N42237.AR.000275
NSB KINGS BAY
5090.3a

LETTER REGARDING CROOKED RIVER PLANTATION SUBDIVISION NSB KINGS BAY GA
5/23/1994
U S DEPARTMENT OF THE INTERIOR

31547.000
19.47.00.0002

[redacted]

United States Department of the Ir

GEOLOGICAL SURVEY
Water Resources Division
Peachtree Business Center, Suite 130
3039 Amwiler Road
Atlanta, Georgia 30360-2824

May 23, 1994

Mr. David Driggers
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive, P.O. Box 190010
North Charleston, SC 29419-9010

Dear David;

Ed Lohr of SOUTHDIV verbally requested earlier this year that the USGS make borehole geophysical logs at a 10-inch diameter well that is located at the Crooked River Plantation subdivision, across highway Spur 40 from the Kings Bay site 11. The work was completed May 4, 1994. Previous correspondence related to the work are: a USGS request to log the well, sent to the Rayland Company (the well owner) and dated February 11, 1994, and; the approval by Rayland Company, which was dated March 28, 1994. Copies of both letters were sent to you.

The 10-inch diameter well is located north of Plantation Drive entrance to the Crooked River Plantation subdivision, and is referred to here as the Rayland well. The well site is shown on maps in several ABB reports with the designation "approximate location of 10-inch well." The same reports show a second well site on the opposite side of Plantation Drive, at a distance of about 300 feet southeast of the Rayland well, with the designation "approximate location of 4-inch well." This second well is referred to here as the Gillette well.

The ABB Environmental Services (ABB) information on the Rayland well, as given on page 4-5 of the draft ABB report "Interim Corrective Measures Screening Investigation Report", dated February 1993, is that the well was drilled by Mr. Danny Meredith, cased to a depth of 280 feet below ground level, approximately 320 to 380 feet deep, and did not flow at the time the well valve was opened by ABB during a site visit.

The USGS information on the Rayland well, obtained from the developer of the subdivision and from personnel with Rayland Company, is that drilling was done by Mr. Joe Riley of South Georgia Pump Company of Brunswick, Georgia. The driller's log could not be located. The USGS geophysical logs show that the well has steel casing from ground level to a depth of 381 feet, and is open hole from depth 381 feet to 640 feet. The lower 158 feet is open to the Upper Floridan aquifer. A flow rate of 80 gallons per minute was measured volumetrically after the well had flowed continuously during about 4 hours of logging.

Geophysical logs recorded are caliper, focused resistivity (guard), long- and short-normal resistivity, gamma, and water temperature. Use of these logs enabled lithologic and stratigraphic interpretation, which was the primary reason for logging the well.

Attempts were made to run several other logging tools, including impeller-flowmeter, fluid resistivity, acoustic velocity, and acoustic televiewer. The attempts were unsuccessful due to considerable precipitate on the inside of the casing. The precipitate was a hard, black, mineral mixture that sloughed off during logging. Fragments of this precipitate found lodged in the impeller-flowmeter logging tool were as large as 2 inches in diameter and one-third inch thick. Hydrologic information from the well is limited, particularly regarding location of zones that contribute flow, because these logging tools could not be lowered below the casing.

Discussions with the owner of the Gillette well during the logging trip were useful in determining how water from the Gillette well is used to periodically supply water to Porcupine Lake. Use of the water for this purpose was briefly described in a USGS letter to you dated January 31, 1994. For various reasons, residents in the subdivision prefer that a specific lake level be maintained. The owner of the Gillette well uses the top of a fountain in the lake as a reference point for maintaining the level. When the level has dropped about 1 to 2 feet below the top of the fountain, well water is discharged into the lake until the level is again slightly above the top of the fountain.

According to the owner, water from the Gillette well was discharged to the lake three or four times last summer, and probably will be discharged to the lake again this summer. Water in the lake is sometimes, therefore, a mixture of water from the surficial aquifer and water from a deeper aquifer. The deeper aquifer is probably the Upper Floridan, based on the owner's reported well depth of 600 to 700 feet. Well depth could not be measured by the USGS because of well-head configuration.

Eleven plots of the geophysical logs from the Rayland well are in the enclosure, and are on letter-size paper for ease in viewing. Expanded depth-scale plots are given of data from the open-hole interval of the well, and of gamma-radiation data from the upper 200 feet of the well. More detailed, expanded plots can be supplied on request, as can the computer-stored digital data. Descriptions of the geophysical logs are also enclosed. The USGS hopes this information is useful to you. A copy of this letter and enclosures are included, in case you want to transmit it to ABB. A copy is also being sent to Rayland Company, as per our agreement with them before logging the well. If you have any questions, please let me know.

Sincerely,

Bud Zehner

Bud Zehner
Hydrologist

Enclosures

cc: Lieutenant Commander M. J. Patterson
Assistant Facilities and Environmental Officer
Naval Submarine Base
1063 Tennessee Avenue
Kings Bay, Georgia 31547-2606

Mr. Paul Sakalosky
Rayland Company, Inc.
501 Centre Street, P.O. Box 1188
Fernandina Beach, FL 32035-1188

Description of geophysical logs from Rayland well, located near Kings Bay submarine base, Georgia

The Rayland well is located at the Crooked River Plantation subdivision, across highway Spur 40 from the Kings Bay site 11. The well is 170 feet north of Plantation Drive, and 150 feet west of Spur 40, at latitude 30 degrees 48 minutes and 50 seconds North, and longitude 81 degrees 34 minutes and 22 seconds West.

All logging depths are referenced to the ground level directly below a flange on the top of the 10-inch diameter well casing. The elevation of the top of the flange is 30.54 feet, and the elevation of the ground level directly below the flange is 29.5 feet. The elevations are referenced to mean low water, and were obtained by leveling from a previously established mark on the locking flange of well 11-1 on the Kings Bay submarine base. This mark was established a year ago from a USGS leveling traverse made from Navy elevation marker PCM 11. Closure of the traverse from well 11-1 to the Rayland well was 0.01 foot.

Well-head attachments were made prior to logging, so that flow could be diverted from the working area. A 6-inch diameter, 5-foot high steel riser pipe was bolted to the flange of the 10-inch diameter casing. A 3-inch diameter outlet had been welded to the lower part of the riser pipe at a distance of 2.0 feet above ground level, and a gate valve and 3-inch diameter PVC pipe attached to the outlet. A hydraulic head of 12.15 feet above ground level was measured at the closed well by use of a manometer. The well was then opened at the gate valve and the cap on the riser pipe removed. Logging tools were lowered through the open top of the riser pipe, as flow was diverted through the gate valve into the PVC pipe.

The PVC pipe extended about 40 feet into a wooded area, where discharge flowed onto the ground and rapidly infiltrated the sandy soil. The discharge was measured volumetrically by use of two 30-gallon barrels and stop watch after the well had been flowing for about 4 hours, and was 80 gallons per minute. The end of the PVC pipe was at the top of the barrel at the time of measurement, which was about 2.5 feet above ground level. After completion of logging, the well was again closed by bolting the cap to the top of the riser pipe and closing the gate valve. The PVC pipe was removed.

