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RECEIVED
'95 MAY -5 P2:15
OFC. OF ENVIRONMENTAL
QUALITY CONTROL

AN EQUAL OPPORTUNITY EMPLOYER
COUNTY OF KAUAI
DEPARTMENT OF PUBLIC WORKS
3021 UMI STREET
LIHUE, KAUAI, HAWAII 96766

May 2, 1995

Mr. Gary Gill, Director
Office of Environmental Quality Control
220 South King Street, Suite 400
Honolulu, Hawaii 96813

Dear Mr. Gill:

Subject: Negative Declaration for
Waimea Wastewater Treatment Plant Effluent Injection Wells

The Draft Environmental Assessment for the referenced project was published in the February editions of the OEQC Bulletin. During the 30 day comment period four letters were received and replies have been sent to all four. This correspondence has been incorporated into the final EA in an Appendix; four copies of the EA are being submitted to OEQC under separate cover by our consultant, Austin, Tsutsumi & Associates.

Please publish notice of a Negative Declaration for this project in your next OEQC Bulletin. If you have any questions, please contact Larry Dill of the Division of Wastewater Management at 241-6642.

Very truly yours,

HARRY FUNAMURA, Chief
Division of Wastewater Management

cc: Ivan Nakatsuka, Austin, Tsutsumi & Associates

LD

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1995-05-23-KA-FEA-Waimea Wastewater Treatment Plant Effluent-Injection Wells

MAY 23 1995

WAIMEA WASTEWATER TREATMENT PLANT EFFLUENT INJECTION WELLS FINAL ENVIRONMENTAL ASSESSMENT

Waimea, Kauai, Hawaii
TMK: 1-2-06:37

May 2, 1995

Prepared for:

COUNTY OF KAUAI
Department of Public Works

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AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

WAIMEA WASTEWATER TREATMENT PLANT
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ENVIRONMENTAL ASSESSMENT

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AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

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APPENDIX

BOUND SEPARATELY

AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
CONTINUING THE ENGINEERING PRACTICE FOUNDED BY H. A. R. AUSTIN IN 1934

TED S. KAWAHIGASHI, P.E.
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IVAN K. NAKATSUKA, P.E.
LAMBERT J. YAMASHITA, P.E
HOWARD H.W. MAU, P.E.

WAIMEA WASTEWATER TREATMENT PLANT

EFFLUENT INJECTION WELLS

ENVIRONMENTAL ASSESSMENT

I. EXECUTIVE SUMMARY

A. Applicant

The Applicant for the proposed project is the County of Kauai, Department of Public Works. The contact person for the County is:

Mr. Harry Funamura
County of Kauai
Department of Public Works
3021 Umi Street
Lihue, Kauai, Hawaii 96766

Phone: (808) 241-6610

B. Agencies Consulted

1. Safe Drinking Water Branch
   Department of Health
   State of Hawaii
   919 Ala Moana Boulevard, #308
   Honolulu, Hawaii 96814

2. Wastewater Branch
   Department of Health
   State of Hawaii
   919 Ala Moana Boulevard, #309
   Honolulu, Hawaii 96814

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OFFICES IN:
HONOLULU, HAWAII
WAILUKU, MAUI, HAWAII • HILO, HAWAII

3. Kikiaola Land Company, Ltd.
P.O. Box 367
Waimea, Kauai, Hawaii 96796

C. Landowner

The landowner of the parcels for the existing Waimea Wastewater Treatment Plant and the site for the proposed injection wells – which is the same as for Wastewater Pump Station (WWPS) 'A' – is the County of Kauai. The proposed effluent line from the WWTP to the injection wells will be within an existing 20-foot wide easement in favor of the County.

D. Project Location and Description

The proposed project is located in the Waimea-Kekaha region on the southwestern portion of the island of Kauai. The Tax Map Keys for the Waimea WWTP and WWPS 'A' are, respectively, 1-2-06:36 and 1-2-06:37. WWPS 'A' abuts the mauka edge of Kaumualii Highway, and the WWTP is approximately 800 feet mauka of WWPS 'A'.

The surrounding area is owned by Kikiaola Land Company, Ltd., and is currently being phased out of sugar cane cultivation by Kekaha Sugar Company. There are also small areas in the vicinity that are cultivated in seed corn.

E. Proposed Action

The proposed action is to construct two injection wells at the site of WWPS 'A', each with a proposed maximum discharge capacity of 1,200,000 gallons per day (gpd). This discharge rate would accommodate diurnal and seasonal variations in flow of relatively short duration. The proposed average discharge capacity will be only 300,000 gpd, which is the same as the average capacity of the WWTP. The well head will have valves and appurtenances to allow for backflushing with a portable air compressor.

A proposed 12-inch pipe along the existing dirt road between the WWTP and WWPS 'A' will convey disinfected secondary effluent from the WWTP, via

gravity, to the injection wells. This pipe will be buried at least three feet below grade.

The necessity to construct the injection wells is based on the expiration of an agreement between Kikiaola and the County for discharge of effluent from the WWTP into Kikiaola's irrigation reservoir. The alternative of injection well disposal was selected after an evaluation of several effluent reuse and disposal alternatives.

F. *Determination*

Construction of the injection wells is required to dispose of effluent from the existing Waimea WWTP, due to the pending cessation of the current method of effluent discharge into Kikiaola's reservoir. The proposed project is intended to provide a reliable long-term system for effluent disposal, the components of which will all be on County land/easements and, hence, not subject to the influence of any other parties.

Alternative methods of effluent disposal, as well as reuse, were evaluated as part of two previous studies. The recommendation of both studies, based on cost and subjective advantages/disadvantages, were to pursue the injection well alternative. The no action alternative is not an option, since cessation of the current method of effluent disposal – i.e., discharge into Kikiaola's reservoir – is, according to Kikiaola, imminent.

The majority of the work will be done at the injection well site, which is the parcel for the County's WWPS 'A'. A drilling rig will be the primary visible equipment item at the site throughout most of the project construction period. The short-term impact generated from construction activities at this site will primarily be related to noise during the daytime hours from operation of the rig.

The project will also involve installation of 800± feet of pipeline along the dirt road from the WWTP to the injection well site. However, this road is primarily used for access to the WWTP, and not a publicly used road. Furthermore, installation

of the pipeline is expected to be completed within a few weeks of commencement. Therefore, any impact from this activity will be very short-term and minimal.

The long-term impact of effluent disposal by injection wells on the groundwater and coastal water was evaluated by Mink & Yuen, Inc., consultant hydrogeologists, in their August 1993 report. Mink recommends that a 600± feet deep well with 14-inch diameter casing be constructed. The upper 400± feet in the caprock would have a solid casing grouted into the caprock, and the lower 200± feet in the Napali basalt would have a screened casing or be an open boring. Based on this well depth and composition, Mink concluded that, "...the difference in density between the waste water and the ground water will cause the injectant to rapidly rise as a cylindrical slug around the well screen. On reaching the caprock/Napali contact, a plume will move to a stagnation point about 640 feet upgradient, and the remainder will move downgradient along the contact. The upgradient slug will not interfere with groundwater containing less than 10,000 mg/l TDS (total dissolved solids).

Eventually the waste water injectant will seep into the caprock. A large surface area of the caprock/Napali interface is required to discharge the basal lens, including the injectant fluid. Most of the seepage into the caprock will take place downgradient of Highway 50 (Kaumualii Highway) and will have no impact at the shore line where the caprock is 600 feet thick. Injectant seeping into the caprock has no opportunity to rise to discharge at an open coast."

In a supplementary January 12, 1995 letter, Mink states that "Injection of the effluent into the basalt aquifer below the caprock interface rules out the possibility of coastal algal blooms because movement of the injected effluent will be suppressed by the low permeability caprock, and eventually the injectant will seep into the caprock over a wide area. The final discharge will be into the sea floor at a considerable distance off shore. The extent of the caprock off the Kekaha coast has not been investigated by either borings or geophysical techniques, so its exact range is unknown. However, the sea floor morphology suggests that the slope of

the caprock meets the slope of the basalt basement at -1500 feet about 9000 feet off shore. The steep slope (about 30%) of the caprock starts 6000 feet off shore where the sea floor is at -300 feet. A conservative estimate would be to assume that seepage incorporating the injectant into the sea floor could start about here."

Subsequent to Mink's August 1993 report, Kikiaola disclosed their intent to construct – as part of their Master Plan for the lands owned by them – an Aquamarine Center makai of Kaumualii Highway in the vicinity of the proposed injection well. As part of this Aquamarine Center, Kikiaola plans to withdraw saline water from approximately the same depth as the proposed injection wells. Therefore, this well(s) by Kikiaola would have to be located and designed to avoid entraining a significant quantity of the injected effluent.

In essence, Mink has concluded that injection of the effluent below the caprock should result in the effluent moving makai, and eventually discharging into a wide area at a considerable distance (6000+ feet) offshore. Therefore, there should be no resultant algal bloom associated with the effluent, or any other significant impact on the coastal water. Furthermore, although there will be a constant plume of effluent at the point of injection, this plume is expected to extend only about 640 feet mauka of the injection well site. Therefore, there should be no impact on any existing, or future, potable water wells.

Based on the foregoing findings, and assuming that Kikiaola's future well for their proposed Aquamarine Center can be located and designed to avoid entraining a significant quantity of the injected effluent, it is concluded that the proposed action will not result in any significant impacts.

II. DESCRIPTION OF PROPOSED PROJECT

The County of Kauai Department of Public Works proposes to construct an injection well system for disposal of disinfected secondary effluent from the County's existing Waimea Wastewater Treatment Plant (WWTP), due to the pending cessation of the current method of effluent discharge into Kikiaola Land Company, Ltd.'s reservoir. The proposed project is intended to provide a reliable long-term system for effluent disposal, the components of which will all be on County land/easements and, hence, not subject to the influence of any other parties.

The primary components of the system will be:

- Two wells – or, possibly, three, if the capacities of the first two wells are inadequate to satisfy the proposed maximum discharge rate – within the parcel for the County's existing Wastewater Pump Station (WWPS) 'A'. (See Exhibits 1 and 2 for maps and Exhibit 3 for site plan.) The wells are expected to be 600± feet deep with a 14-inch diameter casing. The upper 400± feet in the caprock would have a solid casing, grouted into the caprock, and the lower 200± feet in the Napali basalt would have a screened casing or be an open boring. (See Exhibit 4 for well elevation section.)

- Approximately 800 feet of 12-inch effluent gravity line along the existing dirt road between the WWTP and WWPS 'A'. This pipe will be buried at least three feet below grade.

The proposed average discharge rate into the wells will be 300,000 gallons per day (gpd), which is the same as the average capacity of the WWTP. The proposed maximum discharge rate is 1,200,000 gpd, which would accommodate diurnal and seasonal variations in flow of relatively short duration.

III. DESCRIPTION OF EXISTING ENVIRONMENT

A. Land Ownership

The project is located in the Waimea-Kekaha region on the southwestern portion of the island of Kauai. The majority of the land surrounding the project is owned by Kikiaola (Tax Map Keys: TMK: 1-2-06:3, 9, 41 and 42). Land owned by the County is limited to the sites for the Waimea WWTP (TMK: 1-2-06:36) and WWPS 'A' (TMK: 1-2-06:37). (See Exhibit 5.)

Areas mauka of Kaumualii Highway consists primarily of cultivated sugar cane fields and a small area of cultivated seed corn. The fields are divided by dirt cane haul roads and drainage ditches.

Parcel 42, the 42 acre area makai of the highway, is presently the site of a small resort development owned by Kikiaola called Plantation Cottages. Parcel 3 is presently being leased to Northrup King Co. for seed corn cultivation, and the remaining portion of the study area makai of the highway consists primarily of wasteland with grass and shrubs.

Land uses of property farther east (2000+ feet) and west (5000+ feet) include residential and government activities. The Pacific Ocean is to the south, while to the north is the sloping lower mountains which extend northward to Kokee.

The State Land Use Commission and the County Planning Department have different land use classifications for the different parcels within the vicinity of the project. (See Table 1 for a brief summary.) The Conservation areas of Parcels 3 and 41 are along the shoreline.

TABLE 1. LAND USE CLASSIFICATIONS

PARCEL NUMBER	LAND USE CLASSIFICATION	
	State Land Use Commission	County of Kauai, Planning Department
3	Agricultural Conservation Urban	Project District
9	Agricultural	Project District
41	Agricultural Conservation	Project District; Open
42	Urban	Project District; Open

B. Climate

Temperatures in the Waimea-Kekaha region range from the mid 50's to the low 90's (degrees Fahrenheit), with an average temperature of 75°F. Average daily temperatures vary by about ten degrees between winter and summer and about 15 to 18 degrees between day and night.

Mean annual rainfall recorded at Station 944.00 from 1916 to 1983 amounted to 21.77 inches. (See Exhibit 2 for location of Station.) The distribution of rainfall from month to month varies from heavy rainfalls at times to very light at others. Winter months typically have the most rainfall.

The mean annual pan evaporation recorded at Station 944.00 from 1960 to 1983 amounted to 73.53 inches. Summer months typically have the highest evaporation rates. Table 2 summarizes the mean monthly precipitation and pan evaporation for Station 944.00.

TABLE 2. MEAN MONTHLY PRECIPITATION AND PAN EVAPORATION AT STATION 944.00

MONTH	PRECIPITATION[1] (inches)	PAN EVAPORATION[2] (inches)
January	4.17	4.54
February	2.48	4.98
March	2.44	6.31
April	1.42	6.67
May	0.98	7.07
June	0.47	7.29
July	0.51	7.59
August	0.75	7.55
September	0.79	6.82
October	1.89	5.96
November	2.13	4.89
December	3.70	4.15
ANNUAL	21.77	73.53

(1) From "Rainfall Atlas of Hawaii", Report R76, State of Hawaii Department of Land and Natural Resources, June 1986. Years of data include: 1916 to 1983.

(2) From "Pan Evaporation: State of Hawaii, 1894-1983", Report R74, State of Hawaii, Department of Land and Natural Resources, August 1985. Years of data include: 1960 to 1983.

C. Topographic Features

The project is within the Mana Plain, which is characterized by generally flat slopes, with elevations ranging from sea level at the shoreline to about 30 feet mean sea level (msl) at the northern (mauka) boundary. The elevation at the WWTP, approximately 1000 feet mauka of the highway, is about 6 feet msl. The

elevation at WWPS 'A' – the site of the proposed injection wells – is approximately 9 feet msl.

D. Geology and Soils

The project area is comprised of a sequence of sedimentary strata (cap rock) resting on the basement rock of Napali basalt. The caprock varies in depth from 310 feet thick at the Waimea WWTP to 400 feet thick near the Kekaha Sugar Mill. The caprock sediments as a whole are poorly permeable and act as a confining layer on the Napali aquifer. (See Mink & Yuen Inc.'s report in Appendix A for additional information.)

Areas mauka of Kaumualii Highway consists mainly of Kekaha Series soils classified as clay, silty clay and stony silty clay loam. These series consist of well-drained soils with moderate permeability and zero to moderate erosion hazard. (See Exhibit 6 for soils maps based on information published by the U.S. Soils Conservation Service (SCS) for the Islands of Oahu, Kauai, Maui, Molokai, Lanai and Hawaii, in 1972.)

The area between the Department of Health's Underground Injection Control (UIC) Line and the highway is mostly filled land, which consists primarily of bagasse and slurry from sugar mills. This land type is not in a capability classification. Therefore, permeability and the amount of erosion are not provided by the SCS. However, information obtained from Kekaha indicates that the soil consists of a poorly drained, heavy clay, with a depth ranging from 3 to 6 feet.

The WWTP is in the Nohili Clay area. Although WWPS 'A' and the dirt road between this pump station and the WWTP is in filled land, the road and pump station site itself have not been areas for bagasse/slurry disposal since their establishment over 20 years ago.

E. Floods and Tsunamis

The National Flood Insurance Program publishes Flood Insurance Rate Maps for the State of Hawaii which designate areas of flood hazard. (See Exhibit

7.) A large portion of the study area mauka of Kaumualii Highway, including the WWTP and WWPS 'A' sites, are in a Special Flood Hazard Area inundated by 100-year floods with base flood elevations of eight and nine feet, respectively. However, except for the well head valves and appurtenances, the components for the project will be totally below grade. The exposed well head piping will not be subject to damage when flooding occurs at the WWPS 'A' site.

F. Flora and Fauna

Vegetation in the immediate vicinity of the project is primarily sugar cane, seed corn, common grass and weeds. There are no known rare, threatened or endangered plant species in the vicinity of the project.

The areas to be disturbed by construction – WWTP site, WWPS 'A' site and the dirt road between these two sites – are totally cleared and, except for minimal grassed areas within the WWTP site to be disturbed, are devoid of any vegetation.

Avifauna and mammals common to the project area are typical of species found in cane fields. There are no known endangered or threatened wildlife species in the vicinity of the project.

G. Archaeological Resources

The project site is fully cleared and the areas to be disturbed have been utilized for years as County Wastewater facilities, or well-traveled access ways for these facilities. Therefore, surface archaeological resources shouldn't be encountered at the project site.

H. Air Quality

The rural setting of the project area precludes exposure to adverse air quality conditions. There are no fixed sources of emission in the area, although sugar cane harvesting activities may effect levels of carbon monoxide and suspended particulate matter. However, these conditions are intermittent and of temporary duration.

I. Noise Characteristics

The primary fixed noise generator in the vicinity is the WWTP, primarily the positive displacement blowers. Other background noise can be attributed to traffic along Kaumualii Highway.

J. Community Setting

The project area is located in the Waimea-Kekaha region of Kauai. The population has remained stable in this region over the past several years, as evidenced by no significant increase in wastewater flow to the Waimea WWTP during this period. Although some development by Kikiaola in the existing Waimea service areas is anticipated within the next few years, the treatment capacity of the existing treatment plant includes allocation of flows for these developments. Therefore, the additional wastewater generated from these developments shouldn't exceed the current reserve capacity of the WWTP such that expansion of the WWTP, beyond its current capacity of 300,000 gpd, is required. However, any new developments outside of the existing service area – including Kikiaola's projects – would require a plant expansion.

K. Infrastructures

Kaumualii Highway is the major route serving the Waimea-Kekaha region. WWPS 'A' abuts the mauka edge of the highway, and the dirt road – which defines the alignment of the proposed effluent line – provides access to the WWTP from the highway.

There is water and electrical service to both WWPS 'A' and the WWTP. There is no drainage system, other than the irrigation ditches within the surrounding fields.

IV. DESCRIPTION OF EXISTING WASTEWATER SYSTEM

The Waimea WWTP, which treats domestic wastewater generated in Waimea was constructed in 1972. The collection system for the service areas were constructed in four phases from 1972 through 1983. All of the flow is pumped to the WWTP from WWPS 'A'. All of the WWTP effluent is pumped to the lower of two large reservoirs, owned by Kikiaola, where it is combined with stormwater from the upper reservoir before being disposed for irrigation. (See Exhibit 8 for extent of service area and locations of WWTP, WWPS 'A' and effluent reservoirs.) It is the intended closure of the lower reservoir by Kikiaola that required establishment of an alternative means of effluent disposal.

The first, and current, phase of the treatment plant was designed for an average wastewater flow of 272,000 gallons per day (gpd). The WWTP included a standard two-tank system with a capacity of 300,000 gpd, which allowed for a 10% increase in wastewater flow. The two tanks allowed for partial treatment of the wastewater during emergencies when one tank might be taken off-line.

Treatment process of the wastewater includes comminuting and degritting, aeration, final settling and then chlorination. The chlorinated effluent is then pumped to the effluent reservoirs. The sludge is routed to the aerated sludge holding tank, for stabilization, and subsequently pumped to the sludge drying beds for dewatering. Exhibits 9 and 10 show the existing Waimea WWTP site plan, and the Waimea WWTP hydraulic profile, respectively. Design data for the existing WWTP are presented in Table 3.

Allowances were made for future expansion of the WWTP of up to 600,000 gpd to accept future flows from Waimea – as well as wastewater flows from Kekaha Town, which lies less than three miles from the Waimea WWTP. This could be accomplished by installing two more tanks at 150,000 gpd capacity, each. Theoretically, the Waimea WWTP could be expanded to 900,000 gpd by enriching the oxygen supply in the compressed air, should it ever become necessary. However, as of December 1994, the average wastewater flow rate has been in the range of 240,000-250,000 gpd, with no

monthly average exceeding 300,000 gpd. Furthermore, anticipated near-term (within next 5 years) developments are expected to be within existing service areas. Since the treatment capacity of the existing plant has already been allocated to existing service areas, these development should not require expansion of the current Waimea WWTP.

The wastewater treatment plant was designed in accordance with the ASCE - WPF Manual 36 on "Sewage Treatment Plant Design" and the Ten States Standards. The plant was also designed to meet practical requirements of the State and Federal Water Quality Administration Standards.

TABLE 3. TREATMENT PLANT DESIGN DATA

DESIGN POPULATION	3,000	
DAILY SEWAGE FLOW PER CAPITA	100	gpd
DESIGN DAILY FLOW	300,000	gpd
DESIGN AVERAGE FLOW RATE	208	gpm
DESIGN MAXIMUM FLOW RATE (PUMP CAPACITY)	1,050	gpm
DESIGN RAW SEWAGE BIOCHEMICAL OXYGEN DEMAND (B.O.D.)	250 625	mg/l #/day
DESIGN RAW SEWAGE SUSPENDED SOLIDS (S.S.)	200 510	mg/l #/day
AERATION TANKS:		
DETENTION TIME (TOTAL)	24	hours
VOLUME OF AIR	2,000 870	cf/#BOD cfm
SETTLING TANKS:		
SURFACE SETTLING RATE	<600	gal/sf/day
WEIR OVERFLOW RATE	<7,000	gal/f/day
RECIRCULATION RATE	>1	to 1
FINAL CLARIFIER DETENTION	>4	hrs.
VOLUME OF AIR (SLUDGE HOLDING TANK)	90	cfm
VOLUME OF HOLDING TANK	3,000	cf
B.O.D. REMOVAL	90	%
B.O.D. IN CLARIFIER EFFLUENT	25	mg/l
AVERAGE CHLORINE DOSAGE	8	- 10 mg/l
CHLORINE USAGE	25	- 26#/day
CHLORINE CONTACT TIME	30	min. +
OVERALL EFFICIENCY	93	%

Recent conditions, and performance, of the WWTP are summarized in Table 4. The average effluent flow rate ranged from a minimum of 209,000 gpd to a maximum of 274,000 gpd, with a median of 247,000 gpd, during the period of January 1992 through April 1993. The peak day flow rate over the past five years was 920,000 gpd, which occurred on January 21, 1990. This one occurrence, however, was a very unusual storm event, and no flows have approached that rate at any other time over the five-year period.

