

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Principal Facts and Density Estimates for Borehole Gravity Stations
in Boreholes RRL-3, -4, -5, -6B, -7, -8, and -9
at the Hanford Site, Benton County, Washington

by

S. L. Robbins¹, J. R. Kunk², and F. G. Clutson¹

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This report is preliminary and has not been reviewed for conformity with
U.S. Geological Survey editorial standards and stratigraphic nomenclature.
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endorsement by the USGS.

¹U.S. Geological Survey, Denver, Colorado
²Rockwell Hanford Operations, Richland, Washington

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INTRODUCTION

Borehole gravity surveys were conducted in seven boreholes, located within a 10 square mile (25 square km) area in the northwestern portion of the Hanford Site, Washington (fig. 1), in June and July, 1982, by the U.S. Geological Survey (USGS) using La Coste and Romberg slim-hole borehole gravity meter (BHGM) BH-6.

Borehole gravity meters (BHGMs) are primarily density logging tools having a large radius of investigation compared to conventional logging tools and are not significantly affected by casing, borehole rugosity, or other near-borehole conditions. Therefore, a BHGM survey provides a unique and independent measurement of in-situ bulk density, which, when integrated with data from conventional logs and (or) cores, can provide a better understanding of the physical properties of subsurface rocks in areas of "simple" geology, or the structure (remote sensing) when there are density changes horizontally away from the well. Robbins (1980) contains a complete listing of references pertaining to borehole gravimetry.

The primary objective of these surveys was to obtain accurate, average, in-situ densities of the sediments that overlie the basalts in the area. These density values along with lithology data and other well-log information will be integrated into a three-dimensional density model to be used with a detailed surface gravity survey of the area to determine the location of the top of the basalt, which varies between about 600 and 800 ft (200 and 270 m) below the surface. This study is part of the U.S. Department of Energy's assessment as to whether the basalt is suitable for the storage of radioactive wastes.

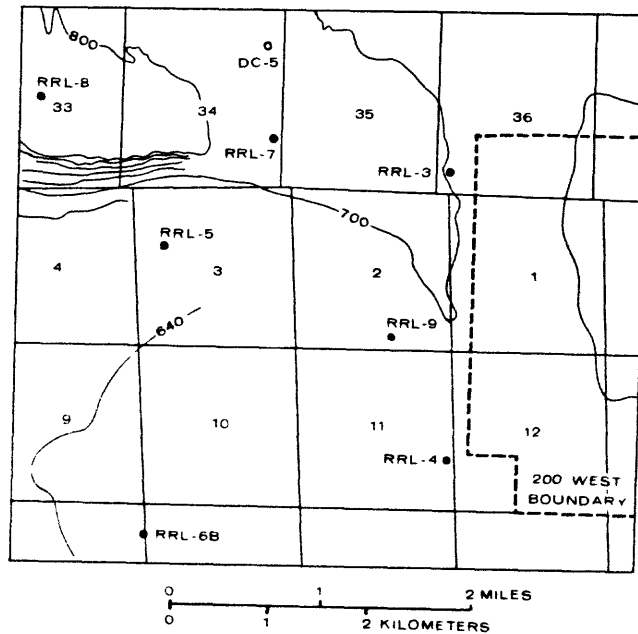
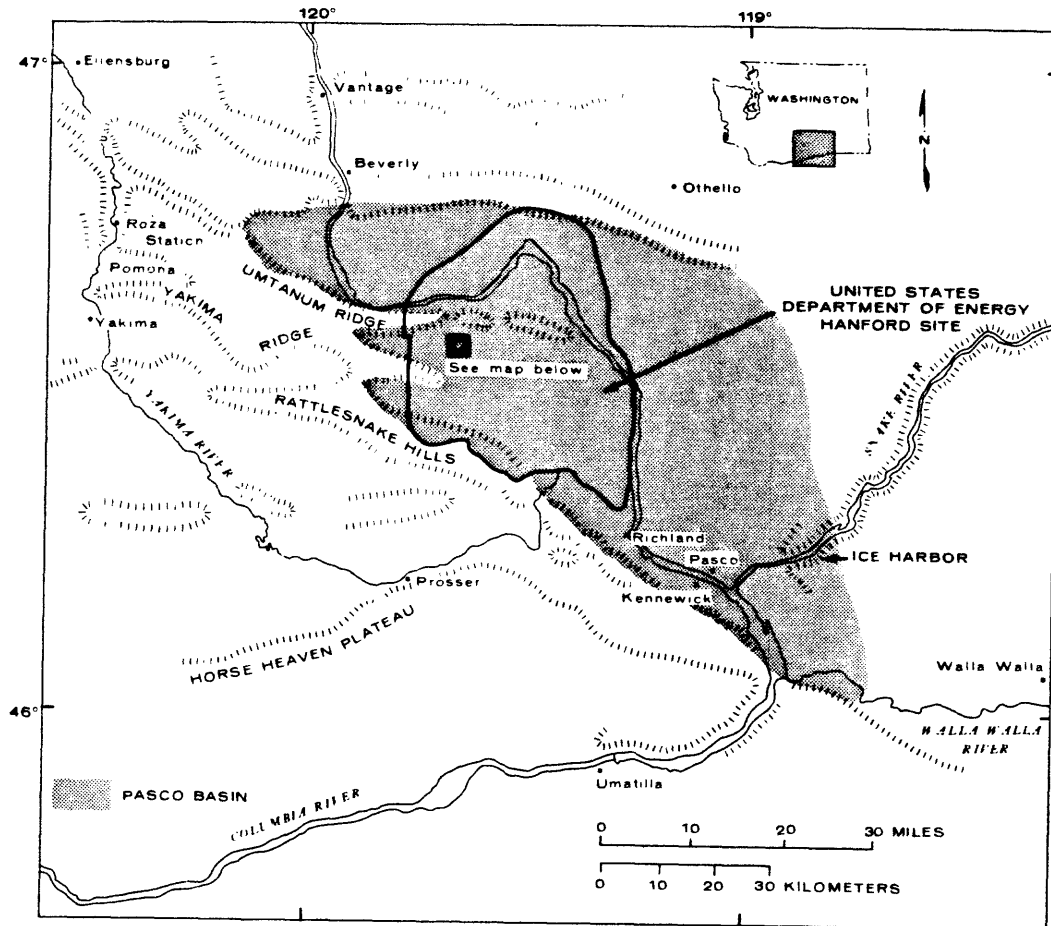
This report contains the principal facts obtained during the surveys (tables 1 through 7) and estimates of in-situ bulk densities from these data (tables 8 through 14). Also included are reduced sections of the gamma-ray logs with the BHGM station locations indicated (figs. 9 through 15) and summaries of the stratigraphic section for each borehole (tables 15 and 16).

This study was carried out in cooperation with Rockwell Hanford Operations at Richland, Washington. This is the second BHGM study that has been made in the area by the USGS (Robbins and others, 1979). Other BHGM studies by the USGS in other radioactive waste storage study areas include Schmoker (1980) and Robbins and others (1982).

BOREHOLE DATA

Tables 1 through 7 present the principal facts for the gravity stations occupied during the BHGM surveys. The column headings for these tables are explained in the following list:

- Reading #: The order in which the borehole gravity stations were read.
- Depth: Depth of station in feet (ft) and meters (m). Datum is the ground elevation at the well.
- Time: Coordinated Universal Time (CUT) of the mean of each set of gravity slope readings (beam velocities).



CONTOUR INTERVALS 20 FEET AND 100 FEET

● BGM SURVEYS THIS REPORT ◐ BGM SURVEY (Robbins and others, 1979)

Figure 1.—Index map showing locations of borehole gravity survey

- Meter readings: Counter reading of the BHGM in scale divisions (S.D.) at the station's calculated null position (no corrections have been made).
- Tide corr.: Theoretical correction for Earth tides in milligals (mgal) (Darroll Wood, 1968, written commun.).
- Drift corr.: Correction for instrument drift in milligals (mgal) derived from station reoccupations. Figures 2 through 8 show the curves used.
- Terrain corr.: Terrain correction in milligals (mgal), calculated for a density of 2.0 g/cm³ for all compartments with elevations between 500 and 900 ft (160 and 300 m), a density of 2.2 g/cm³ for all compartments below 500 ft (160 m), a density of 2.4 g/cm³ for all compartments between 900 and 1,200 ft (300 and 400 m), and a density of 2.7 g/cm³ for all compartments above 1,200 ft (400 m), out to a distance of 71,996 ft (21,944 m). This corresponds to zone M of Hammer's terrain correction chart (Hammer, 1939; Beyer and Corbato, 1972).
- Corr. gravity: Observed gravity in milligals (mgal), referenced to an arbitrary base. The value in this column is calculated by (1) multiplying the meter reading by the "X Factor" number for the appropriate counter interval, (2) adding the product to the "Base Value" in the following table, and (3) adding in the tide, drift, and terrain effects.
- | Counter Interval | X Factor | Base Value |
|------------------|----------|------------|
| 2300-2349.999 | 0.86672 | 1989.873 |
| 2350-2399.999 | 0.86674 | 2033.209 |
- Error +G: This value, in microgals (μgal), is the estimated error caused by the rounding off of the various reduction corrections (that is, tide, drift, etc.) and by determination of the null position from the slope readings (beam velocities).

Prior to conducting the BHGM surveys, a gamma-ray log was run in each borehole for stratigraphic control and wireline depth correlations. These logs are reproduced in figures 9 through 15.

Table 1.--Principal Facts for Borehole RRL-3, Hanford Site,
Benton County, Washington
[Located at lat 46° 33' 47.07" N., long 119° 38' 15.48" W.;
ground elevation 686.8 ft (209.3 m)].

Reading #	Depth (ft)	Depth (m)	Time (CUT)	Meter readings (SD)	Tidal corr. (mgal)	Drift corr. (mgal)	Terrain corr. (mgal)	Corr. gravity (mgal)	Error +G (µgal)
Logged 06-30-82									
1	263.1	80.19	1618	2344.966	+0.058	-0.005	0.190	2029.089	+3
2	263.1	80.19	1629	2344.959	+0.059	0.000	0.190	2029.089	+4
3	294.0	89.61	1647	2346.133	+0.061	+0.001	0.194	2030.113	+2.5
4	313.1	95.43	1702	2346.828	+0.062	+0.003	0.197	2030.722	+3
5	362.1	110.37	1714	2348.659	+0.062	+0.004	0.203	2032.316	+3
6	384.1	117.07	1724	2349.549	+0.061	+0.005	0.206	2033.090	+5
7	425.1	129.57	1740	2351.129	+0.060	+0.007	0.210	2034.465	+2.5
8	263.1	80.19	1756	2344.946	+0.058	+0.012	0.190	2029.089	+3
9	425.1	129.57	1813	2351.130	+0.055	+0.012	0.210	2034.465	+3.5
10	449.1	136.89	1822	2352.086	+0.053	+0.014	0.212	2035.296	+3.5
11	482.1	146.94	1836	2353.579	+0.050	+0.016	0.215	2036.592	+3
12	506.1	154.26	1848	2354.505	+0.047	+0.018	0.217	2037.396	+2.5
13	543.1	165.54	1900	2355.617	+0.043	+0.020	0.219	2038.359	+2.5
14	571.1	174.07	1912	2356.312	+0.040	+0.023	0.221	2038.964	+3
15	425.1	129.57	1927	2351.130	+0.034	+0.033	0.210	2034.465	+4
16	571.1	174.07	1942	2356.313	+0.029	+0.033	0.221	2038.964	+3
17	596.1	181.59	1958	2356.888	+0.023	+0.040	0.222	2039.464	+4
18	624.1	190.23	2010	2357.538	+0.018	+0.046	0.224	2040.030	+3
19	664.1	202.42	2019	2359.482	+0.015	+0.050	0.225	2041.717	+2.5
20	683.1	208.21	2032	2361.442	+0.009	+0.057	0.226	2042.551	+2
21	705.1	214.91	2042	2351.560	+0.005	+0.062	0.227	2043.523	+2.5
22	571.1	174.07	2056	2356.305	0.000	+0.069	0.221	2038.964	+3
23	263.1	80.19	2117	2344.959	-0.008	+0.067	0.190	2029.089	+2.5
24	225.2	68.64	2133	2343.599	-0.015	+0.068	0.183	2027.897	+3
25	263.1	80.19	2143	2344.968	-0.018	+0.069	0.190	2029.089	+2.5
26	225.2	68.64	2157	2343.650	-0.023	+0.032	0.183	2027.897	+3
27	164.2	50.05	2215	2341.181	-0.029	-0.035	0.171	2025.671	+3

Table 1.--Principal Facts for Borehole RRL-3, Hanford Site,
Benton County, Washington
[Located at lat 46° 33' 47.07" N., long 119° 38' 15.48" W.;
ground elevation 686.8 ft (209.3 m)].
(Sheet 2 of 2)

Reading #	Depth (ft)	Depth (m)	Time (CUT)	Meter readings (SD)	Tidal corr. (mgal)	Drift corr. (mgal)	Terrain corr. (mgal)	Corr. gravity (mgal)	Error \pm 6 (μ gal)
28	225.2	68.64	2227	2343.777	-0.032	-0.069	0.183	2027.897	\pm 5
29	164.2	50.05	2241	2341.228	-0.036	-0.070	0.171	2025.671	\pm 2.5
30	225.2	68.64	2254	2343.786	-0.039	-0.070	0.183	2027.897	\pm 4
31	164.2	50.05	2307	2341.227	-0.042	-0.063	0.171	2025.671	\pm 4
32	96.2	29.32	2322	2337.965	-0.045	-0.102	0.153	2022.784	\pm 2.5
33	122.2	37.25	2333	2339.488	-0.046	-0.119	0.160	2024.093	\pm 2.5
34	149.2	45.48	2346	2340.744	-0.048	-0.156	0.167	2025.150	\pm 3
35	164.2	50.05	2359	2341.365	-0.049	-0.176	0.171	2025.671	\pm 3
36	96.2	29.32	0011	2388.094	-0.050	-0.209	0.153	2022.784	\pm 3
37	7.2	2.19	0026	2333.627	-0.051	-0.213	0.117	2018.871	\pm 3
38	45.2	13.78	0038	2335.569	-0.051	-0.217	0.135	2020.568	\pm 2.5
39	77.2	23.53	0048	2337.093	-0.051	-0.220	0.147	2021.898	\pm 3
40	96.2	29.32	0101	2338.113	-0.051	-0.224	0.153	2022.784	\pm 4
41	122.2	37.25	0112	2339.616	-0.051	-0.225	0.160	2024.093	\pm 3
42	149.2	45.48	0122	2340.827	-0.050	-0.226	0.167	2025.150	\pm 3.5
43	164.2	50.05	0132	2341.424	-0.049	-0.227	0.171	2025.671	\pm 4
44	96.2	29.32	0142	2338.114	-0.049	-0.227	0.153	2022.784	\pm 4

Table 2.--Principal Facts for Borehole RRL-4, Hanford Site,
Benton County, Washington

[Located at lat 46° 32' 17.95" N., long 119° 38' 15.94" W.;
ground elevation 658.7 ft (200.8 m)].

