

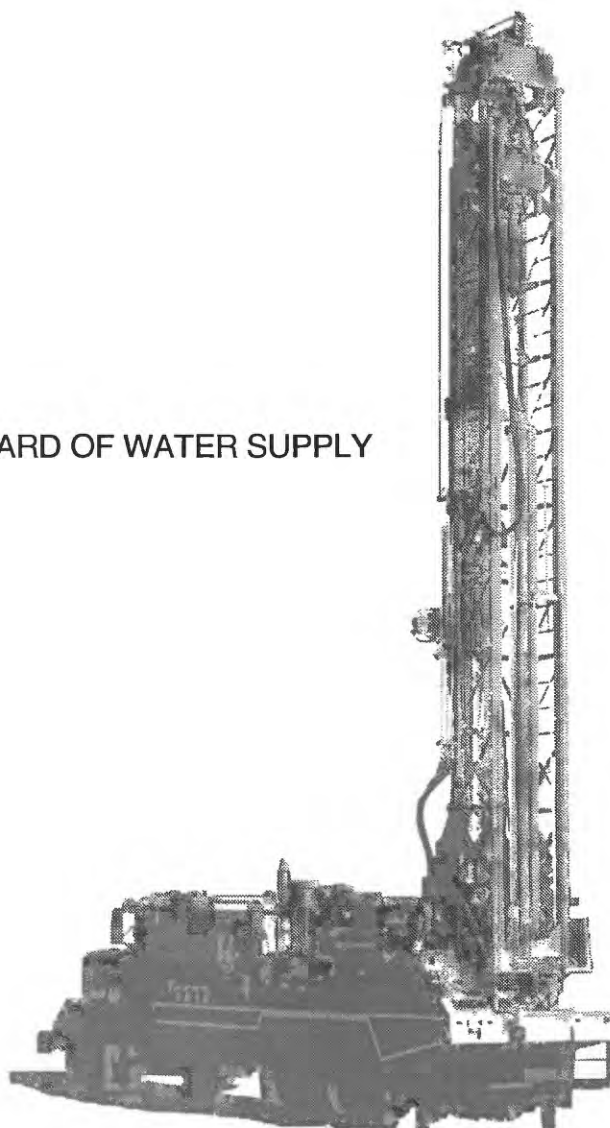
DRILLING, CONSTRUCTION, AND CALIPER-LOG DATA FOR WELL 3-3204-01, KAHEAKA EXPLORATORY WELL, OAHU, HAWAII

U.S. GEOLOGICAL SURVEY

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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 Well 3-3204-01, Kaheaka Exploratory Well, Oahu, Hawaii

By Todd K. Presley and Delwyn S. Oki

Abstract

The Kaheaka exploratory well (State well number 3-3204-01) was drilled about 3.3 miles southeast of the town of Haleiwa. The well is on agricultural land in the Waialua ground-water area. The well penetrates about 67 feet into a basalt aquifer. Well-construction data, logs of drilling notes, geologic descriptions for the samples, and caliper-log data are presented for the well. The well is one of 12 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

