1990-09-23-OA-FEA

OCT 05 1990

FILE COPY

ENVIRONMENTAL ASSESSMENT

FOR

SPECIAL MANAGEMENT AREA (SMA) PERMIT

FOR

* ~~KAOMI LOOP SUBDIVISION, PHASE II~~

Campbell Industrial Subdivision, Ewa, Oahu *

FOR: HAWAII PROJECT MANAGEMENT, INC.

BY: BELT COLLINS & ASSOCIATES

APRIL, 1990

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CITY AND COUNTY OF HONOLULU
DEPARTMENT OF LAND UTILIZATION
650 South King Street, 7th Floor
Honolulu, Hawaii 96813

DLU MASTER APPLICATION FORM

Additional data, drawing/plans, and fee requirements are listed on a separate sheet titled "Instructions for Filing." *PLEASE ASK FOR THESE INSTRUCTIONS.*

All specified materials and fees must accompany this form; incomplete applications could delay processing. You are encouraged to consult with department staff in completing the application. Please call the appropriate phone number given in the "Instructions for Filing" sheet.
Please print legibly or type the required information.

PERMIT REQUESTED (Check one or more as appropriate):

Clusters:
- ☐ Agricultural Cluster
- ☐ Cluster Housing
- ☐ Country Cluster

Conditional Use Permits:
- ☐ Type 1 ☐ Type 2
- ☐ Existing Use
- ☐ Flood Hazard Variance
- ☐ Park Dedication
- ☐ Plan Review Use
- ☐ Planned Development-Housing
- ☒ Shoreline Setback Variance
- ☐ Site Plan Review
- ☐ Site Development Plan
- ☐ Special District: _____ (Indicate District)
- ☒ Special Management Area Permit/Assessment
- ☐ State Special Use Permit
- ☐ Subdivision
- ☐ Sunlight Reflection
- ☐ Variance from LUO Sec.(s): _____
- ☐ Waiver (public uses/utilities)
- ☐ Zero Lot Line
- ☐ Zone Change, From _____ to _____
- ☐ Zoning Adjustment, LUO Sec.(s): _____

TAX MAP KEY(S): 1-9-26: Portion of 28
LOT AREA: 41 Acres
ZONING DISTRICT: I-2, Heavy Industrial **STATE LAND USE DISTRICT:** Urban

STREET ADDRESS/LOCATION OF PROPERTY: Kaomi Loop, Campbell Industrial Park, Ewa, Oahu.

RECORDED FEE OWNER:
Name: James Campbell Estate
Mailing Address: James Campbell Bldg., Suite 500
828 Fort St. Mall, Hon.,HI 96813-4380
Phone Number: 536-1961
Signature:

APPLICANT:
Name: Hawaii Project Management, Inc.
Mailing Address: Central Pacific Plaza, #1460
220 S. King St., Hon., HI 96813
Phone Number: 528-4828
Signature:

PRESENT USE OF PROPERTY/BUILDING: Vacant Lot

AUTHORIZED AGENT/CONTACT PERSON:
Name: Ed Kuniyoshi/Cheryl Palesh
Mailing Address: 680 Ala Moana Blvd., Suite 200
Honolulu,Hawaii 96813
Phone Number: 521-5361
Signature:

PROJECT NAME (if any): Kaomi Loop Subdivision, Phase II

PROJECT PROPOSAL (Briefly describe the proposed activity or project): The proposed project is Phase II of the Kaomi Loop Subdivision which involves the removal of mounds of debris and soil material located on either side of the drainage easement and construction of two drainage ditches.

I. GENERAL INFORMATION

A. APPLICANT

Name: John Anderson Jr.

Mailing Address: Hawaii Project Management, Inc.
Central Pacific Plaza, Suite 1460
220 South King Street
Honolulu, Hawaii 96813

Phone: 528-4828

B. RECORDED FEE OWNER

Name: James Campbell Estate

Mailing Address: James Campbell Estate
James Campbell Building, Suite 500
828 Fort Street Mall
Honolulu, Hawaii 96813-4380

Phone: 536-1961

C. AGENT

Name: Edwin Kuniyoshi
Cheryl Palesh

Mailing Address: Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, Hawaii 96813

Phone: 521-5361

D. TAX MAP KEY

The T.M.K. for the project site is 1-9-26:portion of 28. Refer to Figure 3 for tax map.

E. LOT AREA

The lot area of the project site is 41 acres.

F. AGENCIES CONSULTED IN MAKING ASSESSMENT

Department of Land Utilization, City & County of Honolulu
Historic Sites Section, DLNR, State of Hawaii

In addition, the following agencies were consulted for various other aspects and phases of the Kaomi Loop Subdivision:

U.S. Army Corps of Engineers
Coastal Zone Management (CZM) Program
Department of Public Works, City & County of Honolulu
Division of Forestry and Wildlife, DLNR, State of Hawaii

II. DESCRIPTION OF THE PROPOSED ACTION

A. GENERAL DESCRIPTION

Brief Description of Proposed Project

The project site is located on the makai side of Kaomi Loop in Campbell Industrial Park.

The proposed project is Phase II of the Kaomi Loop Subdivision, which involves clearing of the mounds of debris and soil material, construction of drainage ditches, and construction of a plant sanctuary for the rare and endangered Achyranthes rotunda species.

The project site is littered with mounds of debris that have accumulated over time from unknown sources. These mounds of debris will be cleared and hauled off to an appropriate dump site.

The two drainage ditches will be constructed, one within the existing drainage easement, the other along the makai portion of the lots within the SMA. These ditches will not have any lining and are described in more detail in the Surface Runoff, Drainage and Erosion Hazard portion of the Environmental Characteristics section of this report.

Future action may involve further subdivision of the parcel and the filling of the subdivision to an elevation safe from flooding after negotiations with tenants. There are no tenants and specific types of uses for the lots at present.

Relation of Parcel to SMA

Phase II of the Kaomi Loop Subdivision is within the Special Management Area. The SMA line runs about five hundred feet from the shoreline.

Location Map

Refer to Figures 1 and 2 for the vicinity and location maps.

Land Use Approvals Granted; Approvals Required

The project site is within the State Urban District.

The project site is designated as Industrial and I-2, Heavy Industrial according to the City and County of Honolulu's Development Plan and Land Use Ordinance (LUO), respectively.

The project requires Special Management Area (SMA) permit, subdivision approval, grading, Shoreline Setback Variance, State Conservation District Use Application (CDUA) permit and Corps of Engineers ocean outfall permit.

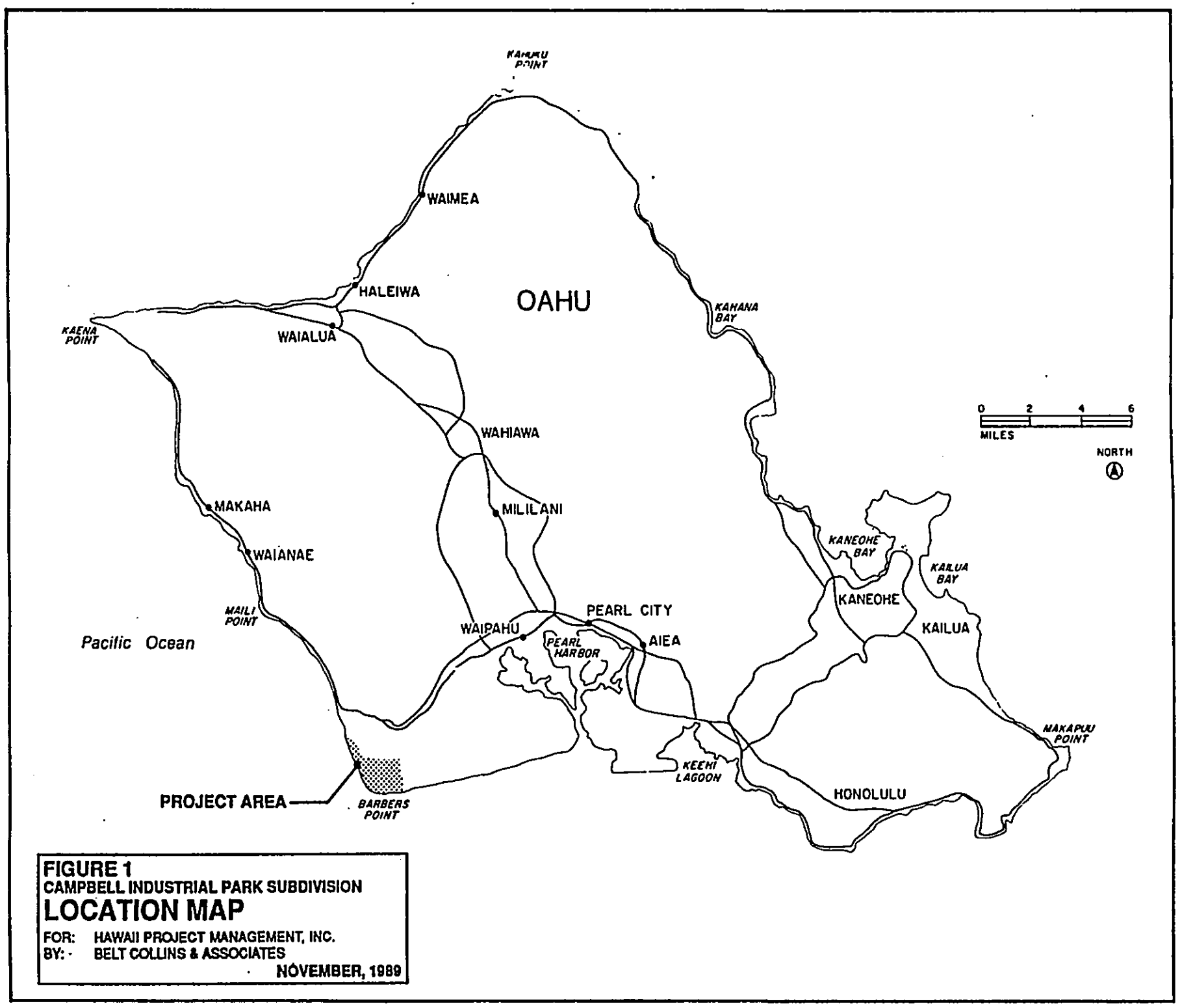


FIGURE 1
CAMPBELL INDUSTRIAL PARK SUBDIVISION
LOCATION MAP
FOR: HAWAII PROJECT MANAGEMENT, INC.
BY: BELT COLLINS & ASSOCIATES
NOVEMBER, 1989

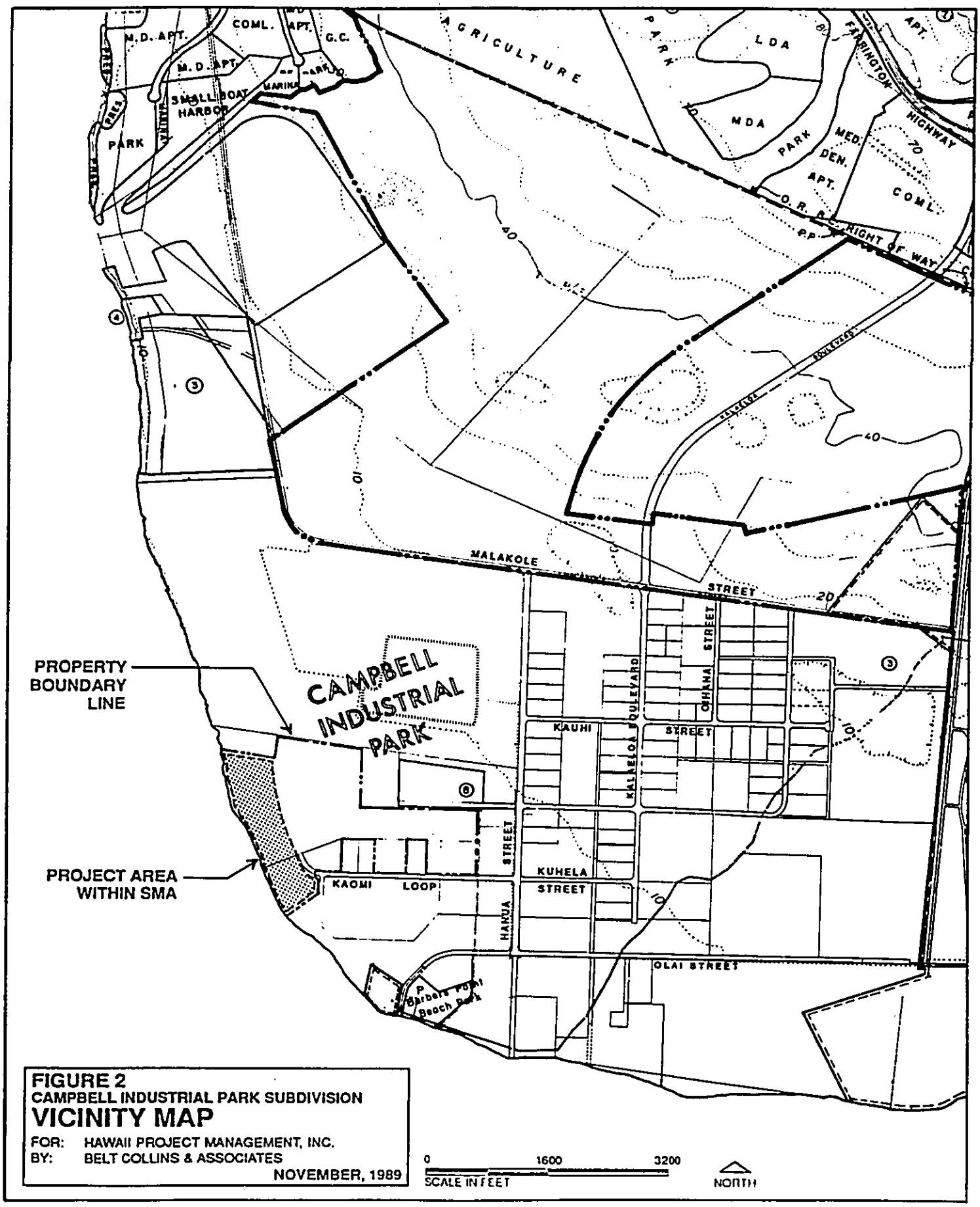
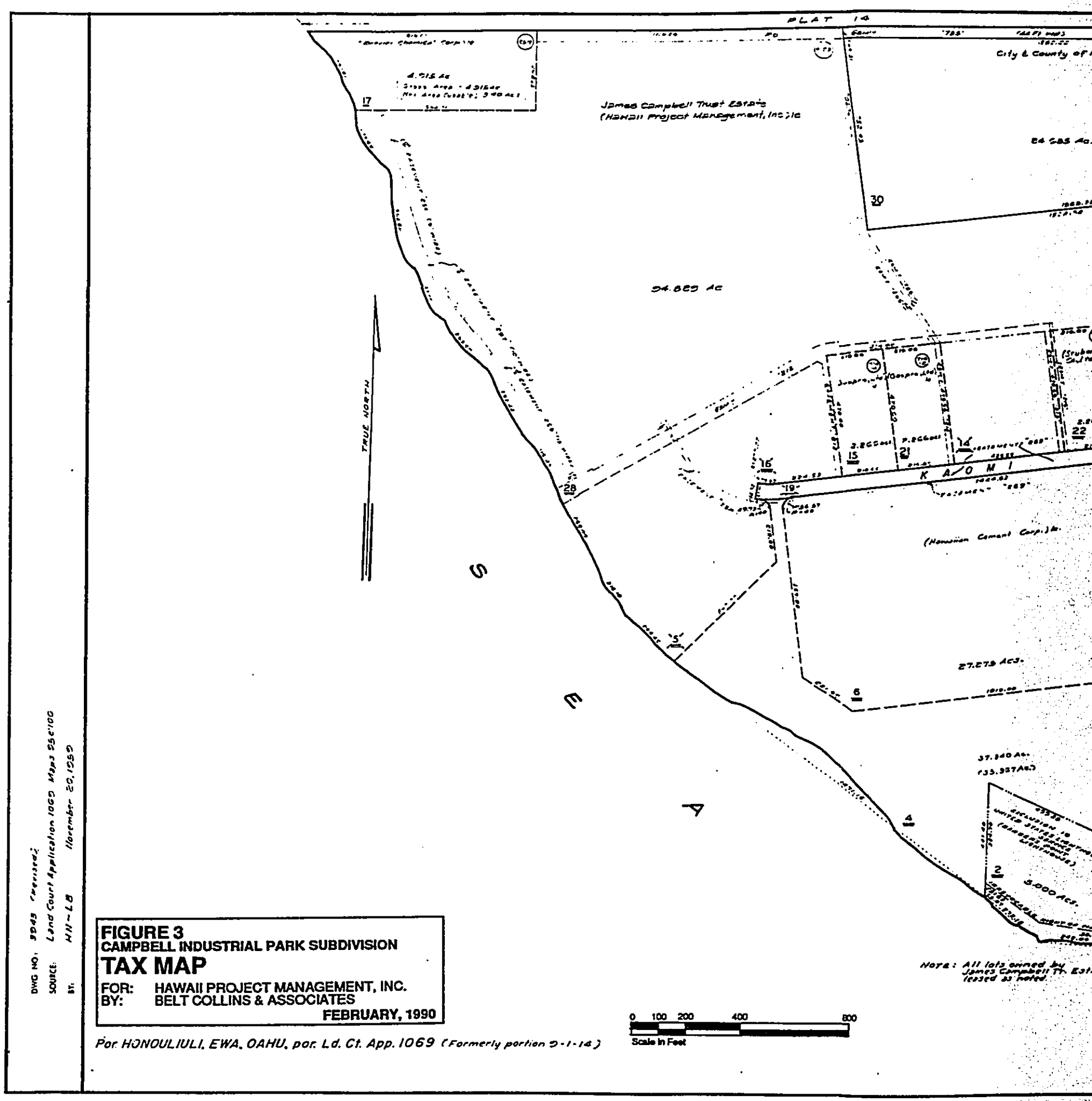


FIGURE 2
CAMPBELL INDUSTRIAL PARK SUBDIVISION
VICINITY MAP
FOR: HAWAII PROJECT MANAGEMENT, INC.
BY: BELT COLLINS & ASSOCIATES
NOVEMBER, 1989



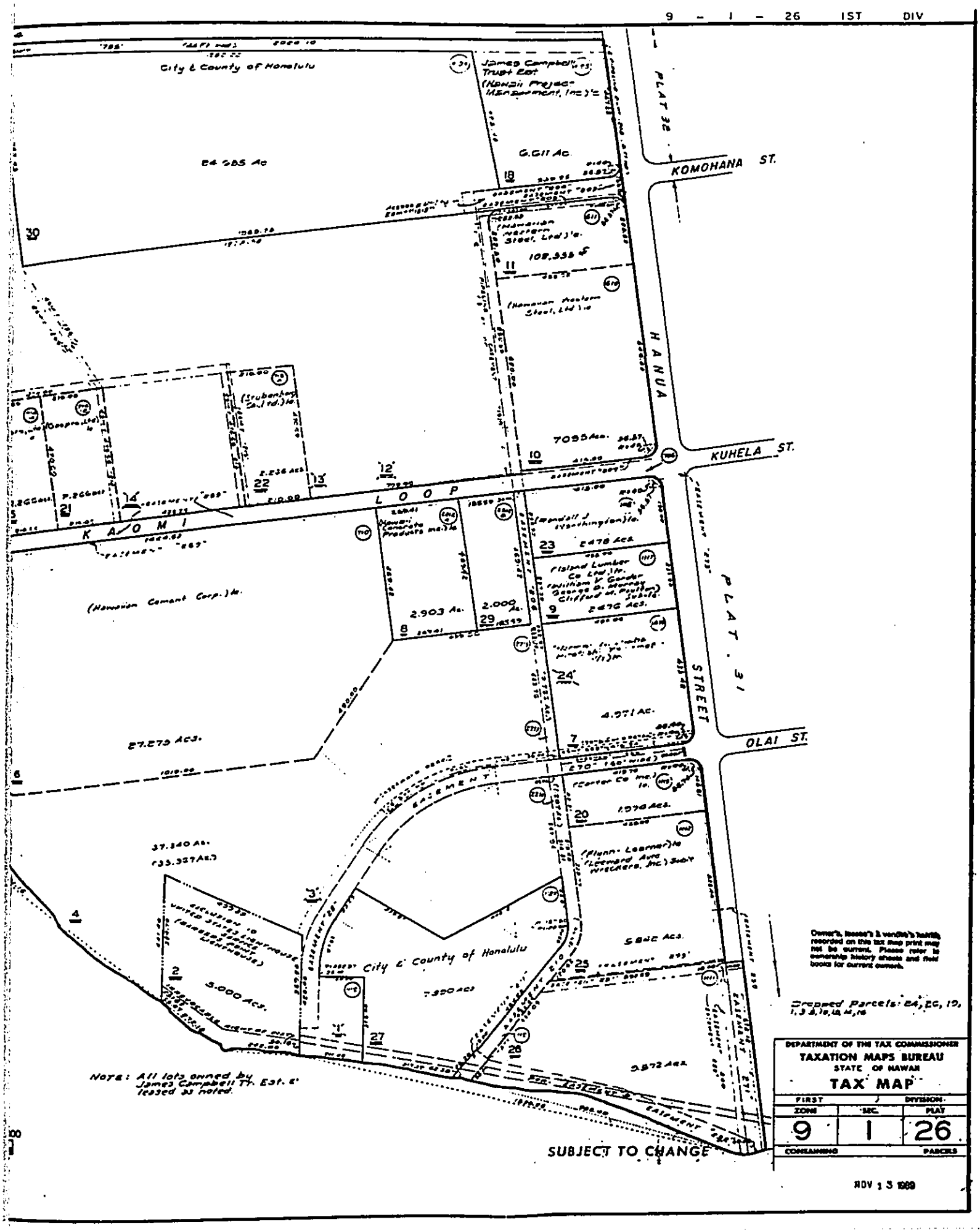
DWG NO: 3943 (revised)
SOURCE: Land Court Application 1069 Maps 25 & 100
BY: HN-LB November 20, 1989

FIGURE 3
CAMPBELL INDUSTRIAL PARK SUBDIVISION
TAX MAP
FOR: HAWAII PROJECT MANAGEMENT, INC.
BY: BELT COLLINS & ASSOCIATES
FEBRUARY, 1990

Por. HONOULIULI, EWA, OAHU, por. Ld. Ct. App. 1069 (Formerly portion 5-1-14)

Note: All lots owned by James Campbell Tr. Est. leased as noted.

9 - 1 - 26 1ST DIV



Note: All lots owned by James Campbell Tr. Est. & leased as noted.

Owner's, lessee's & vendee's liability recorded on this tax map print may not be current. Please refer to ownership history sheets and field books for current owners.

Proposed Parcels: 24, 25, 19, 1, 3, 8, 12, 14, 16

DEPARTMENT OF THE TAX COMMISSIONER
TAXATION MAPS BUREAU
STATE OF HAWAII
TAX MAP

FIRST		DIVISION
ZONE	SEC.	PLAT
9	1	26
CONTAINING		PARCELS

NOV 13 1969

B. TECHNICAL CHARACTERISTICS

Use Characteristics

The proposed project will be a subdivision for various industrial uses with a cutoff ditch and drainage ditch with open ocean outlet.

The applicant has no tenants at present; therefore, no specific uses can be identified at this time. Uses permitted by the current zoning include: automotive related uses, bulk storage yards, manufacturing, processing, extracting, packaging or fabricating establishments, repair establishments, utilities installations and offices, wholesaling, warehousing, storage or distribution establishments, greenhouses and plant nurseries. Adjacent lot uses include heavy industrial uses such as fertilizer plant, cement plant, steel mill, oil refinery and the HPOWER plant.

Two drainage ditches will be constructed. The main ditch that will be built within an existing drainage easement and the other will be a cutoff ditch that will run along the makai portion of the Phase II parcel and connect to the main ditch. These ditches will be unlined and will serve a drainage area of approximately 89 acres.

A 40,957 sq. ft. plant sanctuary located on the northernmost portion of the parcel next to the C. Brewer Chemical fertilizer plant. This approved sanctuary is to mitigate impact on the rare Achyranthes rotunda.

Physical Characteristics

The shoreline is a combination of sand and rock formations. A tidal pond is located on the west side of the property's shoreline. Sinkholes of relatively shallow depth are found on the northern side of the property. The property varies in elevation between 3 and 5 feet. There are no existing buildings on the proposed project site.

Property lines, lot size, certified shoreline, shoreline setback line, reference datum and ground elevations are shown in Figures 4 and 5.

Construction Characteristics

Construction characteristics of the project site will involve clearing, grubbing, grading and filling of the drainage ditches and the subdivision lots. The individual lots will be graded and filled after negotiations with tenants. Tenants have not been determined at the present time. The drainage ditches will be excavated with a bulldozer and will be unlined. See Figure 6 for typical cross section of drainage ditch.

Utility Requirements

Water and electricity will be extended from of lines which will be installed underground in Phase I of the Kaomi Loop Subdivision. Present plans do not include gas lines.

Liquid Waste Disposal

Liquid waste will be handled through the use of septic tanks.

Solid Waste Disposal

Solid waste will be contracted to private haulers. The waste will probably be hauled to Waimanalo Gulch Landfill.

Access to Site

Access will be from Kaomi Loop which is being developed under Phase I of the Kaomi Loop Subdivision. Kaomi Loop is part of the Campbell Industrial Park system of streets that can be accessed from the H-1 Freeway via the Campbell Industrial Park cutoff.