Reading #	Depth		Time	Meter readings	Tidal corr.	Drift corr.	Terrain corr.	Corr. gravity	Error
	(ft)	(m)	(CUT)	(SD)	(mgal)	(mgal)	(mgal)	(mgal)	+G (µgal)
Logged 07-02-82									
1	213.0	64.92	1605	2341.668	+0.066	0.000	0.157	2026.210	+3.5
2	250.9	76.47	1619	2343.103	+0.072	+0.008	0.164	2027.475	+6
3	287.1	87.51	1631	2344.327	+0.077	+0.016	0.171	2028.556	+3
4	350.0	106.68	1644	2346.486	+0.082	+0.024	0.185	2030.454	+2.5
5	386.0	117.65	1700	2347.997	+0.088	+0.034	0.193	2031.788	+2.5
6	213.0	64.92	1718	2341.583	+0.092	+0.047	0.157	2026.210	+3.5
7	386.0	117.65	1748	2347.970	+0.098	+0.047	0.193	2031.788	+3.5
8	416.0	126.80	1803	2349.185	+0.099	0.057	0.200	2032.859	+4
9	458.0	139.60	1815	2351.304	+0.099	+0.066	0.210	2034.714	+3
10	491.0	149.66	1828	2352.900	+0.099	+0.074	0.219	2036.115	+2.5
11	515.0	156.97	1842	2353.719	+0.098	+0.085	0.225	2036.840	+3
12	386.0	117.65	1858	2347.930	+0.095	+0.085	0.193	2031.788	+3.5
13	515.0	156.97	1916	2353.728	+0.091	+0.084	0.225	2036.840	+2.5
14	559.0	170.38	1929	2355.379	+0.088	+0.072	0.236	2038.267	+2.5
15	577.0	175.87	1939	2356.186	+0.084	+0.065	0.241	2038.961	+3
16	592.0	180.44	1948	2356.638	+0.081	+0.057	0.245	2039.345	+2.5
17	515.0	156.97	2003	2353.791	+0.075	+0.045	0.225	2036.840	+3
18	213.0	64.92	2025	2341.621	+0.065	+0.041	0.157	2026.210	+5
19	213.0	64.92	2034	2341.528	+0.060	+0.127	0.157	2026.210	+5
20	183.0	55.78	2047	2340.447	+0.054	+0.130	0.153	2025.266	+2.5
21	213.0	64.92	2100	2341.549	+0.047	+0.122	0.157	2026.210	+4
22	183.0	55.78	2112	2340.484	+0.040	+0.112	0.153	2025.266	+3
23	160.0	48.77	2126	2339.676	+0.032	+0.025	0.151	2024.469	+4
24	183.0	55.78	2136	2340.601	+0.026	+0.024	0.153	2025.266	+3
25	160.0	48.77	2147	2339.739	+0.020	-0.018	0.151	2024.469	+2.5
26	183.0	55.78	2200	2340.681	+0.012	-0.031	0.153	2025.266	+4
27	160.0	48.77	2212	2339.786	+0.005	-0.043	0.151	2024.469	+3

Table 2.--Principal Facts for Borehole RRL-4, Hanford Site,
Benton County, Washington
[Located at lat 46° 32' 17.95" N., long 119° 38' 15.94" W.;
ground elevation 658.7 ft (200.8 m)].
(Sheet 2 of 2)

Reading #	Depth		Time (CUT)	Meter readings (SD)	Tidal corr. (mgal)	Drift corr. (mgal)	Terrain corr. (mgal)	Corr. gravity (mgal)	Error +G (μgal)
	(ft)	(m)							
28	183.0	55.78	2225	2340.718	-0.003	-0.048	0.153	2025.266	+4
29	160.0	48.77	2234	2339.806	-0.008	-0.048	0.151	2024.469	+2.5
30	90.0	27.43	2250	2336.000	-0.017	-0.103	0.149	2021.104	+3
31	107.0	32.61	2301	2337.030	-0.023	-0.119	0.149	2021.975	+3.5
32	140.0	42.67	2311	2338.968	-0.028	-0.146	0.149	2023.622	+3.5
33	160.0	48.77	2324	2339.993	-0.035	-0.183	0.151	2024.469	+4
34	160.0	48.77	2328	2340.016	-0.037	-0.201	0.151	2024.469	+3
35	90.0	27.43	2340	2336.168	-0.042	-0.224	0.149	2021.104	+4
36	107.0	32.61	2349	2337.179	-0.046	-0.225	0.149	2021.975	+2
37	140.0	42.67	0000	2339.085	-0.050	-0.226	0.149	2023.622	+3.5
38	160.0	48.77	0010	2341.066	-0.054	-0.227	0.151	2024.469	+2
39	90.0	27.43	0023	2336.191	-0.058	-0.227	0.149	2021.104	+2.5
40	9.1	2.77	0037	2331.732	-0.062	-0.203	0.169	2017.280	+4
41	38.1	11.61	0048	2333.281	-0.065	-0.193	0.158	2018.618	+2.5
42	58.1	17.71	0059	2334.241	-0.067	-0.182	0.153	2019.454	+3
43	77.1	23.50	0109	2335.380	-0.069	-0.173	0.150	2020.446	+3
44	90.0	27.43	0119	2336.131	-0.071	-0.162	0.149	2021.104	+3
45	9.1	2.77	0131	2331.696	-0.072	-0.162	0.169	2017.280	+5

Table 3.--Principal Facts for Borehole RRL-5, Hanford Site,
Benton County, Washington
[Located at lat 46° 33' 26.09" N., long 119° 40' 41.35" W.;
ground elevation 642.1 ft (195.7 m)].

Reading #	Depth (ft)	Depth (m)	Time (CUT)	Meter readings (SD)	Tidal corr. (mgal)	Drift corr. (mgal)	Terrain corr. (mgal)	Corr. gravity (mgal)	Error +G (μgal)
Logged 06-25-82									
1	171.6	52.30	1656	2341.341	-0.056	0.000	0.361	2026.009	+2.5
2	198.5	60.50	1735	2341.981	-0.046	+0.264	0.384	2026.861	+2.5
3	239.6	73.03	1754	2343.465	-0.039	+0.179	0.418	2028.103	+4
4	239.6	73.03	1832	2343.617	-0.024	+0.032	0.418	2028.103	+4
5	171.6	52.30	1850	2341.349	-0.016	-0.047	0.361	2026.009	+3.5
6	198.5	60.50	1903	2342.298	-0.010	-0.047	0.384	2026.861	+3
7	198.5	60.50	1910	2342.281	-0.006	-0.036	0.384	2026.861	+4
8	239.6	73.03	1922	2343.668	0.000	-0.036	0.418	2028.103	+2
9	284.6	86.75	1938	2345.179	+0.009	-0.034	0.455	2029.461	+3
10	312.6	95.28	1952	2346.134	+0.016	-0.032	0.477	2030.319	+3
11	336.6	102.60	2002	2346.974	+0.021	-0.030	0.496	2031.073	+3
12	336.6	102.60	2006	2346.965	+0.023	-0.025	0.496	2031.073	+2.5
13	363.7	110.86	2021	2346.960	+0.031	-0.023	0.518	2031.967	+3
14	239.6	73.03	2037	2343.607	+0.038	-0.021	0.418	2028.103	+3.5
15	363.7	110.86	2052	2347.936	+0.046	-0.017	0.518	2031.967	+3
16	384.7	117.26	2103	2348.738	+0.051	-0.018	0.534	2032.682	+2.5
17	423.7	129.14	2115	2350.255	+0.056	-0.019	0.564	2034.031	+2.5
18	464.7	141.64	2127	2352.294	+0.061	-0.020	0.595	2035.833	+2.5
19	485.7	148.04	2145	2353.350	+0.068	-0.022	0.611	2036.770	+3
20	508.7	155.05	2157	2354.346	+0.072	-0.023	0.628	2037.653	+5
21	363.7	110.86	2211	2346.909	+0.076	-0.024	0.518	2031.967	+2.5
22	508.7	155.05	2230	2354.325	+0.080	-0.013	0.628	2037.653	+3.5
23	529.7	161.45	2242	2355.094	+0.082	-0.016	0.644	2038.334	+3.5
24	562.7	171.51	2254	2356.290	+0.084	-0.020	0.668	2039.393	+2.5
25	624.7	190.41	2306	2359.132	+0.085	-0.023	0.712	2041.898	+4.5
26	659.7	201.08	2318	2360.162	+0.085	-0.027	0.737	2042.812	+3.5
27	508.7	155.05	2335	2354.342	+0.085	-0.032	0.628	2037.653	+2.5

Table 3.--Principal Facts for Borehole RRL-5, Hanford Site,
Benton County, Washington
[Located at lat 46° 33' 26.09" N., long 119° 40' 41.35" W.;
ground elevation 642.1 ft (195.7 m)].
(Sheet 2 of 2)

Reading #	Depth (ft)	Depth (m)	Time (CUT)	Meter readings (SD)	Tidal corr. (mgal)	Drift corr. (mgal)	Terrain corr. (mgal)	Corr. gravity (mgal)	Error ±G (µgal)
28	171.6	52.30	2400	2341.197	+0.082	-0.013	0.361	2026.009	+3
29	142.6	43.46	0016	2340.243	+0.079	-0.107	0.336	2024.060	+4
30	171.6	52.30	0030	2341.398	+0.075	-0.180	0.361	2026.009	+5
31	142.6	43.46	0041	2341.363	+0.071	-0.203	0.336	2025.060	+6
32	114.7	34.96	0057	2338.920	+0.066	-0.361	0.312	2023.623	+4
33	114.7	34.96	0101	2338.905	+0.035	-0.317	0.312	2023.623	+5
34	114.7	34.96	0117	2338.950	+0.026	-0.347	0.312	2023.623	+4
Logged 06-26-82									
35	114.7	34.96	1605	2338.821	-0.042	-0.167	0.312	2023.623	+3.5
36	8.7	2.65	1625	2333.298	-0.043	-0.167	0.215	2018.738	+3
37	28.7	8.75	1638	2334.434	-0.043	-0.167	0.233	2019.741	+3
38	51.7	15.76	1651	2335.722	-0.043	-0.167	0.255	2020.879	+3.5
39	100.7	30.69	1706	2337.924	-0.042	-0.167	0.299	2022.832	+3
40	114.7	34.96	1718	2338.834	-0.042	-0.178	0.312	2023.623	+3
41	142.6	43.46	1730	2340.457	-0.041	-0.173	0.336	2025.060	+4
42	114.7	34.96	1742	2338.821	-0.040	-0.169	0.312	2023.623	+3.5
43	100.7	30.69	1752	2337.926	-0.039	-0.172	0.299	2022.832	+2.5

Table 4.--Principal Facts for Borehole RRL-6B, Hanford Site,
Benton County, Washington
[Located at lat 46° 31' 59.41" N., long 119° 40' 52.24" W.;
ground elevation 644 ft (196.3 m)].

Reading #.	Depth (ft)	Depth (m)	Time (CUT)	Meter readings (SD)	Tidal corr. (mgal)	Drift corr. (mgal)	Terrain corr. (mgal)	Corr. gravity (mgal)	Error +G (µgal)
Logged 06-23-82									
1	234.7	71.54	1642	2340.061	-0.040	0.000	0.226	2024.781	+3
2	234.7	71.54	1814	2339.979	+0.032	-0.001	0.226	2024.781	+2.5
3	274.7	83.73	1830	2341.362	+0.044	+0.044	0.245	2026.015	+2
4	302.7	92.26	1844	2342.351	+0.056	0.000	0.259	2026.894	+2.5
5	332.7	101.41	1859	2343.371	+0.067	0.000	0.275	2027.806	+3
6	395.6	120.58	1919	2345.985	+0.082	+0.007	0.310	2030.128	+2.5
7	417.7	127.31	1933	2346.865	+0.092	0.000	0.323	2030.907	+3.5
8	234.7	71.54	1942	2339.866	+0.105	+0.024	0.226	2024.781	+2.5
9	274.7	83.73	2007	2341.262	+0.114	+0.020	0.245	2026.015	+2.5
10	302.7	92.26	2020	2342.238	+0.121	+0.032	0.259	2026.894	+4
11	332.7	101.41	2031	2343.264	+0.126	+0.034	0.275	2027.806	+4
12	369.7	112.68	2044	2344.725	+0.131	+0.028	0.295	2029.091	+3
13	395.6	120.58	2057	2345.904	+0.136	+0.023	0.310	2030.128	+5
14	417.7	127.31	2109	2346.778	+0.139	+0.029	0.323	2030.907	+4
15	474.7	144.69	2129	2349.656	+0.143	+0.035	0.356	2033.445	+3
16	537.7	163.89	2144	2352.593	+0.144	+0.040	0.393	2036.033	+2
17	577.7	176.08	2157	2354.251	+0.144	+0.045	0.418	2037.501	+2.5
18	653.7	199.25	2211	2357.820	+0.143	+0.050	0.464	2040.644	+2.5
19	738.7	225.16	2224	2360.097	+0.140	+0.054	0.516	2042.670	+4
20	778.7	237.35	2243	2362.009	+0.135	+0.061	0.541	2044.355	+3.5
21	417.7	127.31	2306	2346.718	+0.127	+0.093	0.323	2030.907	+2.5
22	778.7	237.35	2330	2361.995	+0.115	+0.093	0.541	2044.355	+4
23	802.7	244.66	2344	2363.110	+0.106	+0.099	0.556	2045.333	+3
24	843.7	257.16	2358	2365.168	+0.097	+0.106	0.581	2047.140	+3.5
25	863.7	263.26	0011	2366.158	+0.088	+0.113	0.594	2048.009	+4
26	920.7	280.63	0022	2367.779	+0.080	+0.118	0.629	2049.446	+3
27	994.7	303.18	0037	2369.493	+0.069	+0.125	0.675	2050.973	+3

Table 4.--Principal Facts for Borehole RRL-6B, Hanford Site,
Benton County, Washington

[Located at lat 46° 31' 59.41" N., long 119° 40' 52.24" W.;
ground elevation 644 ft (196.3 m)].