The effluent is of high quality with both the Biochemical Oxygen Demand (BOD) and the Total Suspended Solids (TSS) well below 10 mg/l, and most of the time, below 5 mg/l. In addition to these two regularly analyzed parameters, a recent grab sample was analyzed for nutrient concentration. (See Table 5 for the results of this analysis.) The results are typical of a secondary treatment plant receiving domestic wastewater.

TABLE 4. CURRENT FLOW RATES AND CHEMICAL CHARACTERISTICS OF INFLUENT WASTEWATER AND EFFLUENT

PARAMETER	1992 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	1993 JAN	FEB	MAR	APR
FLOW																
Influent (mgd)	.243	.244	.237	.226	.248	.237	.240	.252	.217	.212	.218	.216	.209	.210	.202	.232
Effluent (mgd)	.258	.247	.250	.245	.274	.250	.251	.261	.232	.245	.209	.241	.222	.235	.222	.255
BOD																
Influent (mg/l)	212	211	167	-	146	-	114	-	-	147	157	219	206	86	116	334
Effluent (mg/l)	2.5	2.5	3.0	-	1.5	-	3.5	-	-	0.8	2.2	2.6	3.0	0.9	0.9	5.2
TSS																
Influent (mg/l)	134	153	163	124	126	155	173	134	133	173	155	96	170	141	163	348
Effluent (mg/l)	6.7	6.9	4.6	2.5	4.1	5.4	4.8	3.9	6.6	4.6	3.9	3.7	4.4	3.4	4.4	3.2
TOTAL COLIFORM (count per 100 ml)	2	2	3	3	7	5	5	6	12	8	6	6	3	4	2	2
CHLORINE RESIDUAL (ppm)	2 1.0	1.1	1.1	1.2	1.3	1.3	1.3	1.3	1.0	2.2	1.1	2.1	2.0	2.4	2.5	1.4

TABLE 5. GRAB SAMPLE ANALYSIS FOR NUTRIENTS

ITEM	INFLUENT	EFFLUENT
Total Kjeldahl Nitrogen	34.7 mg/l	.058 mg/l
Inorganic Nitrogen	.007 mg/l	20.4 mg/l
Total Nitrogen	34.8 mg/l	21.0 mg/l
Phosphorus	5.13 mg/l	0.58 mg/l
Ortho Phosphate	3.15 mg/l	2.70 mg/l
Turbidity		3.50 NTU

V. POTENTIAL IMPACTS

A. Land Ownership

There should be no impact on land ownership, since all components of the project will be on County land/easements.

B. Topography/Drainage

There should be no impact on the existing topography, or drainage conditions since almost all of the components will be below grade – except for the well head valves and appurtenances – and no grading is involved.

C. Water Quality

The most significant concern is the impact of the injected effluent on the groundwater and coastal water. Mink and Yuen, Inc. addresses this issue in their report, "Waste Water Effluent Disposal by Injection Wells, Kikiaola, Kauai, Hawaii," dated August 1993. (See Appendix A for report.) Based on construction of the wells to Mink's specifications, Mink concluded that, "...the difference in density between the waste water and the ground water will cause the injectant to rapidly rise as a cylindrical slug around the well screen. On reaching the caprock/ Napali contact, a plume will move to a stagnation point about 640 feet upgradient, and the remainder will move downgradient along the contact. The upgradient slug will not interfere with groundwater containing less than 10,000 mg/l TDS (total dissolved solids).

Eventually the waste water injectant will seep into the caprock. A large surface area of the caprock/Napali interface is required to discharge the basal lens, including the injectant fluid. Most of the seepage into the caprock will take place downgradient of Highway 50 (Kaumualii Highway) and will have no impact at the shore line where the caprock is 600 feet thick. Injectant seeping into the caprock has no opportunity to rise to discharge at an open coast."

In a supplementary January 12, 1995 letter, Mink states that "Injection of the effluent into the basalt aquifer below the caprock interface rules out the possibility of coastal algal blooms because movement of the injected effluent will be suppressed by the low permeability caprock, and eventually the injectant will seep into the caprock over a wide area. The final discharge will be into the sea floor at a considerable distance off shore. The extent of the caprock off the Kekaha coast has not been investigated by either borings or geophysical techniques, so its exact range is unknown. However, the sea floor morphology suggests that the slope of the caprock meets the slope of the basalt basement at -1500 feet about 9000 feet off shore. The steep slope (about 30%) of the caprock starts 6000 feet off shore where the sea floor is at -300 feet. A conservative estimate would be to assume that seepage incorporating the injectant into the sea floor could start about here."

Subsequent to Mink's August 1993 report, Kikiaola disclosed their intent to construct – as part of their Master Plan for the lands owned by them – an Aquamarine Center makai of Kaumualii Highway in the vicinity of the proposed injection well. As part of this Aquamarine Center, Kikiaola plans to withdraw saline water from approximately the same depth as the proposed injection wells. Therefore, this well(s) by Kikiaola would have to be located and designed to avoid entraining a significant quantity of the injected effluent.

In essence, Mink has concluded that injection of the effluent below the caprock should result in the effluent moving makai, and eventually discharging into a wide area at a considerable distance (6000+ feet) offshore. Therefore, there should be no resultant algal bloom associated with the effluent, or any other significant impact on the coastal water. Furthermore, although there will be a constant plume of effluent at the point of injection, this plume is expected to extend only about 640 feet mauka of the injection well site. Therefore, there should be no impact on any existing, or future, potable water wells.

D. Flora and Fauna

There are no known rare, endangered or threatened species of flora or fauna within the vicinity of the project site. Furthermore, construction will be limited to areas that are already cleared. Therefore, construction of the project is not anticipated to adversely impact the area's flora and fauna.

E. Air Quality and Noise

Air quality and noise parameters in the immediate vicinity of the project are anticipated to be affected by short-term construction activities, primarily from operation of the drilling rig at the injection well site. However, the affected area is relatively small and removed (2000± feet) from any inhabited areas. Therefore, there should be no significant adverse impact in regards to air quality and noise generation associated with the project.

F. Archaeological Resources

The project site has been in its present use for a number of years. Accordingly, the proposed project is not anticipated to have adverse impacts to archaeological resources.

G. Community Setting

Construction of the injection wells should not impact development in the Waimea-Kekaha region, since it is a replacement for the current method of effluent disposal.

H. Infrastructures

No improvements to existing infrastructures (roads, water, electrical) are required for the project.

VI. ALTERNATIVES CONSIDERED

Several alternatives for disposal and reuse of the effluent were evaluated as part of the following two studies prepared by Austin, Tsutsumi & Associates, Inc. (ATA):

- "Waimea Wastewater Treatment Plant Effluent Reuse/Disposal Alternative Study," dated March 7, 1994. (Bound separately.)
- "Alternatives Study for Disposal of Effluent from Waimea Wastewater Treatment Plant via Injection Wells or Rapid Infiltration System," dated December 9, 1994. (Bound separately.)

The latter study was a follow-up to the former, based on a meeting among the County, Kikiaola and ATA to discuss the rapid infiltration system.

The March 7, 1994 ATA study evaluated several reuse/disposal alternatives, including injection wells, but excluding the landscaped strips along the highway evaluated in the December 9, 1994 study. The recommendation of the March 7th report was "...that injection wells, for disposal of effluent from the Waimea WWTP be pursued by the County. The injection wells would be located on land owned by the County at the site of the existing Wastewater Pump Station 'A'."

As was done for the March 7th study, the December 9th study evaluated the cost and subjective advantages/disadvantages of the alternatives. The recommendation of the December 9th study was, again, "that the injection well alternative be selected."

The no action alternative is not an option, since cessation of the current method of effluent disposal – i.e., discharge into Kikiaola's reservoir – is, according to Kikiaola, imminent. Therefore, an alternative method of effluent disposal – which was determined to be disposal via injection wells – has to be implemented as soon as possible.

VII. FINDINGS AND CONCLUSIONS

Construction of the injection wells is required to dispose of effluent from the existing Waimea WWTP, due to the pending cessation of the current method of effluent discharge into Kikiaola's reservoir. The proposed project is intended to provide a reliable long-term system for effluent disposal, the components of which will all be on County land/easements and, hence, not subject to the influence of any other parties.

Alternative methods of effluent disposal, as well as reuse, were evaluated as part of two previous studies. The recommendation of both studies, based on cost and subjective advantages/disadvantages, were to pursue the injection well alternative. The no action alternative is not an option, since cessation of the current method of effluent disposal – i.e., discharge into Kikiaola's reservoir – is, according to Kikiaola, imminent.

The majority of the work will be done at the injection well site, which is the parcel for the County's WWPS 'A'. A drilling rig will be the primary visible equipment item at the site throughout most of the project construction period. The short-term impact generated from construction activities at this site will primarily be related to noise during the daytime hours from operation of the rig.

The project will also involve installation of 800± feet of pipeline along the dirt road from the WWTP to the injection well site. However, this road is primarily used for access to the WWTP, and not a publicly used road. Furthermore, installation of the pipeline is expected to be completed within a few weeks of commencement. Therefore, any impact from this activity will be very short-term and minimal.

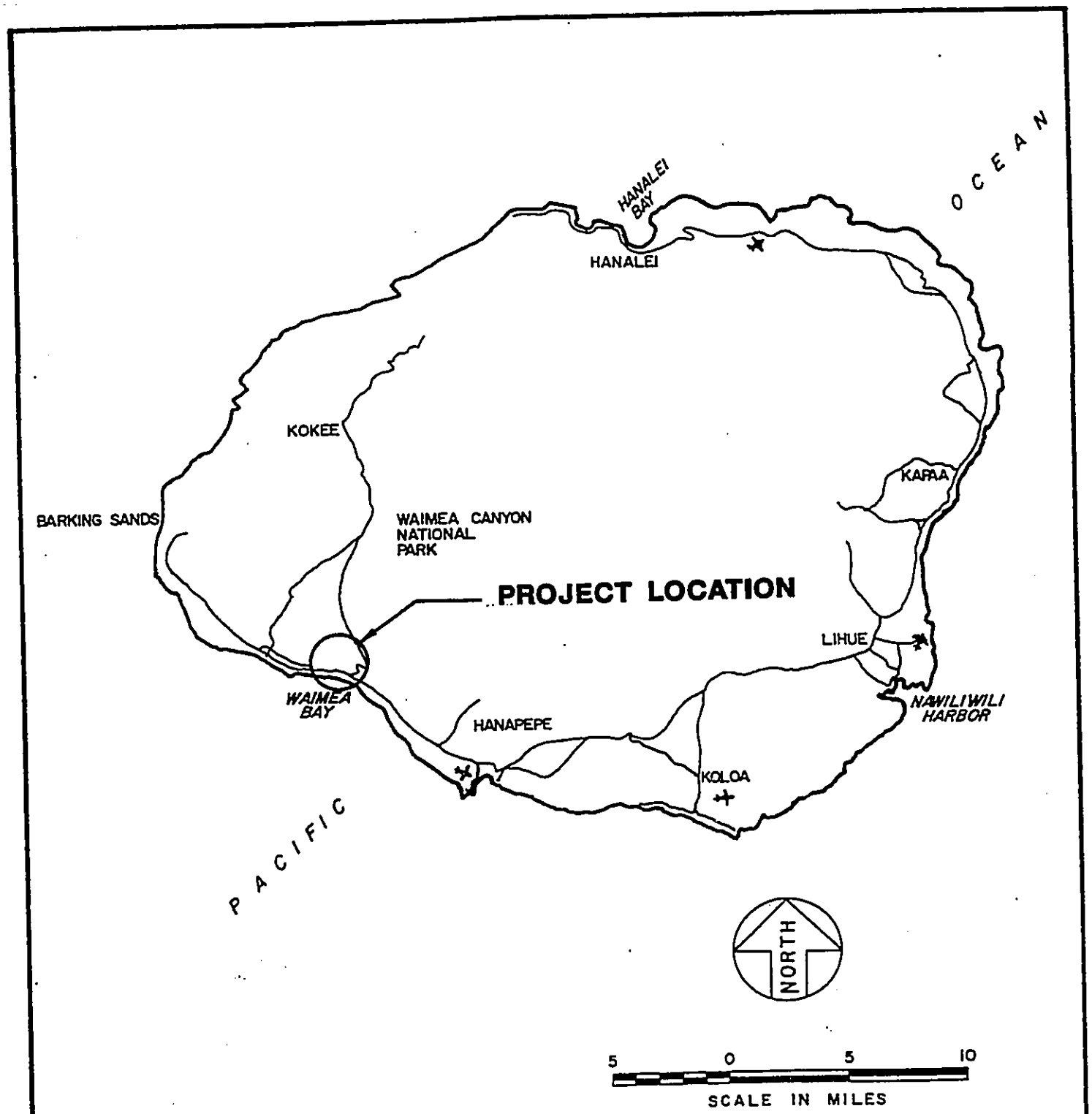
The long-term impact of effluent disposal by injection wells on the groundwater and coastal water was evaluated by Mink & Yuen, Inc., consultant hydrogeologists. Mink recommends that a 600± feet deep well with 14-inch diameter casing be constructed. The upper 400± feet in the caprock would have a solid casing grouted into the caprock, and the lower 200± feet in the Napali basalt would have a screened casing or be an open boring. Based on this well depth and composition, Mink concluded that, "...the difference in density between the waste water and the ground water will cause the injectant to

rapidly rise as a cylindrical slug around the well screen. On reaching the caprock/Napali contact, a plume will move to a stagnation point about 640 feet upgradient, and the remainder will move downgradient along the contact. The upgradient slug will not interfere with groundwater containing less than 10,000 mg/l TDS (total dissolved solids).

Eventually the waste water injectant will seep into the caprock. A large surface area of the caprock/Napali interface is required to discharge the basal lens, including the injectant fluid. Most of the seepage into the caprock will take place downgradient of Highway 50 (Kaumualii Highway) and will have no impact at the shore line where the caprock is 600 feet thick. Injectant seeping into the caprock has no opportunity to rise to discharge at an open coast."

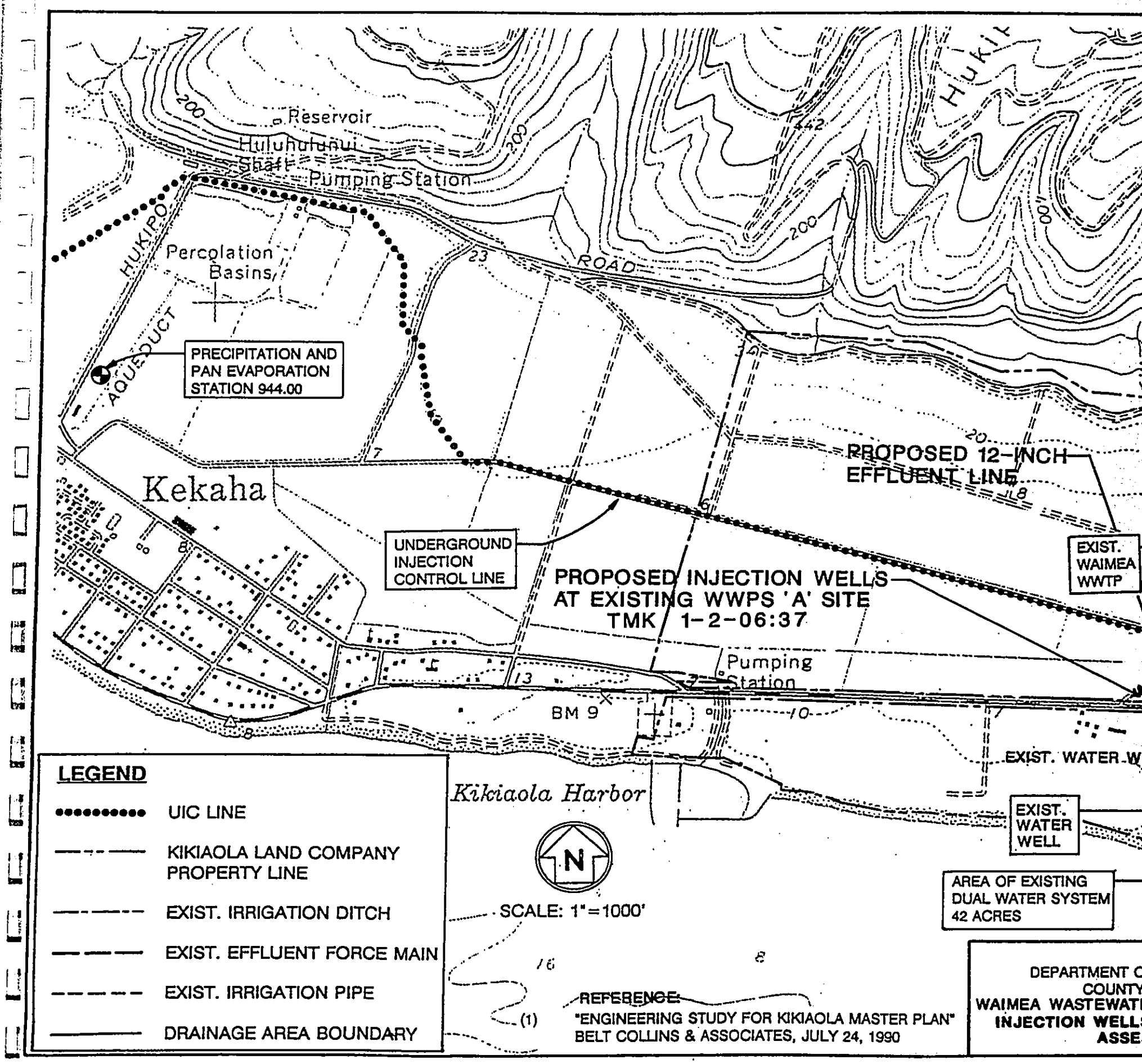
Based on the foregoing findings, and assuming that Kikiaola's future well for their proposed Aquamarine Center can be located and designed to avoid entraining a significant quantity of the injected effluent, it is concluded that the proposed action will not result in any significant impacts.

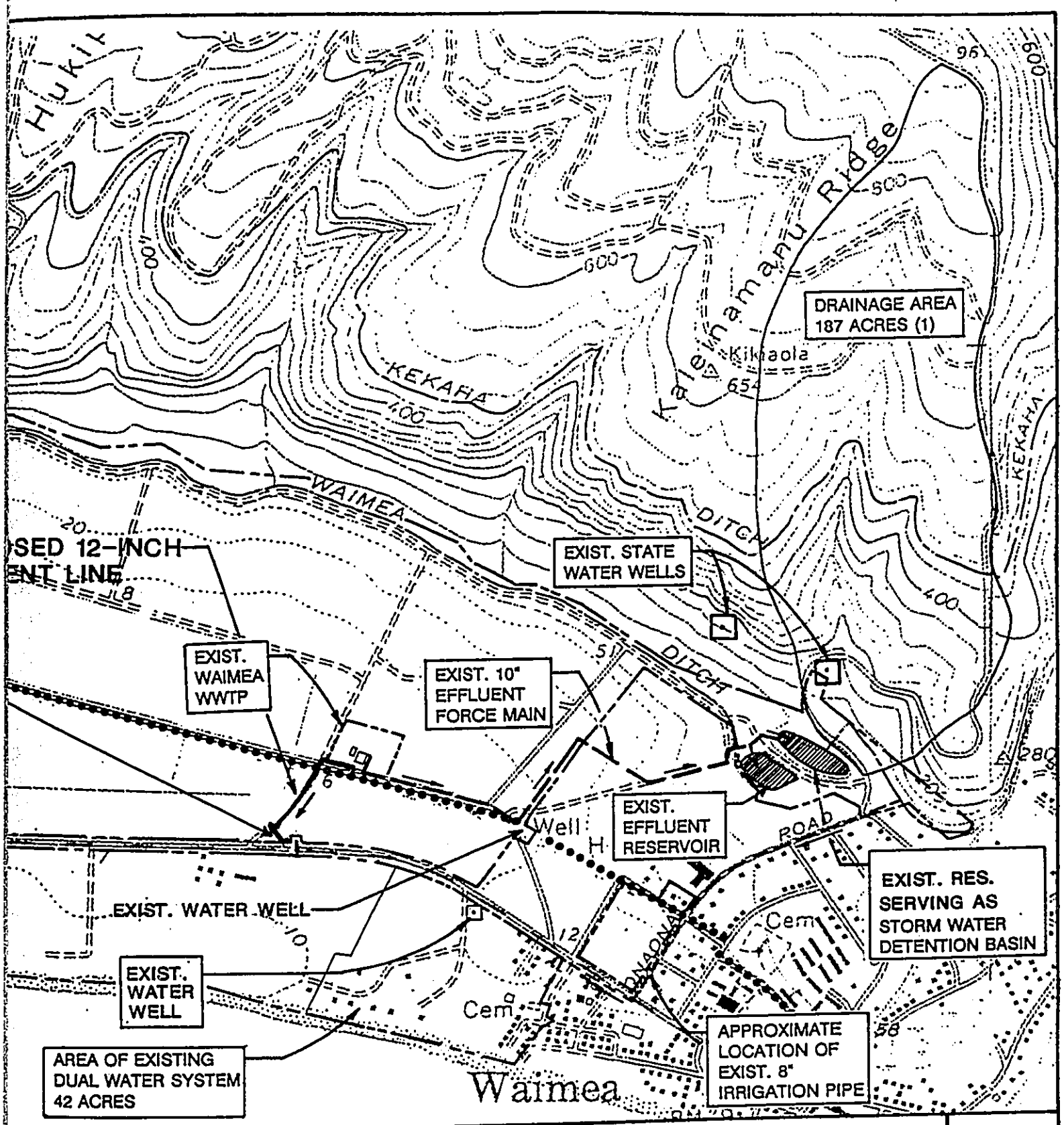
EXHIBITS



ISLAND OF KAUAI

DEPARTMENT OF PUBLIC WORKS COUNTY OF KAUAI WAIMEA WASTEWATER TREATMENT PLANT INJECTION WELLS ENVIRONMENTAL ASSESSMENT	AUSTIN, TSUTSUMI, & ASSOC., INC. ENGINEERS, SURVEYORS • HAWAII LOCATION MAP	EXHIBIT 1


