

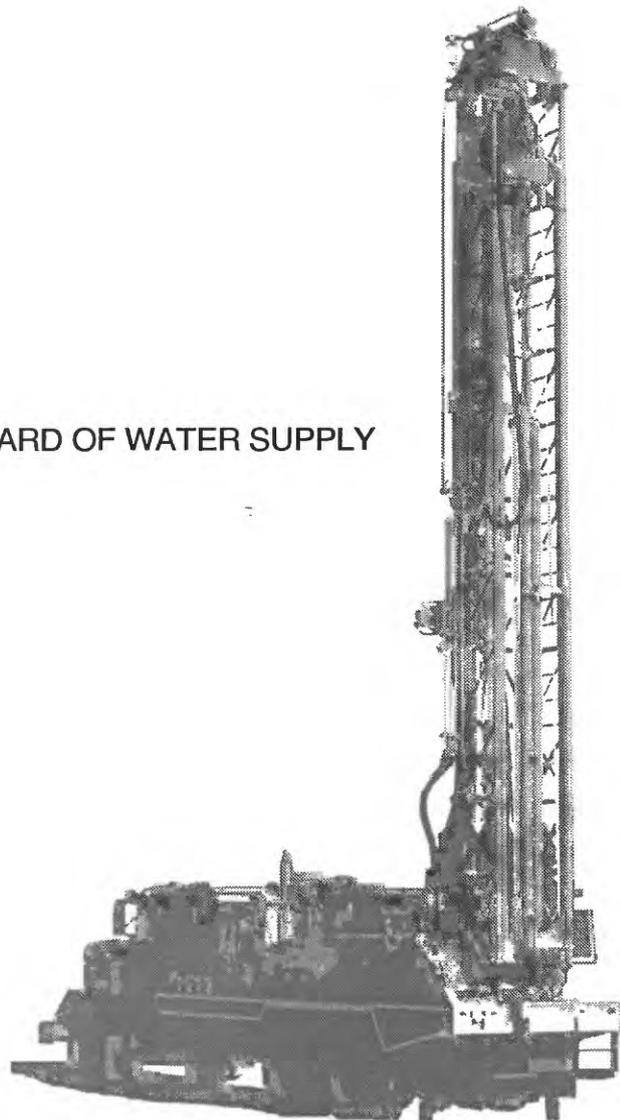
# DRILLING, CONSTRUCTION, AND CALIPER-LOG DATA FOR WELLS 3-3406-14 AND -15, HELEMANO EXPLORATORY WELLS I AND II, OAHU, HAWAII

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U.S. GEOLOGICAL SURVEY

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Prepared in cooperation with the  
CITY AND COUNTY OF HONOLULU BOARD OF WATER SUPPLY



**U.S. DEPARTMENT OF THE INTERIOR**  
**BRUCE BABBITT, Secretary**

**U.S. GEOLOGICAL SURVEY**  
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## Conversion Factors

Multiply	By	To obtain
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
inch (in.)	25.4	millimeter

Elevations in this report are referenced relative to mean sea level.

# Drilling, Construction, and Caliper-Log Data for Wells 3-3406-14 and -15, Helemano Exploratory Wells I and II, Oahu, Hawaii

By Todd K. Presley and Delwyn S. Oki

## Abstract

The Helemano exploratory wells I and II (State well numbers 3-3406-14 and -15) were drilled near Weed Circle, about 3,000 feet south of the town of Haleiwa. The wells are located on agricultural land in the Waialua ground-water area. The wells penetrate through sedimentary deposits (caprock) and into a basalt aquifer. Both wells have short open intervals cased with well screen at the bottom of the hole, and are cased and sealed through the caprock and basalt to the well screen. The shallow well, Helemano exploratory well I, penetrates about 10 feet into the basalt aquifer below the contact of the caprock and basalt. The deep well, Helemano exploratory well II, penetrates about 210 feet into the basalt aquifer. The deep well has a 20-foot open interval at the bottom. Well construction data, logs of drilling notes, geologic descriptions for drill samples, and caliper-log data are presented for the wells. The wells are two of twelve exploratory wells drilled in the north-central Oahu area between July 1993 and May 1994 in cooperation with the Honolulu Board of Water Supply.

## INTRODUCTION

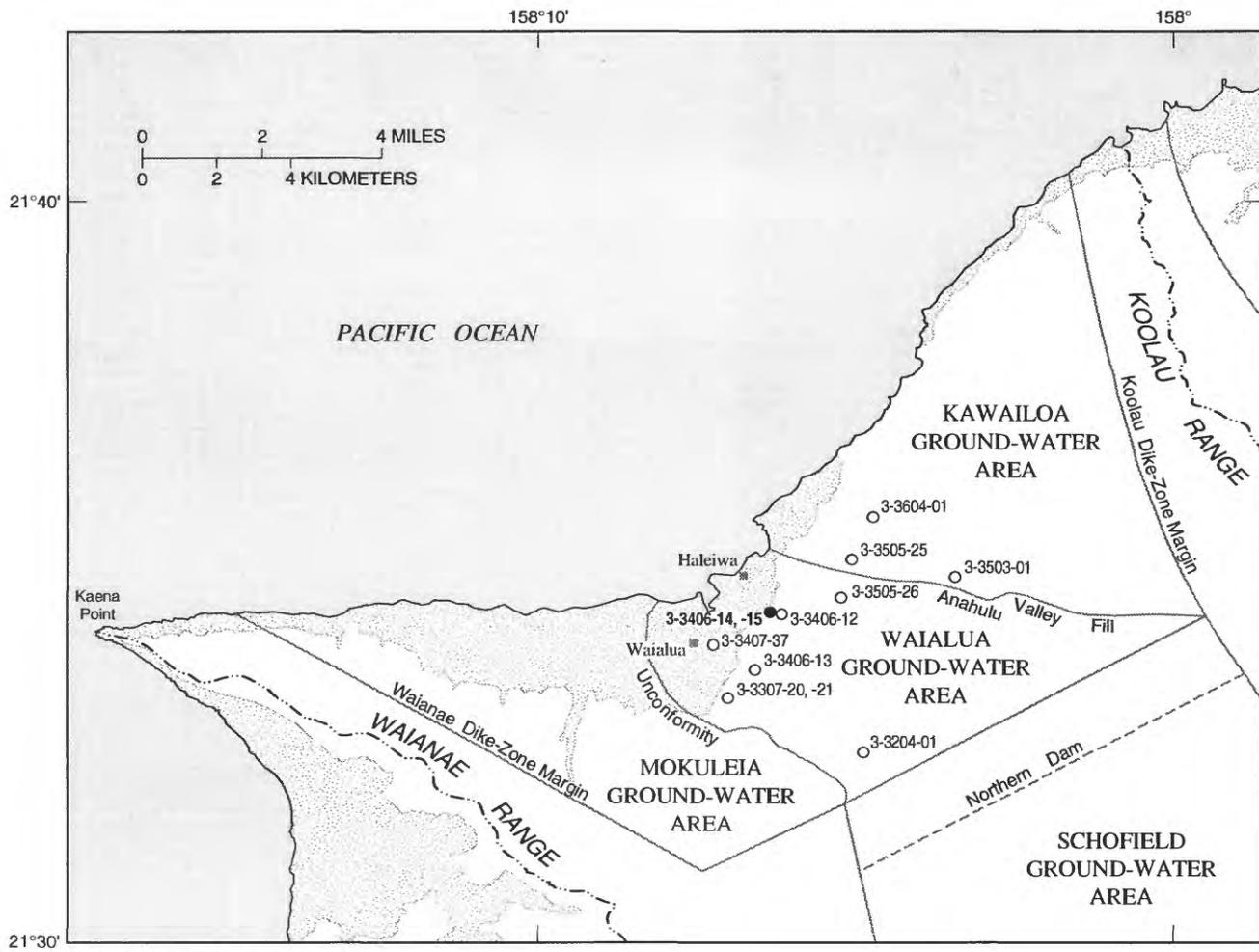
Because of water-supply concerns associated with population increase on the island of Oahu, the Honolulu Board of Water Supply, in cooperation with the U.S. Geological Survey (USGS), conducted a study to assess the availability of ground water in north-central Oahu.