(Sheet 2 of 2)

Reading #	Depth (ft)	Depth (m)	Time (CUT)	Meter readings (SD)	Tidal corr. (mgal)	Drift corr. (mgal)	Terrain corr. (mgal)	Corr. gravity (mgal)	Error \pm G (μ gal)
28	994.7	303.18	0042	2369.468	+0.065	+0.150	0.675	2050.973	\pm 4
29	778.7	237.35	0101	2362.003	+0.050	+0.152	0.541	2044.355	\pm 2.5
30	234.7	71.54	0131	2339.813	+0.025	+0.150	0.226	2024.781	\pm 2.5
31	196.6	59.92	0148	2338.510	+0.011	+0.112	0.209	2023.582	\pm 2.5
32	234.7	71.54	0201	2339.901	+0.001	+0.098	0.226	2024.781	\pm 2.5
33	196.6	59.92	0214	2338.551	-0.011	+0.098	0.209	2023.582	\pm 2.5
34	98.6	30.05	0229	2334.544	-0.022	+0.045	0.185	2020.021	\pm 3
35	196.6	59.92	0244	2338.669	-0.033	+0.018	0.209	2023.582	\pm 3.5
36	132.7	40.45	0259	2366.064	-0.043	+0.018	0.189	2021.294	\pm 2.5
37	98.6	30.05	0311	2334.509	-0.051	+0.018	0.185	2020.021	\pm 5
38	6.4	1.95	0330	2329.631	-0.062	-0.119	0.260	2015.634	\pm 3.5
39	47.8	14.57	0345	2332.215	-0.070	-0.142	0.201	2017.783	\pm 3
40	67.7	20.63	0354	2333.441	-0.075	-0.154	0.190	2018.818	\pm 2.5
41	78.7	23.99	0407	2334.066	-0.080	-0.172	0.187	2019.334	\pm 3
42	98.6	30.05	0418	2334.884	-0.084	-0.188	0.185	2020.021	\pm 3
43	6.4	1.95	0436	2329.743	-0.090	-0.188	0.260	2015.634	\pm 2.5

Table 5.--Principal Facts for Borehole RRL-7, Hanford Site,
Benton County, Washington
[Located at lat 46° 34' 1.31" N., long 119° 39' 47.08" W.;
ground elevation 791 ft (241.1 m)].
(Sheet 2 of 2)

Reading #	Depth (ft)	Depth (m)	Time (CUT)	Meter readings (SD)	Tidal corr. (mgal)	Drift corr. (mgal)	Terrain corr. (mgal)	Corr. gravity (mgal)	Error +G (µgal)
28	323.0	98.45	1914	2340.547	+0.155	+0.089	-0.383	2024.877	+3
29	296.0	90.22	1926	2339.342	+0.159	+0.155	-0.344	2023.941	+2.5
30	323.0	98.45	1936	2340.459	+0.163	+0.157	-0.383	2024.877	+2.5
31	364.0	110.95	1947	2342.046	+0.165	+0.197	-0.440	2026.237	+4
32	364.0	110.95	1953	2341.988	+0.167	+0.245	-0.440	2026.237	+3
33	323.0	98.45	2003	2340.331	+0.168	+0.263	-0.383	2024.877	+3
34	364.0	110.95	2015	2341.965	+0.169	+0.263	-0.440	2026.237	+3
35	391.0	119.18	2023	2342.938	+0.168	+0.253	-0.476	2027.033	+2.5
36	417.0	127.10	2032	2343.961	+0.168	+0.243	-0.510	2027.876	+3
37	467.0	142.34	2041	2345.755	+0.166	+0.233	-0.572	2029.354	+3
38	487.0	148.44	2054	2346.501	+0.164	+0.230	-0.595	2029.975	+3.5
39	364.0	110.95	2115	2342.003	+0.157	+0.242	-0.440	2026.237	+3
40	467.0	142.34	2127	2345.752	+0.151	+0.248	-0.572	2029.354	+2.5
41	487.0	148.44	2136	2346.494	+0.147	+0.253	-0.595	2029.975	+3.5
42	524.0	159.72	2147	2347.988	+0.141	+0.250	-0.638	2031.218	+2.5
43	569.0	173.43	2156	2349.943	+0.136	+0.247	-0.687	2032.856	+3
44	587.0	178.92	2205	2350.890	+0.129	+0.245	-0.706	2033.648	+2.5
45	604.0	184.10	2214	2351.708	+0.123	+0.242	-0.723	2034.331	+3.5
46	487.0	148.44	2227	2346.533	+0.114	+0.252	-0.595	2029.975	+2.5
47	604.0	184.10	2238	2351.710	+0.104	+0.259	-0.723	2034.331	+2.5
48	616.0	187.76	2246	2352.291	+0.098	+0.262	-0.735	2034.820	+5
49	647.0	197.21	2256	2353.424	+0.090	+0.267	-0.766	2035.768	+2.5
50	679.0	206.96	2305	2354.704	+0.081	+0.271	-0.796	2036.842	+5
51	604.0	184.10	2314	2351.727	+0.073	+0.275	-0.723	2034.331	+2.5
52	364.0	110.95	2332	2342.106	+0.056	+0.254	-0.440	2026.237	+2.5
53	323.0	98.45	2344	2340.520	+0.045	+0.223	-0.383	2024.877	+3
54	296.0	90.22	2357	2339.446	+0.033	+0.190	-0.344	2023.941	+4

Table 6.--Principal Facts for Borehole RRL-8, Hanford Site,
Benton County, Washington

[Located at lat 46° 34' 16.61" N., long 119° 41' 27.04" W.;
ground elevation 805.9 ft (245.6 m)].

Reading #	Depth (ft)	Depth (m)	Time (CUT)	Meter readings (SD)	Tidal corr. (mgal)	Drift corr. (mgal)	Terrain corr. (mgal)	Corr. gravity (mgal)	Error ±G (µgal)
Logged 06-18-82									
1	333.5	101.65	1635	2339.024	+0.091	0.000	-0.012	2023.775	±3.5
2	415.5	126.64	1652	2341.976	+0.099	0.000	-0.059	2026.294	±3
3	478.5	145.85	1703	2344.239	+0.103	0.000	-0.094	2028.225	±3
4	499.5	152.25	1714	2345.014	+0.106	0.000	-0.105	2028.889	±3
5	552.5	168.40	1724	2346.975	+0.109	0.000	-0.133	2030.563	±3
6	605.5	184.56	1740	2349.627	+0.112	0.000	-0.160	2032.838	±3
7	333.5	101.65	1800	2338.998	+0.114	0.000	-0.012	2023.775	±2.5
8	605.5	184.56	1819	2349.664	+0.114	-0.034	-0.160	2032.838	±6
9	624.5	190.35	1828	2350.635	+0.113	-0.036	-0.170	2033.666	±3
10	640.5	195.22	1837	2351.396	+0.111	-0.038	-0.178	2034.314	±4
11	703.5	214.43	1848	2353.916	+0.109	-0.040	-0.209	2036.463	±3.5
12	715.5	218.08	1857	2354.460	+0.106	-0.042	-0.215	2036.924	±5
13	605.5	184.56	1909	2349.688	+0.103	-0.044	-0.160	2032.838	±4
14	333.5	101.65	1927	2339.005	+0.096	+0.012	-0.012	2023.775	±4
15	283.6	86.44	1941	2337.075	+0.089	+0.029	+0.017	2022.142	±4
16	333.5	101.65	1953	2338.991	+0.083	+0.037	-0.012	2023.775	±3.5
17	283.6	86.44	2009	2337.084	+0.074	+0.037	+0.017	2022.142	±4
18	149.6	45.60	2034	2329.788	+0.058	-0.160	+0.102	2015.691	±5
19	190.6	58.09	2045	2332.272	+0.051	-0.139	+0.075	2017.831	±3
20	247.6	75.47	2058	2335.696	+0.041	-0.139	+0.039	2020.752	±3
21	283.6	86.44	2109	2337.333	+0.034	-0.139	+0.017	2022.142	±3.5
22	149.6	45.60	2123	2329.804	+0.023	-0.139	+0.102	2015.691	±3
23	190.6	58.09	2138	2332.319	+0.012	-0.141	+0.075	2017.831	±4
24	7.1	2.16	2211	2322.013	-0.012	-0.219	+0.187	2008.908	±4.5
25	37.6	11.46	2226	2323.517	-0.022	-0.219	+0.174	2010.169	±5
26	50.6	15.42	2237	2324.235	-0.029	-0.219	+0.167	2010.797	±3
27	73.6	22.43	2250	2325.506	-0.038	-0.219	+0.152	2011.875	±2.5
28	149.6	45.60	2308	2329.978	-0.048	-0.219	+0.102	2015.691	±3
29	7.1	2.16	2326	2321.975	-0.058	-0.140	+0.187	2008.908	±2.5

Table 5.--Principal Facts for Borehole RRL-7, Hanford Site,
Benton County, Washington
[Located at lat 46° 34' 1.31" N., long 119° 39' 47.08" W.;
ground elevation 791 ft (241.1 m)].

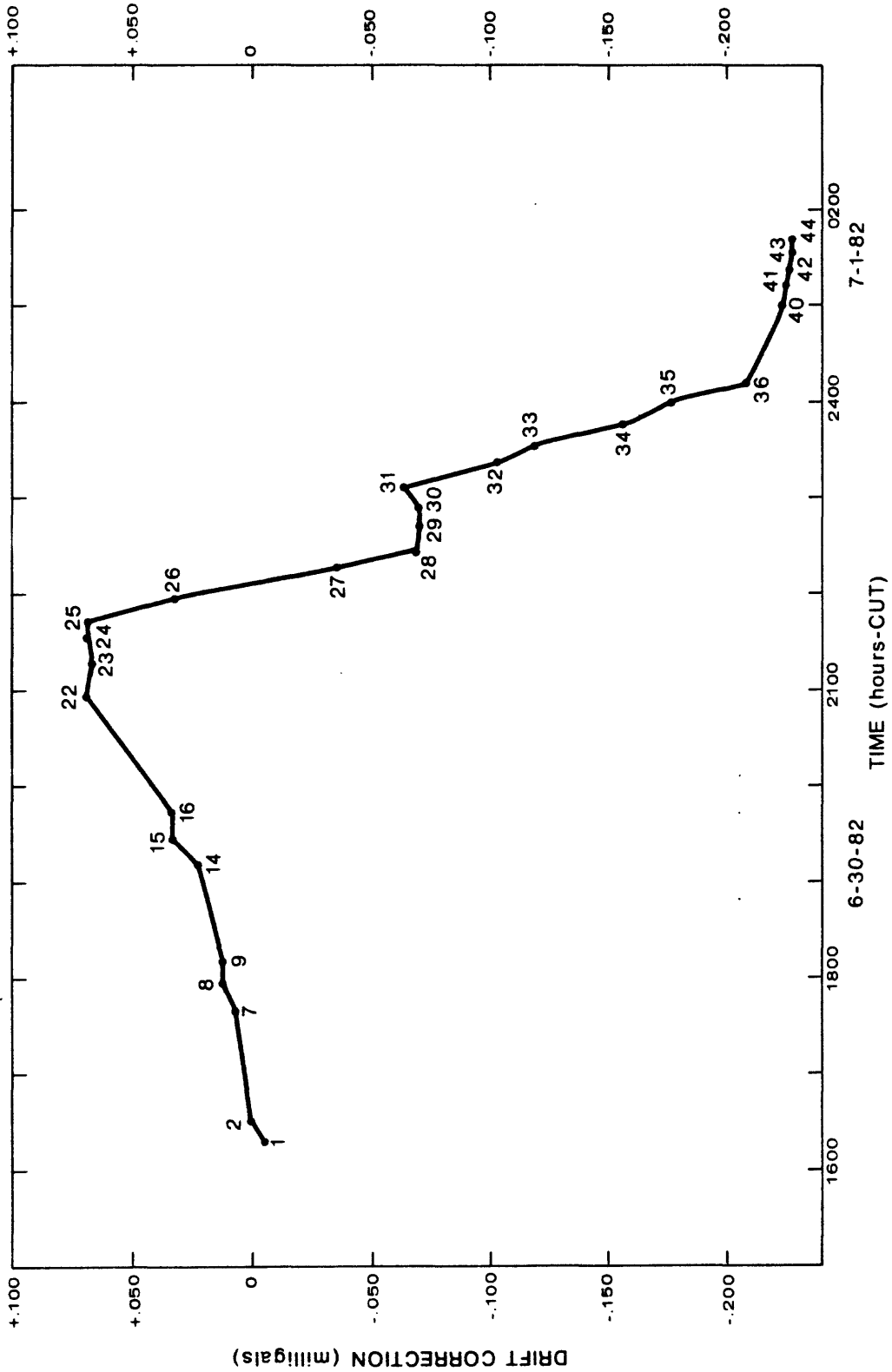
Reading #	Depth (ft)	Depth (m)	Time (CUT)	Meter readings (SD)	Tidal corr. (mgal)	Drift corr. (mgal)	Terrain corr. (mgal)	Corr. gravity (mgal)	Error +G (µgal)
Logged 06-20-82									
1	28.0	8.53	1701	2324.746	+0.091	+0.054	+0.127	2011.593	+2.5
2	5.2	1.58	1722	2323.281	+0.108	+0.050	+0.176	2010.385	+3
3	28.0	8.53	1732	2324.701	+0.115	+0.069	+0.127	2011.593	+3
4	58.0	17.68	1747	2326.460	+0.126	+0.070	+0.066	2013.068	+3
5	102.0	31.09	1759	2328.540	+0.133	+0.071	-0.020	2014.793	+2.5
6	132.0	40.23	1811	2330.333	+0.140	+0.072	-0.075	2016.300	+4
7	149.0	45.42	1827	2331.241	+0.148	+0.074	-0.106	2017.066	+3.5
8	188.0	57.30	1848	2333.548	+0.155	+0.076	-0.173	2019.008	+3.5
9	28.0	8.53	1906	2324.641	+0.160	+0.076	+0.127	2011.593	+3
10	5.2	1.58	1917	2323.177	+0.161	+0.087	+0.176	2010.385	+3
11	188.0	57.30	1938	2333.531	+0.162	+0.084	-0.173	2019.008	+2.5
12	206.0	62.79	1957	2334.493	+0.160	+0.154	-0.203	2019.880	+3
13	232.0	70.71	2015	2335.914	+0.155	+0.177	-0.245	2021.087	+2.5
14	262.0	79.86	2029	2337.876	+0.150	+0.090	-0.292	2022.649	+5
15	188.0	57.30	2100	2333.659	+0.135	0.000	-0.173	2019.008	+3
Logged 06-21-82									
16	188.0	57.30	1645	2333.783	+0.040	-0.012	-0.173	2019.008	+3.5
17	188.0	57.30	1659	2333.753	+0.054	0.000	-0.173	2019.008	+4
18	206.0	62.79	1713	2334.753	+0.067	+0.022	-0.203	2019.880	+4
19	232.0	70.71	1723	2336.164	+0.076	+0.039	-0.245	2021.087	+3
20	262.0	79.86	1736	2337.991	+0.087	+0.053	-0.292	2022.649	+3
21	277.0	84.43	1748	2338.771	+0.092	+0.039	-0.315	2023.299	+3
22	296.0	90.22	1800	2339.519	+0.108	+0.052	-0.344	2023.941	+5
23	188.0	57.30	1817	2333.615	+0.121	+0.052	-0.173	2019.008	+4
24	232.0	70.71	1828	2336.088	+0.129	+0.052	-0.245	2021.087	+4
25	262.0	79.86	1839	2337.936	+0.136	+0.052	-0.292	2022.649	+3
26	277.0	84.43	1848	2338.703	+0.142	+0.054	-0.315	2023.299	+4
27	296.0	90.22	1859	2339.473	+0.148	+0.052	-0.344	2023.941	+3.5

Table 7.--Principal Facts for Borehole RRL-9, Hanford Site,
Benton County, Washington
[Located at lat 46° 33' 1.62" N., long 119° 38' 43.61" W.;
ground elevation 655 ft (199.6 m)].