Reservoir
Huluhululunui
Shaft
Pumping Station
HUKIPO
AQUEDUCT
Percolation
Basins
ROAD
PRECIPITATION AND
PAN EVAPORATION
STATION 944.00
Kekaha
UNDERGROUND
INJECTION
CONTROL LINE
PROPOSED 12-INCH
EFFLUENT LINE
EXIST.
WAIMEA
WWTP
PROPOSED INJECTION WELLS
AT EXISTING WWPS 'A' SITE
TMK 1-2-06:37
Pumping
Station
BM 9
EXIST. WATER W
Kikiaola Harbor
EXIST.
WATER
WELL
AREA OF EXISTING
DUAL WATER SYSTEM
42 ACRES
N
SCALE: 1"=1000'
LEGEND
UIC LINE
KIKIAOLA LAND COMPANY
PROPERTY LINE
EXIST. IRRIGATION DITCH
EXIST. EFFLUENT FORCE MAIN
EXIST. IRRIGATION PIPE
DRAINAGE AREA BOUNDARY
REFERENCE:
(1) "ENGINEERING STUDY FOR KIKIAOLA MASTER PLAN"
BELT COLLINS & ASSOCIATES, JULY 24, 1990
DEPARTMENT O
COUNTY
WAIMEA WASTEWATE
INJECTION WELLS
ASSE



PLAN"

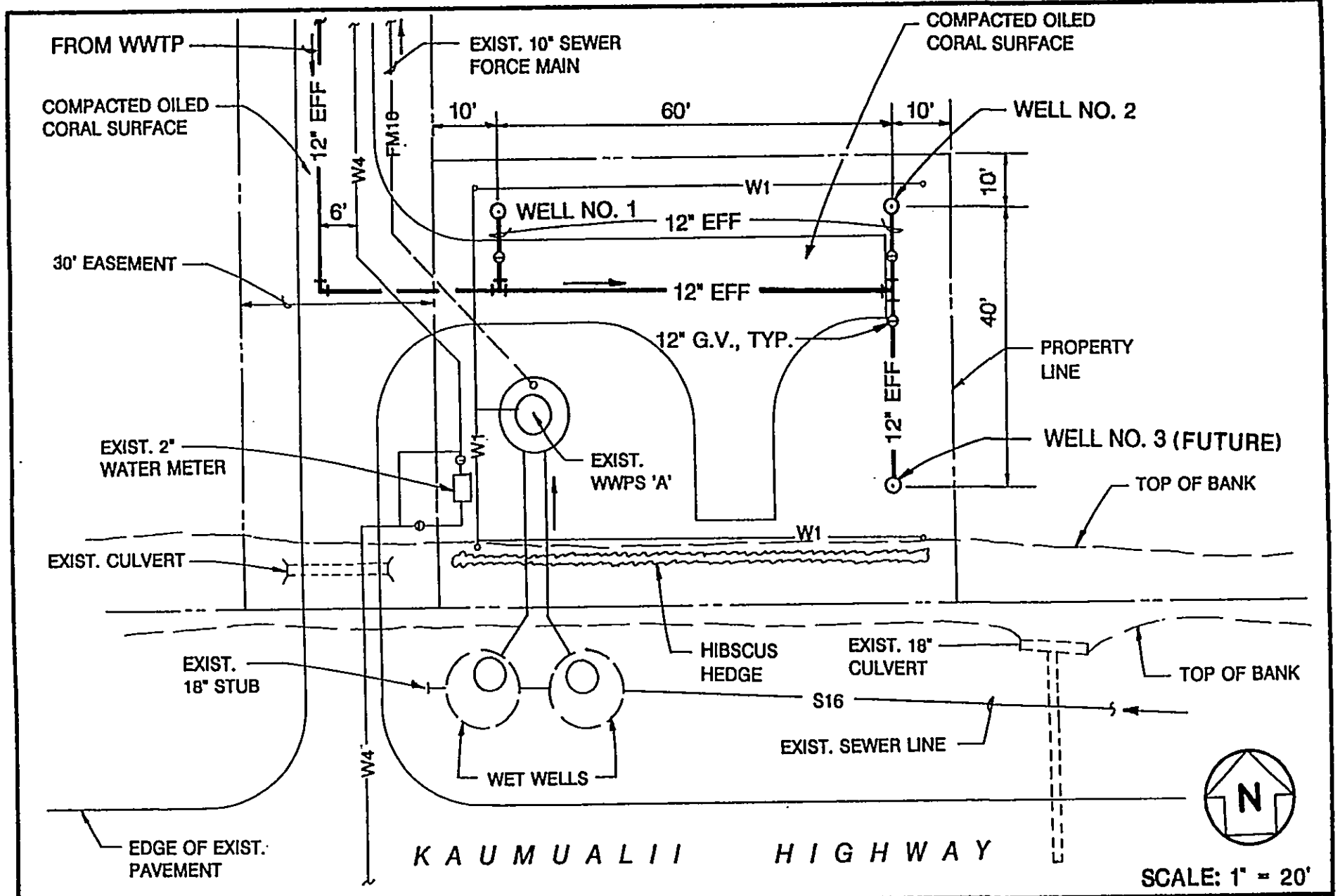
DEPARTMENT OF PUBLIC WORKS
COUNTY OF KAUAI
WAIMEA WASTEWATER TREATMENT PLANT
INJECTION WELLS ENVIRONMENTAL ASSESSMENT

AUSTIN, TSUTSUMI, & ASSOC., INC.
ENGINEERS. SURVEYORS • HAWAII

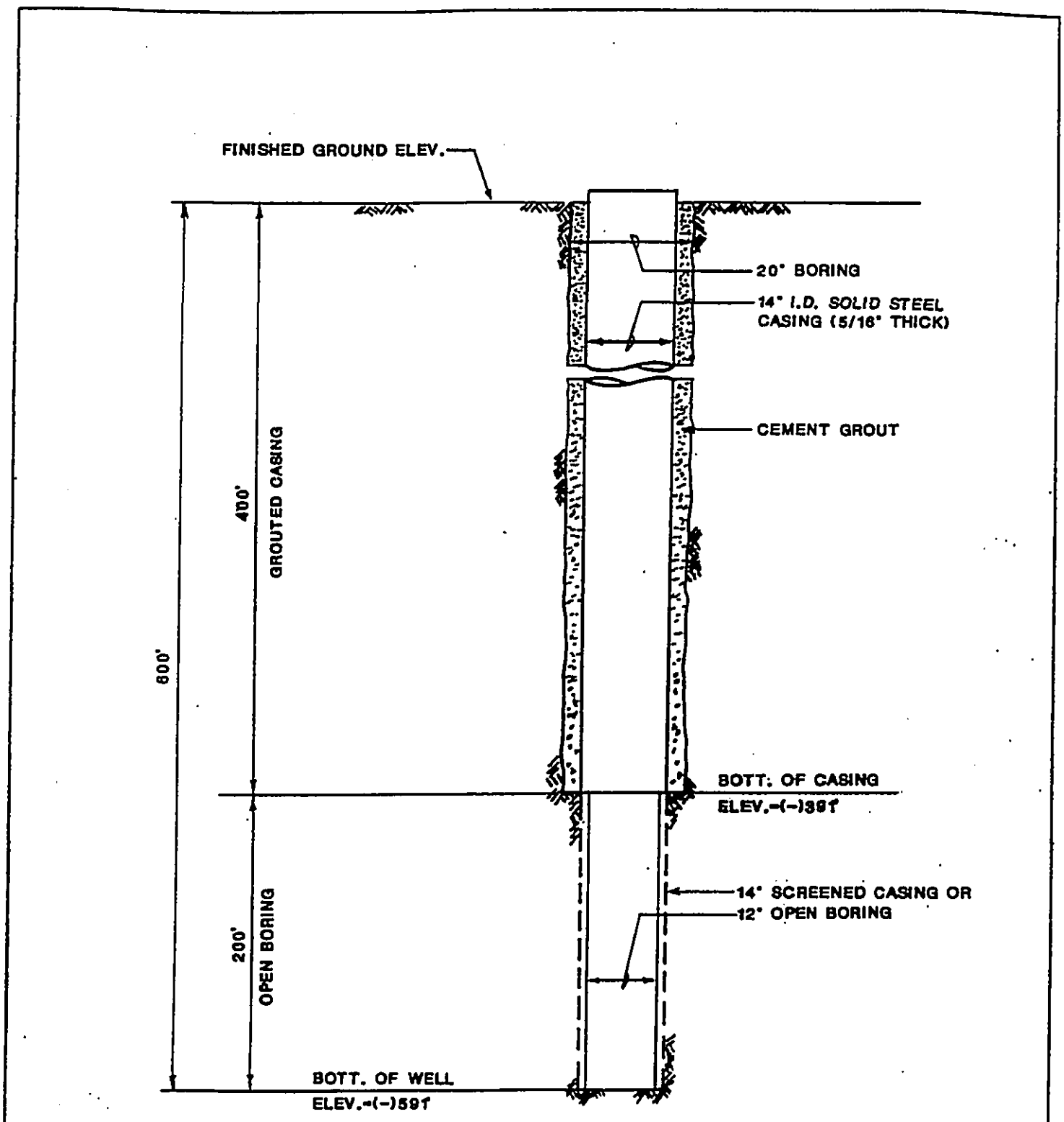
SITE MAP

EXHIBIT

2



DEPARTMENT OF PUBLIC WORKS COUNTY OF KAUAI WAIMEA WASTEWATER TREATMENT PLANT **INJECTION WELLS ENVIRONMENTAL ASSESSMENT**	AUSTIN, TSUTSUMI, & ASSOC., INC. ENGINEERS. SURVEYORS · HAWAII INJECTION WELL **SITE PLAN**	EXHIBIT **3**



DEPARTMENT OF PUBLIC WORKS
COUNTY OF KAUAI

WAIMEA WASTEWATER TREATMENT PLANT
INJECTION WELLS ENVIRONMENTAL
ASSESSMENT

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
ENGINEERS/SURVEYORS • HONOLULU, HAWAII

INJECTION WELL ELEVATION SECTION

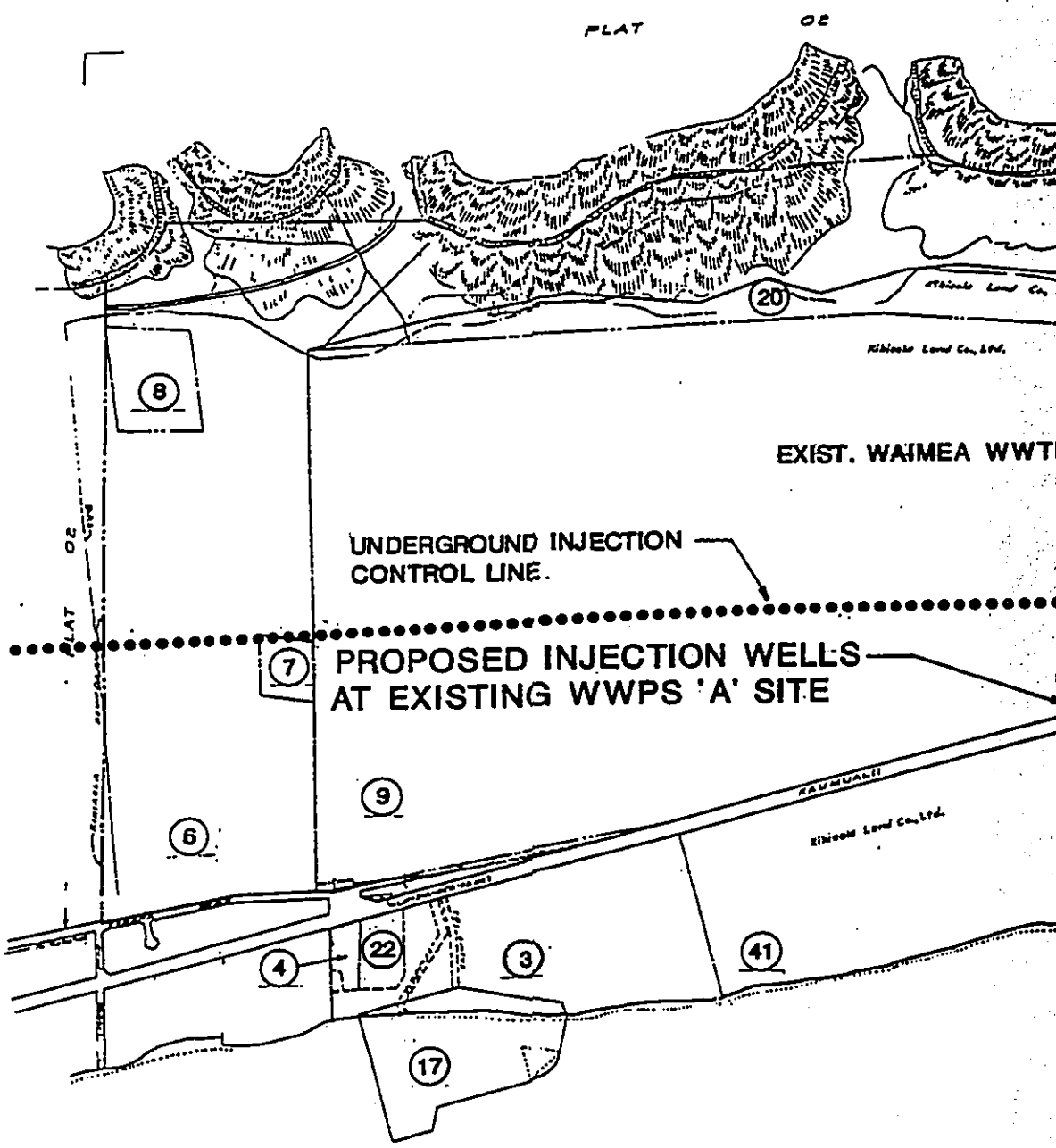
EXHIBIT

4

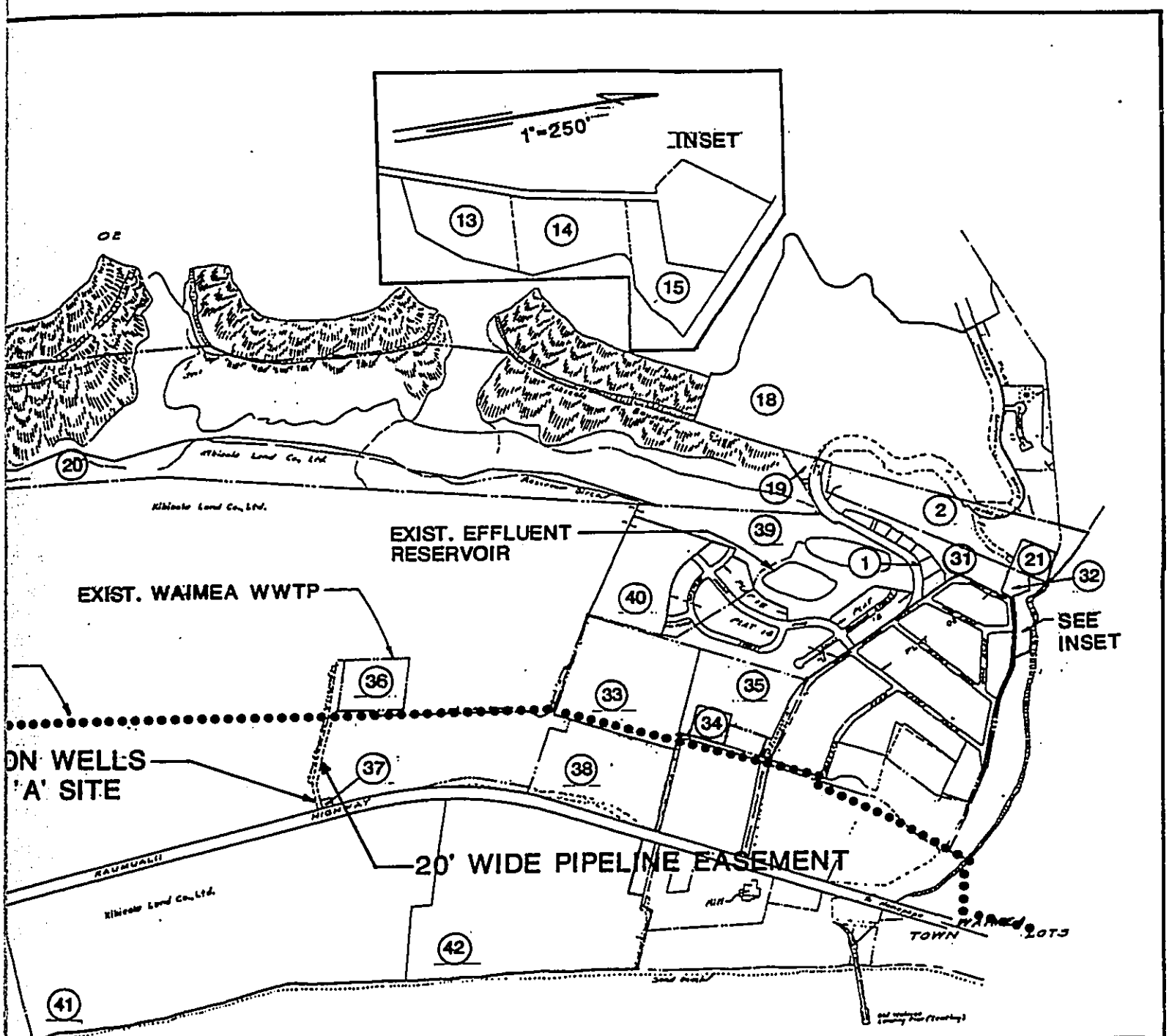
1/12/85

LOT NO.	LAND OWNER	LOT NO.	LAND OWNER
1	KIKIAOLA LAND CO.	21	STATE OF HAWAII
2	OTHER	22	KIKIAOLA LAND CO.
3	KIKIAOLA LAND CO.	31	KIKIAOLA LAND CO.
4	STATE OF HAWAII	32	KIKIAOLA LAND CO.
6	KNUDSEN	33	STATE OF HAWAII
7	KNUDSEN	34	KIKIAOLA LAND CO.
8	KNUDSEN	35	STATE OF HAWAII
9	KIKIAOLA LAND CO.	36	COUNTY OF KAUAI
13	OTHER	37	COUNTY OF KAUAI
14	KIKIAOLA LAND CO.	38	STATE OF HAWAII
15	KIKIAOLA LAND CO.	39	KIKIAOLA LAND CO.
17	STATE OF HAWAII	40	OTHER
18	STATE OF HAWAII	41	KIKIAOLA LAND CO.
19	KNUDSEN	42	KIKIAOLA LAND CO.
20	KIKIAOLA LAND CO.		

NOTE: Land owned by Augustus Knudsen is leased to Kekaha Sugar Co. Ltd.