This study included drilling 12 exploratory and monitoring wells between July 1993 and May 1994.

This report presents drilling data for the Helemano exploratory wells I and II (State well numbers 3-3406-14 and -15). The wells are located about 3,000 ft due south of the town of Haleiwa and about 1,500 ft north-northeast of Weed Circle (figs. 1 and 2) in the Waialua ground-water area (Rosenau and others, 1971; Dale, 1978; Hunt, in press). The purpose of the Helemano exploratory wells I and II is to measure artesian heads at two different depths beneath the coastal confining unit known locally as "caprock." This well configuration allows the determination of the vertical head gradient.

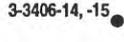
## Regional Setting

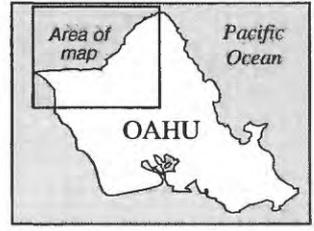
The study area is located in north-central Oahu between the crests of the Koolau Range and the Waianae Range (fig. 1). The mountain ranges are the eroded remnants of two shield volcanoes. The mountain ranges are the eroded remnants of two shield volcanoes. The Mokuleia ground-water area lies within the basalt aquifer of the Koolau Volcano. Previous studies (Rosenau and others, 1971; Dale, 1978; Hunt, in press) that describe the physical and geological aspects of the ground-water area are summarized here. The Mokuleia and Waialua ground-water areas are separated by low-permeability paleosols and saprolite of the Waianae Volcano that lie below the geologic contact between the Waianae and Koolau Volcanoes. The Waialua and Kawaihoa ground-water areas are separated by alluvium and weathered basalt in and beneath Anahulu Gulch. Seaward flow of ground water in the Mokuleia and Waialua ground-water areas is impeded by a coastal



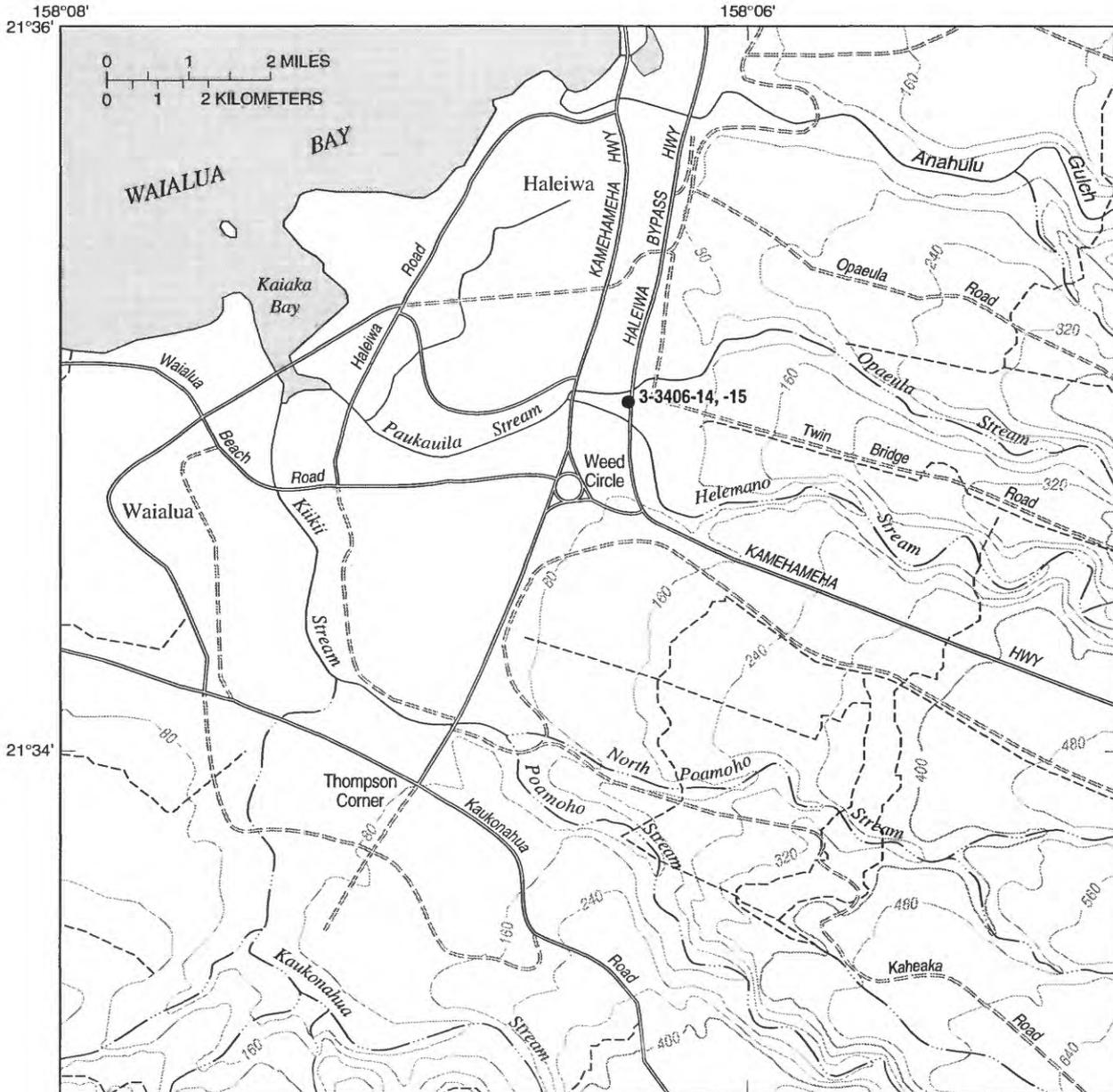
Base modified from U.S. Geological Survey digital data, 1:24,000, 1983, Albers equal area projection, standard parallels 21°15' and 21°45', central meridian 157°59'