Reading #	Depth (ft)	Depth (m)	Time (CUT)	Meter readings (SD)	Tidal corr. (mgal)	Drift corr. (mgal)	Terrain corr. (mgal)	Corr. gravity (mgal)	Error +G (µgal)
Logged 06-28-82									
1	258.2	78.70	1704	2344.754	+0.009	0.000	0.324	2028.995	+4
2	279.0	85.04	1715	2345.493	+0.008	-0.008	0.336	2029.639	+4
3	294.0	89.61	1724	2346.024	+0.007	-0.014	0.344	2030.100	+3
4	325.0	99.06	1735	2347.107	+0.005	-0.023	0.360	2031.044	+3
5	348.0	106.07	1744	2348.009	+0.004	-0.029	0.372	2031.830	+5
6	386.0	117.65	1756	2349.565	+0.002	-0.037	0.390	2033.187	+4.5
7	258.2	78.70	1812	2344.820	-0.001	-0.047	0.324	2028.995	+3.5
8	386.0	117.65	1824	2349.584	-0.003	-0.048	0.390	2033.187	+3.5
9	402.1	122.56	1833	2350.372	-0.004	-0.050	0.398	2033.875	+3
10	402.1	122.56	1835	2350.390	-0.005	-0.065	0.398	2033.875	+4
11	443.1	135.06	1845	2352.023	-0.006	-0.117	0.416	2035.255	+5
12	467.1	142.37	1852	2353.407	-0.007	-0.280	0.427	2036.302	+2
13	493.1	150.30	1859	2354.434	-0.008	-0.117	0.438	2037.365	+3
14	515.1	157.00	1908	2355.197	-0.010	-0.109	0.447	2038.041	+3
15	386.0	117.65	1921	2349.650	-0.012	-0.097	0.390	2033.187	+2
16	443.1	135.06	1932	2351.996	-0.013	-0.087	0.416	2035.255	+3
17	467.1	142.37	1940	2353.190	-0.014	-0.085	0.427	2036.302	+2.5
18	493.1	150.30	1950	2354.404	-0.016	-0.083	0.438	2037.365	+3
19	386.0	117.65	2000	2349.637	-0.017	-0.080	0.390	2033.187	+2.5
20	258.2	78.70	2013	2344.873	-0.018	-0.076	0.324	2028.995	+2.5
21	183.3	55.87	2027	2342.074	-0.019	-0.075	0.280	2026.525	+2.5
22	218.3	66.54	2039	2343.363	-0.020	-0.076	0.301	2027.662	+3
23	234.3	71.41	2047	2343.924	-0.021	-0.077	0.311	2028.156	+3
24	258.2	78.70	2058	2344.880	-0.021	-0.079	0.324	2028.995	+2.5
25	183.3	55.87	2108	2342.098	-0.022	-0.093	0.280	2026.525	+3
26	164.4	50.11	2118	2341.406	-0.022	-0.092	0.268	2025.914	+3.5
27	183.3	55.87	2127	2342.096	-0.022	-0.091	0.280	2026.525	+4

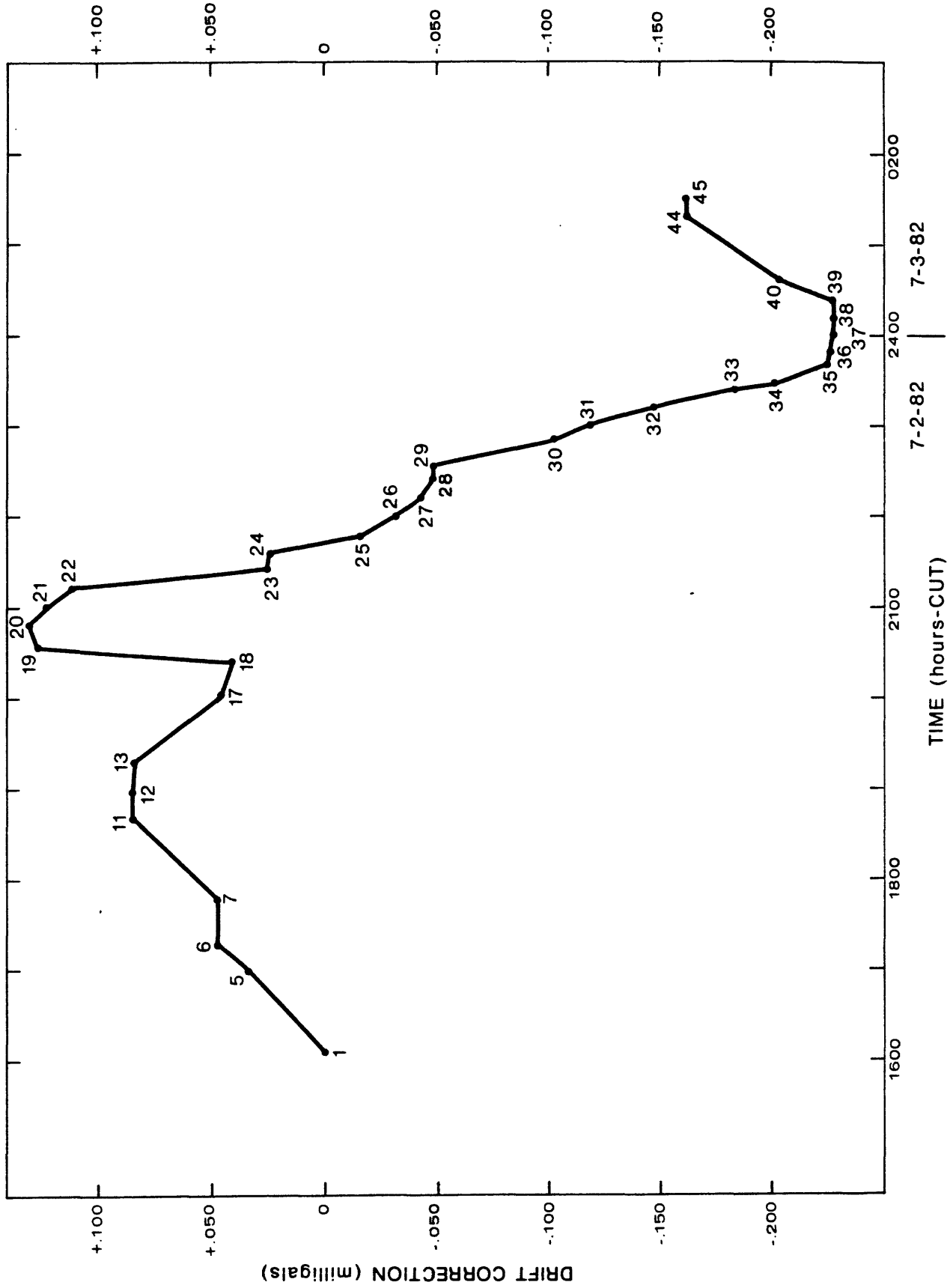
Table 7.--Principal Facts for Borehole RRL-9, Hanford Site,
Benton County, Washington
[Located at lat 46° 33' 1.62" N., long 119° 38' 43.61" W.;
ground elevation 655 ft (199.6 m)].
(Sheet 2 of 2)

Reading #	Depth (ft)	Depth (m)	Time (CUT)	Meter readings (SD)	Tidal corr. (mgal)	Drift corr. (mgal)	Terrain corr. (mgal)	Corr. gravity (mgal)	Error +G (µgal)
28	164.4	50.11	2138	2341.423	-0.022	-0.107	0.268	2025.914	+3
29	114.4	34.87	2149	2339.053	-0.022	-0.127	0.236	2023.808	+3
30	128.4	39.14	2157	2339.804	-0.022	-0.146	0.245	2024.449	+5
31	152.4	46.45	2208	2340.996	-0.021	-0.182	0.261	2025.463	+4
32	164.4	50.11	2215	2341.521	-0.021	-0.193	0.268	2025.914	+2.5
33	114.4	34.87	2225	2339.146	-0.020	-0.210	0.236	2023.808	+3
34	8.4	2.56	2238	2333.870	-0.019	-0.261	0.167	2019.116	+4
35	26.4	8.05	2248	2334.681	-0.018	-0.262	0.177	2019.829	+4
36	66.4	20.24	2257	2336.362	-0.018	-0.272	0.203	2021.302	+5
37	103.4	31.52	2306	2338.612	-0.017	-0.284	0.228	2023.266	+3.5
38	114.4	34.87	2314	2339.240	-0.016	-0.295	0.236	2023.808	+3
39	128.4	39.14	2325	2339.968	-0.015	-0.295	0.245	2024.449	+2
40	152.4	46.45	2335	2341.087	-0.014	-0.268	0.261	2025.463	+3
41	164.4	50.11	2343	2341.589	-0.013	-0.260	0.268	2025.914	+3
42	114.4	34.87	2353	2339.195	-0.012	-0.260	0.236	2023.808	+3
43	128.4	39.14	0007	2339.918	-0.011	-0.256	0.245	2024.449	+2
44	152.4	46.45	0015	2341.067	-0.010	-0.255	0.261	2025.463	+5
45	164.4	50.11	0023	2341.578	-0.009	-0.254	0.268	2025.914	+3
46	114.4	34.87	0031	2339.182	-0.009	-0.252	0.236	2023.808	+3.5
47	8.4	2.56	0043	2333.846	-0.008	-0.251	0.167	2019.116	+4
48	26.4	8.05	0058	2334.655	-0.007	-0.250	0.177	2019.829	+2.5
49	66.4	20.24	0114	2336.321	-0.006	-0.248	0.203	2021.302	+4
50	103.4	31.52	0123	2338.556	-0.005	-0.247	0.228	2023.266	+4
51	114.4	34.87	0133	2339.171	-0.005	-0.246	0.236	2023.808	+3



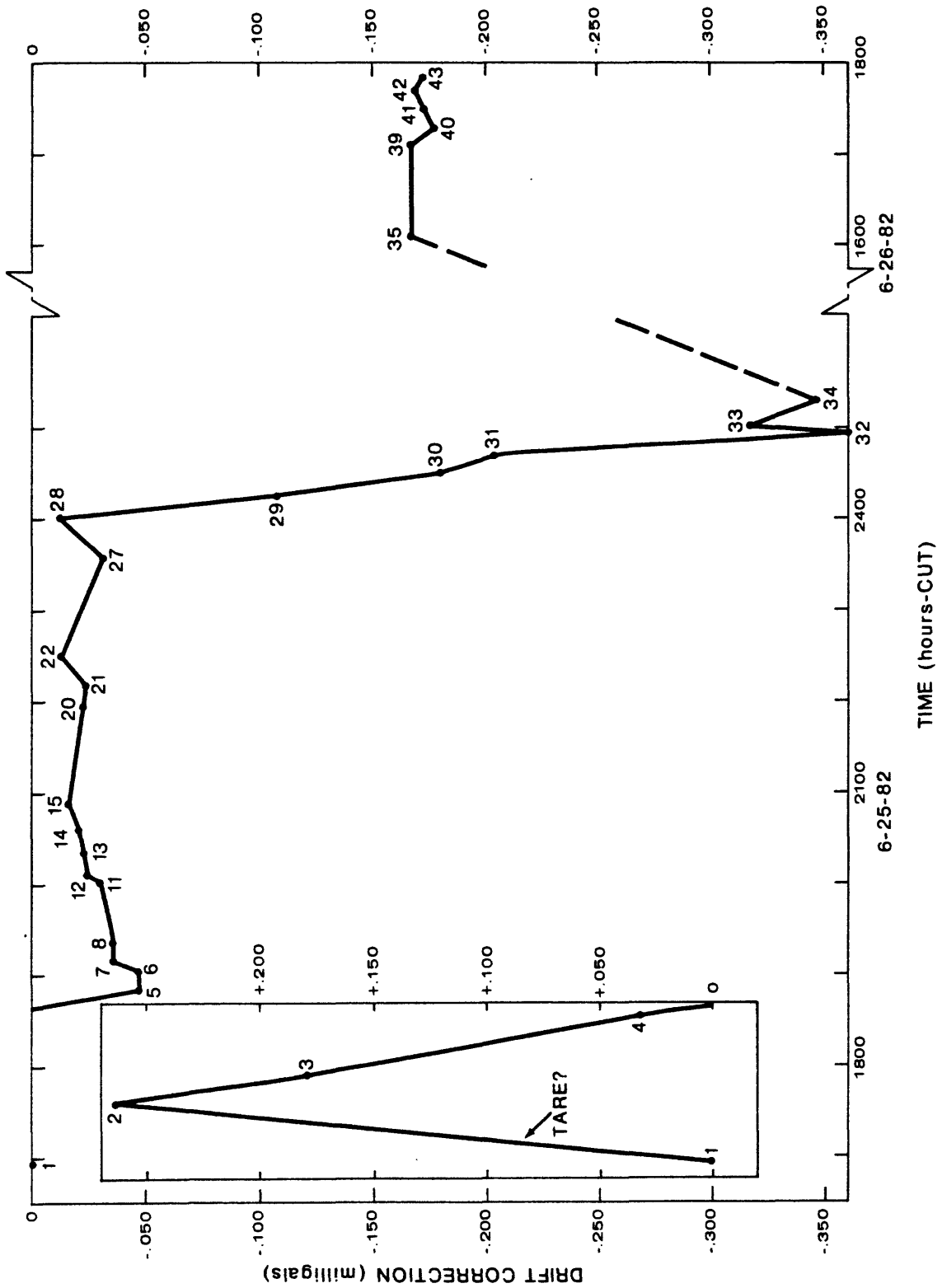
• Drift correction used at particular reading when more than one reading was made at that depth (numbers refer to reading numbers in table 1).

Figure 2.--Drift correction curve for BH-6 in borehole RRL-3; lat 46°33'47.1" N., long 119°38'15.5" W., Hanford Site, Renton County, Washington.



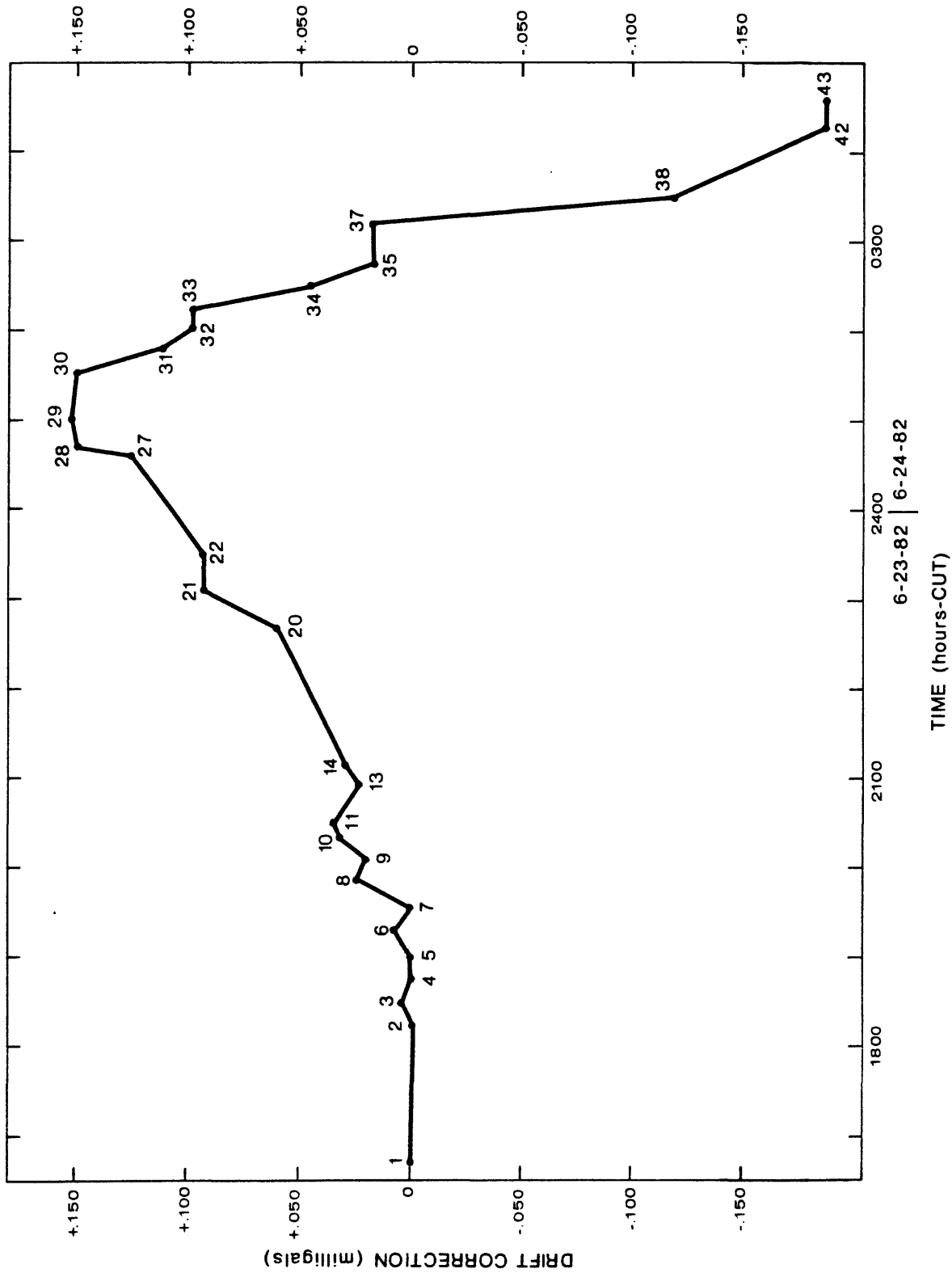
• Drift correction used at particular reading when more than one reading was made at that depth (numbers refer to reading numbers in table 2).