Other Pertinent Information

Plant Sanctuary Easement

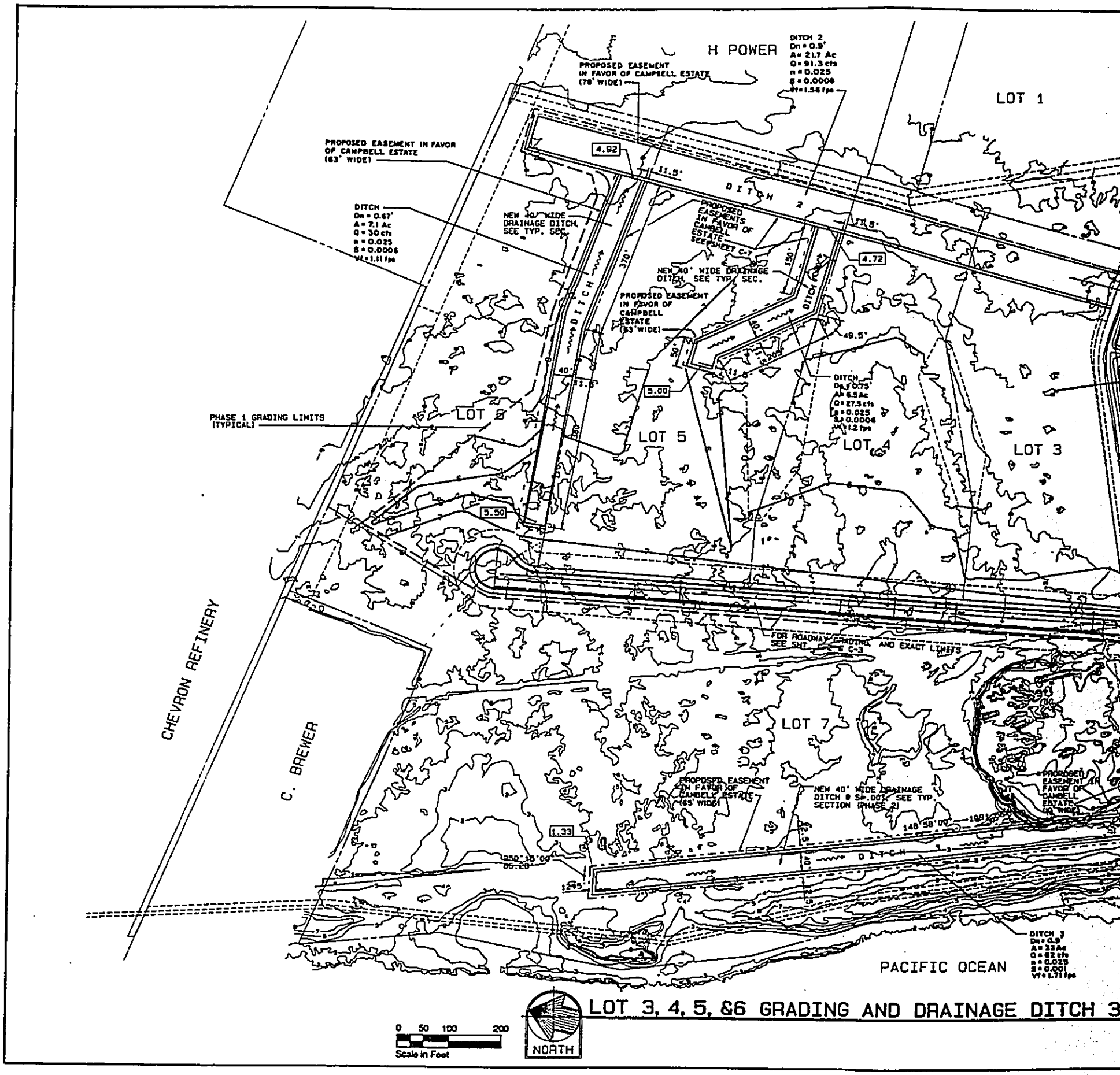
A plant sanctuary easement is part of Phase II of the Kaomi Loop Subdivision. It is located in the northeastern corner of the project site. This sanctuary is for the propagation of the Achyranthes rotunda plant, which is an endangered species listed on the Federal Rare and Endangered list.

Pipeline Easement

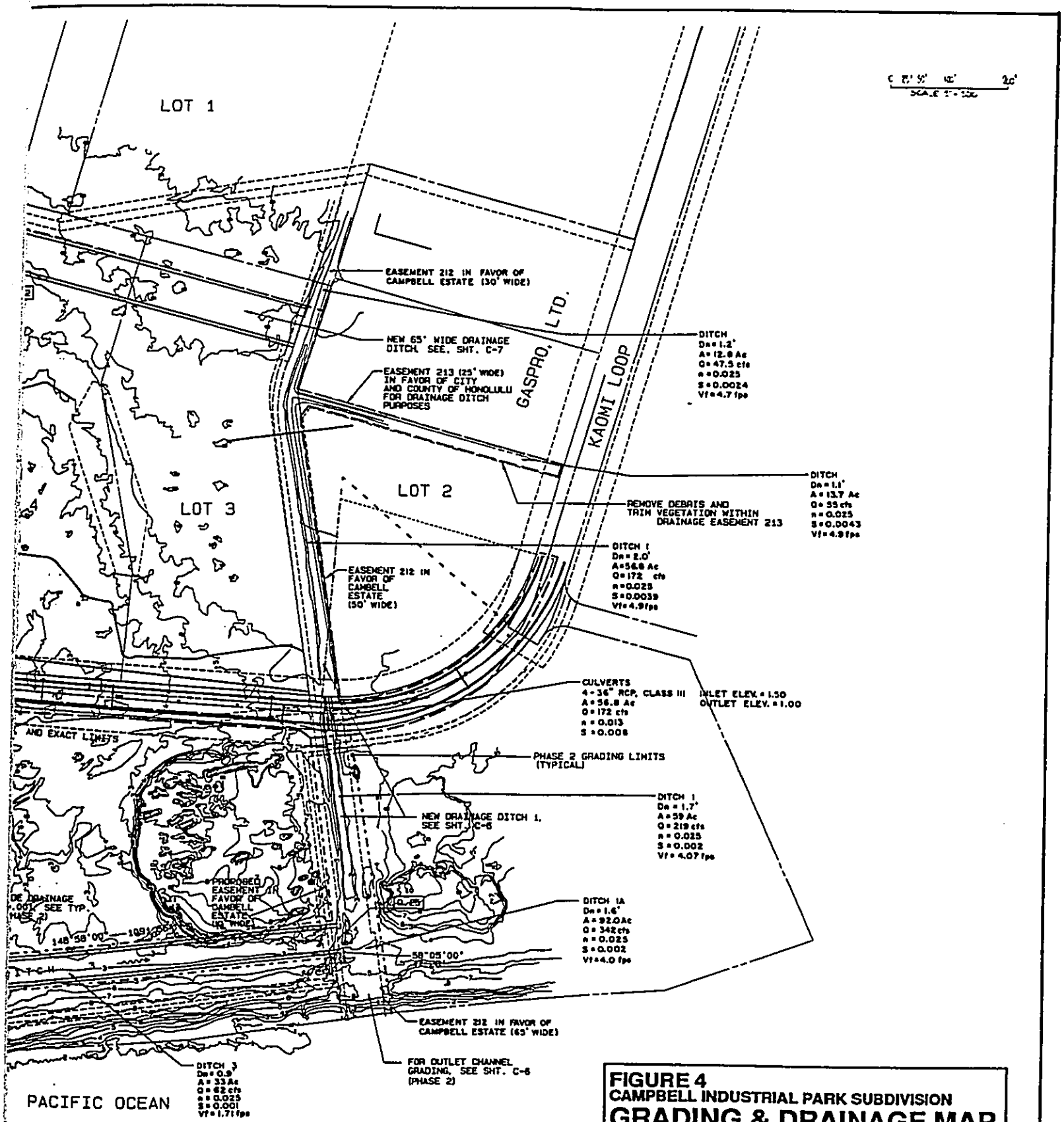
A pipeline easement is located on the makai portion of the project site. The rights to this easement are held by the Chevron Oil Company.

Public Access Easement

A public access easement has been proposed by the applicant. It is to be located in the northwest corner of the parcel adjacent to the C. Brewer Chemical fertilizer plant. The easement consists of an access road off of the end of Kaomi Loop, 10 parking stalls and a drop-off area. The easement ends at the 40-foot shoreline setback. Refer to Figure 7 for proposed public access easement.

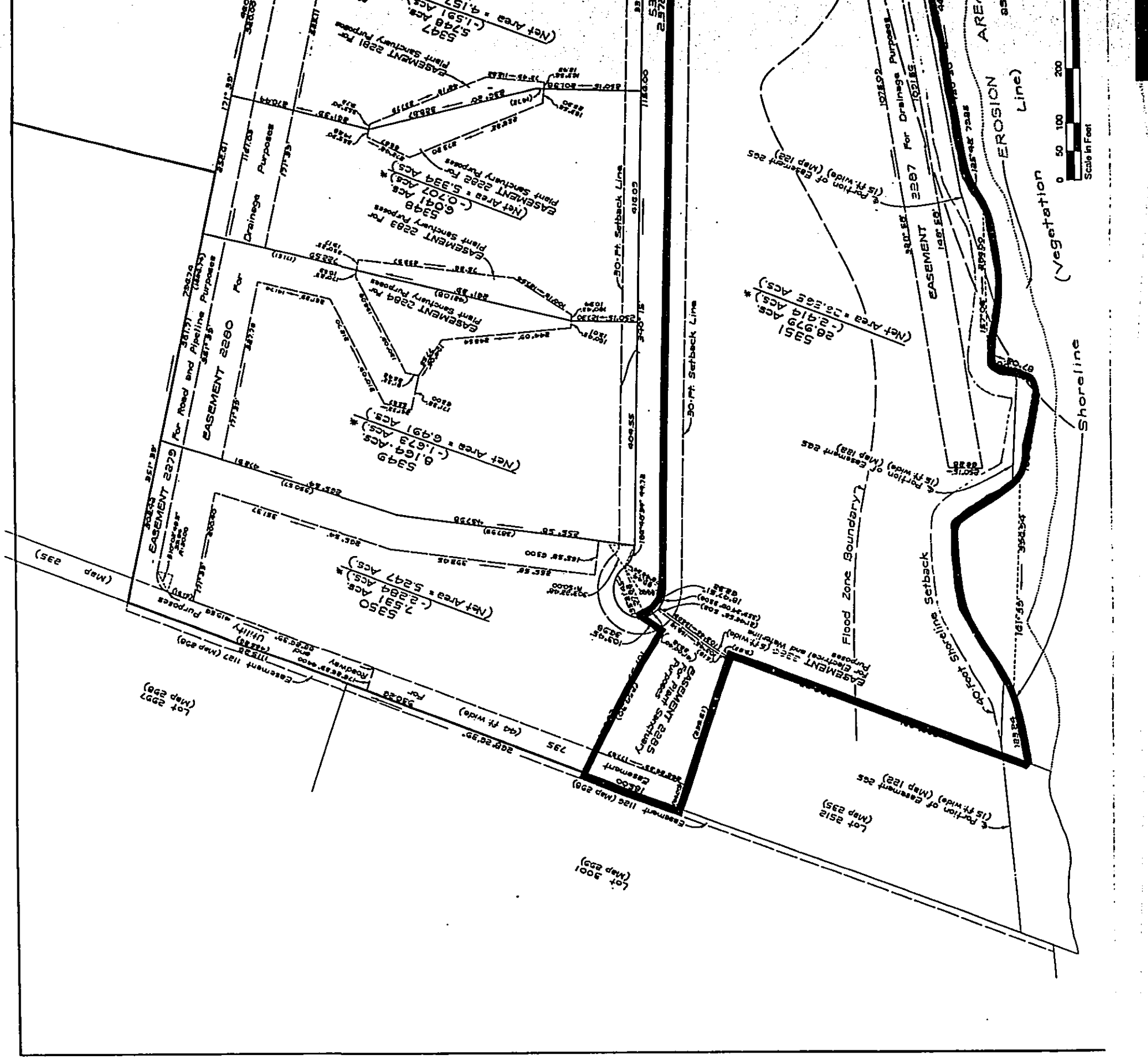


LOT 3, 4, 5, &6 GRADING AND DRAINAGE DITCH 3



AND DRAINAGE DITCH 3 PLAN

FIGURE 4
CAMPBELL INDUSTRIAL PARK SUBDIVISION
GRADING & DRAINAGE MAP
FOR: HAWAII PROJECT MANAGEMENT, INC.
BY: BELT COLLINS & ASSOCIATES
FEBRUARY, 1990


EASEMENT 2280
For Road and Pipeline Purposes
EASEMENT 2279
For Drainage Purposes
EASEMENT 2281 For Plant Sanctuary Purpose
EASEMENT 2282 For Plant Sanctuary Purpose
EASEMENT 2283 For Plant Sanctuary Purpose
EASEMENT 2284 For Plant Sanctuary Purpose
EASEMENT 2285 For Plant Sanctuary Purpose
EASEMENT 3387 For Drainage Purposes
EASEMENT 3326 For Electrical Purposes
5347 (Net Area = 4.157 Acs.) (-1.591 Acs.) 5.748 Acs.
5348 (Net Area = 5.334 Acs.) (-0.707 Acs.) 6.041 Acs.*
5349 (Net Area = 6.991 Acs.) (-1.673 Acs.) 8.664 Acs.*
5350 (Net Area = 5.247 Acs.) (-2.284 Acs.) 7.531 Acs.*
5351 (Net Area = 23.268 Acs.) (-2.919 Acs.) 26.979 Acs.*
30-Ft. Setback Line
Flood Zone Boundary
40-Foot Shoreline Setback
AREA OF EROSION (Vegetation Line)
Shoreline
Portion of Easement 226 (15 Ft. Wide) (Map 182)
Portion of Easement 225 (15 Ft. Wide) (Map 182)
Easement 1126 (Map 256)
Easement 1127 (Map 256)
Lot 2512 (Map 235)
Lot 3001 (Map 225)
Lot 2527 (Map 256)
(Map 235)
Scale in Feet
0 50 100 200

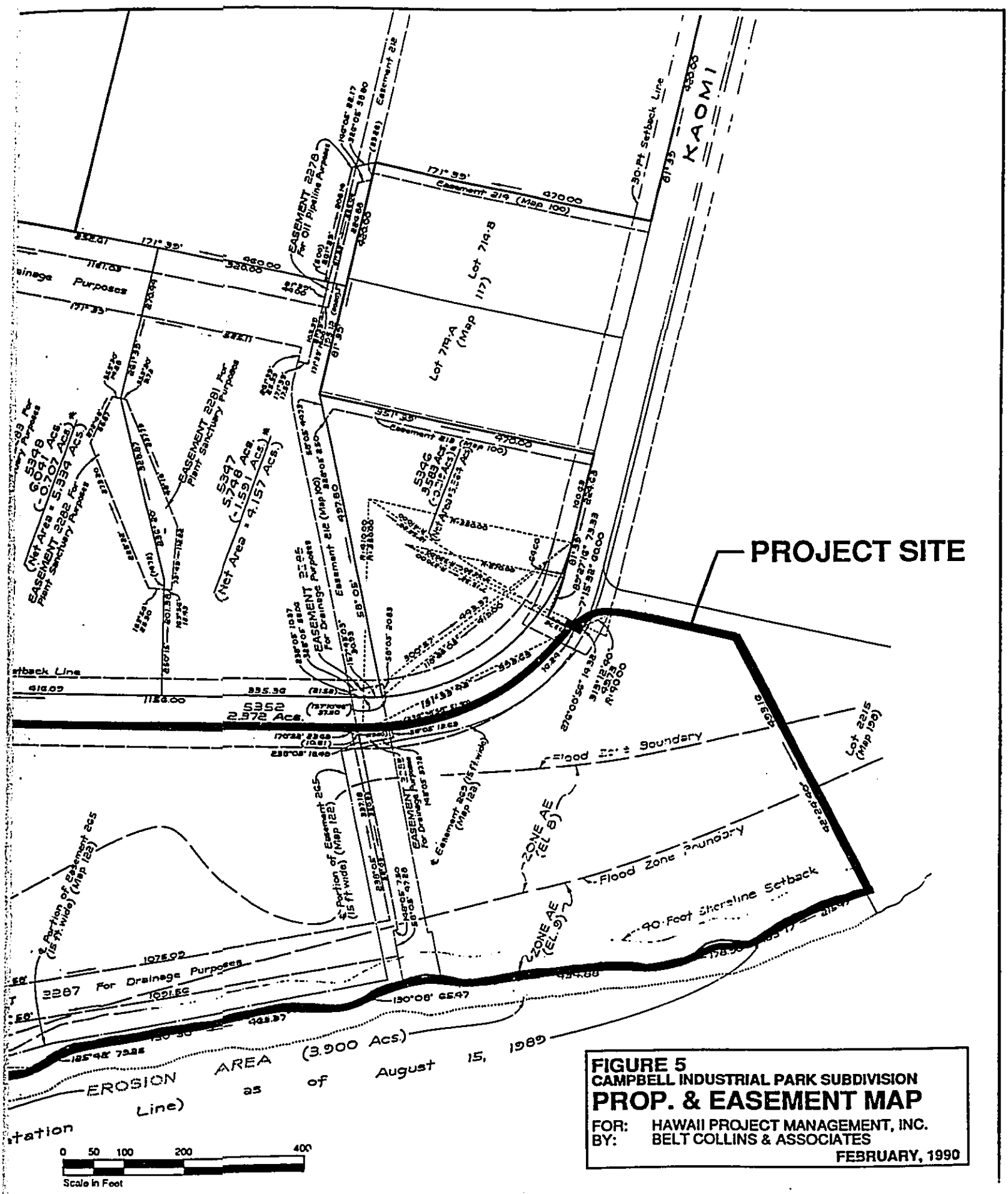
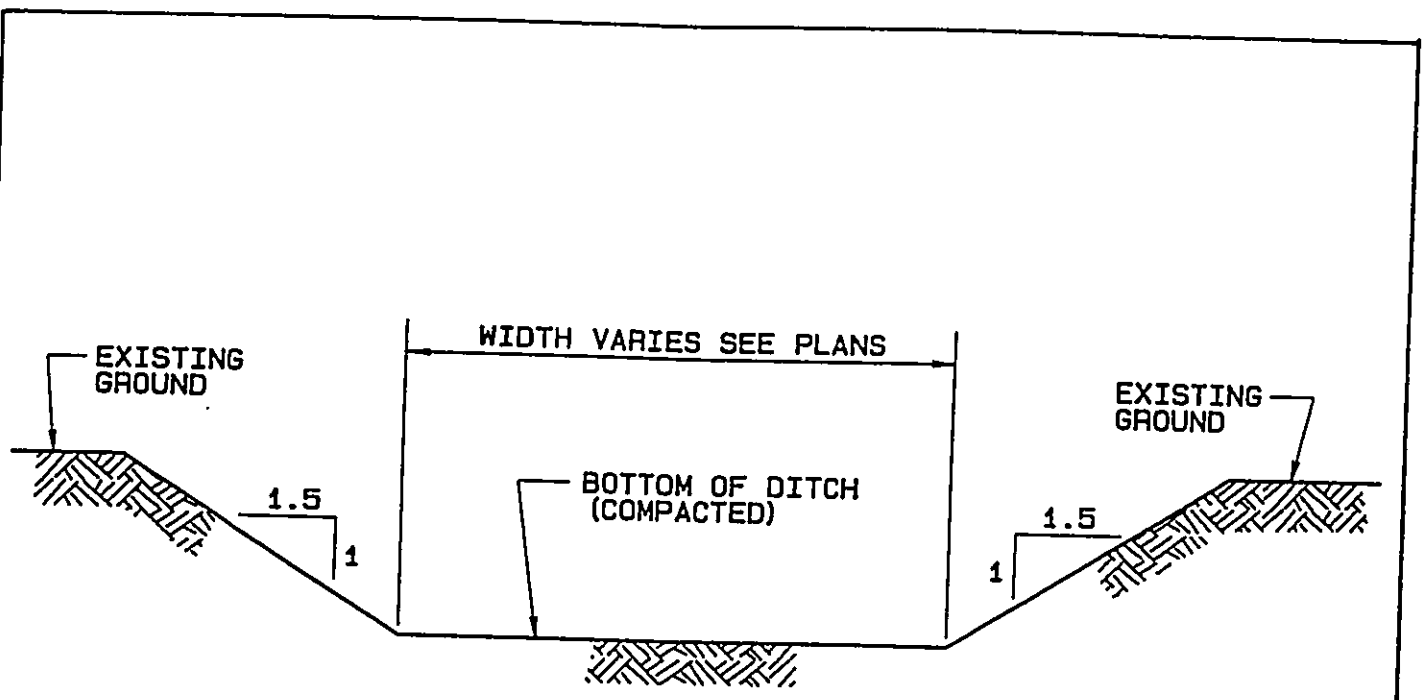


FIGURE 5
CAMPBELL INDUSTRIAL PARK SUBDIVISION
PROP. & EASEMENT MAP
FOR: HAWAII PROJECT MANAGEMENT, INC.
BY: BELT COLLINS & ASSOCIATES
FEBRUARY, 1990



TYPICAL DITCH SECTION

NOT TO SCALE

FIGURE 6
CAMPBELL INDUSTRIAL PARK SUBDIVISION
TYPICAL DITCH SECTION
FOR: HAWAII PROJECT MANAGEMENT, INC.
BY: BELT COLLINS & ASSOCIATES
FEBRUARY, 1990

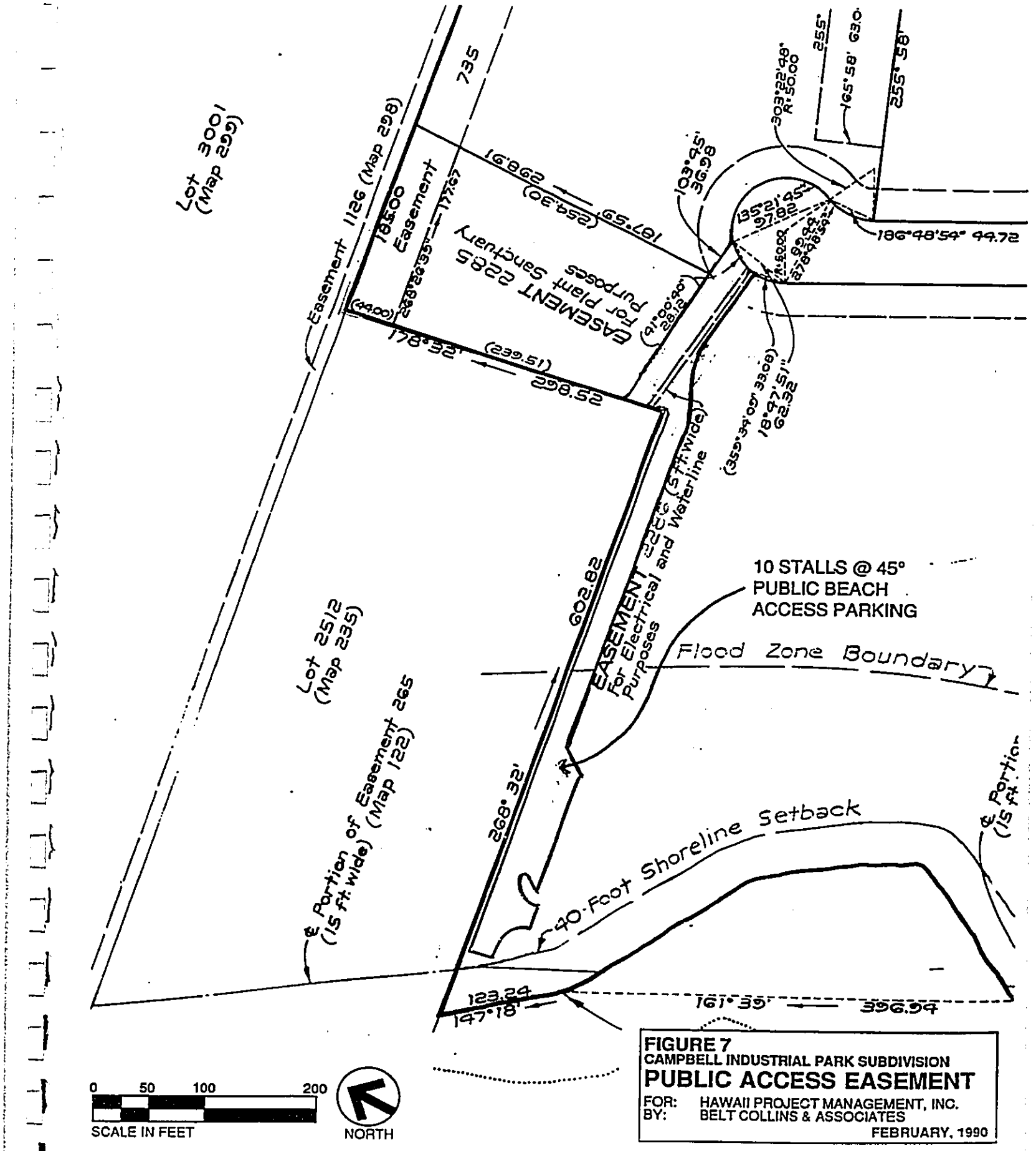


FIGURE 7
CAMPBELL INDUSTRIAL PARK SUBDIVISION
PUBLIC ACCESS EASEMENT
FOR: HAWAII PROJECT MANAGEMENT, INC.
BY: BELT COLLINS & ASSOCIATES
FEBRUARY, 1990

C. ECONOMIC AND SOCIAL CHARACTERISTICS

Estimated Cost and Time Phasing of Project

The estimated construction cost for the proposed on-site improvements is $215,000 in 1990 dollars. This estimate includes only drainage ditch excavation and debris removal.

Filling of the SMA lots to +8 feet mean sea level for compliance with the flood levels will also have to be done at least within the building areas. The cost for filling will be $25 to $30 per cubic yard. If the entire SMA were filled to the 8-foot elevation, the cost would be approximately $4 million.

Construction of the proposed drainage improvements, including debris removal, will take approximately 6 months. The schedule for development of each of the individual lots will be dependent upon lease negotiations and the required tenant facilities. Given the proposed lot sizes within the SMA, it is estimated that individual lot development will take 6 to 8 months.

Other Pertinent Information

See Section C for discussion of plant sanctuary and public access easement.

D. ENVIRONMENTAL CHARACTERISTICS

Soils

The U.S. Department of Agriculture, Soil Conservation Service classifies the soil type of the site as CR, coral outcrop. This soil type consists of coral or cemented calcareous sand. This soil type is the same type as that of the surrounding adjacent parcels which are in heavy industrial use. Therefore, the parcel is suitable for heavy industrial use.