**EXPLANATION**

-  SEDIMENTARY DEPOSITS (CAPROCK)
-  BOUNDARY OF GROUND-WATER AREA
-  TOPOGRAPHIC DIVIDE
-  3-3406-14, -15 HELEMANO EXPLORATORY WELLS I AND II AND STATE WELL NUMBERS
-  3-3406-13 WELL AND STATE WELL NUMBER



**Figure 1.** Ground-water areas of north-central Oahu (modified from Hunt, in press) and wells drilled during the study, Hawaii.



Base modified from U.S. Geological Survey digital data, 1:24,000, 1983, Albers equal area projection, standard parallels 21°15' and 21°45', central meridian 157°59'

EXPLANATION

- 3-3406-14, -15 HELEMANO EXPLORATORY WELLS I AND II AND STATE WELL NUMBERS
- 400 --- TOPOGRAPHIC CONTOUR--Interval 80 feet
- DITCH

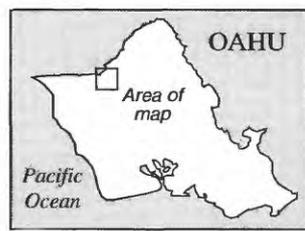


Figure 2. Location of Helemano exploratory wells I and II, Oahu, Hawaii.

confining unit that is composed of marine and terrestrial sediment known locally as "caprock." The caprock creates a confined artesian condition at low elevations near the shore. Further inland however, the aquifer is unconfined.

Water levels in the Waialua and Kawaihoa ground-water areas are about 12 ft and 4 ft, respectively, above mean sea level. Water levels in the Mokuleia ground-water area are about 20 ft. Withdrawal from the Waialua, Kawaihoa, and Mokuleia ground-water areas is primarily for sugarcane irrigation, although there are also several municipal wells and numerous small capacity private wells. Natural ground-water discharge occurs at springs and by subsurface flow through the caprock to the ocean (Rosenau and others, 1971).

## Acknowledgments

The USGS gratefully acknowledges the Waialua Sugar Company for their assistance in identifying and preparing the drill site. The USGS also thanks the Cas-

tle and Cooke Land Company for permission to drill on their land.

## DRILLING, CONSTRUCTION, AND CALIPER-LOG DATA

The Helemano exploratory wells I and II (State well numbers 3-3406-14 and -15) are 50 ft to the west of a bridge embankment of the Haleiwa Bypass highway, about 1,500 ft north-northeast of Weed Circle. The elevation of the ground surface in the area of the drill site is about 9 ft. The two wells are about 20 ft apart and the deep well (Helemano exploratory well number II) is closest to the bypass embankment. Well-construction data is provided in tables 1 and 2 and construction diagrams for the wells are provided in figures 3 and 4.

To measure the greatest vertical head difference, the location of the drill site had to be near the discharge boundary of the basalt aquifer. A site was selected with a minimal thickness of caprock to provide the widest depth spacing between the total depths of the shallow and deep wells. The caprock thickens from 0 ft to about

**Table 1.** Construction data for Helemano exploratory well I, Oahu, Hawaii.

[Elevation datum is mean sea level; in., inch; ft, feet; od, outside diameter]

Well name	Helemano exploratory well I
State well number	3-3406-14
Latitude and longitude	21°34'58"N, 158°06'21"W
Hawaii tax map key number	6-2-07-11
Landowner	Castle and Cooke Land Company
Leaseholder	Waialua Sugar Company
Well completed	October 15, 1993
Working days to complete	11 days
Driller	Fred Thibedeau, USGS
Surface hole diameter	12 1/2 in.
Bottom of surface casing elevation	-51 ft
Surface casing diameter and type	8 5/8-in. od steel, 0.188-in. thick wall
Intermediate hole diameter	7 7/8 in.
Bottom of intermediate casing elevation	-72 ft
Intermediate casing diameter and type	6 5/8-in. od steel, 0.188-in. thick wall
Final hole diameter	6 1/4 in.
Bottom of well elevation	-78.5 ft
Open interval elevations	-72 ft to -78.5 ft
Screened interval elevations	-68.5 ft to -78.5 ft
Inner casing diameter and type	4 1/2-in. od PVC, flush-jointed
Screen type	4 1/2-in. od PVC, flush-jointed, 0.02-in. horizontal slots
Reference mark elevation (bolt)	9.74 ft
Top of casing measuring point elevation	13.79 ft (top of aluminum well cap bracket)
Water level and date of measurement	10.92 ft on February 15, 1995

300 ft in a seaward direction. Test borings and piles driven near the well site during construction of the highway bridge revealed that the borings penetrated 50 to 80 ft of soft sediments and alluvium before entering the basalt aquifer.

The Helemano exploratory wells I and II were drilled using an air-rotary system with flush-jointed 4 1/2-in. diameter drill pipe. Drilling foam and polymer were injected into the air-circulation system to assist the removal of drill cuttings and to stabilize the holes.

