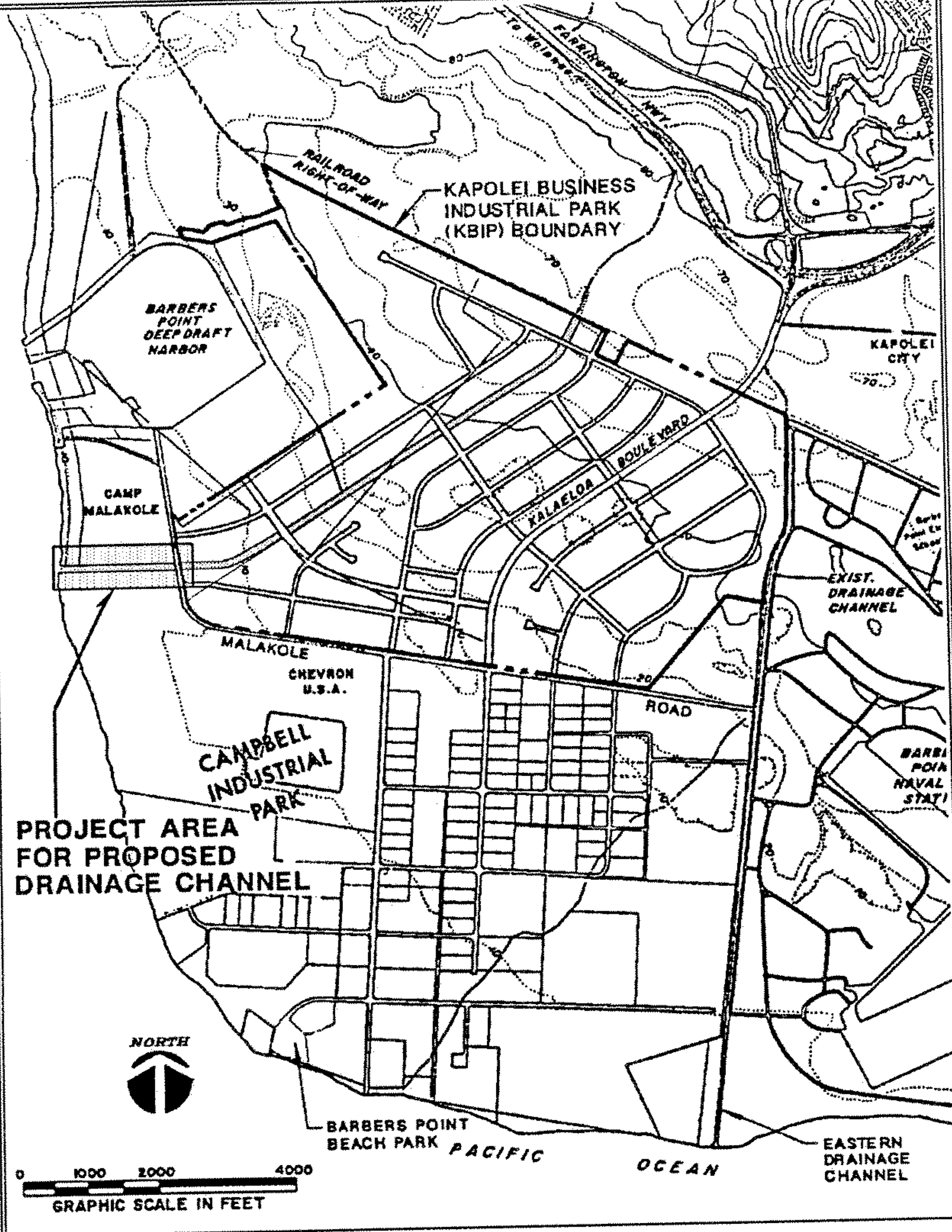

Figure 1. Project location map.

faces (such as buildings, pavement, and storm drains). In a report prepared by Parsons, hawaii (1978), the following observations were made:

> The drainage conditions in the Ewa Plain are rather unique. Run-Off from the Waianae Mountains discharges onto the plain but is readily absorbed by the porous coral substrate so that much of the discharge never reaches the ocean by overland run-off..... There are no well defined or natural surface drainage patterns on the coral plain since its absorptive capacity accommodates most of the storm run-off.

In essence, during heavy rainfall periods, ponded water seeps into the limestone formation where it mingles with the brackish ground water, and eventually leaks out along the shore. The geology and hydrology in the vicinity of the Barbers Point Deep Draft Harbor have been described by Dale (1968) and for other parts of the Ewa Plain in several soils investigation reports (Dames & Moore, 1974, 1977; Harding Lawson & Associates, 1973).

The proposed drainage channel will result in changes in this hydrologic system producing the impacts to be addressed herein. These changes can be summarized as follows: 1) runoff will be gathered and focused at a specific point on the shore, impacting this area; 2) the quality of the run-off, by virtue of the more direct routing of water flow, will differ in certain respects (such as particulate load) from the existing diffuse discharge into the sea; and 3) the quality of the run-off may further be affected by the kinds of activities eventually developed on the watershed. Finally, 4) construction of the channel will physically alter the shoreline, a marine bench environment.

In the Barbers Point area a similar drainage canal located along the eastern boundary of Campbell industrial Park has existed for some time. The lower segment of this canal was enlarged to a size comparable to the proposed drainage channel in the late 1970s. Because of the similarities between this "eastern canal" and the proposed drainage channel, the former may serve as a model for predicting some impacts of the proposed project.

Section B. DESCRIPTION OF MARINE ENVIRONMENT

B.1 WATER QUALITY

B.1.a Introduction

The primary impact of a drainage system project on the marine environment is that produced by the storm-water discharge. A (usually) temporary change in water quality occurs where the effluent mixes with the receiving water. Water quality impacts must consider both the substances carried dissolved or suspended in the effluent as well as the water itself which, by virtue of its low salt content can cause damage to marine ecosystems.

Many drainage improvement projects involve mechanical alterations to existing drainage systems with the result that storm runoff is delivered more rapidly to the discharge point along the shore than was previously the case. Typically, these systems are intended to handle storm water and contribute little or no flow between storms. Alterations may entail enlarging the collection area or otherwise increasing the catchment efficiency (e.g., creation of impermeable surfaces such as buildings and paved areas), thereby producing a greater volume of discharge for a given size storm. The proposed Kapolei Business-Industrial Park drainage follows an older drainage channel, but this channel is very inefficient (see above). Although the drainage area will not be changed, a substantial increase in collection efficiency is planned. The nature of the drainage basin is anticipated to change from mostly vacant land (with some agriculture) to urban use. For practical purposes, the proposed channel must be viewed as a new effluent source with respect to the nearshore environment.

B.1.b Urban Storm Drain Water Quality

A number of studies have been undertaken to characterize storm water runoff from urban areas (early reviews appear in FWPCA, 1969 and AVCO, 1970). Material from street runoff alone has been shown to contain a variety of pollutants, although the primary constituent of street surface contaminants is inorganic material, similar to silt and sand (Sartor and Boyd, 1972). The nature of the pollutants dissolved in the runoff water or associated with the solids will depend upon the kinds and extent of various activities that occur on or adjacent to the street. Pollutants associated with the operation of automobiles (petroleum hydrocarbons, certain heavy metals such as lead, nickel, and zinc) are typical. Observed concentrations of pollutants of all kinds in urban runoff vary widely. In general, contaminant concentrations will be greatest when a long interval has transpired since the last flow-generating rainfall or street cleaning effort (Sartor and Boyd, 1972). For some, but not all, constituents the concentration reaches a maximum early after precipitation starts, then decreases with continuing runoff.

Studies have been conducted in Hawaii designed to characterize the quality of runoff from many different types of watersheds (see Ching, 1972; Fujiwara, 1973, Matsushita, 1973; Yim and Dugan, 1975; DOH, 1980; Yamane & Lum, 1985). The study by Fujiwara (1973) sampled storm drain systems in central Honolulu. Included were urban-residential and industrial areas (Iwilei). The study by Yamane and Lum (1985) is perhaps the most detailed urban watershed study conducted in Hawaii to date. Two watersheds were monitored in Mililani Town in central Oahu and analyses of over 300 samples of storm water runoff were made between 1980 and 1984. This area is mostly residential and suburban in character. The DOH (1980) study looked at runoff from different types of areas ranging from conservation to commercial and distributed from upper Manoa valley to the H-1 Freeway at the mouth of the valley. Only a few samples were collected to represent the storm runoff.

Summarizing the results of the Hawaii and/or the U.S. mainland studies is difficult because of the substantial range over which the concentration of each constituent can vary. Even the study in Mililani Town produced significant differences between adjacent drainage basins in water quality characteristics for all constituents measured except fecal coliforms, pH, and total Kjeldahl nitrogen (Yamane and Lum, 1985). Furthermore, considerable variation is expressed for many constituents from storm to storm, or from time to time during a single storm. Table 1 provides selected results of constituent concentrations from three of the studies cited. Selected, were data sets thought to best represent the kind of industrial and urban settings planned for the proposed Campbell Drainage Channel watershed.

All three of the studies represented in Table 1 made comparisons with similar U.S. mainland results and some aspect of the State of Hawaii Water Quality Standards and/or EPA water quality criteria. The DOH (1980) study noted that nutrient concentrations and NFR (total suspended solids) in the Manoa storm-drain runoff were substantially higher than reported from many mainland urban areas. In fact, while total N values were relatively high at three of the sites sampled by DOH (those listed in our Table 1), total P values were about the same as or less than levels reported by most mainland cities (data in DOH, 1980; see also Fujiwara, 1973). With respect to suspended solids, the DOH values are high relative to the Iwilei storm drain results, but well within the range of values reported by

Table 1. Summary of water-quality characteristics from storm drain studies on Oahu, Hawaii.

	Iwilei[1]	Manoa[2] A	Manoa[2] B	Manoa[2] C	Mililani[3] A	Mililani[3] B
Discharge (ft^3/sec)					30	12
pH	6.5-6.7				7.2	7.0
Total solids (mg/L)	220-263				251	131
NFR (mg/L)	6 - 16	110	452	168	204	96
Turbidity (ntu)					35	20
DO (mg/L)	5.7-7.6					
Conductance (uS/cm)					79	52
Chloride	23-35					
Total hardness (mg/L CaCO3)	64-73					
COD (mg/L)	16.5-82.4	120	84	43	60	34
BOD (mg/L)	3.6-14.1	>16	>16	6.4		
Grease (mg/L)	0.3-2.1					
NUTRIENTS: (mg/L)						
ammonia		0.20	0.18	0.16		
NO_2+NO_3	1.00-1.31	2.71	2.14	0.03	0.21	0.10
TKN	0.08-6.97	4.01	3.28	1.92	1.2	1.4
TN		6.72	5.42	1.95		
ortho P	0.50-1.88					
Total P	1.56-2.76	0.12	0.12	0.16	0.34	0.17
METALS: (ug/L)						
arsenic		ND	ND	ND		
cadmium		ND	ND	ND		
chromium	8-17	ND	ND	ND		
copper	12-28	74	15	40		
iron	26-88					
lead	129-4560	110	ND	630	20	10
mercury		3	ND	2	0.2	0.1
nickel		79	51	68		
zinc	315-1070	371	20	203		
BACTERIA	(MPN)				(no./100 ml)	
Total coliform	9700-14800					
Fecal coliform	287-835				26000	26000
Enterococcus	5100-11800					

1 - Fujiwara (1973); range of flow weighted averages or flow proportioned composite values from three separate storm samplings in Iwilei district of Honolulu (industrial).
2 - DOH (1980); results of single samples representing runoff from A = H1-freeway, B = University commercial area, and C = Manoa mixed residential/commercial area.
3 - Yamane & Lum (1985); Median values from two watersheds (A & B) in Mililani Town over four years. Number of samples varied from 9 to 208.

Yamane and Lum (1985) for Mililani drainages. The relationships between sediment transport and stream flow during flood events have been extensively studied in Hawaii as elsewhere (see Jones, Nakahara, and Chinn, 1971). The subject is complex, but suffice it to say that sediment loads would be lowest from developed watersheds (as at Iwilei) and greatest from watersheds with broad areas of exposed soils (agricultural areas, construction areas).

Fujiwara (1973) noted that the residential and commercial areas in Honolulu contributed organic matter, as measured by the COD, at higher levels than reported elsewhere. He attributed this difference to the greater coverage by vegetation and continuous growing season in Hawaii, factors which might also produce higher nutrient values in some drainage systems (Sartor and Boyd, 1972).

B.1.c Water Quality in the Eastern Drainage Canal

In preparing an environmental assessment for enlargement of the eastern drainage canal at Campbell Industrial Park, R.M. Towill Corp. (1975) presented measurements of water quality "at the discharge site" as given here in Table 2. Sample locations are described in the table. Stations A and B represented brackish water from the channel. The remaining three stations were from off the shore in the general vicinity. Both total nitrogen and total phosphorus were slightly high at all stations. Canal water appeared to be a source of total nitrogen (probably as nitrates), but not of phosphorus.

Table 2. Water quality measurements from within and offshore of the eastern drainage canal, Campbell Industrial Park, circa July 1975 (after R.M. Towill, 1975).

Station	Salinity $^{o}/oo$	Turbidity FTU	Total N mg/L	Total P mg/L
A	4.0	31.0	0.420	0.031
B	27.0	5.4	1.155	0.013
C	34.9	1.8	0.196	0.052
D	34.9	2.2	0.245	0.055
E	34.9	1.7	0.336	0.044

Station Locations
A - drainage canal at Olai Street
B - drainage canal near mouth
C - seaward of mouth 500 feet offshore
D - 500 feet west of mouth, 750 feet offshore
E - 600 feet east of mouth, 500 feet offshore

Measurements of water quality in the eastern canal were also undertaken by Parsons, hawaii (1978). These data are presented in Table 3 and station locations are shown in Figure 2. Station A in this study was at the same location as Station A in the R.M. Towill study. The analyses indicated a water with high nutrients content relative to sea water. Nitrates were particularly high as is frequently typical for ground water. For example, Environmental Consultants, Inc. (ECI, 1975) reported a nitrate concentration of 370 ug-at NO_3-N/L (equal to 5.18 ppm) from a subsurface pool inland from Barbers Point Harbor. The "Total Solids" values given in the report were less than the suspended solids values (by definition total solids includes suspended solids) and were too low to represent dissolved solids alone. The error appears to be one of units (grams/liter should have been entered instead of mg/L) and this has been corrected in Table 3.

Table 3. Eastern drainage canal water quality measurements (from Parsons, hawaii, 1978)

Station	A	B	C	1	2	3	4
Date	7/12/78			8/22/78			
Time	1433	1443	1457	1115	1125	1140	1200
Temp (^{o}C)	29.2	27.1	26.2	31.7	29.5	28.1	26.6
Salinity (^{o}/oo)	4.1	20.2	2.4	2.0	2.0	4.0	12.0
Suspended solids (mg/L)				406	151	48	115
Total solids (mg/L)[1]				3080	3680	3950	17800
Orthophosphate (mg/L)				0.009	0.009	0.016	0.025
Total phosphorus (mg/L)				0.985	0.205	0.065	0.109
Ammonia (mg/L)				0.137	0.060	0.052	0.049
Nitrate + nitrite (mg/L)				2.72	3.40	5.18	2.76
Organic nitrogen (mg/L)				1.18	0.689	0.804	0.840
Total nitrogen (mg/L)				4.04	4.14	6.04	3.64

1 - reported values multiplied by 1000.

B.1.d <u>Water Quality Off the Western Shore of Barbers Point</u>

Several long term water quality studies have been conducted in conjunction with major coastal construction activities along the western portion of the 'Ewa Plain: 1) the Barbers Point Deep Draft Harbor and Deep Draft Harbor Channel construction and 2) the Ko Olina Resort lagoons construction.

Preconstruction water quality measurements for the harbor project are presented in ECI (1975). The results of nutrient analyses at five stations established along a line from inside the Barbers Point Barge Harbor to an offshore point where water depth was 25 meters (82 feet) are shown plotted in Figure 3. This graph demonstrates the transition from an area strongly influenced by ground water influx (within the barge harbor) to open ocean conditions.

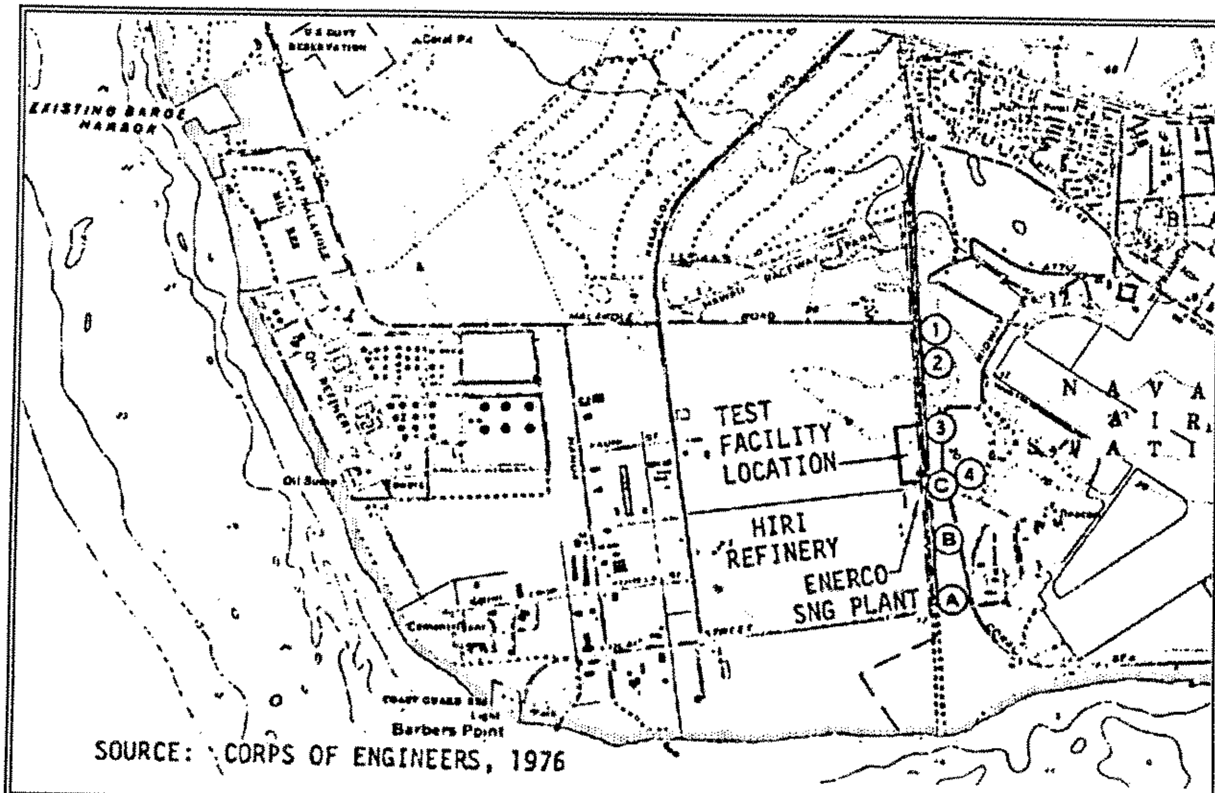

Figure 2. Water sample locations for the Parsons, hawaii survey of water quality in the eastern canal (Parsons, hawaii, 1978).

Preconstruction water quality measurements for the Ko Olina (West Beach) project are provided in Bienfang and Brock (1980). These data encompass the area from near the barge harbor north to the vicinity of Kahe. The results of nutrient analyses at nine stations (and several depths at some stations) are summarized in Table 4. The findings were discussed in part as follows:

> The.. water quality data... describe a pristine, unperturbed coastal region. Temperature and salinity values are indicative of open, well-flushed coastal

areas which are minimally affected by surface run-off. Water clarity is excellent overall; the bottom is clearly visible at nearly all areas..... with the possible and/or occasional exception of the nearshore southern [near harbor] areas.

Two points are further detailed in the discussion: 1) that the water quality is generally poorer to the south; and 2) that the data provide indications of ground water percolation along the shoreline. With respect to the water quality south of the West Beach area:

> The water quality parameters which appear to show some compromise in the south [i.e., towards the barge harbor] relative to the northern stations [i.e., towards Kahe] are turbidity, nitrite, phosphate, ammonium and chlorophyll. The enhanced levels of those criteria suggest that the area is presently under the influence of waters of poorer quality coming from the south. It is not possible to say whether or to what degree the origin of these waters is the...Barge Harbor, the...Refinery, or Pearl Harbor. Observations...indicated that definable areas of more turbid waters (occurring nearshore) from the south can be seen moving north under falling tide conditions.

Table 4. Range of nutrient concentrations in the waters off West Beach from a sampling at nine stations in November 1979 (after Bienfang and Brock, 1980).

Nitrate + Nitrite	0.0004 - 0.026	(mg NO_3+NO_2-N/L)
Ammonia	0.0017 - 0.029	(mg NH_4-N/L)
Phosphate	0.0022 - 0.010	(mg PO_4-P/L)

During and post-construction water quality monitoring for the deep draft harbor channel project are summarized in AECOS (1986). Most of the monitoring effort for the harbor project involved measurements of turbidity and suspended solids, resulting in a relatively large data base for this area compared with almost any other marine environment in Hawaii. Table 5 summarizes turbidity and suspended solids data from this area obtained prior to the start of the deep draft harbor project. A summary of various water quality measurements made between 1975 and 1985 within and seaward of the harbor are given in Table 6.

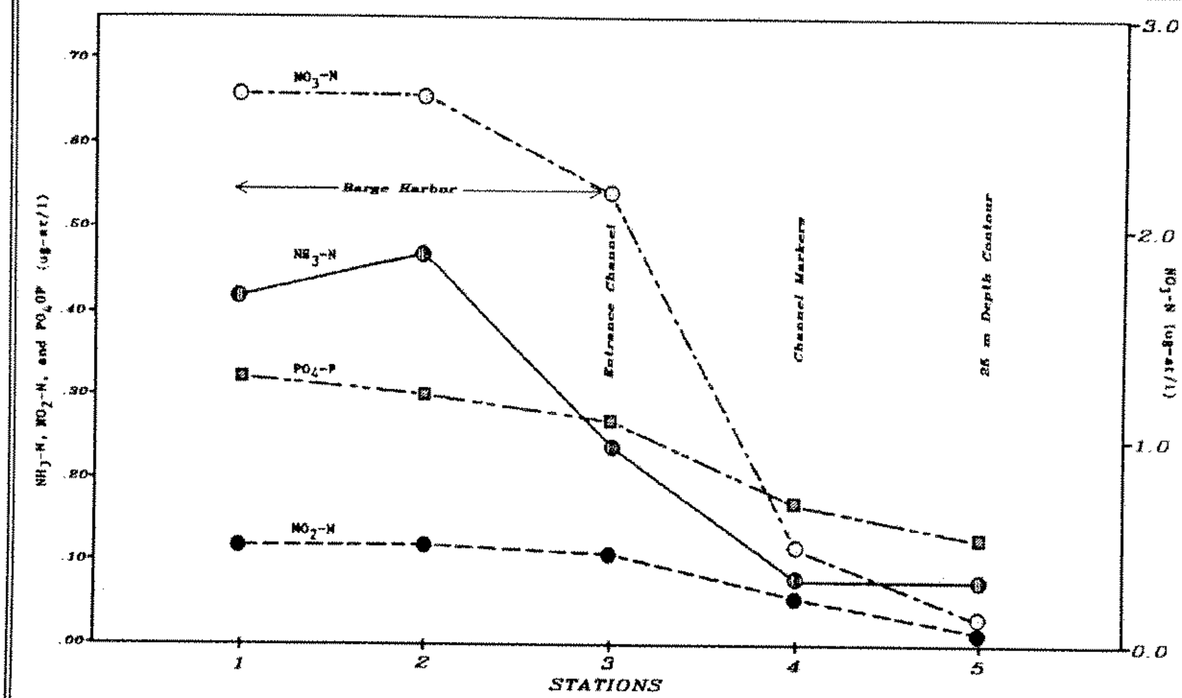

Figure 3. Graph of mean nutrient concentrations at stations extending from inside the Barbers Point Barge Harbor (left side) to far offshore (right side). Note y-axis scales are molar quantities (ug-atoms) (After ECI, 1975).

Table 5. Estimated ambient turbidity and suspended solids concentrations (geometric means) for the Barbers Point area (after AECOS, Inc. 1982b and 1986).

Sub-Area	Turbidity (NTU)		Suspended solids (mg/L)	
	mean	std. dev.	mean	std. dev.
Harbor entrance (Station 2)	3.3	2.1	4.2	2.7
Nearshore waters (Stations 1 & 3)	1.3	2.3	4.2	2.7
Mid-reef waters (Stations 4-6)	0.7	0.5	2.1	1.3
Offshore waters (Stations 7-9)	0.4	0.2	1.4	0.4

Table 6. Comparison of Barbers Point Water Quality Data

	Total Nitrogen (TN)	Ammonia (NH_4)	Nitrate-Nitrite (NO_2+NO_3)	Ortho-Phosphate (PO_4)	Total Phosphorus (TP)	Light Extinction (k)	Chlorophyll a (ug/l)	Suspended Solids (mg/l)	Turbidity (NTU)
	(------ ug/l ------)								
EMBAYMENTS									
State WQ Criteria	150	3.5	5.0	7.0	20	0.15	0.50	15.0	0.40
Barbers Point Harbor (1975)[1]	-	4.1	22.6	8.0	-	0.47	0.32	-	4.0
Barbers Point Harbor (1982)[2]	-	-	-	-	-	-	-	23.0	15.8
Barbers Point Harbor (1985)[3]	-	-	5.1	6.0	-	-	1.94	5.5	3.3
COASTAL WATERS									
State WQ Criteria	110	2.0	3.5	5.0	16	0.10	0.15	10.0	0.20
Barbers Point Harbor (1975)[1]	-	2.2	3.0	4.5	-	0.10	0.06	-	0.33
Barbers Point (1982)[4]	204	2.0	3.9	5.2	60.1	0.15	0.44	2.4	0.85
Barbers Point Harbor (1985)[5]	-	-	2.7	7.0	-	-	0.73	3.2	1.2

1 - from ECI, 1975
2 - from AECOS, 1982b
3 - Optior B, Sta. 3 (excl. 4/24/85 samples)
4 - from AECOS, 1982a
5 - Option B, Sta. 1

Surveys of water quality continued off the West Beach (Ko Olina) shore with two extensive sample collections at 12 stations in 1986 and 1990 (OI Consultants, 1987, 1990). The offshore area covered by these stations begins some 4000 feet north of the proposed drainage outlet; water quality results are summarized in Table 7. In the 1986 survey, mean levels of turbidity, chlorophyll a, ammonia, total nitrogen, and total phosphorus all exceeded water quality criteria for "dry" coastal areas (OI Consultants, 1987). The results of the 1990 survey indicated that only mean phosphate levels exceeded state water quality criteria (OI Consultants, 1990). These calculated "means" in both cases are based on spatial, not temporal, data. Thus the relationship of the ambient water quality and the state water quality standards can only be inferred because the standards apply to time series data that encompass the range of conditions that typify a given location.

Table 7. Summary of water quality conditions at West Beach, Oahu. Values are geometric means of all samples collected on the specified date.

Month/Day Year	1980[1]	8/26 1986[2]	9/10 1986[2]	4/07 1990[3]	4/08 1990[3]
Diss. Oxygen (% sat)	99	91	99	104	97
pH	--	8.11	8.13	8.29	8.26
Light Ext. Coeff.(k units)	--	0.17	0.11	0.15	0.19
Turbidity (NTU)	0.2	0.4	0.2	0.3	1.0
NFR (mg/L)	--	6.27	1.77	3.77	5.93
Chlorophyll a (u/L)	0.36	0.45	0.34	0.19	0.20
Ammonia (mg N/L)	0.013	0.011	0.021	0.006	0.013
Nitrate (mg N/L)	0.001	0.005	0.002	0.002	0.002
Total N (mg N/L)	--	0.154	0.118	0.163	0.143
Orthophosphate (mg P/L)	0.002	0.005	0.002	0.005	0.005
Total P (mg P/L)	--	0.018	0.021	0.014	0.013

1 - Bienfang and Brock, 1980.
2 - OI Consultants, Inc., 1987
3 - OI Consultants, Inc., 1990

Time series measurements from the construction and post-construction periods for the Ko Olina lagoons have been published by S.E.A., Ltd. (1987-1990) as part of the West Beach Monitoring Program (WBOMP) reports. These cover approximately monthly sample collections for a period from September 1987 through 1990. This extensive data set has yet to be summarized. However, OI Consultants (1990) plotted the nearshore nitrate plus nitrite and turbidity values over time. These plots show that the nearshore water exceeds both the nitrate + nitrite (0.0035 mg/l) and turbidity (0.2 NTU) geometric mean criteria essentially all of the time, with or without "events" related to natural circumstances (rainfall) or construction activities.

B.1.e <u>Existing Water Quality</u>

For the purpose of providing recent water quality information for comparison with historical data from this same area, water samples were collected on May 21, 1990 and analyzed for many of the parameters included in the State of Hawaii, water quality criteria (DOH, 1989). A set of three water samples were collected to characterize existing ocean water quality off the project site. Samples were collected directly at, 500 feet north of, and 500 feet south of the proposed outlet location. Samples were also collected immediately west of and 500 feet west of the existing eastern drainage channel (see Figure 2). The results of these analyses are presented in Table 8. Also measured were salinity (by refractive index) and temperature. Salinity varied between 35.5 and 36.5 ppt (essentially sea water); temperature ranged from 26 to 26.5^{o}C.

For some of the parameters measured, the two areas sampled are distinctly different. Nearshore water from the south coast in the vicinity of the existing drainage outlet is more turbid, and had higher nitrate plus nitrite and chlorophyll <u>a</u> values than water from the west shore. These differences would be consistent with the presence, in the latter area, of land run-off. However, the source may or may not be the eastern drainage channel, since water moving westward from the mouth of Pearl Harbor or seepage of ground water influenced by a nearby stockyard operation could impact the south shore water quality in a similar manner.

The geometric mean of the three turbidity values (Table 8) from the shoreline in the project area is 1.24 NTU, essentially agreeing with "ambient" turbidity for nearshore water as presented in Table 5. The value is also consistent with the geometric mean turbidity derived from post-construction (Deep Draft Harbor) monitoring of coastal waters in 1985 as shown in Table 6. Somewhat lower turbidities (0.17 to 1.0 ntu) are reported in Bienfang and Brock (1980) and OI Consultants (1990) for the waters north of the harbor.