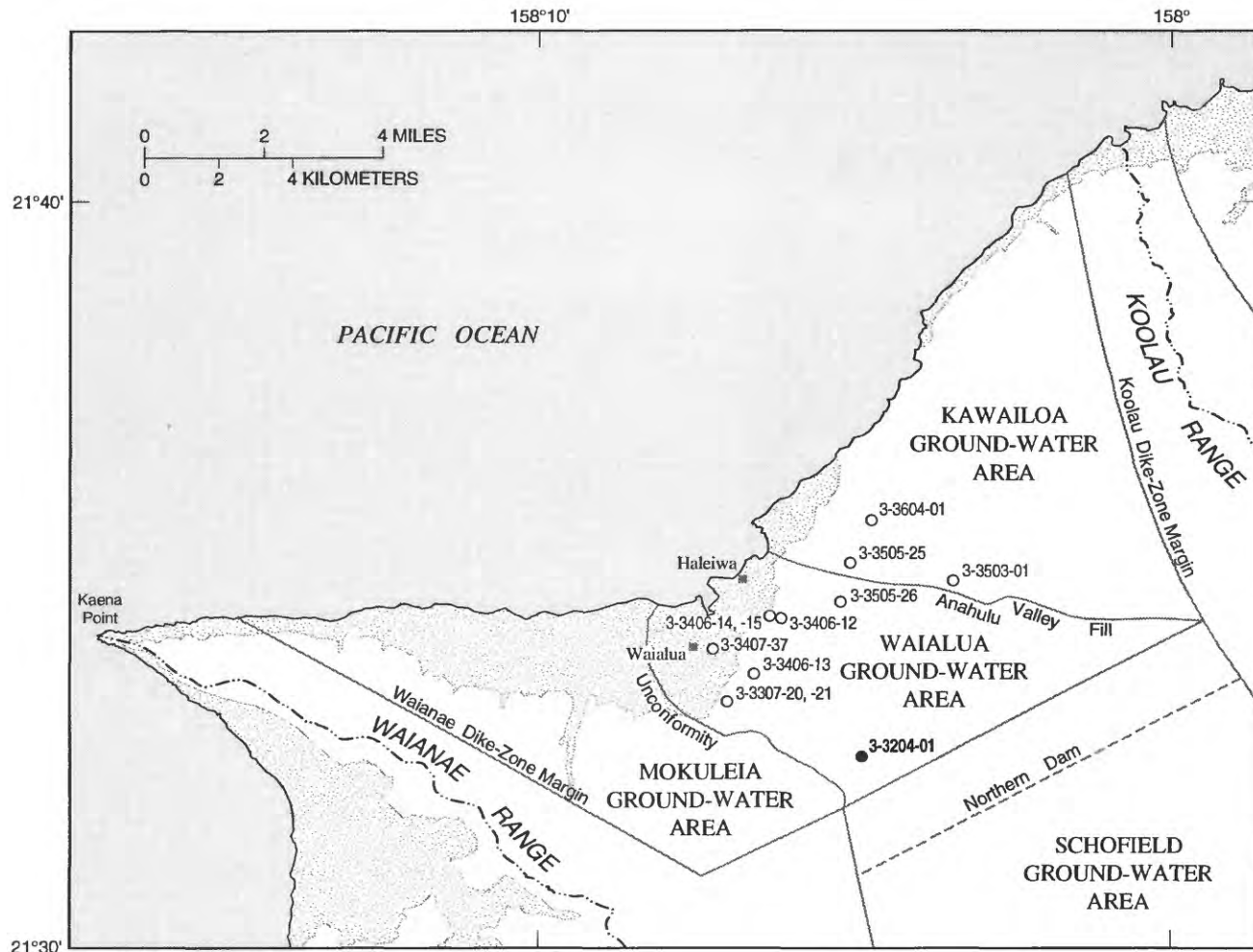
Because of water-supply concerns associated with population increase on the island of Oahu, the Honolulu Board of Water Supply in cooperation with the U.S. Geological Survey (USGS) conducted a study to assess the availability of ground water in north-central Oahu. This study included drilling 12 exploratory and monitoring wells between July 1993 and May 1994.

This report presents drilling data for Kaheaka exploratory well (State well number 3-3204-01). The well is located about 3.3 mi southeast of the town of Haleiwa (figs. 1 and 2). The purpose of the Kaheaka exploratory well is to increase spatial coverage of water-levels in the Waialua ground-water area (Rosenau and others, 1971; Dale, 1978; Hunt, in press) and to provide a water-level observation well for monitoring.






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 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 above mean sea level, respectively. 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).



