RO-2 = SMRU_RO2

RO-1 = M-1359

FLORIDAN AQUIFER WELL COMPLETION REPORT FOR PRODUCTION WELLS RO-1 AND RO-2

SOUTH MARTIN REGIONAL UTILITY

MARTIN COUNTY, FLORIDA

Prepared for

Kimley Horn and Associates, Inc.
4431 Embarcadero Drive
West Palm Beach, Florida 33407

February, 2005

Prepared by
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2/16/05

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STATE OF FLORIDA PROFESSIONAL GEOLOGIST

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February 25, 2005

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ENV RES REGULATION

Ms. Krista Guerrero
MSC - 4320
South Florida Water Management District
3301 Gun Club Road
West Palm Beach, FL 33406

RE: **Floridan Aquifer Well Completion Report**

Dear Ms. Guerrero:

Please find enclosed one copy of the *Floridan Aquifer Well Completion Report*, prepared by James L. Andersen, P.G., of JLA Geosciences, Inc. This report summarizes the methods used to construct and test Wells RO-1 and RO-2, with a summary of conclusions and recommendations, as presented to South Martin Regional Utility.

Sincerely,

, For

Gene A. Rauth
Director of Utilities

Enclosure

pc: Donald R. Hubbs, P.E., Assistant Town Manager (w/o att.)
Kenneth B. Wilson, Assistant Director of Utilities (w/o att.)

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1.0 INTRODUCTION

This report documents the procedures, testing, as-built construction details and recommendations for Floridan Aquifer production wells RO-1 and RO-2 for the South Martin Regional Utility (SMRU). The project site is located in Hobe Sound, Martin County, Florida, in Sections 26 & 27, Township 39 South, Range 42 East, as indicated on Figure 1. The wells are located in the SMRU South System near the water treatment plant. The water plant lies between SE Dixie Highway and SE Federal Highway, approximately 3/4 mile south of Bridge Road. Well RO-1 is located at the Water Plant, just east of the storage tank. Well RO-2 is located off the east edge of SE Federal Highway. The locations are provided in Figure 2.

The wells will supply raw water to the future SMRU reverse osmosis water treatment facility that will be constructed on the same site as the existing South System Water Plant. The South Florida Water Management District (SFWMD) permitted construction of the wells as "test wells". SMRU currently withdraws water from the surficial aquifer by Consent Agreement with the SFWMD. SMRU is building the reverse osmosis plant to reduce dependency on the surficial aquifer.

2.0 WELL CONSTRUCTION AND TESTING

Kimley-Horn & Associates, Inc. (Kimley-Horn), and Stemle, Andersen and Associates, Inc. (SAA) prepared technical specifications and conducted onsite observation during construction, well development, and aquifer performance testing. This report was prepared to document the construction procedures and present lithologic and hydrologic data collected during drilling and testing of the wells.

Because of the unique topography at the South Plant with relic sand dunes rising over 50 feet above mean sea level, the wells were sited at elevations above the artesian water level. In most of South Florida, wells completed in the Floridan Aquifer free flow at land surface. This is because of the aquifer's static head of over 40 feet above mean sea level. The benefits of constructing a Floridan Aquifer well at an elevation above the static head include simpler construction, simpler wellhead design, a reduced potential for contamination of the surficial aquifer by wellhead leaks or catastrophic failure and lower well construction and maintenance costs. A drawback of the high elevation site is the requirement for a submersible pump to be installed in the well. Lower elevation well sites were considered in the well siting process however, because of the generally high elevation of the plant site vicinity, a submersible pump would be required at any of the other possible well locations.

The scope of the project included the following major categories:

- Design of the two Floridan Aquifer artesian wells and raw water main.
- Establish a development water outfall location; obtain permit(s) to discharge water.

- Construction of a temporary development water holding pond on the South Plant site.
- Installation of buried water main piping to transmit raw water from the wells to the south plant site.
- Installation of temporary piping to transmit development water to and from the temporary holding pond and to the outfall.
- Construction and testing of the wells.

The narrative of this report focuses on the construction and testing of the wells only. Wells RO-1 and RO-2 were constructed by Youngquist Brothers, Inc. (YBI) of Fort Myers, Florida. SAA and Kimley-Horn performed construction observation, development and testing. The methods and materials used by the drilling contractor were in accordance with 1) Technical specifications outlined in the Contract Documents, 2) the standards of the American Water Works Association for Deep Wells (AWWA A100-90) and the National Water Well Association, and 3) South Florida Water Management District and 4) Florida Department of Environmental Regulation rules and regulations.

Construction and testing of wells RO-1 and RO-2 began on August 21, 2000 and was completed on January 4, 2001. Drilling and casing depths are provided in Table 1. As-built schematic diagrams of the wells are provided as Figures 3 and 4. The drilling procedures used for the wells are described in the following sections.

2.1 Construction of Well RO-1

For RO-1, a nominal 36.5-inch diameter borehole was drilled to a depth of 245 feet below land surface (BLS) using the mud rotary method. The borehole was circulated to clear the cuttings from the mud and to prepare the hole for logging and setting of the surface casing. Florida Geophysical Logging Inc. conducted geophysical logging on the open hole as described in Section 2.1.6. The surface casing installed was 30-inch diameter, 0.375-inch thick steel pipe with factory-beveled ends. During installation, the ends were welded together, and steel centralizers were welded onto the casing at 40-foot intervals. Final depth of the casing installation was 239 feet below land surface (BLS). Upon completion of the casing installation, the annular space surrounding the casing was pressure grouted in a single stage-using API Class B Portland Cement, which was allowed to cure before drilling was resumed.

After drilling out the cement plug, a nominal 12-inch pilot hole was advanced from the base of the surface casing through the Hawthorn confining group to a depth of 1,010 feet BLS. The pilot hole was drilled using the mud rotary method and a 12 ¼-inch bit. Lithologic samples were collected during drilling from the circulating mud. A field lithologic log was maintained by SAA. Pilot hole drilling continued until suitable competent limestone was encountered near the top of the Floridan aquifer. After the pilot hole was completed, drilling fluid was circulated to clear the hole of cuttings, and to prepare the hole for logging. Florida Geophysical Logging, Inc. conducted geophysical logging of the pilot hole as described in Section 2.1.6.

Following logging, the pilot hole was reamed to 26-inches in diameter using the mud rotary method and a staged bit assembly consisting of a 12-inch diameter lead bit and a nominal 26-inch diameter reamer bit. To keep the reamed hole from deviating from the pilot hole, weight on the bit was kept to a minimum; with the drill string held plumb by the drill collars and bit assembly. After circulating the drilled cuttings and conditioning the drilling fluid, the drilling tools were removed and Florida Geophysical Logging, Inc. conducted logging on the 26-inch reamed hole, as described in Section 2.1.6. Logged depth of the reamed hole was 976 feet BLS.

The 18-inch diameter intermediate casing string was installed into the 24-inch diameter borehole to a depth of 970 feet BLS. The intermediate casing consisted of 0.375-inch steel pipe, with factory-beveled ends, which were arc-welded together during installation. The bottom of the 18-inch casing was set at 970 feet BLS. The top of the 18-inch casing string was completed at 219 feet BLS, rising into and overlapping the 30" surface casing by 20 feet. The intermediate casing was pressure-grouted using API Class B Portland cement. The initial grouting stage used 50 barrels (237 sacks) of neat cement for maximum strength near the base of the casing. The second lift used 253 barrels (645 sacks) of a 12% bentonite mixture. Grouting continued until the annular space between the 18-inch casing and the 24-inch borehole was completely filled with cement.

After the cement cured, drilling resumed using the reverse-air rotary method. Initially, fresh water was added to the well until sufficient formation water was produced to facilitate drill cuttings removal. A nominal 17-inch diameter borehole was drilled from the bottom of the 18-inch casing to a total depth of 1,495 feet BLS. Lithologic samples were collected during drilling, and Stemle, Andersen and Associates, Inc maintained a field lithologic log. Drill stem flow testing was conducted during drilling of the 17-inch borehole. Upon reaching the total depth, the driller cleared the borehole of drill cuttings. Florida Geophysical Logging, Inc. conducted the final suite of borehole geophysical logging as described in Section 2.1.6.

The final casing depth of 1,228 feet BLS was determined based on lithologic samples, water quality data, drill stem flow test results and geophysical logs. The primary objective was to select an interval within the Floridan aquifer with the best water quality and high permeability. The selected interval must have competent formation material to minimize erosion and the subsequent contribution of particulate matter to the raw water. The interval that was selected is a flow zone sequence within the Avon Park formation (described in more detail in Section 3.1). The final casing string consisted of 200 feet of 16-inch diameter PVC casing and 1028 feet of 12-inch diameter PVC casing for a total length of 1228 feet. The two casing strings were connected by a 16-by 12-inch reducer bushing. The PVC casing was Certainteed, Certa-Loc, SDR-17 lock coupling PVC casing. Centralizers were placed on each 20-foot section of casing with stainless steel bands.

Cementing the casing into place was conducted in stages to minimize grouting stress on the PVC casing caused by the heat of hydration. The open hole was filled with gravel to prevent cement grout from migrating into the producing zone of the well. Once the gravel fill was confirmed to be within 2 to 3 feet of the base of the PVC casing, a small batch of neat cement was placed in the bottom of the casing. The casing was raised to allow the cement to flow into the annulus and then the casing was reset to the selected casing depth. The remaining cement lifts were pumped into the casing annulus using the tremmie method. After each lift of cement had hardened, the cement fill depth was measured. The annular space surrounding the PVC casing was grouted to land surface using an initial stage of 37 barrels of neat cement, followed by 18 barrels of a 6% bentonite mixture. Cementing was conducted in five approximately equal stages to completely fill the annular space between the casing and borehole.

The second grouting stage (1st annular tremmie stage) included neat Portland cement only whereas stages 3 through 5 included up to a 6% bentonite grout mixture. The purpose of going to the higher percentage of bentonite in the cement was to minimize the heat of hydration in the cooling process. Once the grouting was completed a video log of the well was performed on the well to assess the status of the grouting and casing. This method of grouting proved to be very successful

2.1.1 Water Quality Testing During Drilling of RO-1

At approximately every ten feet during reverse-air drilling in the Floridan Aquifer, temperature, and specific conductance of the formation water were measured. Water samples were collected from the reverse-air discharge after the bit drilled at the desired sampling depth. Lag time (time it takes for the fluid or cuttings to be brought to the surface) was monitored at the onset of drilling following each drill rod change to ensure that samples were being obtained from the desired depths. Temperature and specific conductance measurements were conducted using a YSI model 3000 SCT meter or a YSI SCT 30 meter. Performance of the meters was checked on a regular basis against reference standards. Chloride analysis was performed using a Hach titrator and silver nitrate titrant. A summary of the water quality data collected during drilling is provided in Table 2a.

2.1.2 Flow Testing During Drilling of RO-1

During reverse air drilling through the Floridan aquifer, drill stem flow tests were performed to evaluate the specific capacity of the penetrated open interval. The tests were performed after every drill rod change (approximately every 30 feet). Each test included pumping the well using the reverse air set up and measuring static and pumping levels in the well. The static water level was measured in the well at the beginning of each day and prior to each test. Pumping water levels were measured in the well after 10 minutes of reverse air pumping. The discharge rate was measured by filling the settling tank and calculating the filled volume divided by the time in minutes.

The water levels in the well, measured during the pump test, were compared to the static, no-flow conditions. Measurement of flow rate (Q) and drawdown in the well (Δh) allowed calculation of specific capacity (C_s) of the well to be approximated using the formula $C_s = Q/\Delta h$ (Freeze and Cherry, 1979).

Table 2a includes a summary of the static and pumping water levels from drill stem flow tests conducted during the reverse-air drilling phase.

2.1.3 Well Acidization of RO-1

Well RO-1 was acid-treated on October 5 and again on October 6, 2000 to increase specific capacity. The acidization procedure involved inserting 1,268 feet of 2-3/8" drop tubing in the well and pumping 32 percent hydrochloric acid into the open interval at a rate of 120 gallons per minute (gpm). Prior to pumping acid, the wellhead was sealed and fitted with a pressure gauge to monitor pressure within the casing. A relief valve and gas discharge hose was in place on the wellhead to vent off excess pressure in the well if needed. Acid treatment was performed in two stages. The first acid treatment stage included pumping 5,000 gallons of acid into the open interval of the well. Following acid treatment, 1,130 gallons of fresh water was pumped into the well to force the acid out into the formation and away from the cemented base of casing. Maximum wellhead pressure was measured to be 13 psi. Water injection was discontinued when the well head pressure was 0 pounds/square inch (psi). The second stage included an additional 5,000 gallons of acid that was pumped in the same manner as the first stage. As in the first stage, chase water was added following the second acid treatment. The maximum wellhead pressure on the second stage was 15 psi. Only 900 gallons of water was required to reduce the pressure at the wellhead to 0 psi. Pressures were monitored continually during and after the treatment process. Following the procedure, the well remained undisturbed until July 12th at which time the reverse air drilling setup was returned to the bottom of the well to remove any accumulated material.

Prior to acidization, the specific capacity was measured to be 29.3 gpm/ft at an artesian flow rate of 460 gpm. To determine the percent improvement resulting from acid treatment, the first step of the step drawdown test is used for the comparison. The step drawdown testing was performed on November 8, 2000. In Step No. 1, at the 620 gpm pumping rate, the specific capacity was 90.8 gpm/ft. This represents a 300 percent increase in specific capacity resulting from the acid treatment.

2.1.4 Well Development Pumping of RO-1

The well was developed using a diesel-powered, vertical turbine test pump equipped with a ten-inch diameter pump and column pipe. Formation water was discharged to the lined pond via temporary 16-inch diameter PVC pipe assembled by YBI. Dissolved hydrogen sulfide (H_2S) in the discharge water was treated prior to discharge to the pond by free chlorine injection. At the development pumping rate of approximately 3000 gpm, an injection of approximately 500 pounds of chlorine/day rate was required. Following settling of solids and confirmation that H_2S levels were less than 0.1 parts per million (ppm), the treated water in the pond was pumped to the outfall.

Initially, the well was pumped at a maximum steady rate until the discharge water was visibly free of solids and turbidity. The maximum flow rate attained was approximately 2,900 gpm. Following the steady flow period, the well was pumped intermittently with surge and rest periods. Development progress was measured by performing silt density index (SDI) testing of the raw water. Additionally, the specific capacity of the well was measured on a daily basis during development to evaluate progress of improvement in well performance. Development began on October 24, 2000 and continued through November 2, 2000.

2.1.5 Pump Testing RO-1

During development, RO-1 was pumped at steady, high rates of flow as described above. At the same time, a data logger was installed on the Jupiter Island Club (The Club) Floridan Aquifer well to determine if pumping RO-1 would have any impact on The Club well which is located 0.7 miles east of RO-1. Well RO-1 is the closest of the SMRU wells to The Club well. On October 26 and 27, 2000, The Club well was off (at static condition) to observe drawdown effects from pumping RO-1. Well RO-1 was pumped at the maximum rate possible, 2,870 gpm, by YBI's test pump to determine if any impact could be detected at The Club's well. The Club's reverse osmosis plant was not in use for several days before the test, so the well was at fully recovered static condition at the time of the test. The tidal fluctuation measured in The Club well was approximately 0.5 feet. Drawdown at The Club well while pumping RO-1 was barely perceptible given the tidal fluctuation, and is estimated to be les than 0.1 feet at 2,870 gpm (more than 1.6 times the design flow rate of 1,725 gpm).

After completion of acidification and well development, a step-drawdown test was performed on the well using the development pump and discharge setup. The completed well was pump-tested to assess well yield and anticipated drawdown, and to aid in final pump selection. The flow rates for the test were measured by SAA with an in-line flow meter that was calibrated just prior to the start of the project. Prior to starting the test, the static water level was measured using an electronic water level tape. The measured static water level was 2.40 feet above land surface (+42.80 feet NGVD) on November 8, 2000. The step-drawdown test was conducted at 600, 1220, 1830 and 2800 gpm. These rates generally bracketed the proposed pumping rate of 1750 gpm for the well upon its completion. Water quality samples, including temperature, specific conductance, and chloride were collected at the end of each test step. SDI testing was also performed by SAA staff. . The results of the step drawdown test and water quality results are included in Table 3. SDI results ranged from 0.3 to 1.1 during the drawdown test.

The drawdown data were used in conjunction with the pumping rates to obtain an estimated specific capacity value of 59 gpm/ft for the well at the proposed pumping rate of 1,750 gpm. It is estimated that at this pumping rate the water level will drop to approximately 25.5 feet below land surface.

2.1.6 Geophysical Logging of RO-1

Various borehole logs were conducted at each stage of well construction. The logs were used to aid in the decision-making and data-gathering process to determine hole dimensions, casing setting depths, geologic formation characteristics, water quality, and flow zone and aquifer characteristics.

The first series of downhole logs was run on August 23, 2000, following the drilling of the 37-inch diameter hole to 245 feet BLS. XY-caliper and gamma ray logs were run on the open hole, followed by resistivity (deep, medium and shallow), and spontaneous potential.

A second series of logs was run on August 30, 2000, following the drilling of the 12-inch pilot hole to 1,010 feet BLS. This series included XY-caliper, gamma ray, resistivity (deep, medium and shallow), and spontaneous potential. On September 7, 2000, after the pilot hole was reamed to 26 inches in diameter, caliper and gamma ray logs were run again on the reamed hole for installation of the intermediate casing.

On September 20, 2000, a final set of geophysical logs was run after completion of the open interval from the bottom of the 18-inch casing to 1,494 feet BLS. This series included XY-caliper, gamma ray, resistivity (deep, medium and shallow), and spontaneous potential.

All geophysical, flow, and video logs were recorded by Florida Geophysical Logging, Inc. Supervision was performed by an SAA hydrogeologist. Copies of the geophysical logs are included in Appendix B.

2.1.7 Video Log

A downhole television survey was run on the entire depth of the completed well on November 20, 2000. The video was performed by Florida Geophysical Logging, Inc. The video survey enabled inspection of the condition of the final casing string as well as the open-hole interval to the 1,495-foot total depth of the well. The video showed that the PVC casing was in good condition. The reduction from 16-inch to 12-inch diameter casing was apparent at 200 feet BLS, and the bottom of the 12-inch casing was noted at 1,231 feet BLS.

Below a depth of 1,279 feet, the formation was seen to be very porous with numerous large holes. At 1,437 feet, flow was evidenced by particles in the water flowing up. Another flow zone was observed at 1,450 feet. At 1,465 to 1,466 feet, a well-defined black layer was evident. A copy of the video log is included with this report.

2.2 Construction of Well RO-2

Drilling of well RO-2 commenced on October 24, 2000. The drilling and casing depths are provided in the well construction details listed on Table 1. An as-built schematic diagram of the well is provided as Figure 4. The drilling procedures used for the well are described below.

A nominal 36.5-inch diameter borehole was drilled to a depth of 243 feet below land surface (BLS) using the mud rotary method. The borehole was circulated to clear the cuttings from the mud and to prepare the hole for logging and setting of the surface casing. Florida Geophysical Logging Inc. conducted geophysical logging on the open hole as described in Section 2.2.7. The surface casing installed was 30-inch diameter, 0.375-inch thick steel pipe with factory-beveled ends. During installation, the ends were welded together, and steel centralizers were welded onto the casing at 40-foot intervals. Final depth of the casing installation was 237 feet BLS. Upon completion of the casing installation, the annular space surrounding the casing was pressure grouted in a single stage-using API Class B Portland Cement, which was allowed to cure before drilling was resumed.

After drilling out the cement plug, a nominal 12-inch pilot hole was advanced from the base of the surface casing through the Hawthorn confining group to a depth of 1,014 feet BLS. The pilot hole was drilled using the mud rotary method and a 12 ¼-inch bit. Lithologic samples were collected during drilling from the circulating mud. A field lithologic log was maintained by SAA. Pilot hole drilling continued until suitable competent limestone was encountered near the top of the

Floridan aquifer. After the pilot hole was completed, drilling fluid was circulated to clear the hole of cuttings, and to prepare the hole for logging. Florida Geophysical Logging, Inc. conducted geophysical logging of the pilot hole as described in Section 2.26.

Following logging, the pilot hole was reamed to 26-inches in diameter using the mud rotary method and a staged bit assembly consisting of a 12-inch diameter lead bit and a nominal 26-inch diameter reamer bit. To keep the reamed hole from deviating from the pilot hole, weight on the bit was kept to a minimum; with the drill string held plumb by the drill collars and bit assembly. After circulating the drilled cuttings and conditioning the drilling fluid, the drilling tools were removed and Florida Geophysical Logging, Inc. conducted logging on the 26-inch reamed hole, as described in Section 2.2.7. Logged depth of the reamed hole was 1,007 feet BLS.

The 18-inch diameter intermediate casing string was installed into the 24-inch diameter borehole to a depth of 1,001 feet BLS. The intermediate casing consisted of 0 .375-inch steel pipe, with factory-beveled ends, which were arc-welded together during installation. The top of the 18-inch casing string was completed at 221-feet BLS, and overlapped the 30-inch diameter surface casing by 16 feet. The intermediate casing was pressure-grouted using API Class B Portland cement. The initial grouting stage used 37 barrels of neat cement for maximum strength near the base of the casing. The second lift used 223 barrels of a 6% bentonite mixture. After tagging the cured cement in the annulus at 376 feet, another stage of 71 barrels with 6% bentonite was pumped. Grouting continued until the annular space between the 18-inch casing and the 24-inch borehole was completely filled with cement.

After the cement cured, drilling resumed using the reverse-air rotary method. Drilling was conducted using formation water with added clear water for drilling fluid. A nominal 17-inch diameter borehole was drilled though the cement plug at the bottom of the 18-inch casing to a total depth of 1,495 feet BLS. Lithologic samples were collected during drilling, and a field lithologic log was maintained by Stemle, Andersen and Associates, Inc. Flow testing was conducted during drilling of the 17-inch borehole. Upon reaching the total depth, the driller cleared the borehole of drill cuttings. Florida Geophysical Logging, Inc. conducted the final suite of borehole geophysical logs as described in Section 2.2.7.

The final casing depth of 1,222 feet BLS was determined based on lithologic samples, water quality data, flow test results and geophysical logs. The primary objective was to select an interval within the Floridan aquifer with the best water quality and high permeability. The selected interval must have competent formation material to minimize erosion and the subsequent contribution of particulate matter to the raw water. The interval that was selected is a flow zone sequence within the Avon Park formation (described in more detail in Section 3.3). The final casing string consisted of 200 feet of 16-inch diameter PVC casing and 1,022 feet of 12-inch diameter PVC casing. A 16-by 12-inch reducer bushing connected the two casing strings. The PVC casing was Certainteed, Certa-Loc, SDR-17 lock-coupling PVC casing. Centralizers were placed on each 20-foot section of casing with stainless steel bands.

Cementing the casing into place was conducted in stages to minimize grouting stress on the PVC casing caused by the heat of hydration. The open hole was filled with gravel to prevent cement grout from migrating into the producing zone of the well. Once the gravel fill was confirmed to be within 2 to 3 feet of the base of the PVC casing, a small batch of neat cement was placed in the bottom of the casing. The casing was raised to allow the cement to flow into the annulus and then the casing was reset to the selected casing depth. The remaining cement lifts were pumped into the casing annulus using the tremmie method. After each lift of cement had hardened, the cement fill depth was measured. The annular space surrounding the PVC casing was grouted to land surface using an initial stage of 50 barrels of neat cement, followed by 10 barrels of a 6% bentonite mixture. Cementing was conducted in five approximately equal stages to completely fill the annular space between the casing and borehole.

The second grouting stage (1st annular tremmie stage) consisted of 40 barrels of 6% bentonite grout mixture. Cementing was conducted in approximately equal stages to minimize grouting stress on the PVC casing. The purpose of going to the higher percentage of bentonite in the cement was to minimize the heat of hydration in the cooling process. Once the grouting was completed a video log of the well was performed on the well to assess the status of the grouting and casing. This method of grouting proved to be very successful

2.2.1 Water Quality Testing During Drilling of RO-2

At approximately every ten feet during reverse-air drilling in the Floridan aquifer, temperature, and specific conductance of the formation water were measured at regular intervals. Water samples were collected from the reverse-air discharge after the bit drilled at the desired sampling depth. Lag time (time it takes for the fluid or cuttings to be brought to the surface) was monitored at the onset of drilling following each drill rod change to ensure that samples were being obtained from the desired depths. Temperature and specific conductance measurements were conducted using a YSI model 3000 SCT meter. Performance of the meter was checked on a regular basis against reference standards. Chloride analysis was performed using a Hach titrator and silver nitrate titrant. A summary of the water quality data collected during drilling is provided in Table 2b.

2.2.2 Flow Testing During Drilling of RO-2

During reverse air drilling through the Floridan aquifer, drill stem flow tests were performed to evaluate the specific capacity of the penetrated open interval. The tests were performed after every drill rod change (approximately every 30 feet). Each test included pumping the well using the reverse air set up and measuring static and pumping levels in the well. The static water level was measured in the well at the beginning of each day and prior to each test. Pumping water levels were measured in the well after 10 minutes of reverse air pumping. The discharge rate was measured by filling the settling tank and calculating the filled volume divided by the time in minutes.

Water levels in the well were measured during the pump test and compared to static, no-flow conditions measured at the beginning of each day and after each test. Measurement of flow rate (Q) and drawdown in the well (Δh) allowed calculation of specific capacity (C_s) of the well to be approximated using the formula $C_s = Q/\Delta h$ (Freeze and Cherry, 1979).

Table 2b includes a summary of the static and flowing water levels from drill stem flow tests conducted during the reverse-air drilling phase.

2.2.3 Well Acidization of RO-2

Well RO-2 was acid-treated on December 11^{th} and again on December 12, 2000 to increase specific capacity. The acidization procedure involved inserting 1,268 feet of 2-3/8" drop tubing in the well and pumping 32 percent hydrochloric acid into the open interval at a rate of 100 gallons per minute (gpm). Prior to pumping acid, the wellhead was sealed and fitted with a pressure gauge to monitor pressure within the casing. A relief valve and gas discharge hose was in place on the wellhead to vent off excess pressure in the well if needed. Acid treatment was performed in two stages. The first acid treatment stage included pumping 4,000 gallons of acid into the open interval of the well. The pressure in RO-2 rose more rapidly than did RO-1, which is the reason acid injection was discontinued after 4,000 gallons were pumped. The maximum pressure reached during acid treatment was 14 psi. Following acid treatment, 2,500 gallons of fresh water was pumped into the well to force the acid out into the formation and away from the cemented base of casing. Water injection was discontinued at 2,500 gallons even though the well head pressure was still 8 psi. The second stage included an additional 6,000 gallons of acid that was pumped in the same manner as the first stage. As in the first stage, chase water was added following the second acid treatment. This time only 1,000 gallons of water was required to reduce the pressure at the wellhead to 0 psi. Pressures were monitored continually during and after the treatment process. Following the procedure, the well remained undisturbed until December 14, 2000 at which time the reverse air drilling setup was returned to the bottom of the well to remove any accumulated material.

2.2.4 Well Development Pumping of RO-2

Development of RO-2 began on December 27, 2000 and was completed on January 2, 2001 after a total of 48 hours of development. Well RO-2 was pumped at rates between 2,400 and 3,150 gpm. Initially, pumping at higher rates was found to cause cavitation. The specific capacity of the well was measured on a daily basis during development to evaluate well performance. On the last day of development, the final steady pumping rate was approximately 2,500 gpm, producing 70 feet of drawdown in the well; the specific capacity at this rate was 35 gpm/ft. Silt density index (SDI) tests were performed on the raw water following completion of well development pumping. The SDI value at the end of development was 1.5.

2.2.5 Pump Testing RO-2

In lieu of performing a step drawdown test as done for RO-1, two constant rate pumping tests were performed for RO-2. The first test was performed to determine aquifer hydraulic characteristics and the second test was performed to determine well pumping characteristics at near-design pumping rate.

The first test, an aquifer performance test, included pumping RO-2 at a steady rate of 2,600 gallons per minute to monitor the drawdown effects in RO-1 and the Jupiter Island Club (The Club) well. Continuous water level data were collected from The Club well throughout development and testing of both RO-1 and RO-2. Throughout the duration of all development and testing, tidal cycles were clearly evident in The Club's well water level data, although no effect on water levels was seen as a result of pumping and testing RO-1 or RO-2.

The second pumping test was run on January 4, 2001 to determine the anticipated drawdown in RO-2 at 1,790 gpm. This test was performed to evaluate water quality and well performance at a rate near the design flow rate of 1,725 gpm. After 170 minutes of constant rate pumping at 1,790 gpm, the maximum drawdown in RO-2 was 45.21 feet.

Continuous water level data was collected from RO-1 during test pumping of RO-2 at a rate of 1,725 gpm using a Hermit 2000 data logger. The maximum drawdown in RO-1, during pump of RO-2, was 0.44 feet.

The drawdown data were used in conjunction with the pumping rates to obtain an estimated specific capacity value of 39.6 gpm/ft for the well at the proposed pumping rate of 1,725 gpm. It is estimated that at this pumping rate the water level will drop to approximately 32.2 feet below static level, as seen during testing. The chloride concentration in the groundwater sample collected after pump testing RO-2 was 1,440 mg/l. The SDI test result at the end of development was 1.5 for RO-2. The results of the aquifer performance test and water quality results are included in Table 3.

2.2.6 Determination of Aquifer Properties

Calculation of aquifer properties was done using the Theis Type-Curve Method as the solution process. The methodology and equations are discussed below.

Transmissivity

Transmissivity was calculated from the first APT (January 3rd data) using the Theis' Type Curve Method for confined aquifers. The method involves matching field data plotted on log-log paper with a "type curve" plotted from the Theis equation. After superimposing field data over the type curve and the two curves are satisfactorily matched, an arbitrary match point is selected. From the match point, values are obtained for substitution into the appropriate equations to obtain aquifer properties. Transmissivity is solved as follows:

$$T = \frac{114.6QW(u)}{s}$$

Where: T = transmissivity (gpd/ft)

Q = discharge rate (gpm) = 2,600

W(u) = well function of Theis = 1

s = drawdown (ft) = 0.5

$$T = \frac{114.6(2600)(1)}{0.5} = 595{,}920\, gpd/ft$$

Storativity

From the above results, storativity was then calculated as follows:

$$S = \frac{Tu}{2693} * t/_{r^2}$$

Where: S = storativity

r = distance from pumping well (ft)

t = time (days)

u = well function from Theis curve

$$S = \frac{595{,}920(1)}{2693} * .0076 \Big/ 1800^2 = 5.2x10^{-7}$$

Leakance

From the above results, leakance was calculated as follows:

Where: K'/b' = leakance in gpd/ft^3

r = distance from pumping well (ft)

T = transimissivity (gpd/ft)

$$K'/b' = \frac{T\left(r/B\right)^2}{r^2}$$

$$K'/b' = \frac{595{,}920(0.6)^2}{(1{,}800)^2} = 0.0662\ gpd/ft^3$$

2.2.7 Geophysical Logging of RO-2

Borehole logs were conducted at each stage of well construction to aid in the decision-making and data-gathering process to determine hole dimensions, casing setting depths, geologic formation characteristics, water quality, and flow zone and aquifer characteristics.

The first series of downhole logs was run on October 26, 2000, following the drilling of the 37-inch diameter hole to 244 feet BLS. XY caliper and gamma ray logs were run on the open hole.

A second run of logs was conducted on November 1, 2000, following the drilling of the 12-inch pilot hole to 1,014 feet BLS. This series included XY-caliper, gamma ray, resistivity (deep, medium and shallow), and spontaneous potential. On November 6, 2000, after the pilot hole was reamed to 26 inches in diameter, caliper and gamma ray logs were run again on the reamed hole for installation of the intermediate casing.

On November 20, 2000, a final set of geophysical logs was run after completion of the open interval from the bottom of the 18-inch casing to 1,495 feet BLS. This series included XY-caliper, gamma ray, resistivity (deep, medium and shallow), and spontaneous potential.

All geophysical, flow, and video logs were recorded by Florida Geophysical Logging, Inc. An SAA hydrogeologist performed supervision. Copies of the geophysical logs are included in Appendix B.

2.2.8 Video Log of RO-2

A downhole television survey was run on the entire depth of the completed well on January 5, 2001. Florida Geophysical Logging, Inc performed the video logging. The video survey enabled inspection of the condition of the final casing string as well as the open-hole interval to the 1,495-foot total depth of the well. The video showed that the PVC casing was in good condition. The reduction from 16-inch to 12-inch diameter casing was apparent at 202 feet BLS in the video, and the bottom of the 12-inch casing was noted at 1,493 feet BLS.

Below a depth of 1,275 feet, the formation was seen to be very porous with numerous large holes. Grout was visible at the base of the 12" casing, and cemented aggregate was evident also. The borehole itself showed no problems.

Flow was not evident from the video although water was clear. The bottom of the borehole was logged at 1,493 feet BLS from the video, as a result of fill settling on the bottom of the well. A copy of the video log is included with this report.

3.0 HYDROGEOLOGY

Beneath Martin County, there are two major aquifer systems, the surficial aquifer system (SAS), and the deeper Floridan Aquifer System (FAS). A thick confining unit separates them. The drilling of wells RO-1 and RO-2 penetrated the full thickness of the SAS, and partially penetrated the FAS. Both wells were drilled to a total depth of 1,495 feet BLS. A hydrogeologist from Stemle, Andersen & Associates, Inc. was present during key phases of the drilling to collect lithologic samples and log the geologic formation materials encountered. The resulting lithologic logs are provided in Appendix A. A generalized hydrostratigraphic section showing the typical lithologies, aquifers and formations encountered during drilling is provided as Figure 5.

3.1 Surficial Aquifer System

In descending order from land surface, the SAS formations include the Pamlico Sand, Anastasia, and the Tamiami Formation (Lichtler, 1960). (Note: The Anastasia is contemporaneous with the Fort Thompson which is found farther to the west, and underlying the Everglades.)

The thin covering of sand present over most of South Florida is known as the Pamlico Sand. It consists of fine- to medium-grained loose quartz sand grains, loose detrital clay and shell, and may be cemented as cap rock near the top of the present or previous water table surface. The sand extends to a depth of 64 feet beneath RO-1 and to 60 feet beneath RO-2.

At this site, sparry calcitic "sandstone" underlies the quartz sand and may constitute the uppermost portion of the Anastasia Formation. This coarsely crystalline material resembles coarse quartz sandstone, although acid tests reveal that it is calcium carbonate. With depth, it becomes interbedded with layers of quartz sand.

The Anastasia Formation can range in composition from coquina ("beach rock") to pure quartz sand, often with varying mixtures of shell, sandy limestone, and sandstone as well. In Martin County, Lichtler (1960) identified the Anastasia Formation as being comprised of sand, shell beds, and thin, discontinuous layers of sandy limestone or sandstone. Here, vertical changes in lithology tend to follow a downward progression from unconsolidated sand and shell to calcareous sandstone and limestone. Sandstone and limestone units in the Anastasia make up the water-producing zone of the surficial aquifer in this area.

At this site, the calcitic sandstone ("sparry limestone") and sandy limestone grade into beds of fine-grained limestone (often shelly or sandy) and shell beginning at a depth of about 120 feet in RO-1 and 95 feet in RO-2. The limestone becomes increasing fine-grained and marly with depth, and at approximately 240 feet beneath the site, olive gray-green silty clay and phosphatic sands of the Tamiami Formation and Hawthorn Group begin to appear, marking the basal confining unit of the SAS.

Although the Tamiami Formation (Pliocene age), and/or the formations of the Hawthorn Group (Miocene age) are known to underlie the Anastasia Formation in this area, specific contact depths are unclear in the available literature, as it is difficult to distinguish between the Tamiami and the Hawthorn Group.

3.2 Intermediate Confining Unit

The intermediate confining unit consists of the relatively impermeable calcareous clays and silts of the Hawthorn Group. The Miocene-aged Hawthorn sediments consist of dense, olive gray, clayey, unlithified lime mud, fine- to very-fine-grained quartz and phosphate sand and silt. Also present are beds of shell and sandy limestone within the upper and lower reaches of the unit. Here, the intermediate confining unit is approximately 500 feet thick, extending to a depth of approximately 900 feet. The predominately clayey upper section of the unit is known as the Peace River Formation.

The sandy-phosphatic limestones and phosphatic lime muds and that underlie the Peace River Formation belong to the Arcadia Formation. These occur to a depth of approximately 900 feet and although they are part of the Hawthorn Group, the permeable beds are considered to be part of the Floridan aquifer and may produce considerable amounts of water.

3.3 Floridan Aquifer System

The Floridan Aquifer System (FAS) is a confined aquifer that underlies the low-permeability beds of the intermediate confining unit. The brackish upper portion, referred to as the upper Floridan aquifer, has been classified by the Florida Department of Environmental Regulation as an underground source of drinking water (USDW) because it has a total dissolved solids (TDS) concentration of less than 10,000 mg/l.

The upper Floridan is composed predominantly of interbedded limestones and dolomites of late Miocene to middle Eocene age. Four primary rock units comprise the upper Floridan aquifer. From approximately 900 feet beneath the site, in descending order, these units are the Arcadia Formation limestones (Miocene age), Suwannee Limestone (Oligocene age), Ocala Group and the Avon Park Limestone (Eocene age).