Topography

The proposed subdivision is located on the Ewa Plain. The Waianae Mountains can be seen to the east. The Pacific Ocean forms the border of the western side. Kaomi Loop is the boundary on the eastern side of the property. The slope of the site ranges from nearly flat to moderate and is of relatively low elevation ranging from two to ten feet. Sinkholes are found

on the project site. The project site is littered with various debris and trash, which can be found in piles scattered throughout the site.

Surface Runoff, Drainage and Erosion Hazard

Surface runoff is slow to medium, permeability is moderate and erosion hazard is slight to moderate. Refer to Appendix A for drainage report.

Two drainage ditches are proposed to be constructed - a ditch within the existing drainage easement and a cutoff ditch that will run along the makai portion of the project site. The ditch within the existing easement will serve an approximate 92-acre area, including all the subdivision and several other lots along Kaomi Loop. This ditch will be 30 feet wide until the confluence of the ditch serving the makai lots, where it will widen to 55 feet. The makai ditch serves a 33-acre portion of the subdivision, and will be 40 feet wide. An easement for this ditch was filed with the subdivision's land court documents.

Federal FIRM Zone, LUO Flood Hazard District, Other Geological Hazards

Most of the proposed project site is located in an area designated as Zone AE, special flood hazard area inundated by 100-year flood with base flood elevations determined. The areas that are prone to flood hazard will be filled to a safe elevation as stated in Section C. Refer to Figure 5 for flood hazard boundary.

Other Pertinent Information to SMA

None

III. AFFECTED ENVIRONMENT

A. BRIEF DESCRIPTION OF SITE IN RELATION TO SURROUNDING AREA

The proposed subdivision site is located in the Campbell Industrial Park. A wide variety of industrial uses are found on the surrounding properties, uses such as the HPOWER plant, a fertilizer plant, a cement plant, a steel mill and the Chevron oil refinery..

The proposed project site is designated as Industrial according to the Development Plan Land Use Zoning Map. The proposed project site is designated as I-2, heavy industrial use, according to the Land Use Ordinance Zoning Map.

B. PROJECT SITE IN RELATION TO COASTAL/NATURAL RESOURCES

The project site is located right on the shoreline and is entirely within the Special Management Area (SMA). The applicant proposes to provide a public shoreline access as shown on Figure 7. This access will consist of an access road, 10 parking spaces and a drop-off area.

C. RELATION TO HISTORIC, CULTURAL AND ARCHAEOLOGICAL RESOURCES

There are no historic sites on the historic sites registry for this parcel. An archaeological inventory survey is currently being done by Paul H. Rosendahl Inc. (PHRI).

D. COASTAL VIEWS FROM SURROUNDING VIEWPOINTS

The Ewa Plain is relatively flat and the only views of the coast will be from the immediate shoreline. The project site is surrounded by industrial buildings, several of which are over 150 feet in height. Because of the relative flatness of the Ewa Plain and the location of the project site within the Campbell Industrial Park, coastal views from the surrounding viewpoints will not be altered.

E. QUALITY OF RECEIVING WATERS AND GROUNDWATER QUALITY

The waters adjacent to the project site are Class A waters according to the Water Quality Standards Map of the Island of Oahu by the State of Hawaii Department of Health, Office of Environmental Planning.

A marine environmental baseline survey done by Marine Research Consultants (1990), engineering analyses suggest that dissolved phosphorus loading may increase a maximum of 28-fold compared to present conditions following a 24-hr., 100-yr. frequency design storm. Considerations of mixing of the material within the nearshore zone and infrequency of subsidies show that the increases are not sufficient to cause the receiving waters to exceed most DOH standards. Since these standards are set to define acceptable conditions of open coastal waters, it appears that the proposed project has little potential to result in negative alterations to water quality.

Similarly, the freshwater discharge is expected to increase up to 4-fold following project construction. There is little potential for impacts owing to both mixing during periods when surf prevails, or density stratification during calm periods, which would prevent freshwater from affecting benthos. The survey concludes that there will be little potential for negative impacts to the quality of the receiving waters and little potential impact to the marine environment as a result of the proposed project. Refer to Appendix F for more information.

The quantities of nitrogen and suspended solids discharged into the receiving waters as a result of storm rainfall will decrease as a result of the proposed project according to a storm drainage discharge analysis done for the Kaomi Loop Subdivision by Belt Collins and Associates (February 1990). Refer to Appendix B for more detailed information on storm runoff.

The groundwater in the area is about ninety percent seawater according to a study done for AES Barbers Point Cogeneration Plant by Tom Nance Water Resources Engineering, Inc. (1989).

F. LOCATION AND SITE MAPS

Refer to Figures 1 to 5 for location and site maps of the project area.

IV. PROJECT IMPACTS AND ALTERNATIVES CONSIDERED

A. COASTAL ZONE MANAGEMENT OBJECTIVES AND POLICIES

The Hawaii Coastal Zone Management Act, which became Chapter 205A, Hawaii Revised Statutes, establishes State policy for any actions affecting the coastal zone. The CZM policies and objectives which pertain to this development are discussed below.

Recreational Resources

Coastal recreational opportunities will continue to be accessible to the public through the provision of a public access within the subdivision site. Access to the shoreline may improve because of the provision of parking stalls and the proximity to the shoreline.

The drainage outlet will cut into the sand from 4 feet at the highest point to no cut at the lowest point; thus it will not affect continuity of the shoreline.

Scenic and Open Space Resources

As stated previously, the coastal views are blocked by existing industrial buildings. The overall appearance of the area is that of heavy industrial use and the construction of this proposed industrial subdivision is consistent with the uses surrounding the project site. The Land Use Ordinance and the Ewa Development Plan limit the height of structures in Campbell Industrial Park to sixty feet. There are several structures, such as the main boiler of the HPOWER plant and the storage silos of the Hawaiian Cement plant, that have received variances and are over 150 feet in height. These structures are located on lots adjacent to the project site and therefore, no significant views will be affected by the project.

Historic Resources

At present, no archaeological or historic sites are listed on the State Historic Site Registry. An archaeological inventory survey is being conducted by Paul H. Rosendahl Inc. (PHRI). If any sites are found on the property, proper mitigation measures will be worked out with the Historic Sites Section of the Department of Land and Natural Resources, State of Hawaii.

Coastal Ecosystems

In an effort to preserve the coastal ecosystem, the project site has a proposed easement for a plant sanctuary. The proposed cutoff ditch is set back in an effort to maintain the sand dunes. A portion of the sand dunes that had been previously removed, but has built back up, will be removed for the drainage ditch outlet.

Economic Uses

The proposed industrial subdivision is appropriately located in the Campbell Industrial Park. The industrial subdivision would be consistent with the uses of the surrounding area.

Coastal Hazards

Most of the proposed industrial subdivision is within Zone AE, the special flood hazard area inundated by 100-year flood as designated by Flood Insurance Rate Map. The areas which will be used for industrial purposes will be filled and built up to a safe elevation of +8 feet, a build-up between 3 to 5 feet of fill.

B. SPECIAL MANAGEMENT AREA GUIDELINES

The following is a discussion of the impacts of the project in relation to the Special Management Area guidelines (Section 33-3.2, ROH):

(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;

(B) Adequate and properly located public recreation areas and wildlife preserves are reserved;

(C) Provisions are made for solid and liquid waste treatment, disposition, and management which will minimize adverse effects upon special management area resources; and

(D) Alterations to existing landforms and vegetation; except crops, and construction of structures shall cause minimum adverse effect to water resources and scenic and recreational

amenities and minimum danger of floods, landslides, erosion, siltation, or failure in the event of earthquake.

The proposed project will provide adequate access to the shoreline as stated in the Section III on the Affected Environment. A wildlife preserve is reserved for the endangered Achyranthes rotunda plants referred to in the section above Coastal Ecosystems. Solid and liquid waste treatment will be handled in a manner that will minimize impact on the Special Management Area. The proposed project will have minimal adverse effects on the water resources, scenic and recreational amenities of the area.

(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 as such adverse effect is minimized to the extent practicable and clearly outweighed by public health and safety, or compelling public interest. 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 Sec. 33-3.1 and area guidelines contained in Sec. 205A-26, HRS.

(C) The development is consistent with the county general plan, development plans, and zoning. Such a finding of consistency does not preclude concurrent processing where a development plan amendment or zoning change may also be required.

As stated in Section III - Affected Environment, the project is not expected to have any substantial, adverse environmental or ecological effect. The project is consistent with the objectives and policies of Chapter 205A, Hawaii Revised Statutes, which is discussed in Section IV - Project Impacts and Alternatives Considered. No development plan amendment or zoning change is needed for this project since it is consistent with the county general plan, development plan and zoning.

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

(C) Any development which would reduce or impose restrictions upon public access to tidal and submerged lands, beaches,

portions of rivers and streams within the special management area and the mean tide line where there is no beach.

(D) Any development which would substantially interfere with or detract from the line of sight toward the sea from the State highway nearest the coast.

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

The project should reduce or impose restrictions on public access to the shoreline area, since a public access easement will be provided and the project has minimal impact on shoreline continuity. The project will not interfere or detract from the line of sight toward the sea from the H-1 freeway because of the relative flatness of the Ewa Plain and height of structures surrounding the project site. The proposed project will have minimal adverse affect on the beaches, tidal and submerged lands of the Special Management Area. The project is located on a coral or cemented calcareous sand soil type that is not suitable for agricultural use according to a soil survey by the U.S. Department of Agriculture, Soil Conservation Service.

C. ALTERNATIVES CONSIDERED

No Action Alternative

The No Action Alternative would mean that the proposed Phase II of the Kaomi Loop Subdivision and drainage system would not be built. This is not a viable alternative since the project area has already been zoned Industrial by both the Development Plan and the Land Use Ordinance of the City and County of Honolulu. The lot is vacant at present and is of no benefit to the applicant or public in its present state. The proposed subdivision and its improvements will be a benefit to the public by providing a safe public access to the shoreline, proper drainage of the area and an area zoned for the intended use.

Other Alternatives

The property is not ideally suited for residential, commercial or agricultural use because it is located in the middle of a region of heavy industrial use.

V. MITIGATION MEASURES

A. PUBLIC ACCESS

The applicant proposes to provide an improved public access to allow public recreational use of the shoreline and waters abutting the project. This public access will also help to minimize the impact of off-road vehicles on the shoreline and sand dunes.

B. MAINTENANCE OF DUNES

The proposed cutoff ditch will be set back away from the sand dunes to preserve these natural features. Buildings will be located mauka of the cutoff ditch.

C. PLANT SANCTUARY

Plant sanctuaries that have State approval will be located on the project site. This action is to mitigate the impact that the project will have on Achyranthes rotunda plants that inhabit the project area.

D. ARCHAEOLOGICAL MITIGATION

An archaeological inventory survey is currently being conducted by Paul H. Rosendahl Inc. (PHRI). If any archaeological sites are found on the property, the applicant proposes to work out proper mitigation measures with the Historic Sites Section of the Department of Land and Natural Resources, State of Hawaii.

APPENDIX A

DRAINAGE REPORT

DRAINAGE REPORT
KAOMI LOOP SUBDIVISION
CAMPBELL INDUSTRIAL PARK
REVISED: 3 FEBRUARY 1990

INTRODUCTION

This drainage report addresses phased development of a 95 acre subdivision located within Campbell Industrial Park. The proposed site is situated between Kaomi Loop, Hanua Street, and the ocean, as shown in the Preliminary Subdivision Map. The preliminary subdivision plan indicates eight (8) lots, all of which will eventually be developed for industrial use.

Under Phase 1 of the project, the 54 acres mauka of the roadway extension, Lots 1 through 6, and the roadway, Lot 8, will be developed. The Shoreline Management Area, Lot 7, will be subdivided and developed under Phase 2 of the project.

The soil type throughout the area is classified by the Soil Conservation Service as CR and consists mostly of coral or cemented calcareous sand. Slopes range from nearly flat to moderate, permeability is moderate, runoff is very slow to medium, and erosion hazard is slight to moderate. Elevations in the subdivision area range from 13 to 3 feet above mean sea level (MSL).

Existing vegetation on the site is relatively sparse, consisting mostly of kiawe and haole koa trees, and patches of fingergrass. Following development, the site will be mostly paved with some small landscaped grassy areas.

PHASE 1 DESCRIPTION

The Phase 1 drainage area discharges to existing area drainage channels. The majority of this area, 44 acres along with 12.8 acres of Kaomi Loop and the adjacent mauka lots, drain to the on-site channel, with culvert crossing at the existing dirt road extension.

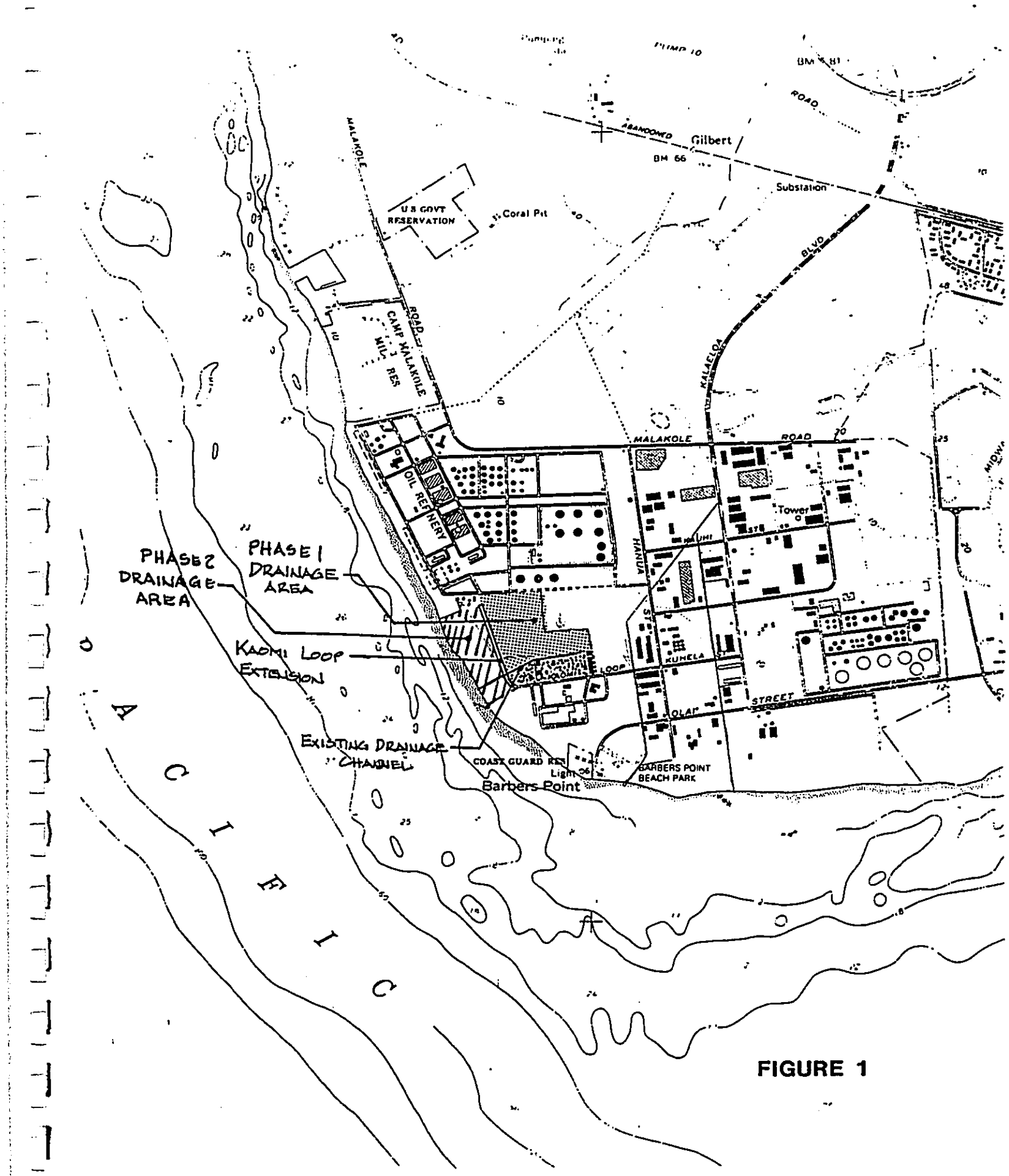

PHASE 2 DRAINAGE AREA
PHASE 1 DRAINAGE AREA
KAOMI LOOP EXTENSION
EXISTING DRAINAGE CHANNEL
PACIFIC
MALAKOLE ROAD
ABANDONED
Gilbert
BM 66
Substation
U S GOVT RESERVATION
Coral Pit
CAMP MALAKOLE MIL RES
OIL REFINERY
KALAELOA BLVD
MALAKOLE ROAD
Tower
HANUA ST
KUMELA ST
OLAI STREET
LOOP
COAST GUARD REF Light
BARBERS POINT BEACH PARK
Barbers Point

FIGURE 1

Phase 1

	Present	Future
Drainage Area	56.8 ac	56.8 ac
Intensity of 1-hr rainfall	2.3 in	2.3 in
Time of Concentration	25 min	25 min
Corrected Intensity	2.79 in	2.79 in
Runoff Coefficient	0.35	0.85
Q_{50}	71 cfs	172 cfs

Phase 2

	Present	Future
Drainage Area	33.0 ac	33.0 ac
Intensity of 1-hr rainfall	2.3 in	2.3 in
Time of Concentration	10 min	8 min
Corrected Intensity	3.57 in	3.57 in
Runoff Coefficient	0.35	0.85
Q_{50}	62 cfs	158 cfs

DRAINAGE IMPROVEMENTS - PHASE 1

With the development of 44 acre on-site basin into industrial use, the quantity of runoff increases by about 2.4 times. A drainage system will be installed within the Kaomi Loop extension to transport the runoff to the existing drainage channel. The existing channel will be widened 5 feet from the road culvert down to the ocean to handle the increase in flow (Appendix B), with vegetation in the channel trimmed back. A multiple pipe culvert consisting of (4) - 36 inch concrete pipes is required to pass the flow under the new road. The culvert analysis is presented in Appendix B. Development of the existing channel on the downstream side of the culvert will be constructed under Phase 2 to provide an outlet for the runoff.

The drainage system within Kaomi Loop will consist of some 500 linear feet of 18 inch pipe connecting to approximately 900 linear feet of 24 inch pipe. This system will serve only the roadway, and discharge to the downstream headwall of the multiple pipe culvert.

The subdivision lots on the mauka side of the roadway will drain to an open, unlined, trapezoidal channel at the back of the lots. This channel will be 65 feet wide and run the length of Lots 4, 5, and 6. It will discharge to the existing unlined channel along Lot 3, which discharges to the pipe culverts.

This existing channel also conveys flows from a portion of Kaomi Loop along the Lot 1 and Gaspro facility which are collected in an existing catch basin and discharged via an open ditch. The main channel is 15 feet wide, except at the confluence of the ditch, where it is widens to 32.5 feet. The main channel will be widened to 25 feet to accommodate the backwater discharge under the 50 year design storm, with the transition to the 32.5 feet maintained. The backwater was determined using the Corps of Engineers HEC-2 computer program, the output data for which is included with the calculations.

DRAINAGE IMPROVEMENTS - PHASE 2

The ocean discharge channel will be 30 feet wide between the culvert and ditch serving Lot 7, with a 0.2 percent slope. Beyond the Lot 7 ditch, the channel will be widened to 55 feet. The ocean outlet structure will be designed following completion of the hydrographic survey and biological analyses.

The ditch serving Lot 7 subdivision lots will drain to the ocean following the existing topographic patterns. The channel will be 40 feet wide at the bottom with side slope of 1.0 to 1.5, horizontal to vertical. The proposed channel slope is 0.1 percent.

APPENDIX A

Rainfall Runoff Calculations

HYDROLOGIC CRITERIA (Present Condition) - PHASE 1

Drainage Area (A) = 56.8 acres

Recurrence Interval (Tm) = 50 yr

Rational Method:

1) From Table 1: (lower part of Band 2 - flat & barren)

C = 0.35

2) From Plate 1 (1-hr Rainfall, Tm=50 yr)

i = 2.30 in

3) Time of Concentration:

L = 2450 ft, H = 13 - 1.6 = 11.4 ft

S = 11.4/2450 = 0.00465

$K = L/S^{1/2} = 35{,}916$

From Plate 5: Tc = 25 min

4) From Plate 4: Correction Factor = 1.55

I = 2.30 x 1.55 = 3.57 in

5) Runoff Quantity:

Q = CIA

= (0.35)(3.57)(56.8)

= 71 cfs

HYDROLOGIC CRITERIA (Future Condition) - PHASE 1

Drainage Area (A) = 56.8 acres

Recurrence Interval (Tm) = 50 yr

Rational Method:

1) Runoff Coefficient from Table 2:

   C = 0.85

2) From Plate 1 (1-hr Rainfall, Tm=50 yr)

   i = 2.30 in

3) Time of Concentration:

   L = 2450 ft

   S = 11.4/2450 = 0.00465

   $K = L/S^{1/2}$ = 35,916

   From Plate 5: Tc = 25 min

4) From Plate 4: Correction Factor = 1.55

   I = (1.55)(2.3) = 3.57

5) Runoff Quantity:

   Q = CIA

   = (0.85)(3.57)(56.8)

   = 172 cfs

HYDROLOGIC CRITERIA (Present Condition) - PHASE 2

Drainage Area (A) = 33 acres

Recurrence Interval (Tm) = 50 yr

Rational Method:

1) From Table 1: (lower part of Band 2 - flat & barren)

C = 0.35

2) From Plate 1 (1-hr Rainfall, Tm=50 yr)

i = 2.30 in

3) Time of Concentration:

L = 650 ft, H = 4 - 2 = 2 ft

S = 2/650 = 0.0031

$K = L/S^{1/2} = 11{,}718$

From Plate 5: Tc = 10 min

4) From Plate 4: Correction Factor = 2.35

I = 2.30 x 2.35 = 5.4 in

5) Runoff Quantity:

Q = CIA

= (0.35)(5.4)(33)

= 62 cfs

HYDROLOGIC CRITERIA (Future Condition) - PHASE 2

Drainage Area (A) = 33 acres

Recurrence Interval (Tm) = 50 yr

Rational Method:

1) Runoff Coefficient from Table 2:

   C = 0.85

2) From Plate 1 (1-hr Rainfall, Tm=50 yr)

   i = 2.30 in

3) Time of Concentration:

   L = 650 ft

   S = (8 - 4)/650 = 0.00615

   $K = L/S^{1/2} = 8{,}286$

   From Plate 5: Tc = 8 min

4) From Plate 4: Correction Factor = 2.45

   I = (2.45)(2.3) = 5.63

5) Runoff Quantity:

   Q = CIA

   = (0.85)(5.63)(33)

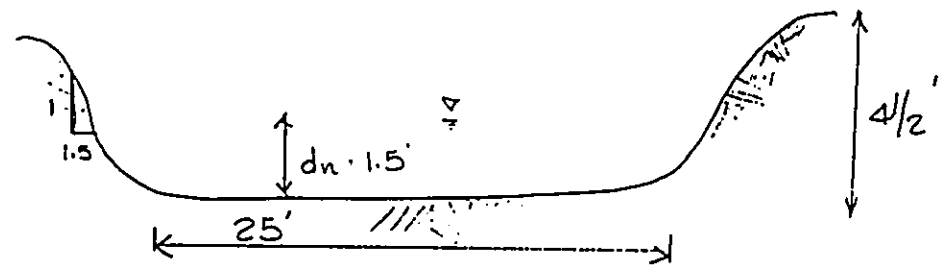
   = 158 cfs

APPENDIX B
Calculations

EXISTING CHANNEL FLOW ANALYSIS

n = 0.025

s = 0.0039



Use Mannings formula to determine average velocity:

$$v = (1.486/n)\, R^{2/3}\, s^{1/2}$$

where: $R = A/P$ $\quad A = (25x1.5)\text{ sf} + 2(.5x1.5^2x2.25) = 40.87\text{ sf}$

$$P = 2(2.25^2 + 2.25^2)^{1/2} + 25 = 29.20\text{ ft}$$

$$V = (1.486/0.025)(40.87/29.20)^{2/3}(0.0039)^{1/2}$$

$$= 4.60\text{ fps}$$

Use continuity equation to determine discharge:

$$Q = v\,A$$

$$= (4.6)(40.87)$$

$$= \underline{189.0\text{ cfs} > 172\text{ cfs}\quad OK}$$

Check Freeboard:

$$2 + .025v\, d^{1/3} = 2 + (.025)(4.6)(1.5)^{1/3}$$

$$= 2.13\text{ ft}$$

available: 4.5 - 1.5 = 3 ft > 2.13 ft

* The existing channel will be widened to handle the increase in flow and backwater discharges.

Above the confluence of the catch basin ditch:

$$Q = .85 \times 2.3 \times 1.9 \times (12.8+21.7) = 128\text{ cfs}$$

with $d_n = .1$, $P = 2[(1.12_2 + (1.1x1.5)^2]^{1/2} + 25 = 29.97\text{ sf}$

$$A = (25 \times 1.1) + 2(1/2x1.1x1.5) = 29.15\text{ sf}$$

$$V = (1.486/.025)\,(1)^{2/3}\,(.0039)^{1/2} = 3.71\text{ fps}$$

$$Q = 29.15 \times 3.71 = 108\text{ cfs}$$

with $d_n = 1.2$ ft $\quad Q = 154$ cfs

with $d_n = 1.15$ ft $\quad Q = 130$ cfs

Project CAMPBELL INDUSTRIAL PARK
– KAOHI LOOP - PHASE I

Design Analysis

Date 10/16/09 By A KATO
Rev. Date ____ By ____
Checked ____

Job No. 933 4200
Location OAHU
Sheet No. 1 of 8

NEW DRAINAGE DITCH BEHIND LOTS 3, 4, 5 AND 6

DRAINAGE AREA (A) = 21.7 ACRES

$Q = CIA$

$C = 0.85$

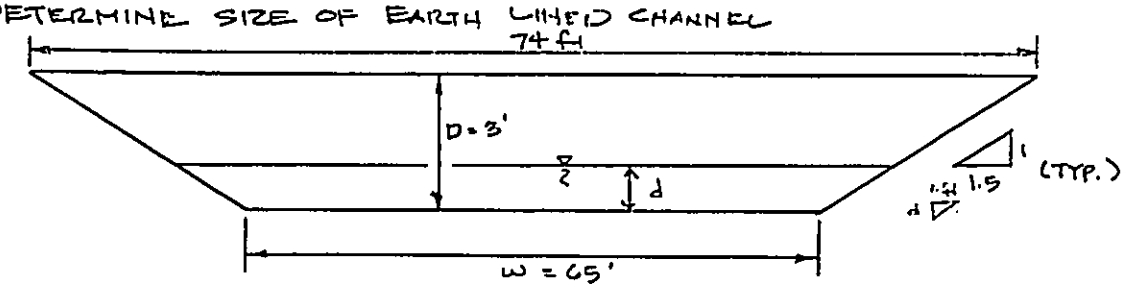
OVERLAND FLOW
$L = 900'$
$T_c = 9.3$ min.