DEPARTMENT
COUNT
WAIMEA WASTEWA
INJECTION WELL
ASSE



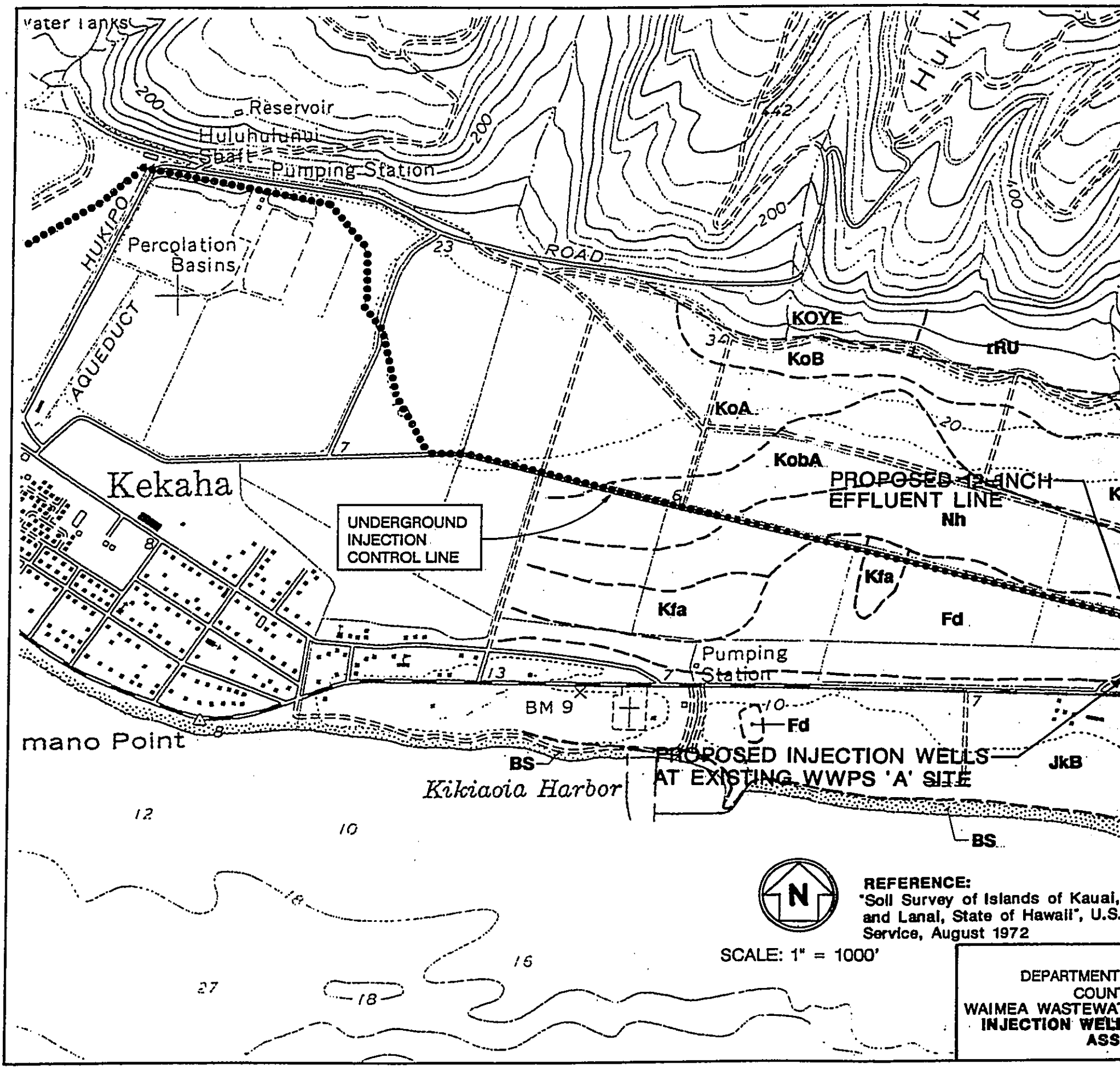
TAX MAP		
FOURTH DISTRICT		
ZONE	SEC	PLAT
1	2	06
SCALE: 1" = 1000'		

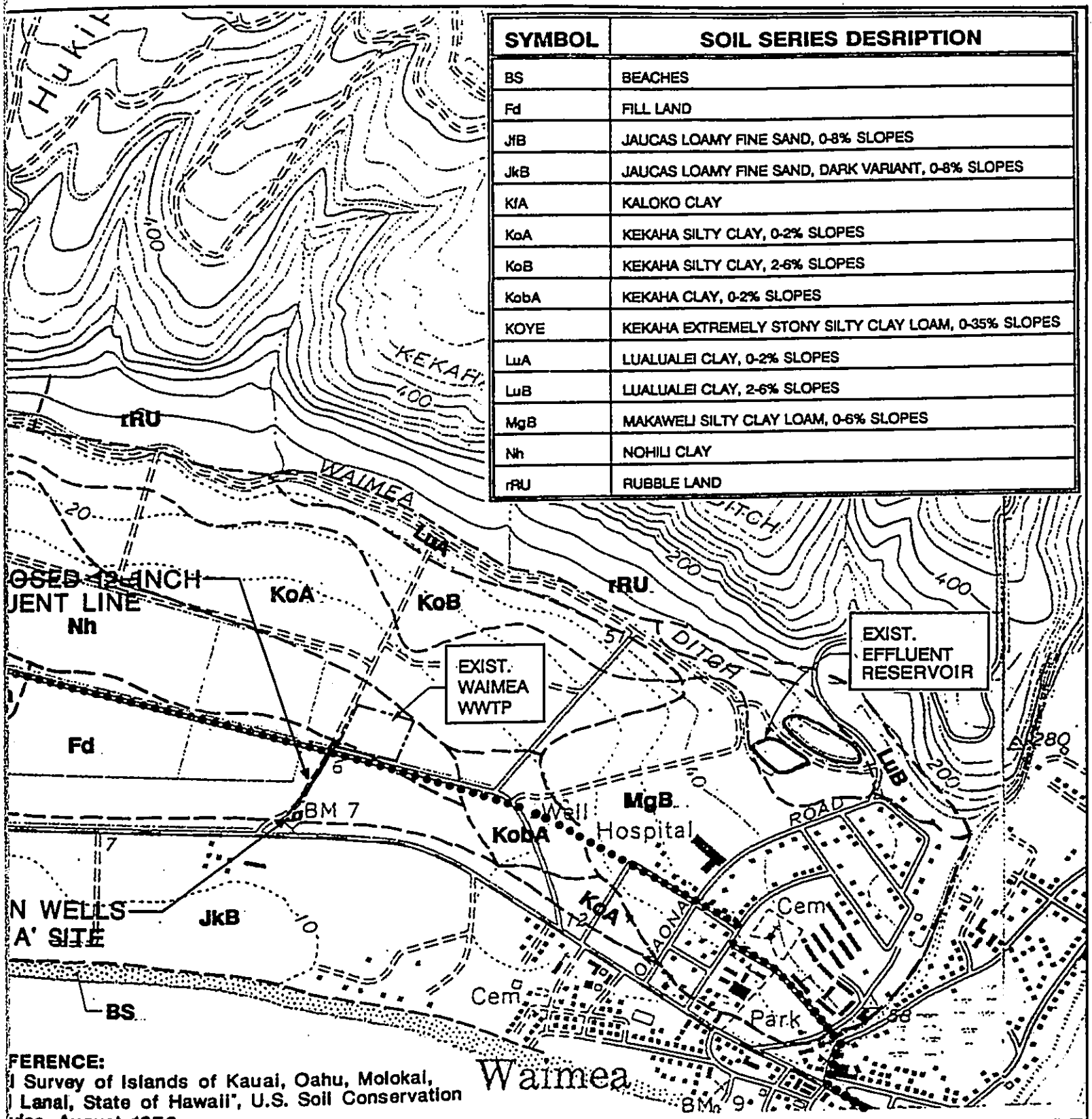
DEPARTMENT OF PUBLIC WORKS
COUNTY OF KAUAI
WAIMEA WASTEWATER TREATMENT PLANT
INJECTION WELLS ENVIRONMENTAL ASSESSMENT

AUSTIN, TSUTSUMI, & ASSOC., INC.
ENGINEERS. SURVEYORS • HAWAII

TAX MAP

EXHIBIT
5


Water Tanks
Reservoir
Huluhuluiwi
Shaft
Pumping Station
HUKIPO
AQUEDUCT
Percolation Basins
ROAD
Kekaha
UNDERGROUND INJECTION CONTROL LINE
PROPOSED 12-INCH EFFLUENT LINE
Pumping Station
BM 9
mano Point
Kikiaola Harbor
PROPOSED INJECTION WELLS AT EXISTING WWPS 'A' SITE
KOYE
KoB
KoA
KobA
Nh
Kfa
Fd
JkB
BS
200
100
42
34
23
20
18
16
13
12
10
8
7
6
27
N
REFERENCE:
"Soil Survey of Islands of Kauai, and Lanai, State of Hawaii", U.S. Service, August 1972
SCALE: 1" = 1000'
DEPARTMENT
COUNT
WAIMEA WASTEWA
INJECTION WELL
ASS



SYMBOL	SOIL SERIES DESRIPTION
BS	BEACHES
Fd	FILL LAND
JfB	JAUCAS LOAMY FINE SAND, 0-8% SLOPES
JkB	JAUCAS LOAMY FINE SAND, DARK VARIANT, 0-8% SLOPES
KfA	KALOKO CLAY
KoA	KEKAHA SILTY CLAY, 0-2% SLOPES
KoB	KEKAHA SILTY CLAY, 2-6% SLOPES
KobA	KEKAHA CLAY, 0-2% SLOPES
KOYE	KEKAHA EXTREMELY STONY SILTY CLAY LOAM, 0-35% SLOPES
LuA	LUALUALEI CLAY, 0-2% SLOPES
LuB	LUALUALEI CLAY, 2-6% SLOPES
MgB	MAKAWELI SILTY CLAY LOAM, 0-6% SLOPES
Nh	NOHILI CLAY
rRU	RUBBLE LAND

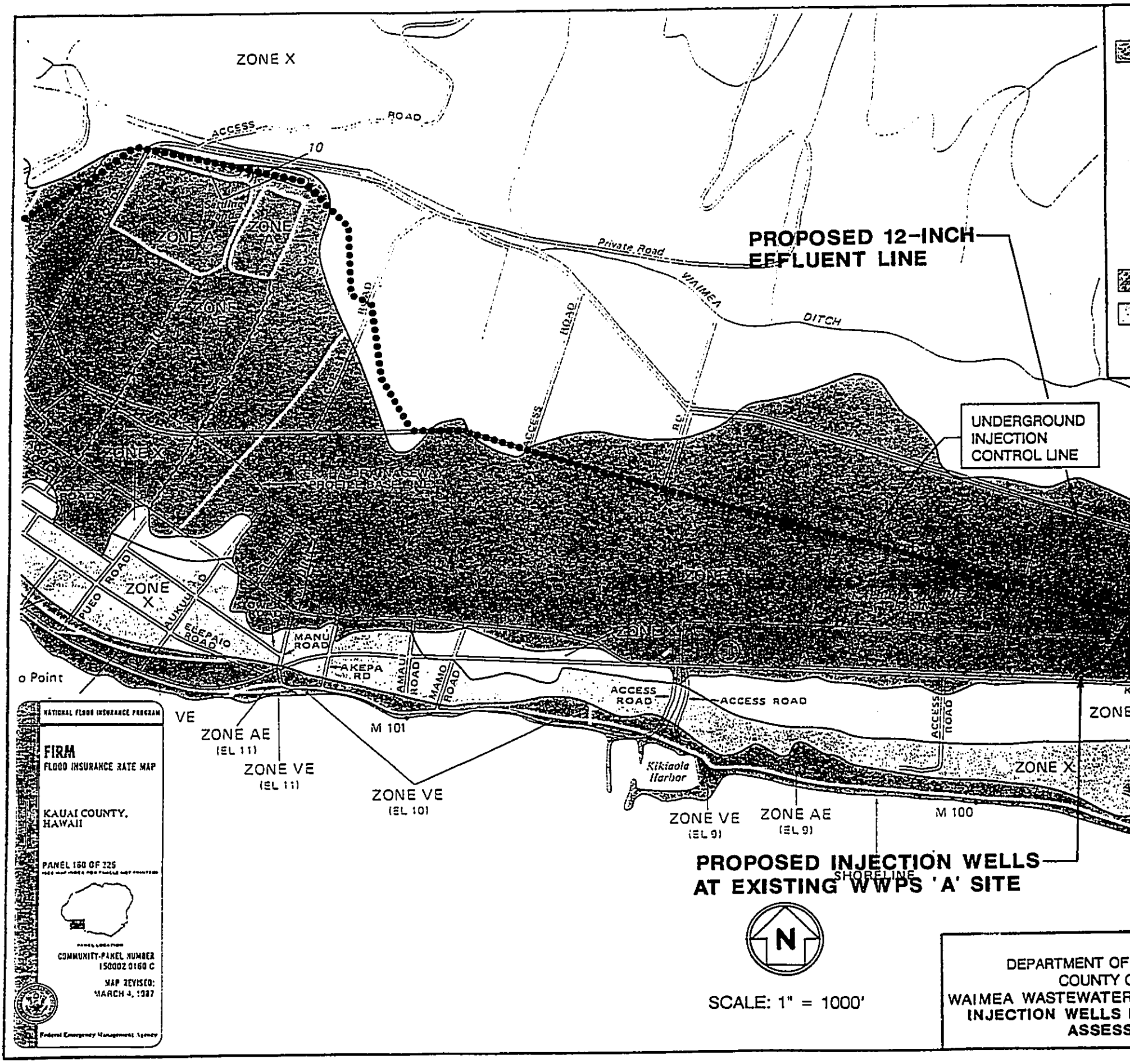
FERENCE:
l Survey of Islands of Kauai, Oahu, Molokai,
l Lanai, State of Hawaii", U.S. Soil Conservation
vice, August 1972

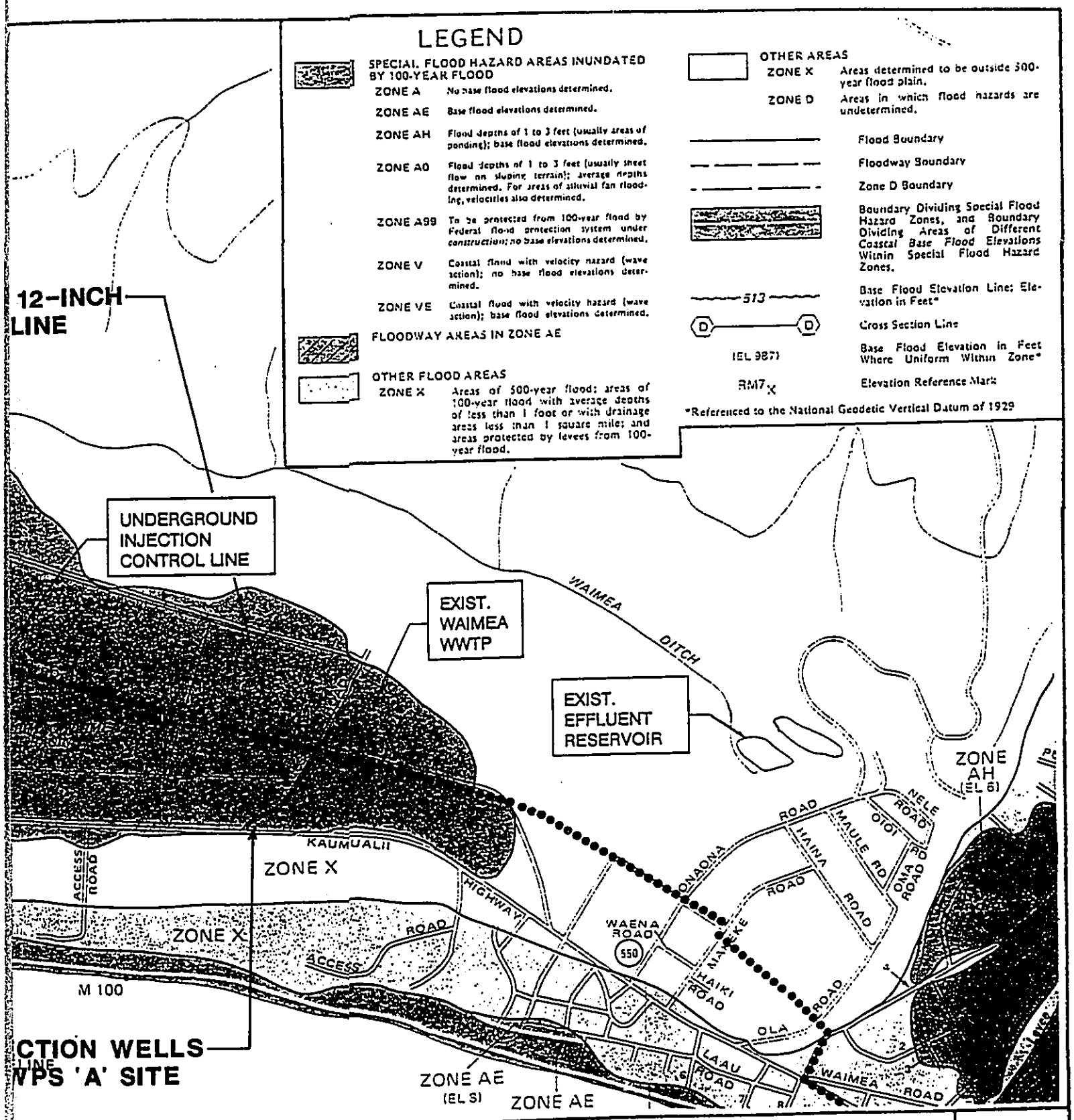
DEPARTMENT OF PUBLIC WORKS
COUNTY OF KAUAI
WAIMEA WASTEWATER TREATMENT PLANT
INJECTION WELLS ENVIRONMENTAL ASSESSMENT

AUSTIN, TSUTSUMI, & ASSOC., INC.
ENGINEERS · SURVEYORS · HAWAII · GUAM

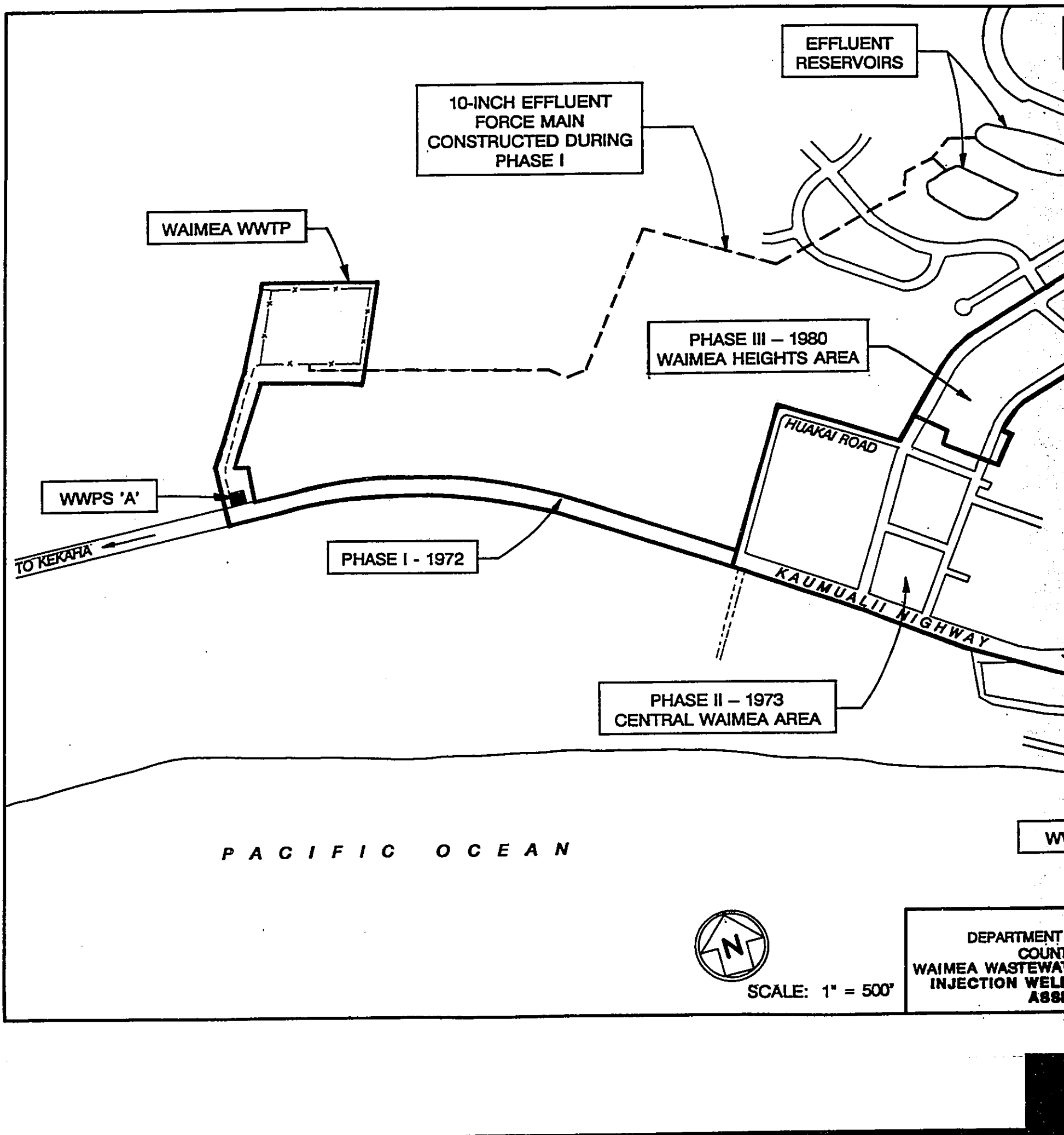
SOIL TYPES IN PROJECT AREA

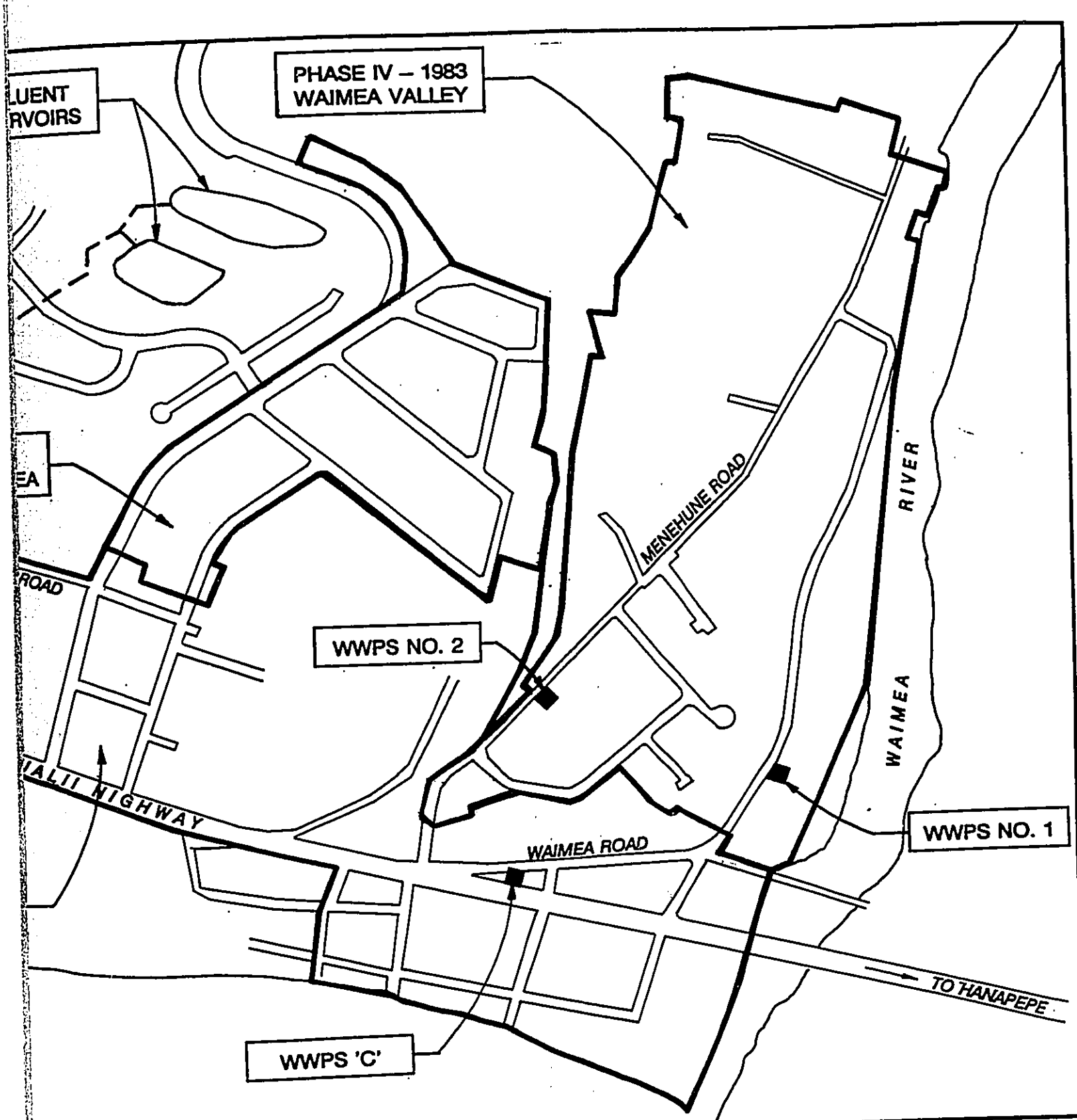
EXHIBIT
6


ZONE X
ACCESS ROAD
10
ZONE A
ZONE A
ZONE A
ZONE A
ROAD
Private Road
WAIMEA DITCH
ACCESS ROAD
PROPOSED 12-INCH EFFLUENT LINE
UNDERGROUND INJECTION CONTROL LINE
ZONE X
PUEO ROAD
AUKUU RD
EEPAIO ROAD
ZONE X
MANU ROAD
AKEPA RD
AMAU ROAD
MAMO ROAD
ZONE X
ACCESS ROAD
ACCESS ROAD
ACCESS ROAD
ZONE X
o Point
VE
ZONE AE
(EL 11)
ZONE VE
(EL 11)
M 101
ZONE VE
(EL 10)
Kikiaola Harbor
ZONE VE
(EL 9)
ZONE AE
(EL 9)
M 100
SHORELINE
PROPOSED INJECTION WELLS AT EXISTING WWPS 'A' SITE
N
SCALE: 1" = 1000'
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
KAUAI COUNTY, HAWAII
PANEL 150 OF 325
COMMUNITY-PANEL NUMBER 150002 0150 C
MAP REVISED: MARCH 4, 1987
Federal Emergency Management Agency
DEPARTMENT OF
COUNTY O
WAIMEA WASTEWATER
INJECTION WELLS
ASSESS