The maximum depth penetrated during drilling was 1,495 feet. The lithology approaching the terminus of the wells consists of interbedded layers of soft calcarenite limestone, dolomitic limestone, and dolomite.

The producing zones within the Floridan aquifer can generally be referred to as "flow zones". A flow zone is typically a thin sequence of highly solutioned rock where water, flowing within the aquifer, is concentrated. Numerous thin flow zones may convey water to the open interval of a well and quite often, a high percentage of the water produced by the well comes from one or two thin flow zones.

Based on the lithologic logs, geophysical logs and wellhead flow data, the most productive flow zones occurred between approximately 1,300 feet and 1,400 feet BLS.

Because the flow zones are typically separated from each other by continuous sequences of lower permeability strata, water quality may very significantly with depth.

3.4 Floridan Aquifer Head Pressures

The aquifer artesian head pressures are just above grade elevation in RO-1 and just below grade elevation in RO-2.

4.0 PREDICATED DRAWDOWNS

Wells RO-1 and RO-2 will experience two types of drawdown when pumped during the useful life of the wells. The first type of drawdown is due pumping the well. The amount of drawdown in the well is a function of its specific capacity (pumping / drawdown rate). The second type of drawdown they will experience is the overall drawdown in the aquifer resulting from the withdrawals of surrounding existing and future wells completed in the same depth interval. This is known as wellfield drawdown or well interference effect. The amount of interference is dependent on the proximity of the surrounding wells.

Based on the drawdown test results, RO-1 has a specific capacity of 59 gpm/ft and is anticipated to have a drawdown of 29.2 feet at the design flow rate of 1,725 gpm. Based on a starting head elevation of 45.2 feet above mean sea level, the pumping water level in RO-1 will be approximately 16 feet above mean sea level. Well RO-2 has a specific capacity of 39.6 gpm/ft at the design flow rate of 1,725 gpm. The predicted drawdown in RO-2 is expected to be 43.5 feet below the static level at a pumping rate of 1,725 gpm. Based on aquifer performance tests, each well will impart less than 0.5 feet of drawdown on the other when pumped at design flow. The impact on the Jupiter Island Club from pumping either well at design flow is negligible.

5.0 CONCLUSIONS

The following is a summary of results of drilling and testing RO-1 and RO-2.

1. Floridan aquifer production wells, RO-1 and RO-2, were constructed for the South Martin Regional Utility between August 21, 2000 and January 5, 2001. The wells were constructed in three casing strings, which enabled testing of the upper Floridan aquifer for productivity and water quality prior to installation of the final PVC casing string. Total depth of the wells is 1,495 feet.

2. RO-1 has a specific capacity of 59 gpm/ft and is anticipated to have a drawdown of 29.2 feet at the design flow rate of 1,725 gpm. Based on a starting head elevation of 45.2 feet above mean sea level (MSL), the water level will be 16 feet above mean sea level. Well RO-2 has a specific capacity of 39.6 gpm/ft at the design flow rate of 1,725 gpm and a drawdown of 43.5 feet below the static level at that rate. Based on a starting head of 45.2 feet above MSL, the pumping water level will be 1.7 feet above MSL.

3. The chloride concentration in the groundwater sample collected from well RO-1 after pump testing was 1,360 mg/l. Average chloride concentration of all samples collected during pump testing of RO-1 was 1,356 mg/l. For RO-2, the chloride concentration in the groundwater sample collected after pump testing was 1,440 mg/l.

4. The SDI test result at the end of development was 1.13 for RO-1 and 1.5 for RO-2.

5. Most of the flow entering the well is produced from a 100-foot thick sequence of dolomite and limestone beds in the Avon Park Limestone. The best flow zones were encountered from about 1,300 feet.

6.0 RECOMMENDATIONS

1. At the design flow rate of 1,725 gpm the wells will have no impact on any existing users. SFWMD allows up to a 10 percent impact on existing users.

2. In time, incrustation of the borehole may cause the specific capacity to degrade and pumping levels to decline. The incrustation is primarily composed of calcium carbonate, and hydrochloric acid treatment is typically an effective remedy for this condition. Acid treatment should be performed on the well if the specific capacity falls more than ten percent.

3. Water levels should be monitored wells RO-1 and RO-2. Water levels should be collected weekly on pumping wells and at least monthly on non-pumping wells. Not only will this confirm that pumping equipment is operating within design criteria, but it will allow tracking of well performance and forecasting of well problems.

4. A monitoring program will also provide background Floridan aquifer water levels, as competition for the resource escalates over time.

5. When the wells are pumping, water quality samples should be collected monthly and at a minimum, analyzed for chloride and specific conductance. Well pumping should be rotated sot that both wells are used and monitored. Any time a water sample is collected, a minimum of three casing volumes of water should be purged from the well prior to sample collection. The Florida Aquifer is a leaky aquifer with varying water quality both vertically and horizontally. Additionally, water quality within the open interval of the well varies with depth. Given this, water quality at RO-1 and RO-2 is expected to vary. Routine monitoring will

better establish the actual range. Rotation of well usage minimizes the stress on the aquifer in one area and will help to limit degradation of water quality.

6. The well construction method specified for this project has proven to be reliable, with fewer construction problems encountered than with alternate techniques on similar wells. This method allows testing of the aquifer at depth for collection of reliable data on aquifer properties and water quality. This method is recommended for future wells constructed for South Martin Regional Utility.

7.0 REFERENCES

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TABLES

TABLE 1

WELL CONSTRUCTION DETAILS
SOUTH MARTIN REGIONAL UTILITY RO-1 AND RO-2

RO-1												
TOTAL DEPTH (FEET)	OUTER CASING			INTERMEDIATE CASING			INNER CASING			OPEN HOLE COMPLETION	
	TYPE	DIAM (in.)	DEPTH (ft.)	TYPE	DIAM. (in.)	DEPTH INTERVAL (ft.)	TYPE	DIAM. (in.)	DEPTH (ft.)	DIAM (in.)	DEPTH INTERVAL (ft.)
1495	STEEL	30	239	STEEL	18	219-970	SCH 80 PVC	16 12	0 - 200 200 - 1228	17	1228-1494

RO-2											
TOTAL DEPTH (FEET)	OUTER CASING			INTERMEDIATE CASING			INNER CASING			OPEN HOLE COMPLETION	
	TYPE	DIAM (in.)	DEPTH (ft.)	TYPE	DIAM. (in.)	DEPTH INTERVAL (ft.)	TYPE	DIAM. (in.)	DEPTH (ft.)	DIAM (in.)	DEPTH INTERVAL (ft.)
1495	STEEL	30	237	STEEL	18	221-1001	SCH 80 PVC	16 12	0 - 200 200 - 1222	17	1222-1495

Abbreviations:
Ft. - feet   in. – inches   DIAM. - Diameter   PVC - Polyvinyl chloride   SCH 80 - Schedule 80
Depths are feet below land surface.
PVC casings were Certa-Lok (TM) type, manufactured by CertainTeed Corporation, Social Circle, Georgia.
12" casing: Certainteed 12" certaloc well casing. IC-1 PVC 1120 SDR17, Class 250, ASTM F480-95 SE.
16" casing: Certainteed Certaloc well casing IC-0 SDR17, Class 250, ASTM F480, 95 SE, NSF-61

TABLE 2a

WATER QUALITY AND WELL FLOW CAPACITY SUMMARY

SOUTH MARTIN REGIONAL UTILITY
PRODUCTION WELL RO-1
DRILLING DATA (FROM 1010 TO 1495 FEET BLS)
Reference elevation: 42.80 feet NGVD

Sample Depth (feet)	Chloride Conc. (mg/l)	Specific Conduct-ance (µmos/cm)	Temp (°C)	Static water level (ft rel. to land surface	*Static water level (ft NGVD)*	Flowing water level (ft. rel. to land surface)	*Flowing water level (ft NGVD)*	Wellhead Flow (gpm)
Static prior to drilling:				-12	*30.8*			
1015		7800	28.1					
1045		7520	27.8					
1075*		4138	28.1					
1075		7570	27.6					
1105		4439	28.7					
1115		4620	26.2					
1125		4490	26.2					
1135		4271	30.1					
1145		3900	24.9					
1155*		3830	25.2					
1165		3730	24.9	-15	*27.8*	-37	*5.8*	490
1175		3460	25.0					
1185		3480	25.2					
1195		3585	24.9	-14	*28.8*	-37	*5.8*	490
1205*		3100	25.1					
1215		3090	24.6					
1225		3015	24.4	-14	*28.8*	-37	*5.8*	490
1235		2998	24.5					
1245		3300	24.1					
1255		3280	23.7	-14	*28.8*	-37	*5.8*	410
1255	Start of day static level:			-10	*32.8*			
1275		3450	24.1					
1285		3490	24.0					
Circulated out fluid from borehole bottom to get fresh formation water. Resampled:								
1285		3300	24.0	-13	*29.8*	-28	*14.8*	490
1295		3100	24.0					
1305		3060	24.1					
1315		3280	25.3	-13	*29.8*	-27	*15.8*	490
1325		2900	24.6					
1335		2700	23.8					

TABLE 2a

WATER QUALITY AND WELL FLOW CAPACITY SUMMARY

SOUTH MARTIN REGIONAL UTILITY
PRODUCTION WELL RO-1
DRILLING DATA (FROM 1010 TO 1495 FEET BLS)
Reference elevation: 42.80 feet NGVD

Sample Depth (feet)	Chloride Conc. (mg/l)	Specific Conduct-ance (µmos/cm)	Temp (°C)	Static water level (ft rel. to land surface	*Static water level (ft NGVD)*	Flowing water level (ft. rel. to land surface)	*Flowing water level (ft NGVD)*	Wellhead Flow (gpm)
1345		3040	24.1	-14	*28.8*	-25	*17.8*	490
1355		3000	24.7					
1365		3250	24.5					
1375		3200	24.2	-14	*28.8*	-25	*17.8*	490
++ begin sp. Cond readings with TLC 3000 meter								
1385		4240	23.8					
1395		4280	24.9					
1404				-15	*27.8*	-24.5	*18.3*	490
1405		4290	23.8					
1415		4280	24.2					
1425		4330	24.0					
1434				-14	*28.8*	-23.5	*19.3*	490
1435		4280	24.0					
1445		4360	23.8					
1455		4300	23.8					
Beginning of day static water level:								
1464				-11.5	*31.3*			
1464		4480	23.8	-14	*28.8*	-23	*19.8*	500
1475		4480	23.8					
1485		4550	24.5					
1494	1175	4480	22.9			-21.5	*21.3*	490
1495		4550	24.5					

TABLE 2b

WATER QUALITY AND WELL FLOW CAPACITY SUMMARY

SOUTH MARTIN REGIONAL UTILITY
PRODUCTION WELL RO-2
DRILLING DATA (FROM 1015 TO 1495 FEET BLS)
Reference elevation: 42.80 feet NGVD

Sample Depth (feet)	Chloride Conc. (mg/l)	Specific Conduct-ance (µmos/cm)	Temp (°C)	Static water level (ft rel. to land surface	*Static water level (ft NGVD)*	Flowing water level (ft. rel. to land surface)	*Flowing water level (ft NGVD)*	Wellhead Flow (gpm)
1015		6470	26.0					
1025		6450	26.0					
1035		6300	25.1					
1045		5570	26.2					
1055		5950	26.3					
1065		5880	26.3					
1075		6010	27.6	-33				0
1085		5270	27.9					
1105		5250	26.4					
1115		5110	26.2					
1120		4490	25.8					
Stopped adding fresh water. Getting a little flow from aquifer.								
1135		4770	24.8	-31		-83		
1145		4880	22.0					
1155	Start of day static level:			-24				
1155		4760	21.1					
1165		4880	21.1					
1175		4830	22.9					
1185		4880	23.3					
1195		5430	23.8	-20		-66		260
1205		4900	24.2					
1215		4680	24.4					
1225		4920	24.6					
1235		4880	24.5					
1245		5020	24.6					
1255		4940	23.5					
1255b		5030	23.4	-20		-49		325
1265		4920	28.6					
1275		4897	24.5					
1285		4710	24.1					
1285		4960	23.8					

TABLE 2b

WATER QUALITY AND WELL FLOW CAPACITY SUMMARY

SOUTH MARTIN REGIONAL UTILITY
PRODUCTION WELL RO-2
DRILLING DATA (FROM 1015 TO 1495 FEET BLS)
Reference elevation: 42.80 feet NGVD

Sample Depth (feet)	Chloride Conc. (mg/l)	Specific Conduct-ance (µmos/cm)	Temp (°C)	Static water level (ft rel. to land surface	*Static water level (ft NGVD)*	Flowing water level (ft. rel. to land surface)	*Flowing water level (ft NGVD)*	Wellhead Flow (gpm)
1295		4960	23.8					
1305		4920	23.8					
1315		4960	23.6					
1315b		4810	23.7	-20		-47		325
1325		4850	24.1					
1335		4840	23.5					
1345		4605	23.5					
1355		4797	22.6					
1365		4743	24.9					
1375		4718	23.2	-19		-36		400
	Start of day level:			-19				
1385		4488	23.8					
1395		4960	23.8					
1406		4360	23.4	-19		-29		410
1415		4451	23.9					
1425		4400	23.9					
1435		4633	23.3	-19		-29		475
1445		4523	23.8					
1455		4828	23.5					
1465		5360	23.3	-19		-26		475
1475		4805	23.5					
1485		4820	23.3					
1495		5030	23.1	-19		-29		475
1495b		4880	23.1			-28.8		475
1495	Start of day static:			-16.6				

TABLE 3a

RO-1 STEP DRAWDOWN TEST RESULTS

SOUTH MARTIN REGIONAL UTILITY
FLORIDAN AQUIFER PRODUCTION WELL RO-1

WELL: RO-1	TEST DATE: 11/8/00
STATIC WATER LEVEL: Referenced starting head, +1.03 feet above flange, or +43.83 feet above mean sea level (NGVD).	

DRAWDOWN DATA

Step	Flow Rate (gpm)	Flow Duration (min)	Water level (feet below flange)	Water elevation (feet of head relative to mean sea level)	Drawdown (feet)	Specific Capacity (gpm/ft)
1	620	200	5.03	37.77	6.06	102.3
2	1220	190	15.97	27.86	17.0	71.8
3	1830	207	29.2	13.6	30.23	58.9
4	2800	130	34.93	7.87	35.96	77.9

RO-1 WATER QUALITY DATA

Step	Flow Rate (gpm)	Flow Duration (min)	SDI Result	H_2S ppm	Dissolved Chloride (mg/l)	Specific Conductance (µmhos/cm)
1	620	200	0.53	3.0	1330	n.m.
2	1220	190	0.33	4.0	1405	n.m.
3	1830	207	1.13	2-3	1330	n.m.
4	2800	130	n.m.	n.m.	1360	n.m.

Notes:
gpm - gallons per minute
mg/l – milligrams per liter
n.m. – not measured
°C – degrees Celsius
µmhos/cm – micromhos per centimeter
SDI – silt density index

Land surface (pad) elevation = 42.8 ft NGVD

TABLE 3b

RO-2 AQUIFER PERFORMANCE TEST RESULTS

SOUTH MARTIN REGIONAL UTILITY
FLORIDAN AQUIFER PRODUCTION WELL RO-2

DRAWDOWN DATA

Test Date & Name	Monitor Wells	Flow Rate (gpm)	Flow Duration (min)	Static Water Level (BMP)	Drawdown (feet)	Specific Capacity (gpm/ft)
Jan 3 2001 *RO-2 APT*	RO-1 & JICC	2600	400	RO-2: 3.66' RO-1: 14.41' JICC: 22.00'	RO-2: 3.66' RO-1: 0.69 JICC: 0	--
Jan 4 2001 *Design Flow Rate Test*	RO-1	1790	360	RO-2: 3.59' RO-1: 14.43'	RO-2 : 45.21 RO-1: 0.435'	RO-2 39.6

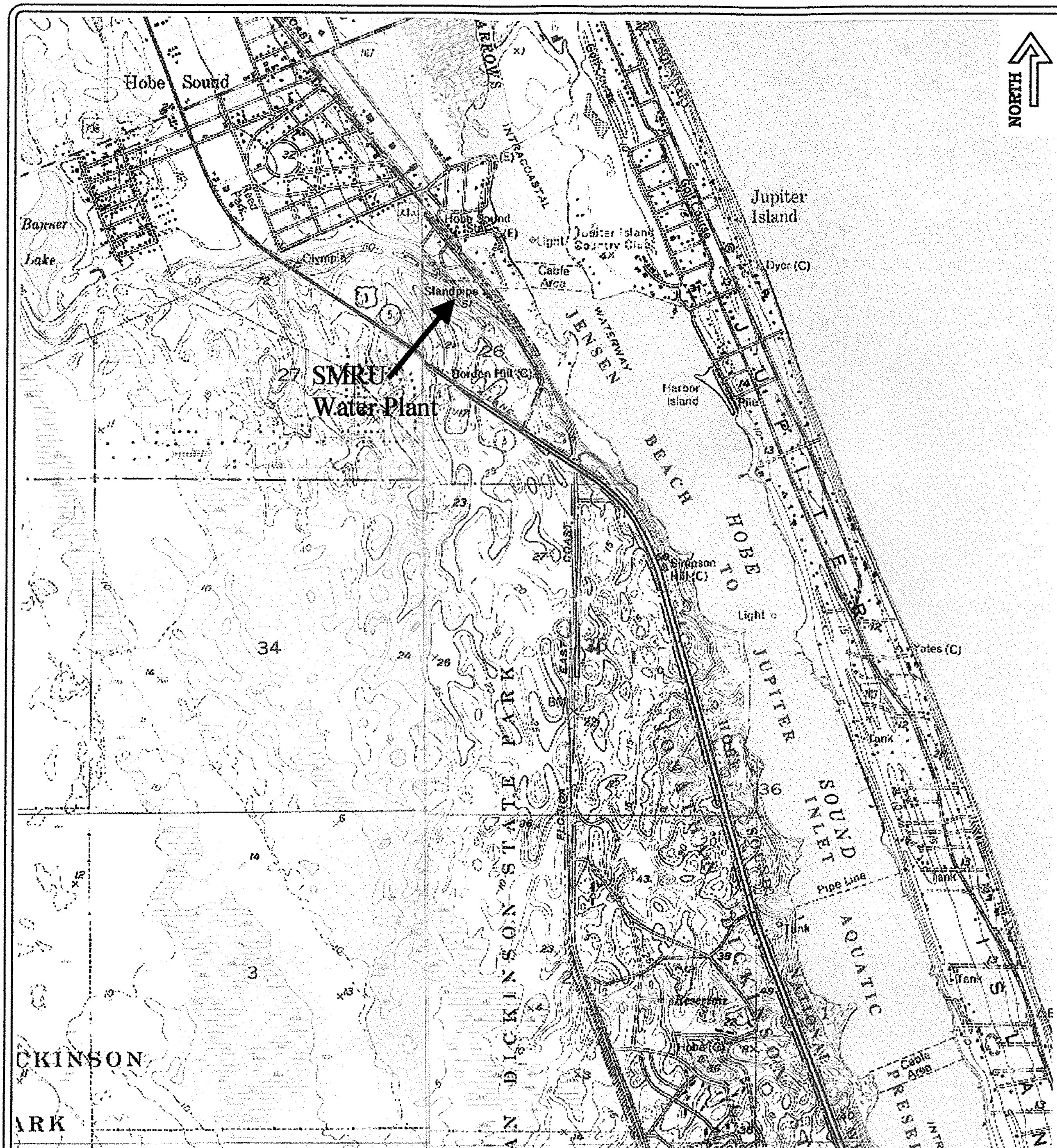
JIM, please verify/decipher appropriate water level elevation data. RO-2 notes say site elevation at top of 4" valve nut +48.40 on 30" casing. Is this the MP used for the tests? Also, the starting head is written as 3.59'. Is that DTW? From what measuring point? I put BMP for the water level column - that's only an assumption.

RO-2 WATER QUALITY DATA

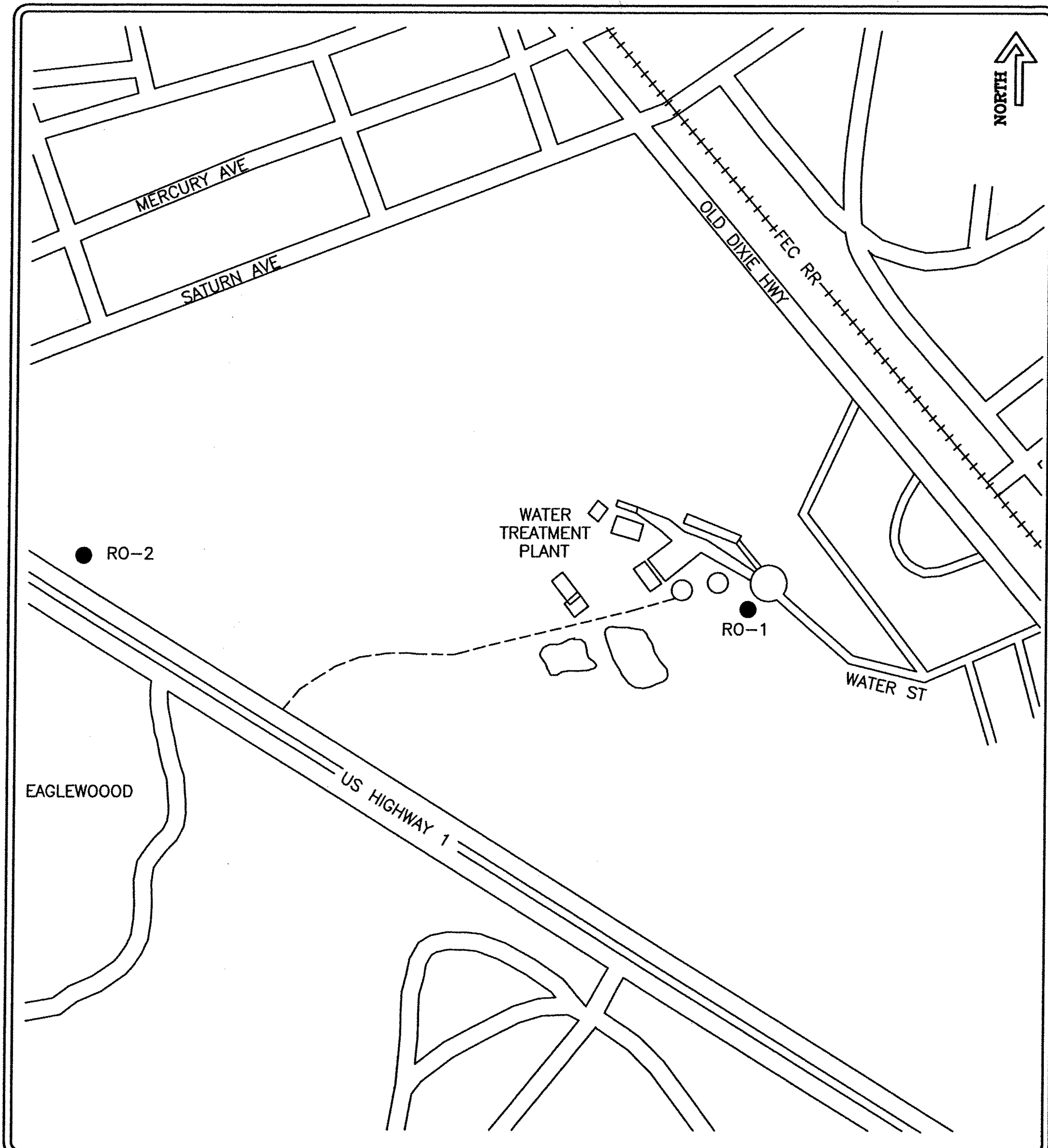
Test Date	Flow Rate (gpm)	Flow Duration (min)	SDI Result	H_2S ppm	Dissolved Chloride (mg/l)	Specific Conductance (µmhos/cm)
Jan 4, 01	1790	360	1.5	2.5	1,440	5,090

Notes:
gpm - gallons per minute
mg/l – milligrams per liter
°C – degrees Celsius
µmhos/cm – micromhos per centimeter
SDI – silt density index

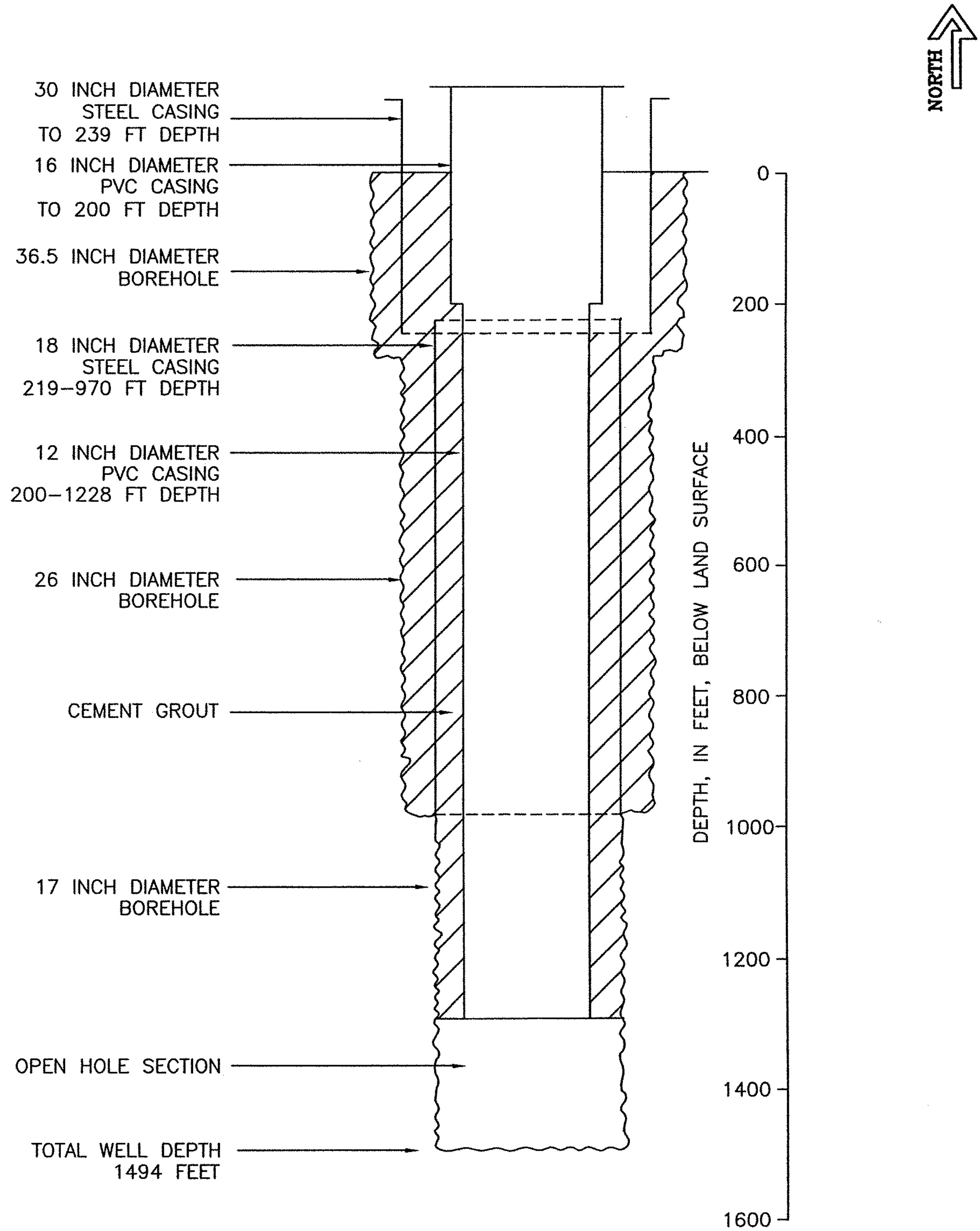
FIGURES



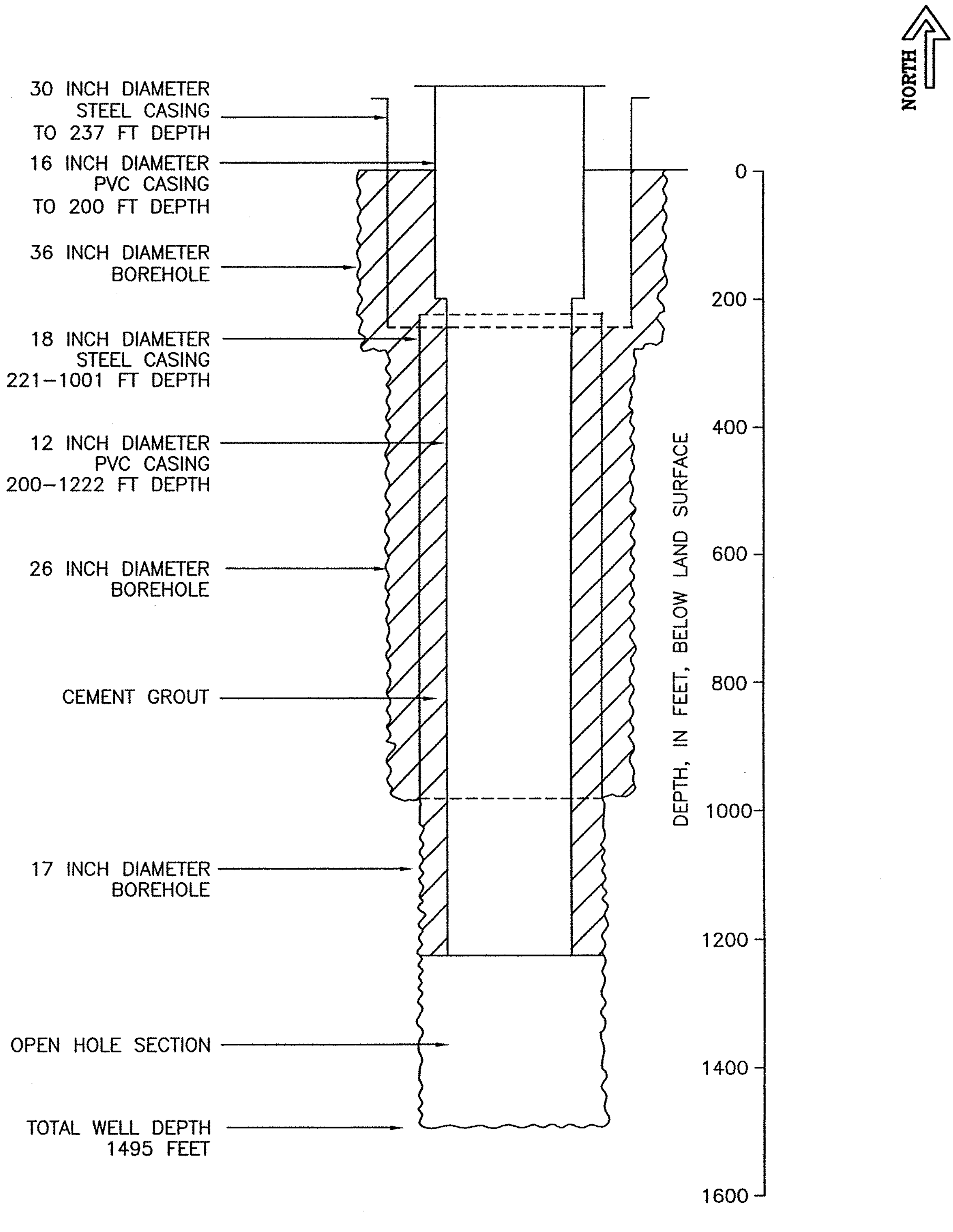
SOURCE: USGS TOPOGRAPHIC 7.5 MINUTE SERIES GOMEZ, FL AND HOBE SOUND, FL QUADRANGLES. PHOTOREVISED, 1983	SCALE 1 : 24,000	Stemle, Andersen & Associates
PREPARED FOR: SOUTH MARTIN REGIONAL UTILITY AND HUTCHEON ENGINEERS		DRAWN BY: JM DATE: 06/23/01 DWG #: 010609F1
FIGURE TITLE: AREA LOCATION MAP	PROJECT NUMBER:	FIGURE NUMBER: 1



LEGEND	APPROXIMATE SCALE 1" = 400'	Stemle, Andersen & Associates
PREPARED FOR: SOUTH MARTIN REGIONAL UTILITY AND HUTCHEON ENGINEERS		DRAWN BY: JM DATE: 06/23/01 DWG #: 010609F2
FIGURE TITLE: WELL LOCATION MAP, RO-1 AND RO-2	PROJECT NUMBER:	FIGURE NUMBER: 2



LEGEND: CEMENT GROUT	SCALE AS SHOWN	Stemle, Andersen & Associates
PREPARED FOR: SOUTH MARTIN REGIONAL UTILITY		DRAWN BY: JM DATE: 06/23/01 DWG #: 010609F3
FIGURE TITLE: FLORIDAN AQUIFER PRODUCTION WELL RO-1 AS-BUILT CONSTRUCTION DETAILS	PROJECT NUMBER:	FIGURE NUMBER: 3



LEGEND: ▨ CEMENT GROUT	SCALE AS SHOWN	Stemle, Andersen & Associates
PREPARED FOR: SOUTH MARTIN REGIONAL UTILITY		DRAWN BY: JM DATE: 06/23/01 DWG #: 010609F4
FIGURE TITLE: FLORIDAN AQUIFER PRODUCTION WELL RO–2 AS–BUILT CONSTRUCTION DETAILS	PROJECT NUMBER:	FIGURE NUMBER: 4

APPENDIX A

LITHOLOGIC LOGS

APPENDIX A

RO-1
LITHOLOGIC LOG

RO-1 LITHOLOGIC LOG

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-1	
Depth in Feet Below Land Surface	**Description**
0-15	SAND, 90%, grayish-orange to pale brown (5YR 7/2 to 5YR 5/2), unconsolidated, fine to medium quartz grains, fine shell; 10% pale orange (10YR 7/2), unconsolidated, with organic material.
15-16	LIMESTONE, medium gray (N5), pale orange (10YR 8/2) and light olive gray (5& 6/1), hard thin layer(s) and SAND as above, unconsolidated.
16-25	SAND, 100%, pale yellowish brown (10YR 6/2), unconsolidated quartz grains, fine to medium size; minor white shell fragments, sand-size; organic matter.
25-30	SAND and interbedded SANDY CLAY, light olive gray (5& 5/2), unlithified, dense clayey texture.
30-35	SAND, 100%, pale yellowish brown (10YR 6/2), unconsolidated, fine to medium quartz grains; and SHELL; LIMESTONE FRAGMENTS (contamination from above).
35-45	SAND, as above, dark yellowish brown (10YR 5/4) to dark yellowish orange (10YR 6/6), unconsolidated.
45-50	SAND, as above, predominantly fine sand; and interbedded CLAY, sandy, light olive gray; and very coarse sand.
50-64	SAND, as above, predominantly fine quartz sand and interbedded light olive gray clay lenses (minor percentage of sample ~5%).
64-70	LIMESTONE, grayish orange (10YR 7/4), soft to medium hardness, sparry calcite, granular texture.
70-90	LIMESTONE, sparry calcite as above; minor SHELL, white, unlithified, and very fine quartz sand, unlithified.
90-110	LIMESTONE, sparry calcite as above, grayish orange to dark yellowish orange, soft to medium hardness, granular texture, sparry calcitic matrix; sandy quartz, fine grains, possible unconsolidated; shell fragments common, white.
110-119	LIMESTONE, grayish orange (10YR 7/4), to dark yellowish orange (10YR 6/6), soft to medium hardness, sparry calcite matrix, sandy granular texture; quartz, shell fragments, fine to coarse cemented grains, minor white shell, loose; SAND, unconsolidated from desander, minor amount, some recirculation.
119-120	SAND layer, fine to coarse quartz grains, and medium gray sandstone/limestone, fine to coarse.
120-125	LIMESTONE, pale yellowish brown (10YR 6/2), hard, sandy, very fine quartz and phosphate grains cemented in calcareous matrix, very fine granular texture, very fine SAND, quartz and phosphatic, being produced from desander (increased amount).

RO-1 LITHOLOGIC LOG

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-1	
Depth in Feet Below Land Surface	**Description**
125-130	LIMESTONE, as above, 80%, darker in color; and SHELL, very pale orange (10YR 8/2), unconsolidated, 20% of sample, from 127 feet.
130-135	As above, hard.
135-140	As above, minor shell.
140-145	As above, abundant phosphate sand and gravel from 142'. Abundant shell and phosphatic sand from 144', unconsolidated.
145-150	SANDY LIMESTONE/ SANDSTONE, 60%, grayish orange (10YR 7/4), pale yellowish brown (10YR 6/2) and medium gray (N5), hard, sparry granular texture to fine micritic matrix, very sandy with fine quartz and phosphate grains; SHELL, 20% as above; SAND, 20%, quartz and phosphate grains, very fine to gravel size.
150-155	SANDY LIMESTONE/ SANDSTONE, 90%, as above, hard, common densely lithified; SHELL and SAND, 10%, unconsolidated, as above; and LIMESTONE, light olive gray, very dense and hard, microcrystalline.
155-160	SANDY LIMESTONE/ SANDSTONE, 40%, as above, large fragments, loose; and SAND, 30%, shelly, phosphatic and quartz grains, fine to coarse size, unconsolidated.
160-165	SHELL, 60%, very pale orange (10YR 8/2), and light olive gray (5Y 6/1), loose fragments, sand size to 5 mm; SAND, 20%, quartz and phosphate grains, fine to coarse size; LIMESTONE, 20%, very pale orange calcarenite, as above, light olive gray, hard, with cemented shell, sandy.
165-170	SHELL, as above, 80%; SAND, quartz and phosphate, 20%, unconsolidated to poorly consolidated.
170-174	LIMESTONE, 80%, medium dark gray, (N3) to grayish olive green (5GY 3/2) hard; sandy, cemented white shell, and loose SHELL, 20%, as above.
174-180	LIMESTONE, 100%, yellowish gray (5Y 8/1) to very light gray (N8), medium hardness, very fine quartz and phosphate sand, cemented, white shell, softer and friable with depth.
180-185	LIMESTONE, as above, and medium gray LIMESTONE, medium hardness, sandy; fine sand grains, 80%, quartz and phosphate; SHELL, 20%, unconsolidated.
185-190	LIMESTONE, as above, 60%; SHELL, 40%; and SAND, minor, unlithified, as above.
190-195	As above, Limestone becoming predominantly medium-light gray (N6).