Table 8. Results of Water Quality Sampling from Selected Coastal Sites in the Vicinity of Barbers Point, Oahu. Samples Collected on 05/21/90 from the Seaward Edge of the Marine Bench.

Station	pH	Turb.	NO_2+NO_3	NH_4	Total N	Total P	Chl a
			Project Site, West Shore				
1	8.34	1.78	0.003	0.012	0.37	0.03	0.56
2	8.34	0.99	0.002	0.004	0.19	0.01	0.47
3	8.32	1.10	0.003	0.001	0.20	0.01	0.44
			South Shore				
4	8.38	3.24	0.019	0.002	0.34	0.01	4.34
5	8.35	2.05	0.052	0.006	0.20	0.01	2.03

Units:
Turbidity - NTU
Nutrients - ppm (e.g., ammonia in mg N/L)
Chlorophyll - ppb (mg/m^3 or ug/L)

The geometric mean of the chlorophyll a values in Table 8 (Stations 1 to 3) is 0.49 ug/L, slightly lower than the 1985 post-construction coastal values shown in Table 6. Bienfang and Brock (1980) reported values between 0.11 and 0.31 ug/L from the waters north of the harbor, with the higher values occurring near shore. The 1987 and 1990 surveys by OI Consultants (1990) also produced slightly lower mean values (Table 7).

The nutrient values in Table 8 may be compared with previous survey data, but attention is drawn to the unit of measurement for nutrient concentration used in Table 6 (ug/l rather than mg/l, or ppb rather than ppm). Thus, the mean nitrate plus nitrite value of 2.7 given for the 1985 data converts to 0.0027 mg N/L. Somewhat higher nitrate plus nitrite (0.006 - 0.026 ppm) and ammonia (0.002 - 0.017 ppm) values were measured by Bienfang and Brock (1980) considering only their nearshore samples (Table 4 gives ranges of all samples, Table 7 gives the geometric means for all samples). Neither phosphate nor ammonia showed a pattern of increasing concentration with closer proximity to the shoreline.

The ammonia and the nitrate plus nitrite levels measured in 1990 from the nearshore environment off the proposed project are comparable to the 1986 and 1990 mean values (Table 7) reported by OI Consultants (1990). Nearshore values tracked by

S.E.A., Ltd. (1987-1990) were higher, usually always between 0.004 and 0.015 mg N/L.

The geometric mean for each parameter presented in Table 8 (considering only Stations 1, 2, and 3) is compared with the State of Hawaii water quality standards (DOH, 1989) applicable to open coastal waters ("dry" criteria) in Table 9. Criteria which appear to be exceeded are typed in bold in the table; these are total nitrogen, ammonia, chlorophyll a, and turbidity. Note that the water quality criteria are intended to be compared with samples from the environment collected over time and thus the inferred "violations" are only speculative. However, historical data (see Tables 6 and 7) indicate these same parameters have tended to exceed the standards in previous samplings in this area (see page 13), particularly in the nearshore area.

The two samples from the south coastal area (Stations 4 and 5 in Table 8) are insufficient to calculate a geometric mean. However, a perusal of the May 1990 results indicates that most of the parameters would exceed the respective criteria.

Table 9. Comparison of project baseline water quality with the State water quality criteria for open coastal waters applicable to the Barbers Point area.

Parameter	Project Site Geometric Mean	State of Hawaii Criteria Mean Not to Exceed	10% Not to Exceed	2% Not to Exceed
Total Nitrogen (mg N/L)	0.240	**0.110**	**0.180**	**0.250**
Ammonia Nitrogen (mg NH_4-N/L)	0.004	**0.002**	**0.005**	**0.009**
Nitrate + Nitrite (mg NO_3+NO_2-N/L)	0.003	0.0035	0.010	0.020
Total Phosphorus (mg P/L)	0.01	0.016	0.030	0.045
Light Extinction Coef. (k units)	--	0.10	0.30	0.55
Chlorophyll a (ug/L)	0.49	**0.15**	**0.50**	1.00
Turbidity (ntu)	1.24	**0.20**	**0.50**	**1.00**

Criteria in bold print are those exceeded by the project site values from a single sampling event at three locations.

B.2 SHORE AND INTERTIDAL AREAS

B.2.a General Description

The proposed drainage channel would enter the ocean via a cut through the limestone formation at the shore. In this area, as along almost the entire coast of Barbers Point from Kahe Point to Barbers Point Beach Park (see AECOS, 1981), erosion along the shore of the ancient emergent reef that comprises the 'Ewa Plain has formed a solution bench (Wentworth, 1939). This bench varies considerably in form from place to place, but the essential feature is a leveled surface of quite variable width positioned near mean sea level on which grows a diverse assemblage of marine algae. This assemblage varies in species composition from place to place in response to such physical factors as width and slope of the bench surface, elevation of the surface relative to tide factors, and exposure to wave energies. Thus, even at any given point, the composition of species will vary across the limestone surface from its seaward to landward aspects; that is, plants (and animals) are zoned or arranged in distinct bands parallel to the shoreline. A general discussion of the zonation on the West Beach shore (approximately one mile north of the project area) is presented in AECOS, Inc. (1991a).

B.2.b Results of a Qualitative Transect Survey

The limestone formation at the location where the proposed channel cut would be made was previously cut for a man-made drainage. This existing cut passes through the upper limestone shelf at an angle trending northwest-southeast (the shore here trends north-south). The cut descends to the level of the solution bench. As an aid to describing the zonation of macrothallic algae, a transect line was laid down the middle of the cut and zonal boundaries noted in relation to the meter marks on the line. This survey was undertaken on May 14, 1990. The physical features and biological zones crossed by the transect line are described below and summarized in Table 10. Measurements off the line are based on a start point (0 meter) at the chain-link security fence of the Chevron U.S.A. refinery property.

The upper portion of the transect line crosses sand and rubble deposited in the old channel. This area supports an assemblage of strand plants including swollen finger grass (Chloris inflata), Bermuda grass (Cynodon dactylon), Indian pluchea (Pluchea indica and Pluchea x fosbergi), golden crown-beard (Verbesina encelioides), Australian saltbush (Atriplex semibaccata), nena (Heliotropium curassavicum), and 'akulikuli (Sesuvium portulacastrum). All of these species are exotics

Table 10. Shoreline zonation along a transect line set down the midline of an existing channel cut through the limestone formation.

Meter Mark		Description
0.0	-	South project bdy.; chainlink security fence.
		Sandy soil with sparse coastal strand vegetation (species listed in text).
7.5	-	Approx. midline of the existing channel running parallel to the fenced property line.
		Sand and rubble deposit ("beach")
25.0	-	Approx. position of vegetation line (laterally, the seaward edge of *Sesuvium portulacastrum*).
		Small boulders in dry drainage channel.
42.3	-	Line along north side of concrete slab (part of former drainage system).
		Quarried limestone surface mostly above high tide level; scattered small limestone and basalt boulders.
47.5	-	Sloped limestone surface. Start of Algae Zone 5.
		Some *Echinometra oblonga* and *E. mathaei*
51.6	-	Landward edge of tidepool (inlet). Start of Zone 4.
		Echinometra oblonga and *E. mathaei* present; *Padina japonica*, *Codium edule*, *Neomeris annulata*, *Halimeda opuntia* present.
53.9	-	Seaward edge of tidepool (inlet).
		Echinometra oblonga and *E. mathaei* abundant;
55.9	-	Landward edge of depression.
		Padina japonica abundant
58.4	-	Seaward edge of depression.
		Padina japonica and *Sphacelaria furcigera* predominate; *Echinometra oblonga* and *E. mathaei* abundant;
62.7	-	Start of *Sargassum* Zone 3
68.5	-	Start of *Asparagopsis* Zone 2
74.7	-	Start of *Pterocladia* Zone 1
75.0	-	Seaward edge of bench; vertical drop into subtidal.

(introduced species) except for the ʻakulikuli, which is an indigenous shoreline plant.

Marine algae appear along the transect at the 47.5 meter mark. At the time of the survey, this upper zone (designated herein as Zone 5) was showing the damaging effects of a series of low tides, low surf, and increasing temperatures: much of the limestone was barren or covered by deteriorating thalli of partially dried seaweeds. Observations made elsewhere along this coast confirmed that the deterioration of the high intertidal algae was a general phenomenon probably caused by a combination of very low tides and low surf conditions. The various species identified from the marine bench, and a qualitative assessment of abundance within each of five designated zones across the bench, are given in Table 11.

Within Zone 5, the limestone surface is a gentle slope down to the level of the bench, which is relatively broad at this location. The inner bench habitat is here designated as Zone 4. A small, subtidal inlet extends inward across the bench, providing habitat for small tidepool and juvenile reef fishes. Most common are two damselfishes (kupipi -- Abudefduf sordidus and Chromis ovalis). The most conspicuous alga in this Zone is Padina japonica, abundant both on the bench surface and in water-filled depressions. However, only the growth in the depressions was not showing degradation from exposure at the time of the survey.

Towards the outer part of the bench where wave wash is more or less constant even at low tide, a band of Sargassum echinocarpum (designated Zone 3) is present. Seaward of the Sargassum, the surface starts to slopes gently downward and is densely covered by limu kohu (Asparagopsis taxiformis; Zone 2). The Asparagopsis Zone gives way to a narrow but conspicuous band of Pterocladia capillacea (Zone 1) along the outer lip of the bench. The Pterocladia and a colorful variety of calcareous species (Corallina, Porolithon, and Amphiroa) and deep green Dictyosphaeria versluysi extend down the nearly vertical face of the front margin of the limestone formation. Typically, algal abundance declines into the subtidal, presumably owing to grazing by herbivorous fishes.

B.2.c Observations in Adjacent Areas

The marine bench to the north of the transect line and beyond the project limits is similarly broad, but somewhat unusual in structure and appearance. The surface is undulating, with numerous closely set pools between one and two feet in depth (below the general surface). The sea urchins, Echinometra oblonga and E. mathaei, are very abundant. These two species bore conspicuous holes in the limestone surface, which here are so close together that the bench surface is reduced to small peaks and ridges between burrows. The broad, pan-like form of the pools appears to be the result of this intense boring activity which may reflect a mechanically soft limestone. Macrothallic algae are not very abundant because the urchins feed on them and the surface area between burrows is sparse.

Table 11. List of algal species observed on the marine bench in the project area and relative abundance by area or zone (see Table 9).

Species	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Area N	Area S
CYANOPHYTA							
Lyngbya majuscula							R
Lyngbya sp.				C	A	C	C
CHLOROPHYTA							
Cladophora ?patula			A		P		P
Cladophora sp.							
Codium edule *				P			
Dictyosphaeria cavernosa				P			
Dictyosphaeria versluysi	A	A				A	A
Halimeda opuntia				P			
Microdictyon setchellianum				A			
Neomeris annulata				R			
Ulva fasciata			R	P	R		R
PHAEOPHYTA							
Chnoospora minima				R	R		P
Colpomenia sinuosa		R	R			P	P
Dictyota bartayresii		R					
Hincksia breviarticulata							C
Hydroclathrus clathratus				C	A		
Padina australis				R	P		C
Padina japonica		P	C	A	P	A	A
Mesopora pangoensis			P	R	C	R	R
Sargassum echinocarpum *		P	A	C	P	A	C
Sargassum obtusifolium *							C
Sphacelaria furcigera		R	R	P	A	C	C
Turbinaria ornata		P	R	R		C	P
RHODOPHYTA							
Amansia glomerata						P	
Amphiroa sp.	A	A	P	P		A	C
Asparagopsis taxiformis *		A				C	A
Coelothrix sp.						C	
Corallina sp.	A	A	P			C	C
Galaxaura fastigiata							C
Gelidiella acerosa							P
Gracilaria coronopifolia *				R			R
Grateloupia phuquoensis *							R
Hypnea chordacea							C
Hypnea musciformis							A

Table 11. Continued.							
Species	Zone					Area	
	1	2	3	4	5	N	S
RHODOPHYTA (Cont)							
Jania sp.	P	P	C	C	P	A	A
Laurencia succisa *							P
Laurencia crustiformans				P			C
Mertensia fragilis						P	
Porolithon gardineri	A	P				C	C
Porolithon onkodes	C	C	A	C	C	A	A
Pterocladia capillacea	A	C					

Zone 1 through 5 - see text.
Area "N" - marine bench north of existing channel outlet;
Area "S" - marine bench south of existing channel outlet.
* - Edible species listed in Abbott (1974).

The bench south of the transect narrows and the surface is elevated a foot or so. Depressions (pools) are numerous here as to the north, but these are steep sided as is more typical in this formation. Algal diversity is greater than along the transect, in part because the pools and irregular front margin of the bench provide for a greater variety of micro-habitats.

Widely scattered heads of coral can be found on the bench here, mostly in pools. Most common are small heads of Pocillopora damicornis. Also seen is Porites lobata. However, percent cover by corals in this environment is very low, certainly less than 1 percent of the bench surface area.

B.3 MARINE REEF ENVIRONMENT

B.3.a General Description

The bottom off the project site extends seaward as a broad, submerged reef platform. This reef, which in places exceeds 4000 feet (1400 m) in width, is termed submerged because the seaward margin does not expose at low tide nor even approach the surface, but is submerged at a depth of between 30 and 50 feet (10 to 15 m). North of Barbers Point Harbor, the limestone shelf terminates offshore as a ledge and drop-off that descends steeply to depths of 65 to 80 feet (20 to 25 m), where a bottom of sand, scattered rubble, and isolated limestone outcrops is present (Kimmerer and Durbin, 1975). The general form of the outer portion of the submerged reef off West Beach (north of the harbor) is described by Brock (Bienfang and Brock, 1980):

> Seaward (west) of... [the] area of... corals... the limestone substratum is virtually free of them. Thus, this [outer] biotope is easily delineated by the low coral cover and is sandwiched between the biotope of large Porites lobata colonies and the seaward edge of the Pleistocene limestone [reef]. This edge or break occurs at depths of 14 to 18 m [46 to 59 feet] where a ledge is encountered, dropping away to greater depths (20-27 m [66-88 feet]). From this point the submarine topography slopes rapidly seaward such that the 100 m [328-foot] isobath is within a kilometer [0.6 mile].

To the south, the outer margin of the shelf occurs around -30 feet (-10 m) some 2500 feet off the shore (ECI, 1975).

The reconnaissance survey conducted on October 30, 1989 extended offshore to depths approaching -25 feet. For this report, additional information was obtained from surveys conducted in conjunction with construction of the channel for the Deep Draft Harbor (ECI, 1975; AECOS, 1985) and the Ko Olina project (Bienfang and Brock, 1980) because quantitative transect stations were surveyed, the stations were arranged progressively offshore, and many were within one half mile of the bottom directly off the present project (see Figure 4). Reconnaissance surveys reported in AECOS (1985) actually covered the nearshore and offshore waters between the Harbor entrance and the present project area. Thus, these surveys provide a reasonable characterization of the bottom off the project site (partly confirmed by our reconnaissance survey in October 1989).

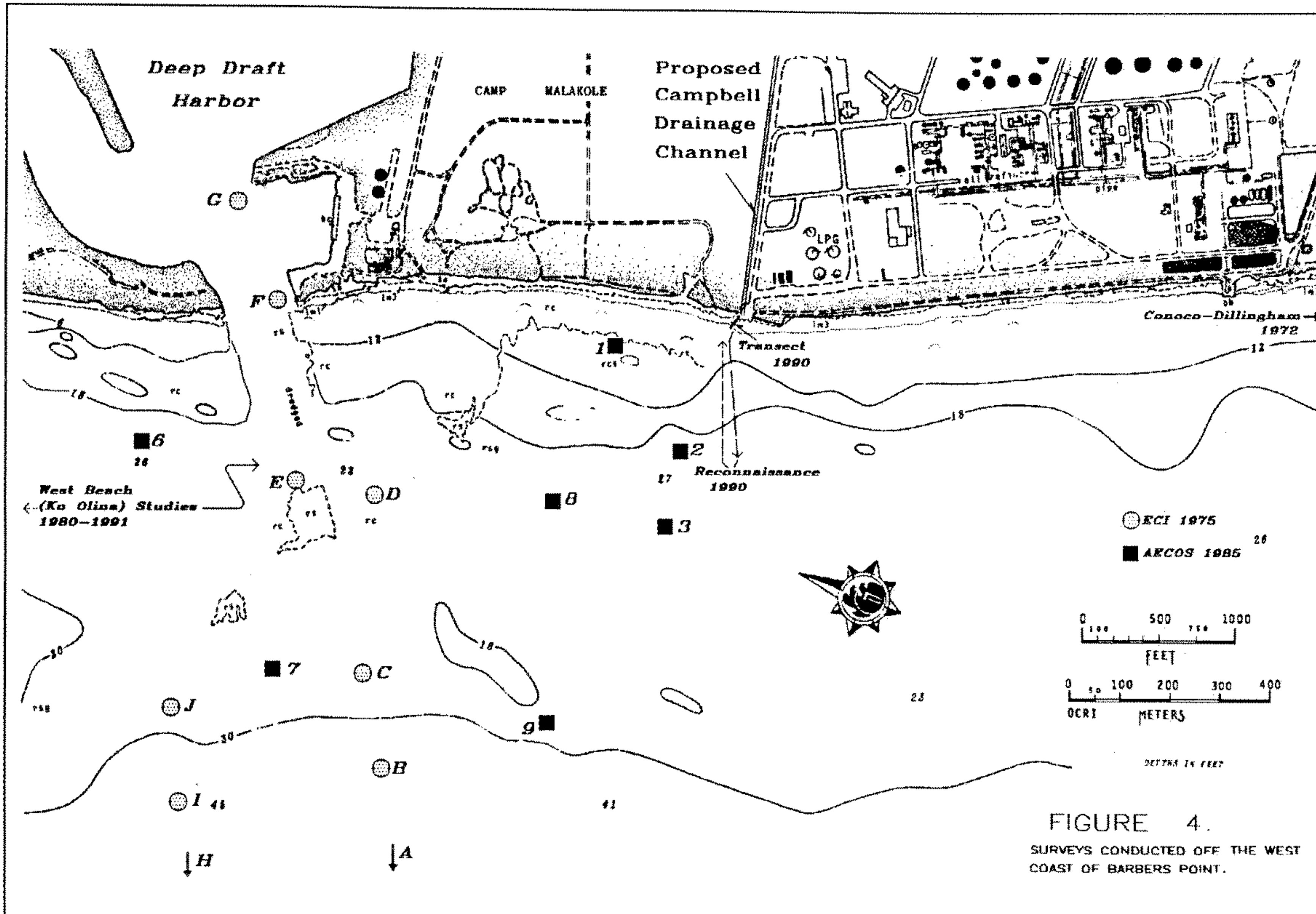

FIGURE 4.

SURVEYS CONDUCTED OFF THE WEST COAST OF BARBERS POINT.

The benthic environment south of the project area to Barbers Point is not well covered by previous studies. An environmental assessment prepared by Conoco-Dillingham (1972) for a proposed oil refinery on a parcel of land south of the existing Chevron Refinery includes lengthy lists of species from the marine littoral (intertidal) and reef flat environments, but no useful quantitative data. Coral growth is less well developed south of the project area than to the north, where the greatest cover and diversity of species offshore of this coast occurs between Ko Olina (West Beach) and Kahe (north of the harbor).

In a 1975 study, Dr. R. Brock recognized three "habitat" areas based on bottom characteristics as shown in Table 12. Dr. Brock described a total of seven biotopes on the submerged reef off West Beach (Bienfang and Brock, 1980). However, two of these occur further north near Kahe Point and a third covers a relatively small area just north of the harbor entrance which is dominated by the coral, _Porites compressa_. The others are listed herein as subtypes in Table 12. Distances and depths are approximate and may differ from area to area.

Table 12. General characteristics of offshore benthic habitats off the west coast of Barbers Point.

Distance	Water Depth	Major Characteristics
Shore to 500 ft	0 to 20 ft	limestone, low relief
0 - 300	0 - 15	low coral cover
500 to 3500 ft	25 to 50 ft	limestone, high relief
300 - 1500	16 - 39	high coral cover
1500 - 3000	29 - 39	large _Porites_ heads
3000 - 3600	39 - 59	low coral cover, low relief.
3500 to 4500 ft	50 to 82 ft	sand/rubble, low relief continues seaward

B.3.b <u>Nearshore Subtidal Zone</u> / <u>Depth Range 0 to -6 feet</u>

Directly seaward of the marine bench at the shore, the bottom is an irregular surface of projecting limestone pinnacles separated by grooves and holes. This area receives the full force of the waves and could be surveyed only during periods of exceptionally calm seas. The waters off the project area were surveyed by snorkeling on October 30, 1989. However, the surf zone was hazardous to cross and no biological observations were possible along the frontal slope of the bench. The bottom drops away to depths between 6 and 8 feet fairly quickly off the bench, then descends more gradually to depths of 9 or 10 feet.

B.3.c Low Relief Limestone Bottom / Depth Range -6 to -20 feet

The nearshore bottom directly off the proposed drainage channel is limestone with a veneer of sand. The sea urchin, Echinometra mathaei, is very abundant. Coral growth reaches perhaps 20% cover, with Porites lobata, Montipora verrucosa, Montipora patula, Pocillopora meandrina and Leptastrea all present. A variety of macrothallic algae, including Asparagopsis taxiformis, Hydrolithon reinboldi, Amansia glomerata, Neomeris annulata, Halimeda opuntia and Mertensia, occur here. Nearly all of these species were observed on the marine bench (mosty in pools), although not in the seaward most Zone 1. The transition between the species dominating the seaward face of the bench (mostly encrusting and branching calcareous forms) and the nearshore bottom occurs in the area deemed to dangerous to survey (See B.3.b).

A 1985 survey (AECOS, 1985) included a reconnaissance of the bottom between the 6- and 12-foot depth contours from about 700 feet north to about 4000 feet north of the proposed drainage channel. The substratum over this area is limestone bisected by surge channels oriented perpendicular to shore. Coral cover is low (less than 1 percent) close to the harbor entrance tending to increase slightly southward. Coral species noted here include Porites lobata, Pocillopora meandrina, Montipora verrucosa, M. verrilli, and M. patula. A quantitative benthic survey was conducted at the southern end of the qualitative survey area (see Table 13). Only seven fish species were encountered in the quantitative transect survey. Most abundant at the time was Pervagor spilosoma.

Three quantitative transects were undertaken within this biotope north of the harbor in 1979 (Bienfang and Brock, 1980). These yielded an average coral cover of 13 percent (quadrat method) to 18 percent (point-intersect method). A total of 12 coral species were encountered, with Porites lobata and Pocillopora meandrina being most conspicuous. Fish censuses yielded 23 species and 134 individuals (mean values) per transect.

Beyond 250 feet from shore the depth exceeds 12 feet. The substratum consists of rubble with sparse coral growth and little vertical relief in the harbor channel and consolidated limestone south of the channel. Coral cover estimates in the channel are less than 1 percent, with mostly small heads of

Table 13. Benthic survey summary at AECOS (1985) Station 1 located 300 feet offshore some 700 feet north of the proposed channel mouth at a depth of -8 feet.

QUADRAT SURVEY:

Species / Substratum Type	Quadrat 1	2	3	4	5
Corals					
Porites compressa	18				
Porites lobata	1	0.5	0.1		1
Pocillopora meandrina		0.1			
limestone	81	99.4	99.9	100	99

POINT SURVEY:

	Percent of Total
Corals	
Porites compressa	10
Porites lobata	3
Montipora verrucosa	3
limestone	84

INVERTEBRATE CENSUS (20 x 4 m area)

	Count
Mollusca	
Conus miles	1
Conus lividus	1
Drupa ricina	3
Arthropoda	
Calcinus sp.	2
Echinodermata	
Echinometra mathaei	367

FISH CENSUS (20 x 4 m area to surface)

7 species
59 individuals
Diversity (H') = 0.87

* Quadrat results are percent within each of five m^2 quadrats
** Point results are number of "hits" out of 40 converted to percent.

Porites lobata and species of *Montipora* present. Coral cover estimates range from 8 to 21 percent in an area just south of the harbor channel first surveyed in 1975 (Table 14); large heads of *Porites lobata* and species of *Montipora* comprised most of the samples. Considerable damage to these corals was noted in 1985 when overall coral cover was estimated at between 3 and 5 percent of the bottom. The octocoral, Anthelia edmondsoni, was abundant in this area in 1975. The sea urchin, Echinothrix diadema, was noted throughout the area.

Table 14. Numerical abundance and cover of corals, and relative abundance of substratum types at -25 feet (ECI, 1975; Station D).

Species / Substratum Type	Transect 1*	Transect 2*	Point 1**	Point 2**
rubble			3	2
limestone			31	33
Porites lobata	608 (3)	7225 (3)	1	3
Montipora verrucosa	372 (3)	617 (3)	1	
other Montipora spp.	2890 (4)	2630 (3)	3	2
Pocillopora meandrina	129 (5)			
Total coral	3999 (15)	10472 (9)	6	5
Percent Coral	8.0	20.9	15	13

* Transect results are area in cm^2 and number of colonies in (); Total area examined was 50,000 cm^2 per transect.
** Point results are number of "hits" out of 40 per frame.

Results of a quantitative transect made in 1985 are given in Table 15. In this area more or less directly off the proposed drainage channel mouth, the hard substratum is broken by small sand/rubble patches and large (up to 4 or 5 feet across) heads of Porites lobata spaced from 15 to 65 feet apart. Coral cover is close to 23 percent. Other invertebrates seen in this area include a sea urchin (Tripneustes gratilla), a sea cucumber (Holothuria atra), and the banded shrimp (Stenopus hispidus).

A total of four fish transects were conducted in this area in 1975. Away from the harbor channel, fish species averaged 24 per transect with a diversity index (H') of 2.4. The number of species present was high in comparison to the harbor channel stations (mean of 11.5 species) because of the greater bottom relief at the former location. A single fish transect conducted in 1985 produced only 7 species and a diversity index (H') of 0.35. The triggerfish, Pervagor spilosoma, accounted for 102 of

Table 15. Benthic survey summary at AECOS (1985) Station 2 located 1000 feet offshore of the proposed drainage channel mouth at a depth of -25 feet.

QUADRAT SURVEY:

Species / Substratum Type	Quadrat 1	2	3	4	5
Corals					
Porites lobata	0.1	1		7	3
<u>Montipora</u> <u>verrucosa</u>	2	15	12		8
<u>Montipora</u> <u>patula</u>	45		2	12	2
<u>Pocillopora</u> <u>meandrina</u>		1		3	0.5
Algae					
<u>Trichogloea</u> <u>requienii</u>	14	58	18	8	7
limestone	38.9	25	63	70	79.5
rubble			5		

POINT SURVEY:

	Percent of Total
Corals	
<u>Porites</u> <u>lobata</u>	5
<u>Montipora</u> <u>patula</u>	5
<u>Montipora</u> <u>verrucosa</u>	15
Algae	
<u>Trichogloea</u> <u>requienii</u>	12.5
limestone	60
sand	2.5

INVERTEBRATE CENSUS (20 x 4 m area)

	Count
Cnidaria	
<u>Palythoa</u> <u>tuberculosa</u>	3 (colonies)
Mollusca	
<u>Conus</u> <u>lividus</u>	2
<u>Rhinoclavis</u> <u>sinensis</u>	1
Echinodermata	
<u>Echinometra</u> <u>mathaei</u>	21
<u>Echinostrephus</u> <u>aciculatum</u>	2

FISH CENSUS (20 x 4 m area to surface)
7 species
109 individuals
Diversity (H') = 0.35

* Quadrat results are percent within each of five m^2 quadrats
** Point results are number of "hits" out of 40 converted to percent.

the 109 individuals censused. This species was unusually abundant throughout the Hawaiian Islands for a period of a year or more.

B.3.d "High Relief" Limestone / Depth Range -15 to -50 feet

The outer part of the limestone "reef" formation off Barbers Point is an area of greater habitat complexity owing to the increased range of vertical relief as compared with the bottom inshore and offshore. This area occurs beyond 300 feet from shore in water over 15 feet and under 50 feet in depth.

Within the depth range of 15 to 40 feet on the submerged reef north of the Deep Draft harbor, coral cover is substantial. Three transects conducted by Dr. Brock (Bienfang and Brock, 1980) gave an average cover value of 58 percent. Twelve species were noted; Porites lobata dominates and Montipora patula, M. verrucosa, and Pocillopora meandrina are other abundant forms. Fish counts at three stations yielded an average of 31 species and 215 individuals per station. Most abundant were the surgeonfish, Acanthurus nigrofuscus, the kole, Ctenochaetus strigosus, and the hinalea, Thalassoma duperryi.

Along the harbor channel alignment just seaward of the channel markers, patches of high coral cover alternate with patches of limestone thinly covered by sand and rubble; patches are about 100 feet in diameter. The coral patches predominate, and make up about 70 percent of the bottom in the area. Live coral cover, however, is in the range of 30 to 46 percent (Table 16). Considerable vertical relief is present. At a distance of 500 feet north of the channel, coral cover ranges from 25 to 36 percent (Table 15). Porites lobata dominates, and species of Montipora are not as abundant as in the channel. Some uniquely large heads of P. lobata are present, one observed being three meters (10 feet) across. The sea urchins, Tripneustes gratilla, Echinothrix diadema, Echinometra mathaei, and Echinostrephus aciculatum, are present.

Another quantitative transect was conducted in 1985 some 300 feet seaward of the station represented in Table 15 (AECOS, 1985). This area is more or less directly offshore of the proposed drainage channel where, at a distance of 1300 feet offshore (and a depth of 30 feet), coral coverage is relatively high (Table 17): mean coral cover in the transect was 34 percent. The bottom consists of limestone with scattered Porites compressa mounds and Porites lobata heads to 6 feet in diameter. Six coral species were recorded. A total of 24 fish species were encountered in the fish transect area.

Table 16. Numerical abundance and cover of corals, and relative abundance of substratum types at -26 feet (ECI, 1975; Stations C and J).

Species / Substratum Type	Quadrat Data*				Point Data**			
	1	2	1	2	1	2	1	2
sand	0.6		0.4	0.6	1	2	4	1
rubble	3.4	6.0	2.6	0.6	5	8	4	4
limestone	6.4	6.6	15.0	14.8	15	15	22	22
Porites lobata	4.8	6.2	4.6	7.8	4	7	8	10
Montipora verrucosa	2.2	0.8	0.6	0.2	6	1		1
other *Montipora* spp.	3.8	3.2	0.6	0.8	5	3	2	2
Porites compressa	0.4	0.2				1		
Poc. meandrina	0.4	0.2	0.4	0.2	1			
dead *P. lobata*	0.4	0.8			1	2		
dead *P. compressa*	2.6	0.8			2	1		
dead *Poc. meandrina*		0.2	0.8					
Total live coral	11.6	10.6	6.2	9.0	16	12	10	13
Percent Coral	46.4	42.4	25	36	40	30	25	32

* Quadrat results are average number of 400 cm^2 subdivisions (25 subdivisions per m^2).
** Point results are number of "hits" out of 40 per frame.