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
 -  KAHEAKA EXPLORATORY WELL AND STATE WELL NUMBER
 -  WELL AND STATE WELL NUMBER

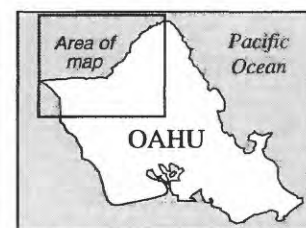
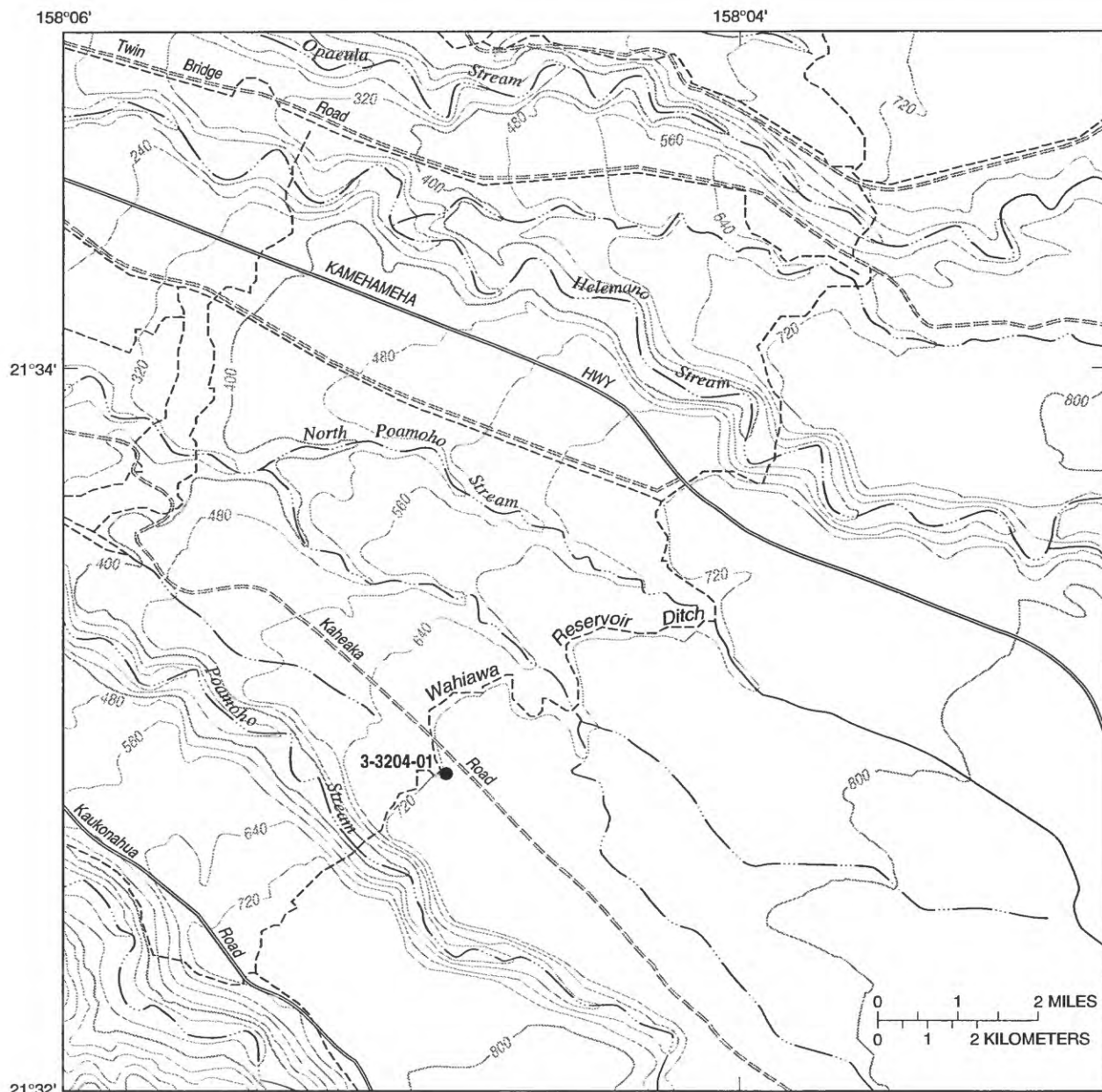


Figure 1. Ground-water areas of north-central Oahu (modified from Hunt, in press) and wells drilled during the study, Hawaii.