RO-1 LITHOLOGIC LOG

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-1	
Depth in Feet Below Land Surface	**Description**
195-200	LIMESTONE, medium light gray (N5-N7), soft to hard, fine granular texture, sandy, fine quartz and phosphate grains, cemented shell fragments; SHELL and SAND as above, interbedded, unconsolidated. Ratio of consolidated to consolidated varies in interval from 50:50 to 80:20, respectively.
200-215	LIMESTONE, 80%, medium gray (N5) to light olive gray (5Y 6/1), medium to hard, fine granular texture, moldic from 203', calcite spar, good permeability from 203', sandy as above; and SHELL, 20%, light yellowish gray, unconsolidated, minor sand.
215-225	As above, minor marly, increase in shell content to 40%.
225-230	LIMESTONE, 60%, as above, becoming predominantly light olive gray (5& 5/2), soft to medium sandy, minor marly (clayey); and SHELL as above, 40%.
230-240	As above, increasing shell content with depth (varies, but max 50% shell), minor unlithified SANDY CLAY, light olive gray, phosphatic.
240-245	LIMESTONE, as above, 50%, and SHELLY MARL, light olive gray to yellowish gray, 50%, fine quartz and phosphatic sand, minor clayey.
245-255	LIMESTONE and MARL, as above, marl 70%; limestone 30%.
255-290	SHELL, 50%, yellowish gray to light olive gray (5Y 7/2 to 5Y 5/2), unconsolidated fragments, and MARL, 50%, light olive gray, loose, clayey, sandy with fine quartz shell fragments and phosphate grains, unlithified.
290-310	LIMEMUD MARL, 70%, light olive gray (5Y 5/2), unlithified, clayey, fine sandy as above, better consolidation, denser clay.
310-320	LIMEMUD MARL, as above, and CLAY, olive gray (5Y 4/1), dense clayey texture, fine silty; and SAND, quartz and phosphate grains.
320-350	CLAY, 100%, grayish olive (10Y 4/2), unlithified, clayey, sandy, very fine quartz and phosphate grains, silty, minor shell fragments, as above.
350-380	CLAY, 100%, olive gray (5& 4/2), unlithified, clayey, very phosphatic, abundant very fine sand, quartz and phosphate grains.
380-410	CLAY, as above, very sandy but dense clayey consolidation, forams.
410-440	CLAY, as above, becoming predominantly very fine silty / clayey texture, less phosphatic, forams.
440-470	CLAY, as above, grayish olive, (10Y 4/2), forams are 0.5 mm in size.
470-500	CLAY, as above, pale olive (10& 5/2), more clayey and finer grained with depth.

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-1	
Depth in Feet Below Land Surface	Description
500-560	CLAY, as above, dense, clayey, greasy texture.
560-590	CLAY, as above, becoming light olive gray with depth; and minor interbedded light gray clay.
590-620	CLAY, dusky yellow green (5GY 5/2, 5 GY 4/2) clayey fine greasy texture, silty; and CLAY, grayish olive green (5GY 3/2), dense clayey to fine sandy texture.
620-680	CLAY, as above, predominantly grayish olive green (5GY 3/2), dense, clayey to very fine sandy texture.
680-770	CLAY, as above, very dense, stiff clay, grayish olive (10& 4/2).
770-800	CLAY, 100%, olive gray (5Y 3/2), very dense, clayey, stiff, trace of light olive gray limemud at 800'.
800-815	CLAY, as above, 90%, and LIMEMUD, light olive gray, (5Y 5/2), sandy, quartz and phosphatic grains, unlithified, loose, sandy texture.
815-825	CLAY, as above, 50%, and LIMEMUD, 50%, light olive gray (5Y 8/2), dense, clayey, with interbedded quartz and phosphatic sandy clay, as above.
825-831	CLAY, 80%, light olive gray (5Y 5/2), dense clayey texture, stiff; and LIMESTONE, light olive gray (5Y 4/2), somewhat darker, hard but brittle, microcrystalline; minor interbedded SAND, quartz and phosphate grains, unconsolidated.
831-834	CLAY, as above, and CHERT, minor percentage, olive gray (5Y 3/2), very hard, microcrystalline, interbedded.
834-845	LIMEMUD, 70%, light olive gray (5Y 5/2), unlithified, clayey, sandy, quartz and phosphate grains, interbedded quartz and phosphatic sand, fine to coarse grains; and LIMESTONE, 30%, moderate olive brown (5Y 4/4) and light olive gray, soft to hard, sandy with cemented quartz phosphatic grains as above, good moldic porosity, casts common.
845-850	Interbedded LIMEMUD 80% and LIMESTONE, 20%, "marl" as above, limestone is soft, friable to medium hardness; large pebble size phosphate fragments; chert nodules within limemud indicates high silica content in clay.
850-860	As above, LIMEMUD (marl), 90%; LIMESTONE, 10%, and highly interbedded with phosphate gravel and chert layers, limestone olive black (5Y 2/1) to black (N1), hard.
860-870	Marl, as above, and light yellowish gray (5Y 8/1), minor marl, sandy, less phosphatic than above. Limestone is soft and friable.
870-882	Marl, as above, predominantly LIMEMUD.
882-895	CLAY, dusky yellow green (5GY 5/2), dense sticky texture, very fine grained, clayey.

RO-1 LITHOLOGIC LOG

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-1	
Depth in Feet Below Land Surface	**Description**
895-900	As above, transitioning to LIMESTONE.
900-920	LIMESTONE, 90%, pale orange (10yr 8/2), soft to medium hardness, calcarenite to microcrystalline, granular to moldic, casts, molds common; and 10% LIMEMUD, same, unlithified and friable LIMESTONE, decreasing percentage with depth. Fair to moderate permeability.
920-950	As above, very soft and friable to medium hardness, predominantly granular, low permeability, minor moldic porosity. (Note: green clay in sample at top of interval. Probably from above.)
950-1010	As above, uniform limestone, very soft to medium hardness.
1010-1030	LIMESTONE, 100%, very pale orange (10YR 7/2), soft, friable, granular texture, calcarenite, low permeability.
1030-1040	LIMESTONE, as above, slightly finer-grained.
1040-1045	LIMESTONE, as above, 90%, but harder, molds casts vugged porosity; 10% darker limestone, mottled dark yellowish brown (10YR 4/2), fine-grained matrix with cemented fossiliferous limestone as above, low to medium permeability.
1045-1050	LIMESTONE, 100%,very pale orange (10YR 7/2), soft to medium hardness, granular texture, calcarenite, low permeability.
1050-1055	LIMESTONE, 100%, as above, with Lepidocyclina Ocalina fossils.
1055-1065	LIMESTONE, 100%, as above, microfossiliferous.
1065-1085	LIMESTONE, 100%, very pale orange, microfossiliferous (cones, casts), soft to medium hardness, from 1075-1080 very soft.
1085-1110	LIMESTONE, 100%, as above, but very soft.
1110-1120	LIMESTONE, 100%, as above, with Lepidocyclina Ocalina fossils.
1120-1125	LIMESTONE, 100%, white (N9), medium-hard, dense, low permeability.
1125-1130	LIMESTONE, 100%, very pale orange (10YR 7/2), microfossiliferous calcarenite, soft, low permeability.
1130-1135	LIMESTONE, 100%, white (N9), medium-hard, dense, low permeability.
1135-1140	LIMESTONE, 100%, very pale orange (10YR 7/2), microfossiliferous calcarenite, medium hardness, low permeability.
1140-1145	LIMESTONE, 100%, as above, with vugged porosity, low to medium permeability.

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-1	
Depth in Feet Below Land Surface	**Description**
1145-1155	LIMESTONE, 100%, very pale orange (10YR 7/2), microfossiliferous calcarenite, numerous discs, cones, casts and molds, vugged porosity, medium hardness, low to medium permeability.
1155-1160	LIMESTONE, 100%, very pale orange (10YR 7/2), microfossiliferous calcarenite, very soft, low permeability.
1160-1165	FOSSILIFEROUS LIMESTONE, 100%, very pale orange (10YR 7/2), very fossiliferous, abundant casts, forams, discs and cones, medium-hard, medium permeability, vugged porosity.
1165-1170	SILTSTONE, 80%, medium gray (N5), soft, friable; LIMESTONE, 15%, as above; MARL (limemud), 5%, very light gray, as apparent in drilling mud. Low permeability.
1170-1175	LIMESTONE, 100%, very pale orange (10YR 7/2), microfossiliferous calcarenite, very soft, low permeability; minor limemud.
1175-1180	FOSSILIFEROUS LIMESTONE, 100%, very pale orange (10YR 7/2), very fossiliferous, abundant casts, forams, discs and cones, medium-hard, medium permeability, vugged porosity.
1180-1190	FOSSILIFEROUS LIMESTONE, as above, but softer, lower permeability.
1190-1195	FOSSILIFEROUS LIMESTONE, as above; trace limemud.
1195-1200	SILTSTONE, 60%, medium gray (N5), soft, friable; LIMESTONE, 40%, as above; MARL, trace, medium gray (N5), clayey. Very low permeability.
1200-1210	LIMESTONE, 100%, microfossiliferous calcarenite, very pale orange (10YR 7/2), very soft, granular texture, low permeability.
1210-1220	FOSSILIFEROUS LIMESTONE, 100%, very pale orange (10YR 7/2), abundant cones and discs with other granular fossil fragments. Low to medium permeability.
1220-1225	LIMESTONE, 100%, very pale orange (10YR 7/2), harder than above (moderately hard), and denser. Frequent discs and cones, moderately well cemented, some vugged porosity. Low permeability.
1225-1235	LIMESTONE, 100%, pale orange to grayish orange (10YR 7/2 to 10YR 7/4), medium hardness and soft; mottled with light gray (N7) medium vugged, moderate permeability.
1235-1240	LIMESTONE, as above, but medium to hard, microcrystalline texture, vugged and moldic porosity, medium to high permeability .
1240-1245	LIMESTONE, very pale orange to very light gray, medium hardness to soft, granular fossiliferous calcarenitic texture to fine microcrystalline, fine vugged porosity, low to medium permeability.

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-1	
Depth in Feet Below Land Surface	**Description**
1245-1250	LIMESTONE, as above, predominantly pale orange, low permeability, fossiliferous.
1250-1255	LIMESTONE, pale orange (107 8/2) to very light gray (N7), soft to medium hardness, fine granular texture, microfossiliferous, large fossil fragments, molds; and microcrystalline, harder limestone, cemented fossil fragments, light mottled appearance, low to medium permeability.
1255-1260	LIMESTONE, 90%, yellowish gray (5Y 7/2), medium hardness, casts and molds, well cemented, fine granular texture, microfossiliferous, low permeability; MARL, 10%, white (n9), clayey; Overall very low permeability.
1260-1265	(Interbedded): LIMESTONE, 50%, very light gray (N8), microcrystalline, medium hard, low permeability; LIMESTONE, 30%, very pale orange (10YR 8/2), medium-hardness, fine granular texture; DOLOMITE, 10%, yellowish gray, dense, microcrystalline, hard, angular cuttings; CLAY, 10%, grayish olive (10Y 4/2), wet, plastic. Overall permeability very low.
1265-1270	LIMESTONE, 50%, very light gray (N8), microcrystalline, medium-hard, low permeability; LIMESTONE, 40%, very pale orange (10YR 8/2), medium hardness, fine granular texture; CLAY, 10%, GRAYISH OLIVE (10Y 4/2), plastic, very low permeability.
1270-1285	LIMESTONE, 100%, very pale orange (10YR 8/2), granular texture, (equivalent to medium grained calcareous sand), microfossiliferous, very soft, poorly lithified, low permeability.
1285-1290	LIMESTONE, 90%, very pale orange (10YR 8/2), medium hardness, dense, microcrystalline, small vugs, forams (discs); trace INTERBEDDED ORGANIC SILT, thin laminar beds, dark gray (N3) and grayish black (N2), soft, friable to muddy texture; trace SILTY CLAY, dark gray (N3), plastic; trace CLAY, greenish gray (5G 6/1). Overall low permeability.
1290-1295	LIMESTONE, 80%, very pale orange (10YR 8/2), microfossiliferous, numerous discs and cones, granular texture, calcarenite; MARL, 20%, white, calcareous, very soft, wet, plastic; trace SILTSTONE, grayish olive (10YR 4/2), interbedded in fine laminar bed(s). Low to moderately low permeability.
1295-1300	As above, but no siltstone noted.
1300-1305	LIMESTONE (CALCAREOUS SANDSTONE), 100%, grayish orange (10YR 7/4), very poorly cemented calcareous grains, (has the appearance of oolitic sand), fine to medium grained, low permeability.
1305-1310	LIMESTONE, 90%, very pale orange (10YR 8/2), soft to medium hardness, fossiliferous (discs, cones), granular texture; MARL, 10%, white, wet, greasy texture. Low permeability.

RO-1 LITHOLOGIC LOG

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-1	
Depth in Feet Below Land Surface	**Description**
1310-1315	LIMESTONE, 100%, very pale orange (10YR 8/2), arenaceous, very soft, poorly cemented (comes up as calcareous sand) medium to coarse-grained, discs, cones, and small shell/fossil fragments; marly limemud infilling. Low permeability.
1315-1325	LIMESTONE, as above; trace CLAY, greenish-gray (5G 6/1); trace SILTSTONE, dark gray (N3), friable. Low permeability.
1325-1335	DOLOMITIC LIMESTONE, 100%, very pale orange (10YR 8/2), well-cemented, microcrystalline, dense, angular fragments, occasional forams (discs), very low permeability.
1335-1340	DOLOMITIC LIMESTONE, as above, with 10% dolomite fragments, pale yellowish brown.
1340-1345	LIMESTONE (CALCAREOUS SANDSTONE), 60%, very pale orange (10YR 8/2) very poorly cemented calcareous grains, (granular calcarenite, has the appearance of oolitic sand), very fine to coarse-grained,; LIMEMUD, 20%, as milky infilling/matrix; CLAY, 10%, yellowish gray (5Y 8/1); DOLOMITE, 10%, pale yellowish brown (10Yr 6/2), angular chips. Low overall permeability.
1345-1350	DOLOMITE, 90%, pale yellowish brown (10YR 6/2), dense, hard, micritic (microcrystalline), angular chips; LIMESTONE, 10%, very pale orange, sparry, dense; trace CLAY, yellowish gray (5Y 8/1), hard. Low primary permeability.
1350-1355	As above, with trace of MARL (limemud), white, clayey.
1355-1360	FOSSILIFEROUS LIMESTONE, 100%, very pale orange (10YR 8/2), soft, abundant forams (discs, cones), granular texture; trace dolomite as above; trace LIMEMUD (matrix). Low permeability.
1360-1365	FOSSILIFEROUS LIMESTONE, as above; echinoids also present.
1365-1370	LIMESTONE, 100%, very pale orange (10YR 8/2), moderately soft, forams and echinoids present, but not as abundant as above; trace LIMEMUD, white. Low permeability.
1370-1375	LIMESTONE, as above, 70%, medium to hard, fine granular texture to microcrystalline, minor fossiliferous, low permeability; and DOLOMITE, 30%, grayish green (10GY 6/2), hard, microcrystalline. Low to medium permeability.
1375-1380	LIMESTONE, 50%, very pale orange (10YR 8/2), medium hardness to soft, granular, fossiliferous, medium is microcrystalline; and interbedded DOLOMITE / DOLOMITIC LIMESTONE, yellowish brown (10YR 6/4), and pale yellowish brown (10Yr 7/2), hard, microcrystalline, dense and vugged, low to medium permeability.
1380-1385	As above, highly interbedded LIMESTONE and DOLOMITE; minor unlithified same limemud and dolosilt.

RO-1 LITHOLOGIC LOG

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-1	
Depth in Feet Below Land Surface	**Description**
1385-1390	LIMESTONE, 60%, grayish orange (10YR 7/4), hard, microcrystalline, dolomitic, well vugged, fine pores, low to medium permeability; and LIMESTONE, 40%, very pale orange (10YR 8/2), as above, medium-soft, granular.
1390-1395	LIMESTONE, 50%, light olive gray (5y 6/1), hard, dolomitic, microcrystalline, low permeability; and LIMESTONE, very pale orange (10Y 8/2), soft to medium, granular, low permeability; minor unlithified LIMEMUD, same.
1395-1400	LIMESTONE, very pale orange (10YR 8/2), soft, granular texture, calcarenite, microfossiliferous, abundant discs, few cones, forams.
1400-1415	LIMESTONE, as above, very soft, friable, very pale orange to white.
1415-1420	LIMESTONE, as above, becoming hard with depth, micritic matrix, very fine grained; and interbedded LIMESTONE, pale orange, (10yr 7/2) (darker color), hard, well vugged, crystalline, low to medium permeability.
1420-1425	DOLOMITE, 60%, pale yellowish brown, hard, microcrystalline; LIMESTONE, 40%, medium-soft, granular as above; LIMEMUD, minor, clayey, greenish gray, dense.
1425-1430	DOLOMITIC LIMESTONE, 60%, as above, dolomite matrix with microfossils, pale orange clasts, medium granular; and LIMESTONE, 40%, pale orange, soft, calcarenite, low permeability.
1430-1435	LIMESTONE, calcarenite, soft, as above, very pale orange.
1435-1440	LIMESTONE, 100%, very pale orange (10YR 8/2), to white, hard to medium, very fine granular to microcrystalline texture, minor fossiliferous, minor vugged, low to medium permeability.
1440-1447	LIMESTONE, as above, 50%, and as more coarse granular and fossiliferous, soft to medium, 50%.
1447-1452	DOLOMITE, pale yellowish brown (10YR 6/2), becoming olive gray (5Y 5/1) with depth, hard, microcrystalline, vugged, black staining in voids, medium permeability; minor DOLOSILT, grayish green (5G 5/2), clayey, dense. Low permeability.
1452-1462	LIMESTONE, 100%, very pale orange (10YR 8/2) to white, soft, granular calcarenitic texture, common fossiliferous, low permeability, cones and discs, forams.
1462-1464	Interbedded LIMEMUD, dark yellowish brown (10YR 4/2) with thin laminar beds of siltstone, dusky brown to black (5YR 2/2 to N1), clayey to very soft lithification, organic, common calcarenitic fragments and microfossils interbedded, low permeability.
1464-1475	LIMESTONE, 100%, very pale orange (10YR 8/2), soft, calcarenite, microfossiliferous cemented sand, abundant forams, low permeability.

RO-1 LITHOLOGIC LOG

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-1	
Depth in Feet Below Land Surface	**Description**
1475-1480	LIMESTONE, as above, to white (N10), medium hardness, minor vugged, molds, low permeability.
1480-1495	LIMESTONE, as above, soft to medium hardness.

APPENDIX A

RO-2
LITHOLOGIC LOG

RO-2 LITHOLOGIC LOG

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-2	
Depth in Feet Below Land Surface	**Description**
0-20	SAND, 90%, colorless, fine to medium quartz grains, sub-rounded; LIMESTONE, 10%, assorted light gray, very light gray and white fragments, microcrystalline to very fine-grained.
20-30	SAND, 100%, colorless, fine to medium quartz grains, sub-rounded.
30-37	SAND, 100%, iron-stained, fine to medium quartz grains, sub-rounded.
37-40	SAND, as above, 80%; CLAY, 20%, medium gray, soft, plastic.
40-50	SAND, 100%, colorless to iron-stained, fine to medium quartz grains, sub-rounded; LIMESTONE, trace, medium gray to very pale orange, small particles; thin layer at 48'.
50-58	SAND, 100%, colorless to frosted quartz grains, medium grained; LIMESTONE, trace, medium gray and very pale orange fragments.
58-60	SAND, as above; LIMESTONE increasing to 10%, as a limestone layer(s) from 58-60', very dense, well indurated.
60-70	LIMESTONE, grayish orange, sparry calcite (crystalline calcite), translucent crystals, medium-grained. (Note: appearance of sandstone; verified calcite with acid).
70-79	LIMESTONE, 90%, grayish orange, medium hardness, sparry calcite, granular texture; SAND, 10%, colorless, very fine-grained quartz, increasing with depth; and CLAY, trace, medium gray, plastic, soft; minor SHELL fragments.
79-80	As above, with shell content increasing to 10%, possible shell layer at 80'.
80-85	LIMESTONE, 80%, as above; SAND, 10%, colorless, very fine-grained quartz (sand may be recirculating); SHELL fragments, 10%; minor clay, medium gray, plastic, soft; sharks teeth minor.
85-90	LIMESTONE, 90%, grayish orange, medium hardness, sparry calcite, fine granular texture; SHELL fragments, 10%, white; SAND, colorless, very fine-grained quartz, possibly recirculating.
90-95	LIMESTONE, 95%, as above, becoming microcrystalline, denser, harder, especially at 91-92', SHELL fragments <5%; SAND, minor, colorless, very fine-grained quartz.
95-103	As above, with minor MARL.
103-110	SHELL FRAGMENTS, 90% very pale orange, loose fragments, sand size to 5 mm; LIMESTONE, 10%, grayish orange, sparry fine granular to microcrystalline texture; SAND, minor, as above.
110-113	SHELL HASH: comprised of shell fragments up to 2 mm with 50% quartz and phosphatic sand grains.

RO-2 LITHOLOGIC LOG

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-2	
Depth in Feet Below Land Surface	**Description**
113-120	SHELLY LIMESTONE: comprised of LIMESTONE, 50%, grayish orange, sparry calcite, fine granular to microcrystalline texture, translucent, dense, moderately hard (rough drilling); SHELL, 50%, small whole shells and fragments, very pale orange; and SAND, 10%, as above.
120-125	SHELLY LIMESTONE, as above, with SHELL increasing to 60%, LIMESTONE 30%, and SAND <10%.
125-130	SHELLY LIMESTONE: comprised of LIMESTONE, 50%, sparry calcite, inclusions of sand-sized shell fragments within the matrix; SHELL, 50%, increasing with depth, various sizes, primarily 1/4" to 1/2", occasionally up to 1", unconsolidated; LIMEMUD, minor; and BEACH ROCK, minor, as well-rounded or flattened pebbles of fine-grained coquina.
130-135	SHELL, 100%, very pale orange and light gray, small fragments from sand-size up to 2 mm; SAND, minor, quartz; LIMESTONE, minor, sparry calcite as above; LIMEMUD, MINOR.
135-140	As above, but shell color changed to 80% grayish black (N2) shell fragments, <1mm in size, and 20% very pale orange (10YR 8/2) (natural color) shell fragments, 1/4" in size.
140-145	As above, but grayish-black shell fragments decreasing in size with depth, avg. size is medium to coarse-grained sand size.
145-160	SHELL HASH: comprised of 80% grayish black shell fragments, sand size particles; and 20% tiny whole shells and shell fragments, very pale orange (natural color); and trace quartz sand. Overall appearance of a black sand beach.
160-163	SHELL HASH: comprised of 30% medium gray (N5) and medium dark gray (N4) tiny sand-sized shell fragments, up to 1mm, with some tiny whole shells; minor quartz sand. Overall appearance is approaching a coarse, calcareous sand. Note: desander inflow contains 50% sand in mud sample. Distribution is 50% quartz and 50% shell (calcareous sand).
163-165	SHELL HASH, as above, 95%; LIMESTONE, 5%, very pale orange (10YR 8/2) as sand-size fragments; QUARTZ grains, 50%; and minor CLAY, medium gray, soft, plastic. Note: Harder layers at 163', 165', and 167'. Possibly very thin shelly limestone layers.
165-171	As above, with increase in dark gray component of shell (50% grayish black and medium dark gray, and 50% very pale orange and yellowish gray).
171-175	SHELLY LIMESTONE: comprised of LIMESTONE, 80%, yellowish gray (5Y 8/1), soft to medium hardness, biosparite, occurring as small fragments (sand-sized to 1 mm); SHELL, 20%, medium gray, medium dark gray and yellowish gray, as small fragments (sand size to 1 mm); trace quartz sand.

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-2	
Depth in Feet Below Land Surface	**Description**
175-180	"PHOSPHATIC" SHELLY LIMESTONE: comprised of LIMESTONE, 60% yellowish gray (5Y 8/1), biosparite, soft to medium hardness, friable, as above, occurring as small fragments (sand sized to 1 mm); SHELL, 20%, medium gray (N5) to dark gray (N3) and yellowish gray (5Y 8/1), as tiny fragments, sand sized up to 2mm; and trace very fine quartz sand.
180-185	SHELLY LIMESTONE: comprised of SHELL, 90%, yellowish gray (5Y 8/1) and light gray (N7), occurring as tiny fragments, all less than 1mm; and LIMESTONE, 10%, yellowish gray (5Y 8/1), biosparite, soft, friable. (Overall appearance is a coarse calcareous sand).
185-187	SHELLY LIMESTONE, as above, limestone increasing to 30%, yellowish gray (5Y 8/1) and also some light gray (N7) due to inclusions of microscopic phosphatic particles.
187-190	SHELLY LIMESTONE: comprised of LIMESTONE, 60%, light gray (N7), fine granular texture, friable; SHELL, 40%, primarily yellowish gray, also light gray, and some medium gray (N5) phosphatic shell fragments, overall larger size fragments than above, shell fragments range from 1/4" to 3/4" in size; and minor phosphatic particles, 1/4' in size, sub-rounded (first appearance). Rough drilling.
190-195	SHELLY LIMESTONE, as above, but limestone increasing to 80% with depth, shell size returned to small fragments up to 1/4". Rough drilling
195-205	SHELLY LIMESTONE: comprised of LIMESTONE, 90%, medium light gray (N6) to medium dark gray (N4) and minor yellowish gray (5Y 8/1), fine granular texture, friable, soft to medium hardness; SHELL <10%, as above, interbedded, fragments varying with layers, most less than 1 mm, but frequently up to 1/2" in size; minor phosphatic granules, grayish black (N2), up to 1/4' in size, sub-rounded; and trace limemud.
205-220	LIMESTONE, 95%, medium light gray to medium gray (N5), with some yellowish gray (5Y 8/1), moderately hard; and SHELL <5%, as small whole shells or fragments up to 1/2".
220-240	LIMESTONE, 90%, light gray (N6) to medium gray (N5), fine granular texture, moderately hard; SHELL, 10%, yellowish gray to very pale orange, as fragments 1mm to 1/2" in size, interbedded; minor clay, light gray (N7), soft; and minor sand, quartz and phosphate, very fine grained. Becoming softer with depth, more friable limestone.
240-243	MARLY LIMESTONE: comprised of LIMESTONE, 50%, as above; MARL, 40%, increasing with depth, to 60%, light gray (N6), soft, sandy (phosphatic), unlithified; and SHELL, 10%, as above.

RO-2 LITHOLOGIC LOG

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-2	
Depth in Feet Below Land Surface	**Description**
243-250	MARL, 80%, light greenish gray (5GY 8/1), unlithified, soft; LIMESTONE, 20%, light olive gray (5Y 6/1), to medium light gray (N6), medium hardness, fine granular texture; and minor phosphatic sand.
250-305	MARL, 90%, as above; SANDY PHOSPHATIC LIMESTONE, 10%, grains from very fine to coarse; minor phosphatic and quartz sand.
305-340	MARL, 80%, as above; LIMESTONE, 20%, as above, particle size increasing to 2mm.
340-355	MARL, 80%, dusk yellow green (5GY 5/2), unlithified, soft; SANDY PHOSPHATIC LIMESTONE, 20%, very fine to coarse-grained fragments.
355-365	As above, marl increasing to 90%.
365-465	SANDY MARL, dusky yellow green (5GY 5//2), as above, unlithified, soft, sandy, calcareous, quartz, and phosphatic sands up to 10% of volume, very fine to medium grained.
465-485	SANDY MARL, as above, with frequent lumps of denser, silty marl, still unlithified, less watery than the main mass, lumps approaching clay-like texture.
485-500	MARLY CLAY, 100%, dusky yellow green (5GY 5/2), marl as above, with frequent lumps of clay, same color, plastic texture, sandy as above, with very fine grains of quartz and phosphate, and fine to medium-grained limestone particles.
500-540	CLAY, 100%, dusky yellow green (5GY 5/2), silty, sandy, phosphatic (as above), soft, slightly plastic.
540-580	CLAY, 100%, dusky yellow green (5GY 5/2), as above, becoming more clay-like (plastic), less silty.
580-600	CLAY, 100%, dark greenish gray (5GY 4/1), as above, plastic.
600-650	CLAY, 100%, as above, becoming more plastic; occasional fragments of biosparite limestone.
650-690	CLAY, 100%, dark greenish-gray (5GY 4/1), plastic, silty, with very fine-grained quartz sand; occasional trace, limestone fragments.
690-700	CLAY, 100%, dark greenish gray (5GY 4/1), and trace of light olive gray (5Y 6/1), plastic, silty, with very fine-grained sand, quartz and some phosphatic; trace limestone fragments.
700-740	CLAY, 100%, olive gray (5Y 3/2), silty, becoming slightly less plastic.

RO-2 LITHOLOGIC LOG

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-2	
Depth in Feet Below Land Surface	**Description**
740-760	CLAY, 100%, olive gray (5Y 3/2), becoming less silty, more "greasy", somewhat plastic; occasional shell fragments.
760-825	CLAY, as above, becoming stiffer, less plastic.
825-840	CLAY, light olive gray (5Y 6/1) to olive gray (5Y 4/1), as above; minor chert, olive gray (5Y 4/1); minor shell fragments; and minor minerals, moderate reddish brown (10R 4/6) and phosphate grains, grayish-black (N2), very fine to coarse-grained, sub-rounded particles.
840-850	CLAY, 90%, light olive gray (5Y 6/1) to yellowish gray (5Y 8/1), soft, marly; and LIMESTONE, <10%, yellowish gray (5Y /2), soft, granular; minor minerals (phosphate grains).
850-855	MARLY CLAY, 95%, as above; LIMESTONE, 5%, as above (interbedded).
855-870	CLAY, 50%, olive gray (5Y 4/1), dense, stiff; interbedded MARLY LIMESTONE, 50%, comprised of limemud, yellowish gray, and limestone, yellowish-gray, soft, friable biomicrite.
870-890	MARLY LIMESTONE, 80%, as above; CLAY, 20%, olive gray (5Y 4/1), as above, decreasing with depth; and minor dolomite, sucrosic to microcrystalline, vugged porosity.
890-895	CLAY, 80%, as above; MARLY LIMESTONE, 20% as above, containing very fine-grained quartz and phosphate sand.
895-910	CLAY, 90%, as above; MARLY LIMESTONE, 10% as above; minor dolomite, sucrosic to cryptocrystalline, vugged porosity.
910-920	MARLY LIMESTONE, 90%, as above, soft; CLAY, 10%, as above; and minor dolomite, as above, with occasional casts of dolomitized shells, vugged, moldic porosity.
920-940	LIMESTONE, 90%, yellowish gray, fine, granular texture; CLAY, 10%, olive gray, as above; and minor dolomite, as above.
940-954	LIMESTONE, 95%, as above, minor marly; clay 5%, as above. Becoming more marly with depth.
954-965	LIMESTONE, 50%, as above; CLAY, 50%, olive gray, as above.
965-970	As above, limestone increasing to 90%.
970-980	As above, but limestone very soft, becoming slightly marly.
980-985	As above, but limestone slightly harder (soft to medium-soft).

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-2	
Depth in Feet Below Land Surface	**Description**
985-990	As above, with minor phosphatic marl, yellowish gray, plastic, speckled with phosphate granules.
990-995	LIMESTONE, 100%, yellowish gray, fine granular texture, soft to medium hardness, minor marly; and minor clay, as above (probably falling in from higher up).
995-1014	LIMESTONE, 100%, yellowish gray, fine granular texture, very soft, minor marly. (Final returns at 1014' contained a few medium-hard limestone pieces.)
1014-1050	LIMESTONE, 100%, yellowish gray (5Y 8/1), fine granular texture, soft, low permeability, minor shell fragments.
1050-1060	LIMESTONE, 100%, 60% yellowish gray and 40% moderate yellowish brown (5Y 8/1 and 10YR 5/4), soft to moderate hardness, increased consolidation, trace fossils (bone); minor marly, very light gray (N8); low to medium permeability.
1060-1065	LIMESTONE, as above, fossils include Lepidocyclina.
1065-1070	LIMESTONE, as above, fewer fossils than above.
1070-1075	LIMESTONE, as above, microfossiliferous.
1075-1085	LIMESTONE, 100%, yellowish gray (5Y 8/1), soft, fine granular texture, low permeability; minor clay, pale olive (10Y 6/2).
1085-1090	LIMESTONE, 100%, yellowish gray (5Y 8/1), soft to medium hardness, fine granular texture, microfossiliferous, small forams present, low to medium permeability.
1090-1100	As above, but very soft. Resembles calcareous beach sand.
1100-1105	LIMESTONE, 100%, yellowish gray (5Y 7/2), medium hardness, coarser texture, fossiliferous, especially forams, discs, cones. Moderate permeability.
1105-1120	LIMESTONE, as above, but soft, granular texture as in 1090-1100'.
1120-1125	LIMESTONE, 100%, yellowish gray, very soft, fine granular texture, microfossiliferous, numerous forams, Lepidocyclina Ocalina, low to moderate permeability, resembles calcareous beach sand.
1125-1140	LIMESTONE, 100%, yellowish gray (5Y 8/1), soft to medium hardness, larger cutting size, some fragments are dense, well indurated, possibly interbedded, fossiliferous, with forams, discs, moderate permeability.
1140-1170	LIMESTONE, 100%, yellowish gray (5Y 8/1), very soft, fine granular texture, low permeability. Resembles calcareous beach sand.
1170-1175	LIMESTONE, as above, but moderately soft.

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-2	
Depth in Feet Below Land Surface	Description
1175-1180	LIMESTONE, 100%, yellowish gray (5Y 8/1), very soft, fine granular texture, low permeability. Resembles calcareous beach sand.
1180-1195	LIMESTONE, 100%, yellowish gray (5Y 8/1), very soft, fine granular texture (as calcareous beach sand), microfossiliferous, low permeability.
1195-1200	LIMESTONE, 100%, yellowish gray (5Y 8/1), very soft, fine granular texture, slightly microfossiliferous, low permeability.
1200-1210	LIMESTONE, 100%, very pale orange (10YR 8/2), lighter color than previous, fine granular calcarenite, soft to medium hardness, small vugs, microfossiliferous, low to medium permeability.
1210-1220	LIMESTONE, 100%, very pale orange (10YR 8/2), microfossiliferous calcarenite, soft to medium hardness, granular texture, low to medium-low permeability; trace LIMEMUD.
1220-1225	LIMESTONE, as above, with small molds, tiny vugs.
1225-1235	LIMESTONE, 100%, mottled very pale orange (10YR 8/2)), yellowish gray (5Y 8/1) and light gray ((N7), granular texture, microfossiliferous calcarenite, soft to medium hardness, low to medium permeability, tiny vugs and molds.
1235-1240	LIMESTONE, 100%, very pale orange (10Yr 8/2) and yellowish gray (5Y 8/1), medium hardness, fossiliferous calcarenite, abundant casts and small molds, vugged porosity, moderate permeability.
1240-1245	DOLOMITIC LIMESTONE, 100%, very pale orange and some very light gray (N8),soft to medium hardness with thin beds of harder interbedded limestone (bedding planes apparent), medium permeability above and below contacts of these denser, more lithified beds, fossiliferous, abundant forams, Lepidocyclina Ocalina present.
1245-1250	LIMESTONE, 100%, very pale orange (10YR 8/2), very soft to soft, fine-grained biosparite, low to medium permeability.
1250-1255	DOLOMITIC LIMESTONE, 100%, very pale orange, hard, dense, microcrystalline, conchoidal fracture, well indurated, low to medium permeability, as vugs, fractures or contacts.
1255-1260	LIMESTONE, 100%, very light gray (N8), interbedded with yellowish gray (5Y 81), medium hardness, (light gray LS is harder and denser), vugged porosity.
1260-1265	LIMESTONE, 100%, yellowish gray (5Y 81) and very pale orange (10YR 8/2), soft to medium hardness, granular biosparite, occasional forams and echinoids, medium permeability.
1265-1275	LIMESTONE, as above, but softer.