A caliper log is a record of the inside diameter of the well. This log indicates casing depth and changes in open-borehole diameter that could be due to solution cavities in the rocks. The first of two caliper logs (left side of figure 1) was made at the beginning of logging operations. The small diameter (less than 7 inches) at the bottom of the first caliper log is common, and is due to slow opening of the caliper-tool arms because of mud accumulation in the well bottom.

The character of plots of caliper data from inside a well casing is normally as shown in figure 1 from ground level to the depth of 62 feet, which is almost a straight line of constant 10-inch diameter. The very irregular surface from 62 to 381 feet, which ranges from 7.5 to 10 inches in diameter, is due to an irregular, hard, black, mineral mixture precipitated on the casing. Fragments of the black precipitate that lodged in the impeller-flowmeter logging tool during later logging were as large as 2 inches in diameter and one-third inch thick.

The second caliper log (right side of figure 1) was made after logging operations were nearly complete, and shows decreases in diameter at several depths inside the casing due to sloughing of the precipitate during logging. Examples of decreased borehole diameter are at depths 210, 270, 350, and 370 feet. The sloughing and reduced borehole diameter prevented use of several logging tools that could have provided information on zones contributing flow to the well.

A resistivity log is a measure of the resistivity of the sediments and rocks open to a well. The logs made at the Rayland well are a "normal resistivity log" and a type of "focused resistivity log" that is referred to as a "guard" log. The electrode spacing on the normal resistivity tools is 16 inches for the short normal and 64 inches for the long normal. The electrode configuration of the normal resistivity log produces a sphere of current flow, and the 16-inch normal has the smaller sphere. The smaller sphere has higher resolution for thin beds, but has less penetration than the 64-inch normal. The guard-tool electrode configuration produces a sheet-like electric-current pattern, which has both high resolution (about 4 inches) and high penetration, and can thus indicate thin beds as well as thick beds.

The most useful resistivity log for indicating lithology at the Rayland well is the guard log (fig. 2). The normal resistivity log (fig. 3) is provided also. The high resistivity values in the interval from 481 feet to the bottom of the well indicate limestone beds in the Upper Floridan aquifer. Differences in resistance of strata in this interval are probably due to differences in purity of the limestone. The lower resistivity strata in the depth interval 381 to 481 feet are probably silt and clay beds of the upper confining unit. The low, nearly constant resistance from ground level to depth 381 feet is due to the steel well casing through this interval.

A gamma log is a record of gamma radiation from the sediments and rocks. Lower gamma count rates usually are found in sand, sandstone, and limestone, whereas higher gamma count rates are usually found in silt, clay, and shale. The particular advantage of the gamma log from a cased well is that the gamma rays penetrate the casing, enabling interpretation of the strata behind the casing. Most logging tools cannot measure characteristics through casing.

The low count rates on the gamma log (fig. 4) from depth 481 feet to the bottom of the well indicate limestone. This interval is interpreted to be the Upper Floridan aquifer. Strata above 481 feet, to the base of the surficial aquifer, are interpreted to be the upper confining unit. The generally lower gamma count rates above 70 feet are probably due to strata that are mostly sand. Several zones of higher count rates between 70 and 185 feet probably represent silty or clayey sand beds between cleaner sand beds. The position of the top of the upper confining unit is uncertain, but is probably at the top of one of the zones of higher count rates, within the depth interval 70 to 142 feet.

The water-temperature log (fig. 5) is a measure of the temperature of water in the well. Temperature changes may indicate zones that contribute flow. The log indicates that little or no flow enters the well from the bottom of the casing, at depth 381 feet, to the upper beds in the Upper Floridan aquifer at depth 495 feet. Zones that contribute most flow are probably in the depth intervals 495 to 535 feet, and about 580 feet to the bottom of the well, based on changes in temperature gradient. Specific zones contributing flow might have been located by use of impeller-flowmeter and acoustic-televiewer logs, but precipitate sloughing from the inside of the casing prevented use of these logging tools.

The complimentary character of the logs is shown by the composite of all logs obtained (fig. 6); that is, the combination of logs enables more certain interpretation than do the individual logs. The caliper and resistivity logs, and a shift to lower count rates on the gamma log, indicate the steel-cased interval from ground level to depth 381 feet. Use of the caliper log, alone, to determine casing depth might result in misinterpretation because of the precipitation on the casing below 62 feet. However, the resistivity logs clearly show constant, low resistivity due to casing below the 62-foot depth, down to 381 feet.

More use is made of the complimentary character of the logs, as follows. The very low gamma count rates and high resistivity below depth 481 feet indicate limestone of the Upper Floridan aquifer. The borehole-diameter increases shown on the caliper log, with corresponding resistivity decreases shown on the guard log, at depth intervals 422 to 428 feet, and 493 to 498 feet, may indicate solution cavities in the limestone. The higher count rates on the gamma log above depth 481 feet indicate the silty, clayey lithology of the upper confining bed, and the temperature log indicates that the part of the confining bed that is open to the well contributes little or no flow.

The most important borehole-geophyical data obtained from the Rayland well, as pertains to the site 11 study at Kings Bay, probably relate to the depth of the surficial aquifer. The plot of gamma radiation from the depth interval 0 to 200 feet (fig. 7) shows that the highest gamma count rates, which probably represent strata having highest silt and clay content, are in the depth interval 142 to 182 feet. The depth interval 102 to 118 feet evidently also has a high silt and clay content. The 118 to 142-foot-depth interval between the silty-clayey beds is probably mostly sand. Strata above depth 102 feet are interpreted to be mostly sand, with probable silty and clayey beds at 22 to 35 feet, 50 to 62 feet, and 70 to 78 feet.

Interpretation of the exact location of the bottom of the surficial aquifer from the borehole-geophyical data is judgemental, unlike the rather obvious interpretation related to the bottom of the upper confining bed. The location of the bottom of the surficial aquifer should be based not only on geophysical data, but also on hydrologic and, possibly, geochemical data.

The contact of the base of the upper confining bed and top of the Upper Floridan aquifer, at depth 481 feet in the Rayland well, is easily seen on more detailed (expanded depth scale) plots of the open part of the well. The detailed plots are expanded in the interval 350 to about 640 feet, from near the bottom of the casing to the bottom of the well, and are: guard resistivity (fig. 8), normal resistivity (fig. 9), and gamma (fig. 10). The detailed plot of water temperature (fig. 11) shows that most, or all, flow is from the Upper Floridan aquifer.