DEPARTMENT OF PUBLIC WORKS COUNTY OF KAUAI WAIMEA WASTEWATER TREATMENT PLANT INJECTION WELLS ENVIRONMENTAL ASSESSMENT	AUSTIN, TSUTSUMI, & ASSOC., INC. ENGINEERS, SURVEYORS • HAWAII **FLOOD MAP**	EXHIBIT **7**


EFFLUENT RESERVOIRS
10-INCH EFFLUENT FORCE MAIN CONSTRUCTED DURING PHASE I
WAIMEA WWTP
PHASE III – 1980 WAIMEA HEIGHTS AREA
HUAKAI ROAD
WWPS 'A'
TO KEKAHA
PHASE I - 1972
KAUMUALII HIGHWAY
PHASE II – 1973 CENTRAL WAIMEA AREA
PACIFIC OCEAN
N
SCALE: 1" = 500'
DEPARTMENT
COUNT
WAIMEA WASTEWA
INJECTION WELL
ASS



DEPARTMENT OF PUBLIC WORKS
COUNTY OF KAUAI
WAIMEA WASTEWATER TREATMENT PLANT
INJECTION WELLS ENVIRONMENTAL ASSESSMENT

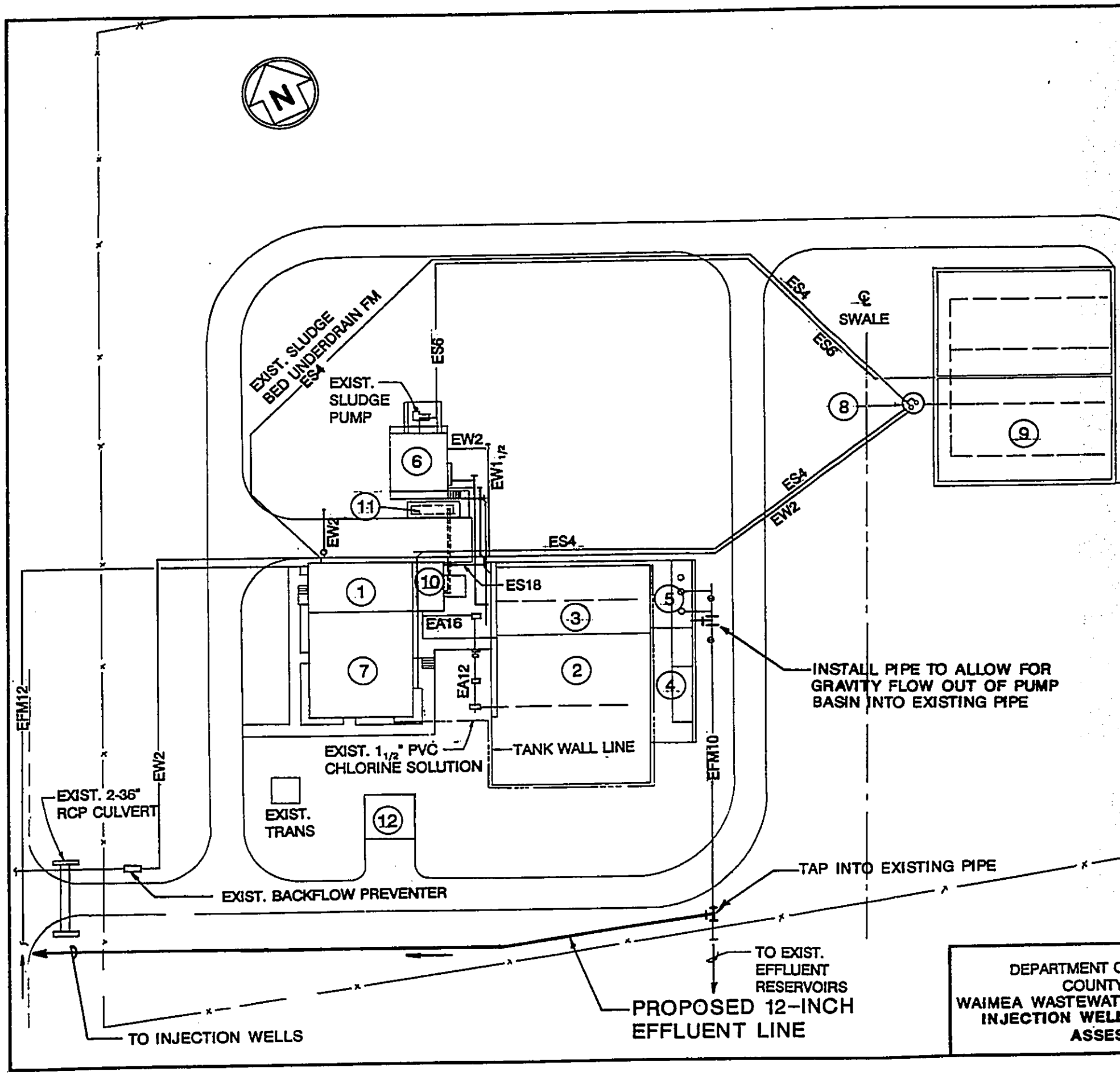
= 500'

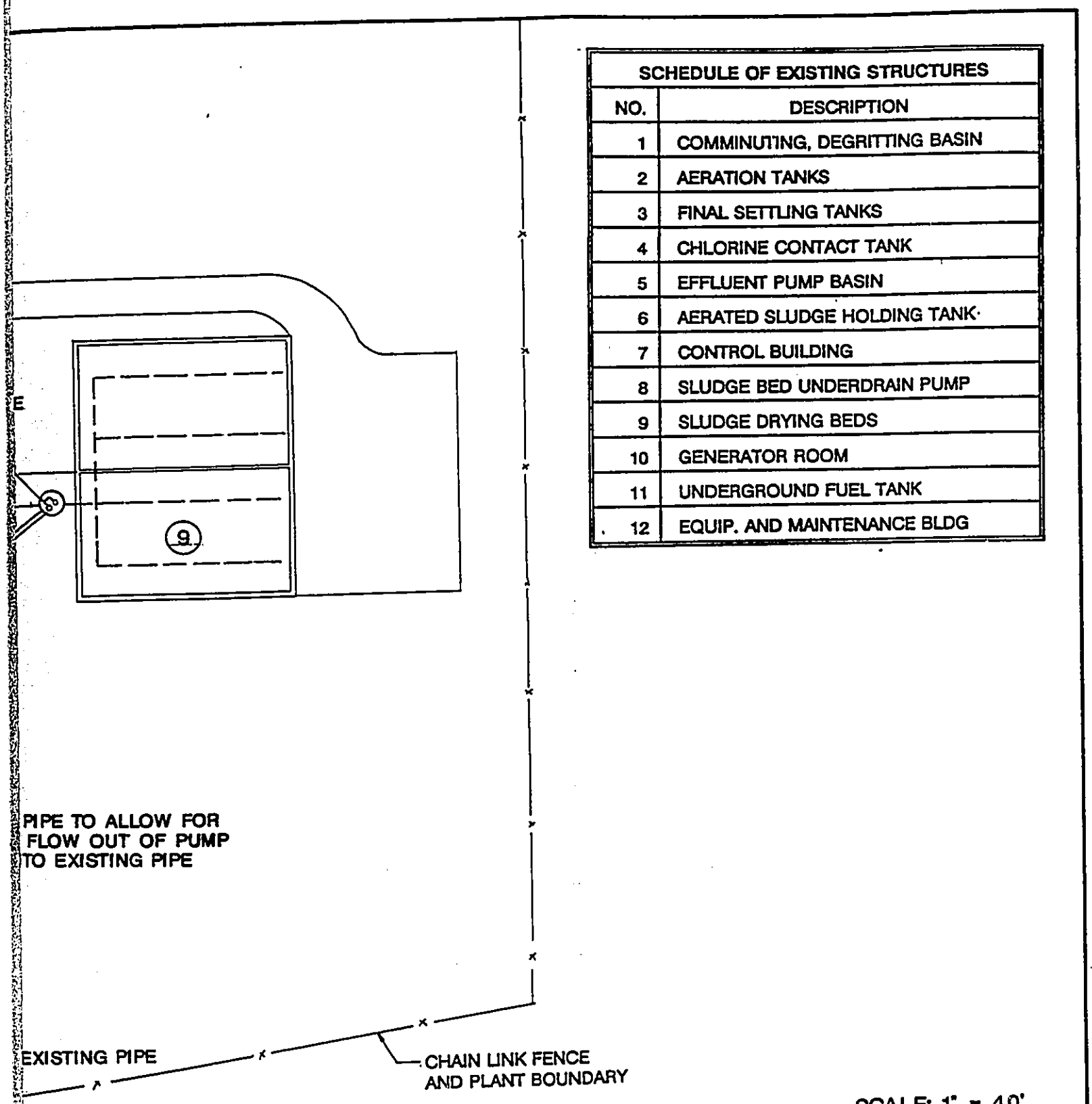
AUSTIN, TSUTSUMI, & ASSOC., INC.
ENGINEERS SURVEYORS • HAWAII

EXISTING WAIMEA WASTEWATER SYSTEM

EXHIBIT

8


N
EXIST. SLUDGE BED UNDERDRAIN FM ES4
ES5
EXIST. SLUDGE PUMP
EW2
EW1 1/2
ES4
SWALE
ES5
ES4
EW2
8
9
6
11
EW2
ES4
10
ES18
1
3
5
EA16
7
2
4
EA12
INSTALL PIPE TO ALLOW FOR GRAVITY FLOW OUT OF PUMP BASIN INTO EXISTING PIPE
EFM12
EW2
EXIST. 1 1/2" PVC CHLORINE SOLUTION
TANK WALL LINE
EFM10
EXIST. 2-36" RCP CULVERT
EXIST. TRANS
12
TAP INTO EXISTING PIPE
EXIST. BACKFLOW PREVENTER
TO EXIST. EFFLUENT RESERVOIRS
TO INJECTION WELLS
PROPOSED 12-INCH EFFLUENT LINE
DEPARTMENT O
COUNTY
WAIMEA WASTEWAT
INJECTION WELL
ASSES



SCHEDULE OF EXISTING STRUCTURES	
NO.	DESCRIPTION
1	COMMINUTING, DEGRITTING BASIN
2	AERATION TANKS
3	FINAL SETTLING TANKS
4	CHLORINE CONTACT TANK
5	EFFLUENT PUMP BASIN
6	AERATED SLUDGE HOLDING TANK
7	CONTROL BUILDING
8	SLUDGE BED UNDERDRAIN PUMP
9	SLUDGE DRYING BEDS
10	GENERATOR ROOM
11	UNDERGROUND FUEL TANK
12	EQUIP. AND MAINTENANCE BLDG

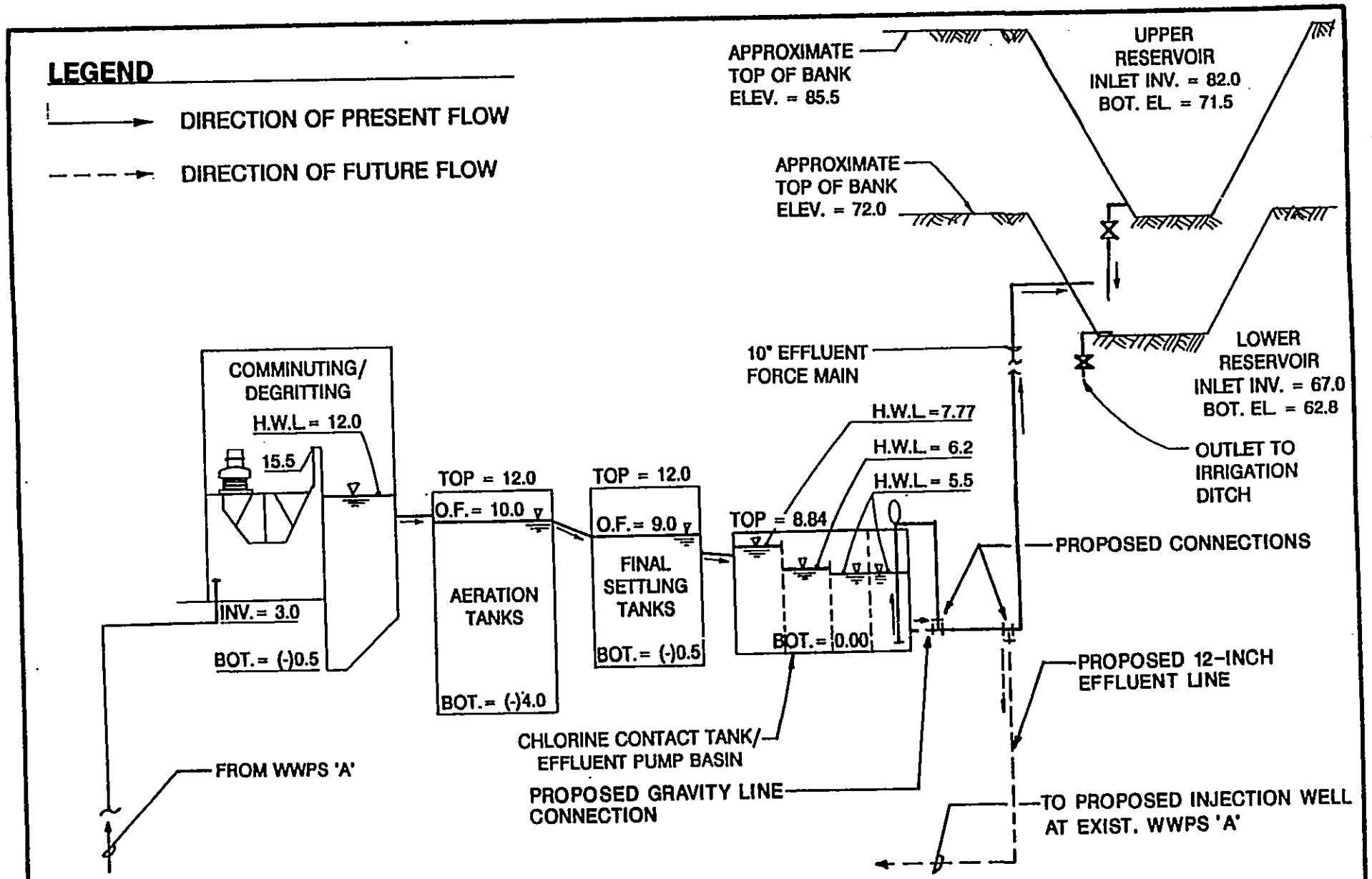
SCALE: 1" = 40'

DEPARTMENT OF PUBLIC WORKS
COUNTY OF KAUAI
WAIMEA WASTEWATER TREATMENT PLANT
INJECTION WELLS ENVIRONMENTAL
ASSESSMENT

AUSTIN, TSUTSUMI, & ASSOC., INC.
ENGINEERS, SURVEYORS · HAWAII

WAIMEA WWTP
SITE PLAN

EXHIBIT
9



NOT TO SCALE

DEPARTMENT OF PUBLIC WORKS
COUNTY OF KAUAI
WAIMEA WASTEWATER TREATMENT PLANT
INJECTION WELLS ENVIRONMENTAL ASSESSMENT

AUSTIN, TSUTSUMI, & ASSOC., INC.
ENGINEERS · SURVEYORS · HAWAII

WAIMEA WWTP HYDRAULIC PROFILE

EXHIBIT

10

APPENDIX A

Mink & Yuen, Inc.'s
"Waste Water Effluent Disposal by Injection Wells,
Kikiaola, Kauai, Hawaii," August 1993

WASTEWATER EFFLUENT DISPOSAL BY INJECTION WELLS

KIKIAOLA, KAUAI, HAWAII

Prepared by

Mink & Yuen, Incorporated

100 North Beretania Street, Suite 303

Honolulu, Hawaii 96817

Prepared for

Austin, Tsutsumi & Associates, Incorporated

501 Sumner Street, Suite 521

Honolulu, Hawaii 96817

August, 1993

TABLE OF CONTENTS

FIGURES

Introduction

The hydrogeological data base for the coastal plain lying between Waimea and Polihale State Park in western Kauai is sparse, even though numerous wells have been drilled. This report utilizes the existing data base and extrapolates beyond it with conceptual models consistent with known patterns of hydrogeological conditions in analogous situations. The analyses that follow are keyed to the State Department of Health requirement that injection is not allowed where the groundwater has a concentration of 10,000 mg/l total dissolved solids (TDS) or less.

For the analyses in this report, the proposed maximum injection rate of 1.2 mgd is used.

General Geology of the Mana-Kekaha Plain

The waste water treatment plant (WWTP) and the sites where injection wells would be feasible are located in the eastern part of the coastal plain as it narrows between Kekaha and Waimea. The plain consists of a sequence of

sedimentary strata resting on the basement rock of Napali basalt. The sedimentary column, also called the caprock, is approximately 270 feet deep at the WWTP and 600 feet thick at the coast. Two miles to the west at well 5842-01 by the Kekaha Sugar Mill the caprock is 400 feet deep. Figure 2 is a lithology log of this well. Figure 1 is a map of the region showing the general surface geology and well locations.

The caprock sediments as a whole are poorly permeable and act as a confining layer on the Napali aquifer. Most of the strata are dominated by clay, but a few horizons of permeable coral and sand are sandwiched between the clays. A typical geological column in the vicinity of the WWTP starts with a layer of sand and coral reaching to about 60 feet below sea level where it rests on clay. Another coral layer about 20 feet thick lies between 110 and 125 feet below sea level, and another about 15 feet thick is sandwiched between clays from about 205 to 220 feet below sea level. The final stratum in the sedimentary column is a clay overlying the weathered zone of the Napali formation. Figure 3 illustrates all of the lithologic logs available for wells in the Mana Plain, and Figure 4, modified from DOWALD Report R 53, shows locations of the wells.

The probable distribution of the coral and clay layers between Kekaha and Waimea is illustrated in Figure 5. This

diagram is a cross-section of the subsurface geology along a line drawn perpendicular to the coast and the cliffs at the inner margin of the plain while passing through the WWTP. Noted on the figure are TDS concentrations encountered in wells when they were first drilled in 1929-1930, before continuous pumping started. The TDS concentrations are converted from chloride concentrations using the chloride to TDS ratio in sea water. The estimated half sea water isoconcentration at 17,500 mg/l TDS is also indicated.

Coral layers are much more permeable than clays and may be able to accept injected fluid. However, only the highest stratum starting at ground level is thick enough to accommodate a high rate of injection. The other two coralline layers are probably too thin to take 1.2 mgd.

The top sand and coral stratum probably could accommodate an injection rate of 1.2 mgd, but this formation is open to the sea at and for some distance off the coast. Unless mixing of sea water with effluent seepage along the coast were rapid, the effluent nutrients might provide an opportunity for marine blooms. The cesspools and septic tanks emplaced in this layer already add nutrient-rich effluent to the ambient groundwater.

The injection alternative having the greatest chance of success with fewest constraints is by way of deep wells

penetrating into brackish to saline water below the fresh water core of the basal lens in the Napali formation. The caprock/Napali contact slopes at an angle of about 8 degrees near Kekaha. To avoid the 10,000 TDS isoconcentration, wells will have to be more than 500 feet deep.

The Groundwater Environment

In Figure 5 the theoretical half sea water concentration (17,500 mg/l TDS) is plotted from head data. This concentration contour is the middle of the transition zone, and its depth below sea level is calculated by multiplying the head by the Ghyben-Herzberg constant, 40. Salinity above the midpoint decreases symmetrically. A fresh water core lies above the transition zone.

The thickness of the upper limb of the transition zone depends on the groundwater flux and the mode of discharge of the lens. In a lens unprotected by caprock, the transition is thin if flux is high because discharge takes place as a line sink along the coast. In a thick lens confined by caprock, the transition zone would be wider for the same rate of groundwater flow because discharge is hampered by the low permeability of the caprock/basalt interface. The upper limb of the transition zone in the vicinity of Kikiaola is probably on the order of 100 feet thick. In this limb the

10,000 mg/l TDS contour lies.

To avoid encountering groundwater containing less than 10,000 mg/l TDS, the injection wells will have to placed seaward of the WWTP somewhere in the vicinity of Highway 50 (Kaumuali Road) or further seaward. At the highway the caprock/Napali contact is about 400 feet below sea level and TDS of the ambient groundwater is at least 13,000 mg/l (the original concentration at the Kekaha Mill well at the time of drilling in 1930) and more likely 22,000 mg/l (an analysis in 1972). To handle 1.2 mgd, the injection well will have to penetrate 200 feet into the Napali aquifer. Thus, at the highway an injection well will have to be 600 feet deep to be reliable. Further seaward the required depth will increase. At the coast, for example, a well would have to be 800 feet deep.

Injection Hydraulics

The waste water injected into the Napali aquifer will have a lower density than the ambient groundwater, and if the density difference is significant, the waste water will rise as a plume around the well until it encounters the caprock. A portion will travel upgradient along the interface to a stagnation point, and the bulk will move downgradient as a slug in the ambient flow field. Eventually the wastewater

will seep into the caprock, driven by a positive potential in the aquifer relative to the potential in the caprock. The area of seepage depends on the permeability of the caprock interface and the injection rate.

