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200-ZP-1 Operable Unit Borehole Summary Report for FY 1995 and FY 1996

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Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Bechtel Hanford, Inc.
Richland, Washington

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200-ZP-1 Operable Unit Borehole Summary Report for FY 1995 and FY 1996

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1.0 INTRODUCTION

This document details the well construction, sampling, analyses, and geologic character of the Ringold Formation fluvial unit E gravels as encountered in 16 boreholes in the 200-ZP-1 Operable Unit. These boreholes were drilled by Water Development Hanford Corporation during fiscal years (FY) 1995 and 1996. Two of the sixteen boreholes were abandoned; the remaining 14 boreholes were completed as functioning production and compliance wells. The boreholes in this text are designated by their standard "299" numbers and by their cross-referencing serial numbers ("B numbers") assigned by the Hanford Site well data group.

Guidance documents supporting the installation of the wells were *Extraction and Injection Wells Description of Work* (Darrach 1995) and *200-ZP-1 Phase II and III Interim Remedial Measure Description of Work* (Myers 1995). These documents detailed specific field activities and procedural requirements to be implemented.

The geology of vadose zone stratigraphic units above the Ringold Formation fluvial unit E gravel is not described in the text of this document. Results of detailed vadose zone investigations for the 200-ZP-1 Operable Unit can be found in Delaney et al. (1991), Reidel et al. (1992), and Lindsey (1995). However, the borehole logs and well summary sheets included as Appendices A and B of this document, respectively, depict and describe the vadose zone stratigraphic units encountered during the course of drilling.

Quantitative groundwater hydrologic information is not included in this document. However, stratigraphic horizons that produce significant quantities of water are identified in the text. Those horizons classified as viable water producers are units with sufficient hydraulic conductivity and transmissivity to notably increase well production volumes. These designations are largely subjective in nature, but are based on direct observation of the geologic materials or drilling characteristics of the formation. Examples of important drilling characteristics include mud viscosity and rates of bit advancement. Highly viscous, naturally developed drilling muds that require addition of water to maintain adequate advancement rates correlate with a formation matrix high in fines and low in hydraulic conductivity. Downhole vertical groundwater chemistry profiling with pneumatic straddle packers in some of the wells discussed in this document has subsequently validated some of the wells designated as significant water producers.

Appendix C contains the results of sieve analyses conducted on samples obtained via resonant sonic coring and standard split-spoon methods. The sieve analyses were the driver behind the majority of the well designs. Also, for completeness, Appendices D and E contain the well design calculations and the well development process. Units of measurements in the appendices are reported in English units and are consistent with those commonly used in the drilling industry. Depths in the main text are reported in Metric units. All depths are referenced to a ground surface datum.

2.0 BOREHOLE SUMMARIES

2.1 WELL 299-W15-29/B2409

Well 299-W15-29/B2409 was drilled as an injection well to support the Phase II activities of the 200-ZP-1 Interim Remedial Measure (IRM) pump-and-treat system. The boring was advanced to 89.06 m using a single string of threaded schedule-40 carbon steel casing with a nominal 30-cm outer diameter (O.D.) The casing shoe used to advance the hole was a nominal 31-cm O.D.

The installed permanent casing is schedule-40 nominal 22-cm-O.D. carbon steel with viton O-ring gaskets. It was emplaced from the surface to 64.08 m. A 22-cm-O.D. 0.020-in. slot continuous wrap stainless steel screen was installed from 64.08 to 88.48 m. The primary sandpack is a 10-20 mesh Colorado silica sand from 62.05 to 88.91 m. A 40-140 mesh secondary sandpack was emplaced from 55.47 to 62.05 m. A Portland cement plug was installed from 54.55 to 59.47 m. This plug was emplaced to prevent the possibility of injection head buildup mobilizing bentonite in the overlying column of completion materials downward onto the screen. A bentonite slurry was installed from 4.58 m below grade to 55.47 m, and a Portland cement plug was installed to the surface.

Sampling in the vadose zone was conducted via grab samples from the sample coring runs. Sieve analyses were conducted from grab samples collected over the interval 75.95 to 76.1 m, at 82.7 m, and over the interval 85.7 to 88.8 m. The analyses were performed using the facilities at the Westinghouse Hanford Company (WHC) Geotechnical Engineering Laboratory (GEL). Sieve results were not employed to assist in designing gravel/sandpack sizing or screen slot size selection for this well (see Appendix C).

The static water level was measured on April 26, 1995 at 70.54 m. The materials encountered in the borehole are described in detail in the borehole logs (Appendix A). All geologic materials encountered below the water table were from the Ringold Formation fluvial unit E gravel.

Notable water-producing units were encountered from 82.4 to 82.7 m and 85.7 to 88.8 m. Near 100% recovery of core allowed for accurate characterization of the saturated interval geology.

2.2 WELL 299-W15-30/B2410

Well 299-W15-30/B2410 was drilled as an extraction well to support Phase II activities of the 200-ZP-1 IRM pump-and-treat system. Subsequent to drilling and well installation, well production volumes, revised plume maps, and groundwater hydrologic modeling data indicated that this well was not suitable for its initial intended purpose, and it was reclassified as a compliance well.

The boring was advanced to a total depth of 81.83 m using a single string of threaded schedule-40 carbon steel casing with a nominal 30-cm O.D. The casing shoe employed to advance the hole was a nominal 31-cm O.D.

The installed permanent casing is schedule-40 nominal 22-cm-O.D. carbon steel with viton O-ring gaskets. It was emplaced from the surface to 66.51 m. A 22-cm-O.D. 0.020-in. slot continuous wrap stainless steel screen was installed from 66.51 to 78.69 m. A stainless steel blank sump was installed below the screen to 80.37 m. The primary sandpack is a 10-20 mesh Colorado silica sand, and it occupies the annulus from 64.21 to 81.23 m. Bentonite pellets (0.38 cm) were installed over the primary sandpack from 63.3 to 64.21 m, and 8-20 mesh bentonite crumbles were situated above the pellets to 3.41 m below grade. A Portland cement plug was emplaced to the surface.

Drilling in the vadose zone was conducted with the air rotary method and resonant sonic assist using a mill-tooth bit. Resonant sonic drilling with a nominal 10-cm core sampling run followed by a nominal 23-cm-O.D. cleanout run was used from 67.4 m to final depth.

Sampling was conducted via grab samples from the sample coring runs. Sieve analysis was conducted from a bulk grab sample collected over the interval 71.37 to 74.42 m and from 76.25 to 78.39 m. This sample was taken for analysis as a bulk composite sample because of the similarity of the two units. The analysis was performed at the WHC GEL. Sieve analysis results were not employed to assist in designing grave/sandpack sizing or screen slot size selection (see Appendix C).

Static water level was measured at 67.65 on May 3, 1996. The materials encountered in the borehole are described in detail in the borehole logs (Appendix A). All geologic materials encountered below the water table were in the Ringold Formation fluvial unit E gravel.

Notable water-producing units were encountered from 71.37 to 74.42 m and 76.25 to 78.39 m. Near 100% recovery of core allowed for accurate characterization of the saturated interval geology.

2.3 WELL 299-W15-31/B2411

Borehole 299-W15-31/B2411 was initially drilled as an extraction well to support the Phase II activities of the 200-ZP-1 IRM. However, temporary casing failure due to a crack in the pin end of a 6.1-m length of casing occurred during routine backpulling completion activities. The boring had to be abandoned. Approximately 6.1 m of stainless steel 22-cm-O.D. 0.020-in. slot screen was left in the borehole from an estimated 73.2 to 79.3 m. Exact depths are indeterminate due to the nature of the casing failure.

The borehole was advanced to a total depth of 80.82 m using a single string of threaded schedule-40 carbon steel casing with a nominal 30-cm O.D. The casing shoe employed to advance the hole was a nominal 31-cm O.D.

The sandpack installed was 10-20 mesh Colorado silica sand. It was emplaced from 67.89 to 80.83 m. However, the exact location of the top of the pack is somewhat questionable because of the nature of the technical problems encountered during the completion. Materials used for the abandonment comply with *Washington Administrative Code* Chapter 173-160-560 and include 0.95-cm bentonite pellets from 64.35-m to 67.89 m, bentonite grout slurry from 5.49 to 64.35 m, and Portland cement grout to the surface.

Drilling in the vadose zone was conducted via air rotary with sonic assist using a tungsten carbide button bit. At 66.18 m the change to resonant sonic drilling was made with nominal 10-cm-diameter core sampling runs followed by nominal 23-cm-O.D. cleanout runs.

Sampling was conducted by collecting grab samples from the coring runs. Sieve samples were run at the WHC GEL for the intervals 73.2 to 74.1 m and 76.86 to 77.47 m. Sieve analysis results were not used to support the design of the sandpack or the screen slot size.

The static water level was measured at 66.52 m on May 12, 1996. The materials encountered in the borehole are described in detail in the borehole logs (Appendix A). Notable water-producing units were encountered from 67.55 to 68.01 m, 68.62 to 69.24 m, 69.54 to 70.45 m, 71.67 to 72.28 m, 73.2 to 74.1 m, 75.03 to 75.64 m, and 76.86 to 77.77 m. Near 100% core recovery allowed for accurate characterization of the saturated interval geology.

2.4 WELL 299-W15-31A/B2415

Borehole 299-W15-31A/B2415 was initially drilled as an extraction well to support the Phase II activities of the 200-ZP-1 IRM. However, subsequent to drilling and well installation, well production volumes, revised plume maps, and groundwater hydrologic modeling data indicated that this well was not suitable for its initial intended purpose, and it was reclassified as a compliance well.

The boring was advanced to a total depth of 78.99 m using a single string of threaded schedule 40 carbon steel casing with a nominal 31-cm O.D. The casing shoe employed to advance the hole was a nominal 31-cm O.D.

The installed permanent casing is schedule 40 nominal 22-cm-O.D. carbon steel with viton O-ring gaskets. It was emplaced from the surface to 64.8 m below grade. A 22-cm-O.D. 0.020-in. slot continuous wrap stainless steel screen was installed from 64.8 to 76.98 m, and a stainless steel end cap was installed at the bottom of the screen to 77.14 m. The primary sandpack is 10-20 mesh Colorado silica sand, and it occupies the annulus from 63.16 to 78.89 m. Bentonite pellets (0.95 cm) were installed above the sandpack from 62.15 to 63.17 m. Bentonite

crumbles (8-20 mesh) were added to 3.96 m below grade, and Portland cement completed the seal to the surface.

Drilling in the vadose zone was conducted with the air rotary method and resonant sonic assist using a tungsten carbide button bit. Below the water table (from 67.1 to 78.99 m), resonant sonic drilling was employed using only the nominal 23-cm-O.D. cleanout barrel; no sampling coring was conducted.

No sampling, geologic logging, or sieve analysis was conducted during advancement of this boring per direction of the 200-ZP-1 Project. This decision stemmed from the contention that the geologic materials encountered in borehole 299-W15-31A were likely to be very similar to those previously encountered in the adjacent (~15 m away) abandoned 299-W15-31 boring. However, the character of drilling below the water table based on drillers' observations and observation of the cuttings stream from the 23-cm cleanout barrel did not fully support this premise. In particular, significant water-bearing strata encountered in the 299-W15-31 boring from 73.20 to 74.12 m and 76.86 to 77.78 m were not noted in the 299-W15-31A boring. It is apparent that the distribution of geologic units varied considerably from those encountered in the 299-W15-31 boring.

The distribution of significant water-bearing strata in this borehole is not known.

2.5 WELL 299-W15-33/B2743

Well 299-W15-33/B2743 was drilled as an extraction well to support the Phase II activities of the 200-ZP-1 IRM pump-and-treat system. This well is presently being pumped as an active extraction well.

The boring was advanced to a total depth of 81.74 m using a single string of threaded schedule-40 carbon steel casing with a nominal 30-cm O.D. The casing shoe employed to advance the hole was a nominal 31-cm O.D.

The installed permanent casing is schedule-40 nominal 22-cm-O.D. carbon steel with viton O-ring gaskets. It was emplaced from the surface to 64.58 m. A 22-cm-O.D. 0.070-in. slot continuous wrap stainless steel screen was installed from 64.58 to 70.69 m and 72.87 to 80.52 m. Between 70.69 and 72.87 m, a schedule-5 type 304 stainless steel piece of blank casing was installed to alleviate concerns associated with a fine-grained interval encountered during the drilling over this depth range. A polyvinyl chloride (PVC) end cap was installed at the bottom of the screen to 80.80 m. A PVC end cap was used in case the well needs to be deepened in the future.

Annular space completion materials consist of in ascending order from the bottom of the well a 6-12 mesh Colorado Silica sand/gravel pack from 60.60 to 81.74 m, bentonite pellets from

58.63 to 60.60 m, 8-20 mesh bentonite crumbles from 2.98 to 58.63 m, and a Portland cement plug to the surface.

Drilling in the vadose zone was conducted with the air rotary method and resonant sonic assist using a tungsten carbide button bit. Drilling below the water table was performed with the cable hard tool drilling method. Because of the nature of this drilling method, the character of the Ringold Formation fluvial unit E gravel geology below the water table is not well characterized. Geologic characterization was dependent on four split-spoon samples representing 11% of the saturated interval encountered in this boring. Mud viscosity and rate of advancement were also used as crude indicators of the nature of formation materials.

As indicated above, sampling was conducted via split-spoon sampling over four separate intervals (66.64 to 67.25 m, 70.15 to 70.60 m, 73.2 to 73.66 m, and 76.25 to 76.71 m) in the borehole. All of these samples were taken from very tight (low hydraulic conductivity) units that did not produce significant influent volumes of water into the borehole. These samples were sieved and plotted in the field in accordance with Field Screening Procedure 1.21, "Particle Size Distribution of Soil-Wet Sieve Analysis" (BHI-EE-05). Information from these plots was used to design the well (slot size and sand/gravel pack gradation).

Geophysical logging was conducted in this borehole prior to completion of drilling activities on November 18, 1995. The logging was conducted over the interval 0 to 74.73 m using the neutron-neutron accelerator porosity/moisture and natural gamma spectroscopy tools. The results of this logging indicated that the interval from 71.98 to 70.76 m that had previously been geologically logged as a major water-producing sand (based on drilling characteristics only) was not a significant water-production zone; it was most likely a mud unit.

The static water level in this well was measured on November 27, 1995 at 65.58 m below grade. The geologic materials in the borehole were described as discussed above. Inferred detailed information is depicted on the borehole logs (Appendix A). All geologic materials encountered below the water table were in the Ringold Formation fluvial unit E gravel. Subsequent to well completion and pumping, it is likely that a significant water-producing interval in the formation near the bottom of the screen. Recent tracer testing in nearby well 299-W15-10 identified a zone of high hydraulic conductivity (~30 m/day) at an elevation equivalent to the lower section of the screen in well 299-W15-33.

2.6 WELL 299-W15-34/B2748

Well 299-W15-34/B2748 was drilled as an extraction well to support Phase II activities of the 200-ZP-1 IRM pump-and-treat system. This well is presently being pumped as an active extraction well.

The boring was advanced to a total depth of 80.22 m using a single string of threaded schedule-40 carbon steel casing with a nominal 30-cm O.D. The casing shoe employed to advance the hole was a nominal 31-cm O.D.

The installed permanent casing is schedule-40 nominal 22-cm-O.D. carbon steel with viton O-ring gaskets. It was emplaced from the surface to 64.21 m. A 22-cm-O.D. 0.040-in. slot continuous wrap stainless steel screen was installed from 64.21 to 79.48 m. A 22-cm-O.D. stainless steel end cap at the bottom of the screen was installed to 79.64 m. This end cap has the welds ground down to allow for ease of removal if deepening of the well is necessary in the future.

Annular space completion materials in ascending order in the borehole consist of a primary 8-16 mesh Colorado Silica sand/gravel pack from 60.30 to 80.22 m, a 40-140 mesh Colorado Silica secondary sandpack from 59.41 to 60.30 m, a Portland cement plug from 55.21 to 59.41 m, 8-20 mesh bentonite crumbles from 4.03 to 55.21 m, and a second Portland cement plug to the surface.

Drilling in the vadose zone was conducted with the resonant sonic method to 15.56 m using a 23-cm-O.D. core barrel with a tungsten carbide button bit. This drilling method was used to minimize radiological contamination risks. Once the possibility of radiological contamination was determined to be negligible, the air rotary method with resonant sonic assist was employed using a tri-cone tungsten carbide button bit. Drilling below the water table was conducted with the cable hard tool technique. Because of the nature of this drilling method, the character of the Ringold Formation fluvial unit E gravel geology below the water table is not well characterized. Geologic characterization was based on drilling observations (e.g., mud viscosity and rate of advancement) and split-spoon samples obtained from the following intervals: 67.1 m, 70.15 to 70.70 m, 72.59 to 73.01 m, 75.95 to 76.56 m, and 78.99 to 79.51 m. These samples represent 13.1% of the saturated interval drilled. The samples were sieved and plotted in the field as appropriate. Information from these plots was used to design the well (slot size and gravel pack gradation).

The static water level in this well was measured on February 28, 1996 at 64.15 m below grade. The geologic materials in the borehole were described as discussed above. Detailed information is depicted on the borehole logs (Appendix A). All geologic materials encountered below the water table were in the Ringold Formation fluvial unit E gravel. Notable water-producing intervals were encountered from 72.29 to 72.44 m and 75.34 to 77.47 m.

2.7 WELL 299-W15-35/B2749

Well 299-W15-35/B2749 was drilled as an extraction well to support the Phase II activities of the 200-ZP-1 IRM pump-and-treat system. This well is presently being pumped as an active extraction well.

The boring was advanced to a total depth of 79.3 m using a single string of threaded schedule-40 carbon steel temporary casing with a nominal 30-cm O.D. The casing shoe employed to advance the hole was a nominal 31-cm O.D.

The installed permanent casing is schedule-40 nominal 22-cm-O.D. carbon steel with viton O-ring gaskets. It was emplaced from the surface to 62.88 m. A 22-cm-O.D. 0.040-in. slot continuous wrap stainless steel screen was installed from 62.87 to 78.14 m. A 23-cm-O.D. stainless steel end cap was installed at the base of the screen from 78.14 to 78.31 m. This end cap had the welds ground down to allow for ease of removal if deepening of the well is necessary in the future.

Annular space completion materials in ascending order in the borehole consist of a primary 8-16 mesh Colorado Silica sand/gravel pack from 60.18 to 78.14 m, a 16-30 mesh secondary Colorado Silica sandpack from 59.05 to 60.18 m, a Portland cement plug from 52.78 to 59.05 m, 8-20 mesh bentonite crumbles from 4.12 to 52.78 m, and a second Portland cement plug to the surface.

Drilling in the vadose zone was conducted with the resonant sonic method to 15.25 m using a 23-cm-O.D. core barrel with a tungsten carbide button bit. This drilling method was used to minimize radiological contamination risks. Once the possibility of radiological contamination was determined to be negligible, the air rotary method with resonant sonic assist was employed using a tri-cone tungsten carbide button bit. Drilling below the water table was conducted with the cable hard tool technique. Because of the nature of this drilling method, the character of the Ringold Formation fluvial unit E gravel geology below the water table is not well characterized. Geologic characterization was based on drilling observations (e.g., mud viscosity, rate of advancement) and split-spoon samples obtained from the following intervals: 64.05 to 64.36 m, 66.19 to 66.49 m, 70.15 to 70.76 m, and 72.59 to 73.2 m. These samples represent 11.2% of the saturated interval drilled. The samples were sieved and plotted in the field. Information from these plots was used to design the well (slot size and sand/gravel pack gradation).

The static water level in this well was measured on March 14, 1996 at 62.89 m below grade. The geologic materials in the borehole were described as discussed above. Detailed information is depicted on the borehole logs (Appendix A). All geologic materials encountered below the water table were in the Ringold Formation fluvial unit E gravel. Notable water-producing intervals were encountered from 63.75 to 67.71 m, 69.84 to 71.22 m, and 72.59 to 73.81 m.

2.8 WELL 299-W15-36/B2752

Well 299-W15-36/B2752 was drilled as an extraction well to support Phase III activities of the 200-ZP-1 IRM pump-and-treat system. This well is presently idle and awaiting expansion of the existing pump-and-treat system.

The boring was advanced to a total depth of 80.22 m using a single string of threaded schedule-40 carbon steel casing with a nominal 30-cm O.D. The casing shoe employed to advance the hole was a nominal 31-cm O.D.

The installed permanent casing is schedule-40 nominal 22-cm-O.D. carbon steel with viton O-ring gaskets. It was emplaced from the surface to 64.26 m. A 22-cm-O.D. 0.040-in. slot continuous wrap stainless steel screen was installed from 64.26 to 79.78 m. A stainless steel end cap at the bottom of the screen was installed to 79.68 m. This end cap had the welds ground down to allow for ease of removal if deepening of the well is necessary in the future.

Annular space completion materials in ascending order in the borehole consist of a primary 8-16 mesh Colorado Silica sand/gravel pack from 60.73 to 79.73 m, a 16-30 mesh secondary Colorado Silica sandpack from 59.23 to 60.73 m, a Portland cement plug from 53.19 to 59.23 m, 8-20 mesh bentonite crumbles from 3.32 to 53.19 m, and a Portland cement plug to the surface.

Drilling in the vadose zone was conducted via the air rotary method using resonant sonic assist. A tungsten carbide tri-cone button bit was employed. Drilling below the water table was conducted with the cable hard tool technique. Because of the nature of this drilling method, the character of the Ringold Formation fluvial unit E gravel geology below the water table is not well characterized. Geologic characterization was based on drilling observations (e.g., mud viscosity, rate of advancement) and split-spoon samples obtained from the following intervals: 64.66 to 65.27 m, 66.34 to 66.80 m, 69.54 to 70.15 m, 72.59 to 73.20 m, and 75.49 to 76.10 m. These samples represent 17.5% of the saturated interval drilled. Notable water-producing samples were sieved and plotted in the field. Information from these plots was used to design the well (slot size and gravel pack gradation). Those samples that were of low apparent hydraulic conductivity were retained for geologic characterization purposes only.

The static water level in this well was measured on May 3, 1996 at 63.62 m below grade. The geologic materials in the borehole were described as discussed above. Detailed information is depicted on the borehole logs (Appendix A). All geologic materials encountered below the water table were in the Ringold Formation fluvial unit E gravels. Notable water-producing intervals were encountered from 64.36 to 65.27 m, 66.19 to 67.71 m, 69.54 to 70.76 m, 71.98 to 73.51 m, and 75.34 to 77.17 m.

2.9 WELL 299-W15-37/B2753

Well 299-W15-37/B2753 was drilled as an extraction well to support Phase III activities of the 200-ZP-1 IRM pump-and-treat system. This well is currently idle and awaiting expansion of the existing pump-and-treat system.

The boring was advanced to a total depth of 78.69 m using a single string of threaded schedule-40 carbon steel casing with a nominal 30-cm O.D. The casing shoe employed to advance the hole was a nominal 31-cm O.D.

The installed permanent casing is schedule-40 nominal 22-cm-O.D. carbon steel with viton O-ring gaskets. It was emplaced from the surface to 62.78 m. A 22-cm-O.D. 0.040-in. slot continuous wrap stainless steel screen was installed from 62.78 to 78.02 m. A stainless steel end cap was installed at the bottom of the screen to a depth of 77.87 m. The end cap had the welds ground down to allow for easy removal if deepening of the well is necessary in the future.

Annular space completion materials in ascending order in the borehole consist of a primary 8-16 mesh Colorado Silica sand/gravel pack from 59.32 to 78.69 m, a 16-30 mesh Colorado Silica secondary sandpack from 58.47 to 59.32 m, a Portland cement plug from 49.93 to 58.47 m, 8-20 mesh bentonite crumbles from 3.63 to 49.93 m, and a Portland cement plug to the surface.

Drilling in the vadose zone was conducted via the air rotary method using resonant sonic assist. A tungsten carbide tri-cone button bit was employed. Drilling below the water table was conducted with the cable hard tool technique. Because of the nature of this drilling method, the character of the Ringold Formation fluvial unit E gravel geology below the water table is not well characterized. Geologic characterization was based on drilling observations (e.g., mud viscosity, rate of advancement) and split-spoon samples obtained from the following intervals: 64.36 to 64.66 m, 68.01 to 68.47 m, 69.54 to 70.00 m, and 72.59 to 73.2 m. These samples represent 11.3% of the saturated interval drilled. Notable water-producing samples were sieved and plotted in the field. Information from these plots was used to design the well (slot size and gravel pack gradation). Those samples that were of low apparent hydraulic conductivity were retained for geologic characterization purposes only.

The static water level in this well was measured on May 16, 1996 at 62.46 m below grade. The geologic materials in the borehole were described as discussed above. Detailed information is depicted on the borehole logs (Appendix A). All geologic materials encountered below the water table were in the Ringold Formation fluvial unit E gravels. Notable water-producing intervals were encountered from 63.44 to 65.88 m and 72.79 to 74.73 m.

2.10 WELL 299-W15-38/ B2754

Well 299-W15-38/B2754 was drilled as a compliance well to support monitoring the performance of the 200-ZP-1 IRM pump-and-treat system.

The boring was advanced to a total depth of 70 m using a single string of threaded schedule-80 carbon steel with a nominal 27-cm O.D. The casing shoe employed to advance the hole was a nominal 29-cm O.D.

The installed permanent casing is 10.16-cm-O.D. schedule-5 type 304 stainless steel with viton O-ring gaskets. It was emplaced from the surface to 62.56 m. A 10.16-cm-O.D. 0.040-in. slot continuous wrap stainless steel screen was installed from 62.56 to 68.66 m. A stainless steel end cap at the bottom of the screen was installed to 68.76 m.

Annular space completion materials in ascending order in the borehole consist of a primary 8-16 mesh Colorado Silica sand/gravel pack installed from 61.24 to 69.85 m, 0.95-cm bentonite pellets from 60.24 to 61.24 m, 8-20 mesh bentonite crumbles from 4.24 to 60.24 m, and a Portland cement plug to the surface.

Drilling in the vadose zone was conducted via the air rotary method using resonant sonic assist. A tungsten carbide tri-cone button bit was employed. Drilling below the water table was conducted with the resonant sonic technique using a nominal 18-cm tungsten carbide button bit core barrel. Geologic characterization was based on drilling observations, visual inspection of the core barrel cuttings stream, and grab samples obtained from the following intervals: 61.92 to 65.27 m and at 66.80 m. These samples were sieved and plotted in the field. Information from these plots was used to design the well (slot size and gravel pack gradation).

The static water level in this well was measured on May 22, 1996 at 62.53 m below grade. The geologic materials in the borehole were described as discussed above. Detailed information is depicted on the borehole logs (Appendix A). All geologic materials encountered below the water table were in the Ringold Formation fluvial unit E gravels. Notable water-producing intervals were encountered from 61.92 to 66.19 m and 69.39 to 70.00 m.

2.11 WELL 299-W15-39/B2755

Well 299-W15-39/B2755 was drilled as a compliance well to support monitoring of the effectiveness of the 200-ZP-1 IRM pump-and-treat system. The boring was advanced to a total depth of 68.01 m using a single string of threaded schedule-80 carbon steel with a nominal 27-cm O.D. The casing shoe employed to advance the hole was a nominal 29-cm O.D.

The installed permanent casing is 10.16-cm-O.D. schedule-5 type 304 stainless steel with viton O-ring gaskets. It was emplaced from the surface to 60.87 m. A 10.16-cm-O.D. 0.040-in. slot continuous wrap stainless steel screen was installed from 60.87 to 66.98 m. A stainless steel end cap at the bottom of the screen was installed to 67.11 m.

Annular space completion materials in ascending order in the borehole consist of a primary 8-16 mesh Colorado Silica sand/gravel pack installed from 59.04 to 67.25 m, 0.95-cm bentonite pellets from 58.01 to 59.04 m, 8-20 mesh bentonite crumbles from 3.05 to 58.01 m, and a Portland cement plug to the surface.

Drilling in the vadose zone was conducted via the air rotary method using resonant sonic assist. A tungsten carbide tri-cone button bit was employed. Drilling below the water table was conducted with the resonant sonic technique using a nominal 18-cm tungsten carbide button bit core barrel. Geologic characterization was based on drilling observations, visual inspection of the cuttings stream, and a grab sample obtained from the interval 65.88 to 67.25 m. This grab sample was sieved and plotted in the field. Information from this plot was used to design the well (slot size and gravel pack gradation).

The static water level in this well was measured on May 29, 1996 at 60.85 m below grade. The geologic materials in the borehole were described as discussed above. Detailed information is depicted on the borehole logs (Appendix A). All geologic materials encountered below the water table were in the Ringold Formation fluvial unit E gravels. An important water-producing interval was encountered from 65.88 to 67.25 m.

2.12 WELL 299-W18-35/B2644

Well 299-W18-35/B2644 was drilled as an injection well to support the Phase II activities of the 200-ZP-1 IRM pump-and-treat system. However, failure of the permanent casing at the junction with the screen due to a sand hitch during completion activities resulted in irreparable damage to the well screen. The decision to abandon the well was made after numerous salvage attempts failed. A 0.040-in. slot 8-in.-O.D. stainless steel wire wrap screen and PVC end cap were abandoned in the well from 66.50 to 82.01 m. The depth below grade to the top of the screen is nominal in large part due to damage incurred during salvage attempts.

The borehole was advanced to a total depth of 82.66 m using a single string of threaded schedule-40 carbon steel casing with a nominal 30-cm O.D. The casing shoe employed to advance the hole was a nominal 31-cm O.D.

The primary sand/gravelpack installed was an 8-16 mesh Colorado Silica sand from 65.76 to 81.47 m. A secondary Colorado silica sandpack was installed from 62.68 to 65.76 m. Abandonment materials include 0.95-cm bentonite pellets from 61.85 to 62.68 m, 8-20 mesh bentonite crumbles from 1.98 to 61.85 m, and a Portland cement plug to the surface.

Drilling in the vadose zone was conducted via the air rotary method with resonant sonic assist using a tri-cone tungsten carbide button bit. A change to cable hard tool drilling was made at 66.34 m below grade. Because of the nature of this drilling method, the character of the Ringold Formation fluvial unit E gravel geology below the water table is not well characterized. Geologic characterization was based on drilling observations (e.g., mud viscosity, rate of bit advancement) and split-spoon samples obtained from the following intervals: 66.49 to 66.95 m, 70.15 to 70.61 m, 73.66 to 73.87 m, 75.03 to 75.64 m, and 76.25 to 76.86 m. These samples represent 14.4% of the saturated interval drilled. Samples from important water-producing zones were sieved and plotted in the field. Information from these plots was used to design the well (slot size and sand/gravel pack gradation). Those samples obtained from low hydraulic conductivity zones were retained for characterization purposes only.

The static water level in this boring was measured prior to abandonment on January 2, 1996 at 66.34 m below grade. The geologic materials in the borehole were described as discussed above. Detailed information is depicted on the borehole logs (Appendix A). All geologic materials encountered below the water table were in the Ringold Formation fluvial unit E gravels. A large significant water-producing interval was encountered from 73.66 to 79.3 m.

2.13 WELL 299-W18-36/B2747

Well 299-W18-36/B2747 was drilled on the same pad as the abandoned well 299-W18-35/B2746. It is approximately 10 m in distance from the abandoned structure. This well was drilled as an injection well to support the Phase II 200-ZP-1 IRM pump-and-treat system. This well is currently idle and awaiting expansion of the existing pump-and-treat system.

The boring was advanced to a total depth of 82.01 m using a single string of threaded schedule-40 carbon steel casing with a nominal 30-cm O.D. The casing shoe employed to advance the hole was nominal 31-cm O.D.

The installed permanent casing is schedule-40 nominal 22-cm-O.D. carbon steel with viton O-ring gaskets. It was emplaced from the surface to 66.48 m. A 22-cm-O.D. 0.040-in. slot continuous wrap stainless steel screen was installed from 66.48 to 81.72 m. A stainless steel end cap at the bottom of the screen was installed to 81.87 m. This end cap had the welds ground down to allow for ease of removal if deepening of the well is necessary in the future.

Annular space completion materials in ascending order in the borehole consist of a primary 8-16 mesh Colorado Silica sand/gravel pack from 63.44 to 82.01 m, a 20-40 mesh Colorado Silica secondary sand pack from 62.34 to 63.44, a Portland cement plug from 57.19 to 62.34 m, 8-20 mesh bentonite crumbles from 3.17 to 57.19 m, and a second Portland cement plug to the surface.

Drilling in the vadose zone was conducted via the air rotary method using resonant sonic assist. A tungsten carbide tri-cone bit was employed. Drilling below the water table was conducted with the cable hard tool technique. Because of the nature of this drilling method, the character of Ringold Formation fluvial unit E gravel geology below the water table is not well characterized. However, data from the adjacent abandoned well 299-W18-35 did provide useful supplemental geologic information. Although substantial stratigraphic variability between the two wells was noted, some sampling decisions were accurately chosen as a function of information obtained from the abandoned boring. Geologic characterization was also based on drilling observations (e.g., mud viscosity, drill bit advancement rates) and split-spoon samples obtained from the following intervals: 66.64 to 67.1 m, 69.48 to 70.00 m, 73.2 to 73.51 m, 75.48 to 76.10 m, and 79.09 to 79.39 m. These samples represent 20.5% of the saturated interval drilled. Samples from important water-producing horizons were sieved and plotted in the field. The analyses were used to design the slot size and sand/gravel pack gradation for the well. Those samples obtained from low hydraulic conductivity zones were retained for geologic characterization purposes only.

The static water level in this well was measured on January 23, 1996 at 66.09 m below grade. The geologic materials in the borehole were described as discussed above. Detailed information is depicted on the borehole logs (Appendix A). However, separate logs were not constructed for this boring due to the proximity of well 299-W18-35. All geologic materials below the water table were in the Ringold Formation fluvial unit E gravels. Notable water-producing intervals were encountered from 72.59 to 73.2 m and 75.49 to 75.95 m. The extent of important water-

producing intervals in this boring is apparently reduced relative to the adjacent abandoned 299-W18-35 boring.

2.14 WELL 299-W18-37/B2756

Well 299-W18-37/B2756 was drilled as an injection well to support the Phase III 200-ZP-1 IRM pump-and-treat system. This well is currently idle and awaiting expansion of the existing pump-and-treat system.

The boring was advanced to a total depth of 82.96 m using a single string of threaded schedule-40 carbon steel casing with a nominal 30-cm O.D. The casing shoe employed to advance the hole was nominal 31-cm O.D.

The installed permanent casing is schedule-40 nominal 22-cm-O.D. carbon steel with viton O-ring gaskets. It was emplaced from the surface to 63.88 m. A 22-cm-O.D. 0.040-in. slot continuous wrap stainless steel screen was installed from 63.88 to 82.19 m. A stainless steel end cap at the bottom of the screen was installed to 82.35 m. This end cap had the welds ground down to allow for ease of removal if deepening of the well is necessary in the future.

Annular space completion materials in ascending order in the borehole consist of a primary 8-16 mesh Colorado Silica sand/gravel pack from 60.57 to 82.23 m, a 20-40 mesh Colorado Silica secondary sand pack from 58.90 to 60.57, a Portland cement plug from 52.80 to 58.90 m, 8-20 mesh bentonite crumbles from 3.08 to 52.80 m, and a second Portland cement plug to the surface.

Drilling in the vadose zone was conducted via the air rotary method using resonant sonic assist. A tungsten carbide tri-cone button bit was employed. Drilling below the water table was conducted with the cable hard tool technique. Because of the nature of this drilling method, the character of Ringold Formation fluvial unit E gravel geology below the water table is not well characterized. Geologic characterization is based on drilling observations (e.g., mud viscosity, drill bit advancement rates) and split-spoon samples obtained from the following intervals: 67.10 m, 70.15 to 70.61 m, 73.20 to 73.81 m, 76.25 to 76.86 m, and 78.69 to 79.30 m. These samples represent 14.3% of the saturated interval drilled. Samples from important water-bearing horizons were sieved and plotted in the field. These analyses were used to design the slot size and sand/gravel pack gradation for the well. Samples obtained from units with low hydraulic conductivity were retained for geologic characterization purposes only.

The static water level in this well was measured on March 25, 1996 at 66.93 m below grade. The geologic materials in the borehole were described as discussed above. Detailed information is depicted on the borehole logs (Appendix A). All geologic materials below the water table were in the Ringold Formation fluvial unit E gravels. An important water-producing interval was encountered from 72.89 to 74.73 m.

2.15 WELL 299-W18-38/B2757

Well 299-W18-38/B2757 was drilled as an injection well to support the Phase III 200-ZP-1 IRM pump-and-treat system. This well is currently idle and awaiting expansion of the existing pump-and-treat system.

The boring was advanced to a total depth of 84.49 m using a single string of threaded schedule-40 carbon steel casing with a nominal 30-cm O.D. The casing shoe employed to advance the hole was nominal 31-cm O.D.

The installed permanent casing is schedule-40 nominal 22-cm-O.D. carbon steel with viton O-ring gaskets. It was emplaced from the surface to 63.74 m. A 22-cm-O.D. 0.040-in. slot continuous wrap stainless steel screen was installed from 63.74 to 83.60 m. A stainless steel end cap at the bottom of the screen was installed to 83.76 m. This end cap had the welds ground down to allow for ease of removal if deepening of the well is necessary in the future.

Annular space completion materials in ascending order in the borehole consist of a primary 8-16 mesh Colorado Silica sand/gravel pack from 60.54 to 84.33 m, a 16-30 mesh Colorado Silica secondary sand pack from 59.11 to 60.54 m, a Portland cement plug from 53.74 to 59.11 m, 8-20 mesh bentonite crumbles from 4.21 to 53.74 m, and a second Portland cement plug to the surface.

Drilling in the vadose zone was conducted via the air rotary method using resonant sonic assist. A tungsten carbide tri-cone bit was employed. Drilling below the water table was conducted with the cable hard tool technique. Because of the nature of this drilling method, the character of Ringold Formation fluvial unit E gravel geology below the water table is not well characterized. Geologic characterization is based on drilling observations (e.g., mud viscosity, drill bit advancement rates) and split-spoon samples obtained from the following intervals: 67.10 to 67.62 m, 69.24 to 69.85 m, 72.29 to 72.90 m, 76.86 to 77.47 m, and 82.96 to 83.57 m. These samples represent 16.4% of the saturated interval drilled. Samples obtained from important water-producing units were sieved and plotted in the field. The analyses were used to design the slot size and sand/gravel pack gradation for the well. Samples obtained from horizons with low hydraulic conductivity were retained for geologic characterization purposes only.

The static water level in this well was measured on April 8, 1996 at 66.40 m below grade. The geologic materials in the borehole were described as discussed above. Detailed information is depicted on the borehole logs (Appendix A). All geologic materials below the water table were in the Ringold Formation fluvial unit E gravels. Important water-producing intervals were encountered from 68.93 to 70.15 m, 74.88 to 77.47 m, and 82.35 to 83.57 m.

2.16 WELL 299-W18-39/B2758

Well 299-W18-39/B2758 was drilled as an injection well to support the Phase III 200-ZP-1 IRM pump-and-treat system. This well is currently idle and awaiting expansion of the existing pump-and-treat system.

The boring was advanced to a total depth of 78.54 m using a single string of threaded schedule-40 carbon steel casing with a nominal 30-cm O.D. The casing shoe employed to advance the hole was nominal 31-cm O.D.

The installed permanent casing is schedule-40 nominal 22-cm-O.D. carbon steel with viton O-ring gaskets. It was emplaced from the surface to 59.32 m. A 22-cm-O.D. 0.040-in. slot continuous wrap stainless steel screen was installed from 59.32 to 77.62 m. A stainless steel end cap at the bottom of the screen was installed to 77.93 m. This end cap had the welds ground down to allow for ease of removal if deepening of the well is necessary in the future.

Annular space completion materials in ascending order in the borehole consist of a primary 8-16 mesh Colorado Silica sand/gravel pack from 56.18 to 78.39 m, a 16-30 mesh Colorado Silica secondary sand pack from 55.63 to 56.18 m, a Portland cement plug from 51.21 to 55.63 m, 8-20 mesh bentonite crumbles from 4.18 to 51.21 m, and a second Portland cement plug to the surface.

Drilling in the vadose zone was conducted via the air rotary method using resonant sonic assist. A tungsten carbide tri-cone bit was employed. Drilling below the water table was conducted with the cable hard tool technique. Because of the nature of this drilling method, the character of Ringold Formation fluvial unit E gravel geology below the water table is not well characterized. Geologic characterization is based on drilling observations (e.g., mud viscosity, drill bit advancement rates) and split-spoon samples obtained from the following intervals: 64.96 to 65.58 m, 67.10 to 67.71 m, 69.38 to 69.93 m, 72.59 to 73.20 m, and 75.34 to 75.82 m. These samples represent 20.2% of the saturated interval drilled. Samples obtained from important water-producing horizons were sieved and plotted in the field. The analyses were used to design the slot size and sand/gravel pack gradation for the well. Samples obtained from horizons with low hydraulic conductivity were retained for geologic characterization purposes only.

The static water level in this well was measured on April 22, 1996 at 62.36 m below grade. The geologic materials in the borehole were described as discussed above. Detailed information is depicted on the borehole logs (Appendix A). All geologic materials below the water table were in the Ringold Formation fluvial unit E gravels. Important water-producing intervals were encountered from 66.95 to 68.02 m, 68.61 to 70.00 m, 72.29 to 73.51 m, and 75.34 to 75.49 m.

3.0 GEOLOGIC OVERVIEW

The knowledge of the Ringold Formation gained as a result of the 200-ZP-1 drilling during 1995 and 1996 establishes a database that may be used to guide later subsurface drilling work in the area. The geology of the area, particularly the Ringold Formation fluvial unit E gravels, was, in general, poorly understood. The geologic results from this project provide a considerable amount of valuable information to this body of knowledge.

The conceptual model of Ringold Formation fluvial unit E gravels in this area that emerges is one of an extremely complex seasonal braided fluvial system with limited predictability regarding the stratigraphic position of units, even over distances as small as 5 m. However, the range of variability in composition of geologic units is generally limited. In addition, particle size distributions within units tend to be strongly bimodal with pebble (in particular, very coarse pebbles, coarse pebbles, and medium pebbles) and medium to fine sand fractions (#60 and #100 mesh) well represented throughout the project area. Indurated silty sandy gravels with local incipient silica/iron oxide cementation around pebble clast margins are volumetrically dominant throughout the area. Sandy gravels, gravelly sands, and sands are subordinate and listed in decreasing order of abundance as encountered in the 16 boreholes.

The silty sandy gravels encountered in the area are interpreted to be an unreported, or under-represented, variant of Lindsey's (1995) facies association I (gravelly bedload deposition on braidplain dominated by shallow, shifting, scoured channels). This association is interpreted here to include braid bars that sustained sufficient subaerial exposure to support pedogenic processes. It is possible that these bars may have been active in flooding events and were subsequently mantled with fines as high water receded. This variant of Lindsey's (1995) facies association I was noted as the most volumetrically important geologic unit in all of the boreholes drilled (16) in the 200-ZP-1 Operable Unit. This unit type invariably forms aquitards in the boreholes. The other units encountered in the boreholes generally fit well into facies association I and support the important aquifer-forming materials encountered.

Geologic features of importance encountered during drilling include the following:

- Numerous structures consistent with incipient paleosol formation. These features include turbation as indicated by disrupted bedding and detached discrete sediments "floating" in finer grained matrix and by rare patches of organic matter interpreted as plant debris. No clearly definable root casts were encountered, however

- Widespread decomposition of coarse-grained plutonic/gneissic clasts to a grus-like consistency

- Rare crossbedding in sandy units

- A unit in well 299-W18-35 interpreted to represent a distal debris flow deposit. This indicates that the Ringold Formation unit E gravel does likely include some materials of local provenance.

4.0 WELL DEVELOPMENT OVERVIEW

Development of the 200-ZP-1 wells was performed in two stages. Primary development was conducted using a dual-plate surge block during emplacement of the screen filter pack material This action promoted settling of the pack as well as development of the formation. Secondary development was conducted with a submersible 7.5-hp pump. This document includes only the procedures followed for the primary development phase. Secondary development was conducted until groundwater pumped from the wells met or exceeded the 5 NTU turbidity standard. These data are recorded in project data files.

Preliminary development and sand pack settlement for all 16 wells (including the two abandoned boreholes) was performed as follows.

- A dual surge block with oversized reinforced rubber surge plates and a large carbon steel sinker bar was used at all times.

- The surge block apparatus was employed in nominal 0.6-m intervals for 10 to 15 minutes from the top to the bottom of the screen. At the end of the surge block development process, long runs over the entire screen were typically performed to assess the quality of the development of the sand pack under extreme conditions. If these long runs did not produce appreciable dropout, the primary development was deemed complete.

- The surge cycles were typically performed at a rate of 25 to 30 strokes per minute. This number reflects the limits of the device before significant buoyancy attenuated the quality of the development.

- Tagging with a steel tape was performed frequently both in the annulus and inside the well to assess the dropout rate of the sandpack and the amount of material entering the screen.

5.0 REFERENCES

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APPENDIX A

BOREHOLE LOGS

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BOREHOLE LOG

Boring or Well No. 299-W15-31 29 MO

Sheet 1 of 8

Location: 200 yds south of MO 720

Project: 200-ZP-1 JRM Pump and Treat Wells

Prepared By: M. Darrach / Mark Darrach (Sign/Print Name) Date:

Reviewed By: Mark Darrach / Mark Darrach (Sign/Print Name) Date: 4/27/95

Depth (0'-40')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
5'	general waste char. and total activity sample			0-37' Gravelly Sand 20% fg 20% vcs 40% vs 5% ms 5% vfs tr silt / 60% basalt 30% quartzofeldspathic 5% misc metamorphics · volcanics · intrusives 5% plag crysts 2.5Y 5/2 · subangular to rounded · dry · moderately sorted · max particle size ≈ 1" ave size 1mm · no $CaCO_3$ HANFORD FM - UPPER COARSE UNIT · resolution of the drilling is generally poor - much is interpretive	air rotary drilling in use on hole
10'					
15'					
20'					
25'	general waste characteristic. and total activity sample				
30'					
35'	waste and t. activity			Abrupt Contact 37'-40' Sand 10% vcs 10% cs 10% ms 25% ms 45% vfs tr sand fine to medium pebbles / 15% basalt (typically the very coarse fraction) 80% quartzofeldspathic 1% heavy minerals and micas 2.5Y 7/2 · angular to subrounded · well sorted	
40'	waste and t. activity				

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W15-3129 MO

Sheet 1 of 8

Location 200 yds south of MO 720

Project 200-ZP-1 DRM Pump and Treat Wells

Prepared By M. Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Mark Darrach / Mark Darrach (Sign/Print Name) Date 4/29/95

Depth (0'-40')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
5'	general waste char. and total activity sample			0-37' Gravelly Sand 20% fg 30% vcs 40% vs 5% ms 5% fs	air rotary drilling in use on hole
				tr silt / 60% basalt 30% quartzofeldspathic 5% misc	
				metamorphics • volcanics • intrusives 5% plag crysts	
				2.5Y 5/2 • subangular to rounded • dry • moderately	
				sorted • max particle size ≈ 1" ave size 1mm • no $CaCO_3$	
				HANFORD FM - UPPER COARSE UNIT • resolution of the	
				drilling is generally poor - much is interpretive	
10'					
15'					
20'					
25'	general waste characteristics and total activity sample				
30'					
35'	waste and t. activity				
				Abrupt Contact	
				37'-40' Sand 10% vcs 10% cs 10% ms 25% ms 45% vfs	
				tr small fine to medium pebbles / 15% basalt (typically the	
				very coarse fraction) 84% quartzofeldspathic 1% heavy minerals	
40'	waste and t. activity			and micas 2.5Y 7/2 • angular to subrounded • well sorted	

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W15-3129 [illegible]

Sheet 2 of 8

Location 200 yds South of MO 720

Project 200-ZP-1 JRM Pump-and-Treat Wells

Prepared By M. Darrach/Mark Darrach (Sign/Print Name) Date

Reviewed By Mark Darrach/Mark Darrach (Sign/Print Name) Date 4/27/95

Depth (40'-80')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				...cont. slightly moist · max particle size 4mm ave <1mm	
				· no HCl rxn to very slight · Sand interbed in the Hanford	
				Upper coarse unit · less basalt sand component than is	
				typical in the Hanford Fm	
45'					
				40-94 Gravel 20% lc 20% sc 30% lp 20% 5% fp 5% vcs/	
				70% basalt 30% mix of other volcanics/metamorphics/intru-	
				sives Subrounded to rounded · poorly sorted · max size 6" ·	
				ave size 1" · 2.5Y4/0 · dry · No HCl rxn · Hanford Upper	
50'	Coarse Unit & Gravel			Coarse Unit · presence of open framework gravels indi-	
				cated by fines coating clast surfaces · local coarse sandy	
				pebbly horizons are totally inferred · material is being	
				largely heavily milled during the drilling process and is	
				only occasionally representative of the true formation	
55'	Same as above			character through this interval	
	Same as above				
60'					
	Same as above				
65'					
	Same as above				
70'	Same as above				
	Same as above				
75'					
	Same as above				
80'					

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W15-31 29 MD

Sheet 3 of 8

Location 200 YDS South of MO-720

Project 200-ZP-1 JRM Pump-and-treat wells

Prepared By M. Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Mark Darrach / Mark Darrach (Sign/Print Name) Date 4/27/95

Depth (80'-120')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
		waste char. total activity			
85'		waste char. total activity			
90'		waste char. total activity			
				abrupt transition to....	
				94'-107.5' Sandy Gravel - this unit is inferred based	
95'		waste char. total activity		on discussions with the driller. The sampling	waste characterization samples were
				system did not have enough resolution to see the	monitored for carbon tetrachloride
				sand fraction. The gravel fraction is of approxi-	from 0'-95'. 13 April 95 10:00 AM and
				mately the same size distribution and composi-	did not register above background
				tion as the unit from 40-94. Depth 107.5 marks	levels on the instrument
100'		waste char. total activity		the base of the Hanford Fm. coarse unit and the	
				top of the Hanford Fine Unit	
105'					
				abrupt transition to....	
		waste char. total activity		107.5-145.5 Sand 2% vcp 3% cp 2% mp and fp 20% vcs	
				20% cs 20% ms 30% fs and vfs 5% silt / 35% basaltic	
110'				fragments (typically most pebbles and coarsest sands) 65% qtzo-	
				feldspathic and some mixed lithics (typically quartz felsic)	
				trace of micas Subangular to well rounded (pebbles) · mod-	
				erately sorted · max size 4cm ave size .5mm · 2.5Y6/2 ·	
				dry · weak HCl rxn (individual clasts reacting) · Sand	
115'		waste char. total activity		Facies of the Hanford Formation (Fine) · material is	
				likely bedded and planar laminated cross bedded	
				with local pebble trains · predominance of the qtzo-	
				feldspathic component is unusual for this part of	
				the Hanford Fm. and may indicate transitional	
120'		waste char. total activity		phase of sand facies to silt facies	

A-6000-382 (01/93)

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BOREHOLE LOG

Boring or Well No. 299-W15-31/29 WO

Sheet 4 of 8

Location 200 yds south of MO-720

Project 200-ZP-1 JRM Pump-and-Treat Wells

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Mark Darrach / Mark Darrach (Sign/Print Name) Date 4/27/95

Depth (120'-160')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
125'					
130'					
135'					
140'					
				gradational contact to....	
145'				145.5'-160.0' Sandy Silt 60% medium to coarse silt 40% vfs / 95% quartzofeldspathic 5% micas lithics and oxi-orted heavy minerals angular to well-rounded · well sorted · max size and ave size < 1mm · 10YR 6/2 · slightly moist · moderate to strong HCl rxn · Silt Unit of Plio-Pleistocene Unit	
150'					
155'					
160'					

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W15-31 29 mo

Sheet 5 of 8

Location 200 yds south of MO-720

Project 200-ZP-1 & RM Pump and Treat Wells

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Mark Darrach / Mark Darrach (Sign/Print Name) Date 4/27/95

Depth (160'-200')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
				160'-167' Silty Sand w/strongly developed caliche stringers 5%cs 10%ms 40%fs 35%vfs 10%silt / 15% basalt 80% quartzofeldspathic w/tr of lithics and micas/ heavy minerals subangular to subrounded grains. moderately sorted. max size 1mm ave size. 2 mm. 2.5Y 6/3. bodaciously strong rxn to HCl Plio-Pleistocene Unit Caliche stringers are discontinuous microcrystalline $CaCO_3$ with widely dispersed Sand grains and local spheres (look like oolites) of concentric $CaCO_3$ around tiny nucleus grains - some of the sand in this silty sand unit is actually comprised of these small $CaCO_3$ spheres - probably an earlier stage in calcrete development. Interlayered with the silty sand is a coarser Sand 5% medium to fine pebbles (basalt) 5% vcs 5%cs 20%ms 35%fs 30%vfs 5%silt / 40% basalt 50% quartzofeldspathic and scattered lithic fragments and ≈ 10% caliche fragments and $CaCO_3$ spheroids subangular to well rounded. poorly sorted. max size 2cm ave <1mm. 10YR 6/3. dry. vigorous HCl rxn	
165'	Waste char tot. act.				
170'	Waste char tot. act.				
175'	Waste char. tot act.				
180'	Waste char tot act.			gradational contact to....	
				167'-177' Silty Sand vcs 5% 5%cs 40%ms 30%fs 5%vfs ≈ 18% silt / 20% basalt fragments 10% carbonate/caliche frags 65% quartzofeldspathic grains 5% micas/heavy minerals Subangular to well-rounded. moderately sorted. max size 2mm ave. 25mm. 10YR 5/4. dry. vigourous HCl rxn Upper Unit of the Ringold	
185'	Waste char tot act.			abrupt contact with...	
				177'-193' Sandy Gravels / Gravelly Sands / Silty Sandy Gravels and Silty Gravelly Sands 0-5% cb 0-10% lc 5-50% sc 15-70% vcp 15-50% cp 5-25% mp, fp, vfp 10-50% vcs, cs 5-20% ms, fs, vfs 0-25% silt / 10-30% basalt clasts (particularly the largest sizes) 70-90% mix of quartzite (metamorphic) misc. felsic plutonic/metamorphic rx. and porphyritic volcanics trace of heavy minerals and micas in the sand fractions Subrounded to well-rounded (pebbles/cobbles typically very well rounded). moderately to poorly sorted. max size ≈ 8" ave size ≈ 2cm. colors various. wet to dry (wet below H_2O table) No HCl rxns noted but maybe $CaCO_3$ local	Note: Air rotary drilling technique being used results in heavy milling of the gravels to a very unrepresentative size and the use of the guzzler vacuum system is almost certainly removing a disproportionate fraction of the silt size fractions. As a result, the logs are necessarily somewhat schematic and based upon previous knowledge of typical Ringold E stratigraphic variation
190'	Waste char tot act.				
195'	Waste char tot act.				
200'	Waste char tot act.				

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W15-29

Sheet 6 of 8

Location 200 yds South of MO-720

Project 200-ZP-1 JRM Pump and Treat Wells

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date

Reviewed By Mark Darrach/Mark Darrach (Sign/Print Name) Date 4/27/95

Depth (200'-240')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				....cont. the silty composition probably greatly dominate the section volumetrically. based on inference to the sonic core section below, most of the silt bearing units are pedogenic in nature. Turbation of these units is strongly present down section. Note: from 193-196' unit becomes quite silty (60% silt) Ringold "E"	
205'	waste char. tet. aat.				
				196'-225' Silty Sandy Gravel and Sandy Silty Gravel 5% lc 15% sc 20% vcp 15% (cp, mp, fp, vfp) 15-25% sand (of the sand fraction ... 5% vcs 10% cs 50% ms 25% fs 10% vfs) 20-30% silt / cobbles: 30% basalt 70% mix of meta-quartzite the sands: 15% basalt 85% quartzofeldspathic with minor (210-150) lithic fragment component trace of heavy min. and micas angular to very well rounded. poorly to very poorly sorted. max size 8" ave size 1cm. 2.5Y 6/2. dry to slightly moist. none to very weak HCl rxn. Ringold "E" material is highly variable often on a scale of inches both vertically and laterally. pockets of nearly pure sand and silt indicate strong bioturbation throughout - strong soil development, but no root casts noted. coarse felsic clasts tend to weather to an in-situ grus	Switched to sonic coring @ 219' w/ the core return at ≈ 100%. Material is coming out of the 7" barrel much too quickly to be properly characterized - we need to change the system. The primary observation on the logging is that there is an outer rind of fines on the core that is not representative at all, but that the interior of the core is typically undisturbed. In short, the method is excellent for our needs with some minor sample-catching modifications
210'	waste char. tet. aat.				
215'	waste char. tet. aat.				
220'	waste char. tet. aat.				
225'	waste char. tet. aat.			226'-227' Gravelly Sand 5% mp 5% fp 15% cs 70% ms 10% fs / pebbles: 75% basalt 25% assorted lithics / sand: 90% quartzofeldspathic 8% basalt/mafic lithics 2% heavy min/micas subangular to rounded (pebbles well rounded) well sorted. max size 1cm ave. .25mm. 2.5Y 6/3 (dry). moist. no HCl rxn.	top of capillary fringe @ 229'
230'	waste char. tet. aat.				
				227'-270' Silty Sandy Gravel and Sandy Silty Gravel. return to the same unit as in 196'-225'. material is moist to 236' and then is saturated. material is not of very desireable hydraulic conductivity. largely bioturbated soil horizons	range in static H_2O level noted for this well
235'	waste char. tet. aat.				Saturated material first noted @ 236' (see above however)
240'	C	charact. zp sample			

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BOREHOLE LOG

Boring or Well No. 299-W15-29

Sheet 7 of 8

Location 200 yds south of MO 720

Project 200-ZP-1 JRM Pump-and-Treat Wells

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Mark Darrach / Mark Darrach (Sign/Print Name) Date 4/27/95

Depth (240'-280')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
	B, A	Characteriz. Sample		... See previous page for unit description	
245'					
					Sieve analysis @ 300 area geo-tech lab on sonic core return HEIS BØCFW8 249'-249½'
250'	Sonic Core C, B, A				Split tube characterization sample from 249½'-251' / Liner C was used for sieve analysis @ 300 area geo-tech lab - HEIS # BØFCW9
255'					Z mo
260'					
265'					
				abrupt contact with...	
270'	Sonic Bulk Sieve Samp.			270'-271' Sandy Gravel 5% vcp 15% cp 15% mp 15% fp 5% vfp 5% cs 30% ms 10% fs / pebbles 30% basalt 70% mix of metaquartzite / assorted volcanics, plutonic and metamorphics / sand 5% basalt / other mafic fragments 95% quartzofeldspathic. Trace heavy minerals / micas subangular to subrounded · poorly sorted · max 4" ave. 5mm · 2.5Y 7/3 · wet · no HCl rxn · Ringold E	Sonic Bulk Sieve Sample 270'-271' HEIS # BØFCX0
275'				abrupt contact with...	
				271'-281' Silty sandy gravel and Sandy silty gravel · Same unit as 196'-225' and 227'-270'	
280'					

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BOREHOLE LOG

Boring or Well No. 299-W15-29

Sheet 8 of 8

Location 200 yds South of MO-720

Project 200-ZP-1 JRM Pump-and-Treat Wells

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Mark Darrach / Mark Darrach (Sign/Print Name) Date 4/27/95

Depth (280'-292')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				281'-292' Gravelly Sand 5% sc 10% vcp 5% cp 10% mp 5% fp 5% vfp / 15% ms 35% fs 5% vfs 5% silt / 50% basalt (cobbles and pebbles) 50% various metaquartzite · porphyritic volcanics · felsic plutonics · felsic metamorphics / Sand: 75% quartzo-feldspathic 25% misc. heavy minerals/mica / moderately sorted - Sand is well-sorted · gravels well rounded · sands subangular to rounded · 5Y 8/2 (dry) · saturated · no HCl rxn. Major water producer	Sonic core bulk sieve sample HEIS # BØFCX9
285'	Sonic core bulk sieve sample 281'-291'				
290'					
292'				T.D. @ 292'	

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BOREHOLE LOG

Boring or Well No. 299-W15-30

Sheet 1 of 7

Location: Directly Adjacent to PFP Perimeter Fence

Project: 200-ZP-1 Pump and Treat Wells

Prepared By: Mark Darrach / Mark Darrach (Sign/Print Name) Date:

Reviewed By: G. Kelty / G. Kelty (Sign/Print Name) Date: 5/7/95

Depth (0'-40')	Sample: Type and No.	Sample: Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				0-52' SAND Tr mp, fg, vfg 20% vcs 60% cs 15% ms 5% fs / gravel: 85% basalt 15% misc. quartzofeldspathic lithics (e.g. quartzite/felsic plutonics) Sand: 65% basalt 30% quartzofeldspathic 5% lithics (felsic) Sand: subangular to subrounded gravel: subrounded to rounded. moderately sorted. 2.5Y 5/0 dry. moderate HCl rxn (individual grains reacting). Hanford Fm. Upper Coarse (Unit 1) Unit fines weakly downward	Air Rotary Drilling Method
5'					
10'					
15'					
20'					
25'					
30'					
35'					
40'					

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BOREHOLE LOG

Boring or Well No. 299-W15-30

Sheet 2 of 7

Location: Directly Adjacent to PFP Perimeter Fence (west)

Project: 200-ZP-1 Pump and Treat Wells

Prepared By: Mark Darrach / Mark Darrach (Sign/Print Name) Date:

Reviewed By: G. Kelly / G. Kelly (Sign/Print Name) Date: 5/9/95

Depth (40'-80')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
					Note: graphics are in the wrong column on this page
45'					
50'				→ could also be an artifact of the drilling method gradational contact with....	
				52-68' SAND 5%cs 15%ms 60%fs 20%vfs Tr silt/10% basalt fragments 85% quartzofeldspathic 5% mica w/tr heavy minerals subangular to well rounded · well sorted · 2.5Y 7/2 · moderate HCl rxn · Hanford Fm - atypical material - this is not a unit described in the stratigraphy - it appears to have a very different provenance than normal Hanford Fm. - perhaps low energy part of flood sequence (sand facies). probably planar laminated - it is depicted as such schematically	
55'					
60'					
65'				apparently gradational with:	
70'				68-89' Gravelly Sand 5%mp 5%fp 5%vfp 40%vcs 30%cs 10%ms 5%fs, vfs Tr silt / 45% basalt (80% of pebble fraction) 55% quartzofeldspathic (mostly plagioclase) pebbles subrounded to well-rounded / moderately to poorly sorted · 2.5Y 7/2 dry · max size 1.5cm, ave size .5mm · moderate HCl rxn · Hanford Fm (Unit 1 - upper coarse)	
75'					
80'					

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BOREHOLE LOG

Boring or Well No. 299-W15-50

Sheet 3 of 7

Location: Adjacent to DFP west perimeter fence

Project: 200-ZP-1 Pump and Treat Wells

Prepared By: ME Darrach / M.E. Darrach (Sign/Print Name) Date:

Reviewed By: K. Kelty / K. Kelty (Sign/Print Name) Date: 5/9/95

Depth (80'-120')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
85'					
90'				abruot contact with....	
				89-135' Gravel w/local Sand and Gravelly Sand 20% lc 20% sc 30% lo 20% mo 5% fp/vfp 5% vcs / 70% basalt 30% mix of metaquartzite / various volcanics / plutonic rx gravels sub rounded to well rounded, sands subangular to rounded · poorly sorted · max size 6" ave size 1" · 2.5 Y 4/6 · dry · no HCl rxn. HANFORD UPPER COARSE UNIT · presence of open framework gravels indicated by fines coating some clasts · much of the above description is inferred from previous knowledge of typical Hanford coarse material, the air rotary drilling technique mills this material far too much for accurate characterization	
95'					
					waste char. sample @ 98' (79-98) <D CCl4 w/Drager tube
100'					
105'					
110'					
115'					
					waste char. sample @ 119' (98-119) <D CCl4 w/Drager tube
120'					

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BOREHOLE LOG

Boring or Well No. 299-W15-30

Sheet 4 of 7

Location: Adjacent to PFP West Perimeter Fence

Project: 200-ZP-1 Pump and Treat Wells

Prepared By: ME Darrach / Mark Darrach (Sign/Print Name) Date:

Reviewed By: S. Kelly / C. Kelly (Sign/Print Name) Date: 5/9/95

Depth (120'-160')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
125'					
130'					
135'				abrupt contact with....	
140'				135'-137' Sandy Silty Gravel [- percentages of size fractions are not possible to obtain accurately due to the skewed nature of the cuttings return. This unit consists of 100% fine and very fine pebbles with silt coatings / ≈90% basalt 10% metaquartzite / misc. volcanics / felsic plutonics pebbles subrounded to rounded (return from cuttings stream is not heavily milled). well sorted. 2.5Y 7/2. vigorous HCl rxn with silt fraction and occasional caliche fragment. dry. max size 6mm, ave. size 1.5mm.	
145'				Hanford Upper Coarse Unit. this unit represents strong scouring of the flood materials into calcareous Plio-Pleistocene strata. the strong silt coatings on pebbles may argue for entrapped fines in an open framework gravel - there may never have been much sand	
150'				137'-169' Slightly Gravelly Sand interbedded with Sandy Gravel [Slightly Gravelly Sand: Tr mp 10% fp, vfp Tr vcs, cs 5% ms 50% fs 30% vfs 5% silt / 90% quartzo-feldspathic 10% basalt / heavy minerals / micas] Sandy Gravel:	
155'				10% mp 45% fp, vfp 5% ms 30% fs, vfs 5% silt / 40% basalt 40% caliche fragments 20% various metaquartzite / volcanics / felsic plutonics (gravels)] 90% quartzofeldspathic 10% basalt / heavy minerals / micas (sand fraction)] pebbles subrounded to rounded, sand subangular to sub rounded. 2.5Y 5/3	
160'				vigorous HCl rxn. dry to slightly moist. max size 3cm. ave	

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BOREHOLE LOG

Boring or Well No. 299-W15-30

Sheet 5 of 7

Location: Adjacent to DEP West Perimeter Fence

Project: 200-ZP-1 Pump and Treat Wells

Prepared By: Mark Darrach / Mark Darrach (Sign/Print Name) Date:

Reviewed By: S. Kelty / G. Kelty (Sign/Print Name) Date: 5/9/95

Depth (160'-200')	Sample: Type and No.	Sample: Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				cont.... ave size .5mm. Material is interpreted as a reworked combination of Plio-Pleistocene silts and caliche stringers. Missoula flood reworking may be responsible. Air rotary method requires estimating some particle size fraction data and inferring formation character	
165'					
				abrupt contact with	
170'				169-224' Silty Sandy Gravels / Sandy Silty Gravels / Sandy Gravels/Gravelly Sands 0-5% sb 0-10% lc 5-50% sc 15-70% vcp 5-25% mp, fp, vfp vcs, cs 5-20% 10-50% ms, fs, vfs 0-45% silt (some clays also) / 10-30% basalt clasts (particularly the larger sizes) 70%-90% mix of metaquartzite, misc. felsic plutonic/metamorphic rx., and misc. (typically porphyritic) volcanics; sands typically 80% quartzofeldspathic 20% basalt tr to a few % heavy minerals and micas; sands subangular to subrounded gravels rounded to well rounded. moderately to poor sorting. max size 8" ave size ≈1.5". clasts various. dry to saturated (water table at 221.8'). HCl rxns. typically slight, but local $CaCO_3$ conc. may produce strong reactions. compositions with silt are volumetrically more significant typically. pedogenic development locally strong. silty layers are particularly abundant from 169'-187' as indicated in the cuttings. RINGOLD "E" UNIT	Note: Air rotary drilling technique being used results in heavy milling of the gravels to very unrepresentative sizes and the use of the guzzler vacuum is probably removing a disproportionate amount of the fines. As a result the logs are schematic down to groundwater and are based on previous knowledge of typical Ringold E stratigraphy
175'					
180'					
185'					
190'					
195'					
200'					

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W15-30

Sheet 6 of 7

Location: Adjacent to DFP West Perimeter Fence

Project: 200-ZP-1 Pump and Treat Wells

Prepared By: Mark Darrach / Mark Darrach (Sign/Print Name) Date:

Reviewed By: G. Kelly / G. Kelly (Sign/Print Name) Date: 5/9/95

Depth (200'-240')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
205'					
210'					
215'					
220'					▽ ▽ } measured static water level range 221.05 - 221.80
225'				change drilling technique.... 224-234' Silty Sandy Gravel 15% sc 20% vfp 10% cp 10% mp, fp, vfp 28 vcs 3% cs 20% ms, fs, vfs 20% silt / gravel: 30% basalt 70% metaquartzite, misc. felsic volcanics, felsic plutonics: Sand: 10% basalt 90% quartzofeldspathic w/TR heavy minerals/micas / gravel well-rounded / sand subangular to subrounded · poorly sorted · saturated · no HCl rxn · 5Y 8/2 · max size 3" ave size 1" · material is heavily bioturbated (paleosol) pockets of isolated sand (particularly around larger gravel clasts are common · material has high dry strength and has high plasticity (indicates some clay fraction also present) · gravels in matrix only	Switch Drilling Technique to continuous 4" Sonic core - geological resolution increases to 100%
230'					
235'				234-244 Slightly Silty Sandy Gravel 15% sc 20% vfp 15% cp 10% fp, vfp 2% vcs 3% cs 20% ms 5% fs vfs 10% silt / gravel: 75% metaquartzites, misc. felsic volcanics, felsic plutonic/metamorphics 25% basalt clasts / Sand: 95% qtz-	Water Recovery Head Test performed @ 237 with resultant K of 55'/day Unit is an important H_2O producer & probably carries significant CCl_4 contam.
240'					

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W15-30

Sheet 7 of 7

Location: Adjacent to DFP West Perimeter Fence

Project: 200-ZP-1 Pump/Treat Wells

Prepared By: Mark Jamach / Mark Darrach (Sign/Print Name) Date

Reviewed By: G. Kelty / G. Kelty (Sign/Print Name) Date 5/9/95

Depth (240'-268')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				...cont..... 5% basalt TR mica, heavy minerals / gravels well rounded, sand subrounded to well-rounded · poor sorting overall, but sand fraction well sorted · 5Y 7/3 · Saturated - good water producing interval · max size	
245'				3" ave size 3/4" · local silt pockets likely soil development related and perhaps sedimentologic deposition of overbank fines into inactive channels in braided streams · gravels in subframework support to local full framework support	
250'				244'-250' Silty Sandy Gravel - see description of unit from 224'-234' - this unit is essentially identical	
255'				250'-257' Slightly Silty Sandy Gravel - See description of unit from 234-244' - this unit is essentially identical · 250'-257' is a major water producing horizon with conductivity probably quite similar to the 234'-244' interval	
260'				257'-267' Silty Sandy Gravel - see description of unit from 224'-234'	
265'					
268'				267'-268.3' See description of unit 224'-234' - this unit is virtually identical	T.D. @ 268 3/4
			END HOLE		• Note: A composite sieve analysis sample from all important water producing horizons was sent in to the 300 area geotechnical lab HEIS # B0FK12
					• Note: total activity sample splits were taken on a 5' basis and a per drum basis below water table
					• Note: waste characterization samples in vadose zone were negative for CCl_4

A-6000-382 (01/93)

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BHI-00927
Rev. 0

BOREHOLE LOG

Boring or Well No. 299-W15-31

Sheet 1 of 7

Location west of 231Z by W18-48 Burial Ground

Project 200-ZP-1 Pump/Treat Wells

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date

Reviewed By G. Kelty/G. Kelty (Sign/Print Name) Date 6/5/95

Depth (0-40')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				0-27' SANDY GRAVEL [10% fp 50% vfp 25% vcs 10% cs	
				5% ms... interbedded with.... 10% cp 15% mp 35% fp 30%	
				10% vfp / 75% basalt 25% mix of quartzofeldspathic, misc.	
				volcanics, metamorphics, plutonics for finer materials	
5'				90% basalt 10% quartzofeldspathic .... for coarser beds]	
				Subangular to well-rounded · poorly sorted · dry · no HCl	
				rxn · 2.5Y5/0 · max size 3cm · ave 4mm (coarse), 1.5mm	
				(fine) · finer-grained beds volumetrically more import-	
				ant · HANFORD FM (UNIT 1 - upper coarse)	
10'					
15'					
					waste char. sample @ 17' (0-17) < D CCl4
					w/Drager Tube
20'					
25'					
				gradational contact with...	
				27'-42' SAND [TR vcp, cp, mp 10% vcs 50% cs 25% ms 15%	
				fs / 60% basalt 40% quartzofeldspatic tr lithics other than	
				basalt] Subangular to well-rounded · well sorted · max	
30'				size 5cm (rare) ave size 1mm · 2.5Y5/0 · dry · no HCl rxn	
				· unit is fairly uniform - local isolated well-rounded	
				larger pebbles are present (may be hydraulic equivalents	
				or dropstones) HANFORD FM. (UNIT 2 - upper fine)	
35'					
					waste char. sample @ 37' (17-57) < D
					CCl4 w/Drager Tube
40'					