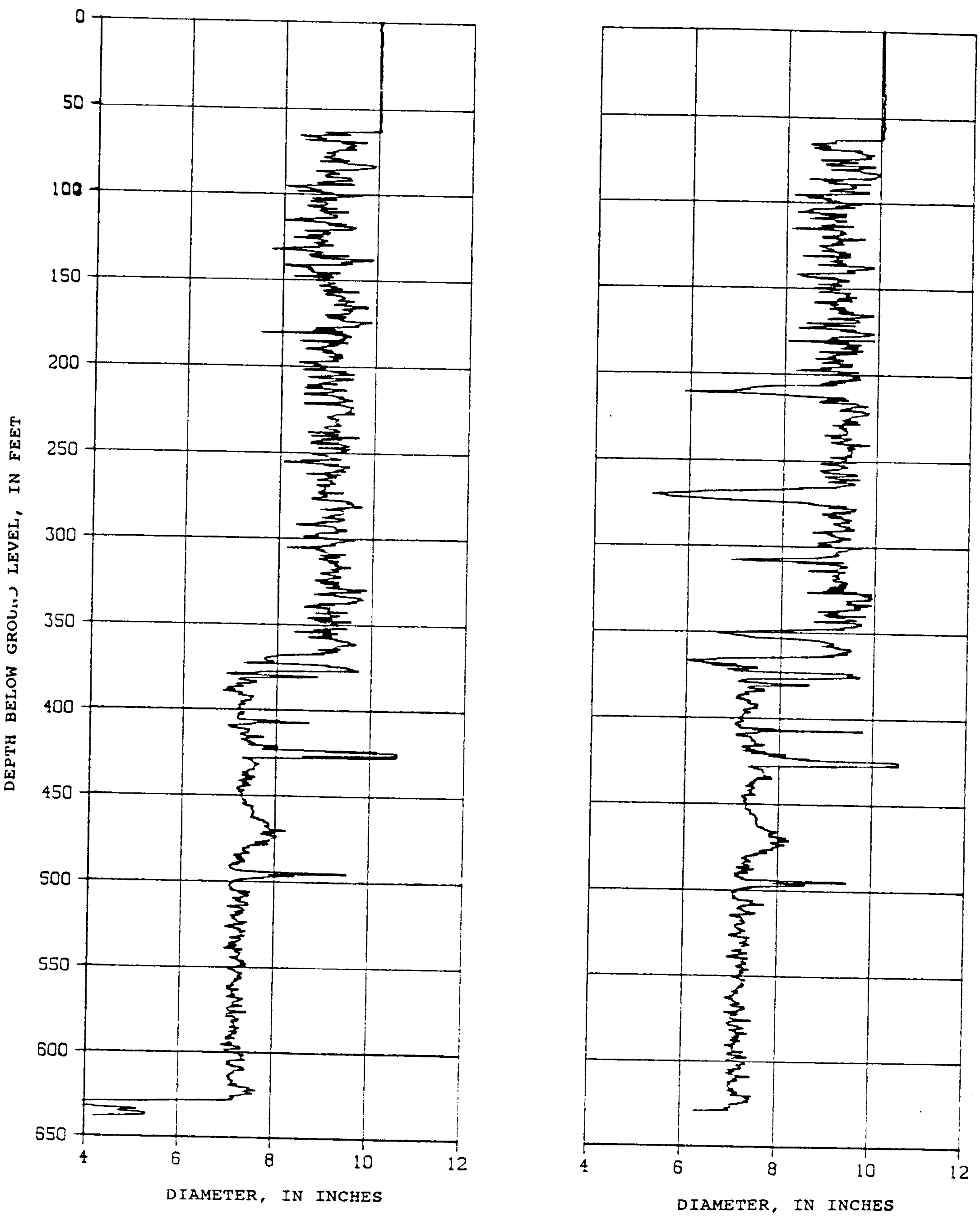

Figure 1. Caliper logs of Rayland well. Left log made at beginning of logging operations, right log made near end of logging operations.

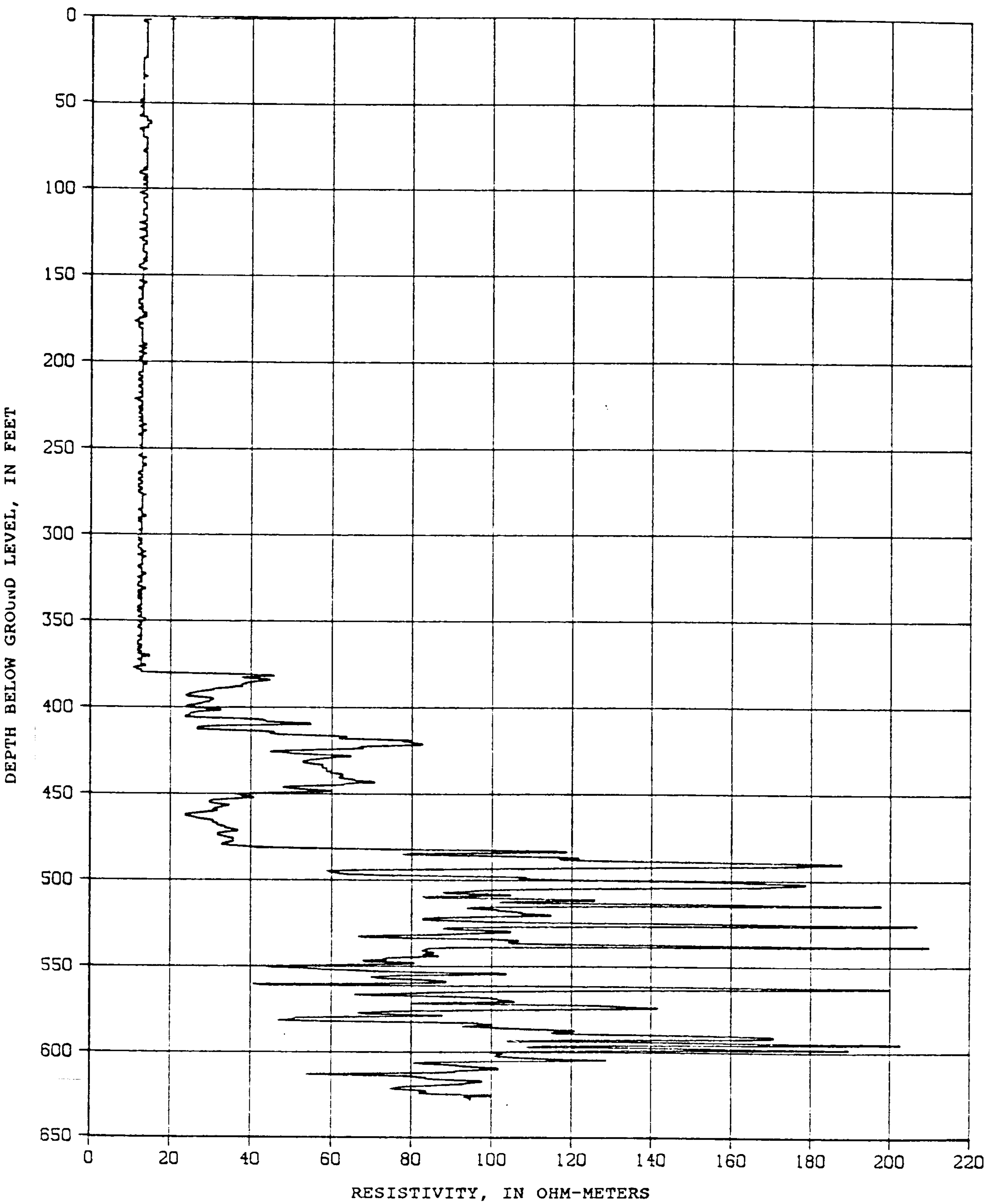

Figure 2. Focused-resistivity (guard) log of Rayland well.