For the shallow well (Helemano exploratory well I), a 12 1/2-in. diameter hole was drilled to an elevation of about -51 ft. The well was cased with 61 ft of 8 5/8-in. outside-diameter steel casing with a 0.188-in. wall thickness. The annular space was grouted with cement to provide a surface seal and to stabilize the shallow soft formations. A 7 7/8-in. diameter tri-cone tungsten-carbide button bit was used to drill to an elevation of -72 ft where an artesian condition was encountered. The well was cased and grouted with 82 ft of 6 5/8-in. outside-diameter casing with a 0.188 wall thickness to eliminate leakage within and into the caprock. The well was then drilled an additional 7 ft to a final depth elevation of

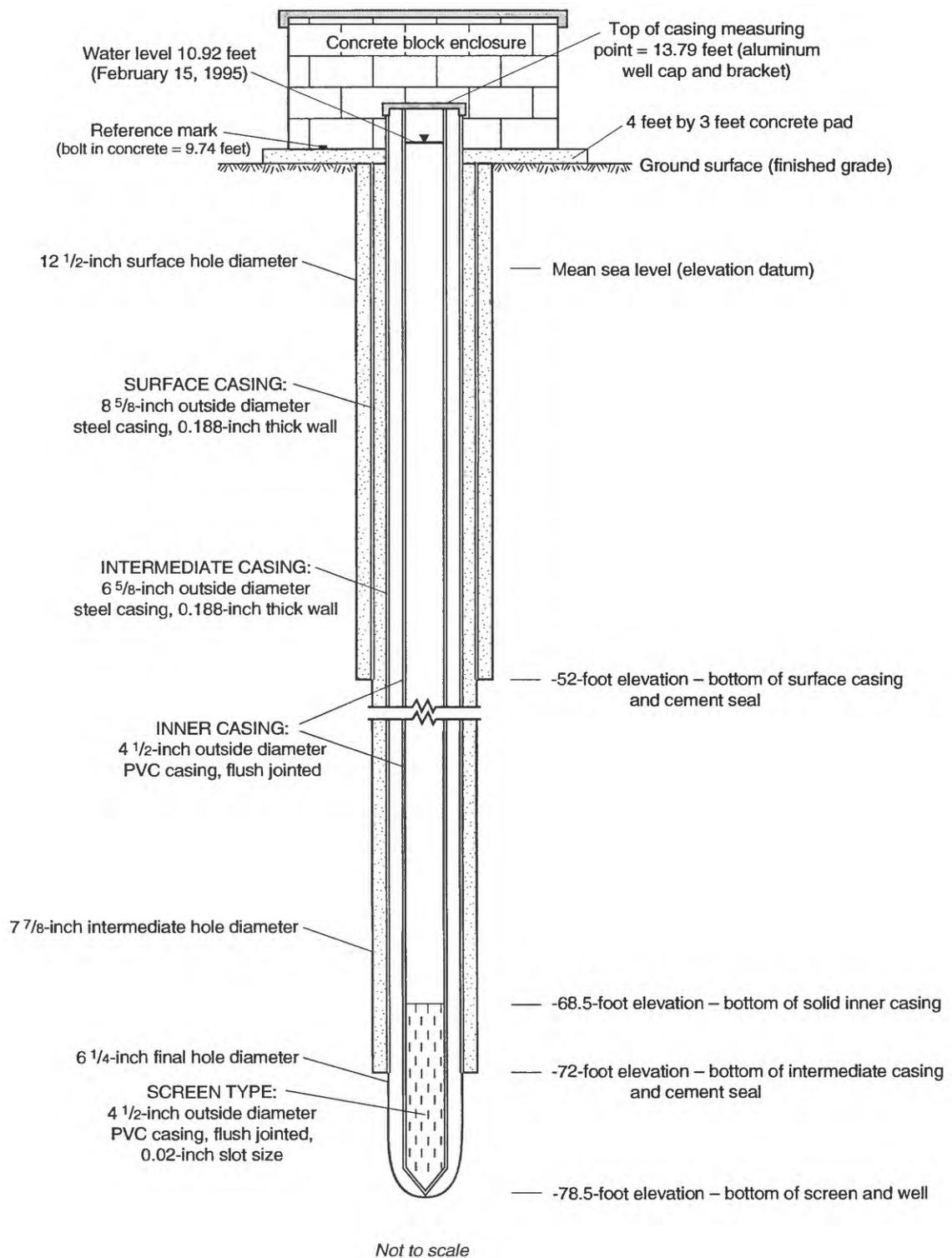
78.5 ft with a 6 1/4-in. diameter bit to remove the grout plug at the bottom, and to establish the artesian condition. To complete the well, the casing was continued above ground and cut off about 2 to 3 ft above the average head to serve as a stand-pipe. An inner, 4 1/2-in. outside-diameter solid PVC casing, with 20 ft of screen at the bottom, was installed to the total depth of the well.

The deep well was constructed similar to the shallow well. A 17 1/2-in. diameter hole was drilled to an elevation of -52 ft. The well bore was unstable within this interval, and only 49 ft of 12 5/8-in. outside-diameter casing, reaching -40 ft elevation, was grouted in place. A 12 1/4-in. diameter hole was drilled through the grout plug at the bottom of the 12 5/8-in. outside-diameter casing to the -52 ft elevation. The drillers cased the hole with 61 ft of 8 5/8-in. outside-diameter steel casing with a 0.188-in. wall thickness to -52 ft. A 7 7/8-in. diameter tri-cone tungsten-carbide button bit was used to drill to an elevation of -291 ft (300-ft depth from surface). A caliper log was recorded after the total depth was reached using a Well Reconnaissance logging unit. The well was cased with 4 1/2-in. outside-diameter flush-jointed steel casing with a 20 ft section