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

- 3-3204-01 ● KAHEAKA EXPLORATORY WELL AND STATE WELL NUMBER
- 400 — TOPOGRAPHIC CONTOUR--Interval 80 feet
- DITCH

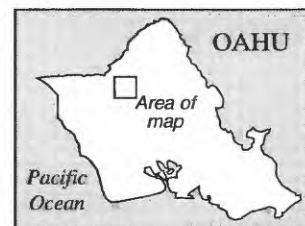


Figure 2. Location of Kaheaka exploratory well, Oahu, Hawaii.

Acknowledgments

The USGS gratefully acknowledges the Waialua Sugar Company for their assistance in identifying and preparing the drill site. The USGS also thanks the Castle and Cooke Land Company for permission to drill on their land.

DRILLING, CONSTRUCTION, AND CALIPER-LOG DATA

The Kaheaka exploratory well (State well number 3-3204-01) is about 3.3 mi southeast of the town of Haleiwa. The well is adjacent to a pineapple field, 30 ft above the Wahiawa Reservoir Ditch between the southern tributary of North Poamoho Stream and Poamoho Stream, and about 500 ft south of Kaheaka Road. Well-construction data is provided in table 1 and construction details are shown in figure 3.

The Kaheaka exploratory well was 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 hole. The elevation of the ground surface in the area of the drill site is about 740 ft. A 12 1/2-in. diameter hole was drilled to an elevation of 643 ft and cased with about 99 ft of 8 5/8-in. outside-

diameter steel casing to provide a surface seal. The annular space was grouted with cement. A 6 3/4-in. diameter tri-cone tungsten-carbide button bit was then used to drill to an elevation of -55 ft. Before casing the well, a caliper log of the well was recorded using a Well Reconnaissance logging unit. The well was cased with 4 1/2-in. outside-diameter flush-jointed steel casing. Slotted, 4 1/2-in. outside-diameter steel casing was installed through the water column.

The caliper log (fig. 4) shows many hole enlargements where the caliper arms extend up to about 12 in. and three hole enlargements of at least 30 in. at elevations of about 487, 130, and 100 ft. The narrowing of the caliper log below the 100-ft elevation is an artifact of the instrumentation. 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 record 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 to 20 ft. Circulation was intermittent between the 643- and 566-ft elevations and was completely absorbed with no

Table 1. Construction data for Kaheaka exploratory well, Oahu, Hawaii

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

Well name	Kaheaka exploratory Well
State well number	3-3204-01
Latitude and longitude	21°32'52"N, 158°04'52"W
Hawaii tax map key number	6-5-01-2
Landowner	Castle and Cooke Land Company
Leaseholder	Waialua Sugar Company
Well completed	March 2, 1994
Working days to complete	16 days
Driller	Wayne Heick, USGS
Surface hole diameter	12 1/2 in.
Bottom of surface casing elevation	643 ft
Surface casing diameter and type	8 5/8-in. od steel, 0.188-in. thick wall
Final hole diameter	6 3/4 in.
Bottom of well elevation	-55 ft
Open interval elevations	643 ft to -55 ft
Screened interval elevations	25 ft to -55 ft
Inner casing diameter and type	4 1/2-in. od steel, flush-jointed
Screen type	4 1/2-in. od steel, slots cut longitudinally, 0.25 x 3.0 in.
Reference mark elevation (bolt)	740.60 ft
Top of casing measuring point elevation	741.59 ft (top of 4 1/2-in. inner casing)
Water level and date of measurement	12.44 ft, January 27, 1995