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-2	
Depth in Feet Below Land Surface	**Description**
1275-1285	LIMESTONE, 100%, yellowish gray (5Y 8/1), very pale orange (10R 8/2) and white, granular biosparite, occasional echinoids and forams; trace limemud (marl).
1285-1290	LIMESTONE, 100%, interbedded mixture of: Limestone, yellowish gray, granular, soft; Limestone, yellowish gray to very pale orange, dense, fine-grained, vuggy, medium hard; and Limestone, medium gray (N5), dense, medium hardness, very fine microcrystalline, occasional fossils - echinoids, forams. Overall medium to good permeability, probably very good at contacts of interbeds.
1290-1295	LIMESTONE, 100%, interbedded mixture of: Limestone, very pale orange (10YR 8/2(), granular texture, soft to medium hardness; and Limestone, yellowish gray (5Y 81), medium hardness, microcrystalline, vugged porosity. Overall permeability fair to good. Some fossils present (leps and dictyconus).
1295-1300	LIMESTONE, as above. Lepidocyclina and dictyconus common. Minor silty clay, pale yellowish brown (10 YR 6/2).
1300-1305	LIMESTONE, 95%, white to very pale orange (10YR 8/2) and yellowish gray (5Y 7/2), fine granular texture, soft to medium hardness, moldic and vugged porosity; CLAY, 5%, pale blue green (5BG 7/2) and grayish blue green (5BG 5/2), soft, greasy to plastic; minor marly, white, soft, unlithified. Overall permeability low to medium.
1305-1310	LIMESTONE, 100%, as above (no clay).
1310-1320	LIMESTONE, 100%, very pale orange (10YR 8/2), fine granular texture to microcrystalline, medium hardness, moldic and vugged porosity, minor fossils (forams, some dolomitized), minor white limestone. Medium permeability.
1320-1335	LIMESTONE, as above, minor marly.
1335-1340	LIMESTONE, 100%, yellowish gray (5Y 8/1), light gray (N7) and very pale orange (10YR 8/2), well indurated, moderately hard, microcrystalline (micritic), fair to good porosity, apparent good permeability.
1340-1345	FOSSILIFEROUS LIMESTONE, 100%, very pale orange (10YR 8/2), to white, soft to medium hardness, abundant forams, vugged and moldic porosity, biosparite, good permeability.
1345-1355	LIMESTONE, 100%, very pale orange to white, soft to medium hardness, biosparite, low to medium permeability.
1355-1360	LIMESTONE, 100%, very pale orange (10YR 8/2) to pale yellowish brown (10YR 7/2), medium to hard, microcrystalline, fine vugged porosity, medium permeability.
1360-1365	LIMESTONE, 60%, very pale orange (10YR 8/2), soft, granular texture, calcarenite, low permeability; and LIMESTONE, as above, 40%.

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-2	
Depth in Feet Below Land Surface	**Description**
1365-1371	LIMESTONE, as above to white (N1), 100%, soft, granular calcarenite, friable, low permeability.
1371-1375	DOLOMITIC LIMESTONE, 100%, grayish green (5G 6/2), hard, crystalline, well bugged, medium to high permeability.
1375-1380	As above, microcrystalline; trace clay, pale green (10G 6/2); interbedded pale yellowish brown 910YR 6/2), hard, microcrystalline, mottled with above and pale orange calcarenite, medium hardness. Overall medium permeability.
1380-1385	As above, interbedded, becoming predominantly (80%) very pale orange (10YR 8/2) LIMESTONE, medium to soft, low permeability; minor DOLOMITE/ DOLOSILT, dark yellowish brown (10YR 6/2), very soft but dense consolidated (not clay) laminar bedded grayish green dolosilt.
1385-1390	LIMESTONE, 60%, light gray (N7), hard, microcrystalline to micritic texture, mottled appearance with pale orange and yellowish gray colors; and LIMESTONE, 40%, pale orange, medium hardness, fine granular texture, fine vugged porosity. Overall low permeability.
1390-1395	As above, becoming softer with depth, calcarenitic, soft, microfossiliferous.
1395-1404	LIMESTONE, 90%, pale orange (10YR 7/2), soft, coarse granular texture, calcarenite, microfossiliferous, very soft to poorly lithified.
1404-1410	DOLOMITE 50%, pale olive (10Y 6/2), hard, microcrystalline, some fine vugged porosity; LIMESTONE, as above, 50%, pale orange, soft, interbedded; and LIMEMUD, very pale orange (10Y 7/2), dolomitic, dense, low permeability, sandy calcarenite grains.
1410-1415	LIMESTONE, 100%, very pale orange to white (10YR 8/2 to N1), very soft to poorly lithified, very clean granules, fossiliferous calcarenite (coarse carbonate sand and gravel), cone forams abundant.
1415-1420	As above, slightly darker color, low permeability.
1420-1425	As above and interbedded light gray (N3) limestone, hard, micritic to microcrystalline, low permeability.
1425-1430	As above, slightly harder.
1430-1435	As above, but no gray limestone.
1435-1450	Missing
1450-1455	LIMESTONE, 50%, as above, and same hard microcrystalline limestone 50%, pale yellowish brown (10YR 6/2), low permeability.

RO-2 LITHOLOGIC LOG

SOUTH MARTIN REGIONAL UTILITY REVERSE OSMOSIS WELL NO. RO-2	
Depth in Feet Below Land Surface	**Description**
1455-1460	DOLOMITIC LIMESTONE AND DOLOMITE, mottled light olive gray an yellowish gray (5Y 5/2), hard, microcrystalline, good vugs; interbedded fossiliferous calcarenitic LIMESTONE (as above), disc forams. Overall medium permeability.
1460-1465	LIMESTONE, pale orange, soft to medium fine granular texture, fossiliferous, disc forams, low permeability, darker with depth; minor limemud, yellowish brown (10YR 6/2), dense clayey, low permeability.
1465-1472	Missing
1472-1495	LIMESTONE, very soft, granular calcarenite, very light pale orange, very soft, low permeability, some harder layers, same.

APPENDIX B

GEOPHYSICAL LOGS

APPENDIX B

RO-1
GEOPHYSICAL LOGS

LOG

Company	SOUTH MARTIN
Well	RO - 1
Field	HOBE SOUND
Country	MARTIN
State/Prv	FLORIDA

Company	SOUTH MARTIN REGIONAL UTILITY		
Well	RO - 1		
Field	HOBE SOUND		
Country	MARTIN	State/Prv	FLORIDA
Location		Other Services	FRT X Y / GR
Permanent Datum	PAD	Elevation	K.B.
Log Measured From	PAD		D.F.
Drilling Measured From	PAD		G.L.

Date	20-SEPT-2000	
Run Number	FOUR	
Depth Driller	1494'	
Depth Logger	1494'	
Bottom Logged Interval	1494'	
Top Log Interval	CASING	
Open Hole Size	00"	
Type Fluid	WATER	
Density / Viscosity	NA	
Max. Recorded Temp.	NA	
Estimated Cement Top	NA	
Time Well Ready	ON ARRIVAL	
Time Logger on Bottom	00:00	
Equipment Number	102 FTM	
Location	FT.MYERS	
Recorded By	LEE	
Witnessed By	JIM ANDERSEN	A.KRUPA

Borehole Record				Tubing Record			
Run Number	Bit	From	To	Size	Weight	From	To
ONE	36 1/2"	SURFACE	245'				
TWO	12 1/4"	CASING	1010'				
THREE	26"	CASING	976'				
FOUR	17"	CASING	1494'				

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String	30"	.375 WT	SURFACE	2?8'
Prot. String				
Production String				
Liner				

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All interpretations are opinions based on inferences from electrical or other measurements and we cannot and do not guarantee the accuracy or correctness of any interpretation, and we shall not, except in the case of gross or wilful negligence on our part, be liable or responsible for any loss, costs, damages, or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to our general terms and conditions set out in our current Price Schedule.

Comments

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

Database File: hobero1.db
Dataset Pathname: run4/pass8
Presentation Format: dil.prs
Dataset Creation: Wed Sep 20 16:21:12 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:120

0 Gamma Ray (GAPI) 100	0.2	Deep Resistivity (Ohm-m)
-100 Spontaneous Potential (mV) 1000	0.2	Medium Resistivity (Ohm-m)
	0.2	Shallow Resistivity (Ohm-m)

0 Gamma Ray (GAPI) 100	0.2	Deep Resistivity (Ohm-m)
-100 Spontaneous Potential (mV) 1000	0.2	Medium Resistivity (Ohm-m)
	0.2	Shallow Resistivity (Ohm-m)

Dual Induction Calibration Report

Serial-Model: 1006-R
Surface Cal Performed: Thu Apr 29 13:35:36 1999
Downhole Cal Performed: Wed Sep 20 16:04:13 2000
After Survey Verification Performed: Wed Sep 20 16:04:13 2000

Surface Calibration

	Readings			References			Results	
Loop:	Air	Loop		Air	Loop		m	b
Deep	-0.004	0.684	V	0.000	400.000	mmho-m	581.281	[illegible]
Medium	0.009	0.737	V	0.000	464.000	mmho-m	637.114	[illegible]
Internal:	Zero	Cal		Zero	Cal		m	b
Deep	0.005	0.675	V	5.050	393.400	mmho-m	579.885	[illegible]
Medium	0.003	0.774	V	-2.270	485.650	mmho-m	633.144	[illegible]

Downhole Calibration

	Readings			References			Results	
Internal:	Zero	Cal		Zero	Cal		m	b
Deep	11.289	418.927	mmho-m	5.020	394.306	mmho-m	0.955	[illegible]
Medium	4.627	524.266	mmho-m	-3.609	487.371	mmho-m	0.945	[illegible]
Shallow	0.033	2.414	V	14.000	1330.000	Ohm-m	552.767	[illegible]

After Survey Verification

	Readings			Targets			Results	
Internal:	Zero	Cal		Zero	Cal		m'	b'
Deep	0.000	0.000	mmho-m	11.289	418.927	mmho-m	0.955	[illegible]
Medium	0.000	0.000	mmho-m	4.627	524.266	mmho-m	0.945	[illegible]
Shallow	0.000	0.000	Ohm-m	14.000	1330.000	Ohm-m	1.000	

FLORIDA GEOPHYSICAL LOGGING, INC.

DUAL INDUCTION LL3/SP LOG

Company	SOUTH MARTIN REGIONAL UTILITY		
Well	RO - 1		
Field	HOBE SOUND		
Country	MARTIN	State/Prv	FLORIDA
Location			Other Services
Permanent Datum	PAD	Elevation	Elevation: K.B. / D.F. / G.L.
Log Measured From	PAD		
Drilling Measured From	PAD		

Company SOUTH MARTIN
Well RO - 1
Field HOBE SOUND
Country MARTIN
State/Prv FLORIDA

Date	30-AUG-2000
Run Number	TWO
Depth Driller	1010'
Depth Logger	1010'
Bottom Logged Interval	1010'
Top Log Interval	CASING
Open Hole Size	12 1/4"
Type Fluid	WATER
Density / Viscosity	NA
Max. Recorded Temp.	NA
Estimated Cement Top	NA
Time Well Ready	ON ARRIVAL
Time Logger on Bottom	16:30
Equipment Number	102 FTM
Location	FT MYERS
Recorded By	LEE
Witnessed By	JIM ANDERSEN

Borehole Record				Tubing Record			
Run Number	Bit	From	To	Size	Weight	From	To
ONE	36 1/2"	SURFACE	245'				
TWO	12 1/4"	CASING	1010'				

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String	30"	.375 W.T	SURFACE	239'
Prot. String				
Production String				
Liner				

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Comments

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

Database File: hobero1.db
Dataset Pathname: run2/pass8
Presentation Format: dil.prs
Dataset Creation: Wed Aug 30 18:03:11 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:120

0	Gamma Ray (GAPI)	100	0.2	Deep Resistivity (Ohm-m)	2000
-100	Spontaneous Potential (mV)	100	0.2	Medium Resistivity (Ohm-m)	2000
			0.2	Shallow Resistivity (Ohm-m)	2000

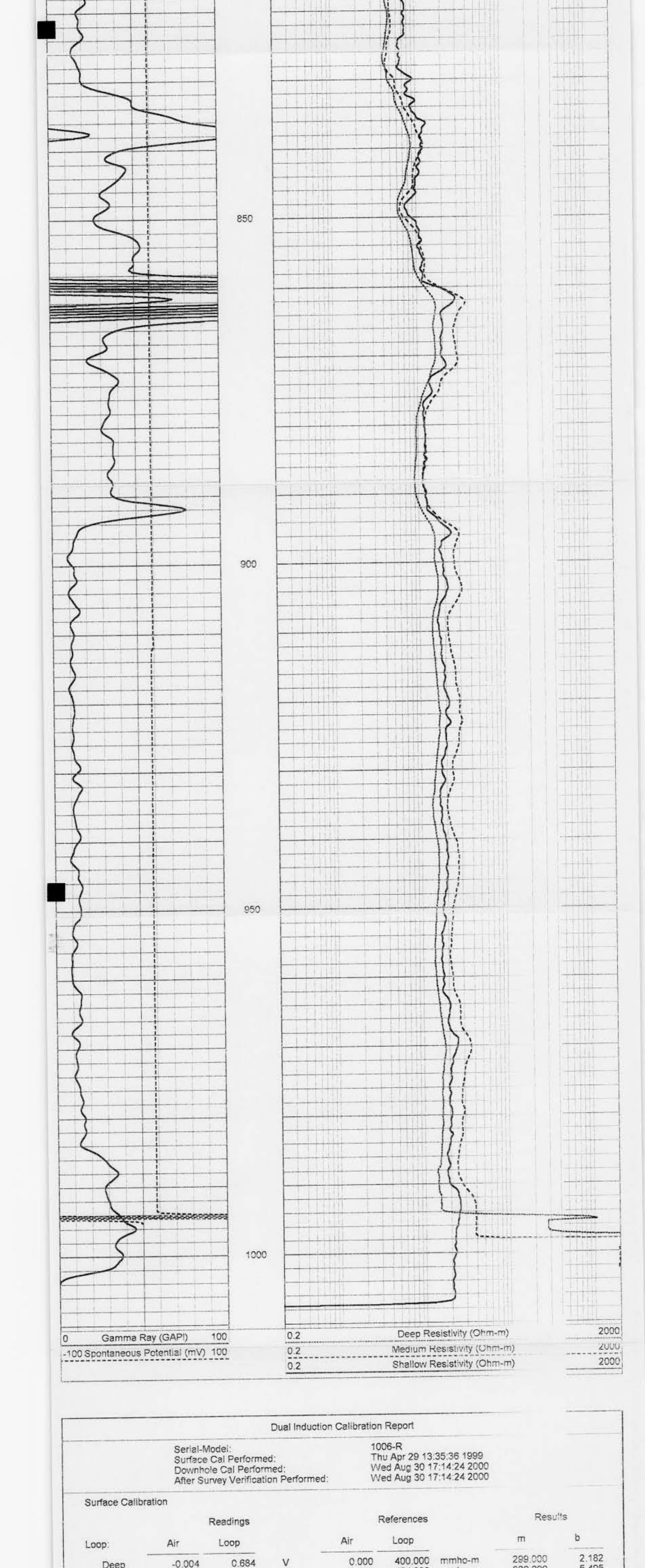
0	Gamma Ray (GAPI)	100	0.2	Deep Resistivity (Ohm-m)	2000
-100	Spontaneous Potential (mV)	100	0.2	Medium Resistivity (Ohm-m)	2000
			0.2	Shallow Resistivity (Ohm-m)	2000

FLORIDA GEOPHYSICAL LOGGING, INC.

REPEAT PASS

Database File: hobero1.db
Dataset Pathname: run2/pass7
Presentation Format: dil.prs
Dataset Creation: Wed Aug 30 17:53:58 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:120

0	Gamma Ray (GAPI)	100	0.2	Deep Resistivity (Ohm-m)	2000
-100	Spontaneous Potential (mV)	100	0.2	Medium Resistivity (Ohm-m)	2000
			0.2	Shallow Resistivity (Ohm-m)	2000



0	Gamma Ray (GAPI)	100	0.2	Deep Resistivity (Ohm-m)	2000
-100	Spontaneous Potential (mV)	100	0.2	Medium Resistivity (Ohm-m)	2000
			0.2	Shallow Resistivity (Ohm-m)	2000

Dual Induction Calibration Report

Serial-Model: 1006-R
Surface Cal Performed: Thu Apr 29 13:35:36 1999
Downhole Cal Performed: Wed Aug 30 17:14:24 2000
After Survey Verification Performed: Wed Aug 30 17:14:24 2000

Surface Calibration

Loop:	Readings Air	Readings Loop		References Air	References Loop		Results m	Results b
Deep	-0.004	0.684	V	0.000	400.000	mmho-m	299.000	2.182
Medium	0.009	0.737	V	0.000	464.000	mmho-m	320.000	-5.495
Internal:	**Zero**	**Cal**		**Zero**	**Cal**		**m**	**b**
Deep	0.005	0.675	V	5.050	393.400	mmho-m	579.885	2.219
Medium	0.003	0.774	V	-2.270	485.650	mmho-m	633.144	-4.144

Downhole Calibration

Internal:	Readings Zero	Readings Cal		References Zero	References Cal		Results m	Results b
Deep	10.182	415.706	mmho-m	5.020	394.306	mmho-m	0.960	-4.754
Medium	11.401	529.407	mmho-m	-3.609	487.371	mmho-m	0.948	-14.415
Shallow	0.035	2.399	V	14.000	1330.000	Ohm-m	556.646	-5.566

After Survey Verification

Internal:	Readings Zero	Readings Cal		Targets Zero	Targets Cal		Results m'	Results b'
Deep	0.000	0.000	mmho-m	10.182	415.706	mmho-m	0.960	-4.754
Medium	0.000	0.000	mmho-m	11.401	529.407	mmho-m	0.948	-14.415
Shallow	0.000	0.000	Ohm-m	14.000	1330.000	Ohm-m	1.000	0.000

FLORIDA GEOPHYSICAL LOGGING, INC.

DUAL INDUCTION LL3/SP LOG

Company SOUTH MARTIN
Well RO-1
Field HOBE SOUND
Country MARTIN
State/Prv FL

Company	SOUTH MARTIN REGIONAL UTILITY
Well	RO-1
Field	HOBE SOUND
Country	MARTIN
State/Prv	FLORIDA
Location	
Other Services	XY/C/GR

Permanent Datum	PAD	Elevation	Elevation K.B. D.F. G.L.
Log Measured From	PAD		
Drilling Measured From	PAD		

Date	8/23/00
Run Number	ONE
Depth Driller	245'
Depth Logger	245'
Bottom Logged Interval	245'
Top Log Interval	10'
Open Hole Size	36.5"
Type Fluid	MUD
Density / Viscosity	NA
Max. Recorded Temp.	NA
Estimated Cement Top	NA
Time Well Ready	1630
Time Logger on Bottom	1730
Equipment Number	103
Location	FT. MYERS
Recorded By	DENISON
Witnessed By	JIM ANDERSEN

Borehole Record				Tubing Record			
Run Number	Bit	From	To	Size	Weight	From	To
ONE	36.5"	SURFACE	245'				

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String				
Prot. String				
Production String				
Liner				

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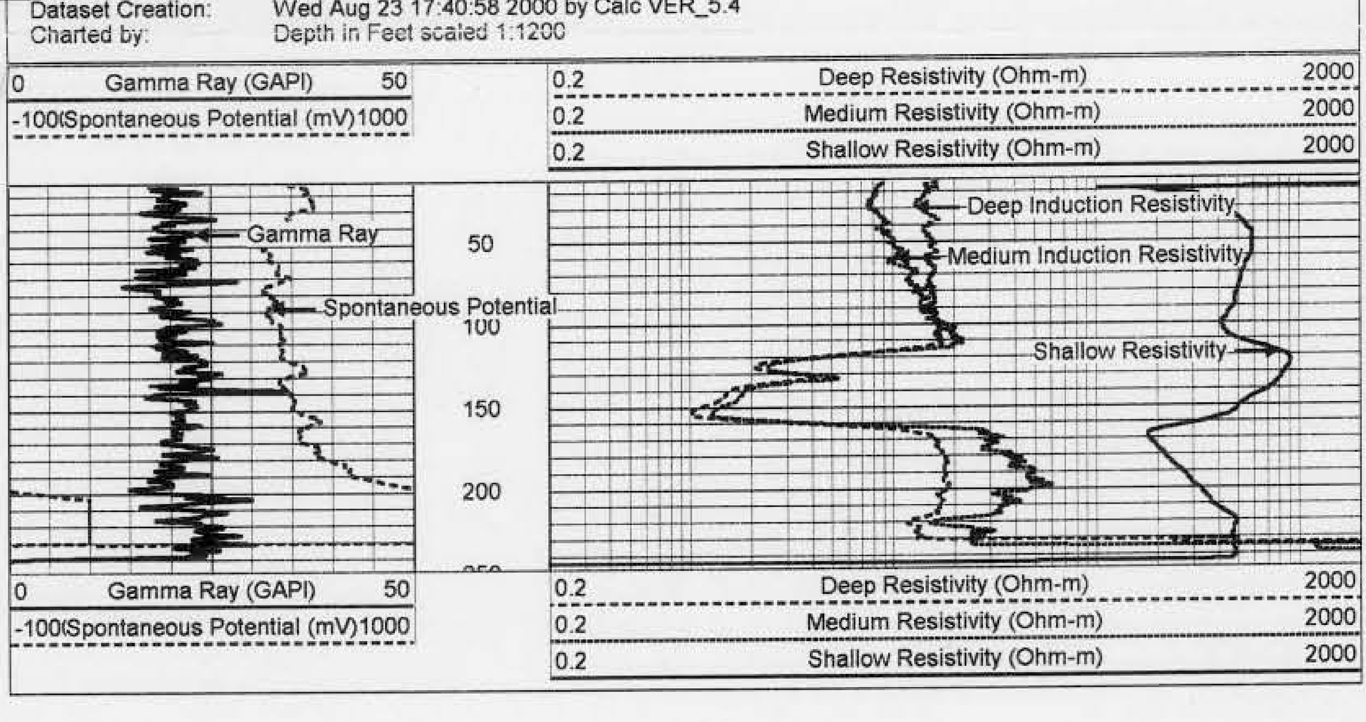
Comments

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

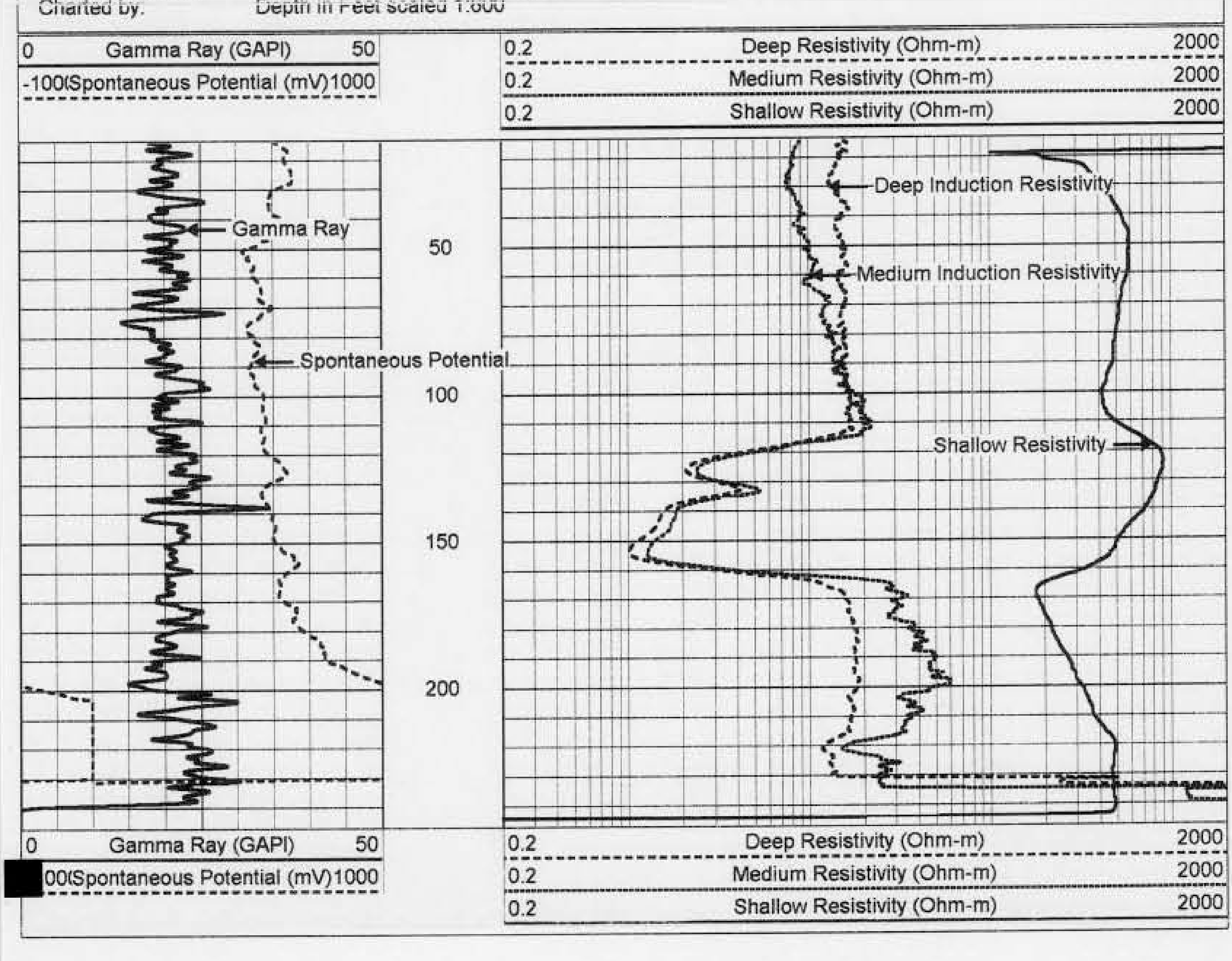
Database File: hobero1.db
Dataset Pathname: pass6.1
Presentation Format: dil.prs
Dataset Creation: Wed Aug 23 17:40:58 2000 by Calc VER_5.4
Charted by: Depth in Feet scaled 1:1200



FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

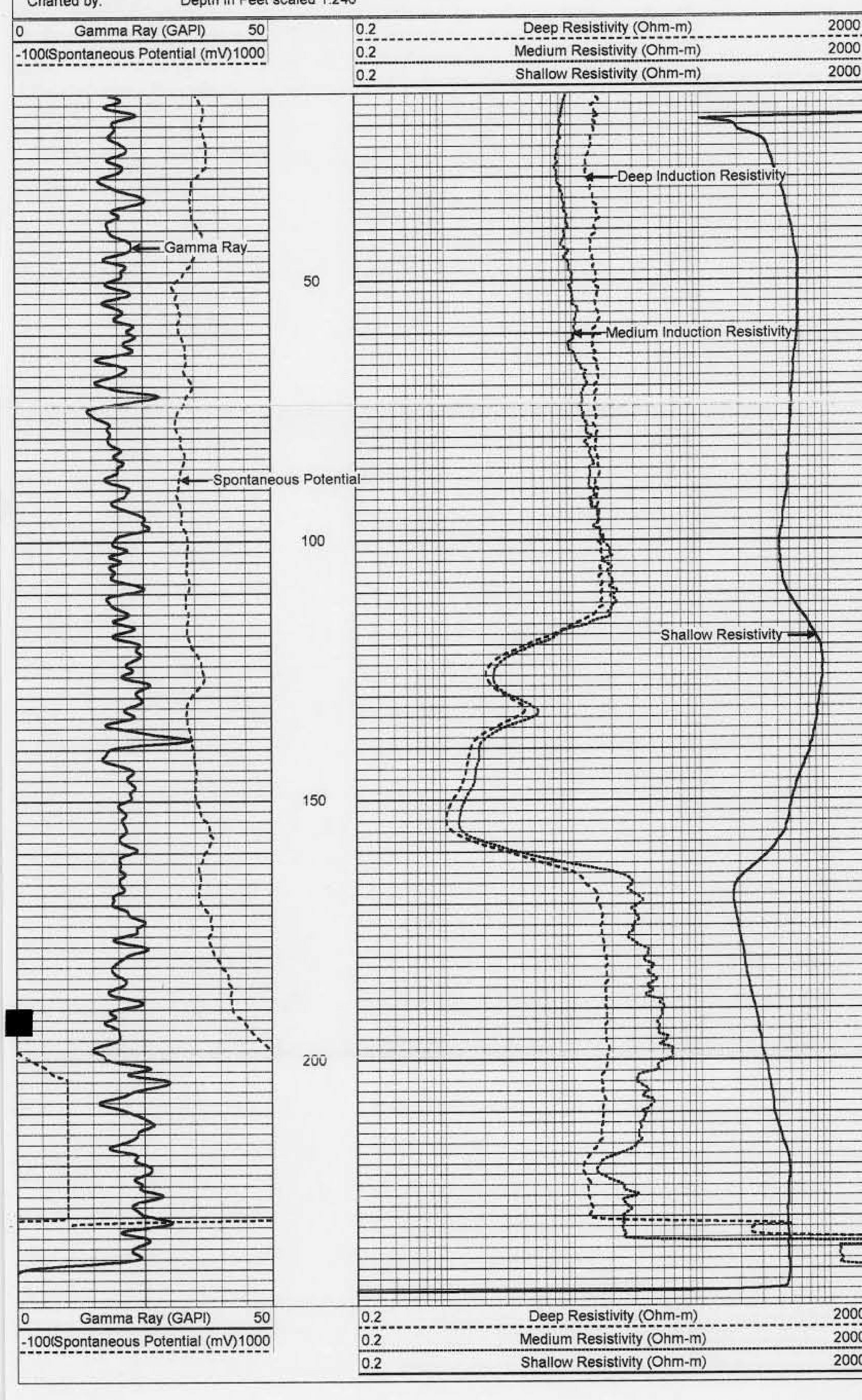
Database File: hobero1.db
Dataset Pathname: pass6.1
Presentation Format: dil.prs
Dataset Creation: Wed Aug 23 17:40:58 2000 by Calc VER_5.4
Charted by: Depth in Feet scaled 1:600



FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

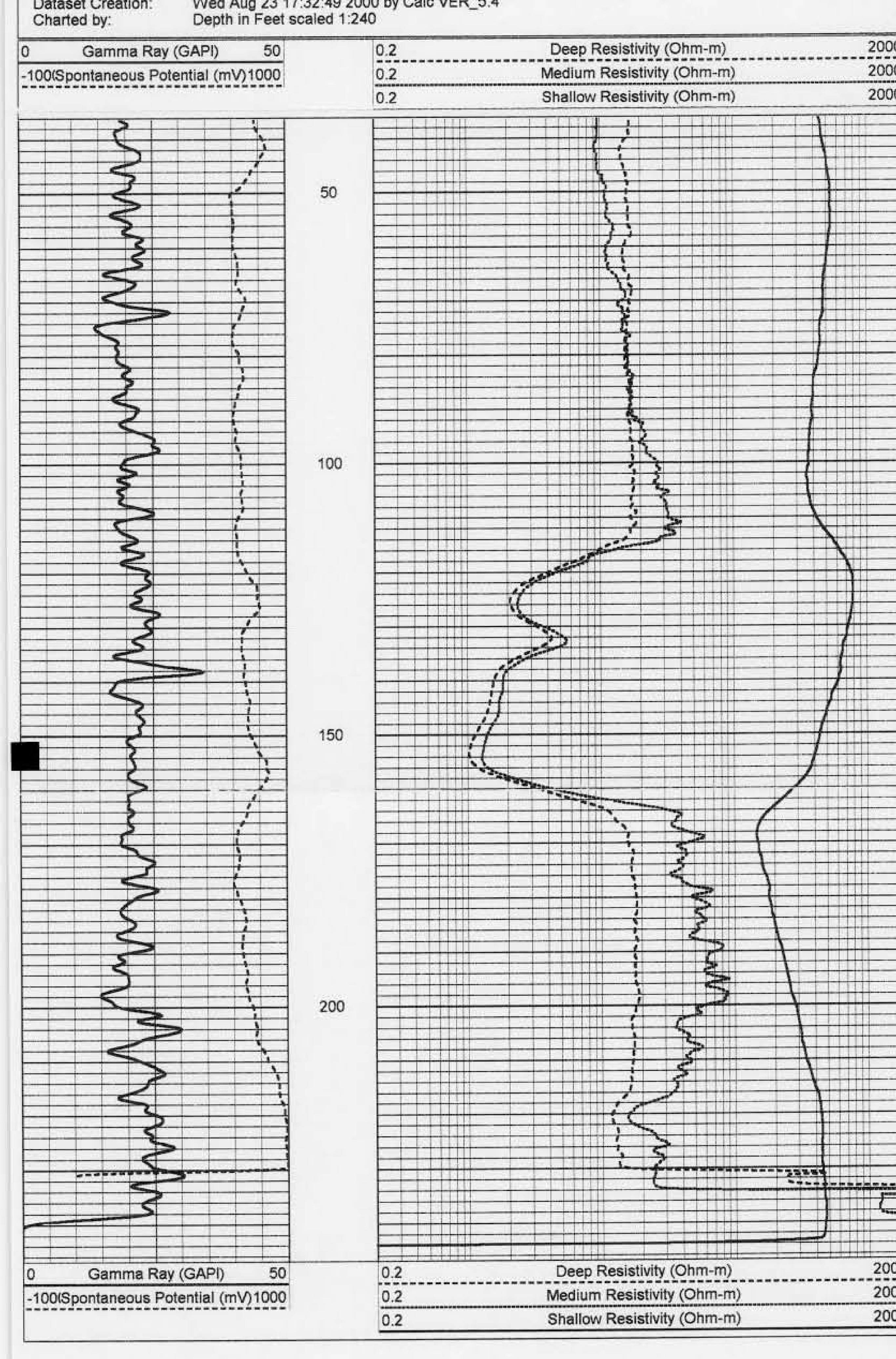
Database File: hobero1.db
Dataset Pathname: pass6.1
Presentation Format: dil.prs
Dataset Creation: Wed Aug 23 17:40:58 2000 by Calc VER_5.4
Charted by: Depth in Feet scaled 1:240

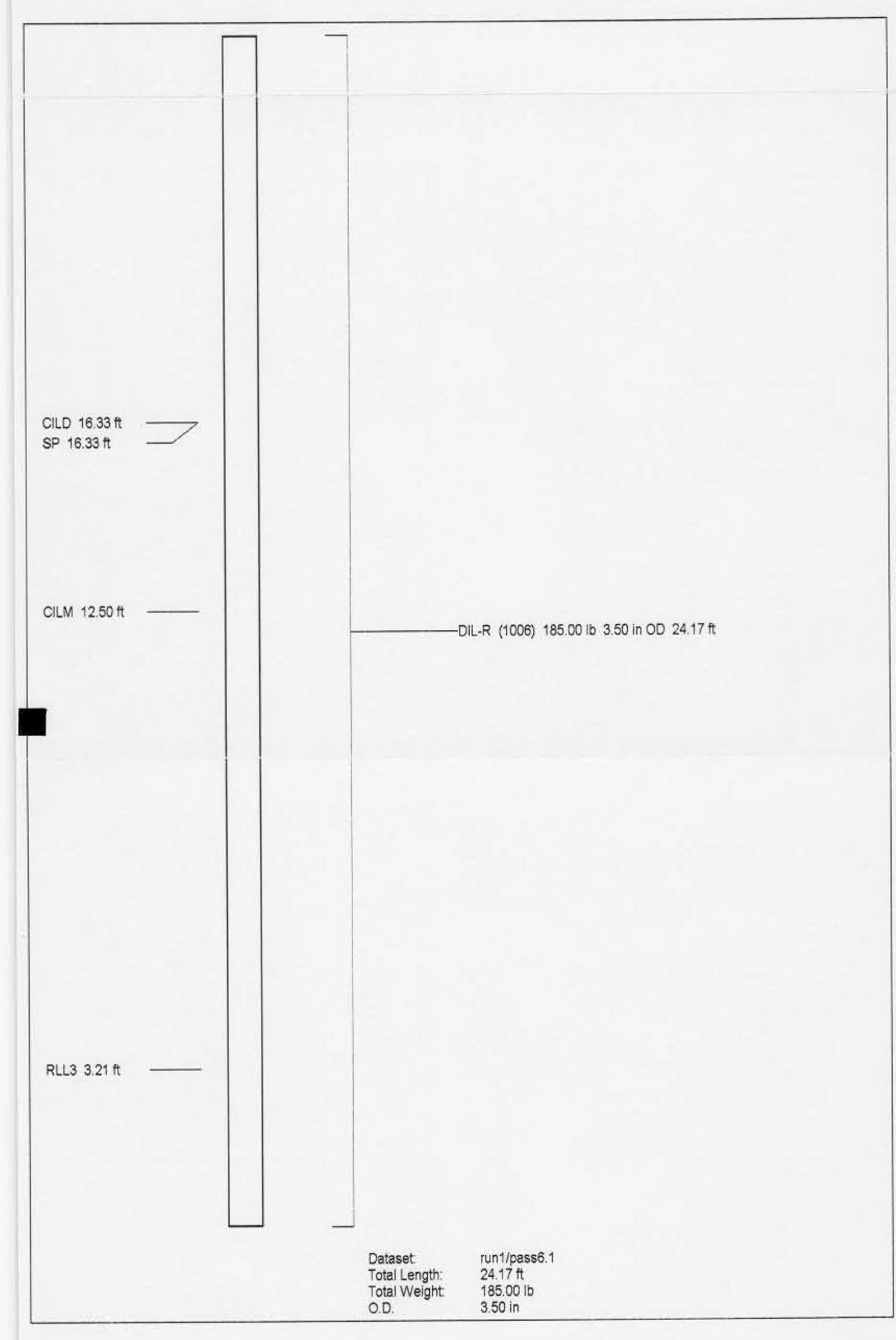


FLORIDA GEOPHYSICAL LOGGING, INC.