Yet further seaward, coral cover and vertical relief tend to decline and the bottom is characterized by large heads of *Porites lobata*, with smaller corals and/or depressions containing sand and rubble interspersed between. In Bienfang and Brock (1980) it was noted that "...this biotope parallels the shore over most of the West Beach... [area and] continues south of the... barge harbor where it becomes broader before gradually disappearing over a kilometer away south of the harbor..." Their survey included three transects within this "biotope of large *Porites lobata* heads". A total of eight coral species occurred in the transects and coral cover averaged about 30 percent of the bottom. In the same study it was determined that fishes were more abundant in this biotope than in any other and noted were a number of commercially important species such as 'uku (*Aprion virescens*), gurutsu (*Aphareus furcatus*), 'opelu (*Decapterus pinnulatus*), akule (*Trachurops crumenophthalmus*), and uluas (Carangidae).

Beyond the area of large *Porites* heads, corals decline in abundance as described herein on page 22. One 1975 transect station was located on a "table-like" formation of consolidated limestone which forms the seaward margin of the submerged reef

Table 17. Benthic survey summary at AECOS (1985) Station 3 located 1200 feet offshore of the proposed channel mouth in water 30 feet deep.

QUADRAT SURVEY:*

Species / Substratum Type	Quadrat 1	2	3	4	5
Corals					
Porites lobata	5	2		2	
Porites compressa	4	40	3	5	85
Porites evermanni	8				
Montipora patula			2		
Montipora verrucosa	0.5		1		
Pocillopora eydouxi			11		
limestone	82.5	58	83	93	15

POINT SURVEY:**

Corals	Percent of Total
Porites lobata	10
Porites compressa	17.5
Porites evermanni	2.5
limestone	70

INVERTEBRATE CENSUS (20 x 4 m area)

	Count
Mollusca	
Rhinoclavis sinensis	1
Arthropoda	
Dardanus sp.	1
Echinodermata	
Echinostrephus aciculatum	1

FISH CENSUS (20 x 4 m area to surface)

24 species
154 individuals
Diversity (H′) = 2.24

* Quadrat results are percent within each of five m^2 quadrats
** Point results are number of "hits" out of 40 converted to percent.

Table 18. Numerical abundance and cover of corals, and relative abundance of substratum types at -33 feet (ECI, 1975; Station B).

Species / Substratum Type	Transect 1*	Transect 2*	Point 1**	Point 2**
rubble			1	
limestone			31	36
Peristernia chlorostoma		(4)		
Echinometra mathaei	(110)	(83)		
Linckia sp.	(1)	(3)		
octopus	(1)			
Echinostrephus aciculatum	(3)	(3)		
Tripneustes gratilla		(1)		
Porites lobata	3645 (32)	1187 (21)	4	2
Montipora verrucosa	105 (10)	50 (6)		1
other *Montipora* spp.	20 (3)	15 (1)		
Porites compressa	500 (2)		4	1
Pocillopora meandrina	38 (3)	20 (4)		
Total coral	4308 (50)	1272 (32)	8	4
Percent Coral	8.6	6.4	20	10

* Transect results are area in cm^2 and number of colonies in (); Total area examined was 50,000 cm^2 (#1) and 20,000 cm^2 (#2).
** Point results are number of "hits" out of 40 per frame.

platform. A second station was located north of the harbor channel on limestone bottom with patches of coral. The "table" area slopes from around -30 feet and then drops abruptly down to -46 feet at the margin. The density of corals (cover values between 8 and 20%) and vertical relief are highest along this ledge. Coral cover is 6 to 10 percent toward the center of the "table" (Table 18). *Porites lobata* comprises 64 to 93 percent of the live coral. Loose material in the form of sand and rubble are virtually absent. Coral cover ranges from 10 to 18 percent of the bottom north of the harbor channel alignment, with *Porites lobata* strongly dominating and comprising 88 percent of the coral cover (Table 19).

Four standard fish transects were conducted at each of the stations described above from near the margin of the reef. Fishes were similar in numbers and composition in all transects. Fish species averaged 33.5 per transect and the fish species diversity index (H′) was 2.97 in one area; an average of 35 fish species was tabulated and the diversity index was 2.8 at the other. In the censusing of fishes at these two stations, one of each pair of transects was placed in an area of relatively high coral cover while the second in each case was laid across a bottom with low coral cover.

Table 19. Numerical abundance and cover of corals, and relative abundance of substratum types at -33 feet (ECI, 1975; Station I).

Species / Substratum Type	Transect 1*	Transect 2*	Point 1**	Point 2**
limestone			32	33
Echinometra mathaei	(49)	(36)		
Echinostrephus aciculatum	(4)	(2)		
Conus lividus	(1)			
Peristernia chlorostoma		(1)		
Porites lobata	4150 (38)	2597 (49)	5	5
Montipora verrucosa	110 (14)	96 (23)	1	
other Montipora spp.	306 (21)	163 (15)		
Porites compressa	18 (1)			
Pocillopora meandrina	126 (9)	64 (7)	1	
Leptastrea bottae	3 (1)	14 (2)		
dead P. lobata			1	
dead Poc. meandrina				1
Total coral	4713 (84)	2934 (96)	7	6
Percent Coral	15.7	9.8	18	15

* Transect results are area in cm^2 and number of colonies in (); Total area examined was 30,000 cm^2 per transect.
** Point results are number of "hits" out of 40 per frame.

B.3.e <u>Deep Offshore Sand and Rubble Bottom / Depth over -50 feet</u>

The bottom seaward of about the 40 to 50-foot isobaths descends gradually and consists of a rather featureless sand and rubble bottom. North of the harbor channel alignment, the bottom consists of a consolidated limestone slope which descends from depths of -36 to -39 feet at an angle of about 25 degrees. This slope is a less precipitous version of the "table-like" formation described above. The substratum is one of rubble patches separated by consolidated limestone with a veneer sand. With increasing depth, the bottom is covered with sand of greater thickness interrupted by rubble patches and less common areas of large (to 6 feet in diameter) boulders;

overall, the substratum is 60 to 70 percent sand bottom. Vertical relief is very low.

Coral cover is around 0.1 percent near the edges of rubble areas and 2 to 15 percent in the center of the these patches (Tables 20 and 21). Porites lobata dominates and is characterized by small colony size. North of the harbor, coral cover in this deep biotope ranged from 8 to 12 percent (Bienfang and Brock, 1980). Organisms usually restricted to greater depths were noted: the button coral, Cycloseris vaughani, the red goatfish, Mulloidichthys pflugeri, large moana kea, Parupeneus chryserydros, and kawakawa, Euthynnus affinis.

Table 20. Numerical abundance and cover of corals, and relative abundance of substratum types at -52 feet (ECI, 1975; Station H).

Species / Substratum Type	Transect 1*	Transect 2*	Point 1**	Point 2**
sand			1	4
rubble			39	35
limestone				1
Pseudoboletia indiana	(2)			
Echinothrix diadema	(1)			
Echinostrephus aciculatum		(1)		
Eucidaris metularia	(1)			
Echinometra mathaei		(1)		
Porites lobata	394 (25)	660 (44)		
Montipora verrucosa	30 (13)	58 (16)		
other Montipora spp.	109 (3)	75 (7)		
Porites compressa	25 (1)			
Pocillopora meandrina	71 (9)	373 (14)		
Coscinerea ostraeiformis	6 (1)			
Total coral	635 (52)	1166 (81)	0	0
Percent Coral	1.3	2.3	0	0

* Transect results are area in cm^2 and number of colonies in (); Total area examined was 50,000 cm^2 per transect.
** Point results are number of "hits" out of 40 per frame.

Reportedly seen around the boulders at -52 feet were numerous commercially important fishes including uku (Aprion virescens), kea (Parupeneus chryserydros), papio (Gnathanodon speciosus, Caranx melampygus), opelu (Decapterus pinnulatus), uhu (Scarus perspicillatus) and weke (Mulloidichthys flavolineatus). Fish transects yielded 30 species and a diversity index of 2.69 in one area and 43 species a diversity index of 3.4. The latter was highest of all transects performed in 1975, probably because of the deeper water and high cover afforded by the boulders. Generally, however, cover is low at these depths and fish numbers and diversity low (Bienfang and Brock, 1980).

Table 21. Numerical abundance and cover of corals, and relative abundance of substratum types at -82 feet (ECI, 1975; Station A.

Species	Transect 1*	Transect 2*	Point 1**	Point 2**	Substratum Type
			3	5	sand
			17	11	rubble
				1	limestone
Porites lobata	90 (11)	2039 (46)		3	
M. verrucosa	15 (1)		4		
other Montipora	10 (2)	8 (1)			
Porites compressa	8 (1)	285 (6)			
Poc. meandrina		7 (4)			
Palythoa sp.		15 (1)			
Total coral	123 (15)	2371 (62)	0	3	
Percent Coral	0.1	2.4	0	15	

* Transect results are area in cm^2 and number of colonies in (); Total area examined was 100,000 cm^2.
** Point results are number of "hits" out of 20 per frame.

B.3.f Conditions off the Eastern Drainage Channel

An area of comparative interest is the marine reef environment seaward of the eastern drainage channel for the Campbell Industrial Park. This area was surveyed briefly on October 30, 1989. Unfortunately, the visibility seaward of the channel mouth was even poorer than that in the channel itself. No coral growth could be found directly seaward of the channel mouth. This area was surveyed in 1975, prior to the enlargement of the drainage channel (R.M. Towill Corp., 1975). The area was described as not very conducive to coral growth, although several species were noted as present away from the channel (only Pocillopora meandrina is mentioned) and quantitative estimates of abundance were not made. Unfortunately, the author consistently referred to limestone as "coral", confusing descriptions of the bottom which consists of limestone outcrops rising several feet above a sand and rubble covered bottom.

A report by Dames & Moore (1974) considered marine impacts of a discharge pipe proposed for the reef area midway between the eastern drainage canal and Barbers Point lighthouse. However, this report only notes that corals were not found in the nearshore area.

Section C. IMPACTS ON MARINE BIOTA AND WATER QUALITY

As noted in the introduction, the impacts of the proposed drainage system encompass both short term (construction) and long term (effluent quality) impacts.

C.1 Short Term Impacts

Short term impacts derive from those activities which accompany construction of the drainage channel. With respect to the marine realm, these impacts would be limited to the marine bench and immediate subtidal area seaward of the outlet. Turbidity generated during construction may temporarily influence a wider area of the submerged reef off the mouth of the proposed channel. Because the location is one of substantial wave action, the impact of this turbidity will be largely aesthetic and will not produce serious short-term or long-term consequences (see below). The channel invert (bottom elevation) at the point where the channel punches through the limestone at the shore will be at -5 feet. The seaward face of the marine solution bench descends steeply to -6 or -7 feet. Thus, removal of material would extend no further seaward, effectively limiting direct short-term impacts to the shoreline environment.

The proposed channel would be a little more than 100 feet wide at the shore, requiring the removal of the limestone outcrop and solution bench along this length of shoreline. Thus, some loss of habitat presently harboring a variety of seaweeds would occur. In terms of uniqueness for this coast, marine bench habitat is the dominant shoreline type, extending for several miles north and at least one mile south (then east around Barbers Point) from the channel opening. The algal community now located along the southern half of the channel mouth is of relatively high diversity, but not unique within this habitat type along the Barbers Point shore.

The belt (or zone) of Pterocladia present along the seaward margin of the bench is of significance as a food source for marine turtles (Balasz, 1980) and a portion of this habitat would be lost without possibility of replacement by the channel construction. The impact on turtles of the loss of this resource is small relative to that available along this coast, but the loss must be viewed as contributory to a cumulative destruction of marine bench habitat that has and may continue to occur (i.e., Barbers Point Harbor and Ko Olina lagoons). At Ko Olina, a total of twelve or more penetrations of the marine bench were made to provide water circulation for a series of four lagoons constructed behind the shore. Monitoring of algal communities on the solution bench at Ko Olina has been underway since before construction started. Post-construction monitoring includes broad-scale surveys of Pterocladia distribution (AECOS, 1991b). Although quantitative changes in the abundance of this alga are not being determined, preliminary qualitative results indicate that losses have been confined to areas of direct habitat removal (channel cuts through the bench) and no more. That is, Pterocladia growth has recovered where suitable substrata at the proper elevation relative to tidal factors remained after channel cuts were made.

If removal of the limestone bench requires blasting with explosives, certain precautions may need to be taken to protect marine life in the vicinity. Of major concern would be death or injury to sea turtles, since these are species protected under Federal law. Limitations on the size and timing of charges and determination that no turtles are present in the area at the time of detonation are the kinds of mitigating actions that would prevent death or injury of protected species.

C.2 Long Term Impacts

C.2.a Channel Habitat

Upon completion, the proposed channel will become a long, narrow inlet of the sea, with the channel invert (bottom elevation) below sea level to and beyond Malakole Road. An intertidal bottom will be created between 2000 and 2500 feet inward from the channel mouth (as well as along the vertical walls of the channel). The channel will be finished, the exposed cuts through limestone concrete-lined on the sides and bottom as requested by the City and County of Honolulu.

A similar channel built (actually enlarged) in the 1970s (see R.M. Towill, 1975) to drain the east side of Campbell Industrial Park enters the sea along the boundary between the industrial park and Barbers Point Naval Air Station. This channel was inspected on October 30, 1989. The channel bottom is limestone outcrop and limestone rubble at the mouth and inward for perhaps 50 feet; thereafter, an extensive sand deposit characterizes the channel bottom. Waves (albeit much diminished) and tidal change extend in some 2500 feet to a series of exposed sandbars where the channel narrows. The water in the channel was (on October 30) too turbid for a biological survey, but is known to harbor tilapia (Oreochromis mossambica), aholehole (Kuhlia sandvicensis), mullet (Mugil cephalus), gobies (Gobiidae), and goatfishes (Mullidae) (R.M. Towill Corp., 1975). Suitable habitat exists for a variety of juvenile reef fishes and nondemersal fishes characteristic of harbors and similar inlets. The sandbars which uncover at low tide attract shore birds.

The proposed channel can be expected to similarly develop as an inlet with a sand or silty-sand bottom. Salinities may be slightly depressed much of the time owing to brackish ground water seepage and would greatly depress during infrequent storm runoff. The presence of brackish water would not be a hindrance to habitation potential, but would define the character of the biological assemblage.

C.2.b Storm Discharge Water Quality

Long term impacts on the marine realm would occur as a consequence of the focused discharge of runoff into the nearshore waters. Several different aspects of the physical and chemical nature of this discharge may have an influence on biological resources at and off the shore. These impacts will tend to be episodic and quite variable in extent as a function of discharge volume. Unknown, but quite possibly important, will be the potential for pollutants from the watershed to be introduced into the marine environment. In general, the drainage basin area located mauka of the H-1 Freeway will contribute most of the water flow and most of the sedimentary material contributing to nearshore turbidity problems during and immediately after storms. Potentially toxic substances are more likely to arise from the drainage basin makai of the H-1 Freeway (see Section C.2.c below).

Most severe, will be the depression of salinity within the lower portion of the channel and the effluent plume extending offshore during events associated with major floods. Salinity depression has been modeled by Edward K. Noda & Assoc. (1990) for a variety of flood events and offshore current conditions. Taking 22.5 ppt (64 to 66% of ambient salinity) as representing a reasonable limit above which potential harm to benthic organisms would not occur, all cases modeled show this contour to extend a maximum of 200 to 400 feet alongshore on either side of the shoreline discharge location and extending no more than 1,300 feet offshore. Highly mobile organisms, such as fishes, can avoid a brackish water plume (and withstand somewhat greater salinity depression for a short period of time). Attached benthic organisms, such as corals, are at greatest risk. Thus, the depth of the plume relative to the bottom is of primary consideration.

Although somewhat dependent upon the temperature differential between the plume and the receiving water and the concentration of suspended material, brackish water will be more buoyant than the receiving water, the lowest salinities reached during discharge will be at the surface. For most cases modeled, the plume depth reaches a maximum on the order of -15 feet, a depth which the bottom exceeds within 300 to 500 feet of shore. The models provide a means of estimating the extent of the offshore bottom at risk as extending seaward to the 15-foot depth contour and laterally up to several hundred feet on either side of the discharge point. This area corresponds to the biota described in Sections B.3.b and B.3.c. Obviously, intertidal areas (e.g., the marine bench habitat) would be impacted as well, but in the case of particularly severe storms would probably suffer damage in the absence of the proposed drainage structure. The offshore area is one of generally low coral cover. Along this coast, areas of significant coral cover tend to occur at depths greater than 15 feet and on the bottom north of the Deep Draft Harbor.

The discharge plume will carry suspended solids into the marine environment. An immediate impact will be the turbid water associated with the plume. This aspect too has been extensively modeled by Edward K. Noda & Assoc. (1990). The high turbidity potentially associated with the discharge plume will have several effects on the marine environment. Most notable will be an aesthetic one which will interfere with other uses of the area (for example, diving) for some period of time. As fine material settles out of the plume, this material may cover the bottom, potentially altering the nature of the bottom with resulting deaths of benthic organisms. Corals can be killed or damaged by excessive siltation. However, given the relatively high energy of the offshore environment, siltation effects are unlikely to occur at any significant distance from the discharge point. The zone of potential damage from fine sediment or even coarser material carried as bedload is most probably less than that ascribed above for salinity depression effects.

Dependent somewhat upon ocean currents prevailing during the period of discharge, most of the very fine material discharged will be carried considerable distance from the outlet before settling out of the water column. Thus, direct smothering of benthic life is unlikely. In some coastal areas, silt derived from construction activities in the nearshore environment has remained for a considerable period of time (years), becoming resuspended by storm waves and shifted about the area by currents. The west shore of Barbers Point appears not to be at substantial risk for retaining fine sediments within the nearshore environment. Bienfang and Brock (1980; p. 101) noted that "... episodic drainage following heavy rains... characteristically transport[s] large quantities of lateritic silt to the nearshore areas, but prevailing advective forces appear to transport such material out of the immediate area within several days." The principal drainage along this coast is located at the north end between Kahe and West Beach, close to the area of greatest reef community development. Construction of the Deep Draft Harbor entrance channel generated considerable amounts of silt (AECOS, 1986) which appears to have moved relatively quickly away from the area.

It is to be noted that despite the relatively high nutrient content of the barge harbor water, the turbidity and chlorophyll a values were relatively low (i.e., the environment was not eutrophic), a fact attributed to the relatively short residence time for water in the old barge harbor (a situation which may not be true today). Thus, despite the potential for nutrient enrichment represented by the proposed drainage channel, flushing of the nearshore environment (through wave and current action) will be sufficient to prevent eutrophication of the nearshore water mass. Observations made during the opening (to the sea) of the Ko Olina lagoons (AECOS, Inc., 1991a) indicate that the nutrient enriched water does stimulate the growth of certain benthic algae (Cladophora, Enteromorpha, Ulva) at the shore, producing a conspicuous green band along the shore and shallow subtidal, at least initially. Enteromorpha was noted along the margins of the eastern drainage channel (R.M. Towill Corp., 1975).

A more subtle impact could develop from the decrease in light energy received at the bottom due to turbid water, harming the growth of coral and algae. This effect is not likely to be serious unless turbid water is generated continuously over a long period of time either because material carried out of the ditch remains in the nearshore environment and is constantly resuspended by waves or the outflow of turbid water is continuous (i.e., the drainage acts as a perennial stream). It is most likely that currents and waves will prevent any significant accumulation of fine sediment in the nearshore environment and will prevent siltation damage to corals offshore.

The primary concern is one that is extremely difficult to assess without modeling the fate of fine material discharged from the ditch and understanding the potentially cumulative effects of the deep draft harbor and other planned or existing discharge points along this same coastline. In general, water quality north of Barbers Point (area impacted by this project) is significantly better than water quality east of Barbers Point (south shore) and the marine environment supports a higher quality assemblage of corals, reef fishes, and other organisms. The reasons for these differences are not entirely clear, but may be related to the substantial differences in runoff frequency and characteristics. The south shore receives discharge from Pearl Harbor which is, due to the number of streams draining wetter parts of the island, somewhat estuarine in character. The west shore presently receives significant runoff only during infrequent storms effecting the generally dry (leeward) Waianae coast. Coral reef development is clearly stunted off stream mouths. This natural phenomenon appears greatly exacerbated by urbanization of the watershed, quite possibly because of increased sedimentation and pollutants.

The most significant source of suspended material of potential harm to the marine environment is likely to be the gulches (e.g. Awanui Gulch, Palailai Gulch) feeding into the system from the Waianae Range in the vicinity of Makakilo. Consideration should be given to the inclusion of siltation basins between the proposed channel and more mauka areas to reduce the quantity of eroded lateritic soil finding its way into the discharge.

C.2.c <u>Impacts of Urban Pollutants</u>

The chronic impacts on marine reef environments of the many substances contributed by urban runoff are not at all understood. Certainly a variety of potentially harmful pollutants may find their way into the new channel as the watershed becomes urbanized. The long-term effects of these chemicals on extant marine resources cannot be predicted in any rational way. An observed decline in resources following urbanization in other parts of the island may as easily be attributed to other factors (increased fishing pressure and human activities generally) as to a general rise in stream-borne and storm water runoff pollutants.

Assessing impacts of storm water contaminants is complicated by the manner in which constituents are delivered to the receiving water. The discharge of water from a storm drainage system is an intermittent occurrence. In many parts of Hawaii the relatively frequent, short-duration, and high intensity rain storms reduce the accumulation of contaminants on streets and other impermeable surfaces (DOH, 1980). Under these conditions, the concentrations of contaminants in the discharge, particularly any constituents which show a pattern of decreasing concentration with increasing storm duration, should be relatively low.

Of course, pollutant loadings (that is, the total amount of a substance delivered into the receiving waters over a period of time) may not be related to rainfall frequency, only the amount that is delivered with each storm. Fujiwara (1973) has suggested that the actual intermittent impact upon receiving waters is far more critical than the total loading. Certainly, for many of the potentially toxic substances that could be found in storm-water runoff, the peaks in concentration may be more significant for a receiving water such as the coastal environment off Barbers Point because the potential for accumulation in the nearshore environment is not great. Studies have shown that the more toxic compounds associated with urban street runoff are associated with the fine solids fraction (Sartor and Boyd, 1972), which will enjoy greater dilution and dispersion upon discharge from the channel.

The Campbell Industrial Park area is typified by infrequent rains; therefore significant time periods for accumulation of contaminants on impermeable surfaces will occur. Potentially significant mitigation of pollution impacts can be achieved by careful attention to recommendations given in Sartor and Boyd (1972; also Sartor, Boyd and Agardy, 1974) with respect to street cleaning and maintenance. Primary, would be a regular program of street sweeping, particularly on weekends when few vehicles are parked near the curbs.

Recognizing that runoff from certain urban and industrial areas can produce significant pollutant loadings into the nation's aquatic environments has prompted the Environmental Protection Agency to promulgate regulations governing storm water discharges under the NPDES program (55 FR 47990 et seq; 56 FR 12098 et seq). The new regulations are to be implemented in 1991/1992. The proposed Campbell Estate Drainage Channel will service an area with facilities that fit the definition of industrial activity and therefore require facility permits. Permits will have to be obtained by each industrial facility that contributes runoff to the channel. However, wholesale, retail, service, and commercial operations are excluded from the facility permit requirements. The channel will presumably come under the program for municipal storm sewers, requiring the filing of a permit application and development of a variety of programs to control the discharge of pollutants into the channel by the operator of the storm drainage system.

Requirements under the permits issued will focus on "pollution prevention measures" rather than "end-of-pipe" technological controls (McCubbin, Becker, and Hill, 1991). EPA will use the application process to determine what control and pollution prevention measures are currently used by industries, and later incorporate the successful techniques into permits.

Filing requirements are detailed and include site drainage mapping, listing of significant materials used or stored on the site, control measures used to reduce pollutants in runoff, and testing of the discharge. Samples must be collected from the discharge resulting from a storm event that is greater than 0.1 inch. Further, the sampled event must occur at least 72 hours after a previously measurable storm event of more than 0.1 inch of rainfall. Analytical testing requirements include (1) any pollutant limited in an effluent guideline to which the facility is subject; (2) any pollutant listed in a facility's NPDES permit for process wastewater; (3) all of the following: oil & grease, pH, BOD_5, COD, NFR, total phosphorus, TKN, and nitrate plus nitrite nitrogen, and (4) any toxics that the applicant knows or has reason to believe may be present at the facility or may have been present in the past (Tarbert, 1991).

Implementation of the new regulations is expected to begin the process of bringing under control discharges into streams or the ocean from drainage systems that are typically intermittent and represent nonpoint sources of pollution. Application of the State of Hawaii water quality standards (which are based on averaged values over unspecified time periods) has been difficult in such cases because of the intermittent nature of the discharge.

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APPENDIX C

STORMWATER FLOW MODELING IN THE
RECEIVING OCEAN WATERS FOR THE
PROPOSED CAMPBELL DRAINAGE CHANNEL
KAPOLEI BUSINESS-INDUSTRIAL PARK
EWA, OAHU, HAWAII

by

EDWARD K. NODA AND ASSOCIATES, INC.

NOTE: The input values used in the computer model are based on conservative storm runoff data. The suspended sediment yield and concentrations listed in Tables 2 and 3 are approximately a factor of 10 larger than the calculated values for the stated storms. The results of the computer modeling of sediment concentrations are therefore more conservative (approximately 10 times higher) than expected sediment concentrations for the given storms. Tables and figures referenced from this report and included in the text of the EIS have been revised to reflect the expected sediment yields and concentrations (approximately 10 times lower than values listed in this report).

STORMWATER FLOW MODELING IN THE RECEIVING OCEAN WATERS FOR THE PROPOSED CAMPBELL DRAINAGE CHANNEL, KAPOLEI BUSINESS-INDUSTRIAL PARK, EWA, OAHU, HAWAII

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May 1990

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FOR THE PROPOSED CAMPBELL DRAINAGE CHANNEL,
KAPOLEI BUSINESS-INDUSTRIAL PARK, EWA, OAHU, HAWAII

1.0 INTRODUCTION

In order to evaluate potential impacts to the ocean receiving waters due to the discharge of suspended sediments carried by storm waters discharged from the proposed Campbell Drainage Channel, numerical modeling of the discharges were performed. The following report documents the results of this modeling effort.

Figure 1 describes the site area and the proposed location of the Campbell drainage channel. At the shoreline exit, the proposed unlined, trapezoidal channel would be 106 ft wide, invert at -5 ft MSL, with 4V on 1H side slopes daylighting at +3 ft MSL at the top of the bank.

The analysis of mixing plumes is a very complex task and historically, in order to reduce the complexity to analytically manageable levels, the receiving water processes are usually divided into physical regions designated the near-field and far-field. As applied to the proposed Campbell drainage channel discharge, in the near-field region, the stormwater which discharges at the shoreline exit, mixes with the local receiving waters through turbulent shear flow in the jet. In this region, both the momentum and buoyancy forces are important.

The far-field region is encountered when the momentum of the surface discharge is spent, and the diluted stormwater drifts relatively passively in the ocean and is transported by the ambient ocean currents.

In the following study, the near-field and far-field modeling are considered separately, where the inputs for the far-field model are obtained from the output of the initial near-field modeling results. The stormwater discharge characteristics and suspended sediment load were based on information provided by Engineering Concepts, Inc.

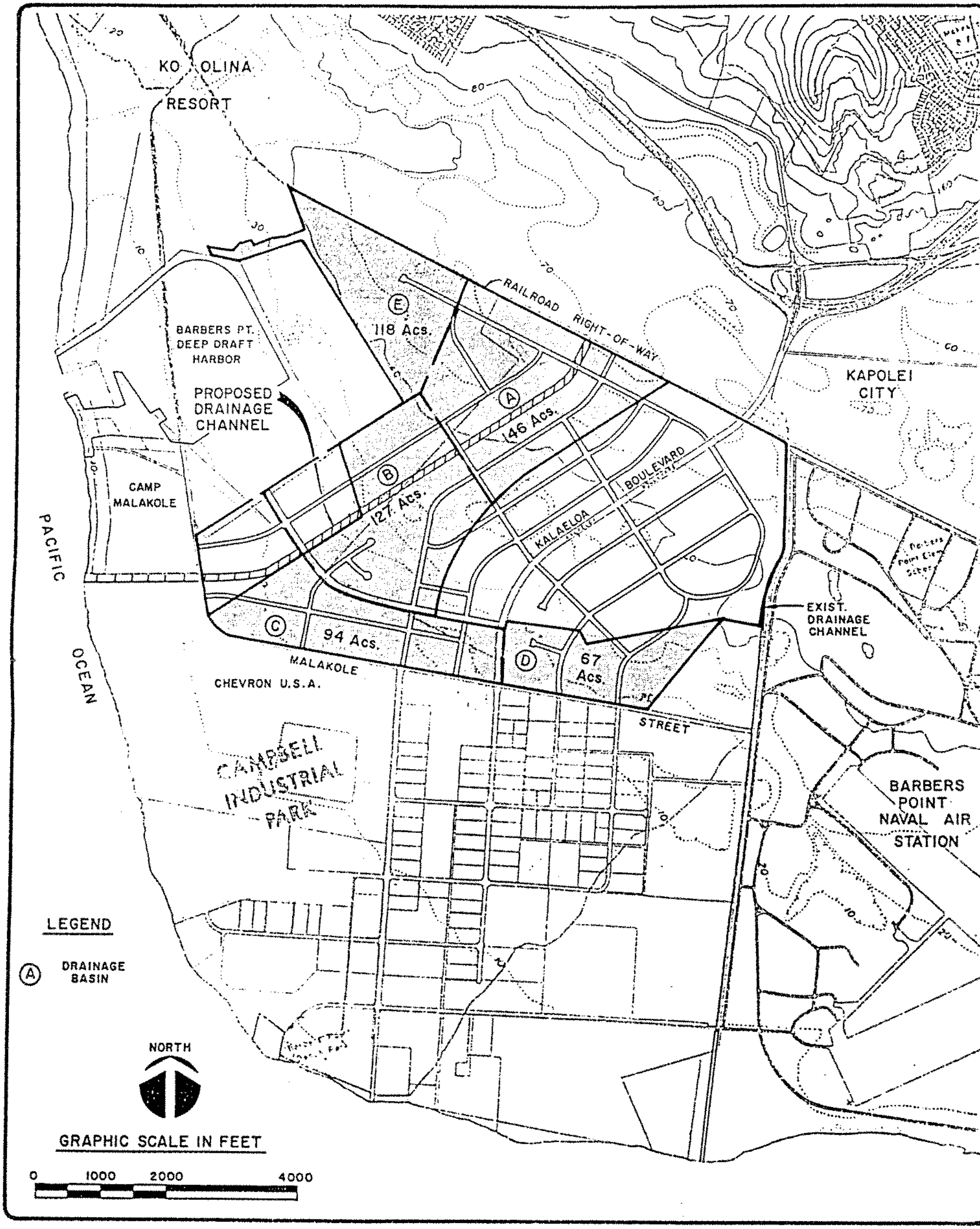

Figure 1: Proposed Campbell Drainage Channel, Kapolei Business - Industrial Park, Ewa, Oahu, Hawaii.