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W15-31

Sheet 2 of 7

Location West of 231Z Bldg. by W18-48 Burial Ground

Project 200-ZP-1 Pump/Treat Wells

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date

Reviewed By G. Kelty/G. Kelty (Sign/Print Name) Date 6/5/95

Depth (40'-80')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				gradational contact with....	
				42'-46' SAND tr cs 5% ms 50% fs 45% vfs tr silt/	
				5% basalt 85% quartzofeldspathic 10% mix of heavy min-	
45'				erals (qt. tour zr hb sph ...) and micas angular to round-	
				ed · very well sorted · max size 1mm ave size · 2mm · 2.5Y 4/2	
				· dry · moderate HCl rxn. HANFORD FM. (Unit 2 - Upper Fine)	
				gradational contact with....	
				46'-52' SAND 10% cs 50% ms 30% fs 10% vfs tr silt/	
50'				20% basalt (typically largest grains) 75% quartzofeldspathic	
				5% heavy min/micas Subangular to well rounded · moder-	
				ately sorted · max size 1mm /ave size . 3mm · 2.5Y 7/2 · dry	
				· mild HCl rxn (a few carbonate grains) · HANFORD FM	
				(UNIT 2 - Upper Fine)	
55'				gradational contact with....	
				52'-56' SAND ... see description for unit above @ 42'-46'	
					waste char. sample @ 57' (57-67) <D CCl_4
				56'-68' SAND .... see description for unit above @ 46'-52'	w/Drager tube
60'					
65'					
				abrupt contact with....	
				68'-84' GRAVELLY SAND 5% fg 10% vfg 60% vcs 20% cs 5%	
				ms tr fs, vfs / 55% basalt (particularly the larger size	
70'				fractions) 45% quartzofeldspathic w/minor limestone/cal-	
				iche fragments, misc. volcanic and plutonic/metamorphic	
				fragments Subangular to well-rounded · moderately	
				sorted · max size 6mm /ave. size 1mm · 2.5Y 5/0 · dry ·	
				local HCl rxn on individual carbonate-rich clasts · HAN-	
75'				FORD FM. Upper Fine	
					waste char. sample @ 79' (57-79) <D CCl_4
80'					w/Drager tube

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W15-31

Sheet 3 of 7

Location West of 231Z Bldg by W18-48 Burial Ground

Project 200-ZP-1 Pump/Treat Wells

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date

Reviewed By G. Kelty/G. Kelty (Sign/Print Name) Date 6/5/95

Depth (80'-120')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				84'-126' GRAVEL w/local SAND and GRAVELLY SAND 20% lc 20% sc 30% lp 20% mp 5% fp/vfp 5% vcs/70% basalt 30% mv of metaquartzite/misc. volcanics/plutonic and metamorphic rx gravel subrounded to very well rounded/Sands subangular to rounded · poorly sorted · max size 6"/ave size 1" · 2.5Y4/6 · dry · no HCl rxn · HANFORD FM. LOWER COARSE UNIT · material fines upward in upper 5' of the unit · open framework gravels likely present · much of the above description is inferred from previous knowledge of typical Hanford Fm. coarse material. The air rotary drilling technique generally mills this material far too much for accurate characterization.	
85'					
90'					
95'					waste char. sample @ 98' (79-98) <D CCl4 w/Drager tube
100'					
105'					
110'					
115'					waste char. sample @ 119' (98-119) <D CCl4 w/Drager tube
120'					

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W15-31

Sheet 4 of 7

Location: West of 231Z Bldg by W18-48 Burial Ground

Project: 200-ZP-1 Pump/Treat Wells

Prepared By: Mark Darrach / Mark Darrach (Sign/Print Name) Date: _____

Reviewed By: S. Kelly / G. Kelly (Sign/Print Name) Date: 6/5/95

Depth (120'-160')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
125'					
130'				126'-130' SILTY GRAVEL 10% vcp 40% cp 30% mp, fp, vfp 20% silt / 80% basalt 20% mix of metaquartzite / misc. volcanics / plutonic / metamorphic rx Subrounded to well-rounded / poor sorting · max size 2" ave ½" · 2.5Y 7/2 · dry · vigorous HCl rxn · HANFORD FM. LOWER COARSE UNIT · this unit represents a scour of the Hanford Fm. Gravels into the silty Plio-Pleistocene interval – silt coating on the gravels indicate entrapped silt-rich H_2O in with the gravel · the silt % of this unit is estimated because it is suspected that silt was preferentially removed from the cuttings stream	
135'				gradational to · · · ·	
140'				130'-135' SILTY SAND Tr vcs, cs, 5% ms 50% fs, vfs, 45% silt / 5% basalt 15% micas 80% quartzofeldspathic grains Subangular to subrounded / well-sorted · max size ½ mm ave size < .1 mm · 2.5Y 6/3 · slightly moist · vigorous HCl rxn · PLIO-PLEISTOCENE UNIT	waste char. sample @ 138' (119-138) <0 CCl4 w/Drager tube
145'				gradational to · · · ·	
150'				135'-153' SILTY SAND interbedded w/local SILTY SANDY GRAVEL tr mp 5% fp, vfp 10% ms 35% fs 35% fs 15% silt / 15% vcp 15% cp 20% mp, fp, vfp 20% ms 15% fs, vfs 15% silt / Silty Sand 5% basalt 15% caliche fragments 75% quartzofeldspathic 5% heavy minerals (particularly olivine) ⋮ Silty Sandy Gravel · · · Sand essentially same as above, gravel 60% basalt 20% misc plutonic / metaquartzite / volcanics 20% caliche fragments Sands angular to rounded gravels angular to rounded · sorting poor to moderate · max size 5cm ave < 1mm · 2.5Y 6/3 · slightly moist · vigorous HCl rxn · PLIO-PLEISTOCENE UNIT · Some discontinuous caliche stringers likely	
155'					
160'				153'-175' SANDY SILTY GRAVEL / SILTY SANDY GRAVEL / SLIGHTLY SILTY SANDY GRAVELS 5% lc – 15% lc 5% – 20% sc 10% – 40% vcp 10% – 40% cp 15% – 40% mp, fp vfp 20 – 40% vcs cs 20% – 30% ms 5% – 15% fs, vfs –	waste char. sample @ 158' (138-158) <0 CCl4 w/Drager tube

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W15-31

Sheet 5 of 7

Location West of 231Z Bldg by W18-48 Burial Ground

Project 200-ZP-1 Pump/Treat Wells

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date

Reviewed By G. Kelly/G. Kelly (Sign/Print Name) Date 6/5/95

Depth (160'-200')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				...cont. 0%-45% silt (significant clay fraction inclusive in this number)/10-30% basalt clasts (typically the larger sizes 70-90% mix of metaquartzite, misc. plutonic/metamorphic rx and misc. volcanics; Sands typically 80% quartzofeldspathic 20% basalt tr to a few % heavy minerals and mica] Sands subangular to subrounded/gravels are rounded to well rounded · moderate to poor sorting · max size 8" ave size 1.5" · colors various · dry to saturated (water table @ 215.1) · HCl rxns. typically slight, but local $CaCO_3$ conc. may produce strong rxns. silty intervals are typically volumetrically most common · RINGOLD "E" UNIT	NOTE: Air rotary/sonic assist drilling technique being used results in heavy milling of the gravels to very unrepresentative sizes, and the use of the guzzler vacuum system is probably removing a disproportionate amount of the fines. As a result, the logs are schematic down to groundwater
165'					
170'					
				abrupt transition to...	
175'				175'-200' SLIGHTLY SILTY GRAVELLY SAND [Gravel sizes not representative in cuttings return; Sand fraction 60% ms 15% fs 15% vfs 10% silt/90% quartzofeldspathic 10% basalt tr heavy minerals · gravels likely well rounded/sands subangular to rounded · overall sorting poor · max/ave size unknown · dry · no HCl rxn · gravel content clearly is atypically low for the Ringold E unit - virtually no silt content seen in cuttings - it is inferred because the guzzler system is clearly preferentially sucking off the fines	
180'					waste char. sample @ 179' (158-179) <D CCl_4 w/Drager tube
185'					
190'					
195'					
					waste char. sample @ 198' (179-198) <D CCl_4 w/Drager tube
200'					

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BOREHOLE LOG

Boring or Well No. 299-W15-31

Sheet 6 of 7

Location West of 231Z Bldg by W18-4B Burial Ground

Project 200-ZP-1 Pump/Treat Wells

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date

Reviewed By G. Kelly/G. Kelly (Sign/Print Name) Date 6/5/95

Depth (200'-240')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				200'-217' See description of unit from 153'-175' for details	
205'					
210'					
215'					▽ SWL @ 215'
				217'-221.5' SILTY SANDY GRAVEL 15%sc 20%vcp 10%cp 10%mp fp, vfp 2%vcs 3%ccs 20%ms, fs, vfs 20%silt (includes a significant clay component also - the fine material is ∴ a mud) /gravel: 80% basalt 70% metaquartzite, misc. volcanics, metamorphics, plutonics: sand: 10% basalt 90% quartzo-feldspathic w/tr heavy minerals/micas gravel well-rounded /sand subangular to subrounded · poorly sorted · saturated · no HCl rxn · 5YR 3/2 (dry color) · max size 6" ave size 1" · material is largely an old soil horizon and it is locally bioturbated with small (≈2cm) sand pockets isolated in a silty matrix · FeOx staining localized around some gravel clasts locally common · coarse gr. felsic plutonic/metamorphic rx. tend to form weathered grussy masses · gravel in matrix support abrupt transition to...	Switch to sonic coring @ 217 - over excavation here via air rotary blow-out capillary fringe @ 217.5 as noted in sonic core · waste char. sample @ 217' (198-217) < D CCl_4 w/ Drager Tube. Resolution of the geologic characterization increases to 100% - virgin formation material is available
220'					
225'					
230'					
				221.5-223 SLIGHTLY SILTY SANDY GRAVEL 15%sc 20%vcp 15%mp 10%fp, vfp 2%vcs 3%ccs 20%ms 5%fs, vfs 10%silt: gravel: 75% metaquartzites, misc. felsic volcanics, plutonic/metamorphic rx (typically felsic) 25% basalt clasts: sand 95% quartzofeldspathic 5% basalt Tr mica, heavy minerals gravels well-rounded, sand subrounded to well-rounded · poor sorting overall, but sand fraction well sorted · 5YR 3/2 saturated - major water producing horizon · max size 3" ave size 3/4" · gravels in sub to full framework support	recovery head test performed @ 237' ~~44 ft~~/day K /18gal/min/ft calculated yield
235'					
240'					

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W15-31

Sheet 7 of 7

Location: West of 231Z Bldg by W18-4B Burial Ground

Project: 200-ZP-1 Pump/Treat Wells

Prepared By: Mark Dacmach / Mark Dacmach (Sign/Print Name) Date

Reviewed By: [illegible] / [illegible] (Sign/Print Name) Date 6/5/95

Depth (240-)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
				223'-225' SILTY SANDY GRAVEL ··· see description for the interval 217'-221.5'	
				225-227' SLIGHTLY SILTY SANDY GRAVEL ··· See description for the interval 221.5'-223'· water producer	
245'				227'-228' SILTY SANDY GRAVEL ··· see description for the interval 217'-221.5'	
				228'-231' SLIGHTLY SILTY SANDY GRAVEL ··· see description for the interval 221.5'-223'· water producer	
250'				231'-235' SILTY SANDY GRAVEL ··· See description for the interval 217'-221.5'	
				236'-237' SLIGHTLY SILTY SANDY GRAVEL ··· See description for the interval 221.5'-223'· water producer	
255'				237'-240' SILTY SANDY GRAVEL ··· see description for the interval 217'-221.5'	
260'				240'-248' SLIGHTLY SILTY SAND 5% vcs 10% cs 60% ms 10% fs 5% vfs 10% silt / 10% basalt 90% quartz/feldspath 1% tr heavy min/micas Subrounded to well-rounded· well-sorted· 2.5Y 7/2 (dry)· saturated/major water producing horizon	performed head recovery test @ 237' and a K was calculated @ 44'/day with a potential yield of 18gal/min
265'			END HOLE	245'-246' SILTY SANDY GRAVEL ··· see description for the interval 217'-221.5'	
				246'-248' SLIGHTLY SILTY SANDY GRAVEL ··· see description for the interval 221.5-223'	
				248'-252' SILTY SANDY GRAVEL ··· See description for the interval 217'-221.5'	
				252'-255' SLIGHTLY SILTY SANDY GRAVEL ··· see description for the interval 221.5-223	
				255'-266' SILTY SANDY GRAVEL ··· See interval 217'-221.5'	

A-6000-382 (01/93)

200-ZP-1

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BOREHOLE LOG

Boring or Well No. 299-W15-33/B2643

Sheet 1 of 8

Location NW of 231Z Bldg. in parking lot

Project 200-ZP-1 Extraction Wells

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 11/15/95

Reviewed By Edward Rafer / Edward C. Rafer (Sign/Print Name) Date 1/30/96

Depth (0-40')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				0-17' GRAVEL · G [estimate 85% mix of mostly vfp, fp, mp with subordinate cp, vcp and rare cobbles] 15% sand [5% vcs, trcs, 15% ms (lower) 40% fs 40% vfs] tr silt · Gravels 90% basalt 10% mix or quartzite / felsic plutonics, metamorphics, phyric non-CRB volcanics, Sand 60% quartzofeldspathic 40% basalt · 2.5Y 6/2 light brownish gray · dry · poorly sorted · moderate to well rounded · max estimate 7cm ave 5mm · weak HCl rxn · HANFORD FM COARSE · contact with under lying unit is poorly defined (see note in comments)	Note: All vadose zone logging is based on samples available on a 20' basis only and inferences based on the drilling rate / rig behaviour / discussions with the driller. As such, the vadose logging is very crude and numerous lithologic transitions have no doubt been missed entirely. Lumping of units may occur as a function of poor geologic resolution.
5					
10					
					Note: 18 Nov 95 Schlumberger conducted geophysical logging on this hole from 0 → 240 feet with the following tools:
15					1) accelerator porosity (neutron ad.)
				17-85' SAND · S [5% vsc 10% cs 20% ms 40% fs 25% vfs tr silt tr local fine pebbles to vf pebbles / sand ranges from 10-40% basalt and 60-90% quartzofeldspathic] · 2.5Y 7/2 to 2.5Y 6/4 (light grey to light yellowish brown) · slightly moist · moderate to well sorted · subangular to rounded · max 3mm ave. 25mm · moderate HCl rxn. unit is somewhat variable in terms of grain size distribution and is necessarily lumped due to drilling configuration (see note in comments) HANFORD FM COARSE	2) moisture and porosity (" ")
20					3) reservoir saturation tool
					4) natural γ spectroscopy
25					
30					
35					
40					

A-6000-382 (01/93)

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BOREHOLE LOG

Boring or Well No. 299-W16-83 / B2643

Sheet 2 of 8

Location NW of 231Z Bldg. in parking lot

Project 200-ZP-1 Extraction Well

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 11/15/95

Reviewed By Edward C. Rafuse / Edward C. Rafuse (Sign/Print Name) Date 1/30/96

Depth (40-80)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				For unit description please see previous page	
45					
50					
55					
60					
65					
70					
75					
80					

A-6000-382 (01/93)

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BOREHOLE LOG

Boring or Well No. 299-W15-33/B2643

Sheet 3 of 8

Location NW of 231Z Bldg. in parking lot

Project 200-ZP-1 EXTRACTION WELL

Prepared By Mark Daniel / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward Rafuse / EDWARD RAFUSE (Sign/Print Name) Date 1/30/96

Depth (80-120)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
85				85'-117' GRAVEL · G [gravel sizes estimated as being dominated by small cobbles and very large pebbles; some sand interbeds probably exist also and are schematically depicted on the logs / gravels - 90% basalt 10% mix of quartzite, etc.] 2.5Y 5/0 · gray · dry · poorly sorted · well rounded (gravels) max. est 20cm. no HCl rxn. · contact with above unit probably abrupt · local planar laminated sands schematically represented and may not be present (typically they are present in coarse HANFORD FM. gravels)	Samples from cuttings stream too badly milled to determine initial size distributions accurately
90					
95					
100					
105					
110					
115				117'-142' SILTY SAND / SANDY SILTS / SILTY GRAVELLY SANDS / SILTY SANDY GRAVELS · mS/sM/mgS/msG [size fractions vary widely as a function of sediment type; gravels probably mostly medium pebbles → vf pebbles	lumped Plio-Pleistocene Unit
120					

A-6000-382 (01/93)

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BOREHOLE LOG

Boring or Well No. 299-W15-33 / B26H3

Sheet 4 of 8

Location NW of 231Z BLDG in parking lot

Project 200-ZP-1 Extraction Well

Prepared By Mark Darnach / Mark Darnach (Sign/Print Name) Date

Reviewed By Edward C. Rogers / EDWARD ROGERS (Sign/Print Name) Date 1/30/96

Depth (160')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				Cont... Sands: 65% fs 20% vfs 10% ms 5% cs vcs silt content variable / gravels largely basalt, sand are very strongly quartzofeldspathic [2.5Y 7/4 pale yellow (dry color) · sorting poor to well · gravels likely sub-angular to rounded, sands subangular to rounded · max. est. @ 4cm · very strong HCl rxn - material is calcareous throughout and cuttings indicate there are @ least local stringers that have supported caliche development · abrupt contact with the above unit is indicated by the geophysical logs done by Schlumberger on 11/18/95 · PLIO-PLEISTOCENE UNIT	
125'					
130'					
135'					
140'				142'-218.5' [SILTY SANDY GRAVELS / SILTY GRAVELLY SANDS · msG / msS [gravels: lc to vfp with vcp-mp predominating, gravels range typically from 30%-70% / sands dominated by medium and fine grained sizes (typically 70% or more) sand >90% quartzofeldspathic [2.5Y 7/2 light gray (dry) · sorting generally poor, but local thin sand lenses may be well sorted · gravels well-rounded / sands subangular to rounded · max typically 10cm · no HCl rxn · paleosol development likely to be strong in some horizons · RINGOLD FM. "E"	
145'					
150'					
155'					
160'					

A-6000-382 (01/93)

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BOREHOLE LOG

Boring or Well No. 299-W15-33/B2643

Sheet 5 of 8

Location NW of 231Z Bldg. in parking lot

Project 200-ZP-1 Extraction Well

Prepared By Mark Jarnack / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward C. Rohr / EDWARD ROHR (Sign/Print Name) Date 1/30/96

Depth (160'-200')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				MD 11/14/95 23	
				See previous page for unit description	
165'					
170'					
175'					
180'					
185'					
190'					
195'					
200'					

A-6000-382 (01/93)

BOREHOLE LOG

COPY

Boring or Well No. 299-W1S-33/82643

Sheet 6 of 8

Location NW of 231Z Bldg. in parking lot

Project 200-ZP-1 Extraction Well

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward C. Rafes / Edward Rafes (Sign/Print Name) Date 1/30/96

Depth (200'-240')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
205'					
210'					
215'		▼			Static Water Level @ 215'
218.5'	SPLIT SPOON SAMPLE	200 BLOWS		218.5'→219.7' Note: characterization is directly from split spoon sample return: SILTY SANDY GRAVEL · msG · [25% sc 30% vcp 10% cp 10% mp, fp, vfp / tr vcs, cs 15% ms, fs 10% silt/clay | gravels: 30% basalt 30% quartzite 40% mix of coarse felsic plutonics, metamorphosed plutonics and occasional intermediate volcanics (typically phyric)] 2.5Y 5/2 grayish brown (wet color) · saturated · very poorly sorted as a bulk sample, however sand fraction taken separately is well-sorted · gravels well-rounded · sands subangular to subrounded · max: 10cm ave 3cm · no HCl rxn · material shows signs of bioturbation (paleosol) with discrete compositional lenses of sand and silty/clayey muds. Based on discussions with driller there may be a water producing zone from 222-223', but the drilling rate did not show a change. This unit description is extrapolated through 232'. A split spoon sample taken from 230.0 → 231.6 showed no appreciable differences and no separate unit is designated, although it is described below.	Switched over from air rotary to cable-tool drilling at 218.5'/split spoon sample from 218.7→219.7 HEIS # BØGT31
220'					
225'					
230'	SPLIT SPOON SAMPLE	200 BLOWS			HEIS # BØGTL1
235'					Note: sand depicted here from 232-236' is probably not correct. It is more likely to be a silt - see comment on page 7
240'				236'-240' Inferred based on extrapolation of split spoon @ 240-241.5 and drillers observations	

A-6000-382 (01/93)

BOREHOLE LOG

COPY

Boring or Well No. 299-W15-33/B2643

Sheet 7 of 78 MD 11/17/95

Location NM of 231Z Bldg in parking lot

Project 200-ZP-1 Extraction Well

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward C. Rafuse / EDWARD RAFUSE (Sign/Print Name) Date 1/30/96

Depth (240'-268')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
	SPLIT SPOON SAMPLE	120 BLOWS		230.0-231.6 Note: this is not a separate unit, but it is being described due to the paucity of physical samples in this hole. SILTY SANDY GRAVEL · msG · [15% sc 15% vlp 20% cp 10% mp 15% fp, vfp / tr cs, vcs 15% ms, fs 10% silt/clay] gravels: 40% basalt 25% quartzite 35% mix of coarse felsic plutonics, metamorphosed plutonics and occasional intermediate volcanics (typically phyric) 2.5Y 6/2 light brownish gray and 2.5Y 6/6 light olive brown - both wet colors · very poorly sorted · gravels rounded to well-rounded sands subangular to rounded · max ≈ 8cm ave 2cm · no HCl rxn · minor incipient silica cementation noted on gravel clasts · textures consistent with paleosol development noted in this sample are the same as the previous sample · oxidized color 2.5Y 6/6 widely distributed through sample is from palagonitic alteration of basaltic glass (tachylite) and is probably not diagenetic in origin considering typical Ringold fm. oxidation states	HEIS # BØGTL2
245'					driller suspects significant water is being produced from 246'-247'
250'	SPLIT SPOON SAMPLE	150 BLOWS			HEIS# BØGYR2
255'					
260'	Split Spoon Sample	200 Blows		232'-236' based on drillers observations, a sand unit is inferred here. If this inferred sand conforms to typical Ringold "E" sands it is probably largely lower medium to upper fine sand. However, because no sample of this material was allowed this inference is conjectural and significant gravel content that would allow for a more liberal well design cannot be precluded	→ move to comments section. Note: later geophysical logging done by Schlumberger (11-18-95) indicates this unit was not a sand - it was more likely a silt and not a water producer - it may be inert relative to the well design
265'					
T.D. = 268'			T.D. = 268'		
				240'-241.5' Note: this interval does not comprise a separate unit, but is being described due to the infrequency of sampling events. SILTY SANDY GRAVEL · msG · [10% sc 25% vcp 15% cp 10% mp, fp, vfp / 5% vcs 5% cs 15% ms, fs, vfs 20% silt/clays] gravels: 25% basaltic 45% quartzite 30% mix of felsic plutonics, metamorphosed felsic plutonics, intermediate volcanics 2.5Y 5/2 (dominant color) and 2.5Y 6/6 both are wet colors grayish brown and light olive brown · very poorly sorted · gravels rounded to well-rounded / sands subangular to rounded · max 8cm, ave 1cm., no HCl rxn	

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W15-33/B2643

Sheet 8 of 8

Location NW of 231Z Bldg in parking lot

Project 200-ZP-1 CERCLA Extraction Well

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward C. Rafi / Edward C. Rafi (Sign/Print Name) Date 1/30/96

Depth (NA)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				cont ··· paleosol features not obvious in this sample · color 2.5Y 6/6 is disposed in discrete patches - it's exact origin is unclear in this sample (likely to be derived from basalt however)	this page is for descriptive text continuation only
				250'-261.7' SPLIT SPOON SAMPLE - this sample displays virtually the same characteristics as the previous split spoons - it is not sufficiently unique to warrant a detailed description / SILTY SANDY GRAVEL · MSG Gravel: 70% SAND: 20% SILT/CLAYS: 10% · discrete irregular patches of silt/clay and sand indicate the material has supported significant soil development	
				260'-261.2' SPLIT SPOON SAMPLE - exactly the same as the above entry @ 250'-261.7. The material is not sufficiently different to warrant a detailed description / SILTY SANDY GRAVEL · MSG · Gravel 65% Sand 20% Silt/clays 15% · distribution of matrix constituents indicates significant soil development has likely occurred. Sampling method has tended to shatter some of the larger gravels skewing the mode to the coarser end	

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BOREHOLE LOG

Boring or Well No. 299-W15-34 / B2748

Sheet 1 of 7

Location ENE of the 231Z Bldg

Project 200-ZP-1

Prepared By Mark Jarnach / Mark Darnach (Sign/Print Name) Date 2/29/96

Reviewed By Edward Rouse / EDWARD ROUSE (Sign/Print Name) Date 3/11/96

Depth (0-40)	Sample: Type and No.	Sample: Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				0-15 SANDY GRAVEL · SG [tr. lc tr sc 5% vcp 15% cp 5% mp 5% fp 5% vfp 10% vcs 40% cs 10% ms 5% fs, vfs tr. silt/clays / Gravels: 60% c.r. basalt 20% quartzite 10% unassd granitoids and metamorphosed granitoids 10% intermediate to felsic volcanics Sand: 40% basaltic 60% quartzofeldspathic tr. micas and heavy minerals] 2.5Y 7/2 light gray · dry · poorly sorted · gravels rounded to well-rounded / sands angular to rounded · max 15cm · weak HCl rxn Hanford Fm. Upper Coarse	Note: grain size distribution of samples in the vadose zone drilled with the sonic drilling method (0-51') are skewed to the fine side by the drilling method. Air rotary drilling was employed from 51'-218' and gravel clast size distribution is strongly skewed to the fine end as an artifact of the drilling method
5					
10					
15				15-89' SANDY GRAVEL · SG [5% lc, sc 10% vcp 10% cp 5% mp 5% fp, vfp 15% vcs 10% cs 20% ms 10% fs 5% vfs 5% silt / GRAVEL: 60% basalt 20% quartzite 10% assorted granitoids and metamorphosed granitoids 10% intermediate to felsic volcanics (typically phyric) Sand: 50% basaltic 50% quartzofeldspathic w/tr. of micas and heavy minerals] 2.5Y 5/2 grayish brown · slightly moist · poorly sorted · gravel rounded to well-rounded / sand angular to rounded · max ≈ 20 cm or more · very weak HCl rxn · Hanford Fm. Upper Coarse	
20					
25					
30					
35					
40					

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BOREHOLE LOG

Boring or Well No. 299-W15-34/B2748

Sheet 2 of 7

Location ENE of 231Z Bldg

Project 200-ZP-1

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward Rohr / EDWARD ROHR (Sign/Print Name) Date 03/11/96

Depth (40-80)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
45					
50					
55					
60					
65					
70					
75					
80					

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BOREHOLE LOG

Boring or Well No. 299-W15-34 / B2748

Sheet 3 of 7

Location ENE of 231Z Bldg

Project 200-ZP-1

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward C. Rafuse / EDWARD RAFUSE (Sign/Print Name) Date 03/11/96

Depth (80-120)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
85					
90				89-107 Gravelly Sand · gS [5%mp 5%fp 5%vfp 5%vcs 15%cs 40%ms 10%fs 10%vfs 5%silt / Gravel: 80% c.r. Basalt 10% quartzite 10% mix of various plutonics and intermediate to felsic volcanics / Sand: 85% quartzo feldspathic 5% basalt 5% other lithics 5% micas and heavy minerals] 2.5Y 7/2 light grey · slightly moist · poorly sorted · gravel: rounded to well rounded sand: angular to subrounded · max 3cm · moderate HCl rxn (individual clasts are reacting) · Hanford Fm. Lower Fine	
95					
100					
105					
110				107-131 SILTY SAND / SANDY SILTS / SILTY GRAVELLY SAND / SILTY SANDY GRAVEL · mS/sM/mgS/msG · [size fraction distributions vary widely as a function of sediment type / gravels mostly medium → vf pebbles / sands: 10%cs 60%ms 20%fs 10%vfs is typical silt/clay content varies from ≈15% → 70% / gravels: predominately basalt sand: 90% quartzofeldspathic 5% basalt / associated lithics 5% micas and various heavy minerals] 2.5Y 7/2 light grey · poorly sorted overall · gravels subangular to well-rounded, sand angular to rounded · max ≈5cm · violent HCl rxn · caliche development strong but discontinuous (likely no massive caliche - just well-developed thin stringers · Pliocene Pleistocene Unit	
115					
120					

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BOREHOLE LOG

Boring or Well No. 299-W15-34 / B274B

Sheet 4 of 7

Location ENE of 231Z Bldg.

Project 200-ZP-1

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward Rafuse / EDWARD RAFUSE (Sign/Print Name) Date 3/11/96

Depth (120-160)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
125					
130				131-218 SILTY SANDY GRAVELS / SILTY GRAVELLY SANDS / SANDY GRAVELS / SAND • msG / msS / sG / S gravels: lc to vfp with vco → mp volumetrically dominant, gravel content ranging from a few % up to ≈70% max / Sand: dominated by the medium and fine grained sizes (typically 70% or more) / Gravel typically ≈30% quartzite 40% various granitoids 20% intermediate to felsic volcanics and 10% C.R. basalt. Sand 85-90% quartzofeldspathic 5-10% assorted lithics 5% micas / heavy minerals 2.5Y 7/2 light grey (dry) • dry to moist • poorly sorted (sand units well sorted) • gravels rounded to well-rounded / Sands subangular to rounded • max 20 cm • no HCl rxn • textures consistent with paleosol horizons probably common throughout • RINGOLD "E" FLUVIAL GRAVEL	Note: the adjacent unit description is a composite typical of Ringold Fm. "E" fluvial gravels. Associated graphics are schematic only. Units presented do not equate with actual formation character @ any given locality
135					
140					
145					
150					
155					
160					

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BOREHOLE LOG

Boring or Well No. 299-W15-34 / B274B

Sheet 5 of 7

Location ENE of the 231Z Bldg.

Project 200-ZP-1

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward Rofuse / EDWARD ROFUSE (Sign/Print Name) Date 3/11/96

Depth (160-200)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
165					
170					
175					
180					
185					
190					
195					
200					

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BOREHOLE LOG

Boring or Well No. 299-W15-94 / B2748

Sheet 6 of 7

Location ENE of 231Z Bldg.

Project 200-ZP-1

Prepared By Marie Jurnak / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward Rahm / Edward Rahm (Sign/Print Name) Date 3/11/96

Depth (200-240)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
205					
210		▽			Static Water Level 210.3' 28Feb96
215					
220	Sieve Analy			218-237 SILTY SANDY GRAVEL · MSG 5% sc 10% vcp 30% cp 10% mp 2% fp 3% vfp tr. vcs 5% cs 10% ms 10% fs 5% vfs 10% silt/clays / 40% quartzite 30% misc. felsic plutonics 10% basalt 20% intermediate to felsic plutonics 2.5Y 7/2 light gray (dry color) · saturated · poorly sorted · gravels - sub-rounded to well-rounded / sand: subangular to sub-rounded · max = 20cm (est.) · no HCl rxn · material is in general of apparent low K · paleosol development in this unit was significant (mottling, bioturbation) · silt/clay concentrations more common adjacent to gravel clasts	Swithout from air rotary → cable tool / Sieve analysis sample @ 218' was from drive barrel - not a typical split spoon sample
225					
230	Split Spoon Sieve Anaty. Sample				Split spoon sample @ 230-231.8 was very tight low K material
235					
240	Split Spoon Characterization Sample			237-237.5 SANDY GRAVEL · SG · composition not known (see comment) · saturated · poorly sorted and gravels well-rounded · unit may be producing some significant volume of water	Note: the presence of this unit from 237 → 237.5 is conjectural and is based solely on drillers' observations of mud density decreases @ this depth

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BOREHOLE LOG

Boring or Well No. 299-W15-34 / B274B

Sheet 7 of 7

Location ENE of 237Z Bldg.

Project 200-ZP-1

Prepared By Mark Darrach / MARK DARRACH (Sign/Print Name) Date

Reviewed By Edward Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date 3/11/96

Depth (240-263)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				237.5-247 SILTY SANDY GRAVEL · msG 5% sc 15% vcp 25% cp 10% mp 5% fp, vfp tr. vcs 5% cs 10% ms 5% fs 5% vfs 15% silt/clays / Gravel: 40% quartzite 30% intermediate to felsic volcanics 20% intermediate to felsic plutonics/metamorphics 10% C.R. basalts / Sand: 90% quartzofeldspathic 5% lithic 5% micas and heavy minerals 2.5Y 7/2 light gray (dry color) · Saturated · poorly sorted · gravels sub to well-rounded / Sands subangular to subrounded · max ≈ 20cm (estimated) · no HCl rxn · material was a paleosol (strongly bioturbated) · very low K · fines very high in clay content	
245					
250	Sieve Analysis Sample 46558				
				247-254 SANDY GRAVEL · sG 10% sc 15% vcp 25% cp 15% mp 5% fp tr. vcs, cs 5% ms 15% fs 5% vfs 5% silt/clays / Gravels: 30% quartzite 40% intermediate to felsic plutonics/metamorphics 20% intermediate to felsic volcanics 10% C.R. basalt Sand: 90% quartzofeldspathic 5% lithic 5% micas/heavy minerals 2.5Y 7/2 light gray (dry color) · Saturated · poorly sorted overall (sand well sorted) · gravels subrounded to well-rounded / Sands subangular to subrounded · no HCl · basalt clasts typically decaying or decayed to limonitic punky masses · unit does produce water	
255					
260			T.D. = 263'	254-263 SILTY SANDY GRAVEL · msG 5% sc 10% vcp 30% cp 15% mp 5% fp, vfp tr. vcs 5% cs 10% ms 5% fs, vfs 15% silt/clays / Gravels: 40% quartzite 20% felsic plutonics and metamorphic plutonics 20% intermediate to felsic volcanics (typically phyric) 20% C.R. basalt / Sands: 90% quartzofeldspathic 5% lithic 5% micas/heavy minerals 2.5Y 7/2 light grey (dry color) · saturated · poorly sorted · gravels subrounded to well rounded · max ≈ 10-15cm (estimate) · no HCl rxn · unit probably dominated by paleosol horizons · unit has low K, but may have thin water-producing horizons not detected during drilling	

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BOREHOLE LOG

Boring or Well No. 299-W15-35 / BZ749

Sheet 1 of 7

Location NE of PCP

Project 200-ZP-1

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward Rafuse / EDWARD RAFUSE (Signature Name) Date 03/22/96

Depth (0-40)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
				0-49 SANDY GRAVEL · SG 5% lc, sc 10% vcp 10% cp 15% mp 5% fp, vfp 5% vcs 35% cs 5% ms 5% fs 5% vfs tr. silt / Gravel: 45% basalt 25% quartzite 15% intermediate to felsic volcanic 15% misc. felsic granitoids and metamorphosed granitoids / Sand: 60% basaltic 30% quartzofeldspathic 10% misc. lithics tr. micas / heavy minerals / 2.5Y 6/6 brev · dry · poorly sorted · gravel well rounded sand subangular to rounded · max ≈ 5" (possibly larger locally) · weak HCl rxn. (a few individual clasts) · HANFORD FM (coarse)	
5					
10					
15					
20					
25					
30					
35					
40					

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BOREHOLE LOG

Boring or Well No. 299-W15-95/B2749

Sheet 2 of 7

Location NE of PFP

Project 200-ZP-1

Prepared By Mark Jancaci / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward Rafuse / Edward RaFuse (Sign/Print Name) Date 03/22/96

Depth (40-80)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
45					
50				49-52 SILT · m 5% vfs 95% silt tr. clays / sand and silt predominantly quartzofeldspathic 2.5Y 7/2 light gray · slightly moist · well sorted · angular to subangular · max .1 mm · strong HCl rxn · local sand partings with coarse sand dominant	
55				52-80 SAND · S 5% vcs 40% cs 35% ms 10% fs 10% vfs tr. silt / 70% quartzofeldspathic 25% basalt 5% assorted lithics 2.5Y 7/2 · light gray · dry · well sorted · subangular to rounded · max 4mm · moderate HCl rxn · HANFORD FM - Upper Coarse	
60					
65					
70					
75					
80					

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BOREHOLE LOG

Boring or Well No. 299-W15-35 / BZ749

Sheet 3 of 7

Location NE of DEP

Project 200-ZP-1

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward Rafuse / EDWARD RAFUSE (Sign/Print Name) Date 03/22/96

Depth (80-120)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				80-105 SAND. S [tr. vcs 20% cs 60% ms 10% fs 5% vfs 5% silt / 90% quartzofeldspathic 5% basaltic 5% assorted lithics tr. heavy minerals / micas] 2.5Y 7/2 light grey. moist. very well sorted. angular to sub-rounded. max 2mm. very strong HCl rxn (likely the influence of the immediately underlying Plio-Pleistocene unit. HANFORD FM - lower fine unit	
85					
90					
95					
100					
105				105-117 SILTY SAND / SANDY SILTS / SILTY GRAVELLY SANDS / SILTY SANDY GRAVEL. mS/sM/mgS/msG/ [unit is complex and consists of multiple thin units with variable size fraction distributions / gravels mostly medium to vf pebbles / Sands: 10% cs 60% ms 10% fs 20% vfs / silt content ranges from 5%-70% dependent upon the unit / gravels predominately basalt Sand: 90% quartzofeldspathic 5% assorted lithics 5% micas / heavy minerals] 2.5Y 7/2. light grey. moist. well sorted to poorly sorted (dependent on unit). gravel rounded to well-rounded sand subangular to rounded. max 3cm. vigorous HCl rxn. caliche stringers numerous but massive caliche is absent. PLIOCENE-PLEISTOCENE UNIT	
110					
115					
120					

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BOREHOLE LOG

Boring or Well No. 299-W15-35 / 82749

Sheet 4 of 7

Location NE of DFP

Project 200-ZP-1

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward Rafuse / EDWARD RAFUSE (Sign/Print Name) Date 03/22/96

Depth (120-160)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				117-209 SILTY SANDY GRAVELS / SILTY GRAVELLY SANDS / SANDY GRAVELS / SAND · msG / msS / sG / S (msG is the dominant lithology in the unit) Gravels: lc to vfp with vco and co volumetrically dominant gravel content typically 45-70%, but may be entirely absent / Sand dominated by the medium and fine grained sizes / Gravel averages ≈40% quartzite 30% assorted felsic granitoids 20% volcanics 10% basalt Sand - 85-90% quartzofeldspathic 5-10% assorted lithics 5% micas/heavy minerals 2.5Y 7/2 light gray · dry to moist to saturated (@ H_2O table - 206.2') poorly sorted (sand units well sorted) · gravels rounded to well-rounded / sands subangular to rounded · max 20 cm · no HCl rxns · paleosol horizons probably common · RINGOLD "E" - fluvial gravel	
125					
130					
135					
140					
145					
150					
155					
160					

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BOREHOLE LOG

Boring or Well No. 299-W15-35/BZ749

Sheet 5 of 7

Location NE of PFP

Project 200-ZP-1

Prepared By Mark Darracii / Mark Darracii (Sign/Print Name) Date

Reviewed By Edward Rafes / Edward Rafes (Sign/Print Name) Date 03/22/96

Depth (160-200)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
165					
170					
175					
180					
185					
190					
195					
200					

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BOREHOLE LOG

Boring or Well No. 299-W15-35/B2749

Sheet 6 of 7

Location NE of PFP

Project 200-ZP-1

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date

Reviewed By Edward Rafuse/EDWARD RAFUSE (Sign/Print Name) Date 03/22/96

Depth (200-240)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
205					S.W.L. @ 206.2 (3/12/96)
210				209-211 SANDY GRAVEL · SG 5%sc 10%vcd 15%cd 15%mm 5% fg 5%vfg 5%vcs tr.cs tr.ms 25%fs 10%vfs 5% silt/clays / Gravels 50% quartzite 20% felsic plutonics 20% intermediate to felsic volcanics 10% basalt Sand 90% quartzofeldspathic 5% lithics 5% micas/heavy minerals 2.5Y 8/2 white (dry) · material is saturated and a major water producer · Poorly sorted overall (but matrix taken separately is very well sorted) · Gravel well-rounded sand is subangular to rounded · max 5" · no HCl rxn.	
215					
220				211-218 SAND · S tr.fg, vfg 5% vcs 10% cs 70% ms 10% fs, vfs 3% silt / 95% quartzofeldspathic 5% lithics tr. heavy metals 2.5Y 8/2 white (dry color) · saturated - unit is a major ~~water~~ water producer · very well sorted · subangular to rounded · max 5mm · no HCl rxn.	
225					
230				218-222 SANDY GRAVEL · SG material was not observed directly, its presence is inferred based on drilling characteristics · material is saturated and a major water producer	
235				222-229 SILTY SANDY GRAVEL · msG material was not observed directly, its presence is inferred based on drilling characteristics (mud viscosity in particular) · material is saturated but very tight	
240				229-233.5 SANDY GRAVEL · SG 5%sc 10% vcd 30%cd 10% mg 5%fg tr. vfg tr.vcs tr.cs 15%ms 10%fs 10% vfs 5% silt/clays / Gravels · 60% quartzite	

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BOREHOLE LOG

Boring or Well No. 299-W15-35/B2749

Sheet 7 of 7

Location 200-ZP-1 NE of PFP

Project 200-ZP-1

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward Rafuse / EDWARD RAFUSE (Sign/Print Name) Date 03/22/96

Depth (240-260)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				25% assorted plutonics 10% intermediate to felsic volcanics 5% basalt tr. micas/heavy minerals Sand: 95% quartzofeldspathic 5% assorted lithics 2.5Y 7/2 light gray (dry color) · poorly sorted overall, but sand fraction taken separately is well sorted · gravel is well-rounded sand is subangular to rounded · max 5 inches · HCl rxn - none · major water-producing unit	
245					
				233.5-238 SILTY SANDY GRAVEL · msG material was not observed directly. its presence is inferred based on drilling characteristics (mud viscosity in particularly) · material is saturated, but not an important water producer	
250					
				238-242 SANDY GRAVEL · sG 5%sc 10%vcn 20%cn 10%mn 5%fn tr. vfs 20%ms 20%fs 5% vfs 5% silt/clays Gravels: 50% quartzite 20% assorted plutonics and metamorphosed plutonics 20% intermediate to felsic volcanics 10% basalt Sand: 90% quartzofeldspathic 5% assorted lithic fragments 5% micas/heavy minerals 2.5Y 8/2 white (dry color) · saturated and a major water producer · poorly sorted overall, but matrix taken separately is well-sorted · gravel well-rounded sand subangular to rounded · max ≈5" · no HCl rxn	
255					
260			T.D. 260		
				242-260 SILTY SANDY GRAVEL · msG material was not observed directly - presence is inferred based on drilling character (mud viscosity) · material is a poor water producer	

A-6000-382 (01/93)

5.2.5

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BOREHOLE LOG

Boring or Well No. 299-W16-36

Sheet 1 of 7

Location 300 Yards ESE of P.F.P.

Project 200-ZP-1 J.R.M.

Prepared By Mark Janacik / Mark Darrach (Sign/Print Name) Date 5/2/96

Reviewed By _____ (Sign/Print Name) Date _____

Depth (0-40)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				0-33 SAND · S tr. vfp, vcs 5% cs 45% ms 40% fs 5% vfs 5% silt / 85% quartzofeldspathic 10% lithic 5% mica 2.5Y 7/2 light grey · dry · very well sorted · angular to rounded · max 4mm · moderate HCl	
5					
10					
15					
20					
25					
30					
35				33-74 GRAVEL · G 5% lc 5% sc 30% vcp 20% cp 20% mp 10% fp 5% vfp 5% vcs / Gravel 70% basalt 30% mix of various plutonics, metamorphics, volcanics / Sand 50% basalt 50% quartzofeldspathic tr. mica, heavy minerals 2.5Y 4/0 dark grey · dry · poorly sorted · gravels rounded to well rounded / sand angular to rounded · max ≈ 30cm estimated · no HCl rxn.	
40					

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BOREHOLE LOG

Boring or Well No. 299-W15-36

Sheet 2 of 7

Location 300 yds ESE of P.F.P.

Project 200-ZP-1 J.R.M.

Prepared By Mike Darrach / Mark Darrach (Sign/Print Name) Date 5/2/96

Reviewed By _____ (Sign/Print Name) Date _____

Depth (40-80)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
45					
50					
55					
60					
65					
70					
75				74-97 SAND · S 5% fp, vfp 20% vcs 45% cs 20% ms 5% fs · 5% vfs tr. silt / 70% quartzofeldspathic 20% basalt 5% assorted lithics 5% micas tr. heavy minerals. 2.5Y 7/2 light grey · moderately sorted · angular to rounded · max 1cm · weak to moderate HCl rxn	
80					

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BOREHOLE LOG

Boring or Well No. 299-W15-36

Sheet 3 of 7

Location 300 yds. ESE of P.F.P.

Project 200-ZP-1 J. R. M.

Prepared By Mark Jarrach/Mark Darrach (Sign/Print Name) Date 5/2/96

Reviewed By _____ (Sign/Print Name) Date _____

Depth (80-120)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
85					
90					
95				94-	
				94-110 SILTY SAND · mS tr. cs 25% ms 30% fs 20% vfs 25% silt / 90% quartzofeldspathic 10% micas tr. heavy minerals / 2.5Y 7/2 light grey (dry color) · moist · very well sorted · angular to rounded · max 1 mm · very strong HCl rxn.	
100					
105					
110				110-123 SAND w/local CALICHE stringers · S 5% fp, vfp 25% vcs 40% cs 20% ms 5% fs, vfs 5% silt/clays / 55% quartzofeldspathic 35% basalt 5% assorted lithics 5% micas tr. heavy minerals / 2.5Y 7/2 light grey · dry · poor to moderately sorted · angular to rounded · max 1cm · violent HCl rxn	
115					
120					

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BOREHOLE LOG

Boring or Well No. 299-W15-36

Sheet 4 of 7

Location 300 yds ESE of P.F.P.

Project 200-ZP-1 J.R.M.

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 5/2/96

Reviewed By _____ (Sign/Print Name) Date _____

Depth (120-160)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
125				123-212 SILTY SANDY GRAVEL w/local slightly silty sandy gravel and sand · msG [5% sc 15% vcp 20% cp 10% mp 5% fp, vfp tr. vcs 5% cs 20% ms 5% fs 5% vfs 10% silt/clays / 35% quartzite 25% assorted plutonics 20% metamorphics 10% intermediate to felsic volcanics 10% basalt] 2.5Y 7/2 light grey (dry color) · dry (saturated from 208.5 to 212) · poorly sorted · gravel rounded to well-rounded · sand angular to rounded · max ≈ 10cm · no HCl rxn. · unit description is an average for the Ringold Fm. unit "E" in the vadose zone - unit graphics reflect the dominant sediment type	
130					
135					
140					
145					
150					
155					
160					

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BOREHOLE LOG

Boring or Well No. 299-W15-36

Sheet 5 of 7

Location 300 yards ESE of PFP

Project 200-ZP-1 J.R.M.

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 5/2/96

Reviewed By _____ (Sign/Print Name) Date _____

Depth (160-200)	Sample: Type and No.	Sample: Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
165					
170					
175					
180					
185					
190					
195					
200					

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BOREHOLE LOG

Boring or Well No. 299-W15-36

Sheet 6 of 7

Location 300 YARDS ESE of P.F.P.

Project 200-ZP-1 J.R.M.

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 5/2/96

Reviewed By _____ (Sign/Print Name) Date _____

Depth (200-240)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
205					
▽5/2/96					
210				211-214 SANDY GRAVEL · SG 5%sc 20%vcp 20%cp 10%mp 5%fp tr. vfp tr. vcs 5%cs 15%ms 5%fs 5% vfs 10% silt/clays / gravels: 40% quartzite 25% assorted (mainly felsic) plutonics 15% assorted metamorphics (mainly felsic gneisses derived from plutonics) 10% intermediate to felsic (typically phyric) volcanics 10% basalt 2.5Y 7/2 light gray (dry color) · saturated · poorly sorted (but strongly bimodal with good sorting in the matrix) · gravel rounded to well-rounded / sand angular to rounded · max ≈ 10cm · no HCl rxn · the unit is a significant water producing unit	
	Split Spoon Sieve Analysis B0HG31				
215					
	Split Spoon Sieve Analysis B0HG32				
220				214-217 SILTY SANDY GRAVEL · msG · unit was not actually observed – the character of the unit is inferred from drilling character (mud viscosity in particular) · for description see the narrative for the unit from 123-211 ft.	
225					
	Split Spoon Sieve Analysis B0HG33			217-222 SANDY GRAVEL · SG tr. sc 20%vcp 25%cp 10%mp 5%fp tr. vfp tr. vcs tr. cs 15%ms 10%fs 5% vfs 10% silt/clays / gravels: 40% quartzite 25% assorted (mainly felsic) plutonics 15% assorted gneissic metamorphics 10% intermediate to felsic volcanics (typically phyric) 10% basalt / sands: 85% quartzofeldspathic 10% lithic 5% micas tr. heavy minerals 2.5Y 7/2 light gray (dry color) · saturated · poorly sorted (but strongly bimodal with good sorting in the matrix) · gravel rounded to well-rounded / sand angular to rounded · max ≈ 10cm · no HCl rxn · unit is a significant water-producer	
230					
235					
	Split Spoon Sieve Analysis B0HG34				
240					

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BOREHOLE LOG

Boring or Well No. 299-W15-36

Sheet 7 of 7

Location 300 YARDS ESE of P.F.P.

Project 200-ZP-1 & R.M.

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 5/2/96

Reviewed By _____ (Sign/Print Name) Date _____

Depth (240-263)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				222-228 SILTY SANDY GRAVEL · see text for the unit from 214-217 ft. for description	
245				228-232 SANDY GRAVEL · SG tr. sc 5% vcp 25% cp 20% mp 5% fp 5% vfp tr. vcs 5% cs 15% ms 10% fs 5% vfs 5% silt/clays / Gravel: 40% quartzite 20% assorted plutonics 20% intermediate to felsic volcanics 10% metamorphics (typically gneissic) 10% basalt / Sand: 85% quartzofeldspathic 10% lithic 5% micas tr. heavy minerals 2.5Y 7/2 light gray (dry color) · saturated · poorly sorted, but bimodal with the matrix well-sorted · gravel rounded to well-rounded sand angular to rounded · max ≈ 10cm · no HCl rxn · unit is an important water-producer	
	Split-Spoon Sieve Analysis B4H435				
250					
255				232-236 SILTY SANDY GRAVEL · see text for the unit from 214-217 ft for description	
260				236-241 SANDY GRAVEL · SG tr. sc 20% vcp 20% cp 5% mp 5% fp tr. vfp tr. vcs tr. cs 20% ms 15% fs 5% vfs 10% silt/clays / Gravel: 30% quartzite 20% felsic plutonics 20% intermediate to felsic ~~plutonics~~ volcanics 15% assorted gneissic metamorphics 15% basalt / Sand: 85% quartzofeldspathic 10% lithic 5% micas tr. heavy minerals 2.5Y 7/2 light gray (dry color) · saturated · poorly sorted - matrix well sorted when taken separately · gravel rounded to well-rounded / sand: angular to rounded · max 10cm · no HCl rxn · unit is an important water-producer	
			T.D.=263		
				241-247 SILTY SANDY GRAVEL · msG · see text for the unit from 214-217 ft for description	
				247-253 SANDY GRAVEL · SG · see description for the unit from 236-241 (it is nearly identical)	
				253-263 SILTY SANDY GRAVEL · msG · see text for the unit from 214-217 ft. for description	

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5.2.5

BOREHOLE LOG

Boring or Well No. 299-W15-37/82753

Sheet 1 of 7

Location Immediately NE of U-241 Tank Farm

Project 200-ZP-1 J.R.M.

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward Rafuse / Edward Rafuse (Sign/Print Name) Date 05/21/96

Depth (0-40)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
				0-36 GRAVELLY SAND. gS [5% bc 6% vcp 5% cp 5% mp 5% fp, vfp 25% vcs 20% cs 20% ms 5% fs 5% vfs tr. silt/clay / Gravel 70% basalt 15% assorted plutonics 10% quartzite 5% misc. / Sand: 40% basalt 50% quartzofeldspathic 10% lithic] 2.5Y 7/2 light grey dry · poorly sorted · gravels rounded to well-rounded · max ≈ 15cm (estimated) · very weak HCl rxn.	Hanford Fm.
5					
10					
15					
20					
25					
30					
35				GRAVEL 35-76 G [5% lc 5% sc 30% vcp 20% cp 20% mp 10% fp 5% vfp 5% vcs / Gravel 90% basalt 30% mix of various plutonics, metamorphics, plutonics / Sand: 50% basalt 50% quartzofeldspathic tr. mica tr. heavy minerals] 2.5Y 4/6 dark grey · dry · poorly sorted · gravels -	
40					

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BOREHOLE LOG

Boring or Well No. 299-W15-37/B2753

Sheet 2 of 7

Location immediately NE of U-241 Tank Farm

Project 200-ZP-1 A.R.M.

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date

Reviewed By Edward C. Rafuse/Edward C. Rafuse (Sign/Print Name) Date 05/21/96

Depth (40-80)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				rounded to well-rounded / Sand angular to rounded.	
				max ≈ 30cm (estimated). no HCl rxn.	
45					
50					
55					
60					
65					
70					
75					
				78-113 SANDY GRAVEL. SG tr. sc 10% vcp 10% cp	
				10% mp 5% fp 5% vfp 20% vcs 20% cs 10% ms 5%	
				fs 5% vfs / Gravel 70% basalt 30% mix of various	
80				plutonics, metamorphics, volcanics. Sand 30%	

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BOREHOLE LOG

Boring or Well No. 299-W15-37 / B2753

Sheet 3 of 7

Location immediately NE of U-241 Tank Farm

Project 200-ZP-1 J.R.M.

Prepared By Mark Jarnach / Mark Darnach (Sign/Print Name) Date

Reviewed By Edward C. Rogers / Edward Rogers (Sign/Print Name) Date 05/21/96

Depth (80-120)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				basalt 60% quartzofeldspathic 5% lithics 5% micas 4% heavy minerals | 2.5Y 7/2 light grey · dry · poorly sorted · gravels rounded to well-rounded / sand angular to rounded · max 20cm (est) · moderate HCl rxn	
85					
90					
95					
100					
105					
110					
115				113-143 | SILTY SAND · mS | tr. cs 25% ms 30% fs 20% vfs 26% silt / 90% quartzofeldspathic 5% lithics 5% micas tr. heavy minerals | 2.5Y 7/2 light grey · moist · very well-sorted · angular to rounded · max 1mm · very strong HCl rxn	Pliocene - Pleistocene Unit
120					

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BOREHOLE LOG

Boring or Well No. 299-W15-57/B2753

Sheet 4 of 7

Location Immediately NE of U-241 Tank Farm

Project 200-ZP-1 J.R.M.

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date

Reviewed By Edward C. Rafuse/Edward C. Rafuse (Sign/Print Name) Date 5/21/96

Depth (120-160)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
125					
130					
135					
140					
145				143-208 SILTY SANDY GRAVEL w/local slightly silty sandy gravel and sand · msG 5% sc 15% vcp 20% cp 10% mp 5% fp, vfp tr. vcs 5% cs 20% ms 5% fs 5% vfs 10% silt/clays 35% quartzite 25% assorted plutonics 20% metamorphics 10% intermediate to felsic volcanics 10% basalt 2.54 7/2 light gray (dry color) · dry (saturated from 204.6 → 208) · poorly sorted · gravel rounded to well-rounded sand angular to rounded · max ≈10 cm (estimated) · no HCl rxn · unit description is an average for the Ringold fm. unit E in the vadose zone - unit graphics reflect the dominant sediment type	Ringold Fm. unit "E" gravels
150					
155					
160					

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BOREHOLE LOG

Boring or Well No. 299-W15-37 / B2753

Sheet 5 of 7

Location Immediately NE of U-241 Tank Farm

Project 200-ZP-1 J.R.M.

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward C. Rojas / Edward Rojas (Sign/Print Name) Date 05/21/96

Depth (160-200)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
165					
170					
175					
180					
185					
190					
195					
200					

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BOREHOLE LOG

Boring or Well No. 299-W15-37 / B2753

Sheet 6 of 7

Location: Immediately NE of U-241 Tank Farm

Project: 200-ZP-1 J.R.M.

Prepared By: Mark Darnell / Mark Darnell (Sign/Print Name) Date:

Reviewed By: Edward C. Rafuse / Edward Rafuse (Sign/Print Name) Date: 05/21/96

Depth (200-240)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
205					▽ S.W.L 204.8 o.g.s. 16 May 96
210	Core Barrel for Specification	NA		208-216 SLIGHTLY SILTY SANDY GRAVEL · (m)sG [5% vcp 10% cp 5% mp 15% fp 10% vfp 5% vcs tr. cs 20% ms 15% fs 5% vfs 10% silt/clays / 40% quartzite 20% assorted granitoids 20% intermediate to felsic volcanics 10% assorted metamorphics 10% basalt / sand: 85% quartzofeldspathic 10% lithic 5% micas tr. heavy minerals] 2.5Y 7/2 light grey (dry color) · saturated · poorly sorted overall, but sand fraction is well sorted when taken separately / gravel rounded to well rounded / sand angular to rounded · max ≈ 10cm (estimated) · no HCl rxn · important water-producing unit	
215					
220				216-226.5 SILTY SANDY GRAVEL · msG [5% sc 15% vcp 20% cp 10% mp 5% fp, vfp tr. vcs 5% cs 20% ms 5% fs 16% silt/clays / 35% quartzite 25% assorted plutonics 20% metamorphics 10% intermediate to felsic volcanics 10% basalt / sand 85% quartzofeldspathic 10% lithics 5% micas w/tr. heavy minerals] 2.5Y 7/2 light grey (dry color) · saturated · poorly sorted · gravel rounded to well-rounded · sand angular to rounded · max ≈ 10cm (estimated) · no HCl rxn · unit is not a significant producer of water	
225					
230					
235				226.5-231 SILTY SANDY Gravel w/local thin stringers of slightly silty sandy gravel (m)sG · for description of msG see the above unit from 216'-226.5' / for description of slightly silty sandy gravel see the above unit from 208-216 · thin (m)sG seams produce significant water when integrated over the thickness of the unit	
240	Split Spoon Sample Sieve Analysis	167 BLOWS			

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BOREHOLE LOG

Boring or Well No. 299-W16-37/B2753

Sheet 7 of 7

Location Immediately NE of U-241 Tank Farm

Project 200-ZP-1 O.R.M.

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date

Reviewed By Edward C. Rafuse/EDWARD C. RAFUSE (Sign/Print Name) Date 05/21/96

Depth (240-258)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
245				231-237 SILTY SANDY GRAVEL · msG - for description of unit see 216'-226.5' · this unit was not directly observed - it is inferred based on drilling characteristics (mud viscosity in particular)	
250				237-245 SANDY GRAVEL · sG [5% vcp 20% cp 10% mp 10% fp 5% vfp tr. vcs tr. cs 20% ms 15% fs 10% vfs 5% silt/clays / gravels 40% quartzite 20% assorted plutonics 20% intermediate to felsic volcanics 10% assorted metamorphics 10% basalt / sand: 85% quartzo-feldspathic 10% lithics 5% micas tr. heavy minerals] 2.5Y 7/2 light gray (dry color) · saturated · poorly sorted (sand well-sorted as a separate fraction) · gravel rounded to well-rounded / sand angular to rounded · max=10cm · no HCl rxn · important water-producing unit	
265			T.D.=258'	245-258 SILTY SANDY GRAVEL · msG - for description of unit see 216'-226.5' - this unit was not directly observed - it is inferred based on drilling characteristics (mud viscosity in particular)	

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5.2.5

BOREHOLE LOG

Boring or Well No. 299-W15-38/B2754

Sheet 1 of 6

Location 150' North of ZP-2 Vapor Extraction System

Project 200-ZP-1 I.R.M.

Prepared By Mark Darrach / MARK DARRACH (Sign/Print Name) Date 5/23/96

Reviewed By Edward C. Rafuse / EDWARD RAFUSE (Sign/Print Name) Date 06/04/96

Depth (0-40)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				0-29 SAND · S tr. vfp 10% vcs 15% cs 40% ms 15% fs 15% vfs 5% silt / 40% basalt 50% quartzo-feldspathic 5% assorted lithics 5% micas tr. heavy minerals 2.5Y 7/2 light grey · dry color · dry · moderately sorted · angular to rounded · max 4mm · moderate rxn. to HCl	Air Rotary Drilling w/sonic assist 0-200' / Drilled with resonant sonic and rotary assist to T.D. Drive casing 10.75" O.D.
5					
10					
15					
20					
25					
30				29-51 GRAVEL · G 5% lc 5% sc 30% vcp 20% cp 20% mp 10% fp 5% vfp 5% vcs / Gravel 70% basalt 30% mix of various plutonics, metamorphics, felsic to intermediate volcanics / Sand: 50% basalt 50% quartzofeldspathic w/ tr. micas, tr. heavy minerals 2.5Y 5/2 gray · dry · poorly sorted · gravel subrounded to well rounded · max estimated @ 30cm · no HCl rxn	
35					
40					

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BOREHOLE LOG

Boring or Well No. 299-W15-38 1B275-

Sheet 2 of 6

Location 150' North of ZP-2 Vapor Extraction System

Project 200-ZP-1 J.R.M

Prepared By Mark Darrach / MARK DARRACH (Sign/Print Name) Date 5/23/96

Reviewed By Edward C. Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date 06/04/96

Depth (40-80)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
45					
50				51-96 | SAND · S | tr. vfg tr. vcs tr. cs 15% ms 50% fs 30% vfs 5% silt / 85% quartzofeldspathic 10% lithics 5% micas heavy minerals 2.5Y 7/2 light gray · dry · well sorted · angular to subrounded · max 3mm · moderate HCl rxn.	
55					
60					
65					
70					
75					
80					

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W15-38/B2754

Sheet 3 of 6

Location 150' NORTH OF ZP-2 VAPOR EXTRACTION SYSTEM

Project 200-ZP-1 J.R.M.

Prepared By Mark Darrach / MARK DARRACH (Sign/Print Name) Date 5/23/96

Reviewed By Edward C. LaFuse / EDWARD C. LaFUSE (Sign/Print Name) Date 06/04/96

Depth (80-120)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
85					
90					
95				96-112 SILTY SAND · mS tr. vcs tr. cs 5% ms 5% fs 60% vfs 30% silt / 85% quartzofeldspathic 5% assorted lithics 10% micas, heavy minerals 2.5Y 7/2 light gray · well sorted · angular to subrounded · max 2mm · vigorous HCl rxn · moist to wet (possible perched H_2O)	possible perched water here, but leaving the hole idle for ≈ 1 hr did not result in free water in the hole
100					
105					
110				112-208 SILTY SANDY GRAVEL w/local SLIGHTLY SILTY SANDY GRAVEL · msG w/local (m)sG 5% lc 10% sc 10% vcp 15% cp 10% mp 5% fp, vfp tr. vcs 5% cs 20% ms 15% fs, vfs 5% silt/clays to max. of 15% silt and clays / 35% quartzite 25% assorted plutonics 10% assorted metamorphics 15% intermediate to felsic volcanics 15% basalt 2.5Y 7/2 light grey (dry color) · dry (saturated from 205.0 → 208.0) · poorly sorted · gravel rounded to well-rounded / sand angular to rounded	
115					
120					

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BOREHOLE LOG

Boring or Well No. 299-W15-38/82754

Sheet 4 of 6

Location 150' NORTH OF ZP-2 VAPOR EXTRACTION SYSTEM

Project 200-ZP-1 O.R.M.

Prepared By Mark Hanson / Mark Darrach (Sign/Print Name) Date 5/23/96

Reviewed By Edward C. Rohr / EDWARD C. ROHR (Sign/Print Name) Date 06/04/96

Depth (120-140) 6 m	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				... cont. · max 15 cm (observed) · no HCl rxn · unit description is an average for the Ringold Fm. unit E in the vadose zone - unit graphics reflect the dominant sediment type	
125					
130					
135					
140					
145					
150					
155					
160					

A-6000-382 (01/93)

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BOREHOLE LOG

Boring or Well No. 299-W5-38 / B2254

Sheet 5 of 6

Location 150' NORTH OF ZP-2 VAPOR EXTRACTION SYSTEM

Project 200-ZP-1 J.R.M.

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 5/23/96

Reviewed By Edward C. Rich / EDWARD C. RICH (Sign/Print Name) Date 06/04/96

Depth (60-200)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
165					
170					
175					
180					
185					
190					
195					
200					

A-6000-382 (01/93)

9713540.1829

BHI-00927
Rev. 0

BOREHOLE LOG

Boring or Well No. 299-W1S-38 / 52754

Sheet 6 of 6

Location 150' NORTH OF ZP-2 VAPOR EXTRACTION SYSTEM

Project 200-ZP-1 - J. R. M.

Prepared By Marc Janacek / MARK DARRACH (Sign/Print Name) Date 5/23/96

Reviewed By Edward C. Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date 06/04/96

Depth (200-229.5)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
205	BULK GRAB SAMPLE FOR WELL DESIGN SIEVE ANALYSIS CHOSEN FROM THE INTERVAL 205'-217'			203-217 SLIGHTLY SILTY SANDY GRAVEL · (m) sG 5% lc 5% sc 15% vcp 20% cp 15% mp 5% fp, vfp tr. vcs tr. cs 20% ms 10% fs, vfs 5% silt/clays / 35% quartzite 30% intermediate to felsic plutonics and gneisses 15% intermediate to felsic volcanics 20% basalt / Sand: 85% quartzofeldspathic 10% assorted lithics 5% micas, heavy minerals 2.5Y 7/2 light grey (dry color) · saturated · poorly sorted · gravels rounded to well-rounded / sand angular to rounded · max ≈ 15cm · no HCl rxn	Static Water Level 205.0 b.g.s. on 22 May 96
210					
215				217-227.5 SILTY SANDY GRAVEL · msG 5% lc 5% sc 15% vcp 20% cp 10% mp 5% fp, vfp tr. vcs tr. cs 20% ms 15% fs, vfs 5% silt/clays / 35% quartzites 30% intermediate to felsic plutonics and plutonically-derived gneisses 15% intermediate to felsic volcanics 20% basalt / sand: 85% quartzofeldspathic 10% assorted lithics 5% micas and assorted heavy minerals 2.5Y 7/2 light grey (dry color) · saturated · poorly sorted · gravels rounded to well-rounded / sand angular to rounded · max 15cm · no HCl rxn.	
220					
225			T.D=229.5	227.5-229.5 SLIGHTLY SILTY SANDY GRAVEL · msG [see description for the unit from 203-217 for detailed items on this lithology]	

A-6000-382 (01/93)

5.25

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BOREHOLE LOG

Boring or Well No. 299-W15-39 / B2755

Sheet 1 of 6

Location Immediately Adjacent to 200-ZP-2 V.E.S.

Project 200-ZP-1 I.R.M.

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 6/4/96

Reviewed By Edward C. Refuse / Edward C. Refuse (Sign/Print Name) Date 06/07/96

Depth (0-40)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				0-14 | GRAVELLY SAND · gS | 10% mp 5% fp 5% vfp 26% vcs 25% cs 15% ms 10% fs 5% vfs tr. silt / Gravel: 70% basalt 30% mix of assorted intermediate to felsic volcanics, intermediate to felsic plutonics, quartzite, and metamorphics (typically igneous gneisses) Sand: 50% basalt 30% quartzofeldspathic 20% misc. lithics tr. micas, heavy minerals | 2.5Y 6/2 light brownish grey · dry · poorly sorted gravel rounded to well-rounded sand angular to rounded · max ≈ 5cm · weak HCl rxn (a few individual clasts are reacting)	
				14-43 | GRAVEL · G | 5% lc 15% sc 25% vcp 25% cp 15% mp 10% fp 5% vfp / 60% basalt 15% quartzite 15% intermediate to felsic plutonics 5% intermediate to felsic volcanics 5% assorted metamorphics | 2.5Y 5/0 gray · dry · poorly sorted · subrounded to well-rounded · max ≈ 30cm · no HCl rxn	

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BOREHOLE LOG

Boring or Well No. 299-W15-39 / B2755

Sheet 2 of 6

Location Immediately Adjacent to 200-ZP-2 V.E.S.

Project 200-ZP-1 I.R.M.

Prepared By Mark Darrach / MARK DARRACH (Sign/Print Name) Date 6/4/96

Reviewed By Edward C. Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date 06/07/96

Depth (40-80)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				43-67 | GRAVELLY SAND · gS | 5% cg 10% mg 10% fg 10% vfg 30% vcs 20% cs 10% ms 5% fs / gravel: 70% basalt 30% mix of assorted intermediate to felsic plutonics, intermediate to felsic volcanics, quartzite and other metamorphics / Sand: 50% basalt 40% quartzofeldspathic 10% assorted lithics tr. micas and heavy minerals | 2.5Y 7/2 light grey · dry · poorly sorted · gravel subrounded to well-rounded / sand subangular to rounded · max 5cm · weak HCl rxn (individual clasts reacting)	
45					
50					
55					
60					
65				67-106 | SAND · S | 10% vcs 15% cs 30% ms 30% fs 10% vfs 5% silt / 15% basalt 5% assorted lithics 5% micas and heavy minerals 75% quartzofeldspathic | 2.5Y 7/2 light grey · moderately to well sorted · subangular to rounded max 4mm · moderate HCl rxn (many individual clasts are reacting)	
70					
75					
80					

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BOREHOLE LOG

Boring or Well No. 299-W15-39/B2755

Sheet 3 of 6

Location Immediately Adjacent to 200-ZP-2 V.E.S.

Project 200-ZP-1 - I. R. M.

Prepared By Marie Darrach / Mark Darrach (Sign/Print Name) Date 6/4/96

Reviewed By Edward C. Rafuse / E. Rafuse (Sign/Print Name) Date 06/07/96

Depth (80-120)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
85					
90					
95					
100					
105				106-111 | SILTY SAND · mS · | tr. vcs tr. cs 5% ms 5% fs 60% vfs 30% silt / 85% quartz/feldspathic 5% assorted (rtlus, micas, heavy minerals) | 2.5Y 7/2 light gray · very well sorted · angular to subrounded · max 2mm · violent HCl rxn · moist	
110				111-116 | CALICHE (calichefied silty sand) · calichefied sands and small gravels · 10YR8/1 - white · dry · massive · violent HCl rxn.	
115				116-200 | SILTY SANDY GRAVEL w/local, SLIGHTLY SILTY SANDY GRAVEL · msG w/local (m)sG | 5% lk 10% sk 10% vcp 15% cp 10% mp 5% fp vfp tr. vcs 5% cs 20% ms 15% fs vfs 5% silt/clays / 85% quartzite 25% assorted plutonics 10% assorted metamorphics 15% intermediate to felsic ···	
120					

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BOREHOLE LOG

Boring or Well No. 299-W15-39 / B2755

Sheet 4 of 6

Location Immediately Adjacent to 200-ZP-2 V.E.S.

Project 200-ZP-1 J.R.M.

Prepared By Mark Darrach / MARK DARRACH (Sign/Print Name) Date 6/4/96

Reviewed By Edward C. Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date 06/07/96

Depth (120-160)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
				volcanics 15% basalt 2.5Y 7/2 light grey (dry color) · dry (Saturated 199.5 → 200) · poorly sorted · gravel subrounded to rounded / sand - angular to subrounded · max 20 cm · no HCl rxn	
125					
130					
135					
140					
145					
150					
155					
160					

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BOREHOLE LOG

Boring or Well No. 299-W15-39 / B2755

Sheet 5 of 6

Location Immediately Adjacent to 200-ZP-2 U.E.S.

Project 200-ZP-1 ~ R.M.