If the difference in density between the ambient groundwater and the injected fluid is very small, the injectant will not rise but, instead, will form a plume in the ambient flow field. The difference in density for the Kikiaola injection, however, is likely to be significant enough to result in vertical movement of the injectant. Assuming the injection takes place in the lower limb of the transition zone where the TDS concentration ranges from 17,500 mg/l to sea water, the average density of the ambient groundwater will be 1.0188. The density of the waste water is taken as 1.0000 because it is very nearly fresh water.

To predict where the injectant will travel and if it might impact ambient groundwater having less than 10,000 mg/l TDS, four behavioral characteristics of the injectant need to be examined: 1) the buoyancy gradient, 2) radius of the buoyant column, 3) upgradient movement of the slug along the caprock interface, and 4) rate of discharge into the caprock and area over which discharge takes place. Once in the caprock, the injectant will move seaward to eventually discharge at the sea bottom.

Buoyancy Gradient

The buoyancy gradient is expressed as:

$$\{g(a) - g(c)\}/g(a)$$

in which g(a) is density of the ambient groundwater, taken as 1.0188, and g(c) is density of the waste water, 1.0000. The density difference is .0188; if the ambient groundwater were sea water, the difference would be .025. Derivations of the buoyancy gradient are given in Mink and Lau (1980); Burnham, Larson and Cooper (1977); and Wheatcraft (1979).

The gradient is high, and therefore the upward velocity of flow is rapid. Assuming the vertical hydraulic conductivity (k) in the Napali basalt is 200 ft/day, equal to about one tenth the horizontal conductivity, and effective porosity (n) is .05 (these parameters are commonly used in numerical modeling), the velocity is:

$$v = .0188\ (k/n) = 75 \text{ ft/day}.$$

Manifestly the vertical plume will quickly establish itself all the way from the bottom of the screen to the caprock interface because the vertical velocity is much greater than the ambient flow field velocity of 5 to 10 ft/day.

Radius of the Vertical Cylindrical Slug

In their analysis of the fate of injected waste water at

the Kahului, Maui WWTP, Burnaham, et al (1977) derived an expression for the radius of the cylindrical slug along the screen of the injection well. The average radius, r(av), is written as:

$$r(av) = (2/3)\ (Q/\pi k g)^{1/2}$$

in which Q is injection rate, k is vertical hydraulic conductivity, and g is the buoyancy gradient. For an injection rate of 1.2 mgd over a screen length of 200 feet, the average radius of the slug will be 78 feet. The maximum radius at the top of the screen will be 117 feet.

The caprock, because of its low permeability, can't accept all of the injectant over this small a radius. The injectant will move upgradient to a stagnation point where the potential of the slug equals that of the ambient flow, and downgradient along the caprock/basalt interface.

Upgradient Movement of Injectant

The methods employed to predict injected effluent behavior are simple and straightforward because the absence of reliable caprock and basalt aquifer parameters does not justify use of numerical modeling. The vertical distribution of salinity is based on information from pumping wells, and the position of the transition zone is inferred from heads measured at wells. The depth to the midpoint of the

transition zone is equal to 40 times the head. The position of the fresh water core, transition zone and sea water is illustrated in Figure 5.

The injectant enters the aquifer with a higher potential than the ambient groundwater and therefore will travel as a slug upgradient until the potential of the two fluids are equal. At the edges of the slug hydrodynamic dispersion will occur, but by and large the slug will retain its identity. The stagnation radius, or the distance the slug will travel upgradient before stopping, is:

$$r(stag) = Q/(2\pi bki)$$

in which Q is the injection rate, b is the thickness of the slug, k is horizontal hydraulic conductivity, and i is gradient of the ambient flow field.

This formula assumes the aquifer is homogeneous and isotropic, confined and infinite in extent. In spite of these limitations, it is a reasonable approximation of behavior of the injectant after it rises into the basal lens. The EPA software program WHPA utilizes this equation. Hydrodynamic dispersion is not accounted for.

For Q of 1.2 mgd, b of 100 feet, k at 2000 ft/day, and i of 1/5000, r(stag) is 638 feet. The b value is a compromise, chosen as one half the screen length; the k and i values are typical of basal aquifers in Hawaii.

Under the stated assumptions the maximum width of the plume can be calculated as:

$$w = Q/kbi.$$

The plume will expand to this width several miles downgradient of the well. However, the caprock, beneath which the plume travels, behaves as a leaky confining layer into which the injectant is able to seep. If the caprock contact were impermeable, the plume would continue downgradient until it encountered openings where the sedimentary blanket tails off.

Employing the same values for Q, k, b and i as above, the width of the plume at the injection site will be 2000 feet, or 1000 feet on either side of the well. Two wells located next to each other but receiving 0.6 mgd each would generate a similar plume width. Injection wells capable of accepting a combined rate of 1.2 mgd do not have to be distant from each other because neither the plume width nor the stagnation radius will impact other wells.

For a well located at Highway 50, the slug of injected waste water would travel upgradient to about where the 50 percent sea water concentration encounters the caprock. Under these circumstances, groundwater with less than 10,000 mg/l would not be impacted. A well between the WWTP and the road, however, would encroach into the upper limb of the transition

zone and might affect water having less than 10,000 mg/l TDS. Note that if the average injection rate was to be as high as 0.6 mgd, the stagnation radius would be only 316 feet.

The landward extent of the injection slug will not affect any operational wells driven into the basalt aquifer. The nearest Kauai County Water Department wells are 5840-01, about 0.9 miles upgradient of the proposed injection site, and 5840-02, about 0.75 miles upgradient (see Figure 1). The upgradient reach of the injection plume will be less than 1000 feet and will be restricted to a depth of about 300 feet below sea level. The depth of wells 5840-01 and 5840-02 are 52 and 18 feet below sea level, respectively. According to the Department of Water Supply, the next well to be drilled will be located between Waimea and Kekaha at the cliff line at the inner margin of the coastal plain. The well will be at least one mile upgradient of the injection site.

Well 5840-01 is the principal well used for municipal water supply. It is equipped with a 500 gpm pump. At this rate of pumpage the downgradient stagnation point is 380 feet. This distance added to the upgradient stagnation distance of 638 feet for the proposed injection well will allow a separation of about 3000 feet between the envelope of flow to 5840-01 and the upgradient reach of the injection plume.

Seepage of Waste Water into the Caprock

The permeability of the clay at the base of the caprock is quite low, probably less than 1 ft/day and perhaps on the order of 0.1 ft/day. The seepage rate per unit area from the Napali aquifer into the caprock is correspondingly small. Yet the caprock is the ultimate destination of the basal water.

An analysis employing leaky aquifer concepts provides an estimate of the area of caprock required to accept the injected waste water. Figure 6 illustrates the hydrogeological environment on which the analysis is based. The expression:

$$q(x)/q(0) = \exp\{-x/(kbC)^{1/2}\}$$

gives the ratio of flow remaining at a distance downgradient of the section where flow is q(0). In the expression, q(x) is flow at a distance x from the section q(0), k is horizontal hydraulic conductivity, b is depth of flow, and C = b'/k' in which b' is the thickness of the caprock stratum receiving seepage and k' is hydraulic conductivity of this stratum.

For k (Napali) = 2000 ft/day, b = 100 feet, b' = 50 feet and k' = 0.1 ft/day,

$$q(x)/q(0) = .9048$$

which states that approximately 10 percent of the flow in the Napali seeps into the caprock over a distance of 1000 feet.

Over a linear distance of 10,000 feet, 63 percent seeps into the caprock. For k' = 1 ft/day, the respective seepage values would be 27 percent and 96 percent.

A large caprock/Napali interface area is required to discharge the basal lens and its slug of injected waste water, but most of the area of seepage will be downgradient of the injection well. Over the upgradient distance (638 feet) less than 10 percent of the effluent will enter the caprock; the remainder moves down the interface slope.

Fate of Nutrients

Nutrients and other dissolved matter in the injectant will eventually dissipate into the sedimentary caprock, and then ultimately discharge into the sea at a considerable distance from the coast and deep below sea level. The process of dispersion in the saline water of the caprock and distributed seepage from the caprock into sea water will reduce the concentration of dissolved matter at the caprock-sea water interface.

The injected effluent will be prevented from mixing in coastal waters by the thick wedge of caprock. The caprock extends as a low permeability blanket for an unknown distance off shore. It is not possible to state just where the injectant will finally mix with water in the open sea, but

unquestionably it will be a considerable distance off shore and at a depth of hundreds of feet.

The sea floor slopes gently from 0 to 60 feet depth over a distance of 3000 feet from the coast, indicating that the caprock wedge extends at least over this distance. It then slopes more steeply, from depth 60 to depth 300 feet over the next 3000 feet, and more steeply over the next 1000 feet from depth 300 to depth 600 feet. The steepening slope traces the descent of the front of the caprock wedge. The depth of 600 feet lies 7000 feet off shore. Whether the injectant seepas into the caprock or remains in the basalt aquifer, its emergence in the sea floor will take place no closer than one half mile from the coast.

Summary

Groundwater in the Napali basalt aquifer inland of the WWTP contains less than 10,000 mg/l TDS and therefore is ineligible for injection wells. The 10,000 mg/l TDS isoconcentration intersects the caprock about midway between the WWTP and Highway 50. Between here and the coast all groundwater has more than 10,000 mg/l TDS.

The waste water effluent will have a density nearly that of fresh water while the ambient groundwater will range from half to full sea water salinity. At Highway 50 groundwater in

the Napali constitutes the lower half of the transition zone and has an average composition of 26,000 mg/l TDS and density of 1.0188. In an injection well located here, the difference in density between the waste water and the ground water will cause the injectant to rapidly rise as a cylindrical slug around the well screen. On reaching the caprock/Napali contact, a plume will move to a stagnation point about 640 feet upgradient, and the remainder will move downgradient along the contact. The upgradient slug will not interfere with groundwater containing less than 10,000 mg/l TDS.

Eventually the waste water injectant will seep into the caprock. A large surface area of the caprock/Napali interface is required to discharge the basal lens, including the injectant fluid. Most of the seepage into the caprock will take place downgradient of Highway 50 and will have no impact at the shore line where the caprock is 600 feet thick. Groundwater seeping into the caprock has no opportunity to rise to discharge at an open coast.

Recommendation

Locate two injection wells at Highway 50, or between the Highway and the coast, wherever a site is available. If each well is rated at a maximum of 1.2 mgd, with an average that is up to half of this rate (i.e., 0.6 mgd), they can be placed within 50 feet of each other.

Wells at Highway 50 will have to be 600 feet deep. They will be cased and grouted throughout the 400 feet thickness of the caprock. The 200 feet section in the Napali basalt will either be screened or open, depending upon the nature of the formations encountered. The diameter of the casing and screen will depend on the volume rate of injection. At an injection rate of 1.2 mgd for each well, a 12 or 14 inch diameter casing will be required.

Data Summary

Mana Coastal Plain Wells with a Data Record

Well	Grd. El(ft)	Napali El(ft)	Depth El(ft)	Cl(0) mg/l	Cl(P) mg/l	h(ft)
5842-01	9	-394	-481	7130	11,800	8.3
0044-13	8	-153	-206	81	200-800	10.5
0044-14	8	-155	-237	139	400-900	10.3
0045-03	10	-181	-252	135	130-180	9.5
0145-22	9	-149	-236	94	310-650	10.4
0145-23	10	-154	-244	93	250-700	10.4
0145-24	10	-152	-265	114		
0146-04	9	-235	-352	498	1000	9.6
0245-01	55	-160	-243			

Column Explanation

Well: State number.
Grd.El(ft): Elevation of ground surface above sea level.
Napali El(ft): Elevation of caprock/Napali contact.
Depth El(ft): Elevation bottom of well.
Cl(0) mg/l: Initial chloride during drilling, before pumping.
Cl(P) mg/l: Chloride during pumping.
h(ft): Average head, feet above sea level.

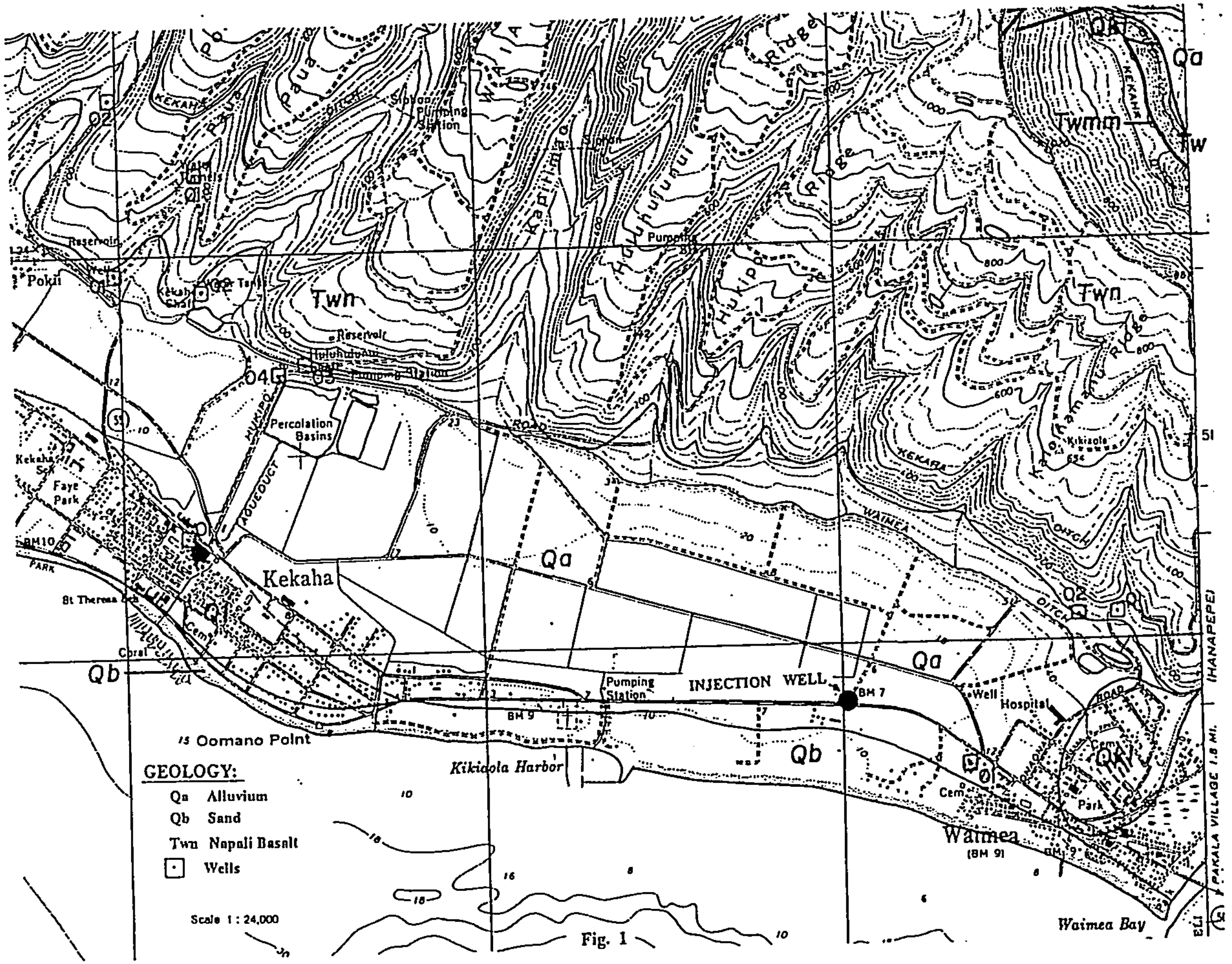
References

1. Burnham, W.L., Larson, S.P., and Cooper, H.H., 1977, Distribution of Injected Wastewater in the Saline Lava Aquifer, Wailuku-Kahului Wastewater Treatment Facility, Kahului, Maui, Hawaii: U.S. Geological Survey OFR 77-469.

2. Burt, R.J., 1979, Availability of Groundwater for Irrigation on the Kekaha-Mana Coastal Plain, Island of Kauai, Hawaii: State of Hawaii Dept. Land and Natural Resources, Report R53.

3. Mink, J.F., and Lau, L.S., 1980, Hawaiian Groundwater Geology and Hydrology and Early Mathematical Models: Univ. Hawaii Water Resources Research Center, Tech. Mem. 62.

4. Macdonald, G.A., Davis, D.A., and Cox, D.C., 1960, Geology and Ground-Water Resources of the Island of Kauai, Hawaii: State of Hawaii Division Hydrography, Bulletin 13.



Kekaha
INJECTION WELL
Pumping Station
Percolation Basins
Aqueduct
Reservoir
Pokii
Faye Park
St Theresa
Oomano Point
Kikiaola Harbor
Waimea
Waimea Bay
Hospital
Well
Qa
Qb
Twn
BM 7
BM 9
BM 10
(HANAPEPE)
PAKALA VILLAGE 1.8 MI.
GEOLOGY:
Qa Alluvium
Qb Sand
Twn Napali Basalt
Wells
Scale 1 : 24,000

Fig. 1

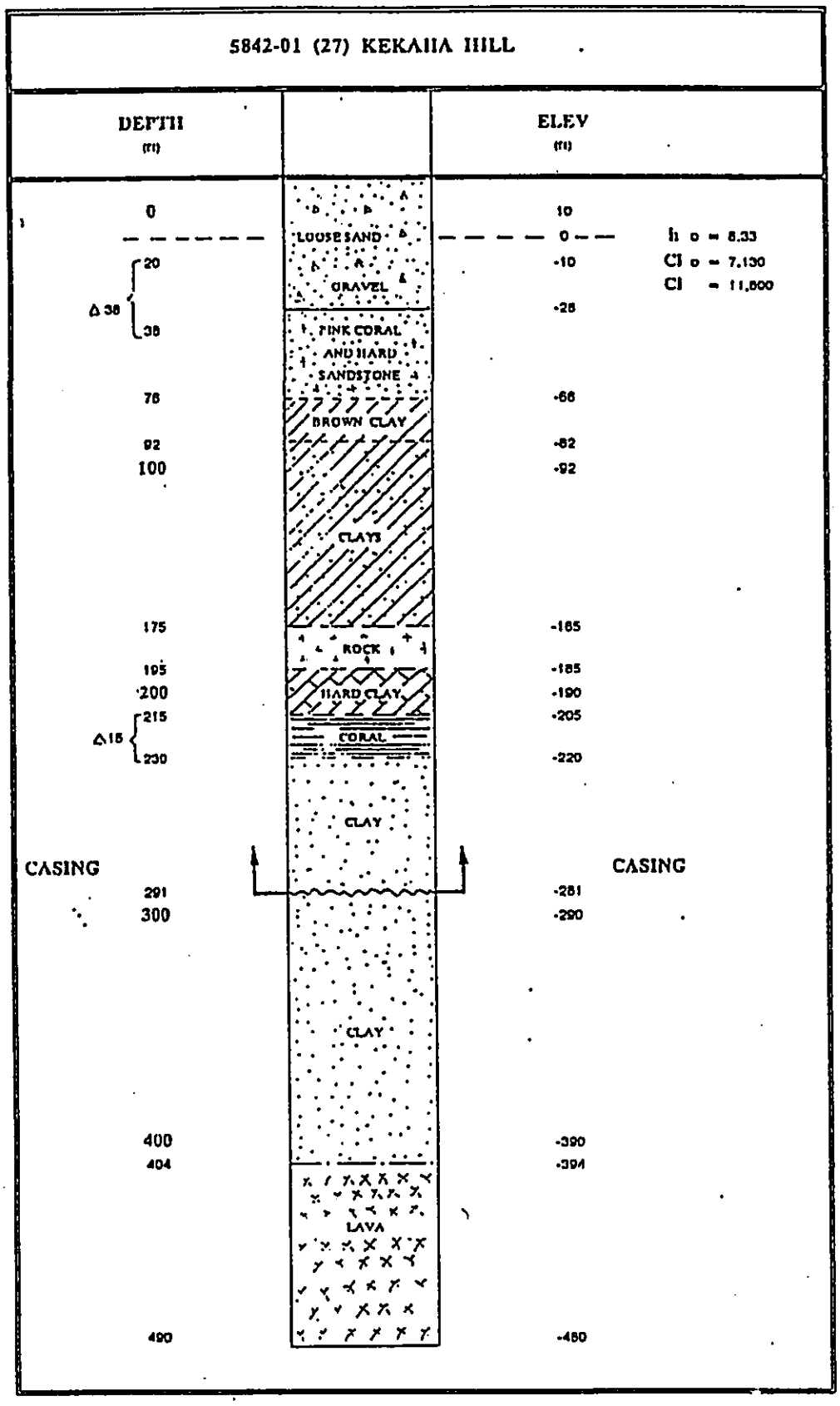

5842-01 (27) KEKAIHA HILL
DEPTH (ft)
ELEV (ft)
0
10
LOOSE SAND
0
h o = 8.33
Cl o = 7,130
Cl = 11,600
20
-10
Δ 38
GRAVEL
38
-28
PINK CORAL AND HARD SANDSTONE
78
-68
BROWN CLAY
92
-82
100
-92
CLAYS
175
-165
ROCK
195
-185
200
-190
HARD CLAY
215
-205
Δ 15
CORAL
230
-220
CLAY
CASING
CASING
291
-281
300
-290
CLAY
400
-390
404
-394
LAVA
490
-480