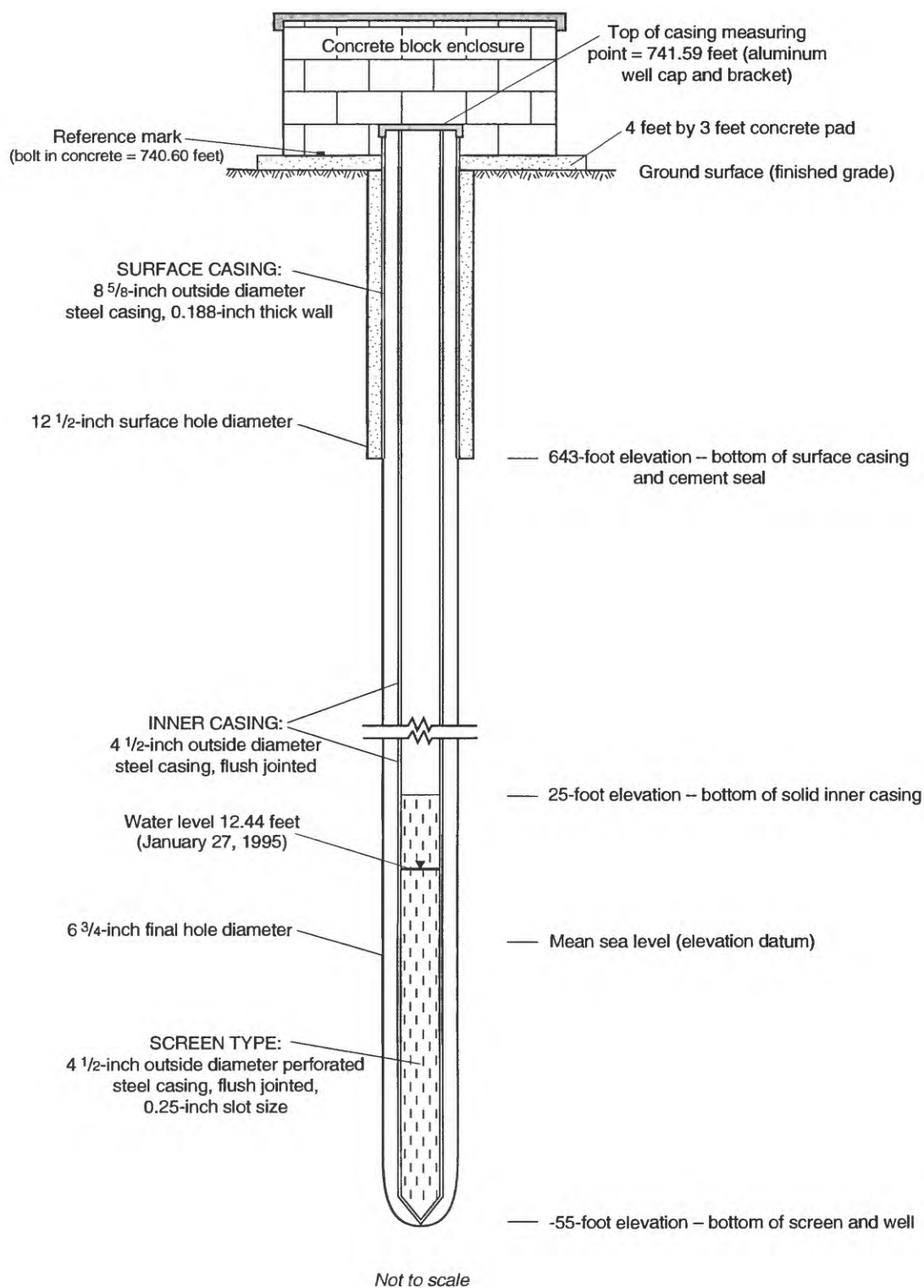


Figure 3. Construction details for Kaheaka exploratory well (State well number 3-3204-01), Oahu, Hawaii.