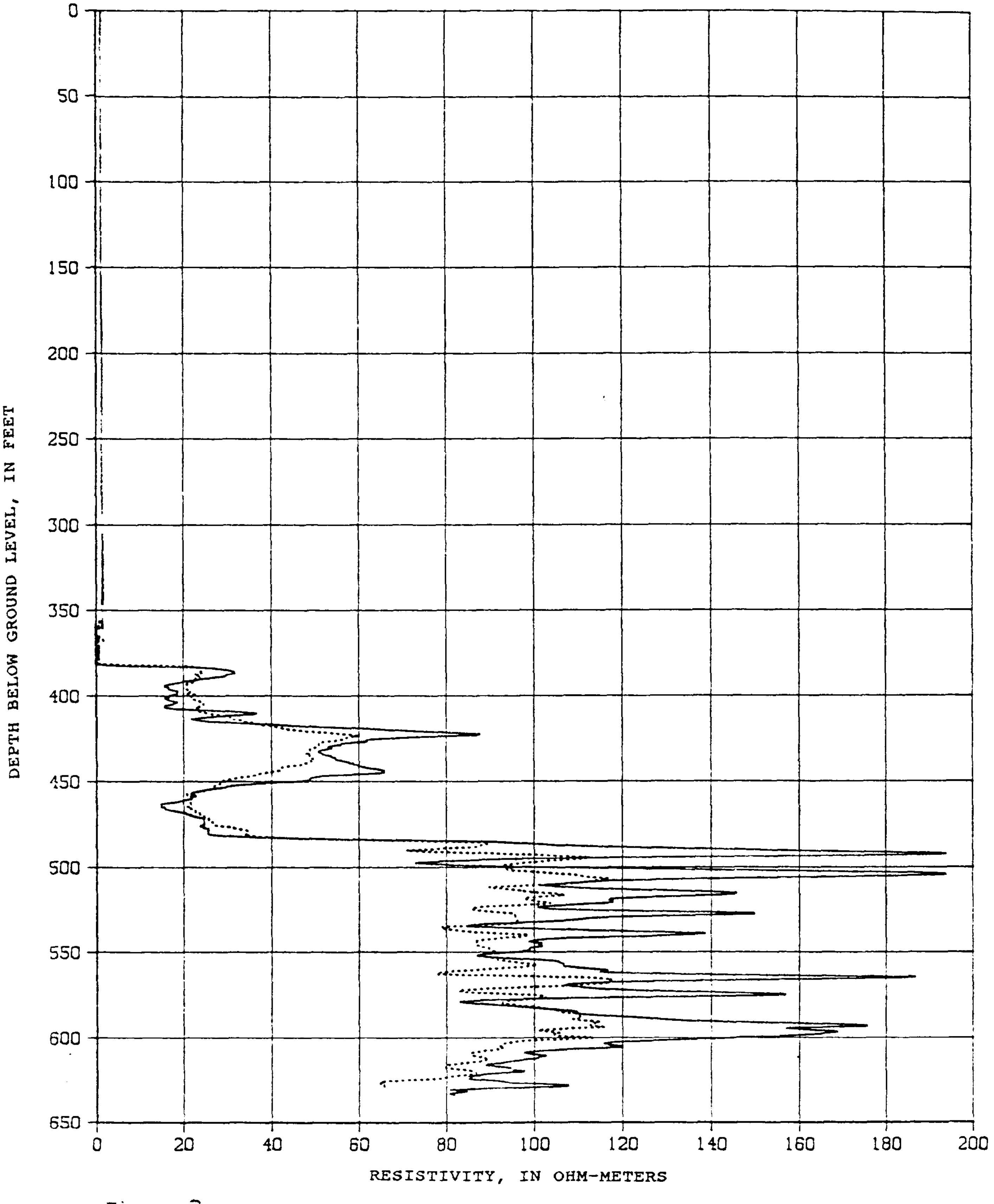

Figure 3. Normal-resistivity log of Rayland well. Solid line from 16-inch electrode spacing, dotted line (not plotted above depth 352 feet) from 64-inch electrode spacing.

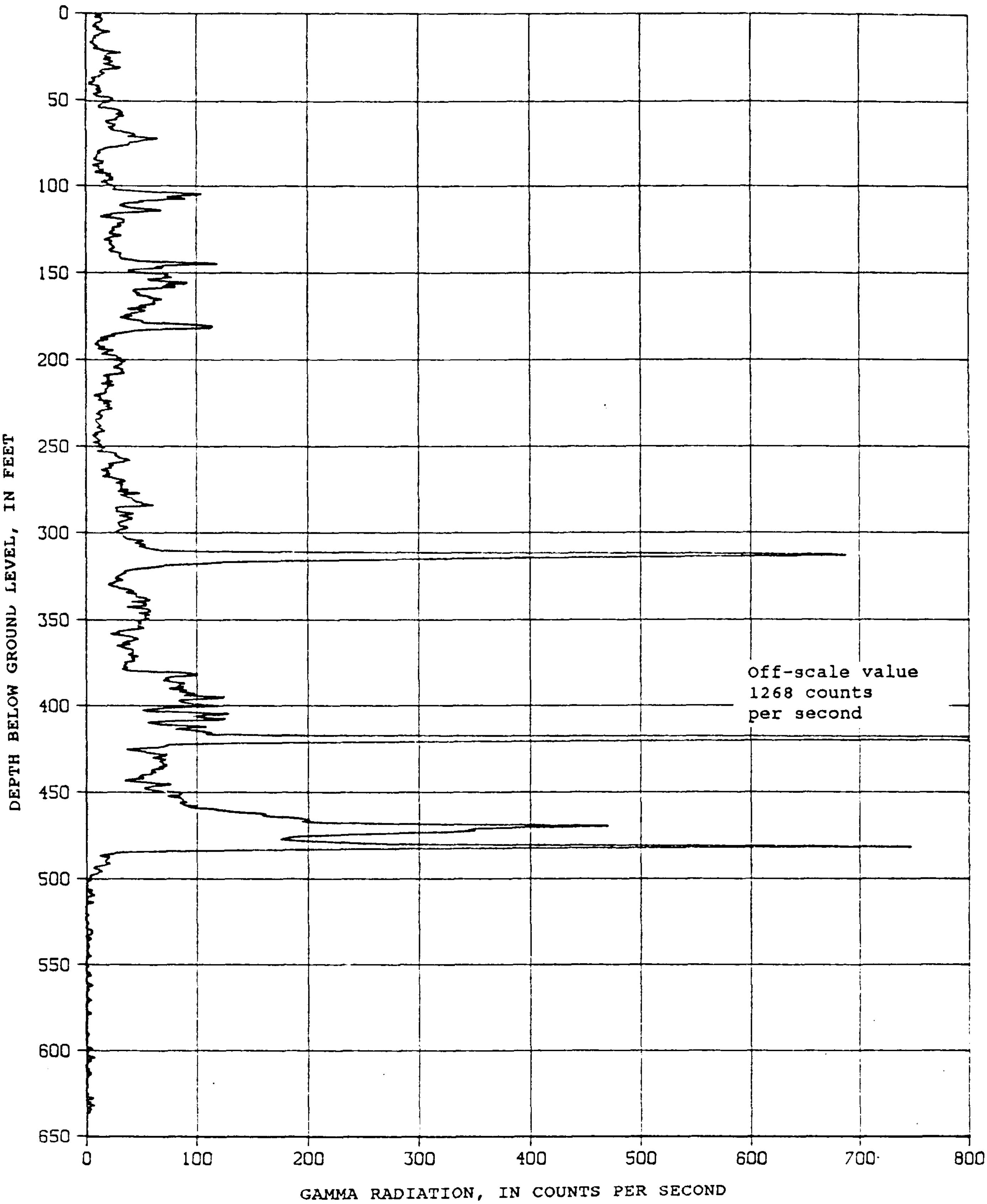

Figure 4. Gamma log of Rayland well.