Figure 3.--Drift correction curve for BH-6 in borehole RRL-4; lat 46°32'18.0" N., long 119°38'15.9" W., Hanford Site, Benton County, Washington.



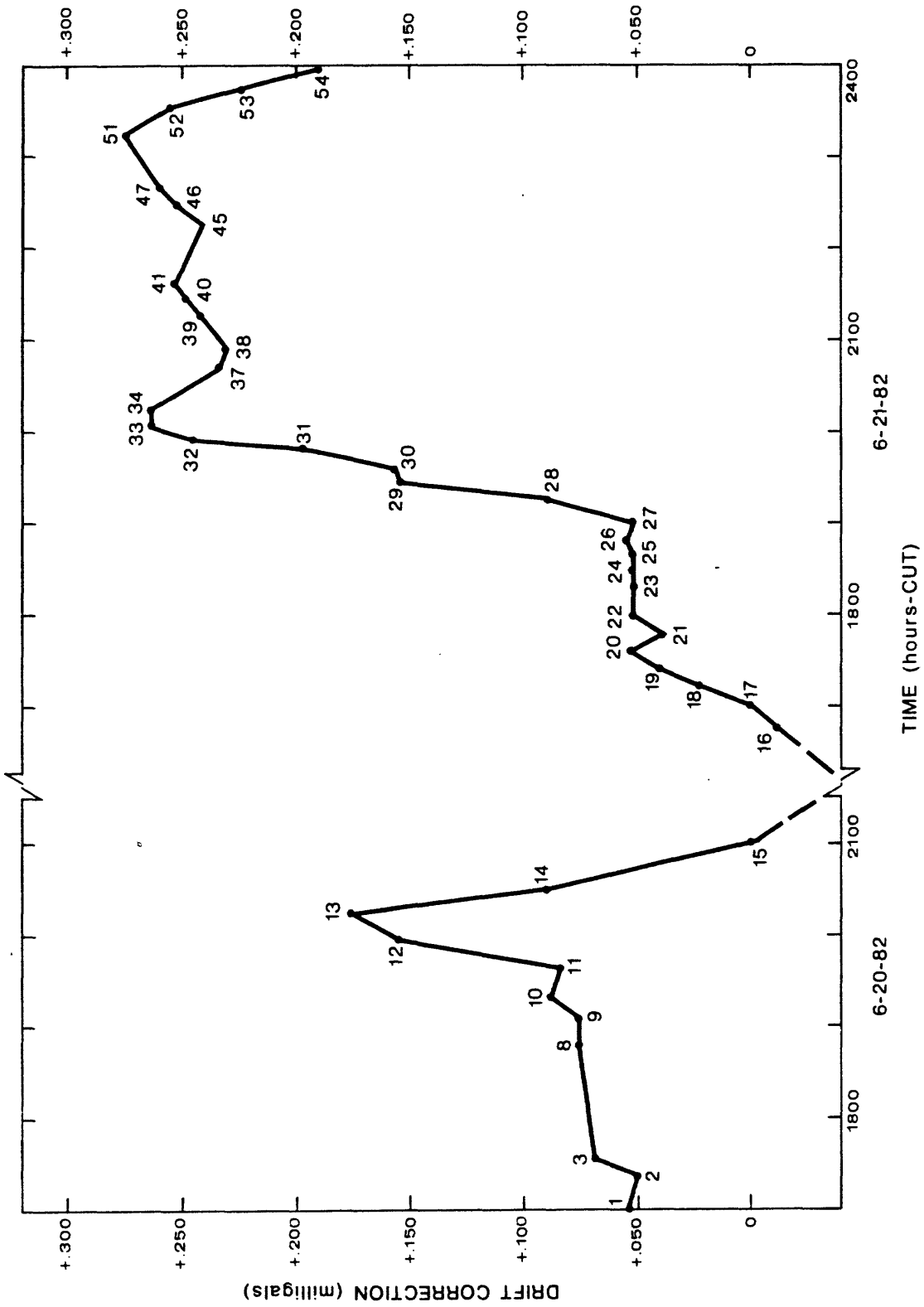
• Drift correction used at particular reading when more than one reading was made at that depth (numbers refer to reading numbers in table 3).

Figure 4.--Drift correction curve for BH-6 in borehole RRL-5; lat 46°33'26.1" N., long 119°40'41.4" W., Hanford Site, Benton County, Washington.



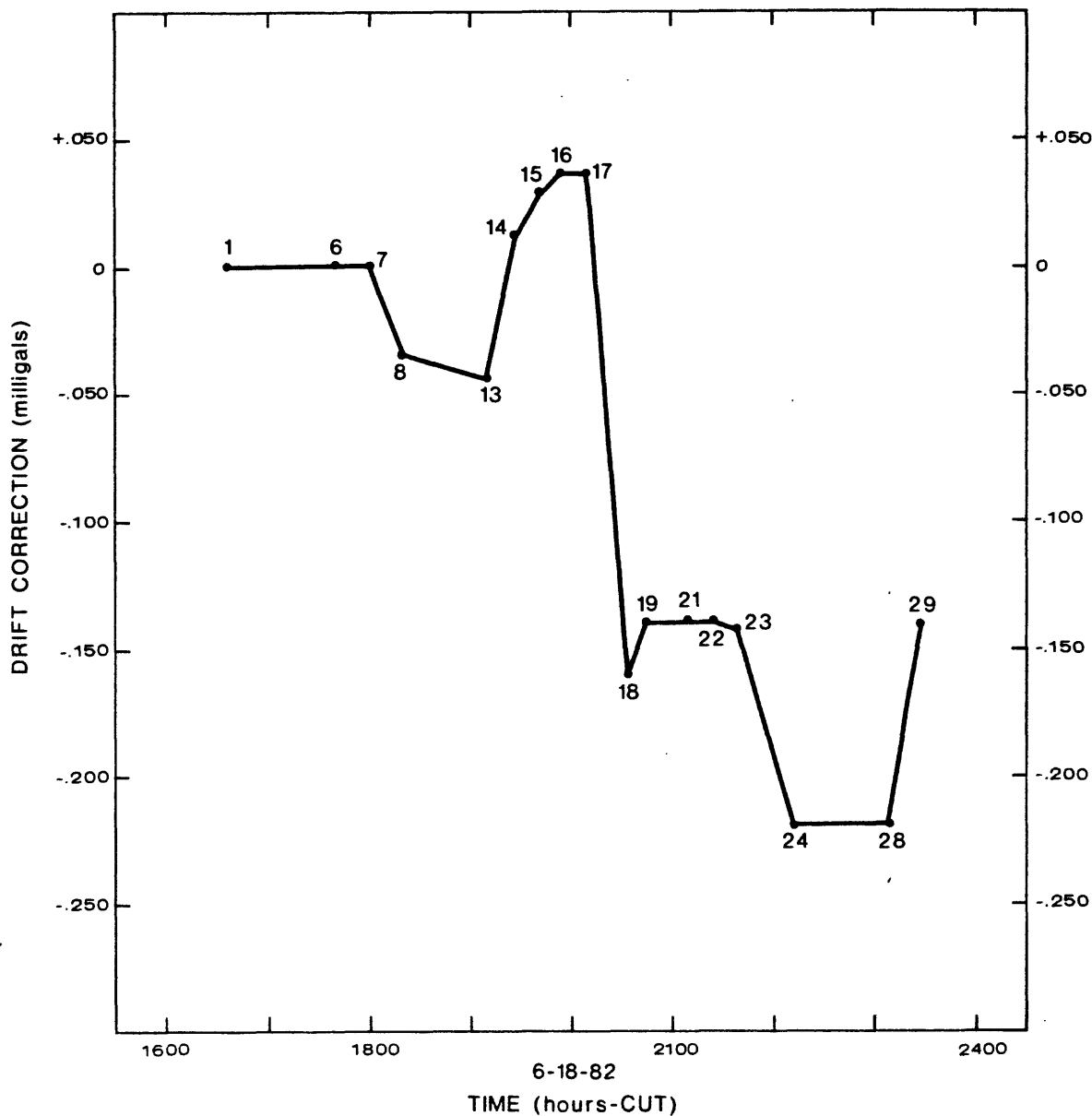
• Drift correction used at particular reading when more than one reading was made at that depth (numbers refer to reading numbers in table 4).

Figure 5.--Drift correction curve for BH-6 in borehole RRL-6B; lat 46°31'59.1" N., long 119°40'52.2" W., Hanford Site, Benton County, Washington.



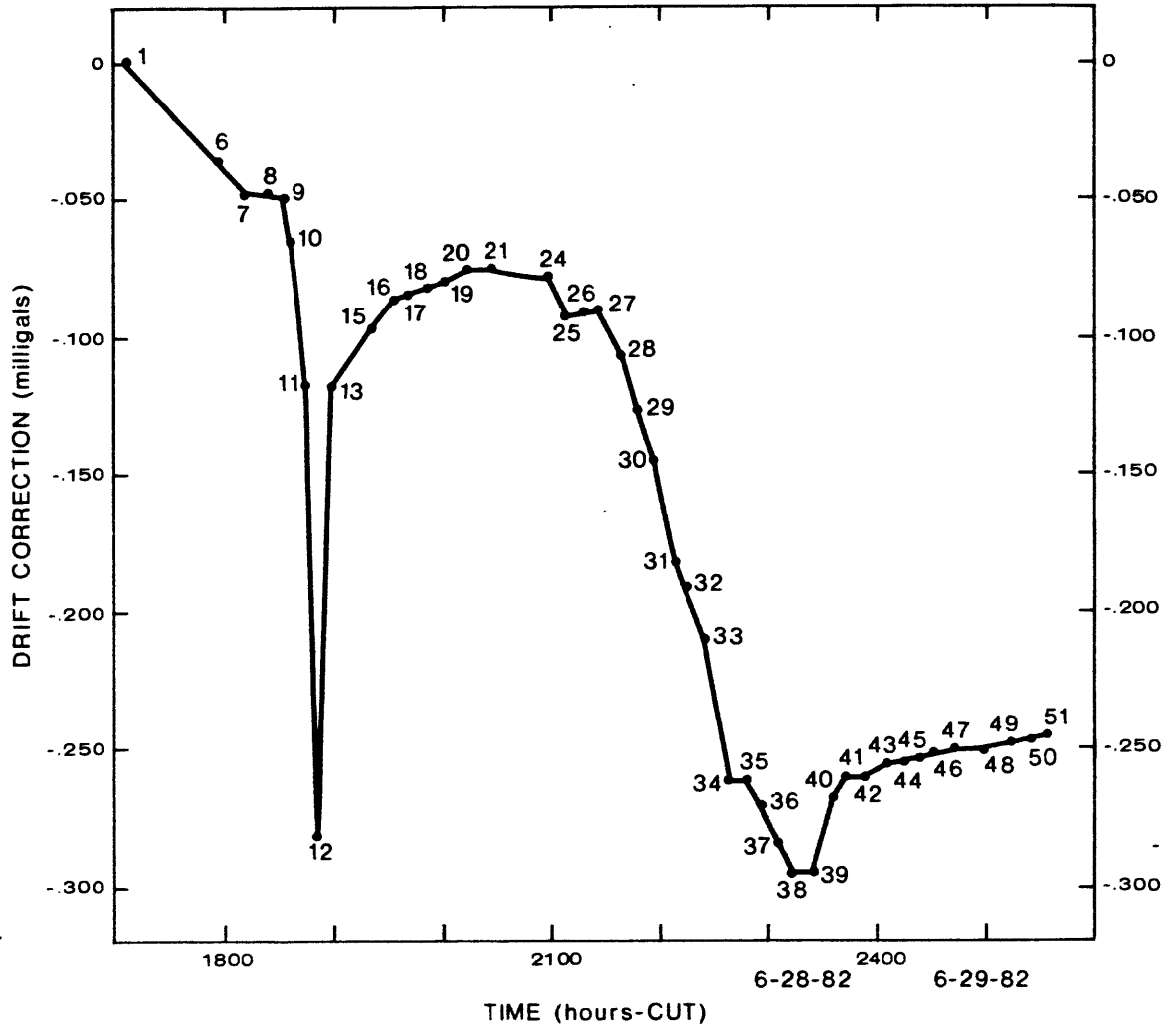
• Drift correction used at particular reading when more than one reading was made at that depth (numbers refer to reading numbers in table 5).

Figure 6.--Drift correction curve for BH-6 in borehole RRL-7; lat 46°34'1.3" N., long 119°39'47.1 W., Hanford Site, Benton County, Washington.



• Drift correction used at particular reading when more than one reading was made at that depth (numbers refer to reading numbers in table 6).

Figure 7.--Drift correction curve for BH-6 in borehole RRL-8; lat 46°34'16.6" N., long 119°41'27.0" W., Hanford Site, Benton County, Washington.



Drift correction used at particular reading when more than one reading was made at that depth (numbers refer to reading numbers in table 7).

Figure 8.—Drift correction curve for BH-6 in borehole RRL-9; lat 46°33'1.6" N., long 119°38'43.6" W., Hanford Site, Benton County, Washington.