2.0 NEAR-FIELD PLUME MODELING

2.1 Technical Introduction

When the shoreline stormwater discharge exits the channel, it mixes with the nearshore ambient water due to turbulent entrainment of the jet. The density difference between the discharge water and the receiving water also induces a vertical force on the plume. Since the plume is already on the surface, the buoyancy force tends to collapse the plume vertical thickness while forcing the width of the plume to increase in the horizontal. Entrainment of ambient fluid is constrained to the bottom and side edges of the plume. In this region, termed the near-field, momentum and buoyancy in the discharged flow as well as the turbulent entrainment of ambient fluid due to these forces dominate. Following this near-field plume mixing, the diluted effluent becomes dynamically passive, and further transport and dispersion is a function primarily of the ocean transport characteristics driven by the local ocean current structure. This latter phase, termed the far-field, is described in Section 3.0.

The surface discharge plume from the shoreline channel outlet involves the complex interactions of such factors as the jet discharge characteristics, the ambient water current and turbulence level, atmospheric conditions which may be important if the temperature of the discharge is different from the ambient water, and bottom and shoreline geometries. Since the precise effects of all factors and their mutual interaction on the dynamics of a plume in a natural environment are not well understood, only solutions to an idealized situation can be obtained.

For the Campbell drainage channel shoreline discharge, the model selected was the thermal plume model of Shirazi and Davis (1974). In a major effort to provide a workbook type of document for the calculation of surface discharged thermal plumes from power plants, Shirazi and Davis, under U.S. Environmental Protection Agency sponsorship, reviewed all major models and selected the model developed by Prych (1972). When compared to experimental data, some deviations were noted, and Sharazi and Davis introduced modifications to Prych's model to obtain better agreement with existing data. This new model has been termed the PDS Model (Prych-Davis-Shirazi).

While the shoreline discharge of stormwater flow is not immediately recognized as a thermal plume, the PDS Model incorporates all the appropriate hydrodynamic processes for stormwater discharge. In fact, the temperature of the discharge effluent and ambient water could be set equal to each other, thereby terminating any temperature dependence. Briefly, the PDS

Model is a three-dimensional model which represents uniform and steady surface discharge of heated water from a rectangular channel into a large and deep body of water that is either at rest or moving at a uniform and constant velocity. Utilizing similarity assumptions, the governing equations can be integrated perpendicular to the direction of flow and a set of nonlinear ordinary differential equations derived, which can be numerically solved using standard integration techniques. The details of the development and description of the PDS Model are beyond the scope of this report, and the Shirazi-Davis (1974) report should be consulted if more information is desired.

In the very initial phase of the plume development, termed the jet development zone, the flow characteristics are complicated due to the need to examine simultaneously the characteristics of the core region as well as a turbulent outer jet region. In this region, the PDS Model has adopted a one-dimensional model for the solution with the length of this development zone based on experimental data. Thus, the model output essentially begins at this development length from the shoreline exit point. In the subsequent graphics displays, this development zone is depicted by dotted lines.

2.2. PDS Model Input Variables

The PDS Model requires specification of a number of input variables. Some of these input variables are associated with the characteristics of the ambient receiving waters, the stormwater effluent, the hydraulic flow at the shoreline channel exit, and the geometry of the channel outlet. This section describes the various input parameters used in the near-field modeling.

To describe the ambient water characteristics, the salinity, temperature and current velocity need to be specified. Figure 2 shows the seasonal variation of the ocean water salinity in the nearshore zone off Kahe Point, Oahu, as derived from data obtained by Leis (1978). The salinity data shown in Figure 2 is considered representative of the west coast of Oahu. Notice in Figure 2 that the salinity shows a definite seasonal trend ranging from a minimum of about 34.6 o/oo (parts per thousand) during the spring, to a maximum of about 35.1 o/oo during the fall.

Figure 3 describes the ambient water temperature variation between 1975 to 1986 recorded by Hawaiian Electric Company (HECO) in the nearshore waters adjacent to the Kahe Generating Station. This data clearly shows the consistent seasonal trend represented by a water temperature of about 24°C during the winter time and about 27°C during the summer season.

In order to quantify the ambient currents, the current

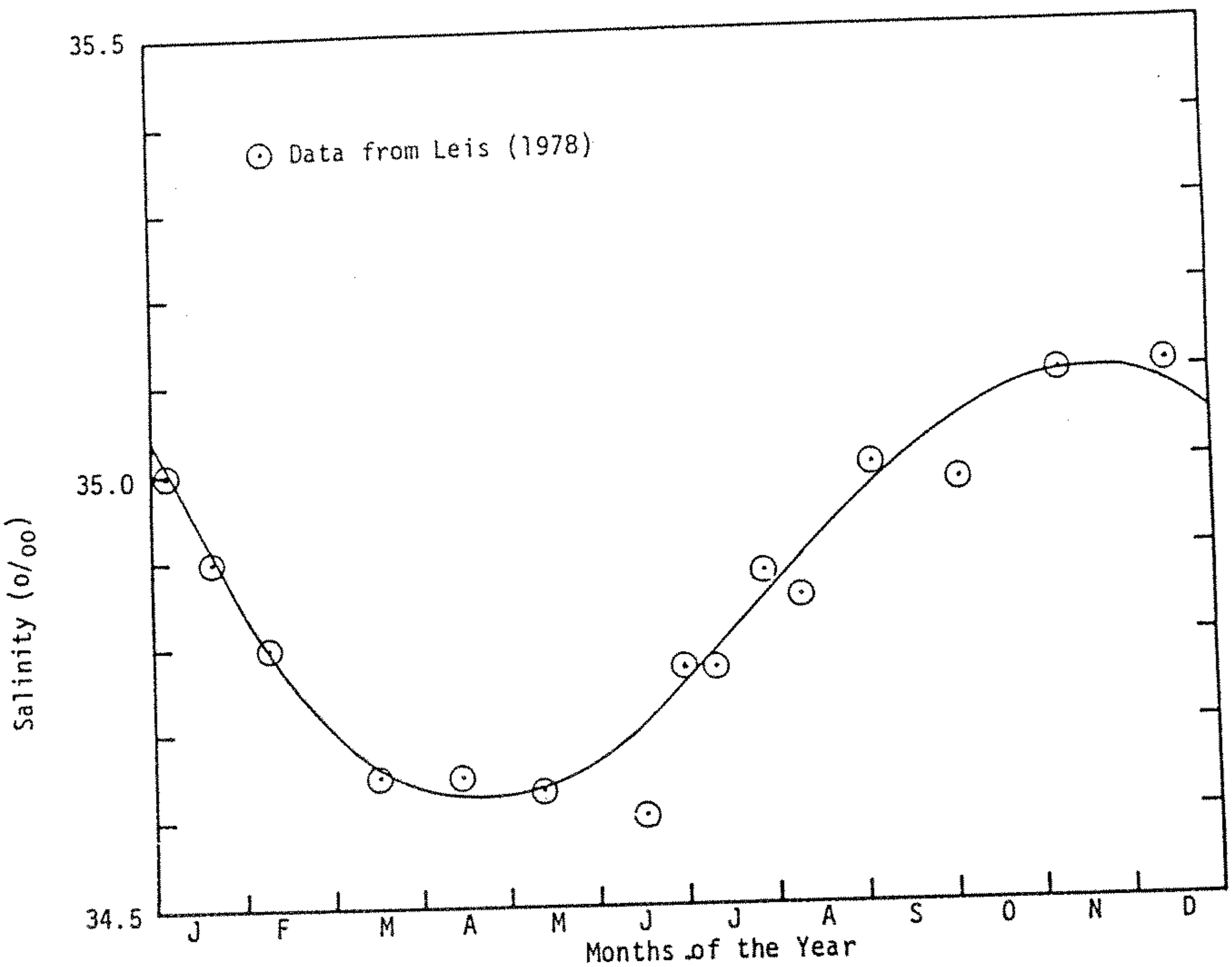

Figure 2: MONTHLY SALINITY VARIATION IN THE NEARSHORE ZONE OFF KAHE POINT, OAHU (From Leis, 1978)

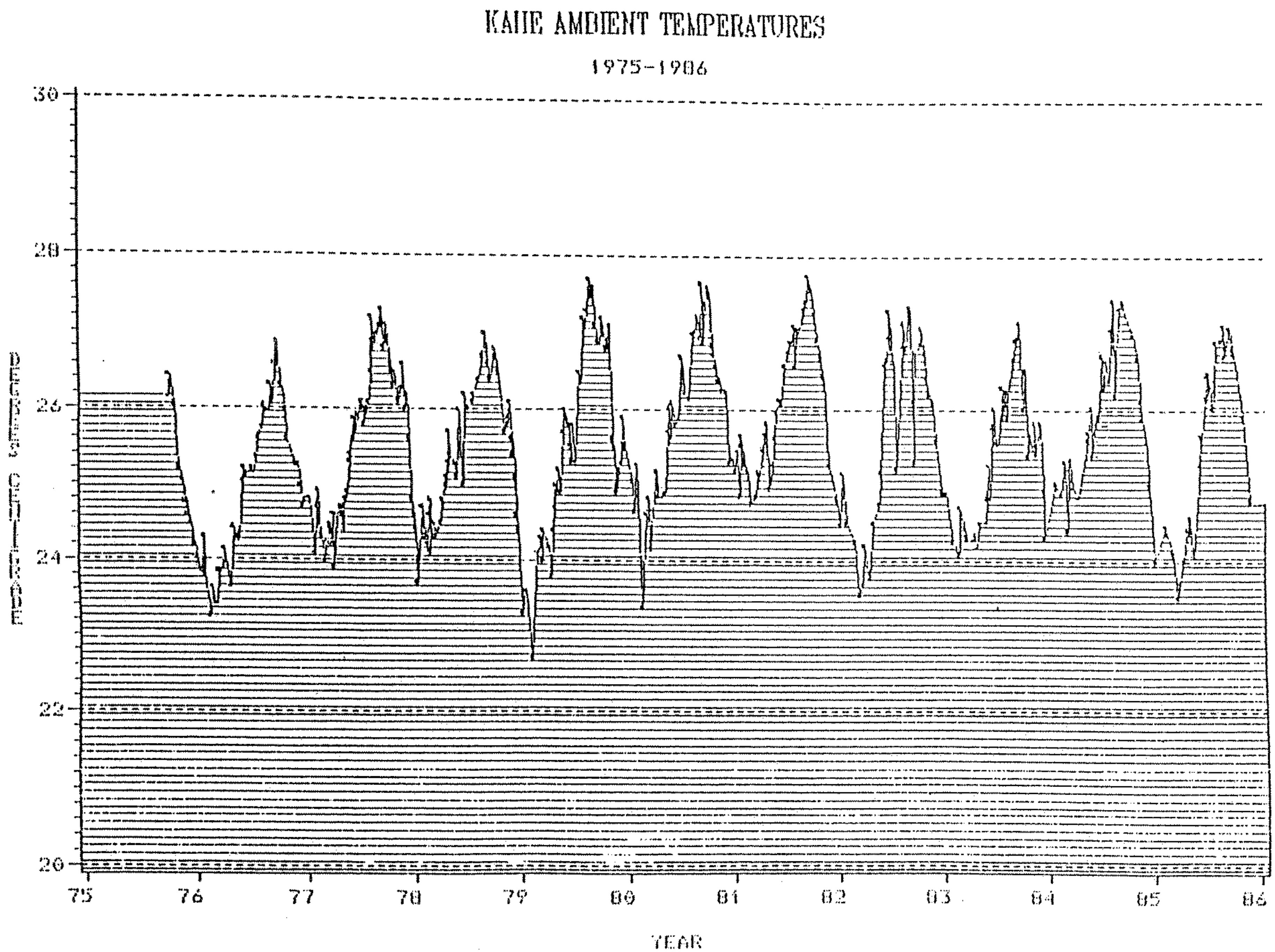

Figure 3: Ambient Temperatures for the Kahe Generating Station

measurements obtained by Sea Engineering, Inc. (1988) were used. The Sea Engineering, Inc. (SEI) study involved current measurements offshore of the Barbers Point Deep Draft Harbor entrance channel. Currents were measured at 3 locations; 5,200 ft offshore along the channel alignment in water depth of 120 ft with the meter at 30 ft; 2,700 ft offshore just north of the dredged entrance channel in a water depth of 30 ft with the meter at 18 ft; and 1,800 ft offshore just north of the dredged entrance channel in a water depth of 24 ft with the meter at 12 ft below the surface. Table 1 summarizes the pertinent characteristics of each deployment and the resulting data.

In general, the SEI results indicate that there is a pronounced difference in the magnitude of the current speeds between the inshore stations (A1 and A2) and the outer meter (B) with the demarcation line occurring at about the 50 ft depth contour. Both the mean and maximum current speeds at the inshore stations are consistently about 55% of the values of the offshore station currents. The current flow was strongly associated with tidal fluctuations, with the dominant directions towards the northwest (NW) and southeast (SE), essentially parallel to the shoreline.

For the near-field plume modeling, the current characteristics measured at Station A1 are considered most representative of this nearshore region. In the following section related to the far-field plume dynamics, the currents measured at the offshore station, B, will be utilized.

For the near-field ambient water characteristics, a base case representing the winter season was selected, consisting of a water temperature of 24°C, a salinity of 35.1 o/oo, with a maximum current speed of 1.31 ft/sec. To evaluate the effects of seasonal variations in ambient water characteristics, a summer season condition was also used where a water temperature of 27°C and 34.6 o/oo salinity were selected.

Since the purpose of the present stormwater discharge modeling study is to evaluate the worst case impacts in the ocean receiving water, the associated "worst case" stormwater discharge flow conditions must be determined. A priori, it is difficult to define these worst case conditions, and consequently a matrix of probable stormwater discharge conditions must be developed which will bracket the worst case impacts. These stormwater discharge conditions for the Campbell drainage channel are shown in Table 2. To bracket the offshore impacts, the durations of 1 and 24 hours were used with their associated rainfall intensities, each varied as a function of the recurrence interval (frequency) or return period in years. Not shown in Table 2 are the time to peak runoff and total duration of the runoff. In general, both of these variables are strongly associated with the duration of the rainfall, and insensitive to the recurrence interval.

Table 1: Summary Of Currents Measured Offshore Of The Barbers Point Deep Draft Harbor By SEI (1988).

Mooring Designation No.	Meter/Water Depth (ft)	Distance Offshore (ft)	Record Interval (m/d/y)	Maximum Current Speed (fps)	Current Dir.	Mean Current Speed (fps)
A1	12/24	1,800	7/29/88-9/13/88	1.31	NW-SE	0.45
A2	18/30	2,700	9/13/88-10/3/88	1.37	NW-SE	0.50
B	30/120	5,200	7/29/88-10/3/88	2.44	NW-SE	0.79

Note: Maximum current speeds are represented by 30 minute averaged values. The actual highest current speeds from the 7-1/2 minute individual current readings were about 10% higher.

Table 2: Campbell Drainage Channel Storm Runoff Parameters For Developed Conditions.

Frequency (yr)	Duration (hr)	Intensity (in)	Runoff Volume (a-f)	Peak Flow Rate (cfs)	Exit Velocity (fps)	Exit Depth (ft)	Suspended Sediment Yield (tons)	Suspended Sediment Concentration (lbs/cf)
100	1	2.70	413	5,200	6.81	7.09	33,390	3.12
50	1	2.40	352	3,772	5.26	6.66	25,507	2.80
25	1	2.10	293	3,090	4.42	6.50	20,585	2.71
10	1	1.90	254	2,639	3.96	6.36	17,395	2.65
5	1	1.50	170	1.798	2.66	6.28	11,535	2.49
2	1	1.25	134	1,308	1.95	6.22	8,207	2.37
1	1	1.00	93	868	1.30	6.19	5,317	2.21
100	24	12.20	2,484	5,956	7.50	7.37	98,397	1.53
50	24	10.70	2,151	5,158	6.77	7.07	83,751	1,50
25	24	9.50	1,886	4,559	6.15	6.88	72,610	1.49
10	24	8.00	1,555	3,779	5.26	6.66	58,671	1.46
5	24	6.75	1,281	3,126	4.46	6.51	47,331	1.43
2	24	4.50	792	1,944	2.87	6.30	27,713	1.35
1	24	3.25	327	1,285	1.92	6.22	13,392	1.58

a-f = acre-ft
cfs = cubic ft/second
fps = ft/sec
Frequency = Recurrence interval or return period of the storm, years
Duration = Length of the rainfall duration, hours
Intensity = Rainfall intensity over the duration of the storm, inches
Runoff Volume = Total volume of the runoff, acre-ft
Exit Velocity = The representative cross-sectional average velocity at the shoreline exit
Exit Depth = The water depth in the discharge channel at the shoreline exit
Sediment Concentration = The sediment concentration due to clays and silts which represents 84% of the total sediment yield.

Consequently, the time to peak runoff and total duration of the runoff are about 1.3 hours and 4.9 hours for the 1 hour duration rainfall, and 9.7 hours and 27.6 hours for the 24 hour duration rainfall, respectively. In Table 2, the sediment yield data represents the total suspended sediment load for the event specified as obtained from the modified universal soil loss equation.

The total suspended sediment yield as described in Table 2 consists of a gradation of sediment sizes ranging from clay materials (< 0.004 mm diameter), through silts (0.004 - 0.062 mm), to sands (0.062 - 2.0 mm). In general, since the larger sand size materials will rapidly settle out of the effluent, of primary concern related to turbidity impacts in the near-field would be due to the clay and silt materials. Jones et al. (1971) studied a number of streams on Oahu, and obtained representative suspended load size distributions. While the project area was not studied, representative data is considered to be provided by the Kalihi Stream, at Gage Station No. 2293. Jones et al. (1971) indicates that about 84% of the suspended sediment load will consist of clays and silts. This percentage value was used to calculate the sediment concentration as shown in Table 2.

The physical geometry of the Campbell drainage channel at the shoreline exit will have side with 4:1 (V/H) slopes. Since the PDS program assumes a rectangular channel, the equivalent channel width based on the depth of water was calculated and used as the input variable.

For all near-field plume calculations described herein, the horizontal discharge angle was set to 90°, which represented a channel discharge perpendicular to the shoreline. The current flow is then configured to flow parallel to the shoreline, which is the appropriate direction for the present study.

2.3 Near-Field Model Plume Results

In order to test the sensitivity of the input data to seasonal changes in the ambient water conditions, the PDS model calculations for a storm with a 100 year recurrence interval with a 24 hour rainfall duration was performed, for both winter (Case 1) and summer ambient water conditions. Table 3 describes the general results of these calculations and indicates that the summer conditions provide a slightly higher densimetric Froude No., thereby providing a greater jet interaction with the receiving waters, resulting in a larger plume with a slightly greater dilution, than its winter counterpart. While the difference between summer and winter conditions are not significant, the use of winter conditions for the ambient water provides a more conservative estimate of the nearshore impacts. Thus, in all subsequent PDS plume calculations, winter ambient

Table 3: Campbell Drainage Channel Near-Field Plume Solutions Comparing Winter And Summer Ambient Water Conditions

PLUME CHARACTERISTICS	Case 1 Winter	Case 1 Summer
At Maximum Plume Depth:		
Maximum Depth (ft)	15.4	16.4
Y-Distance (ft)	478	515
X-Distance (ft)	0	0
Plume Width (ft)	528	553
Average Dilution	3.50	3.71
Average Suspended Sediment Concentration (lbs/cf)	0.437	0.413
Excess Speed (ft/sec)	3.27	3.09
Time (minutes)	1.7	1.9
At 3,200 ft Travel Distance:		
Plume Depth (ft)	13.4	14.5
Y-Distance (ft)	3,200	3,200
X-Distance (ft)	0	0
Plume Width (ft)	2,349	2,359
Average Dilution	5.20	5.44
Average Suspended Sediment Concentration (lbs/cf)	0.294	0.281
Excess Speed (ft/sec)	1.26	1.20
Time (minutes)	29.2	29.8

Note: Case 1 - 100 yr Storm Frequency, 24 hr Rainfall Duration, 0 Ambient Current Speed, Initial Suspended Solids Concentration = 1.53 lbs/cf.
Winter Ambient Water - 24°C Temperature, 35.1 o/oo Salinity
Summer Ambient Water - 27°C Temperature, 34.6 o/oo Salinity

water conditions have been used.

The full range of PDS model plume calculations for Case 1, 1A, 2, 2A, 3, 3A, 4 and 4A as described in Table 4 were calculated. As typical examples of the output, Figures 4 and 5 describe the graphical results for Case 1 (no current) and Figures 6 and 7 describe the graphical results for Case 1A (maximum current, 1.31 ft/sec). A full description of all the near-field plume results are provided in Appendix A. Figures 4 and 6 describe the plan view of the plumes as they mix with the receiving waters and expand in width, for the no current and 1.31 ft/sec along shore current cases respectively. Figures 5 and 7 graphically describe the standard output results from the PDS model. The abscissa or x axis represents the distance along the centerline of the plume starting at the shoreline exit location, which will be curved if a current is present. Graphs of dilution, time, depth and excess speed are associated with the individual scales on the ordinate or y axis. Time (minutes) represents the time after discharge from the shoreline exit. Dilution is represented by the average dilution at a given cross-section of the plume and is represented by Q/Q_o, where Q_o is the initial discharged stormwater flow rate and Q represents the total flow rate in the plume, which is the sum of the initial discharged flow rate and the entrained ambient water flow rate. The depth (ft) of the plume is calculated at the centerline of the plume. Excess speed (ft/sec) represents the absolute difference between the velocity of the plume at its centerline and the ambient current velocity in the direction of the plume centerline flow.

For comparison purposes, Table 5 provides a partial summary of the results for the 8 cases described in Table 4, where results have been provided at two offshore locations; at the maximum plume depth and at 3,200 ft travel distance from the shoreline exit. The maximum plume depth occurs in the nearshore region due to aggressive jet mixing following discharge, subsequently followed by a vertical collapse phase as the jet momentum is reduced and the plume buoyancy becomes important. In some of the results, a clearly defined maximum plume depth does not exist. In these cases, the point where the rate of change of the plume depth is smallest was selected for Table 5, which is considered representative for comparison purposes.

The suspended sediment concentrations shown in Table 5 have been based on the average dilution of the plume, Q/Q_o, and not on the peak centerline values. It is our assessment that the average dilution is more representative of the areal impacts of the suspended sediment concentration than the point centerline concentrations.

The selection of a location 3,200 ft downstream from the shoreline exit has been arbitrarily selected as the end point of

Table 4: Campbell Drainage Channel Stormwater Flow Characteristics And PDS Model Input Parameters.

Description	Case 1 (1A)	Case 2 (2A)	Case 3 (3A)	Case 4 (4A)
STORM CHARACTERISTICS				
Storm Recurrence Interval (yr)	100	100	1	1
Rainfall Duration (hrs)	24	1	24	1
Time To Peak Runoff (hrs)	9.69	1.21	9.93	1.38
Total Runoff Duration (hrs)	27.70	4.80	27.60	4.95
Total Runoff Volume (acre-ft)	2,484	413	327	93
Peak Runoff (cfs)	5,956	5,200	1,285	868
Total Sediment Yield (tons)	98,397	33,390	13,392	5,317
Total Sediment Concentration (lbs/cf)[1]	1.82	3.72	1.88	2.63
PDS MODEL INPUT VARIABLES				
Exit Channel Width (ft)	107.8	107.8	107.6	107.5
Exit Channel Water Depth (ft)	7.37	7.09	6.22	6.19
Exit Ave. Flow Velocity (ft/sec)	7.50	6.81	1.92	1.30
Discharge Angle (degrees)	90	90	90	90
Ambient Current Velocity (ft/sec)[2]	0 (1.31)	0 (1.31)	0 (1.31)	0 (1.31)
Suspended Sediment Concentration (lbs/cf)[3]	1.53	3.12	2.21	1.58
Ambient Water Temperature (degrees C)[4]	24	24	24	24
Ambient Water Salinity (o/oo)	35.1	35.1	35.1	35.1

Notes:
1 Total Sediment Concentration = (Total Sediment Yield)/(Total Runoff Volume).
2 Ambient Velocity = 0 for Cases 1, 2, 3 & 4.
Ambient Velocity = 1.31 fps for Cases 1A, 2A, 3A and 4A.
3 Suspended Sediment Concentration = 84% of Total Sediment Concentration.
4 Ambient Water conditions represent winter season conditions.

CASE 1

SURFACE WARM WATER JETS -- CAMPBELL DRAINAGE CHANNEL, BARBERS POINT

```
AMBIENT CONDITIONS: TEMP. TA          =  24.0 DEG. C
                    VEL.  UA          =  0.00 FT/SEC
                    HEAT CONVECTION = .1000E-05
                    SALINITY          = 35.10 PPT

DISCHARGE CONDITIONS : UNIT WEIGHT   =  63.18 LBS/CU FT
                       VEL.  U0      =   7.50 FT/SEC
                       WIDTH W0      = 107.80 FT.
                       DEPTH H0      =   7.37 FT.
                       ANGLE         =   90.0 DEG.
                       INIT. CONC.   =  1.530 LBS SUS. SED./CU. FT. DISCHARGE

DISCHARGE DENSIMETRIC FROUDE NO.     =     4.56
```

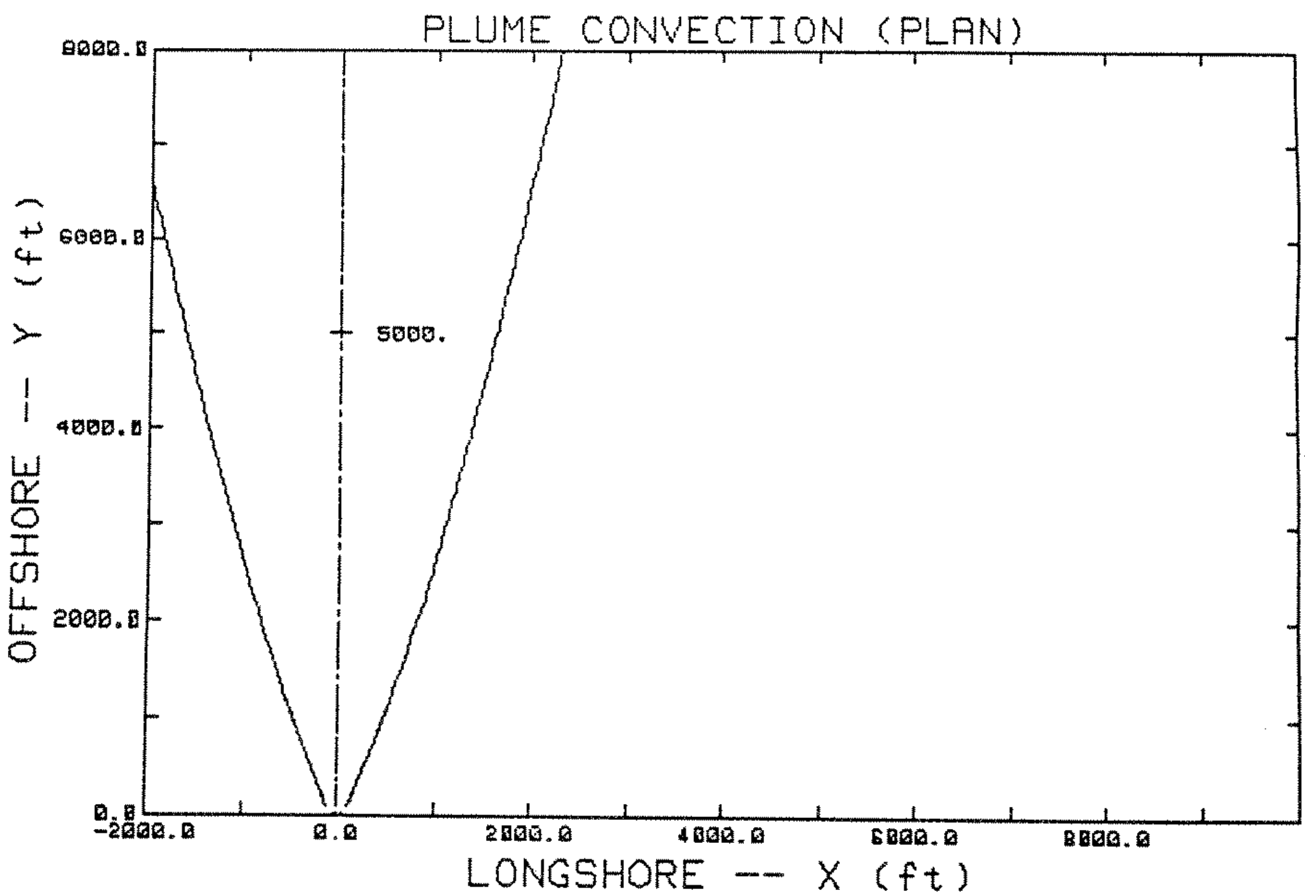

Figure 4: Plume Plan View For Case 1, No Current.