Prepared By Mark Darrach / MARK DARRACH (Sign/Print Name) Date 6/4/96

Reviewed By Edward C. Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date 06/07/96

Depth (160-200)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
165					
170					
175					
180					
185					
190					
195					
200				▽	Static Water Level 199.5' 29 May 96

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BOREHOLE LOG

Boring or Well No. 299-W15-39 / B2755

Sheet 6 of 6

Location: immediately adjacent to 200-ZP-2 V.E.S.

Project: 200-ZP-1 J. R. M.

Prepared By: Mark Darrach / MARK DARRACH (Sign/Print Name) Date: 6/4/96

Reviewed By: Edward C. Rohn / EDWARD C. ROHN (Sign/Print Name) Date: 06/07/96

Depth (200-223)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				200-216 | SILTY SANDY GRAVEL · msG [tr. lc 5% sc 15% vcp 15% cp 10% mp 5% fp tr. vfp tr. vcs 5% cs 25% ms 10% fs, vfs 10% silt/clays / Gravels: 35% quartzite 20% assorted plutonics 20% intermediate to felsic volcanics 15% basalt 10% assorted metamorphics (mainly plutonically derived gneisses)] 2.5Y 7/2 light grey (dry color) · saturated · poorly sorted · gravels subrounded to well-rounded / sand subangular to rounded · max 20cm · no HCl rxn	
205					
210					
215				216-220.5 | SANDY GRAVEL · sG [tr. lc 5% sc 15% vcp 15% cp 10% mp 5% fp tr. vfp tr. vcs tr. cs 25% ms 15% fs 5% vfs 5% silt/clays / Gravel: 35% quartzite 20% assorted intermediate to felsic plutonics 20% intermediate to felsic volcanics 15% basalt 10% metamorphics (gneisses with plutonic protoliths for the most part) / Sand: 85% quartzofeldspathic 10% assorted lithics 5% micas, heavy minerals] 2.5Y 7/2 light grey (dry color) · ~~dry~~ moist · saturated · poorly sorted · gravels subrounded to well-rounded / sands: subangular to rounded · max 20cm · no HCl rxn.	
220	BULK GRAB SAMPLE FOR SIEVE ANALYSIS HEIS # B0H6C1		T.D. = 223'	220.5-223 | SILTY SANDY GRAVEL · smG · see description of unit from 200-216 for details	

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W15-35 / B2644

Sheet 1 of 8

Location 300' of 299-W15-29 Well

Project 200-ZP-1 Pump/Treat Injection Well

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 12/18/95

Reviewed By Edward Rafuse / EDWARD RAFUSE (Sign/Print Name) Date 12/21/95

Depth (0-40')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
				0-23' Gravelly SAND · gS [tr vcp 5% cp 5% mp 15% fp, vfp 5% vcs 40% cs 20% ms 10% fs, vfs, tr silt] gravels: mostly basalt / sands: 45% basalt 40% quartzofeldspathic 15% lithics] 2.5Y 5/0 dark gray (dry color) · gravel rounded to well-rounded · dry · moderately sorted · max 4cm · weak HCl rxn (a few individual clasts) HANFORD FM UPPER COARSE	DRILLING TECHNIQUE: AIR ROTARY 0-218 ft: Geologic resolution is typically strongly modified - particularly in the coarser units
5'					
10'					
15'					
20'				23-28 GRAVELLY SAND / SANDY GRAVEL · sG and gS · [tr vcp 5% cp 5% mp 35% mp, fp, vfp 10% vcs 10% cs 30% ms 5% fs, vfs, tr silt] gravels: mostly basalt / sands: 45% basalt 40% quartzofeldspathic 15% lithic] 2.5Y 5/2 grayish brown (dry color) · gravel rounded to well rounded sands subangular to rounded · dry · moderately sorted · max 5cm · weak HCl rxn (a few individual clasts are reacting · HANFORD FM UPPER COARSE	Contact to 23'-28' unit is probably transitional
25'					
30'				28-40 GRAVEL · G [20% lc 20% sc 25% vcp 20% cp 10% mp, fp, vfp 5% vcs / 70% basalt 30% mix of various metamorphic intermediate to felsic volcanics, felsic plutonics] 2.5Y 4/0 dark gray (dry) · dry · poorly sorted · rounded to well rounded · max ≈ 20 cm (?) · no HCl rxn · local lenses may display clasts with fine silt smearings due to entrapped fines in framework gravels during deposition · transition to this unit is probably abrupt	
35'					
40'					

A-6000-382 (01/93)

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BOREHOLE LOG

Boring or Well No. 299-W18-35/B2644

Sheet 2 of 8

Location 300' south of 299-W15-29 well

Project 200-ZP-1 Pump/Treat Injection Well

Prepared By M. Darrach / Mark Darrach (Sign/Print Name) Date 12/19/95

Reviewed By Edward Rafuse / EDWARD RaFuse (Sign/Print Name) Date 12/20/95

Depth (40'-80')	Sample: Type and No.	Sample: Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
45'					
50'					
55'					
60'					
65'					
70'					
75'					
80'					

A-6000-382 (01/93)

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BOREHOLE LOG

Boring or Well No. 299-W18-35 / B2A4

Sheet 3 of 8

Location 300' South of well # 299-W15-29

Project 200-ZP-1 Pump/Treat Injection Well

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 12/19/95

Reviewed By Edward C. Rafter / EDWARD RAFTER (Sign/Print Name) Date 12/21/95

Depth (80'-120')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				80'-99' GRAVELLY SAND - gS 5%co 5%mp 5% fp, vfp tr. vcs, tr cs, 5% ms 40% fs 35% vfs 5% silt / gravel: 75% basalt 25% mix of plutonics, volcanics, metamorphics / Sand: 90% quartzofeldspathic 5% basalt 5% micas, tr. heavy minerals 2.5Y 7/2 light grey (dry color) • dry • moderate to well sorted • gravels round to well-rounded Sand angular to subrounded • max 2cm • moderate HCl rxn • gravels typically present as pebble trains and also scattered throughout the unit	
85'					
90'					
95'					
100'				99'-135' SAND - S 5% mp, fp, vfp tr vcs 5% cs 5% fs 20% ms 40% fs 25% vfs 5% silt / Gravel: basalt dominant Sand: 90% quartzofeldspathic 5% micas 5% basalt tr heavy minerals 2.5Y 6/2 light brownish gray (dry) • slightly moist • well sorted • gravels subrounded to rounded Sand-angular to subrounded • max 1 cm • weak HCl rxn (individual clasts reacting) • local pebble trains may be present • transitional/gradational with the above unit is likely	
105'					
110'					
115'					
120'					

A-6000-382 (01/93)

9713540.1834

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BOREHOLE LOG

Boring or Well No. 299-W1B-35/B2644

Sheet 4 of 8

Location 300' South of well # 299-W15-29

Project 200-ZP-1 Pump/Treat Injection Well

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date 12/19/95

Reviewed By Edward C. Rohn/Edward Rohn (Sign/Print Name) Date 12/21/95

Depth (120'-160')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
125'					
130'					
135'				135'-143' SANDY SILT · SM [50% silt 50% sand / sand 85% quartzofeldspathic 5% micas tr heavy minerals] 10YR 6/2 light brownish gray (dry color) · material is moist · well sorted · sands angular to subrounded · max size .25 mm · strong HCl rxn · nature of contact with above unit is likely abrupt	DLIOCENE- DLEISTOCENE UNIT
140'					
145'				143'-160' Silty SAND · mS · with local strongly developed but not very thick (perhaps 6"-1') caliche stringers [5% vcs 10% cs 25% ms 30% fs 10% vfs 20% silt/clays / 85% quartzofeldspathic 10% lithic 5% micas tr. heavy minerals] 10YR 6/2 light brownish gray (dry) · moderately sorted · sands angular to subrounded · max size 2mm · strong HCl rxn · nature of contact with the above unit not known	
150'					
155'					
160'					

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W18-35/B2644

Sheet 5 of 8

Location 300' South of Well # 299-W15-29

Project 200-ZP-1 Pump/Treat Injection Well

Prepared By Mark Darnach/Mark Darnach (Sign/Print Name) Date 12/19/95

Reviewed By Edward C. Rafuse/Edward Rafuse (Sign/Print Name) Date 12/21/95

Depth (160'-200')	Sample: Type and No.	Sample: Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				160'-218' SLIGHTLY SILTY SANDY GRAVELS / SILTY SANDY GRAVELS / SILTY GRAVELLY SANDS [≈0-5% lc 0-5% sc 10-35% vcp 10-80% cp 10-20% mp 5-15% fp, vfp tr-5% vcs, cs 10-35% ms 5-20% fs 5-15% vfs 10-20% silt/clays / gravels: ave: 45% quarzite 25% intermediate → felsic volcanics (typically phyric) 20% granitoids and various metamorphics 10% basalts (CRB) Sand: 85% quartzofeldspathic 10% lithic 5% micas tr. heavy minerals • 2.5YR 6/2 typical dry color • dry • poorly sorted • gravels rounded to well-rounded, sands angular to subrounded • max ≈ 30cm • no to local weak HCl rxn • paleosol development typically present but sporadic • Contact with above unit is abrupt	
165'					
170'					
175'					
180'					
185'					
190'					
195'					
200'					

A-6000-382 (01/93)

9713540.1835

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BOREHOLE LOG

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Boring or Well No. 299-W18-35/B2644

Sheet 6 of 8

Location 300' South of Well # 299-W15-33

Project 200-ZP-1 Pump/Treat & Injection Well

Prepared By Mark Jarrach/Mark Darrach (Sign/Print Name) Date 12/19/95

Reviewed By Edward C. Rafuse/Edward Rafuse (Sign/Print Name) Date 12/21/95

Depth (200'-240')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
205					
210					
215					Transition to cable tool @ 217.5'
▽					Static Water Level 217.7' BGS 12/18/95
	Split Spoon Sample	150 Blows		218'-241.5' Silty Sandy Gravel · msG 5% sc 10% vcp 20% cp 15% mp 5% fp 5% vfp 5% vcs 5% cs 10% ms 10% fs vfs 10% silt/clays gravels: 40% quartzite 30% intermediate to felsic volcanics (typically phyric) 20% felsic granitoids and metamorphics 10% basalt (CRB) Sands: 90% quartz-feldspathic 5% basalt 5% micas, tr heavy minerals · 2.5Y 7/2 light gray (dry color) · saturated · poorly sorted both as framework and matrix taken separately - gravels well rounded, sand subangular to rounded · max ≈ 10cm no HCl rxn · thin silt/clay concentrations common around larger gravel clasts · minor silica cementation noted as thin discontinuous coating of sand grains on larger gravel clasts	Sieve Analysis conducted 218'-219.5' B#6275 - HEIS #/ Note: no significant water-producing intervals were noted through the interval 218'-241.5'. However, characterization is largely based on 2 split spoon samples and inferences derived from factors such as drilling rate - the presence of important water-producing horizons cannot be precluded. Material most probably has significant cohesive strength.
220					
225					
230	Split Spoon Sample B#6276	145 Blows			
235					
240					

A-6000-382 (01/93)

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BOREHOLE LOG

Boring or Well No. 299-W18-35/B2644

Sheet 7 of 8

Location 300' South of Well # 299-W15-29

Project 200-ZP-1 Pump/Treat Injection Wells

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date 12/19/95

Reviewed By Edward C. Rafuse/EDWARD RaFuse (Sign/Print Name) Date 12/21/95

Depth (240'-271')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				241.5'-242.2' SLIGHTLY SILTY SAND · (m)S [tr gravel · tr vcs · 10% cs · 45% ms 30% fs/vfs 15% silt/clay / Sand 85% quartzofeldspathic 10% micas 5% basaltic tr heavy minerals] 2.5Y 7/2 light grey (dry color) · Saturated · well sorted · subangular to rounded · max 1cm · no HCl rxn · no cohesive strength when wet to speak of · contact is abrupt	HE/S # B0GZ77 · unit should be a good water producing unit, but a guide bail-down/recovery check indicated very minor volumes of water were influent into the well over the exposed interval 240.5-248. Any sandy units over this interval would appear to be lentils in a less conductive matrix
245	SPLIT SPOON SAMPLE #B0GZ77	120 Blows			
	SPLIT SPOON SAMPLE #B0GZ78	100 Blows			
250				242.2'-250' SLIGHTLY SILTY GRAVELLY SAND · (m)gS [Gravel: 5% cp, mp 5% fp 10% vfp / Sand: 10% vcs 10% cs 25% ms 15% fs 5% vfs 15% silt/clays / Gravels: 40% quartzite 30% intermediate → felsic volcanics (typically phyric) 20% misc. felsic to basic metamorphics 10% basalt (CRB)] 2.5Y 7/2 light grey (dry color) · Saturated · poor to moderately sorted · gravel angular to well rounded · max 3cm · no HCl rxn · Sand subangular to rounded · material has considerable cohesion · transition to this material is abrupt	Unit 242.2'-250' has an unusually high percentage of angular and subangular fragments in the gravel size range. This unit may represent some local reworking (possibly distal debris flow deposits). The unit is not likely to be a significant water producer (see above entry)
	SPLIT SPOON SAMPLE #B0GZF6	138 Blows			
260'				250'-256' SLIGHTLY SILTY GRAVELLY SAND · (m)gS [tr. mp 10% fp 10% vfp 5% vcs 10% cs 30% ms 15% fs 5% vfs 15% silt/clays / Gravels: 40% quartzite 30% misc. non-basalt volcanics 20% misc. metamorphics 10% basalt (CRB) / Sand: 90% quartzofeldspathic 10% micas, tr basalt/heavy minerals] 7.5YR 3/2 very dark brown (wet color) · Saturated · poor to moderately sorted · gravel angular to well rounded / Sand subangular to rounded · material generally is poorly consolidated · this material is the matrix of a unit which includes numerous rip-ups of ... SILTY SANDY GRAVEL · msG [10% SC 10% vcp 10% cp 15% mp 10% fp, vfp tr. vcs 5% cs 15% ms 10% fs/vfs 15% silt/clays / gravels: 40% quartzite 30% misc. felsic/basic metamorphics 20% basalt (CRB) 10% intermediate to felsic volcanics] 2.5Y 5/2 grayish brown (wet) · Saturated · poorly sorted · gravel well rounded / Sand is subangular to rounded · material is cohesive ·	Unit from 250'-256' is volumetrically dominated by matrix. Rip ups comprise ≈20% of the total material. The material in the split spoon sample from 250'-292' should be a significant water producing unit. The unit is unusual for Ringold Fm. gravel "E", yet, like the unit above it, appears to represent reworking of typical Ringold materials in a distal debris flow setting (e.g. distal flash flood deposits). NOTE: extrapolation of unit beyond 252' to 256' is conjectural due to the poor resolution of the drilling technique. Rip-up sizes from 1cm - 10+cm. The matrix unit represents the pertinent unit relative to well design
265'					
270'			T.D.=271'		
				256'-256.5' SAND · S · unit not characterizable · 100% saturated · no cohesive strength · if this unit conforms to typical Ringold "E" sand it should be dominantly medium/fine sand w/≈10% silt/clay	This unit is inferred based on drillers observation of sand coming into casing after bailing

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BOREHOLE LOG

Boring or Well No. 299-W18-35 / B2644

Sheet 8 of 8

Location 300' South of Well # 299-W15-29

Project 200-ZP-1 Pump / Treat Injection Well

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 12/19/95

Reviewed By Edward C. Rohr / Edward C. Rohr (Sign/Print Name) Date 12/21/95

Depth (NA)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				256.5'-260' SANDY GRAVEL · SG 25%cp 20% mp 5% fp 5% vfp 5% vcs 5% cs 15% ms 5% fs 2% vfs 8% silt/clays / Gravels: 70% quartzite 15% intermediate-felsic plutonics 10% intermediate to felsic (typically pyric) volcanics 5% basalts (CRB) / SANDS: 90% quartzofeldspathic 5% micas 5% lithics tr. heavy minerals 2.5Y 5/2 grayish brown (wet color) · Saturated · poorly sorted · gravels rounded to well-rounded / Sands angular to rounded · max 7cm (likely larger in larger formation sample) · little cohesive strength when wet · no HCl rxn. Contact w/above unknown	NOTE: THIS PAGE IS FOR UNIT DESCRIPTION/COMMENTS TEXT CONTINUATION ONLY 265.5 → 260 is an important water-producing unit. Extrapolation of this unit beyond the 258.8 split spoon sample is conjectural and based solely on drilling rate and slow rate of mud viscosity buildup
				260'-271' SILTY SANDY GRAVEL · msG · (Unit size distributions and lithologic character not characterizable · unit probably has significant strength · saturated · nature of contact with above unit not known	260'-271' Unit character based solely on drilling observations (rate, mud viscosity, open hole below the shoe)

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BOREHOLE LOG

Boring or Well No. 299-W18-39/BZT56

Sheet 1 of 7

Location 300' South of the W18-36 Well

Project 200-ZP-1 Pump/Treat Injection Well

Prepared By Mark Darnack / Mark Darnack (Sign/Print Name) Date 3/96

Reviewed By Edwina Rafuse / EDWINA RAFUSE (Sign/Print Name) Date 04/01/96

Depth (0-40')	Sample: Type and No.	Sample: Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				0-17 GRAVELLY SAND · GS 5%vcp 5%cp 5%mp 5%fp 10%vfp 20%vcs 30%cs 10%ms 10% fs/vfs tr. silt / Gravels 70% basalt 10% plutonics of various denominations 10% intermediate to felsic volcanics 10% quartzite Sands 50% basalt 50% quartzofeldspathic 2.5Y 7/2 light gray · dry · poorly sorted · gravel well rounded to subrounded; Sands angular to subrounded · max ≈ 3" · minor HCl rxn (individual clasts)	
5					
10					
15					
				17-37 SAND · S tr. fp, vfp 20% vcs 50% cs 15% ms 10% fs 5% vfs tr. silt 2.5Y 7/2 light gray · dry · moderately sorted · subangular to subrounded · max 5mm · weak HCl rxn · Sand 40% basalt 55% quartzofeldspathic 5% micas tr. heavy minerals	
20					
25					
30					
35					
				37-79 GRAVEL · G 20% lc 20% sc 25% vcp 20% cp 10% mp 5% vcs/cs / 70% basalt 30% mix of various metamorphics, intermediate to felsic volcanics, and felsic plutonics 2.5Y 4/0 dark grey · dry · poorly sorted	
40					

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BOREHOLE LOG

Boring or Well No. 299-W18-37 / B2T56

Sheet 2 of 7

Location 300' SOUTH OF THE W18-36 WELL

Project 200-ZP-1 PUMP/TREAT +INJECTION WELL

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 3/96

Reviewed By Edward Rolin / EDWARD ROLIN (Sign/Print Name) Date 04/01/96

Depth (40'-80')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
				rounded to well-rounded · max ≈10" (?) · local lenses	
				may display clasts with fine silt smearings due to en-	
				trapped fines in open framework gravels during ini-	
				tial deposition · thin coarse sand intervals with	
45				well-developed planar tabular cross bedding may	
				be encountered locally (this is typical of Han-	
				ford Fm. gravels and is inferred only)	
50					
55					
60					
65					
70					
75					
				79-86 Gravelly Sand · gS 10%cg 5%mg 5%fg, vfg	
80				tr vcs 10%cs 10%ms 20%fs 35%vfs 5% silt / gravels:	

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BOREHOLE LOG

Boring or Well No. 299-W18-37/B2756

Sheet 3 of 7

Location 300' SOUTH OF THE W18-36 WELL

Project 200-ZP-1 PUMP/TREAT INJECTION WELL

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date 3/96

Reviewed By Edward Rafuse/EDWARD RAFUSE (Sign/Print Name) Date 04/01/96

Depth (80'-120')	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
85				70% basalt 30% mix of quartzite, plutonics, assorted metamorphics Sand: 90% quartzofeldspathic 5% lithics 5% micas tr. hvy. minerals [2.5Y 7/2 light grey · slightly moist · poorly sorted overall, but sand fraction taken separately is well-sorted · gravel rounded to well rounded sand angular to subrounded · 3cm max · weak HCl rxn	
				86-88 GRAVEL · G (see description for 37-79)	
90				88-104 SAND · S [tr. co, mp, fo, vfo tr. vcs 5% cs 20% ms 40% fs 25% vfs 5% slt [Gravel: mostly basalt Sand: 90% quartzofeldspathic 5% assorted lithics 5% micas tr. heavy minerals] 2.5Y 7/2 light grey · slightly moist · very well sorted · sand angular to rounded · strong HCl rxn · max 3cm · may be gradational with the above unit	
95					
100					
105				104-127 SAND · S [5% vcs 20% cs 10% ms 30% fs 30% vfs 5% slt / 90% quartzofeldspathic 10% lithic tr. micas / heavy minerals] 2.5Y 7/2 light grey · slightly moist · very well sorted · sand angular to subrounded · max 2mm · strong HCl rxn	
110					
115					
120					

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BOREHOLE LOG

Boring or Well No. 299-W18-37 / 82756

Sheet 4 of 7

Location 300' South of the well W18-36

Project 200-ZP-1 JRM

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 3/96

Reviewed By Edward Rafuse / EDWARD RAFUSE (Sign/Print Name) Date 04/01/96

Depth (120'-160')	Samples Type and No.	Samples Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
125					
				127-146 SILTY SAND · mS · with strongly developed but not very thick (≈.2 – 1') caliche stringers [tr. vcs tr. cs tr. ms 10% fs 80% vfs 10% silt / 85% quartzo-feldspathic 10% lithics 5% micas tr. heavy minerals] 2.5Y 7/2 light gray (dry color) · moist · very well sorted · angular to rounded · max 1mm · bodacious HCl rxn · PLIOCENE-PLEISTOCENE UNIT	
130					
135					
140					
145				146-162 SILTY SAND · mS · with massive strongly developed caliche horizons · caliche forms as a conglomeration of cemented sands and typically basaltic gravels (mp → vfp) [tr. vcs 5% cs 10% ms 20% fs 50% vfs 15% silt / 80% quartzofeldspathic 10% lithics (mainly basalt) 5% micas 5% heavy minerals] 2.5Y 7/2 light gray (dry color) · moist · well sorted · angular to rounded · max 2mm · bodacious HCl rxn. PLIOCENE-PLEISTOCENE UNIT	
150					
155					
160					

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BOREHOLE LOG

Boring or Well No. 299-W18-37 / B2756

Sheet 5 of 7

Location 300' South of the W18-36 well

Project 200-ZP-1 Pump/Treat Injection Well

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 3/96

Reviewed By Edward Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date 04/01/96

Depth (160-200)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
				162-220 SLIGHTLY SILTY SANDY GRAVELS / SILTY SANDY GRAVELS / SILTY GRAVELLY SANDS [≈0-5 lc 0-5% sc :0-35% vcd 10-30% cd 10-20% md 5-15% fd. vfd tr.-5% vcs. cs 10-35% ms 5-20% fs 5-15% vfs 10-20% silt/clays / gravels: ave: 45% quartzite 25% intermediate to felsic volcanics (often strongly phyric) 20% granitoids and assorted metamorphics (typically metamorphosed granitoids) ≈10% basalt Sand: 85% quartzofeldspathic 10% lithic 5% micas tr. heavy minerals · 2.5 Y 7/4 typical dry color (light grey) · dry to moist · poorly sorted but matrix taken separately is typically well sorted · gravels rounded to well-rounded · Sands angular to rounded · max. est. 30cm · none to local weak HCl rxn · some paleosol development common but sporadic · contact with above unit is abrupt and non conformable · Ringold Fm. "E" FLUVIAL GRAVELS	Note:
165					
170					
175					
180					
185					
190					
195					
200					

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BOREHOLE LOG

Boring or Well No. 299-W15-37 / BZT56

Sheet 6 of 7

Location: 300' South of the W18-36 Well

Project: 200-ZP-1 Pump / Treat Injection Well

Prepared By: Mark Darrach / Mark Darrach (Sign/Print Name) Date: 3/96

Reviewed By: Edward Rafuse / EDWARD RAFUSE (Sign/Print Name) Date: 04/01/96

Depth (200-240)	Sample: Type and No.	Sample: Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
205					
210					
215					
220				220-235' SILTY SANDY GRAVEL · msG · mp-10% fp-15% vfp-10% vcs-10% cs-10% ms-10% fs-10% vfs-10% silt/clay 15% / gravels: 35% quartzite 30% assorted intermediate to felsic volcanics 25% intermediate to felsic volcanics 10% basalt/sand 85% quartz/feldspathic 10% assorted lithics 5% micas tr. heavy minerals. 2.5Y 7/2 light gray (dry color) · saturated · poorly sorted · gravels rounded to well rounded sands angular to rounded · max 2cm (likely larger) · no HCl rxn · unit is very tight (not a significant water producer)	▽ S.W.L = 219.45 3/25/96
225					
230					
235					
240				235-245 SAND (slightly silty) · (m)S 5% cp, mp 45% fp, vfp tr. vcs 10% cs 40% ms 25% fs 5% vfs 10% silt/clays	

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BOREHOLE LOG

Boring or Well No. 299-W18-37 / B2756

Sheet 7 of 7

Location 300' South of Well W18-36

Project 200-ZP-1 / RM

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 3/96

Reviewed By Edward Rafuse / Edward Rafuse (Sign/Print Name) Date 04/01/96

Depth (240-260)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				Sand: 85% quartzofeldspathic 10% accessory lithics 5% biotite tr. heavy minerals / 2.5Y 7/2 light gray (dry color) · saturated · well sorted · gravels rounded to well rounded sand subangular to rounded · max 2cm · no HCl rxn · unit is a major water producer	
245				245-272' Silty Sandy Gravel · mSG / tr. lc.ss 5% vcp 15% cp 20% mp 10% fp 5% vfp 5% vcs 5% cs 15% ms 5% fs, vfs 15% silt/clays / Gravels 40% quartzite 20% assorted intermediate to felsic granitoids 20% metamorphics (typically metamorphosed granites) 10% intermediate to felsic volcanics (typically rhyolites) 10% basalt / 2.5Y 7/2 light gray (dry color) · saturated · gravel rounded to well rounded sand subangular to subrounded · poorly sorted · max 2x 20cm · no HCl rxn · unit is not a significant water producer	
250					
255					
260					
265					
270			T.D. = 272'		

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BOREHOLE LOG

Boring or Well No. 299-W1E-3B / B275Z

Sheet 1 of 7

Location 300' South of well 299-W1B-37

Project 200-ZP-1 JRM

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward C. Rafuse / EDWARD RAFUSE (Sign/Print Name) Date 04/15/96

Depth (0-40)	Sample: Type and No.	Sample: Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				0-19 SAND · S tr. cp, mp, fp, vfp, vcs 5% cs 15% ms 25% fs 50% vfs 5% silt / gravel 90% basalt 10% assorted lithics sand 65% quartzofeldspathic 30% basalt / assorted lithics 2.5Y 7/2 light grey · dry · very well sorted · gravel rounded to well rounded sand angular to rounded · max 3cm · moderate HCl rxn HANFORD FM.	
5					
10					
15					
20				19-73 GRAVEL · G 20% lc 20% sc 25% vcp 20% cp 5% mp 5% fp, vfp 5% vcs, cs / 70% basalts 30% mix of assorted metamorphics, intermediate to felsic volcanics, intermediate to felsic plutonics 2.5Y 4/0 dark grey · dry · poorly sorted · rounded to well-rounded · max ≈ 30cm · no HCl rxn · local gravelly sand lenses with planar tabular crossbeds are inferred based upon outcrop expression typical of the Hanford Fm. gravels · local lenses may display clasts with fine silt smearings due to entrapped fines in framework support gravels during deposition HANFORD FM	
25					
30					
35					
40					

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BOREHOLE LOG

Boring or Well No. 299-W1B-38 / B2757

Sheet 2 of 7

Location 300' SOUTH OF WELL 299-W1B-37

Project 200-ZP-1 JRM

Prepared By Mark Jarrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date 04/15/96

Depth (40-80)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
45					
50					
55					
60					
65					
70					
75				73-85 GRAVELLY SAND · gS 5% vcp 5% cp 5% mp 5% fp, vfp 20% vcs 20% cs 10% ms 15% fs 15% vfs tr. silt / gravel 70% basalt 30% mix of various lithologies sand 75% quartzofeldspathic 25% lithic (mostly basalt) 2.5Y 7/2 light grey · dry · poorly sorted · gravel subrounded to well rounded / sand angular to rounded · max 4cm (est.) weak HCl rxn. (a few individual clasts reacting)	
80				HANFORD FM.	

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BOREHOLE LOG

Boring or Well No. 299-W18-38/B2757

Sheet 3 of 7

Location 300' SOUTH OF Well 299-W18-37

Project 200-ZP-1 JRM

Prepared By Mark Jarvach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward C. Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date 04/15/96

Depth (80-120)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
85				85-125 SAND · S [5% cb, mp, fp, vfp tr. vcs 5% cs 25% ms 30% fs 30% vfs 5% silt / gravel ≈ 70% basalt 30% mix of various lithologies Sand: 85% quartzofeldspathic 10% lithic 5% micas tr. heavy minerals] 2.5Y 7/2 light grey · moist · well sorted · gravels subrounded to well rounded sand angular to rounded · max 3cm (est.) · moderate HCl rxn · gravels are likely present as well-defined pebble trains in low angle crossbed geometries HANFORD FM	
90					
95					
100					
105					
110					
115					
120					

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BOREHOLE LOG

Boring or Well No. 299-W15-38 / B2757

Sheet 4 of 7

Location 300' SOUTH OF WELL 299-W18-37

Project 200-ZP-1 / JRM

Prepared By Mark Darrach / MARK DARRACH (Sign/Print Name) Date

Reviewed By Edward C. Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date 04/15/96

Depth (120-160)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
125				125-140 SILTY SAND · mS [tr. vcs 10% cs 15% ms 35% fs 30% vfs 10% silt / 90% quartzofeldspathic 5% lithic 5% micas tr. heavy minerals] 2.5Y 7/2 light grey (dry color) · moist · very well sorted · angular to rounded] · max 2mm · vigorous HCl rxn · PLIOCENE-PLEISTOCENE UNIT	
130					
135					
140				140-147 MASSIVE CALICHE · composed apparently almost entirely of strongly cemented sand and silt · 2.5Y 8/2 white · dry · cemented material is in general moderately to well sorted and angular to rounded · max. size 2mm · violent HCl rxn	
145					
150				147-160 SILTY SAND w/incipient caliche formation · mS [tr. vcs 10% cs 20% ms 20% fs 20% vfs 30% silt / 60% quartzofeldspathic 30% lithic 5% micas 5% heavy minerals] 2.5Y 6/4 light yellowish brown · moist · very well sorted · angular to rounded · max 2mm · vigorous HCl rxn.	
155					
160					

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BOREHOLE LOG

Boring or Well No. 299-W18-38/B2757

Sheet 5 of 7

Location 300' South of Well 299-W18-37

Project 200-ZP-1/JRM

Prepared By Mark Jarrach/Mark Darrach (Sign/Print Name) Date

Reviewed By Edward C. Rafuse/Edward C. Rafuse (Sign/Print Name) Date 07/15/92

Depth (160-200)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
165				160-220 SILTY SANDY GRAVELS / SLIGHTLY SILTY SANDY GRAVELS (LOCAL) AND SANDS (LOCAL) • msG/(m)SG/S [0-5% lc 0-5% sc 10-35% vcp 10-30% ccp 10-20% mp 5-15% fp, vfp tr.-5% vcs, cs 10-50% ms 5-20% fs 5-10% vfs 10-25% silt/clays / gravels ave. 45% quartzite 25% intermediate to felsic volcanics (typically phyric) 20% granitoids and various metamorphics 10% basalts (CRB) Sand: 85% quartzofeldspathic 10% lithic 5% micas tr. heavy minerals] 2.5Y 6/2 light gray (typical dry color) • dry to moist • typically poorly sorted, but sand units are very well sorted • gravels rounded to well-rounded sands: angular to rounded • max ≈ 30 cm • none to local weak HCl rxn. textures consistent with paleosols likely present commonly	
170					
175					
180					
185					
190					
195					
200					

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BOREHOLE LOG

Boring or Well No. 299-W18-38/B2757

Sheet 6 of 7

Location 300' South of Well 299-W18-37

Project 200-ZP-1 / ARM

Prepared By Mark Jarrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward C. Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date 04/15/96

Depth (200-240)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
205					
210					
215					
220	SPLIT SPOON SAMPLE	200 BLOWS		220-226 SILTY SANDY GRAVEL · mSG 5%sc 25% vcp 10%cp 5% mp 5%fp 5% vfp tr. vcs 5%cs 15% ms 15% fs, vfs 10% silt/clays / gravels: 40% quartzite 25% assorted (mainly felsic) granitoids 15% intermediate to felsic volcanics 10% assorted metamorphics 10% basalt tr. misc. Sand: 85% quartzofeldspathic 10% lithics 5% micas tr. heavy minerals 2.5Y 7/2 light grey (dry color) · saturated · no HCl rxn · max ≈ 10cm (estimated) · unit has low K and is not a significant water producer · poor sorting · well rounded	
225					
	SPLIT SPOON SAMPLE	130 BLOWS			
230				226-230 SANDY GRAVEL · SG 5%sc 30% vcp 10%cp 5%mp tr. fp, vfp tr. vcs 15% cs 15% ms 10% fs 5% vfs 5% silt/clays / gravels ≈ 50% quartzite 15% assorted felsic granitoids 15% intermediate to felsic volcanics 10% assorted metamorphics 10% basalt Sand: 85% quartzofeldspathic 10% lithic 5% micas tr. heavy minerals 2.5Y 7/2 light grey (dry color) · saturated · well sorted · subangular to rounded · max ≈ 10cm (estimated) · no HCl rxn. over all the sample is poorly sorted, but as stated above, the sand fraction is well sorted · gravels well rounded · unit is an important water-producer in the well	
235					
	SPLIT SPOON SAMPLE	200 BLOWS			
240					

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BOREHOLE LOG

Boring or Well No. 299-W18-38/B2757

Sheet 7 of 7

Location 300' South of Well 299-W18-37

Project 200-ZP-1 / JRM

Prepared By Mark Darnell / Mark Darnell (Sign/Print Name) Date

Reviewed By Edward Rafuse / EDWARD C. RaFuse (Sign/Print Name) Date 04/15/96

Depth (240-)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
245	Split Spoon Sample	200 Blows		230-245.5 SILTY SANDY GRAVEL · msG 5% sc 25% vcp 10% cp 5% mp 5% fp 5% vfp tr. vcs 5% cs 15% ms 15% fs, vfs 10% silt/clays / gravels: 40% quartzite 25% assorted (mainly felsic) granitoids 15% intermediate to felsic volcanics 10% assorted metamorphics 10% basalt Sand 85% quartzofeldspathic 10% lithic 5% micas tr. heavy minerals 2.5Y 4/2 dark brownish grey (wet color) · saturated · poorly sorted · gravels rounded to well-rounded sand subangular to rounded · max ≈ 10cm (estimated) · no HCl rxn · unit has low K and is a poor water producer	
250					
255	Split Spoon Sample	200 Blows		245.5 – 254 SILTY SANDY GRAVEL (as described in the previous unit (230-245.5) admixed with sparsely distributed thin (a few inches thick maximum thickness) lenses of... SLIGHTLY SILTY SANDY GRAVEL · (m)sG 10% vcp 10% cp 30% mp 10% fp 5% vfp 5% vcs 5% cs 10% ms 5% fs vfs 10% silt/clays / gravels 40% quartzite 30% assorted (mainly felsic granitoids) 15% intermediate to felsic granitoids 5% assorted metamorphics 10% basalt / Sand: 85% quartzofeldspathic 10% lithics 5% micas tr. heavy minerals 2.5Y 7/2 light gray (dry color) · saturated · poorly sorted · gravels rounded to well-rounded, sand subangular to rounded · max ≈ 6cm (estimated) · no HCl rxn · unit has significant water production, but distribution is unconstrained	
260					
265				254-270 See description of 230-245.5	
270	Split Spoon Sample	179 Blows		270-274 SANDY GRAVEL · sG 15% vcp 20% cp 10% mp 5% fp 5% vfp tr. vcs tr. cs 10% ms 15% fs 15% vfs 5% silt/clays / gravels: 40% quartzite 25% felsic granitoids 15% intermediate to felsic volcanics 10% assorted metamorphics 10% basalt / Sand 85% quartzofeldspathic 10% lithics 5% micas tr. heavy minerals 2.5Y 7/2 light grey (dry color) · saturated · poorly sorted · gravels well-rounded sand - subang. to round · max 6cm · no HCl rxn · important water producer	
275			T.D.@ 277'		
				274-277 See description of 230-245.5	

A-6000-382 (01/93)

COPY

BOREHOLE LOG

Boring or Well No. 299-W1B-39/B2T58

Sheet 1 of 7

Location 300' South of well W1B-38

Project 200-ZP-1 DRM

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date

Reviewed By Edward Rafuse/EDWARD RAFUSE (Sign/Print Name) Date 05/02/96

Depth (0-40)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				0-12 SAND · S tr. cc, mp, fp, vfp, vcs 5% cs 15% ms 25% fs 50% vfs 5% silt / gravel-80% basalt 10% assorted lithics-sand 65% quartzofeldspathic 30% basalt 5% micas w/tr. heavy minerals 2.5Y 7/2 light grey · dry · very well sorted · gravel rounded to well-rounded / sand angular to rounded · max 3cm · moderate HCl rxn. HANFORD FM.	
5					
10					
				12-73 GRAVEL · G 10% lc 10% sc 25% vcp 20% cp 15% mp 5% fp, vfp 10% vcs, cs 5% ms / 70% basalt 30% mix of assorted metamorphics, intermediate to felsic volcanics and intermediate to felsic plutonics 2.5Y 4/0 dark grey · dry · poorly sorted · rounded to well-rounded · max ≈ 30cm · no HCl rxn · local gravelly sand lenses with planar tabular crossbeds are inferred based upon outcrop expression typical of the Hanford Fm · gravels · local lenses may display clasts with fine silt smearings due to entrapped fines in framework support gravels during deposition · HANFORD FM.	
15					
20					
25					
30					
35					
40					

A-6000-382 (01/93)

BOREHOLE LOG

Boring or Well No. 299-W1B-39/B2758

Sheet 2 of 7

Location 300' SOUTH OF WELL W1B-38

Project 200-ZP-1 IRM

Prepared By Mark Darrock/Mark Darrock (Sign/Print Name) Date

Reviewed By Edward Rafuse/EDWARD RAFUSE (Sign/Print Name) Date 05/02/96

Depth (40-80)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
45					
50					
55					
60					
65					
70					
75				T3-86 Gravelly SAND · gS 5% vcp 5% cp 5% mp 5% fp, vfp 20% vcs 20% cs 10% ms 15% fs 15% vfs tr. silt / gravel 70% basalt 30% mix of various lithologies / sand 70% quartzofeldspathic 30% lithic (basalt dominant) · 2.5 Y 7/2 · light grey · dry · poorly sorted · gravel sub-rounded to well rounded / sand angular to rounded · max 4cm (estimated) · weak HCl rxn · HANFORD FM.	
80					

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BOREHOLE LOG

Boring or Well No. 299-W1B-39/B2758

Sheet 3 of 7

Location 300' South of Well W1B-38

Project 200-ZP-1 IRM

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward C. Rafuse / Edward Rafuse (Sign/Print Name) Date 05/02/96

Depth (80-120)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
85				86-120 SAND · S [5% cp, mp, fp, vfp tr. vcs 5% cs 25% ms 30% fs 30% vfs 5% silt / gravel 70% basalt 30% mix of various lithologies / Sand 85% quartzofeldspathic 10% lithic 5% micas tr. heavy minerals] 2.5Y 5/2 · light grey · moist · well sorted · gravels subrounded to well-rounded / Sand angular to rounded · max 3cm (est.) · moderate HCl rxn · gravels are likely present as pebble trains · HANFORD FM	
90					
95					
100					
105					
110					
115					
120					

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BOREHOLE LOG

Boring or Well No. 299-W18-39/B2758

Sheet 4 of 7

Location 300' SOUTH OF WELL W18-38

Project 200-ZP-1 IRM

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward Rafuse / EDWARD RAFUSE (Sign/Print Name) Date 05/02/96

Depth (120-160)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				120-135 SILTY SAND · mS [tr. vcs 10% cs 15% ms 35% fs 30% vfs 10% silt / 90% quartzofeldspathic 5% lithic 5% micas tr. heavy minerals] 2.5Y 7/2 light grey (dry color) · moist · very well sorted · angular to rounded] · max 2mm · strong HCl rxn · PLIOCENE-PLEISTOCENE UNIT	
125					
130					
135				135-142 MASSIVE CALICHE · composed of strongly cemented sand and silt · 2.5Y 8/2 · white · dry · cemented sand grains are moderately to well sorted and angular to rounded · max size 4mm · very strong HCl rxn.	
140					
145				142-150 SILTY SAND w/minor caliche stringers · mS [tr. vcs 10% cs 20% ms 20% fs 20% vfs 30% silt / 60% quartzofeldspathic 30% lithic 5% micas 5% heavy minerals] 2.5Y 7/2 light grey (dry color) · very well sorted · angular to rounded · max 2mm · strong HCl rxn.	
150				150-213 SILTY SANDY GRAVELS / SLIGHTLY SILTY SANDY GRAVELS / SAND (local) · msG / (m)sG / S [0-5% lc 0-5% sc 10-35% vcp 10-30% cp 10-20% mp 5-15% fp, vfp tr.-5% vcs, cs 10-50% ms 5-20% fs 5-10% vfs 10-25% silt/clays gravels ave: 45% quartzite 25% intermediate to felsic volcanics 20% granitoids and various metamorphics 10% basalts (CRB) / Sand 85% quartzofeldspathic 10% lithics 5% micas tr. heavy minerals] 2.5Y 6/2 light grey (typical dry color) · dry to saturated · typically poorly sorted, but sands are typically well sorted · gravels rounded to well-rounded / sands angular to ...	
155					
160					

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BOREHOLE LOG

Boring or Well No. 299-W1B-39/B2758

Sheet 5 of 7

Location 300' SOUTH OF WELL W1B-38

Project 200-ZP-1 JRM

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date

Reviewed By Edward Rafuse/EDWARD RAFUSE (Sign/Print Name) Date 05/02/96

Depth (160-200)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description: Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level
				... cont. well-rounded · max ≈ 30cm · none to local weak HCl rxn · textures consistent with paleosols likely common	
165					
170					
175					
180					
185					
190					
195					
200					

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BOREHOLE LOG

Boring or Well No. 299-W18-39/B2758

Sheet 6 of 7

Location 300' SOUTH OF WELL W18-38

Project 200-ZP-1 IRM

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date

Reviewed By Edward Rafuse/EDWARD RAFUSE (Sign/Print Name) Date 05/02/96

Depth (200-240)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
205					
210					
215	Split Spoon Sample 200 Blows			213-219.5 SILTY SANDY GRAVEL · msG 5% sc 25% vcp 10% cp 5% mp 5% fp 5% vfp tr. vcs 5% cs 15% ms 15% fs. vfs 10% silt/clays / gravels: 40% quartzite 25% assorted felsic granitoids 15% intermediate to felsic volcanics 10% assorted metamorphics 10% basalt / Sand: 85% quartzofeldspathic 10% lithics 5% micas tr. heavy minerals 2.5Y 7/2 light grey (dry color) · saturated · no HCl rxn · max ≈ 10cm(est.) · poorly sorted · gravel rounded to well rounded / sand subangular to rounded · poor water producing unit	
220	Split Spoon Sample HEIS: B0H58 110 Blows				
225				219.5-223 SAND · S tr. vfp tr. vcs tr. cs 35% ms 40% fs 10% vfs 15% silt / 85% quartzofeldspathic 10% lithic 5% micas tr. heavy minerals 2.5Y 7/2 light grey (dry color) · saturated · well sorted · subangular to rounded · no HCl rxn · major water producer	
	Split Spoon 170 Blows HEIS: B0H59				
230				223-225 SILTY SANDY GRAVEL · msG · see description from 213-219.5 above for further text	
235				225-229.5 SILTY SANDY GRAVELS · msG 10% vcp 15% cp 10% mp 5% fp 5% vfp tr. vcs tr. cs 20% ms 20% fs 5% vfs 10% silt/clays Gravels: 40% quartzite 30% felsic granitoids 20% assorted metamorphics 10% basalt tr. misc. / Sand: 85% quartzofeldspathic 10% 5% micas tr. heavy minerals 2.5Y 7/2 light grey (dry color) · saturated · no HCl rxn · max 10 cm · poorly sorted · gravel rounded to well rounded / sand subangular to rounded · important H_2O producer	
240	Split Spoon 200 Blows HEIS: B0H60				

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BOREHOLE LOG

Boring or Well No. 299-W1B-39 / B2758

Sheet 7 of 7

Location 300' SOUTH OF WELL W1B-38

Project 200-ZP-1 O/RM

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date

Reviewed By Edward C. Glass / Edward C. Glass (Sign/Print Name) Date 05/02/94

Depth (240-257.5)	Sample Type and No.	Sample Blows or Recovery	Graphic Log	Sample Description (Group Name, Group Symbol, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl)	Comments (Depth of Casing, Drilling Rate, Casing Size & Type, Bit Size, Water Level)
				229.5-237 SILTY SANDY GRAVEL · msG · see description from 213-219.5 for further text	
245	Split Spoon 200 Blows			237-241 SLIGHTLY SILTY SANDY GRAVEL · (m)sG 10%vcp 30%cp 10%mp 5%fp 5%vfp tr. vcs 5%cs 15%ms 5%fs 5% vfs 10% silt/clays / Gravel: 40% quartzite 30% assorted metamorphics 20% 10% basalt / Sand 85% quartz/feldspathic 10% lithic 5% micas tr. heavy minerals 2.5Y 7/2 light gray (dry color) · saturated · poorly sorted · gravels rounded to well-rounded / sand angular to rounded · max ≈ 10cm · important water-producer	
250				241-247 SILTY SANDY GRAVEL · msG · see description from 213-219.5 for text	
255			T.D.: 257.5'	247-247.5 SAND · S · unit was not observed - it was inferred based on drilling character - likely important water producer	
				247.5-257.5 SILTY SANDY GRAVEL · msG · see description from 213-219.5 for text	

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WELL SUMMARY SHEETS

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WELL SUMMARY SHEET

Boring or Well No. 299-W15-29 / B2409

Sheet 1 of 2

Location 125 yds South of CWC Office Trailers

Project 200-ZP-1 Pump-and-Treat Wells

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 6/5/95

Reviewed By D. D. Kelly / G. G. Kelly (Sign/Print Name) Date 6/7/95

CONSTRUCTION DATA

Description

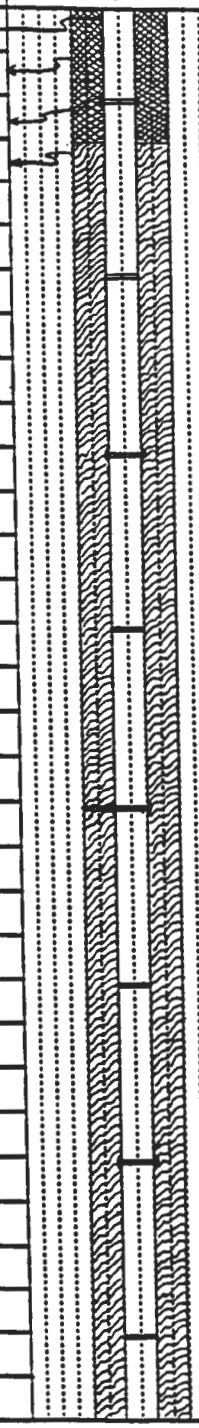
8" I.D 8.63" O.D Carb. Steel Perm. Casing

Portland Cement 0-15'

12.75" hole (12.75" O.D. CS temo casing)

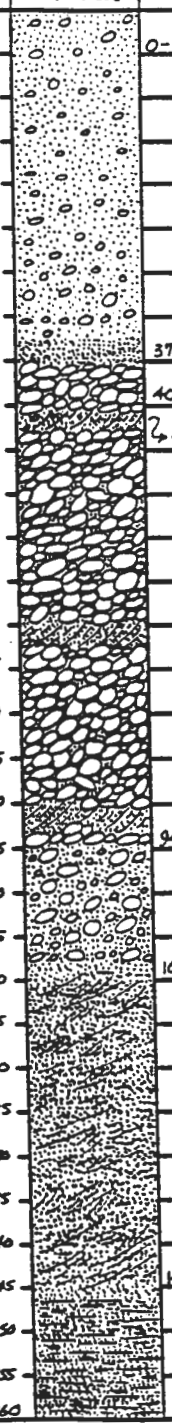
Bentonite Slurry 15'-178.84'

Diagram



Depth in Feet

Graphic Log



GEOLOGIC/HYDROLOGIC DATA

Lithologic Description

0-37' GRAVELLY SAND [HANFORD FM. UPPER COAR

37-40 SAND

40-94 GRAVEL w/local SANDY GRAVEL [UPPER COA

? schematic

94-107.5 SANDY GRAVEL [HANFORD UPPER COA

107.5-145.5 SAND [HANFORD FORMATION FINE U

145.5'-160' SANDY SILT [PLIO-PLEISTOCENE

A-8000-384

WELL SUMMARY SHEET

Boring or Well No. 299-W15-29/B2409

Sheet 2 of 2

Location 125 yds South of CWC Office Trailers

Project 200-ZP-1 Pump-and-Treat Wells

Prepared By Mark Jonach/Mark Darrach (Sign/Print Name) Date 6/5/95

Reviewed By G. G. Kelty/G. G. Kelty (Sign/Print Name) Date ~~7/7/~~ GK 6/7/

CONSTRUCTION DATA

Description

Portland Cement Plug 178.84'-194.99'

40-140 Secondary Sand Pack From 194.99' to 203.46

10-20 Primary Sand Pack From 203.46 → 291.50

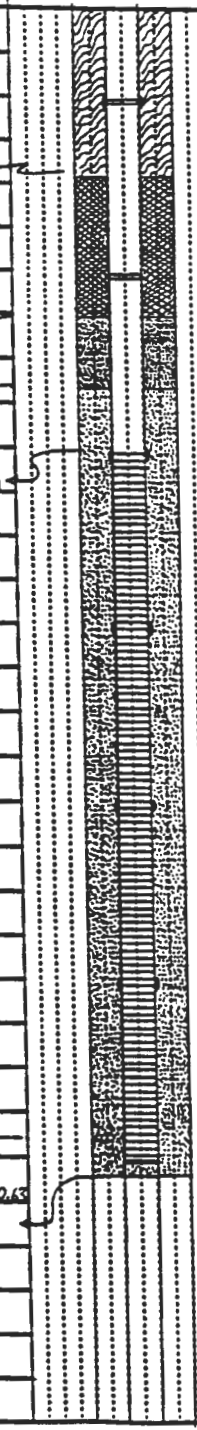
Top of 8" I.D. .020 slot stainless steel screen @ 210.11'

Static Water Level 231.29 BGS 4/22/95

Bottom of 8" I.D. .020 slot stainless steel screen @ 290.11/end cap to 290.63

Bottom of 10-20 Sand pack @ 291.50

Diagram



Depth in Feet

165, 170, 175, 180, 185, 190, 195, 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260, 265, 270, 275, 280, 285, 290

GEOLOGIC/HYDROLOGIC DATA

Graphic Log

Lithologic Description

160'-167' Calichefied Silty Sand interlayered with non caliche Sand w/minor pebbles

167'-177' Silty Sand [UPPER RINGOLD]

177'-193' Sandy Gravels/Gravelly Sands/Silt Sandy Gravels and Silty Gravelly Sands [Ri "E" GRAVELS] Schematic representation - See

193'-196' Sandy Gravelly Silt

196'-225' Silty Sandy Gravel, Sandy Silt Gravel

225'-227' Gravelly Sand

227'-270' Silty Sandy Gravel and Sandy Si Gravel

270'-271' Sandy Gravel

271'-281' Silty Sandy Gravel/Sandy Silty G

281'-292' Gravelly Sand

292' = T.D.

A-6000-384

WELL SUMMARY SHEET

Boring or Well No. 299-W15-30/B2410

Sheet 1 of 2

Location 75' West of PFP Perimeter Fence

Project 200-ZP-1 Pump/Treat Wells

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date 6/6/95

Reviewed By Monty Mehlhorn/Monty Mehlhorn (Sign/Print Name) Date 6-8-95

CONSTRUCTION DATA

Description

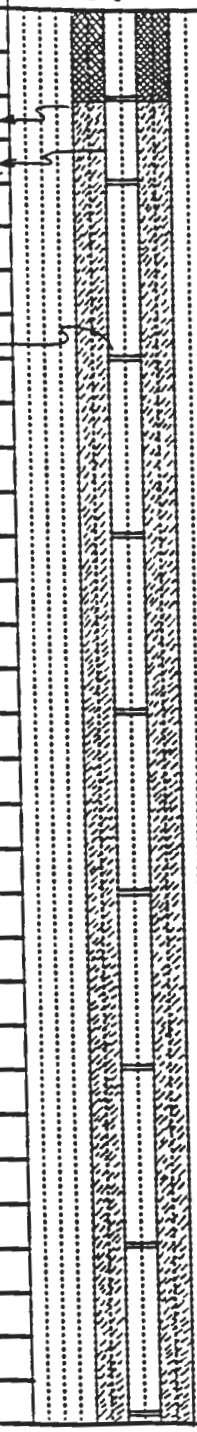
Portland Cement 11.2' → Surface

12.75" Drilled Hole Diameter (CS temp. Casing 12")

8" I.D. Carbon Steel Threaded Permanent Casing

threaded joint

Diagram

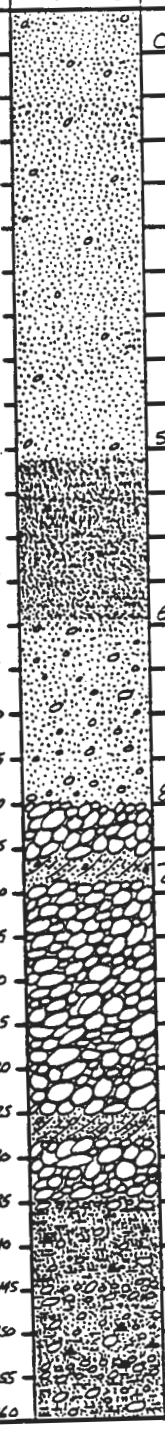


Depth in Feet

5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130, 135, 140, 145, 150, 155, 160

GEOLOGIC/HYDROLOGIC DATA

Graphic Log



Lithologic Description

0'-52' Sand (Hanford Fm. Upper Coarse)

52'-68' Sand (mostly quartzofeldspathic) (Hanford Fine Unit)

68'-89' Gravelly Sand

89'-135' Gravel w/local sand and Gravelly Sand [Hanford Fm. Lower Coarse.

Schematically represented planar tabular cross bedded sand/gravelly sand

135'-137' Sandy Silty Gravel (Plio Pleistoce

137'-169' Silty Gravelly Sand interbedded with Sandy Gravel

Both of the above units are highly calcareous, but with only very m

Caliche formation

A-6000-384 (0

WELL SUMMARY SHEET

Boring or Well No. 299-W15-30 / B2410

Sheet 2 of 2

Location 75' West of PFP Perimeter Fence

Project 200-ZP-1 Pump/Treat Wells

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 6/6/95

Reviewed By Monty McWhorter / Monty McWhorter (Sign/Print Name) Date 6-8-95

UNCONTROLLED COPY

CONSTRUCTION DATA

Description

Bentonite Crumbles ~~210~~ 207 mod 6/6/95 .54' → 11.2'

Bentonite Pellets 207.54' → 210.54'

Top of .020 continuous wrap stainless steel screen @ 218.08'

Bottom of .020 slot screen (s.s.) 258.00'

Stainless Steel Blank Sump 258'-263'

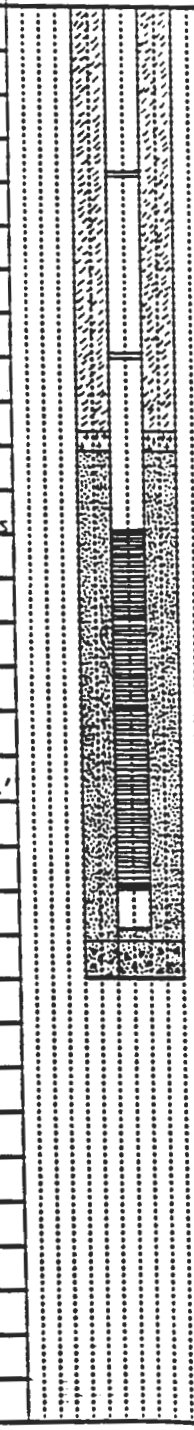
End cap 263'-268.53'

10-20 Sandpack 210.54' → 266.36'

Slough 266.36' → 268.3'

Drilled Depth = 268.3'

Diagram

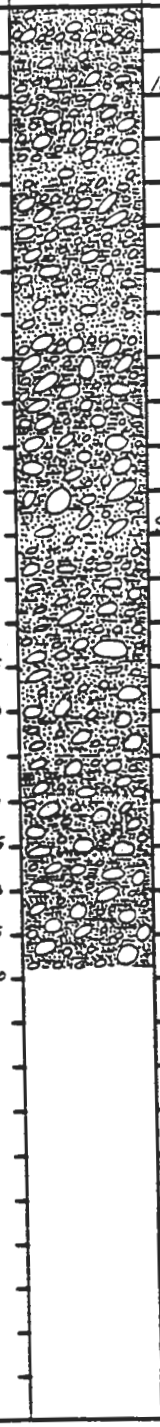


Depth in Feet

165, 170, 175, 180, 185, 190, 195, 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260, 265, 270

GEOLOGIC/HYDROLOGIC DATA

Graphic Log



Lithologic Description

169'-224' Silty Sandy Gravels / Sandy Silty Gravels / Sandy Gravels / Gravelly Sands (Ringold "E" Unit)

Static H_2O Level 221.80 on 5/2/95

224'-234' Silty Sandy Gravel

234'-244' Slightly Silty Sandy Gravel

244'-250' Silty Sandy Gravel

250'-257' Slightly Silty Sandy Gravel

257'-267' Silty Sandy Gravel

267'-268.3' Silty Sandy Gravel

A-6000-384 (0)

WELL SUMMARY SHEET

Boring or Well No. 299-W15-31

Sheet 1 of 2

Location: West of 231Z Bldg

Project: 200-ZP-1 Pump/Treat Wells

Prepared By: Mark Darrach / Mark Darrach (Sign/Print Name) Date: 6/8/95

Reviewed By: [illegible] / [illegible] Kelty (Sign/Print Name) Date: [illegible]

CONSTRUCTION DATA

Description

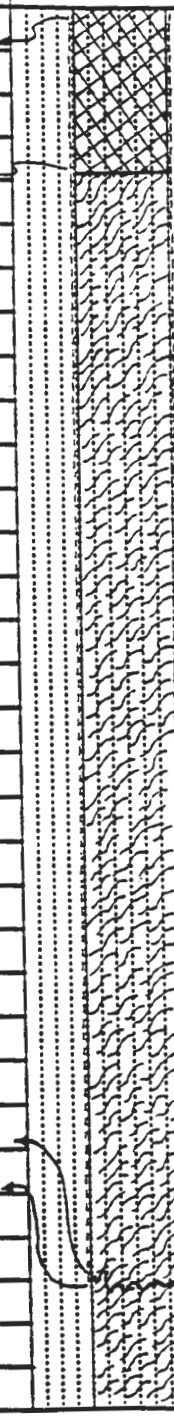
cement grout 0'-18'

bentonite grout slurry 18' → 211.0'

schematic representation of ruptured casing

top of carbon steel 12" abandoned casing 144'

Diagram

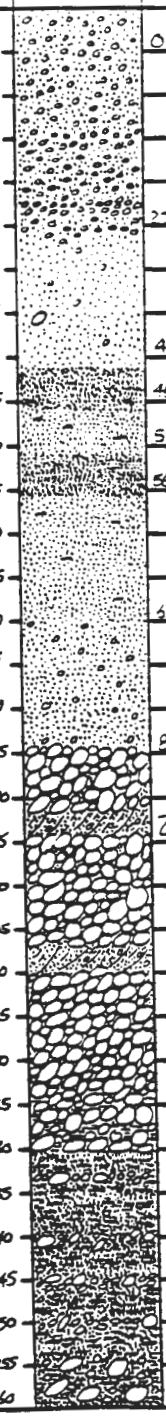


Depth in Feet

5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130, 135, 140, 145, 150, 155, 160

GEOLOGIC/HYDROLOGIC DATA

Graphic Log



Lithologic Description

0-27' Sandy Gravel (Hanford Fm. Upper Coarse

27-42' Sand (Hanford Fm. Upper Coarse

42-46' Sand (Hanford Fm. Upper Fine)

46-52' Sand (Hanford Fm. Upper Fine)

52-56' Sand (" " ")

56-68' Sand (" " ")

68-84' Gravelly Sand (Hanford Fm Upper Fine)

84'-126' Gravel (Hanford Fm. Lower Coarse)

→ Schematic representation of cross bedded sandy gravel

126'-130' Silty Gravel (Hanford Fm. Lower Coarse Unit mixed w/ Plio-Pleistocene

130'-135' Silty Sand w/local Silty Sandy Gravel (Plio-Pleistocene)

135'-153' Silty Sand interbedded w/Silty Sandy Gravel (Plio Pleistocene)

153'-175' Sandy Silty Gravels/Silty Sandy Gravel

Slightly Silty Sandy Gravels (Ringold "E"

A-6000-384 (01/9

WELL SUMMARY SHEET

Boring or Well No. 299-W15-31

Sheet 2 of 2

Location West of 231Z Bldg

Project 200-ZP-1 Pump/Treat Wells

Prepared By Mark Jamodis / Mark Darrach (Sign/Print Name) Date 6/8/95

Reviewed By [illegible] / C. Kelty (Sign/Print Name) Date 6/12/95

CONSTRUCTION DATA: Description	CONSTRUCTION DATA: Diagram	Depth in Feet	GEOLOGIC/HYDROLOGIC DATA: Graphic Log	GEOLOGIC/HYDROLOGIC DATA: Lithologic Description
joint		165		
		170		
		175		175-200' Slightly Silty Gravelly Sand (Ringold "E" Gravels)
bentonite slurry not cement as		180		
depicted		185		
		190		
		195		
		200		200-217 Sandy Silty Gravels / Silty Sandy
bentonite slurry from 190.5 to 211.0 mo 9/18/95		205		Gravels / Slightly Silty Sandy Gravels
		210		(Ringold "E")
3/8" bentonite pellets 211 → 221.61		215 ▽		Static Water Level 215.1 15 May 95
		220		217'-221.5' Silty Sandy Gravel
top of 10-20 sand estimated @ 221.61		225		221.5'-223' Slightly Silty Sandy Gravel
after settling / withdrawal of materials		230		223'-225' Silty Sandy Gravel
		235		225-227' Slightly Silty Sandy Gravel
		240		227-228' Silty Sandy Gravel
abandoned 20 slot stainless steel		245		228-231' Slightly Silty Sandy Gravel
continuous wire wrap screen 240'-260'		250		231'-235' Silty Sandy Gravel
nominal (uncertainty due to casing		255		235-237' Slightly Silty Sandy Gravel
failure		260		237'-240' Silty Sandy Gravel
Drilled Depth 265'		265		240'-243' Slightly Silty Sand
				243'-246' Silty Sandy Gravel
				246-248' Slightly Silty Sandy Gravel
				248'-252' Silty Sandy Gravel
				252'-255' Slightly Silty Sandy Gravel
				255'-265' Silty Sandy Gravel

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WELL SUMMARY SHEET

Boring or Well No. 299-W15-31A

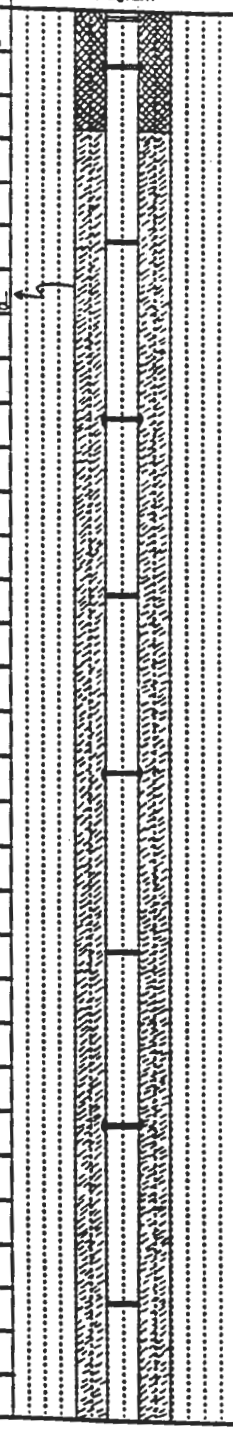
Sheet 1 of 2

Location: West of 231Z Bldg.

Project: 200-ZP-1 Pump/Treat Wells

Prepared By: Mark Darrach / Mark Darrach (Sign/Print Name) Date: 6/8/95

Reviewed By: _____ (Sign/Print Name) Date: _____

CONSTRUCTION DATA: Description	Diagram	Depth in Feet	GEOLOGIC/HYDROLOGIC DATA: Graphic Log	Lithologic Description
8" carbon steel permanent casing from 0'-206.49		5 5	NOTE: THIS WELL WAS NOT LOGGED DUE TO ITS PROXIMITY TO THE 299-W15-31 WELL. PLEASE REFER TO RECORDS FOR THE 31 WELL FOR LITHOLOGIC DATA	See 299-W15-31 Well for lithologic data
Portland Cement 0'-13'		10 10		
		15 15		
Bentonite Crumbles 13'-203.80'		20 20		
		25 25		
12.75" hole from carbon steel threaded temporary casing / shoe		30 30		
		35 35		
		40 40		
		45 45		
		50 50		
		55 55		
		60 60		
		65 65		
		70 70		
		75 75		
		80 80		
		85 85		
		90 90		
		95 95		
		100 100		
		105 105		
		110 110		
		115 115		
		120 120		
		125 125		
		130 130		
		135 135		
		140 140		
		145 145		
		150 150		
		155 155		
		160 160		

A-6000-384 (1)

WELL SUMMARY SHEET

Boring or Well No. 299-W1S-31A

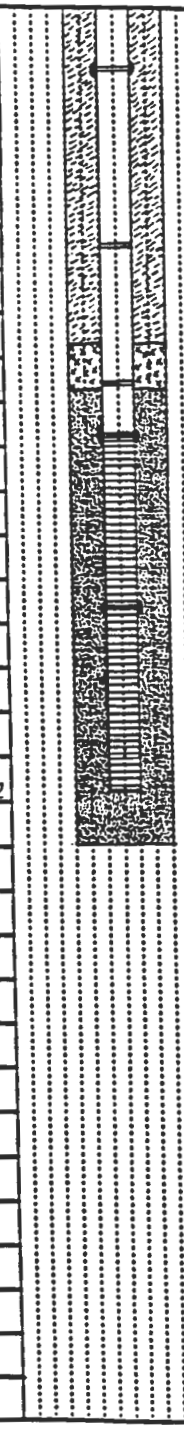
Sheet 2 of 2

Location West of 231-Z Bldg.

Project 200-ZP-1 Pump/Treat Wells

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 6/8/95

Reviewed By _____ (Sign/Print Name) Date _____

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
		165	SEE WELL 299-W1S-31 FOR LITHOLOGIC INFORMATION THE 31A WELL WAS NOT LOGGED DUE TO PROXIMITY TO 31	
		170		RECORD COPY
		175		
		180		
		185		
		190		
		200		
Bentonite Pellets 203.8 → 207.1		205		
8" stainless steel 5.99' blank from		210		
206.49 – 212.48		215		Static Water Level @ 215.6' 5/26/95
.020 continuous wrap stainless		220		
steel screen 212.48 → 252.41		225		
10-20 mesh silica sand pack from		230		
207.1 → 258.64		235		
		240		
		245		
		250		
Stainless steel end cap 252.41 – 252.92		255		
slough 258.64 → 259'		260		
drilled depth 259.0'				

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WELL SUMMARY SHEET

Boring or Well No. 299-W15-33 / 82743

Sheet 1 of 2

Location: North of the 231Z Bldg

Project: 200-ZP-1 CERCLA EXTRACTION WELL

Prepared By: Mark Jarrett / Mark Darrach (Sign/Print Name) Date: 1/12/96

Reviewed By: Edward C. Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date: 1/30/96

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
		5		0-17' GRAVEL (Hanford Fm. Upper Coarse)
top of bentonite crumbles @ 9.8'		10		
		15		17-85 SAND (Hanford Fm. Upper Coarse)
		20		
		25		
		30		
		35		
		40		
		45		
		50		
		55		
		60		
		65		
		70		
		75		
		80		
		85		85-117' GRAVEL (Hanford Fm. Upper Coarse?)
		90		
		95		
		100		
		105		
		110		
		115		
		120		117-142' Silty Sand / Sandy Silt / Silty Gravelly
		125		Sand / Silty Sandy Gravels (Lumped Plio-Pleisto-
		130		cene Unit)
		135		
		140		
		145		142-218.5' Silty Sandy Gravels / Silty Gravelly Sands
		150		(Ringold Fm. Gravel "E")
		155		
		160		

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WELL SUMMARY SHEET

Boring or Well No. 299-W15-33/B2745

Sheet 2 of 2

Location: North of 231Z Bldg

Project: 200-ZP-1 Pump-and-Treat Extraction well

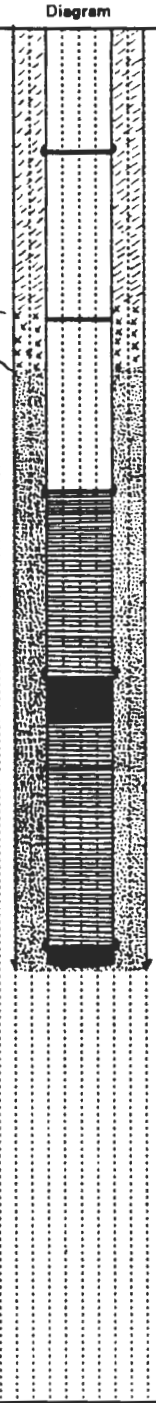
Prepared By: Mark Darrach / Mark Darrach (Sign/Print Name) Date:

Reviewed By: Edward C. Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date: 1/30/96

CONSTRUCTION DATA

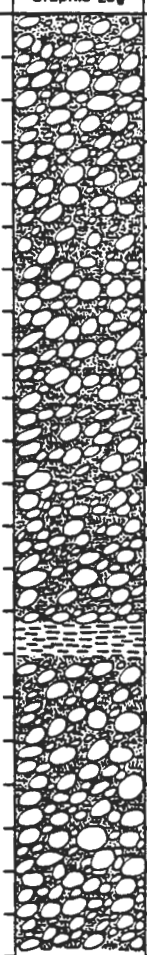
Description	Depth in Feet
	165
	170
	175
	180
	185
	190
top of bentonite pellets @ 192.25'	195
top of 6-12 Sandpack @ 198.7'	200
	205
	210
top of .070" slot continuous wire wrap screen @ 211.75'	215
	220
	225
	230
	235
top of stainless steel blank @ 231.80	240
bottom of stainless steel blank @ 238.91'	245
	250
	255
	260
	265
bottom of .070" slot continuous wire wrap screen @ 244.0 (as of 1/24/96)	
bottom of PVC end cap @ 264.93'	

Diagram



GEOLOGIC/HYDROLOGIC DATA

Graphic Log



Lithologic Description
215 SAND - this thin (<1' thick) sand is inferred based on the development history of the well
218.5'-232' SILTY SANDY GRAVEL
232'-236' SILT - this unit is inferred based on both drillers observations and geophysical logging - and lack of significant development time in this interval
236'-268' SILTY SANDY GRAVEL
T.D. = 268'

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200-ZP-1

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WELL SUMMARY SHEET

Boring or Well No. 299-W15-34/B2748

Sheet 1 of 2

Location ≈200' ENE of the 231 Z Bldg

Project 200-ZP-1 Production/Monitoring Well

Prepared By Mark Darrach / MARK DARRACH (Sign/Print Name) Date 3/7/96

Reviewed By Edward C. Rohrer / EDWARD ROHRER (Sign/Print Name) Date 03/11/96

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
Cement Surface Plug 0-13.2'		5		0-15 SANDY GRAVEL (Hanford Fm. - coarse)
		10		
Bentonite 8-20 Mesh Crumbles 13.2'-181'		15		15-89 SANDY GRAVEL (Hanford Fm - coarse)
		20		
Borehole Diameter 12.25"		25		
Permanent Casing 8" nominal C-steel		30		
		35		
		40		
		45		
		50		
		55		
		60		
		65		
		70		
		75		
		80		
		85		
		90		
		95		
		100		
		105		107-131 SILTY SAND / SANDY SILTS / SILTY GRAVELLY SAND / SILTY SANDY GRAVELS (Pliocene-Pleistocene Unit)
		110		
		115		
		120		
		125		
		130		131-218 SILTY SANDY GRAVELS / SILTY GRAVELLY SANDS / SANDY GRAVELS / SAND (Ringold "E" fluvial gravels - composite)
		135		
		140		
		145		
		150		
		155		
		160		

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WELL SUMMARY SHEET

Boring or Well No. 299-W15-34 / B2748

Sheet 2 of 2

Location ENE of 231Z Bldg

Project 200-ZP-1

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 3/7/96

Reviewed By Edward C. Rafuse / EDWARD RAFUSE (Sign/Print Name) Date 03/11/96

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
		165		
		170		
		175		
Cement Plug 181'-194.8'		180		
		185		
		190		
Secondary Sandpack 40-140 194.8-197.7		195		
Primary Sandpack 8-16 197.7'-263'		200		
		205		
Stainless Steel Continuous Wire Wrap .040"		210		
Screen from 210.51 → 260.6		215		
		220		218'-237' SILTY SANDY GRAVEL
		225		
		230		
		235		237'-237.5 SANDY GRAVEL (water producer)
		240		237.5-247 SILTY SANDY GRAVEL
		245		
		250		247-254 SANDY GRAVEL (water producing unit)
		255		254-263 SILTY SANDY GRAVEL
Stainless Steel End Cap from 260.3-261.13		260		
Drilled Depth = 263'				T.D. @ 263'

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WELL SUMMARY SHEET

Boring or Well No. 299-W15-35/B2749

Sheet 1 of 2

Location N/E of DFP

Project 200-ZP-1 Pump/Treat Production Wells

Prepared By Mark Dazeach / MARK DAZEACH (Sign/Print Name) Date 3/19/96

Reviewed By Edward C. Refuse / EDWARD REFUSE (Sign/Print Name) Date 03/21/96

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
		5		0-49 SANDY GRAVEL - HANFORD FM.
		10		
Top of bentonite crumbles 13.5' BGS		15		
		20		
		25		
		30		
		35		
		40		
		45		
		50		49-52 SILT - HANFORD FM.
		55		52-80 SAND - HANFORD FM.
		60		
		65		
		70		
		75		
		80		80-105 SAND - HANFORD FM.
		85		
		90		
		95		
		100		
		105		105-117 SILTY SAND/SANDY SILTS/SILTY GRAVELLY
		110		SAND/SILTY SANDY GRAVEL PLIOCENE-
		115		PLEISTOCENE UNIT
		120		117-209 SILTY SANDY GRAVELS/SILTY GRAVELLY
		125		SANDS/SANDY GRAVELS/SAND RINGOLD FM.
		130		"E" FLUVIAL GRAVELS
		135		
		140		
		145		
		150		
		155		
		160		

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WELL SUMMARY SHEET

Boring or Well No. 299-W15-35 / B2749

Sheet 2 of 2

Location NE of DFP

Project 200-ZP-1 Pump/Treat Production Wells

Prepared By Mark Darrach / MARK DARRACH (Sign/Print Name) Date 3/19/96

Reviewed By Edward C. Rafuse / EDWARD RAFUSE (Sign/Print Name) Date 03/21/96

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
		165		
		170		
top of cement plug @ 173.05'		175		
		180		
		185		
		190		
top of 16-30 secondary sandpack 193.6'		195		
top of 8-16 primary sand/gravel pack		200		
@ 197.3		205		STATIC WATER LEVEL 206.2' BGS 8/14/96
.040 slot stainless steel continuous		210		209-211 SANDY GRAVEL (WATER-PRODUCER)
wrap screen @ 206.15		215		211-218 SAND (WATER-PRODUCER)
		220		218-222 SANDY GRAVEL (WATER-PRODUCER)
		225		222-229 SILTY SANDY GRAVEL
		230		229-233.5 SANDY GRAVEL (WATER-PRODUCER)
		235		233.5-238 SILTY SANDY GRAVEL
		240		238-242 SANDY GRAVEL (WATER-PRODUCER)
		245		242-260 SILTY SANDY GRAVEL
bottom of .040 slot stainless steel screen		250		
@ 256.21 / endcap from 256.21 → 256.74		255		
bottom of 8-16 primary sand/gravel pack		260		T.D. = 260'
@ 256.2'				
Slough 256.2 → 260.0'				

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WELL SUMMARY SHEET

Boring or Well No. 299-W15-36

Sheet 1 of 2

Location ≈300 YARDS ESE of P.F.P.