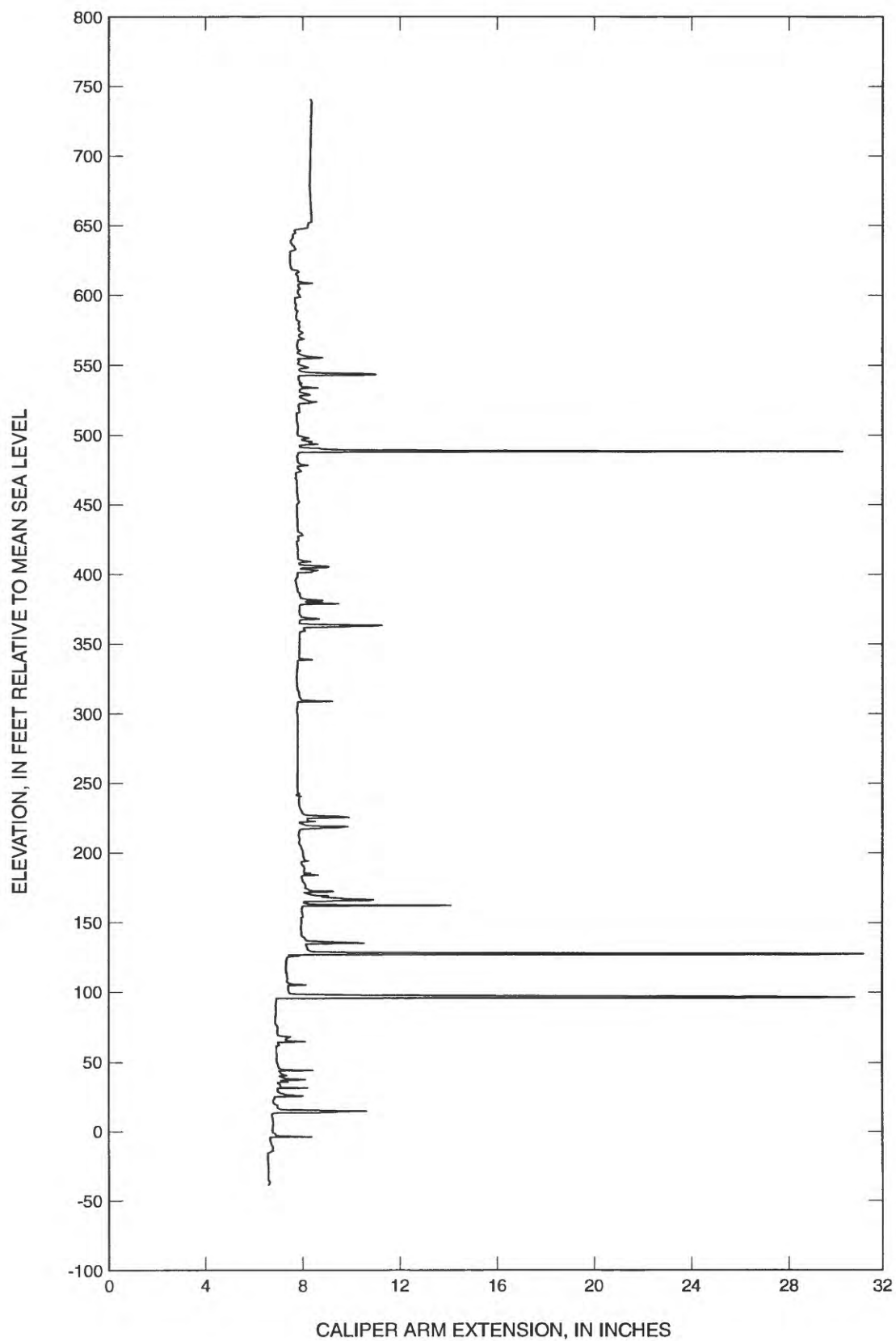


Figure 4. Caliper log for Kaheaka exploratory well (State well number 3-3204-01), Oahu, Hawaii.

sample recovery after reaching the 566-ft elevation. The geologic log (geologic descriptions of the recovered samples from drilling) is presented in table 2, and the driller's log (driller's observations while drilling) is presented in table 3. From the surface, the bore penetrated about 90 ft of saprolite and 60 ft of weathered basalt before losing circulation.