CHANNEL FLOW
$L = 1200'$
$V_{max} = 5$ fps
$T_c = 1200/5 = 240$ sec
$= 4$ min

$T_c = 13.3$ min.
CF = 2.15
$i = 2.3$
$I = 2.3\ (2.15)$
$= 4.95$

$Q = (0.85)(4.95)(21.7)$
$Q = 91.3$ CFS

DETERMINE SIZE OF EARTH LINED CHANNEL



$A = wd + 2(\frac{1}{2})(d)(1.5d) = wd + 1.5d^2$

$P_{wet} = w + 2\sqrt{d^2 + (1.5d)^2} = w + 2d\sqrt{3.25}$

Project CAMPBELL INDUSTRIAL PARK
-KAOMI LOOP . PHASE I

Design Analysis

Date 10/16/89 By A. KATO
Rev. Date ____ By ____
Checked ____

Job No. 833.4300
Location OAHU
Sheet No. 2 of 10

NEW DRAINAGE DITCH BEHIND LOTS 3, 4, 5 AND 6

$$Q = AV$$
$$= A\left(\frac{1.486}{n}\left(\frac{A}{P_{wet}}\right)^{2/3} S^{1/2}\right)$$

$n = 0.025$

$S = \frac{11'}{1200'}$

$$Q = (wd + 1.5d^2)\left(\frac{1.486}{0.025}\left(\frac{wd + 1.5d^2}{w + 2d\sqrt{3.25}}\right)^{2/3}\left(\frac{1}{1200}\right)^{1/2}\right)$$

USE $Q = 91.3$ cfs

$d = 0.9$ ft

$$91.3 = (w(0.9) + 1.5(0.9)^2)\left(\frac{1.486}{0.025}\left(\frac{w(0.9) + 1.5(0.9)^2}{w + 2(0.9)\sqrt{3.25}}\right)^{2/3}\left(\frac{1}{1200}\right)^{1/2}\right)$$

$$53.2087 = (0.9w + 1.215)\left(\frac{0.9w + 1.215}{w + 3.245}\right)^{2/3}$$

w	( )( )$^{2/3}$	
90'	75.59	
80'	67.21	
70'	58.82	
65'	54.62	← USE w = 65'
60'	50.43	

CHECK ACTUAL DEPTH

$$91.3 = (65d + 1.5d^2)\left(\frac{1.486}{0.025}\left(\frac{65d + 1.5d^2}{65 + 2d\sqrt{3.25}}\right)^{2/3}\left(\frac{1}{1200}\right)^{1/2}\right)$$
$$53.21 = (65d + 1.5d^2)\left(\frac{65d + 1.5d^2}{65 + 2d\sqrt{3.25}}\right)^{2/3}$$

d	( )( )$^{2/3}$	
0.8'	44.66	
0.9'	54.63	
0.85'	52.02	
0.87'	53.02	← d = 0.87'

Project CAMPBELL INDUSTRIAL PARK - KAOMI LOOP - PHASE 1

Date 10/16/89 By A KATO

Rev. Date ____ By ____

Checked ____

Design Analysis

Job No. 88-4300

Location OAHU

Sheet No. 3 of 8

NEW DRAINAGE DITCH BEHIND LOTS 3, 4, 5 AND 6

CHECK FREEBOARD

FREEBOARD = $2.0 + 0.025 V \sqrt[3]{d}$

$$V = \frac{1.486}{n}\left(\frac{wd + 1.5d^2}{w + 2d\sqrt{3.25}}\right)^{2/3}\left(\frac{1}{1200}\right)^{1/2}$$

$$= \frac{1.486}{0.025}\left(\frac{65(0.89) + 1.5(0.89)^2}{65 + 2(0.89)\sqrt{3.25}}\right)^{2/3}\left(\frac{1}{1200}\right)^{1/2}$$

$V = 1.56$ ft/sec

FREEBOARD = $2.0 + 0.025(1.56)\sqrt[3]{0.89}$

= 2.04 ft

ACTUAL FREEBOARD = 3' − 0.89'

= 2.11 ft ✓ acceptable

Project CAMPBELL INDUSTRIAL PARK-
KAOMI Loop Subdivision - Phase I

Design Analysis

Date 10/16/89 By A KATO
Rev. Date _____ By C. Palesh
Checked _____

Job No. 83341300
Location Oahu
Sheet No. 4 of 8

! TRIAL CRITICAL DEPTH OF FLOW

$$Q = \left(\frac{K'}{n}\right) b^{8/3} s^{1/2}$$

(Ref. - Handbook of Hydraulics, Brater and King, Tbls 7-11 and pg. 6-41)

$b = 15'$
$Q = 134$ cfs
$S = 0.0039$
$n = 0.025$

$$134 = \frac{K'}{0.025}(15)^{8/3}(0.0039)^{1/2}$$
$$K' = 0.0390$$

$$\frac{D}{b} = 0.1105$$
$$D = 0.1105(15')$$
$$D = 1.66 \text{ ft}$$

PROJECT: CAMPBELL INDUSTRIAL PARK - KAOMI LOOP EXTENSION
Culvert Analysis (4 - 36" Pipes)
STATION:
CULVERT DESIGNATION:

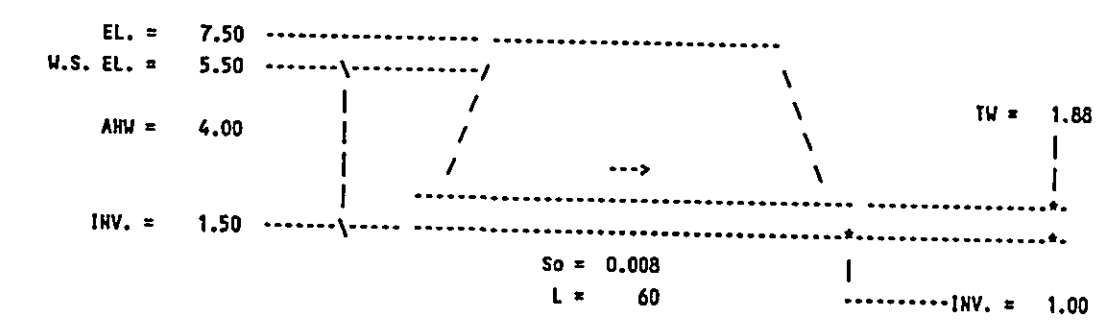
CULVERT DESIGN

DESIGNED BY: A. KATO
CHECKED BY:
DATE: October 16, 1989
REVISED: January 19, 1990

HYDROLOGIC AND CHANNEL INFORMATION

DESIGN FLOW Q_{50} = 43.0 CFS TW = 1.88

DESIGN FLOW Q = CFS TW =



CULVERT DESCRIPTION (ENTRANCE TYPE)	Q	SIZE	INLET CONTROL		OUTLET CONTROL HW=H+ho-LSo								CONT	OUTLT		COMMENTS
			HW/D	HW	Ke	H	dc	dc+D/2	TW	ho	LSo	HW	HW	VEL		
CON (HEADWALL)	43	36	1.16	3.49	0.50	1.11	2.17	2.58	1.88	2.58	0.50	3.19	3.49			INLET CONTROL
													Compare HW with this value --->		4.0	

A

Kaoni Loop (BCA Job No. 833.4300)

DATE: 12/13 /1989

TC	C	I50	INTEN CORR FACTOR	I50	DRAIN AREA	ACCUM DRAIN AREA	Q RUNOFF	ACCUM Q	DN	VF	VN	SIZE OF PIPE	LENGTH OF PIPE	SF	S	INVERT ELEV.	DROP INVERT ELEV.	HF	<-----MANHOLE LOSSES-----> A	B	C
																1.00					
5.0	0.90	2.3	2.80	6.44	0.36	2.04	2.09	11.82	1.56	3.76	4.49	24	97	0.0027	0.0030	1.29		0.26	0.07	0.13	0.05
0.0	0.90	2.3	2.80	6.44	0.00	1.32	0.00	7.65	1.14	2.44	4.15	24	193	0.0011	0.0030	1.87		0.22	0.03	0.00	0.02
5.0	0.90	2.3	2.80	6.44	0.28	1.32	1.62	7.65	1.14	2.44	4.13	24	193	0.0011	0.0030	2.44		0.22	0.03	0.06	0.02
0.0	0.90	2.3	2.80	6.44	0.00	0.76	0.00	4.40	0.82	1.40	3.61	24	207	0.0004	0.0030	3.06		0.08	0.01	0.00	0.01
5.0	0.90	2.3	2.80	6.44	0.26	0.76	1.51	4.40	0.83	1.40	3.59	24	207	0.0004	0.0030	3.67		0.08	0.01	0.02	0.01
0.0	0.90	2.3	2.80	6.44	0.00	0.24	0.00	1.39	0.50	0.79	2.67	18	178	0.0002	0.0030	4.20		0.03	0.00	0.00	0.00
5.0	0.90	2.3	2.80	6.44	0.12	0.24	0.70	1.39	0.50	0.79	2.67	18	178	0.0002	0.0030	4.73		0.03	0.00	0.01	0.00
5.0	0.90	2.3	2.80	6.44	0.12	0.12	0.70	0.70	0.31	0.39	2.64	18	76	0.0000	0.0050	5.11		0.00	0.00	0.00	0.00
5.0	0.90	2.3	2.80	6.44	0.36	0.36	2.09	2.09	0.45	1.18	4.64	18	36	0.0004	0.0100	1.65		0.01	0.00	0.00	0.00
5.0	0.90	2.3	2.80	6.44	0.28	0.28	1.62	1.62	0.40	0.92	4.31	18	36	0.0002	0.0100	2.80		0.01	0.00	0.00	0.00
5.0	0.90	2.3	2.80	6.44	0.26	0.26	1.51	1.51	0.38	0.85	4.22	18	36	0.0002	0.0100	4.03		0.01	0.00	0.00	0.00

Invert + Entrance Control + 'CD' losses.
'ABCD' losses.
eam manhole highest invert + normal depth + friction headloss + 'ABCD' losses.
eam manhole water elevation + friction headloss + 'ABCD' losses.
invert + normal depth.

HYDRAULIC GRADE ELEVATION UP1	UP2	UP3	UP4	FINISH GRADE ELEV.	FREE BOARD DIFF	MIN COVER	CALC-ULATED COVER	<=====PIPE VELOCITY AND DEPTH CALCULATIONS=====> Enter n factor n	Enter Depth in Inches D	Match Q with ACCUM Q from column K Q	ANGLE	A	P	A/P	<=MANHOLE LOSSES=> Enter direc-tional change in main line degrees	Enter branch velocity in fps
			3.00													
3.28	3.12	3.10	3.54	6.7	3.16	2.00	3.41	0.013	18.7	11.82	55.829	2.6319	4.3344	0.6072	0	1.18
3.33	3.06	2.70	3.81	7.5	3.66	2.00	3.60	0.013	13.6	7.65	82.193	1.8416	3.4141	0.5394	0	0
3.91	3.70	3.35	4.15	7.4	3.25	2.00	2.96	0.013	13.7	7.65	81.807	1.8548	3.4276	0.5412	0	0.92
4.09	3.90	3.36	4.24	8.3	4.03	2.00	3.21	0.013	9.9	4.40	79.824	1.2193	2.7864	0.4376	0	0
4.70	4.54	4.01	4.70	8.3	3.60	2.00	2.63	0.013	9.9	4.40	80.018	1.2259	2.7932	0.4389	0	0.85
4.79	4.71	4.21	4.79	9.0	4.22	2.00	3.31	0.013	6.0	1.39	70.731	0.5192	1.8517	0.2804	0	0
5.32	5.24	4.75	5.32	9.1	3.76	2.00	2.85	0.013	6.0	1.39	70.731	0.5192	1.8517	0.2804	0	0
5.65	5.42	5.04	5.65	9.0	3.35	2.00	2.39	0.013	3.7	0.70	54.236	0.2657	1.4199	0.1871	90	0
2.40	2.10	4.67	4.67	6.7	2.03	2.00	3.55	0.013	5.5	2.09	66.769	0.4516	1.7480	0.2584	90	0
3.45	3.20	0.41	3.82	7.4	3.62	2.00	3.14	0.013	4.8	1.62	62.038	0.3761	1.6241	0.2316	90	0
4.67	4.41	0.39	4.67	8.3	3.63	2.00	2.77	0.013	4.6	1.51	60.805	0.3574	1.5919	0.2245	90	0

:INLET CONTROL CALCULATIONS=============>								<======OUTLET CONTROL CALCULATIONS=======>						
IP ze . it.	CHP HW ratio range 0 to 1	CHP HW ratio range 1 to 2	CHP HW ratio range 2+	CON pipe ent. cont.	CON HW ratio range 0 to 1	C H r r 1 2	CON HW ratio range 2+	Enter ke ke	V FULL FLOW	H	CRIT. DEPTH	dc+D ---- 2	LSo	HW
1.85	0.92	0.88	0.61	1.89	0.95 *		0.59	0.50	3.76	0.59	1.23	1.61	0.29	1.92
1.42	0.71	0.57	0.32	1.44	0.72 *		0.30	0.50	2.44	0.36	0.96	1.48	0.58	1.26
1.42	0.71	0.57	0.32	1.44	0.72 *		0.30	0.50	2.44	0.36	0.96	1.48	0.57	1.27
1.02	0.51	0.33	0.14	1.02	0.51 *		0.12	0.50	1.40	0.12	0.72	1.36	0.62	0.86
1.02	0.51	0.33	0.14	1.02	0.51 *		0.12	0.50	1.40	0.12	0.72	1.36	0.61	0.87
0.59	0.39	0.21	0.07	0.58	0.39 *		0.06	0.50	0.79	0.05	0.43	0.97	0.53	0.48
0.59	0.39	0.21	0.07	0.58	0.39 *		0.06	0.50	0.79	0.05	0.43	0.97	0.53	0.48
0.59	0.39	0.21	0.07	0.58	0.39 *		0.06	0.50	0.79	0.05	0.43	0.97	0.53	0.48
0.39	0.26	0.11	0.03	0.38	0.25 *		0.02	0.50	0.39	0.01	0.32	0.91	0.38	0.54
0.75	0.50	0.32	0.13	0.75	0.50 *		0.12	0.50	1.18	0.05	0.53	1.01	0.36	0.70
0.65	0.43	0.25	0.09	0.64	0.43 *		0.08	0.50	0.92	0.03	0.47	0.98	0.36	0.65
0.62	0.41	0.23	0.08	0.61	0.41 *		0.07	0.50	0.85	0.02	0.45	0.98	0.36	0.64

Project CAMPBELL INDUSTRIAL PARK-
KAOMI LOOP - PHASE 2

Date 10/26/89 By C. PALESH

Rev. Date By

Checked

Design Analysis

Job No. 833.4300

Location OAHU

Sheet No. 1 of 2

NEW MAKAI DRAINAGE DITCH FOR LOT 7

DRAINAGE AREA = 33 AC

Q = 62 CFS L = 1650' T_c = ...

OUTLET @ OCEAN DISCHARGE CHANNEL - INV. = .15

USE S: .001

TRY 40' width w/ 1' flow depth

$A = 40 \times 1 + 1.5(1)^2 = 41.5$ #

$P = 40 + 2(1)\sqrt{1^2 + (1.5)(1)^2} = 43.6'$ $R = 41.5/43.6 = 0.95$

$V = (1.486)/.025 \times (.95)^{2/3} \times .001^{1/2} = 1.818$ fps

$Q = 1.818 \times 41.5$ # = 75 CFS > 62 CFS - OK

TRY 35' width w/ 0.8' depth

$A = 35 \times .8 + 1.5(.8)^2 = 28.04$

$P = 35 + 2(.8)\sqrt{.8^2 + (1.5 \times .8)^2} = 37.3$ $R = 28.04/37.3 = .768$

$V = 1.486/.025 \times (.768)^{2/3} \times .001^{1/2} = 1.57$ FPS

$Q = 1.57 \times 28.04 = 45$ CFS X No

TRY 40' width w/ .8' depth

$A = 40 \times .8 + 1.5(.8)^2 = 32.96$ #

$P = 40 + 2(.8)\sqrt{.8^2 + (.8 \times 1.5)^2} = 42.3$ $R = 32.96/42.3 = .78'$

$V = 1.486/.025 \times (.78)^{2/3} \times .001^{1/2} = 1.57$ FPS

$Q = 1.57 \times 32.96 = 52.45 < 62$ X No

TRY 40' width w/ 0.9 depth

$A = 40 \times .9 + 1.5(.9)^2 = 37.21$ #

$P = 40 + 2(.9)\sqrt{.9^2 + (1.5 \times .9)^2} = 42.65'$ $R = 37.21/42.65 = .87'$

$V = 1.486/.025 \times .87^{2/3} \times .001^{1/2} = 1.71$ FPS

$Q = 37.21 \times 1.71 = 63.85$ CFS > 62 - OK

Project CAMPBELL INDUSTRIAL PARK
KAOMEA LOOP - PHASE 2

Date 10/26/81 By Palesh

Rev. Date ____ By ____

Checked ____

Design Analysis

Job No. 833.4300

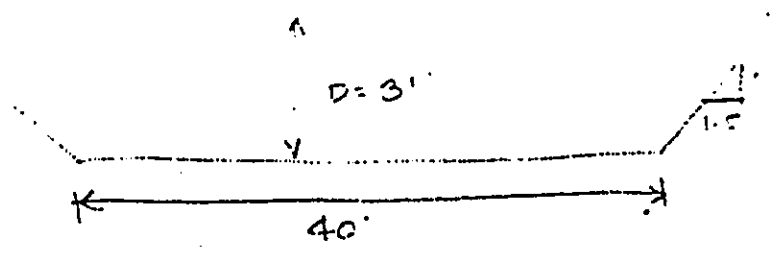
Location OAHU

Sheet No. 2 of 2

Channel INVERT @ END = .15 + (.001)(1650')
= 1.8

Freeboard = 2' + .025 v $d^{1/3}$ = 2 + .025(1.71)(.9)$^{1/3}$ = 2.041

Top of Channel = 2.041 + 1.8 = 3.84'



Top width = (1.5 x 3)2 + 40 = 49'

Vol. of cut: Avg. Depth = 3' x 1650' x 42' = 7,700 CY

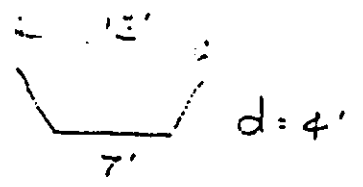
Project Kaoni Loop Subdivision
Campbell Industrial Park
Date 1/19/90 By C. Palesh
Rev. Date ____ By ____
Checked ____

Design Analysis

Job No. 833.4300
Location Oahu
Sheet No. 1 of 5

LOT 1 - AREA TO DITCH EASEMENT = 12.8 Ac
i = 2.3"
l = 1050'
S = 1/410' = .0024
Tc = 16 min Correction Factor = 1.9

DITCH



$Q = .85 \times 2.3 \times 1.9 \times 12.8 = 47.5$ CFS

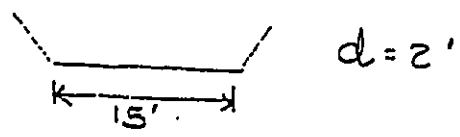
$P = 7 + 2\sqrt{4^2+4^2} = 18.3'$
$A = 7' \times 4' + \frac{1}{2}(4 \times 4) \times 2 = 44$ SF
$R = 44/18.3 = 2.4'$

$V = 1.486/.025 \times 2.4^{2/3} \times \sqrt{.0024} = 4.7$ FPS

$Q_{MAX} = 4.7 \times 44 = 206.8$ CFS > 47.5 CFS ✓ OK.

MAUKA PORTION OF DITCH 1
DITCH 1 improvement Q = culvert Q = 172CFS

Proposed Section



S = .0039

$P = 15 + 2.0\sqrt{(2.0)^2+(2.0 \times 1.5)^2} = 22.2$
$A = 15 \times 2.0 + 1.5(2)^2 = 36$ SF
$R = 36/22.2 = 1.62'$

$V = 1.486/.025 \times 1.62^{2/3} \times \sqrt{.0039} = 4.9$ FPS

$Q = VA = 36 \times 4.9 = 177$ CFS > 172 CFS ✓ OK

Project KAAPA LOOP SUBDIVISION
CALCULATE INDUSTRIAL DRAIN

Design Analysis

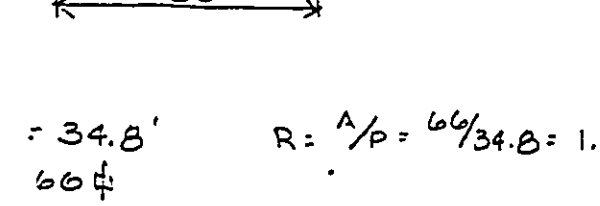
Date 1/9/90 By C. DAVEY
Rev. Date ____ By ____
Checked ____

Job No. 88-430
Location OAHU
Sheet No. 4 of 5

MAKAI PORTION OF DITCH 1. ABOVE DITCH 2.

Additional area drained = 3.3 + 2.6 = 5.9 Ac
longest run still from bdy: Tc = 16 min Correction = 1.9
Q = .85 × 2.3 × 1.9 × 5.9 = 219 CFS

Proposed section



dmin = 2.1'
say 2'

$P = 30 + 2\sqrt{(2^2)+(2\times1.5)^2} = 34.8'$ $R = A/P = 66/34.8 = 1.9'$
$A = 30 \times 2 + (1.5\times2)2 = 66\,\text{ft}^2$

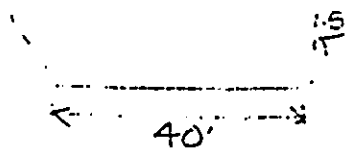
$V = \frac{1.486}{.025} \times 1.9^{.667} \times \sqrt{.002} = 4.07$ FPS

$Q = VA = 4.07 \times 66 = 269$ CFS > 219 CFS ✓ OK

dn = 1' Q = 80 CFS ∴ dn = 1.7'
dn = 1.5 Q = 134 CFS
dn = 1.8 Q = 250 CFS
dn = 1.65 Q = 186 CFS

MAKAI PORTION OF DITCH 1, BELOW DITCH 3
ADDED AREA DRAINED = 33 Ac + 59 Ac = 92 Ac
Q = .85 × 2.3 × 1.9 × 92 = 342 CFS dmin = 2'

Widen section:



S = .002
$P = 40 + 2\sqrt{(2^2)+(2\times1.5)^2} = 47.2'$
$A = 40\times2 + (1.5\times2)(2) = 86\,\text{ft}^2$
$R = 86/47.2 = 1.82'$

$V = 1.48/.025 \times 1.82^{2/3} \times \sqrt{.002} = 3.76$ FPS $\times$ 86 = 340 CFS

Design Analysis

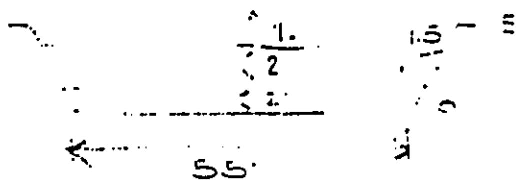
Project: Kaomi Loop Subdivision
Campbell Industrial Park

Date: 1/19/90 By: C. Palest
Rev. Date: By:
Checked:

Job No. 833.4300
Location: OAHU
Sheet No. 3 of 5

TO ALLOW FOR TIDAL INFLUENCE [illegible] DITCH
TO MAXIMUM ALLOWABLE [illegible] 55'

CAPACITY w/ 2' tide
W = 1.5x2x2 + 55 = 61'



$P = 61 + 2\sqrt{2^2 + (2x1.5)^2} = 68.2'$
$A = 61 \times 2 + (1.5 \times 2)2 = 128$ ft²
$R = 1.87'$
$V = 1.486/.025 \times 1.82^{2/3} \times \sqrt{.002} = 4.03$ FPS
$Q = 4.03 \times 128 = 516$ CFS

$d = 1.5'$
$P = 61 + 2\sqrt{1.5^2 + (1.5)^2} = 65.2'$
$A = 61 \times 1.5 + (1.5^2)2 = 96$ ft²
$R = 96/65.2 = 1.47'$
$V = 1.486/.025 \times 1.47^{2/3} \times \sqrt{.002} = 3.4$
$Q = 3.4 \times 96 = 303'$

say $d_n = 1.6$ above tide

w/o tide $d = 2'$
$P = 55 + 2\sqrt{2^2 + (2x1.5)^2} = 62.2'$
$A = 55 \times 2 + (1.5 \times 2)2 = 116$ ft²
$R = 116/62.2 = 1.86'$
$V = 1.486/.025 \times 1.86^{2/3} \times \sqrt{.002} = 4.02$ FPS
$Q = 4.02 \times 116 = 467$ CFS

$d_n = 1.5$ $Q = 300$ CFS
$d_n = 1.8$ $Q = 395$ CFS

say $d_n = 1.6'$

Project CAMPBELL Industrial - Kaomi Loop
LOT DRAINAGE

Date 11/2/89 By C. Palesh

Rev. Date 1/10/90 By "

Checked

Design Analysis

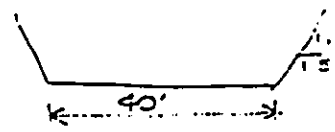
Job No. 83-2.4300

Location Oahu

Sheet No. 4 of 5

Lot 6/5 ditches Q = 30 cfs

S = .0006



d = 8" = 0.667

$A = 40' \times .667 + 1.5(.667)^2 = 27.35$ ☥

$P = 40' + 2(.667)\sqrt{(.667)^2 + (1.5 \times .667)^2} = 41.6'$

$R = 27.35/41.6 = 0.65$

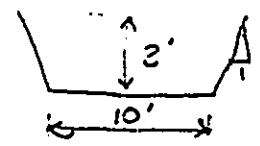
$V = 1.486/.025 \times .65^{2/3} \times \sqrt{.0006} = 1.11$ FPS

$Q = 1.11 \times 27.35 = 30.35$ CFS

Lot 2 Drainage area = ~~1/2 Lot~~ 2 + Roadway + Roadlots ✓ INCLUDED IN 44 Ac.
= ~~1/2 x 31.6~~ Ac + 1450' x 40' + 1150 x 470' = ~~15.5~~ Ac 13.7 Ac

L = 1450' + 470' = 1920' S = 11-6/1450 = .003 Tc = 21 min
I = 2.3" x 1.8 = 4.14" 13.7
Q = .85 x 4.14" x ~~15.5~~ Ac = ~~55~~ CFS 48.3 CFS

Existing Channel: S = 1/230 = .0043 SECTION:



$d_{max} = 2'$

$A = 10' \times 2' + \sqrt{2^2 + 2^2} = 22.8$ ☥

$P = 10' + 2(\sqrt{2^2 + 2^2}) = 15.7'$

$R = A/P = 22.8/15.7 = 1.45'$

$V = 1.486/.025 \times 1.45^{2/3} \times \sqrt{.0043} = 4.9$ FPS

$Q = 5 \times 22.8 = 114.2$ CFS = MAX. CAPACITY

W/ d = 1' A = 11.4' P = 12.8 R = 0.89
V = 3.6 Q = 41.0 CFS

Project CAMPBELL INDUSTRIAL - KAOMI LOOP LOT DRAINAGE

Design Analysis

Date 1/12/90 By C. Palesh

Rev. Date 2/2./90 By C. Palesh

Checked

Job No. 633.4300

Location Oahu

Sheet No. 5 of 5

W/ d = 1.5' A = 17.1 ft² P = 14.1' R = 17.1/14.1 = 1.21

V = 4.43 FPS Q = 75.7 cfs

∴ d_n = 1.1'

LITCH - EASEMENT - 213 CONFLUENCE

TYPICAL SECTION - STA 5+30

Q = 172 cfs

32.5

d_n = 1.4 A = (1.4 x 32.5) + 1.4 x 5.1 + 1/2 (1.4 x 5.1) = 52.8 ft²

P = $\sqrt{1.4^2 + 2.7^2}$ + $\sqrt{1.4^2 + 5.1^2}$ + 32.5 = 2.7 + 5.3 + 32.5 = 40.5'

R = A/P = 1.37

V = 4.6 Q = 243.0

d_n = 1.1 A = (1.1 x 32.5) + 1.1 x 5.1 + 1/2 (1.1 x 5.1) = 41.8 ft²

P = $\sqrt{1.1^2 + 2.7^2}$ + $\sqrt{1.1^2 + 5.1^2}$ + 32.5 = 5.2 + 32.5 = 40.1'

R = .99

V = 3.37 Q = 141

KAOMI 1.