Project 200-ZP-1 J.R.M.

Prepared By Mark Jarrach / Mark Darrach (Sign/Print Name) Date 5/7/96

Reviewed By (Sign/Print Name) Date

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
borehole diameter 12.65"		5		0-33 | SAND HANFORD FM.
Cement plug 0-10.9'		10		
permanent carbon steel casing is 8⅝" O.D.		15		
and 8" I.D.		20		
bentonite 8-20 mesh crumbles 10.9→174.4'		25		
		30		
		35		33-74 | GRAVEL " "
		40		
		45		
		50		
		55		
		60		
		65		
		70		
		75		74-97 | SAND " "
		80		
		85		
		90		
		95		97-110 | SILTY SAND PLIOCENE-PLEISTOCENE UNIT
		100		
		105		
		110		110-123 | SAND w/ local caliche stringers " "
		115		
		120		
		125		123-211 | SILTY SANDY GRAVEL
		130		
		135		
		140		
		145		
		150		
		155		
		160		

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WELL SUMMARY SHEET

Boring or Well No. 299-W15-36

Sheet 2 of 2

Location ≈ 300 YARDS E.S.E. OF P.F.P

Project 200-ZP-1 J.R.M.

Prepared By Mark Darnach / Mark Darnach (Sign/Print Name) Date 5/7/96

Reviewed By _____ (Sign/Print Name) Date _____

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
		165		
		170		
top of cement plug @ 174.4'		175		
		180		
		185		
		190		
top of 16-30 secondary sandpack @ 194.2'		195		
top of B-16 primary pack @ 199.1'		200		
		205		
top of .040 slot stainless steel wire wrap		5/3/96 ▽ 208.6 210		211-214 SANDY GRAVEL - water producer
screen at 210.7'		215		214-217 SILTY SANDY GRAVEL
		220		217-222 SANDY GRAVEL - water producer
		225		222-228 SILTY SANDY GRAVEL
		230		228-232 SANDY GRAVEL - water producer
		235		232-236 SILTY SANDY GRAVEL
		240		236-241 SANDY GRAVEL - water producer
		245		241-247 SILTY SANDY GRAVEL
		250		247-253 SANDY GRAVEL - water producer
		255		253-263 SILTY SANDY GRAVEL
stainless steel end cap from 260.72'-261.23'		260		
total drilled depth = 263'			T.D. = 263	
bottom of sand/gravel pack @ 261.4'				

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WELL SUMMARY SHEET

Boring or Well No. 299-W15-37/82753

Sheet 1 of 2

Location Immediately NW of 241-U Tank Farm

Project 200-ZP-1 J.R.M.

Prepared By Mark Darrach / MARK DARRACH (Sign/Print Name) Date 5/16/96

Reviewed By Edward C. Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date 5/21/96

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CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
Borehole Diameter - 12.65"		5	0-36	GRAVELLY SAND — HANFORD FORMATION
Well Diameter: 8" I.D. 8 5/8" O.D. CARBON STEEL		10		
CEMENT PLUG 0-11.9' TOP OF B-20		15		
BENTONITE CRUMBLES		20		
		25		
		30		
		35	35-76	GRAVEL — HANFORD FORMATION
		40		
		45		
		50		
		55		
		60		
		65		
		70		
		75	76-113	SANDY GRAVEL — HANFORD FORMATION
		80		
		85		
		90		
		95		
		100		
		105		
		110		
		115	113-143	SILTY SAND — PLIOCENE-PLEISTOCENE
		120		
		125		
		130		
		135		
		140		
		145	143-208	SILTY SANDY GRAVEL W/ LOCAL SLIGHTLY
		150		SILTY SANDY GRAVEL AND SAND — RINGOLD FM.
		155		
		160		

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WELL SUMMARY SHEET

Boring or Well No. 299-W15-37/B2753

Sheet 2 of 2

Location Immediately NW of 241-U Tank Farm

Project 200-ZP-1

Prepared By Mark Darrach/MARK DARRACH (Sign/Print Name) Date 5/16/96

Reviewed By Edward C. Rafuse/EDWARD C. RAFUSE (Sign/Print Name) Date 05/21/96

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
TOP OF CEMENT PLUG @ 163.7'		165		
		170		
		175		
		180		
		185		
		190		
TOP OF 16-30 SECONDARY SANDPACK		195		
@ 191.7'		200		
TOP OF 8-16 PRIMARY SAND/GRAVEL		205		
PACK @ 194.5'		210		208-216 SLIGHTLY SILTY SANDY GRAVEL
TOP OF .040" SLOT STAINLESS STEEL		215		216-226.5 SILTY SANDY GRAVEL
WIRE WRAP SCREEN @ 205.84		220		
		225		226.5-231 SILTY SANDY GRAVEL w/local thin stringers
		230		of slightly SILTY SANDY GRAVEL
		235		231-237 SILTY SANDY GRAVEL
		240		237-245 SANDY GRAVEL
		245		
		250		
BOTTOM OF SCREEN @ 255.83'		255		
BOTTOM OF STAINLESS STEEL ENDCAP				
@ 255.30				
DRILLED DEPTH: 258'				

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WELL SUMMARY SHEET

Boring or Well No. 299-W15-38 / B2754

Sheet 1 of 2

Location ≈150' North of ZP-2 Vapor Extraction System

Project 200-ZP-1 J. R. M.

Prepared By Mark Darrah / MARK DARRAH (Sign/Print Name) Date 6/3/96

Reviewed By Edward C. Rafuse / EDWARD RAFUSE (Sign/Print Name) Date 06/04/96

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
cement surface plug 0-13.6'		5		0-29 / SAND HANFORD FM.
		10		
top of B-20 bentonite crumbles @ 13.6'		15		
		20		
borehole diameter 11.25"		25		
permanent casing is 4" schedule 5		30		29-51 / GRAVEL HANFORD FM.
stainless steel		35		
		40		
		45		
		50		51-96 / SAND HANFORD FM.
		55		
		60		
		65		
		70		
		75		
		80		
		85		
		90		
		95		
		100		96-112 / SILTY SAND PLIOCENE-PLEISTOCENE U
		105		
		110		
		115		112-208 / SILTY SANDY GRAVEL w/ LOCAL SLIGHTLY
		120		SILTY SANDY GRAVEL RINGOLD FM. FLUVIAL "E"
		125		
		130		
		135		
		140		
		145		
		150		
		155		
		160		

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WELL SUMMARY SHEET

Boring or Well No. 299-W15-38 / B2754

Sheet 2 of 2

Location ≈ 150' North of ZP-2 Vapor Extraction System

Project 200-ZP-1 J.R.M

Prepared By Marc Jarosch / MARK DARRACH (Sign/Print Name) Date 6/3/96

Reviewed By Edward C. Rolin / EDWARD C. ROLIN (Sign/Print Name) Date 06/04/96

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
		165		
		170		
		175		
		180		
		185		
		190		
bentonite pellets from 197.5'-200.8'		195		
8-16 sand/gravel pack top @ 200.8'		200		STATIC WATER LEVEL: 205' B.G.S. 22 MAY 96
top of wire wrap S.S. 40 slot 4"		205		203-217 / SLIGHTLY SILTY SANDY GRAVEL
screen @ 205.1		210		
		215		217-227.5 / SILTY SANDY GRAVEL
bottom of screen @ 225.12'		220		
bottom of S.S. endcap @ 225.45'		225		227.5-229.5 / SLIGHTLY SILTY SANDY GRAVEL
			T.D = 229.5'	

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WELL SUMMARY SHEET

Boring or Well No. 299-W15-39/B2755

Sheet 1 of 2

Location IMMEDIATELY ADJACENT TO 200-ZP-2 V.E.S.

Project 200-ZP-1 J.R.M.

Prepared By Mark Lamb / MARC DARRACH (Sign/Print Name) Date 6/5/96

Reviewed By Edward C. Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date 06/07/96

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CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
Portland Cement Plug @ 0-10.0'		5		0-14 | GRAVELLY SAND HANFORD FM.
		10		
top of 8-20 bentonite crumbles @ 10.0'		15		14-43 | GRAVEL
		20		
borehole diameter = 11.50"		25		
permanent casing is 4" schedule 5 threaded stainless steel		30		
		35		
		40		
		45		43-67 | GRAVELLY SAND
		50		
		55		
		60		
		65		
		70		67-107 | SAND
		75		
		80		
		85		
		90		
		95		
		100		
		105		106-111 | SILTY SAND PLIOCENE-PLEISTOCENE UNIT
		110		
		115		111-116 | CALICE
		120		116-200 | SILTY SANDY GRAVEL RINGOLD "E" GRAVEL
		125		
		130		
		135		
		140		
		145		
		150		
		155		
		160		

A-6000-384 (01/93)

WELL SUMMARY SHEET

Boring or Well No. 299-W15-39 / B2755

Sheet 2 of 2

Location IMMEDIATELY ADJACENT TO 200-ZP-2 V.E.S.

Project 200-ZP-1 J. R. M.

Prepared By Mark Darrach / MARK DARRACH (Sign/Print Name) Date 6/5/96

Reviewed By Edward C. Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date 06/07/96

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
		165		
		170		
		175		
		180		
		185		
top of 3/8" bentonite pellets @ 190.7 bgs		190		
top of 8-16 CSSI Sandpack @ 193.6' bgs		195		
top of S.S. 4" wire wrap 40 slot screen		200		STATIC WATER LEVEL 199.5' bgs 5/30/96
@ 199.6' bgs		205		
		210		
		215		216-220.5 | SANDY GRAVEL
bottom of S.S. 40 slot screen @ 219.6 bgs		220		220.5-223 | SILTY SANDY GRAVEL
bottom of S.S. end cap @ 220.02 bgs				

A-6000-384 (01/93)

WELL SUMMARY SHEET

Boring or Well No. 299-W18-35/82644

Sheet 1 of 2

Location 300' SOUTH OF WELL 299-W15-29

Project 200-ZP-1 PUMP/TREAT INJECTION WELL (ABANDONED)

Prepared By Mark Darnach/Mark Darnach (Sign/Print Name) Date 1/29/96

Reviewed By Edward C. Rafuse/EDWARD C. RAFUSE (Sign/Print Name) Date 1/30/96

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
Borehole diameter: 12" (nominal)		5		0-23 Gravelly Sand (Hanford Fm. Upper Coarse)
Top of 8-20 Bentonite Crumbles @ 6.5'		10		
		15		
		20		
		25		23-28 Gravelly Sand/Sandy Gravel (" ")
		30		28-80 Gravel (Hanford Fm. Upper Coarse)
		35		
		40		
		45		
		50		
		55		
		60		
		65		
		70		
		75		
		80		80-99 Gravelly Sand (Hanford Fm. Lower Fine)
		85		
		90		
		95		
		100		99-135 SAND (Hanford Fm. Lower Fine)
		105		
		110		
		115		
		120		
		125		
		130		
		135		135-143 SANDY SILT (Plio-Pleistocene Unit) w/
		140		Local Strong Caliche Development
		145		143-160 Silty Sand (Plio-Pleistocene Unit)
		150		
		155		
		160		

A-6000-384 (01/93)

WELL SUMMARY SHEET

Boring or Well No. 299-W18-35/82644

Sheet 2 of 2

Location 300' South of the 299-W15-29 Well

Project 200-ZP-1 Pump/Treat-Injection Well (Abandoned)

Prepared By Mark Damasch / Mark Darrach (Sign/Print Name) Date 1/29/96

Reviewed By Edward C. Rose / Edward Rose (Sign/Print Name) Date 1/30/96

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
		165		160-218 Slightly Silty Sandy Gravels / Silty Sandy
		170		Gravels / Silty Gravelly Sands (Ringold "E" Gravels)
		175		
		180		
		185		
		190		
		195		
Top of bentonite 3/8" pellets @ 202.8'		200		
Top of 20-40 secondary pack @ 205.5'		205		
		210		
Top of 8-16 sand/gravel pack @ 215.6'		215		Static Water Level: 217.5' 2 Jan 96
Top of abandoned and damaged, .040 slot		220		218-241.5' Silty Sandy Gravel (Ringold "E" -)
continuous wrap stainless screen @ 218.02'		225		
(nominal due to damage)		230		
		235		
		240		241.5-242.2 Slightly Silty Gravelly Sand
		245		242.2-250 Slightly Silty Gravelly Sand w/rip-raps
		250		250-256 Slightly Silty Gravelly Sand
		255		256-256.5 Sand
		260		256.5-260 Sandy Gravel
Bottom of .040 slot stainless screen @ 268.0'		265		260-271 Silty Sandy Gravel
Bottom of end cap @ 268.91 (cap is PVC)		270		T.D. = 271'

A-6000-384 (01/93)

WELL SUMMARY SHEET

Boring or Well No. 299-W18-36/B2747

Sheet 1 of 2

Location 300' South of the 299-W15-29 Well

Project 200-ZP-1 Injection Well/Dump and Treat Project

Prepared By Mark Darrach / MARK DARRACH (Sign/Print Name) Date 1/24/96

Reviewed By EDMUND C. RAFFA / Edmund C. Raffa (Sign/Print Name) Date 1/30/96

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
8" carbon steel casing 0'-217.98		5		0-23' GRAVELLY SAND (Hanford Fm. Upper Coarse)
borehole diameter 12"		10		
Top of B-20 bentonite crumbles @ 10.4'		15		
transition to cement plug to the surface		20		
		25		23-28' GRAVELLY SAND (SANDY GRAVEL (" "))
		30		28'-80' GRAVEL (Hanford Fm. Upper Coarse)
		35		
		40		
		45		
		50		
		55		
		60		
		65		
		70		
		75		
		80		80-99 GRAVELLY SAND (Hanford Fm. Lower Fine)
		85		
		90		
		95		
		100		99'-135' SAND (Hanford Fm. Lower Fine)
		105		
		110		
		115		
		120		
		125		
		130		
		135		135'-143' SANDY SILT (PLIO-PLEISTOCENE UNIT)
		140		LOCAL STRONG CALICHE DEVELOPMENT NOTED
		145		143'-160' SILTY SAND (PLIO-PLEISTOCENE UNIT)
		150		
		155		
		160		

A-6000-384 (01/93)

WELL SUMMARY SHEET

Boring or Well No. 299-W18-36 / B2747

Sheet 2 of 2

Location: 300' SOUTH OF THE 299-W15-29 WELL

Project: 200-ZP-1 INJECTION WELL / PUMP AND TREAT PROJECT

Prepared By: Mark Darrach / MARK DARRACH (Sign/Print Name) Date: 1/24/96

Reviewed By: Edward C. Rafuse / EDWARD RAFUSE (Sign/Print Name) Date: 1/30/96

CONSTRUCTION DATA

Description

Top of cement plug @ 187.5'

Top of 20-40 secondary sandpack @ 204.4'

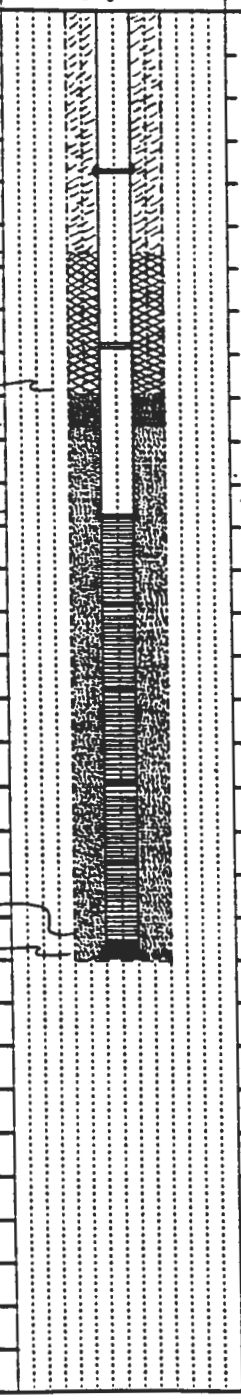
Top of 8-16 sandpack @ 208.0'

Top of .040" slot screen 217.98 (8")

Bottom of .040" slot screen 267.92'

Bottom of end cap @ 268.42'

Diagram

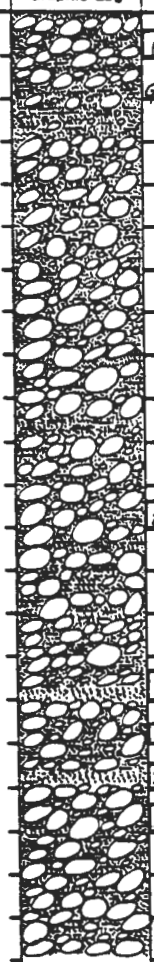


Depth in Feet

165, 170, 175, 180, 185, 190, 195, 200, 205, 210, 215, 220, 225, 230, 235, 240, 245, 250, 255, 260, 265

GEOLOGIC/HYDROLOGIC DATA

Graphic Log



Lithologic Description

160'-218' SLIGHTLY SILTY SANDY GRAVELS / SILTY SANDY GRAVELS / SILTY GRAVELLY SANDS (RINGOLD "E" GRAVELS)

Static Water Level @ 216.7' BGS 23 Jan 96

218'-238' SILTY SANDY GRAVEL (RINGOLD "E" GRAVELS)

238'-240' SAND (RINGOLD "E" UNIT)

240'-247.5' SILTY GRAVELLY SAND (RINGOLD "E" UNIT)

247.5-249 SAND

250'-269' SILTY SANDY GRAVEL

T.D. = 268.9'

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WELL SUMMARY SHEET

Boring or Well No. 299-W18-37 / B2758

Sheet 1 of 2

Location 300' SOUTH OF WELL 299-W18-36

Project 200-ZP-1 IRM INJECTION WELL

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 4/1/96

Reviewed By Edward C. Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date 04/01/96

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
Cement Surface Plug 0-10.1 ft.		5		0-17 GRAVELLY SAND HANFORD FM
Vadose Casing - carbon steel 8"		10		
Bentonite Crumbles 10.1 ft - 173.1'		15		
		20		17-37 SAND
		25		
		30		
		35		
		40		37-79 GRAVEL
		45		
		50		
		55		
		60		
		65		
		70		
		75		
		80		79-86 GRAVELLY SAND
		85		86-98 GRAVEL
		90		98-104 SAND
		95		
		100		
		105		104-127 SAND
		110		
		115		
		120		
		125		127-146 SILTY SAND w/local caliche horizons
		130		PLIOCENE-PLEISTOCENE UNIT
		135		
		140		
		145		146-162 SILTY SAND w/massive caliche horizon
		150		PLIOCENE - PLEISTOCENE UNIT
		155		
		160		

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WELL SUMMARY SHEET

Boring or Well No. 299-W18-37

Sheet 2 of 2

Location 300' South of Well 299-W18-36

Project 200-ZP-1 DRM Injection Well

Prepared By Mark Darrach / Mark Darrach (Sign/Print Name) Date 4/1/96

Reviewed By Edward C. Rafuse / Edward C. Rafuse (Sign/Print Name) Date 04/01/96

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
		165		162-239 Silty Sandy Gravel Ringold Fm "E"
		170		
Cement Plug 173.1 → 193.1		175		
		180		
		185		
		190		
16-30 Secondary Sandpack 193.1 → 198.6		195		
		200		
8-16 Primary Sandpack 198.6 → 269.6		205		
Top of .040" Slot stainless steel wire		210		
wrap screen @ 209.45' 8" nominal diameter		215		
		220		Static Water Level 219.45' 25 Mar 96
		225		
		230		
		235		
		240		239-245 Sand Ringold Fm "E" Gravel
		245		Important Water Producing Unit
		250		245-272 Silty Sandy Gravel
		255		
		260		
		265		
Slough 269.6 → 272		270		
Stainless steel end cap 269.5 → 270.01				

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WELL SUMMARY SHEET

Boring or Well No. 299-W18-38/82757

Sheet 1 of 2

Location 300' South of Well 299-W18-37

Project 200-ZP-1 JRM Injection Well

Prepared By Mark Darrach/Mark Darrach (Sign/Print Name) Date 4/15/96

Reviewed By Edward C. Rafuse/EDWARD C. RAFUSE (Sign/Print Name) Date 4/20/96

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CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
hole diameter 12.63"		5		0-19' SAND HANFORD FORMATION
well I.D. 8.63"		10		
cement plug to 8-20 Bentonite Crumbles		15		
transition @ 13.8'		20		19-73 GRAVEL " " "
		25		
		30		
		35		
		40		
		45		
		50		
		55		
		60		
		65		
		70		
		75		73-85 GRAVELLY SAND " " "
		80		
		85		85-125 SAND " " "
		90		
		95		
		100		
		105		
		110		
		115		
		120		
		125		125-140 SILTY SAND PLIO-PLEISTOCENE UNIT
		130		
		135		
		140		140-147 MASSIVE CALICHE " " "
		145		
		150		147-160 SILTY SAND w/incipient caliche formation
		155		
		160		

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WELL SUMMARY SHEET

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Boring or Well No. 299-W18-38 / B2757

Sheet 2 of 2

Location 300' South of Well 299-W18-37

Project 200-ZP-1 IRM Injection Well

Prepared By Mark Darrach / MARK DARRACH (Sign/Print Name) Date 4/5/96

Reviewed By Edward C. Rafuse / EDWARD C. RAFUSE (Sign/Print Name) Date 04/22/96

CONSTRUCTION DATA: Description	Diagram	Depth in Feet	GEOLOGIC/HYDROLOGIC DATA: Graphic Log	Lithologic Description
		165		160-220 Silty Sandy Gravels / Slightly Silty Sandy
		170		Gravels / Sands Ringold Fm. "E" Unit
Bentonite Crumbles → Cement Plug transition @ 176.2		175		
		180		
		185		
		190		
Cement Plug → 16-30 Secondary sand-pack transition @ 193.8		195		
		200		
		205		
16-30 Secondary sandpack → 8-16 primary sandpack transition @ 198.5		210		
		215		Static Water Level 217.7 BGS on 8 Apr. 1996
transition from carbon steel casing to .040" slot continuous wrap wire screen @ 208.38		220		220-226 Silty Sandy Gravel Ringold Fm "E" Unit
		225		226-230 Sandy Gravel / water " " "
		230		230-245.5 Silty Sandy Gravel " " "
		235		
		240		
		245		245.5-254 Silty Sandy Gravel admixed thin lenses of
		250		Slightly Silty Sandy Gravel Ringold Fm "E" Unit
		255		254-270 Silty Sandy Gravel " " "
		260		
bottom of .040 slot screen @ 274.09		265		
Stainless steel end cap 274.09-274.61		270		270-274 Sandy Gravel " " "
		275		unit is an important water-producing interval
bottom of 8-16 sandpack @ 276.5'				274-277 Silty Sandy Gravel Ringold Fm "E" Unit
total drilled depth 277'				

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WELL SUMMARY SHEET

Boring or Well No. 299-W18-39/B2758

Sheet 1 of 2

Location 300' South of Well W18-38

Project 200-ZP-1 GRA

Prepared By L.D. Walker / M. Darrach (Sign/Print Name) Date 4-23-96

Reviewed By Edward Rafuse / Edward Rafuse (Sign/Print Name) Date 05/01/96

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
Hole diameter 12.63"				0-12 | SAND
		10		
Cement seal transition to bentonite crumbles at 13.7'				12-73 | GRAVEL
		20		
		30		
		40		
		50		
		60		
		70		73-86 | GRAVELLY SAND
		80		86-120 | SAND
		90		
		100		
		110		
		120		120-135 | SILTY SAND PLIO-PLEISTOCENE UNIT
		130		135-142 | MASSIVE CALICHE
		140		142-150 | SILTY SAND w/local caliche stringers
		150		150-213 | SILTY SANDY GRAVELS (dominant) Ringold "E" Gravels

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WELL SUMMARY SHEET

Boring or Well No. 299-W18-39 / B2758

Sheet #2 of 2

Location 300' South of WELL W18-38

Project 200-ZP-1 IRM

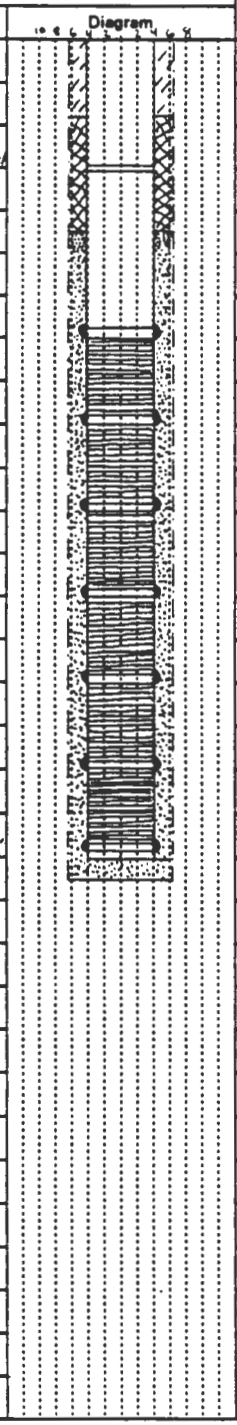
Prepared By L.D. Walker / Mark Darrach (Sign/Print Name) Date 4-22-96

Reviewed By Edward Rafuse / Edward Rafuse (Sign/Print Name) Date 05/02/96

CONSTRUCTION DATA

Description
hole diameter 12.63"
Top of cement at 167.9'
Cement plug → 16-30 secondary sandpack
transition at 182.4'
16-30 secondary sandpack → 8-16
primary transition at 184.2'
top of .040 slot SS wire wrap
screen at 194.5'
- carbon steel casing to stainless
steel screen
Bottom of .040 slot screen at 254.5'
~~Bottom of~~ SS endcap 254.5-255.52' (RE 05/02/96)
Bottom of 8-16 sandpack at
257'
Total drilled depth 257.5

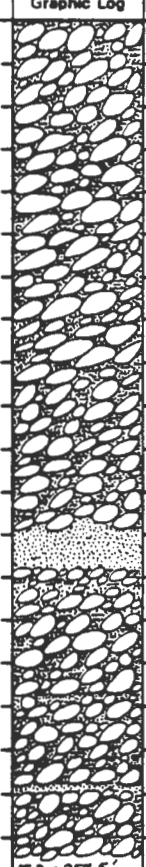
Diagram



Depth in Feet: 165, 170, 180, 190, 200, 210, 220, 230, 240, 250, 260, 270

GEOLOGIC/HYDROLOGIC DATA

Graphic Log



T.D. = 257.5'

Lithologic Description

Static water level 204.45' bgs on April 22nd, 1996

213-219.5 | SILTY SANDY GRAVEL

219.5-223 | SAND • H_2O producing unit

223-225 | SILTY SANDY GRAVEL

225-229.5 | SILTY SANDY GRAVELS • H_2O producing unit

229.5-237 | SILTY SANDY GRAVEL

237-241 | SLIGHTLY SILTY SANDY GRAVEL • H_2O prod. unit

241-247 | SILTY SANDY GRAVEL

247-247.5 | SAND

247.5-257.5 | SILTY SANDY GRAVEL

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APPENDIX C

SIEVE ANALYSES

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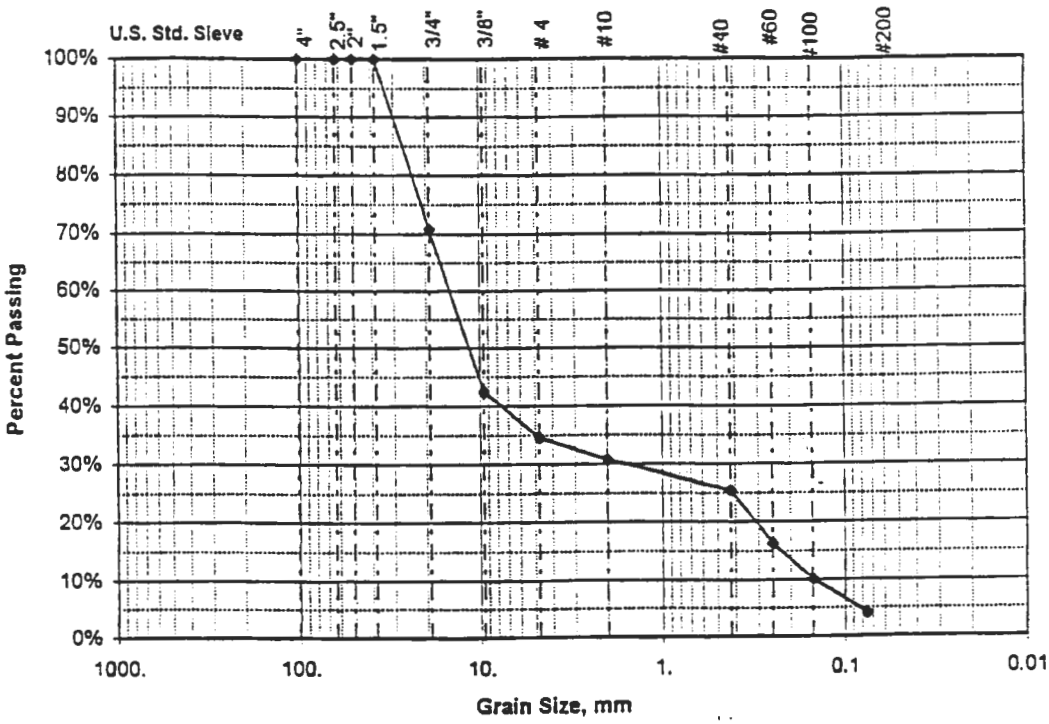
GEOTECHNICAL ENGINEERING LABORATORY
GEL-07
SIEVE ANALYSIS

WELL #	299-W15-29	DEPTH	249-249.5 ft	LAB#	5-0140	HEIS #	BOCF WB (Sonic)
TESTED BY	PRH	CONTACT	M. Darrach	PHONE	372-9264	DATE	04/20/95

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
1032.0	4"	0.0	0.0	100.0	101.600	
	2.5"	0.0	0.0	100.0	63.500	
	2"	0.0	0.0	100.0	50.800	
	1.5"	0.0	0.0	100.0	38.100	
	3/4"	301.3	29.2	70.8	19.050	
	3/8"	593.5	57.5	42.5	9.525	
WT.-#10	# 4	674.4	65.3	34.7	4.750	
SAMP.(g)	#10	715.2	69.3	30.7	2.000	
161.0	#40	28.0	17.4	25.4	0.425	
	#60	75.2	46.7	16.4	0.250	
	#100	108.4	67.3	10.0	0.150	
	#200	139.3	86.5	4.1	0.075	

Sieve Analysis Data for Sample 5-0140



All data are accurately and completely recorded. The test operator was trained and used calibrated instruments.

Checked By: J. H. Rodgers

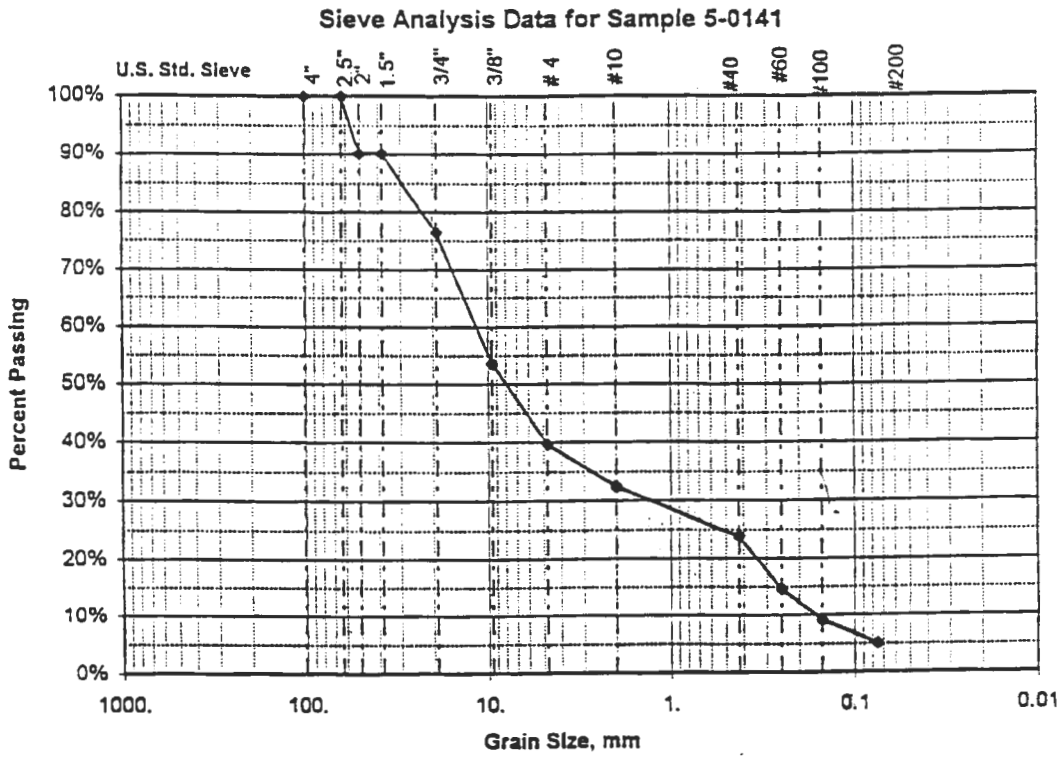
Post-It™ brand fax transmittal memo 7671 | # of pages ▸

To J. Freeman-Pollard	From P R Heller
Co. BHI	Co. WHC
Dept.	Phone # 376-4676
Fax # 372-9702	Fax # 372-2810

GEOTECHNICAL ENGINEERING LABORATORY
GEL-07
SIEVE ANALYSIS

WELL #	299-W15-29	DEPTH	249.5-250 ft	LAB#	5-0141	HEIS #	B0CFW9 (Split Tube)
TESTED BY	PRH	CONTACT	M. Darrach	PHONE	372-9264	DATE	04/20/95

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
2008.9	4"	0.0	0.0	100.0	101.600	
	2.5"	0.0	0.0	100.0	63.500	
	2"	198.5	9.9	90.1	50.800	
	1.5"	198.5	9.9	90.1	38.100	
	3/4"	472.9	23.5	76.5	19.050	
	3/8"	930.7	46.3	53.7	9.525	
WT.-#10	# 4	1212.6	60.4	39.6	4.750	
SAMP.(g)	#10	1358.1	67.6	32.4	2.000	
206.2	#40	54.8	26.6	23.8	0.425	
	#60	113.2	54.9	14.6	0.250	
	#100	148.7	72.1	9.0	0.150	
	#200	174.2	84.5	5.0	0.075	



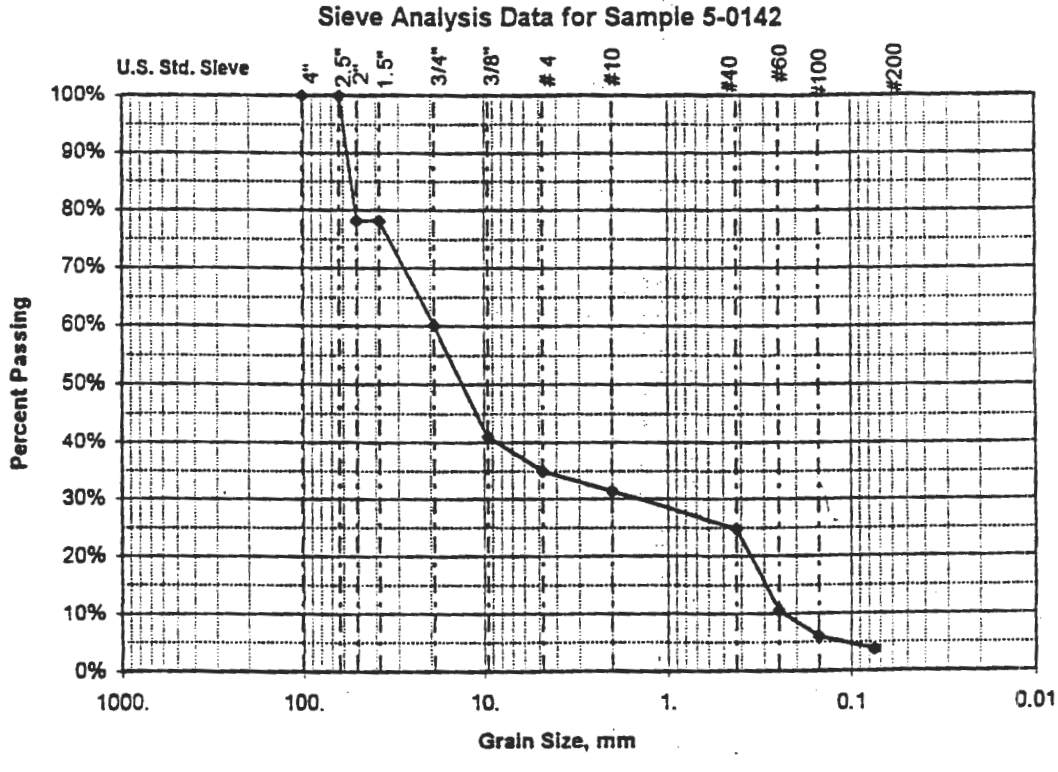
All data are accurately and completely recorded. The test operator was trained and used calibrated instruments.

Checked By: [signature] Date: 4-20-95

GEOTECHNICAL ENGINEERING LABORATORY
GEL-07
SIEVE ANALYSIS

WELL #	299-W15-29	DEPTH	271 ft	LAB#	5-0142	HEIS #	BØFCXØ
TESTED BY	PRH	CONTACT	M. Darrach	PHONE	372-9264	DATE	04/20/95

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
1183.9	4"	0.0	0.0	100.0	101.600	
	2.5"	0.0	0.0	100.0	63.500	
	2"	257.8	21.8	78.2	50.800	
	1.5"	257.8	21.8	78.2	38.100	
	3/4"	471.9	39.9	60.1	19.050	
	3/8"	698.9	59.0	41.0	9.525	
WT.-#10	# 4	770.7	65.1	34.9	4.750	
SAMP.(g)	#10	813.1	68.7	31.3	2.000	
184.0	#40	38.5	20.9	24.8	0.425	
	#60	121.5	66.0	10.6	0.250	
	#100	149.5	81.3	5.9	0.150	
	#200	161.9	88.0	3.8	0.075	



All data are accurately and completely recorded. The test operator was trained and used calibrated instruments.

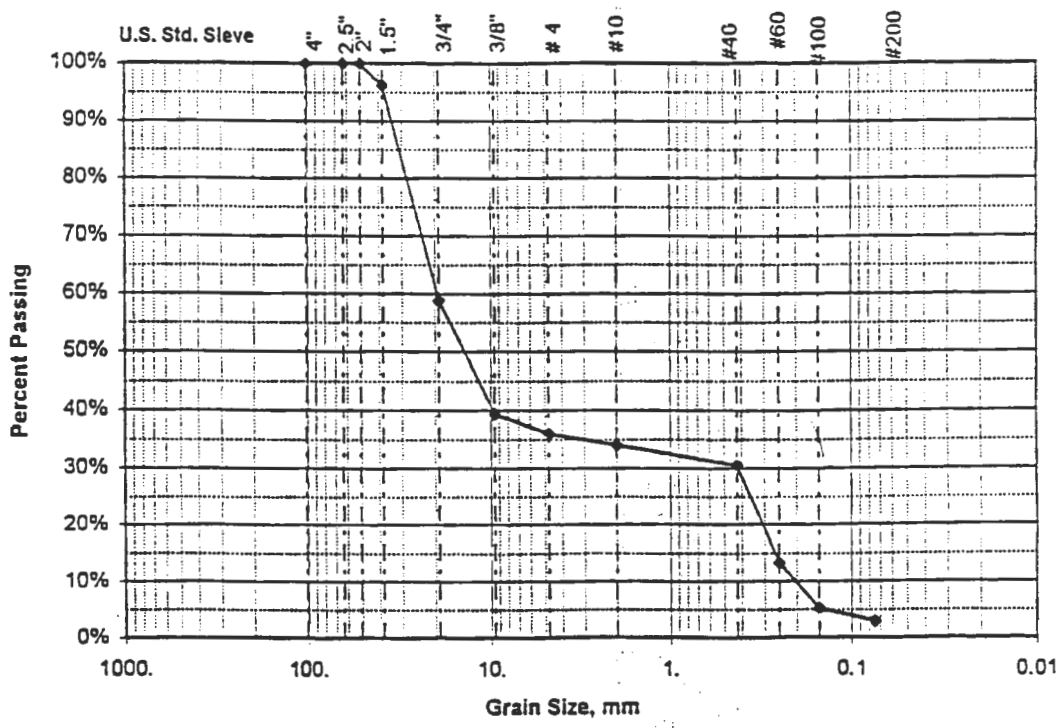
Checked By: J T Rilyea Date: 4-20-95

GEOTECHNICAL ENGINEERING LABORATORY
GEL-07
SIEVE ANALYSIS

WELL #	299-W15-29	DEPTH	281-291 ft	LAB#	5-0143	HEIS #	BØFCX1
TESTED BY	PRH	CONTACT	M. Darrach	PHONE	372-9264	DATE	04/20/95

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
3094.6	4"	0.0	0.0	100.0	101.600	
	2.5"	0.0	0.0	100.0	63.500	
	2"	0.0	0.0	100.0	50.800	
	1.5"	119.4	3.9	96.1	38.100	
	3/4"	1272.3	41.1	58.9	19.050	
	3/8"	1876.3	60.6	39.4	9.525	
WT.-#10	# 4	1980.8	64.0	36.0	4.750	
SAMP.(g)	#10	2043.2	66.0	34.0	2.000	
227.4	#40	23.1	10.2	30.5	0.425	
	#60	139.0	61.1	13.2	0.250	
	#100	193.1	84.9	5.1	0.150	
	#200	207.7	91.3	2.9	0.075	

Sieve Analysis Data for Sample 5-0143



All data are accurately and completely recorded. The test operator was trained and used calibrated instruments.

Checked By: [signature] Date: 4-20-95

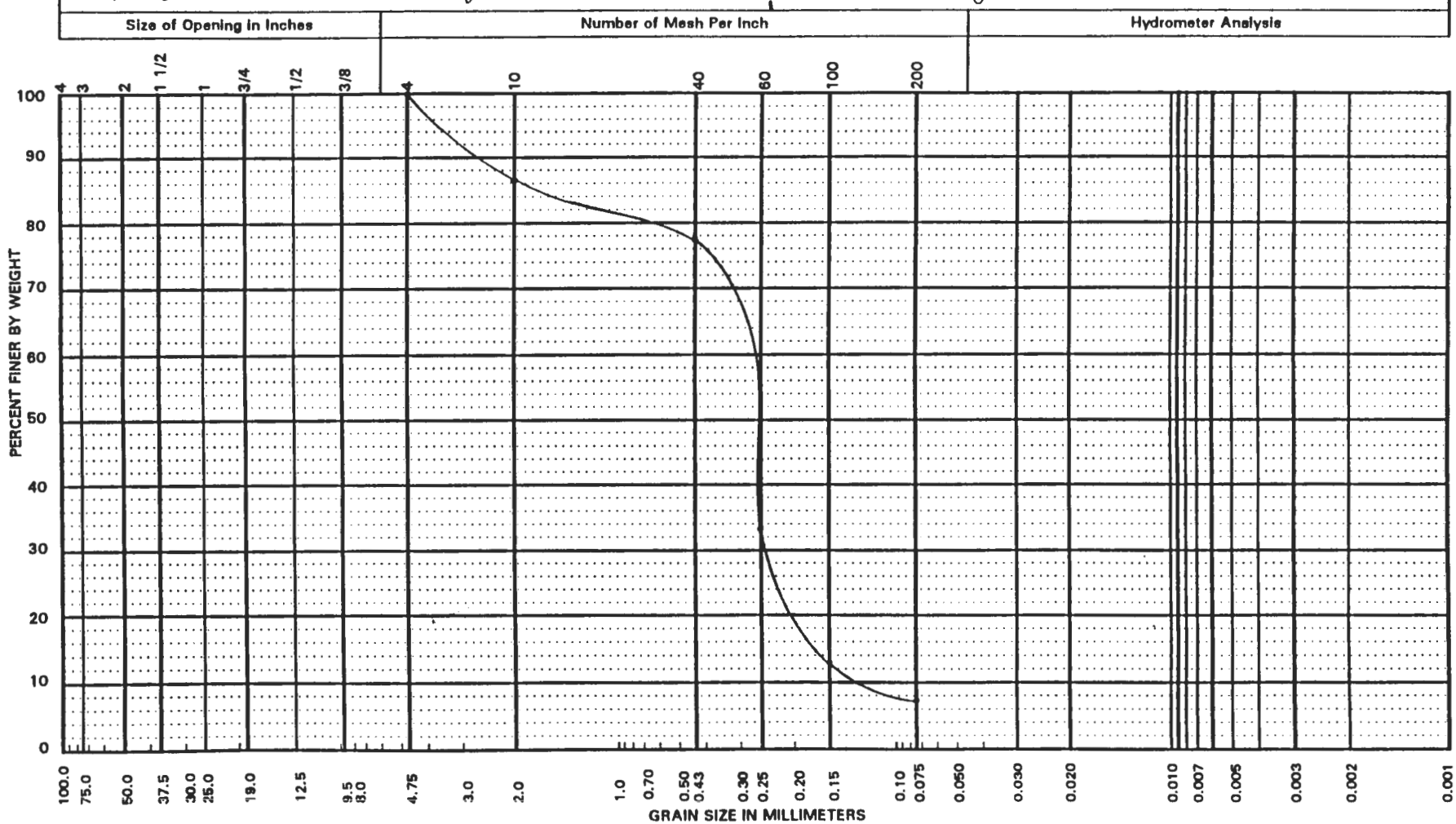
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 299-W15-29 281-291 ft

Page 2 of 2

Remarks Initial Sample wt: 262.9g / #10-35.5g / #40-23.1g / #60-115.9g / #100-54.1g / #200-14.6g / PAN-19.7g Uniformity Coefficient $^{60}/_{10}$ = 2.1

50% passing = .0098" * 6 = .0588 ∴ Design should have been 10-20 sand w/30 or 40 slot screen / Design was 10-20 sand with 20 slot - this is why the well produces



Plotte Mark Darrach / Mark Darrach Date 4/5/96 Plot Checked By _____ Date _____

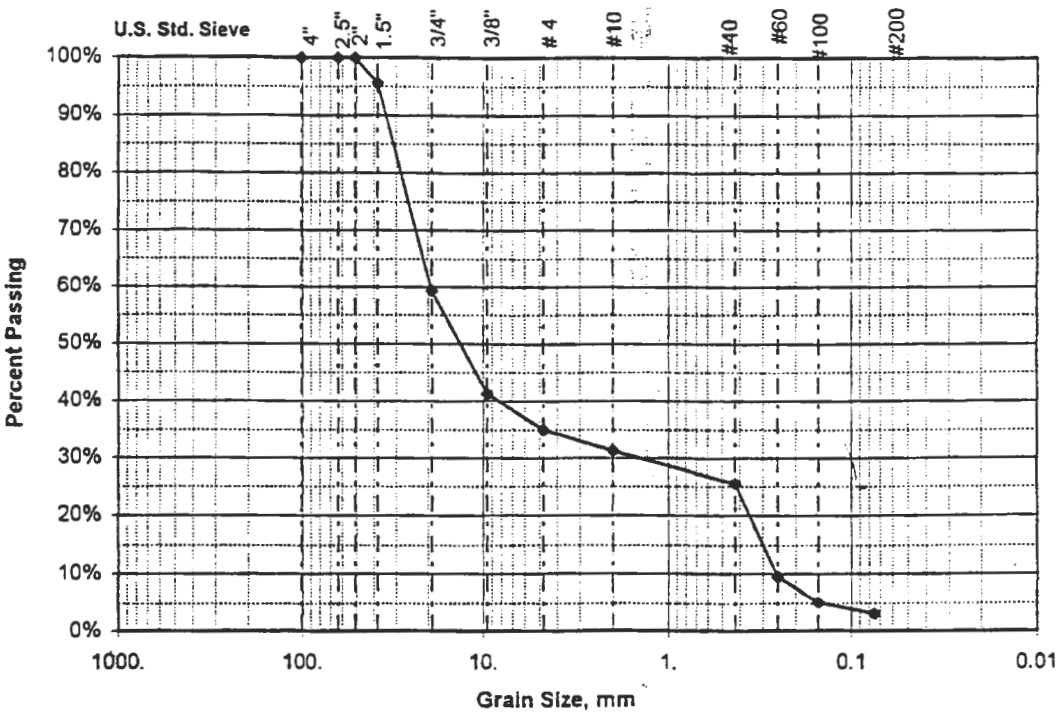
BD-6000-799 (04/92)

GEOTECHNICAL ENGINEERING LABORATORY
GEL-07
SIEVE ANALYSIS

WELL #	299-W15-30	DEPTH - Composite sample from H2O bearing units - See logs		LAB#	5-0144	HEIS #	BOFK12
TESTED BY	PRH	CONTACT	M. Darrach	PHONE	372-9264	DATE	05/09/95

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
2686.5	4"	0.0	0.0	100.0	101.600	
	2.5"	0.0	0.0	100.0	63.500	
	2"	0.0	0.0	100.0	50.800	
	1.5"	115.8	4.3	95.7	38.100	
	3/4"	1095.2	40.8	59.2	19.050	
	3/8"	1576.6	58.7	41.3	9.525	
WT.-#10	# 4	1747.2	65.0	35.0	4.750	
SAMP.(g)	#10	1848.3	68.8	31.2	2.000	
198.0	#40	36.4	18.4	25.5	0.425	
	#60	138.0	69.7	9.5	0.250	
	#100	166.2	83.9	5.0	0.150	
	#200	178.5	90.2	3.1	0.075	

Sieve Analysis Data for Sample 5-0144



All data are accurately and completely recorded. The test operator was trained and used calibrated instruments.

Checked By: P Heller Date

Post-It™ brand fax transmittal memo 7671 | # of pages ▸ 1

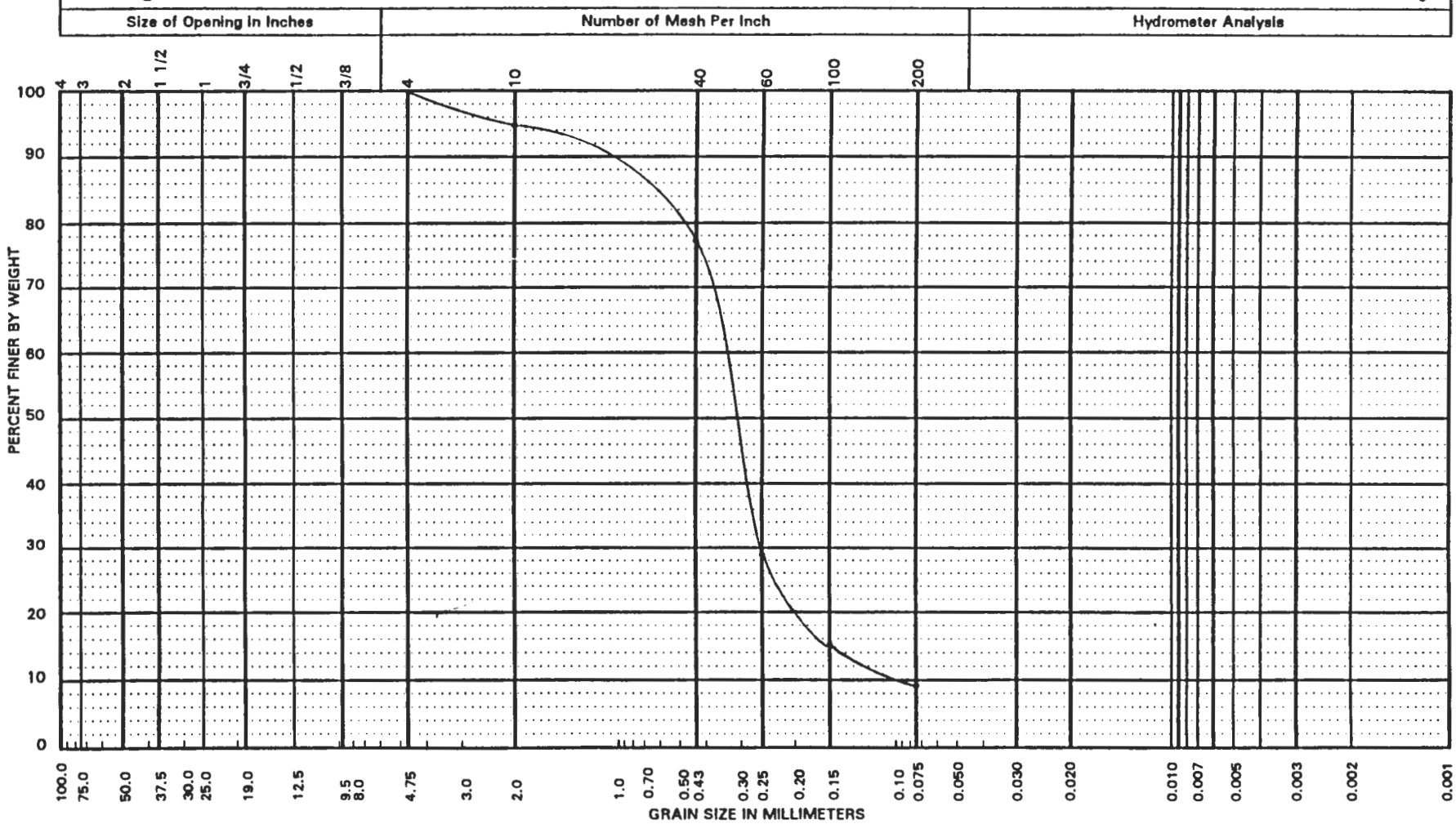
To J Freeman-Pollock	From Paula Heller
Co. BHI	Co. WHC
Dept.	Phone # 376-8809
Fax # 372-9702	Fax # 372-2810

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 299-W15-30 / BULK H_2O SAMPLE BOKIZ

Page 1 of 2

Remarks INITIAL SAMPLE WT: 209.5g | #10 - 11.5g / #40 - 36.4g / #60 - 101.6g / #100 - 28.2g / #200 - 12.3g / PAN - 19.5g | Uniformity Coefficient 60%: 3.55
50% passing = .0122" # 6 = .073 ∴ Design sandpack is 8-16 with either .040" or .050" slot screen / ∴ W15-30 well (10-20 w/.020" slot) was a bad design



Plotted Mark Darrach / Mark Darrach Date 4/5/96

Plot Checked By _____ Date _____

BD-6000-799 (04/92)

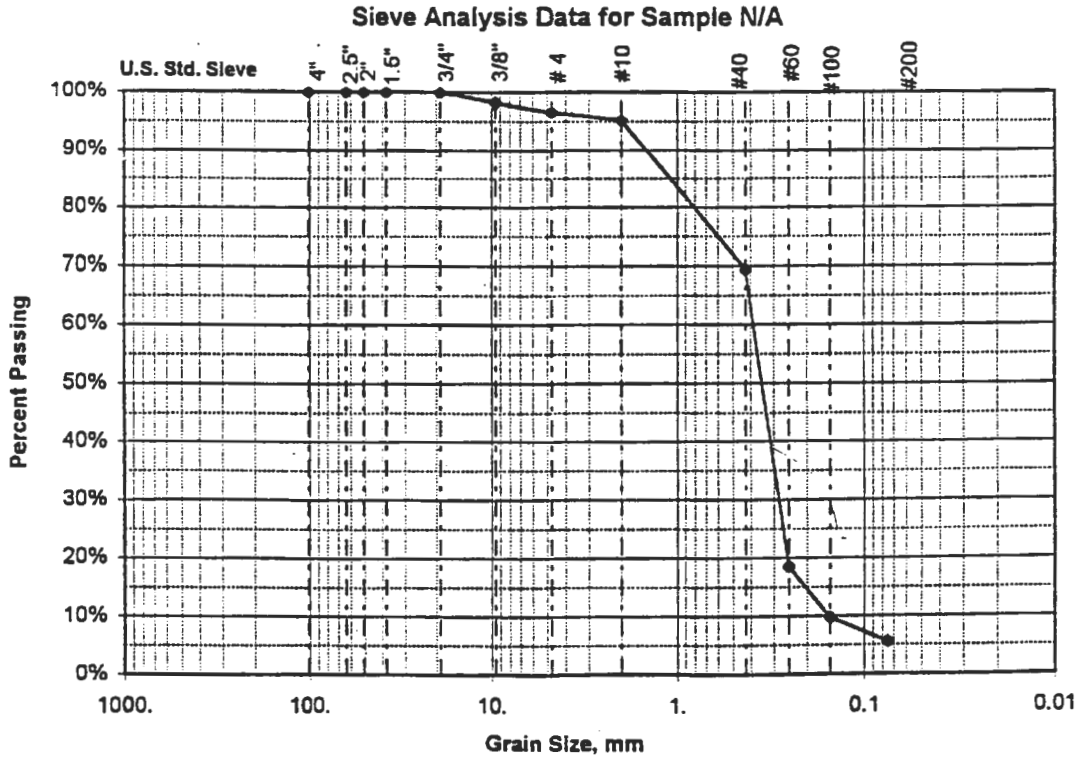
97350.1868

BHI-00927
Rev. 0

GEOTECHNICAL ENGINEERING LABORATORY
GEL-07
SIEVE ANALYSIS

WELL #	299-W15-31	DEPTH	240' to 243	LAB#	N/A	HEIS #	B0FKQ8
TESTED BY	JF Relvea	CONTACT	Mark Darrach	PHONE	372-9264	DATE	06/05/95

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
1130.1	4"	0.0	0.0	100.0	101.600	
	2.5"	0.0	0.0	100.0	63.500	
	2"	0.0	0.0	100.0	50.800	
	1.5"	0.0	0.0	100.0	38.100	
	3/4"	0.0	0.0	100.0	19.050	
	3/8"	19.0	1.7	98.3	9.525	
WT.-#10	# 4	38.7	3.4	96.6	4.750	
SAMP.(g)	#10	54.4	4.8	95.2	2.000	
254.2	#40	69.0	27.1	69.3	0.425	
	#60	204.8	80.6	18.5	0.250	
	#100	228.2	89.8	9.7	0.150	
	#200	239.4	94.2	5.5	0.075	



All data are accurately and completely recorded. The test operator was trained and used calibrated instruments.

Checked By: Paula Heller Date: 6-5-95

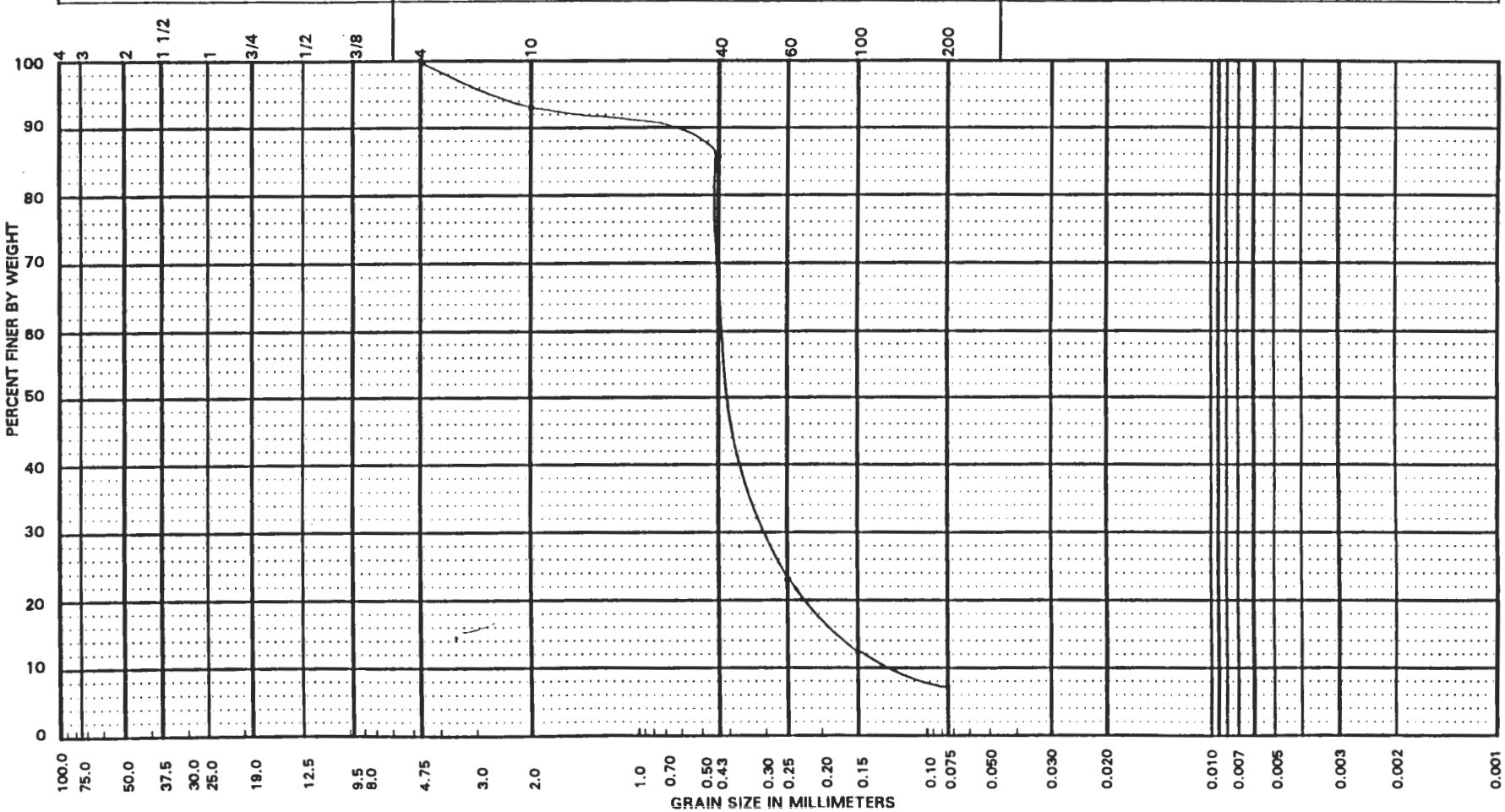
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. Well 299-W6-9 240-248'

Page 2 of 2

Remarks Initial Recalculated WT: 215.5g / #10 - 15.7g / #40 - 14.6g / #60 - 135.8g / #100 - 23.4g / #200 - 11.2g / PAN - 14.8g Uniformity Coefficient: 3.2

50% passing = .0156" #6 = .0936 Design: 6-12 sand .070 slot screen



Plotted By Mark Darrach / Mark Darrach Date 4/5/96

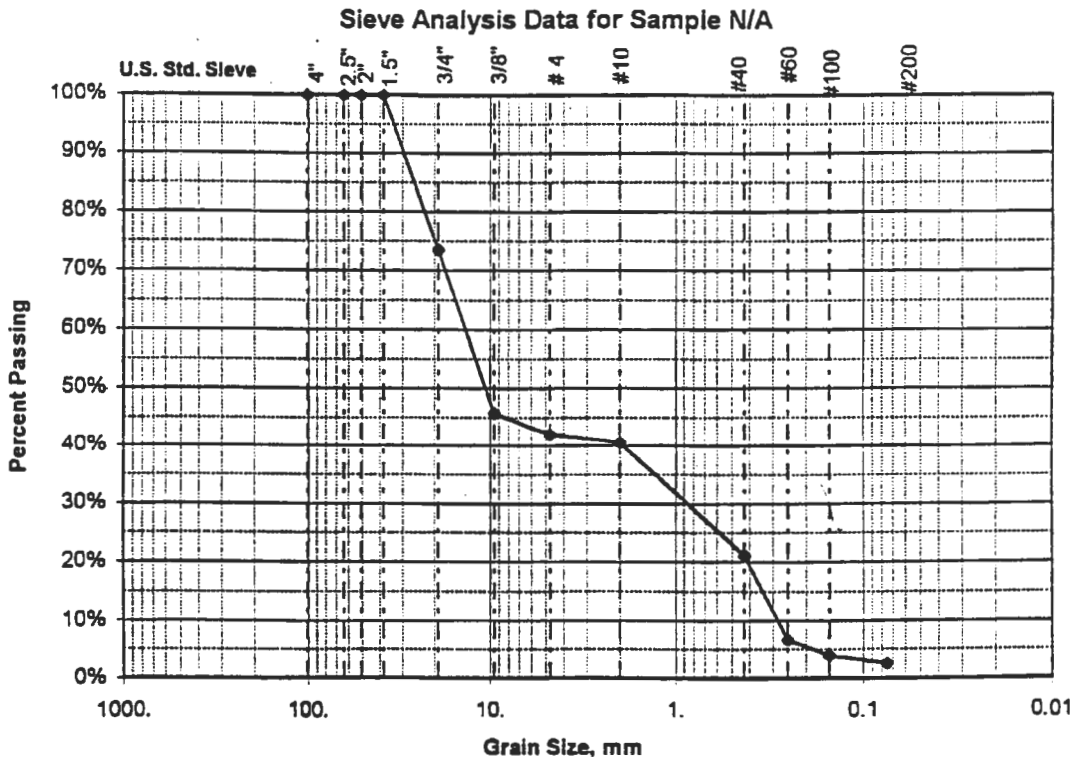
Plot Checked By _____ Date _____

9715445.1869

GEOTECHNICAL ENGINEERING LABORATORY
GEL-07
SIEVE ANALYSIS

WELL #	299-W15-31	DEPTH	252' to 254	LAB#	N/A	HEIS #	B0FKQ9
TESTED BY	JF Relvea	CONTACT	Mark Darrach	PHONE	372-9264	DATE	06/05/95

SAMPLE WT (g)	SIEVE SIZE IN.	CUMULATIVE WEIGHT	% WEIGHT RETAINED	% PASSING	Grain Size (mm)	COMMENTS
810.2	4"	0.0	0.0	100.0	101.600	
	2.5"	0.0	0.0	100.0	63.500	
	2"	0.0	0.0	100.0	50.800	
	1.5"	0.0	0.0	100.0	38.100	
	3/4"	214.4	26.5	73.5	19.050	
	3/8"	440.5	54.4	45.6	9.525	
WT.-#10	# 4	470.7	58.1	41.9	4.750	
SAMP.(g)	#10	482.1	59.5	40.5	2.000	
328.1	#40	156.9	47.8	21.1	0.425	
	#60	274.6	83.7	6.6	0.250	
	#100	296.4	90.3	3.9	0.150	
	#200	308.0	93.9	2.5	0.075	



All data are accurately and completely recorded. The test operator was trained and used calibrated instruments.