CASE 1

URFACE WARM WATER JETS -- CAMPBELL DRAINAGE CHANNEL, BARBERS POINT

```
MBIENT CONDITIONS: TEMP. TA            =  24.0 DEG. C
                   VEL.  UA            =  0.00 FT/SEC
                   HEAT CONVECTION     =  .1000E-05
                   SALINITY            = 35.10 PPT

)ISCHARGE CONDITIONS : UNIT WEIGHT     =  63.18 LBS/CU FT
                       VEL.  U0        =   7.50 FT/SEC
                       WIDTH W0        = 107.80 FT.
                       DEPTH H0        =   7.37 FT.
                       ANGLE           =   90.0 DEG.
                       INIT. CONC.     =  1.530 LBS SUS. SED./CU. FT. DISCHARGE

DISCHARGE DENSIMETRIC FROUDE NO.       =       4.56
```

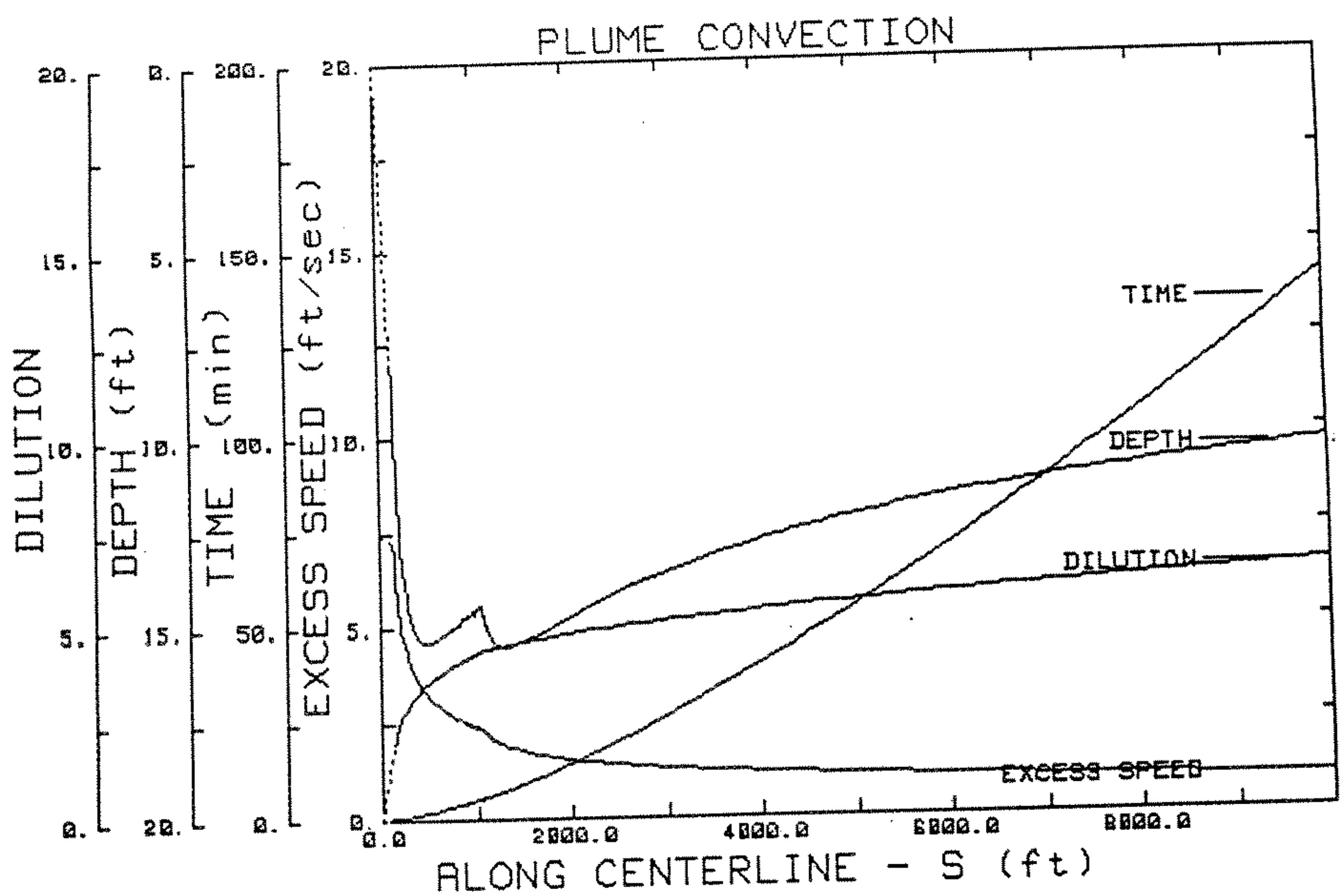

Figure 5: Dilution, Depth, Time, And Excess Speed As A Function Of S-Distance Along Plume Centerline For Case 1.

CASE 1A

SURFACE WARM WATER JETS -- CAMPBELL DRAINAGE CHANNEL, BARBERS POINT

```
AMBIENT CONDITIONS: TEMP. TA          =  24.0 DEG. C
                    VEL.  UA          =  1.31 FT/SEC
                    HEAT CONVECTION = .1000E-05
                    SALINITY          = 35.10 PPT

DISCHARGE CONDITIONS : UNIT WEIGHT  =  63.18 LBS/CU FT
                       VEL.  U0      =   7.50 FT/SEC
                       WIDTH W0      = 107.80 FT.
                       DEPTH H0      =   7.37 FT.
                       ANGLE         =   90.0 DEG.
                       INIT. CONC.   =  1.530 LBS SUS. SED./CU. FT. DISCHARGE

DISCHARGE DENSIMETRIC FROUDE NO.     =       4.56
```

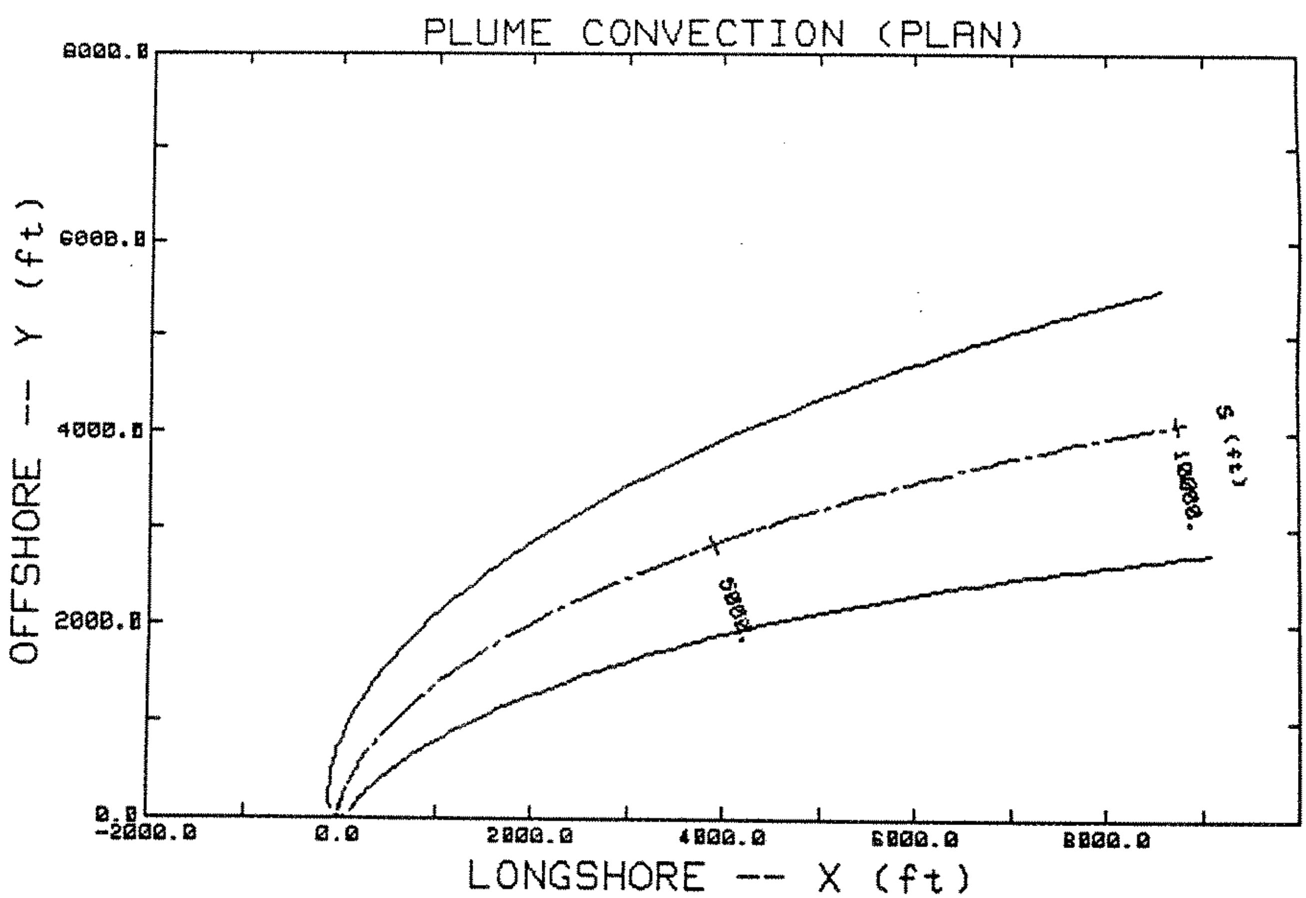

Figure 6: Plume Plan View For Case 1A, Maximum Current.

CASE 1A

RFACE WARM WATER JETS -- CAMPBELL DRAINAGE CHANNEL, BARBERS POINT

```
IBIENT CONDITIONS: TEMP. TA          =  24.0 DEG. C
                   VEL.  UA          =  1.31 FT/SEC
                   HEAT CONVECTION  =  .1000E-05
                   SALINITY          = 35.10 PPT

ISCHARGE CONDITIONS : UNIT WEIGHT  =  63.18 LBS/CU FT
                      VEL.  U0     =   7.50 FT/SEC
                      WIDTH W0     = 107.80 FT.
                      DEPTH H0     =   7.37 FT.
                      ANGLE        =   90.0 DEG.
                      INIT. CONC.  =  1.530 LBS SUS. SED./CU. FT. DISCHARGE

ISCHARGE DENSIMETRIC FROUDE NO.    =      4.56
```

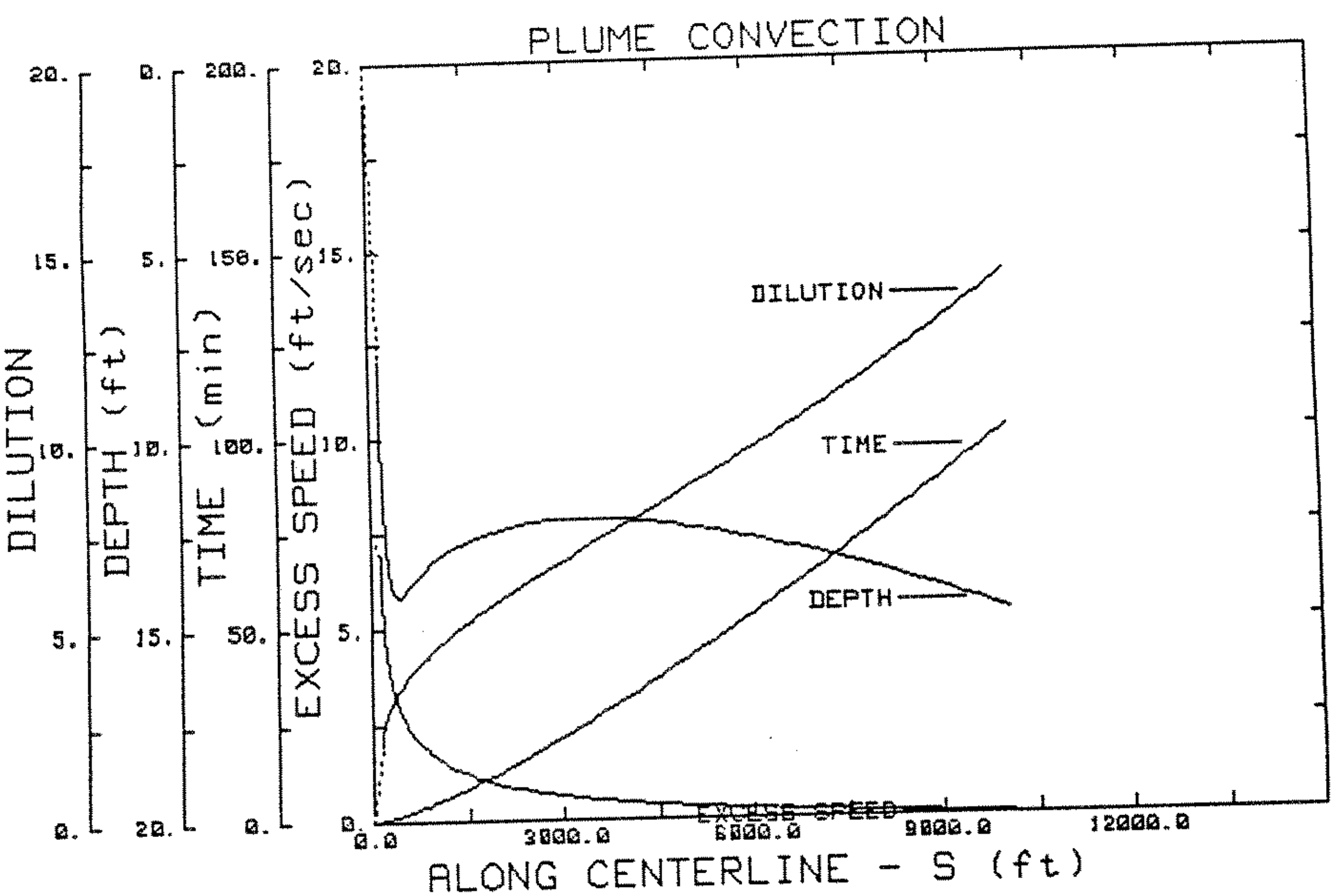

Figure 7: Dilution, Depth, Time, And Excess Speed As A Function Of S-Distance Along Plume Centerline For Case 1A.

INTRODUCTION

Cultural Surveys Hawaii was asked to conduct a reconnaissance survey for the drainage easement of the proposed Kapolei Business/Industrial Park from the O.R.& L. Railroad through former Camp Malakole Military Reservation to the Ocean. (Figs. 1-4). Assessment of the location and present condition of extant archaeological and paleontological sites within the boundaries of the proposed park has recently been completed by Hammatt and Shideler (1989). This previous work included in its scope, the location of sensitive areas particularly related to the proposed drainage channel within the park and west to the mauka side of Malakole Road about 800 ft. (243.8 m.) north of the SW corner of the proposed park. In the results of their fieldwork Hammatt and Shideler (1989:27) note that from Malakole Road east and northeast, "to where the western boundary of the proposed park jogs to the NNW, (the proposed drainage channel) lies totally within an area that has been greatly studied and massively impacted and it seems exceedingly unlikely that any significant subsurface remains would be encountered during the course of the excavation for the drainage extension."

In light of the previous assessment (above) the present reconnaissance focuses on the <u>mauka</u> extent of the proposed drainage where it meets the O. R. & L. Railroad, and the <u>makai</u> end from Malakole Road westward through the south end of Camp Malakole to the shoreline. The results of this reconnaissance are intended as a supplement to Hammatt and Shideler's (1989)

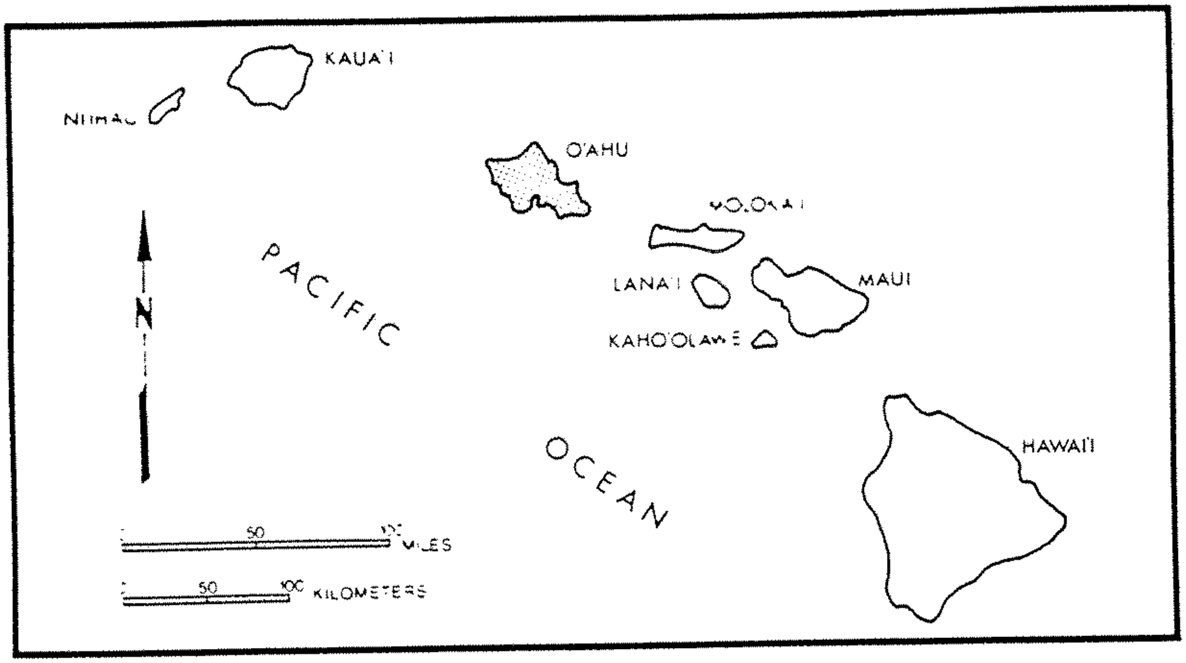

Fig. 1. State of Hawai'i

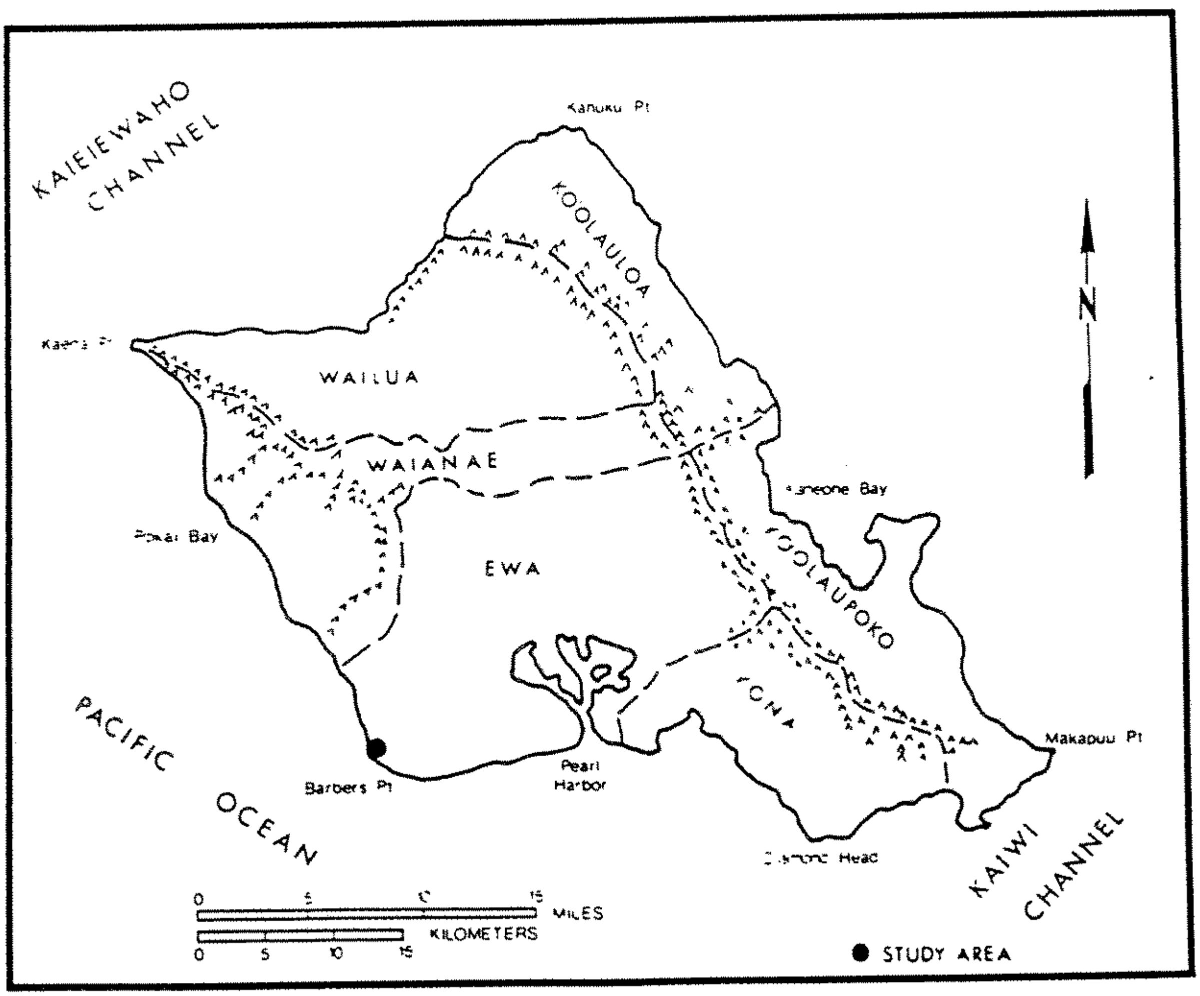

Fig. 2. General Location Map, O'ahu Island.

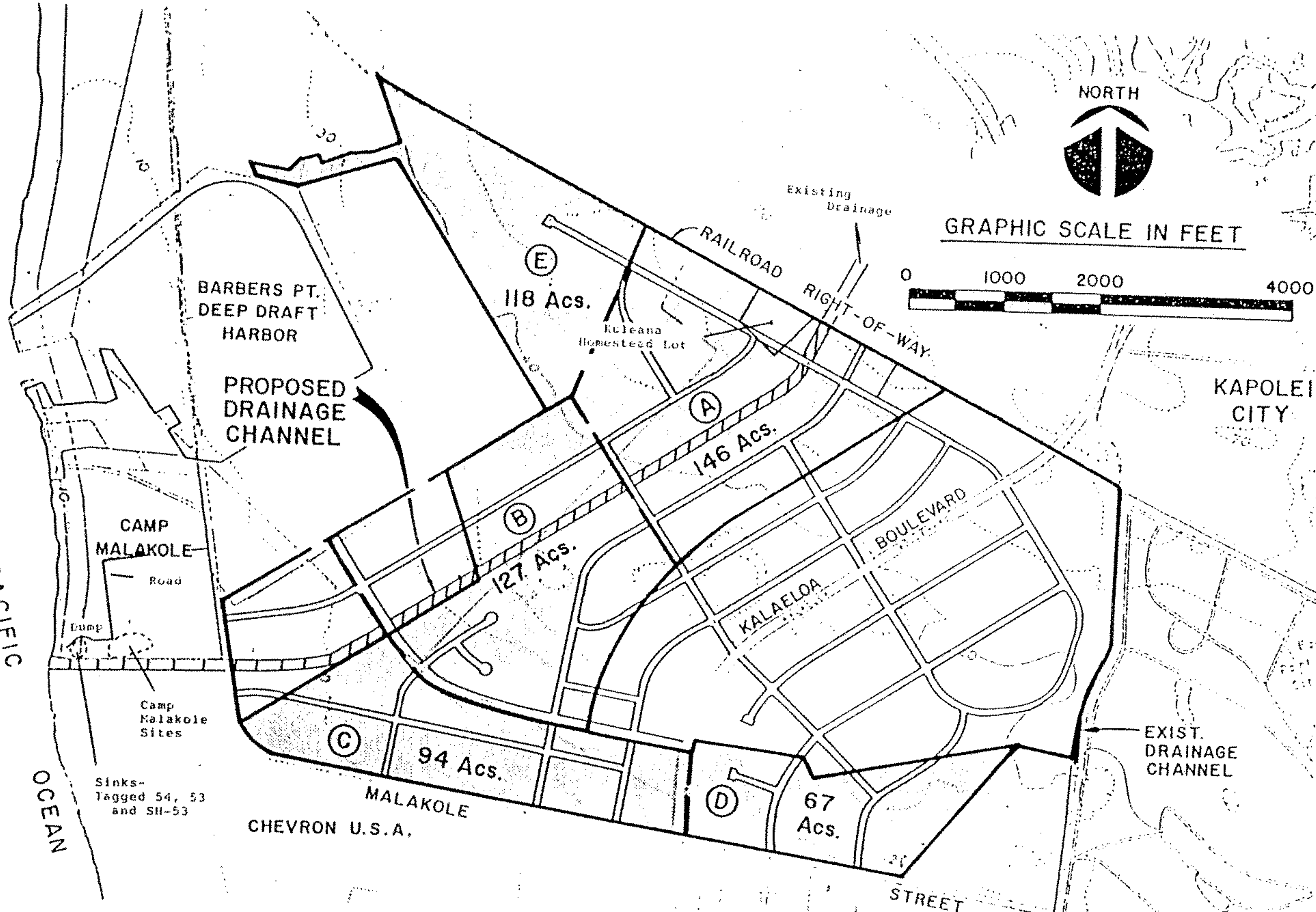

Fig. 3 USGS `Ewa Quadrangle Map, Showing Project Area and Approximate Location of Sites.

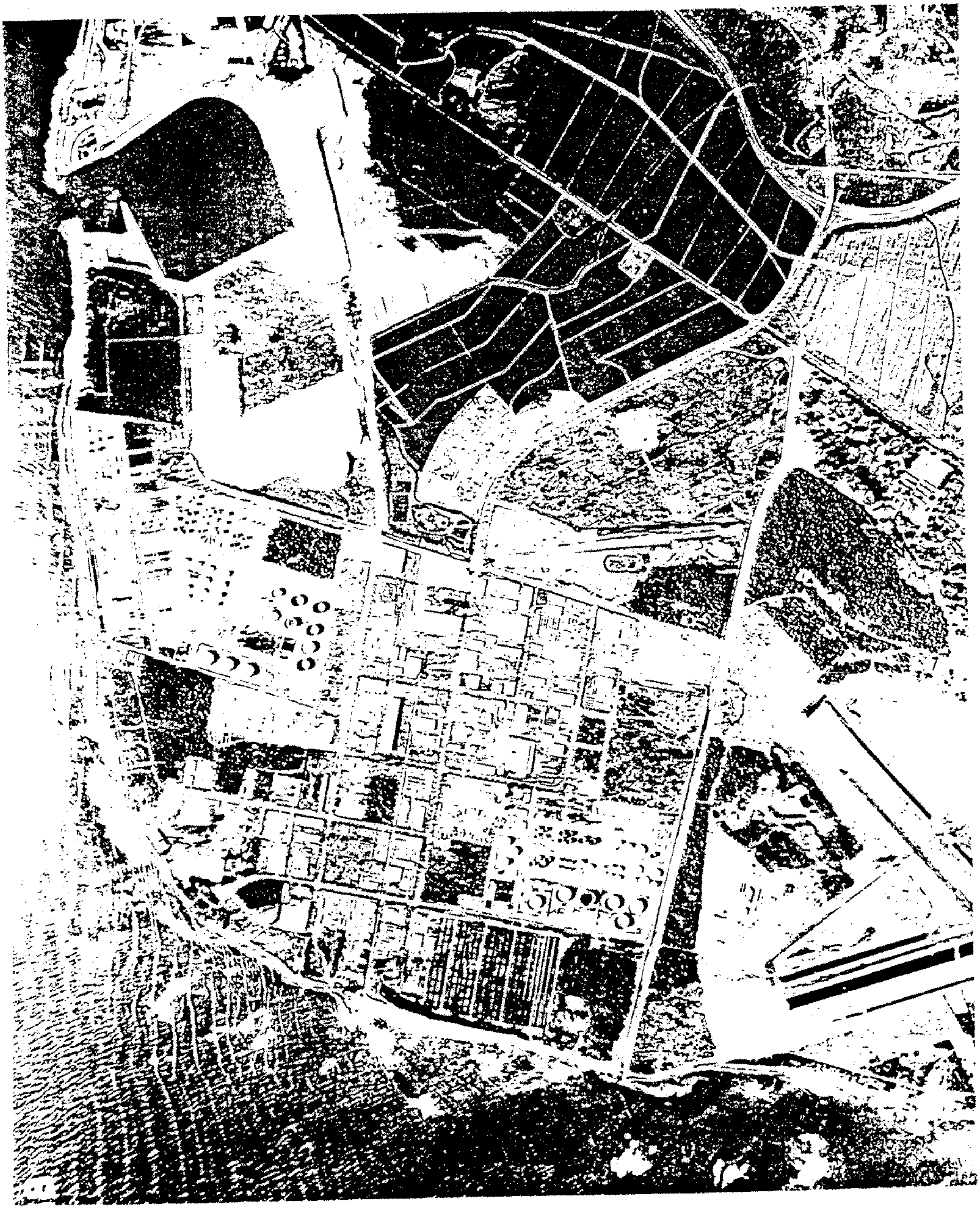

Fig. 4 Reproduction of Aerial Photo of Barber's Point, Showing Project Area.

archaeological assessment. The reader is referred to that report for the review of past archaeological/paleontological studies at Barber's Point, and recommendations for the remaining areas containing extant archaeological and paleontological resources within the proposed park. Recommendations for the Camp Malakole area are presented herein following the results of the field work.

Camp Malakole Wartime Historical Review (Refer to Albert 1980)

Land belonging to the estate of James Campbell, identified by survey of boundaries, lots and easements in land application 1069, was acquired by the United States Government on December 11, 1940 for the purpose of building the Camp Malakole Military Reservation. The property has about 1,853 ft. (564.8 m.) of beach frontage extending from the existing oil refinery at the south end to the new deep draft harbor at the north, at Barber's Point, Honouliuli, Ewa.

The camp initially functioned as a defensive gun and firing position sector for the 251st Coast Artillery Regiment of the California National Guard. It later became a base camp for anti-aircraft and anti-tank weapons training schools and then was utilized as a staging and billeting center for personnel preparing to enter the Pacific theater at the height of WWII.

Structures and land use at Camp Malakole included barracks, administrative buildings, supply warehouses, latrines, parade grounds, areas for temporary tents, roads, gun emplacements, firing range impact areas and moveable target tracks among other things. The facilities at the camp served the billeting and staging needs of a total of 43,350 army and marine personnel through the duration of the war in the Pacific.

A great many more details of the men of 251st Coast Artillery Regiment and the acquisition, building and use of Camp Malakole including photographs of these activities and sources of additional documents (including blue prints of the camp plan) are presented in the excellent work of Robert H. Albert (1980). The reader is referred to his monograph for further details.

Camp Malakole Archaeology/Paleontology Review

Of the innumerable studies, conducted on the "Karst" landscape of Barber's Point's raised coral reef only a few have dealt specifically with the property that was once Camp Malakole.