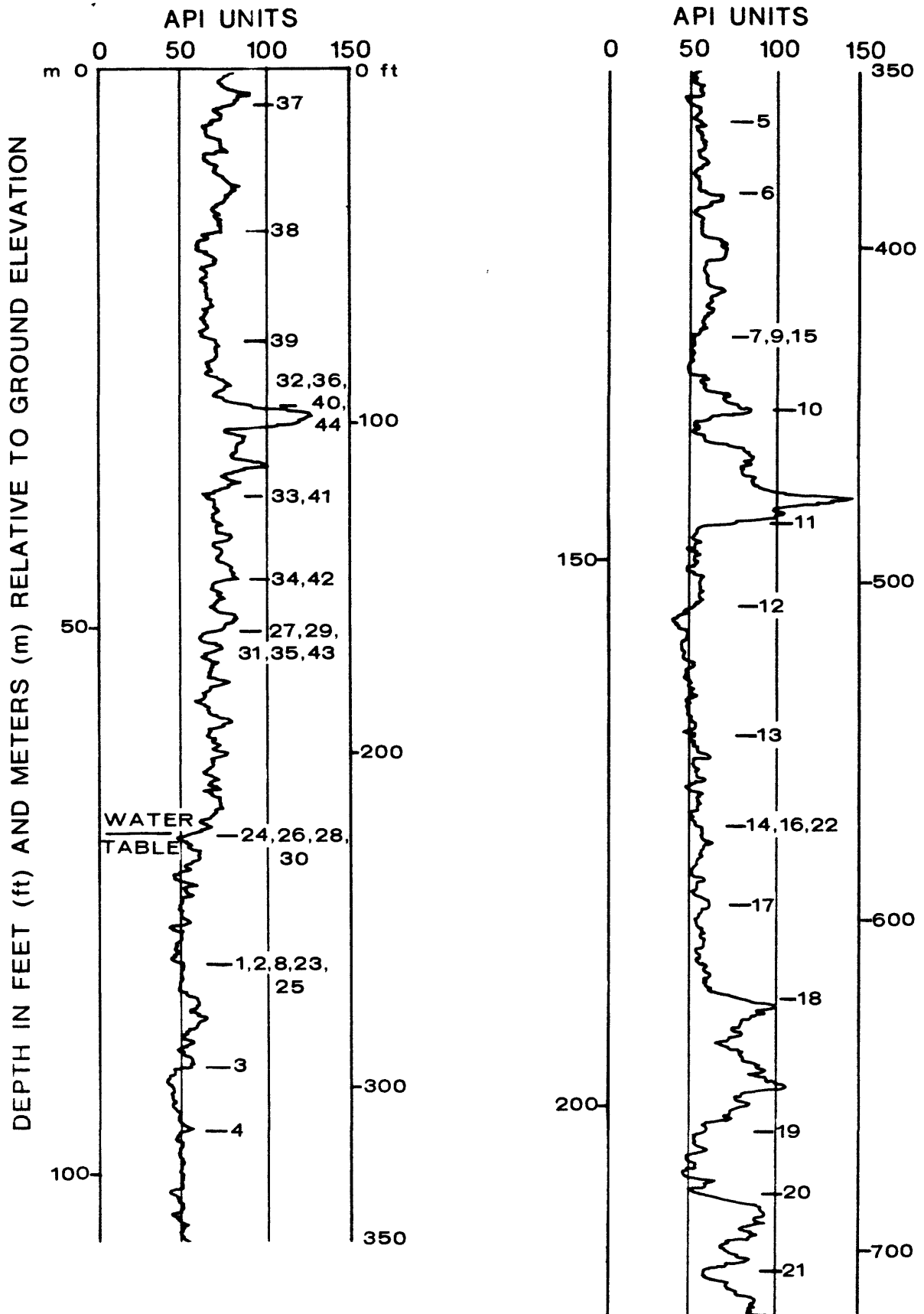


Figure 9.--Gamma-ray intensity log in API units from borehole RRL-3; lat 46°33'47.1" N., long 119°38'15.5 W., Hanford Site, Benton County, Washington. Numbers refer to BHGM reading numbers in table 1.

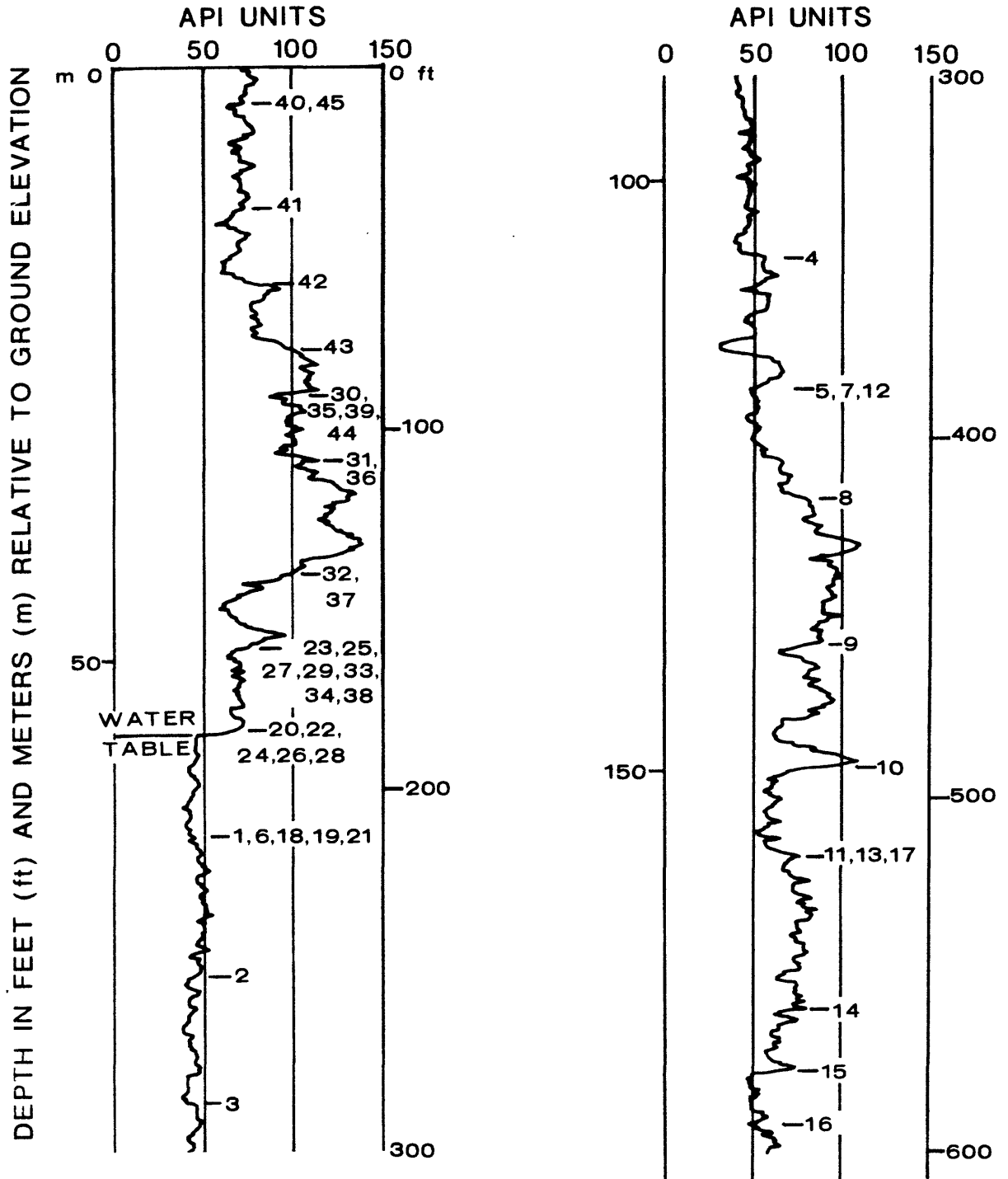


Figure 10.--Gamma-ray intensity log, in API units, from borehole RRL-4; lat 46°32'18.0" N., long 119°38'15.9" W., Hanford Site, Benton County, Washington. Numbers refer to BHGM reading numbers in table 2.

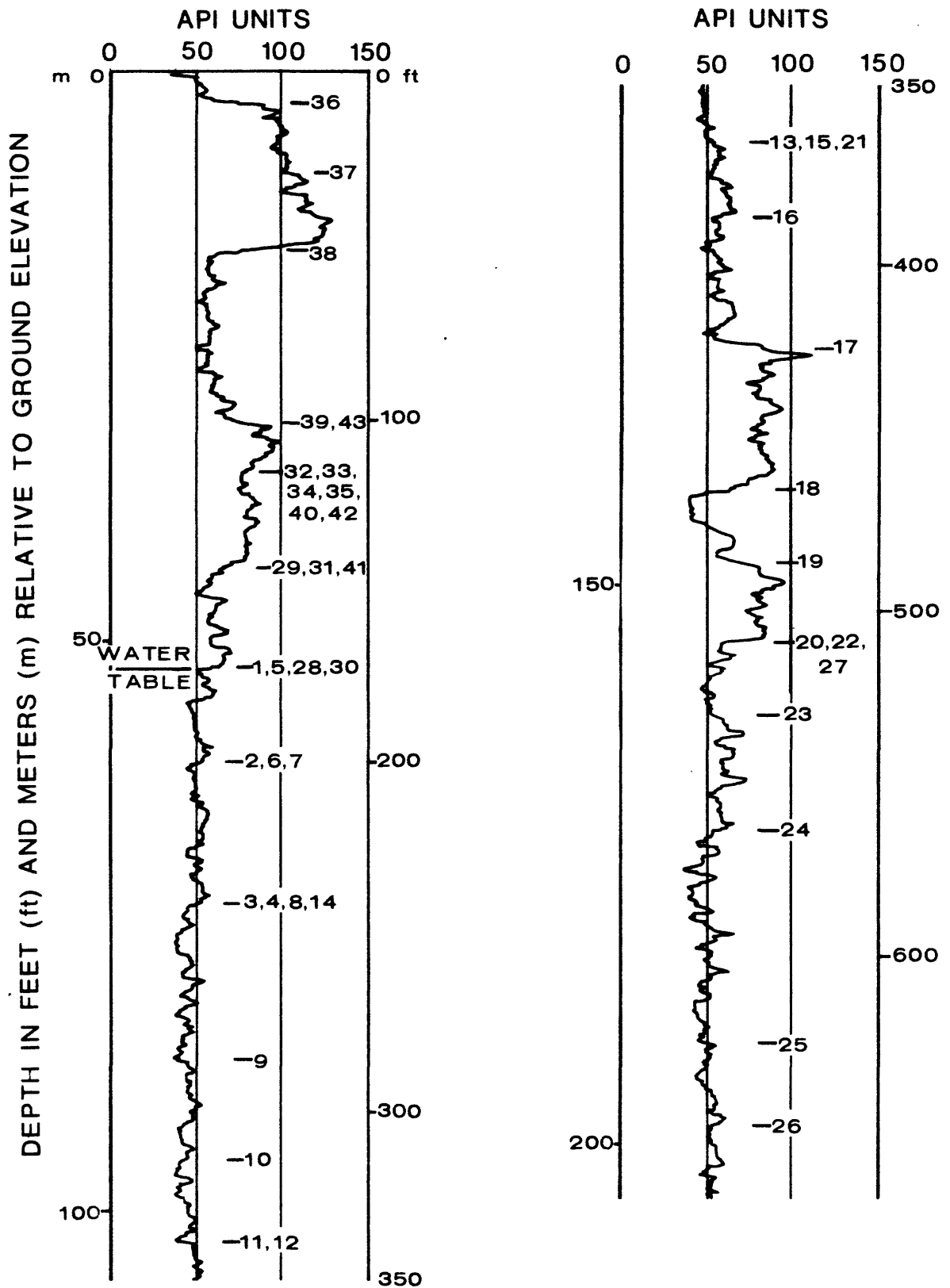


Figure 11.--Gamma-ray intensity log, in API units, from borehole RRL-5; lat 46°33'26.1" N., long 119°40'41.4" W., Hanford Site, Benton County, Washington. Numbers refer to BHGM reading numbers in table 3.

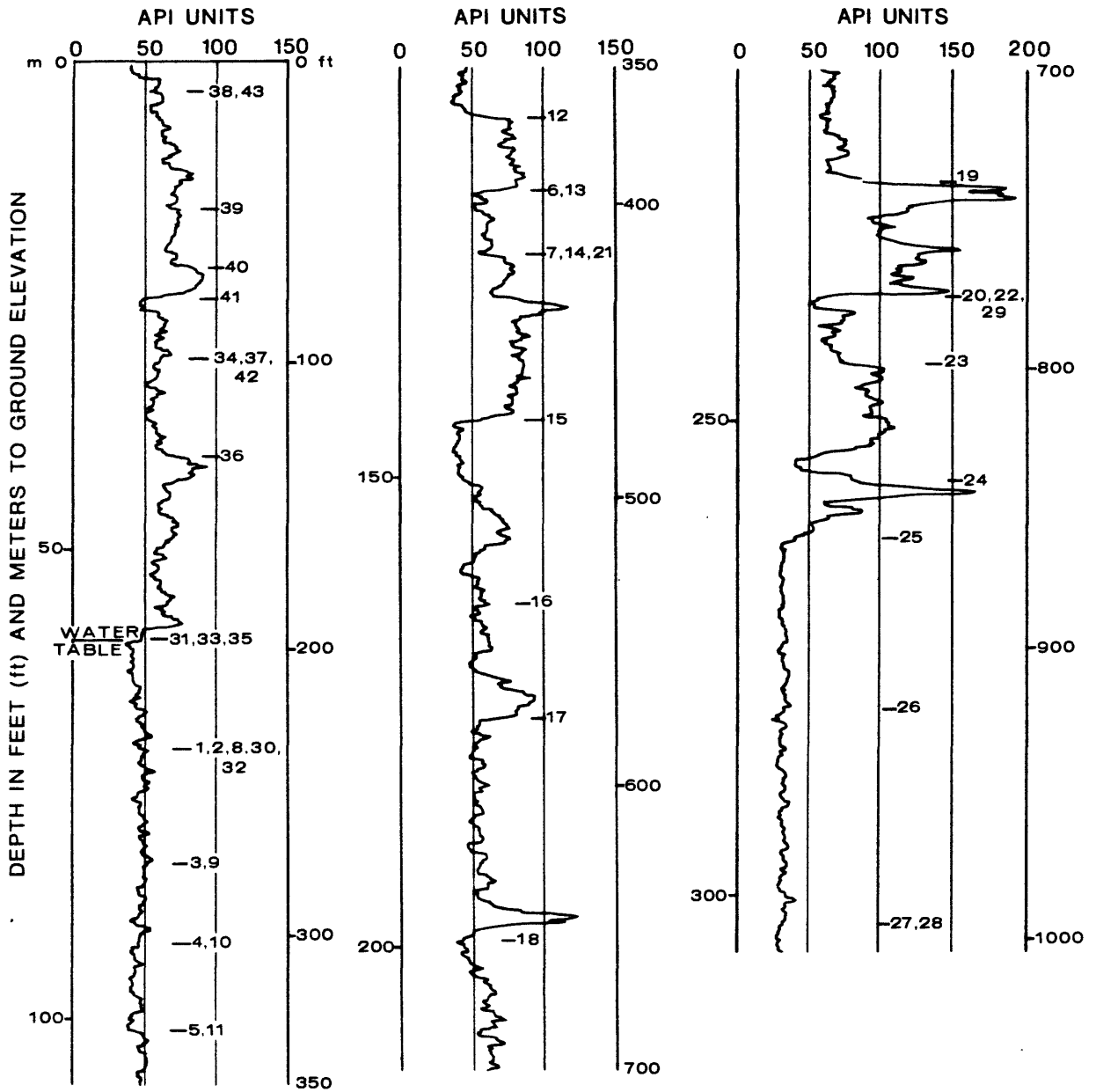


Figure 12.--Gamma-ray intensity log, in API units, from borehole RRL-6B; lat 46°31'59.1" N., long 119°40'52.2" W., Hanford Site, Benton County, Washington. Numbers refer to BHGM reading numbers in table 4.