THIS RUN EXECUTED 06/22/80 23:15:05

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**************************************************
 HEC2 RELEASE DATED NOV 76 UPDATED MAY  1984
 ERROR CORR -  01,02,03,04,05,06
 MODIFICATION -  50,51,52,53,54,55,56
 IBM-PC-XT VERSION
**************************************************

T1      KAOMI LOOP SUBDIVISION
T2      JAN  1990     DRAINAGE DITCH ANALYSIS
T3      UPSTREAM OF PROPOSED CULVERT  -  25' WIDE CHANNEL

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       -1.       2.        0.        0.  .000000       .00        .0        0.     3.500      .000

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
    -1.000      .000      .000      .000      .000      .000      .000      .000      .000      .000

NC      .025      .025      .025      .000      .000      .000      .000      .000      .000      .000
QT     1.000   172.000      .000      .000      .000      .000      .000      .000      .000      .000
X1      .000     5.000   -40.750      .000      .000      .000      .000      .000      .000      .000
GR     7.500   -40.750     1.500   -31.800     1.500   -19.300     1.500    -6.750     7.500      .000

X1    50.000     5.000   -41.500      .000    50.000    50.000    50.000      .000      .000      .000
GR     7.500   -41.500     1.700   -32.800     1.700   -20.300     1.700    -7.810     6.900      .000

X1   250.000     5.000   -38.380      .000   200.000   200.000   200.000      .000      .000      .000
GR     7.400   -38.380     2.500   -31.030     2.500   -18.530     2.500    -6.030     6.520      .000

X1   450.000     5.000   -36.060      .000   200.000   200.000   200.000      .000      .000      .000
GR     7.600   -36.060     3.250   -29.530     3.250   -17.030     3.250    -4.530     6.270      .000

QT     1.000   138.800      .000      .000      .000      .000      .000      .000      .000      .000
X1   530.000     5.000   -33.900      .000    80.000    80.000    80.000      .000      .000      .000
GR     7.000   -33.900     3.600   -28.820     3.600   -16.320     3.600    -3.820     6.150      .000

X1   600.000     5.000   -34.100      .000   130.000   130.000   130.000      .000      .000      .000
GR     7.700   -34.100     3.840   -28.290     3.840   -15.780     3.840    -3.290     6.030      .000

QT     1.000    91.300      .000      .000      .000      .000      .000      .000      .000      .000
X1   700.000     5.000   -73.700      .000   100.000   100.000   100.000      .000      .000      .000
GR     8.000   -73.700     4.100   -67.850     4.100   -35.300     4.100    -2.850     6.000      .000

X1   800.000     5.000   -73.290      .000   100.000   100.000   100.000      .000      .000      .000
GR     8.000   -73.290     4.270   -67.690     4.210   -35.180     4.210    -2.680     6.000      .000
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X1   1000.000      5.000    -72.890       .000     200.000     200.000     200.000       .000       .000       .000
GR       8.000   -72.890       4.370    -67.450       4.370    -34.950       4.370    -2.450      6.000       .000

X1   1300.000      5.000    -73.600       .000    1300.000    1300.000    1300.000       .000       .000       .000
GR       8.000   -73.600       4.670    -68.600       4.610    -36.100       4.610    -3.600      7.000       .000

X1   1700.000      5.000    -72.400       .000     400.000     400.000     400.000       .000       .000       .000
GR       8.000   -72.400       4.930    -69.600       4.930    -37.100       4.930    -4.600      8.000       .000

X1   1810.000      5.000    -77.700       .000     110.000     110.000     110.000       .000       .000       .000
GR       9.500   -77.700       5.020    -71.000       5.020    -38.500       5.020    -6.000      9.000       .000
EJ        .000       .000       .000       .000       .000       .000       .000       .000       .000       .000
1
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   SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS   BANK ELEV
   Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA   LEFT/RIGHT
   TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN      SSTA
   SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID     ENDST


*PROF 1

*SECNO  .000
      .00     2.00     3.50      .00     3.50     3.65      .15      .00      .00     7.50
     172.       0.     172.       0.       0.      55.       0.       0.       0.     7.50
      .00      .00     3.11      .00     .025     .025     .025     .000     1.50   -34.78
  .001299       0.       0.       0.        0        0        0      .00    30.28    -4.50

*SECNO 50.000
    50.00     1.85     3.55      .00      .00     3.72      .17      .07      .00     7.50
     172.       0.     172.       0.       0.      52.       0.       0.       0.     6.90
      .00      .00     3.33      .00     .025     .025     .025     .000     1.70   -35.59
  .001640      50.      50.      50.        1        0        0      .00    30.57    -5.02

*SECNO 250.000
   250.00     1.40     3.90      .00      .00     4.22      .32      .50      .00     7.40
     172.       0.     172.       0.       0.      38.       0.       0.       0.     6.52
      .02      .00     4.52      .00     .025     .025     .025     .000     2.50   -33.14
  .004219      200.     200.     200.        2        0        0      .00    29.21    -3.92

*SECNO 450.000
   450.00     1.47     4.72      .00      .00     5.01      .29      .78      .00     7.60
     172.       0.     172.       0.       0.      40.       0.       0.       0.     6.27
      .03      .00     4.32      .00     .025     .025     .025     .000     3.25   -31.73
  .003658      200.     200.     200.        2        0        0      .00    29.40    -2.33
0
*SECNO 530.000
   530.00     1.46     5.06      .00      .00     5.25      .19      .24      .00     7.00
     139.       0.     139.       0.       0.      40.       0.       1.       0.     6.15
      .04      .00     3.51      .00     .025     .025     .025     .000     3.60   -31.00
  .002434      80.      80.      80.        2        0        0      .00    29.36    -1.64