Fig. 2

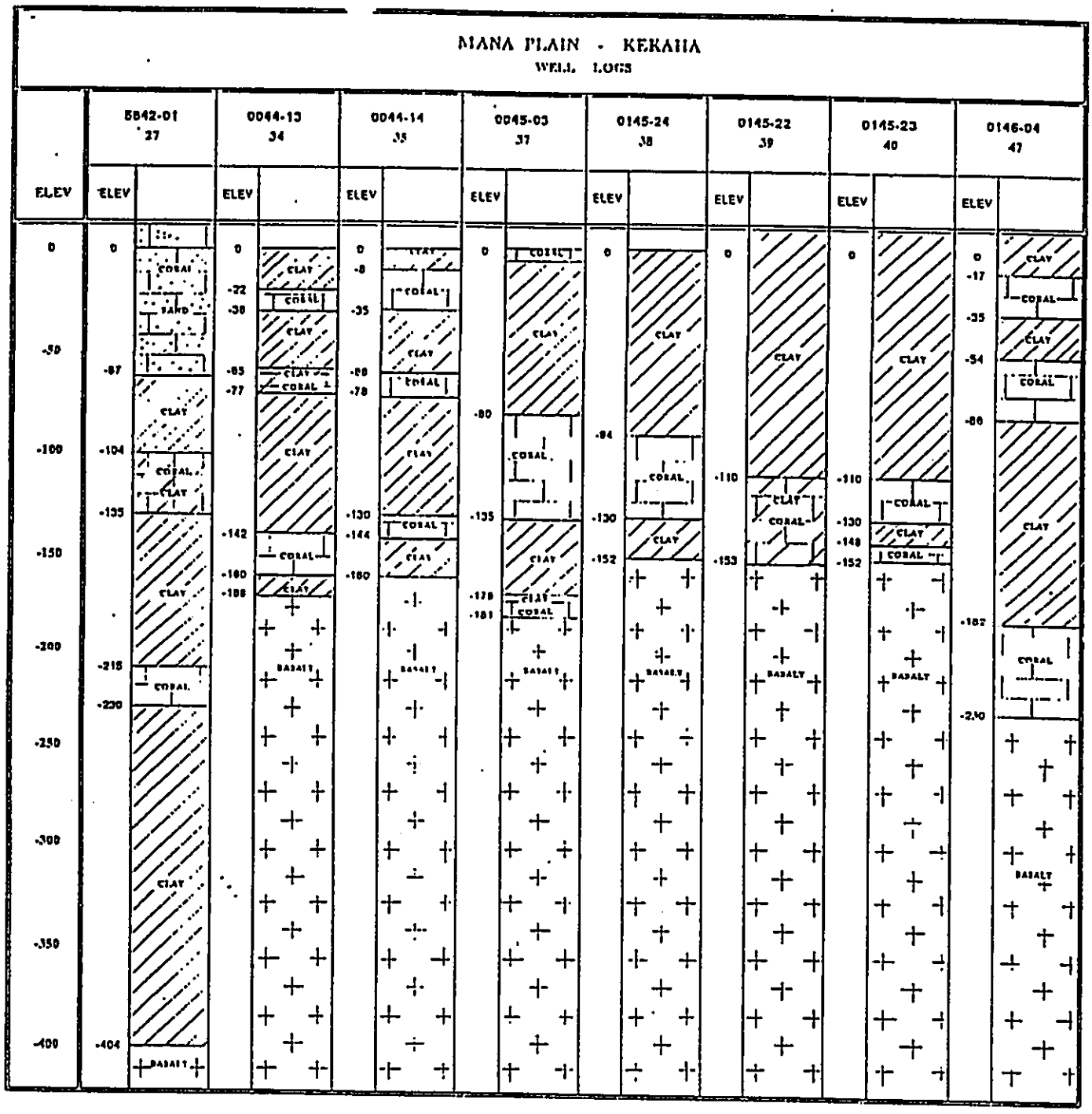
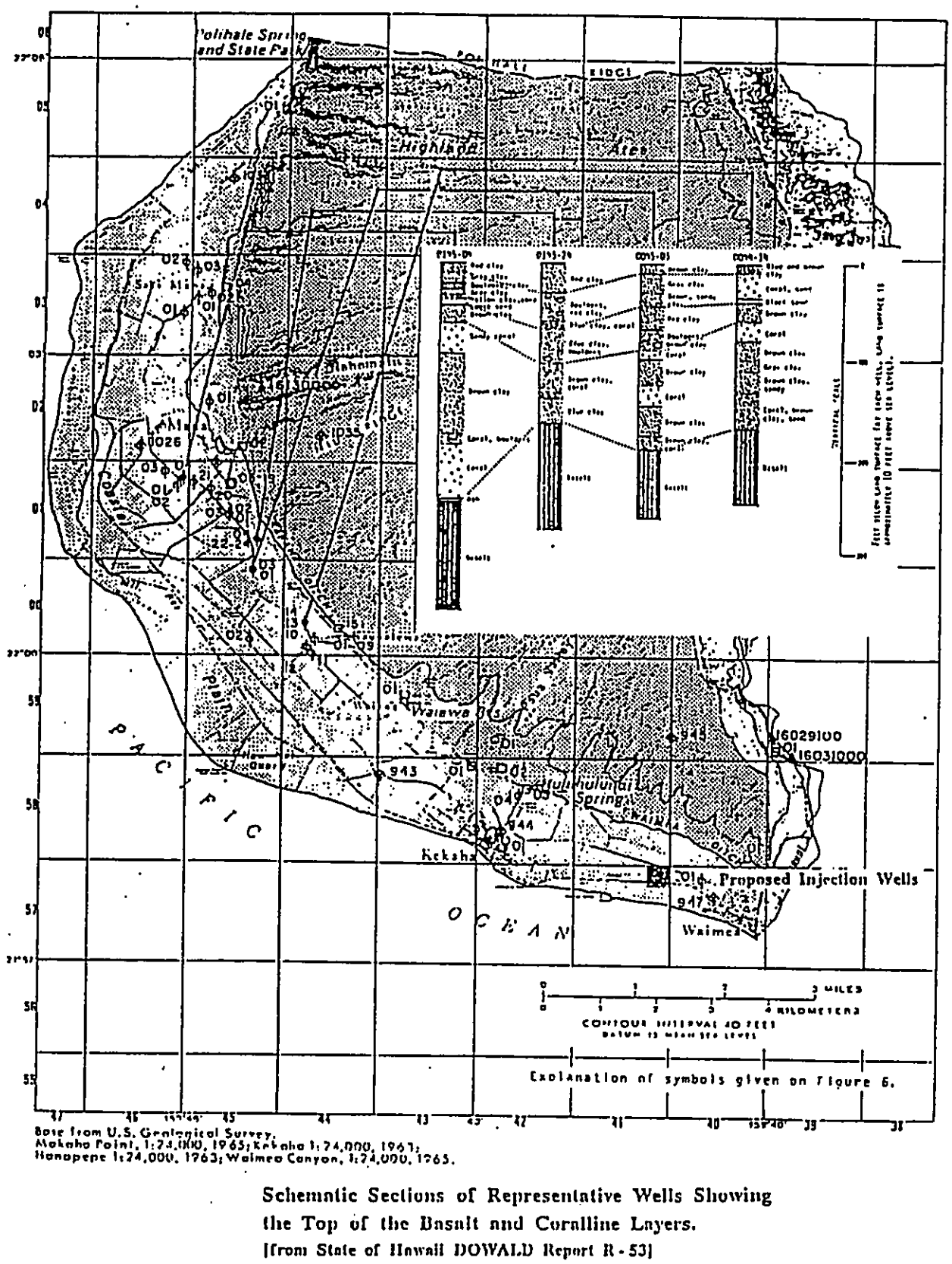
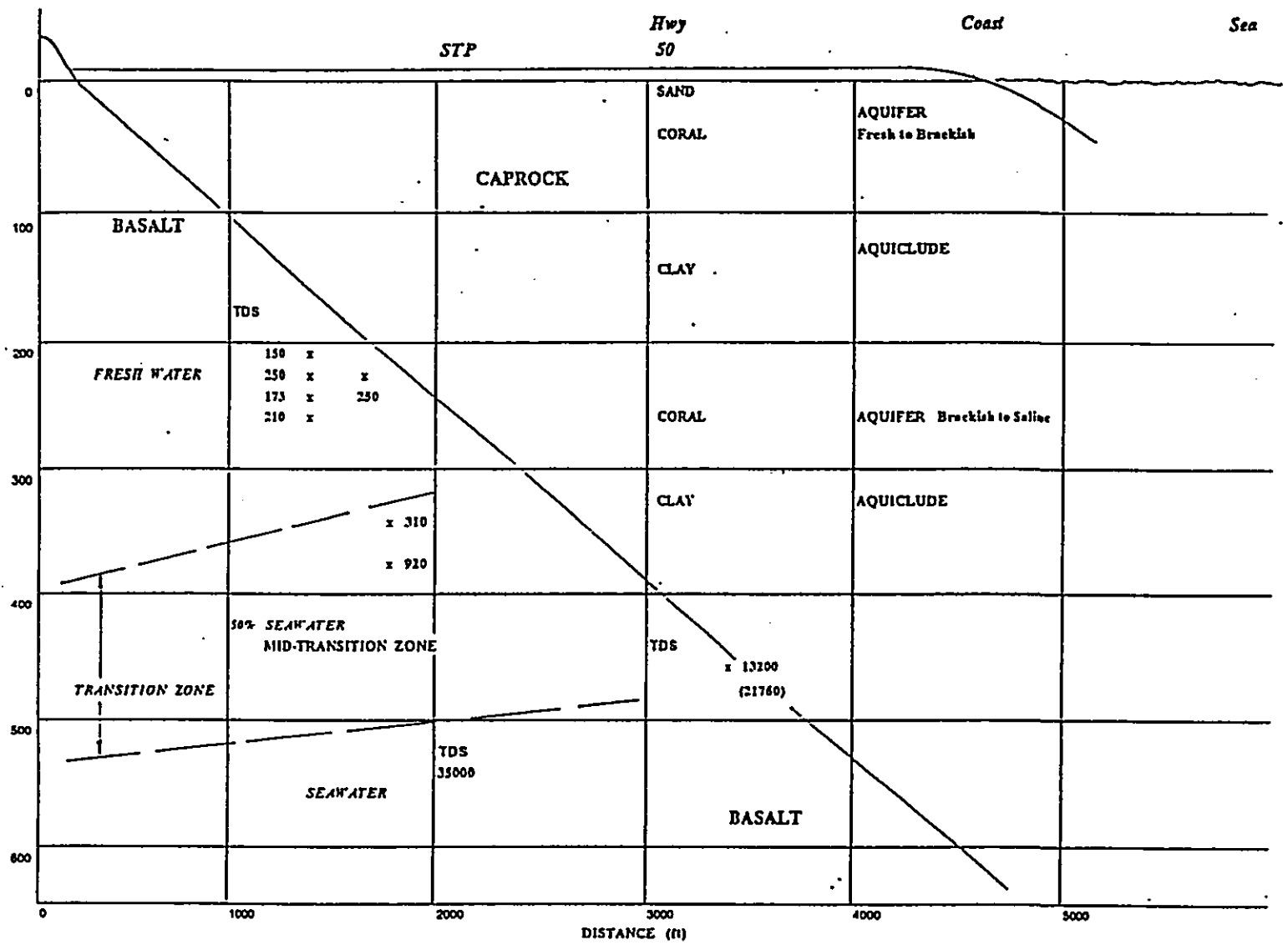

MANA PLAIN - KEKAHA
WELL LOGS
5842-01
27
0044-13
34
0044-14
35
0045-03
37
0145-24
38
0145-22
39
0145-23
40
0146-04
47
ELEV
CORAL
SAND
CLAY
BASALT

Fig. 3



Schematic Sections of Representative Wells Showing the Top of the Basalt and Coralline Layers.
[from State of Hawaii DOWALD Report R-53]

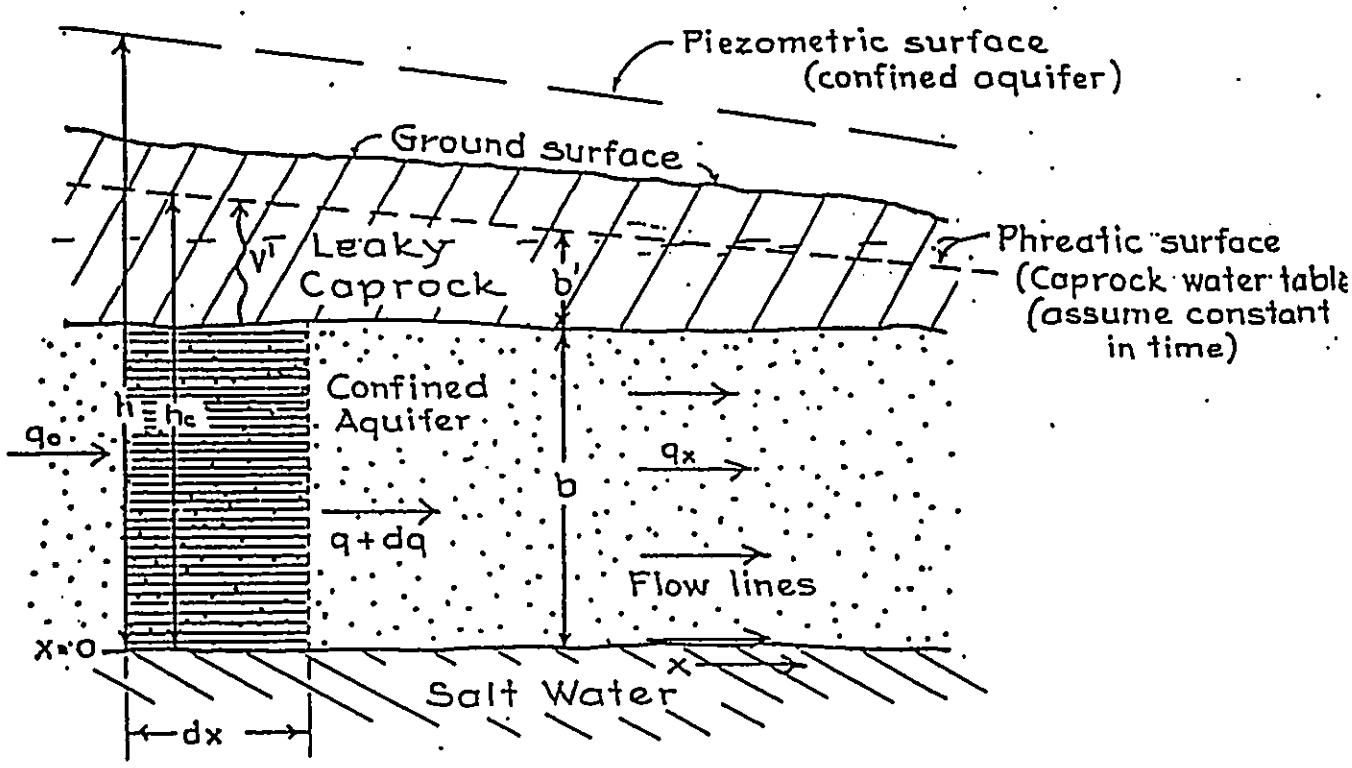
Fig. 4



KIKIAOLA
SECTION
CLIFF LINE
THROUGH STP to COAST

Fig. 5

Steady flow, two dimensional, flow through aquifer horizontal; flow through caprock vertical. Aquifer and caprock isotropic, infinite extent.



NOTE: Assume sharp interface, lowest fresh water flow line undeformable, thus salt water equivalent to impermeable boundary.

Fig. 6

APPENDIX B

Responses to Comments on Draft of "Waimea Wastewater Treatment Plant Effluent Injection Wells Environmental Assessment," January 17, 1995

February 28, 1995

Mr. Harry Funamura
County of Kaua'i
Department of Public Works
3021 Umi Street
Lihue HI 96766

Dear Mr. Funamura:

I wish to comment on the following:

Draft Environmental Assessment for the Waimea Wastewater Treatment
Plant Effluent Injection Wells (Waimea, Kaua'i)

This document outlines the plan of Kaua'i County to dispose of up to 1.2 million gallons a day of treated wastewater by injecting it into two (or perhaps more) injection wells.

The possible negative impact of the injection wells on potable water sources is dismissed, for all practical purposes. This dismissal is based on a report by John Mink that predicts the injectate will form a "slug" that will float atop the brackish or saline water that lies below the freshwater core of the basal lens, until it hits the boundary between the Napali basalt and the caprock sediments. Part of it will then "travel upgradient along the interface to a stagnation point," Mink says, while "the bulk will move downgradient" and "eventually will seep into the caprock.... Once in the caprock, the injectant will move seaward to eventually discharge at the sea bottom."

Mink states confidently that "the landward extent of the injection slug will not affect any operational wells driven into the basalt aquifer." I have only the greatest respect for John Mink, yet I do not know how such confidence can be obtained when his report is prefaced by the statement that "the hydrogeological data base for the coastal plain" where these wells are proposed "is sparse." He states that he uses what data exist, "and extrapolates beyond it with conceptual models consistent with known patterns of hydrogeological conditions in analogous situations." This is a reasonable approach, of course, but it does hinge on an assumption that the geology in the Waimea plain contains no unexpected deviation from apparently similar areas that have been better studied.

A great deal is riding on this assumption. Should it prove wrong, municipal drinking water sources could be adversely impacted by operation of the injection wells.

A second point I would like to make concerns the loss of a resource entailed when effluent is injected rather than re-used. The Kekaha-Waimea area is not one where water is abundant. It seems foolish to abandon an existing effluent re-use system in favor of disposal through injection wells.

I believe it would be in the long-term environmental and economic interests of the County of Kaua'i to look for alternate users of treated effluent than to become reliant on injection wells as a means of effluent disposal. As you are aware, of course, injection wells are not cost-free or

maintenance-free. They can and do plug up (just ask Maui County's Department of Public Works and Waste Management).

Finally, the Mink study expresses a degree of confidence about the ultimate fate of the nutrients in the effluent that is based more on trust than it is on knowledge of undersea geology. "The injected effluent will be prevented from mixing in coastal waters by the thick wedge of caprock," Mink writes. "The caprock extends as a low permeability blanket for an unknown distance off shore. It is not possible to state just where the injectant will finally mix with water in the open sea, but *unquestionably* it will be a considerable distance offshore and at a depth of hundreds of feet." (Emphasis added)

I would suggest it is difficult to assert anything "unquestionably" when so little is known about the offshore geological formations. The scenario outlined may be probable as well as reasonable; it is not, however, unquestionable until a stronger foundation for it is laid.

Even should the nutrients mix with ocean water "a considerable distance offshore," why should we not believe that this will impact nearshore water quality? It is reasonable to believe that nutrients may be carried inshore by ocean currents; indeed, much of the research now being conducted by the Mamala Bay Study Commission on O'ahu indicates how wrong have been some of our conventional beliefs about the fate of effluent discharged into the open ocean environment. The mere fact that effluent enters the water at a point "a considerable distance offshore," in other words, is no assurance that that effluent will never work its way back to nearshore environs.

In short, I believe this Draft EA has the following deficiencies:

1. Not enough attention has been paid to looking for alternatives for effluent re-use.

2. There is not enough information to state with confidence that no potable water sources will be harmed by the injection wells.

3. There is too great a reliance on "dilution as a solution to pollution" insofar as the effects of nutrients on nearshore water quality are concerned.

Thank you very much for your attention to my concerns.

Yours truly,

Patricia Tummons

Patricia Tummons
187-C Hokulani Street
Hilo HI 96720

cc: OEQC
Department of Health, Safe Drinking Water Branch
EPA Region IX Underground Injection Control Program

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AN EQUAL OPPORTUNITY EMPLOYER
COUNTY OF KAUAI
DEPARTMENT OF PUBLIC WORKS
3021 UMI STREET
LIHUE, KAUAI, HAWAII 96766

March 13, 1995

Ms. Patricia Tummons
187-C Hokulani Street
Hilo, Hawaii 96720

Dear Ms. Tummons:

Subject: Draft Environmental Assessment
Waimea Wastewater Treatment Plant Effluent Injection Wells
Waimea, Kauai, Hawaii

Thank you for your letter of February 28, 1995 expressing your concerns about the referenced project. We forwarded your comments to Mr. John Mink, our consultant in this matter, and his reply is attached. We believe that his comments adequately address your concerns as stated in your letter.

We agree that effluent reuse is a desirable alternative, especially in areas such as Kekaha and Waimea where water is not abundant. Accordingly, the effluent from the Waimea Wastewater Treatment Plant (WWTP) has been used for sugar cane irrigation since 1973. Unfortunately, the agreement by which the County was permitted to discharge into privately-owned irrigation reservoirs has expired, and with diminishing sugar cane irrigation demands combined with the landowner's desire to close the reservoirs and develop the property, alternative means of reuse and/or disposal were investigated. As indicated in the Draft Environmental Assessment, a "Waimea Wastewater Treatment Plant Effluent Reuse/Disposal Alternative Study", and a "Alternatives Study for Disposal of Effluent from Waimea Wastewater Treatment Plant via Injection Wells or Rapid Infiltratin System" were prepared. Currently, no reliable, cost-effective means of effluent reuse is available, which led to our selection of injection wells.

Fortunately, a large scale development is planned in the Waimea area, and we have been working closely with the developer with regards to reuse of the effluent in the future. In fact, installation of the injection wells by the County means that any future user of the

MAR 14 1995

effluent will not be required to provide a backup disposal system, so reuse will actually be facilitated. Therefore, our view of the injection well disposal system is that it will provide a reliable, safe disposal system in the interim until a reuse opportunity arises, at which time the injection wells will revert to a backup role.

If you have any questions, please feel free to call Larry Dill of the Wastewater Section at 241-6616.

Very truly yours,

STEVE OLIVER
County Engineer

Attachment

cc: OEQC (w/att)
County of Kauai Planning Department (w/att and Ms. Tummons' letter)

LD

A:\031395PT.LTR

RESPONSE BY JOHN MINK TO PATRICIA TUMMONS' LETTER
OF FEBRUARY 28, 1995 RELATIVE TO
THE PROPOSED INJECTION WELLS AT WAIMEA, KAUAI

In evaluating subsurface hydrogeology and groundwater behavior, such as the character of the caprock and the movement and fate of the injectant, we employ whatever collected data and analytical tools are available. None is perfect, all are weakened by assumptions. However, there exists fundamental physical laws on which we rely. The landward extension of the injection slug will be limited by these laws unless some sort of unknown phenomenon comes into play. The prevailing groundwater flow and transport paradigm does not include such an unknown. The current paradigm, within which our evaluations were done, still prevails--it has not been falsified and replaced by a new paradigm.

Certainly it is true that the hydrogeological data base for the coastal plain is sparse, as we noted in our report, but this does not invalidate our conclusions. As stated in Ms. Tummons' letter, we employed existing data "and extrapolated patterns of hydrogeological conditions in analagous situations". This is the standard approach in scientific and engineering evaluations. Ms. Tummons' implicit argument that the method is unsatisfactory because it "hinges on an assumption that the geology in the Waimea Plain contains no unsuspected deviations from apparently similar areas that have been studied" is irrational because it requires unambiguous certainties in any of the environmental sciences.