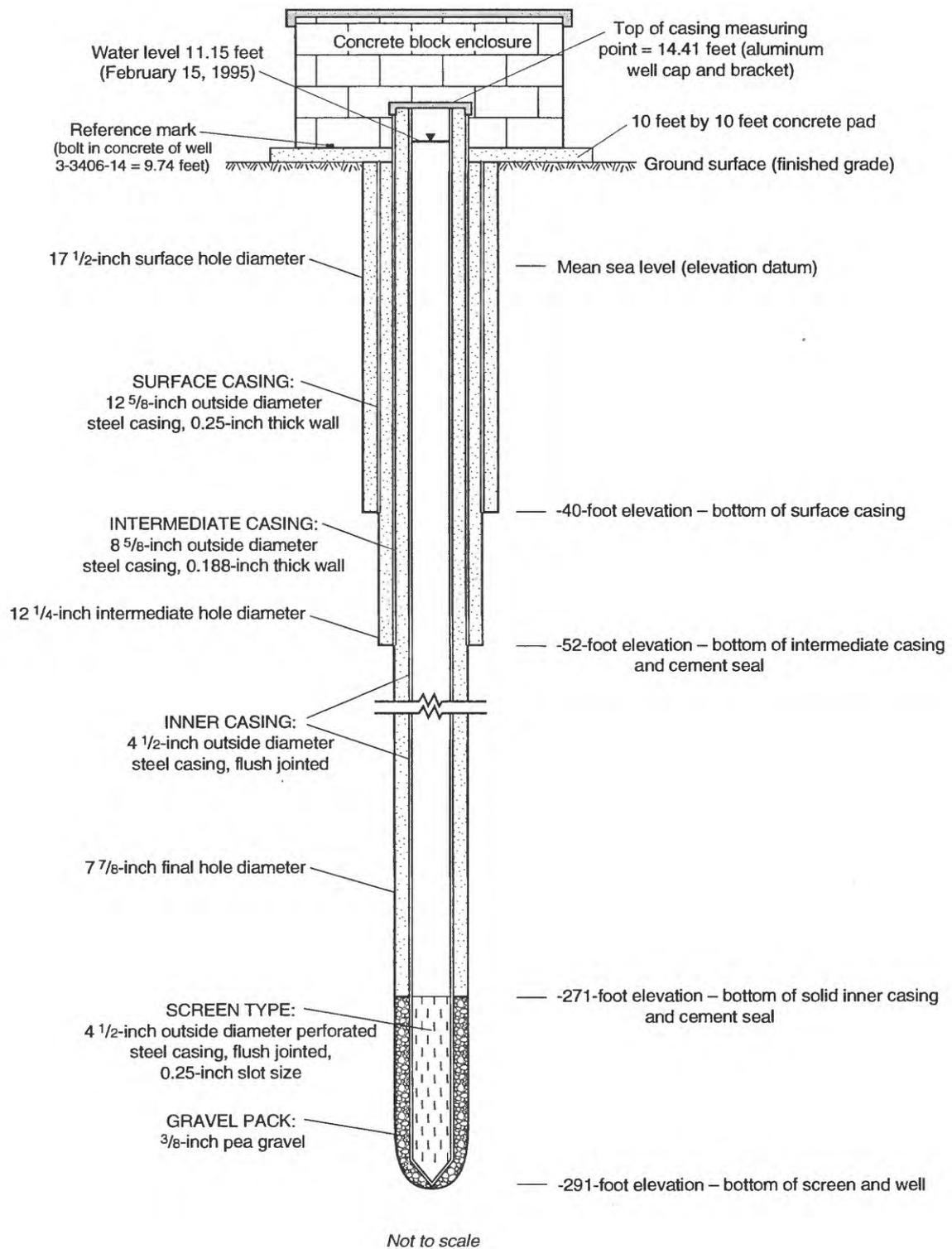
**Table 2.** Well construction data for the Helemano exploratory well II, Oahu, Hawaii.

[Elevation datum is mean sea level; in., inch; ft, feet; od, outside diameter]

Well name . . . . .	Helemano exploratory well II
State well number . . . . .	3-3406-15
Latitude and longitude . . . . .	21°34'58"N, 158°06'21"W
Hawaii tax map key number . . . . .	6-2-07-11
Landowner . . . . .	Castle and Cooke Land Company
Leaseholder . . . . .	Waialua Sugar Company
Well completed . . . . .	November 15, 1993
Working days to complete . . . . .	15 days
Drillers . . . . .	Wayne Heick and Fred Thibedeau; USGS
Surface hole diameter . . . . .	17 1/2 in.
Bottom of surface casing elevation . . . . .	-40 ft
Surface casing diameter and type . . . . .	12 5/8-in. od steel, 0.25-in. thick wall
Intermediate hole diameter . . . . .	12 1/4 in.
Bottom of intermediate casing elevation . . . . .	-52 ft
Intermediate casing diameter and type . . . . .	8 5/8-in. od steel, 0.188-in. thick wall
Final hole diameter . . . . .	7 7/8 in.
Bottom of well elevation . . . . .	-291 ft
Open interval elevations . . . . .	-271 ft to -291 ft
Screened interval elevations . . . . .	-271 ft to -291 ft
Inner casing diameter and type . . . . .	4 1/2-in. od steel, 0.025-in. thick wall, flush-jointed
Screen type . . . . .	4 1/2-in od steel, slots cut longitudinally, 0.25 by 3.0 in.
Reference mark elevation (bolt) . . . . .	9.74 ft
Top of casing measuring point elevation . . . . .	14.41 ft (top of aluminum well cap bracket)
Water level and date of measurement . . . . .	11.15 ft on February 15, 1995



**Figure 3.** Construction details for Helemano exploratory well I (State well number 3-3406-14), Oahu, Hawaii.



**Figure 4.** Construction details for Helemano exploratory well II (State well number 3-3406-15), Oahu, Hawaii.

of perforated steel casing at the bottom. After setting the casing, the well was carefully gravel packed around the annulus of the 20-ft perforated casing section. A grout and bentonite seal was emplaced using a tremmie line from above the gravel pack to the ground surface.

The wells were grouted and sealed from the ground surface to the top of a 7-ft (shallow well) and 20-ft (deep well) screened interval. The shallow well (Helemano exploratory well I) was screened once the basalt was penetrated and an artesian condition was established at an elevation of about -73 ft. The deep well (Helemano exploratory well II) was screened 20 ft from the bottom, to the -271 ft elevation. The artesian head in the deeper well is about 0.25 ft higher than in the shallow well.

The caliper log (fig. 5) shows a few hole enlargements where the caliper arms extend up to 16 in. between the elevations of -150 to -215 ft. The enlargement at the bottom of the hole correlates with a zone of loose material described in the driller's log. The caliper tool has three 16-in. spring-loaded arms that are extended when the tool is at the bottom of the hole. As the tool is raised, the logging unit records the extension of the arms as they drag against the walls of the bore. The caliper extension is an indication of hole diameter and wall smoothness, but the instrument does not measure these attributes directly. The maximum extension for the caliper tool is 32 in.

Samples of the materials expelled by the circulation system while drilling were collected every 5 ft, although at certain depths circulation was lost and no sample was recovered. The geologic logs (geologic descriptions of the recovered samples from drilling) are presented in tables 3 and 4, and the driller's log (driller's observations while drilling) are presented in tables 5 and 6. From the surface, the shallow well (Helemano exploratory well I) penetrated about 23 ft of brown, sticky clay, 16 ft of saprolite boulders, 16 ft of fine-grained alluvium, and 45 ft of basalt. The deep well (Helemano exploratory well II) penetrated about 25 ft of brown sticky clay, 28 ft of silty clay, 8 ft of fine-grained alluvium, and 239 ft of basalt.