*SECNO 600.000
   600.00     1.53     5.37      .00      .00     5.54      .17      .29      .00     7.70
     139.       0.     139.       0.       0.      42.       0.       1.       0.     6.03
      .05      .00     3.33      .00     .025     .025     .025     .000     3.84   -30.59
```

.002075	130.	130.	130.	2	0	0	.00	29.59	-1.00

0

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST
*SECNO 700.000									
700.00	1.47	5.57	.00	.00	5.59	.01	.05	.00	8.00
91.	0.	91.	0.	0.	100.	0.	1.	1.	6.00
.08	.00	.92	.00	.025	.025	.025	.000	4.10	-70.07
.000149	100.	100.	100.	1	0	0	.00	69.45	-.63
*SECNO 800.000									
800.00	1.38	5.59	.00	.00	5.60	.02	.02	.00	8.00
91.	0.	91.	0.	0.	91.	0.	1.	1.	6.00
.10	.00	1.00	.00	.025	.025	.025	.000	4.21	-69.67
.000198	100.	100.	100.	2	0	0	.00	69.05	-.62
*SECNO 1000.000									
1000.00	1.26	5.63	.00	.00	5.65	.02	.05	.00	8.00
91.	0.	91.	0.	0.	84.	0.	1.	1.	6.00
.16	.00	1.09	.00	.025	.025	.025	.000	4.37	-69.33
.000262	200.	200.	200.	0	0	0	.00	68.76	-.57
*SECNO 1300.000									
1300.00	1.34	5.95	.00	.00	5.96	.02	.31	.00	8.00
91.	0.	91.	0.	0.	88.	0.	4.	3.	7.00
.50	.00	1.04	.00	.025	.025	.025	.000	4.61	-70.51
.000223	1300.	1300.	1300.	1	0	0	.00	68.91	-1.60

0

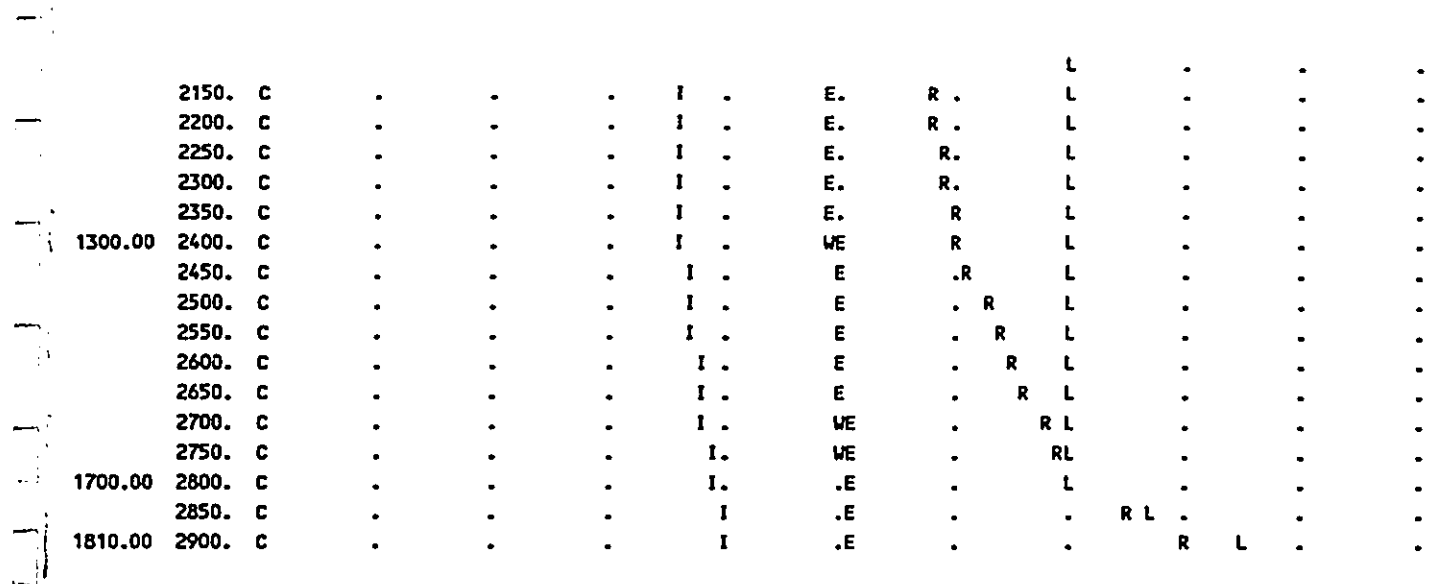
*SECNO 1700.000									
1700.00	1.12	6.05	.00	.00	6.08	.02	.12	.00	8.00
91.	0.	91.	0.	0.	74.	0.	5.	4.	8.00
.59	.00	1.23	.00	.025	.025	.025	.000	4.93	-70.62
.000385	400.	400.	400.	1	0	0	.00	67.70	-2.92
*SECNO 1810.000									
1810.00	1.08	6.10	.00	.00	6.12	.03	.05	.00	9.50
91.	0.	91.	0.	0.	71.	0.	5.	4.	9.00
.62	.00	1.28	.00	.025	.025	.025	.000	5.02	-72.60
.000447	110.	110.	110.	0	0	0	.00	68.21	-4.39

PROFILE FOR STREAM UPSTREAM OF PROPOSED CUL

PLOTTED POINTS (BY PRIORITY)-E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA

ELEVATION	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
SECNO CUMDIS										
.00	0. C	I .	.	.	W E	.	.	.	. L	. . . .

50.00	50.	C	I . . WE . . . . R. L . . . .
	100.	C	I. . WE . . . . R . L . . . .
	150.	C	.I . W E . . . . R . L . . . .
	200.	C	. I . W .E . . . . R . L . . . .
250.00	250.	C	. I . W. E . . . . R . L . . . .
	300.	C	. I . .W E . . . . R . L . . . .
	350.	C	. I. . W E . . . . R . L . . . .
	400.	C	.I . W E . . . . R . L . . . .
450.00	450.	C	. I . W E . . . . R . L . . . .
	500.	C	I . W. E . . . . R . L . . . .
530.00	550.	C	I . .W E . . . . R . L . . . .
	600.	C	I . . W E . . . . R . L . . . .
	650.	C	I . . W E . . . . R . L . . . .
600.00	700.	C	I . . WE . . . . R . L . . . .
	750.	C	I . WE . . . . R . L . . . .
700.00	800.	C	.I . E . . . . R . L . . . .
	850.	C	. I . E . . . . R . L . . . .
800.00	900.	C	. I . E . . . . R . L . . . .
	950.	C	. I . E . . . . R . L . . . .
	1000.	C	. I . E . . . . R . L . . . .
	1050.	C	. I . E . . . . R . L . . . .
1000.00	1100.	C	. I . WE . . . . R . L . . . .
	1150.	C	. I . WE . . . . R . L . . . .
	1200.	C	. I . WE . . . . .R . L . . . .
	1250.	C	. I . E . . . . .R . L . . . .
	1300.	C	. I . E . . . . . R . L . . . .
	1350.	C	. I . E . . . . . R . L . . . .
	1400.	C	. I . E . . . . . R . L . . . .
	1450.	C	. I . E . . . . . R . L . . . .
	1500.	C	. I . E . . . . . R . L . . . .
	1550.	C	. I . WE . . . . . R . L . . . .
	1600.	C	. I . WE . . . . . R . L . . . .
	1650.	C	. I . E . . . . . R . L . . . .
	1700.	C	. I . E . . . . . R . L . . . .
	1750.	C	. I . E . . . . . R . L . . . .
	1800.	C	. I . E . . . . . R . L . . . .
	1850.	C	. I . E . . . . . R . L . . . .
	1900.	C	. I . E . . . . . R . L . . . .
	1950.	C	. I . WE. . . . . R . L . . . .
	2000.	C	. I . WE. . . . . R . L . . . .
	2050.	C	. I . E. . . . . R . L . . . .
	2100.	C	. I . E. . . . . R .



	2150.	C	.	.	.	I	.	E.	R .	L	.	.	.
	2200.	C	.	.	.	I	.	E.	R .	L	.	.	.
	2250.	C	.	.	.	I	.	E.	R.	L	.	.	.
	2300.	C	.	.	.	I	.	E.	R.	L	.	.	.
	2350.	C	.	.	.	I	.	E.	R	L	.	.	.
1300.00	2400.	C	.	.	.	I	.	WE	R	L	.	.	.
	2450.	C	.	.	.	I	.	E	.R	L	.	.	.
	2500.	C	.	.	.	I	.	E	. R	L	.	.	.
	2550.	C	.	.	.	I	.	E	. R	L	.	.	.
	2600.	C	.	.	.	I	.	E	. R	L	.	.	.
	2650.	C	.	.	.	I	.	E	. R	L	.	.	.
	2700.	C	.	.	.	I	.	WE	. R	L	.	.	.
	2750.	C	.	.	.	I.		WE	. RL		.	.	.
1700.00	2800.	C	.	.	.	I.		.E	. L		.	.	.
	2850.	C	.	.	.	I		.E	. .	R L	.	.	.
1810.00	2900.	C	.	.	.	I		.E	. .	R L	.	.	.

THIS RUN EXECUTED 06/22/80 23:15:47

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HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984
ERROR CORR - 01,02,03,04,05,06
MODIFICATION - 50,51,52,53,54,55,56
IBM-PC-XT VERSION
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

UPSTREAM OF PROPOSED CUL

SUMMARY PRINTOUT TABLE 150

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
.000	.00	.00	.00	1.50	172.00	3.50	.00	3.65	12.99	3.11	55.33	47.73
50.000	50.00	.00	.00	1.70	172.00	3.55	.00	3.72	16.40	3.33	51.62	42.47
250.000	200.00	.00	.00	2.50	172.00	3.90	.00	4.22	42.19	4.52	38.06	26.48
450.000	200.00	.00	.00	3.25	172.00	4.72	.00	5.01	36.58	4.32	39.84	28.44
530.000	80.00	.00	.00	3.60	138.80	5.06	.00	5.25	24.34	3.51	39.56	28.13
600.000	130.00	.00	.00	3.84	138.80	5.37	.00	5.54	20.75	3.33	41.66	30.47
700.000	100.00	.00	.00	4.10	91.30	5.57	.00	5.59	1.49	.92	99.64	74.69
800.000	100.00	.00	.00	4.21	91.30	5.59	.00	5.60	1.98	1.00	91.34	64.91
1000.000	200.00	.00	.00	4.37	91.30	5.63	.00	5.65	2.62	1.09	83.78	56.40

1300.000	1300.00	.00	.00	4.61	91.30	5.95	.00	5.96	2.23	1.04	88.00	61.10
1700.000	400.00	.00	.00	4.93	91.30	6.05	.00	6.08	3.85	1.23	74.25	46.55
1810.000	110.00	.00	.00	5.02	91.30	6.10	.00	6.12	4.47	1.28	71.12	43.19

UPSTREAM OF PROPOSED CUL

SUMMARY PRINTOUT TABLE 150

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
.000	172.00	3.50	.00	.00	.00	30.28	.00
50.000	172.00	3.55	.00	.05	.00	30.57	50.00
250.000	172.00	3.90	.00	.35	.00	29.21	200.00
450.000	172.00	4.72	.00	.81	.00	29.40	200.00
530.000	138.80	5.06	.00	.34	.00	29.36	80.00
600.000	138.80	5.37	.00	.31	.00	29.59	130.00
700.000	91.30	5.57	.00	.21	.00	69.45	100.00
800.000	91.30	5.59	.00	.01	.00	69.05	100.00
1000.000	91.30	5.63	.00	.04	.00	68.76	200.00
1300.000	91.30	5.95	.00	.32	.00	68.91	1300.00
1700.000	91.30	6.05	.00	.11	.00	67.70	400.00
1810.000	91.30	6.10	.00	.04	.00	68.21	110.00

SUMMARY OF ERRORS AND SPECIAL NOTES

THIS RUN EXECUTED 06/22/80 23:15:52

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HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984
ERROR CORR - 01,02,03,04,05,06

Project KAOMI LOOP SUBDIVISION
CAMPBELL INDUSTRIAL PARK

Design Analysis

Date [illegible] By C. Paleck

Job No. 833.4300

Rev. Date ____ By ____

Location OAHU

Checked ____

Sheet No. 1 of ____

TAILWATER ANALYSIS

HEADWATER @ CULVERT = 3.5'   Width 15'   width = 25'

CROSS SECTION

Channel section

STA 0+00	0/7.5	6.75/1.5	16.75/1.5	26.75/1.5	33.5/7.5
	✓	✓	19.25/1.5	31.75/1.5	40.75/7.5
STA 0+50	0/6.5	7.2/1.7	14.7/1.7	22.2/1.7	30.9/7.5
	✓	✓	19.7/✓	32.2/✓	40.9/✓
STA 2+50	0/5.77	4.8/2.5	12.3/2.5	19.8/2.5	27.15/7.4
	✓	✓	17.3/✓	29.8/✓	39.55/7.4
STA 4+50	0/5.3	3.1/3.25	10.6/3.25	18.1/3.25	24.65/7.6
	✓	✓	15.6/✓	28.1/✓	34.6/✓
STA 5+30	0/5.15	2.3/3.6	9.8/3.6	17.3/3.6	22.4/7
	✓	✓	14.8/✓	34.8/3.6	39.9/7
STA 6+00	0/5.0	1.74/3.84	9.24/3.84	16.7/3.84	22.53/7.7
	✓	✓	14.24/✓	26.7/✓	32/53
STA. 7+00	0/5.0	1.38/4.07	33.9/4.07	66.38/4.07	723/8.0
STA. 10+00	0/4.6	1.0/4.37	33.5/4.37	66/4.37	71.4/8.0
STA. 13+00	0/7.0	3.6/4.61	36.1/4.61	65.6/4.67	73.6/8.0
STA 17+00	0/8.0	4.6/4.93	37.1/4.93	69.6/4.93	74.2/8.0
STA. 18+10 END	0/9.0	6.0/5.02	38.5/5.02	71/5.02	77.7/9.5

Q STA 0+00 to 5+30 = 172 CFS
Q STA 5+30 to 7+00 = 138.8 cfs
Q STA 7+00 to 18+10 = 91.3 cfs

BELT COLLINS & ASSOCIATES Engineering • Planning • Landscape Architecture

APPENDIX B

STORM RUNOFF REPORT

CAMPBELL INDUSTRIAL PARK
KAOMI LOOP SUBDIVISION
STORM DRAINAGE DISCHARGE ANALYSIS

1 FEBRUARY 1990

INTRODUCTION

The purpose of this analysis is to address the discharge of potentially significant pollutants into the ocean as a result of drainage ditch and outlet construction for the proposed expansion of the James Campbell Industrial Park along Kaomi Loop. The storm water volumes for various storms are presented in the appendix. The outlet ditch design storm is the 50-year, 24-hour event, which will generate a peak discharge of 342 cubic feet per second.

ANALYSES

Using the Soil Conservation Service methods, estimates of the storm water runoff volumes discharged to the ocean under existing and proposed developed conditions can be made (Reference 1). The estimated volumes generated under different storm durations and intervals can then be used to assess the amount of various constituents entering the harbor during a specific storm event.

No representative storm water quality data for the existing site were available, therefore, general concentrations for undeveloped land were used. For developed conditions, concentrations from storm water discharge studies on Oahu were available (Reference 2). Due to the limited data available for undeveloped sites, no assessment of biocides, heavy metals or petroleum, oil and lubricant (POL) products can be made, however, the concentrations found in urban storm water discharge on Oahu are presented in Table 1.

The analyses for discharge of nitrogen, phosphorus and suspended solids to the ocean under existing and proposed developed conditions, for various storm events, are presented in the appendix. In general, the amount of nitrogen and suspended solids discharged to the receiving water during rainfall events will decrease as a result of development.

The nitrogen concentrations in urban storm water are less than that from a vegetated area. The concentrations of suspended solid are decreased as a result of development due to the increased hardstand areas, which will mitigate some soil erosion. The amount of suspended solids discharged through the outlet is also not considered significant when compared to the typical soil erosion losses on Oahu. The average standard erosion severity rating number for the island is established as 50,000 (Reference 3). The comparable number for the suspended solids discharged under developed site conditions, for the 100-year, 24-hour storm, is around 4,000, which is 8-1/4 percent of the average soil erosion value. Hence, the solids released as a result of the storm water discharge into the ocean are not significant when compared to the typical soil erosion hazard potential, under similar storm events.

The amount of phosphorus released to the ocean will increase as a result of development. In general, additional phosphorus will have no significant impact given the industrial use of the area and the magnitude of the additional amount discharged relative to the overall volume of ocean water.

FINDINGS

The impact of the development based on the concentrations of nitrogen, phosphorus and suspended solids discharged to the ocean as a result of the storm drainage discharge is not significant. Other constituents potentially present in storm water runoff that are of general concern included biocides, heavy metals, and POL products. Typically, biocides currently available on the market break down more readily than those previously used. As a result, other than agricultural applications, the types and concentrations of biocides found in urban storm water runoff are considered insignificant.

Heavy metals, apparently increase as a result of urbanization, but their concentrations are difficult to assess. The concentration of any constituent will decrease with increased storm intensity as a result of dilution. Assessing the impact of storm water discharges on a body of water is further complicated by the fact that air borne pollutants are also deposited during rainfall events.

The only anticipated release of POL products into the ocean via the storm water is washdown from roads and parking lots, as occurs in any urbanized area. Treatment of accidental spills will need to be addressed on an emergency, case specific situation.

CONCLUSION

In summary, the potential impacts as related to the storm drain outlet for the proposed Kaomi Loop Subdivision will be no worse than from the existing, James Campbell Industrial Park and adjacent Barbers Point deep draft harbor activities. No major water quality degradation or pollution has been identified as a result of either of these two other major similar developments. Subsequently, the impact of the proposed subdivision development and associated storm water outlet are not viewed as possibly causing significant water quality impacts or related environmental damage.

REFERENCES

1. U.S. Department of Agriculture, Soil Conservation Service, "Erosion and Sediment Control Guide for Hawaii," Honolulu, Hawaii, March 1981.

2. Dugan, G.L., "Environmental Aspects of Storm Water Runoff Pikoiloa Cemetery Windward Oahu, Hawaii," June 1989.

3. Department of Public Works, City and County of Honolulu, "Soil Erosion Standards & Guidelines," November 1975.

APPENDIX A
Runoff Calculations

Project KAOMI LOOP SUBDIVISION
STORM DRAINAGE DITCH

Date 2/1/90 By C. Palesh

Rev. Date _____ By _____

Checked _____

Design Analysis

Job No. 833.4301

Location OAHU

Sheet No. 1 of 2

DETERMINATION OF RUNOFF VOLUMES:
based on SCS, "Soil and Sediment Guide for Hawaii"

Soil = CR: HYDROLOGICAL SOIL GROUP D

CN = curve number - Existing = 80 (WOOD/forest land)
Developed = 93 (INDUSTRIAL district)

DRAINAGE AREA = 92 AC

Constituent	Concentration Undeveloped	Developed
Nitrogen	1.6 lb/Ac-Ft	0.6 lb/Ac-Ft
Phosphorus	0.16 lb/Ac-Ft	1.5 lb/Ac-Ft
Suspended Solids	9.2 TN/Ac-Ft	3.25 TN/Ac-Ft

RUNOFF VOLUME ANALYSIS

	Storm Duration (hr.)	Storm Interval (Yr.)	Storm I† (in.)	Runoff Inches Exist.	Runoff Inches Future	Runoff Acre-Feet Exist.	Runoff Acre-Feet Future	Runoff Acre-Feet Δ
A.	1	2	1.5	0.29	0.79	2.22	6.06	3.84
B.	1	10	1.8	0.44	1.15	3.37	8.82	5.45
C.	1	50	2.1	0.63	1.40	4.83	10.73	5.90
D.	1	100	3.0	1.25	2.22	9.58	17.02	7.44
E.	24	2	4.5	2.65	3.66	20.3	28.06	7.76
F.	24	10	8.0	5.65	7.10	43.3	54.43	11.1
G.	24	50	10.5	8.0	8.9	61.3	68.23	6.93
H.	24	100	12.5	10.05	11.7	77.1	89.7	12.6

† "RAINFALL-FREQUENCY ATLAS OF THE HAWAIIAN ISLANDS", 1962.

Project KAOMI LOOP SUBDIVISION
STORM DRAINAGE DITCH

Date 2/1/90 By C. PALESH

Rev. Date ____ By ____

Checked ____

Design Analysis

Job No. 833.4301

Location OAHU

Sheet No. 2 of 2

STORM	CONSTITUENT NITROGEN (lb) EXIST.	FUTURE	Δ	PHOSPHORUS (lb) EXIST.	FUTURE	Δ	SUSPENDED SOLIDS (TNS) EXIST.	FUTURE	Δ
A	3.6	3.6	-	0.36	9.09	8.73	20.4	19.7	-0.7
B	5.4	5.3	-.1	0.54	13.23	12.7	31.0	28.7	-2.3
C	7.7	6.4	-1.3	0.77	16.1	15.3	44.4	349	-9.5
D	15.3	10.2	-5.1	1.53	25.5	39.1	88.1	55.3	-32.8
E	32.5	16.8	-15.7	3.25	42.1	38.8	186.8	91.2	-95.6
F	69.3	32.7	-36.6	6.93	81.6	74.7	398.4	177	-221.5
G	198.1	40.9	-57.2	9.81	102.3	92.5	564	221.7	-342.2
H	123.4	53.8	-69.6	12.3	134.6	122.3	709	291	-417

Soild analysis: MAX. RELEASE = 291 TONS / 92 AC = 3.2 TN/AC = E

SEVERITY RATING - based on EROSION STANDARDS FOR Oahu:

$(2FT + 3D)AE = (2 \times 4 \times 1 \text{ YR} + 3 \times 2)(92)(3.2) = 4,121$

4,121 << 50,000 average severity rating for Oahu
~ 8¼ %

Where: F = down slope damage factor = 4 - maximum value
T = duration = 1 YR
D = WATER QUALITY FACTOR CLASS A = 2
A = area in acres

APPENDIX C

FAUNA REPORT

SURVEY OF THE AVIFAUNA AND FERAL MAMMALS AT THE PROPOSED CAMPBELL INDUSTRIAL PARK SUBDIVISION, EWA, OAHU

Prepared for

Belt Collins and Associates

by

Phillip L. Bruner
Assistant Professor of Biology
Director, Museum of Natural History
BYU-H
Laie, Hawaii 96762

17 January 1990

SURVEY OF THE AVIFAUNA AND FERAL MAMMALS AT THE PROPOSED CAMPBELL INDUSTRIAL PARK SUBDIVISION, EWA, OAHU

INTRODUCTION

The purpose of this report is to summarize the findings of a one day (13 January 1990) bird and mammal field survey at the proposed Campbell Industrial Park Subdivision, Ewa, Oahu. 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 of 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 scrubby second growth patches of trees and brush as well as open areas exposed to flooding. The dominant plants in the area are: Kiawe (*Prosopis pallida*), Indian Pluchea (*Pluchea indica*), Naio (*Myoporum sandwicense*) and Pickleweed (*Batis maritima*).

Weather during the field survey was generally clear with some brief cloudy periods. Winds were NE trades.

STUDY METHODS

Field observations were made with the aid of binoculars and by listening for vocalizations. 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 were also kept. These counts provide the basis for the population estimates given in this report.

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 1989), Field Guide to the Birds of 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 region of Oahu was apparently inhabited by a variety of endemic birds in the past given the fossil evidence recovered from "sink-holes" (pers. comm. A. Ziegler-soologist 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 Campbell Industrial Park property in the distant 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 and human disturbance.

Migratory Indigenous (Native) Birds:

Only two species of migratory shorebird were found during the survey. the Pacific Golden Plover (Pluvialis fulva) and Wandering Tattler (Heteroscelus incanus). 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 16 plover were recorded on the survey. Time did not permit a determination of how many of these plover were territorial residents. A total of two Wandering Tattler were observed on the shoreline fronting the property. It is not known if this species is territorial or site-faithful. The only other likely migratory species that may occur along the shoreline at this site is the Ruddy Turnstone (Arenaria interpres).

Exotic (Introduced) Birds:

A total of 13 species of exotic birds were found during this field survey. This compares with 17 exotic species found on nearby lands (Bruner 1989a, 1989b). Table One shows the species recorded and their relative abundance. The most abundant species were Zebra Dove (Geopelia striata), Red-vented Bulbul (Pycnonotus cafer), and Japanese White-eye (Zosterops japonicus). Exotic species not recorded on the actual survey but which potentially could occur at this locality include: Japanese Bush-warbler (Cettia diphone), Ring-necked Pheasant (Phasianus colchicus),

Chestnut Mannikin (Lonchura malacca), Cattle Egret (Bubulcus ibis), Red Avadavat (Amandava amandava) and Barn Owl (Tyto alba)(Bruner 1989a, 1989b).

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 documented (Williams 1983, Williams and Giddings 1984, and Williams and Evenson 1985).

Java Sparrow (Padda oryzivora) have also experience 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. 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 bires one would expect at this elevation and in this type of environment on Oahu.

2- Doves and finches should 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.

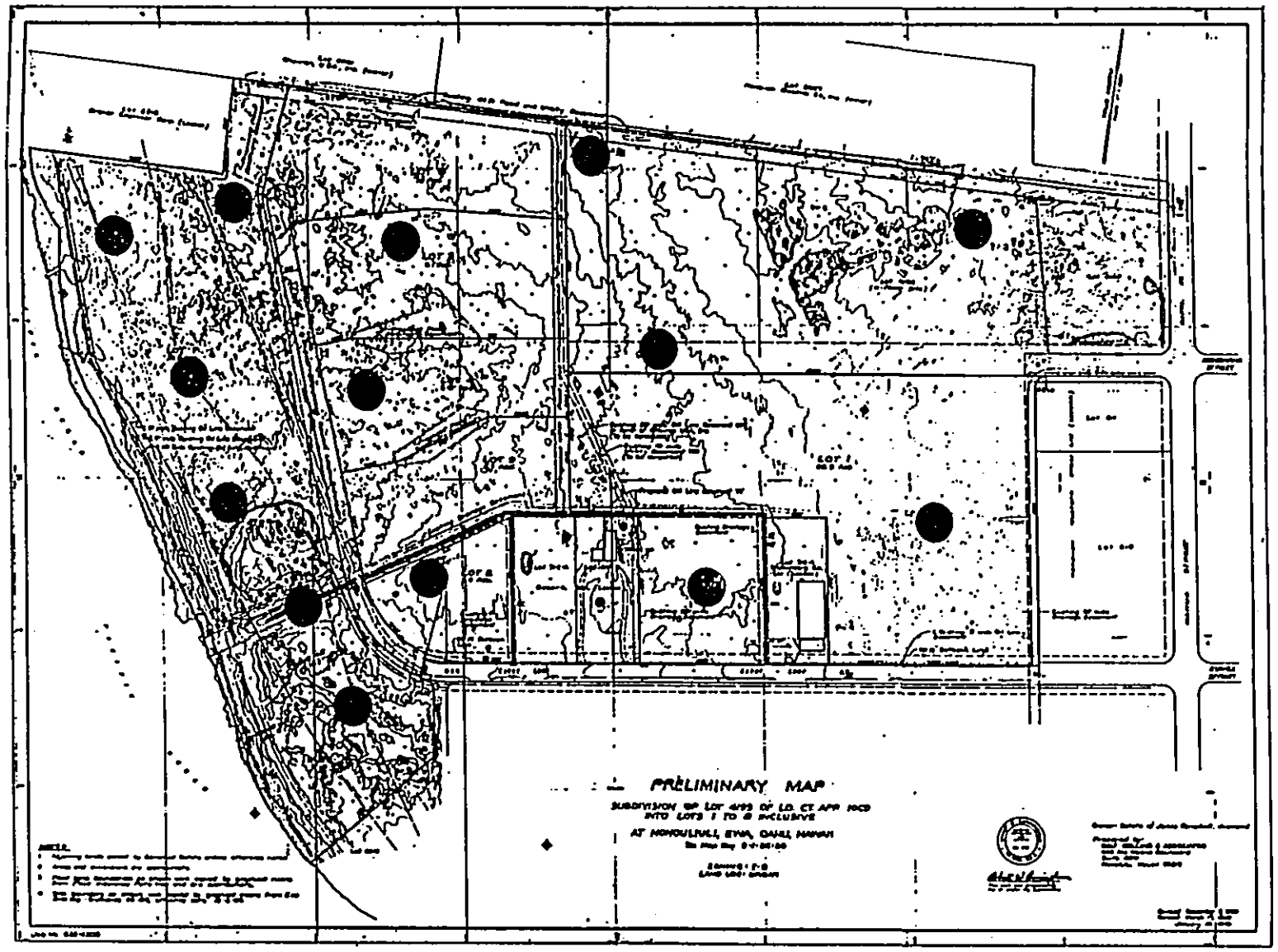

Fig. 1. Project site with eight minute census (count) stations indicated by solid circles.

TABLE 1

Relative abundance of exotic birds at the Campbell Industrial Park Subdivision, Ewa, Oahu.

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE*
Spotted Dove	Streptopelia chinensis	U = 4
Zebra Dove	Geopelia striata	A = 12
Common Myna	Acridotheres tristis	U = 2
Red-vented Bulbul	Pycnonotus cafer	A = 13
Northern Mockingbird	Mimus polyglottos	R = 1
Northern Cardinal	Cardinalis cardinalis	U = 2
Red-crested Cardinal	Paroaria coronata	R = 2
Japanese White-eye	Zosterops japonicus	A = 10
House Sparrow	Passer domesticus	R = 2
House Finch	Carpodacus mexicanus	C = 8
Java Sparrow	Padda oryzivora	R = 50
Common Waxbill	Estrilda astrild	C = 6
Nutmeg Mannikin	Lonchura punctulata	C = 6

* (see page 11 for key to symbols)

KEY TO TABLE 1

Relative abundance = number of individuals observed during walking survey or frequency on eight minute counts in appropriate habitat.

A = abundant (10+) on 8 min. counts

C = common (5-10) on 8 min. counts

U = uncommon (less than 5) on 8 min. counts

R = recorded but not on 8 min. counts (number which follows is the total recorded over the course of the entire survey)

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APPENDIX D

MARINE REPORT

APPENDIX E

PLANT SANCTUARY AGREEMENTS

MARINE ENVIRONMENTAL BASELINE SURVEY

TO ASSESS THE EFFECTS OF DRAINAGE DISCHARGE

FROM THE CAMPBELL INDUSTRIAL PARK SUBDIVISION

Prepared for

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by

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March 13, 1990

INTRODUCTION

Purpose

Planning is currently underway for developing approximately 65 acres of land located within Campbell Industrial Park. The proposed site, bounded by Kaomi Loop and Hanua Street, is to be divided into eight (8) lots and developed for industrial use. With such development, it has been estimated that drainage runoff will increase about 3-fold over the present situation. To accommodate the increase, a drainage system will be installed within the industrial site to transport runoff to an existing drainage channel. The existing channel is adequate to handle the increase in flow, but a multiple pipe culvert consisting of 5-36" concrete pipes is required to pass the flow under the new road. Development of the existing channel on the downstream side of the culvert would also be required to provide an outlet for the runoff. The channel should be cut and graded down to the ocean resulting in a new ocean outfall discharging at the shoreline.

Such a modification in the existing drainage pattern has the potential to result in modification of the nearshore marine environment owing to increased input of freshwater, particulate material (silt), and dissolved materials (primarily nitrogen and phosphorus). The purpose of this report is to present the results of a baseline survey designed to evaluate the potential effects on water quality and marine biological community structure resulting from modification of the existing drainage pattern. The baseline evaluation includes description of the environments directly offshore of the drainage outfall, as well as neighboring areas that may be influenced by water quality changes caused by drainage discharge. The baseline survey can also serve as the preliminary phase of any monitoring programs that may be required to meet all requirements for permit approval by county, state and federal government agencies.

Specific Objectives

1) to characterize, in both qualitative and quantitative terms, water quality in the vicinity of the existing and proposed drainage outfall at Campbell Industrial Park. Chemical composition of the environment will be evaluated by analysis of all parameters specified by State of Hawaii, Department of Health water quality standards (Chapter 11-54 S11-54-06 (3)), as well as several other parameters that are not listed by DOH, but provide important information. Of particular importance will be potential changes that may result from sediment and freshwater carried to the ocean during storm events.

2) to establish a descriptive baseline of biotic communities in the vicinity of the existing and proposed drainages.

3) to evaluate the degree of natural stresses (sedimentation, wave scour, freshwater input, etc.) that influence the nearshore marine environment in the vicinity of the proposed project. Typically, the composition of nearshore marine communities is intimately associated with the magnitude and frequency of these stresses, and any impacts caused by the proposed project may be mitigated in large part by natural environmental factors. Therefore, evaluating the range of natural stress is a prerequisite for assessing the potential for additional change to the marine environment owing to shoreline modification;

4) To assess the probable effects of construction of the proposed ocean outfall and increased drainage on water chemistry and marine biota in the area.

ANALYTICAL METHODS

Water Quality

All field work was conducted on February 24-25, 1990. Figure 1 is a sketch showing Campbell Industrial Park and the location of the proposed ocean drainage outfall. The location of 2 survey transects sites are also shown. Sites are located directly off the drainage outfall as well as approximately 500 meters (m) to the north. At each of the ocean sampling sites a series of chemical stations were established on transects perpendicular to the shoreline; samples were collected at 5 distances from the shoreline (0.1, 1, 10, 50 and 100 m from shore). Such sampling spanned the greatest range of salinity with respect to freshwater efflux at the shoreline. At each site, with the exception of the two most shoreward, two samples were collected; a surface sample from within 10 centimeters (cm) of the air-sea interface, and a deep sample approximately 1 m from the sea floor.