Checked By: Paula Heller Date: 6-5-95

Post-it™ brand fax transmittal memo 7671 # of pages ▸ 2

To J Freeman Pollard	From P R Heller
Co. BHI	Co. WHC
Dept.	Phone # 376-8809
Fax # 372-9703	Fax # 376-2910

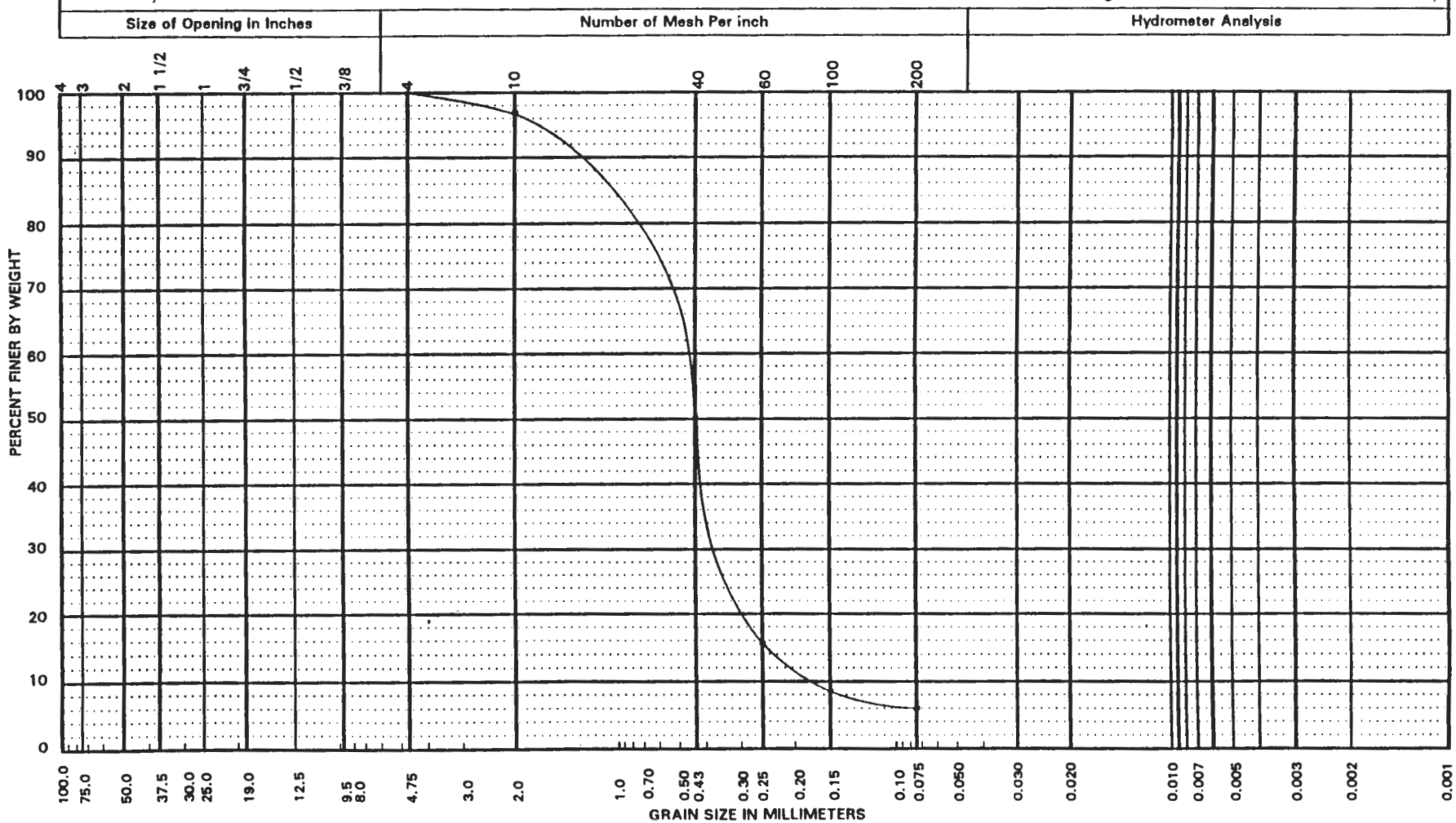
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. Well 299-W15-31 252-254

Page 2 of 2

Remarks Initial Sample Wt (recalculated): 339.5g / #10 - 11.4g / #40 - 156.9g / #60 - 117.7g / #100 - 21.8g / #200 - 11.6g / PAN - 20.1g

Uniformity Coeff: 2.6 * 6 # 50% passing = .0169 * 6 = .1016 Design = 6-12 sand w/70 slot screen / with .0169 * 5 design is also 6-12 sand w/70 slot screen



Plotted Mark Darrach / Mark Jarrach Date 4/5/96

Plot Checked By _____ Date _____

BD-6000-799 (04/92)

GEL-07 GRAIN SIZE ANALYSIS PLOT

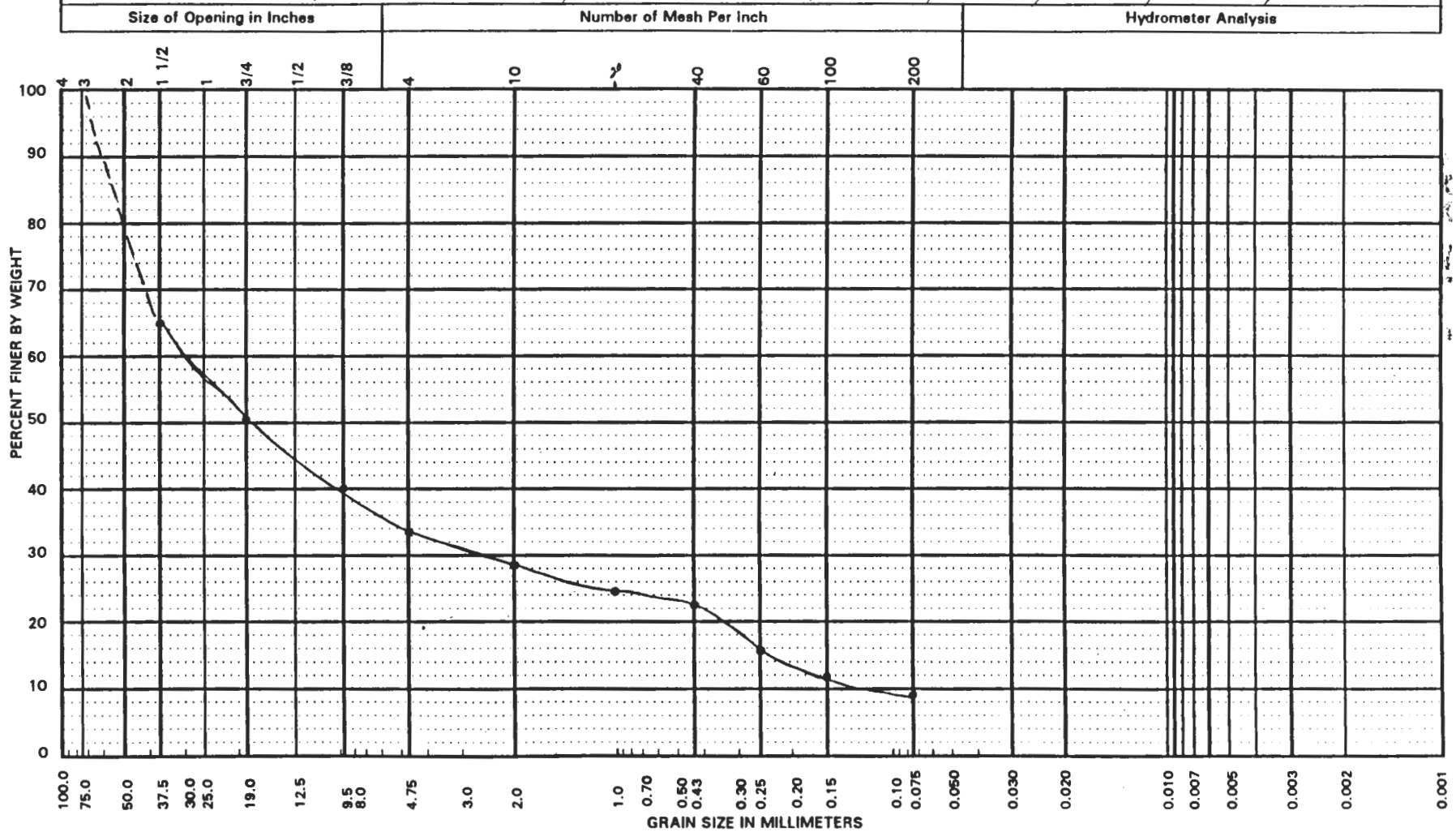
RECEIVED

Sample No. 218.5-220.5

Page 1 of 1

Remarks Well 299-W15-33; Dry Weight 881 g. HEIS # B0GT31

1½"-308.1g/¾"-135.5g/⅜"-93.8g/#4-55.2g/#10-47.7g/#20-34.2g/#40-25.3g/#60-49.0g/#100-35.6g/#200-24.9g/Pan 79.4g



Plotted M. Faurote Date 11/16/9

Plot Checked By M. Jarrach Date 5/95

BD-6000-799 (04/92)

Sample: 218.5'-219.7' split spoon sample
B0GT31 HEIS #

Type: Wet Sieve Analysis

Split: Quartering Method

Well: 299-W15-33/B2643
200-ZP-1 Extraction Well

Performed: M. Faurote
11/16/95

Total Initial Wt: 881g

SIEVE SIZE	WT. IN GRAMS
1½"	308.1 g
¾"	125.5 g
⅜"	93.8 g
#4	55.2 g
#10	47.7 g
#20	34.2 g
#40	25.3 g
#60	49.0 g
#100	35.6 g
#200	24.9 g
PAN	79.4 g
	878.7 g = .27% error

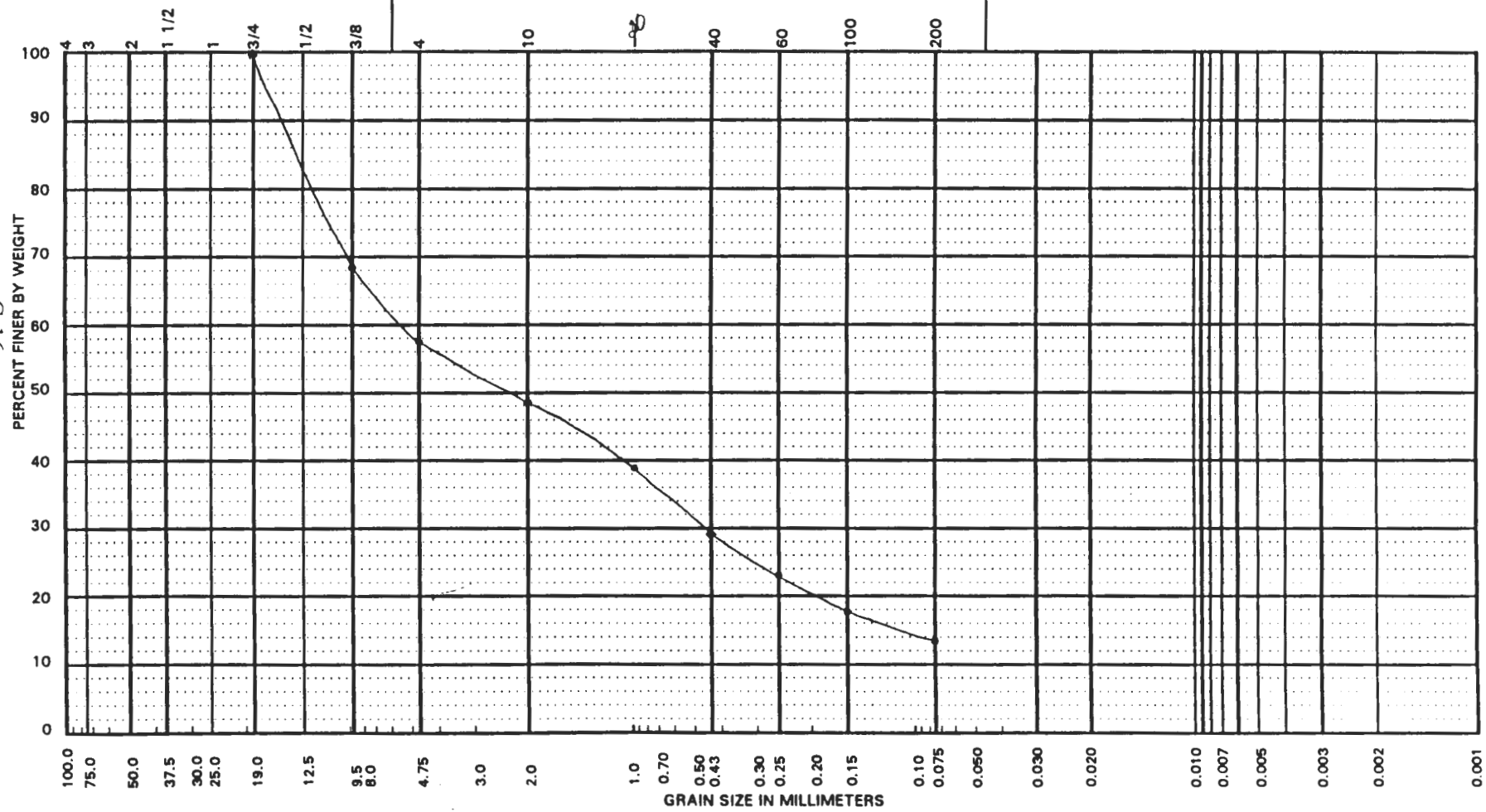
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 230'-231.5'

Page 1 of

Remarks Well 299-W15-33 ; total sample wt. 795.3 , HEIS # BØGTL1

1½"-0%; ¾"-345.4g; ⅜"-85.8g; #4-72.0g; #10-77.3g; #20-47.1g; #40-30.8g; #60-41.6g; #100-44.2g; #200-41.3g; Pan 107.7g



Plotted J.M. Fourate Date 11/17/9

Plot Checked By Mark Jarrad Date 1/95

BD-6000-799 (04/92)

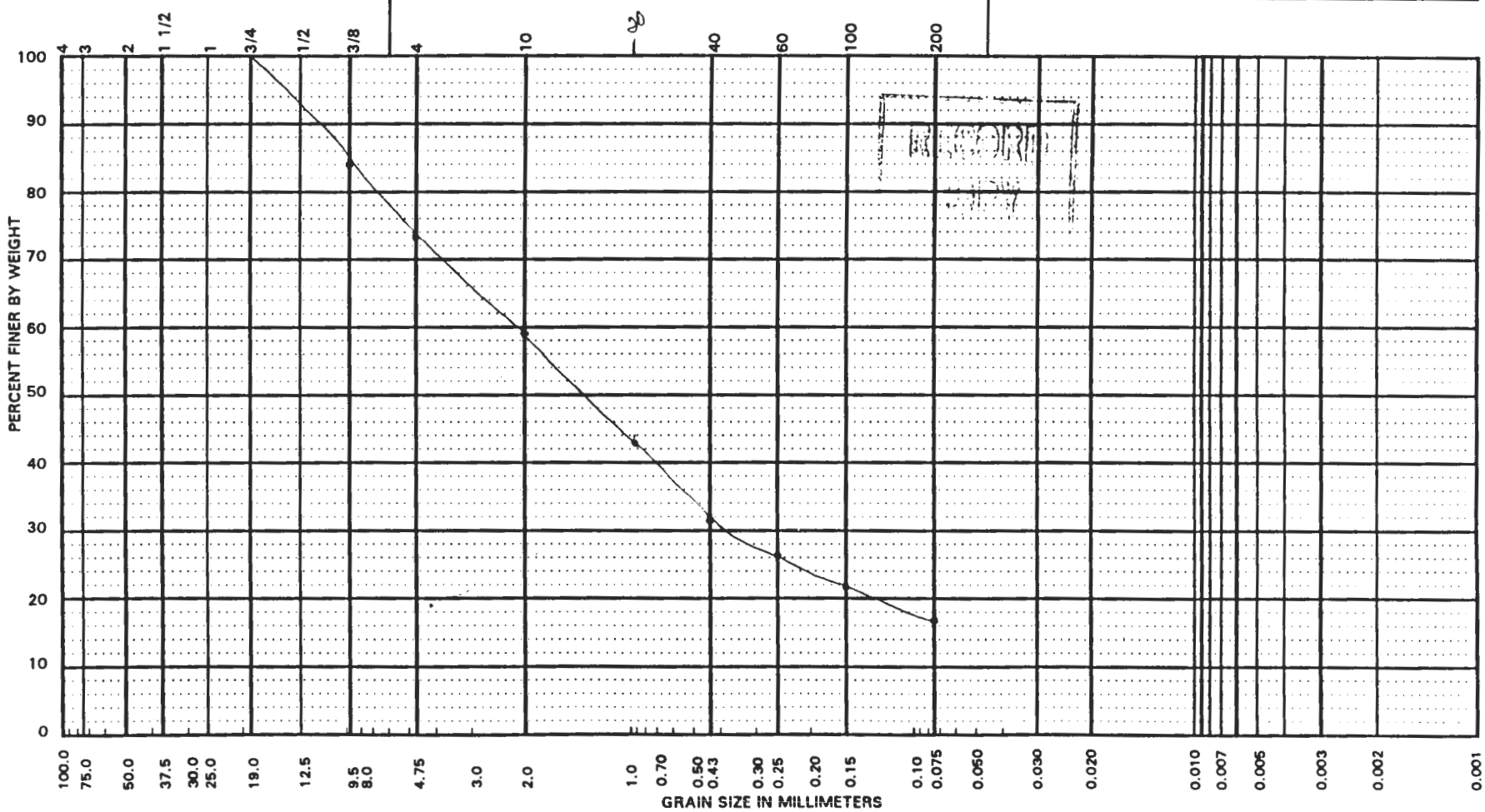
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 240-241.5

Page 1 of ____

Remarks Well 299-W15-33, Sample weight, dry = 619.4g HEIS # BOGTL2

1½"-00; ¾"-59.6g; ⅜"-65.7g; #4-87.6g; #10-101.8g; #20-69.7g; #40-~~80.5~~ 40.5 JMF g; #60-33.5g; #100-29.0g; #200-30.1g; Pan-102.8



Plotted J.M. Fourate Date 11/17/95

Plot Checked By Mark Darrach / Mark Darrach Date 11/95

BD-6000-799 (04/92)

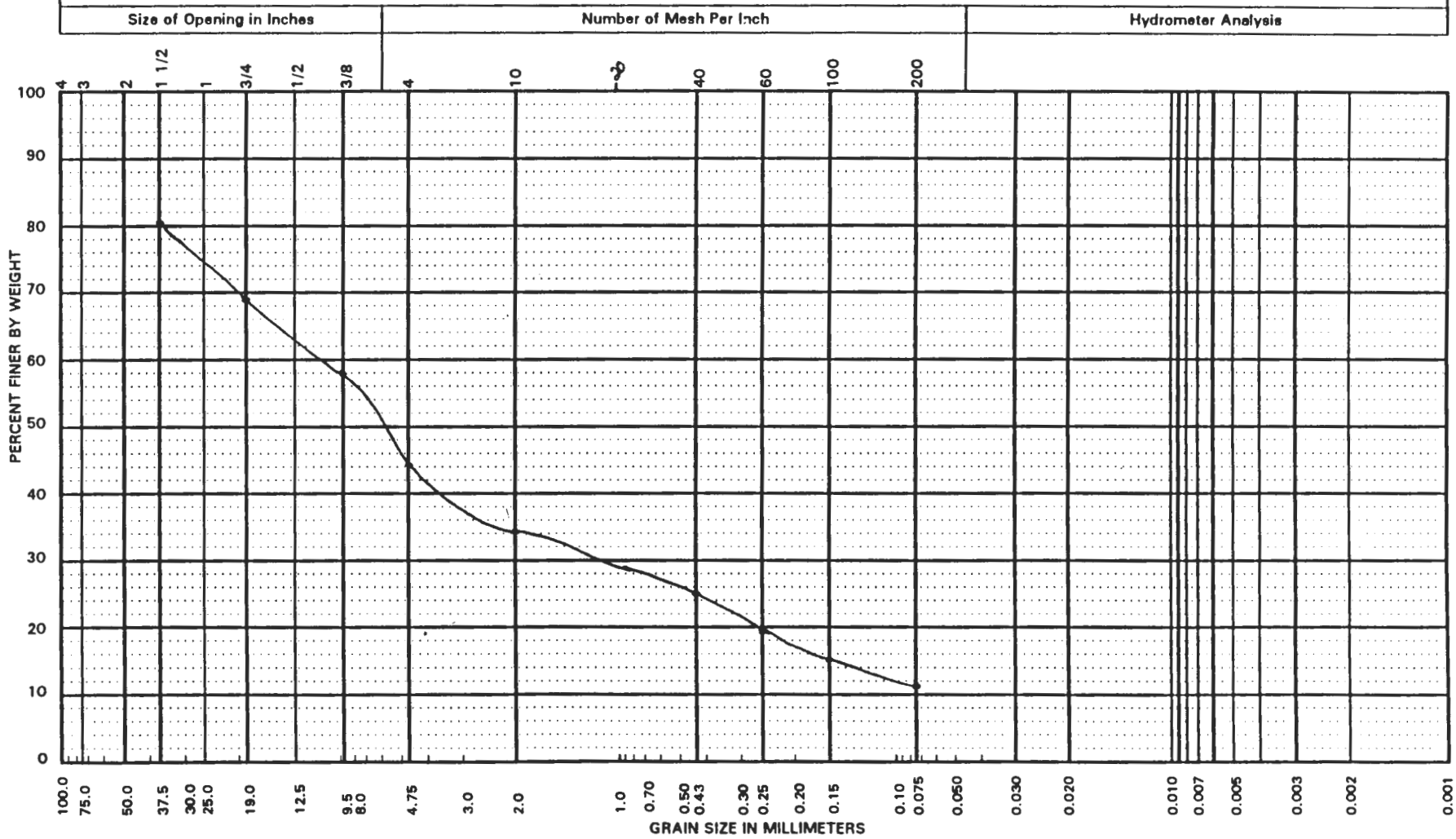
9725010.1872

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 250 - 251.5

Page 1 of 1

Remarks Well # 299-W15-33, tot. sample wt @ 1062.1 g & contains 94.7+ g >200 mesh HEIS # B0GYR2
1½"-209.2; ¾"-120.8g; ⅜"-117.1g; #4-145.1g; #10-106.3g; #20-59.8g; #40-40.0g; #60-58.9g; #100-44.0g; #200-41.1g; >#200-120.0



Plotted Mike Faurote Date 11/20/9

Plot Checked By Mark Darrach/Mark Darrach Date 1 195

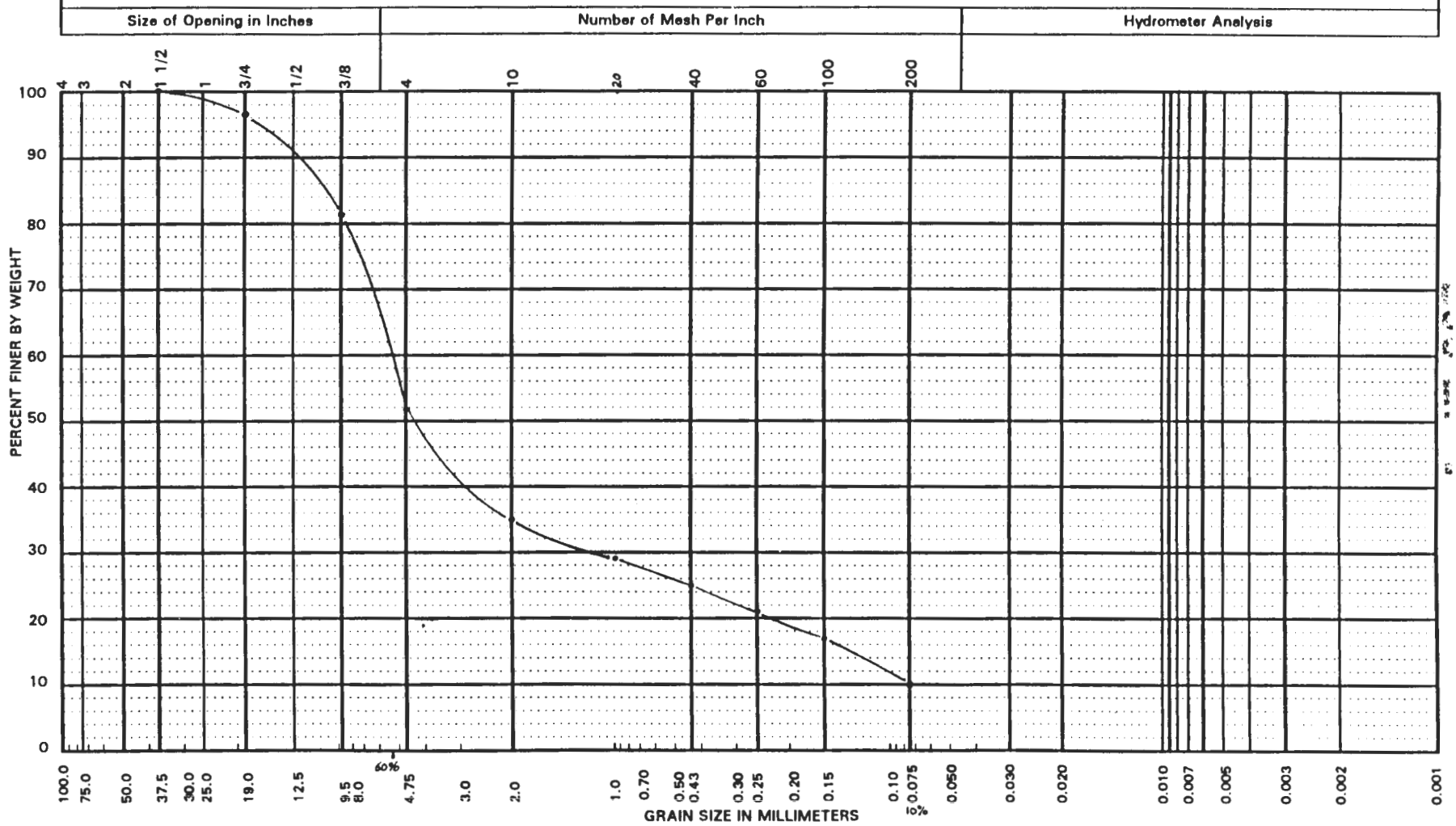
BD-6000-799 (04/92)

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No 0'
Well 299-W15-34
Page 1 of 1

Remarks INITIAL SAMPLE WT: ~~802.6~~ 762.0 g (mo 2/28/96) | 3/4" - 28.7g | 3/8" - 111.2g | #4 - 227.3g | #10 - 126.3 | #20 - 47.1g | #40 - 33.4g | 60 - 28.8g | 100 - 32.1g | #200 - 50.6g | PAN - 76.5g

Uniformity Coefficient: 69



Plotted By Mark Darrach / Marc Darrach Date 2/28/96

Plot Checked By EDWARD C. RAFUSE / Edward C. Rafuse Date 02/28/96

BD-6000-799 (04/92)

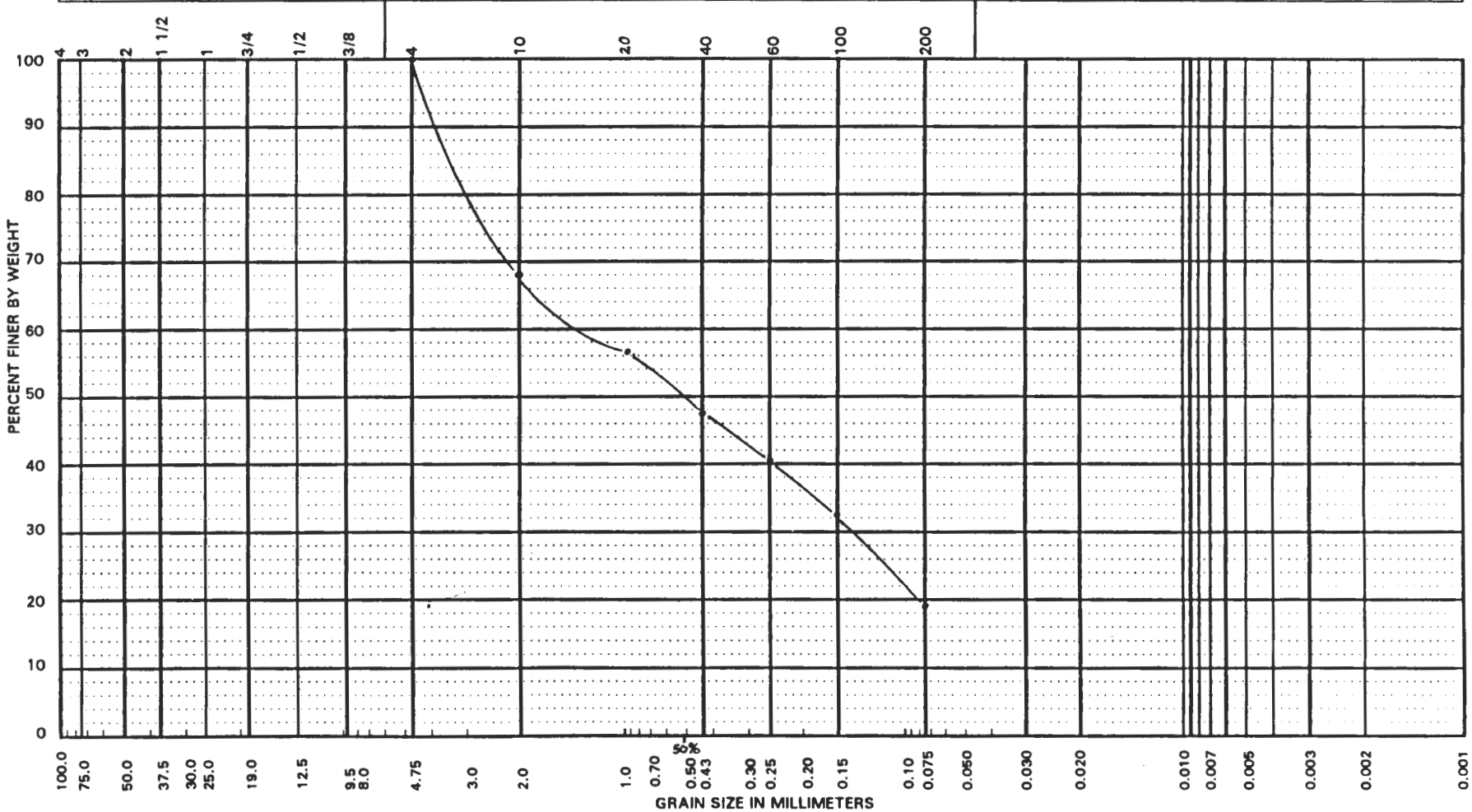
9736.1873

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No 2'
Well 299-W15-34

Page 1 of 1

Remarks Recalculated Sample Normalized to ≤#4 Sieve / Initial wt. = 394.8g / #10 - 126.3g / #20 - 47.1g / #40 - 33.4g / #60 - 28.8g / #100 - 32.1g / #200 - 50.6g / PAN - 76.5g
50% passing = .020" 50% passing ×5 = .10" Sandpack ∴ should be 6-12 sand relative to this sample with a .070" slot screen



Plotted By Mark Darrach / Mark Darrach Date 2/28/96

Plot Checked By EDWARD C. RoFuse Date 02/29/96

BD-6000-799 (04/92)

COPY

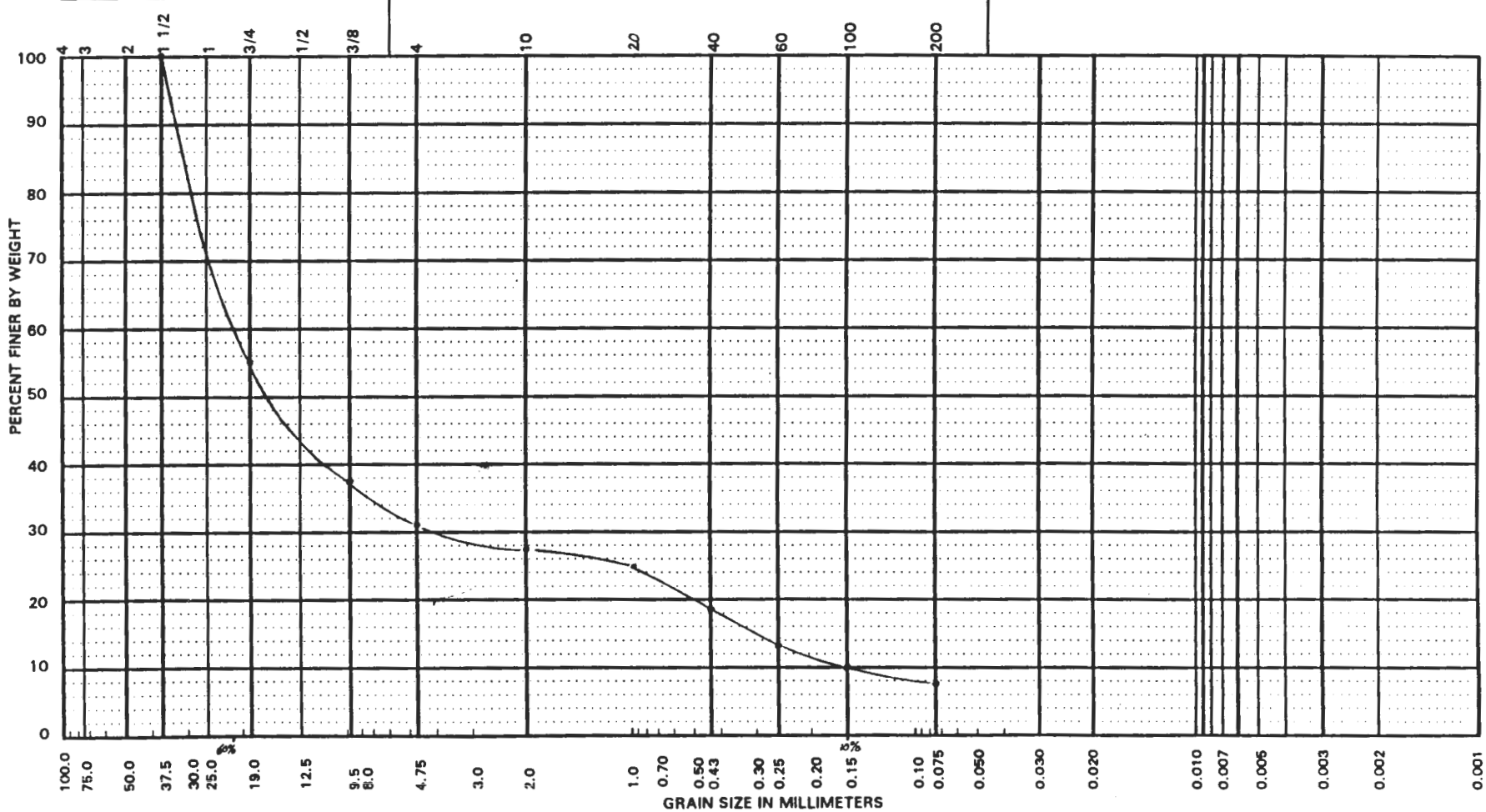
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No)-231-B
299-W15-34

Page 1 of 2

Remarks Initial Sample Wt: 725.2g / 3/4"-325.4g / 3/8"-127.8g / #4-46.0 / #10-26.5g / #20-20.3g / #40-45.2g / #60-38.6g / #100-22.2g / #200-18.5g / PAN-54.7g

Uniformity Coefficient: =147



Plotted By Mark Darrach / Mark Darrach Date 2/29/96

Plot Checked By Edward Rafuse / Edward Rafuse Date 03/01/96

BD-6000-799 (04/92)

97750.1874

BHI-00927
Rev. 0

RECORD COPY

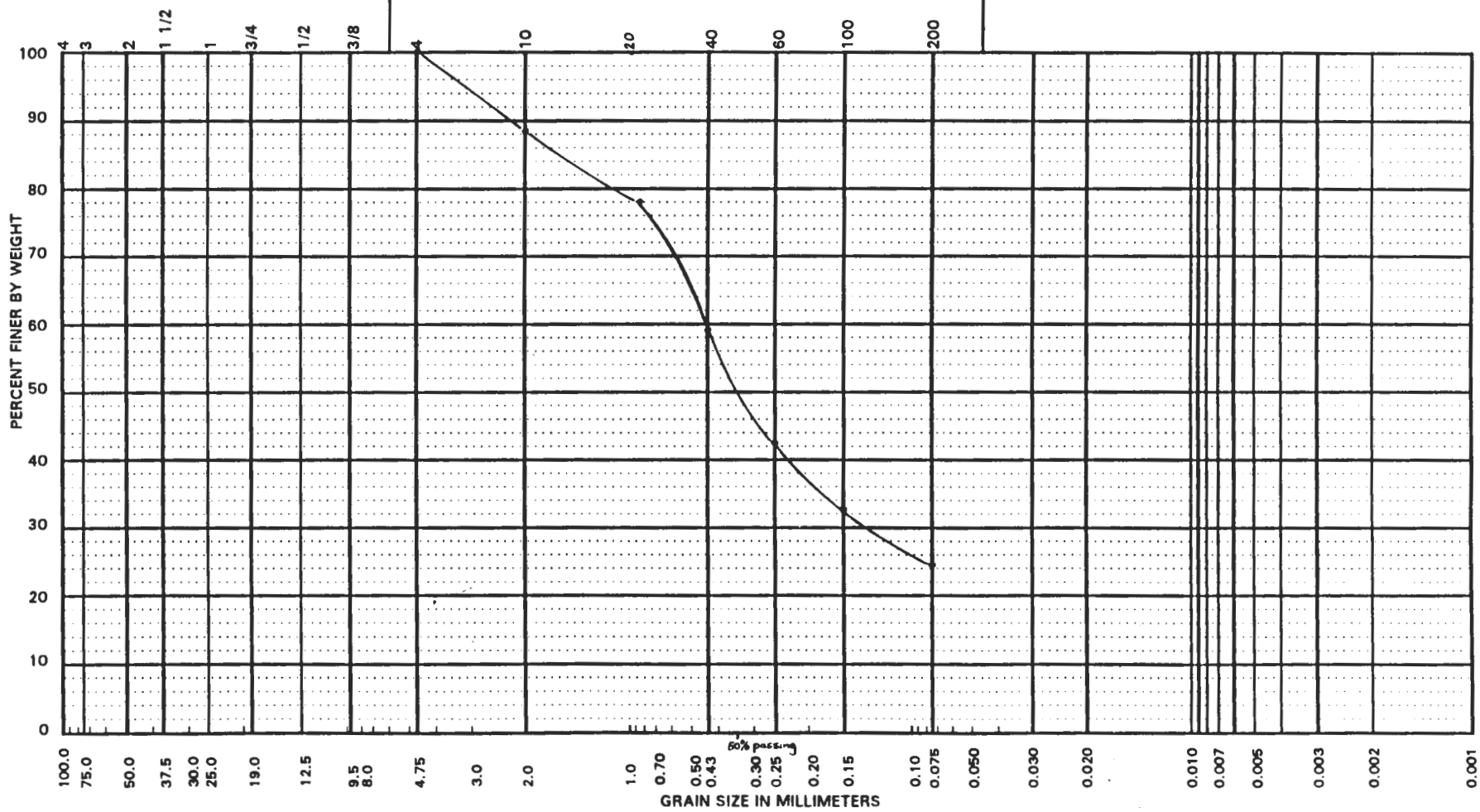
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No -W15-34
Depth: 230 231.8

Page 2 of 2

Remarks Recalculated Sample Normalized to ≤ #4 Sieve | Initial Wt: 226.0g / #10-26.5g / #20-20.3g / #40-45.2g / #60-38.6g / #100-22.2g / #200-18.5g / PAN-54.7g

50% passing = .33mm (.013") 50% passing #5 = .065" Sandpack ∴ should be 8-16 sand with a .050" slot screen



Plotted By Mark Darrach / Mark Darrach Date 2/29/96

Plot Checked By EDWARD RaFuse / Edward Rafuse Date 03/01/96

BD-6000-799 (04/92)

RECORD COPY

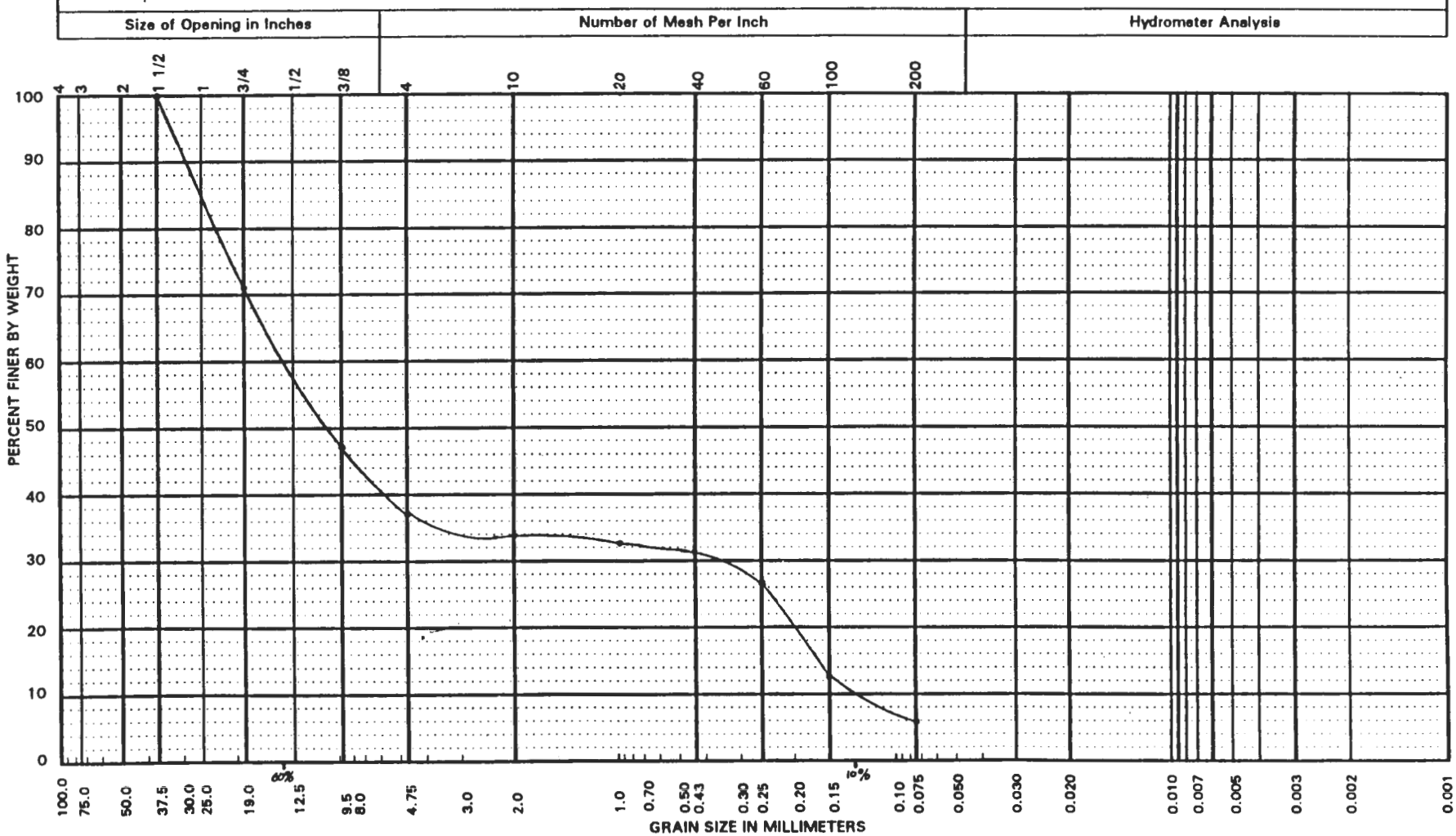
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 9-251
299-W15-34

Page 1 of 2

Remarks INITIAL SAMPLE WT: 667.0g / 3/4" - 195.0g / 3/8" - 157.5 / #4 - 65.8 / #10 - 22.50 / #20 - 11.0g / #40 - 8.9g / #60 - 28.6 / #100 - 95.3 / #200 - 39.6 / PAN - 42.8g

UNIFORMITY COEFFICIENT: ≈ 104 / Unit does produce significant water



Plotted By MARK DARRACH / Mark Darrach Date 3/1/96

Plot Checked By EDWARD C. LAFUE / Edward C. LaFue Date 03/01/96

BD-6000-799 (04/92)

97 3641 1875

BHI-00927
Rev. 0

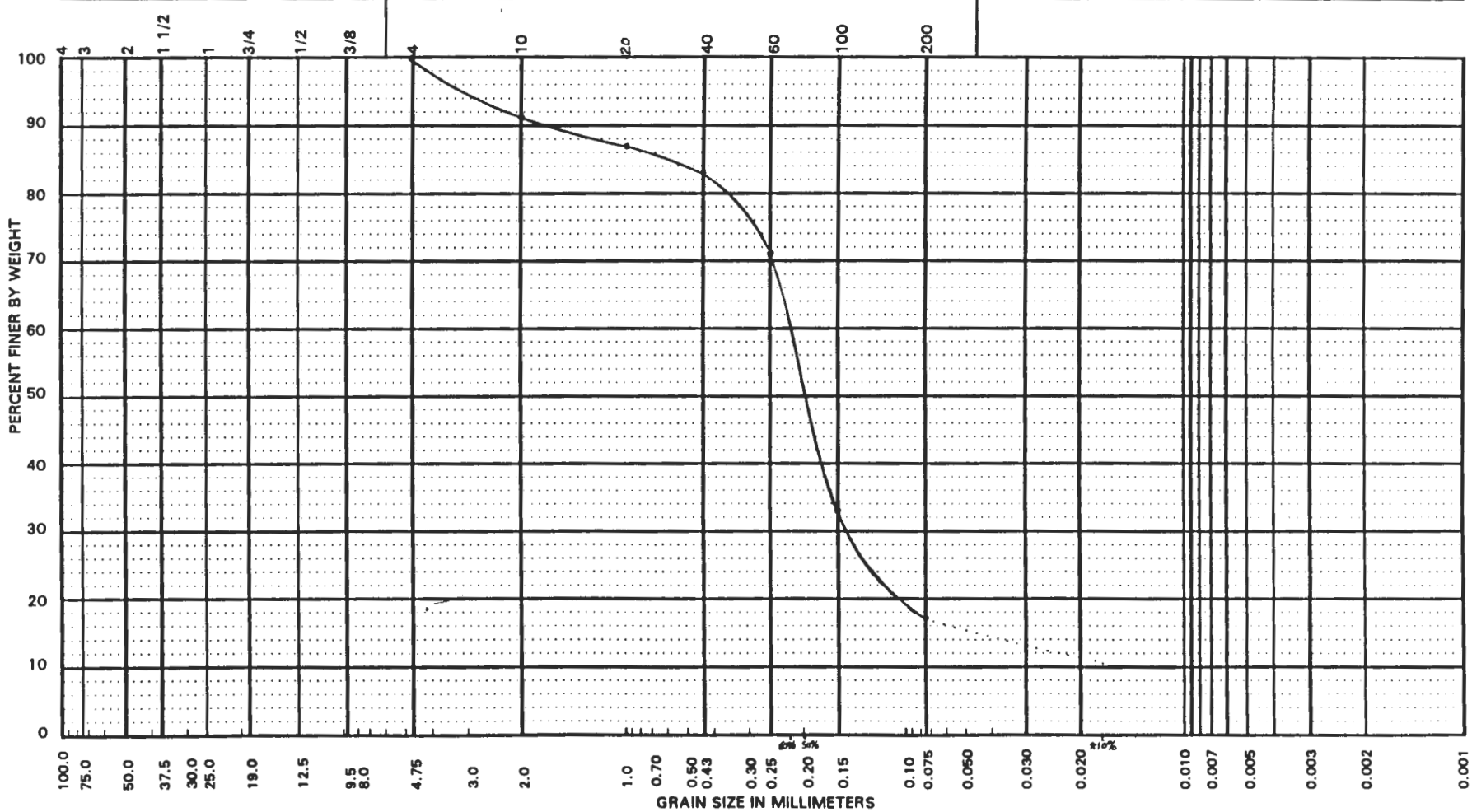
COPY

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 49-251
299-W15-34

Page 2 of 2

Remarks Recalculated Sample Normalized to ≤4 Sieve | Initial Wt: 248.7g | #10-22.5g | #20-11.0g | #40-8.9g | #60-28.6g | #100-95.3g | #200-39.6g | PAN-42.8g
UNIFORMITY COEFFICIENT: ≈13 | 50% passing = .008" 50% passing #5 = .039" ∴ SANDPACK SHOULD BE 16-30 with 30 slot screen based on existing inventory |



Plotted By Mark Darrach / Mark Darrach Date 3/1/96

Plot Checked By EDWARD C. Rafuse / Edward C. Rafuse Date 03/01/96

BD-6000-799 (04/92)

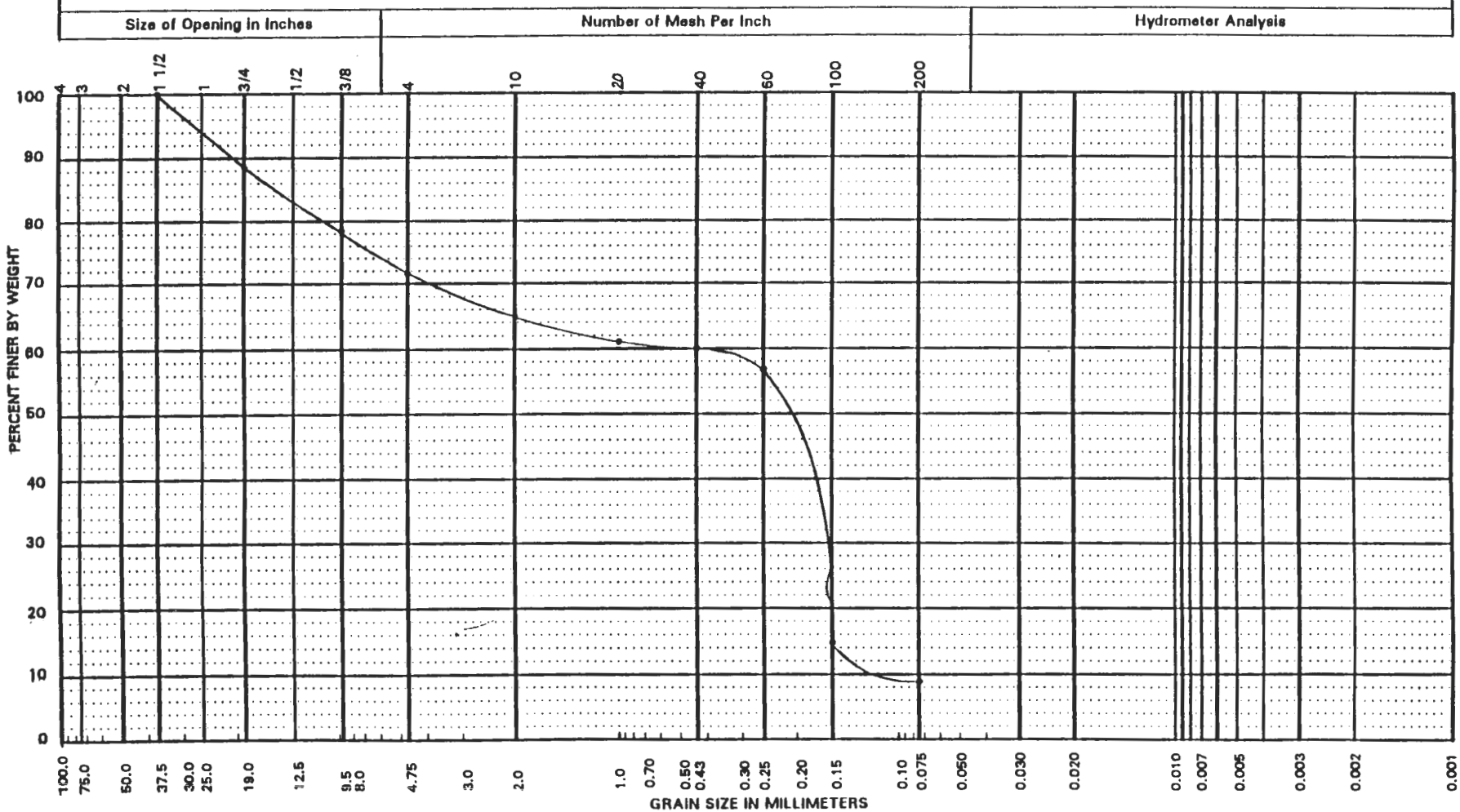
RECORD COPY

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 2[redacted] 11 B04406
Well 299-W[redacted]5

Page 1 of 2

Remarks INITIAL SAMPLE WT: 386.0g / 3/4" - 39.2g / 3/8" - 24.5g / #4 - 25.2 / #10 - 13.4 / #20 - 6.9g / #40 - 11.1g / #60 - 164.3 / #100 - 41.8g / #200 - 22.3
PAN - 34.3g



Plotted By Mark Darrach / Mark Darrach Date 3/12/96

Plot Checked By Edward C. Lefever / Edward C. Lefever Date 03/13/96

BD-6000-799 (04/92)

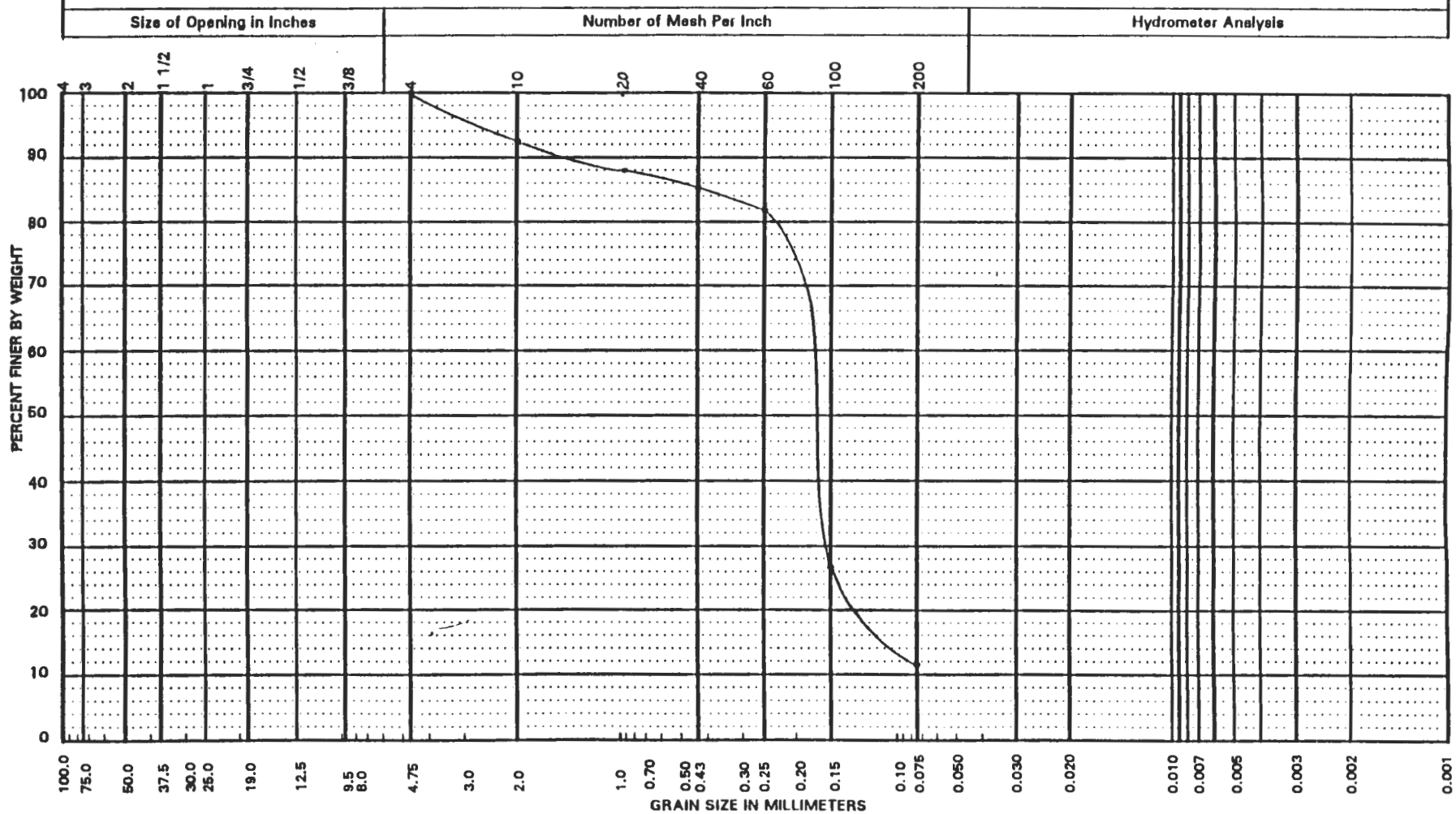
9745918.1874

RECORD COPY

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 210-211 B&HGD6
Well 299-W15-85
Page 2 of 2

Remarks Recalculated Initial Sample Weight Normalized to <#4 Sieve: 297.1g | #10-13.4g | #20-6.9g | #40-11.1g | #60-164.3g | #100-44.8g | #200-22.3g
PAN-34.3g | Uniformity Coefficient ≈3.4 50% passing .0067" * 5 = .034" * 6 = .040" | With *5 design = 16-30 Sand w/30 slot With *6 design is also 16-30, 30 slot



Plotted By Mark Marbach / Mark Marbach Date 3/12/96

Plot Checked By Edward C. Rathbone / Edward Rathbone Date 03/13/96

BD-6000-799 (04/92)

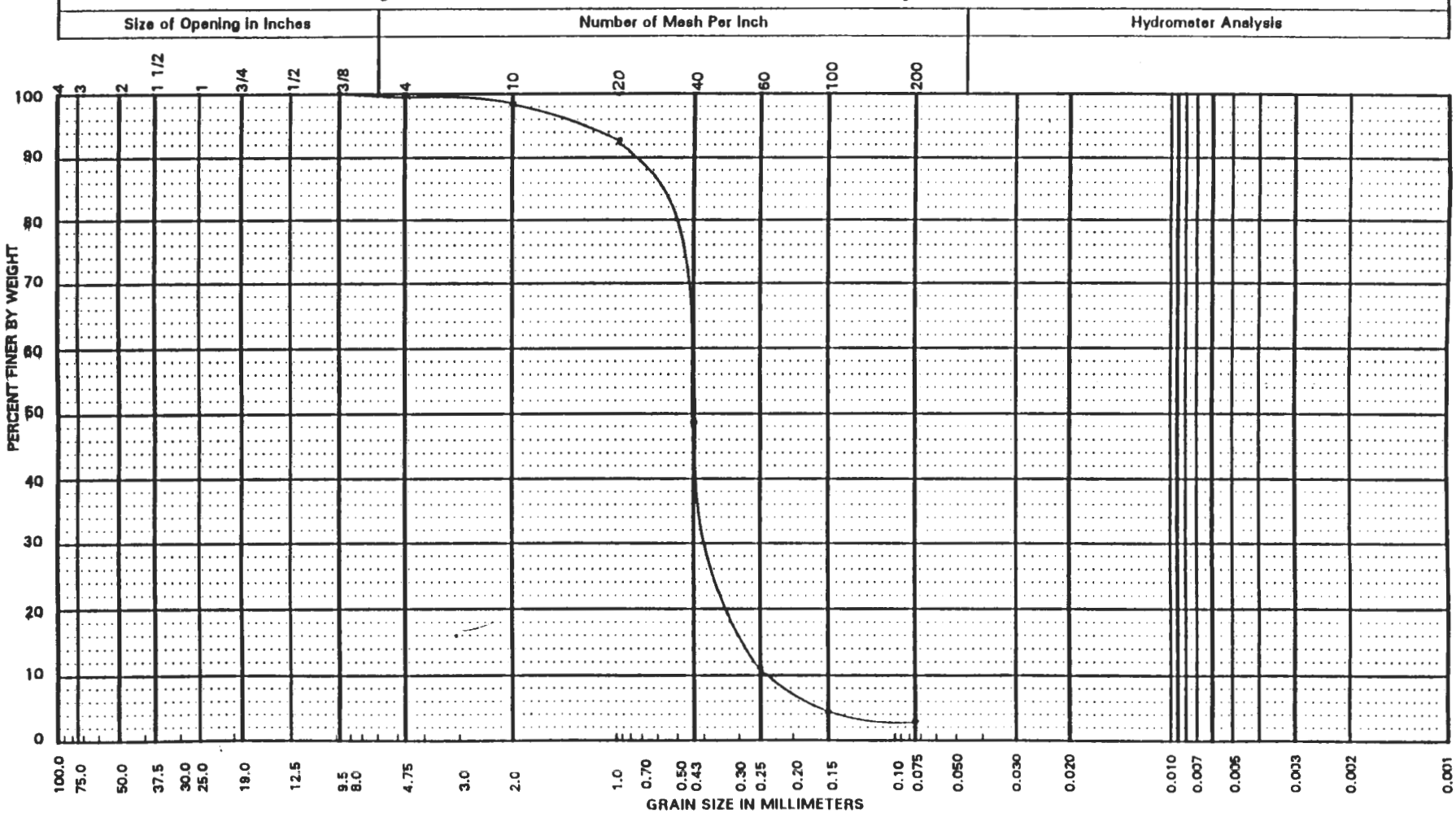
RECORD COPY

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. [illegible] 18' BOHGP
Well: 299-W[illegible]-35

Page 1 of 1

Remarks Initial Sample Wt: 300.0g | #4 - .8g | #10 - 4.0g | #20 - 17.4g | #40 - 132.3 | #60 - 112.8 | #100 - 19.9g | #200 - 4.6g | Pan - 3.2 + 5.0g
Uniformity Coefficient: 1.8 50% passing = .017" * 5 = .085" Based on existing inventory the design should be 6-12 sand w/ .070 slot screen



Plotted By Mark Darrach / Mark Darrach Date 3/12/96

Plot Checked By Edward C. Rafuse / Edward C. Rafuse Date 03/12/96

BD 6000 799 (04/92)

C-27

BHI-00927
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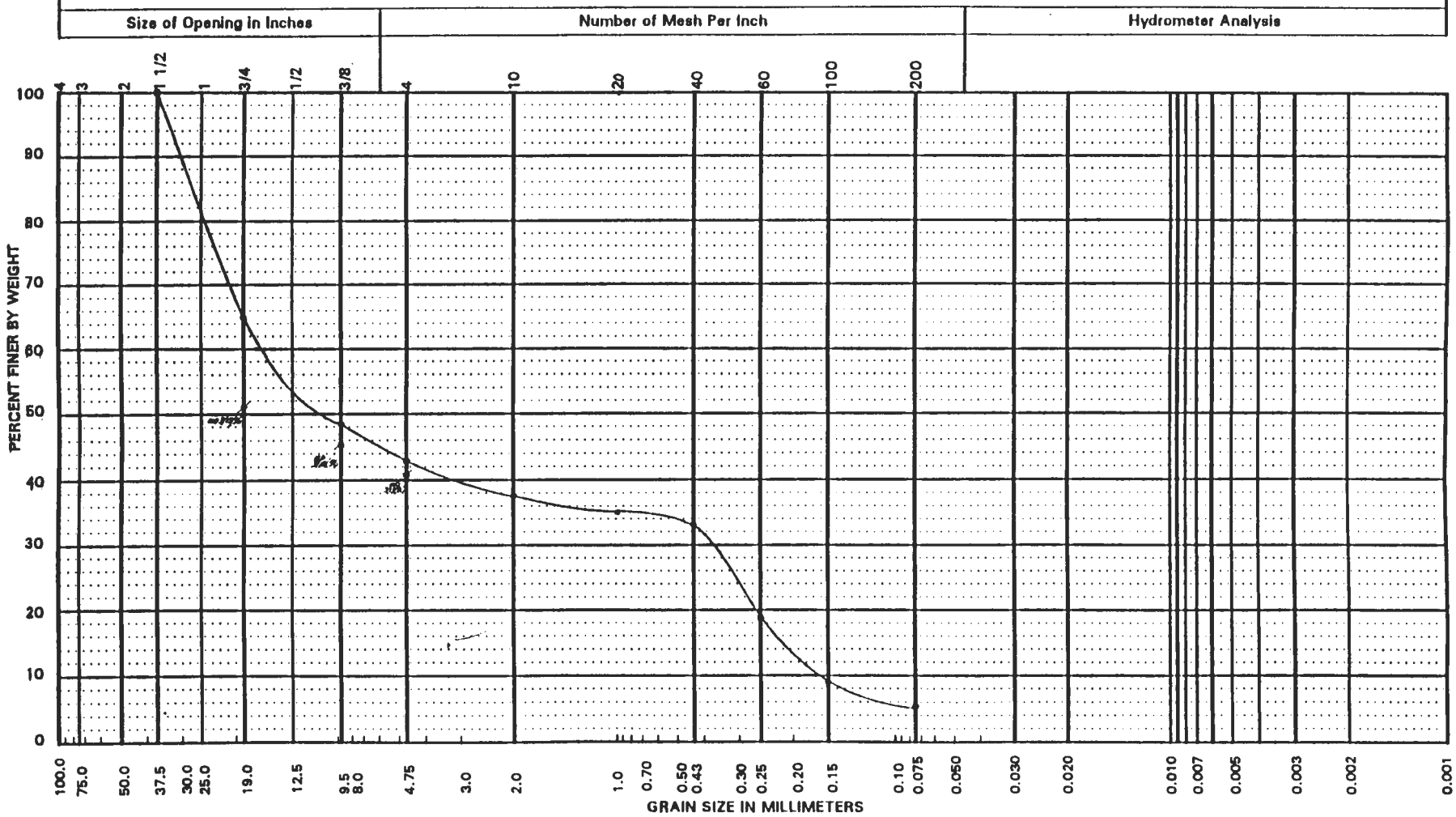
GEL-07 GRAIN SIZE ANALYSIS PLOT

RECORD COPY

Sample No. 230-232'
Well 299-W[illegible]: BØHGD8
Page 1 of 2

Remarks INITIAL SAMPLE WT: 652.1g | 3/4" - 227.6g | 3/8" - 109.6g | #4 - 37.2g | #10 - 30.9g | #20 - 18.1g | #40 - 11.2g | #60 - 94.9g | #100 - 64.7g | #200 - 20.1g
PAN - 37.8g



Plotted By Mark Darrach / Mark Darrach Date 3/13/96

Plot Checked By EDWARD C. RAFFAC / Edward C. Raffac Date 03/13/96

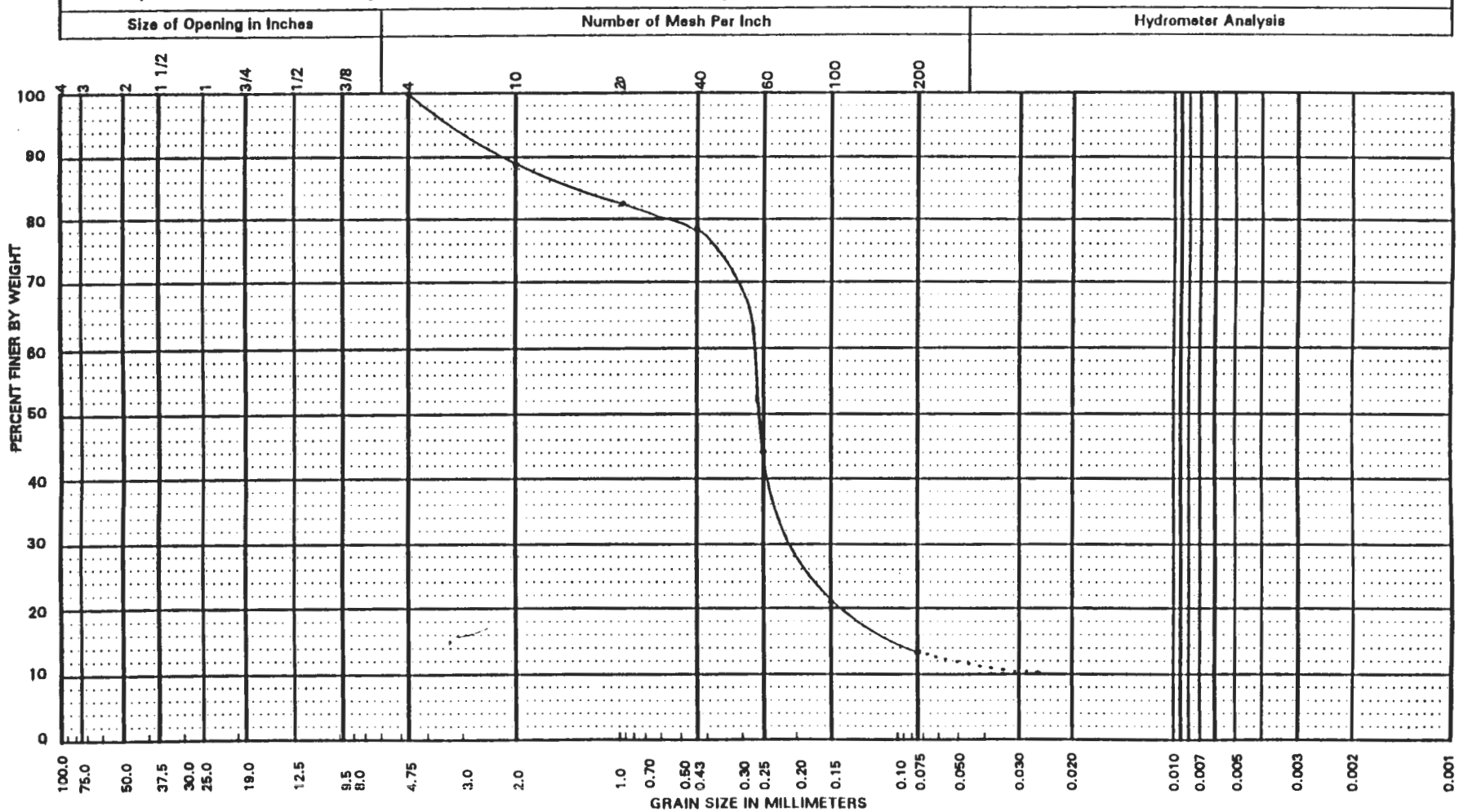
BD-6000-799 (04/92)

GEL-07 GRAIN SIZE ANALYSIS PLOT

RECORD COPY

Sample No. 230-232
Well # 299-W15-35 BOHGDB
Page 2 of 2

Remarks <INITIAL SAMPLE WT RECALCULATED AND NORMALIZED TO < #4 SIEVE: 277.7g / #10-30.9g / #20-18.1g / #40-11.2g / #60-34.9g / #100-64.7g / #200-20.1g / PAN-37.8g
Uniformity Coefficient: ≥10.0 / 50% passing .010" #5 = .050; #6 = .060" / With #5 design = 10-20 SAND / 30 or 40 slot screen / With #6 design = 8-16 SAND and 40 or 50 slot screen



Plotted By Mark Darrach / Mark Darrach Date 3/13/96

Plot Checked By Edward C. Rafuse / Edward Rafuse Date 03/13/96

BD-6000-799 (04/92)

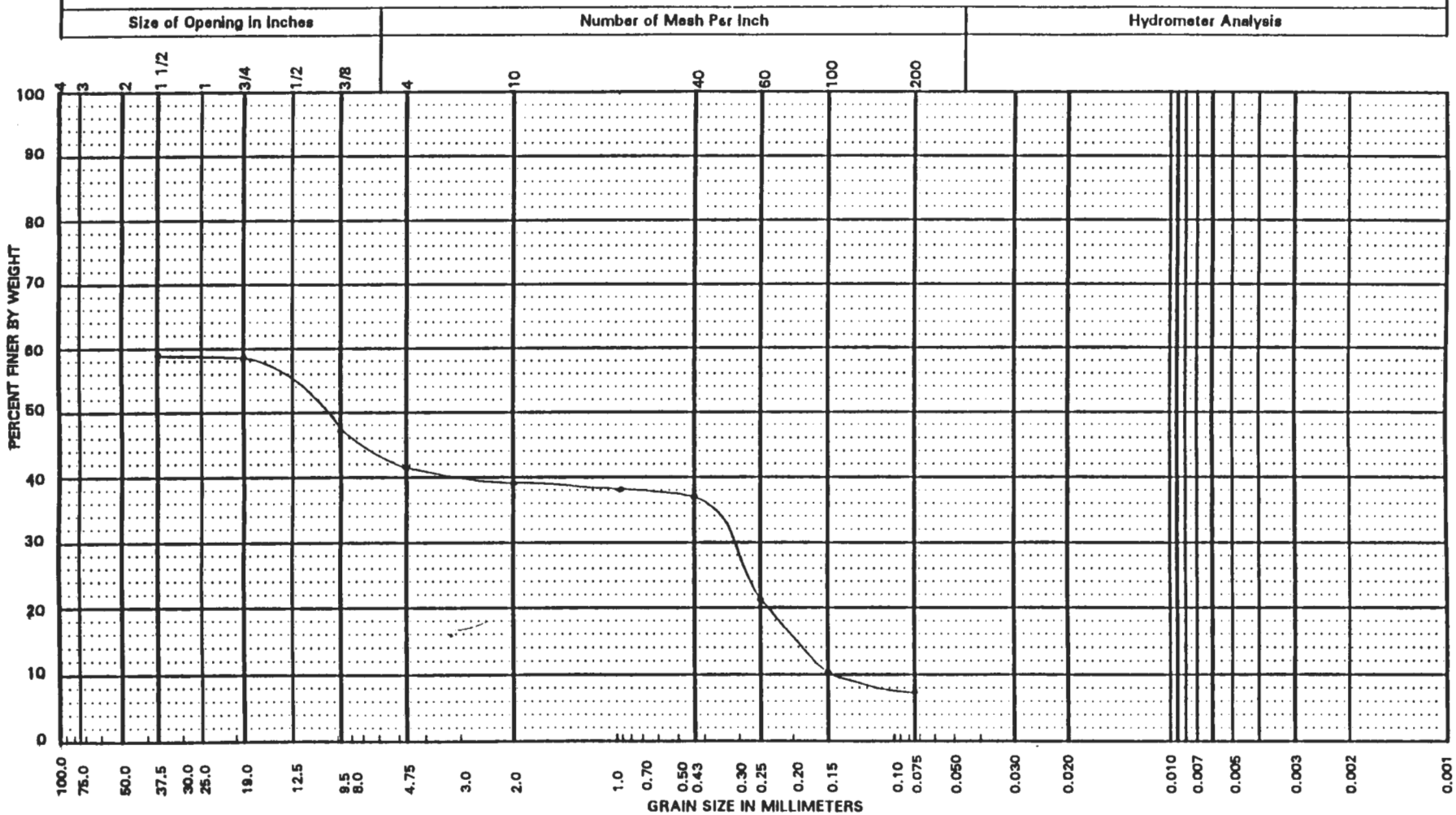
RECORD COPY

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. [redacted]-24a'
Well #299-W15-35