REPEAT PASS

Database File: hobero1.db
Dataset Pathname: pass5.2
Presentation Format: dil.prs
Dataset Creation: Wed Aug 23 17:32:49 2000 by Calc VER_5.4
Charted by: Depth in Feet scaled 1:240





Dataset: run1/pass6.1
Total Length: 24.17 ft
Total Weight: 185.00 lb
O.D. 3.50 in

Dual Induction Calibration Report

Serial-Model: 1006-R
Surface Cal Performed: Thu Apr 29 13:35:36 1999
Downhole Cal Performed: Wed Aug 23 17:20:08 2000
After Survey Verification Performed: Wed Aug 23 17:34:18 2000

Surface Calibration

	Readings			References			Results	
Loop:	Air	Loop		Air	Loop		m	b
Deep	-0.004	0.684	V	0.000	400.000	mmho-m	581.281	2.182
Medium	0.009	0.737	V	0.000	464.000	mmho-m	637.114	-5.495
Internal:	Zero	Cal		Zero	Cal		m	b
Deep	0.005	0.675	V	5.050	393.400	mmho-m	579.885	2.219
Medium	0.003	0.774	V	-2.270	485.650	mmho-m	633.144	-4.144

Downhole Calibration

	Readings			References			Results	
Internal:	Zero	Cal		Zero	Cal		m	b
Deep	9.455	420.932	mmho-m	5.020	394.306	mmho-m	0.946	-3.925
Medium	-0.369	519.491	mmho-m	-3.609	487.371	mmho-m	0.944	-3.260
Shallow	0.039	2.419	V	14.000	1330.000	Ohm-m	552.872	-7.597

After Survey Verification

	Readings			Targets			Results	
Internal:	Zero	Cal		Zero	Cal		m'	b'
Deep	8.934	420.790	mmho-m	9.455	420.932	mmho-m	0.946	-3.925
Medium	-1.163	518.763	mmho-m	-0.369	519.491	mmho-m	0.944	-3.260
Shallow	61.661	1333.680	Ohm-m	14.000	1330.000	Ohm-m	1.035	-49.793

LOG

Company	SOUTH MARTIN REGIONAL UTILITY
Well	RO - 1
Field	HOBE SOUND
Country	MARTIN
State/Prv	FLORIDA
Location	
Other Services	FRT DIL/LL3/SP

Permanent Datum	PAD	Elevation	K.B.
Log Measured From	PAD		D.F.
Drilling Measured From	PAD		G.L.

Date	20 SEPT 2000
Run Number	FOUR
Depth Driller	1494'
Depth Logger	1494'
Bottom Logged Interval	1494'
Top Log Interval	950'
Open Hole Size	00"
Type Fluid	WATER
Density / Viscosity	NA
Max. Recorded Temp.	NA
Estimated Cement Top	NA
Time Well Ready	ON ARRIVAL
Time Logger on Bottom	00:00
Equipment Number	102 FTM
Location	FT.MYERS
Recorded By	LEE
Witnessed By	A.KRUPA

Borehole Record				Tubing Record			
Run Number	Bit	From	To	Size	Weight	From	To
ONE	36 1/2"	SURFACE	245'				
TWO	12 1/4"	CASING	1010'				
THREE	26"	CASING	976'				
FOUR	17"	CASING	1494'				

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String	30"	3/5 W.T.	SURFACE	239'
Prot. String	18"	3/5 W.T.	219'	970'
Production String				
Liner				

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All interpretations are opinions based on inferences from electrical or other measurements and we cannot and do not guarantee the accuracy or correctness of any interpretation, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to our general terms and conditions set out in our current Price Schedule.

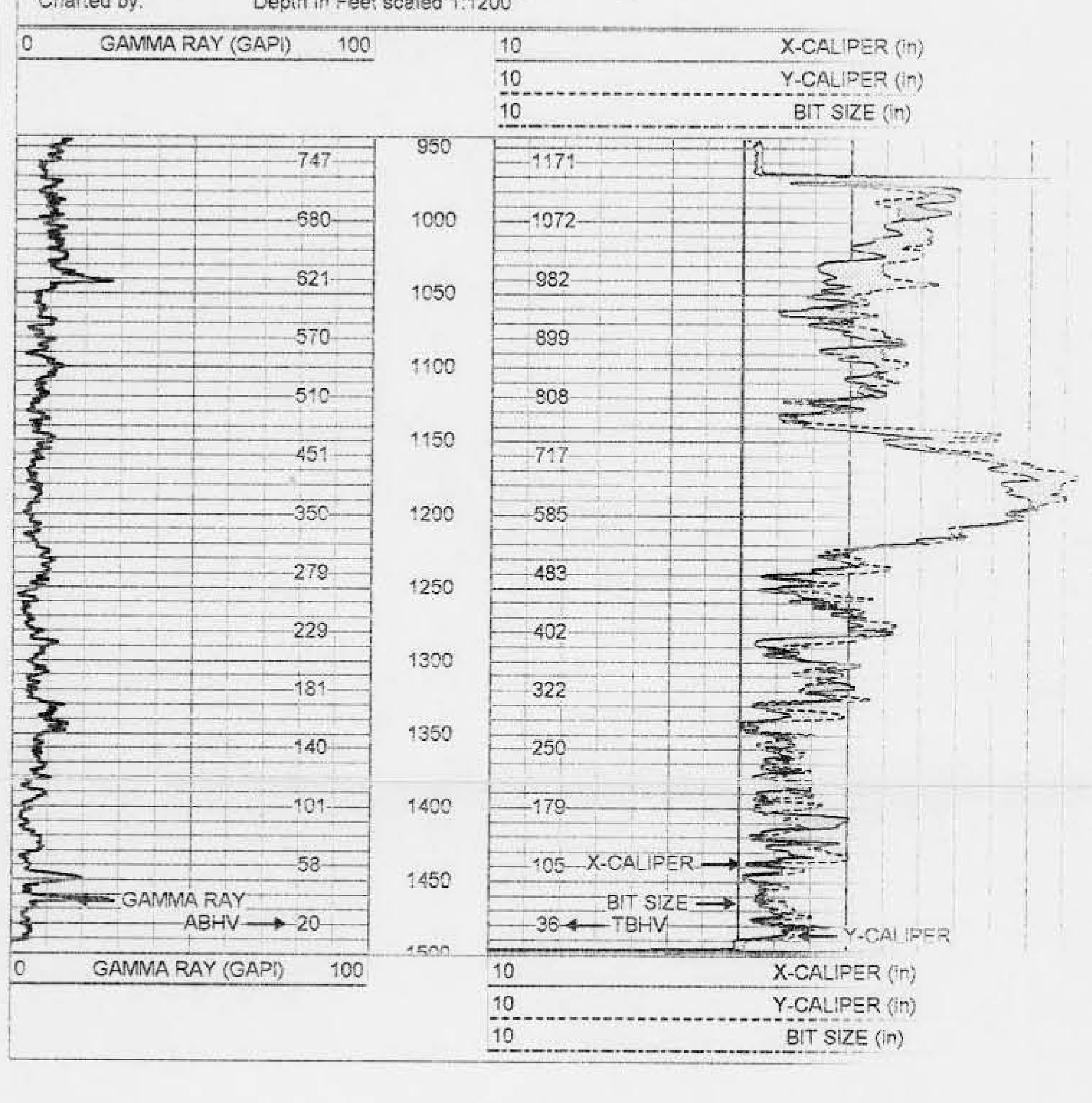
Comments

ABHV COMPUTED WITH 12" CASING

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

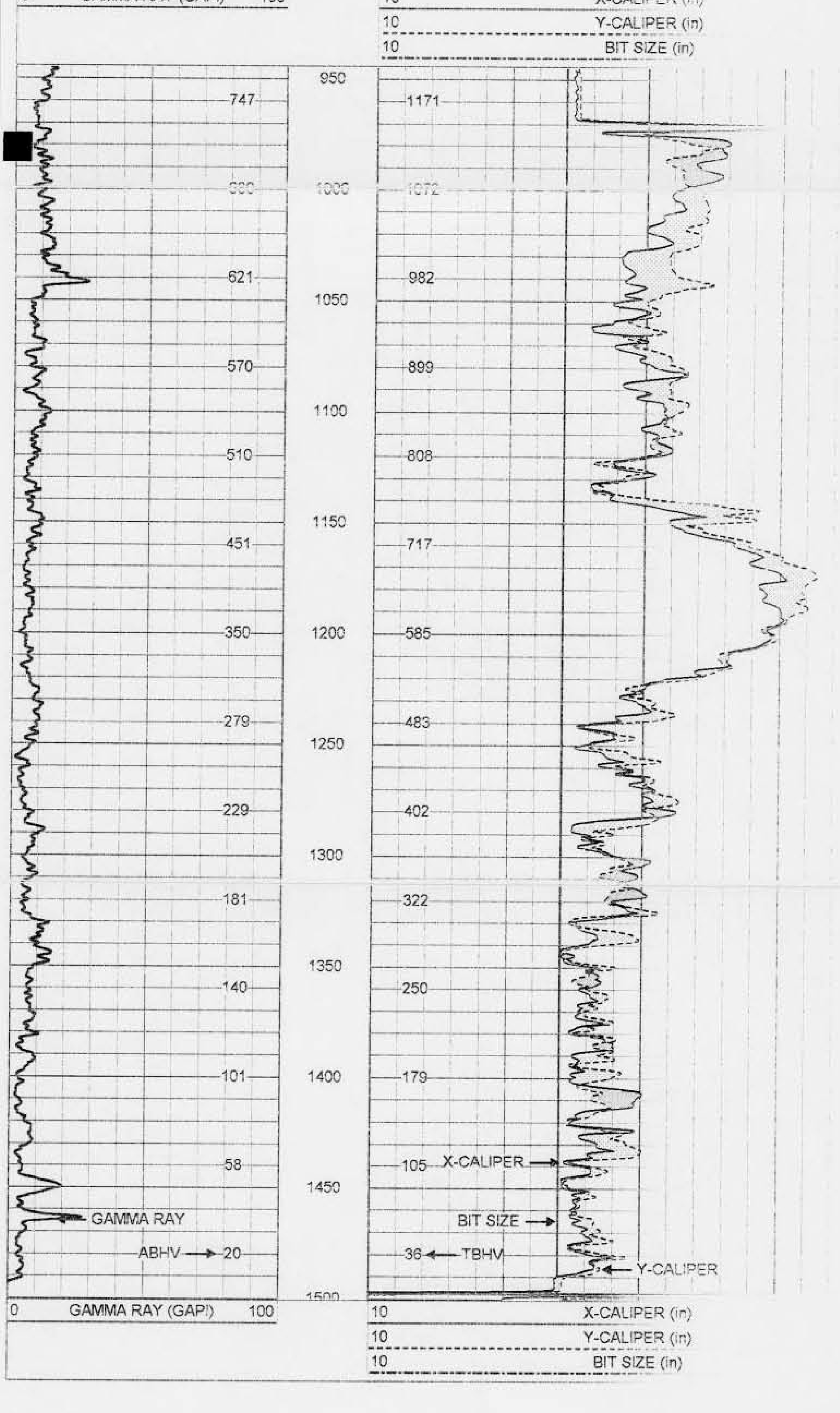
Database File: hoberc1.db
Dataset Pathname: run4/pass3.1
Presentation Format: grxyc.prs
Dataset Creation: Wed Sep 20 15:30:43 2000 by Calc VER_5.4
Charted by: Depth in Feet scaled 1:1200



FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

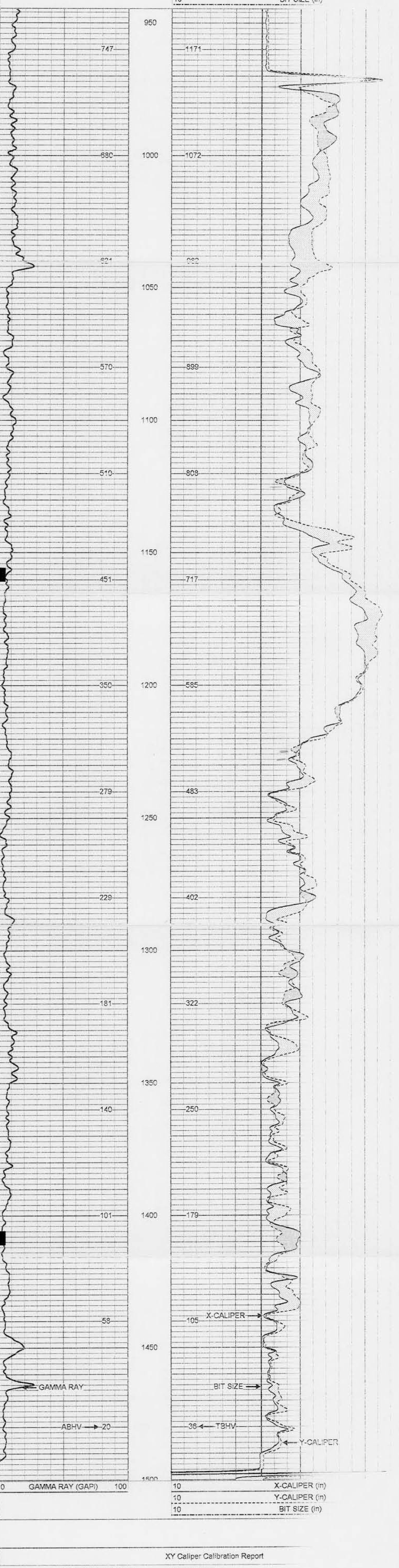
Database File: hobero1.db
Dataset Pathname: run4/pass3.1
Presentation Format: grxyc.prs
Dataset Creation: Wed Sep 20 15:30:43 2000 by Calc VER_5.4
Charted by: Depth in Feet scaled 1:600



FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

Database File: hobero1.db
Dataset Pathname: run4/pass3.1
Presentation Format: grxyc.prs
Dataset Creation: Wed Sep 20 15:30:43 2000 by Calc VER_5.4
Charted by: Depth in Feet scaled 1:240



XY Caliper Calibration Report

Serial Number/Model: 14LM-XYCLM
Performed: Wed Sep 20 14:17:55 2000

Ring			X Caliper		Y Caliper	
1:	10	in	383.584	cps	385.986	cps
2:	20	in	491.792	cps	492.092	cps
3:	30	in	612.513	cps	610.911	cps
4:		in		cps		cps
5:		in		cps		cps
6:		in		cps		cps

Gamma Ray Calibration Report

Serial Number: 12
Tool Model: GROH
Performed: Wed Aug 18 15:33:07 1999

Calibrator Value: 120 GAPI

Background Reading: 39.6042 cps
Calibrator Reading: 163.975 cps

Sensitivity: 0.964856 GAPI/cps

FLORIDA GEOPHYSICAL LOGGING, INC.

X-Y CALIPER GAMMA RAY LOG

Company	SOUTH MARTIN REGIONAL UTILITY
Well	RO - 1
Field	HOBE SOUND
Country	MARTIN
State/Prv	FLORIDA
Location	
Other Services	

Permanent Datum	PAD	Elevation	K.B.
Log Measured From	PAD		D.F.
Drilling Measured From	PAD		G.L.

Company	SOUTH MARTIN
Well	RO - 1
Field	HOBE SOUND
Country	MARTIN
State/Prv	FLORIDA

Date	30-AUG-2000
Run Number	TWO
Depth Driller	1010'
Depth Logger	1010'
Bottom Logged Interval	1010'
Top Log Interval	CASING
Open Hole Size	12 1/4"
Type Fluid	WATER
Density / Viscosity	NA
Max. Recorded Temp.	NA
Estimated Cement Top	NA
Time Well Ready	ON ARRIVAL
Time Logger on Bottom	16:30
Equipment Number	102 FTM
Location	FT.MYERS
Recorded By	LEE
Witnessed By	JIM ANDERSEN

Borehole Record				Tubing Record			
Run Number	Bit	From	To	Size	Weight	From	To
TWO	12 1/4"	CASING	1010'				

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String	30"	375 W.T	SURFACE	239'
Prot. String				
Production String				
Liner				

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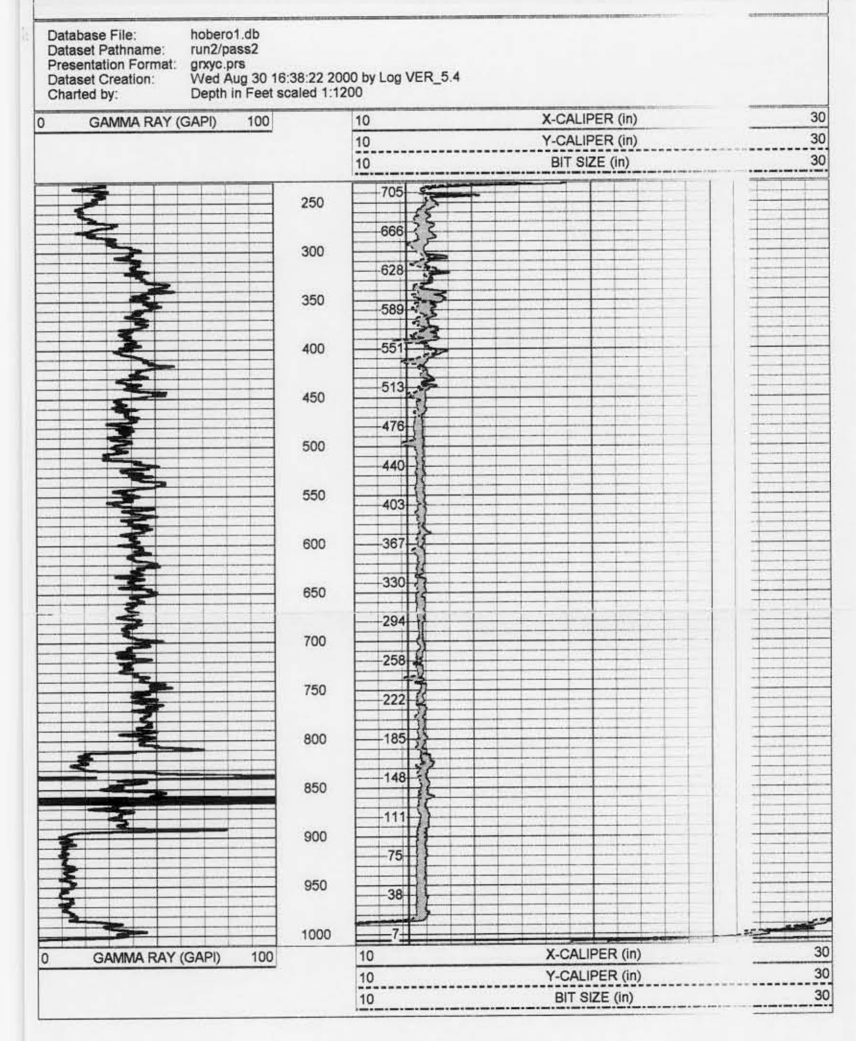
Comments

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

Database File: hobero1.db
Dataset Pathname: run2/pass2
Presentation Format: grxyc.prs
Dataset Creation: Wed Aug 30 16:38:22 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:1200

0 GAMMA RAY (GAPI) 100	10 X-CALIPER (in) 30	
	10 Y-CALIPER (in) 30	
	10 BIT SIZE (in) 30	



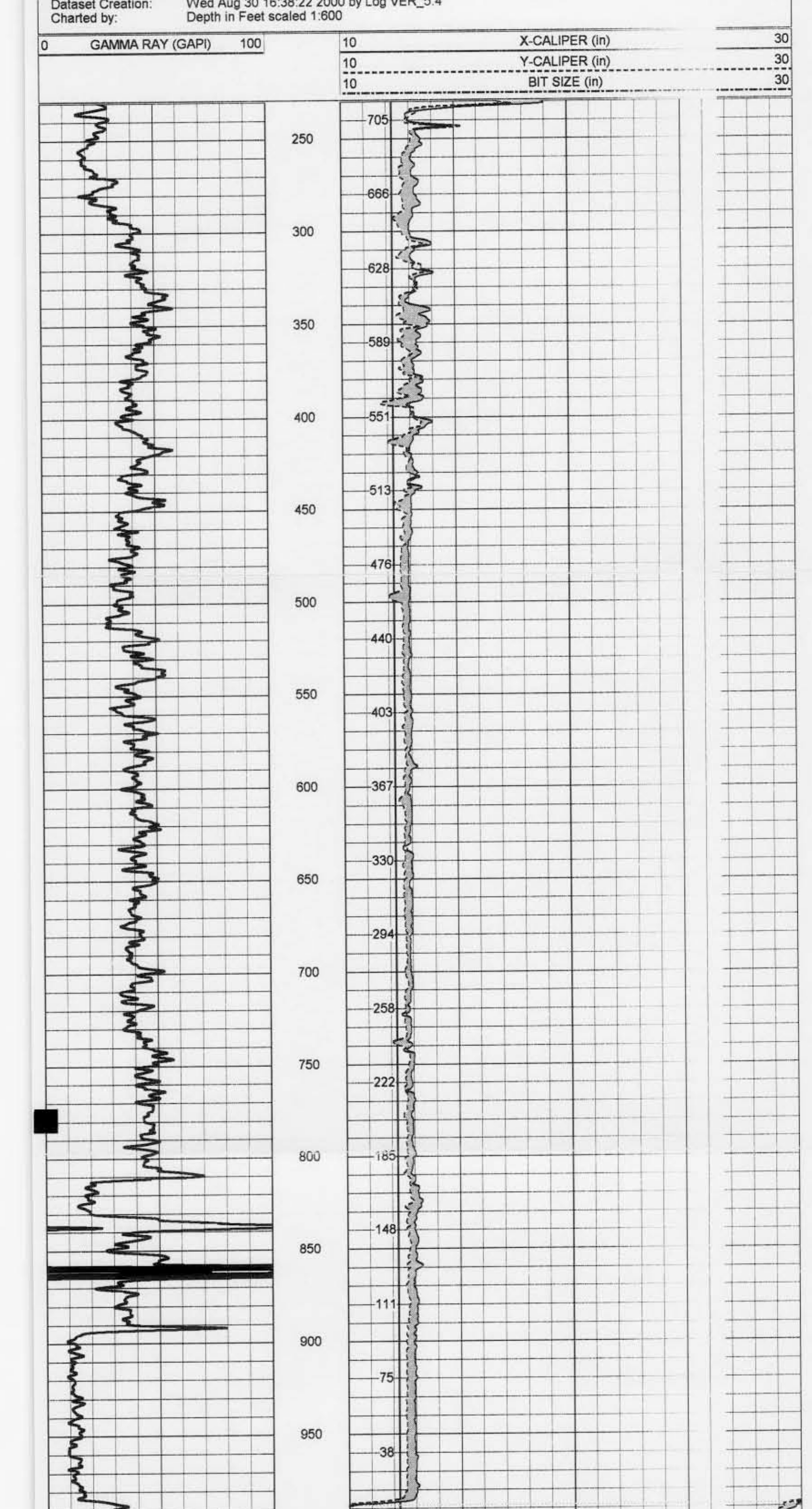
0 GAMMA RAY (GAPI) 100	10 X-CALIPER (in) 30
	10 Y-CALIPER (in) 30
	10 BIT SIZE (in) 30

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

Database File: hobero1.db
Dataset Pathname: run2/pass2
Presentation Format: grxyc.prs
Dataset Creation: Wed Aug 30 16:38:22 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:600

0 GAMMA RAY (GAPI) 100	10 X-CALIPER (in) 30
	10 Y-CALIPER (in) 30
	10 BIT SIZE (in) 30



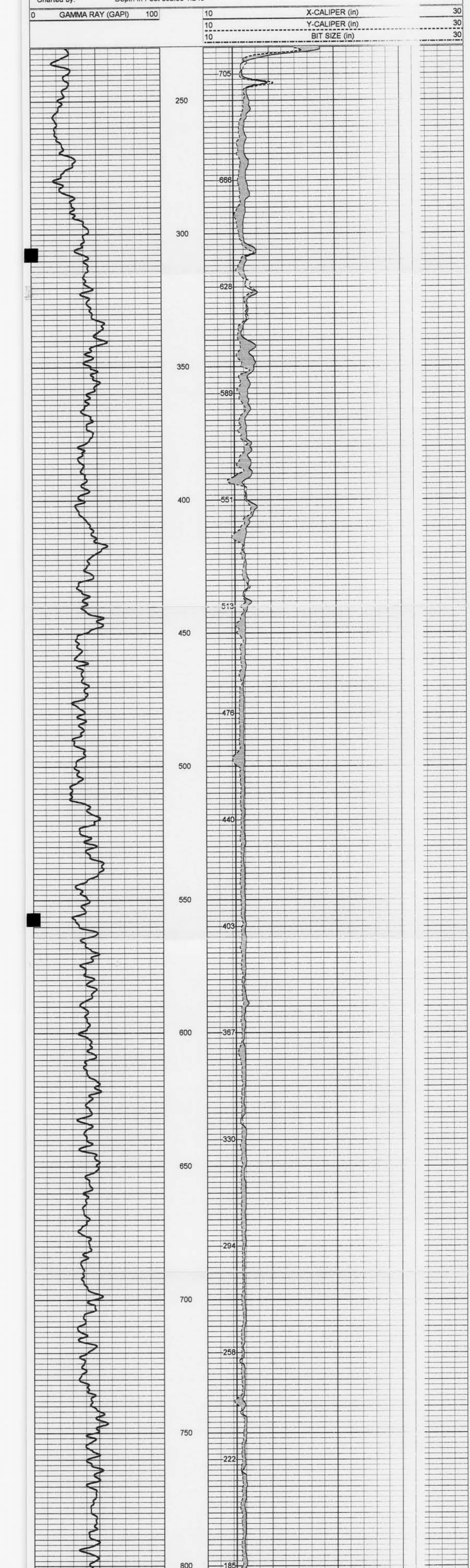
0 GAMMA RAY (GAPI) 100	10 X-CALIPER (in) 30
	10 Y-CALIPER (in) 30
	10 BIT SIZE (in) 30

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

Database File: hobero1.db
Dataset Pathname: run2/pass2
Presentation Format: grxyc.prs
Dataset Creation: Wed Aug 30 16:38:22 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:240

0 GAMMA RAY (GAPI) 100	10 X-CALIPER (in) 30
	10 Y-CALIPER (in) 30
	10 BIT SIZE (in) 30



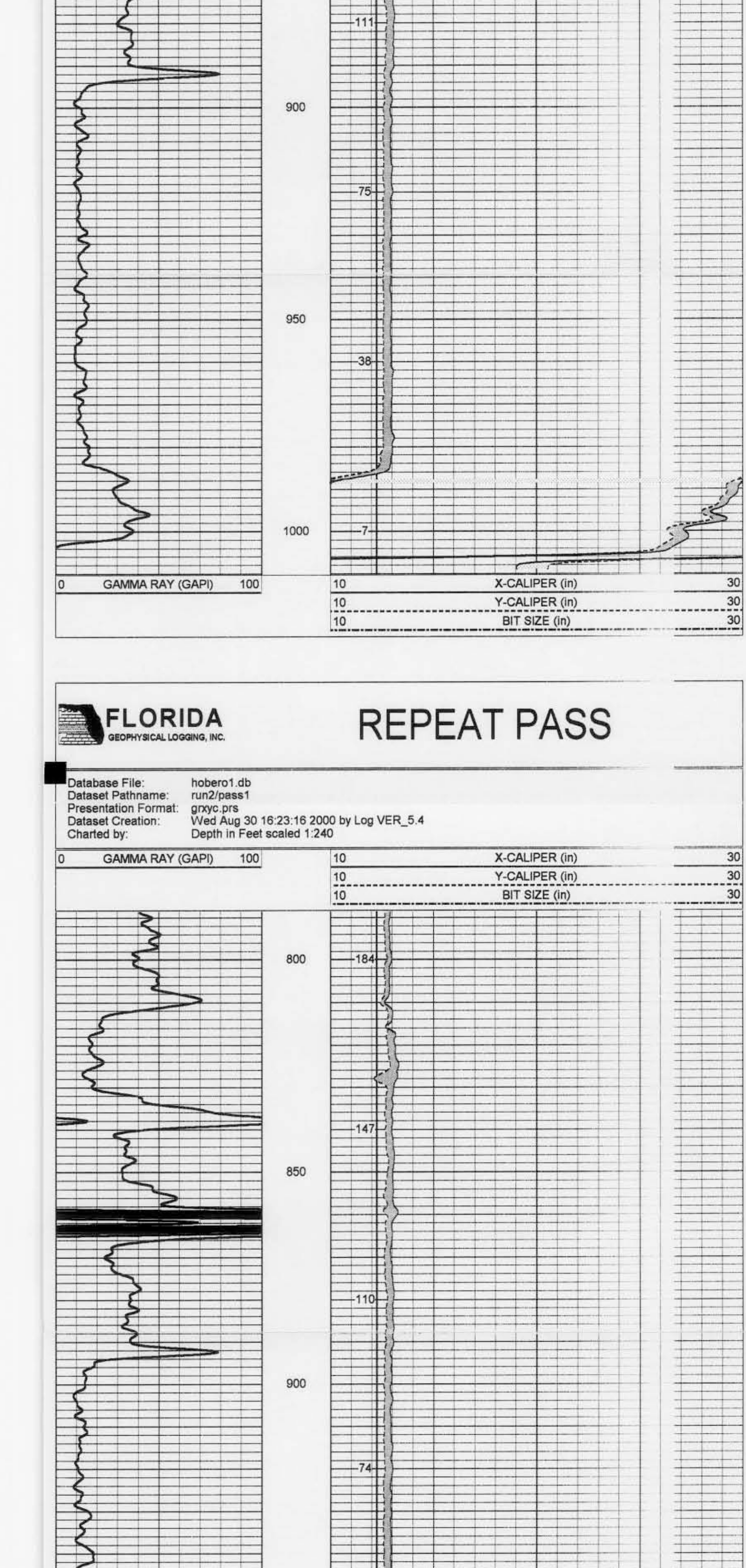
0 GAMMA RAY (GAPI) 100	10 X-CALIPER (in) 30
	10 Y-CALIPER (in) 30
	10 BIT SIZE (in) 30

FLORIDA GEOPHYSICAL LOGGING, INC.

REPEAT PASS

Database File: hobero1.db
Dataset Pathname: run2/pass1
Presentation Format: grxyc.prs
Dataset Creation: Wed Aug 30 16:23:16 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:240

0 GAMMA RAY (GAPI) 100	10 X-CALIPER (in) 30
	10 Y-CALIPER (in) 30
	10 BIT SIZE (in) 30



0 GAMMA RAY (GAPI) 100	10 X-CALIPER (in) 30
	10 Y-CALIPER (in) 30
	10 BIT SIZE (in) 30

XY Caliper Calibration Report

Serial Number:	46S		
Tool Model:	XYCS		
Performed:	Wed Aug 30 16:06:16 2000		
Small Ring:	10	in	
Large Ring:	20	in	
	X Caliper	Y Caliper	
Reading with Small Ring:	661.261	634.835	cps
Reading with Large Ring:	874.875	850.25	cps
Gain:	0.0468135	0.0464219	
Offset:	-20.956	-19.4703	

Gamma Ray Calibration Report

Serial Number:	12	
Tool Model:	GROH	
Performed:	Wed Aug 18 15:33:07 1999	
Calibrator Value:	120	GAPI
Background Reading:	39.6042	cps
Calibrator Reading:	163.975	cps
Sensitivity:	0.964856	GAPI/cps

FLORIDA GEOPHYSICAL LOGGING, INC.

Company	SOUTH MARTIN
Well	RO-1
Field	HOBE SOUND
Country	MARTIN
State/Prv	FL

XY-CALIPER GAMMA RAY LOG

Company	SOUTH MARTIN REGIONAL UTILITY		
Well	RO-1		
Field	HOBE SOUND		
Country	MARTIN	State/Prv	FLORIDA
Location		Other Services	DIL/LL3/SP
Permanent Datum	PAD	Elevation	K.B.
Log Measured From	PAD		D.F.
Drilling Measured From	PAD		G.L.