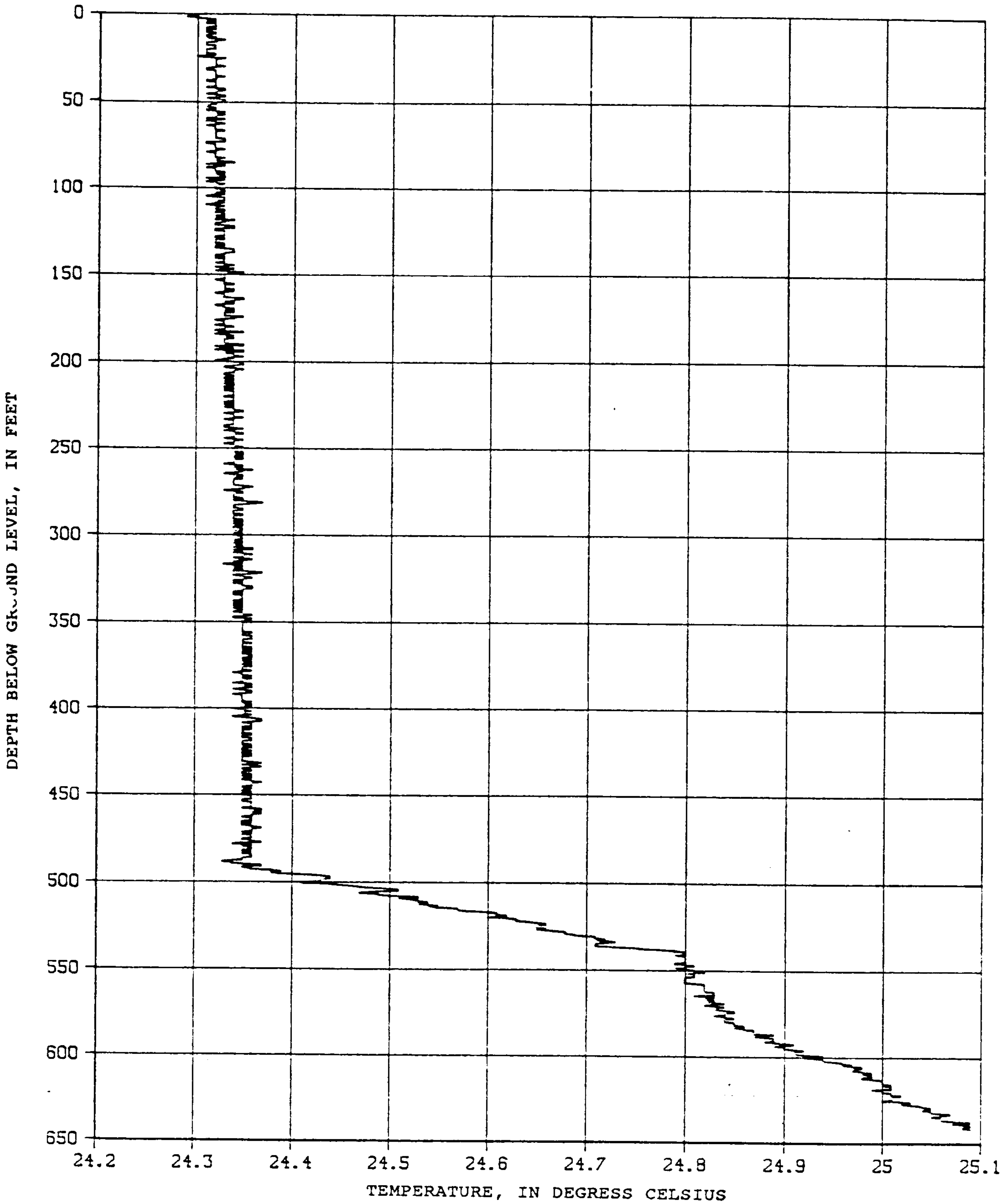

Figure 5. Water-temperature log of Rayland well.