The first site in the camp area, recorded by Roger Green in 1969 an assigned the Bishop Museum No. BM-OA-B6-14 (Hawaii State Site No. 50-80-12-2722) was subsequently reported by Barrera in 1975 as having been destroyed; then reinstated as still existing in 1978 by Davis and Griffin (1978:165-166). Davis and Griffin labeled the Camp Malakole area "Survey Zone V" and recorded only site 2722 (above) in that "Zone" (Fig. 5). They describe the site as a cultural layer containing charcoal, bone and shell midden, fire-cracked vesicular basalt, burnt coral and artifacts, buried within the along shore beach berm-sand dune and measuring about 60 meters long (N-S) and 5 to 15 meters wide (E-W). The site was partially excavated as part of their work, and they suggest that two cultural strata may be present.

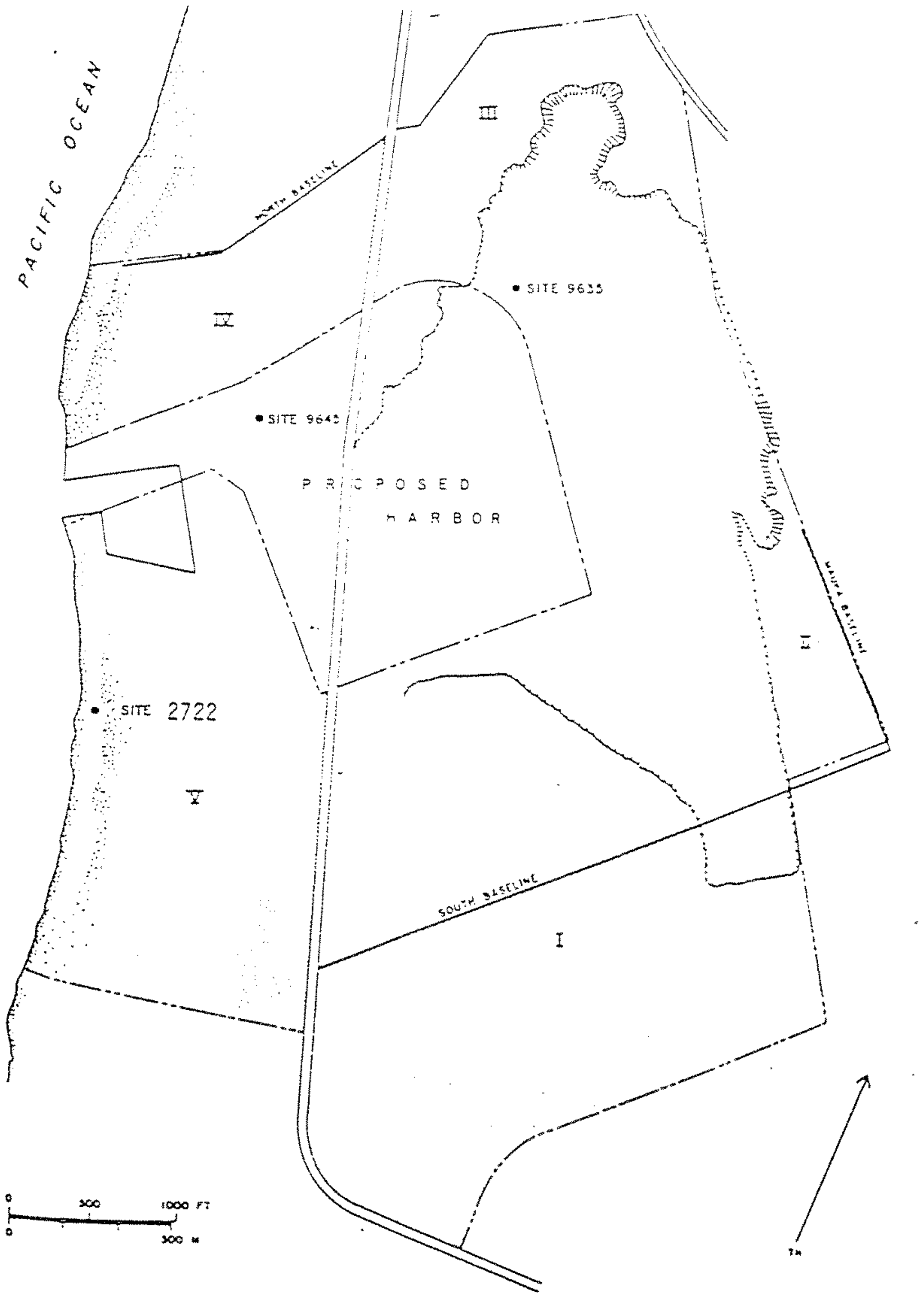

Fig. 5 Archaeological "Survey Zones" from Davis and Griffin 1978 (Fig. 10), Barber's Point Study Area

In 1988 Paul Rosendahl conducted a reconnaissance followed by test excavations within the former Camp Malakole Site. The letter report summarizing the excavations (Rosendahl 1988) gives objectives: "(a) to determine the presence or absence of any potentially significant archaeological or paleontological remains within the sinkholes, and if remains were present, to determine the general nature of the remains; (b) to evaluate the potential general significance of all identified remains"; etc. Addressing these objectives Rosendahl groups the sinkhole sites located into three groups, Clusters 1, 2 and 3 situated at the south end, the north end and the central inland side respectively, of the study area. Although no maps are provided it seems certain that only Complex 1 is pertinent to the present study area that consists of a 100 ft. (30.5 m.) wide corridor along the south boundary of the Camp premises.

Based on Rosendahl's plan to test, "those (sinks) most likely to contain bird bones. . .", and concurrence with the State Historic Sites Office that a 5% sample was adequate to assess potential (Rosendahl 1988:2), a total of 25 sinks were selected, only three of which were located in Rosendahl's Complex 1. In the course of work the total sample number was reduced to 15 sinks because the initial excavations showed the sinks in the Camp Malakole area to contain, "significantly lesser numbers and significantly lesser species of bird bones." This decision did not affect Complex 1 however, where three sinks were still excavated; these were numbered 28, 33 and 52 and excavation data and soil samples from each sink are available from Rosendahl

(1988:2). Bird bones from these sinks was analyzed by Dr. Alan Zigler (refer to attachments to Rosendahl:1988), and then forwarded to Dr. Storrs Olson at the Smithsonian Inst. Only sinks 96 and 131 (neither of which are in complex 1) contained cultural material other than masonry and rock fill associated with Camp Malakole use of the area.

In summary Rosendahl states, "the sinkholes do not appear to be of any significance in terms of interpretive or cultural values; in terms of information content. . . , the sinkholes are less significant than similar sinkholes in nearby project areas." And, "that it is not necessary that subsequent mitigation/data recovery excavations be conducted," in the Camp Malakole area. (Rosendahl 1988:3).

RESULTS OF FIELDWORK

The present reconnaissance of the proposed Kapolei Business/Industrial park drainage channel was conducted on June 2, 1990 by the author. Investigation in the field concentrated on the drainage channel corridor's mauka extreme where it passes just west of the existing Kuleana lot adjacent to the O.R. & L Railroad; and at the makai extreme between Malakole Road and the shoreline. (Refer to Fig. 3). A check of the central portion of the channel corridor confirmed that it lies "totally within an area that has been greatly studied and massively impacted". (Hammatt and Shideler 1989:27).

The mauka end of the proposed drainage channel meets the O. R. & L. Railroad at the existing drainage channel (Figs. 6 & 7; Photo Appendix) about 100 ft. (30.5 m.) east of the Kuleana lot. They are separated by an existing cane field (Fig. 8; Appendix). Although it is not expected that the proposed, enlarged channel will impact the Kuleana lot archaeological monitoring during construction is recommended unless other mitigative measures for the Kuleana lot precede drainage channel construction.

The makai end of the proposed channel through the south end of former Camp Malakole contained historic remains of former camp structures, and solution sinks in the limestone bedrock. These latter features are those discussed in the previous archaeology section that were designated Complex 1 in Rosendahl's (1988) work. They are situated along the north edge of this east-west oriented section of the proposed channel (refer to Fig. 3) just inland from the beach berm-dune along the shore. The ten to fifteen sinkholes noted in the general area are all small (1 to 2 meters diameter) and probably of similar 1 to 2 meter depth due to the low elevation, relative to sea level, of the terrain here. Standing water was observed in two of the sinks at about 1.5 meters below the surface. The majority of these sinks are filled with rock and chunks of an old mortar brick wall (Fig. 10; Appendix). Two were observed to have been excavated and one of these was marked with an aluminum tag labeled "52". Aluminum tags marked 54 and SH-53 on two other sinks were also noted in the field.

Along the shoreline is a ridge composed of beach sand overlain by aeolean dune sand (Figs. 11 & 12; Appendix). This feature extends the entire length of the camp property but is considerably larger and less disturbed at the north end where site 2722 is located. Nevertheless, the potential for buried cultural layers within the dune area is still present.

The remains of the military camp structures consist of concrete slabs, raised concrete platforms, curb like building footings, a road section with metal gate and curvert and a square pit mechanically excavated and presently filled with water (Figs. 14 - 19). This latter pit was previously marked with an aluminum tag labeled "T-2".

SUMMARY AND RECOMMENDATIONS

Major modern alteration of the landscape has already occurred throughout most of the proposed drainage channel corridor with extant archaeological and paleontological resources remaining only at the mauka and makai ends of this corridor (refer to Fig. 3). In most cases impact on the archaeological and paleontological resources has been mitigated by large scale data recovery.

The two remaining areas that may potentially be impacted by the drainage channel are briefly described and discussed below.

1. Homestead (Kuleana) Lot

The small parcel just NW of the mauka end of the proposed drainage channel has apparently never been under cultivation of sugar cane. Hammatt and Shideler (1989:32) located approximately 10 limestone sinkholes in the SE portion of the parcel. They are considered to have paleontological significance based on their relative elevation above sea level and distance from the shoreline. Historical features are also evident on the parcel.

No research on the origin and history of this homestead, and no excavation of the sinkholes has been conducted. Both aspects of study are recommended for the parcel (Hammatt and Shideler 1989) before land alteration.

Based on the above information archaeological monitoring of this specific locality is recommended during construction of the drainage channel unless the necessary research on the homestead has been completed prior to channel construction.

2. Camp Malakole

The Camp Malakole parcel extends from the existing deep draft harbor south to the Chevron refinery and from the west side of Malakole Road to the shoreline. Limestone sinkholes and World War II military building foundations, pits and roads are still extant within the parcel, as is a sand, beach berm/dune between the camp parcel and the ocean.

An archaeological/paleontological investigation conducted by Paul Rosendahl in 1988 involved excavation of a number of sinkholes in the camp parcel. Cultural and paleontological remains associated with these sinks were not voluminous and were characterized by Rosendahl as not of further import for future scientific study. Viewing the sinkholes at the southern end of the camp area (Rosendahl's Complex 1) during the present reconnaissance, the author tends to agree with Rosendahl's conclusion. Sinkholes in Rosendahl's Complex 2 and 3 will not be impacted by construction of the proposed drainage.

The remnant foundations and other features of historical age at Camp Malakole are described in detail in the letters and documents compiled by Robert Albert (1981) in his study of the wartime history of the camp. The letters received by Albert, from Bob MacDonald and Ken Bandel (Albert 1981:321-322), provide two sources for blueprints of the camp's buildings and activity areas. In the opinion of this author, the current availability of these documents precludes a necessity for additional survey of these historic remains. In addition, the drainage channel corridor skirts the south side of these remains.

Camp Malakole parcel must be breached for the proposed drainage channel. Although the feature is less prominent at its southern extreme and appears to have been heavily disturbed in the past the possibility that buried cultural layers may be present must be addressed. Therefore archaeological testing is recommended for this specific locality before construction of the drainage channel. This testing recommendation is consistent with a DLNR letter dated May 7, 1991.

Subsurface testing should be conducted for the proposed drainage channel area particularly at its north extreme along the Kuleana (Homestead) lot and at its south extreme at the beach berm/dune site. A report on this testing should be produced which details the results of the findings, evaluates significance, and recommends appropriate mitigation measures. This report will be reviewed and approved by the State Historic Preservation Office of the DLNR and will be considered a further step in the completion of inventory survey.

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PHOTOGRAPHIC APPENDIX

Fig. 6 View of Existing Drainage Channel. Facing Makai.

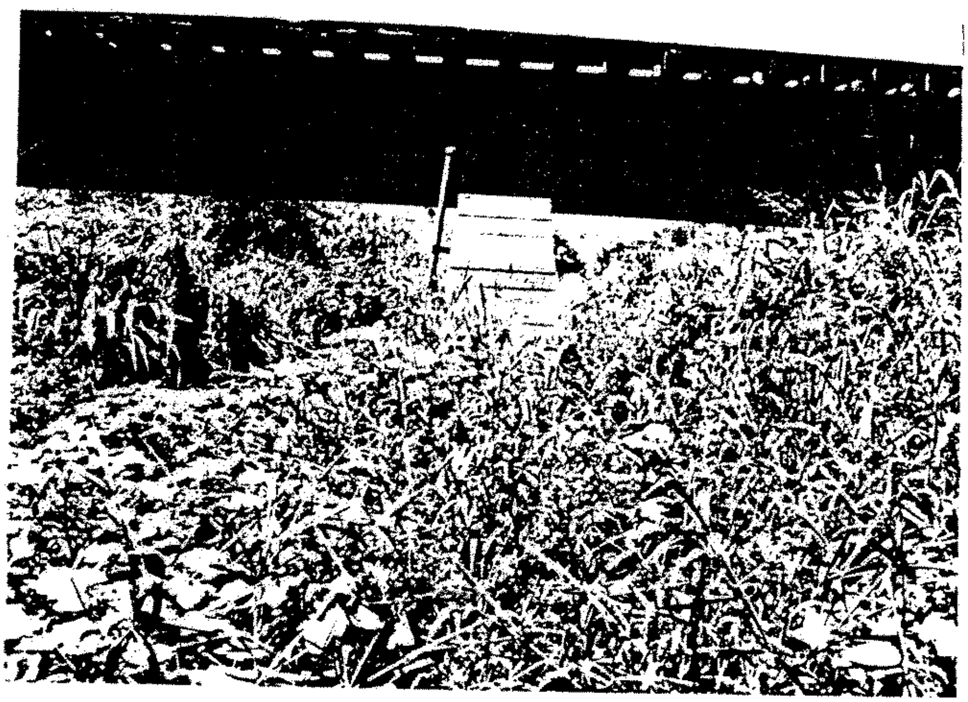

Fig. 7 View of Existing Drainage Channel. Facing Mauka, Showing Railroad Trestle.

Fig. 8 Boundary of Existing Cane Field and Kuleana Lot (right), Facing SW. Existing Drainage is to Left of Photo.

Fig. 9 General View of Proposed Drainage Channel Makai Corridor Through Camp Malakole. Facing West from Malakole Road.

Fig. 10 Sinkhole in Camp Malakoli Area Filled with Rock and Brick Rubble.

Fig. 11 Excavated Sinkhole No. 52 (Rosendahl, 1988). Facing South.

Fig. 12 General View of the Beach Berm/Dune to the North of the Study Area. Looking Towards Site 2722 (upper left).

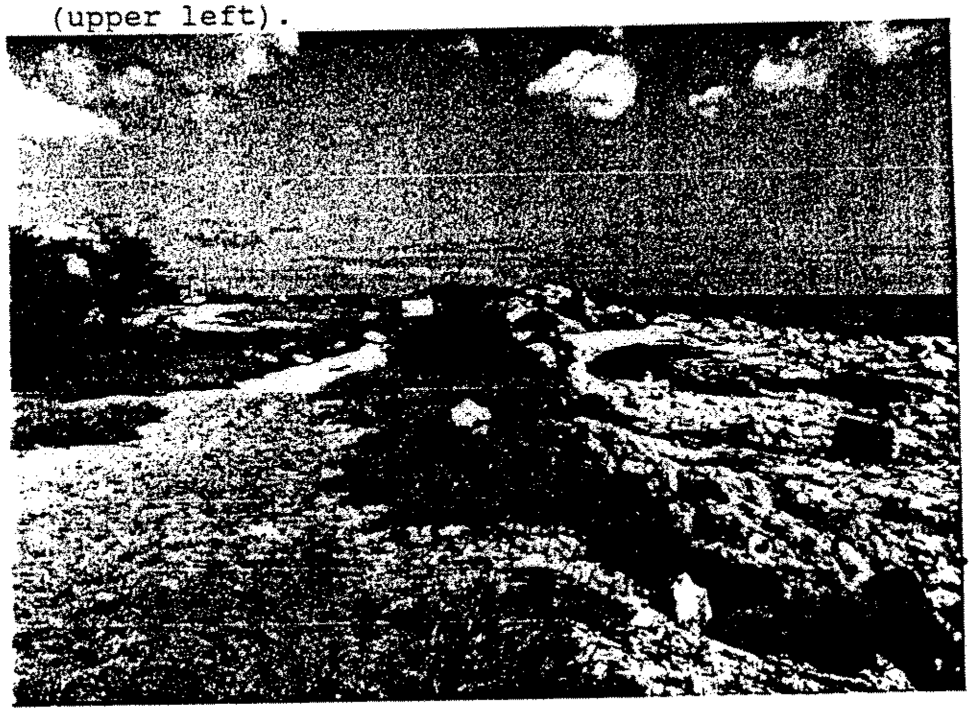

Fig. 13 View of the Beach Berm/Dune in the Study Area. Facing South, Chevron Facility in the Background.

Fig. 14 Concrete Slab Disturbed By Uprooted Kiawe Tree.

Fig. 15 Raised Concrete, Building Floor Foundation. Facing East.

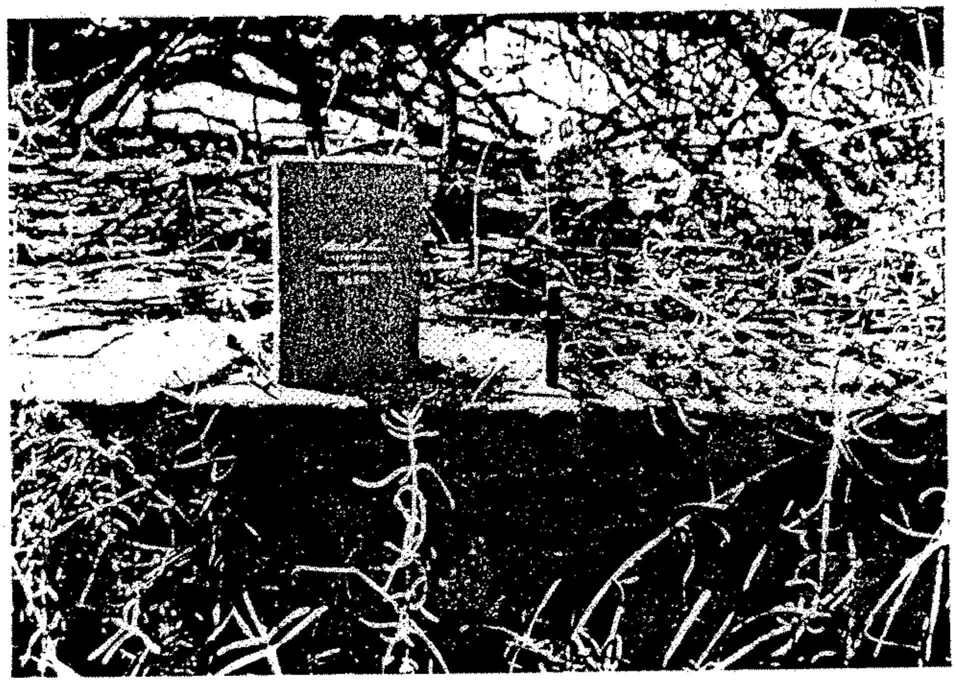

Fig. 16 Detail of Fig. 15, Showing Bolt in Slab For Receiving Wall Bottom Plate.

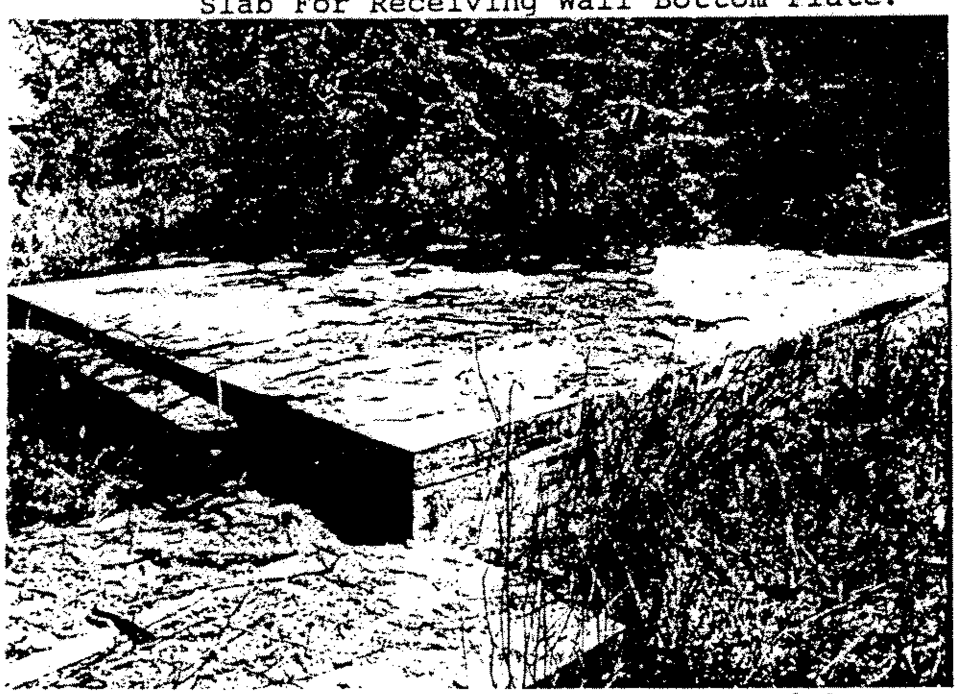

Fig. 17 Raised Concrete Floor With Multiple Adjoining Slabs and a Wooden Plank.

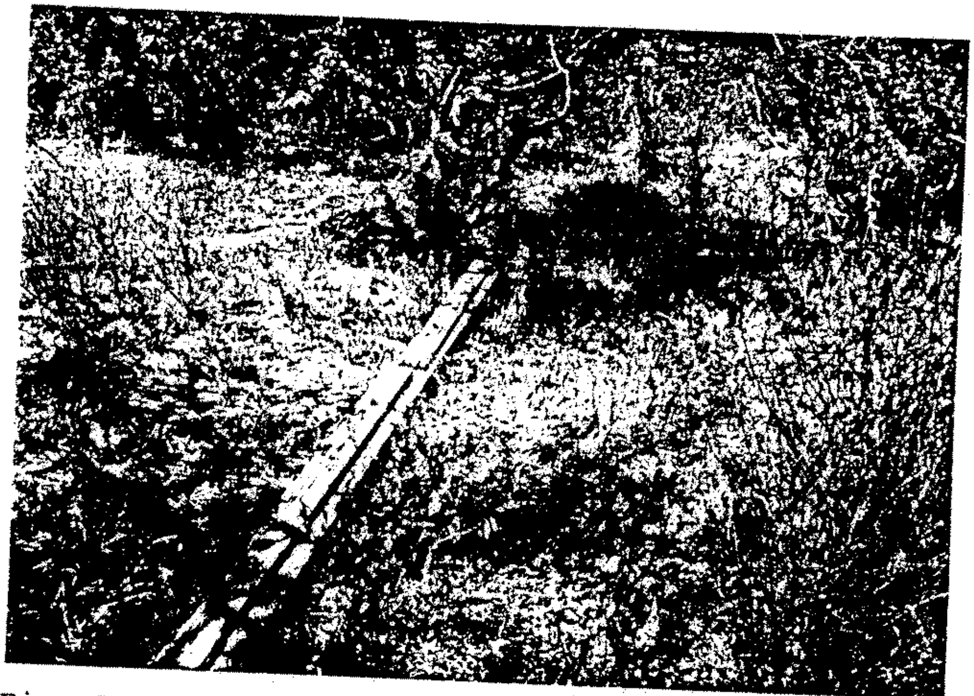

Fig. 18 Section of Curb Like Footing of a Large (@ 100 ft. sq.) Warehouse Type Structure; Showing Bottom Plate and Bolts.

Fig. 19 Manmade 15 ft. square Pit Containing Water. Aluminum Site Marker #T-2 Adjacent to Flagging Tape in Foreground. Facing North.

APPENDIX E

CAMPBELL DRAINAGE CHANNEL,

EWA DISTRICT, ISLAND OF OAHU

by

CHAR & ASSOCIATES

Table 5: Campbell Drainage Channel Near-Field Plume Solutions For The Cases Shown In Table 4.

PLUME CHARACTERISTICS	Case 1	Case 1A	Case 2	Case 2A	Case 3	Case 3A	Case 4	Case 4A
At Maximum Plume Depth:								
Maximum Depth (ft)	15.4	14.1	47.7	33.0	7.5	6.3	9.2	6.5
Y-Distance (ft)	478	391	1,814	1,005	411	423	628	157
X-Distance (ft)	0	121	0	1,661	0	747	0	309
Plume Width (ft)	528	437	1,558	804	553	472	675	261
Average Dilution	3.50	3.37	10.72	11.30	2.43	4.22	2.95	3.63
Average Suspended Sediment								
Concentration (lbs/cf)	0.437	0.452	0.291	0.276	0.910	0.524	0.535	0.435
Concentration (ppm)	2,640	2,731	1,756	1,669	5,503	3,166	3,236	2,631
Excess Speed (ft/sec)	3.27	2.95	0.96	0.27	0.96	-0.17	0.52	-0.16
Time (minutes)	1.7	1.4	19.4	17.4	5.0	11.8	13.5	4.9
At 3,200 ft Travel Distance:								
Plume Depth (ft)	13.4	12.2	45.5	36.5	5.3	11.9	7.0	15.3
Y-Distance (ft)	3,200	2,135	3,200	1,284	3,200	724	3,200	391
X-Distance (ft)	0	2,240	0	2.740	0	3,051	0	3,133
Plume Width (ft)	2,349	1,481	2,664	1,020	2,043	815	2,087	572
Average Dilution	5.20	6.89	13.04	15.32	3.24	14.80	3.76	20.31
Average Suspended Sediment								
Concentration (lbs/cf)	0.294	0.222	0.239	0.204	0.682	0.150	0.421	0.078
Concentration (ppm)	1,778	1,343	1,446	1,231	4,125	904	2,543	472
Excess Speed (ft/sec)	1.26	0.57	0.71	0.15	0.49	-0.12	0.28	-0.07
Time (minutes)	29.2	23.0	47.9	29.8	84.5	46.1	137.3	44.7

Note: Case 1 and 1A: 100 yr Frequency, 24 hr Rainfall Duration, 0 and 1.31 fps current.
Case 2 and 2A: 100 yr Frequency, 1 hr Rainfall Duration, 0 and 1.31 fps current.
Case 3 and 3A: 1 yr Frequency, 24 hr Rainfall Duration, 0 and 1.31 fps current.
Case 4 and 4A: 1 yr Frequency, 1 hr Rainfall Duration, 0 and 1.31 fps current.
ppm = parts per million

the near-field plume. This distance corresponds to a water depth of 50 ft offshore of the proposed Campbell drainage channel, and is the approximate demarcation line between the nearshore and offshore current regimes. In addition, since a constant ambient current speed has been assumed, the time to reach this end distance which defines the limit of the near-field should be of the order of 1-1.5 hours after exit. As shown in Table 5, all cases except Case 4 meets this time constraint.

In addition to elevated suspended solids concentrations in the receiving waters, another parameter of concern is the absolute value of the salinity. Corals are sensitive to salinity, and salinity values below about 21-23 o/oo may be harmful. Table 6 provides the distance from the discharge location for various specified salinities for Cases 1-4 where the average dilution of the plume has been applied. In addition to the no-current and maximum 1.31 ft/sec along shore current, calculation for in-between current speeds of 0.33 and 0.65 ft/sec are also provided.

From the results of Table 5, it is difficult to select a single case that can be considered a worst case situation for the entire near-field. For example, Case 3 shows the highest suspended sediment concentration for no current conditions, while Case 1A shows the highest suspended sediment concentration during a maximum 1.31 ft/sec ambient current. In order to provide a better representation of the results, the plume calculations for each of the 4 cases, for both zero and maximum ambient current are shown in Figures 8 to 11, for Cases 1 to 4 respectively. To provide additional information, ambient current speeds of 50% (0.66 ft/sec) and 25% (0.33 ft/sec) relative to the maximum current were used in the PDS model and the resulting plumes are also shown in Figures 8 to 11 and in Appendix A. Finally, Figures 8 to 11 also show the salinity contours as defined in Table 6.

For the no-current situation, the low flow velocity from the discharge channel for Cases 3 and 4 do not provide an aggressive mixing process which is directly associated with the relative velocity or shear between the jet flow and the ambient water. Thus, the stormwater moves slowly offshore with its centerline suspended sediment concentrations remaining high. This is contrasted with the aggressive mixing processes associated with Cases 1 and 2. When an ambient current is imposed, since the Case 3 and 4 jets have a very low velocity in comparison with the ambient current, as the plume turn and flows with the current, the flow shear as represented by the excess velocity becomes large, leading to significant increases in mixing and dilution. Similarly, since the Case 1 and 2 jet flows are already large, imposing an ambient current does not provide the relative magnitude of flow shear as experienced by the Case 3 and 4 plumes.

Table 6: Distance From The Shoreline Discharge Location Along The Plume Centerline, S, For A Given Salinity Contour Value.