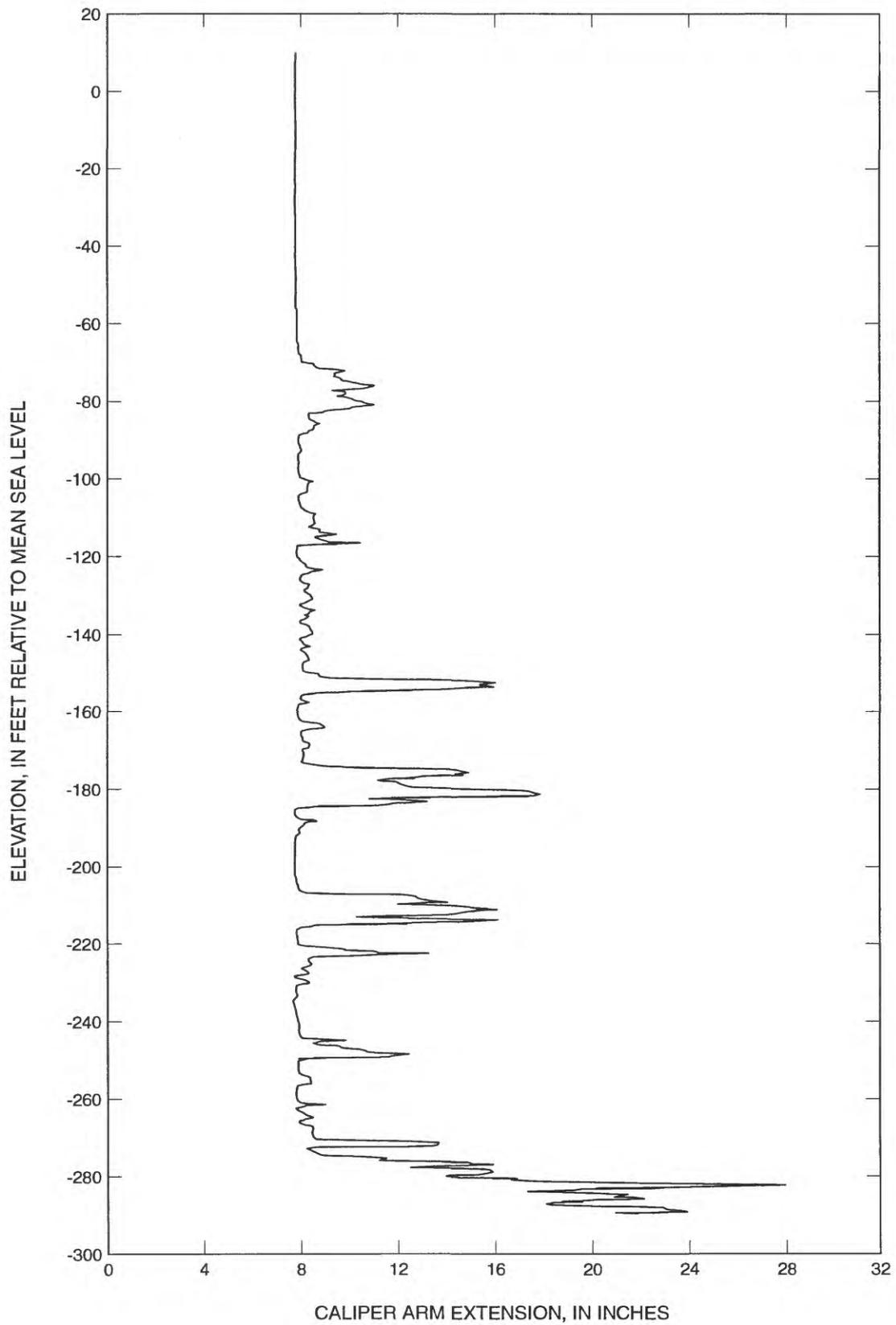
Measuring points for water-level determination using a measuring tape were established for both wells. The measuring point (elevation 13.79 ft) for the shallow well is on the southeast side of the aluminum well-cap bracket affixed to the top of the 8 5/8-in. outside-diameter steel surface casing. The measuring point (elevation 14.41 ft) for the deep well is on the north (lock tab) side of the aluminum well-cap bracket affixed to the top of the 8 5/8-in. outside-diameter steel surface casing. An additional reference mark (elevation 9.74 ft) for the well sites located on the top of a stainless steel bolt emplaced into the concrete pad surrounding the shallow well.

## ADDITIONAL INFORMATION

Information for the 12 wells drilled during the north-central Oahu study is listed in table 7. Nine of the wells, including the Helemano exploratory wells I and II (State well numbers 3-3406-14 and -15), were drilled in the Waialua ground-water area, and three wells were drilled north of Anahulu Gulch in the Kawaihoa ground-water area. Water-level time-series data were collected for all of the wells drilled and for numerous other existing wells as part of the overall monitoring effort for the project (unpublished data in files of the USGS, Honolulu). Data were collected using electronic data loggers coupled to shaft encoder-float systems or pressure transducers.

## REFERENCES CITED

- Dale, R.H., 1978, A ground-water inventory of the Waialua basal-water body, island of Oahu, Hawaii: U.S. Geological Survey Open-File Report 78-24, 71 p.
- Hunt, C.D. Jr., in press, Geohydrology of the island of Oahu, Hawaii: U.S. Geological Survey Professional Paper 1412-B.
- Rosenau, J.C., Lubke, E.R., and Nakahara, R.H., 1971, Water resources of north-central Oahu, Hawaii: U.S. Geological Survey Water-Supply Paper 1899-D, 40 p.