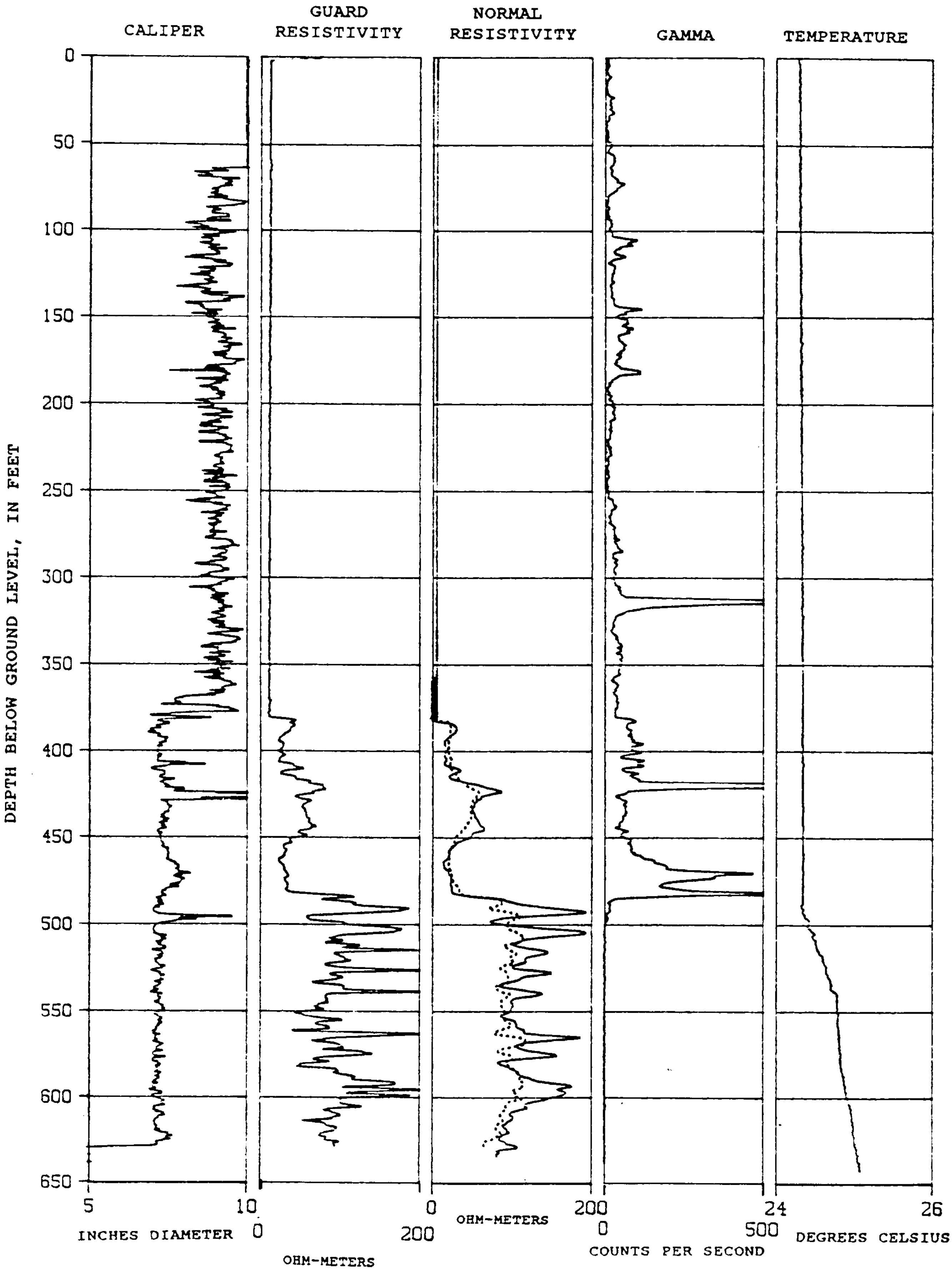

Figure 6. Logs of Rayland well; caliper (first log run), guard resistivity, normal resistivity, gamma radiation, and temperature. Normal resistivity plot has solid line from 16-inch electrode spacing, dotted line from 64-inch electrode spacing.

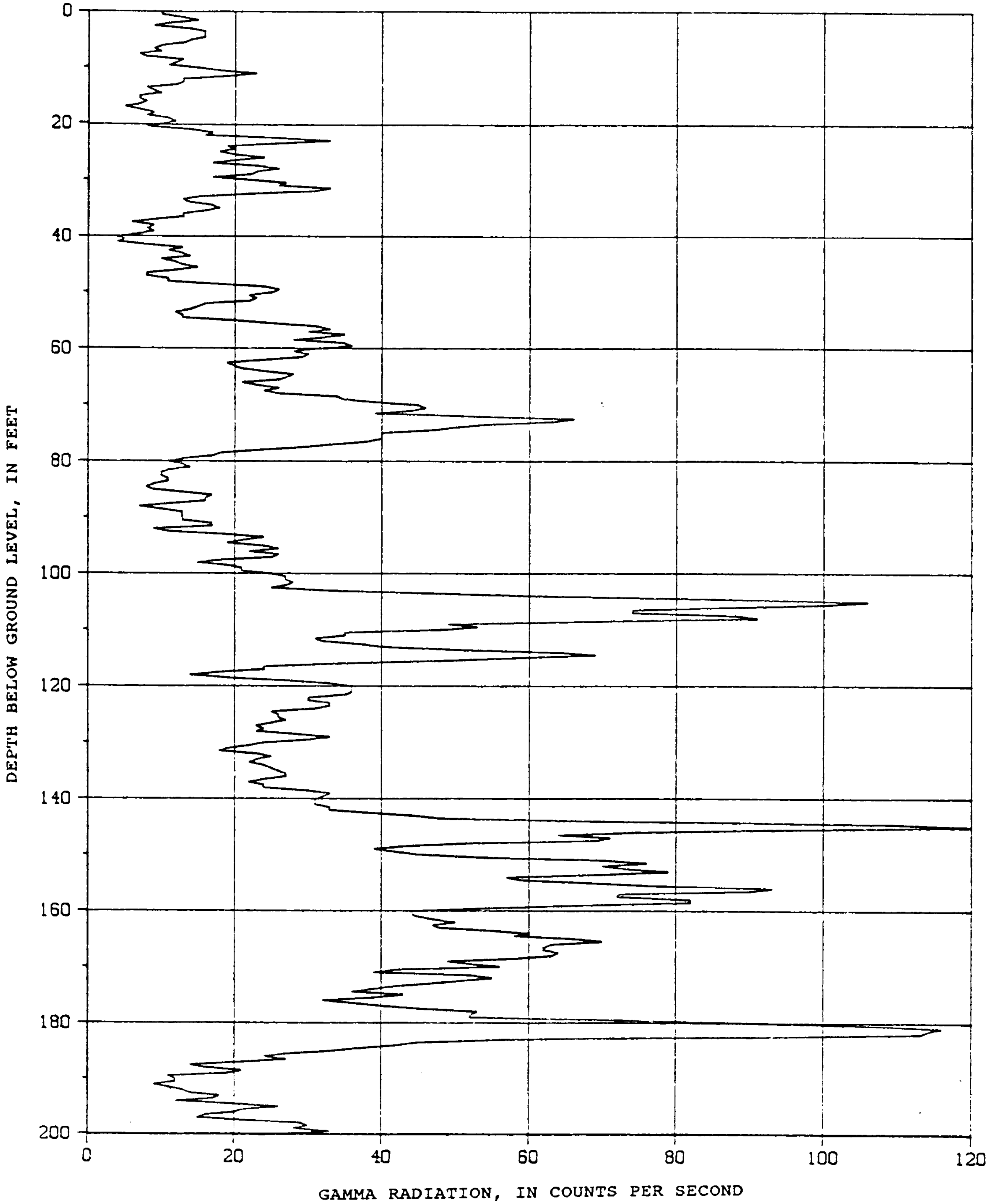

Figure 7. Gamma-radiation log of part of Rayland well from ground level to depth 200 feet.