Case No.	Salinity: 20 o/oo S(ft)	22.5 o/oo S(ft)	25 o/oo S(ft)	30 o/oo S(ft)
1	166		469	>10,000
1C	165		465	>10,000
1B	165		465	4,781
1A	165		459	3,184
2	112		218	707
2C	112		218	712
2B	112		218	728
2C	112		218	811
3	270	1,344	4,664	>10,000
3C	256	697	1,810	>10,000
3B	225	537	1,352	5,240
3A	192	291	553	1,681
4	193	437	2,047	>10,000
4C	189	381	921	5,246
4B	179	285	582	2,034
4A	170	221	325	961

For n = 1, 2, 3 and 4
Case n : No Current Conditions
Case nC: 0.33 ft/sec Current Speed
Case nB: 0.65 ft/sec Current Speed
Case nC: 1.31 ft/sec Current Speed

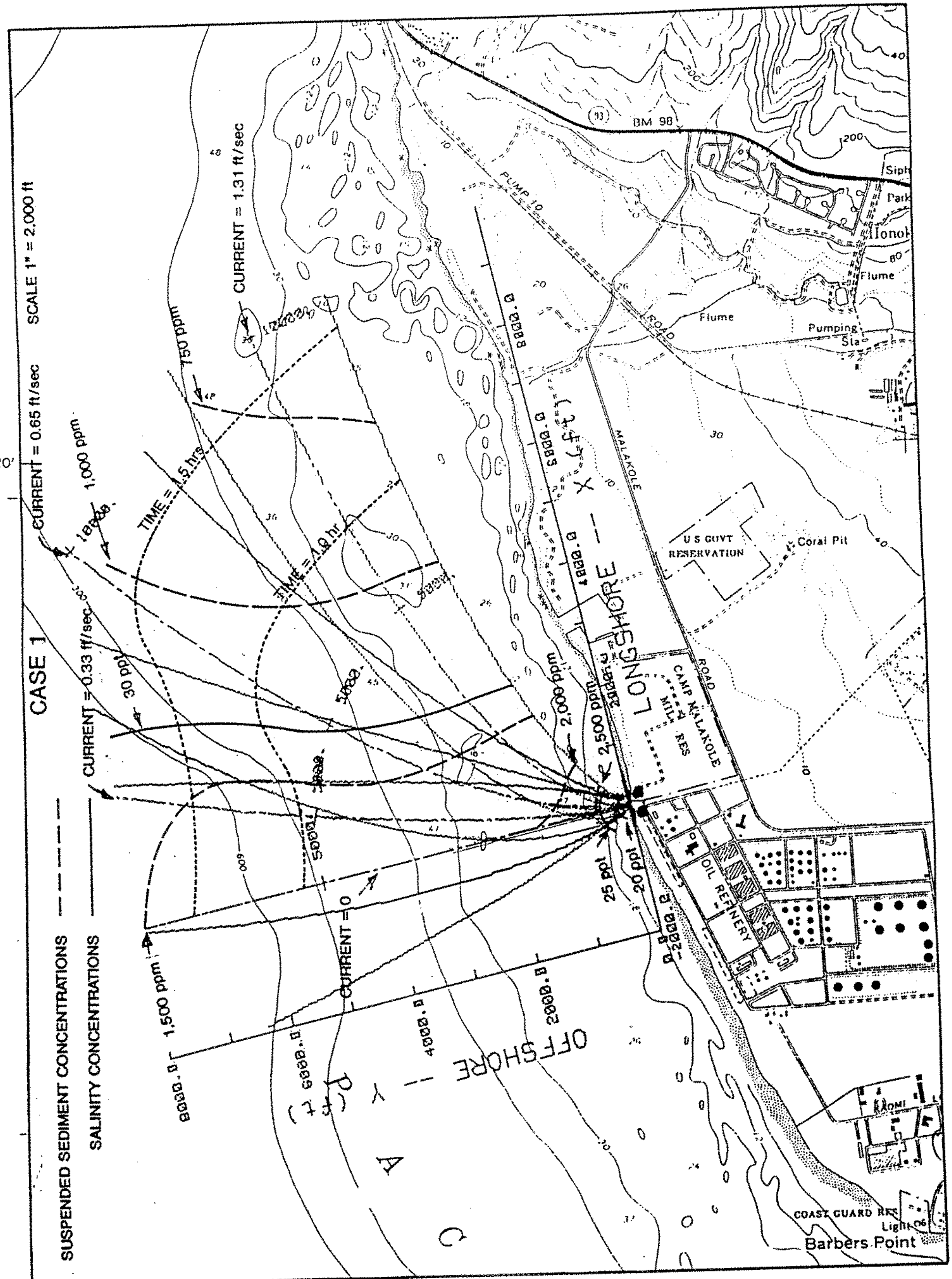

Figure 8: Overplot Of Plume Plan Views For Ambient Current Speeds Of 0, 0.33, 0.65, and 1.31 ft/sec. For Case 1.

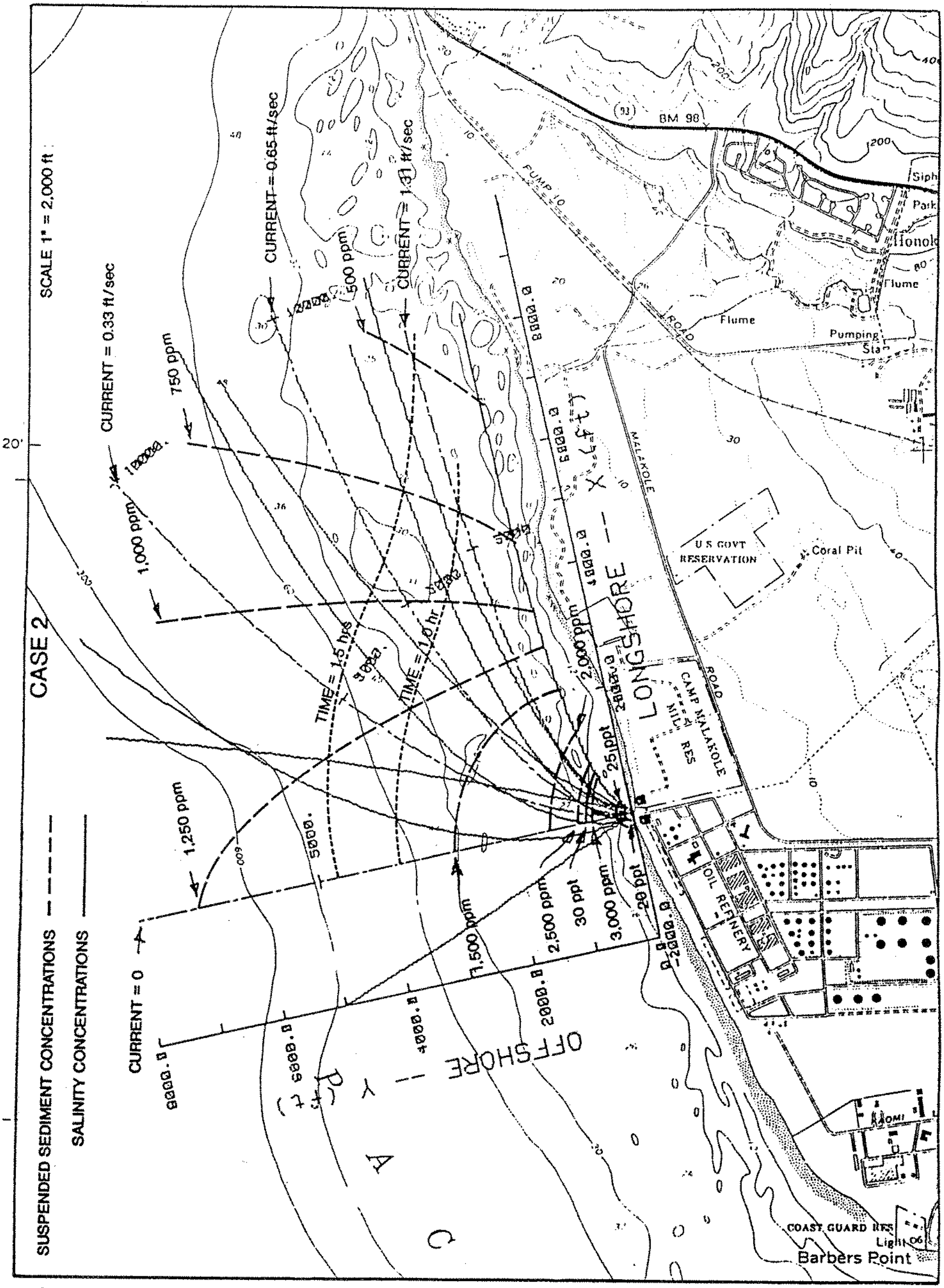

Figure 9: Overplot Of Plume Plan Views For Ambient Current Speeds Of 0, 0.33, 0.65, and 1.31 ft/sec. For Case 2.

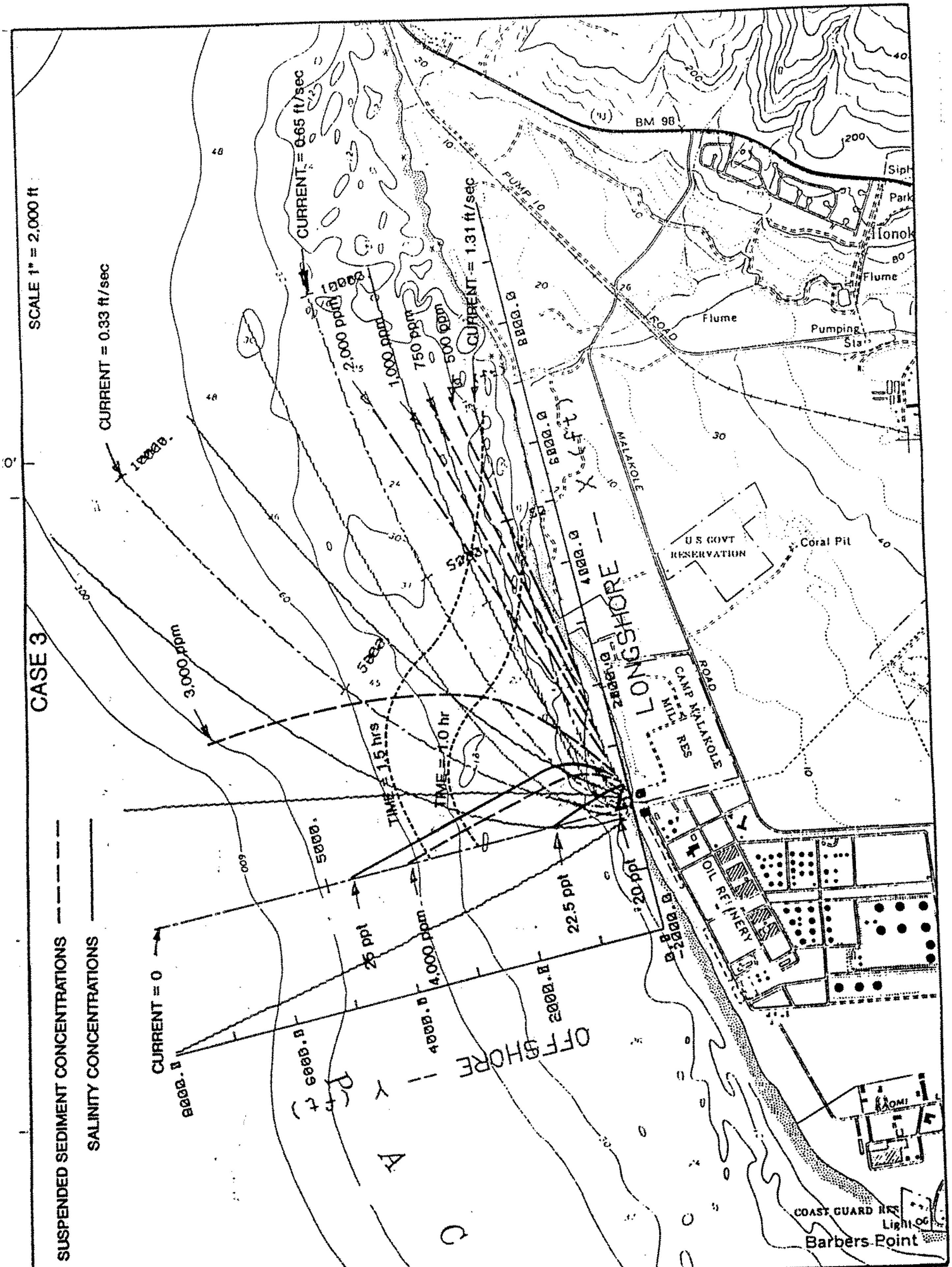

Figure 10: Overplot Of Plume Plan Views For Ambient Current Speeds Of 0, 0.33, 0.65, and 1.31 ft/sec. For Case 3.

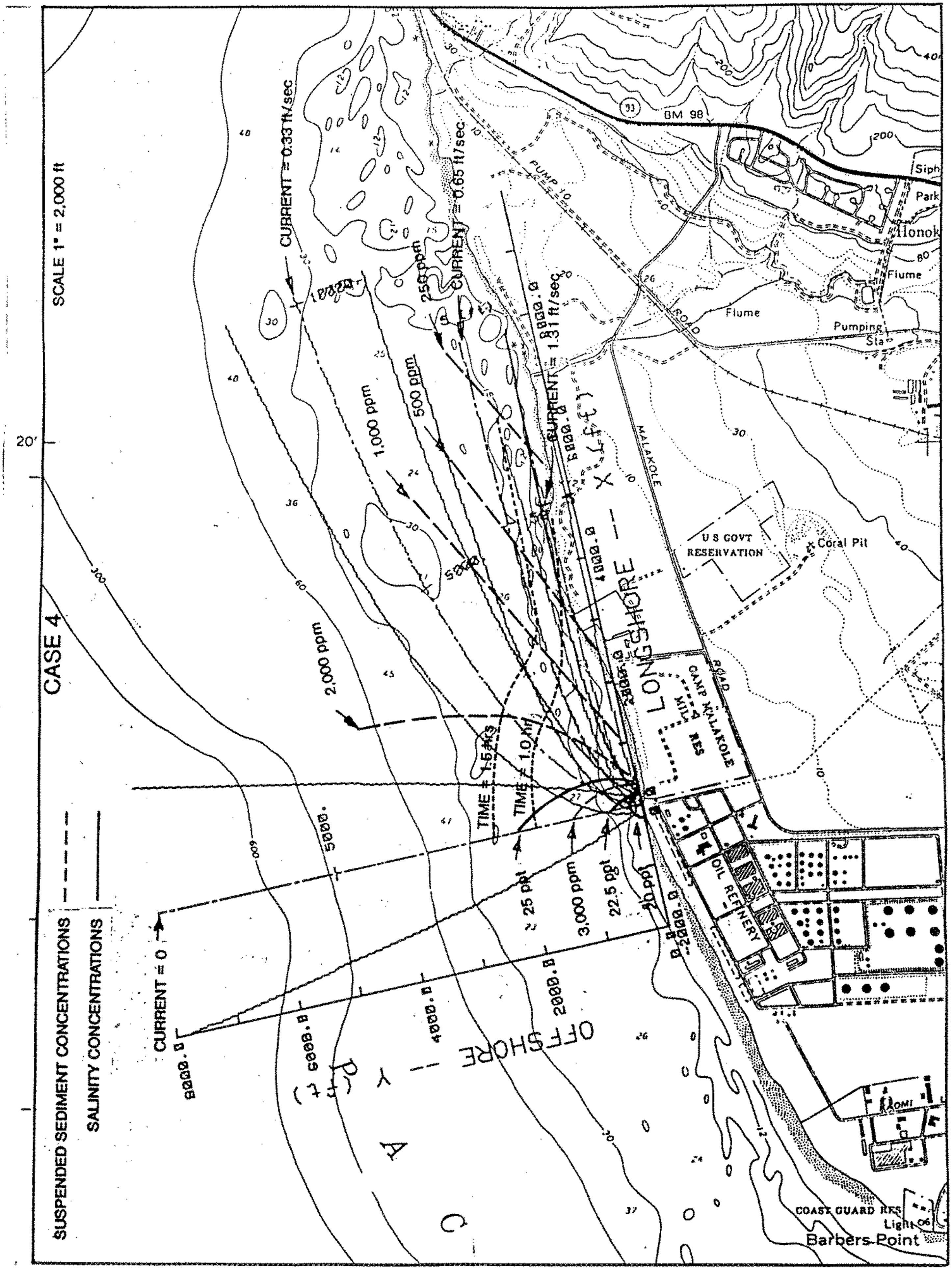

Figure 11: Overplot Of Plume Plan Views For Ambient Current Speeds Of 0, 0.33, 0.65, and 1.31 ft/sec. For Case 4.

Finally, from the tabular plume data, the 1 hr and 1.5 hour time contour lines and the suspended sediment concentration contour lines (parts per million, ppm) are also shown in Figures 8 to 11. The suspended sediment concentrations (ppm) are determined from the lbs/cf values by assuming that the sediment has a specific weight of 165 lbs/cf (density 2.65).

In order to interpret Figures 8 to 11, it should first be noted that the PDS model can only consider a constant ambient current speed. Since the ambient current flow offshore of the Barbers Point Deep Draft Harbor is known to follow the tidal cycle, a typical minimum to maximum current flow in one direction will take about 3 hours (assuming a 12 hour period semi-diurnal tide). Thus, if a series of quasi-steady ambient currents were considered, divided into say 3 to 4 current speeds between zero to the maximum speed, then a maximum time associated with each constant current speed would be about 1 hour. Consequently, the area between the channel shoreline exit and the 1 hr contour line represents the primary region where the PDS solutions are physically realistic. Within the 1 hr contour line, the average suspended solids concentrations of the plumes have been contoured to provide an overall representation of the spatial change in concentration as the current changes.

Evaluating Figures 8 to 11, the largest suspended sediment concentrations in the near-field are given by Case 3, Figure 10, where suspended sediment concentrations immediately offshore of the discharge exceed 4,000 ppm for the zero ambient current condition. As the current is imposed, the suspended sediment concentration decreases significantly, with concentrations in the 500- 750 ppm levels in the nearshore waters at distances of about 3,000 ft from the discharge location, in the direction of the current flow. Note that Figures 8 to 11 only show current flow conditions towards the north. The suspended sediment concentration and time contour lines should be mirror imaged about the channel centerline to provide plume conditions for ambient flow towards the south.

Again examining Figures 8, 9 and 11, for Cases 1, 2 and 4 respectively, it is noted that the highest suspended sediment concentrations in the nearshore water about 3,000 ft down current from the discharge is about 1,000 to 1,250 ppm for Case 2, Figure 9. Furthermore, it is interesting to note that while Case 1, Figure 8 would provide the highest suspended sediment concentration at about 3,000 ft down current, the plume is not able to physically reach the nearshore area, adjacent to the shoreline.

The salinity contours shown in Figures 8 to 11 indicate that Case 3 provides the "worst case" receiving water impacts for salinities less than and equal to 25 o/oo. In general, all the cases indicate that the limiting 22.5 o/oo salinity contour extends a maximum distance of about 200-400 ft alongshore on either side of the shoreline discharge location for flood and ebb tide current flow conditons, and extends a maximum of about 1,300 ft directly offshore for the no current condition.

3.0 FAR-FIELD PLUME MODELING

3.1 Technical Introduction

For the proposed Campbell drainage channel, the results from the PDS model are only applicable to the near-field plume region, which has been assumed to extend offshore about 3,200 ft from the shoreline exit. In order to determine the longer term impacts in the "far-field", a far-field model was run to extend the results beyond the near-field region. The input variables at the "start" of the far-field simulations were based on the endpoint characteristics from the near-field plumes as shown in Table 5. The concentration of suspended sediment materials is based on the total amount of suspended sediment discharged at the outlet. This is considered to be a conservative estimate since there will be some fallout of particles from the plume over time.

The far-field model results provide a probabilistic representation of the potential areas of impact of the discharge after periods of many hours or days subsequent to the release of the stormwater discharge into the ocean. Contours representative of concentrations provide estimates of the probability that the discharged materials will impact the location at time t after release. It is unlikely that the concentrations would actually be as shown by the contour plots on any given day. However, for many repeated instances of discharge, on average the discharge would impact the areas in as shown in the following diagrams. The far-field model is described in more detail below.

3.2 Description Of The Far-Field Plume Model

Following the near-field mixing when the plume momentum and buoyancy have been dissipated, the diluted effluent plume would be largely dynamically passive and would be transported and dispersed by the ocean current field. A far-field model is then utilized, based on a simulation approach which incorporates detailed current meter data which is representative of the site area.

The far-field model utilizes a Monte Carlo simulation of the transport process directly. It is known that the solution to the simple diffusion equation is equivalent to that resulting from a random walk process. Utilizing computer capability, it is feasible to simulate ocean transport processes directly. For the present study, the ocean current data in the site area will provide the ocean transport information.

The simulation model described herein is concerned with the transport of a conservative substance. Suppose that the velocity field in the ocean can be completely described. Let a parcel of marked fluid be released at the discharge point at the end of the near-field regime, called the origin. Since the velocity field is completely known, it is possible to trace the motions of the particle as a function of time [x(t), y(t), z(t)] where t is the time since release in the far-field. This process can now be repeated at any other time. A function of practical interest is the probability density f(x,y,z,t) that parcels released at the origin will be in the cell x to x+dx at t. This can be estimated by counting the number of such parcels and dividing by the total number of releases and by the volume of the elemental cell. If the velocity field were a pure random walk, this particular simulation would lead to an estimate of f(x,y,z,t) which would satisfy the classical Fickian diffusion equation. For other stochastic velocity fields, it is still possible to perform the simulation and the interpretation of the resulting f(x,y,z,t) remains the same. However, the differential equation to which it is the solution would not be a Fickian diffusion equation. In-as-much as the goal of the present modeling effort is to obtain estimates of environmental impact, the probability density of visitation at various locations around the discharge site and the estimated travel times would be of interest.

The scheme described above has been utilized in the present far-field model development. The stochastic velocity field is represented by the actual time series of currents as obtained from recording current meters. The model implemented and used to generate the following results assumes that there is spatial homogeneity in the currents or that the Langrangian velocity field can be adequately represented by the Eulerian measurements.

The above discussion assumed that adequate knowledge of ocean currents was available. In the present situation for the Campbell drainage channel, the available current data is represented by the measurements obtained by SEI (1988), where only the mooring at location B is representative of the offshore regime. With this single current meter located at a fixed water depth, the three dimensional form of the equations described above have been reduced to two dimensions, representing the horizontal plane. Finally, the current data at site B was obtained for a two-month period and consequently, may not characterize seasonal or other long-term variations in the current dynamics. Thus, the far-field results should be interpreted with consideration of these limitations.

In order to use the SEI (1988) current data, the tabulated hourly data from the report was digitized into a form compatible with the input data for the far-field plume program. For reference purposes, the digitized current data for all 3 mooring locations are provided in a standard processed format in Appendix C.

3.3 Far-Field Plume Model Results

The far-field model was run for time periods of 3, 6, 9, 12, 24, 36 and 48 hours after the start of discharge into the far-field for the four near-field cases. The results indicate that Case 1 provides the greatest offshore impacts, which are primarily associated with the total volume of suspended sediment discharged. Figures 12a-12g describes the far-field simulation results for Case 1 for time horizons of 3, 6, 9, 12, 24, 36 and 48 hours respectively. The far-field results for the other 3 cases are shown in Appendix B. In general, the far-field results as shown in Figure 12 describe a gradually growth of the overall size of the plume as a function of time after discharge, with the maximum suspended sediment concentration also decreasing as a function of time. The suspended sediment concentrations in the far-field are relatively low, reaching a peak value of about 29 ppm after 3 hours in the far-field and decreasing continually with time.

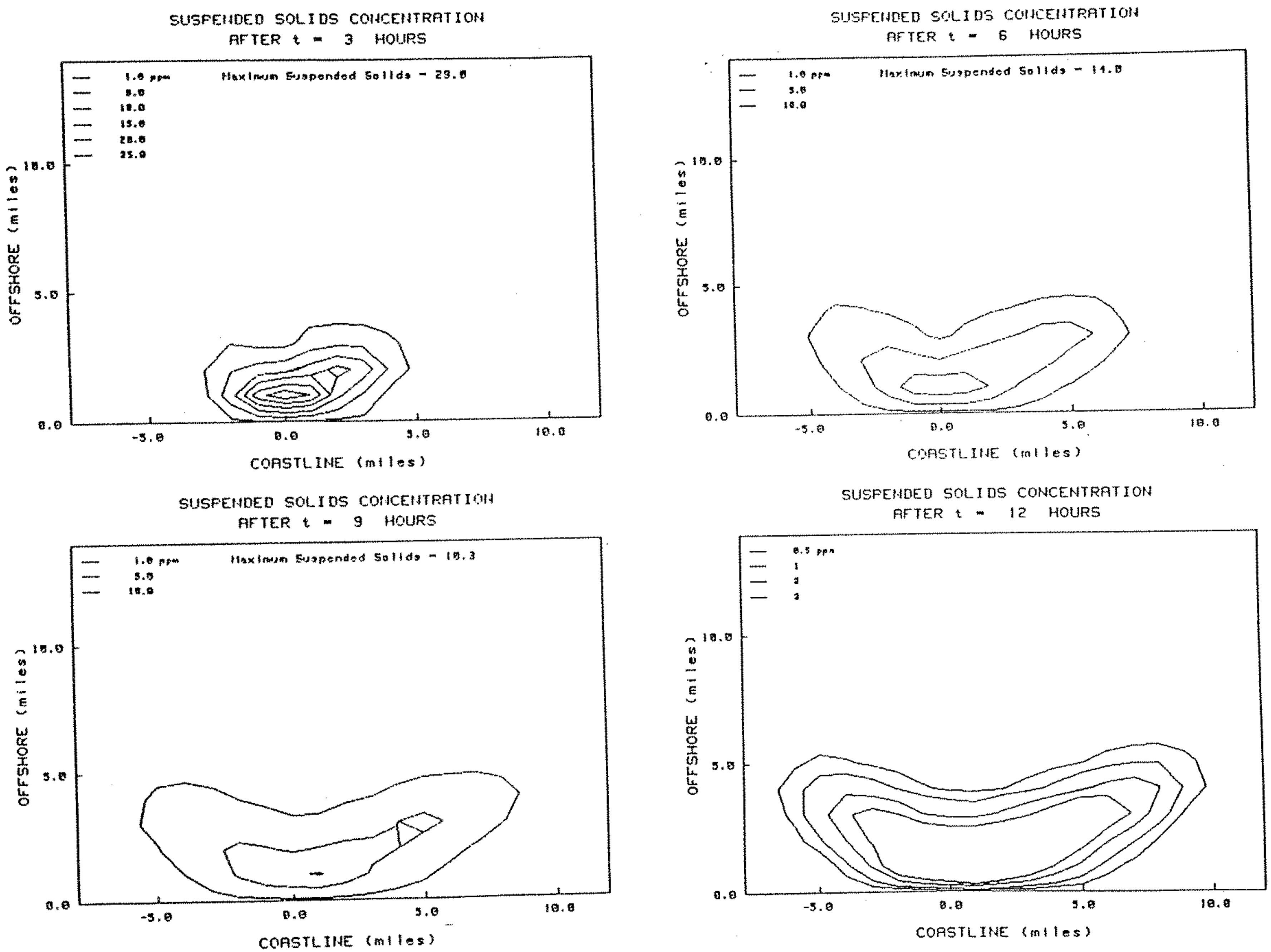

Figure 12a - 12d: Far-Field Plume Results For Case 1 Showing Suspended Sediment Concentrations After Various Times After Discharge.

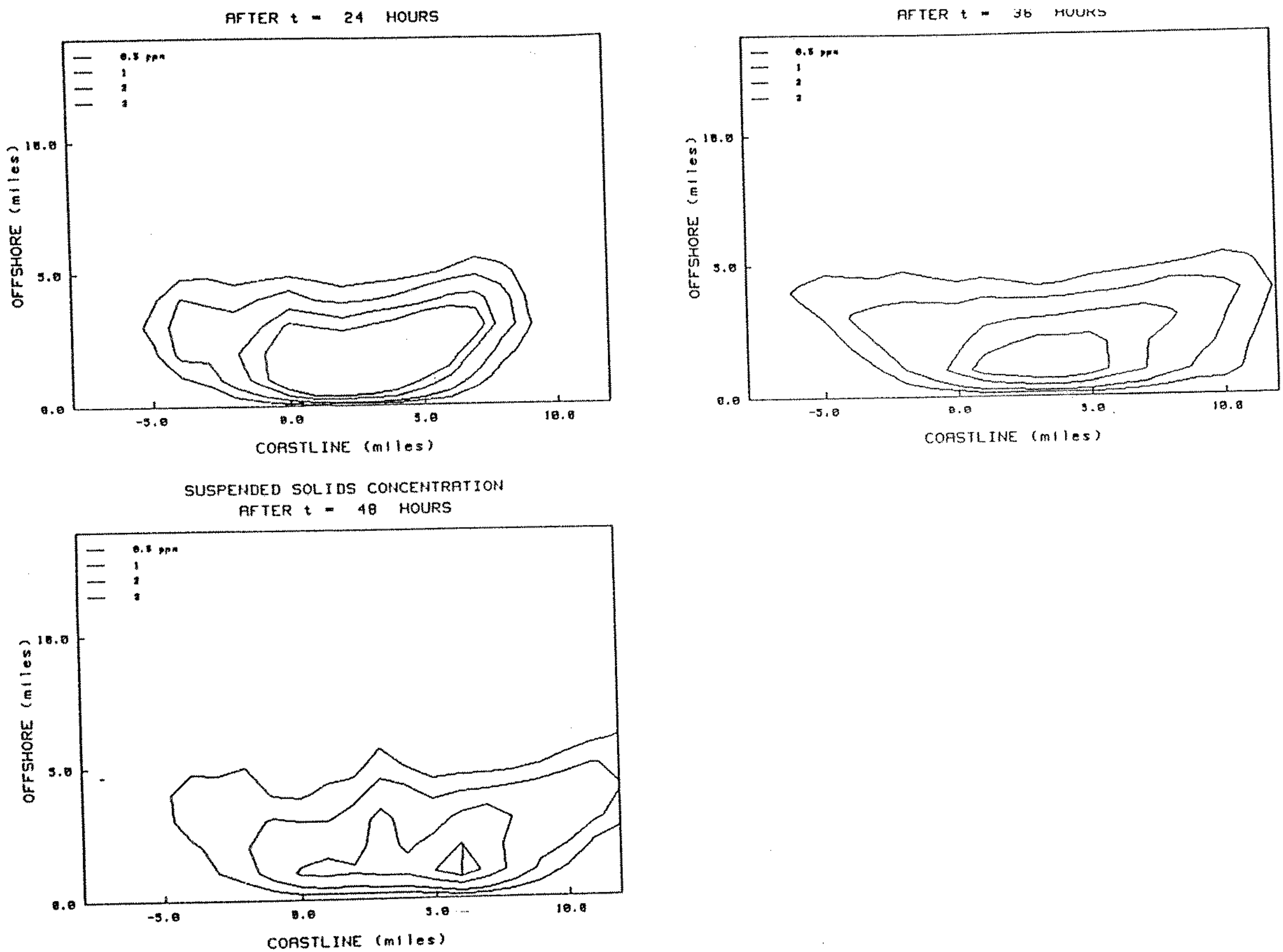

Figure 12e - 12g: Far-Field Plume Results For Case 1 Showing Suspended Sediment Concentrations After Various Times After Discharge.