**Figure 5.** Caliper log for Helemano exploratory well II (State well number 3-3406-15), Oahu, Hawaii.

**Table 3.** Geologic log for Helemano exploratory well I (State well number 3-3406-14), Oahu, Hawaii.  
[Elevation datum is mean sea level]

Depth below grade (feet)	Elevation (feet)	Sample description	Comments
0 to 5	9 to 4	Brown, sticky clay	
5 to 10	4 to -1	Brown, sticky clay	
10 to 15	-1 to -6	Brown, sticky clay	
15 to 23	-6 to -14	Brown, sticky clay	
23 to 30	-14 to -21	Orangish-brown clay with small, angular basalt cuttings	
30 to 36	-21 to -27	Orangish-brown, highly weathered material	Saprolite
36 to 39	-27 to -30	Orangish-brown, highly weathered material	Rounded grains
39 to 44	-30 to -35	Greyish-brown, sticky clay	
44 to 50	-35 to -41	Weathered, alluvial material	Small, rounded grains
50 to 55	-41 to -46	Greyish-brown, silty and sandy alluvium	
55 to 60	-46 to -51	Grey, nonvesicular, massive, unweathered basalt	Possible boulder
60 to 60.9	-51 to -51.9	Grey, nonvesicular, massive, unweathered basalt	Fresher than above
60.9 to 65	-51.9 to -56	Grey, nonvesicular, massive, unweathered basalt	
65 to 70	-56 to -61	Grey, nonvesicular, massive, unweathered basalt	
70 to 75	-61 to -66	Grey, nonvesicular, massive, unweathered basalt	
75 to 80	-66 to -71	Dark reddish-grey, massive, unweathered basalt	
90 to 100	-81 to -91	Dark reddish-grey, massive, unweathered basalt with weathered, vesicular clinker	

**Table 4.** Geologic log for Helemano exploratory well II (State well number 3-3406-15), Oahu, Hawaii  
[Elevation datum is mean sea level]

Depth below grade (feet)	Elevation (feet)	Sample description	Comments
0 to 10	9 to -1		No sample
10 to 15	-1 to -6	Brown, sticky clay	
15 to 20	-6 to -11	Brown, sticky clay	
20 to 25	-11 to -16	Brown, sticky clay	
25 to 30	-16 to -21	Dark-brown, silty clay	
30 to 40	-21 to -31	Orange-brown, silty clay	
41 to 48	-32 to -39	Dark-brown, silty clay	
48 to 53	-39 to -44	Dark-brown, silty and sandy clay	
53 to 54	-44 to -45	Orangish-brown and greyish-brown alluvial material	Rounded grains, well sorted
55 to 60	-46 to -51	Orangish-brown and greyish-brown alluvial material	
61 to 65	-52 to -56	Grey, nonvesicular, massive, unweathered basalt	
65 to 70	-56 to -61	Medium-grey, slightly vesicular, aphyric, massive basalt	
70 to 75	-61 to -66	Medium-grey, slightly vesicular, aphyric, massive basalt	
75 to 79	-66 to -70	Dark pinkish-grey, nonvesicular, aphyric, massive basalt	Angular fragment
79 to 90	-70 to -81	Orangish-brown, highly weathered rock	
100 to 105	-91 to -96	Dark-grey, massive, nonvesicular, hard, fresh, aphyric basalt	Angular chips
105 to 110	-96 to -101	Brownish-grey, massive, nonvesicular, aphyric basalt	Some oxidation
110 to 120	-101 to -111	Dark greyish-brown, highly vesicular, weathered basalt	
120 to 130	-111 to -121	Dark brownish-grey, highly vesicular, slightly weathered basalt	
130 to 140	-121 to -131	Dark-grey, highly vesicular, unweathered basalt with some weathered basalt	
140 to 160	-131 to -151	Very dark-grey, highly vesicular basalt	Spherical pores with some oxidation
165 to 170	-156 to -161	Reddish, dark-grey, highly vesicular, slightly oxidized basalt	
170 to 175	-161 to -166	Dark-grey, vesicular to highly vesicular basalt	
175 to 185	-166 to -176	Reddish-brown to dark-grey, weathered and unweathered clinkers; dark grey, nonvesicular basalt	
190 to 195	-181 to -186	Reddish-brown to dark-grey, weathered and unweathered clinkers; dark grey, nonvesicular basalt	
195 to 200	-186 to -191	Dark-grey, slightly vesicular, massive basalt	
200 to 205	-191 to -196	Dark-grey, slightly vesicular, massive basalt; some clinker	
205 to 210	-196 to -201	Dark-grey, nonvesicular, massive basalt	Angular fragments
210 to 215	-201 to -206	Dark-grey, nonvesicular, massive basalt; few pieces of clinker	
215 to 220	-206 to -211	Dark-grey, massive basalt; red, highly vesicular basalt	
220 to 225	-211 to -216	Red and grey, highly vesicular basalt	
225 to 230	-216 to -221	Dark-grey, slightly vesicular basalt; large chunks of dark-grey, highly vesicular clinker	
240 to 250	-231 to -241	Dark-grey, slightly vesicular and vesicular basalt; red, vesicular basalt	Olivine
250 to 260	-241 to -251	Dark-grey, mostly nonvesicular basalt; few pieces of dark-grey, highly vesicular basalt; some red basalt	Olivine
260 to 270	-251 to -261	Dark-grey, slightly vesicular to vesicular basalt; some red oxidized basalt	
270 to 280	-261 to -271	Dark-grey, nonvesicular and vesicular clinker; oxidized chunks of clinker	
280 to 290	-271 to -281	Dark-grey, vesicular basalt; oxidized chunks of clinker	
290 to 300	-281 to -291	Dark reddish-grey, weathered clinker	

**Table 5.** Driller's log for Helemano exploratory well I (State well number 3-3406-14), Oahu, Hawaii

[Elevation datum is mean sea level]

Depth below grade (feet)	Elevation (feet)	Description
0 to 2	9 to 7	Loose soil
2 to 5	7 to 4	Brown soil
5 to 9	4 to 0	Brown, muddy soil
9 to 25	0 to -16	Grey, muddy soil
25 to 28	-16 to -19	Broken grey rock and mud
28 to 39	-19 to -30	Oxidized rock and mud
39 to 48	-30 to -39	Oxidized, broken rock
48 to 57	-39 to -48	Hard, dense rock
57 to 64	-48 to -55	Very hard rock
64 to 78	-55 to -69	Very hard rock, small fracture
78 to 80	-69 to -71	Weathered zone, red tint, rounded, black rock, artesian water reached
80 to 88	-71 to -79	Reddish-grey oxidized rock
88 to 88.5	-79 to -79.5	Red clinker, oxidized basalt

**Table 6.** Driller's log for Helemano exploratory well II (State well number 3-3406-15), Oahu, Hawaii

[Elevation datum is mean sea level]