Water quality parameters evaluated included the 10 specific criteria designated for open coastal waters in Chapter 11-54, Section 06 (Open Coastal waters) of the Water Quality Standards, Department of Health, State of Hawaii. These criteria include: *total nitrogen, nitrate + nitrite nitrogen* ($NO_3^- + NO_2^-$), ammonium (NH_4^+), total phosphorus, chlorophyll a (Chl a), turbidity, dissolved oxygen, temperature, pH and salinity. In addition, orthophosphate phosphorus (PO_4^{-3}) and silica (Si) were also reported because these parameters are sensitive indicators of biological activity and the degree of groundwater mixing, respectively.

Water samples were collected in 1-liter polyethylene bottles. Subsamples for nutrient analyses were filtered in the field through glass-fiber filters into 125-milliliter (ml) acid-washed, triple rinsed, polyethylene bottles and immediately placed on ice. Analysis for NH_4^+, PO_4^{3-}, and $NO_3^- + NO_2^-$ were performed using manual spectrophometric techniques on a fiber optic colorimeter. Total nitrogen (TN) and total phosphorus (TP) were analyzed in a similar fashion following ultra-violet digestion. Dissolved inorganic nitrogen (DON) and dissolved inorganic phosphorus (DOP) were calculated as the difference between total dissolved and dissolved inorganic N and P. The chemistry procedures were according to standard methods for seawater analysis (Strickland and Parsons 1968).

Water for other analyses was subsampled from 1-liter polyethylene bottles and kept chilled until analysis. Turbidity was determined on 60-ml subsamples fixed with HgCl to terminate biological activity. Fixed samples were kept refrigerated until turbidity was measured on a Monitek Model 21 nephelometer, and reported in nephelometric turbidity units (NTU) . Chl. a was measured by filtering 300 ml of water through glass fiber filters; pigments on filters were extracted and assessed fluorometrically. Salinity was determined using a AGE Model 2100 laboratory salinometer with a readability of 0.0001 $^{o}/_{oo}$.

In-situ field measurements included dissolved oxygen and water temperature (YSI Model 58 meter with a readability of 0.01 milligrams per liter (mg/l) and 0.1^{o} C. , respectively). pH was determined in the field with a Cole-Parmer Digisense millivolt meter with a readability of 0.001 pH units.

Biological Community Structure

Sea conditions during the present survey were characterized by 4-6 ft. breaking waves over the reef platform. As a result of the extreme water motion associated with the surf, quantitative reef community transecting methods were not possible. Qualitative reconnaissance surveys covering the area offshore of the region where drainage from the proposed channel would empty were conducted by divers swimming from shore out to approximately the 10 m depth contour. These reconnaissance

surveys were useful in making relative comparisons between areas, identifying any unique or unusual biotic resources, and providing a general picture of the physiographic structure and benthic assemblages occurring throughout the region of study.

RESULTS

Physical Structure

The shoreline area off Campbell Industrial Park is composed of a steep white sand beach bounded on the shoreward side by scrub vegetation. The intertidal zone is composed of a calcium carbonate bench predominantly covered by benthic algal mats and associated bound sediment. Width of the bench is approximately 10-15 m, and during low tidal stands, the bench is emergent. At the seaward edge of the intertidal bench, the reef surface drops to a depth of approximately 1-3 m below the wash of waves. A broad reef flat extends approximately 100-200 m seaward. The reef flat is characterized by numerous calcium carbonate projections that reach to the sea surface. The shallow depth of the reef flat, as well as the predominance of high-relief reef structures suggests the area is an erosional remnant of the extensive geologically ancient emergent reef which forms much of central Oahu. Predominant benthic organisms on the reef flat are algae; reef corals were scarce and limited to less than 1% of bottom cover.

The seaward edge of the reef flat is marked by a second terrace, similar in structure to the intertidal region, but with a deeper bottom (2-4 m). The outer terrace forms a shoal which absorbs most of the energy of breaking waves. As a result of the frequent concussive energy and elevated water motion, attached benthos on the outer reef terrace is restricted to flat encrustations of algae. Poor visibility during the present survey prevented observations of the deep reef zones beyond the outer reef terrace.

Water Chemistry

Table 1 shows results of water chemistry analyses at all of the Campbell Industrial Park sampling sites shown in Figure 1, as are specified limits of water quality parameters set forth by the Department of Health for coastal waters. Figure 2 shows plots of nine of the parameters as functions of distance from the shoreline.

Water chemistry sampling was conducted during a period of approximately 7 days of continually rainy weather. Sampling was conducted during this period because it approximates the marine conditions that will occur during runoff from the planned drainage of the Industrial Subdivision. With respect to salinity, it can be seen in Figure 2 that salinity tends to increase with distance from shore, with the lowest sample value directly off the existing drainage culvert. Turbidity, chlorophyll a, DON and DOP showed no apparent pattern with respect to distance from the shoreline. NO_3^+, Si, and PO_4^{3-}, are parameters that are present in high concentration in groundwater relative to ocean water. Plots of these nutrients do not show indications of groundwater efflux as concentrations near the shoreline are lower than offshore values. The pattern of increasing concentration of salinity, NO_3^+, Si, and PO_4^{3-} suggests that rainwater runoff is entering the marine environment at the shoreline and is mixed with ocean water by wave and current action within the nearshore zone (i.e. 100 m from shore). NH_4^+ values at the 0.1 m distance from shore at both transects was elevated relative to all other locations. NH_4^+, is generally not present in groundwater, but is a preliminary breakdown product of organic material. Beyond the 0.1 m samples, concentrations of NH_4^+ were uniformly low, and displayed no pattern with respect to distance from shore. Dissolved oxygen, temperature, and pH, while not

surveys were useful in making relative comparisons between areas, identifying any unique or unusual biotic resources, and providing a general picture of the physiographic structure and benthic assemblages occurring throughout the region of study.

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represented graphically, do not display any pattern with respect to distance from the shoreline. None of the chemical parameters displayed any degree of vertical stratification; an expected result owing to the high degree of mixing of the water column by the rough surf.

When comparing water sample results with Department of Health water quality standards (Table 1), it can be seen that geometric mean values for parameters (except Chl. a at transect 2) are below the mean DOH standards. Only one sample in the data set (NH_4^+ at CIP-1-1) exceeded the "not to exceed more than 10% of the time" criteria, while no samples exceeded any of the "not to exceed more than 2% of the time criteria. As stated above, sampling was conducted following a period of moderate rain, so the overall compliance with DOH criteria suggests that runoff in the area presently is not resulting in substantial impacts to water quality.

Marine Biota

As described in the section above on physical structure of the nearshore environment, biological communities on the reef flat are characterized predominantly by benthic algae. Owing to the strong surge and concussive force of wave action, corals and unattached fauna are relatively rare. On the subtidal bench, corals were not present. On the reef flat, observed coral species were limited to Porites lobata, Pocillopora meandrina and Montipora patula. Most observed colonies of P. lobata and M. patula were flat encrustations, while P. meandrina occurred in the typical hemispherical growth form. Coral cover across the entire reef flat never exceeded 1% of bottom cover, and in most areas was even less.

Other invertebrates observed in the intertidal and reef bench zones included the sea urchins Echinometra matheai, Echinostrephus aciculatum, and Tripneustes gratilla. The former two species were generally found within interstitial grooves bored into the limestone substratum. T. gratilla, occurred predominantly in depressions on the reef surface, where the individuals were somewhat sheltered from water motion from breaking waves.

Fishes observed during the qualitative reconnaissance surveys on the subtidal bench were limited to the wrasse, Thallosoma duperry, the goatfish, Parupeneus multifasciatus, and the surgeonfish, Acanthurus blochii and A. nigrofuscus. On the reef bench, in addition to the above species, aholehole, Kulia sandvicensis, and mullet, Neomyxus chaptalii were also observed. None of the observations of fishes consisted of large numbers of individuals, and in general the entire area was devoid of most common reef fishes.

The most dominant taxa observed in all areas of the nearshore environment were various species of benthic algae. While virtually the entire calcium carbonate surface is covered with a thin multi-species algal turf, several species of fleshy algae were abundantly observed. These species included Halimeda discoidea, Codium spp., Asparagopsis taxiformis, Amphiroa fragilissima, Dictyota spp., Acanthophora specifera, Enteromorpha spp., and Ulva spp. Encrusting calcareous alga of the genera Peyssonellia, Hydrolithon, and Porolithon were abundant throughout the reef bench.

DISCUSSION

The purpose of this assessment is to apply the results of the survey to an analysis of the effects of potential pollutants, should they enter the ocean through the planned drainage system for the expansion of Campbell Industrial Park. In order to assess the effects of discharge, it is necessary to have an idea of the magnitude of change associated with the discharge relative to existing conditions. To address this issue a "Storm Drainage Discharge Analysis" was prepared by Belt, Collins &

Associates. Using appropriate methodology, this analysis estimates the discharge of nitrogen, phosphorus and suspended solids to the ocean under existing and developed conditions for various storm events ranging in duration from 1 to 24 hrs. and with intervals of 2 to 100 yrs. recurrence.

Based on the calculations in the drainage report, it appears that nitrogen and suspended solids output to the ocean will decrease under developed conditions relative to existing conditions, under all theoretical storm regimes. Net decreases in material discharge increase in magnitude with the severity of the storm; thus the most intense storm show the largest relative decrease in runoff of nitrogen and suspended solids. As it has been observed that the most damage events to marine communities are often infrequent, but high intensity events, it appears that the proposed action will not only cause no impacts from runoff of nitrogen and suspended solids, but may actually improve the potential for such damage compared to existing conditions. As such, there is no potential for environmental degradation from nitrogen and suspended solids runoff.

Storm drainage estimates for phosphorus runoff increase for the proposed development relative to existing conditions, primarily owing to increases of concentrations of 1.5 lb/ac.ft. following development compared to 0.16 lb/ac.ft. under present conditions. These increases result in a net increase in phosphorus runoff from the 93 acre parcel of from 8.7 lbs. for the 1 hr., 2 yr. interval storm, to a net increase of 122.3 lb. for the 24 hr., 100 yr. interval storm.

In order to estimate what the effects to water quality would be under the scenarios described above, several assumptions have been made. The receiving environment is assumed to be the nearshore reef flat extending 100 m from shore, with an average depth of 2 m. and a width along the shoreline of 1,000 m. Using the mean total phosphorus concentration of 0.33 uM (Table 1), the total phosphorus content of the receiving environment is 4.36 lbs. A net increase of 122.3 lbs. under the most severe storm conditions therefore represents a 28 fold increase over existing conditions. Such an increase in a static water column would result in a concentration of 9.24 uM. DOH standards for the "not to exceed more than 2%" of the time are 11.29 uM for total P. Therefore, for a storm that occurs for one day once every 100 years, the increased concentration could remain at 9.24 uM for 730 days (2% of the 100 years), before water quality standards would be violated. Such an occurrence is highly unlikely, as mixing in the receiving environment is generally vigorous, and never stagnant. Applying the same rationale to the least intense storm event (1 hr., 2 yr. recurrence), phosphorus loading would double (from 4.36 lbs. to 8.73 lbs.). In terms of concentration in the receiving environment, the mean observed value of 0.33 uM would double to 0.66 uM. Comparing this value to the DOH mean value of 0.64 uM indicates that such an event would barely result in exceedence of the most stringent DOH water quality standard.

The calculations above are made assuming a static water column (no current movement). Assuming a normal current velocity for the area of 0.25 kt (12.5 cm/sec.) provides for a more realistic estimate of the effects of the projected increased discharge of phosphorus. Assuming current is unidirectional, the receiving water parcel (1000 m x 100 m x 2 m) will have an exchange period of 2.2 hrs., or 10.9 turnovers per day. If the "worst case storm scenario" increase of 122.3 lbs. of phosphorus is discharged over 24 hrs., 11.3 lbs. will be discharged per turnover cycle. Evenly distributed over the receiving water parcel, the discharge would result in an increase of mean phosphorus from 0.33 uM to 1.15 uM. This concentration is above the allowable geometric mean in the DOH standards, but below the "not to exceed more than 10% of the time" standard. As this occurrence would theoretically take place once every hundred years, there is little probability of violating DOH standards. The same scenario for the lowest intensity storm results in a increase in mean phosphorus concentration to 0.39 uM, well below the DOH geometric mean limit of 0.64 uM.

While the parameters used in the above arguments are somewhat arbitrary, they present a general perception of order of magnitude changes that are likely to occur under the development scenario. In

all cases, it appears that the potential change to water quality, and hence to marine community structure, from the proposed development is extremely remote. While the drainage report does not address the changes in fresh water discharge, it has been estimated that discharge volume will increase by approximately 3-fold. In many areas of the Hawaiian Islands, freshwater (groundwater), enters the marine environment at the shoreline as a natural occurrence. Such discharges do not appear to affect marine communities for several reasons. In most marine environments, physical mixing is rapid and continual, especially in the nearshore surf zone. Thus, freshwater is rapidly mixed with ocean water, and the depressed salinity is restricted to a narrow zone, that is generally not inhabited by diverse marine communities. In addition, in areas where mixing is not complete within the intertidal zone, freshwater forms a surface lens owing to decreased density relative to sea water. The surface lens generally does not extend to the sea floor, which is the site of most biotic assemblages. Thus, even in areas where freshwater efflux (without accompanying sediment loading) occurs at the shoreline, there is little potential for impacts to marine communities. There is no reason to suspect that the scenario at Campbell Industrial Park should result in adverse environmental impacts owing to an increase, or concentrating effect, of freshwater as it enters the ocean.

SUMMARY AND CONCLUSIONS

1. The physical regime of the marine environment offshore of the proposed drainages for the Campbell Industrial Park Subdivision is characterized by a intertidal limestone bench, and a broad reef flat interspersed with erosional features. The reef flat terminates in a seaward terrace which absorbs much of the energy of breaking waves.

2. Water chemistry profiles on two transects extending from the shoreline out to the seaward margin of the reef flat collected during a period of prolonged rainfall show increasing values of salinity, NO_3^-, Si, and PO_4^+, with increasing distance from shore. The profiles are not characteristic of groundwater efflux, but rather of rainwater drainage. Other water chemistry parameters showed no pattern with respect to distance from shore. Water chemistry parameters showed no indications of vertical stratification owing to vigorous mixing by wave action. With one exception, respectively, all means of water chemistry parameters from each transect, as well as all individual measurements, are within the compliance limits of DOH water quality standards.

3. Marine communities in the nearshore reef flat zone and intertidal area are sparse, except for benthic algae. Reef corals are limited in abundance, most likely owing to physical stress from breaking waves. Reef fish can also be considered scarce in abundance during the regime of high surf that prevailed during the survey.

4. Storm drainage engineering analyses for a range of design storms indicates that dissolved nitrogen and suspended solids loading will decrease under the planned development scenario compared to the present situation of undeveloped lands. As a result, there is little or no potential for environmental damage from these two parameters following construction of the Industrial Subdivision. Even though water chemistry analysis indicated that these parameters (nitrogen and suspended solids) were not near the level of providing negative impacts to the marine environment under present, undeveloped conditions, the proposed development may actually improve the potential for pollution to the marine environment from severe storm events.

5. Engineering analyses suggest that dissolved phosphorus loading may increase a maximum of 28-fold compared to present conditions following a 24 hr. 100 yr. frequency design storm. While such increases appears to be substantial with the potential to impact water quality, considerations of mixing of the material within the nearshore zone, and infrequency of subsidies (i.e. once in 100 yrs) show that the increases are not sufficient to cause the receiving waters to exceed most DOH

standards. As these standards are set to define acceptable conditions of open coastal waters, it appears that the proposed project has little potential to result in negative alterations to water quality. Likewise, while freshwater discharge is expected to increase up to 4-fold following construction, there is little potential for impacts owing to both mixing during periods when surf prevails, or density stratification during calm periods, which would prevent freshwater from affecting benthos.

6. With little or no impact to water quality, there is also little potential to impact marine biological community structure. Impacts to community structure would be difficult to achieve in any event, owing to the extreme natural stresses applied to communities as a result of frequent impacts from winter surf that routinely occurs in the area.

TABLE 1. Water quality parameters from stations offshore of the Campbell Industrial Park Subdivision.
For station locations, see Figure 1.

STATION SAMPLE ID	DISTANCE FROM SHORE (m)	PO4 (uM)	NO3 (uM)	NH4 (uM)	SI (uM)	DOP (uM)	DON (uM)	TDP (uM)	TDN (uM)	TURB (NTU)	SALINITY (o/oo)	CHL. a (ug/l)	OXYGEN (% sat)	TEMP. (deg. C.)	pH
CIP-1- 1	0.1	0.12	0.13	0.90	2.26	0.20	4.40	0.32	5.43	0.37	34.303	0.67	88.5	22.5	8.17
CIP-1- 2	1	0.12	0.13	0.03	1.67	0.19	3.60	0.31	3.76	0.30	34.591	0.18	82.3	22.6	8.17
CIP-1- 3-S	10	0.13	0.13	0.20	2.85	0.19	3.92	0.32	4.25	0.30	34.642	0.36	87.8	23.0	8.17
CIP-1- 3-D	10	0.12	0.16	0.01	1.86	0.19	4.15	0.31	4.32	0.28	34.665	0.38	85.1	22.9	8.17
CIP-1- 4-S	50	0.13	0.21	0.01	1.86	0.19	3.69	0.32	3.91	0.34	34.699	0.48	87.2	22.9	8.17
CIP-1- 4-D	50	0.15	0.21	0.01	1.86	0.20	3.75	0.35	3.97	0.41	34.701	0.08	87.2	22.8	8.17
CIP-1- 5-S	100	0.16	0.24	0.01	1.86	0.19	3.82	0.35	4.07	0.29	34.734	0.21	86.6	22.9	8.18
CIP-1- 5-D	100	0.18	0.24	0.01	1.86	0.21	5.62	0.39	5.87	0.34	34.722	0.20	87.2	22.8	8.17
CIP-1- GEOM. MEAN		0.14	0.18	0.03	1.98	0.19	4.08	0.33	4.39	0.33	34.632	0.27	86.5	22.8	8.17
CIP-1- ST. DEV.		0.02	0.05	0.29	0.35	0.01	0.62	0.03	0.72	0.04	0.132	0.18	1.8	0.2	0.00
CIP-2- 1	0.1	0.13	0.26	0.45	1.27	0.19	4.36	0.32	5.07	0.44	34.665	0.47	92.0	22.9	8.20
CIP-2- 2	1	0.13	0.11	0.01	0.87	0.20	3.92	0.33	4.04	0.34	34.673	0.21	89.6	23.1	8.16
CIP-2- 3-S	10	0.12	0.16	0.01	1.27	0.19	3.64	0.31	3.81	0.40	34.671	0.38	85.4	23.1	8.16
CIP-2- 3-D	10	0.13	0.16	0.01	1.07	0.18	4.00	0.31	4.17	0.33	34.673	0.42	84.7	23.1	8.16
CIP-2- 4-S	50	0.13	0.19	0.01	1.27	0.18	3.82	0.31	4.02	0.32	34.678	0.34	85.1	23.1	8.14
CIP-2- 4-D	50	0.13	0.19	0.08	2.66	0.18	3.41	0.31	3.68	0.32	34.672	0.27	86.6	23.0	8.14
CIP-2- 5-S	100	0.15	0.19	0.15	1.67	0.17	3.73	0.32	4.07	0.30	34.679	0.29	86.0	23.2	8.15
CIP-2- 5-D	100	0.15	0.19	0.01	2.85	0.18	6.92	0.33	7.12	0.38	34.683	0.35	89.6	23.2	8.14
CIP-2- GEOM. MEAN		0.13	0.18	0.03	1.49	0.18	4.12	0.32	4.40	0.35	34.674	0.33	87.3	23.1	8.16
CIP-2- ST. DEV.		0.01	0.04	0.14	0.69	0.01	1.05	0.01	1.06	0.04	0.005	0.08	2.5	0.1	0.02
DOH WATER QUAL. STDS.															
GEOMETRIC MEAN			0.36	0.25				0.64	10.71	0.50		0.30			
NOT TO EXCEED 10%			1.00	0.61				1.29	17.85	1.25		0.90			
NOT TO EXCEED 2%			1.78	1.07				11.29	25.00	2.00		1.75			

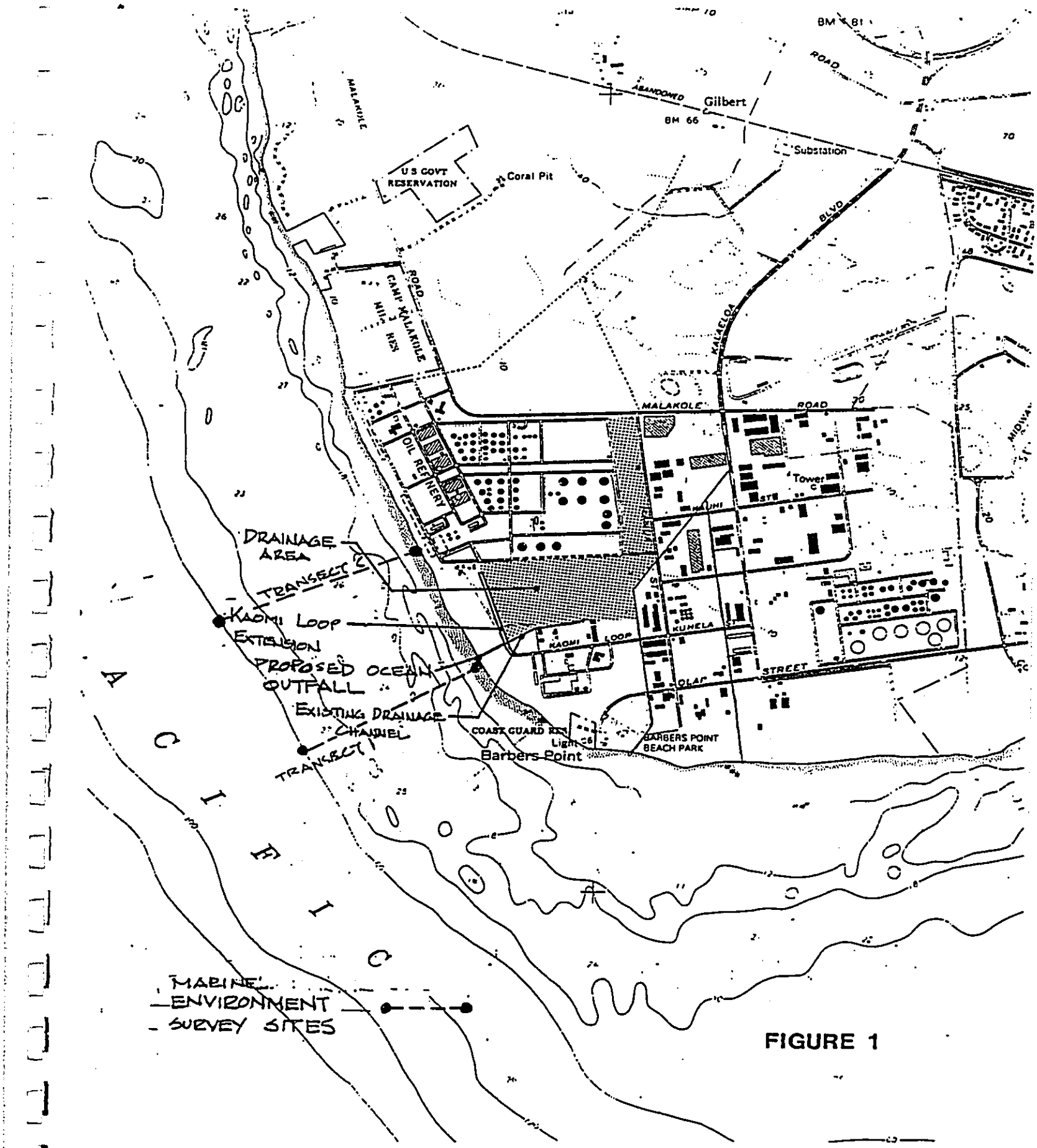

BM 81
ROAD
ABANDONED
Gilbert
BM 66
Substation
U S GOVT RESERVATION
Coral Pit
BLVD
KALAELOA
CAMP MALAKOLE
MALAKOLE
ROAD
OIL REFINERY
Tower
KAOMI LOOP
KUHELA
STREET
OLAI
DRAINAGE AREA
TRANSECT
KAOMI LOOP EXTENSION
PROPOSED OCEAN OUTFALL
EXISTING DRAINAGE CHANNEL
TRANSECT
COAST GUARD
Barbers Point
BARBERS POINT BEACH PARK
PACIFIC
MARINE ENVIRONMENT SURVEY SITES

FIGURE 1

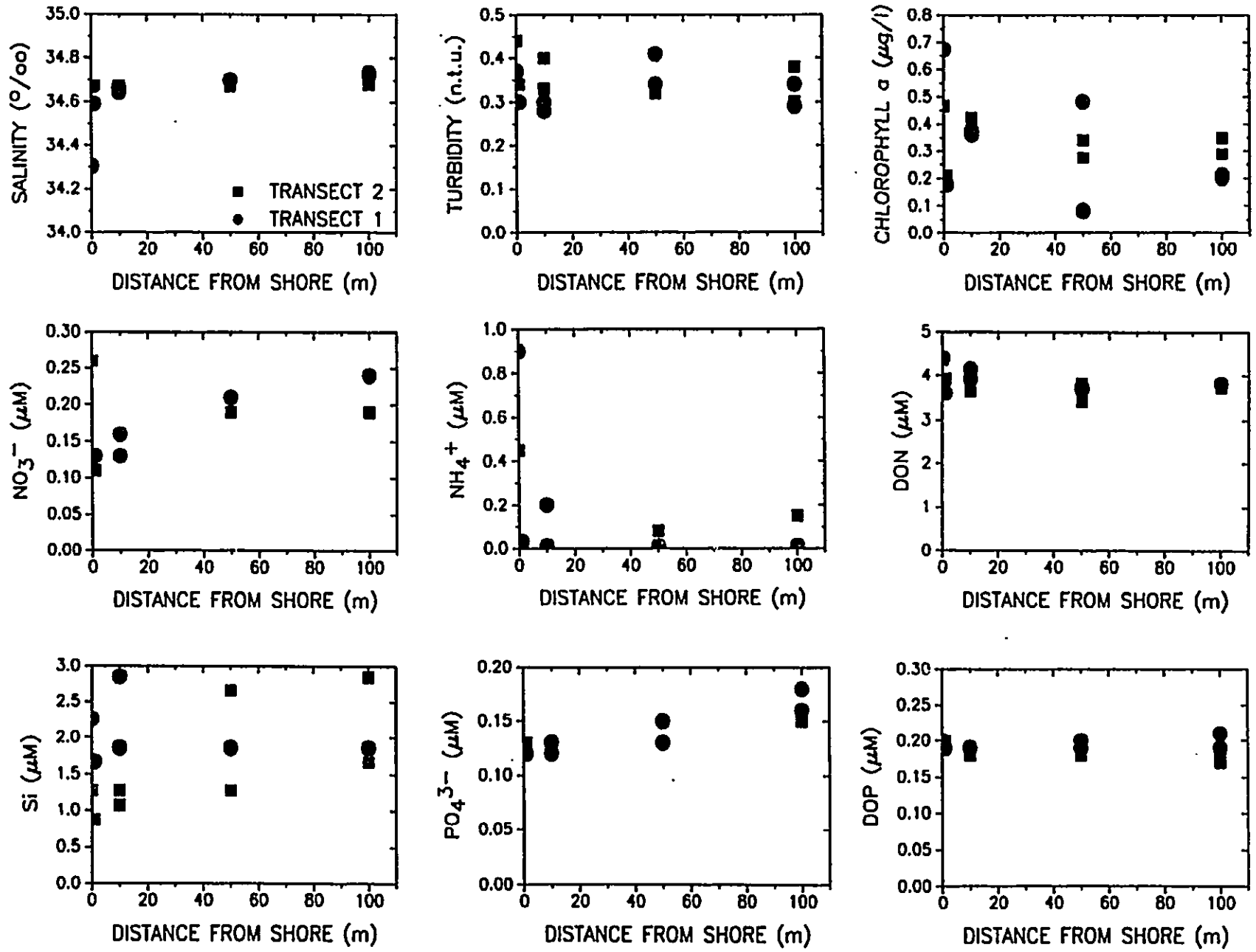


FIGURE 2. Plots of 9 water chemistry parameters on transects off the proposed Campbell Industrial Park Industrial Subdivision as functions of distance from shore. For locations of transects, see Figure 1.

APPENDIX F

PLANT SANCTUARY AGREEMENTS

JOHN WAIHEE
GOVERNOR OF HAWAII

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

March 1, 1990

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

DEPUTIES

KEITH W. AHUE
MOKUHU TAGOMORI
RUSSELL N. FUKUMOTO

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

In reply, please refer to:
REF:DOFAW

Mr. Warren Haight
Hawaii Project Management, Inc.
Suite 1465, Central Pacific Plaza
220 S. King Street
Honolulu, HI 96813

Dear Mr. Haight:

Enclosed is an approved Mitigation Plan for Achyranthes rotundata plants at Campbell Industrial Park. The Mitigation plan details the activities Hawaii Project Management as lessee, and Campbell Estate as land owner, have agreed to do in protecting the Achyranthes rotundata plants located at Campbell Industrial Park.

I want to thank you and the Estate for their patience and interest in protecting Hawaii's unique natural resources.

Sincerely,

WILLIAM W. PATY

Enclosure

MITIGATION PLAN FOR ACHYRANTHES ROTUNDATA PLANTS AT CAMPBELL INDUSTRIAL PARK

APPROVED:

Michael G. Buck 2/29/90

MICHAEL G. BUCK, Administrator
Division of Forestry and
Wildlife

APPROVED:

Kirk W. Kline

WILLIAM W. PATY, Chairperson
Department of Land and
Natural Resources

PREPARED BY:
HAWAII PROJECT MANAGEMENT, INC.
(February 1990)

MITIGATION PLAN FOR ACHYRANTHES ROTUNDATA PLANTS AT CAMPBELL INDUSTRIAL PARK

INTRODUCTION:

Achyranthes rotundata (Hbd.) St. John (syn.: A splendens var. rotundata Hbd.), a member of the amaranth family, is currently listed by the U.S. Fish and Wildlife Service as a Rare and Endangered Species (Anon., 1986) and is thus protected by both Federal and State regulations. Very small populations occur in several localities within Campbell Industrial Park and at Kaena Point but the largest occurs in the vacant land mauka of Kaomi Loop, between the C. Brewer Ultramar plant and the Hawaiian Cement Corp. plant at Campbell Industrial Park.