Page 1 of 2

Remarks INITIAL SAMPLE WT: 395.3g | 1½"-163.4g | ¾"-0.0g | ⅜"-46.5g | #4-21.0g | #10-8.8 | 20-5.1g | 40-3.7g | 60-62.6 | 100-43.8g | 200-10.9g
PAN-28.5



Plotted By Mark Darrach / Mark Darrach Date 3/13/96

Plot Checked By EDWARD C. RAFUSE / Edward Rafuse Date 3/13/96

GEL-07 GRAIN SIZE ANALYSIS PLOT

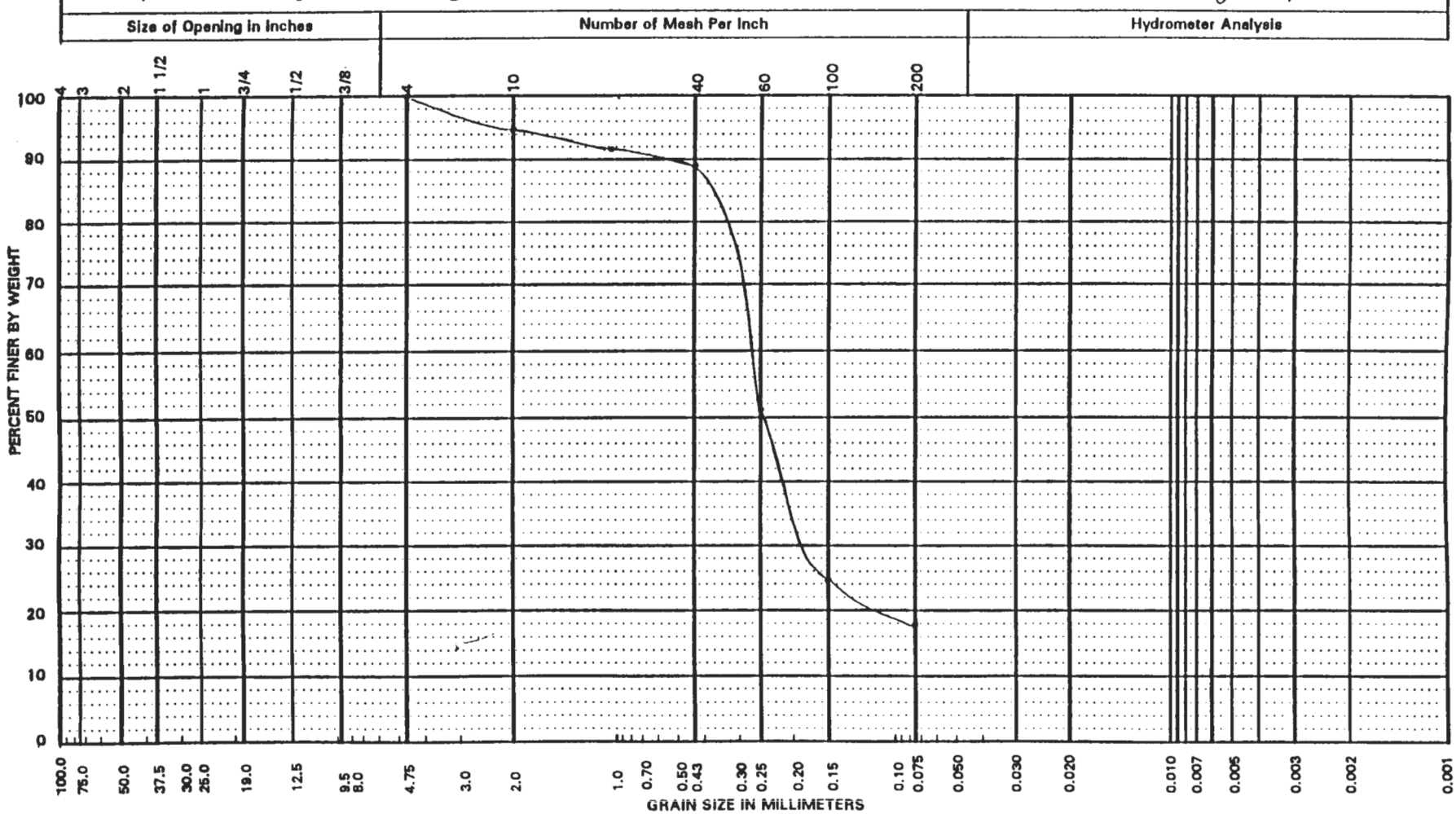
RECORD COPY

Sample No. - [redacted] 240'
Well 299-W15 [redacted]

Page 2 of 2

Remarks Recalculated Sample Normalized to <#4 Sieve; Initial Wt - 164.4g / #10 - 8.8g / #20 - 5.1g / #40 - 9.9g / #60 - 62.6g / #100 - 43.8g / #200 - 10.9g / PAN - 29.5

Uniformity Coefficient: very large (≈15) / 50% passing = .009" * 5 = .045" / With #5 well design = 10-20 sand with 40 slot screen With #6 well design also yields 10-20/40 slot



Plotted By Mark Darrach / Mark Darrach Date 3/13/96

Plot Checked By EDWARD C. RAFFE / Edward C. Raffe Date 03/18/96

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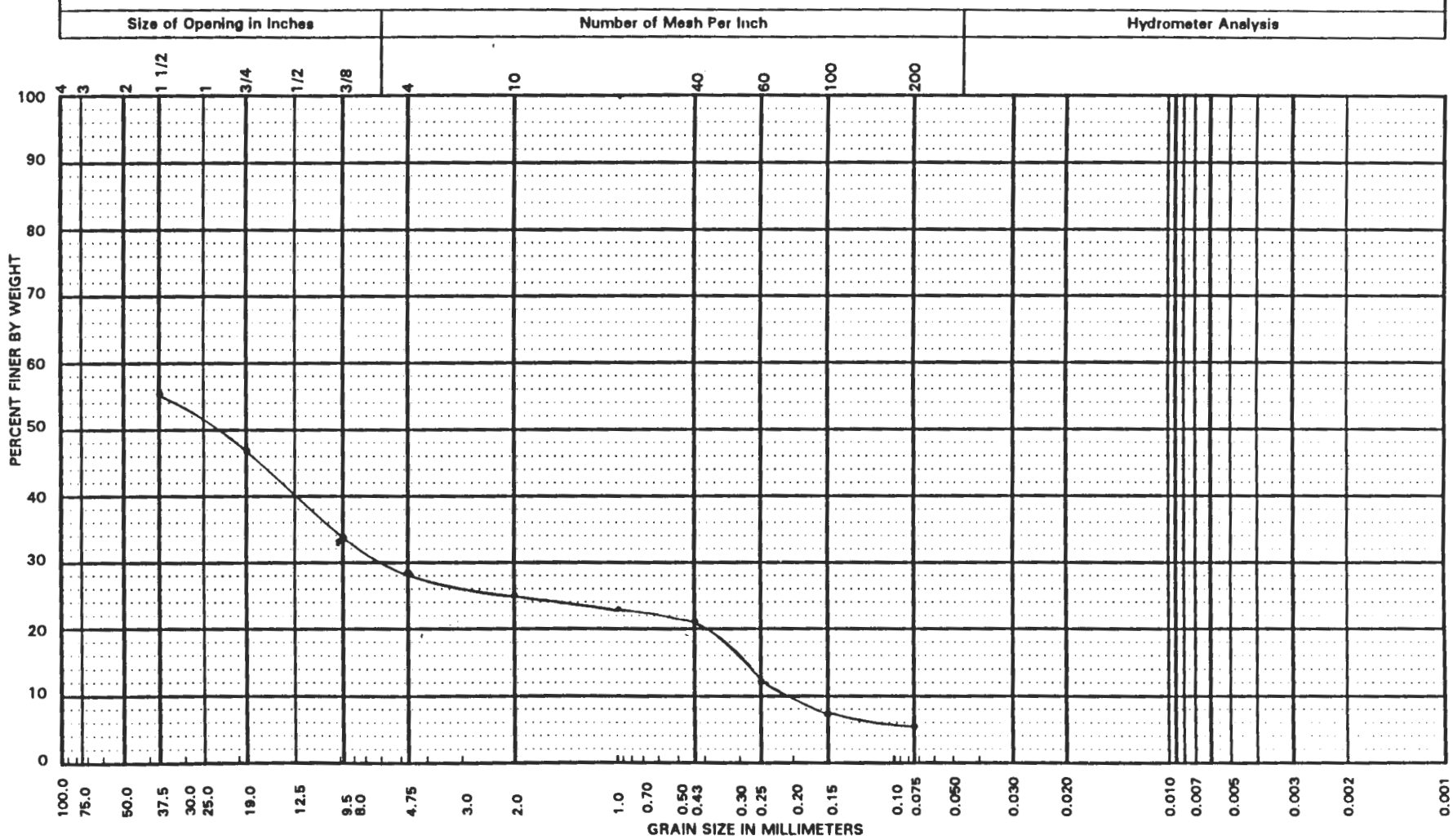
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. Well W15-36 / 212-214 BOHG31

Page 1 of 2

Remarks Initial Wt. 817.9g / 1½"-361.2g / ¾"-75.3g / ⅜"-104.5g / #4-46.1g / #10-27.1 / #20-14.0g / #40-17.3 / #60-73.6g / #100-37.8 / #200-15.5g / PAN-45.5g



Plotted By Mark Darrach / Mark Darrach Date 4/20/96

Plot Checked By Edward C. Rafuse / Edward C. Rafuse Date 04/29/96

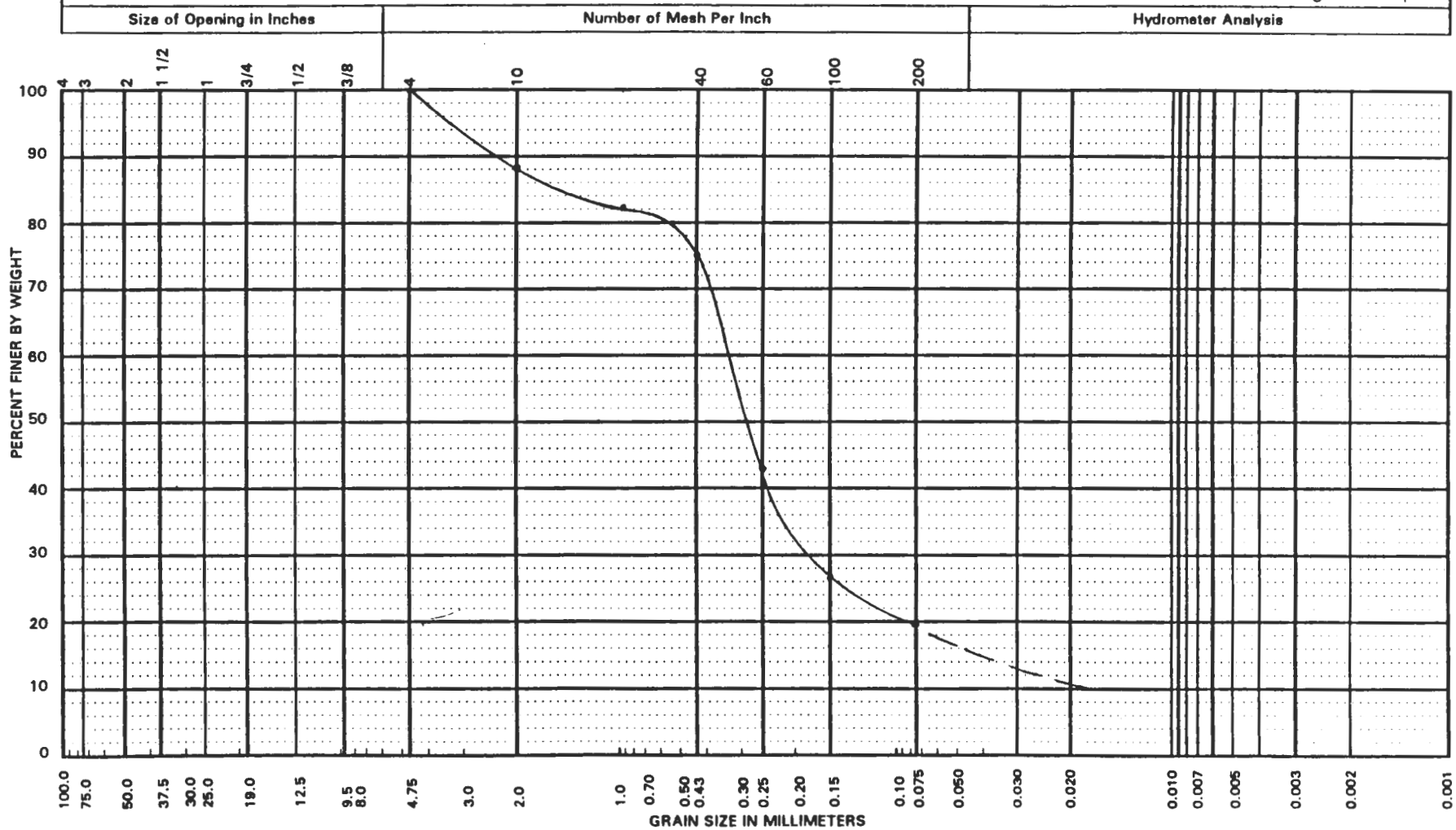
BD-6000-799 (04/92)

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. Well W15-36/~~217.5 → 219~~ 212-214 EJ 2/20/98

Page 2 of 2

Remarks Plot normalized to the #4 and smaller sieve size /#10-27.1 /#20-14.0 /#40-17.3 /#60-93.6 /#100-37.8 /#200-15.5g /#PAN-45.5g /INITIAL WT: 230.8g
Uniformity Coefficient 60/10 = approximately 17.8 / 50% passing = .011" * 6 = .066 Design is B-16 Sand w/40 or 50 slot screen based on existing inventory



Plotted By Mark Darrach / Mark Darrach Date 4/29/98

Plot Checked By Edward C. Rafuse / Edward C. Rafuse Date 04/29/98

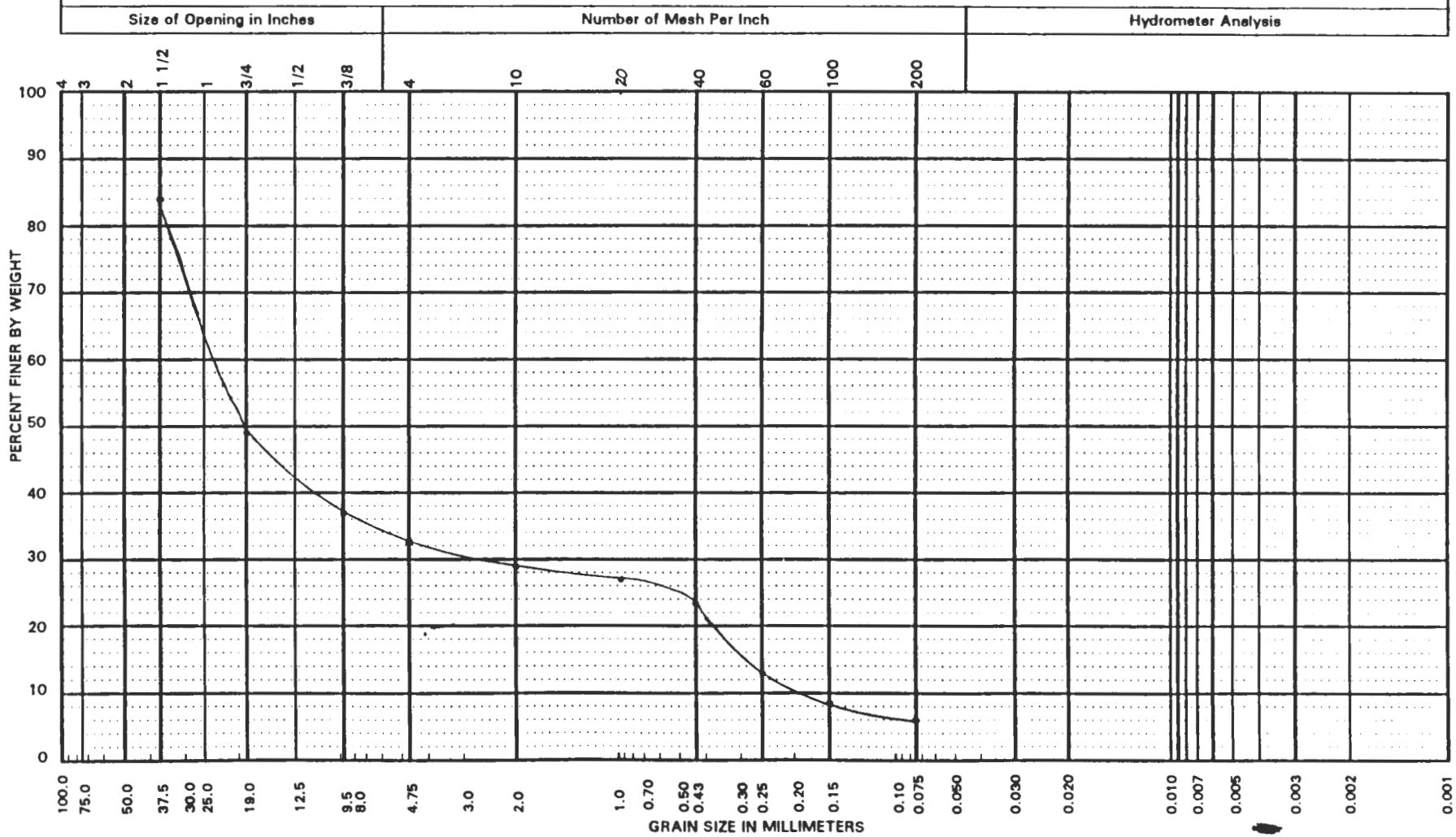
BD-6000/799 (04/92)

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 8[illegible]32
Well W15-36/217.5-219

Page 1 of 2

Remarks INITIAL WT: 790.5g / #1½"-125.3 / ¾"-277.5 / ⅜"-93.5 / #4-39.6 / #10-25.2 / #20-17.4 / #40-23.2 / #60-87.6 / #100-34.6 / #200-18.7
PAN-47.9



Plotted By Mark Darrach / Mark Darrach Date 4/29/96

Plot Checked By EDWARD C. RATCLIFF / Edward C. Ratcliff Date 05/01/96

BD-6000-799 (04/92)

RECORD COPY

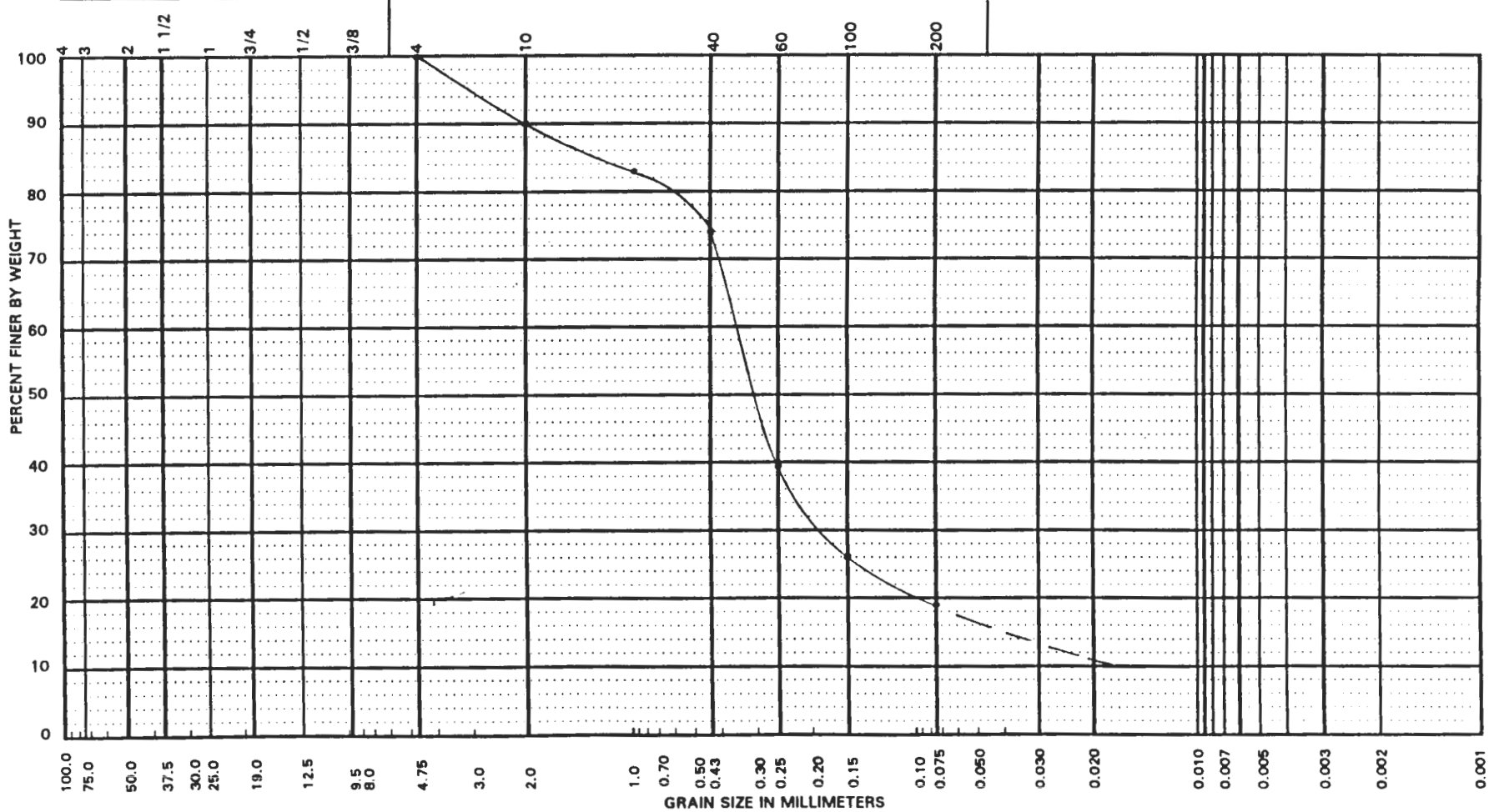
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. W15-36/217.5-219

Page 2 of 2

Remarks Plot normalized to #4 sieve Initial Wt: 254.6g /#10-25.2 /#20-17.4 /#40-23.2 /#60-87.6 /#100-34.6 /#200-18.7 /PAN-47.9

Uniformity Coefficient: 60/10 = approximately 18.9 50% passing = .0118" * 6 = .0709 / Design = 8-16 sand w/40 or 50 slot screen



Plotted By Mark Darrach / Mark Darrach Date 4/29/96

Plot Checked By EDWARD C. ROTSCH / Edward C. Rotsch Date 05/01/96

BD-6000-799 (04/92)

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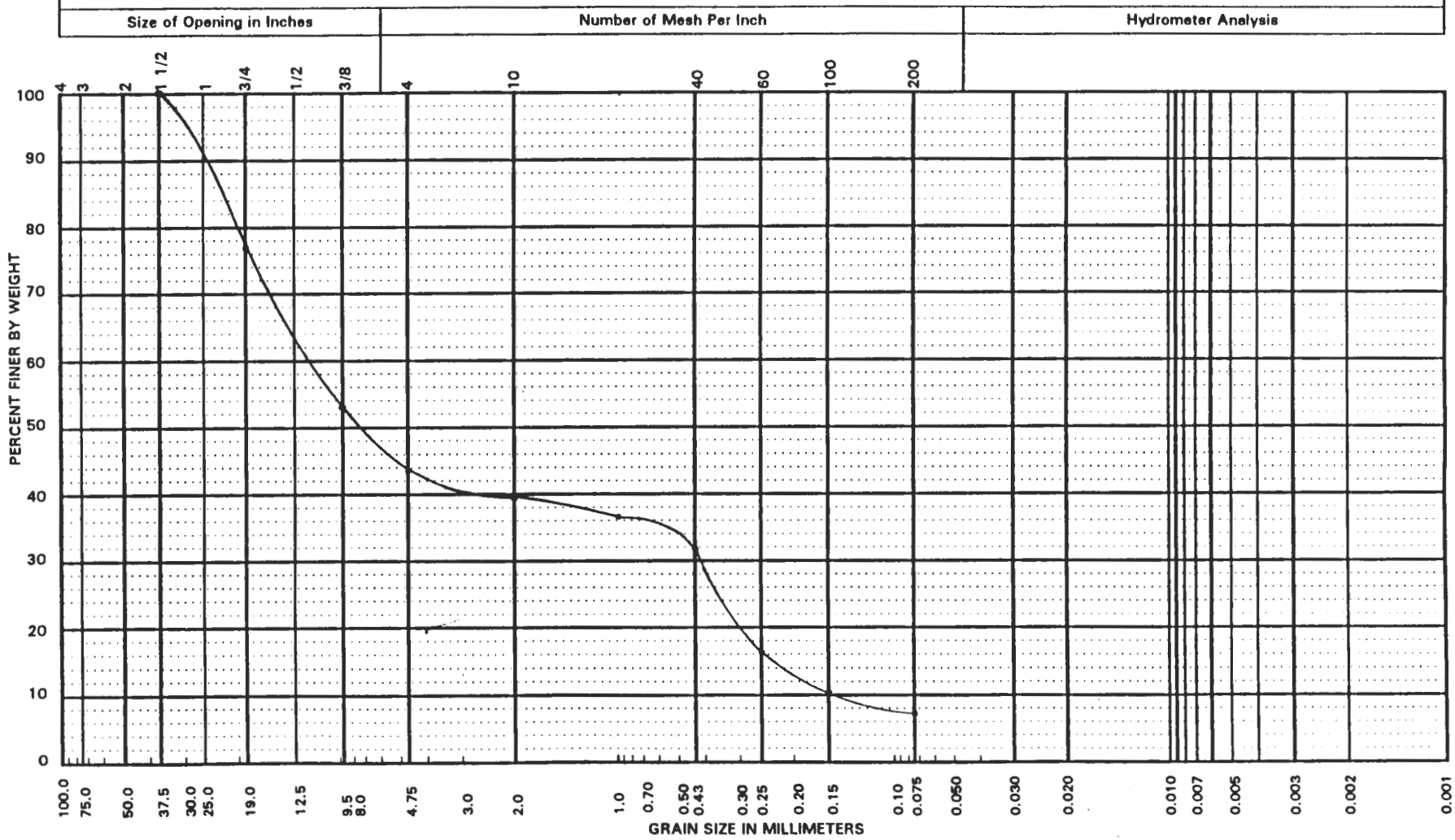
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. W15-36 228-230 BØ1653

Page 1 of 2

Remarks INITIAL WT: 512.6g | 3/4"-118.4 | 3/8"-123.4 | #4-46.3 | #10-21.9 | #20-14.8 | #40-24.5 | #60-80.6 | #100-29.4 | #200-15.3 | PAN-38.0g



Plotted By Mark Darrach / Mark Darrach Date 4/30/96

Plot Checked By EDWARD C. RAFUSE / Edward C. Rafuse Date 05/01/96

BD-6000-799 (04/92)

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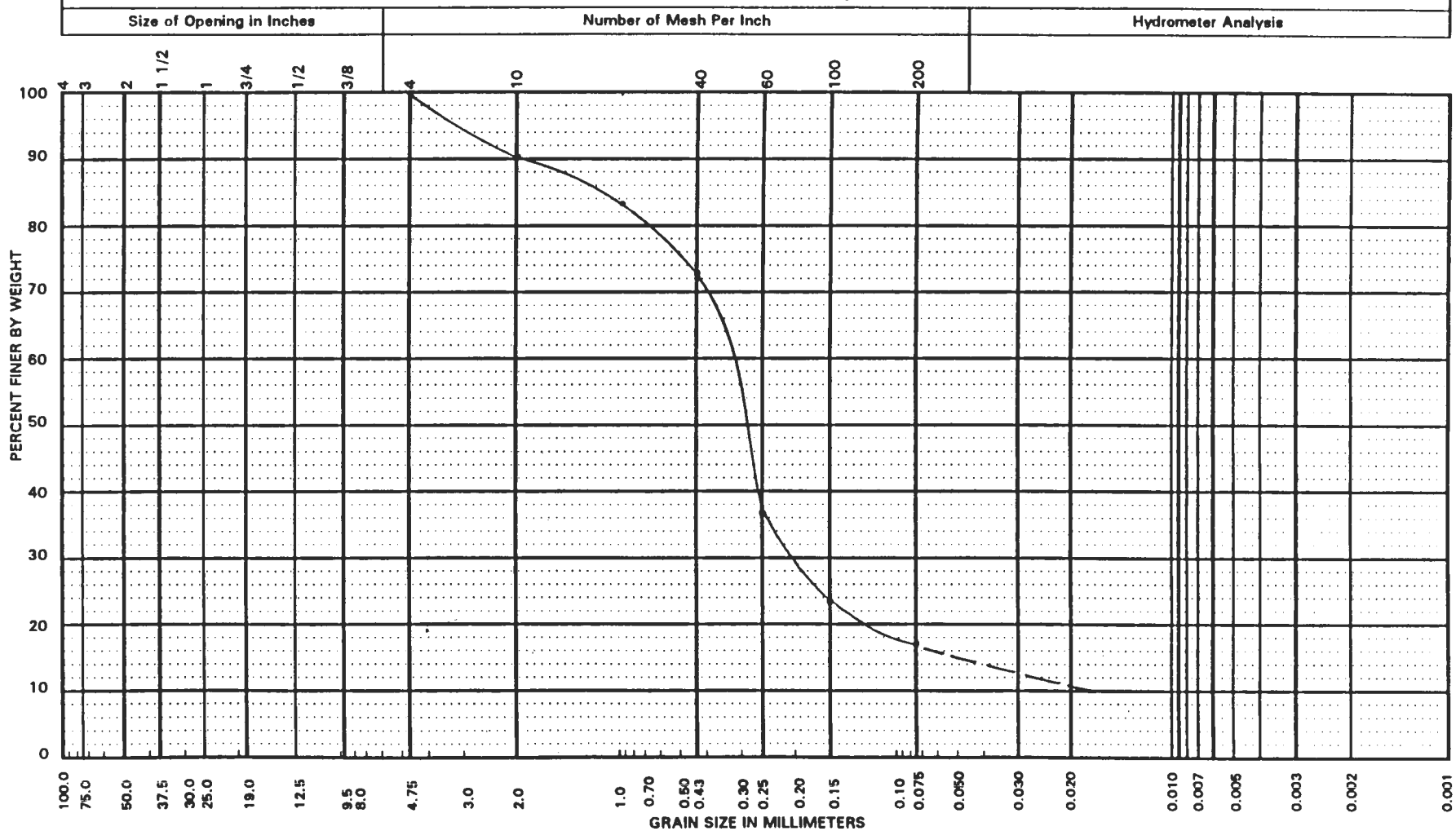
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. WIS-36 228-230

Page 2 of 2

Remarks Plot normalized to ≤#4 Sieve Initial Wt: 224.5 | #10-21.9 | #20-14.8 | #40-24.5 | #60-80.6 | #100-29.4 | #200-15.3 | PAN-38.0

Uniformity Coefficient 60/10 = 19.4 50% passing = .0110 × 6 = .0661 Design = B-16 sand/gravel pack with 40 or 50 slot screen



Plotted By Mark Darrach / Mark Darrach Date 4/30/96

Plot Checked By EDWARD C. RAFFAE / Edward C. Raffae Date 05/01/96

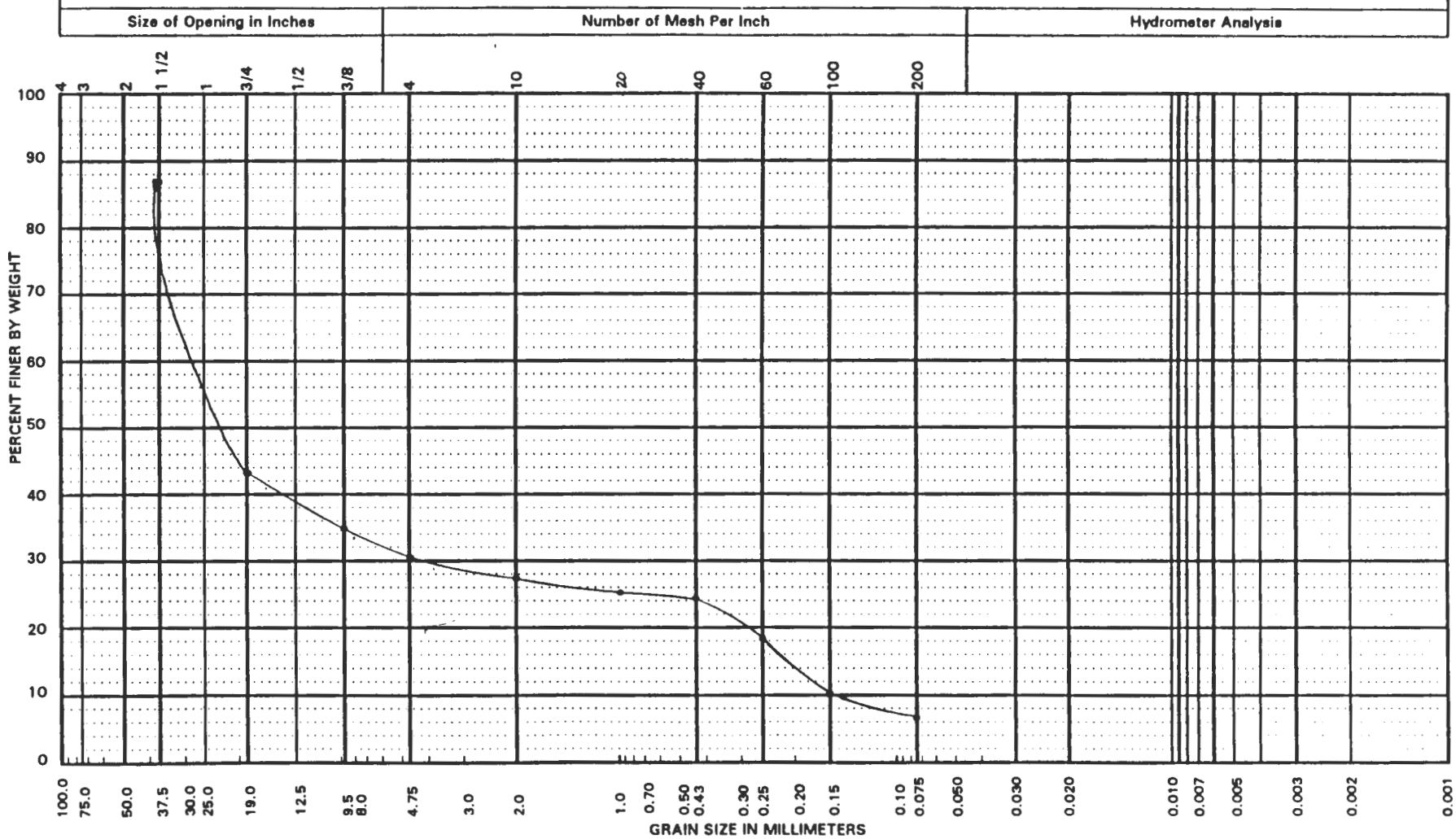
BD-6000-799 (04/92)

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. W15-36 / 238-240 BØHG34

Page 1 of 2

Remarks INITIAL WT: 782.9g / 1½"-103.5 / ¾"-342.9 / ⅜"-63.9 / #4-33.2 / #10-22.9 / #20-15.0 / #40-10.1 / #60-47.5 / #100-64.3 / #200-30.0 / PAN-49.6



Plotted By Mark Darrach / Mark Darrach Date 4/30/96

Plot Checked By EDWARD C. RAFFIZE / Edward C. Raffize Date 05/01/96

BD-6000-799 (04/92)

RECORD COPY

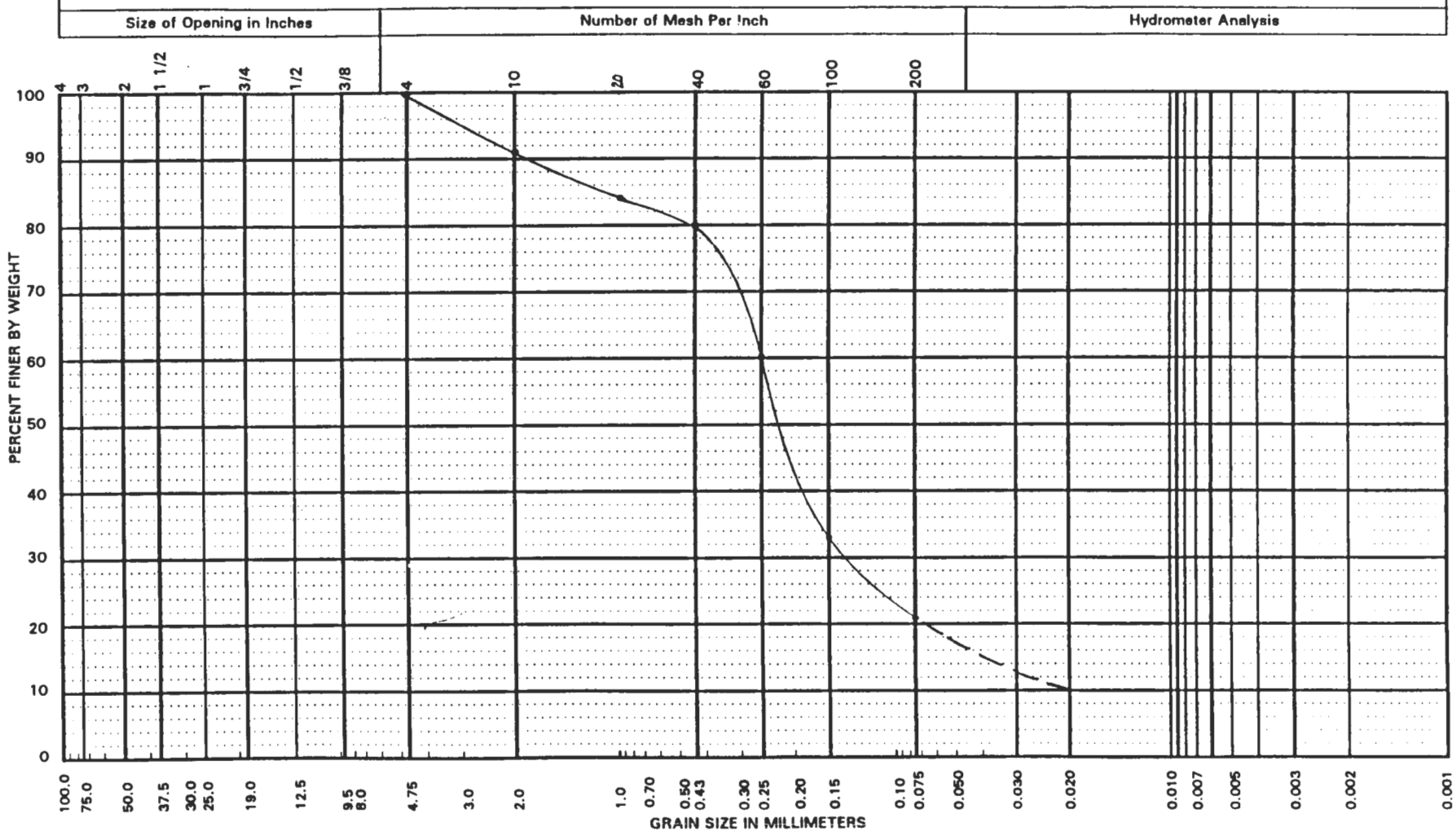
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. W15-36/238-240

Page 2 of 2

Remarks Plot recalculated to ≤ #4 sieve Initial Wt: 239.4g /#10-22.9 /#20-15.0 /#40-10.1g /#60-47.5g /#100-64.3g /#200-30.0 / PAN-49.6

Uniformity Coefficient $D_{60}/D_{10} \approx 12.5$ 50% passing = .00906" High uniformity coef. justifies large multipliers 50% × 8 = .0725 / Design = 8-16 pack w/40 slot screen



Plotted By Mark Darrach / Mark Darrach Date 4/30/96

Plot Checked By EDWARD C. RAFFAS / Edward C. Raffas Date 05/01/96

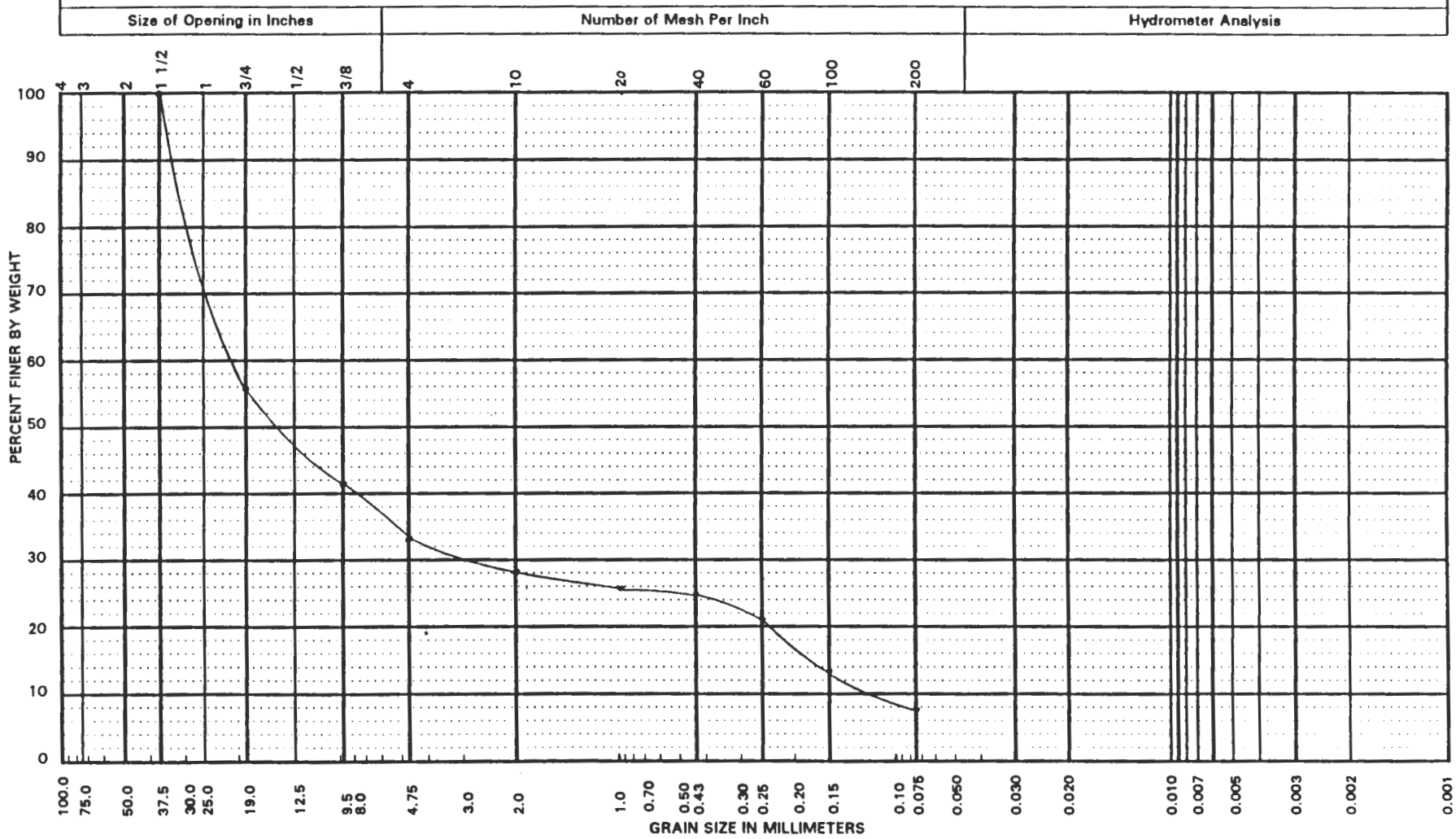
BD-6000-799 (04/92)

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. BØH535
W15-36/247.5-249.5

Page 1 of 2

Remarks Initial Wt: 817.6 g | 3/4"-360.9 | 3/8"-115.0 | #4-73.3 | #10-37.3 | #20-19.1 | #40-10.5 | #60-29 | 100-60.5 | 200-48.2 | PAN-63.8



Plotted By Mark Darrach / Mark Darrach Date 5/1/96

Plot Checked By EDWARD C. RATFIEL / Edward C. Ratfiel Date 05/01/96

BD-6000-799 (04/92)

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. WIS-36/247.5-249.5

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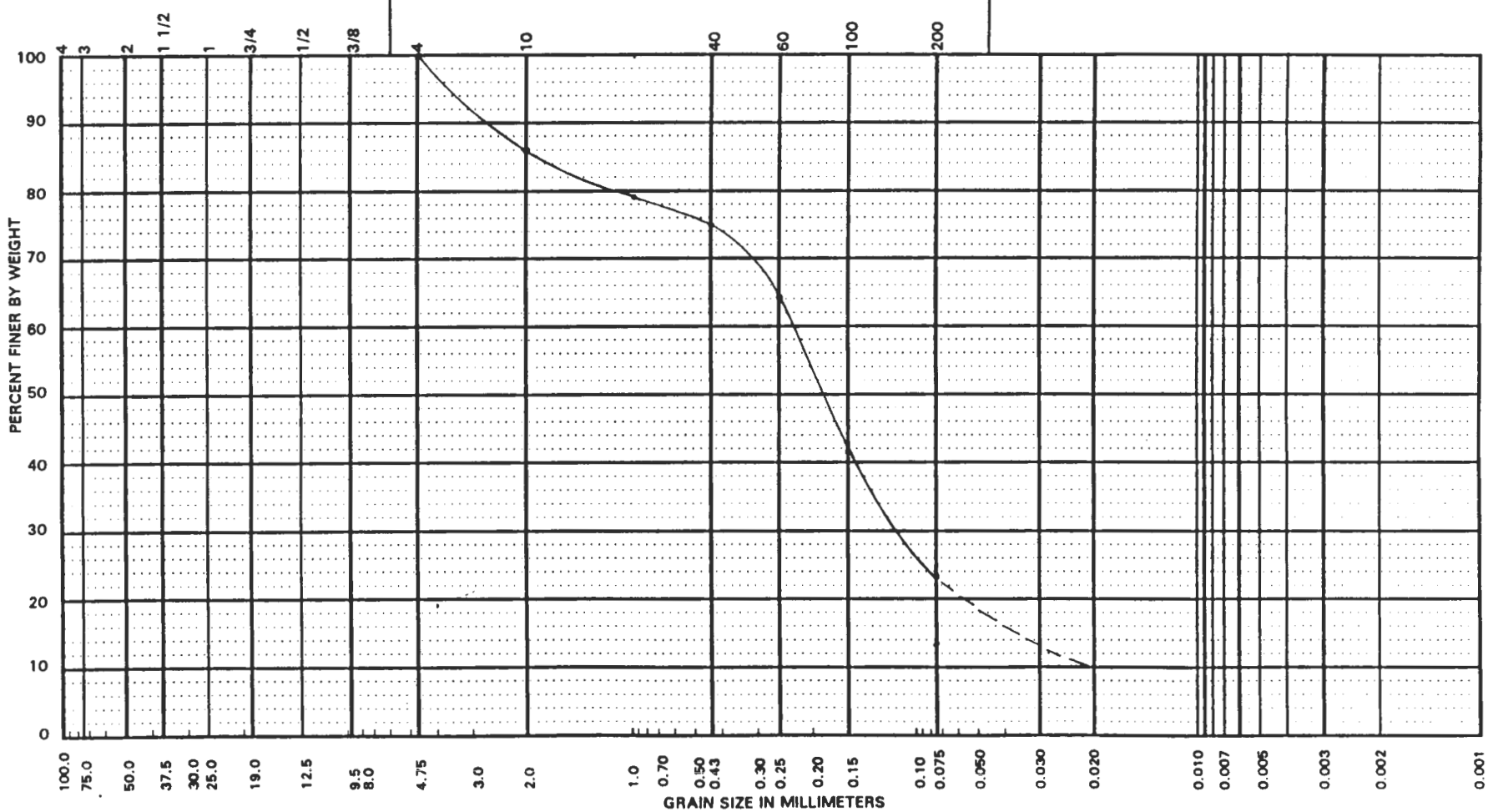
Remarks Plot normalized to ≤#4 Initial Wt: 268.4 / #10-37.3 / #20-19.1 / #40-10.5 / #60-29.0 / #100-60.5 / #200-48.2 / PAN-63.8

Uniformity Coefficient 60%/10% = 11.5 50% passing = .00709 High u.c. justifies a large multiplier ... 50% passing * 10 = .0709 Design = 8-16 w/40 or 50 slot screen



Plotted By Mark Darnach / Mark Darnach Date 5/1/96

Plot Checked By EDWARD C. RATUSZ / Edward C. Ratusz Date 05/01/96

BD-6000-799 (04/92)

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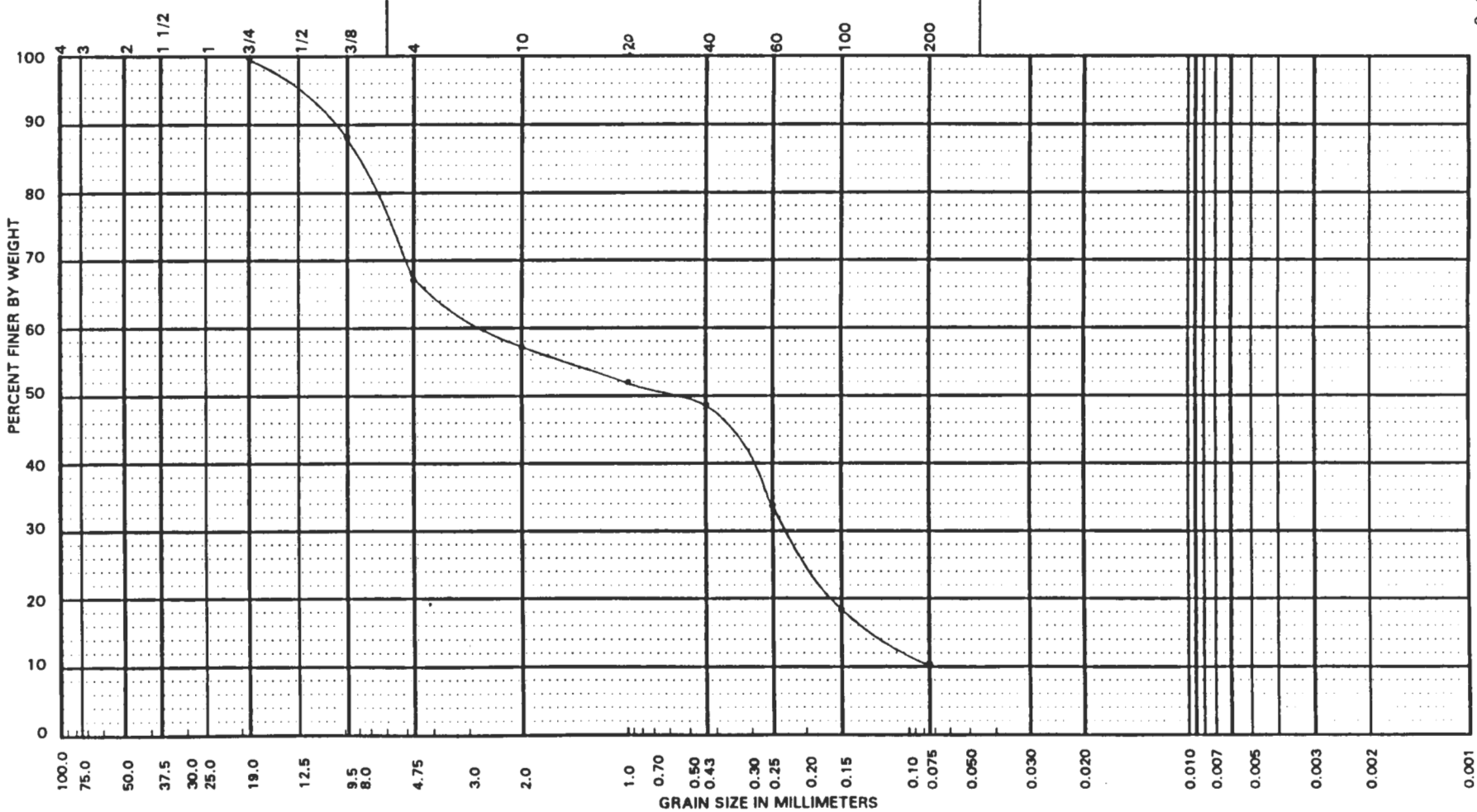
8.2

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. W15-37 / 211-212

Page 1 of 2

Remarks INITIAL WT: 457.2g / 3/8" - 54.7g / #4 - 94.9 / #10 - 45.7 / #20 - 23.8 / #40 - 16.2 / #60 - 66.5 / #100 - 73.0 / #200 - 34.7 / PAN - 47.7g



Plotted By Mark Darrach / Mark Darrach Date 5/9/96

Plot Checked By Edward Rafuse / Edward L. Rafuse Date 05/21/96

BD-6000-799 (04/92)

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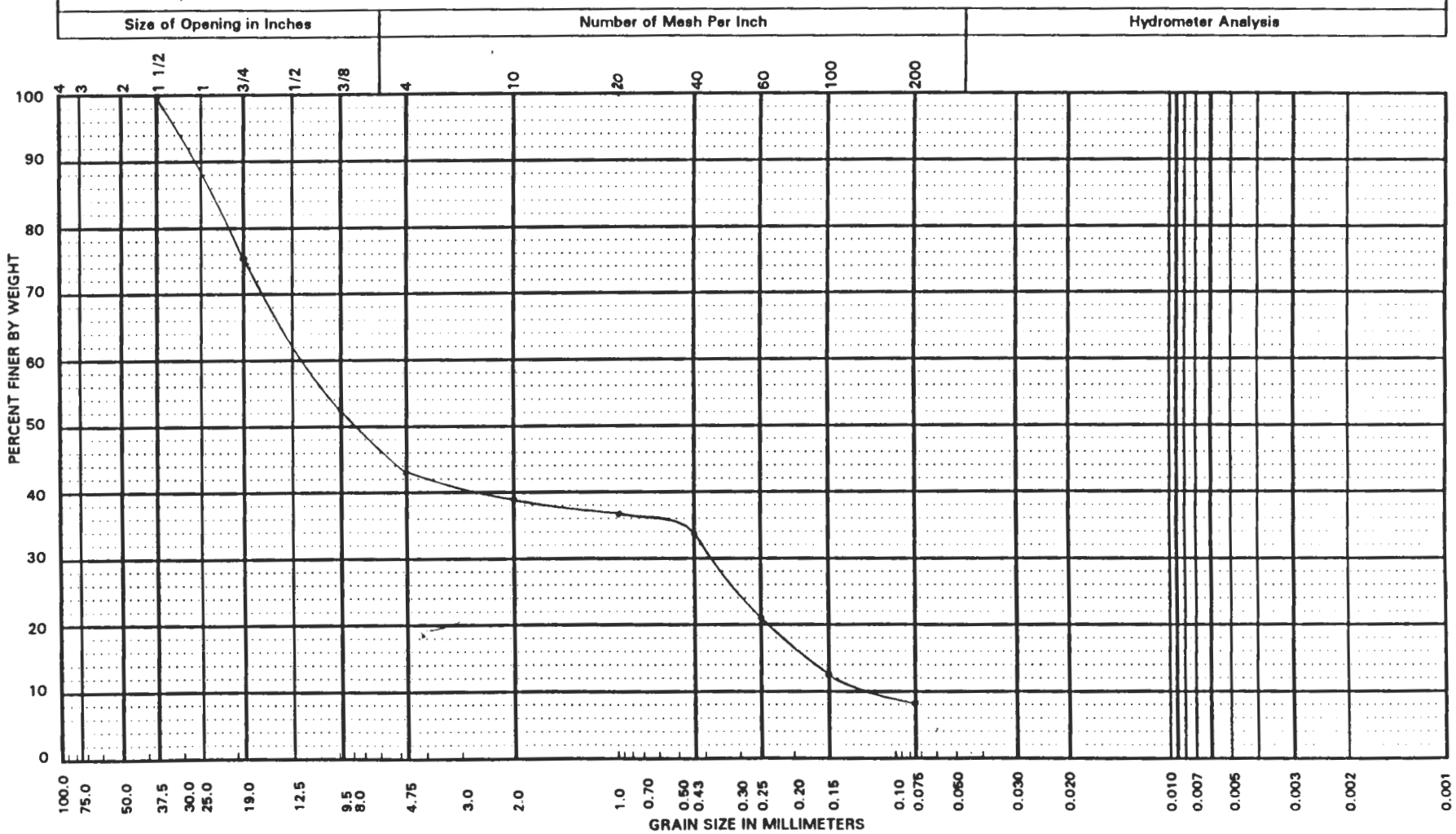
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. WS-37/238-240'

Page 1 of 2

Remarks INITIAL WT: 529.8g / 3/4" - 121.3 / 3/8" - 122.5 / #4 - 48.2 / #10 - 22.9 / #20 - 14.2 / #40 - 13.5 / #60 - 67.9 / #100 - 50.7 / #200 - 17.0 / PAN - 43.4 + 8.2



Plotted By Mark Darrach / Mark Darrach Date 5/13/96

Plot Checked By Edward C. Rafuse / Edward C. Rafuse Date 05/21/96

BD-6000-799 (04/92)

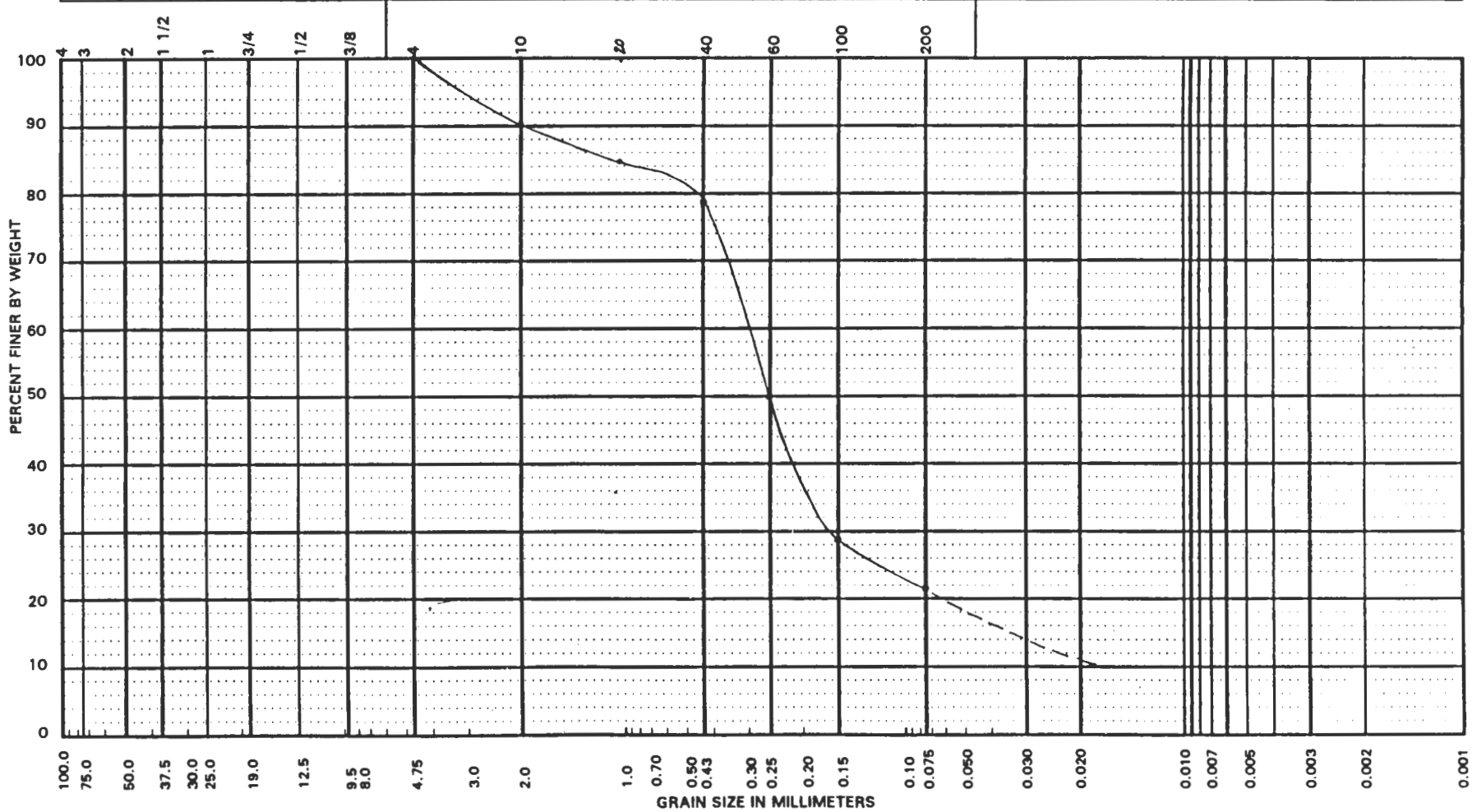
GEL-07 GRAIN SIZE ANALYSIS PLOT

RECORD COPY

Sample No. W15-37/238-240'

Page 2 of 2

Remarks Sample normalized to ≤#4 / #10-22.9 / #20-14.2 / #40-13.5 / #60-67.9 / #100-50.7 / #200-17.0 / PAN-51.6 / TOTAL WT: 237.8 g / Uniformity Coefficient 60/10 = 16.6 (approx.) 50% passing = .00984" High Uniformity Coefficient justifies a multiplier of 7 ∴ .00984 * 7 = .069" / Design = 8-16 Sand w/.040" slot screen



Plotted By Mark Darrach / Mark Darrach Date 5/13/96

Plot Checked By Edward C. Rafuse / Edward C. Rafuse Date 05/21/96

BD-6000-799 (04/92)

8.2

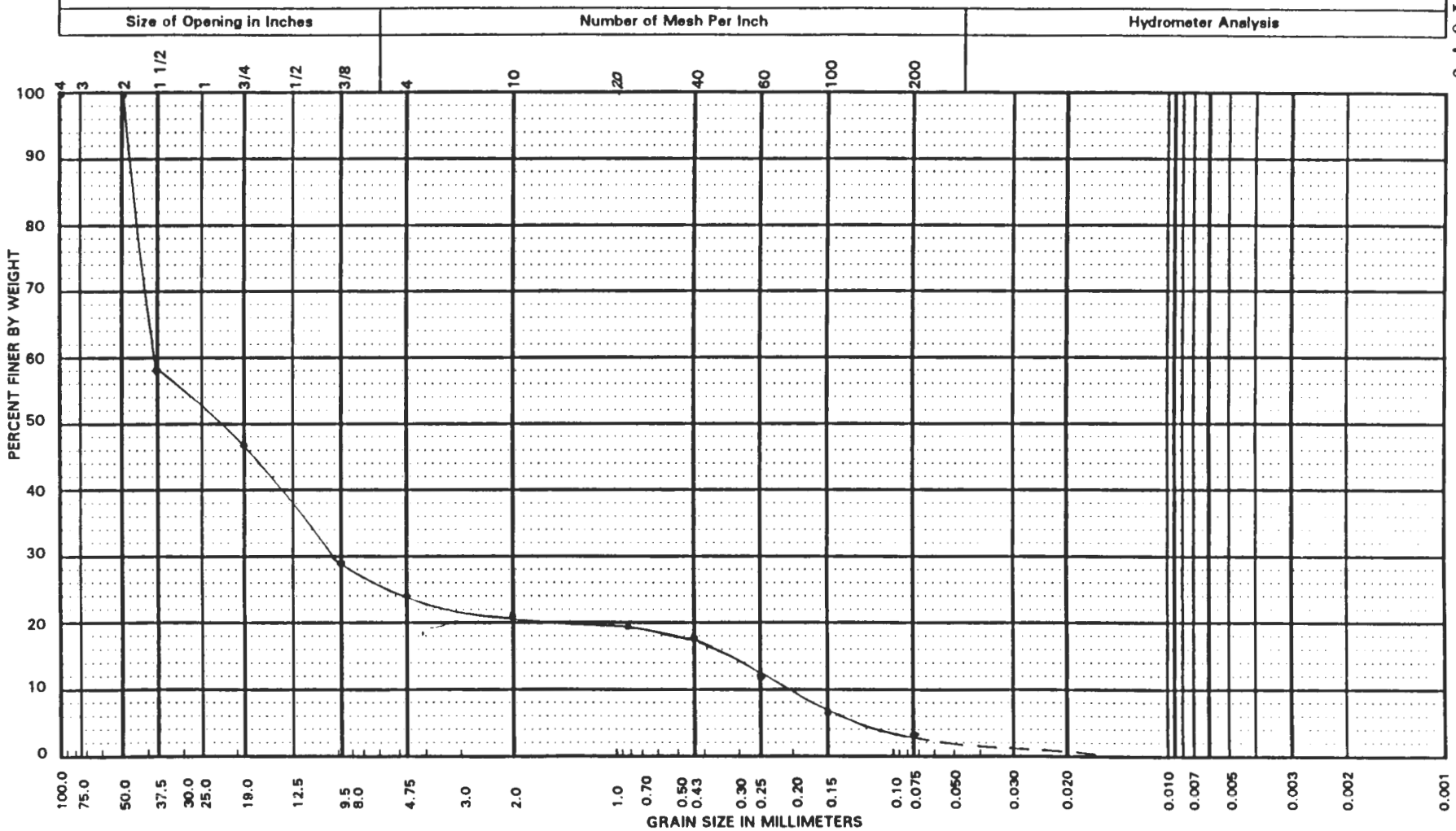
GEL-07 GRAIN SIZE ANALYSIS PLOT

UNCONTROLLED COPY

Sample No. 203-214'/Well W15-38

Page 1 of 2

Remarks Initial wt: 857.8g | 1½"-363.1 | ¾"-95.1 | ⅜"-147.5 | #4-45g | #10-27.1 | #20-15.2 | #40-12.8 | #60-50.5 | #100-46.9 | #200-27 | PAN-27.6



Plotted By Les Walker Date 5/21/96

Plot Checked By EDWARD RAFUSE/Edward Rafuse Date 05/23/96

BD-6000-799 (04/92)

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Rev. 0

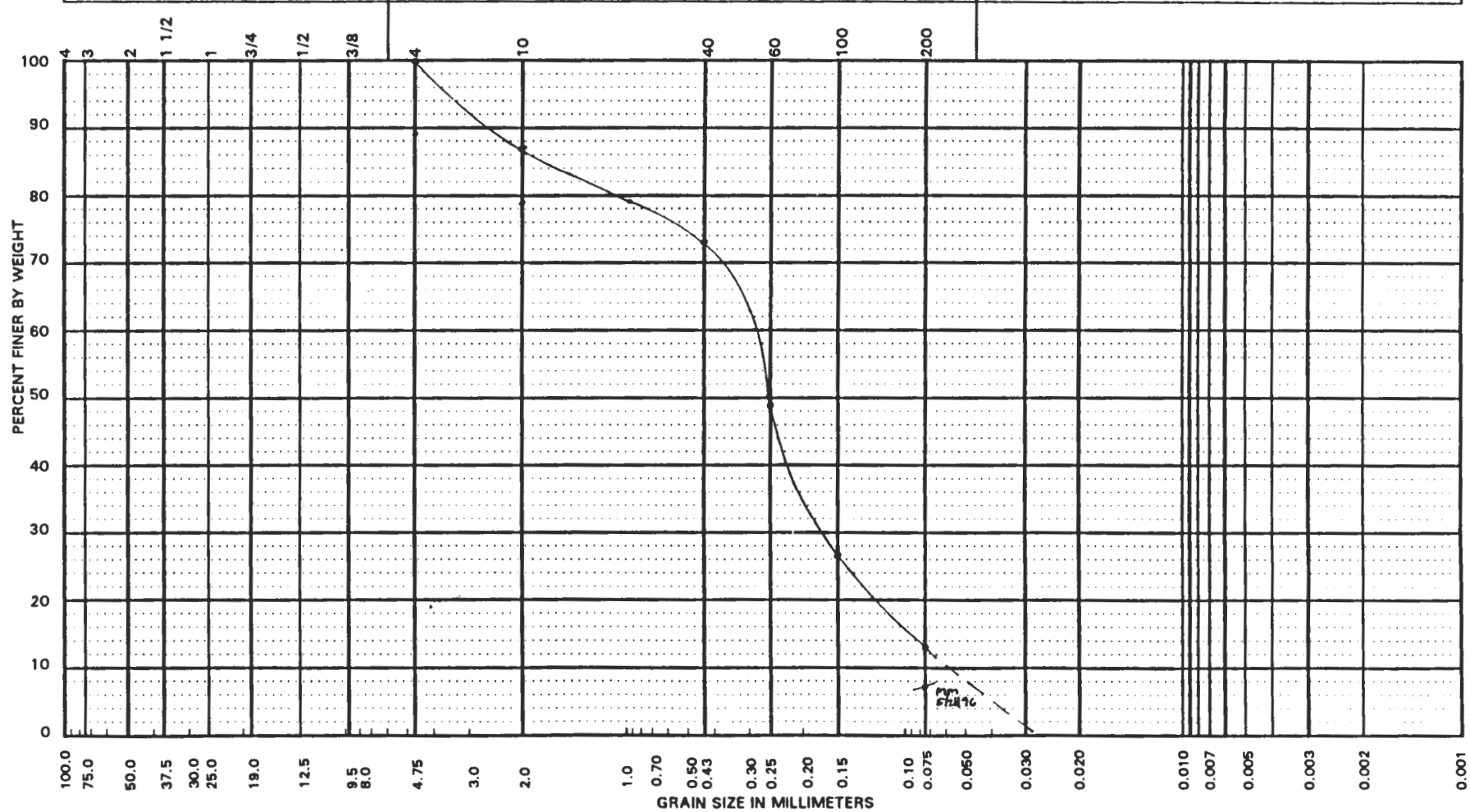
GEL-07 GRAIN SIZE ANALYSIS PLOT

COPY

Sample No. 203'-214'/Well W15-38

Page 2 of 2

Remarks Normalized plot. Initial wt.: 207.1 g / #10-27.1 / #20-15.2 / #40-12.8 / #60-50.5 / #100-46.9 / #200-27 / Pan-27.6
60%/10% = 4.33, 50% passing = 0.0098 in x 7 = 0.0686; sandpack = 8/16 screen = 40 slot



Plotted By Monty Mellon Date 5-21-96

Plot Checked By Edward C. Rafuse / Edward C. Rafuse Date 05/23/96

BD-6000-799 (04/92)