Date	8/23/00
Run Number	ONE
Depth Driller	245'
Depth Logger	245'
Bottom Logged Interval	245'
Top Log Interval	10'
Open Hole Size	36.5"
Type Fluid	MUD
Density / Viscosity	NA
Max. Recorded Temp.	NA
Estimated Cement Top	NA
Time Well Ready	1630
Time Logger on Bottom	1700
Equipment Number	103
Location	FT. MYERS
Recorded By	DENISON
Witnessed By	JIM ANDERSEN

Borehole Record				Tubing Record			
Run Number	Bit	From	To	Size	Weight	From	To
ONE	36.5"	SURFACE	245'				

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String				
Prot. String				
Production String				
Liner				

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Comments

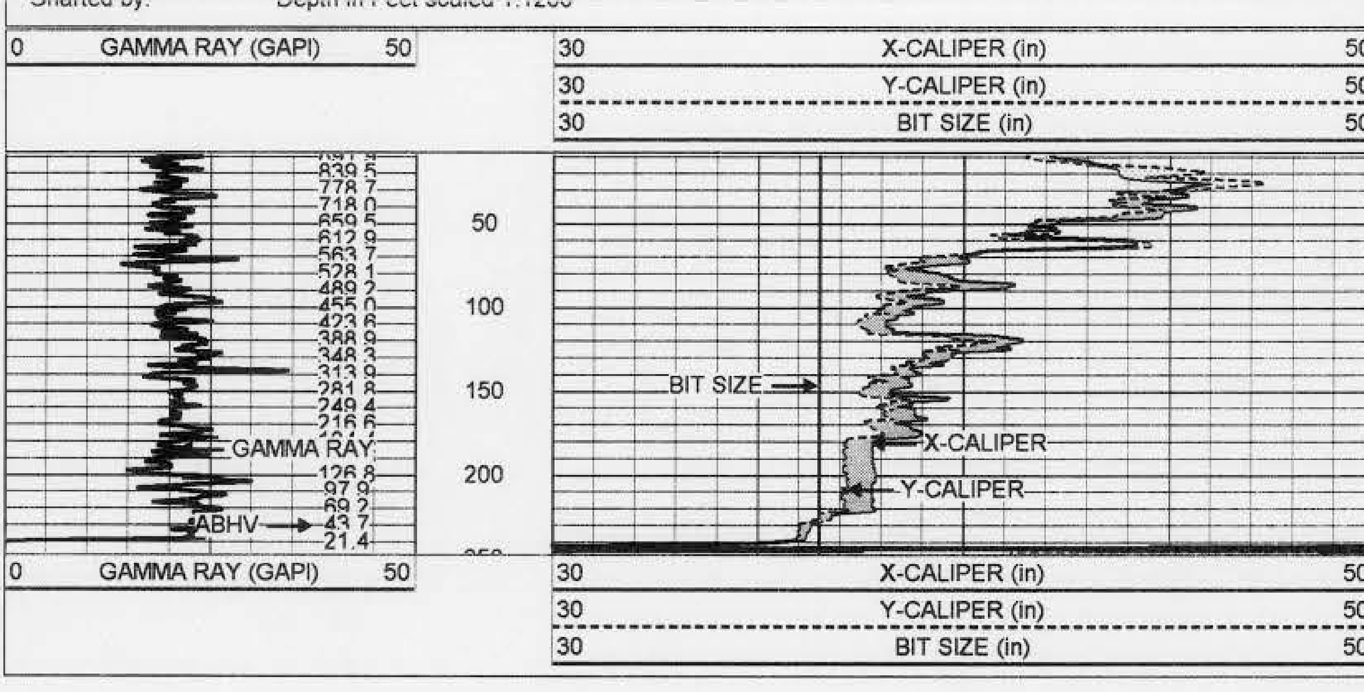
ANNULAR HOLE VOLUME
CALCULATED FOR 30" CASING

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

Database File: hobero1.db
Dataset Pathname: pass3
Presentation Format: grxyc.prs
Dataset Creation: Wed Aug 23 17:03:45 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:1200

0 GAMMA RAY (GAPI) 50 | 30 X-CALIPER (in) 50 | 30 Y-CALIPER (in) 50 | 30 BIT SIZE (in) 50



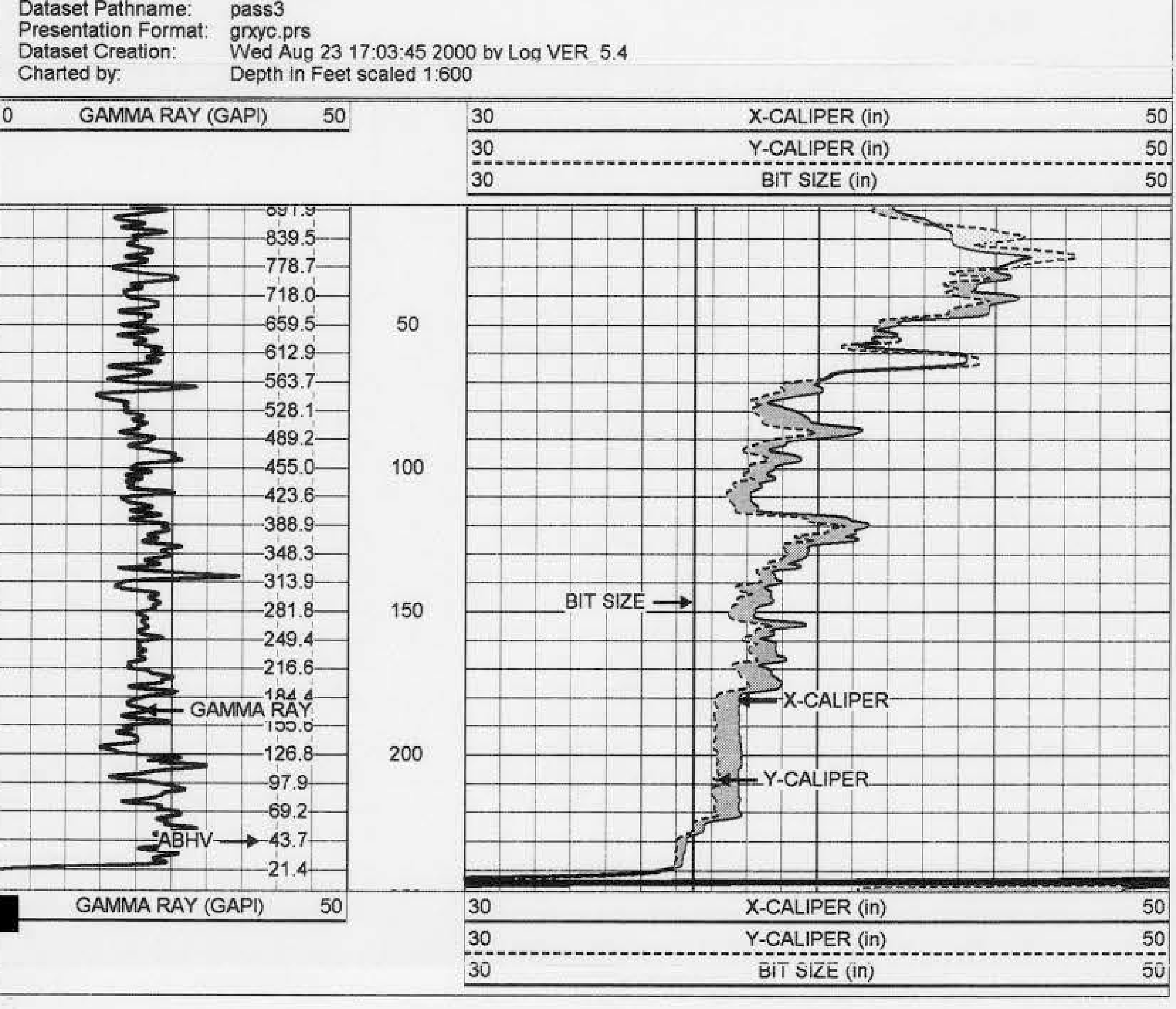
0 GAMMA RAY (GAPI) 50 | 30 X-CALIPER (in) 50 | 30 Y-CALIPER (in) 50 | 30 BIT SIZE (in) 50

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

Database File: hobero1.db
Dataset Pathname: pass3
Presentation Format: grxyc.prs
Dataset Creation: Wed Aug 23 17:03:45 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:600

0 GAMMA RAY (GAPI) 50 | 30 X-CALIPER (in) 50 | 30 Y-CALIPER (in) 50 | 30 BIT SIZE (in) 50



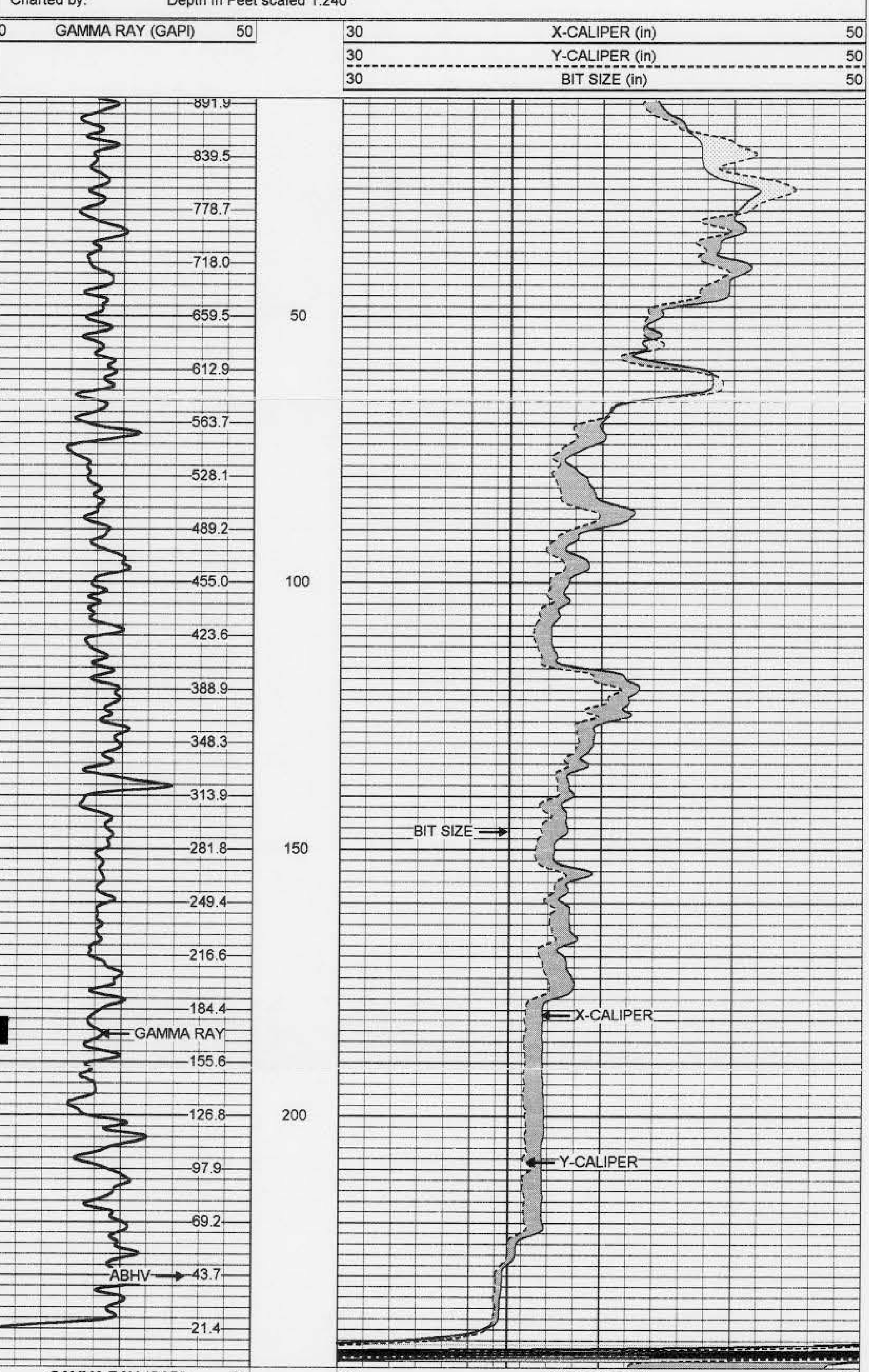
GAMMA RAY (GAPI) 50 | 30 X-CALIPER (in) 50 | 30 Y-CALIPER (in) 50 | 30 BIT SIZE (in) 50

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

Database File: hobero1.db
Dataset Pathname: pass3
Presentation Format: grxyc.prs
Dataset Creation: Wed Aug 23 17:03:45 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:240

0 GAMMA RAY (GAPI) 50 | 30 X-CALIPER (in) 50 | 30 Y-CALIPER (in) 50 | 30 BIT SIZE (in) 50



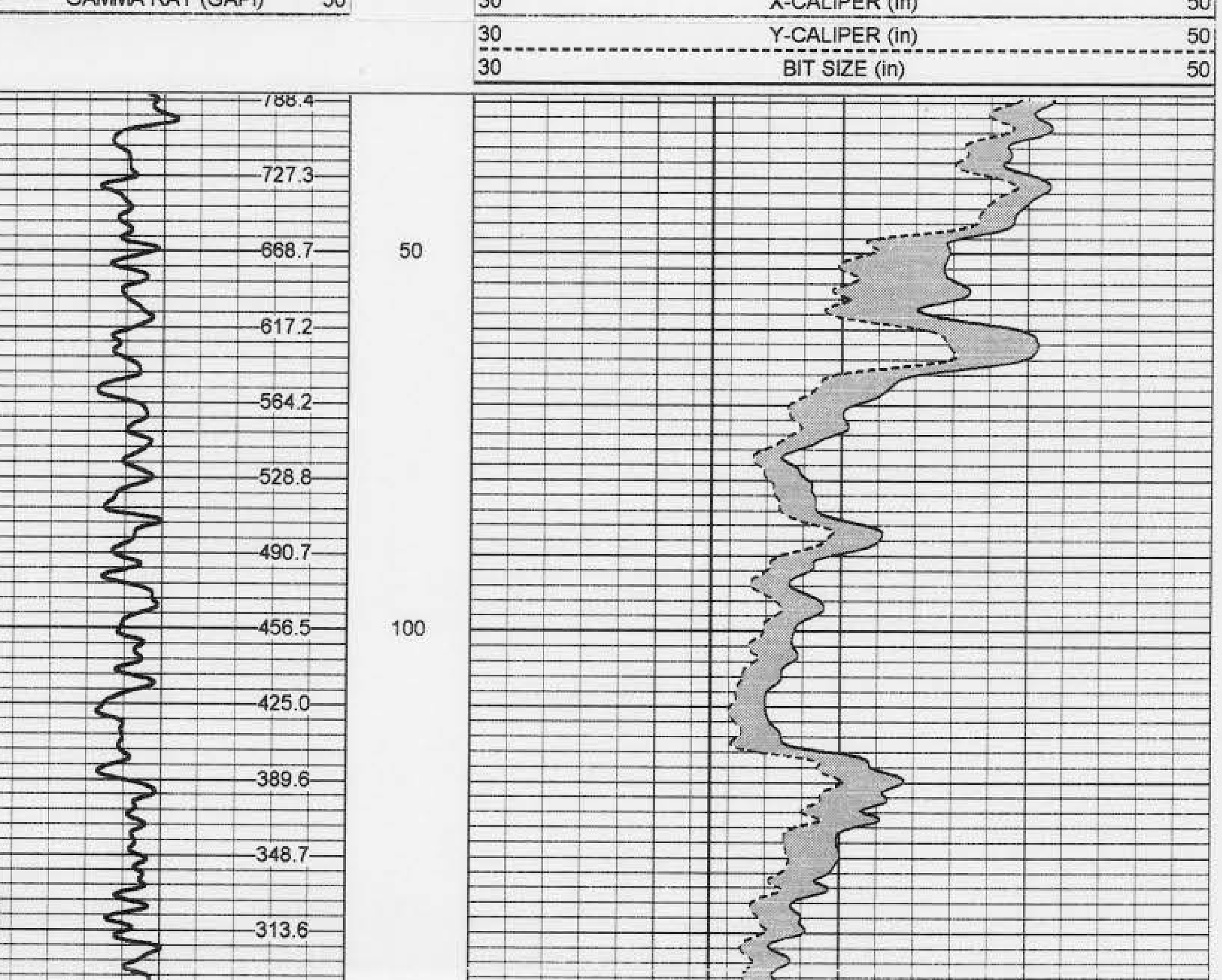
0 GAMMA RAY (GAPI) 50 | 30 X-CALIPER (in) 50 | 30 Y-CALIPER (in) 50 | 30 BIT SIZE (in) 50

FLORIDA GEOPHYSICAL LOGGING, INC.

REPEAT PASS

Database File: hobero1.db
Dataset Pathname: pass2
Presentation Format: grxyc.prs
Dataset Creation: Wed Aug 23 16:51:29 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:240

0 GAMMA RAY (GAPI) 50 | 30 X-CALIPER (in) 50 | 30 Y-CALIPER (in) 50 | 30 BIT SIZE (in) 50



0 GAMMA RAY (GAPI) 50 | 30 X-CALIPER (in) 50 | 30 Y-CALIPER (in) 50 | 30 BIT SIZE (in) 50

Dataset: run1/pass3
Total Length: 9.35 ft
Total Weight: 127.00 lb
O.D. 3.50 in

XY Caliper Calibration Report

Serial Number/Model: 02LM-XYCLM
Performed: Wed Aug 23 16:44:57 2000

Ring			X Caliper		Y Caliper	
1:	30	in	1008.21	cps	1019.92	cps
2:	40	in	1132.13	cps	1168.07	cps
3:	56.5	in	1390.89	cps	1377.18	cps
4:		in		cps		cps
5:		in		cps		cps
6:		in		cps		cps

Gamma Ray Calibration Report

Serial Number: 12
Tool Model: GROH
Performed: Fri Aug 18 11:57:46 2000

Calibrator Value: 120 GAPI

Background Reading: 36.8246 cps
Calibrator Reading: 157.057 cps

Sensitivity: 0.998066 GAPI/cps

APPENDIX B

RO-2
GEOPHYSICAL LOGS

FLORIDA GEOPHYSICAL LOGGING, INC.

FLUID CONDUCTIVITY TEMPERATURE LOG

Company	SOUTH MARTIN REGIONAL UTILITY
Well	RO-2
Field	HOBE SOUND
Country	MARTIN
State/Prv	FLORIDA
Location	

Other Services: SEE COMMENTS

Permanent Datum	PAD	Elevation
Log Measured From	PAD	
Drilling Measured From	PAD	

Elevation: K.B. / D.F. / G.L.

Date	20-NOV-2000
Run Number	FOUR
Depth Driller	1495'
Depth Logger	1496'
Bottom Logged Interval	1496'
Top Log Interval	CASING
Open Hole Size	17"
Type Fluid	MUD
Density / Viscosity	NA
Max. Recorded Temp	78 DEG F
Estimated Cement Top	NA
Time Well Ready	1000
Time Logger on Bottom	1110
Equipment Number	103
Location	FT. MYERS
Recorded By	DENISON
Witnessed By	J. ANDERSEN

Run Number	Borehole Record: Bit	From	To	Tubing Record: Size	Weight	From	To
ONE	36.5"	SURFACE	244'				
TWO	12.25"	CASING	1014'				
THREE	26"	CASING	1007'				
FOUR	17"	CASING	1495'				

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String	30"	375 W.T.	SURFACE	237'
Prot. String	18"	375 W.T.	221'	1001'
Production String				
Liner				

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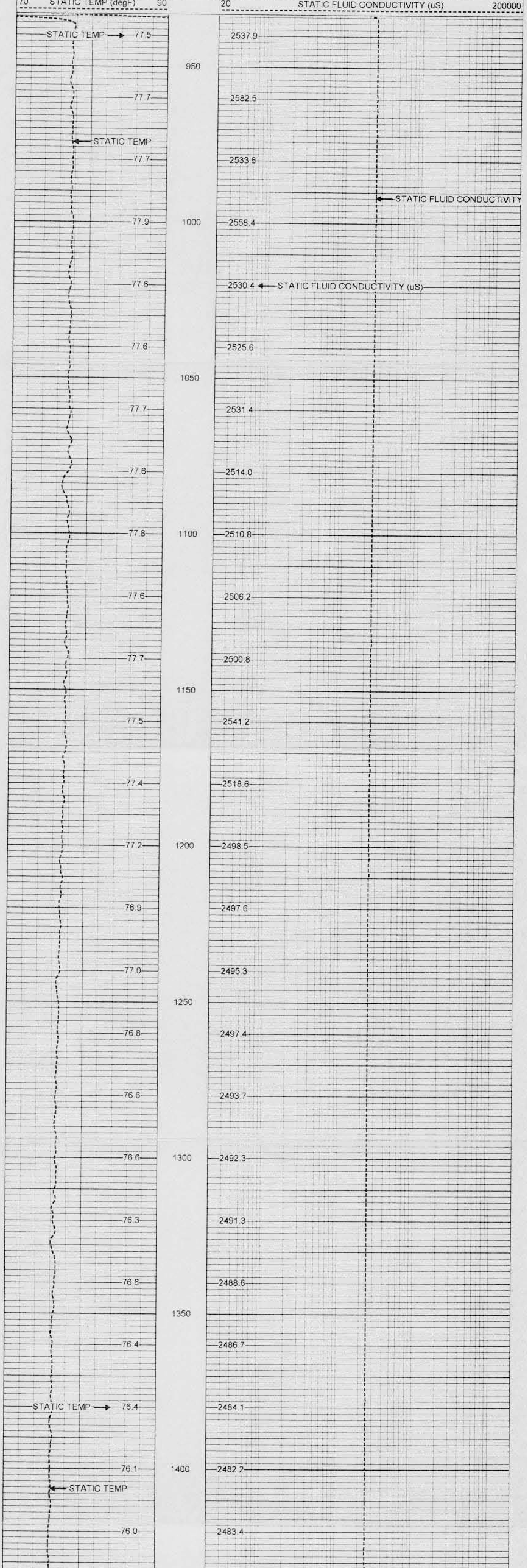
Comments

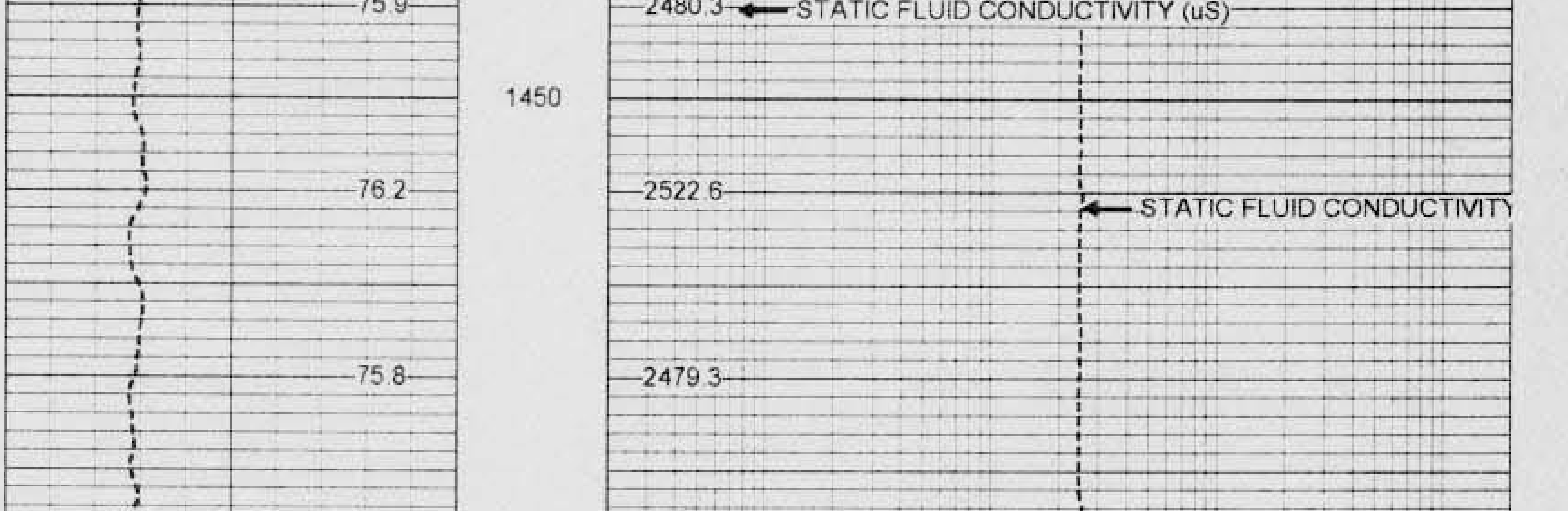
OTHER SERVICES:

DUAL INDUCTION/LL3/SP
X-Y CALIPER/GAMMA RAY

FLORIDA GEOPHYSICAL LOGGING, INC. — STATIC FCT

Database File:	hobero2.db
Dataset Pathname:	run5/pass1
Presentation Format:	frt_mg.prs
Dataset Creation:	Mon Nov 20 11:04:23 2000 by Log VER_5.4
Charted by:	Depth in Feet scaled 1:240





Dataset:	run5/pass1
Total Length:	1.80 ft
Total Weight:	20.00 lb
O.D.:	1.69 in

FRT Calibration Report

Serial Number:	31
Tool Model:	SONDEX
Performed:	Wed Aug 30 16:12:48 2000

Point #	Reading		Reference
1	25.476	cps	500.000
2	31.707	cps	1000.000
3	205.970	cps	10000.000
4	1184.540	cps	50000.000
5		cps	
6		cps	

Temperature Calibration Report

Serial Number:	31
Tool Model:	SONDEX
Performed:	Wed Aug 30 10:51:49 2000

Point #	Reading		Reference	
1	123.142	cps	36	degF
2	304.454	cps	75	degF
3	694.864	cps	156	degF

FLORIDA GEOPHYSICAL LOGGING, INC.

XY-CALIPER GAMMA RAY LOG

Company	SOUTH MARTIN
Well	RO-2
Field	HOBE SOUND
Country	MARTIN
State/Prv	FL

Company	SOUTH MARTIN REGIONAL UTILITY		
Well	RO-2		
Field	HOBE SOUND		
Country	MARTIN	State/Prv	FLORIDA
Location		Other Services	DIL/LL3/SP
Permanent Datum	PAD	Elevation	Elevation
Log Measured From	PAD		K.B.
Drilling Measured From	PAD		D.F.
			G.L.

Date	01-NOV-2000
Run Number	TWO
Depth Driller	1014'
Depth Logger	1014'
Bottom Logged Interval	1014'
Top Log Interval	10'
Open Hole Size	12.25"
Type Fluid	MUD
Density / Viscosity	NA
Max. Recorded Temp.	NA
Estimated Cement Top	NA
Time Well Ready	ON ARRIVAL
Time Logger on Bottom	09:30
Equipment Number	103
Location	FT. MYERS
Recorded By	LEE
Witnessed By	M.KRUPA

Borehole Record				Tubing Record			
Run Number	Bit	From	To	Size	Weight	From	To
ONE	36.5"	SURFACE	244'				
TWO	12.25"	CASING	1014'				

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String	30"	375 W.T.	SURFACE	237'
Prot. String				
Production String				
Liner				

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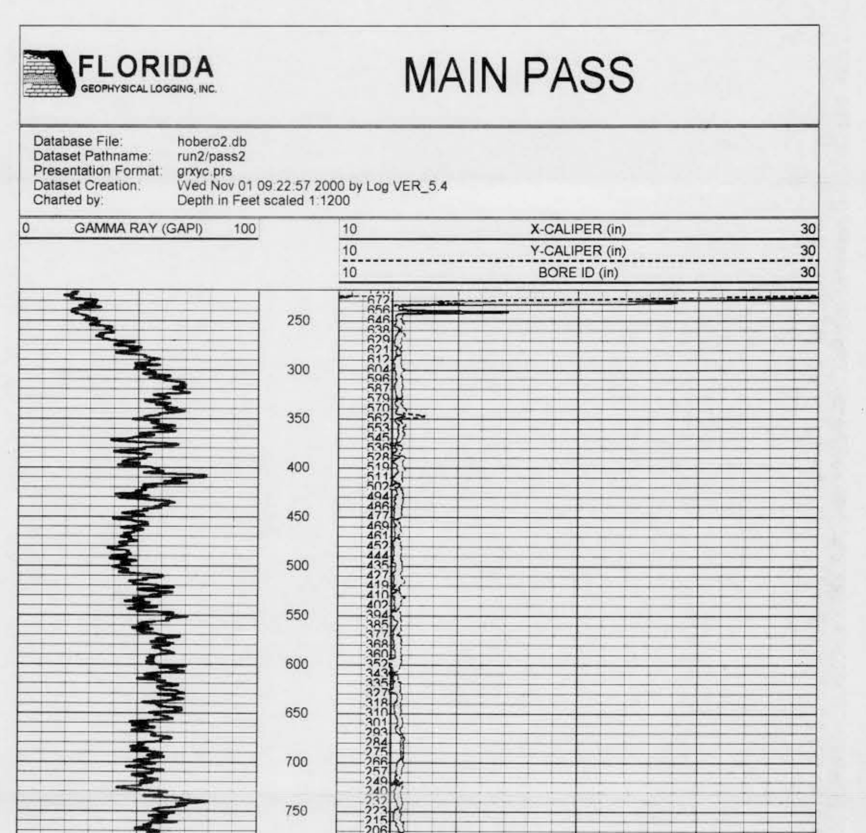
Comments

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

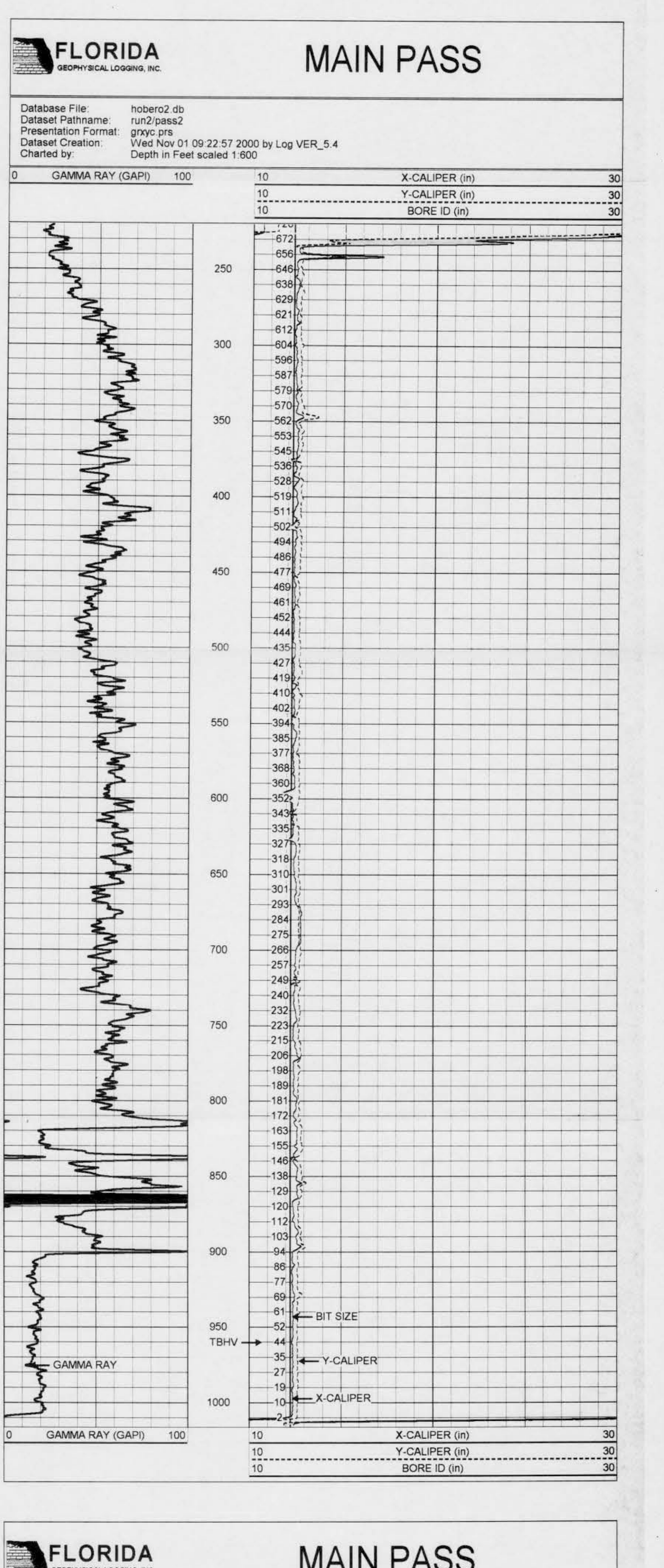
Database File: hobero2.db
Dataset Pathname: run2/pass2
Presentation Format: grxyc.prs
Dataset Creation: Wed Nov 01 09:22:57 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:1200



FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

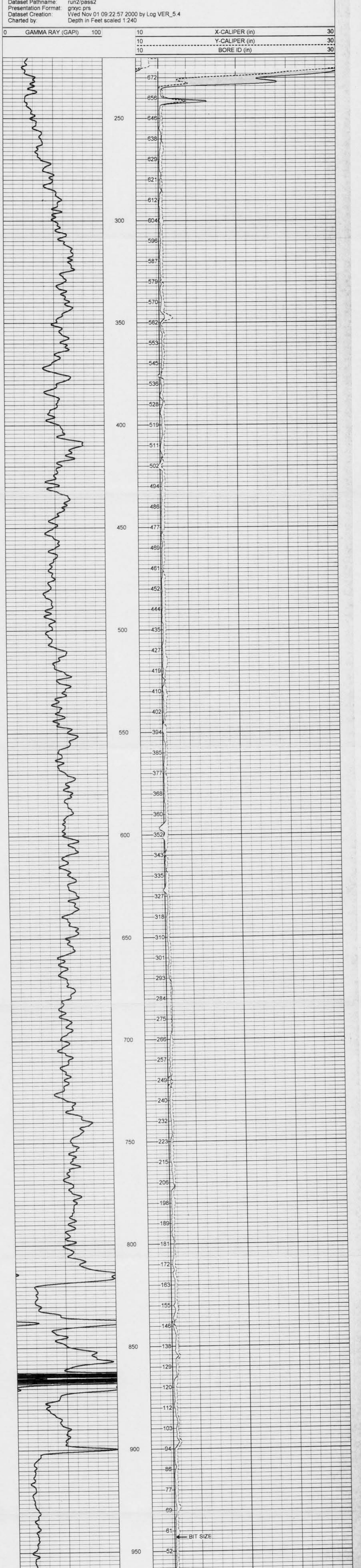
Database File: hobero2.db
Dataset Pathname: run2/pass2
Presentation Format: grxyc.prs
Dataset Creation: Wed Nov 01 09:22:57 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:600



FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

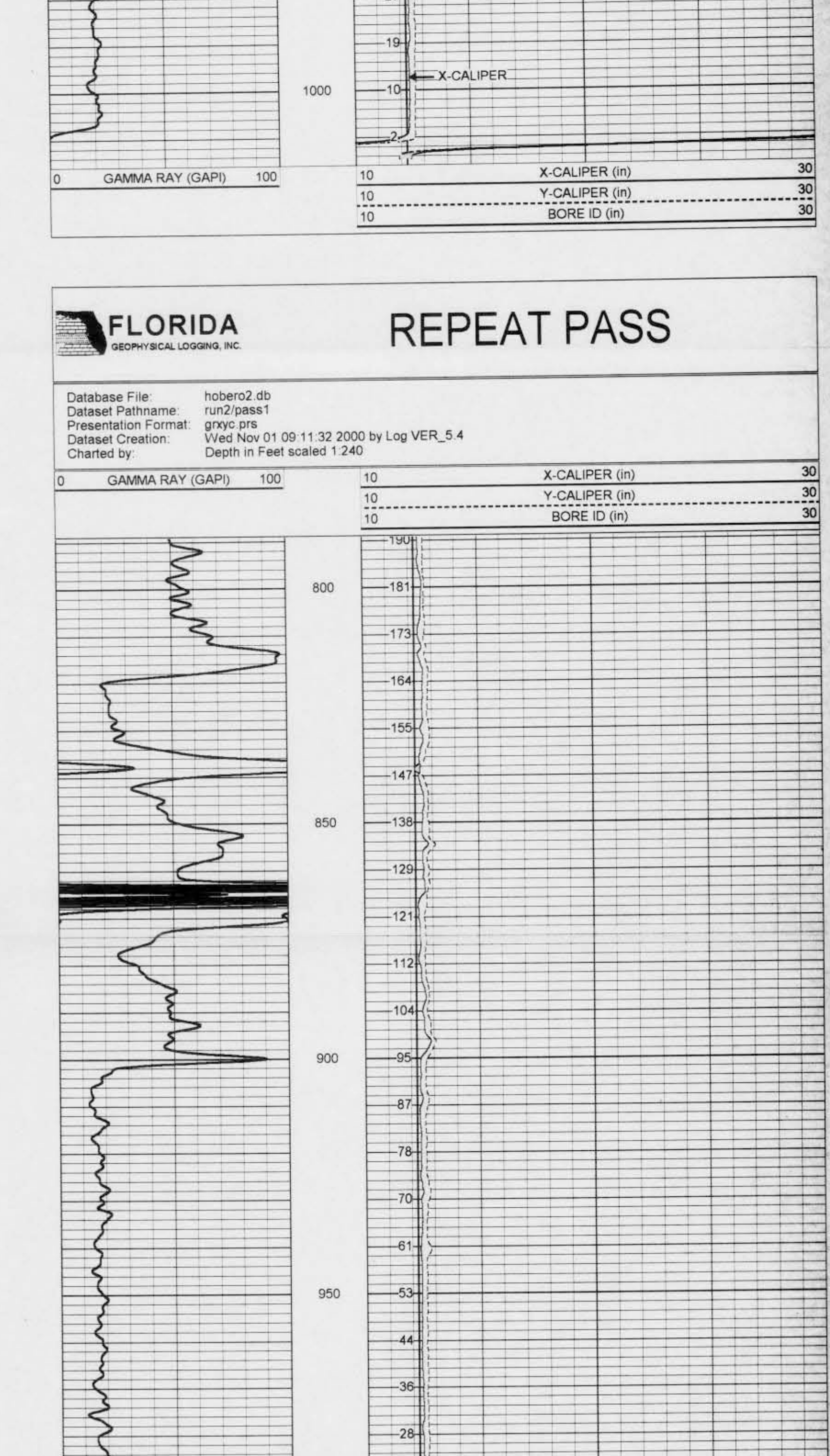
Database File: hobero2.db
Dataset Pathname: run2/pass2
Presentation Format: grxyc.prs
Dataset Creation: Wed Nov 01 09:22:57 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:240



FLORIDA GEOPHYSICAL LOGGING, INC.

REPEAT PASS

Database File: hobero2.db
Dataset Pathname: run2/pass1
Presentation Format: grxyc.prs
Dataset Creation: Wed Nov 01 09:11:32 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:240



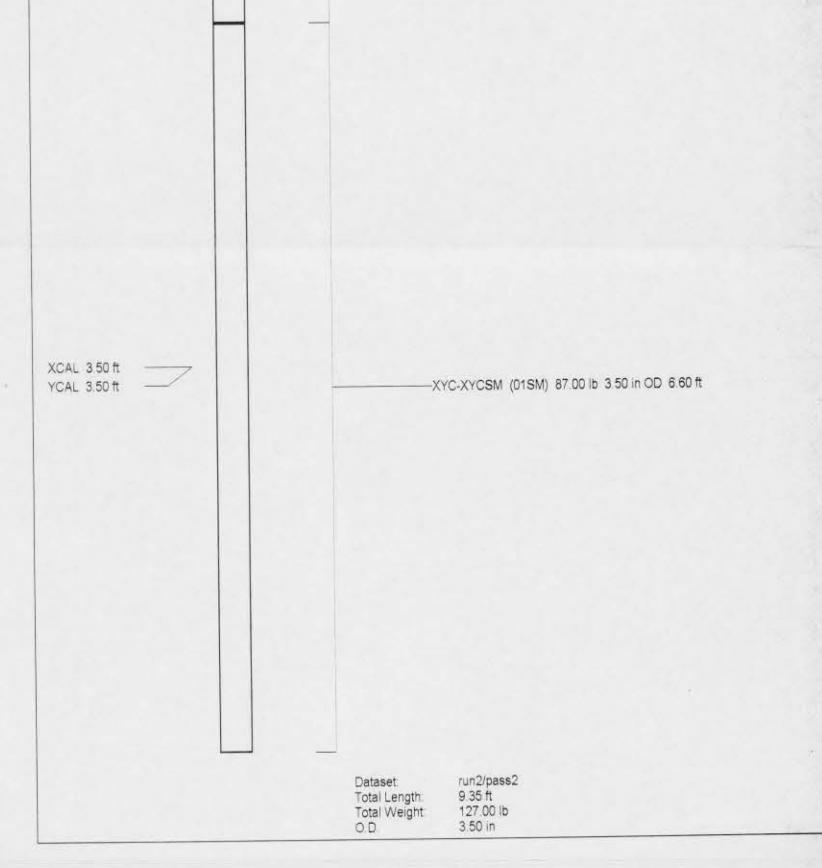
XY Caliper Calibration Report

Serial Number/Model: 01SM-XYCSM
Performed: Wed Nov 01 08:58:24 2000

Ring			X Caliper		Y Caliper	
1:	10	in	477.678	cps	437.638	cps
2:	20	in	749.349	cps	679.279	cps
3:	30	in	1062.96	cps	961.061	cps
4:		in		cps		cps
5:		in		cps		cps
6:		in		cps		cps

Gamma Ray Calibration Report

Serial Number:	12	
Tool Model:	GROH	
Performed:	Wed Aug 18 15:33:07 1999	
Calibrator Value:	120	GAPI
Background Reading:	39.6042	cps
Calibrator Reading:	163.975	cps
Sensitivity:	0.964856	GAPI/cps



Dataset: run2/pass2
Total Length: 9.35 ft
Total Weight: 127.00 lb
O.D.: 3.50 in

FLORIDA GEOPHYSICAL LOGGING, INC.