The measuring point (elevation 741.59 ft) for water-level determination by measuring tape is located on the top of the south side of the inner 4 1/2-in. outside-diameter steel casing. An additional reference mark (elevation 740.60 ft) for the well site is located on the top of a stainless steel bolt emplaced into a concrete pad surrounding the well.

The well was drilled close to the weathered contact that serves as the barrier between the Mokuleia and Waialua ground-water areas, however, water levels in this well are reflective of Waialua ground-water area water levels, which are about 12 ft.

ADDITIONAL INFORMATION

Information for the 12 wells drilled during the north-central Oahu study is listed in table 4. Nine of the

wells, including the Kaheaka exploratory well (State well number 3-3204-01), were drilled in the Waialua ground-water area, and three wells were drilled north of Anahulu Gulch in the Kawaiiloa 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.

Table 2. Geologic log for Kaheaka exploratory well (State well number 3-3204-01), Oahu, Hawaii
[Elevation datum is mean sea level]

Depth below grade (feet)	Elevation (feet)	Sample description	Comments
0 to 5	740 to 735	Red soil	
5 to 10	735 to 730	Red, hard soil	
10 to 15	730 to 725	Red, hard soil	
15 to 26	725 to 714	No sample	
26 to 43	714 to 697	Orangish-brown, weathered material	Saprolite
43 to 63	697 to 677	Dark, greyish-brown, weathered material	Saprolite
63 to 83	677 to 657	Reddish-brown, weathered material	Saprolite
83 to 90	657 to 650	Brownish-grey, weathered material	Saprolite
104 to 114	636 to 626	Light brownish-grey, weathered basalt	Light-weight chunk
114 to 134	626 to 606	Dark-grey, slightly vesicular basalt	Aa core
154 to 174	586 to 566	Dark-grey, highly vesicular, slightly oxidized basalt	

Table 3. Driller's log for Kaheeka exploratory well (State well number 3-3204-01), Oahu, Hawaii
[Elevation datum is mean sea level]

Depth below grade (feet)	Elevation (feet)	Description
0 to 10	740 to 730	Clay, red and moist
10 to 36	730 to 704	Red clay, moist with some rock
36 to 64	704 to 676	Red-brown-blue, medium-soft rock
64 to 85	676 to 655	Brown-gray, soft rock
85 to 99	655 to 641	Hard blue rock, dry, casing set to here
99 to 108	641 to 632	Brown-blue, hard rock
108 to 110	632 to 630	Brown-red, medium-hard rock
110 to 115	630 to 625	Brown-red, oxidized, soft rock; fracture zone
115 to 128	625 to 612	Blue, hard rock
128 to 140	612 to 600	Red-brown, oxidized, medium-hard rock
140 to 147	600 to 593	Red-brown, oxidized, soft rock; very broken, lost circulation
147 to 150	593 to 590	Red-brown, oxidized medium-soft rock, no return
150 to 151	590 to 589	Medium-soft, blue rock; circulation regained
151 to 167	589 to 573	Gray-brown medium-soft rock; good return
167 to 175	573 to 565	Red-brown oxidized rock; broken and soft
175 to 193	565 to 547	Very soft, clinker-like; several voids; lost circulation.
193 to 194	547 to 546	Medium-hard, competent rock; no circulation
194 to 197	546 to 543	Clinker-like; no circulation
197 to 199	543 to 541	Medium-hard, competent rock, and clinkers; no circulation
199 to 203	541 to 537	Clinker-like, loose rocks, voids; no circulation
203 to 213	537 to 527	Competent rock, oxidized, medium soft, no circulation
213 to 214	527 to 526	Medium-hard, competent rock; no circulation
214 to 229	526 to 511	Very fractured, very soft, clinker-like rock; no circulation
229 to 234	511 to 506	Medium-hard, stiff, competent rock; no circulation
234 to 248	506 to 492	Very hard, competent rock; no circulation
248 to 255	492 to 485	Medium-hard, loose rock; no circulation
255 to 257	485 to 483	Void, tools dropped; no circulation
257 to 266	483 to 474	Medium-hard, competent rock; no circulation
266 to 282	474 to 458	Soft rock; no circulation
282 to 300	458 to 440	Medium-hard, competent rock; no circulation
300 to 307	440 to 433	Soft, broken rock; no circulation
307 to 314	433 to 426	Competent, hard rock; no circulation
314 to 329	426 to 411	Loose, broken, soft rock; no circulation
329 to 332	411 to 408	Hard, broken rock; no circulation
332 to 336	408 to 404	Medium-soft, broken, rock; no circulation
336 to 353	404 to 387	Very broken, very soft rock; no circulation
353 to 362	387 to 378	Competent, hard rock; no circulation
362 to 433	378 to 307	Medium-soft to soft rock; no circulation
433 to 440	307 to 300	Medium-hard to hard, competent rock; no circulation
440 to 451	300 to 289	Medium-soft to soft rock; no circulation
451 to 463	289 to 277	Medium-hard, competent rock; no circulation
463 to 493	277 to 247	Medium-soft rock; no circulation
493 to 498	247 to 242	Medium-hard, competent rock; no circulation
498 to 505	242 to 235	Loose, clinker-like, medium-soft rock; no circulation
505 to 509	235 to 231	Medium-hard, competent rock; no circulation
509 to 550	231 to 190	Clinker-like, rough going; no circulation
550 to 557	190 to 183	Medium-hard, competent rock; no circulation
557 to 570	183 to 170	Soft rock with gas-pocket like voids; no circulation
570 to 579	170 to 161	Medium-hard, competent rock; no circulation
579 to 590	161 to 150	Soft with many voids; no circulation
590 to 591	150 to 149	Big void; no circulation
591 to 596	149 to 144	Medium-hard, competent rock; no circulation
596 to 611	144 to 129	Soft rock with voids; no circulation
611 to 624	129 to 116	Medium-hard, competent rock; no circulation