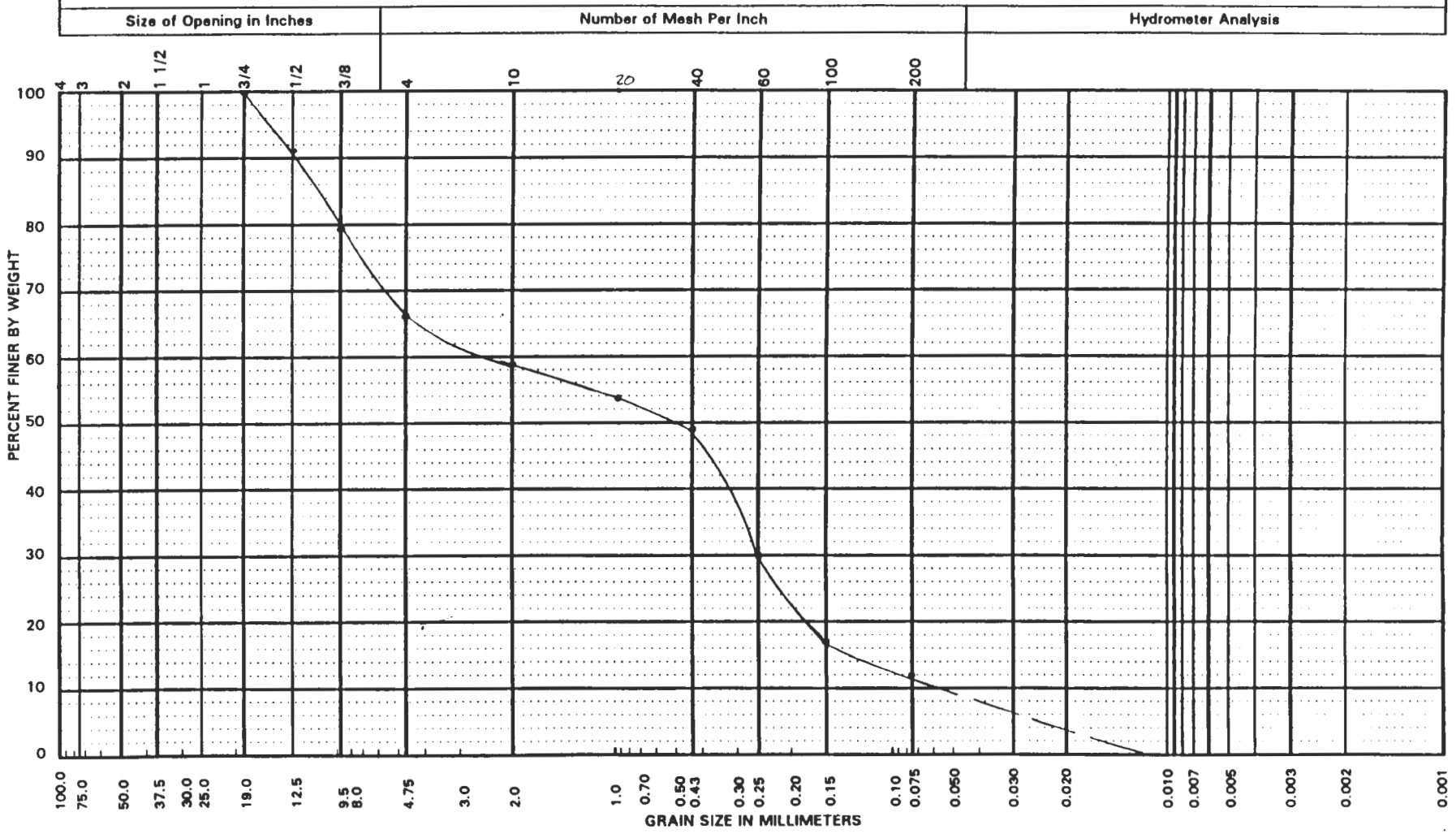
GEL-07 GRAIN SIZE ANALYSIS PLOT

RECORD COPY

Sample No. 219' /Well W15-38

Page 1 of 2

Remarks Initial wt: 512.2 : 1½": 0 / ¾"-67.3 / ⅜"-55.8 / #4-70.1 / #10-37.5 / #20-25 / #40-22.6 / #60-95.1 / #100-73.4 / #200-29.3 / Pan = 36.1 [+19.2 = 55.3]



Plotted By Monty McMillan Date 5-21-96

Plot Checked By Edward C. Rafuse / Edward C. Rafuse Date 05/23/96

BD-6000-799 (04/92)

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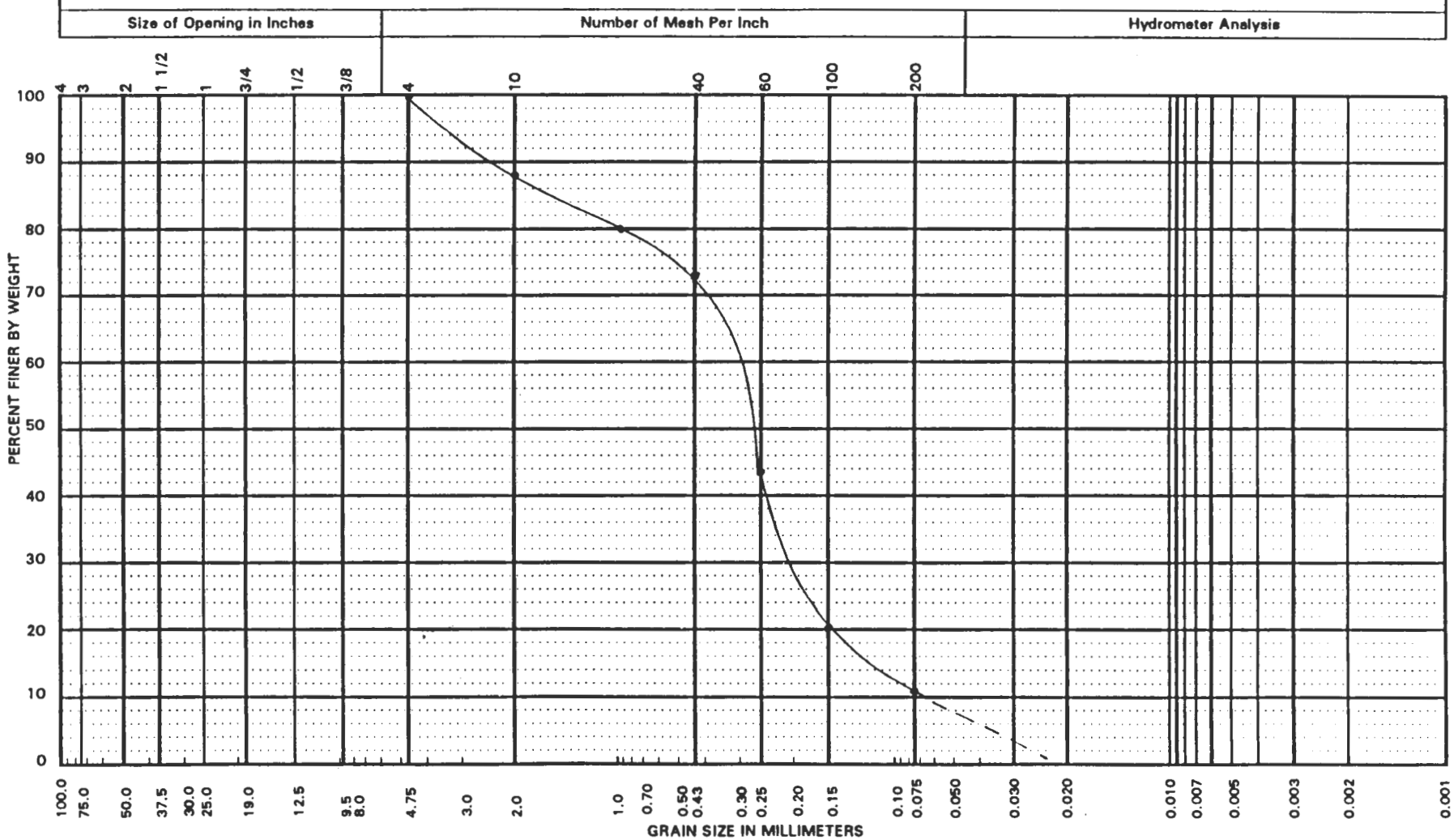
GEL-07 GRAIN SIZE ANALYSIS PLOT

RECORD COPY

Sample No. 219' / Well W15-38

Page 2 of 2

Remarks Normalized plot Initial wt. 319.0 g / #10 - 37.5 / #20 - 25 / #40 - 22.6 / #60 - 95.1 / #100 - 73.4 / #200 - 29.3 / Pan - 36.1 60%/10% ≈ 4.46 50% passing = .0102 in. x 7 = .0714 ; sandpack = 8/16 screen = 40 slot



Plotted By Les Walker Date 5/21/96

Plot Checked By Mark Darnell Date 6/3/96

BD-6000-799 (04/92)

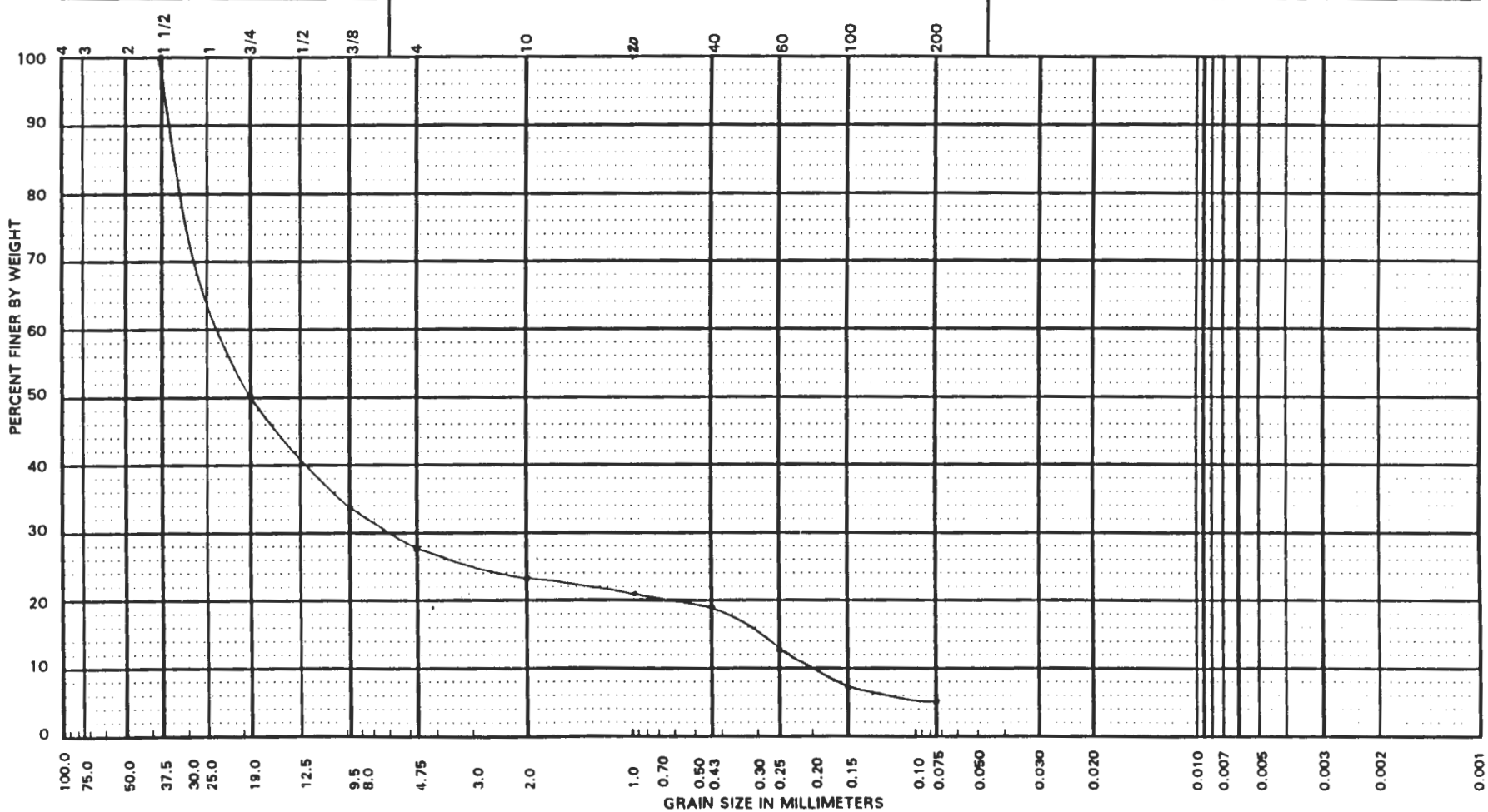
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. W15-99 216'-220.5 HEISA BOHGC1

Page 1 of 2

Remarks Initial Sample Wt: 665.0g / 3/4"-327.9g / 3/8"-112.8g / #4-40.1g / #10-29.4g / #20-16.5g / #40-12.0g / #60-42.4g / #100-33.6g / #200-17.4

PAN- 11.9 + 21.0 = 32.9g



Plotted By Mark Darrach / Mark Darrach Date 5/28/96

Plot Checked By Edward C. Rafuse / Edward C. Rafuse Date 06/03/96

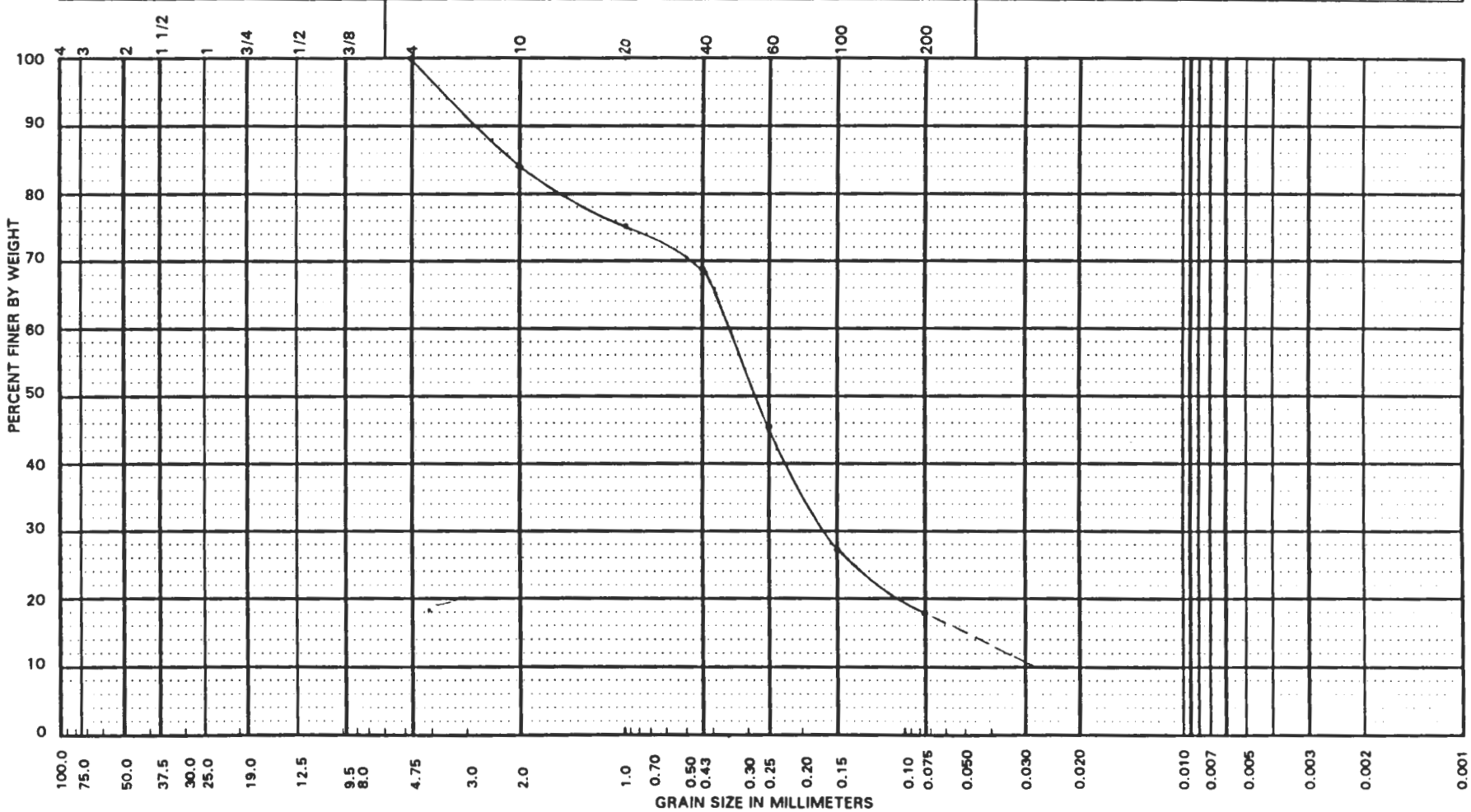
BD-6000-799 (04/92)

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. BDH9C1 HEIS #
W15-39 216-220.5'

Page 2 of 2

Remarks INITIAL WT: 184.2g / #10 - 29.4g / #20 - 16.5g / #40 - 12.0g / #60 - 42.4g / #100 - 33.6g / #200 - 17.4 / PAN - 32.9g | Unif. Coef. 60/10 = approx 12.4
50% passing = .01063" * 7 = .074" Sand/Gravel pack = 8-16 w/40 or 50 slot screen



Plotted By MARK DARRACH / Mark Darrach Date 5/28/96

Plot Checked By EDWARD C. RAFFUSE / Edward C. Raffuse Date 06/03/96

BD-6000-799 (04/92)

C-50

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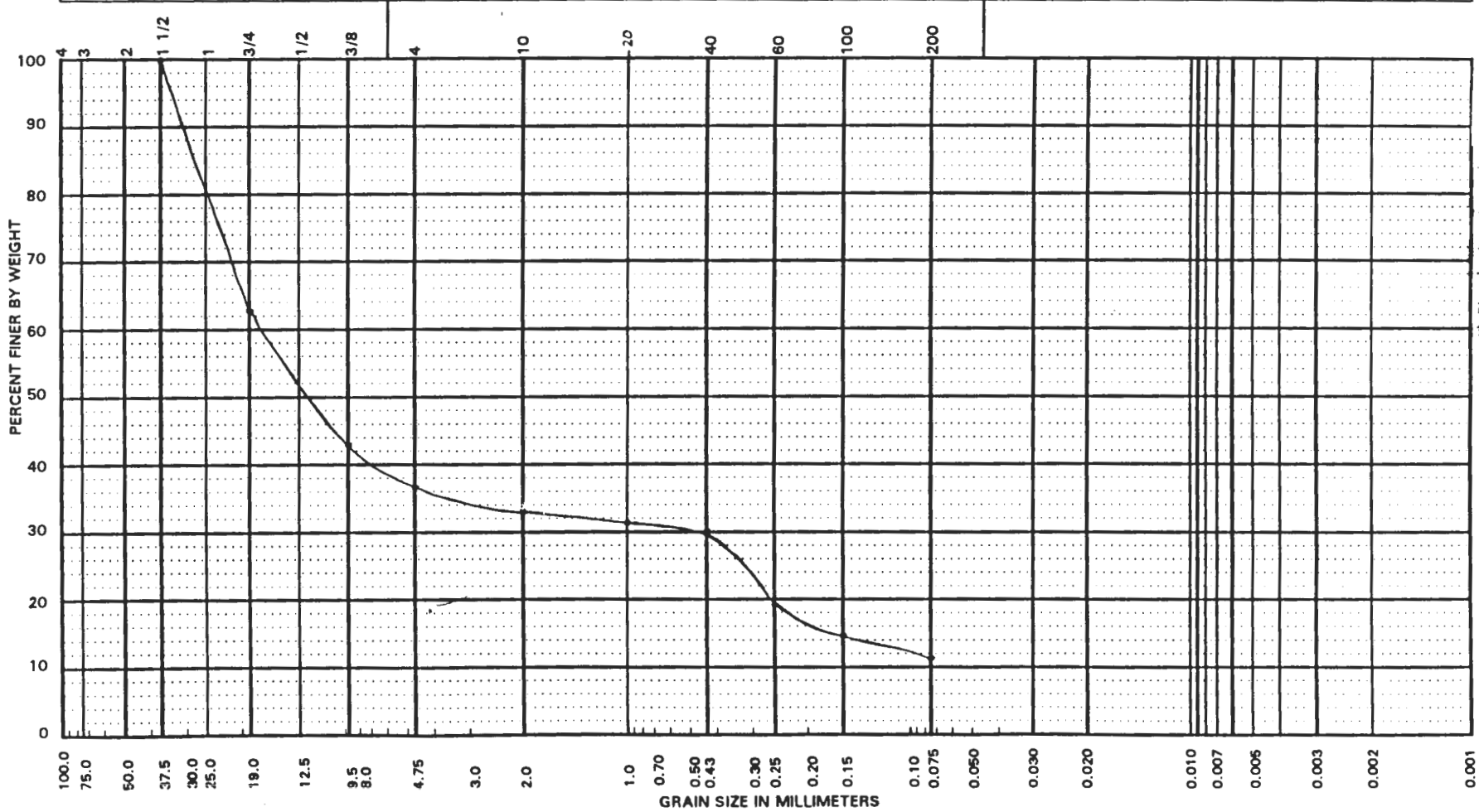
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 218-219.5 cm
B06Z75 299-W15-385

Page 1 of 1

Remarks INITIAL SAMPLE WT: 512.0g || 1½" - NONE / ¾" - 191.30g / ⅜" - 99.90g / #4 - 33.70g / #10 - 17.00g / #20 - 8.80g / #40 - 7.60g / #60 - 55.70g / #100 - 25.30g / #200 - 13.30g / -200 - 59.40g | minus 200 is 27.8% of matrix



Plotted By Mark Darrach / Mark Darrach Date 6 Dec 95

Plot Checked By EDWARD RAFUSE / Edward C. Rafuse Date 07 Dec 95

BD-6000-799 (04/92)

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GEL-07 GRAIN SIZE ANALYSIS PLOT

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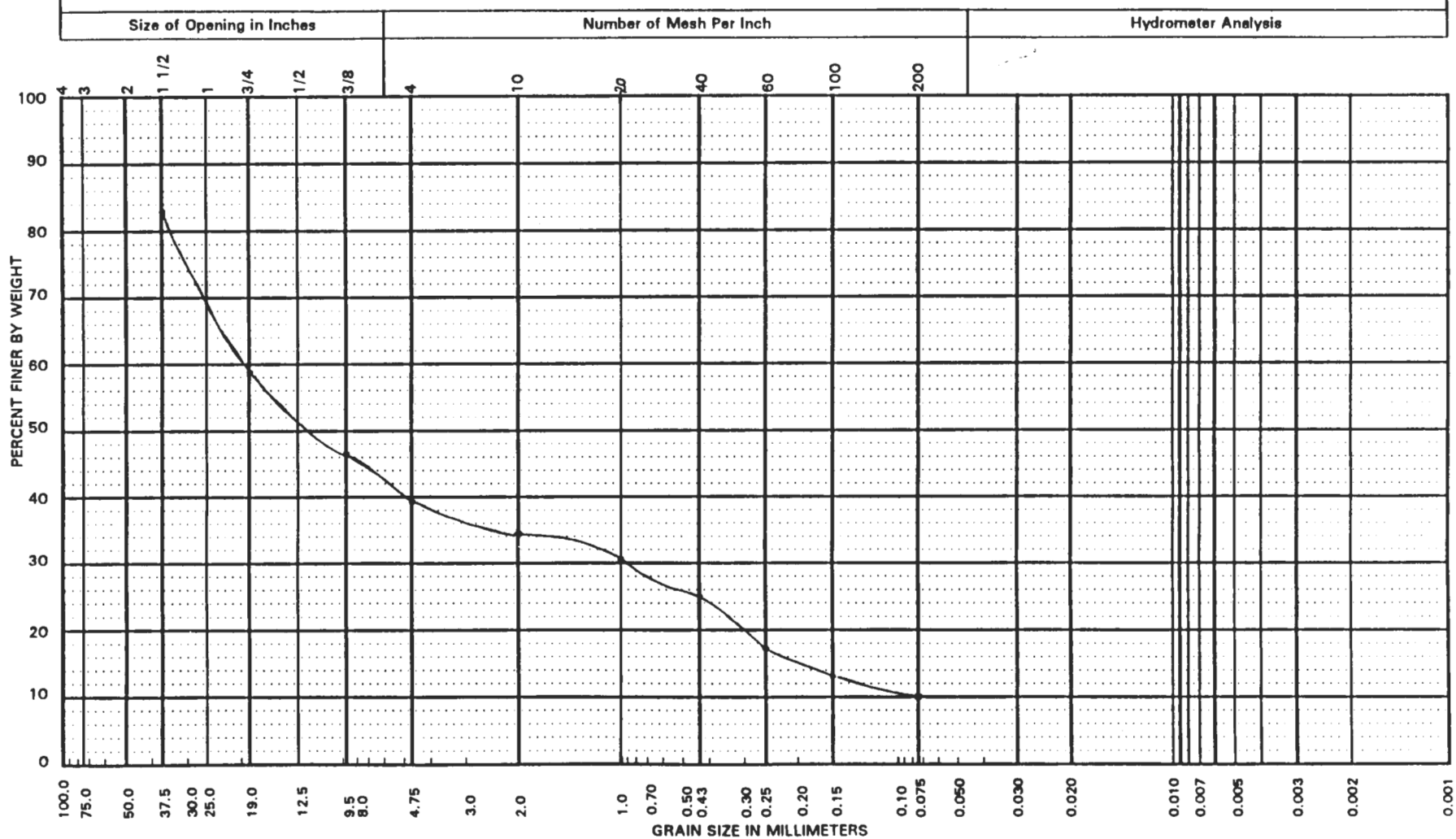
Sample No. HE13 230-231.5 -0
B06Z76 289-W15-385

Page 1 of 1

Remarks INITIAL SAMPLE WT: 917.2g || 1½" - 154.2g / ¾" - 226.9g / ⅜" - 110.10g / #4 - 63.60g / #10 - 49.40g / #20 - 35.60g / #40 - 49.30g / #60 - 70.40g / #100 - 32.30g / #200 - 33.20g / 200(-) - 92.2g | matrix is 21.6% minus 200 mesh



Plotted By Mark Darrach / Mark Darrach Date 7 Dec 95

Plot Checked By Edward LaFleur / Edward C. Lafleur Date 12/12/95

BD-6000-799 (04/92)

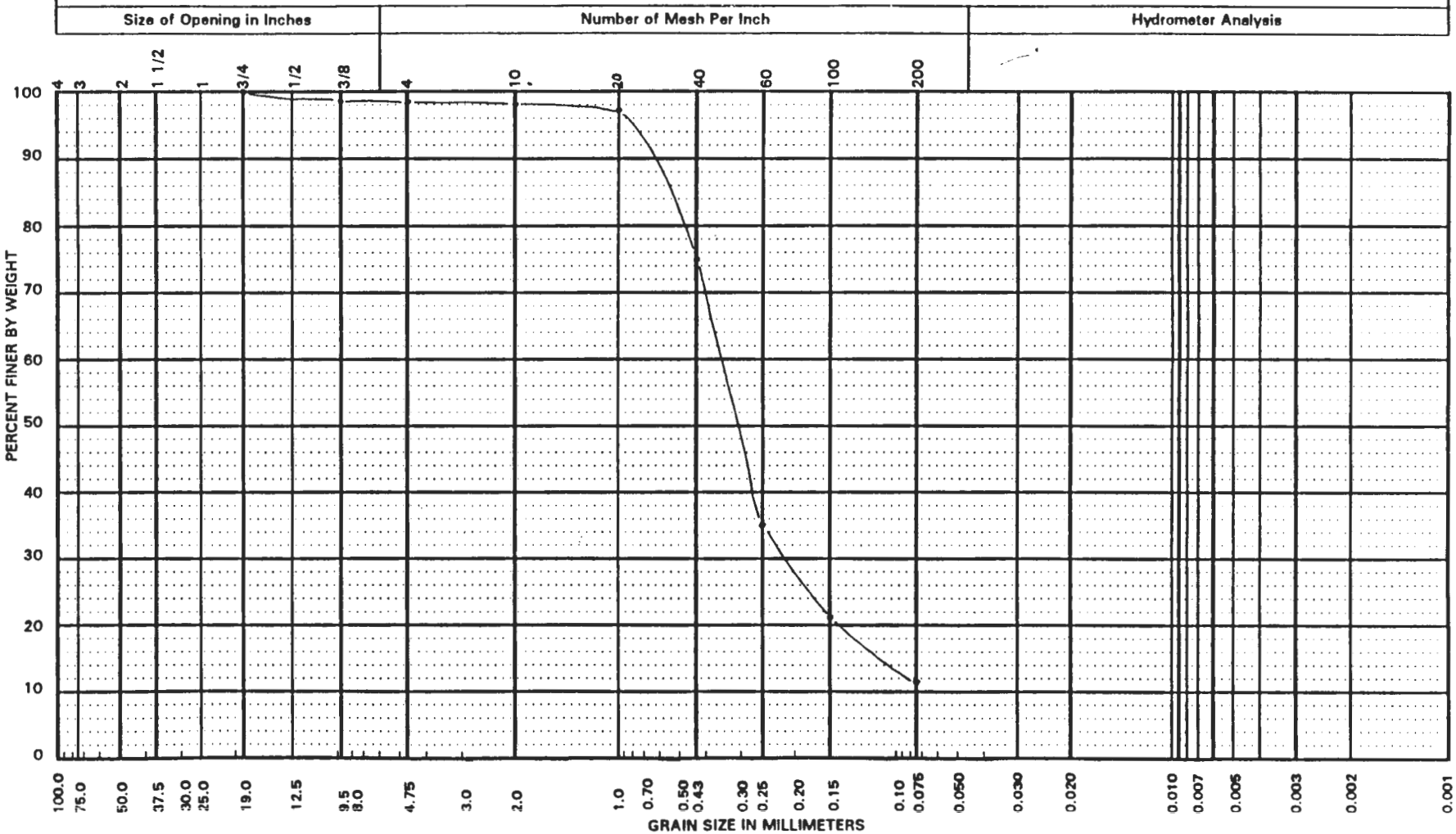
GEL-07 GRAIN SIZE ANALYSIS PLOT

RECORD COPY

Sample No. HEIS# 806277 241.5-242.2' 299-W15-385 MO

Page 1 of 1

Remarks INITIAL SAMPLE WEIGHT - 287.6 g || 3/8" - 4.3 / #4 - .1g / #10 - 1.3g / #20 - 1.5g / #40 - 62.70g / #60 - 116.60g / #100 - 40.30g / #200 - 26.70g / #200 MINUS - 34.10g | matrix includes 12% minus 200 fraction | major water producing unit



Plotted By Mark Darrach / Mark Darrach Date 8 Dec 95

Plot Checked By Edward Rafuse / Edward Rafuse Date 12/12/95

BD-6000-799 (04/92)

9413240.1694

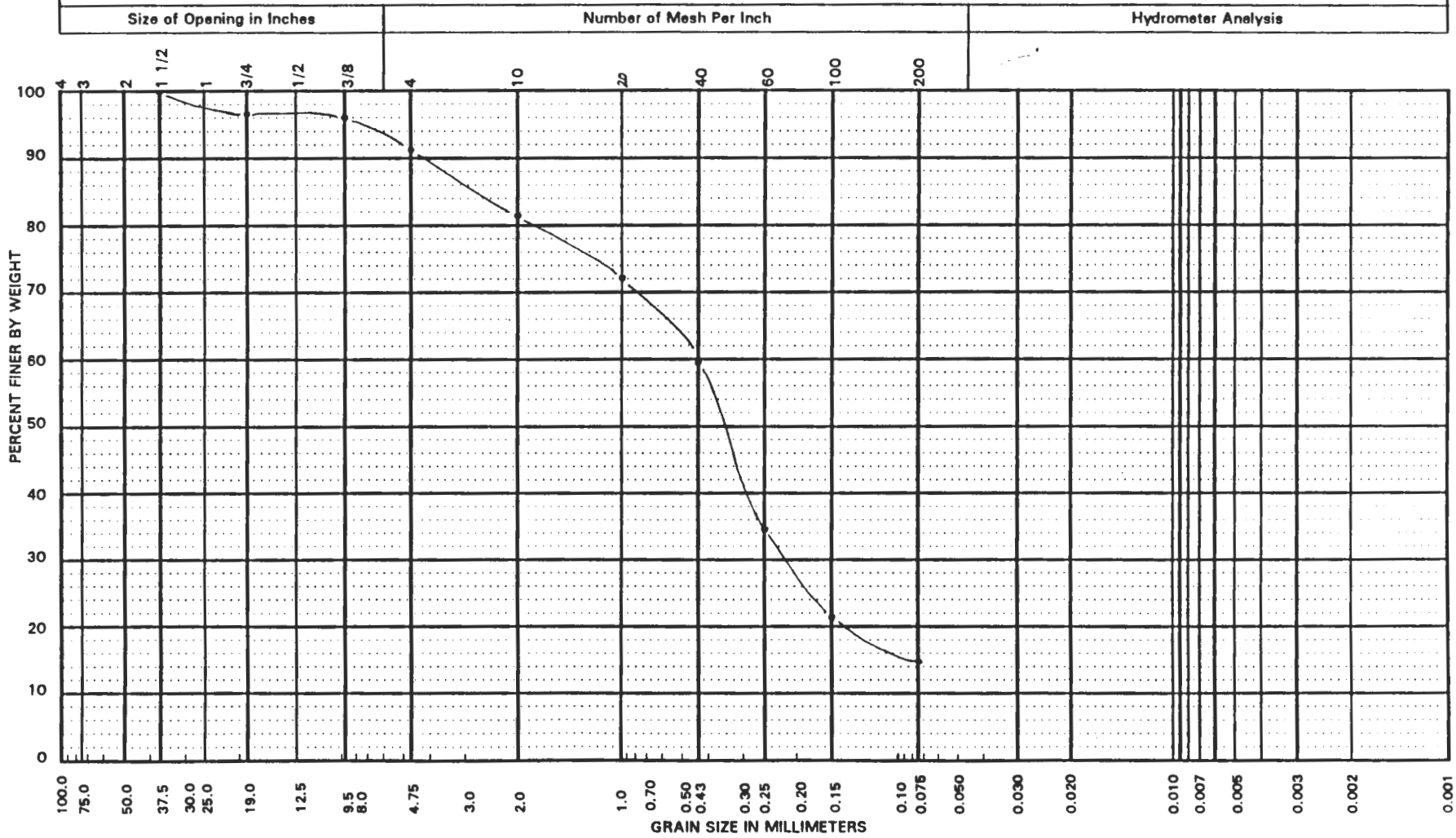
GEL-07 GRAIN SIZE ANALYSIS PLOT

299-W15-3B 5 no

Sample No. 246'-248' HES# B0GZ7B

Page 1 of 1

Remarks INITIAL SAMPLE WEIGHT: 351.1g // 3/4" - 11.90g / 3/8" - 1.5g / #4 - 17.0g / #10 - 34.2g / #20 - 33.1g / #40 - 43.3g / #60 - 89.0g / #100 - 45.7g / #200 - 23.8g / PAN - 51.6g | matrix includes 15.3% minus 200 fraction | may be a minor water producing unit



Plotted By Mark Darrach / Mark Darrach Date 8 Dec. 95

Plot Checked By _____ Date _____

BD-6000-799 (04/92)

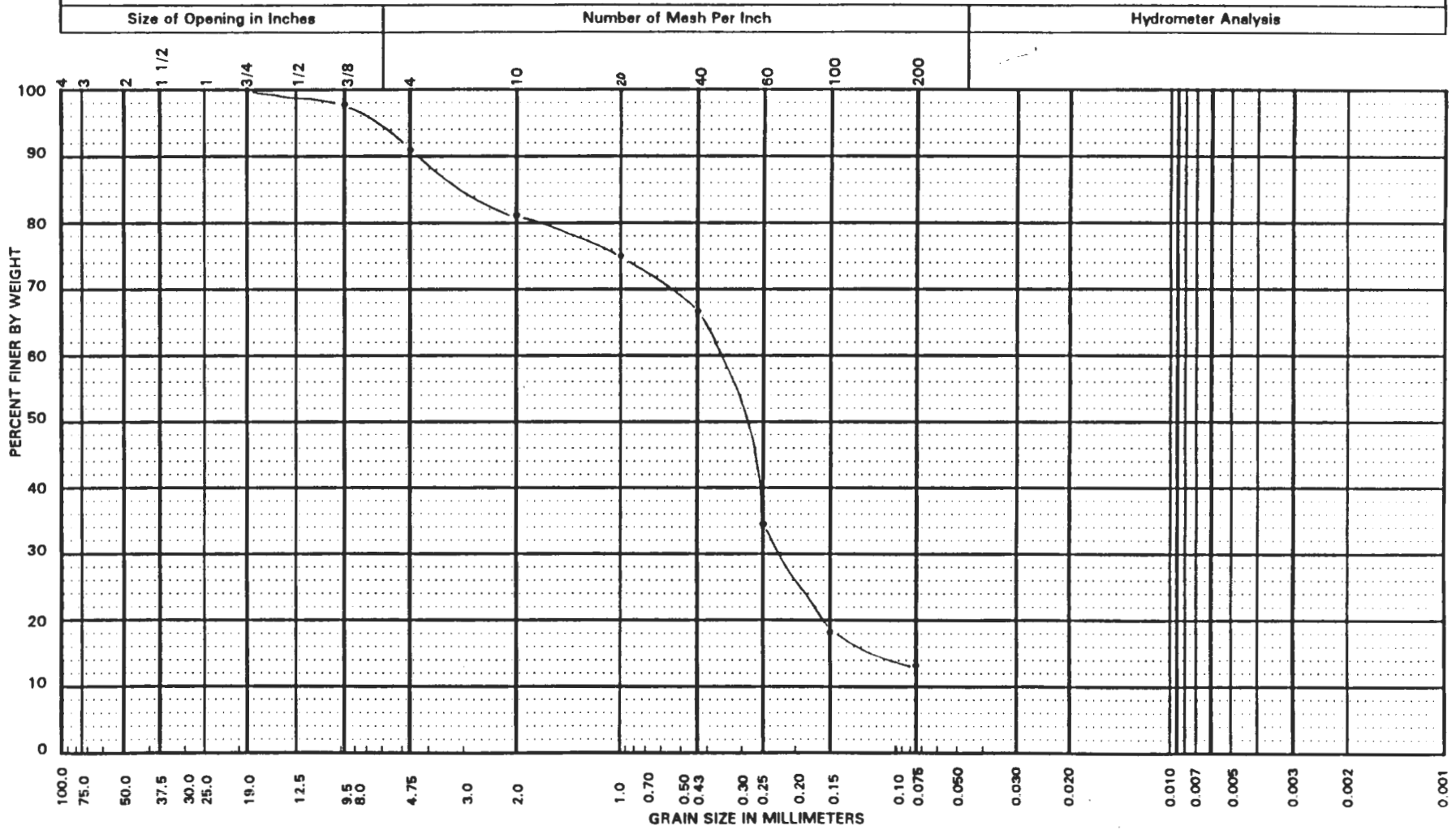
GEL-07 GRAIN SIZE ANALYSIS PLOT

RECORD COPY

Sample No. HEIS # 250-252' BØGZ79 219-W13-375

Page 1 of 1

Remarks INITIAL SAMPLE WT: 375.30g || ~~3/4" 7.8g~~ (no 12/19/95) / 3/8" - 7.8g / #4 - 25.70g / #10 - 37.60g / #20 - 22.3g / 30.9g - #40 / #60 - 121.3g / #100 - 57.8g / #200 - 21.0g / #200 MINUS - 50.90g | matrix includes 13.8% minus 200 fraction | unit produces significant water



Plotted By Mark Darrach / Mark Darrach Date 8 Dec 95

Plot Checked By _____ Date _____

BD-6000-799 (04/92)

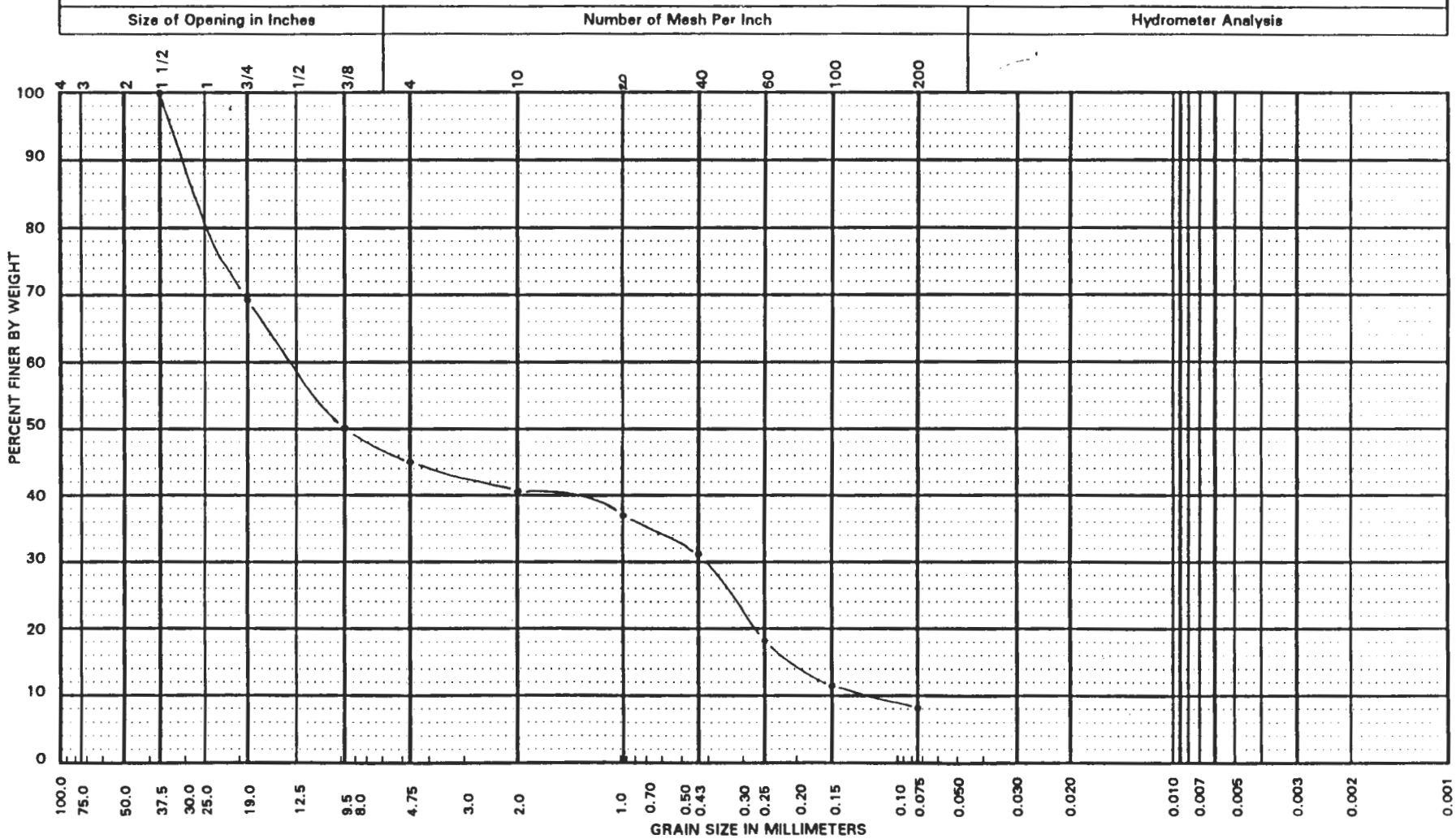
9/26/96 1:09 PM

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. BØGZF6 257-258.8mo 299-W15-37

Page 1 of 1

Remarks INITIAL SAMPLE WT: 641.7g | 3/4" - 194.8g / 3/8" - 125.4g / #4 - 33.40g / #10 - 28.4g / #20 - 22.40g / #40 - 36.60g / #60 - 77.5g / #100 - 47.5g / #200 - 23.2g #200 MINUS - 52.5g | matrix includes 18.2% minus 200 mesh | unit may be a minor water producer



Plotted By Mark Darrach / Mark Darrach Date 12/15/95

Plot Checked By _____ Date _____

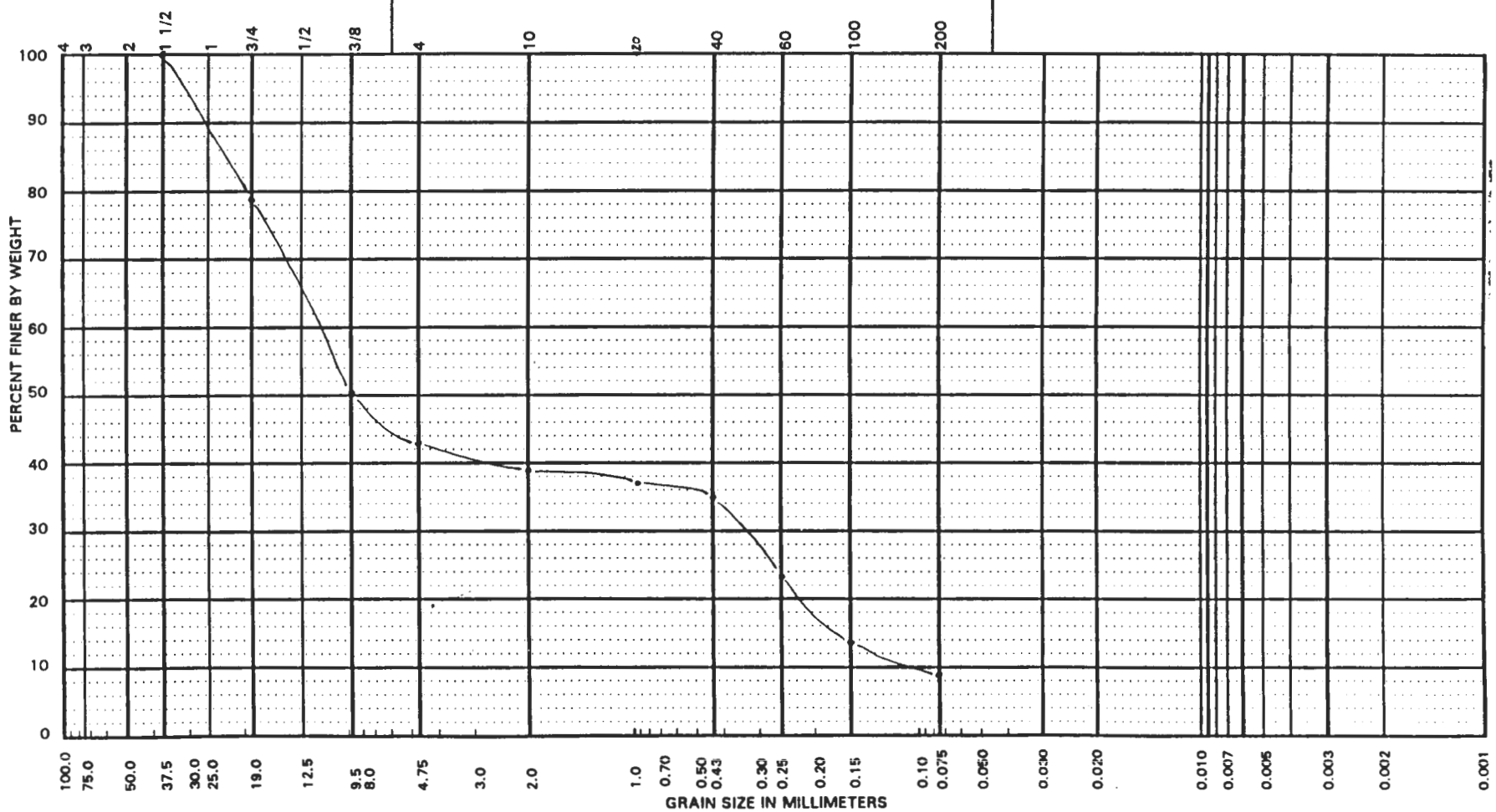
BD-6000-799 (04/92)

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 210.5-220'
299-W18-36 BØH6L6

Page 1 of 1

Remarks Initial Sample Weight: 690.5g | 3/4" - 146.9g | 3/8" - 196.4g | #4 - 53.2g | #10 - 24.1g | #20 - 15.9g | #40 | 13.9g | #60 - 83.5 | #100 - 62.0g
#200 - 35.2g | PAN - 59.4g | minus 200 is ~~20.2~~ 17.1% of matrix material | may be a minor water producing unit



Plotted By Mark Darrach / Mark Darrach Date 16 Jan 96

Plot Checked By Edward C. Rafuse / Edward C. Rafuse Date 01/17/96

BD-6000-799 (04/92)

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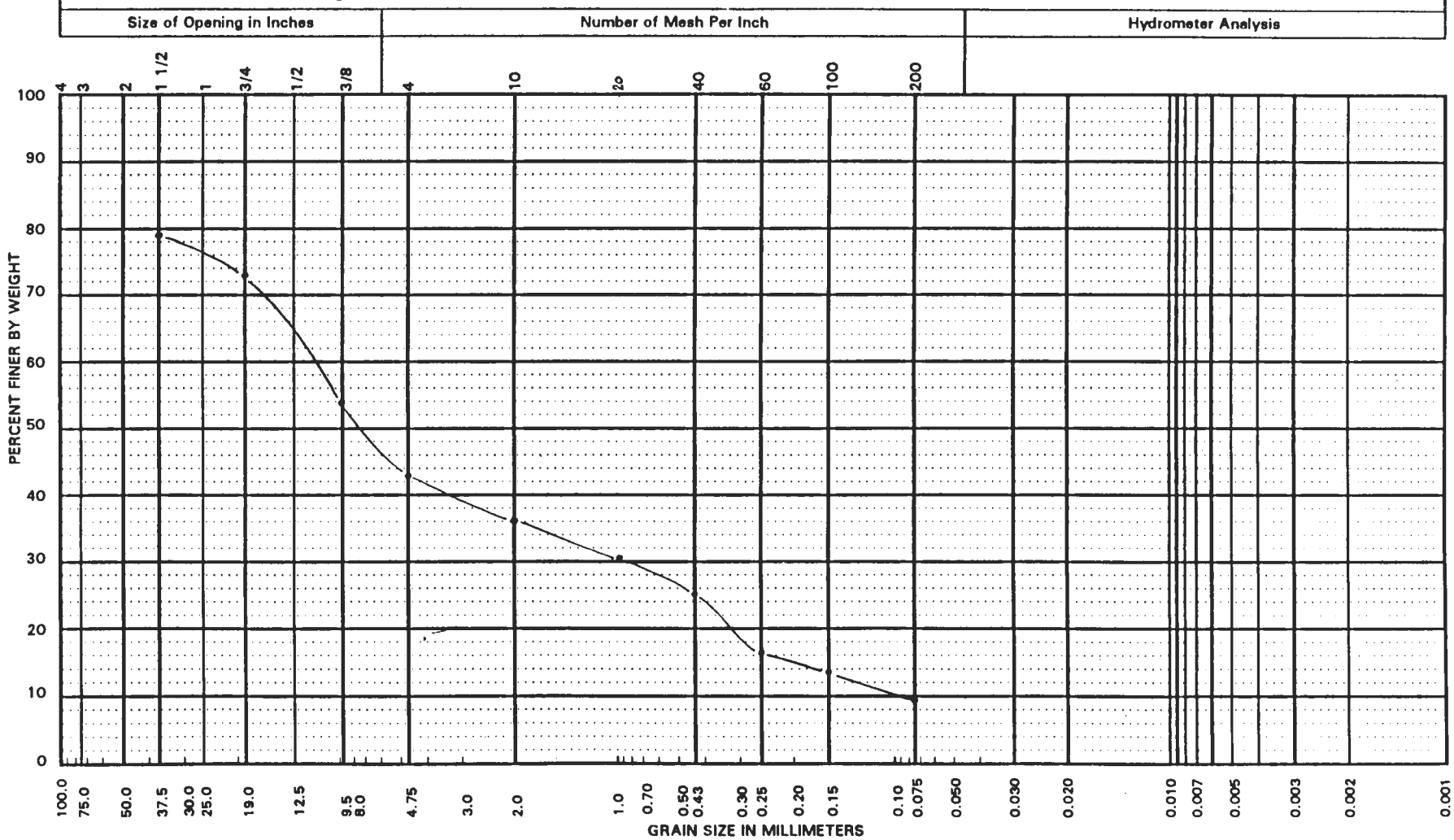
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 299 W18-36 227-229' BØH6L7

Page 1 of 1

Remarks INITIAL SAMPLE WT: 819.2g | 1½"-174.3g | ¾"-48.7g | ⅜"-150.9 | #4-94.1g | #10-56.1g | #20-44.2g | #40-47.4g | #60-70.2g | #100-29.2g | #200-26.1g | PAN-78.0g | minus 200: 17.5% of matrix



Plotted By Mark Darrach / Mark Darrach Date 1/16/96

Plot Checked By EDWARD C. RATFIELD / Edward C. Ratfield Date 1/17/96

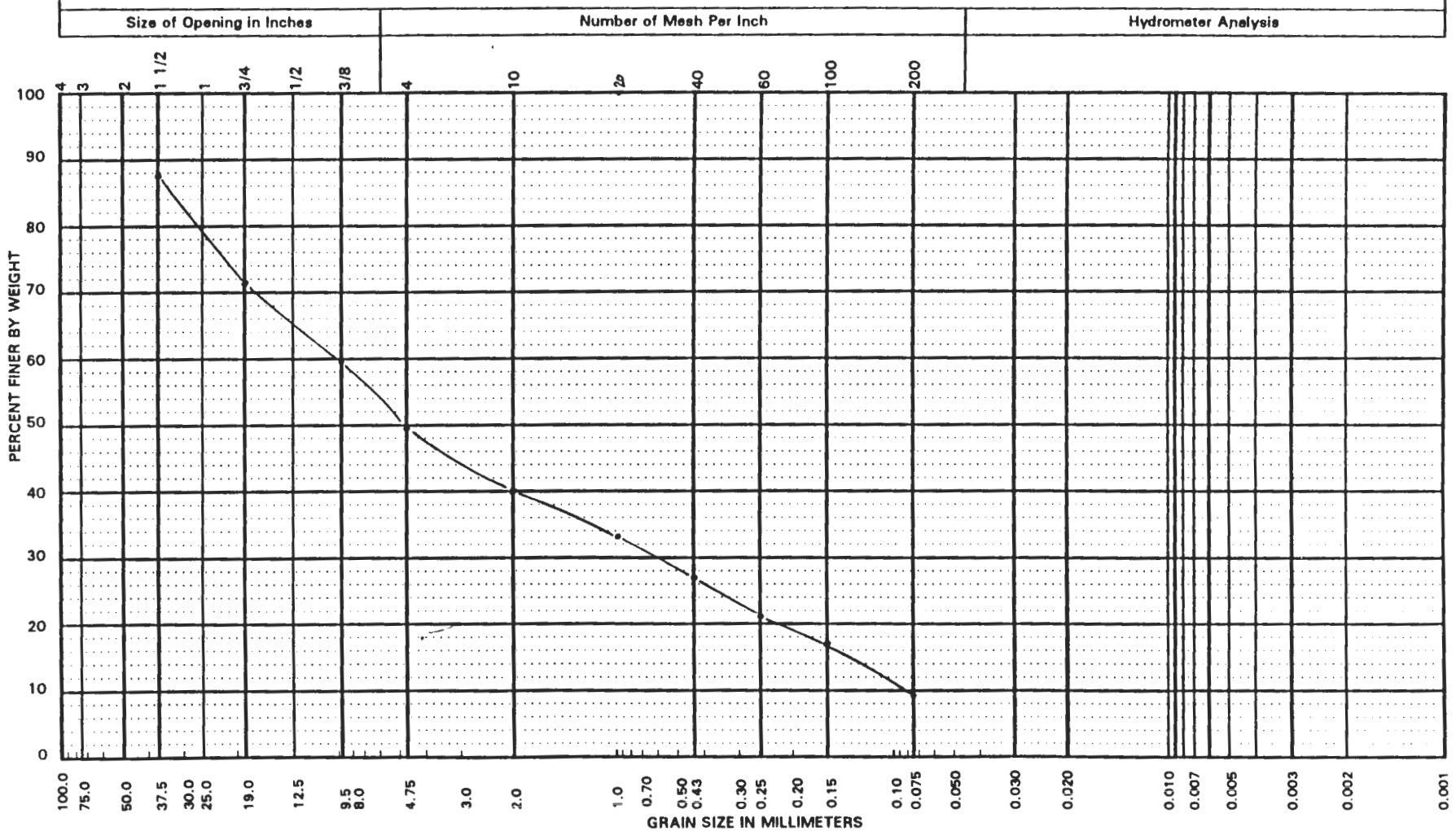
BD-6000-799 (04/92)

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 2-10-241
299-W18-36 BOH6L8

Page 1 of 1

Remarks INITIAL WT: 959.1g | 1½"-117.7 | ¾"-159.8 | ⅜"-108.6 | #4-98.4 | #10-92.7g | #20-61.8g | #40-62.3g | #60-58.7g | #100-38.7 | #200-68.0g | PAN-92g | minus 200 is 16.0% of matrix



Plotted By Mark Darrach / Mark Darrach Date 1/16/96

Plot Checked By Edward C. Patrick / Edward C. Patrick Date 01/17/96

BD-6000-799 (04/92)

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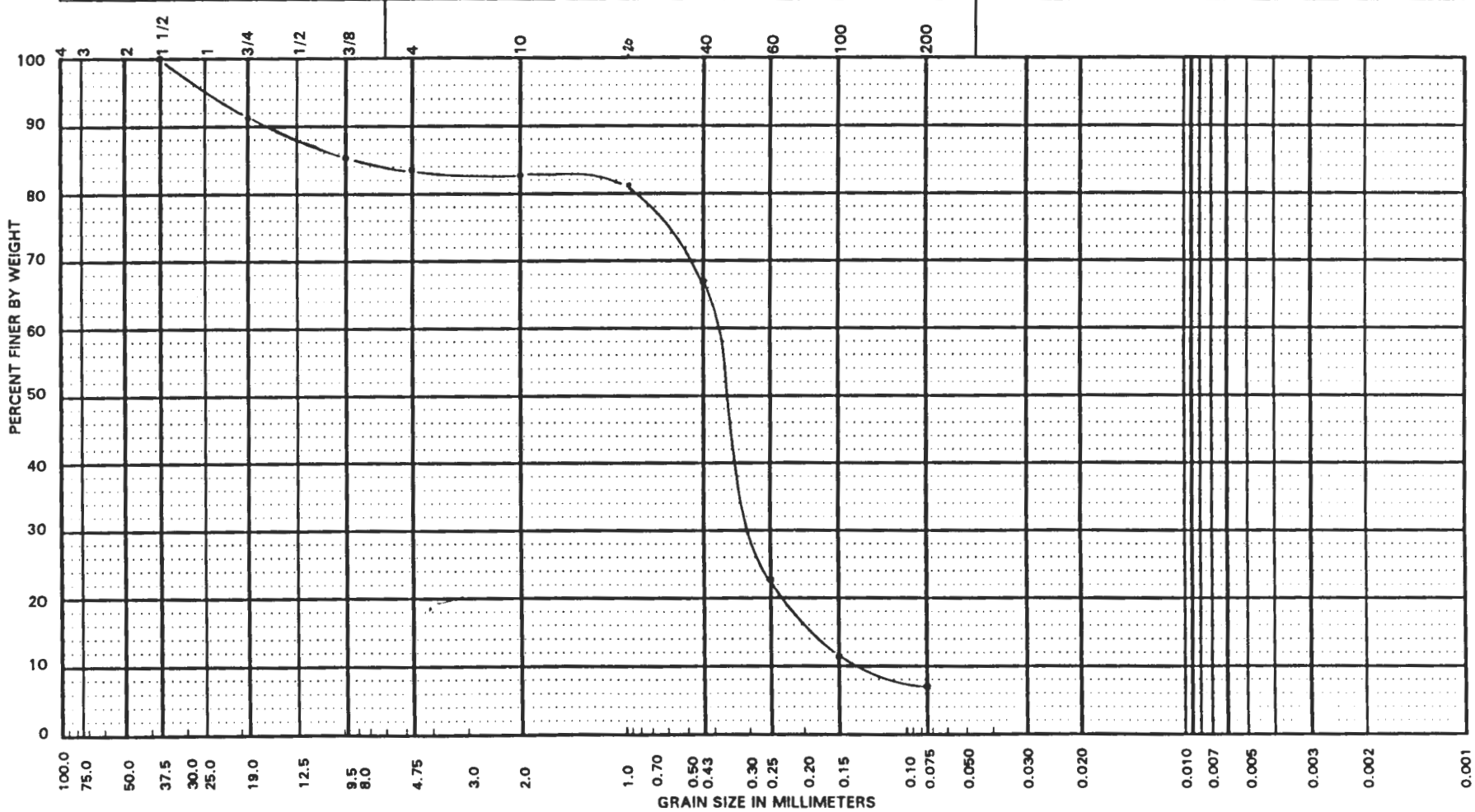
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 2-1.5-249.5
299-W18-36 BØH6L9

Page 1 of 1

Remarks INITIAL SAMPLE WT: 274.1g | 3/4" - 23.2g / 3/8" - 16.3g / #4 - 5.3g / #10 - 3.2g / #20 - 2.3g / #40 - 40.0g / #60 - 122.8g
#100 - 29.90g / #200 - 12.4g / PAN - 6.9g + 11.8 = 18.7g | minus 200 is 8.7% of fraction ≤ #4 sieve - a major water producer



Plotted By Mark Darrach / Mark Darrach Date Jan 17 96

Plot Checked By Edward O. Rafuse / Edward Rafuse Date 01/17/96

BD-6000-799 (04/92)

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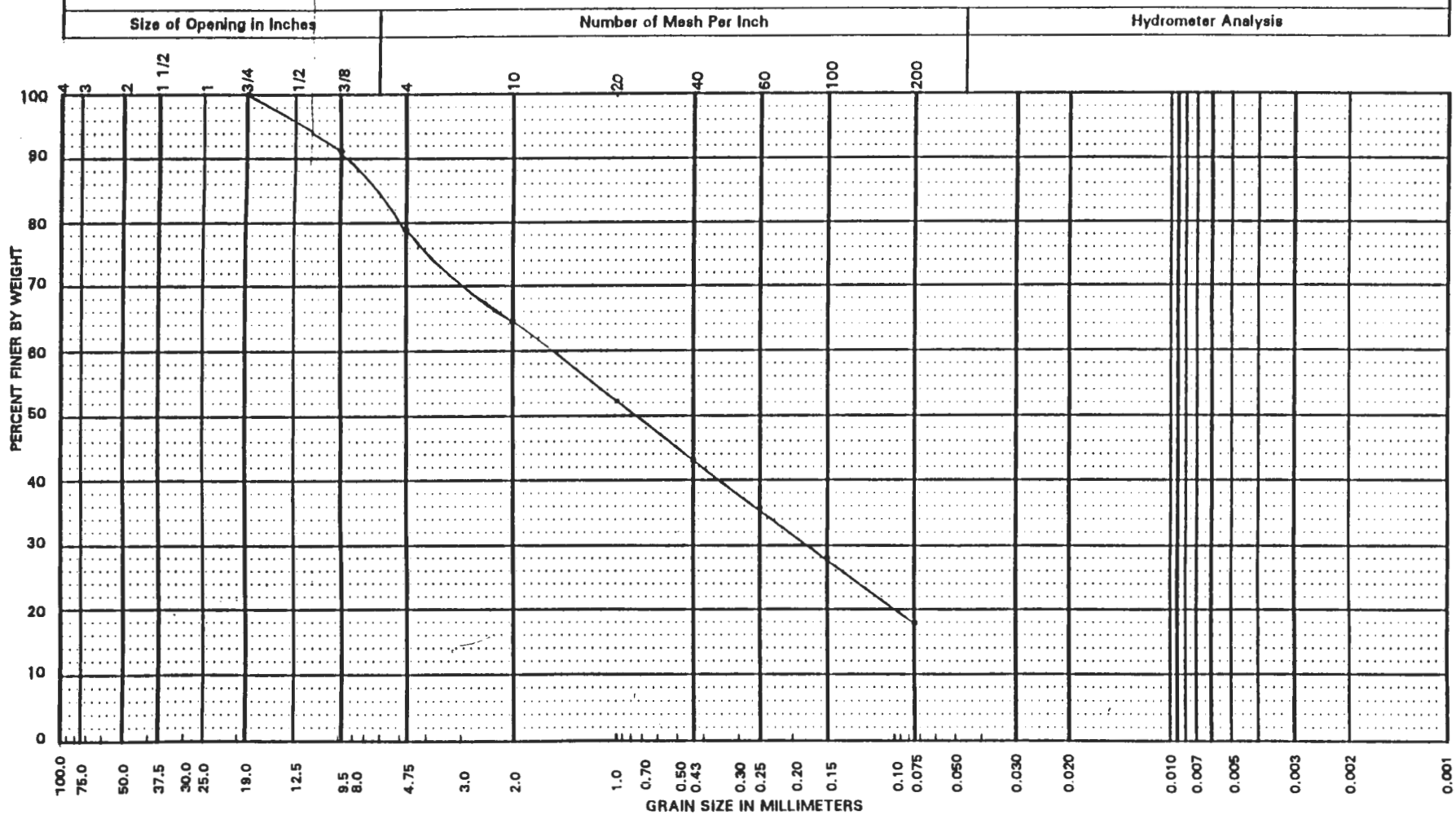
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. [redacted] BØHGCB
Well 299-W[redacted]37

Page 1 of 2

Remarks INITIAL WT: 309.7g / 3/8" - 26.1 / #4 - 39.7g / #10 - 44.8g / #20 - 37.5g / #40 - 29.3g / #60 - 21.6g / #100 - 23.7g / #200 - 31.4g / #PAN - 55.6g



Plotted By Mark Darrach / Mark Darrach Date 3/22/96

Plot Checked By Edward C. Rafuse / Edward C. Rafuse Date 3/26/96

BD-6000-799 (04/92)

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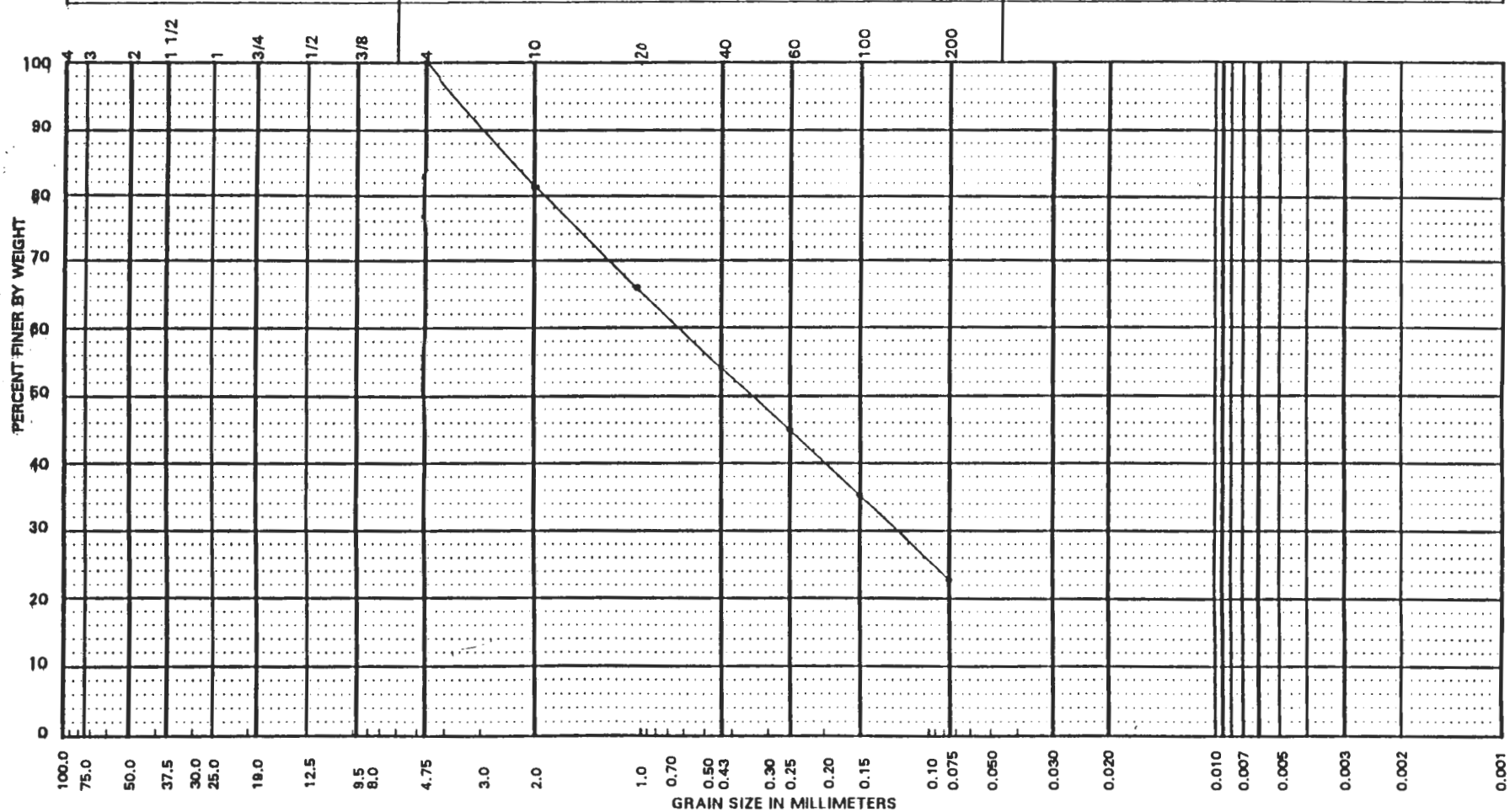
RECORD COPY

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 220' BØHGCB
Well 299-W19-37
Page 2 of 2

Remarks Sample @ 220' recalculated to 100% based upon < #4 sieve | Initial wt: 243.9g | #10 - 44.8 | #20 - 37.5 | #40 - 29.3g | #60 - 21.6g | #100 - 23.7g
#200 - 31.4g PAN - 55.6g | Uniformity coef: 25 50% passing .013" * 5 = .065" * 6 = .078" | Well design = B-12 SAND 70 slot



Plotted By Mark Darnach / Mark Darnach Date 3/22/96

Plot Checked By EDWARD C. RAFUSE / Edward C. Rafuse Date 3/26/96

BD-6000-799 (04/92)

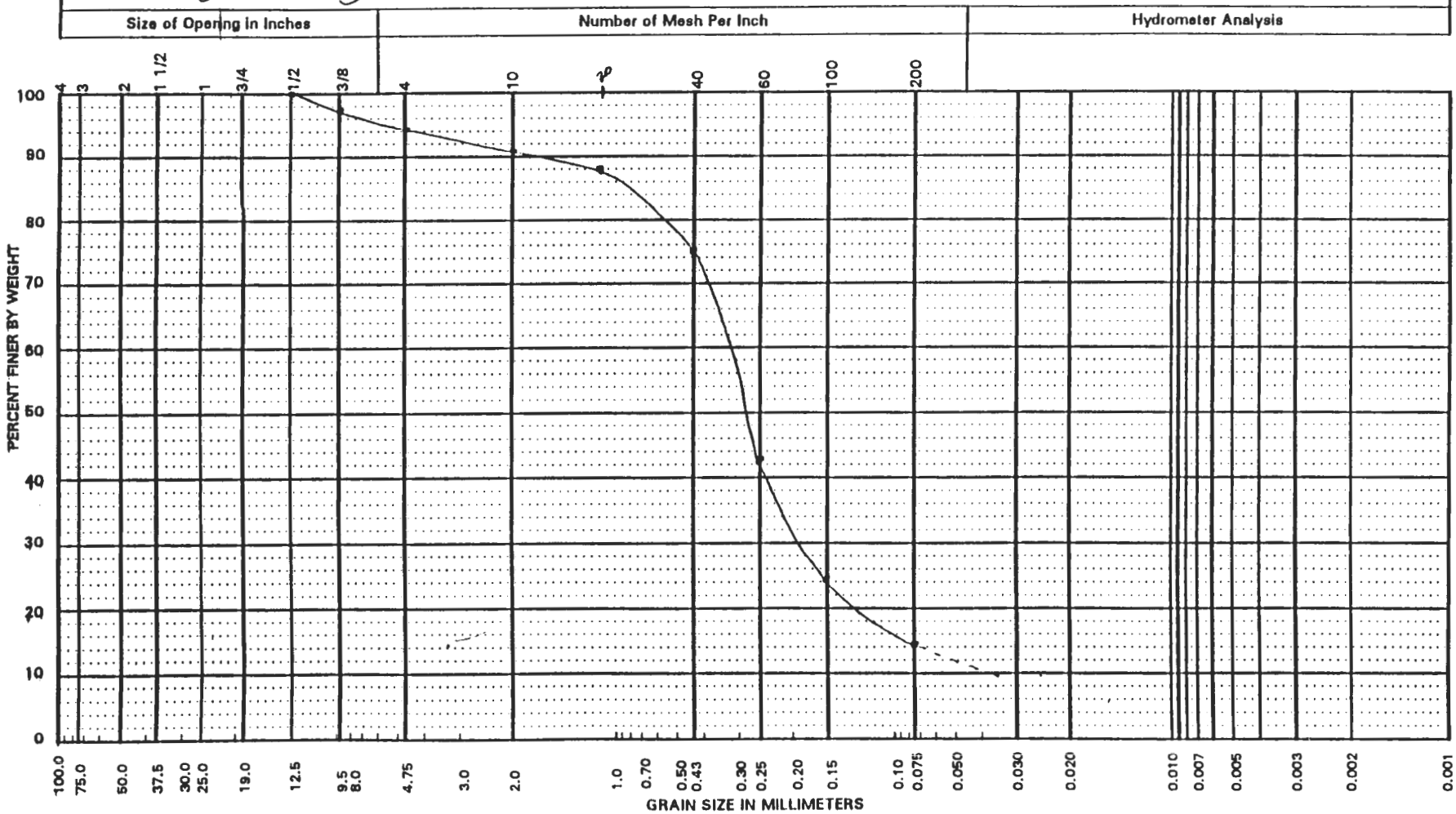
RECORD COPY

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 282-WL8-37 BØHSC9

Page 1 of 2

Remarks Initial Sample WT: 305.0g / 3/8-7.3g / #4-0.4g / #10-9.0g / #20-7.5g / #40-35.2g / #60-103.1g / #100-57.8g / #200-27.5g Pan 47.2g