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APPENDIX D

ARCHAEOLOGICAL RECONNAISSANCE OF A PROPOSED DRAINAGE CHANNEL:

SUPPLEMENT TO AN ARCHAEOLOGICAL ASSESSMENT

FOR THE PROPOSED KAPOLEI BUSINESS-INDUSTRIAL PARK

HONOULIULI, EWA, OAHU

by

CULTURAL SURVEYS HAWAII

ARCHAEOLOGICAL RECONNAISSANCE OF A PROPOSED DRAINAGE CHANNEL:

Supplement To An Archaeological Assessment For The Proposed Kapolei Business/Industrial Park, Honouliuli, ʻEwa, Oʻahu

By

WILLIAM H. FOLK, II

Prepared For

ENGINEERING CONCEPTS, INC.

By

CULTURAL SURVEYS HAWAII

HALLETT H. HAMMATT, PH.D.

JUNE, 1990
Revised MAY 31, 1991

ABSTRACT

An archaeological reconnaissance was conducted for a 100 ft. (30.5 m.) wide proposed drainage channel through the Kapolei Business/Industrial Park at Barber's Point, Honouliali, 'Ewa, O'ahu. The study area extends from the O.R. & L Railroad at the north, south, and west through the southern extreme of the former Camp Malakole Military Reservation. The corridor extends through lands that have undergone massive recent modification subsequent to intensive archaeological and paleontological data recovery studies. No known surface archaeological or paleontological sites will be directly impacted. However, because of the possibility of disturbing dune deposits containing cultural layers on the north side of the channel, particularly at the makai end, archaeological subsurface testing is recommended to determine the presence or absence of cultural material and to make evaluations of significance. A report on this testing should be produced which addresses significance of findings and presents appropriate mitigation measures.

ACKNOWLEDGEMENTS

I would like to thank Dana Yamamoto of Engineering Concepts, Inc. for providing maps and helping with questions of development plans. Typing was performed by Charlotte Cordes. Special thanks to Dr. Hal Hammatt and Dave Shideler for their assistance and support.

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CAMPBELL DRAINAGE CHANNEL,

EWA DISTRICT, ISLAND OF OAHU

by

CHAR & ASSOCIATES

CAMPBELL DRAINAGE CHANNEL

'EWA DISTRICT, ISLAND OF O'AHU

by

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October 1989

CAMPBELL DRAINAGE CHANNEL
'EWA DISTRICT, ISLAND OF O'AHU

INTRODUCTION

Improvements are planned for an existing drainage that services the area near the State's deep-draft harbor and Campbell Industrial Park. The majority of the drainage at present passes through actively cultivated sugar cane fields; where it nears the coast, it runs adjacent to the Standard Oil Refinery.

A survey to inventory the botanical resources along the proposed drainage channel was conducted on 18 August 1989. The primary objectives of the survey were to (1) inventory the terrestrial vascular flora; (2) describe the vegetation along the drainage channel; and (3) search for any threatened and endangered plants along its entire length.

SURVEY METHODS

Prior to the field survey, a search was made of the botanical literature pertinent to the project site to familiarize the principal investigator with other plant studies conducted in the same general area. Aerial photographs and project site maps were examined to determine vegetation patterns, access points, boundaries, and reference points. Access onto the portion mauka of Malakole Road was by a number of cane haul roads which transit the area; makai of Malakole Road, an overgrown footpath follows along almost the entire length of the existing drainage.

A walk-through survey method was used. Areas most likely to harbor native plants, as along the makai portion, were surveyed more intensively. Notes were made on plant associations and distribution, substrate types, topography, exposure, etc. Species identifications were made in the field and plants which could not be positively identified were collected for later determination in the herbarium and for comparison with the taxonomic literature. The species inventoried are indicative of the season ("rainy" vs. "dry") and environmental conditions under which the survey was taken. A survey taken during the wetter, rainy season (about October through January) would no doubt yield slight variations in the species list especially of the weedy, annual taxa.

DESCRIPTION OF THE VEGETATION

Vegetation in the general area of the drainage channel was described and mapped during the U. S. Fish and Wildlife Service sponsored 'Ewa Plains Botanical Survey (Char and Balakrishnan 1979). Recently, a flora study was made of lands bordering a portion of the drainage for Campbell Estates' proposed ±552-acre industrial and commercial project site (Char 1989). Most of the vegetation consisted of sugar cane fields with smaller areas covered by kiawe forest and fallow fields.

In this survey, the drainage channel passes through two major vegetation types -- cane fields and the kiawe/pickleweed community.

Where the drainage crosses sugar cane fields, it is often overgrown with dense mats of California grass (*Brachiaria mutica*). Along its banks, small clumps of koa-haole (*Leucaena leucocephala*) and castor bean (*Ricinus communis*) as well as a few trees of kiawe (*Prosopis pallida*) and 'opiuma (*Pithecellobium dulce*) are found. Often forming dense patches between the shrubs and trees are buffel grass (*Cenchrus ciliaris*) and Guinea grass (*Panicum maximum*). Weedy species associated with the adjacent cane fields are also found along the drainage. These commonly include fuzzy rattlebox (Crotalaria incana), pigweed (Portulaca oleracea), two species of Amaranthus, and wild bittermelon (Momordica charantia).

Where the drainage nears the coast, makai of Malakole Road, it borders the Standard Oil Refinery and an open kiawe forest with a ground cover dominated by tangled mats of pickleweed (Batis maritima). Pickleweed is a slat water tolerant plant and is found in areas that are subjected to periodic inundation by sea water and in areas where the salinity of the soil is high. Pluchea shrubs, 3 to 6 ft. high, are common along the drainage and all three species are present. In places, 'akulikuli (Sesuvium portulacastrum) and swollen finger grass (Chloris barbata) are abundant. Besides the 'akulikuli, other natives found along this part of the drainage include kipukai (Heliotropium curassavicum), 'ilima (Sida fallax), and a few shrubs of the false sandalwood or naio (Myoporum sandwicense).

DISCUSSION AND RECOMMENDATIONS

The proposed improvements to the existing drainage channel will affect vegetation dominated almost exclusively by introduced species. California grass, koa-haole, Guinea grass, buffel grass, and an assortment of other weedy plants occur where the drainage crosses agricultural lands mauka of Malakole Road. Near the coast, makai of Malakole Road, the drainage crosses an open kiawe forest with large areas covered by pickleweed. Soil salinity in this area is high.

Of a total of 62 plant species inventoried, 55 (89%) are introduced or alien; six (10%) are indigenous, i.e. native to the islands and also elsewhere; and one (1%) is originally of Polynesian introduction (refer to species checklist at end of report). No endemic species, i.e. native only to the islands were found.

No officially listed threatened or endangered plants occur along the drainage site; nor are any plants candidate or proposed for such status on the site (U. S. Fish and Wildlife Service 1985; Herbst 1987). Although *Achyranthes rotundata*, an officially listed endangered species, has been found on the adjacent Camp Malakole property (Char and Balakrishnan 1979; Whistler 1985), it does not occur on or near the drainage site. *Achyranthes* is found on exposed coralline substrate; the wet, highly saline soils around the drainage channel would not provide suitable habitat for the *Achyranthes*.

The proposed improvements should not have a significant impact on the total island populations of the species involved as the majority are introduced species. If landscaping is planned for the drainage area, then native plants such as naio, 'ilima, 'akulikuli, etc., should be considered. Such lowland native species are adapted to the local conditions of the area and would require less maintenance and water over the long term.

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SPECIES CHECKLIST -- Campbell Drainage Channel

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within each of two groups: Monocots and Dicots. Taxonomy and nomenclature of the flowering plants (Monocots and Dicots) are in accordance with Wagner et al (in press). In most cases, common English and/or Hawaiian names follow St. John (1973) or Porter (1972).

For each species the following information is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name, when known.
3. Biogeographic status. The following symbols are used:
   - I = indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s)
   - P = Polynesian = plants originally of Polynesian introduction prior to Western contact (1778); not native
   - X = introduced or alien = all those plants brought to the islands intentionally or accidentally after Western contact; not native.

Scientific name	Common name	Status
MONOCOTS		
COMMELINACEAE (Spiderwort Family)		
Commelina benghalensis L.	hairy honohono	X
Commelina diffusa N. L. Burm.	honohono	X
CYPERACEAE (Sedge Family)		
Cyperus rotundus L.	nutgrass	X
POACEAE (Grass Family)		
Brachiaria mutica (Forssk.) Stapf	California grass	X
Cenchrus ciliaris L.	buffel grass	X
Chloris barbata (L.) Sw.	swollen finger grass, mau'ulei	X
Digitaria insularis (L.) Mez. ex Ekman	sourgrass	X
Eleusine indica (L.) Gaertn.	wiregrass	X
Eragrostis tenella (L.) Beauv. ex Roem. & Schult.	lovegrass	X
Leptochloa uninervia (K. Presl.) Hitchc. & Chase	leptochloa	X
Panicum maximum Jacq.	Guinea grass	X
Panicum maximum var. trichoglume Eyles ex Robyns	green panic grass	X
Saccharum officinarum L.	sugar cane, ko	P
Setaria verticillata (L.) Beauv.	bristly foxtail	X
DICOTS		
AIZOACEAE (Fir-marigold Family)		
Sesuvium portulacastrum (L.) L.	'akulikuli	I
AMARANTHACEAE (Amaranth Family)		
Achyranthes aspera L.	achyranthes	X
Amaranthus spinosus L.	spiny amaranth, pakai kuku	X
Amaranthus viridus L.	amaranth, pakai	X
ASTERACEAE (Sunflower Family)		
Ageratum conyzoides L.	maile hohono	X
Conyza bonariensis (L.) Cronq.	hairy horseweed, ilioha	X
Crassocephalum crepidioides (Benth.) S. Moore	crassocephalum	X
Eclipta alba (L.) Hassk.	false daisy	X
Pluchea indica (L.) Less.	Indian pluchea	X
Pluchea symphytifolia (Mill.) Gillis	pluchea	X

Scientific name	Common name	Status
Pluchea X fosbergii Cooperr. & Galang	hybrid pluchea	X
Sonchus oleraceus L.	sow thistle, pualele	X
Verbesina encelioides (Cav.) Benth. & Hook.	golden crownbeard	X
Xanthium strumarium var. canadense (Mill.) Torr. & A. Gray	cocklebur	X
BATIDACEAE (Saltwort Family)		
Batis maritima L.	pickleweed	X
BORAGINACEAE (Heliotrope Family)		
Heliotropium curassavicum L.	kipukai, nena	I
CHENOPODIACEAE (Goosefoot Family)		
Atriplex semibaccata R. Br.	Australian saltbush	X
Atriplex suberecta Verd.	saltbush	X
Chenopodium murale L.	'aheahea	X
CONVOLVULACEAE (Morning-glory Family)		
Ipomoea obscura (L.) Ker-Gawl.	field bindweed	X
Ipomoea triloba L.	little bell	X
Jacquemontia ovalifolia (Choisy) H. Hallier	pa'u-o-Hi'iaka	I
Merremia aegyptia (L.) Urb.	hairy merremia, koali kua hulu	X?
CUCURBITACEAE (Gourd Family)		
Coccinia grandis (L.) Voight	coccinia	X
Momordica charantia L.	wild bittermelon	X
EUPHORBIACEAE (Spurge Family)		
Chamaesyce hirta (L.) Millsp.	hairy spurge	X
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	X
Chamaesyce prostrata (Aiton) Small	prostrate spurge	X
Ricinus communis L.	castor bean, koli	X
FABACEAE (Pea Family)		
Acacia farnesiana (L.) Willd.	klu	X
Chamaecrista nictitans (L.) Moench	partridge pea, lauki	X
Crotalaria incana L.	fuzzy rattlebox, kukae hoki	X
Desmanthus virgatus (L.) Willd.	virgate mimosa	X
Leucaena leucocephala (Lam.) de Wit.	koa-haole	X
Macroptilium lathyroides (L.) Urb.	cow pea	X
Pithecellobium dulce (Roxb.) Benth.	'opiuma	X
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	kiawe	X

Scientific name	Common name	Status
LAMIACEAE (Mint Family)		
Leonotis nepetifolia (L.) R. Br.	lion's ear	X
MALVACEAE (Mallow Family)		
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	X
Sida fallax Walp.	'ilima	I
Sida spinosa L.	prickly sida	X
MYOPORACEAE (Myoporum Family)		
Myoporum sandwicense A. Gray	false sandalwood, naio	I
PLANTAGINACEAE (Plantain Family)		
Plantago major L.	common plantain, lau-kahi	X
PORTULACACEAE (Purslane Family)		
Portulaca oleracea L.	common purslane, pigweed	X
SOLANACEAE (Nightshade Family)		
Lycopersicon pimpinellifolium (Jusl.) Mill.	wild tomato, currant tomato	X
Nicotiana glauca R. C. Graham	tree tobacco	X
Physalis angulata L.	physalis	X
STERCULIACEAE (Cocoa Family)		
Waltheria indica L.	'uhaloa, hi'aloa	I?

APPENDIX F

SURVEY OF AVIFAUNA AND FERAL MAMMALS

AT THE PROPOSED CAMPBELL COMMERCIAL-INDUSTRIAL SITE

EWA, OAHU

by

PHILLIP L. BRUNER

SURVEY OF THE AVIFAUNA AND FERAL MAMMALS AT THE PROPOSED CAMPBELL COMMERCIAL-INDUSTRIAL SITE, EWA, OAHU

Prepared for

William E. Wanket Inc.

by

Phillip L. Bruner
Assistant Professor of Biology
Director, Museum of Natural History
BYU-H
Laie, Hawaii 96762

28 August 1989

SURVEY OF THE AVIFAUNA AND FERAL MAMMALS AT THE PROPOSED CAMPBELL COMMERCIAL-INDUSTRIAL SITE, EWA, OAHU

INTRODUCTION

The purpose of this report is to summarize the findings of a three day (27 July, 5, 18 August 1989) bird and mammal field survey at the proposed Campbell Commercial-Industrial Site, Ewa, Oahu (see Fig. 1). Also included are references to pertinent literature as well as unpublished reports.

The objectives of the field survey were to:

1- Document what bird and mammal species occur on the property or may likely occur given the range of habitats available.

2- Provide some baseline data on the relative abundance of each species.

3- Supplement these findings with published and/or unpublished data.

4- Evaluate the possible changes that might occur in the bird and mammal populations following the proposed development on the property.

GENERAL SITE DESCRIPTION

The proposed project property is located on the west shore of Oahu at Campbell Industrial Park (see Fig. 1). The site presently contains sugar cane fields, scrubby second growth patches of vegetation and some urban facilities ie. auto racing park, nursery and land fill dumping. The overall habitat could best be described as dry parkland and cultivated fields. Aside from sugar cane the dominant plants in the area are: Kiawe (*Prosopis pallida*) and Koa Haole (*Leucaena leucocephala*).

Weather during the field survey was generally clear mornings with occasional cloudy periods in the afternoons. Winds were NE trades.

STUDY METHODS

Field observations were made with the aid of binoculars and by listening for vocalizations. These observations were concentrated during the peak activity periods of early morning and late afternoon. Attention was also paid to the presence of tracks and scats as indicators of bird and mammal activity.

At various locations (see Fig.1) eight minute counts were made of all birds seen or heard. Between these count stations walking tallys of birds seen or heard were also kept. These counts provide the basis for the population estimates given in this report. A special effort was made to census the specific area of the property designated as a "drainage ditch" (Fig.1). Data from this sector are reported separately in Table 1 of results.

Observations of feral mammals were limited to visual sightings and evidence in the form of scats and tracks. No attempts were made to trap mammals in order to obtain data on their relative abundance and distribution.

Scientific names used herein follow those given in the most recent American Ornithologist's Union Checklist (A.O.U. 1983), Hawaii's Birds (Hawaii Audubon Society 1984), Field Guide to the Birds Hawaii and the Tropical Pacific (Pratt et al. 1987), Mammal species of the World (Honacki et al. 1982) and Hawaiian Coastal Plants (Merlin 1980).

RESULTS AND DISCUSSION

Resident Endemic (Native) Land Birds:

No endemic land birds were recorded during the course of the field survey. The only likely endemic species which might occasionally forage in the area are the Hawaiian Owl or Pueo (*Asio flammeus sandwichensis*) and the Hawaiian Stilt (*Himantopus mexicanus knudseni*). Pueo are diurnal and can be found in upland forest as well as lowland grasslands and agricultural fields. Stilt are opportunistic and will forage in flooded fields where they search for invertebrate prey. This site apparently was inhabited by a variety of endemic birds in the past given the fossil evidence recovered from the "sink-holes" located on the makai protions of the property (pers. comm. A. Ziegler-zoologist formerly with the Bishop Museum, Honolulu.

Resident Indigenous (Native) Birds:

No resident indigenous land birds were recorded. The only potential species is the Black-crowned Night Heron (*Nycticorax nycticorax*). This species is opportunistic and may forage in flooded ditches and other temporary wet areas when such are available on the property.

Resident Indigenous (Native) Seabirds:

Seabirds typically nest on offshore islands which are free from disturbance by dogs, cats, mongooses and rats. However, there are areas on the main islands were predators lack access and nesting can be successful (Bruner 1988). Fossil evidence indicates seabirds have occurred on the property in the past (pers. comm. A. Ziegler). No seabirds were found during the survey and it is unlikely any would nest at this site due to an abundance of predators. Seabirds such as the Great Frigatebird (*Fregata minor*) may be seen overhead.

Migratory Indigenous (Native) Birds:

Only one species of migratory shorebird was found during the survey - Pacific Golden Plover (*Pluvialis fulva*). Plover are probably the most common migratory species in Hawaii. They prefer open areas such as mud flats,fields and lawns. Plover arrive in Hawaii in early August and depart to their arctic breeding grounds during the last week of April. Johnson et al. (1981) and Bruner (1983) have shown plover are extremely site-faithful on their wintering grounds and many establish foraging territories which they vigorously defend. Such behavior makes it possible to acquire a fairly good estimate of the abundance of plover in any one area. These populations likewise remain relatively stable over many years. A total of ten plover were recorded,all on the final day of the survey. Time did not permit a determination of how many of these plover were territorial residents and how many were passing through the area on their migration further south. The only other likely migratory species that may occur on the property is the Ruddy Turnstone (*Arenaria interpres*).

Exotic (Introduced) Birds:

A total of 17 species of exotic birds were found during this field survey. Table 1 shows the species recorded on this survey and their relative abundance. The most abundant species were Zebra Dove (*Geopelia striata*), Red-vented Bulbul (*Pycnonotus cafer), Japanese White-eye (Zosterops japonicus), Chestnut Mannikin (Lonchura malacca) and Nutmeg Mannikin (Lonchura punctulata). Exotic species not recorded on the actual survey but which potentially could occur at this locality include: Japanese Bush-warbler (Cettia diphone) and Ring-necked Pheasant (Phasianus colchicus). The habitat is probably too dry for White-rumped Shama (Copsychus malabaricus) and too open for Melodious Laughing-thrush (Garrulax canorus). The abundance and wide variety of finch and finch-like birds at this site is due to the dry brushy/ grassy habitat which these species prefer.

Red-vented Bulbul have become one of Oahu's most abundant species in recent years. The adaptability of this species to a wide variety of habitats and its remarkable population increase have been well documentd (Williams 1983, Williams and Giddings 1984, and Williams and Evenson 1985).

Java Sparrow (Padda oryzivora) have also experienced a population increase and expansion in recent years (Pratt et al. 1987). Their occurrence at this site was not unexpected.

Feral Mammals:

The only feral mammals observed during the survey were cats and the Small Indian Mongoose (Herpestes auropunctatus). Without a trapping program it is difficult to conclude much about the relative abundance of rats, mice, cats and mongooses at this site, However, it is likely that their numbers are typical of what one would find elsewhere in similar habitat on Oahu.

Records of the endemic and endangered Hawaiian Hoary Bat (Lasiurus cinerus semotus) are sketchy but the species has been reported from Oahu (Tomich 1986). None were observed on this field survey. However, bats have been observed in urbanized habitat elsewhere in Hawaii (Bruner 1985).

CONCLUSION

A brief field survey can at best provide a limited perspective of the wildlife present in any given area. Not all species will necessarily be observed and information on their use of the site must be sketched together from brief observations and the available literature. The number of species and the relative abundance of each species may vary throughout the year due to available resources and reproductive success. Species which are migratory will quite obviously be a part of the ecological picture only at certain times during the year. Exotic species sometimes prosper for a time only to later disappear or become a less significant part of the ecosystem (Williams 1987). Thus only long term studies can provide the insights necessary to acquire a complete understanding of the bird and mammal populations in a particular area. However, when brief studies are coupled with data gathered from other similar studies the value of the conclusions drawn are significantly increased.

The following are some broad conclusions related to bird and mammal activity on this property:

1- The present environment provides a limited range of habitats which are utilized by the typical array of exotic birds one would expect at this elevation and in this type of environment on Oahu.

2- Doves and finches could decline in abundance as a result of habitat changes brought about by the proposed development. House Sparrows (Passer domesticus) and Common Myna (Acridotheres tristis) should increase in abundance following urbanization.

3- In order to obtain more data on mammals, a trapping program would be required. The brief observations of this survey did not reveal any unusual mammal activity.

4- The section of the site designated for a drainage canal was specifically censused throughout its entire length and did not contain any unusual or distinctive habitat nor did the fauna found in this area differ significantly from that recorded elsewhere on the property.

Williams, R.N., and W.E. Evenson. 1985. Foraging niche of two introduced bulbul species (Pycnonotus) on Oahu, Hawaii. Unpubl. ms.

Williams, R.N. and L.V. Giddings. 1984. Differential range expansion and population growth of bulbuls in Hawaii. Wilson Bulletin 96:647-655.

APPENDIX G

CORRESPONDENCE WITH STATE OF HAWAII

DEPARTMENT OF TRANSPORTATION

HARBORS DIVISION

ENGINEERING CONCEPTS, INC.

CONSULTING ENGINEERS

January 15, 1990

Department of Transportation
Harbors Division
79 South Nimitz Highway
Honolulu, Hawaii 96813

Attention: Mr. Harry Murakami

Subject: Kapolei Business-Industrial Park

The Estate of James Campbell is proposing to develop approximately 930 acres of land mauka of the existing industrial park, adjacent to the Barbers Point Harbor. We are assisting the Estate in the planning of the infrastructure for the proposed development and are currently preparing an environmental assessment for a major drainage channel intended to serve the area. The attached figure indicates the preliminary alignment of the proposed channel. Construction of the channel will require various permits and approvals, including Corps of Engineers, SMA, and CDUA permits.

The environmental assessment, which will be used in the permit applications, requires alternative drainage solutionsbe considered, including the possibility of discharging runoff into the Barbers Point Harbor. This scenario would require a drainage channel/box culvert through the mauka portion of the harbor site to the harbor waters. Although this alternative would not eliminate the need for an additional outlet to the ocean, it would divert a large portion of the runoff to the harbor. Under this scenario, all of the runoff mauka of the railroad right-of-way (approx. 4200 cfs) would be diverted to the harbor, reducing the runoff discharged at the shoreline from approximately 5200 cfs to 1800 cfs. Consequently, impacts at the shoreline would be reduced under this scenario.

We realize the above scenario would have an impact on the development of the harbor facilities, maintenance and possibly operations of the harbor. We would appreciate your comments and concerns on the matter to help us evaluate the feasibility of this drainage alternative .

Please call me if you have any questions or require additional information.

Sincerely,

Craig Arakaki

Craig Arakaki, P.E.
Associate

250 Ward Avenue, Suite 206 • Honolulu, Hawaii 96814 • Tel: (808) 538-0920 • FAX: (808) 538-3463

4. The outlet of the proposed culvert is located in the vicinity of the future harbor expansion.

Therefore, the proposed rerouting of the major drainage channel into the harbor is completely unacceptable.

Please call Harry Murakami at 548-2535 if you need additional information.

Very truly yours,

Calvin M. Tsuda
Deputy Director for Harbors

ENGINEERING CONCEPTS, INC.
CONSULTING ENGINEERS

January 15, 1990

Department of Transportation
Harbors Division
79 South Nimitz Highway
Honolulu, Hawaii 96813

Attention: Mr. Harry Murakami

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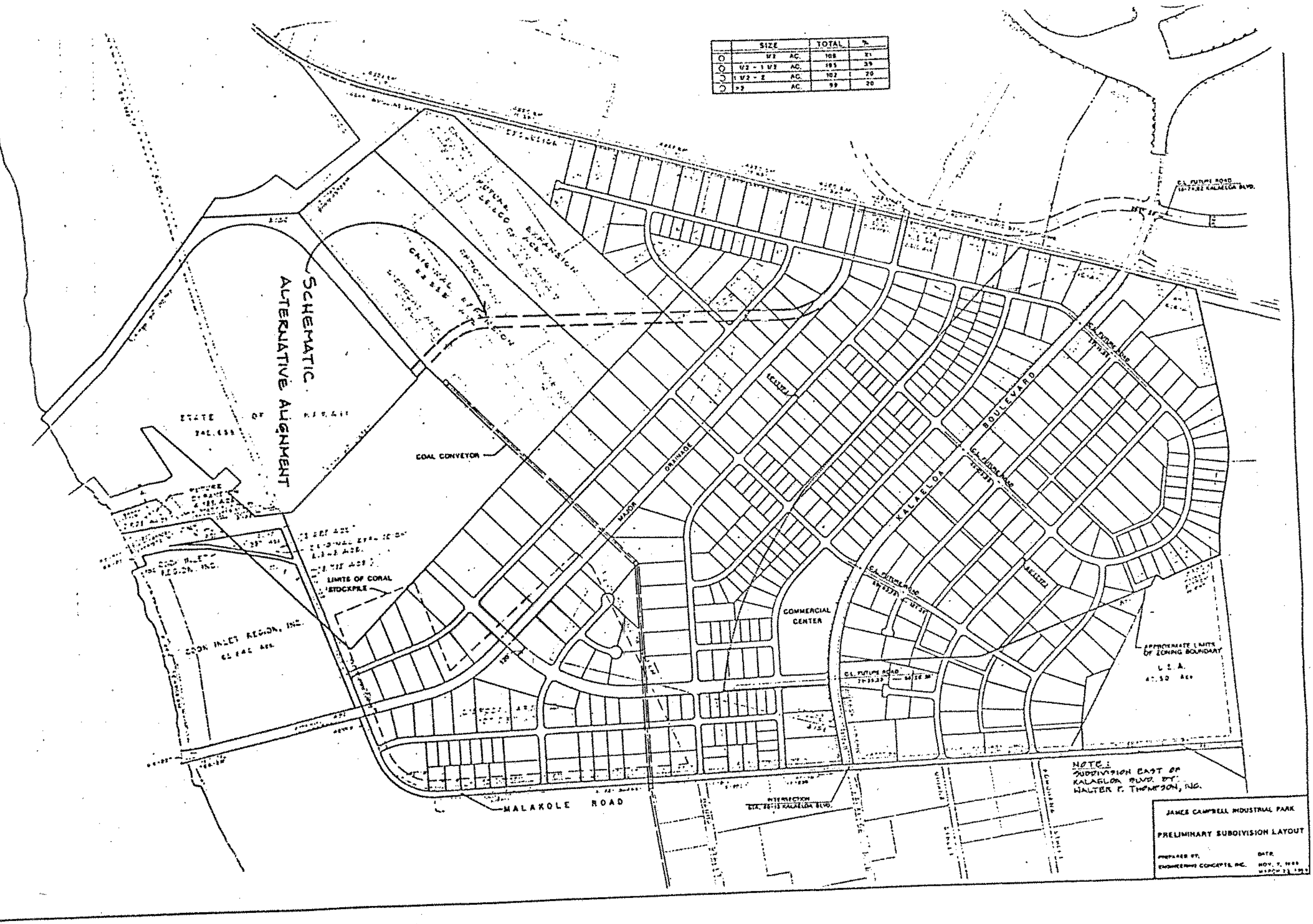
Sincerely,

Craig Arakaki

Craig Arakaki, P.E.
Associate

250 Ward Avenue, Suite 206 • Honolulu, Hawaii 96814 • Tel: (808) 538-0920 • FAX: (808) 538-3463



SIZE TOTAL %
1/2 AC. 108 21
1/2 - 1 1/2 AC. 193 39
1 1/2 - 2 AC. 102 20
>2 AC. 99 20
SCHEMATIC
ALTERNATIVE ALIGNMENT
STATE OF HAWAII
COAL CONVEYOR
LIMITS OF CORAL STOCKPILE
COOK INLET REGION, INC.
MAJOR DRAINAGE
KALAELOA BOULEVARD
C.L. FUTURE ROAD
COMMERCIAL CENTER
APPROXIMATE LIMITS OF ZONING BOUNDARY
L.S.A.
MALAKOLE ROAD
INTERSECTION
NOTE:
SUBDIVISION EAST OF KALAELOA BLVD. BY: WALTER F. THOMPSON, INC.
JAMES CAMPBELL INDUSTRIAL PARK
PRELIMINARY SUBDIVISION LAYOUT
PREPARED BY:
ENGINEERING CONCEPTS, INC.
DATE:

JOHN WAIHEE
GOVERNOR

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS

RONALD N. HIRANO
DAN T. KOCHI
JEANNE K. SCHULTZ
CALVIN M. TSUDA

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HARBORS DIVISION
79 SO. NIMITZ HWY. • HONOLULU, HAWAII 96813-4898

IN REPLY REFER TO:

February 1, 1990

HAR-EP 2237

RECEIVED
FEB 8 1990
ENGINEERING CONCEPTS

Engineering Concepts, Inc.
250 Ward Avenue, Suite 206
Honolulu, Hawaii 96814

Attention Mr. Craig Arakaki

Gentlemen:

Kapolei Business Industrial Park
Environmental Assessment

Thank you for your letter of January 15, 1990 on the subject project in which you desired comments from us on your environmental assessment for a major drainage channel intended to serve the area.

As stated in your letter, one alternative is to "divert" a large portion of the runoff (approximately 4200 cfs) into the harbor. This diversion is not acceptable to the State for the following reasons:

1. Any form of diversion is not acceptable. Runoff from any drainage basin that is not now contributing runoff into the harbor will not be allowed.

2. It appears that the runoff would be generated from drainage areas mauka of Farrington Highway, which are in sugar cane production and areas at higher elevations which are bare and sparsely vegetated. These drainage areas would contribute great volumes of soil and silt in its runoff. This would result in added perpetual expense to the State for frequent harbor maintenance dredging.

3. The velocity and volume of runoff (4200 cfs) would affect the hydraulics within the harbor and depending on how it strikes a vessel, it would be difficult to maneuver a vessel to a pier, and it could also displace a vessel from the pier after it has been tied down.

4. The outlet of the proposed culvert is located in the vicinity of the future harbor expansion.

Therefore, the proposed rerouting of the major drainage channel into the harbor is completely unacceptable.

Please call Harry Murakami at 548-2535 if you need additional information.

Very truly yours,

Calvin M. Tsuda
Deputy Director for Harbors