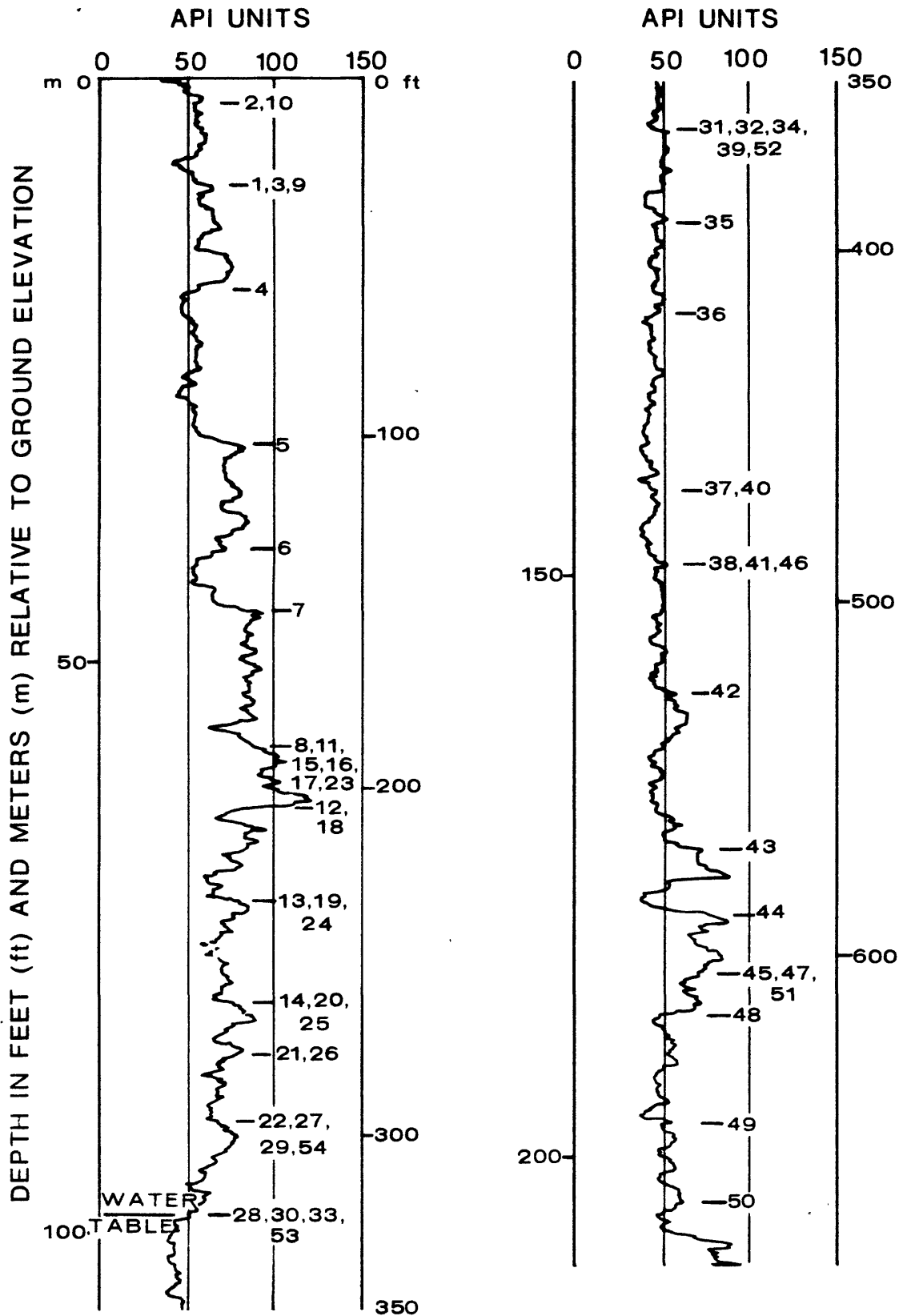


Figure 13.—Gamma-ray intensity log, in API units, from borehole RRL-7; lat $46^{\circ}34'1.3''$ N., long $119^{\circ}39'47.1''$ W., Hanford Site, Benton County, Washington. Numbers refer to BHGM reading numbers in table 5.

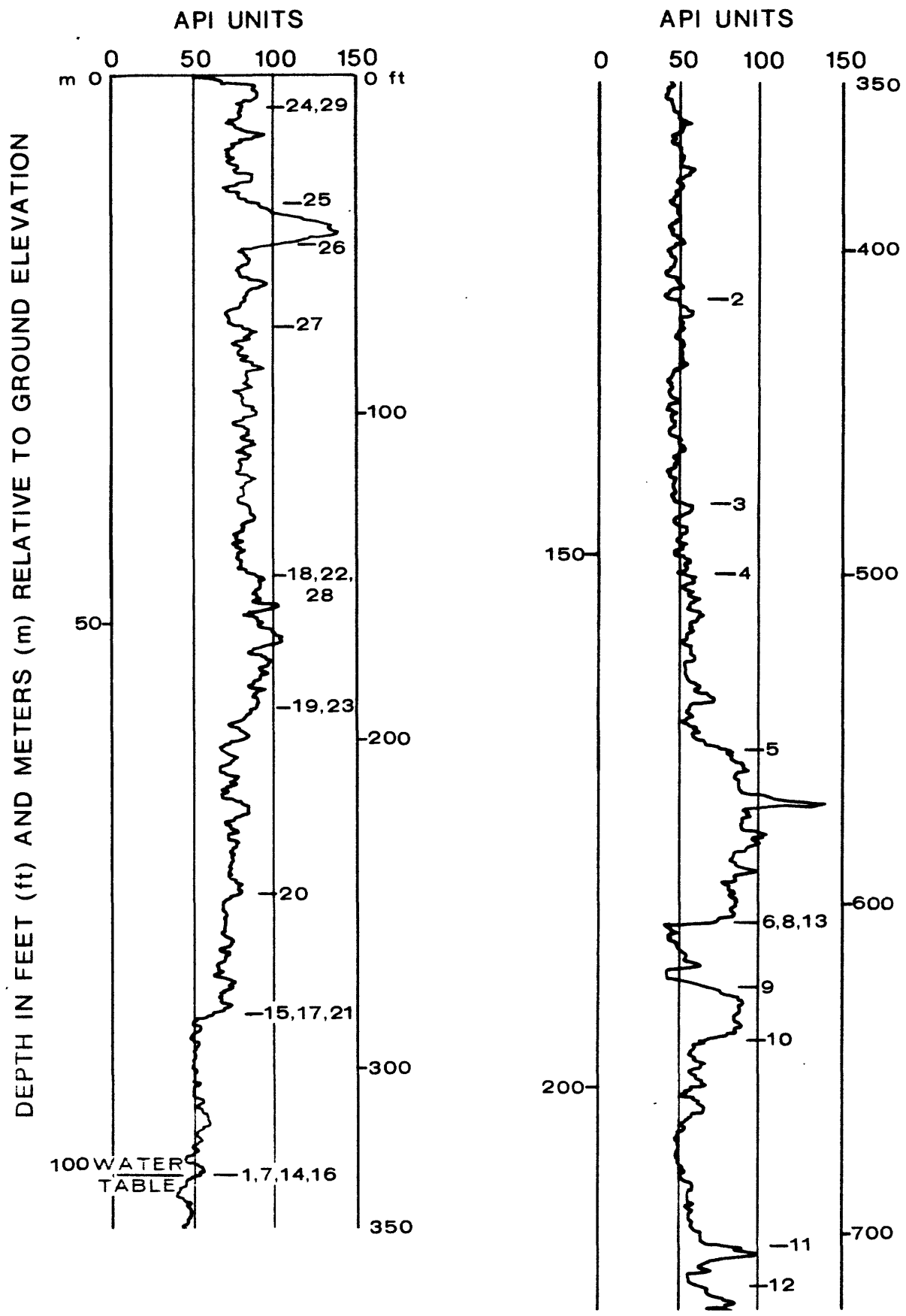


Figure 14.--Gamma-ray intensity log, in API units, from borehole RRL-8; lat 46°34'16.6" N., long 119°41'27.0" W., Hanford Site, Benton County, Washington. Numbers refer to BHGM reading numbers in table 6.

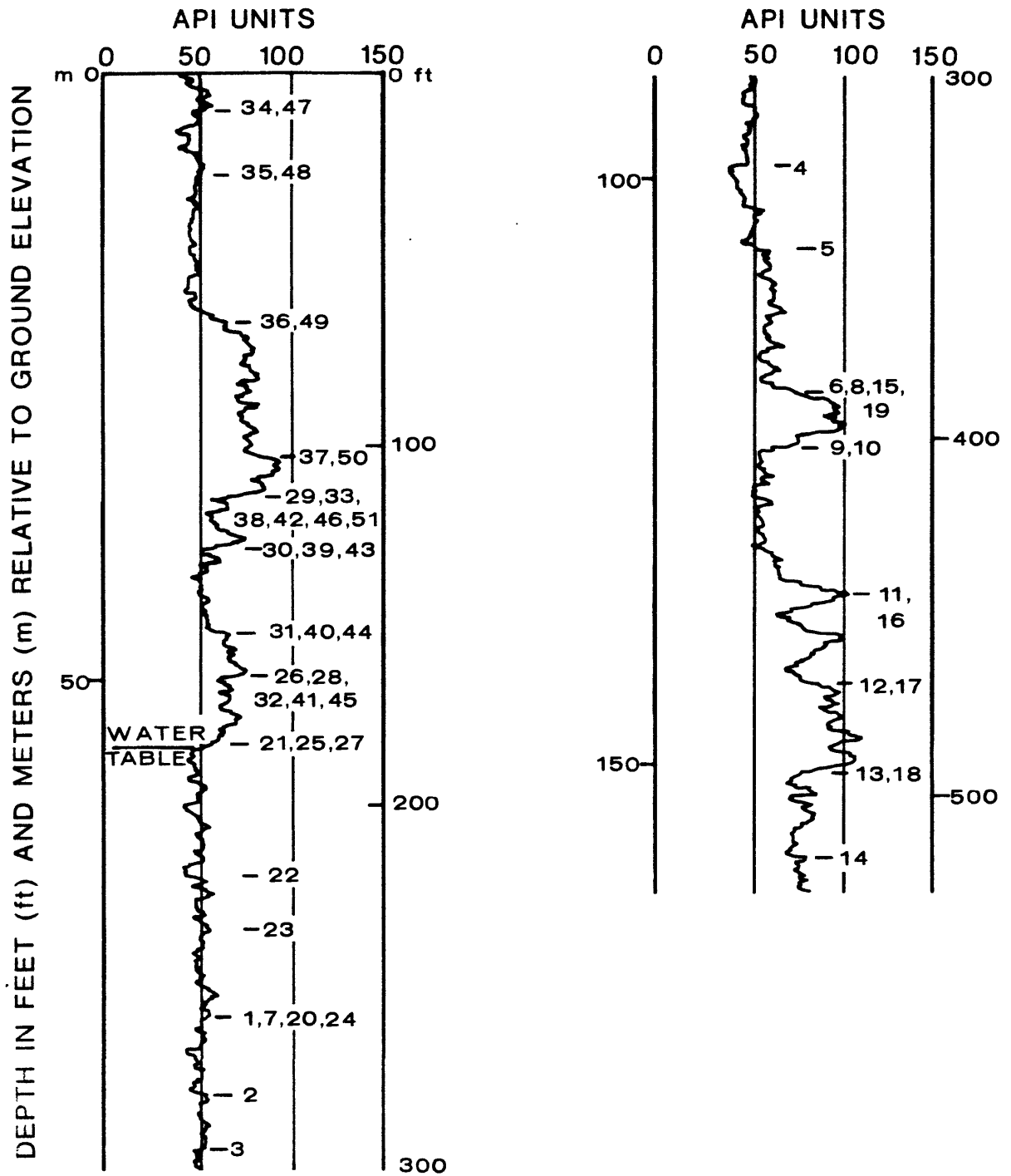


Figure 15.—Gamma-ray intensity log, in API units, from borehole RRL-9; lat $46^{\circ}33'1.6''$ N., long $119^{\circ}38'43.6''$ W., Hanford Site, Benton County, Washington. Numbers refer to BHGM reading numbers in table 7.

BOREHOLE GRAVITY METER INTERPRETATIVE SUMMARY

References to fundamentals of borehole gravity logging, data interpretation, and relationships between subsurface gravity measurements and mass distribution in the Earth can be found in Robbins (1980). In the absence of complicating factors (assuming near-horizontal beds), the in-situ bulk density (ρ_B , in g/cm^3) between two points in a borehole is given by:

$$\rho_B = \frac{F - \frac{\Delta G}{\Delta Z}}{0.02556} \quad (1)$$

where F is the free-air gradient of gravity in mgal/ft (Robbins, 1981), and $\frac{\Delta G}{\Delta Z}$ is the measured gradient of gravity between the two stations on a vertical line underground in mgal/ft.

Tables 8 through 14 present the calculated bulk densities, and the column headings are explained in the following list:

- Station depth: Point in borehole in feet (ft), at which the BHGM was read one or more times. The points are in descending order relative to the ground surface at the borehole.
- Interval (ΔZ): Vertical distance between the two adjacent station points in the borehole. Values are given in both feet (ft) and meters (m).
- ΔG : Gravity difference between the two adjacent stations in the borehole in milligals (mgal).
- $\rho(.09406)$: In-situ bulk density (in g/cm^3) as determined by equation (1) using the "normal" value of 0.09406 for F. This assumed value can vary from area to area and is probably on the high side when used for wells located within sediment-filled basins. Therefore, caution should be exercised in using these densities. If the actual value of F is lower than "normal," the computed densities will then have a DC shift and be too high. However, density differences (contrasts) between intervals will not be affected. Efforts are presently being made to determine the correct values of F at the boreholes in figure 1.

Error: The first value listed is the sum of the estimated errors (error column, tables 1 through 7) of the two adjacent stations in microgals (μgal). The second value is the equivalent error in g/cm^3 . The values in this column do not include any error associated with uncertainties in the drift curves or depth measurements. Schmoker (1978) found the accuracy of most measurements between two points to be about +10 μgals . The mean errors for the data in this report are about +6 μgals which are similar to the errors in three previous BHGM studies, including Robbins (1982; a total of 19 wells including this report). This suggests that 4 μgals for drift and depth uncertainties be added to the values in this column for a total error.

A stratigraphic section and unit depths for each borehole (as interpreted by B. N. Bjornstad, 1983, Rockwell Hanford Operations) are provided in tables 15 and 16. A comprehensive discussion of the geology of the area can be found in Myers and Price (1981).

Table 8.--Density Estimates for Borehole RRL-3, Hanford Site,
Benton County, Washington

[Located at lat 46° 33' 47.07" N., long 119° 38' 15.48" W.;
ground elevation 686.8 ft. (209.3 m)]

Station depth (ft)	Interval (ΔZ)		ΔG (mgal)	ρ (g/cm ³) for F= 0.09406 mgal/ft	Error	
	(ft)	(m)			$\pm G$ (μ gal)	$\pm \rho$ (g/cm ³)
7.2						
	38.0	11.58	1.697	1.933	± 5.5	± 0.005
45.2	32.0	9.75	1.330	2.054	± 5.5	± 0.007
77.2	19.0	5.79	0.886	1.856	± 6	± 0.012
96.2	26.0	7.92	1.309	1.710	± 5	± 0.008
122.2	27.0	8.23	1.057	2.148	± 5.5	± 0.008
149.2	15.0	4.57	0.521	2.321	± 6	± 0.015
164.2	61.0	18.59	2.226	2.252	± 6	± 0.004
225.2	37.9	11.55	1.192	2.449	± 5.5	± 0.005
263.1	30.9	9.42	1.024	2.383	± 5.5	± 0.007
294.0	19.1	5.82	0.609	2.433	± 5.5	± 0.011
313.1	49.0	14.94	1.594	2.407	± 6	± 0.005
362.1	22.0	6.71	0.774	2.304	± 8	± 0.015
384.1	41.0	12.50	1.375	2.368	± 7.5	± 0.007
425.1	24.0	7.32	0.831	2.325	± 7	± 0.011
449.1	33.0	10.06	1.296	2.143	± 6.5	± 0.008
482.1	24.0	7.32	0.804	2.369	± 5.5	± 0.009
506.1	37.0	11.28	0.963	2.662	± 5	± 0.006
543.1	28.0	8.53	0.605	2.835	± 5.5	± 0.008
571.1	25.0	7.62	0.500	2.897	± 7	± 0.010
596.1	28.0	8.53	0.566	2.889	± 7	± 0.010
624.1	40.0	12.19	1.687	2.030	± 5.5	± 0.005
664.1	19.0	5.79	0.834	1.963	± 4.5	± 0.010
683.1	22.0	6.71	0.972	1.951	± 4.5	± 0.008
705.1						