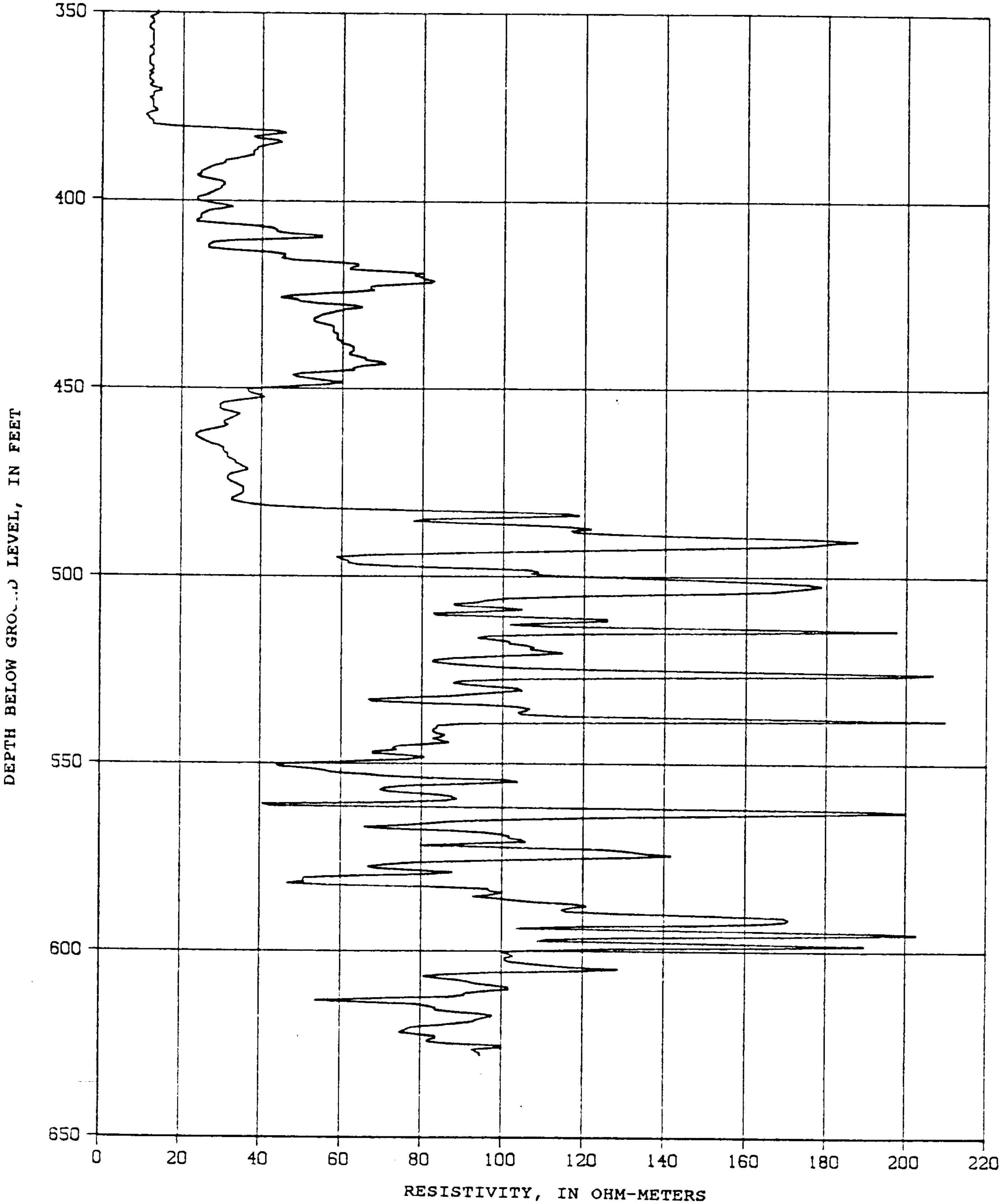

Figure 8. Guard-resistivity log of part of Rayland well from depth interval 350 to 628 feet.

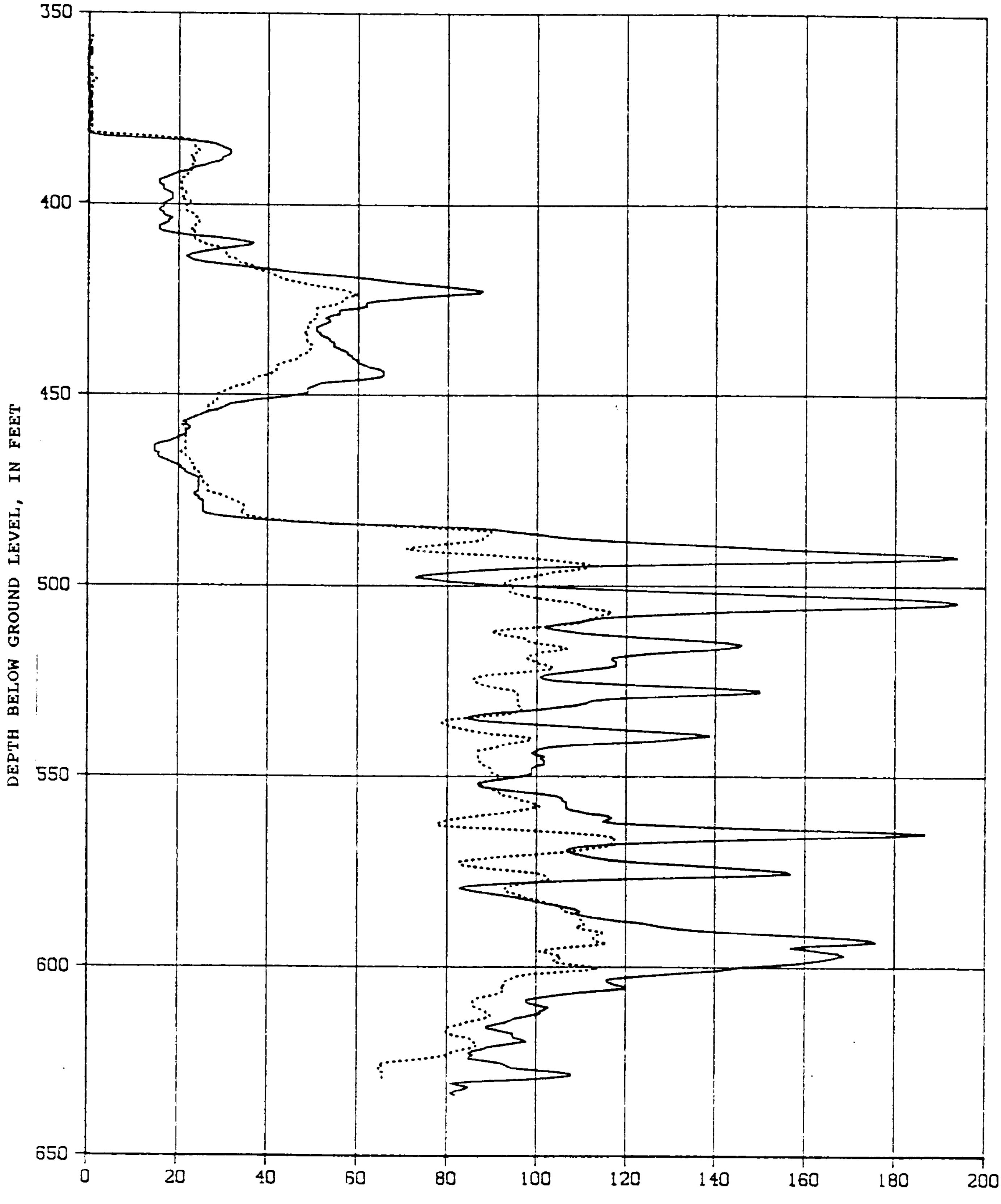

Figure 9. Normal-resistivity log of part of Rayland well from depth interval 350 to 631 feet. Solid line from 16-inch electrode spacing, dotted line from 64-inch electrode spacing.