We will not comment on the issue of the benefits of re-using effluent rather than injecting it except to note that irrigation with effluent yields a percolate high in total dissolved solids, perhaps also nutrients, that will have an impact on shallow groundwater which eventually discharges along the coast. This is not an alternative free of unknown consequences.

Ms. Tummons' concern about the extent of the caprock offshore can be readily dispensed with because, in fact, the caprock is deep at the shoreline and much deeper offshore. We do not need expensive borings to prove this; the plunge of the basalt basement and the morphology of the sea floor adequately support this model. For it to be violated would require another unkown geological phenomenon which is not consistent with the working paradigm. Also, the effluent will not seep into the sea floor at this point, as feared by Ms. Tummons. It will be disseminated over a large area in deep water. The unit rate of effluent seepage will be extremely small compared with the column of water above it. During its passage through the caprock it will mix with ambient formation water having the salinity of sea water and become highly diluted.

John F. Mink p.p.

John F. Mink, 3/3/95

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

LAWRENCE MIIKE
DIRECTOR OF HEALTH

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

In reply, please refer to:
EMD /

March 2, 1995

Mr. Steve Oliver
County Engineer
County of Kauai
Department of Public Works
3021 Umi Street
Lihue, Hawaii 96766

ATTENTION: Mr. Harry Funamura

Dear Mr. Oliver:

SUBJECT: ENVIRONMENTAL ASSESSMENT (EA) DOCUMENT
WAIMEA WASTEWATER TREATMENT PLANT INJECTION WELLS

This document implies that injection well use may end up to be the eternal method for effluent disposal. Injection well use should not be considered an acceptable long-term practice for effluent disposal; instead, it should be considered only an interim solution to the impending unavailability of reuse due to the closing of Kikiaola's irrigational use of effluent.

The EA needs to address aspects of an aggressive future strategy for the reimplementation of reuse of treated effluent. Without such a strategy, the EA falls short of completing an effective assessment by not including future discharge/disposal considerations in light of post and present conditions.

If you have any questions about this subject, please contact me or the Underground Injection Control program of the Safe Drinking Water Branch at 586-4304 or 586-4258 (Honolulu) or call toll free from the neighbor islands at 1-800-468-4644, ext. 64304 or 64258, respectively.

Sincerely,

THOMAS E. ARIZUMI, P.E., Chief
Environmental Management Division

JR:kh

c: 1. Harold Eichelberger, SDWB Sanitarian, Kauai
2. Clyde Takekuma, Chief Sanitarian, Kauai
3. Office of Environmental Quality Control
4. Mr. Ivan Nakatsuka, Austin, Tsutsumi and Associates, Inc.

MARYANNE W. KUSAKA
MAYOR

STEVE OLIVER
COUNTY ENGINEER
TELEPHONE 241-6600

EDMOND P.K. RENAUD
DEPUTY COUNTY ENGINEER
TELEPHONE 241-6600

AN EQUAL OPPORTUNITY EMPLOYER
COUNTY OF KAUAI
DEPARTMENT OF PUBLIC WORKS
3021 UMI STREET
LIHUE, KAUAI, HAWAII 96766

March 10, 1995

Mr. Thomas E. Arizumi, P.E., Chief
Environmental Management Division
State of Hawaii Department Of Health
P.O. Box 3378
Honolulu, Hawaii 96801

Dear Mr. Arizumi:

Subject: Environmental Assessment (EA) Document
Waimea Wastewater Treatment Plant Injection Wells

Thank you for your letter of March 2, 1995 regarding the referenced subject.

Please be assured that we are certainly not considering injection wells as our "eternal" method of effluent disposal for the Waimea Wastewater Treatment Plant. Though we can understand how a reader might infer from the Draft EA that injection wells might be considered as the "eternal" solution, the Draft EA was certainly not intended to imply as such.

The injection well solution was selected after investigating available reuse options in the "Waimea Wastewater Treatment Plant Effluent/Reuse Disposal Study" and "Alternatives Study for Disposal of Effluent from Waimea Wastewater Treatment Plant via Injection Wells or Rapid Infiltration System", prepared by Austin, Tsutsumi & Associates, Inc. Unfortunately, no reliable, cost-effective means of effluent reuse are presently available. However, Kikiaola Land Company has long-range plans for a master-planned development immediately west of Waimea, which will provide opportunities for effluent reuse. Several discussions between the County and Kikiaola have already occurred on this subject, and both parties agree that this is a desirable long term solution. However, due to the uncertainty of the timing and specifics of this reuse option, no mention was made of it in the Draft EA.

It is therefore our view that the injection wells will serve as the effluent disposal

system for an interim period until a desirable reuse option can be established between the County and Kikiaola Land Company.

If you have any questions, please contact Larry Dill of the Wastewater Section at 241-6616.

Very truly yours,

STEVE OLIVER
County Engineer

cc: OEQC
County of Kauai Planning Department (w/Mr. Arizumi's letter)

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

W-6-3

OFFICE OF THE
REGIONAL ADMINISTRATOR

MAR 15 1995

Mr. Harry Funamura
County of Kauai
Department of Public Works
3021 Umi Street
Lihue, HI 96766

RE: FEDERAL UIC PERMIT APPLICATION

Dear Mr. Funamura:

This letter is in response to Mr. Larry Dil's phone call regarding a Federal Underground Injection Control (UIC) Permit Application for the Waimea Wastewater Treatment Plant. The EPA supports treated wastewater reclamation efforts as an alternative to underground injection for the disposal of treated effluent. The treated effluent may be required to comply with the strict Maximum Contaminant Level requirements stipulated in Class V permits.

A letter mailed by the EPA dated March 10, 1995 stated that an UIC application would be required within the first quarter. If the County of Kauai elects to inject treated wastewater effluent into groundwater, then the County may be required to submit an UIC application as early as the second quarter, not the first quarter as stated in the letter. We will notify the County of Kauai of their requirements and possible permitting of the Waimea Wastewater Treatment Plant injection well.

If you have any questions please contact Jose Gutierrez at (415) 744-1829.

Sincerely,

Doris Betuel, Chief
Source Water Protection Section

cc: Chauncey Hew, HDOH

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorn Street
San Francisco, CA 94105-3901
Mail Code: W-6-3

3/20

March 10, 1995

Mr. Harry Funamura
County of Kauai
Department of Public Works
3021 Umi Street
Lihue, HI 96766

RE: Waimea Wastewater Treatment Plant Effluent Injection Wells
Environmental Assessment (EA)

Dear Mr. Funamura:

Thank you for allowing us the opportunity to comment on the EA for the proposed injection wells at the Waimea Wastewater Treatment Plant.

The U.S. Environment Protection Agency (EPA) strongly encourages and supports wastewater reclamation. Therefore, I wish more discussion was given in the EA as to why wastewater reclamation is not a viable option for the Waimea facility. Since this was addressed in other documents, I would like to request one copy each of the "Waimea Wastewater Treatment Plant Effluent Reuse/Disposal Alternative Study," dated August 7, 1994, and the "Alternatives Study for Disposal of Effluent from Waimea Wastewater Treatment Plant via Injection Wells or Rapid Infiltration System," dated December 9, 1994.

I also want to bring to your attention that, within the NEXT quarter, EPA will be requiring municipal wastewater treatment facilities that use injection wells for disposal to apply for federal UIC permits. Therefore, before you contruct your injection wells, you will need to apply for a federal UIC permit as well as a state permit.

If you have any questions regarding a federal UIC permit, please contact Jose Gutierrez at (415) 744-1829.

Sincerely,

Shannon Fitzgerald
for
Doris Betuel, Chief
Source Water Protection Section

cc: Chauncey Hew, HDOH

MARYANNE W. KUSAKA
MAYOR

STEVE OLIVER
COUNTY ENGINEER
TELEPHONE 241-6600

EDMOND P.K. RENAUD
DEPUTY COUNTY ENGINEER
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AN EQUAL OPPORTUNITY EMPLOYER
COUNTY OF KAUAI
DEPARTMENT OF PUBLIC WORKS
3021 UMI STREET
LIHUE, KAUAI, HAWAII 96766

April 6, 1995

Ms. Doris Betuel, Chief
Source Water Protection Section
U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Dear Ms. Betuel:

Subject: Waimea Wastewater Treatment Plant Effluent Injection Wells
Draft Environmental Assessment (Draft EA)

Thank you for your letter responding to the referenced Draft EA published in the Office of Environmental Quality Control (OEQC) bulletin. We trust that the reports prepared for us and sent to you under separate cover by our consultant, Austin, Tsutsumi & Associates, "Waimea Wastewater Treatment Plant Effluent Reuse/Disposal Alternative Study", dated March 7, 1994, and "Alternatives Study for Disposal of Effluent from Waimea Wastewater Treatment Plant via Injection Wells or Rapid Infiltration System", dated December 9, 1994, address any concerns you may have.

The reports indicate that at present, no viable reclamation alternatives exist, which is why disposal by injection wells is the recommended alternative. However, meetings have already been occurring between the County and Kikiaola Land Company to discuss effluent reuse opportunities in conjunction with their proposed master planned development in the Waimea area. Upon implementation of a future reuse program with Kikiaola, the currently proposed injection wells will revert to a backup role.

It is our understanding that at present, no action is required on the County's part to apply for a federal UIC permit, and that EPA will notify us if and when a federal UIC permit is necessary.

APR 0 7 1995.

If you have any questions, please contact Larry Dill of my staff at 241-6616.

Very truly yours,

HARRY FUNAMURA, Chief
Division of Wastewater Management

cc: County of Kauai Planning Department (w/EPA 3/10/95 and 3/15/95 letters)
OEQC (w/EPA 3/10/95 and 3/15/95 letters)

LD

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AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
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IVAN K. NAKATSUKA, P.E.
LAMBERT J. YAMASHITA, P.E.
HOWARD H.W. MAU, P.E.

#0-93-104.1

March 15, 1995

Ms. Doris Betuel, Chief
Source Water Protection Section
United States Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Dear Ms. Betuel:

Subject: Waimea Wastewater Treatment Plant Effluent Injection Wells Environmental Assessment (EA), Kauai, Hawaii

In response to your March 10, 1995 letter to the County of Kauai Department of Public Works (DPW), we are pleased to transmit one copy each of the following reports which we had prepared for DPW:

- "Waimea Wastewater Treatment Plant Effluent Reuse/Disposal Alternative Study", dated March 7, 1994. (Our EA had mistakenly referred to the date as being August 7th. It should be March 7th.)

- "Alternatives Study for Disposal of Effluent from Waimea Wastewater Treatment Plant via Injection Wells or Rapid Infiltration System", dated December 9, 1994.

Please feel free to call me at (808) 533-3646 if we can be of any further assistance.

Sincerely,

AUSTIN, TSUTSUMI & ASSOCIATES, INC.

By
IVAN K. NAKATSUKA, P.E.
Vice President and
Chief Environmental Engineer

IKN:CDC

Enclosures

cc w/o encls.:
Harry Funamura, Kauai DPW
Chauncey Hew, Hawaii DOH

REPLY TO:
501 SUMNER STREET, SUITE 521 • HONOLULU, HAWAII 96817-5031
PHONE (808) 533-3646 • FAX (808) 526-1267

OFFICES IN:
HONOLULU, HAWAII
WAILUKU, MAUI, HAWAII • HILO, HAWAII

3/13/95

University of Hawai'i at Mānoa

Environmental Center
A Unit of Water Resources Research Center
Crawford 317 • 2550 Campus Road • Honolulu, Hawai'i 96822
Telephone: (808) 956-7361 • Facsimile: (808) 956-3980

March 10, 1995
EA:00108

Mr. Harry Funamura
County of Kauai
Department of Public Works
3021 Umi Street
Lihue, Hawaii 96766

Dear Mr. Funamura:

Draft Environmental Assessment (EA)
Waimea Wastewater Treatment Plant Effluent Injection Wells
Waimea, Kauai

Due to the pending cessation of the current method of effluent discharge into Kikiaola's reservoir, Kauai County proposes to construct two injection wells at the site of its Wastewater Pump Station (WWPS) 'A' located in the Waimea-Kekaha region of Kauai. The project is intended to provide a reliable long-term system for effluent disposal. Maximum discharge capacity for each well is 1.2 million gallons per day (gpd), with the proposed average discharge capacity being 300,000 gpd. The well head will have valves and appurtenances to allow for backflushing with a portable air compressor. Conveyance of disinfected secondary effluent from WWTP and WWPS 'A' to the injection wells will be facilitated by a proposed 12-inch pipe buried at least three feet below grade along an existing dirt road.

We have reviewed this document with the assistance of Frank Peterson, Geology and Geophysics, and Malia Akutagawa of the Environmental Center.

No Accountability

The proposing agency, the Kauai County Department of Public Works, also is charged by Chapter 343, HRS to make the determination as to the potential significance of impacts of the proposed project. In this case, we concur that the prospective impacts are not likely to be significant, and therefore a negative declaration will be appropriate. However, we find any discretionary approval process wherein the proponent and the approving agencies are the same to be disconcerting. Such an arrangement is lacking in accountability and provides for an inherent conflict in interest. If possible, some system of segregating project advocacy from project approval within the agency should be implemented and noted in the documentation in order to enhance public confidence in the discretionary objectivity of the agency.

Alternatives to Proposed Action Not Fully Explored

The section on "Alternatives" (p. 21) states that several options "for disposal and reuse of effluent were evaluated," but there is no indication of what alternatives were considered. A list of alternatives and their

advantages and disadvantages should be included in this section.

No Data Available on Injection Capacity

Neither the document nor the appended Mink & Yuen report contain data on injection capacity. We would like to see data from pumping wells in the Napili formation confirming the 1.2 million gpd capacity which is reported.

Insufficient Information on Well Maintenance

More information is needed on an injection well maintenance/rehabilitationprogram since the most common problem associated with injection well operation is clogging and loss of injection capacity.

Screened or Perforated Casing

Screened or perforated casing in the Napili basalt should be considered to generally facilitate well cleaning and to eliminate possible caving, especially during cleaning with compressed air.

Possible Impacts to Deep Sea Ecology

It was stated in the "Water Quality" section (p. 18-19) of the Draft EA that the injected effluent would not likely affect the groundwater and coastal water, and that discharge will occur at 6000+ feet offshore. Is there any evidence that such effluent would significantly impact the deep sea ecology off the coast of Kauai?

Conclusion

In order to make a proper assessment of the environmental impacts, alternatives to the project must be considered fully, and more information is needed as to how the County will maintain its injection well operations.

Thank you for the opportunity to review this Draft EA.

Sincerely,

John T. Harrison
Environmental Coordinator

cc: OEQC
Tsutsumi and Associates, Inc.
Roger Fujioka
Frank Peterson
Malia Akutagawa

MARYANNE W. KUSAKA
MAYOR

STEVE OLIVER
COUNTY ENGINEER
TELEPHONE 241-6600

EDMOND P.K. RENAUD
DEPUTY COUNTY ENGINEER
TELEPHONE 241-6600

AN EQUAL OPPORTUNITY EMPLOYER
COUNTY OF KAUAI
DEPARTMENT OF PUBLIC WORKS
3021 UMI STREET
LIHUE, KAUAI, HAWAII 96766

April 26, 1995

Mr. John T. Harrison, Environmental Coordinator
University of Hawaii at Manoa
Environmental Center
2550 Campus Road
Honolulu, Hawaii 96822

Dear Mr. Harrison:

Subject: Draft Environmental Assessment (EA)
Waimea Wastewater Treatment Plant Injection Wells
Waimea, Kauai, Hawaii

Thank you for your letter of March 10, 1995 commenting on the referenced EA.

The accountability issue raised in your letter is relevant in our particular situation, with the County of Kauai acting as both the proposing and approving agencies. Since we are bound by Chapter 343, HRS, we are providing the maximum possible amount of segregation with the Department of Public Works as the proposing Department, and the Planning Department as the approving Department. Ultimately, of course, it is the State of Hawaii Office of Environmental Quality Control which provides final approval of the EA.

As indicated on page 21 of the EA, several alternatives to an injection well effluent disposal system were thoroughly investigated in two separate consultant-prepared studies: "Waimea Wastewater Treatment Plant Effluent Reuse/Disposal Alternative Study" dated August 7, 1994, and "Alternatives Study for Disposal of Effluent from Waimea Wastewater Treatment Plant via Injection Wells or Rapid Infiltration System" dated December 9, 1994. These two documents will be incorporated into the Appendix of the Final EA by reference.

The remainder of the comments made in your letter are addressed in the attached letters from Austin, Tsutsumi & Associates, Inc., and Mink & Yuen, Inc.

APR 2 7 1995

If you have any questions, please contact Larry Dill of the Division of Wastewater Management at 241-6642.

Very truly yours,

HARRY FUNAMURA, Chief
Division of Wastewater Management

cc: OEQC
County of Kauai Planning Department (w/Mr. Harrison's letter)
Austin, Tsutsumi & Associates, Inc.

Attachments

LD

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Mink & Yuen, Inc.

100 N. Beretania Street • Suite 303 • Honolulu, Hawaii 96817 • Telephone: (808) 536-0081 • Fax: (808) 536-0082

April 19, 1995

Mr. Ivan Nakatsuka
Austin, Tsutsumi and Associates, Inc.
501 Sumner Street, Suite 521
Honolulu, Hawaii 96817-3646

Re: Response to Comments by J. T. Harrison, Environmental Coordinator, University of Hawaii

The following will respond to comments by J.T. Harrison of the UH relative to the proposed Waimea Injection Wells, Kauai:

J.T.H.: NO DATA AVAILABLE ON INJECTION CAPACITY

M&Y: The Napali basalt is highly permeable and wells can be developed to yield several million gallons per day (gpd) each. An aquifer responds to injection in the same ways it does to pumping. Pump capacity data and length of penetration into the Napali basalt for wells listed on page 17 of the Mink & Yuen, Inc. report are as follows:

Well	Pump Capacity (mgd)	Napali Basalt (ft)
5842-01	N/A	87
0044-13	3.02	53
0044-14	2.30	82
0045-03	2.30	71
0145-22	2.45	87
0145-23	2.30	90
0145-24	2.30	113
0146-04	N/A	117
0245-01	N/A	83

Napali wells are capable of yielding twice the proposed injection rate for a length of penetration less than half that proposed.

J.T.H.: SCREENED OR PERFORATED CASING

M&Y: Based on our knowledge and experience and the experience of others, it is our opinion that a screened casing is not necessary. We cannot guarantee that caving will not occur but our hydrologist feels that the Napali basalt is sufficiently stable to preclude such an occurrence. We believe that the

perforations in the screen tend to get clogged faster, thereby reducing the efficiency of the well. Moreover, clogging of the fissures and interstices in the open hole outside of the screen will make it very difficult to clean because of the interference of the screen.

Our opinion is confirmed by the experience of injection wells in Waimanalo, Oahu, Wailuku-Kahului, Lahaina, and Kihei, Maui, all of which have unscreened open holes that are air-cleaned.

J.T.H.: <u>POSSIBLE IMPACTS TO DEEP SEA ECOLOGY</u>

M&Y: The dispersal of the injectant over a wide area of caprock into which the injectant will seep means that the unit rate of seepage into the sea floor will be very small. The injectant plume will dissipate into thousands of square feet of caprock, then further disperse in the saturated caprock before emerging into the sea floor. An example based on approximations and assumptions will illustrate the phenomenon. The maximum width of the injection plume will be on the order of 4000 feet (based on standard capture zone analysis), and all of the injectant is likely to be dissipated over a down gradient distance of 10,000 feet from the well. Thus, the total caprock surface will be 10 to 40 million square feet. The seepage rate for an area of 10 million square feet at an injection rate of 1.2 mgd is 0.12 gpd/sq. ft. Because seepage is into saturated caprock, it will mix with caprock water, diluting its composition. The seepage rate will be very small, and its effect on sea floor ecology would be negligible. The seepage rate and composition will be many magnitudes less than discharges from ocean outfalls and natural shore discharges.

We hope this will provide the clarification desired.

Sincerely,

Geo. Yuen

George A.L. Yuen
President

AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
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IVAN K. NAKATSUKA, P.E
LAMBERT J. YAMASHITA, P.E.
HOWARD H.W. MAU, P.E.

#0-93-104.1

March 27, 1995

Mr. Larry Dill
County of Kauai
Department of Public Works
3021 Umi Street
Lihue, Kauai, Hawaii 96766

Dear Larry:

Subject: Waimea Wastewater Treatment Plant (WWTP)
Injection Wells – Draft Environmental Assessment

In response to John T. Harrison's March 10, 1995 request for more information on the maintenance/rehabilitation program for the subject wells, we have prepared the following description of the program for your consideration.

The injection wells will include an airline within the well casing, extending from the well head to the bottom of the solid casing, approximately 400 feet belowground. A portable compressor will be mobilized at the well site, and high-pressure air will be injected to scour the solids buildup on the well surface. This procedure will also result in air-lifting of the scoured solids at this 400-foot deep level to the well head, at which point the waste product would be discharged into the wet well of the adjacent existing pump station, via a proposed standpipe with connected flexible hose. The waste would then be pumped – like the normal domestic wastewater entering this pump station – to the existing Waimea WWTP for treatment.

It is proposed that this backflushing program be conducted on a monthly basis as a preventive maintenance measure. The well head piping will also include provisions for addition of caustic to allow for chemical cleansing of the well.

This type of air scouring/lifting maintenance/rehabilitation program for injection wells is being practiced at Maui County's three major WWTPs (Wailuku-Kahului, Kihei and Lahaina) and at the Waimanalo WWTP on Oahu.

REPLY TO:
501 SUMNER STREET, SUITE 521 • HONOLULU, HAWAII 96817-5031
PHONE (808) 533-3646 • FAX (808) 526-1267

OFFICES IN:
HONOLULU, HAWAII
WAILUKU, MAUI, HAWAII • HILO, HAWAII

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

Mr. Larry Dill
County of Kauai
Department of Public Works

March 27, 1995

Please feel free to call me at 533-3646 should you have any questions.

Sincerely,

AUSTIN, TSUTSUMI & ASSOCIATES, INC.

By
IVAN K. NAKATSUKA, P.E.
Vice President and
Chief Environmental Engineer

IKN:CDC