Table 9.--Density Estimates for Borehole RRL-4, Hanford Site,
Benton County, Washington
[Located at lat 46° 32' 17.95" N., long 119° 38' 15.94" W.;
ground elevation 658.7 ft. (200.8 m)]

Station depth (ft)	Interval (ΔZ)		ΔG (mgal)	ρ (g/cm ³) for F= 0.09406 mgal/ft	Error	
	(ft)	(m)			$\pm G$ (μ gal)	$\pm \rho$ (g/cm ³)
9.1	29.0	8.84	1.338	1.875	± 6.5	± 0.009
38.1	20.0	6.10	0.836	2.045	± 5.5	± 0.010
58.1	19.0	5.79	0.992	1.637	± 6	± 0.012
77.1	12.9	3.93	0.658	1.684	± 7	± 0.022
90.0	17.0	5.18	0.871	1.675	± 5	± 0.011
107.0	33.0	10.06	1.647	1.727	± 5.5	± 0.007
140.0	20.0	6.10	0.847	2.023	± 5.5	± 0.011
160.0	23.0	7.01	0.797	2.324	± 5.5	± 0.010
183.0	30.0	9.14	0.944	2.449	± 6.5	± 0.009
213.0	37.9	11.55	1.265	2.374	± 9.5	± 0.010
250.9	36.2	11.03	1.081	2.512	± 9	± 0.010
287.1	62.9	19.17	1.898	2.499	± 5.5	± 0.004
350.0	36.0	10.97	1.334	2.230	± 5	± 0.005
386.0	30.0	9.14	1.071	2.283	± 6.5	± 0.008
416.0	42.0	12.80	1.855	1.952	± 7	± 0.007
458.0	33.0	10.06	1.401	2.019	± 5.5	± 0.007
491.0	24.0	7.32	0.725	2.498	± 5	± 0.008
515.0	44.0	13.41	1.427	2.411	± 5	± 0.005
559.0	18.0	5.49	0.694	2.172	± 5.5	± 0.012
577.0	15.0	4.57	0.384	2.678	± 5.5	± 0.014
592.0						

Table 10.--Density Estimates for Borehole RRL-5, Hanford Site,
Benton County, Washington
[Located at lat $46^{\circ} 33' 26.09''$ N., long $119^{\circ} 40' 41.35''$ W.;
ground elevation 642.1 ft. (195.7 m)]

Station depth (ft)	Interval (ft)	(ΔZ) (m)	ΔG (mgal)	ρ (g/cm ³) for F= 0.09406 mgal/ft	Error $\pm G$ (μgal) $\pm \rho$ (g/cm ³)	
8.7	20.0	6.10	1.003	1.718	± 6	± 0.012
28.7	23.0	7.01	1.138	1.744	± 6.5	± 0.011
51.7	49.0	14.94	1.953	2.121	± 6.5	± 0.006
100.7	14.0	4.27	0.791	1.469	± 6	± 0.016
114.7	27.9	8.50	1.437	1.665	± 7	± 0.010
142.6	29.0	8.84	0.949	2.400	± 7	± 0.009
171.6	26.9	8.20	0.852	2.441	± 5	± 0.007
198.5	41.1	12.53	1.242	2.498	± 6	± 0.006
239.6	45.0	13.72	1.358	2.499	± 5	± 0.005
284.6	28.0	8.53	0.858	2.481	± 6	± 0.008
312.6	24.0	7.32	0.754	2.451	± 5.5	± 0.009
336.6	27.1	8.26	0.894	2.389	± 5.5	± 0.008
363.7	21.0	6.40	0.715	2.348	± 5.5	± 0.010
384.7	39.0	11.89	1.349	2.327	± 5	± 0.005
423.7	41.0	12.50	1.802	1.960	± 5	± 0.004
464.7	21.0	6.40	0.937	1.934	± 5.5	± 0.011
485.7	23.0	7.01	0.883	2.178	± 7	± 0.012
508.7	21.0	6.40	0.681	2.411	± 7	± 0.013
529.7	33.0	10.06	1.059	2.424	± 6	± 0.008
562.7	62.0	18.90	2.505	2.099	± 7	± 0.004
624.7	35.0	10.67	0.914	2.658	± 8	± 0.009
659.7						

Table 11.--Density Estimates for Borehole RRL-6B, Hanford Site,
Benton County, Washington
[Located at lat 46° 31' 59.14" N., long 119° 40' 52.24" W.;
ground elevation 644 ft. (196.3 m)]

Station depth (ft)	Interval (ft)	(ΔZ) (m)	ΔG (mgal)	ρ (g/cm ³) for F= 0.09406 mgal/ft	Error	
					$\pm G$ (μ gal)	$\pm \rho$ (g/cm ³)
6.4						
47.8	41.4	12.62	2.149	1.649	± 5.5	± 0.005
67.7	19.9	6.07	1.035	1.645	± 5.5	± 0.011
78.7	11.0	3.35	0.516	1.845	± 5.5	± 0.019
98.6	19.9	6.07	0.687	2.329	± 6	± 0.012
132.7	34.1	10.39	1.273	2.219	± 5.5	± 0.006
196.6	63.9	19.48	2.288	2.279	± 6	± 0.004
234.7	38.1	11.61	1.199	2.449	± 5	± 0.005
274.7	40.0	12.19	1.234	2.473	± 4.5	± 0.004
302.7	28.0	8.53	0.879	2.452	± 4.5	± 0.006
332.7	30.0	9.14	0.912	2.491	± 4.5	± 0.006
369.7	37.0	11.28	1.285	2.321	± 6	± 0.006
395.6	25.9	7.89	1.037	2.114	± 5.5	± 0.008
417.7	22.1	6.74	0.779	2.301	± 6	± 0.011
474.7	57.0	17.37	2.538	1.938	± 7	± 0.005
537.7	63.0	19.20	2.588	2.073	± 5	± 0.003
577.7	40.0	12.19	1.468	2.244	± 4.5	± 0.005
653.7	76.0	23.16	3.143	2.062	± 5	± 0.003
738.7	85.0	25.91	2.026	2.747	± 6.5	± 0.003
778.7	40.0	12.19	1.685	2.032	± 7.5	± 0.007
802.7	24.0	7.32	0.978	2.086	± 6.5	± 0.010
843.7	41.0	12.50	1.807	1.956	± 6.5	± 0.006
863.7	20.0	6.10	0.869	1.980	± 7.5	± 0.015
920.7	57.0	17.37	1.437	2.694	± 7	± 0.004
994.7	74.0	22.56	1.527	2.873	± 6	± 0.003

Table 12.--Density Estimates for Borehole RRL-7, Hanford Site,
Benton County, Washington
[Located at lat 46° 34' 1.31" N., long 119° 39' 47.08" W.;
ground elevation 791 ft. (241.1 m)]

Station depth (ft)	Interval (ΔZ)		ΔG (mgal)	ρ (g/cm ³) for F= 0.09406 mgal/ft	Error	
	(ft)	(m)			$\pm G$ (μ gal)	$\pm \rho$ (g/cm ³)
5.2						
	22.8	6.95	1.208	1.607	± 5.5	± 0.010
28.0	30.0	9.14	1.475	1.756	± 6	± 0.007
58.0	44.0	13.41	1.725	2.146	± 5.5	± 0.005
102.0	30.0	9.14	1.507	1.715	± 6.5	± 0.009
132.0	17.0	5.18	0.766	1.917	± 7.5	± 0.017
149.0	39.0	11.89	1.942	1.732	± 6	± 0.006
188.0	18.0	5.49	0.872	1.785	± 5.5	± 0.011
206.0	26.0	7.92	1.207	1.864	± 5.5	± 0.008
232.0	30.0	9.14	1.562	1.643	± 6	± 0.008
262.0	15.0	4.57	0.650	1.985	± 6	± 0.016
277.0	19.0	5.79	0.642	2.358	± 7.5	± 0.016
296.0	27.0	8.23	0.936	2.324	± 5	± 0.007
323.0	41.0	12.50	1.360	2.382	± 5.5	± 0.005
364.0	27.0	8.23	0.796	2.527	± 5.5	± 0.008
391.0	26.0	7.92	0.843	2.411	± 5.5	± 0.008
417.0	50.0	15.24	1.478	2.523	± 6	± 0.005
467.0	20.0	6.10	0.621	2.465	± 6	± 0.012
487.0	37.0	11.28	1.243	2.366	± 6	± 0.007
524.0	45.0	13.72	1.638	2.256	± 5.5	± 0.005
569.0	18.0	5.49	0.792	1.959	± 5.5	± 0.012
587.0	17.0	5.18	0.683	2.108	± 6	± 0.014
604.0	12.0	3.66	0.489	2.086	± 7.5	± 0.024
616.0	31.0	9.45	0.948	2.484	± 7.5	± 0.009
647.0	32.0	9.75	1.074	2.367	± 7.5	± 0.009
679.0						

Table 13.--Density Estimates for Borehole RRL-8, Hanford Site,
Benton County, Washington
[Located at lat 46° 34' 16.61" N., long 119° 41' 27.04" W.;
ground elevation 805.9 ft. (245.6 m)]

Station depth (ft)	Interval (ft)	(ΔZ) (m)	ΔG (mgal)	ρ (g/cm ³) for F= 0.09406 mgal/ft	Error	
					$\pm G$ (μ gal)	$\pm \rho$ (g/cm ³)
7.1	30.5	9.30	1.281	2.037	± 7.5	± 0.010
37.6	13.0	3.96	0.608	1.850	± 8	± 0.024
50.6	23.0	7.01	1.078	1.846	± 5.5	± 0.010
73.6	76.0	23.16	3.816	1.716	± 5.5	± 0.002
149.6	41.0	12.50	2.140	1.638	± 7	± 0.007
190.6	57.0	17.37	2.921	1.675	± 6	± 0.004
247.6	36.0	10.97	1.390	2.169	± 6.5	± 0.007
283.6	49.9	15.21	1.633	2.400	± 7.5	± 0.006
333.5	82.0	24.99	2.519	2.478	± 5.5	± 0.003
415.5	63.0	19.20	1.931	2.481	± 6	± 0.004
478.5	21.0	6.40	0.664	2.443	± 6	± 0.011
499.5	53.0	16.15	1.674	2.444	± 6	± 0.004
552.5	53.0	16.15	2.275	2.001	± 6	± 0.005
605.5	19.0	5.79	0.828	1.975	± 6	± 0.012
624.5	16.0	4.88	0.648	2.095	± 7	± 0.018
640.5	63.0	19.20	2.149	2.345	± 7.5	± 0.005
703.5	12.0	3.66	0.461	2.177	± 8.5	± 0.028

Table 14.--Density Estimates for Borehole RRL-9, Hanford Site,
Benton County, Washington
[Located at lat $46^{\circ} 33' 1.62''$ N., long $119^{\circ} 38' 43.61''$ W.;
ground elevation 655 ft. (199.6 m)]

Station depth (ft)	Interval (ft)	(ΔZ) (m)	ΔG (mgal)	ρ (g/cm ³) for F= 0.09406 mgal/ft	Error	
					$\pm G$ (μ gal)	$\pm \rho$ (g/cm ³)
8.4	18.0	5.49	0.713	2.130	± 6.5	± 0.014
26.4	40.0	12.19	1.473	2.239	± 6.5	± 0.006
66.4	37.0	11.28	1.964	1.603	± 8	± 0.008
103.4	11.0	3.35	0.542	1.752	± 6.5	± 0.023
114.4	14.0	4.27	0.641	1.889	± 5	± 0.014
128.4	24.0	7.32	1.014	2.027	± 5	± 0.008
152.4	12.0	3.66	0.451	2.210	± 6.5	± 0.022
164.4	18.9	5.76	0.611	2.415	± 6.5	± 0.013
183.3	35.0	10.67	1.137	2.409	± 5.5	± 0.006
218.3	16.0	4.88	0.494	2.472	± 6	± 0.015
234.3	23.9	7.28	0.839	2.307	± 5.5	± 0.009
258.2	20.8	6.34	0.644	2.469	± 8	± 0.015
279.0	15.0	4.57	0.461	2.478	± 7	± 0.019
294.0	31.0	9.45	0.944	2.489	± 6	± 0.008
325.0	23.0	7.01	0.786	2.343	± 8	± 0.014
348.0	38.0	11.58	1.357	2.283	± 8.5	± 0.009
386.0	16.1	4.91	0.688	2.008	± 6.5	± 0.016
402.1	41.0	12.50	1.380	2.363	± 6	± 0.006
443.1	24.0	7.32	1.047	1.973	± 5.5	± 0.009
467.1	26.0	7.92	1.063	2.080	± 5	± 0.007
493.1	22.0	6.71	0.676	2.478	± 6	± 0.010
515.1						

Table 15.--Stratigraphic Section and Unit Depths in Boreholes RRL-8, RRL-7, RRL-3, RRL-9, and RRL-4
Hanford Site, Benton County, Washington (from E. N. Bjornsted, 1983, written commun.)

[T.D. = bottom of BHGM survey]
[w.t. = water table]

Stratigraphic Units	Boreholes and depths				
	RRL-8	RRL-7	RRL-3	RRL-9	RRL-4
(Surface)					
Hanford Formation					
Upper Ringold	150 ft (46 m)	206 ft (63 m)	96 ft (29 m)	114 ft (35 m)	107 ft (33 m)
Middle Ringold	248 ft (75 m)	277 ft (84 m)	164 ft (49 m)	152 ft (46 m)	160 ft (49 m)
Conglomerate	~334 ft (102 m) w.t.	~323 ft (99 m) w.t.	~225 ft (69 m) w.t.	~183 ft (56 m) w.t.	~183 ft (56 m) w.t.
Lower Ringold	553 ft (168 m)	569 ft (173 m)	449 ft (137 m)	443 ft (135 m)	416 ft (127 m)
Basal Ringold	640 ft (195 m)	604 ft (184 m)	482 ft (147 m)	493 ft (150 m)	491 ft (150 m)
Conglomerate	716 ft (218 m) T.D.	679 ft (207 m) T.D.		515 ft (157 m) T.D.	
Elephant Mountain Basalt	741 ft (226 m)	707 ft (215 m)	506 ft (154 m)	547 ft (168 m)	577 ft (176 m)
Rattlesnake Ridge Interbed			624 ft (190 m)		592 ft (180 m) T.D.
Ponoma Basalt			705 ft (215 m) T.D.		642 ft (196 m)
			724 ft (221 m)		

Table 16.--Stratigraphic Section and Unit Depths in Boreholes RRL-7, RRL-5, and RRL-6B, Hanford Site, Benton County, Washington (from B.N. Bjornstad, 1983, written commun.)
[T.D. = bottom of BHGM survey]
[w.t. = water table]

Stratigraphic Units	Boreholes and depths		
	RRL-7	RRL-5	RRL-6B
(Surface)			
Hanford Formation			
Upper Ringold	206 ft (63 m)	52 ft (16 m)	79 ft (24 m)
Middle Ringold	277 ft (84 m)	143 ft (43 m) w.t.	133 ft (41 m)
Conglomerate	~323 ft (99 m) w.t.	~172 ft (52 m) w.t.	~197 ft (60 m) w.t.
Lower Ringold	569 ft (173 m)	424 ft (129 m)	418 ft (127 m)
Basal Ringold	604 ft (184 m)	509 ft (155 m)	538 ft (164 m)
Conglomerate	679 ft (207 m) T.D.		
Elephant Mountain Basalt	707 ft (215 m)	625 ft (190 m)	654 ft (199 m)
Rattlesnake Ridge Interbed		660 ft (201 m) T.D.	
Ponoma Basalt		701 ft (214 m)	739 ft (225 m)
			864 ft (263 m)
			995 ft (303 m) T.D.

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