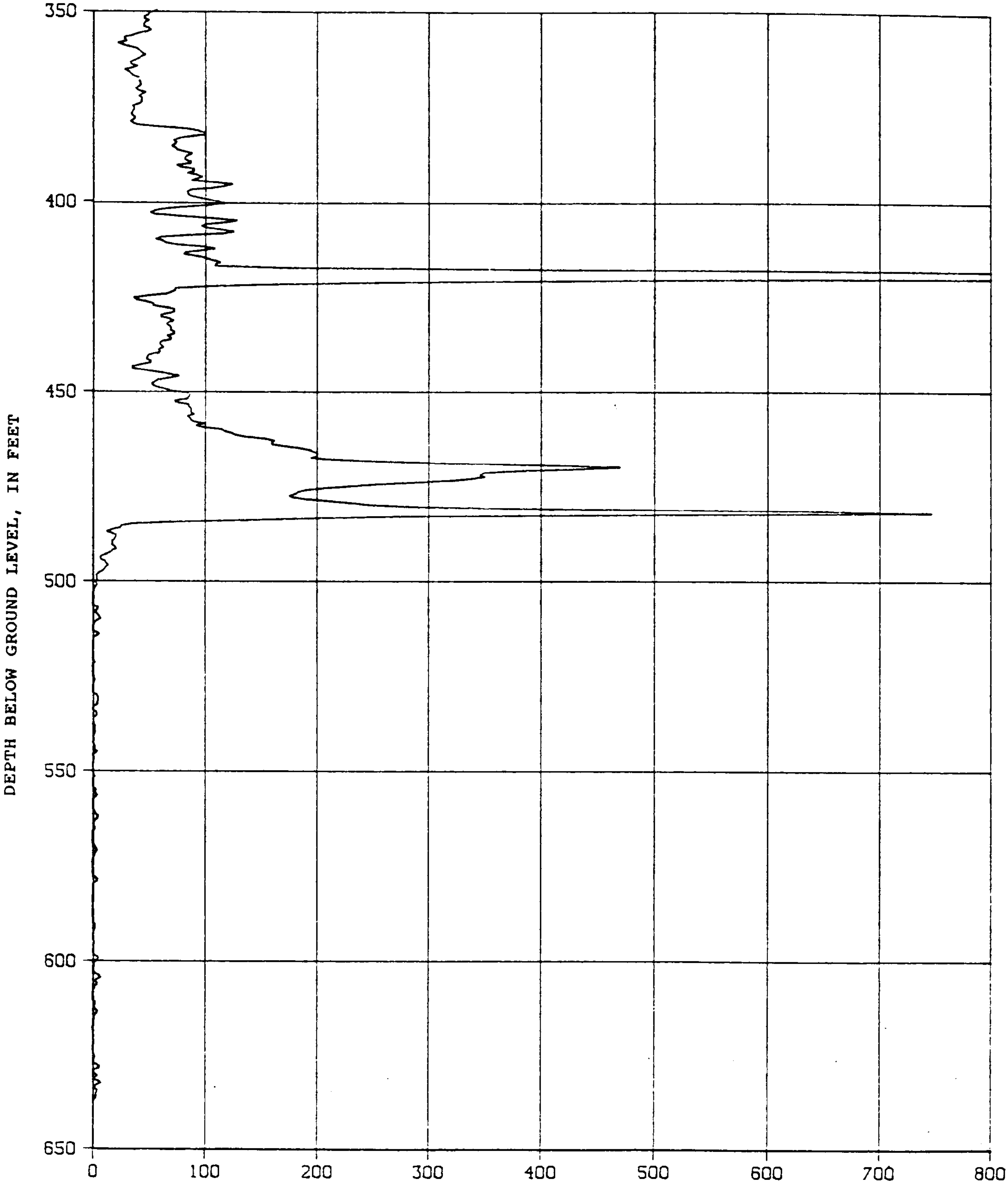

Figure 10. Gamma log of part of Rayland well from depth interval 350 to 635 feet.

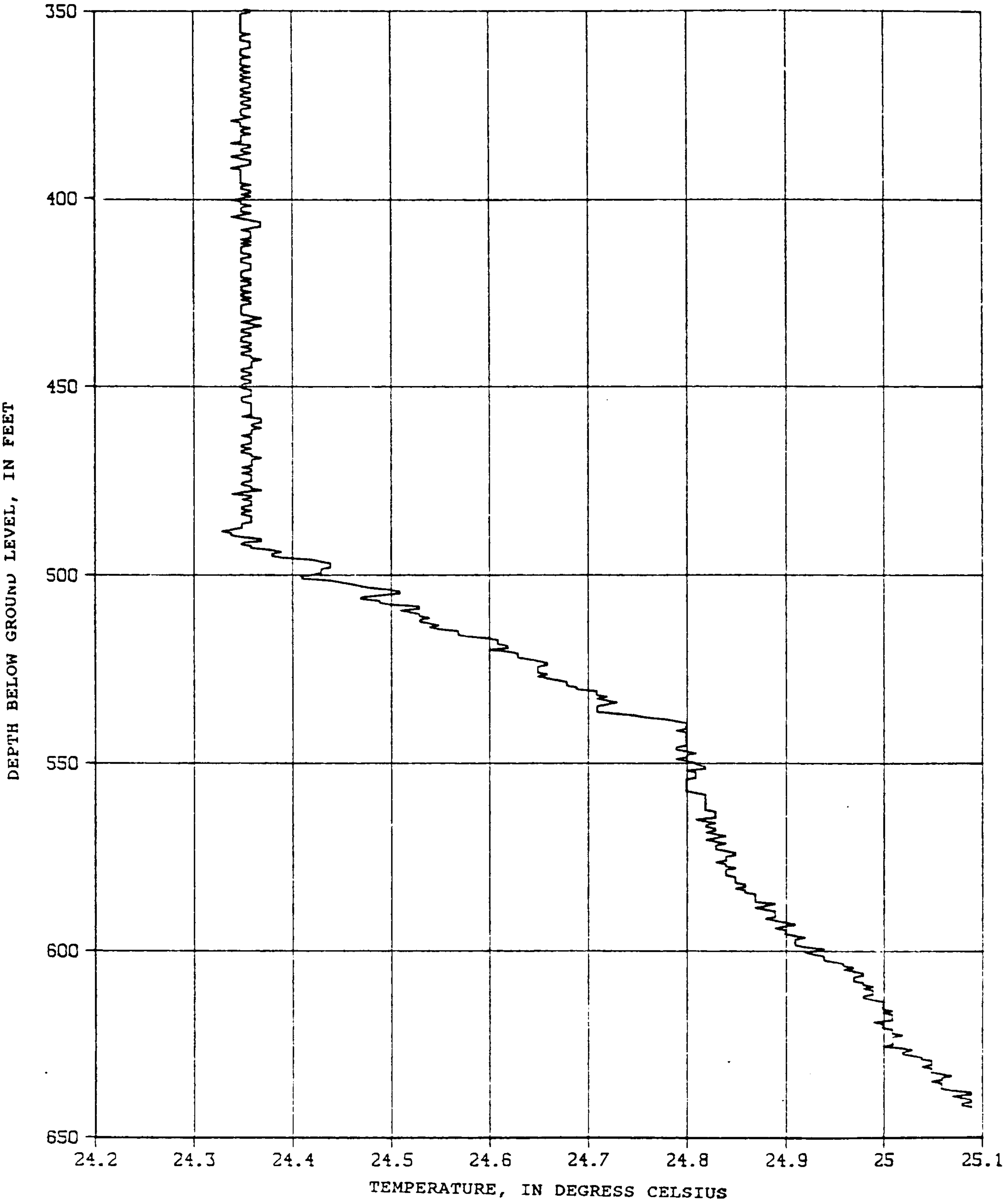

Figure 11. Water-temperature log of part of Rayland well from depth interval 350 to 640 feet.