DUAL INDUCTION LL3/SP LOG

Company	SOUTH MARTIN REGIONAL UTILITY
Well	RO-2
Field	HOBE SOUND
Country	MARTIN
State/Prv	FLORIDA
Location	
Other Services	X-Y / GR

		Elevation		Elevation
Permanent Datum	PAD		K.B.	
Log Measured From	PAD		D.F.	
Drilling Measured From	PAD		G.L.	

Company SOUTH MARTIN
Well RO-2
Field HOBE SOUND
Country MARTIN
State/Prv FL

Date	01-NOV-2000
Run Number	TWO
Depth Driller	1014'
Depth Logger	1014'
Bottom Logged Interval	1014'
Top Log Interval	10'
Open Hole Size	12.25"
Type Fluid	MUD
Density / Viscosity	NA
Max. Recorded Temp.	NA
Estimated Cement Top	NA
Time Well Ready	ON ARRIVAL
Time Logger on Bottom	10:30
Equipment Number	102
Location	FT. MYERS
Recorded By	LEE
Witnessed By	M KRUPA

Borehole Record / Tubing Record

Run Number	Bit	From	To	Size	Weight	From	To
ONE	36.5"	SURFACE	244'				
TWO	12.25"	CASING	1014'				

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String	30"	3/5 W.T.	SURFACE	237'
Prot. String				
Production String				
Liner				

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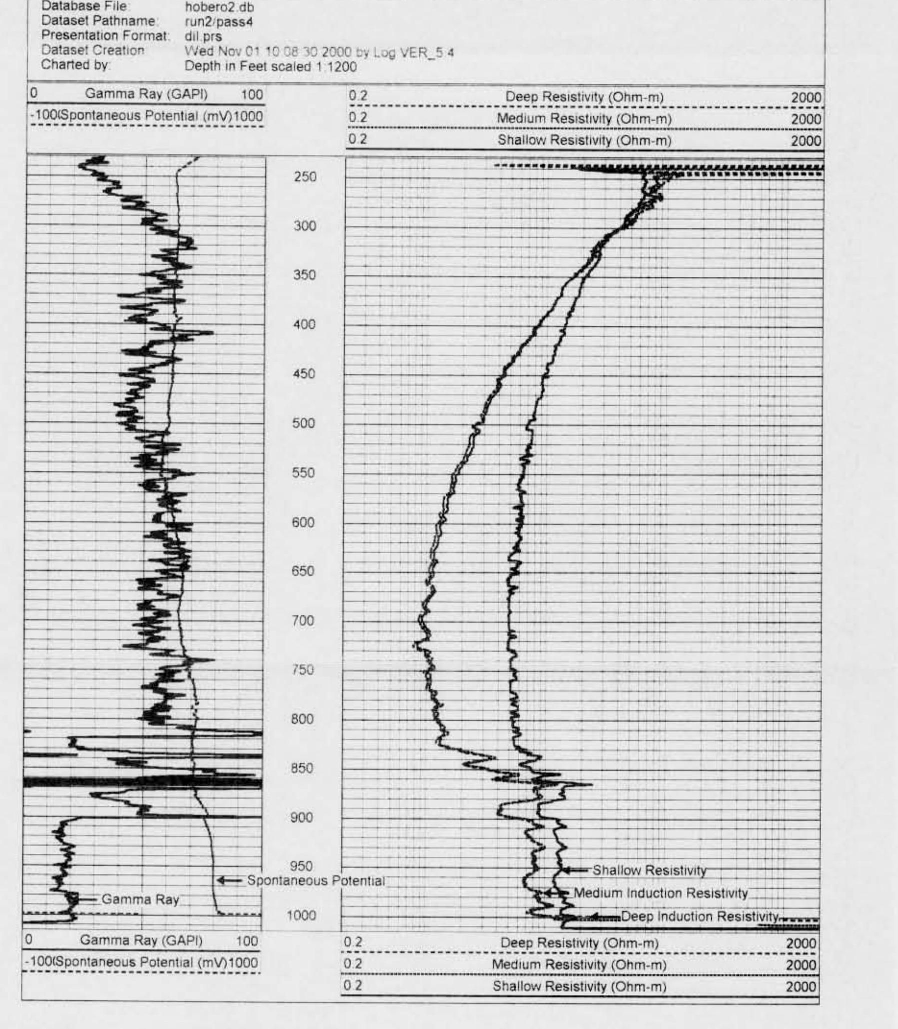
Comments

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

Database File: hobero2.db
Dataset Pathname: run2/pass4
Presentation Format: dil.prs
Dataset Creation: Wed Nov 01 10:08:30 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:1200

0	Gamma Ray (GAPI)	100	0.2	Deep Resistivity (Ohm-m)	2000
-100	(Spontaneous Potential (mV)	1000	0.2	Medium Resistivity (Ohm-m)	2000
			0.2	Shallow Resistivity (Ohm-m)	2000



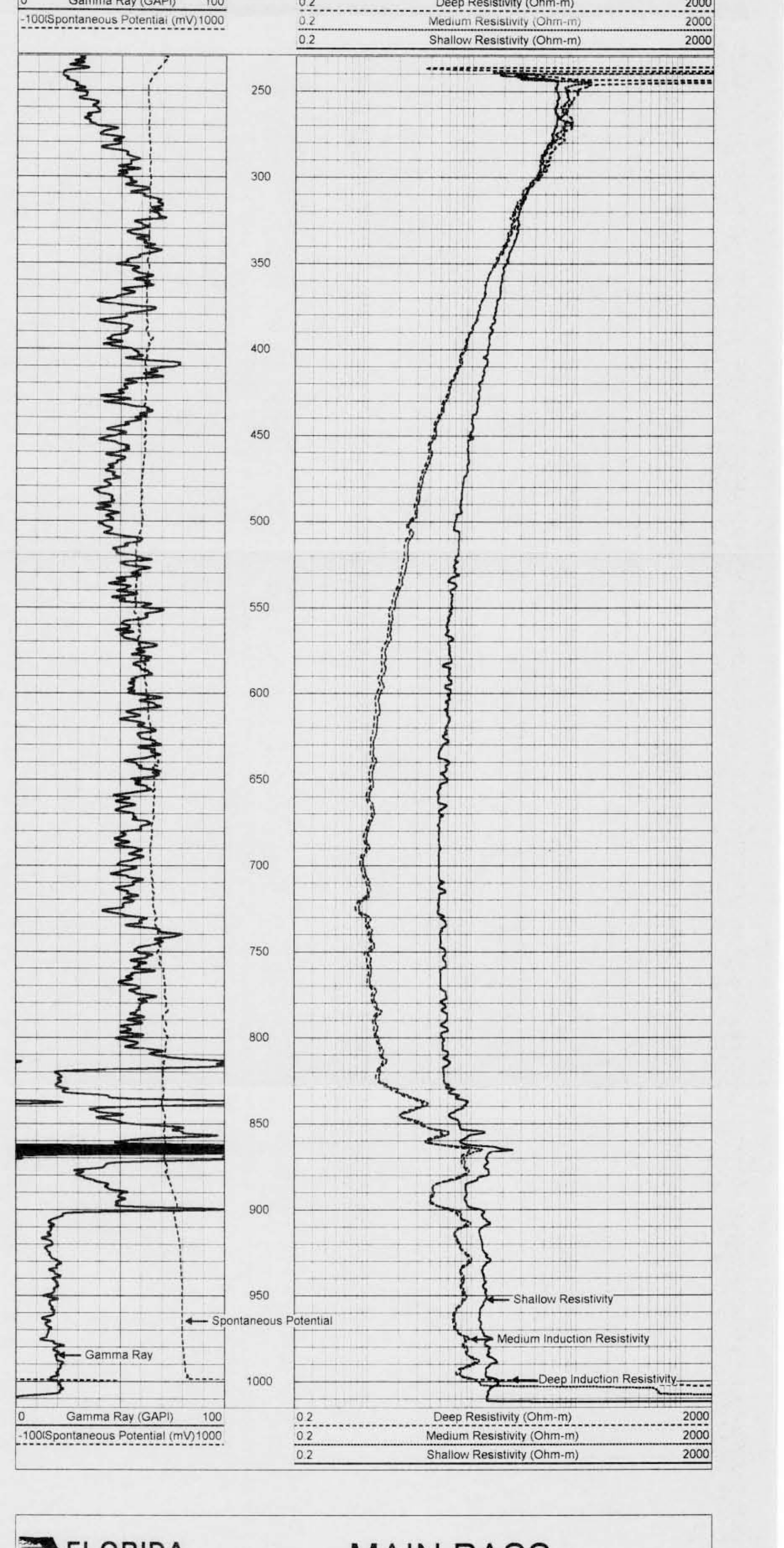
0	Gamma Ray (GAPI)	100	0.2	Deep Resistivity (Ohm-m)	2000
-100	(Spontaneous Potential (mV)	1000	0.2	Medium Resistivity (Ohm-m)	2000
			0.2	Shallow Resistivity (Ohm-m)	2000

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

Database File: hobero2.db
Dataset Pathname: run2/pass4
Presentation Format: dil.prs
Dataset Creation: Wed Nov 01 10:08:30 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:600

0	Gamma Ray (GAPI)	100	0.2	Deep Resistivity (Ohm-m)	2000
-100	(Spontaneous Potential (mV)	1000	0.2	Medium Resistivity (Ohm-m)	2000
			0.2	Shallow Resistivity (Ohm-m)	2000



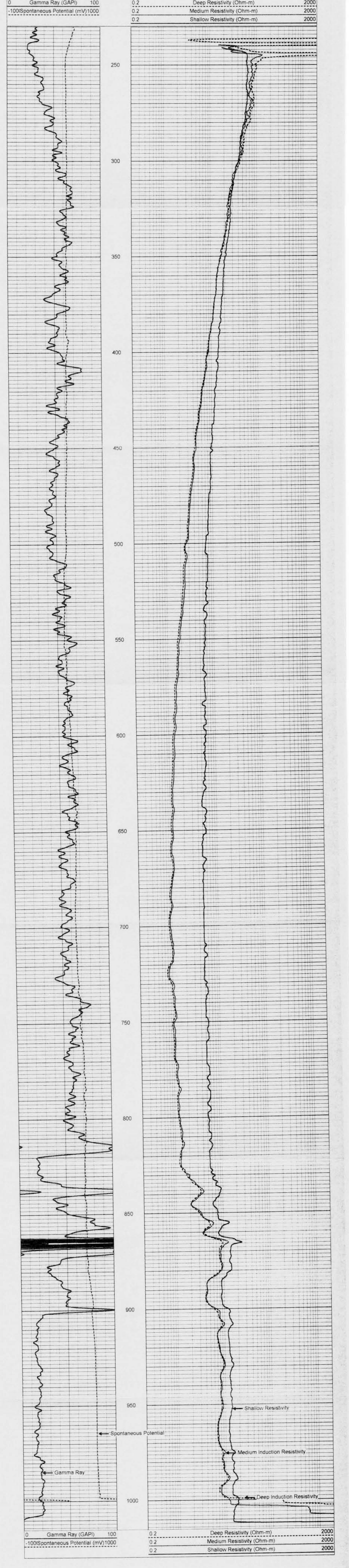
0	Gamma Ray (GAPI)	100	0.2	Deep Resistivity (Ohm-m)	2000
-100	(Spontaneous Potential (mV)	1000	0.2	Medium Resistivity (Ohm-m)	2000
			0.2	Shallow Resistivity (Ohm-m)	2000

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

Database File: hobero2.db
Dataset Pathname: run2/pass4
Presentation Format: dil.prs
Dataset Creation: Wed Nov 01 10:08:30 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:240

0	Gamma Ray (GAPI)	100	0.2	Deep Resistivity (Ohm-m)	2000
-100	(Spontaneous Potential (mV)	1000	0.2	Medium Resistivity (Ohm-m)	2000
			0.2	Shallow Resistivity (Ohm-m)	2000



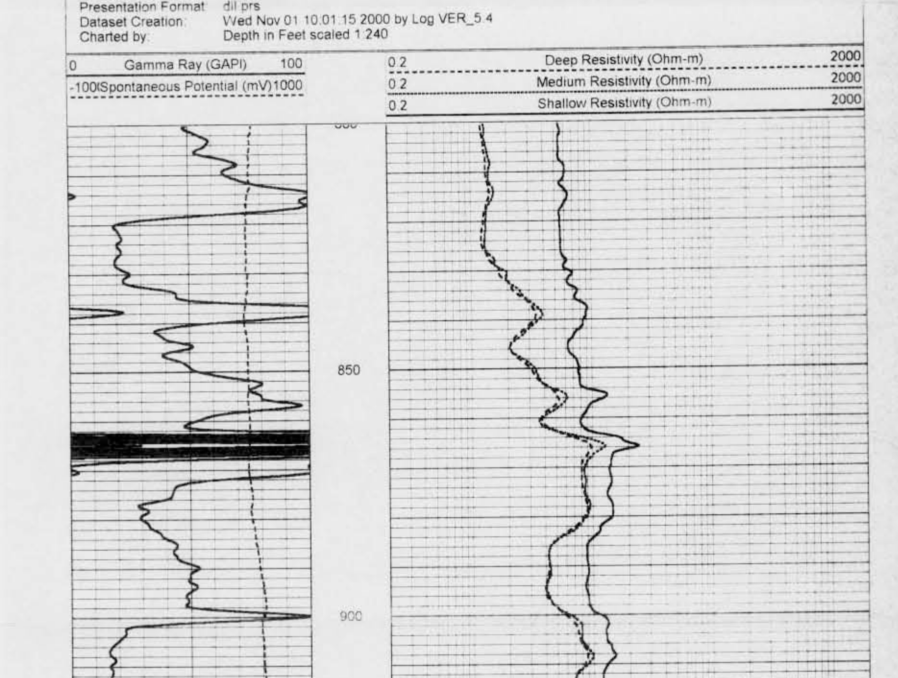
0	Gamma Ray (GAPI)	100	0.2	Deep Resistivity (Ohm-m)	2000
-100	(Spontaneous Potential (mV)	1000	0.2	Medium Resistivity (Ohm-m)	2000
			0.2	Shallow Resistivity (Ohm-m)	2000

FLORIDA GEOPHYSICAL LOGGING, INC.

REPEAT PASS

Database File: hobero2.db
Dataset Pathname: run2/pass3
Presentation Format: dil.prs
Dataset Creation: Wed Nov 01 10:01:15 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:240

0	Gamma Ray (GAPI)	100	0.2	Deep Resistivity (Ohm-m)	2000
-100	(Spontaneous Potential (mV)	1000	0.2	Medium Resistivity (Ohm-m)	2000
			0.2	Shallow Resistivity (Ohm-m)	2000



0	Gamma Ray (GAPI)	100	0.2	Deep Resistivity (Ohm-m)	2000
-100	(Spontaneous Potential (mV)	1000	0.2	Medium Resistivity (Ohm-m)	2000
			0.2	Shallow Resistivity (Ohm-m)	2000

Dual Induction Calibration Report

Serial-Model: 0615-C
Surface Cal Performed: Thu Apr 29 14:55:23 1999
Downhole Cal Performed: Wed Nov 01 09:54:11 2000
After Survey Verification Performed: Wed Nov 01 09:54:11 2000

Surface Calibration

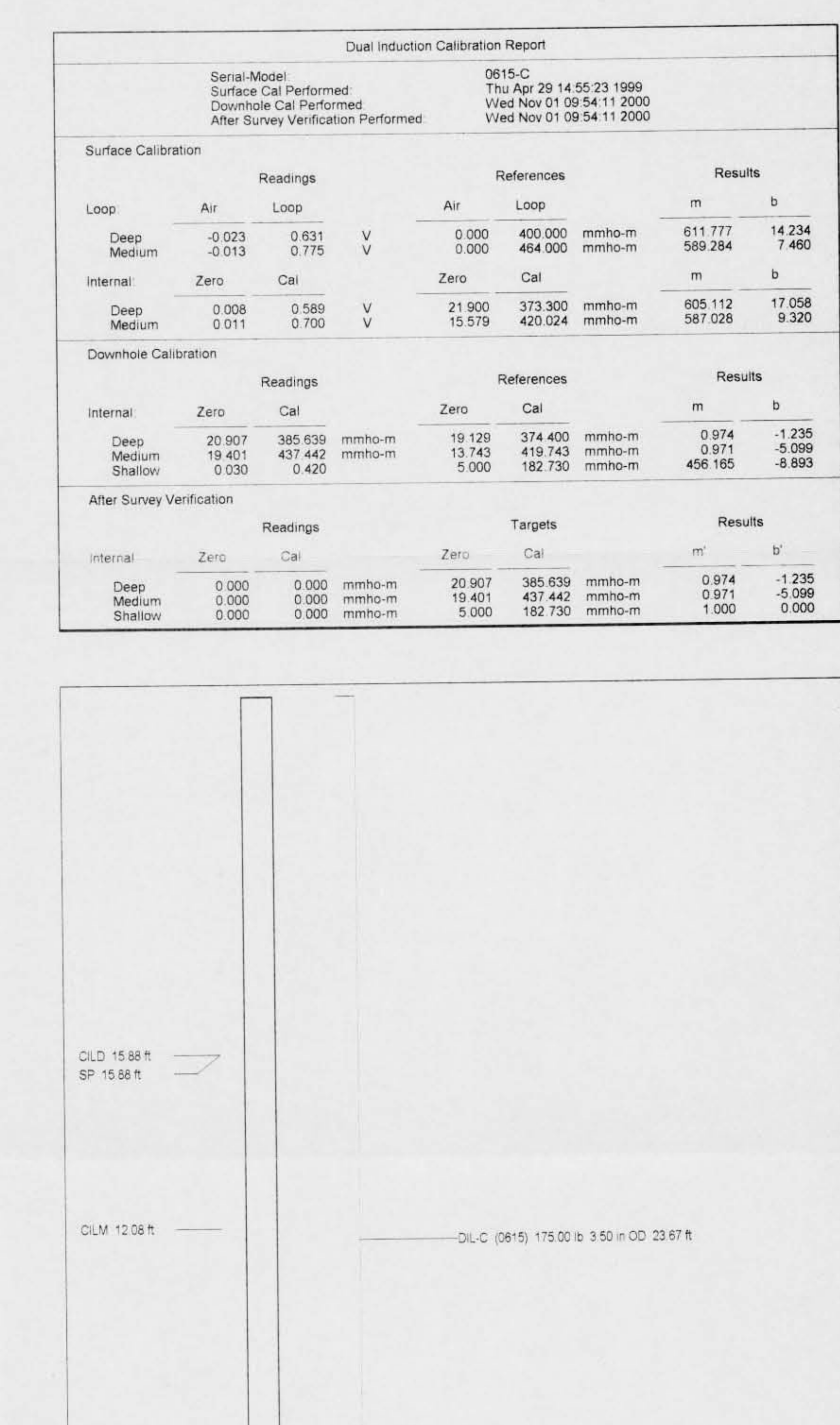
Loop:	Readings Air	Readings Loop		References Air	References Loop		Results m	Results b
Deep	-0.023	0.631	V	0.000	400.000	mmho-m	611.777	14.234
Medium	-0.013	0.775	V	0.000	464.000	mmho-m	589.284	7.460
Internal:	**Zero**	**Cal**		**Zero**	**Cal**		**m**	**b**
Deep	0.008	0.589	V	21.900	373.300	mmho-m	605.112	17.058
Medium	0.011	0.700	V	15.579	420.024	mmho-m	587.028	9.320

Downhole Calibration

Internal:	Readings Zero	Readings Cal		References Zero	References Cal		Results m	Results b
Deep	20.907	385.639	mmho-m	19.129	374.400	mmho-m	0.974	-1.235
Medium	19.401	437.442	mmho-m	13.743	419.743	mmho-m	0.971	-5.099
Shallow	0.030	0.420		5.000	182.730	mmho-m	456.165	-8.893

After Survey Verification

Internal:	Readings Zero	Readings Cal		Targets Zero	Targets Cal		Results m'	Results b'
Deep	0.000	0.000	mmho-m	20.907	385.639	mmho-m	0.974	-1.235
Medium	0.000	0.000	mmho-m	19.401	437.442	mmho-m	0.971	-5.099
Shallow	0.000	0.000	mmho-m	5.000	182.730	mmho-m	1.000	0.000



Dataset: run2/pass4
Total Length: 23.67 ft
Total Weight: 175.00 lb
O.D.: 3.50 in

FLORIDA GEOPHYSICAL LOGGING, INC.

XY-CALIPER GAMMA RAY LOG

Company	SOUTH MARTIN
Well	RO-2
Field	HOBE SOUND
Country	MARTIN
State/Prv	FL

Company	SOUTH MARTIN REGIONAL UTILITY
Well	RO-2
Field	HOBE SOUND
Country	MARTIN
State/Prv	FLORIDA
Location	
Other Services	SEE COMMENTS

		Elevation
Permanent Datum	PAD	K.B.
Log Measured From	PAD	D.F.
Drilling Measured From	PAD	G.L.

Date	20-NOV-2000
Run Number	FOUR
Depth Driller	1495'
Depth Logger	1496'
Bottom Logged Interval	1496'
Top Log Interval	CASING
Open Hole Size	17"
Type Fluid	MUD
Density / Viscosity	NA
Max. Recorded Temp.	NA
Estimated Cement Top	NA
Time Well Ready	1000
Time Logger on Bottom	1100
Equipment Number	103
Location	FT. MYERS
Recorded By	DENISON
Witnessed By	J. ANDERSEN

Borehole Record

Run Number	Bit	From	To
ONE	36.5"	SURFACE	244'
TWO	12.25"	CASING	1014'
THREE	26"	CASING	1007'
FOUR	17"	CASING	1495'

Tubing Record

Size	Weight	From	To

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String	30"	375 W.T.	SURFACE	237'
Prot. String	18"	375 W.T.	221'	1001'
Production String				
Liner				

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Comments

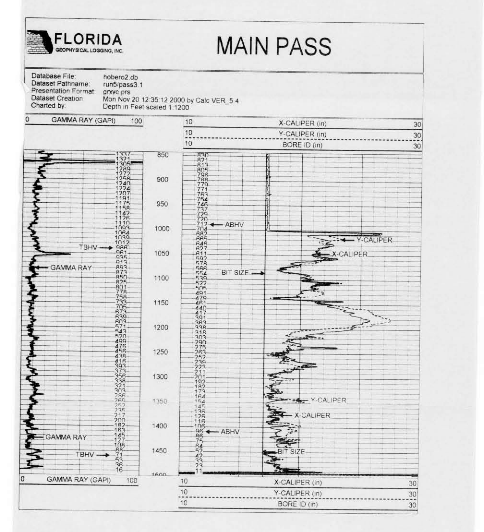
ANNULARE HOLE VOLUME
CALCULATED FOR 12" CASING

OTHER SERVICES:
FLUID CONDUCTIVITY/TEMPERATURE
DUAL INDUCTION/LL3/SP

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

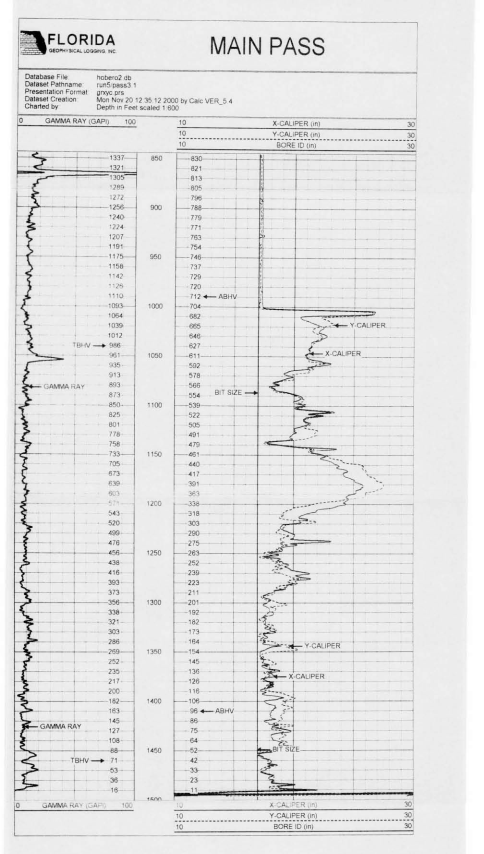
Database File:	hobero2.db
Dataset Pathname:	run5/pass3.1
Presentation Format:	grxyc.prs
Dataset Creation:	Mon Nov 20 12:35:12 2000 by Calc VER_5.4
Charted by:	Depth in Feet scaled 1:1200



FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

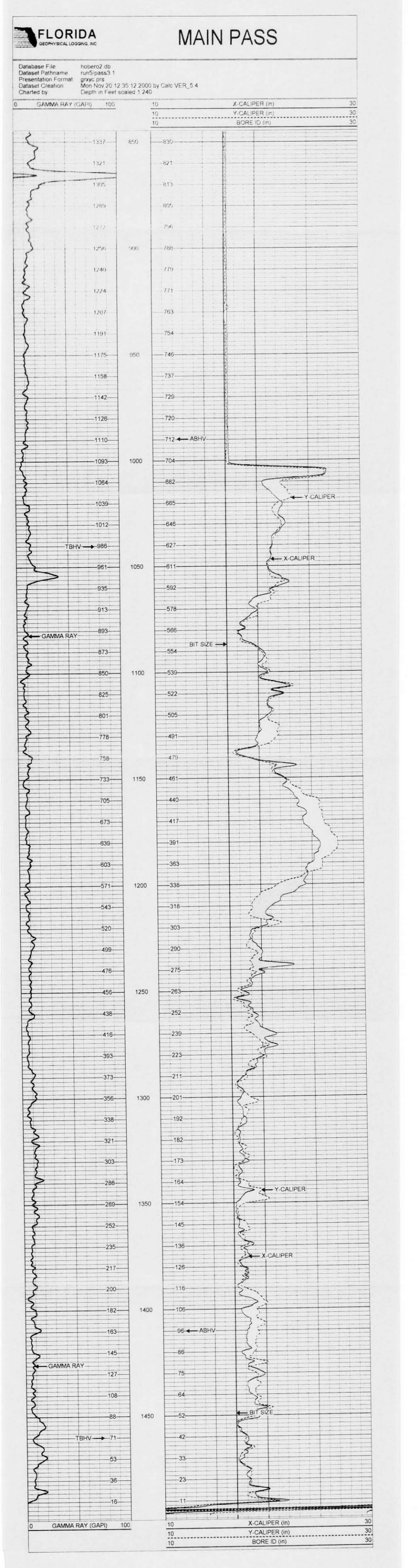
Database File:	hobero2.db
Dataset Pathname:	run5/pass3.1
Presentation Format:	grxyc.prs
Dataset Creation:	Mon Nov 20 12:35:12 2000 by Calc VER_5.4
Charted by:	Depth in Feet scaled 1:600



FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

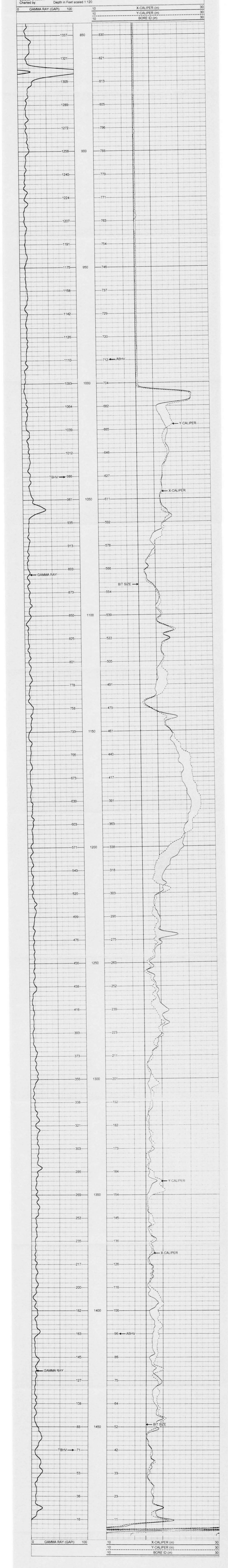
Database File:	hobero2.db
Dataset Pathname:	run5/pass3.1
Presentation Format:	grxyc.prs
Dataset Creation:	Mon Nov 20 12:35:12 2000 by Calc VER_5.4
Charted by:	Depth in Feet scaled 1:240



FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

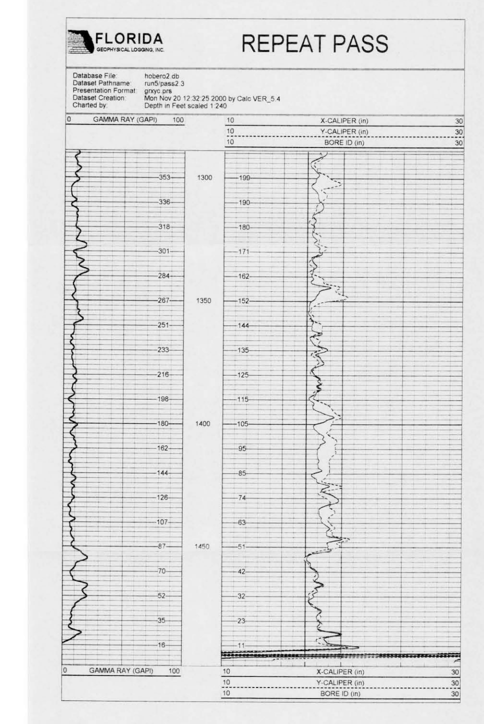
Database File:	hobero2.db
Dataset Pathname:	run5/pass3.1
Presentation Format:	grxyc.prs
Dataset Creation:	Mon Nov 20 12:35:12 2000 by Calc VER_5.4
Charted by:	Depth in Feet scaled 1:120

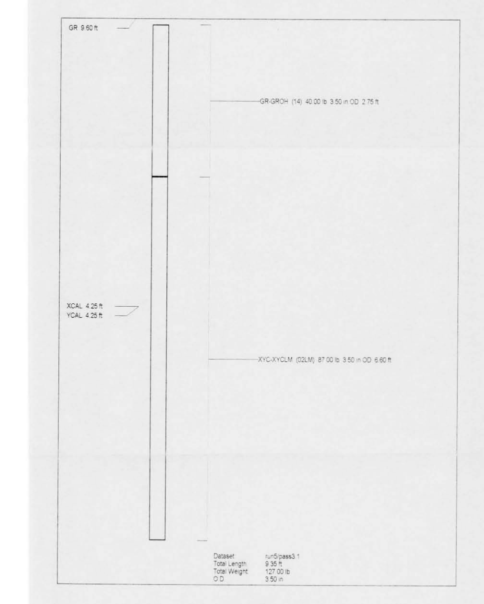


FLORIDA GEOPHYSICAL LOGGING, INC.

REPEAT PASS

Database File:	hobero2.db
Dataset Pathname:	run5/pass2.3
Presentation Format:	grxyc.prs
Dataset Creation:	Mon Nov 20 12:32:25 2000 by Calc VER_5.4
Charted by:	Depth in Feet scaled 1:240





Dataset	run5/pass3.1
Total Length	9.35 ft
Total Weight	127.00 lb
O.D.	3.50 in

XY Caliper Calibration Report

Serial Number/Model: 02LM-XYCLM
Performed: Mon Nov 20 11:16:35 2000

Ring			X Caliper		Y Caliper	
1:	10	in	750.05	cps	836.136	cps
2:	17.25	in	884.219	cps	944.986	cps
3:	29.25	in	1114.32	cps	1145.66	cps
4:	42	in	1398.2	cps	1390.09	cps
5:		in		cps		cps
6:		in		cps		cps

Gamma Ray Calibration Report

Serial Number:	14	
Tool Model:	GROH	
Performed:	Fri Sep 01 10:52:17 2000	
Calibrator Value:	120	GAPI
Background Reading:	21.4476	cps
Calibrator Reading:	133.923	cps
Sensitivity:	1.0669	GAPI/cps

FLORIDA GEOPHYSICAL LOGGING, INC.

DUAL INDUCTION LL3/SP LOG

Company SOUTH MARTIN
Well RO-2
Field HOBE SOUND
Country MARTIN
State/Prv FL

Company	SOUTH MARTIN REGIONAL UTILITY
Well	RO-2
Field	HOBE SOUND
Country	MARTIN
State/Prv	FLORIDA
Location	
Other Services	SEE COMMENTS
Permanent Datum	PAD
Log Measured From	PAD
Drilling Measured From	PAD
Elevation	KB / DF / GL

Date	20-NOV-2000
Run Number	FOUR
Depth Driller	1495'
Depth Logger	1496'
Bottom Logged Interval	1496'
Top Log Interval	CASING
Open Hole Size	17"
Type Fluid	MUD
Density / Viscosity	NA
Max. Recorded Temp	NA
Estimated Cement Top	NA
Time Well Ready	1000
Time Logger on Bottom	1230
Equipment Number	103
Location	FT. MYERS
Recorded By	DENISON
Witnessed By	J. ANDERSEN

Borehole Record				Tubing Record			
Run Number	Bit	From	To	Size	Weight	From	To
ONE	36.5"	SURFACE	244'				
TWO	12.25"	CASING	1014'				
THREE	26"	CASING	1007'				
FOUR	17"	CASING	1495'				

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String	30"	375 W.T.	SURFACE	237'
Prot. String	18"	375 W.T.	221'	1001'
Production String				
Liner				

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All interpretations are opinions based on inferences from electrical or other measurements and we cannot and do not guarantee the accuracy or correctness of any interpretation, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages, or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to our general terms and conditions set out in our current Price Schedule.

Comments

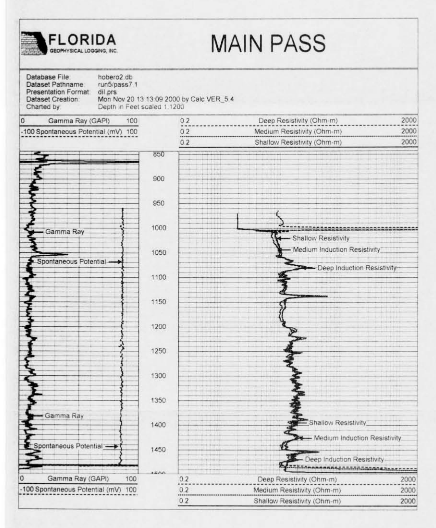
OTHER SERVICES:

FLUID CONDUCTIVITY/TEMPERATURE
X-Y CALIPER/GAMMA RAY

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

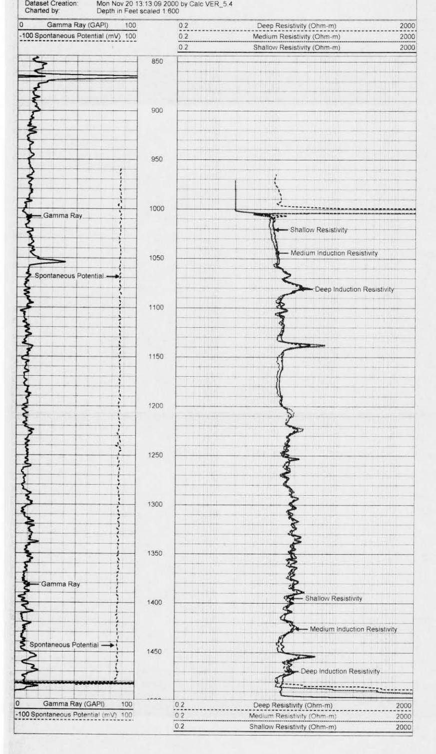
Database File: hobero2.db
Dataset Pathname: run5/pass7.1
Presentation Format: dil.prs
Dataset Creation: Mon Nov 20 13:13:09 2000 by Calc VER_5.4
Charted by: Depth in Feet scaled 1:1200



FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

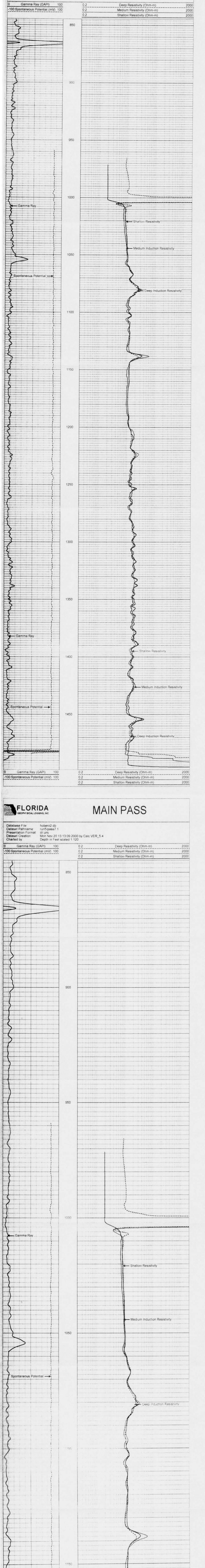
Database File: hobero2.db
Dataset Pathname: run5/pass7.1
Presentation Format: dil.prs
Dataset Creation: Mon Nov 20 13:13:09 2000 by Calc VER_5.4
Charted by: Depth in Feet scaled 1:600



FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

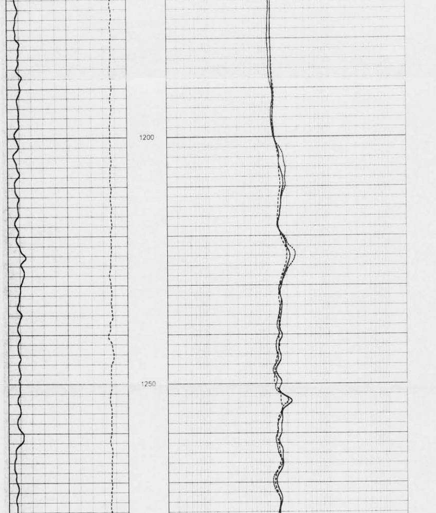
Database File: hobero2.db
Dataset Pathname: run5/pass7.1
Presentation Format: dil.prs
Dataset Creation: Mon Nov 20 13:13:09 2000 by Calc VER_5.4
Charted by: Depth in Feet scaled 1:240

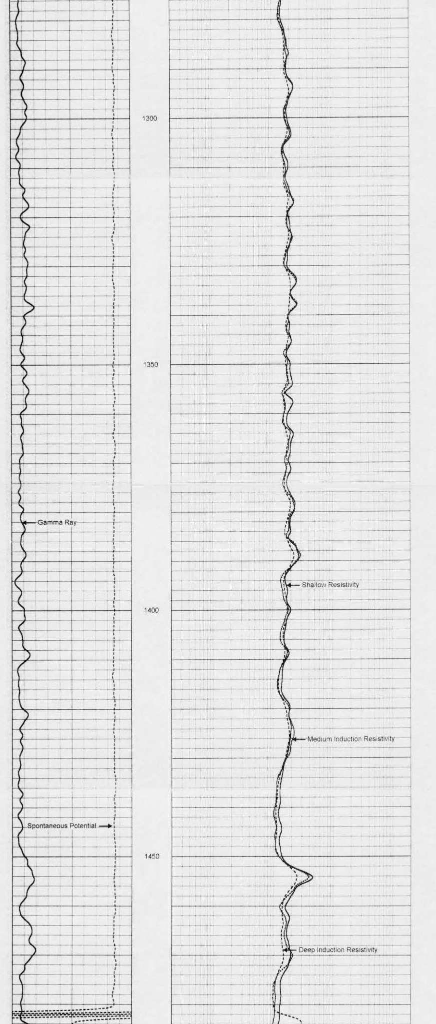


FLORIDA GEOPHYSICAL LOGGING, INC.