Depth below grade (feet)	Elevation (feet)	Description
0 to 9	9 to 0	Saprolite
9 to 26	0 to -17	Black mud
26 to 29	-17 to -20	Boulders, mud
29 to 38	-20 to -29	Black mud
38 to 40	-29 to -31	Boulders
40 to 41	-31 to -32	Caving alluvium
41 to 52	-32 to -43	Brown silt, boulders
52 to 54	-43 to -45	Basalt boulder
54 to 62	-45 to -53	Saprolite
62 to 82	-53 to -73	Competent rock, artesian water reached
82 to 100	-73 to -91	Fractured rock
100 to 104	-91 to -95	Hard zone
104 to 112	-95 to -103	Very hard rock
112 to 116	-103 to -107	Soft, silty red clay
116 to 139	-107 to -130	Medium-red rock
139 to 172	-130 to -163	Medium-hard rock
172 to 182	-163 to -173	Very hard, red rock
182 to 187	-173 to -178	Hard, fractured rock
187 to 200	-178 to -191	Red clinker, medium hard
200 to 219	-191 to -210	Hard rock, blue-grey
219 to 225	-210 to -216	Red, medium-soft, fractured rock
225 to 240	-216 to -231	Red, oxidized rock, medium-hard
240 to 254	-231 to -245	Very hard grey rock
254 to 264	-245 to -255	Red, oxidized, medium-soft fractured rock
264 to 275	-255 to -266	Grey rock, hard to medium-hard
275 to 278	-266 to -269	Red, oxidized, fractured, medium-soft rock
278 to 280	-269 to -271	Fractured, medium-hard rock
280 to 282	-271 to -273	Fractured rock
282 to 285	-273 to -276	Large fracture-zone, oxidized clinker, soft
285 to 302	-276 to -293	Soft, fractured rock; loose, caving material on bottom

**Table 7.** Construction data for wells drilled during the study, Oahu, Hawaii

State well number	Well name	Latitude	Longitude	Hawaii state tax map key number	Landowner	Well completed	Working days to complete
3-3204-01	Kaheeka exploratory well	21°32'52"	158°04'52"	6-5-01-2	Castle and Cooke Land Company	March 2, 1994	16 days
3-3307-20	Thompson Corner exploratory well I	21°33'41"	158°07'02"	6-5-01-1	Castle and Cooke Land Company	July 9, 1993	14 days
3-3307-21	Thompson Corner exploratory well II	21°33'41"	158°07'02"	6-5-01-1	Castle and Cooke Land Company	August 9, 1993	15 days
3-3406-12	Twin Bridge Road deep monitor well	21°34'56"	158°06'10"	6-4-01-1	Castle and Cooke Land Company	March 9, 1994	27 days
3-3406-13	Kaamooloa exploratory well	21°34'06"	158°06'36"	6-5-01-2	Castle and Cooke Land Company	January 12, 1994	4 days
3-3406-14	Helemano exploratory well I	21°34'58"	158°06'21"	6-2-07-11	Castle and Cooke Land Company	October 15, 1993	11 days
3-3406-15	Helemano exploratory well II	21°34'58"	158°06'21"	6-2-07-11	Castle and Cooke Land Company	November 15, 1993	15 days
3-3407-37	Kiikii exploratory well	21°34'28"	158°07'16"	6-6-23-3	Castle and Cooke Land Company	April 21, 1994	27 days
3-3503-01	North Upper Anahulu exploratory well	21°35'30"	158°03'25"	6-2-09-1	Bishop Estate	May 5, 1994	8 days
3-3505-25	North Lower Anahulu exploratory well	21°35'45"	158°05'04"	6-2-09-1	Bishop Estate	December 23, 1993	7 days
3-3505-26	Opaaula exploratory well	21°35'11"	158°05'14"	6-2-10-1	Bishop Estate	October 4, 1993	10 days
3-3604-01	Kawailoa deep monitor well	21°36'24"	158°04'44"	6-1-05-1	Bishop Estate	January 9, 1994	28 days

Table 7. Construction data for wells drilled during the study, Oahu, Hawaii--Continued

State well number	Well name	Bottom of casing		Hole diameter (inch)	Bottom of well elevation (feet)	Open interval elevations (feet)	Inner casing outside diameter (inch) and type	Screened interval elevations (feet)	Measuring point elevation (feet)	Water level	
		surface casing elevation (feet)	surface casing outside diameter (inch)							Height above sea level (feet)	Date and time
3-3204-01	Kaheka exploratory well	643	8 5/8	6 3/4	-55	643 to -55	4 1/2, steel	25 to -55	741.59 (top of casing)	12.44	Jan. 27, 1995
3-3307-20	Thompson Corner exploratory well I	-65	12 5/8	12 1/4	-82	-65 to -82	12 5/8, steel	-65 to -82	99.10 (bolt)	11.32	Aug 5, 1993
3-3307-21	Thompson Corner exploratory well II	17	8 5/8	7 7/8	-80	17 to -80	4 1/2, PVC	20 to -80	101.40 (top of casing)	11.29	Aug. 5, 1993
3-3406-12	Twin Bridge Road deep monitor well	9	6 5/8	6 1/4	-596	9 to -596	4 1/2, steel	24 to -596	53.10 (top of casing)	11.10	Feb. 15, 1995
3-3406-13	Kaamooloa exploratory well	10	6 5/8	6 1/4	-10	10 to -10	4 1/2, PVC	10 to -10	42.35 (top of casing)	11.87	Feb. 13, 1995
3-3406-14	Helemano exploratory well I	-51	8 5/8	7 7/8	-78.5	-72 to -78.5	4 1/2, PVC	-68.5 to -78.5	13.79 (top of casing)	10.92	Feb. 15, 1995
3-3406-15	Helemano exploratory well II	-52	8 5/8	7 7/8	-291	-271 to -291	4 1/2, steel	-271 to -291	14.41 (top of casing)	11.15	Feb. 15, 1995
3-3407-37	Kiikii exploratory well	-115	8 5/8	6 3/4	-135	-125 to -135	4 1/2, steel	-115 to -135	14.68 (top of casing)	11.70	Feb. 13, 1995
3-3503-01	North Upper Anahulu exploratory well	592	8 5/8	6 3/4	-103	592 to -103	4 1/2, steel	17 to -103	671.74 (top of casing)	7.15	Feb 14, 1995
3-3505-25	North Lower Anahulu exploratory well	182	8 5/8	7 7/8	-18	182 to -18	4 1/2, PVC	22 to -18	234.24 (top of casing)	4.75	Feb. 14, 1995
3-3505-26	Opaaula exploratory well	229	6 5/8	6 1/4	-65	229 to -65	4 1/2, PVC	15 to -65	288.08 (top of casing)	10.52	Feb. 15, 1995
3-3604-01	Kawaihoa deep monitor well	190	6 5/8	6 1/4	-392	190 to -392	4 1/2, steel	9 to -391	309.01 (top of casing)	4.40	Feb. 14, 1995