Hawaii Project Management, Inc., the applicant herein, is the present leasee of the parcel upon which the main Achyranthes population exists. The applicant intends to use a portion of the land which could be detrimental to the integrity of the population. As an alternative to a "no development" stance, conservation options involving minimizing impacts by limiting the degree and magnitude of disturbance, rectifying the impact by rehabilitating and restoring portions of the plant's natural habitat, and reducing the impact by preserving and maintaining existing plant populations until the species is no longer listed as threatened or endangered are proposed. Pursuant to this proposal, the subject Mitigation Plan for the propagation and continued maintenance of Achyranthes has been prepared with the State Department of Land and Natural Resources, Division of Forestry and Wildlife. This document reviews the horticultural history of the species and details its propagation, cultivation and plans for its long term survival. It must be recognized that mitigation options for "taking" of endangered plants must be determined on a case by

case basis for each species. The ease of propagation and weedy nature of Achyranthes rotundata provide an opportunity for mitigative options that may not be available for other endangered species.

In an effort to preserve portions of the population within its present site, two parcels within the main population will be designated as sanctuaries and fenced. Selection of these sanctuaries has been based on density of individuals as well as integrity of remaining habitat. It should be remembered, however, that the remaining habitat is severely degraded. It is intended that all individuals outside these sanctuaries will be relocated to the C. Brewer sanctuary.

The result would be three sanctuaries totalling approximately three acres to be preserved within the present habitat of the largest existing population for so long as A. Rotundata requires federal and/or state protection as an endangered species. The plan provides for the relocation of all individuals into one of these three sites. In addition, all propagants of the current propagation trials will be transplanted into the C. Brewer (Area 1) sanctuary. Thus the total population of Achyranthes within the property in question will be greater than the current population.

CHRONOLOGY

In late 1986, the applicant applied for a permit for trial propagation and planting of the Endangered Species, Achyranthes rotundata located on the property between the C. Brewer Ultramar plant and the Hawaiian Cement Corp. plant at Campbell Industrial Park.

In February 1988 License No. P-3 was received from the Department of Land and Natural Resources, State of Hawaii, to experimentally propagate the Endangered Species. The license authorized the collection of 2000 seeds, 30 transplants and 200 cuttings and was subject to 13 special

conditions. The intent of the project has been to demonstrate the feasibility of propagating and re-establishing Achyranthes rotundata within its historical range.

The initial site selected for establishment of the nursery-grown propagants was the U.S. Navy runway clear zone area outside the fence at Naval Air Station, Barbers Point, approximately one mile from the main Achyranthes population. Due to the problems with ultimately securing this property, however, the applicant proposed a change of the relocation site from the U.S. Navy property to a parcel adjacent to the C. Brewer Ultramar plant. A new permit for this change was applied for and was issued on September 1, 1989 (License No. P-4). This new site is considered a more ideal environment as it is actually within the present habitat of the Achyranthes.

Licenses P-3 and P-4 are considered the first of several necessary permits for the implementation of all phases of the project.

PROGRESS

PHASE I: PROPAGATION TRIALS:

The propagation trials were successful. As summarized in the First Year Project Report (K. Nagata 1989) the propagation and survival rates through March 1989 were excellent. Of the 2105 propagules harvested, 1156 were successfully grown. The propagation phase of the project clearly demonstrates the feasibility of propagating this Endangered Species.

License P-3 which was due to expire in February 1989, was extended to May 1989. License P-4 granted the applicant a further extension until September 31, 1992.

Presently, contractural negotiations are underway regarding site preparation, field planting and irrigation installation. Site preparation and irrigation procedures and other management activities are detailed in Exhibit "A" attached hereto.

Ideally the nursery stock should have been field planted several months ago while in smaller containers and before reaching maturity. Presently all are in gallon containers and nearly all of the cuttings and transplants have gone through a flowering stage. The flowering process may have induced senility, resulting in a weaker planting stock. Fortunately, only a few of the seedlings had begun to flower. The applicant will plant the original stock of seedlings and cuttings from the field in Area 1. Additional cuttings originating from the nursery stock will be used for outplanting around Campbell Industrial Park..

SITE CHARACTERISTICS:

The proposed site (Area 1) occupies approximately one acre between the C. Brewer Ultramar plant and the SMA line. Vegetation and substrate are identical to those of the rest of the Achyranthes habitat. The vegetation consists of Pluchea scrub dominated by stands of Pluchea indica, P. odorata and P. x fosbergii which provides approximately 80% cover in the site. Kiawe (Prosopis pallida) is occasionally emergent through the scrub. The native naio (Myoporum sandwicense var. stellatum) is also an occasional species in this area. Three small clusters of Achyranthes totalling approximately 100 individuals are present in the site. The majority of these are seedlings less than 20 cm tall, many of which are showing severe water stress indicating high seedling mortality during the summer months.

The substrate is typical of the region. It is a raised fossil reef characterized by large coralline outcrops and sinkholes which are formed by dissolution of the limestone. Almost no true soils are found. Small amounts of organic matter accumulate in cracks and crevasses in the coral but most of the vegetation grows out of seemingly solid coral.

PLANTING PLAN:

The technique to be employed is more fully described in Exhibit "A". Spacing between individual plants will be largely determined by the size and configuration of the sinkholes. Intervals of 18-24 inches have proven to be ideal under cultivated situations at Lyon Arboretum, Waimea Arboretum and at Kamehameha School. All propagants will be labelled and planted in three contiguous colonies - cuttings in one colony, transplants in another and seedlings in the third. A drip irrigation system will be installed. Initial watering will be on a regular basis with a gradual decrease in frequency until the first rainy season when the plants can be completely weaned from irrigation.

Heavy equipment may be required to clear away the dense stands of pluchea that cover certain portions of the site. All existing Achyranthes will be clearly flagged and avoided and the shrubbery around them cut manually. The existing Achyranthes colonies will serve as a nucleus from which the new plantings will radiate. Only enough land will be cleared to accommodate the nursery stock. The remainder will be left intact. Ultimately a buffer zone of 5-10 feet of intact vegetation will be provided all along the outside of the fenceline.

MAINTENANCE:

A maintenance schedule as described in Exhibit "A" is intended to be used. The continued maintenance of the sanctuaries shall be provided by the Campbell Estate and/or the applicant (until the end of its lease) for so long as A. Rotundata remains an endangered species warranting federal and/or state protection. Maintenance will include the yearly removal of exotic plants of Areas 1, 2 and 3 and other actions deemed necessary to protect these endangered plants.

SECURITY:

Access into the site will be restricted by a chain link fence with locked gates. Public access to the site is

presently restricted on weekends by the security guard posted at the main entrance to Campbell Industrial Park and by a locked gate at Hawaiian Cement Corp.

There have been no incidents of major fires in the property. The threat of fire must surely be a constant fear to all of the businesses within the Park, especially to C. Brewer and the oil refineries. Their employees and visitors therefor must certainly be aware of the danger and adequate precautions and provisions made. The development of the sanctuary should in no way increase the fire hazard. In the unlikely event of a fire, however, the site is easily accessible to fire equipment via Kaomi Loop. A fire plan will be submitted and approved by the Division of Forestry and Wildlife.

FUTURE

In an effort to preserve and enhance portions of the population within its present site, two parcels within the main population have been designated as sanctuaries and will be fenced. At the time of fencing, a detailed census will be made on the number of individuals within each fenced area and follow up censuses will be carried out at annual intervals. Selection of these sanctuaries were based on density of individuals as well as integrity of remaining habitat. They were surveyed and sited in early 1989 and again in November and December 1989. (See Exhibits "B", "C", "D" and "E" attached hereto.)

Based on the annual wet-dry climate cycle at the area, and what appears to be a generally annual cycle for germination of seeds and growth of seedlings followed by loss of many seedlings during the dry season, it would probably be most useful to conduct such a census once a year, at the end of the dry season, in order to obtain data that could be compared from year to year. The first detailed census will be made in these areas as soon as fencing is completed. At

the moment it is estimated that there are several hundred to 1000 or more plants in each of these two areas. No active management is proposed within these two "sanctuary" areas at the present time, although over the long term, annual weeding will remove alien plant species which could encroach on the Achyranthes habitat.

A detailed census of the Achyranthes plants which occur outside the proposed fence lines around the two main natural population areas was conducted in November and December 1989 by Dr. Charles Lamoureux for the applicant. (See Exhibit "B" attached hereto.) This census identified 329 "established" individuals, i.e., all plants more than 6 inches tall, plus any plants less than 6 inches tall which had flowered or bore visible flower buds. Plants less than 6 inches tall which had no woody branches and no signs of reproductive activity were considered to be seedlings not yet established in the population. Very few of these seedlings were found at the time of the census.

It is planned that these outlying plants would be removed to Area 1 which is adjacent to the C. Brewer property, (16 of the 329 are already growing on that site). Those plants which are small enough to move successfully and rooted in soil which permits them to be transplanted will be transplanted to the Brewer site. Cuttings will be made from all other outlying plants and these cuttings will be propagated, rooted, and then transplanted at the Brewer site. This combination of techniques will provide for maintaining the integrity of the gene pool of the species which now exists at the Kaomi Loop property.

In addition to maintaining the existing populations, this plan also provides for an increase in the number of individuals of Achyranthes, both in the Kaomi Loop area and elsewhere. In the sanctuary areas populations should be maintained and perhaps even increased by natural

regeneration by natural seeding and seedling establishment. In the "out-plant" site active efforts can be made to scatter seeds and promote seedling growth.

The result of these activities will be three sanctuaries to be preserved by Campbell Estate or its leasees for so long as these endangered plants require state and/or federal protection. All plants will be relocated into one of the three sanctuaries and all of the nursery stock will be planted in the C. Brewer site. The result will be a population larger and more secure than the present one.

Nursery operations will also be undertaken to provide additional plants grown from seeds or cuttings which can be used in landscaping in the Campbell Industrial Park. If regulations permit, plants could be made available through the nursery trade for landscaping uses throughout the islands. Given the current interest in using plants in Hawaiian landscaping which require little water and have great drought resistance, this species should be a highly desirable addition to Hawaiian gardens.

The combination of approaches described here should offer the continued survival in situ of the last major population, while at the same time providing for the maintenance of the total diversity of the current gene pool, and offering an opportunity to increase the size of the total world population of this species.

In addition, the applicant intends to continue the search for a site away from Campbell Industrial Park to add to the three proposed sanctuaries. When a feasible site is located, additional cuttings of A. Rotundata plants will be planted in the new off site location. In such a manner, the long term survival of the species will be enhanced under applicant's monitoring and propagation plans.

SUMMARY

Applicant's basic plan is to consolidate the entire population within the property in question into three designated sanctuaries.

The plan is to be executed in five phases:

PHASE 1. Propagation Trials.

Permit required. Permit secured February 1988.

Status: Completed; 1156 plants obtained.

PHASE 2. Secure the parcel (Area 1) near C. Brewer for transplanting of propagants and begin transplanting.

Permit secured September 1, 1989.

PHASE 3. Begin relocation of small colonies within the property into the C. Brewer sanctuary.

Approval of Mitigation Plan.

PHASE 4. Designate and fence two parcels within main concentration of Achyranthes as sanctuaries.

Approval of Mitigation Plan.

PHASE 5. Complete the relocation of all individuals into the C. Brewer parcel.

Approval of Mitigation Plan.

PROPOSED ACTIVITIES FOR ACHYRANTHES ROTUNDATA
PLANTS AT CAMPBELL INDUSTRIAL PARK

I. Management Activities

a. C. Brewer out plant site (Area #1).

This site will be used only for transplanted achyranthes rotundata plants and to maintain the current existing population that is found within the boundaries of area #1. In addition to the terms stated in License P-4, the following procedures are to be utilized at that site:

(i) Non-native Vegetation will be cleared without the use of heavy equipment other than a 5' wide path which is planned around the perimeter for fence installation.

(ii) It is intended that the fence will be placed down the center of this path resulting in a 5' cleared path on either side of the fence.

(iii) All non-native (alien) shrubs will be eliminated inside the fenced area, but several kiawe trees will be left. All native species will be saved.

(iv) An appropriate herbicide (e.g. Round-Up) can be used if application does not endanger the native species. Accepted methods of application include painting of stumps, injection, or if extraordinary precautions are taken, low pressure low volume large droplet spraying.

(v) Application of a pre-emergent herbicide, preferrably in granular form may be used, but not in the vicinity of achyranthes planting.

(vi) Existing cracks, sinkholes and crevasses will be utilized as primary planting sites regardless of spacing. Excessive crowding is to be avoided.

(vii) Out-planted individuals will be labelled and mapped.

(viii) After plant establishment (between 3-6 months), maintenance, including watering and weeding of achyranthes rotundata plants and habitat, will be terminated. It is intended that watering will be reduced slowly and terminated during the first rainy season.

APPLICANT'S EXHIBIT A

b. Present population (Areas #2 and #3).

There will be no transplanting of Achyranthes rotundata plants to these sites. The two major populations will be fenced. Besides annual weeding, no further activities other than entrance for annual reporting to the Division of Forestry and Wildlife Administator as required under any permit will be allowed in these areas or for scientific research approved by DLNR. The following procedures are to be utilized at these sites:

(i) These areas will be fenced in by 6' high fences;

(ii) Vegetation will be cleared up to the perimeter of the fences; and

(iii) A heavy equipment path 10' wide is planned around the perimeter for fence installation. It is intended that each fence will be placed down the center of the path resulting in a 5' cleared path on either side of the fence.

II. Follow up propagation and transplanting

After the three reserve areas have been established, no further propagation and/or transplantation will occur in any of the three reserve areas, unless exemption is granted by the Department of Forestry and Wildlife in writing, until after F_2 generation results.

III. Guidelines for Incidental Taking

The Applicant will transplant a number of A. Rotundata plants at Campbell Industrial Park which are located outside of the three sanctuaries. The final survey of these plants was completed in December 1989 by Dr. Charles Lamoureux who recommended a change in the configuration of Areas #2 and #3 to conform to the present location of the large population of these plants. The Applicant agrees with Dr. Lamoureux' proposed changes to the boundaries of Areas #2 and #3 and will implement this change with the proper governmental authorities.

Due to the high success of the propagation trials from cuttings of A. Rotundata plants, the applicant will be allowed to take cuttings from the plants found within the Kaomi Loop road realignment, and the incidental "strays", rather than digging these plants out and transplanting them into Area #1. This proposal is based on the research done so far which shows a high rate of success for transplantation of 6" and smaller plants, but not for older more root bound plants.

The applicant will transplant all plants under 6" in height using the procedures described in the Mitigation Plan. All plants over 6" would then have cuttings and seeds taken for transplanting and the parent plant destroyed.

IV. Monitoring And Reporting Requirements

The applicant will be submitting six (6) month progress reports for three (3) years to the Division of Forestry & Wildlife Administrator indicating the status of the plants in Areas #1, #2 and #3.

ACHYRANTHES PLANTS OUTSIDE SANCTUARY AREAS
BARBER'S POINT
Dec. 1989

Numbered plants have been identified with small yellow cardboard tags. They include all plants 6 inches or more in height which have woody branches, and any plants less than 6 inches tall which have flowered. Plants less than 6 inches tall without woody branches are seedlings which have not yet become established in the population.

Site A. 11 plants, #1-11. Site about 3 ft X 10 ft.
Site B. 14 plants, # 12-25. Site about 3 ft by 6 ft.
(Sites C, D, and E are within the proposed nursery/sanctuary area. Plants here may not require transplanting):
Site C. 5 plants, #26-30. Site about 2 ft by 6 ft./
Site D. 3 plants, #39-41. Site 3 ft diam.
Site E. 8 plants, #31-38. Site 8 ft diam.
Site F. 1 plant, # 42.
Site G. 37 plants+, #43-79. (Tag #75 designates a group of about 12 small plants growing together in the middle of a kiawe thicket). Site about 20 ft by 50 ft.
Site H. 173 plants, #80-252. Site about 60 ft diam.
Site I. 32 plants. #253-284. Site about 20 ft diam.
Site J. 18 plants. #285-302. Site about 10 ft diam.
Site K. 3 plants. #303-305.
Site L. 5 plants. #306-310.
Site M. 4 plants. #311-314.
Site N. 8 plants. #315-322. Site 10 ft diam.
Site O. 1 plant. #323.

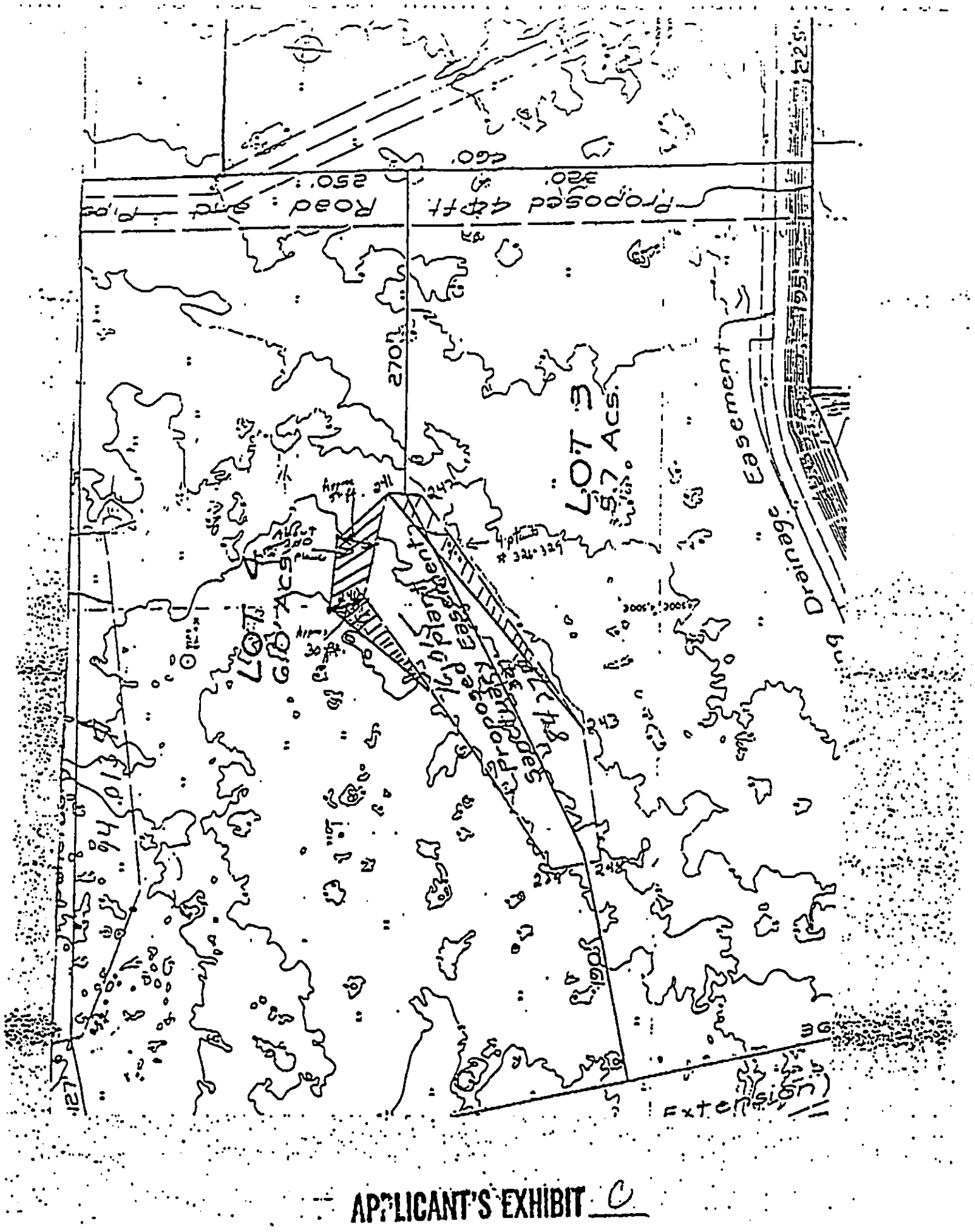
In addition to these plants which lie outside the proposed sanctuary areas and are thus candidates for transplanting into the site adjacent to the Brewer property, there are another 250 or so plants which lie outside but directly adjacent to the sanctuary limits as now defined. I would recommend modifying the sanctuary boundaries to accommodate these plants.

For the proposed northern sanctuary this would necessitate moving corner points 232 and 233, and also moving corner points 234 and 235 to include more than 150 plants which currently lie just outside the proposed boundaries.

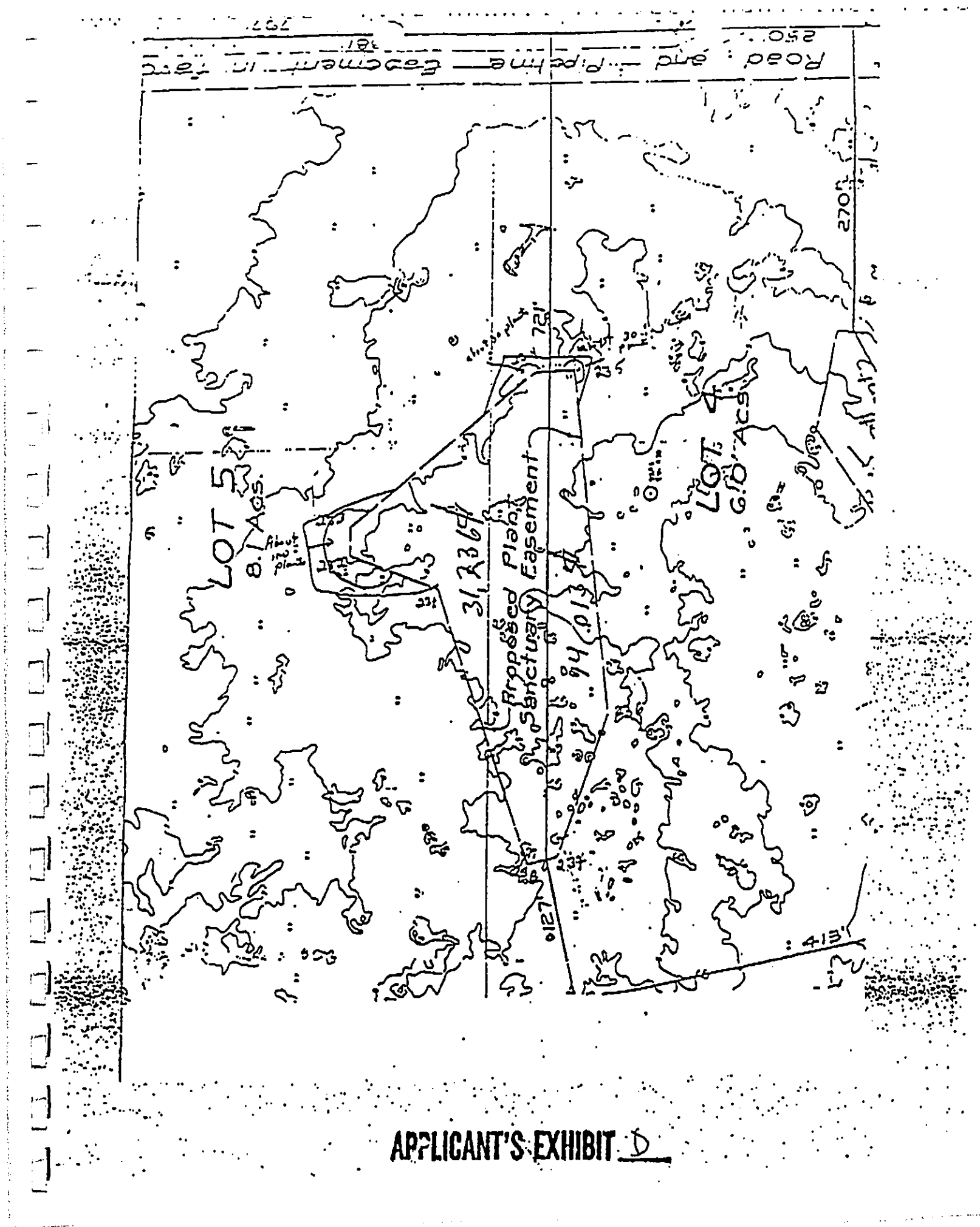
For the proposed southern sanctuary this would necessitate moving corner point 240, and locating a new corner point between 240 and 241 north of the current line between these points. This would allow for the inclusion of another 100 or more plants. On the other hand, the fence line could run directly from corner 241 to corner 243, eliminating part of the proposed sanctyary along the southeast side. This would remove 4 plants (tagged as #326-329) from the sanctuary and make them candidates for transplanting.

Charles Lamoureux
Dec. 12, 1989

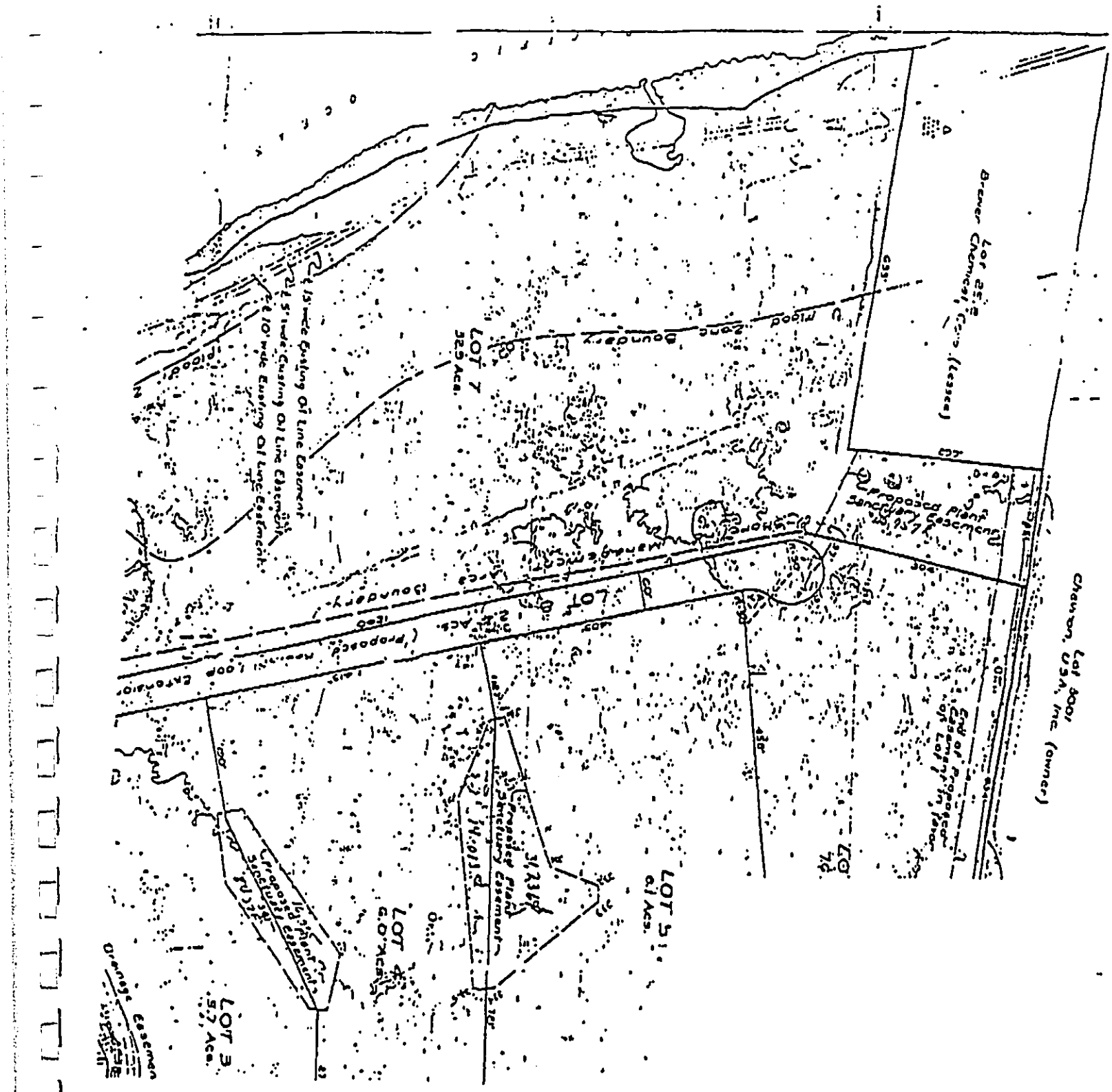
APPLICANT'S EXHIBIT B



APPLICANT'S EXHIBIT C



APPLICANT'S EXHIBIT D



APPLICANT'S EXHIBIT E

SUPPLEMENTAL INFORMATION

FOR

SHORELINE SETBACK VARIANCE

1. **Sections of Shoreline Setback Rules and Regulations proposed for variance.**

Variance is proposed for the following sections of the Shoreline Setback Rules and Regulations:

Rule 13. Prohibitions

13.1 Removal Prohibited

The removal of sand, coral, rocks, soil, shells, or other beach compositions or natural plants and materials within the shoreline setback is prohibited. Such removal shall be prohibited for any purpose except for reasonable domestic, non-commercial use which shall not involve construction, repairs, reconstruction, grading or filling.

13.2 Topographic Change

Removal of sand, coral, etc., enumerated in Rule 13.1 for reasonable domestic, non-commercial use shall not be made in any manner or extent so as to change the basic topography, physical appearance, or configuration of the shoreline setback.

13.3 Structure Not Permitted

No structure or any portion thereof, including but not limited to seawalls, groins, and revetments, whether built above, or below the ground surface, is permitted within the shoreline setback unless indicated otherwise under these Rules and Regulations. Construction of facilities that are accessory or incidental to structures located in the areas immediately adjacent to the shoreline setback shall not be permitted. Roads, streets, driveways, paved walkways, utility lines (whether overhead, surface, or underground), grading and filling work, and any and all other construction work whether related to structures or not, are not permitted within the shoreline setback.

Variance is proposed for the Rules and Regulations above since the project requires a drainage outlet to the ocean. Removal of a portion of a sand dune is needed, thus removing material, changing the topography and construction of a structure is proposed within the shoreline setback.

2. **Hardship caused to applicant if proposed structure is not allowed within the shoreline setback.**

The applicant will be caused significant hardship if the proposed drainage outlet is not allowed because it is a condition for the subdivision and drainage report approvals.

The health and safety of those employed and using the subdivision will be in danger if the proposed drainage outlet is not allowed. This would create an inconsistency between the subdivision and the Coastal Zone Management Objectives and Policies.

Substantial financial hardship will also be experienced by the applicant because no development will be allowed for the project site. The drainage outlet is part of a drainage system that serves Phases 1 and 2 of the Kaomi Loop Subdivision, a total of 91 acres.

The AES Cogeneration Facility is a tenant in Phase 1 of the Kaomi Loop Subdivision and will not be built if the shoreline setback variance is not approved. This generation facility will benefit the public as well as HECO in adding additional generating capacity, which in turn will decrease the likelihood of power failures.