REPEAT PASS

Database File: hobero2.db
Dataset Pathname: run5/pass4.2
Presentation Format: dil.prs
Dataset Creation: Mon Nov 20 13:16:34 2000 by Calc VER_5.4
Charted by: Depth in Feet scaled 1:240





Dataset: run5/pass4.2
Total Length: 23.67 ft
Total Weight: 175.00 lb
O.D.: 3.50 in

Dual Induction Calibration Report

Serial-Model: 1510-C
Surface Cal Performed: Thu Apr 29 16:47:18 1999
Downhole Cal Performed: Mon Nov 20 12:22:27 2000
After Survey Verification Performed: Mon Nov 20 12:22:27 2000

Surface Calibration

Loop:	Readings: Air	Loop		References: Air	Loop		Results: m	b
Deep	-0.014	0.631	V	0.000	400.000	mmho-m	620.172	8.975
Medium	-0.001	0.703	V	0.000	464.000	mmho-m	659.905	0.362

Internal:	Zero	Cal		Zero	Cal		m	b
Deep	0.012	0.641	V	17.680	407.650	mmho-m	620.191	10.098
Medium	0.009	0.728	V	6.060	482.670	mmho-m	662.558	0.111

Downhole Calibration

Internal:	Readings: Zero	Cal		References: Zero	Cal		Results: m	b
Deep	18.975	425.255	mmho-m	16.557	406.514	mmho-m	0.960	-1.656
Medium	8.354	503.476	mmho-m	6.287	480.989	mmho-m	0.959	-1.722
Shallow	0.034	0.423		3.000	88.900	mmho-m	220.763	-4.546

After Survey Verification

Internal:	Readings: Zero	Cal		Targets: Zero	Cal		Results: m'	b'
Deep	0.000	0.000	mmho-m	18.975	425.255	mmho-m	0.960	-1.656
Medium	0.000	0.000	mmho-m	8.354	503.476	mmho-m	0.959	-1.722
Shallow	0.000	0.000	mmho-m	3.000	88.900	mmho-m	1.000	0.000

Company	SOUTH MARTIN
Well	RO-2
Field	HOBE SOUND
Country	MARTIN
State/Prv	FL

FLORIDA GEOPHYSICAL LOGGING, INC.

XY-CALIPER GAMMA RAY LOG

Company	SOUTH MARTIN REGIONAL UTILITY		
Well	RO-2		
Field	HOBE SOUND		
Country	MARTIN	State/Prv	FLORIDA
Location		Other Services	
Permanent Datum	PAD	Elevation	Elevation
Log Measured From	PAD		K.B.
Drilling Measured From	PAD		D.F.
			G.L.

Date	06-NOV-2000
Run Number	THREE
Depth Driller	1007'
Depth Logger	1007'
Bottom Logged Interval	1007'
Top Log Interval	CASING
Open Hole Size	26"
Type Fluid	MUD
Density / Viscosity	NA
Max Recorded Temp.	NA
Estimated Cement Top	NA
Time Well Ready	ON ARRIVAL
Time Logger on Bottom	11:00
Equipment Number	102
Location	FT. MYERS
Recorded By	LEE
Witnessed By	M KRUPA

Borehole Record				Tubing Record			
Run Number	Bit	From	To	Size	Weight	From	To
ONE	36.5"	SURFACE	244'				
TWO	12.25"	CASING	1014'				
THREE	26"	CASING	1007'				

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String	30"	375 W.T.	SURFACE	237'
Prot. String				
Production String				
Liner				

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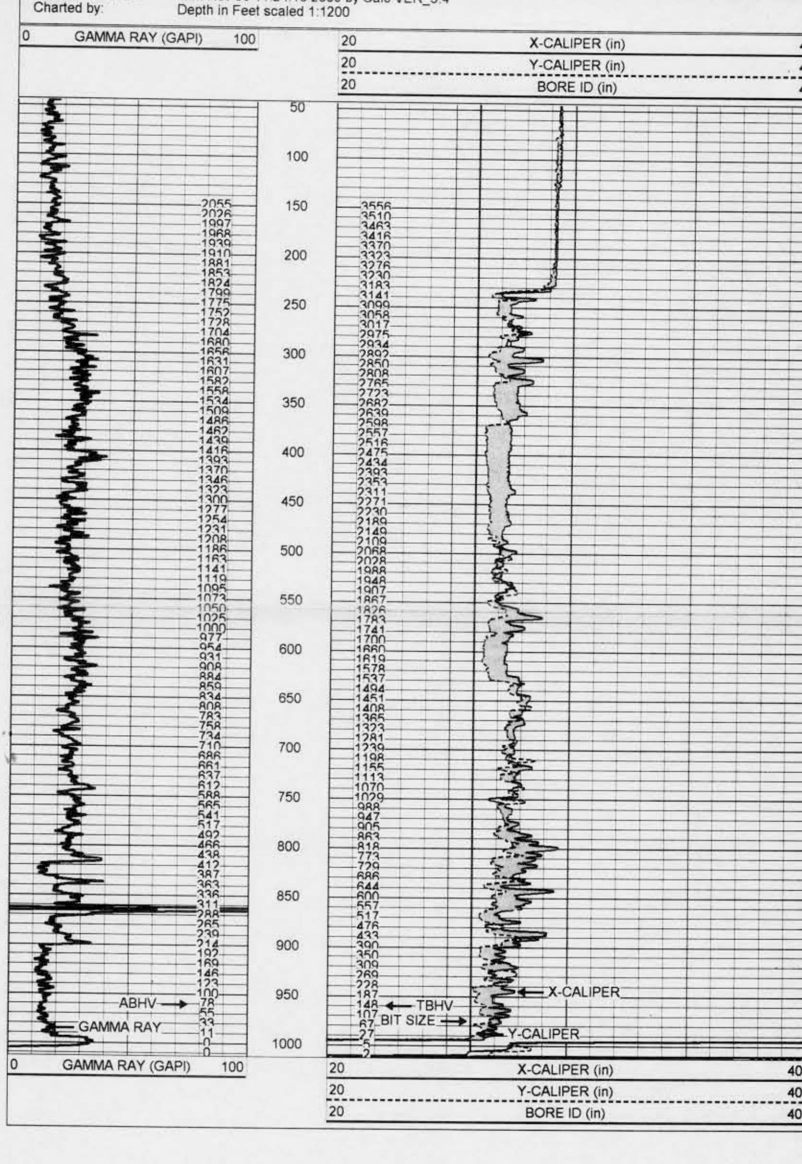
Comments

ABHV COMPUTED WITH 18" CASING

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

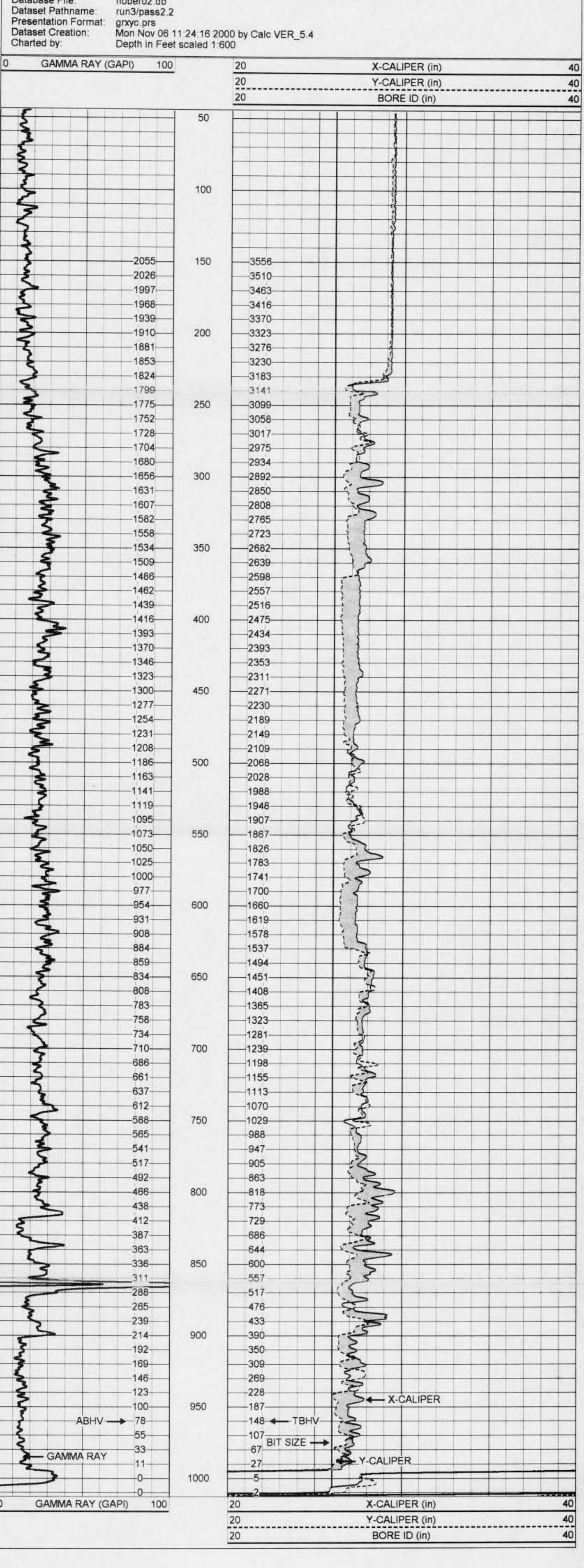
Database File:	hobero2.db
Dataset Pathname:	run3/pass2.2
Presentation Format:	grxyc.prs
Dataset Creation:	Mon Nov 06 11:24:16 2000 by Calc VER_5.4
Charted by:	Depth in Feet scaled 1:1200



FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

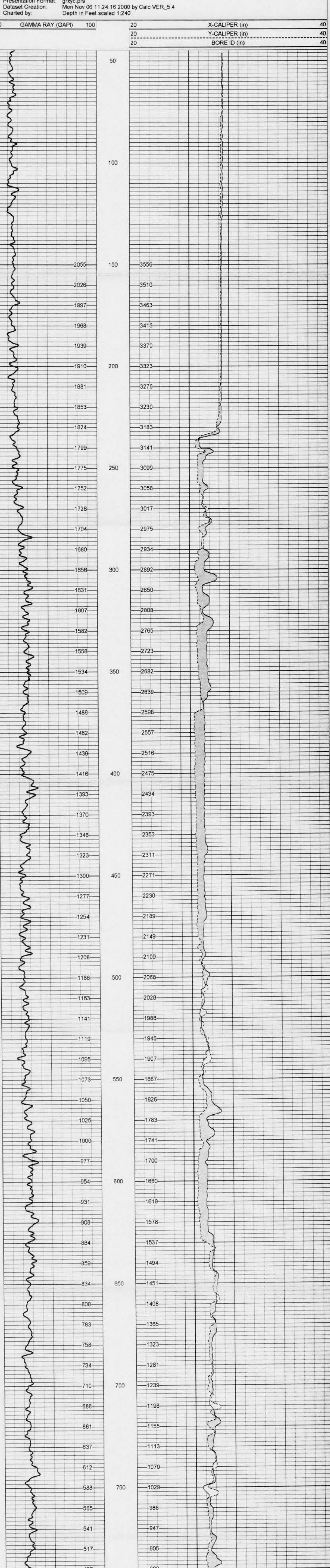
Database File:	hobero2.db
Dataset Pathname:	run3/pass2.2
Presentation Format:	grxyc.prs
Dataset Creation:	Mon Nov 06 11:24:16 2000 by Calc VER_5.4
Charted by:	Depth in Feet scaled 1:600



FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

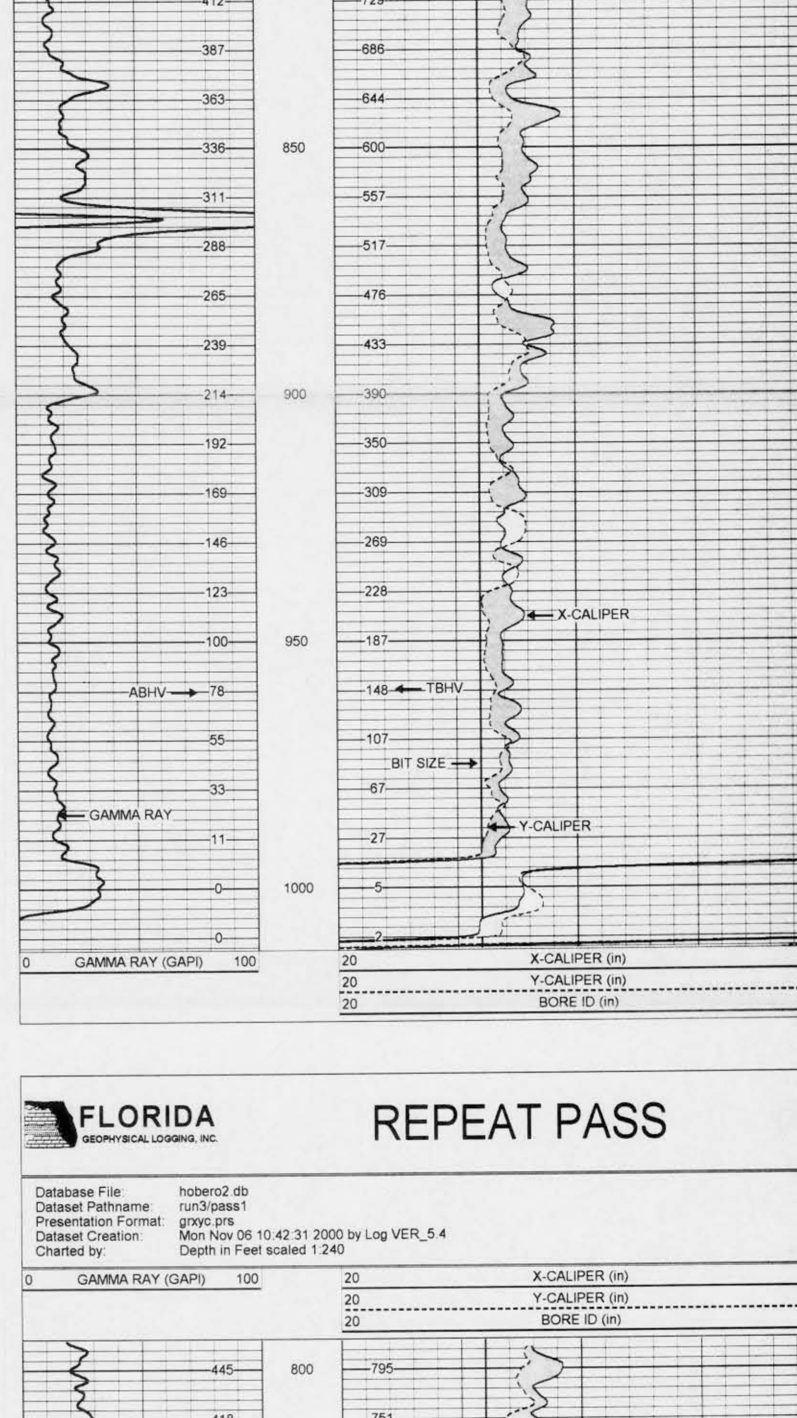
Database File:	hobero2.db
Dataset Pathname:	run3/pass2.2
Presentation Format:	grxyc.prs
Dataset Creation:	Mon Nov 06 11:24:16 2000 by Calc VER_5.4
Charted by:	Depth in Feet scaled 1:240



FLORIDA GEOPHYSICAL LOGGING, INC.

REPEAT PASS

Database File:	hobero2.db
Dataset Pathname:	run3/pass1
Presentation Format:	grxyc.prs
Dataset Creation:	Mon Nov 06 10:42:31 2000 by Log VER_5.4
Charted by:	Depth in Feet scaled 1:240



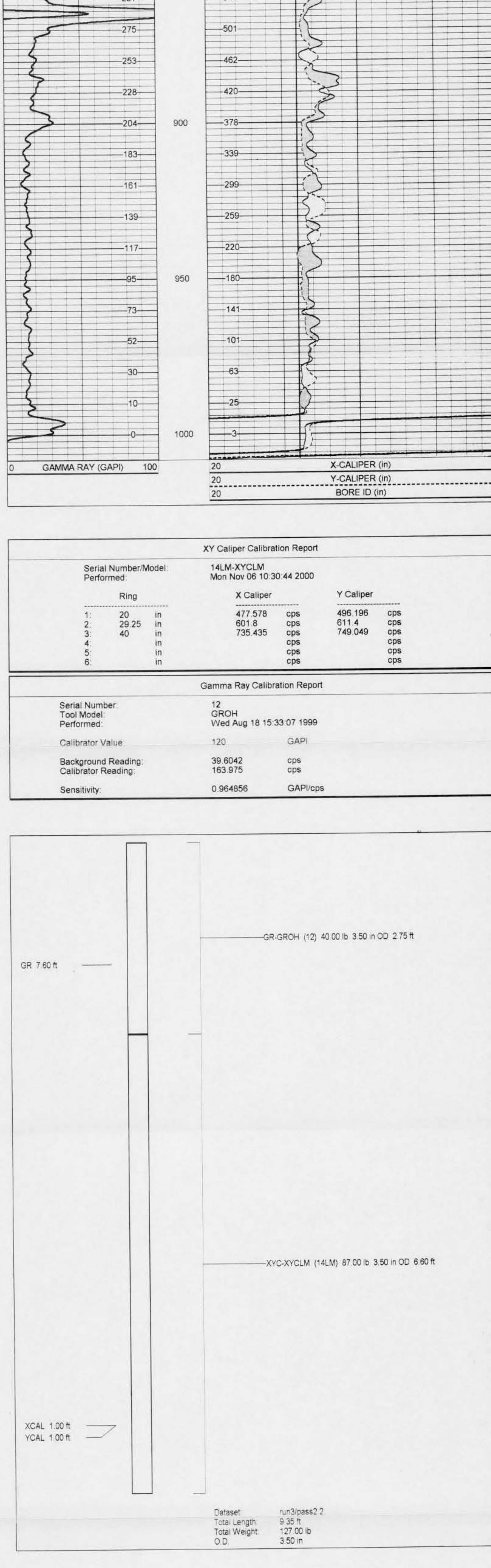
XY Caliper Calibration Report

Serial Number/Model:	14LM-XYCLM
Performed:	Mon Nov 06 10:30:44 2000

	Ring		X Caliper		Y Caliper	
1:	20	in	477.578	cps	496.196	cps
2:	29.25	in	601.8	cps	611.4	cps
3:	40	in	735.435	cps	749.049	cps
4:		in		cps		cps
5:		in		cps		cps
6:		in		cps		cps

Gamma Ray Calibration Report

Serial Number:	12	
Tool Model:	GROH	
Performed:	Wed Aug 18 15:33:07 1999	
Calibrator Value:	120	GAPI
Background Reading:	39.6042	cps
Calibrator Reading:	163.975	cps
Sensitivity:	0.964856	GAPI/cps



Dataset:	run3/pass2.2
Total Length:	9.35 ft
Total Weight:	127.00 lb
O.D.:	3.50 in

FLORIDA GEOPHYSICAL LOGGING, INC.

XY-CALIPER GAMMA RAY LOG

Company: SOUTH MARTIN REGIONAL UTILITY
Well: RO-2
Field: HOBE SOUND
County: MARTIN
State/Prv: FLORIDA

Other Services: NONE

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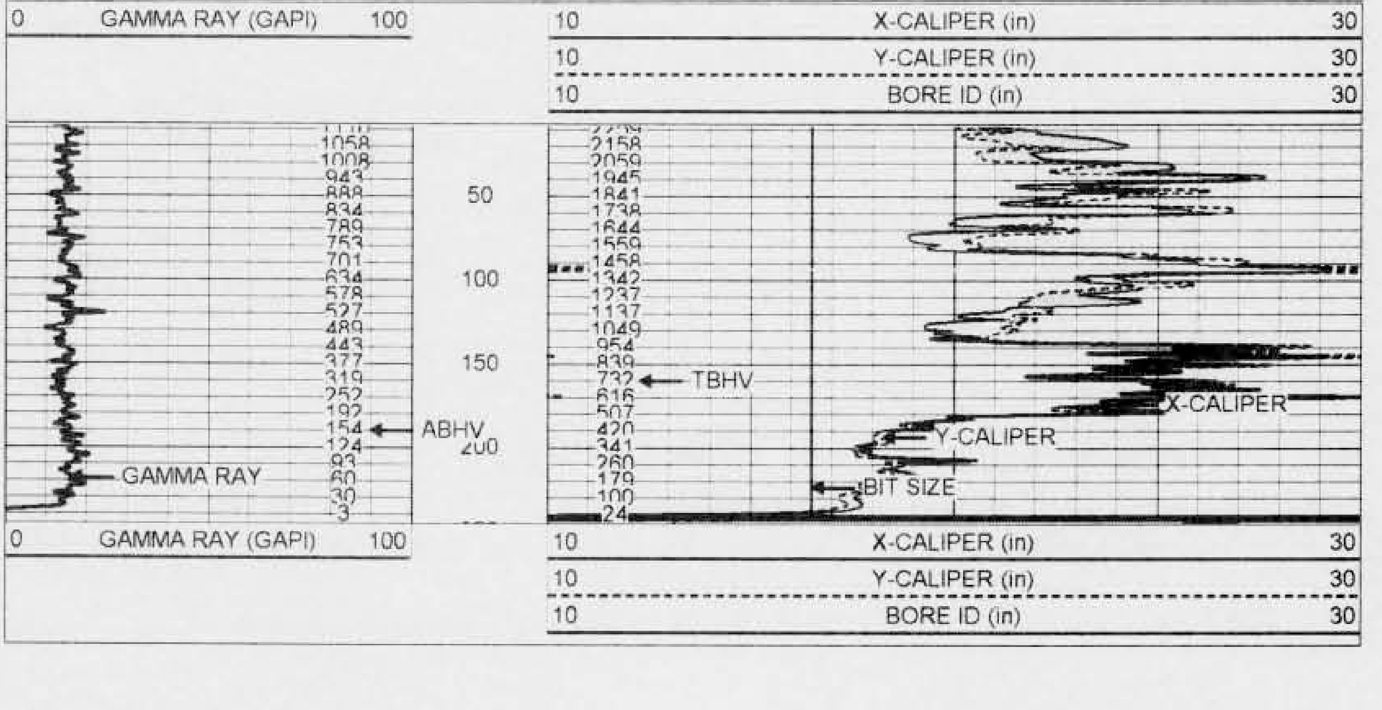
Comments

ANNULAR HOLE VOLUME
CALCULATED FOR 30" CASING

FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

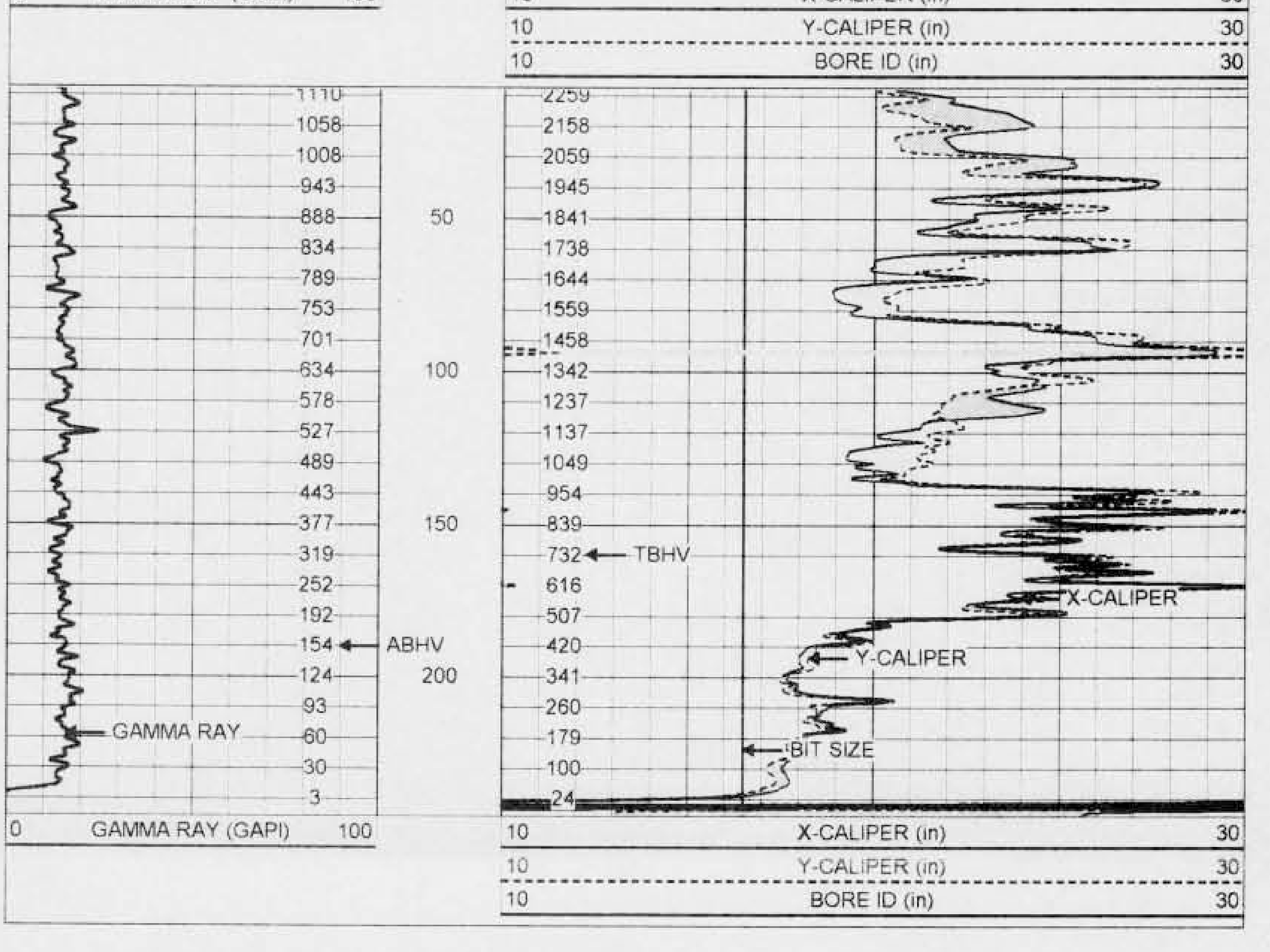
Database File: hobero2.db
Dataset Pathname: pass2
Presentation Format: grxyc.prs
Dataset Creation: Thu Oct 26 15:19:20 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:1200



FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

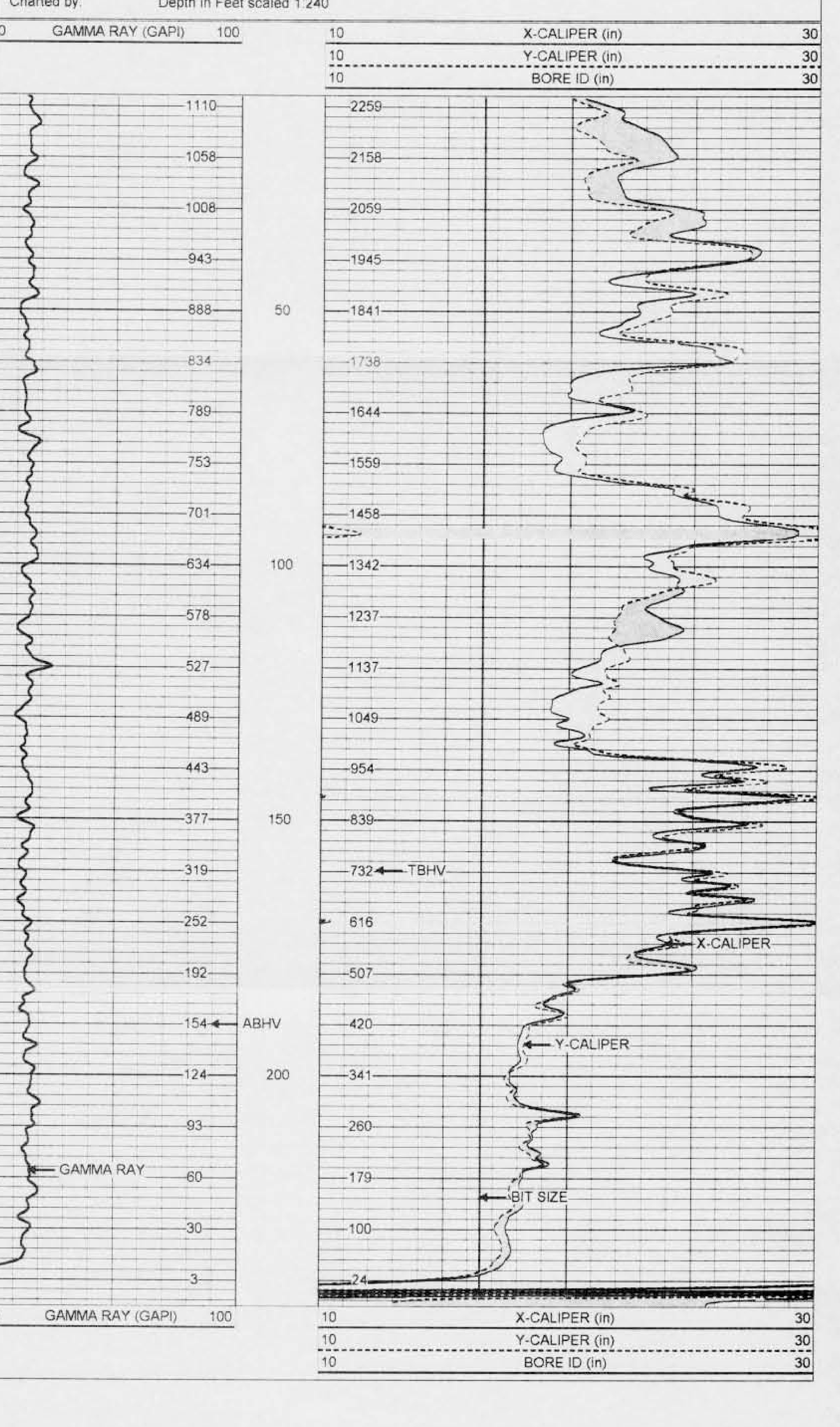
Database File: hobero2.db
Dataset Pathname: pass2
Presentation Format: grxyc.prs
Dataset Creation: Thu Oct 26 15:19:20 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:600



FLORIDA GEOPHYSICAL LOGGING, INC.

MAIN PASS

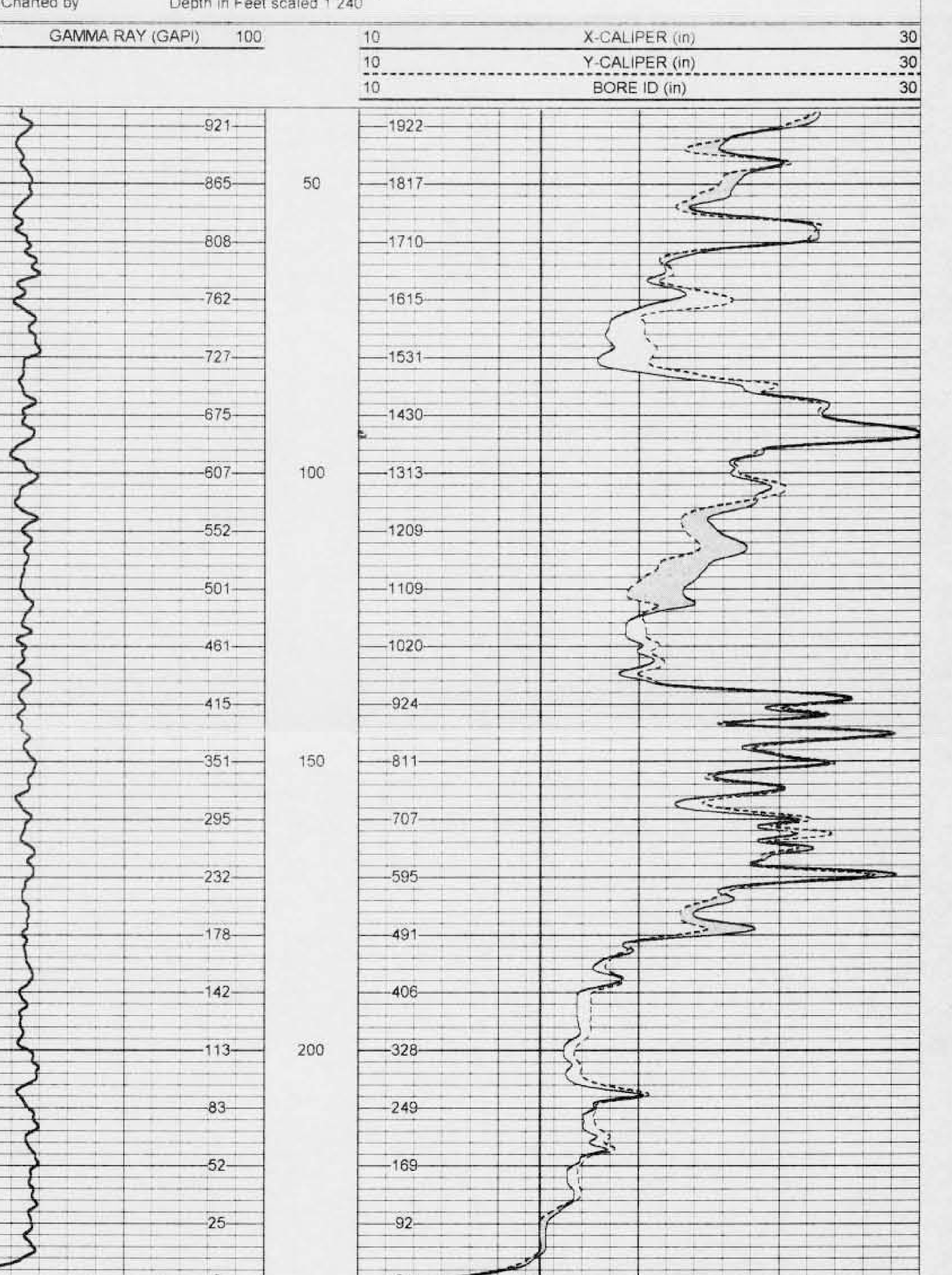
Database File: hobero2.db
Dataset Pathname: pass2
Presentation Format: grxyc.prs
Dataset Creation: Thu Oct 26 15:19:20 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:240



FLORIDA GEOPHYSICAL LOGGING, INC.

REPEAT PASS

Database File: hobero2.db
Dataset Pathname: pass1
Presentation Format: grxyc.prs
Dataset Creation: Thu Oct 26 15:05:38 2000 by Log VER_5.4
Charted by: Depth in Feet scaled 1:240



Dataset: run1/pass2
Total Length: 9.35 ft
Total Weight: 127.00 lb
O.D.: 3.50 in

XY Caliper Calibration Report

Serial Number/Model: 02LM-XYCLM
Performed: Thu Oct 26 14:57:08 2000

Ring			X Caliper		Y Caliper	
1:	30	in	982.482	cps	1022.62	cps
2:	40	in	1135.04	cps	1155.36	cps
3:	55	in	1384.48	cps	1368.47	cps
4:		in		cps		cps
5:		in		cps		cps
6:		in		cps		cps

Gamma Ray Calibration Report

Serial Number: 14
Tool Model: GROH
Performed: Fri Sep 01 10:52:17 2000

Calibrator Value: 120 GAPI

Background Reading: 21.4476 cps
Calibrator Reading: 133.923 cps

Sensitivity: 1.0669 GAPI/cps