Table 3. Driller's log for Kaheaka exploratory well (State well number 3-3204-01), Oahu, Hawaii --Continued
[Elevation datum is mean sea level]

Depth below grade (feet)	Elevation (feet)	Description
624 to 626	116 to 114	Void; no circulation
626 to 654	114 to 86	Medium-soft rock with many voids; no circulation
654 to 658	86 to 82	Large void; no circulation
658 to 672	82 to 68	Medium-soft to soft rock; no circulation
672 to 677	68 to 63	Medium-hard, competent rock; no circulation
677 to 702	63 to 38	Medium-soft rock, rough drilling, voids; no circulation
702 to 704	38 to 36	Medium-hard, fractured rock; no circulation
704 to 711	36 to 29	Medium-soft, clinker-like zone; no circulation
711 to 713	29 to 27	Void, tools dropped; no circulation
713 to 715	27 to 25	Medium-hard, competent rock; no circulation
715 to 727	25 to 13	Broken, soft rock; no circulation, possibly reached water
727 to 738	13 to 2	Medium-hard, competent rock; no circulation
738 to 746	2 to -6	Soft, broken rock, many small voids; no circulation, water reached
746 to 770	-6 to -30	Medium-hard, competent rock, many voids; no circulation
770 to 774	-30 to -34	Fractured, broken, very soft rock; no circulation
774 to 784	-34 to -44	Competent rock; no circulation, definitely into water
784 to 790	-44 to -50	Broken, soft rock; no circulation, uneven drilling
790 to 794	-50 to -54	Medium-hard, competent rock; no circulation
794 to 797	-54 to -57	Soft rock; no circulation

Table 4. 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	Kaheaka 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 4. Construction data for wells drilled during the study, Oahu, Hawaii--Continued.

State well number	Well name	Bottom of surface casing elevation (feet)	Surface casing outside diameter (inch)	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	
										Height above sea level (feet)	Date and time
3-3204-01	Kaheaka 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 17:20
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 15:51
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 15:51
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 12:09
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 14:45
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 12:26
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 12:28
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 13:44
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 13:54
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 15:08
3-3505-26	Opaeula 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 11:14
3-3604-01	Kawailoa 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 14:18