Plotted By EDWARD C. ROFUSE / Edward C. Rofuse Date 03/25/96

Plot Checked By Mark Durrach / Mark Durrach Date 3/26/96

BD 6000-799 (04/92)

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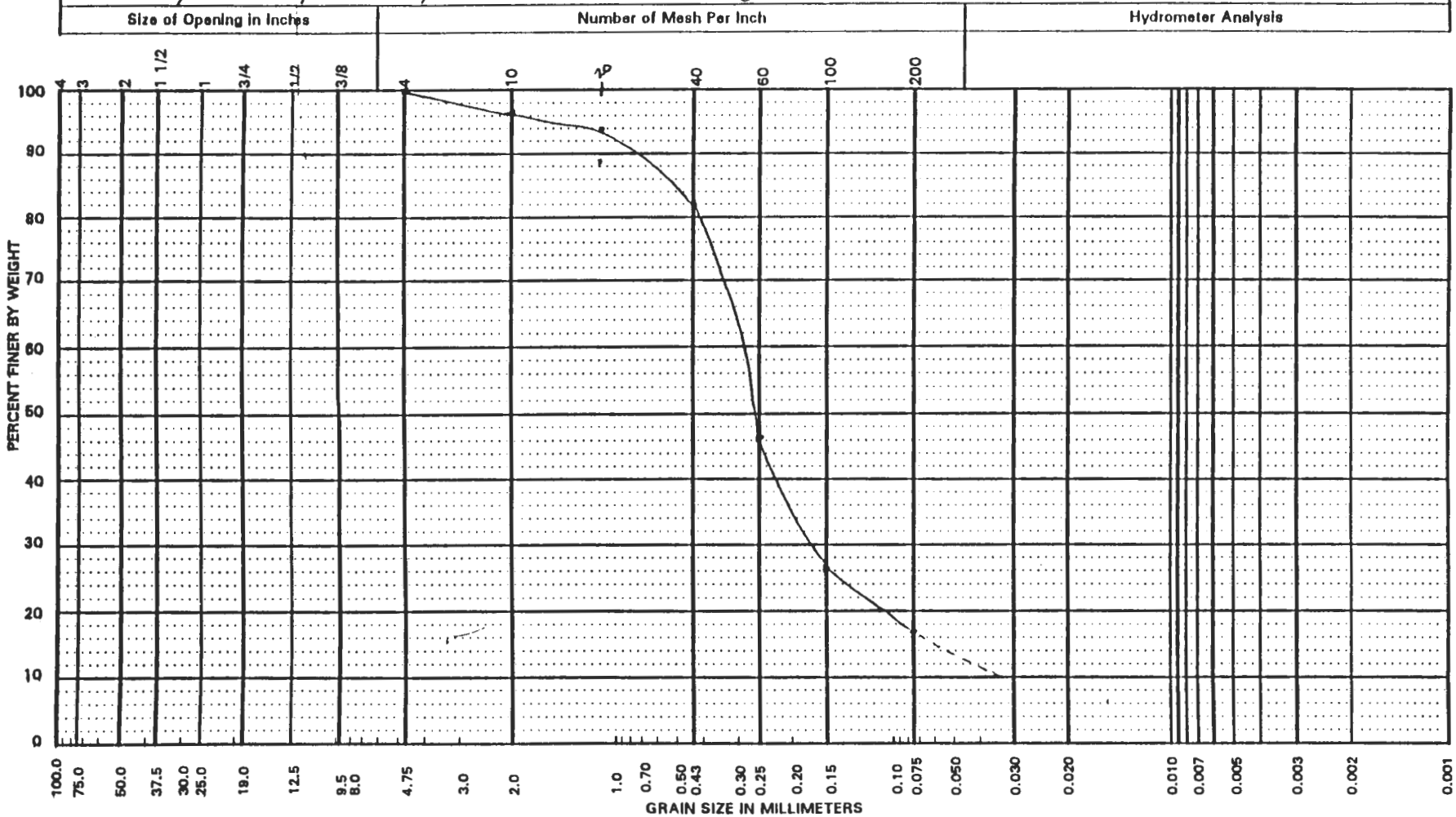
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. [redacted]-242
299-W18-37 BOHG09

Page 2 of 2

Remarks Sample D 242, RECALCULATED TO 100% based on < #4 sieve / Initial wt 287.3 #10-9.0g / #20-7.5g / #40-35.2g / #60-103.1g / #100-57.8g / #200-27.5g / Pan 47.2g / uniformity coef: ≈8.0 50% passing ≈ .0102 #5 = .052" #6 = .062" / $0 SLOT 8-16 sand



Plotted By EDWARD RoFUSE / Edward C. Rafuse Date 03/25/96

Plot Checked By Mark Darrach / Mark Darrach Date 3/26/96

PD 6000 799 (04/92)

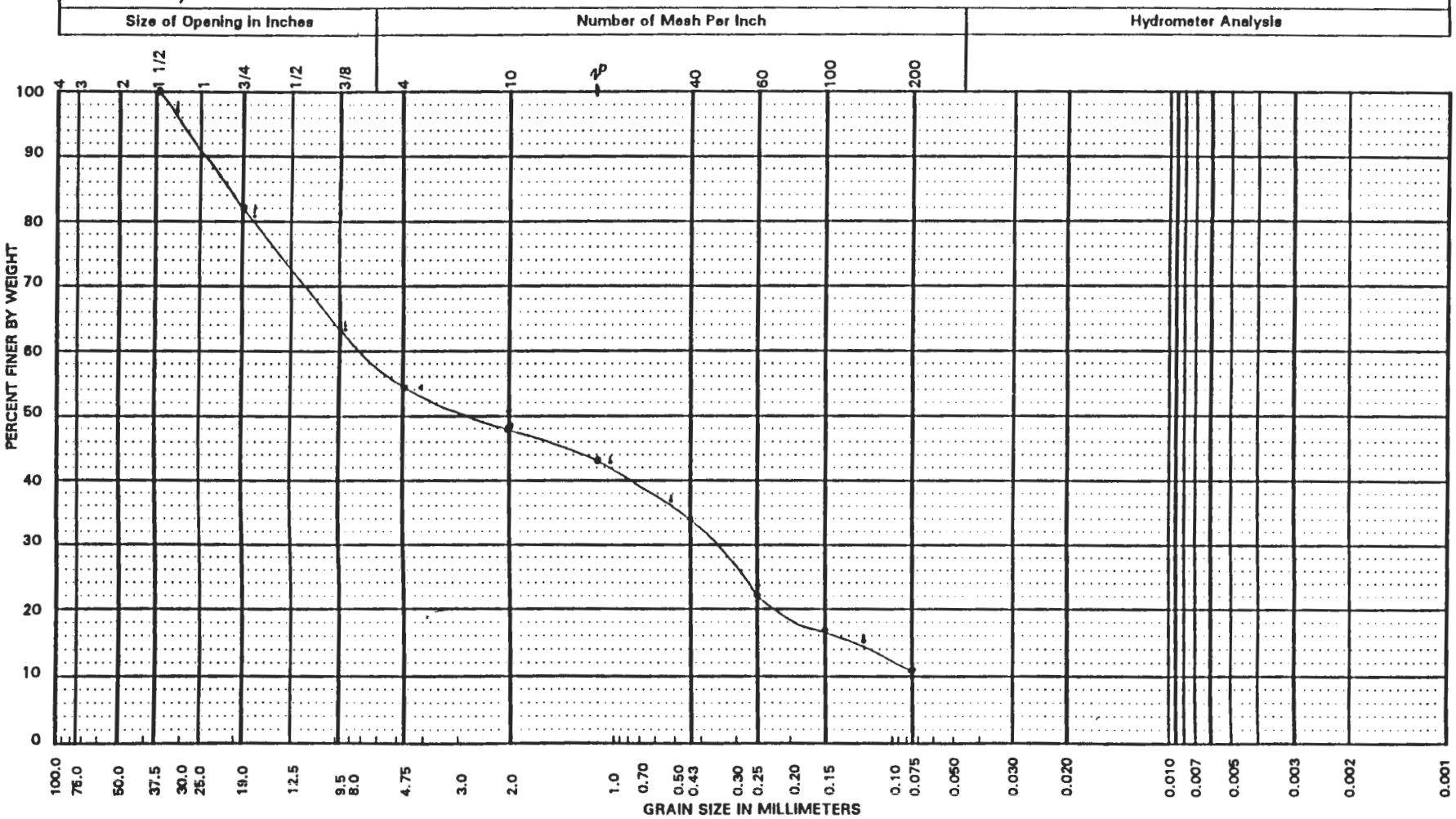
RECORD COPY

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 299-252
299-W1[illegible] BOHGD0

Page 1 of 2

Remarks Initial Sample WT 404.4g / 3/4 - 71.8g / 3/8 - 73.9g / #4 - 38.2g / #10 - 25.5g / #20 - 20.2 / #40 - 34.5g / #60 - 51.2g / #100 - 23.3 / #200 - 19.3g / Pan 46.5g



Plotted By Edward C. Rafuse / Edward C. Rafuse Date 03/25/96

Plot Checked By Mark Darrach / Mark Darrach Date 3/26/96

BD-6000-799 (04/92)

9 7 4 5 0 1 8 9 6

RECORD COPY

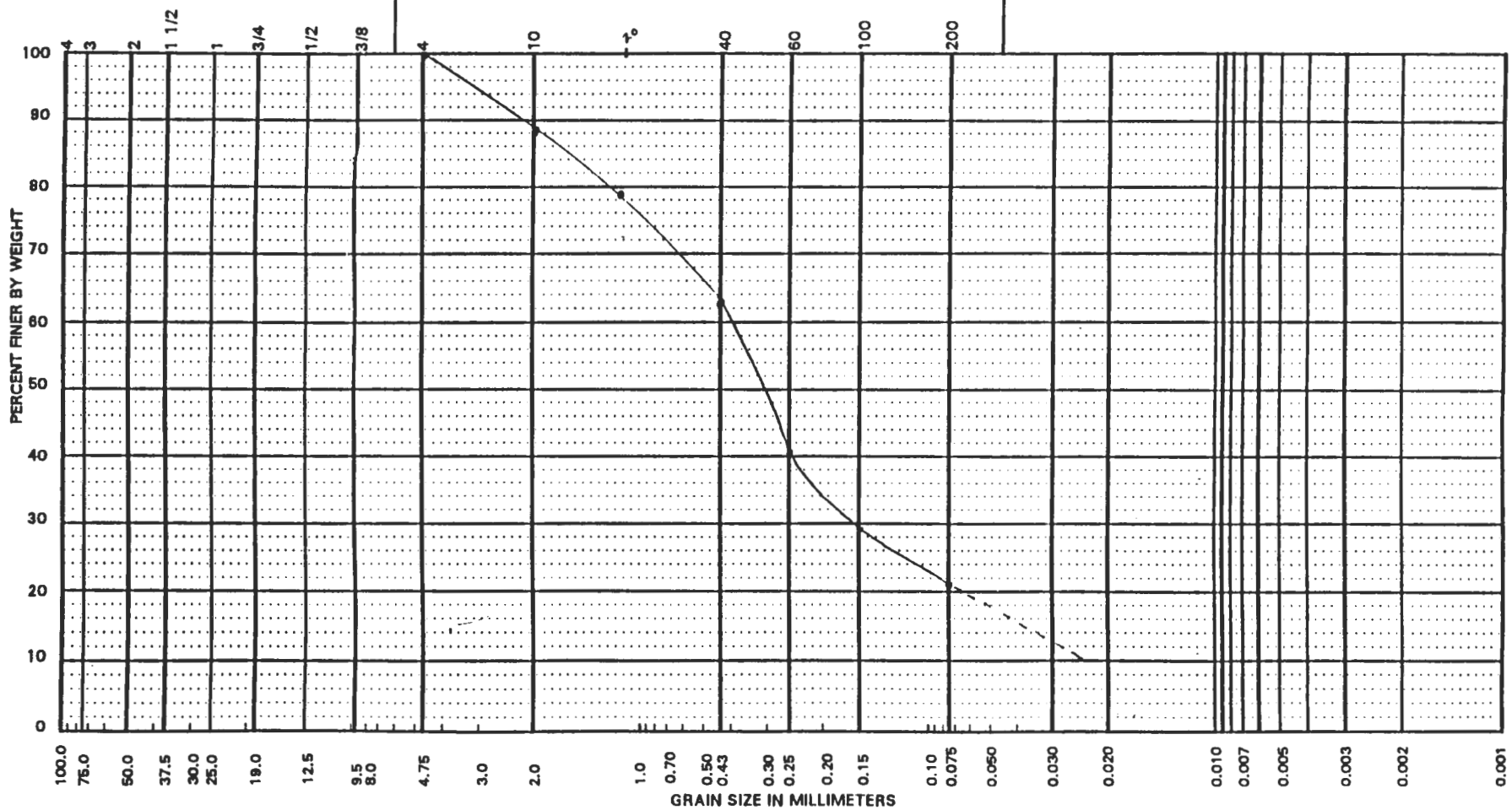
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 299-W18-[illegible] BOHGDD

Page 2 of 2

Remarks Sample @ 250', RECALCULATED TO 100% based on #4 sieve / Initial wt. 220.5g / #10-25.5g / #20-20.2g / #40-34.5g / #60-51.2g / #100-23.3g / #200-19.3g / Pan 46.5g / uniformity coef: 12.8, 50% passing = .009 x5 = .047 x6 = .054 50 SLOT, 8-16 SAND

Size of Opening in Inches	Number of Mesh Per Inch	Hydrometer Analysis



Plotted By EDWARD RoFuse / Edward Rofuse Date 03/25/96

Plot Checked By Mark Darrach / Mark Darrach Date 3/26/96

BD-6000-799 (04/92)

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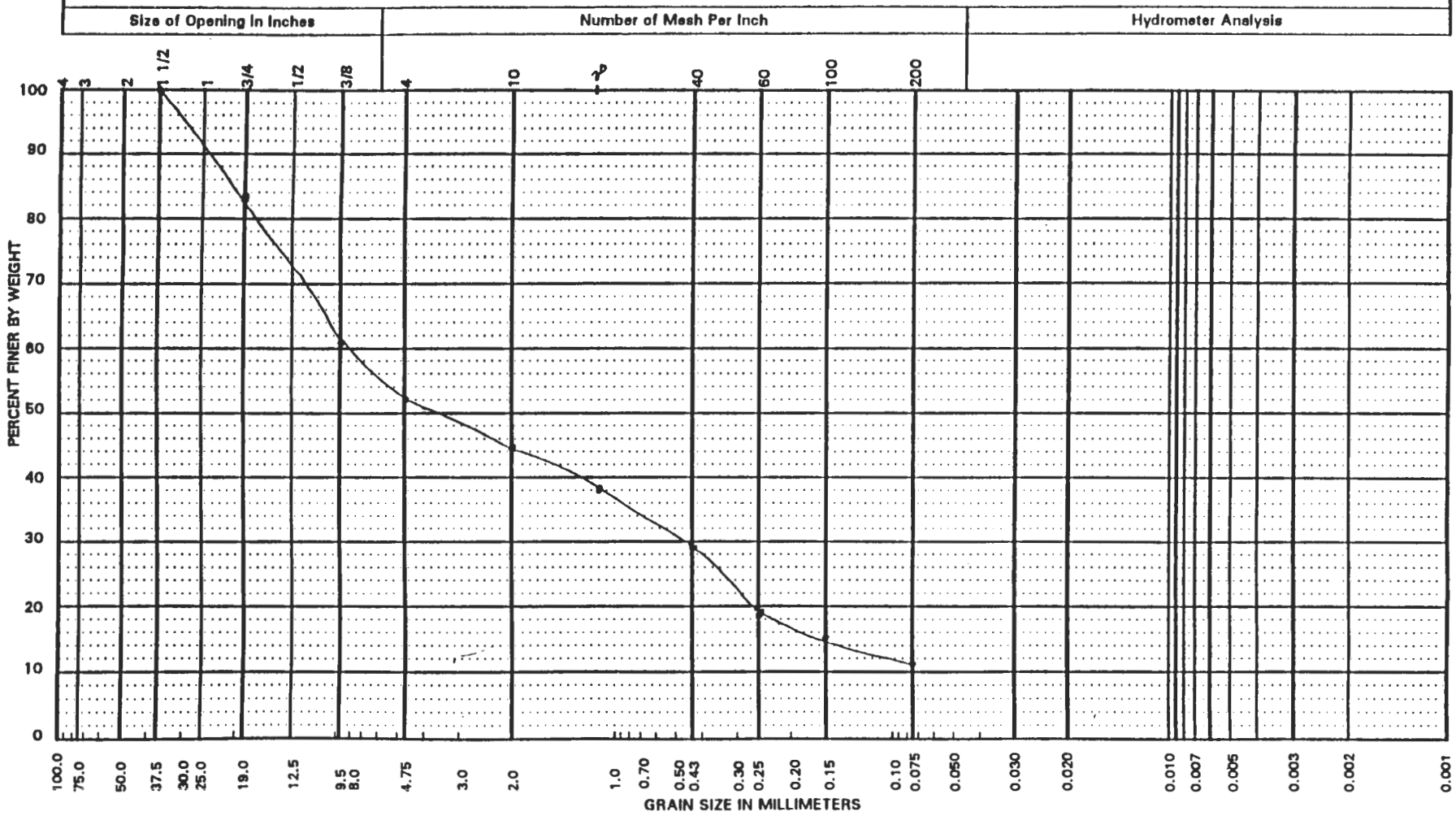
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 258-260
299-W[redacted]7 B0HGD1

Page 1 of 2

Remarks Initial sample wt. 306.7g / 3/4" 50.5g / 3/8" 68.7g / #4 - 26.4g / #10 - 24.1g / #20 - 20.0g / #40 - 27.3g / #60 - 32.5g / #100 - 12.3g / #200 - 10.8g
3#1 ccc
Pan 44.0g 03/25/96



Plotted By Edward C. ReFuse / Edward Refuse Date 03/25/96

Plot Checked By Mark Darrach / Mark Darrach Date 3/26/96

BD-6000-799 (04/92)

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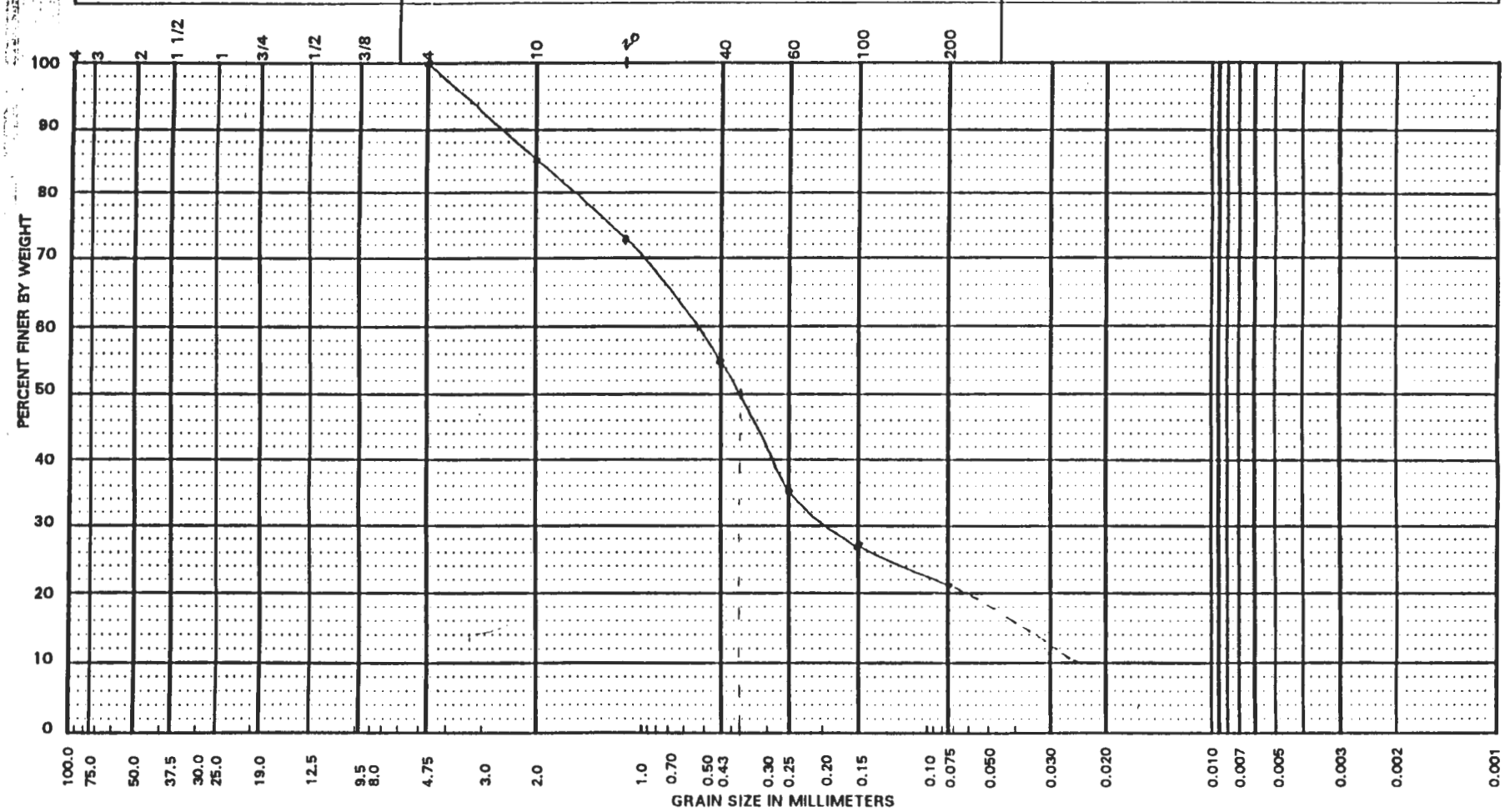
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 2[illegible]260 BGH001
299-[illegible]37

Page 2 of 2

Remarks Sample @ 260 recalculated @ 100% based on #4 sieve / Initial wt. 161.1g / #10-24.1g / #20-20.0g / #40-27.3g / #60-32.5g / #100-12.3g / #200-10.8g / pan 34.1g / Uniformity coef.: 22.0 50% passing: .015 x5: .0748 x 6: .090, [illegible] #70 slot or 60, w/ 8-12 sand



Plotted By EDWARD C. RATUSZ / Edward C. Ratusz Date 03/25/96

Plot Checked By Mark Darrach / Mark Darrach Date 3/26/96

BD-6000-799 (04/92)

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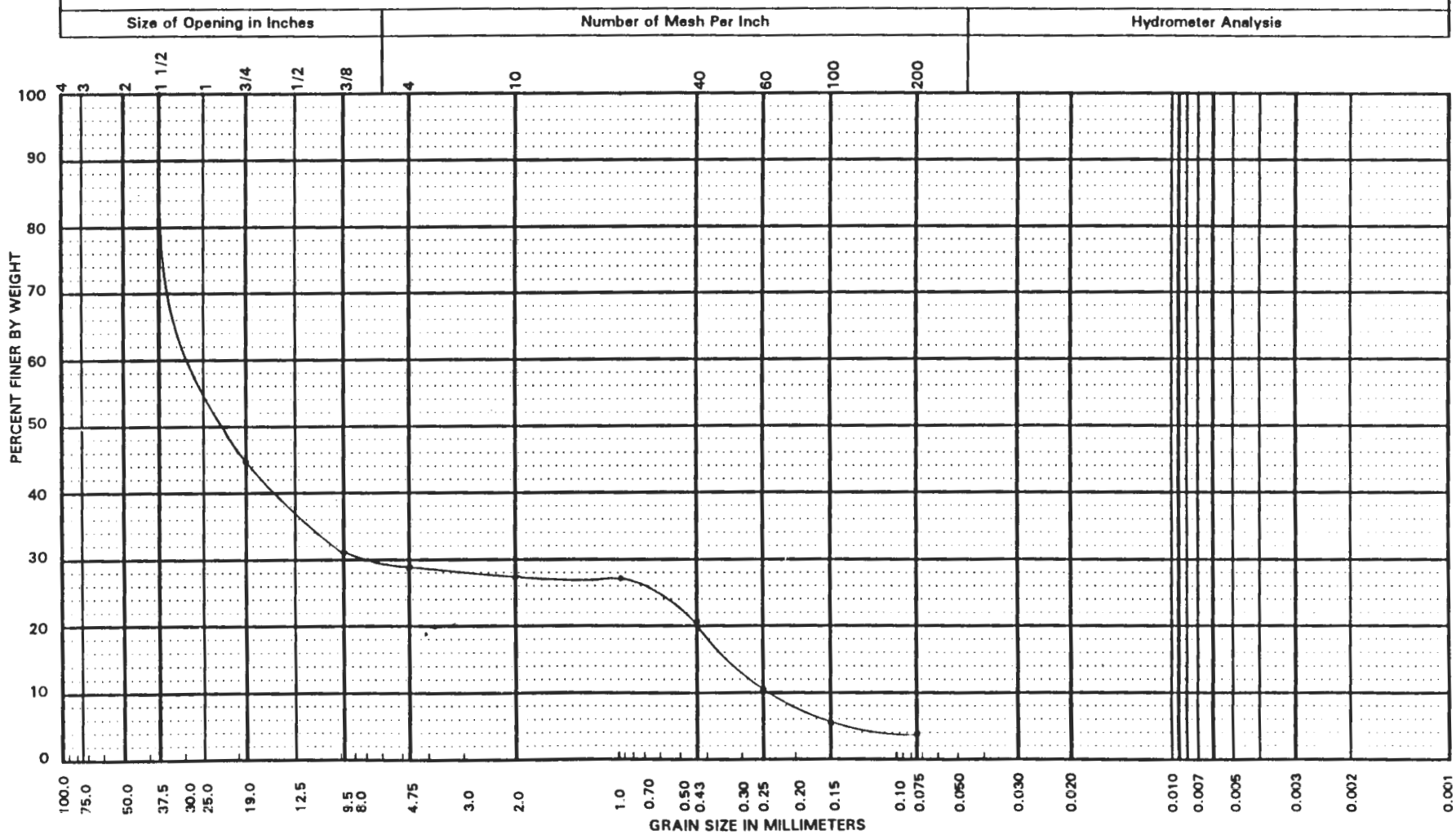
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. Well 299-W18-38 227-229'

Page 1 of 2

Remarks INITIAL SAMPLE WT: 676.7g | 3/4"-375.4g | 3/8"-88.5g | #4-18.2g | #10-6.9g | #20-3.7g | #40-14.0g | #60-69.4 | #100-31.5g | #200-12.7g | PAN-26.4g



Plotted By Mark Darrach / Mark Darrach Date 4/4/96

Plot Checked By EDWARD RAFUSE / Edward Rafuse Date 04/05/96

BD-6000-799 (04/92)

GEL-07 GRAIN SIZE ANALYSIS PLOT

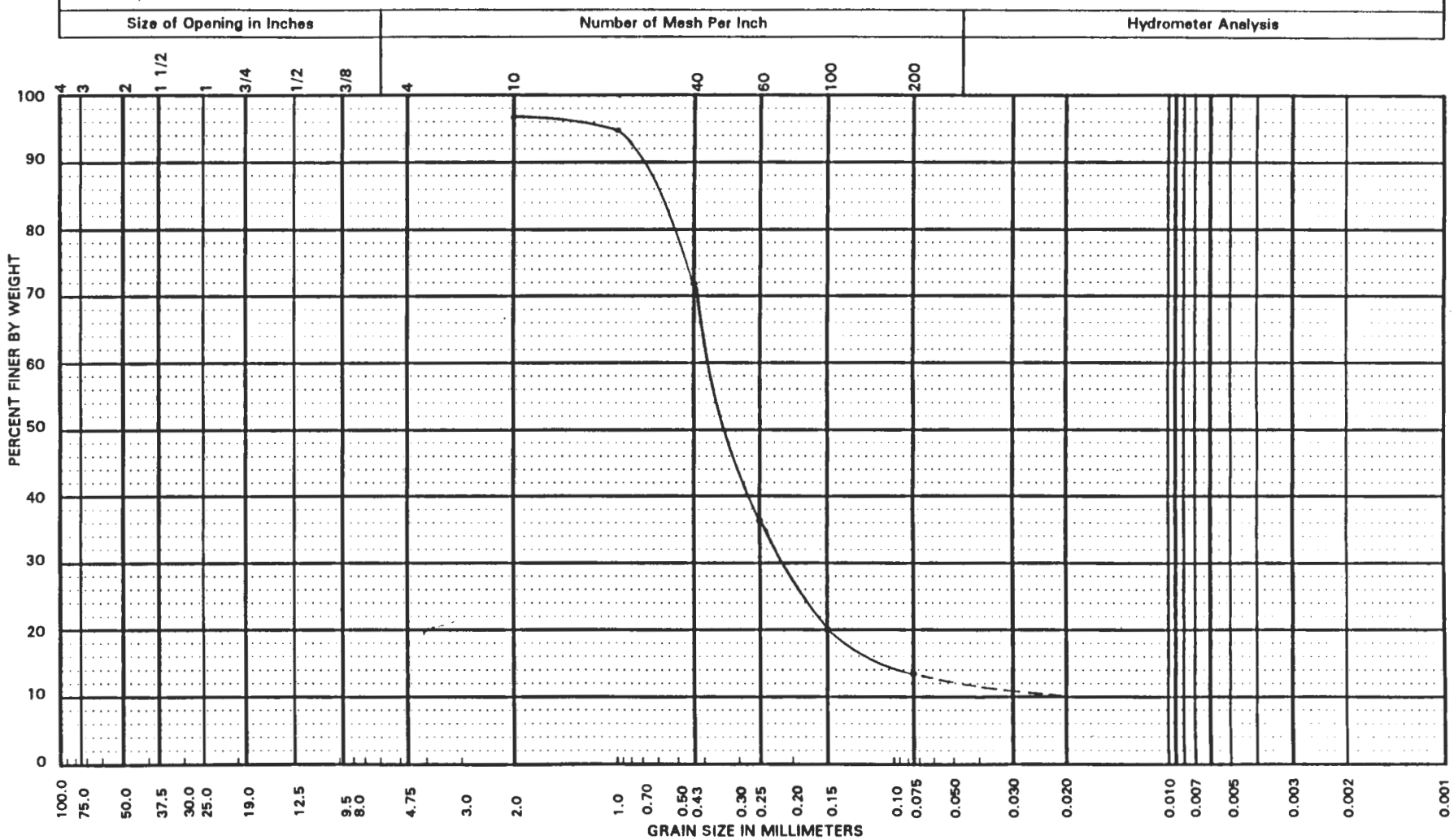
RECORD COPY

Sample No. Well 299-W18-38 227'-229'

Page 2 of 2

Remarks Sample Recalculated and normalized to <#4 fraction: Initial wt: 194.6g / #10-6.9g / #20-3.7g / #40-44.0g / #60-69.4 / #100-31.5g / #200-12.7g / PAN-26.4g

Uniformity Coefficient 60/10 = 19.0 / 50% passing = .0134" * 6 = .080" Design based on this sample - B-12 PACK with .070" SLOT SCREEN



Plotted By Mark Darrach / Mark Darrach Date 4/4/96

Plot Checked By Edward Rafuse / Edward Rafuse Date 04/05/96

BD-6000-799

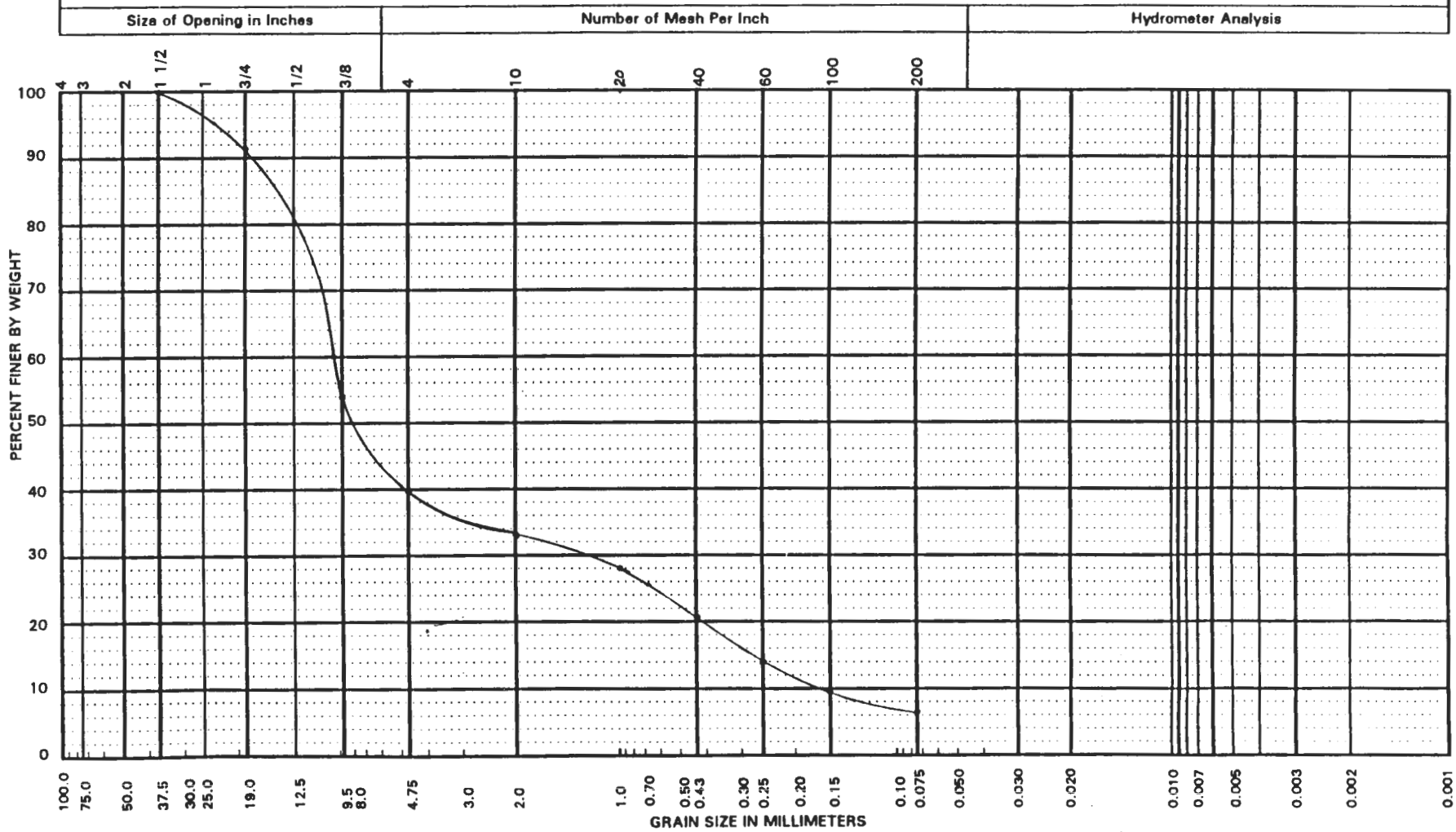
GEL-07 GRAIN SIZE ANALYSIS PLOT

RECORD COPY

Sample No. WK11 209-W18-38 253-253.4

Page 1 of 2

Remarks Initial Sample wt. 295.2g | 3/4"-25.0g | 3/8"-110.9g | #4-41.7g | #10-19.6g | #20-15.3g | #40-21.7g | #60-19.7 | #100-13.0g | #200-9.5g | PAN-18.8g



Plotted By Mark Darrach / Mark Darrach Date 4/8/96

Plot Checked By EDWARD Rafuse / Edward Rafuse Date 05/02/96

BD-6000-799 (04/92)

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GEL-07 GRAIN SIZE ANALYSIS PLOT

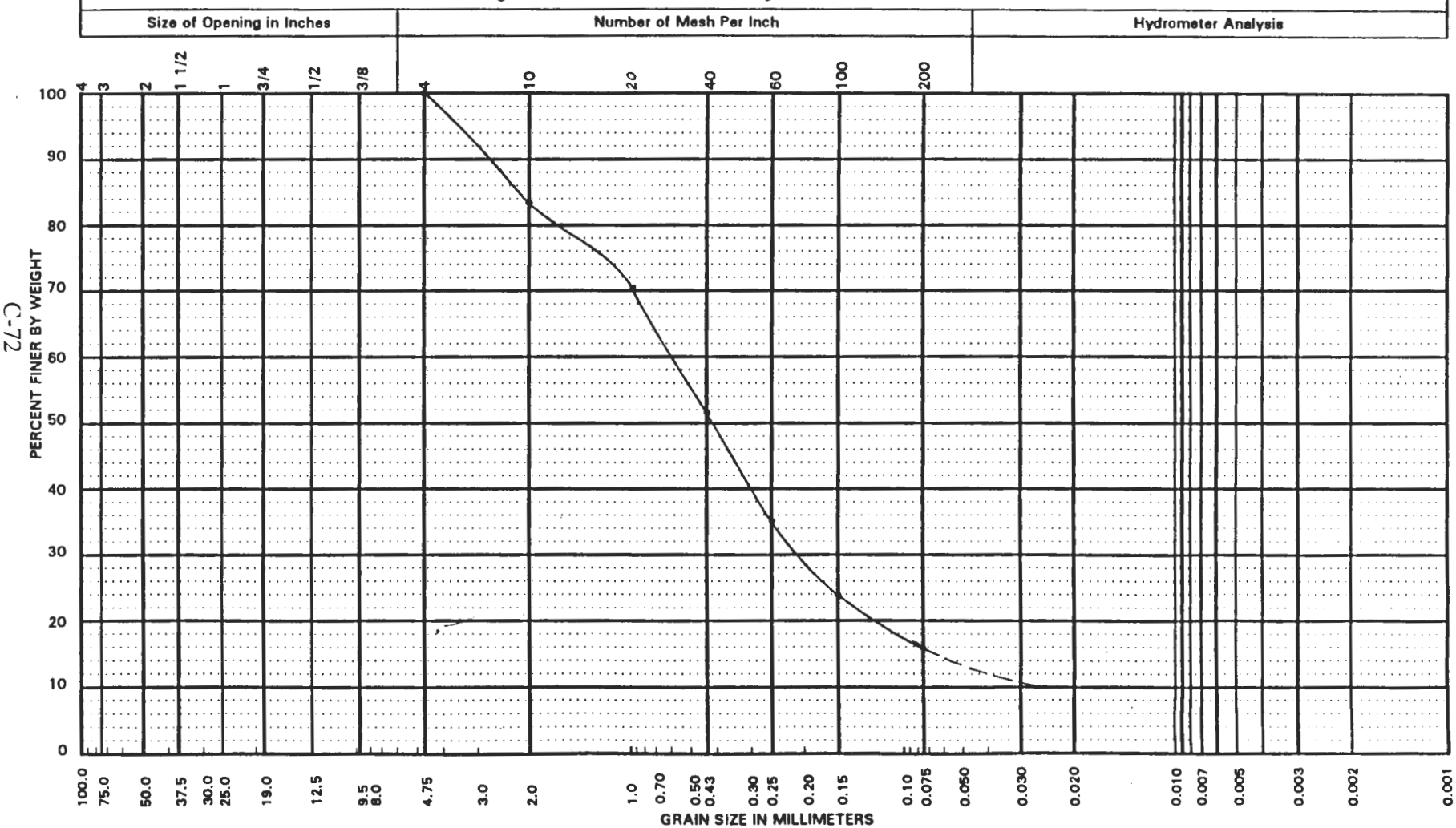
RECORD COPY

Sample No. Well 299-W18-38 253-253.4

Page 2 of 2

Remarks Initial Sample Wt. Recalculated to the ≤#4 Fraction: 117.6g | #10-19.6g | #20-15.3g | #40-21.7g | #60-19.7g | #100-13.0g | #200-9.5g | PAN-18.8g

Uniformity Coefficient: 60/10 = 21.4 50% passing = .0161 #6 = .0969 / Design = 6-12 SAND w/.070" Slot Screen



Plotted By Mark Darrach / Mark Darrach Date 4/8/96

Plot Checked By EDWARD LaFuse / Edward LaFuse Date 05/02/96

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Rev. 0

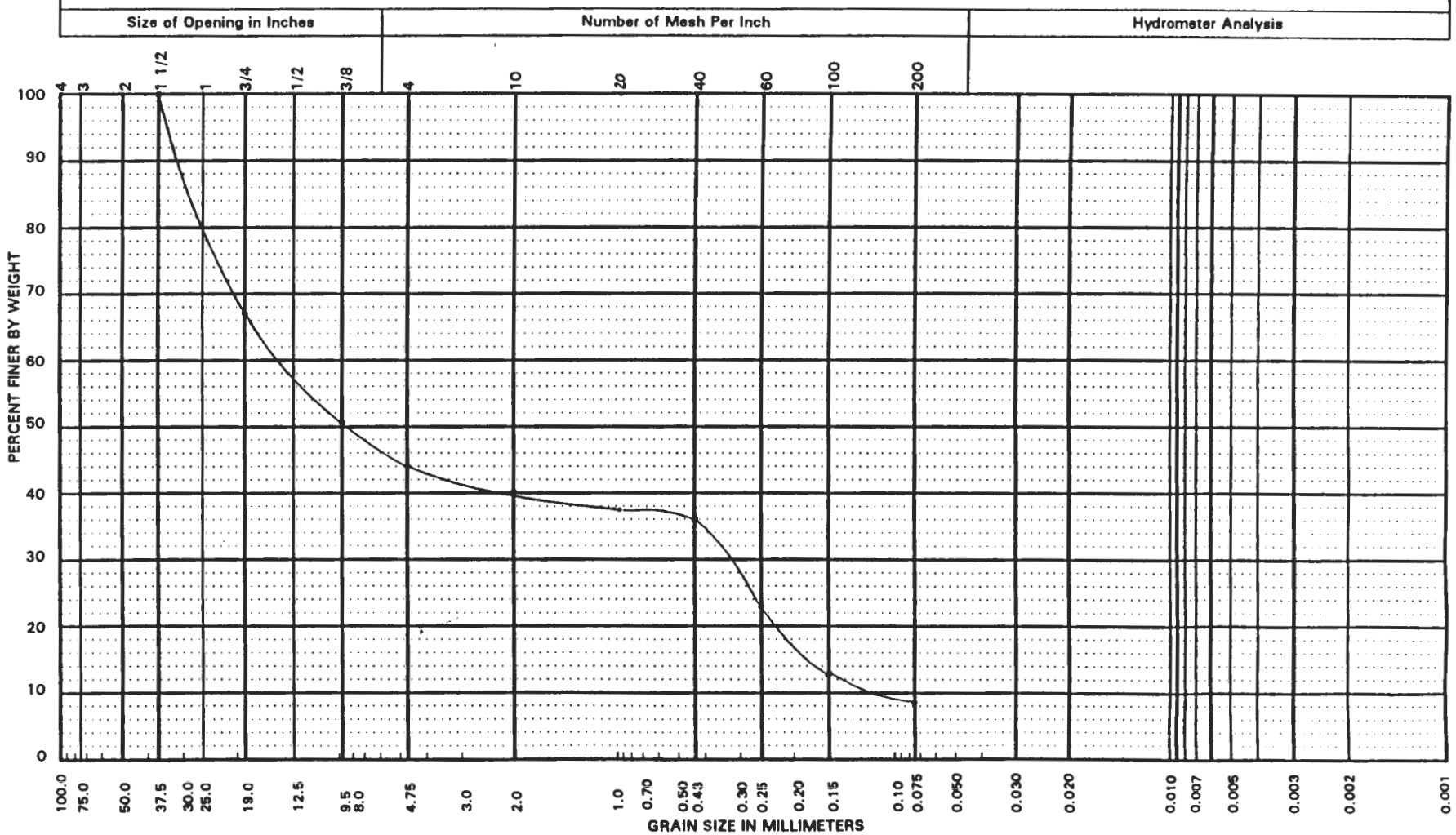
GEL-07 GRAIN SIZE ANALYSIS PLOT

RECORD COPY

Sample No. Well 299-W8-38 272-274

Page 1 of 2

Remarks Initial Dry Sample Wt : 522.4g | 3/4" - 172.4 | 3/8" - 85.7g | #4 - 33.9g | #10 - 21.0g | #20 - 12.2g | #40 - 8.9g | #60 - 69.3g | #100 - 53.0g | #200 - 21.9g PAN - 44.1g



Plotted By Mark Darrach / Mark Darrach Date 4/8/96

Plot Checked By Edward Rotise / Edward Rotise Date 05/02/96

BD-6000-799 (04/92)

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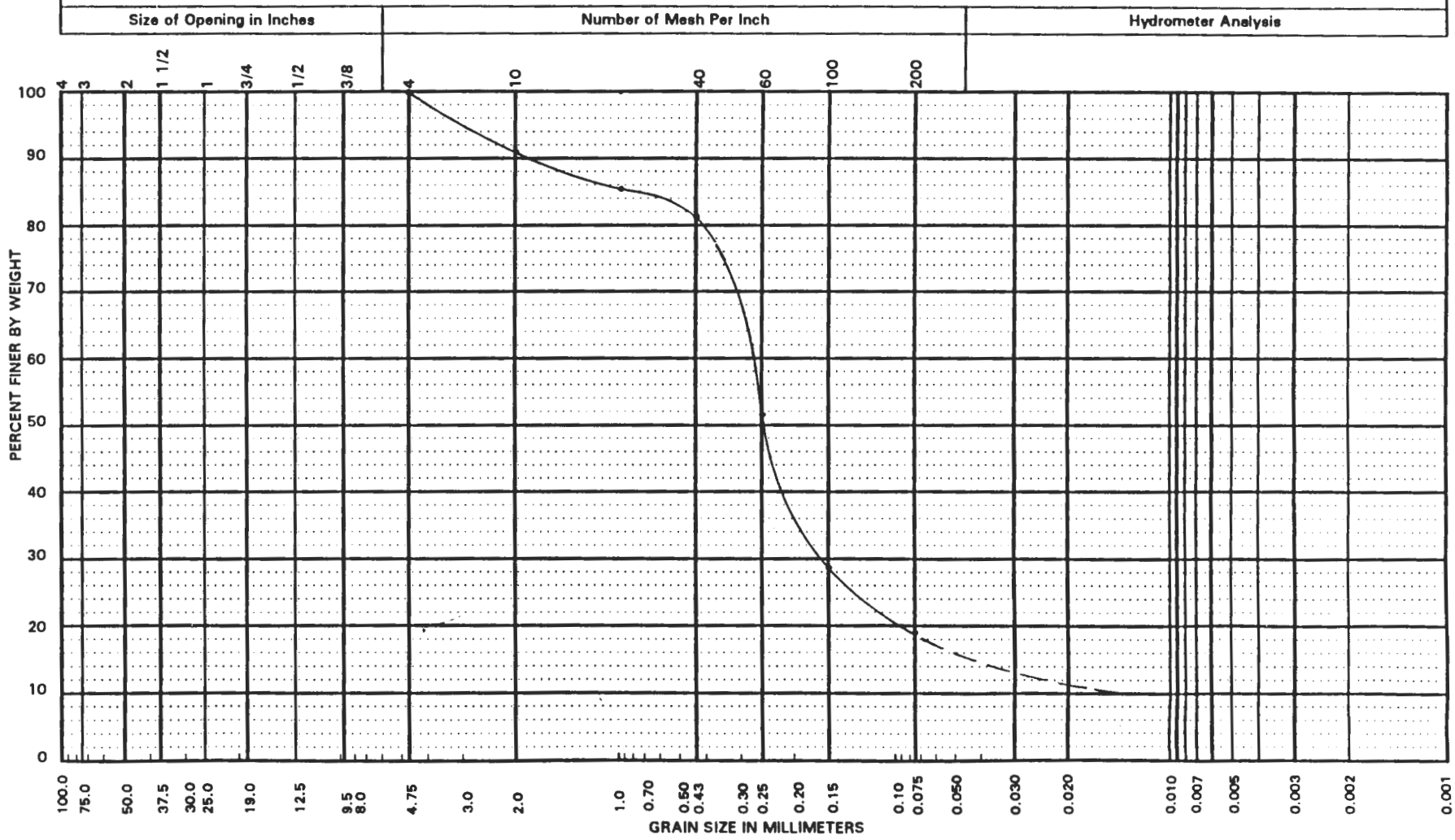
GEL-07 GRAIN SIZE ANALYSIS PLOT

RECORD COPY

Sample No. Well 299-W18-38 272-274'

Page 2 of 2

Remarks Initial Sample Wt. Recalculated to the ≤#4 fraction: 230.4g | #10-21.0g | #20-12.2g | #40-8.9g | #60-69.3g | #100-53.0g | #200-21.9g | PAN-44.1g
Uniformity Coefficient: 19.3 50% passing = 9.84×10^{-3} *6 = .0591 | Design Sandpack is 10-20 w/.040" Screen



Plotted By Mark Darrach / Mark Darrach Date 4/8/96

Plot Checked By EDWARD C. RATFORD / Edward Ratford Date 5/22/96

BD-6000-799 (

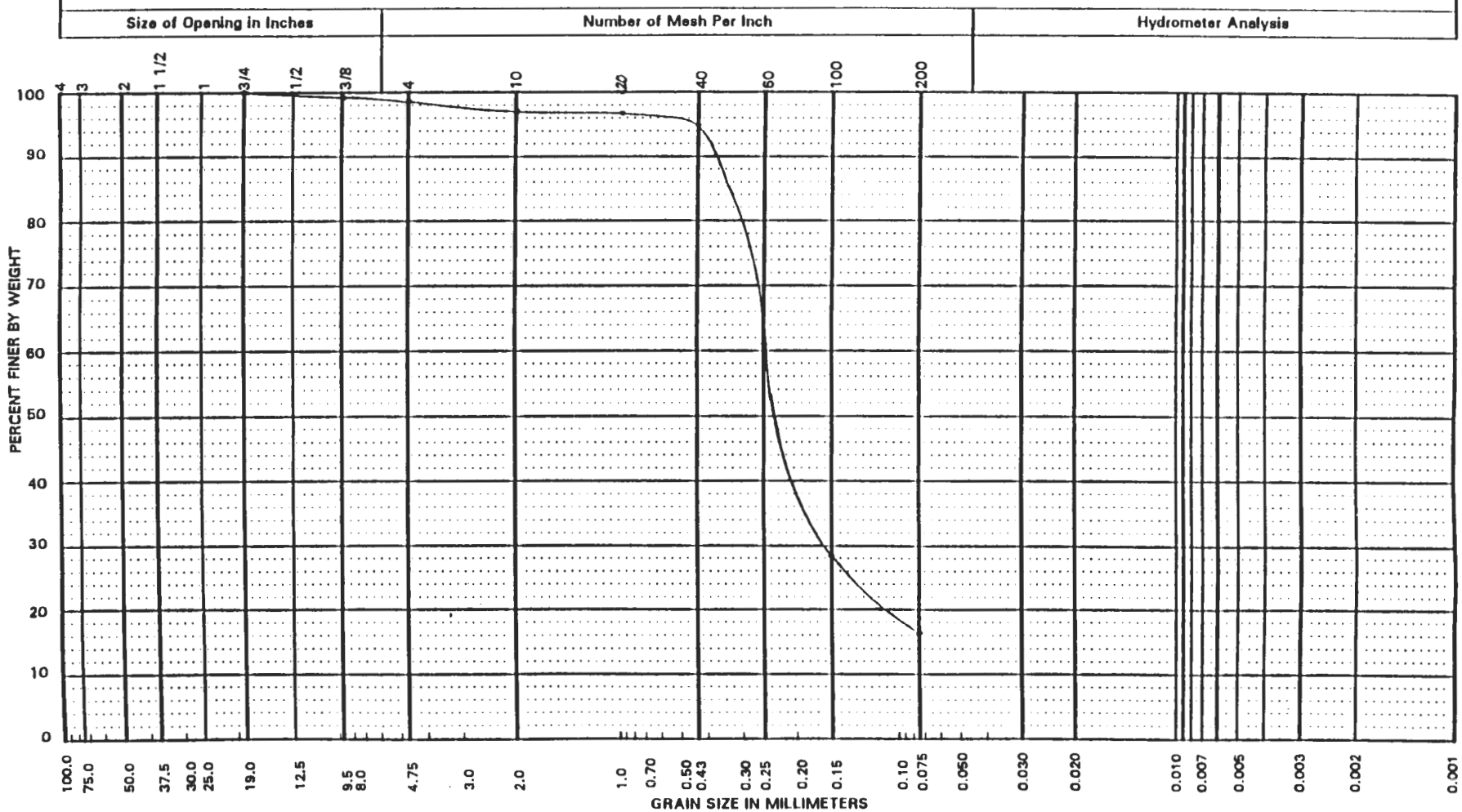
GEL-07 GRAIN SIZE ANALYSIS PLOT

COPY

Sample No. HE- 0#58
220'-222' well W18-39

Page 1 of 2

Remarks Initial Sample Weight: 250.0 grams | 3/8" - 1.8g | #4 - 1.8g | #10 - 2.9g | #20 - 1.5g | #40 - 4.8g | #60 - 84.6g | #100 - 79.7g | #200 - 32.2g | PAN - 14.7g + 26.0 = 40.7



Plotted By Mark Darrach / Mark Darrach Date 4/17/96

Plot Checked By Edward C. LaFuse / Edward C. LaFuse Date 4/18/96

BD-6000-799 (04/92)

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Rev. 0

GEL-07 GRAIN SIZE ANALYSIS PLOT

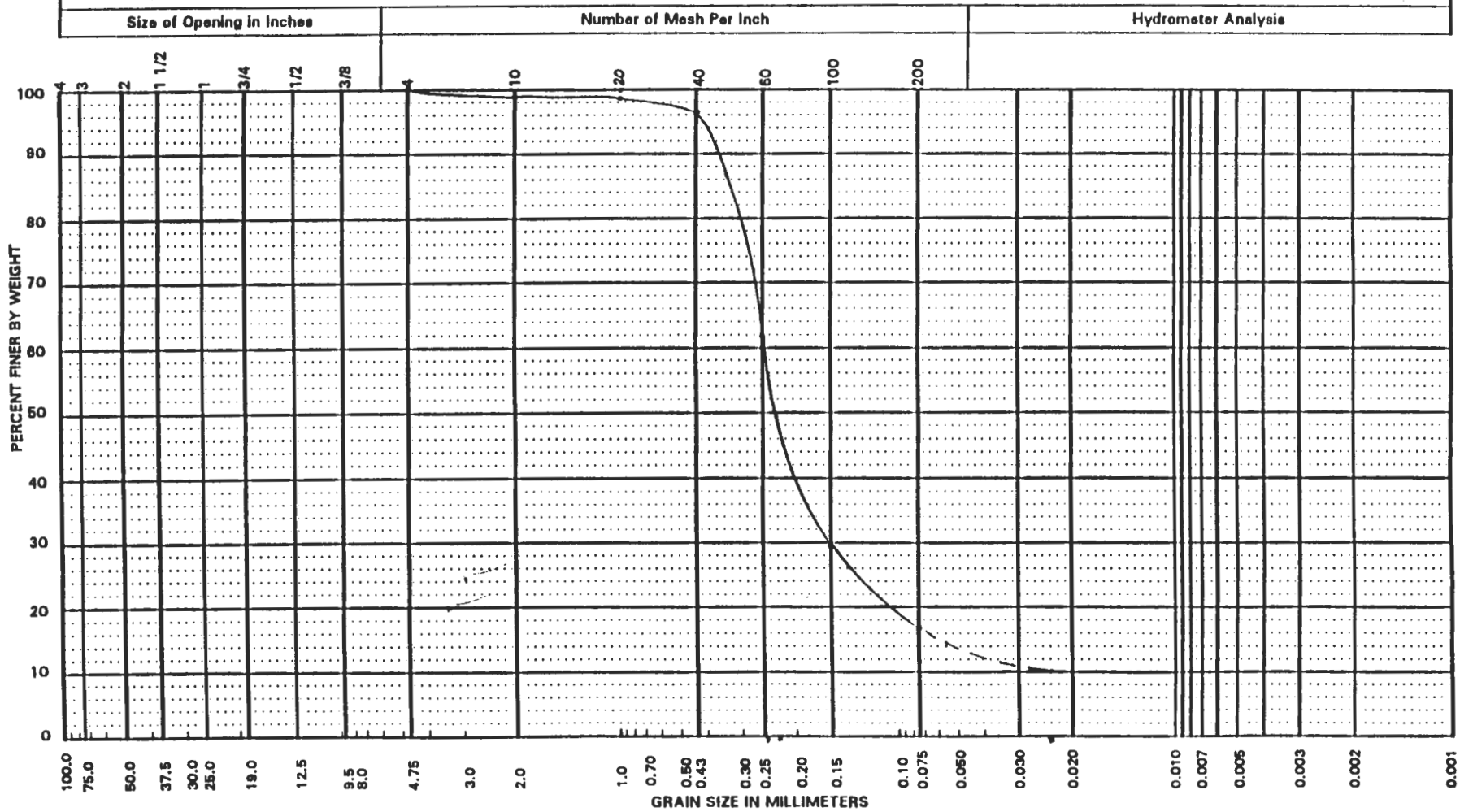
RECORD COPY

Sample No. Bp. 220-222' Well W18-39

Page 2 of 2

Remarks Recalculated Sample normalized to ≤#4 | #10 - 2.9g | #20 - 1.5g | #40 - 4.8g | #60 - 84.6g | #100 - 79.7g | #200 - 32.2g | PAN - 40.7g TOTAL WEIGHT 246.4g

Uniformity Coefficient: 60/10 = 10.4 50% passing = 9.06×10^{-5} Large uniformity coefficient justifies a multiplier > 6. An 8 mult. is used ∴ = .0725 ∴ pack = 8-16 #/40s/ft



Plotted By Mark Darcach / Mark Darcach Date 4/17/96

Plot Checked By Edward C. Rafuse / Edward C. Rafuse Date 4/18/96

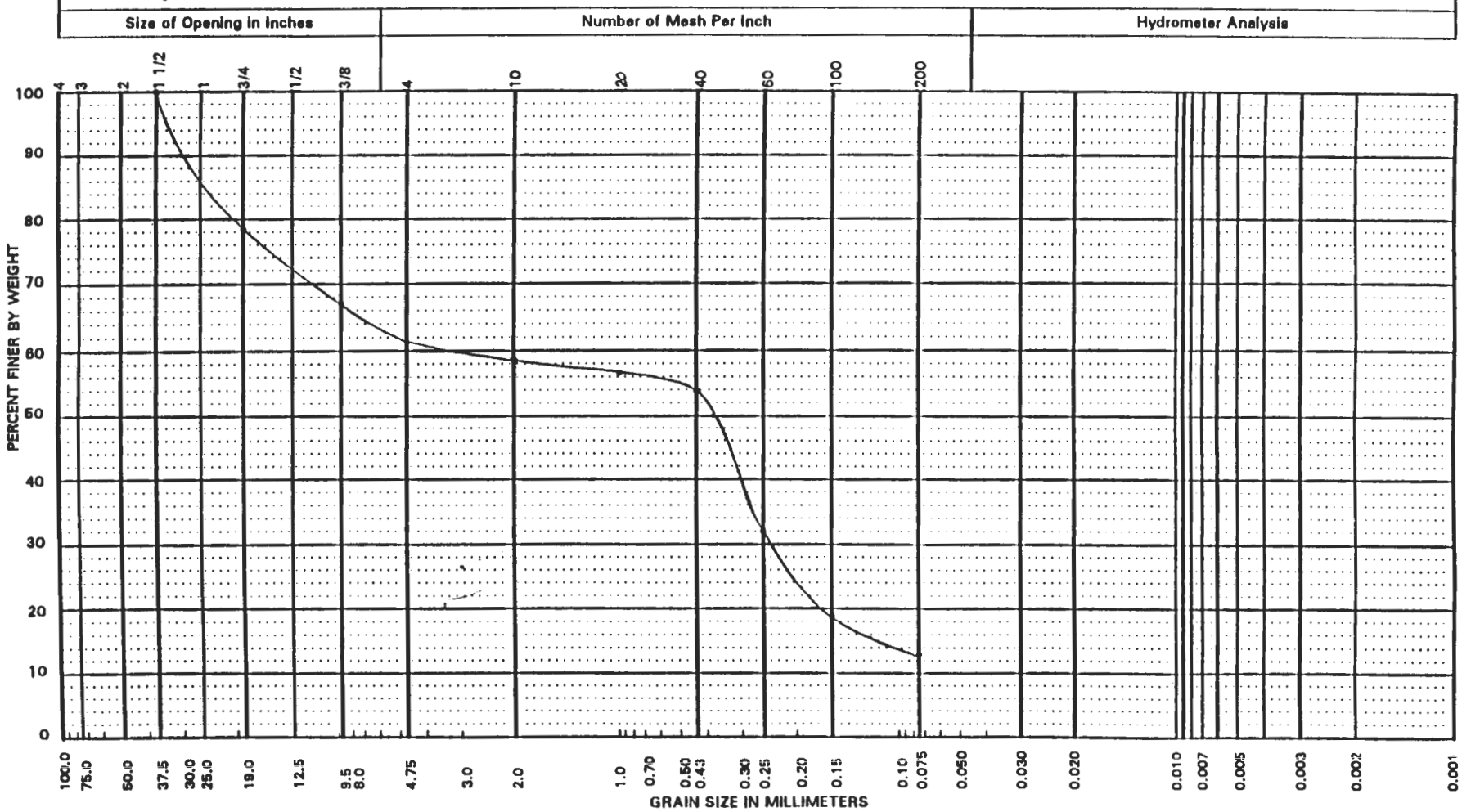
BD-6000-799 (04/92)

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. Bonny 227.5-229.3 Well W18-39

Page 1 of 2

Remarks Initial Sample Wt: 368.1g | 3/4" - 79.5g | 3/8" 42.2g | #4 - 20.5g | #10 - 11.4g | #20 - 5.9g | #40 - 9.6g | #60 - 81.1g | #100 - 49.8g | #200 - 20.0g
PAN - 48.1g



Plotted By Mark Darrach / Mark Darrach Date 4/18/96

Plot Checked By Edward Rabice / Edward Rabice Date 4/18/96

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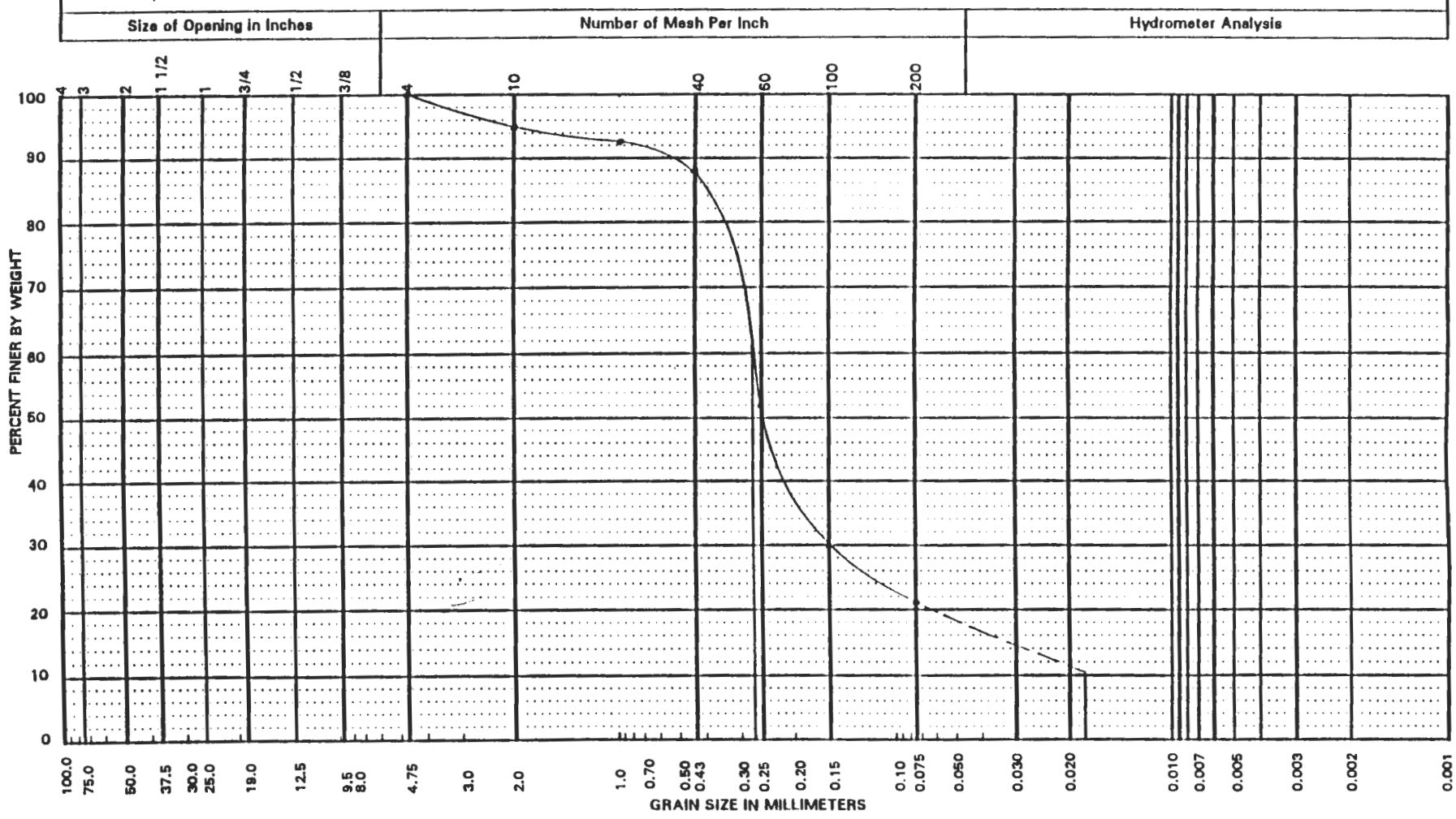
GEL-07 GRAIN SIZE ANALYSIS PLOT

COPY

Sample No. B#1159
227.5-229.3/Well W18-39

Page 2 of 2

Remarks Recalculated Sample Normalized to ≤#4 | #10-11.4g / #20-5.9g / #40-9.6g / #60-81.1g / #100-49.8g / #200-20.0g / PAN-48.1g | INITIAL WT: 225.9g
Uniformity Coefficient ≅ 14.2 / 50% passing = .0098 / An 8 multiplier is used based upon high U.C. / .0098 * 8 = .0784 / ∴ Design = 8-16 w/ .040" SLOT SCREEN



Plotted By Mark Darrach / Mark Darrach Date 4/18/96

Plot Checked By Edward LaFuse / Edward LaFuse Date 04/18/96

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Rev. 0

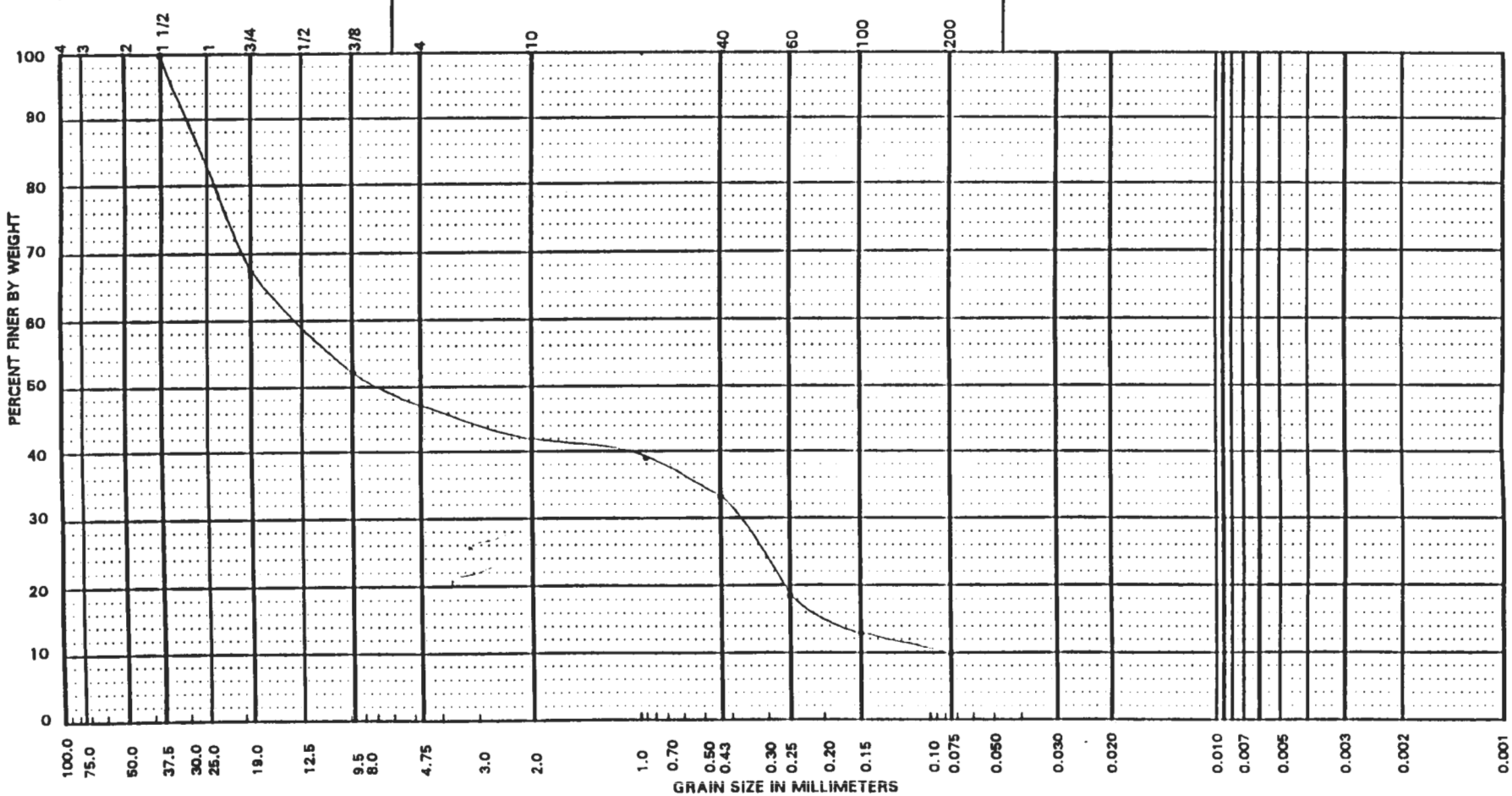
GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 238-240 / W18-39 HEIS B0160

Page 1 of 2

Remarks Initial Sample Wt: 693.8g / 3/4" - 224.3g / 3/8" - 107.1g / #4 - 35.8g / #10 - 35.0g / #20 - 21.5g / #40 - 41.3g / #60 - 101.9g / #100 - 36.8g / #200 - 21.1g

PAN - 69g



Plotted By Mark Darrach / Mark Darrach Date 4/18/96

Plot Checked By Edward LaFaso / Edward LaFaso Date 07/18/96

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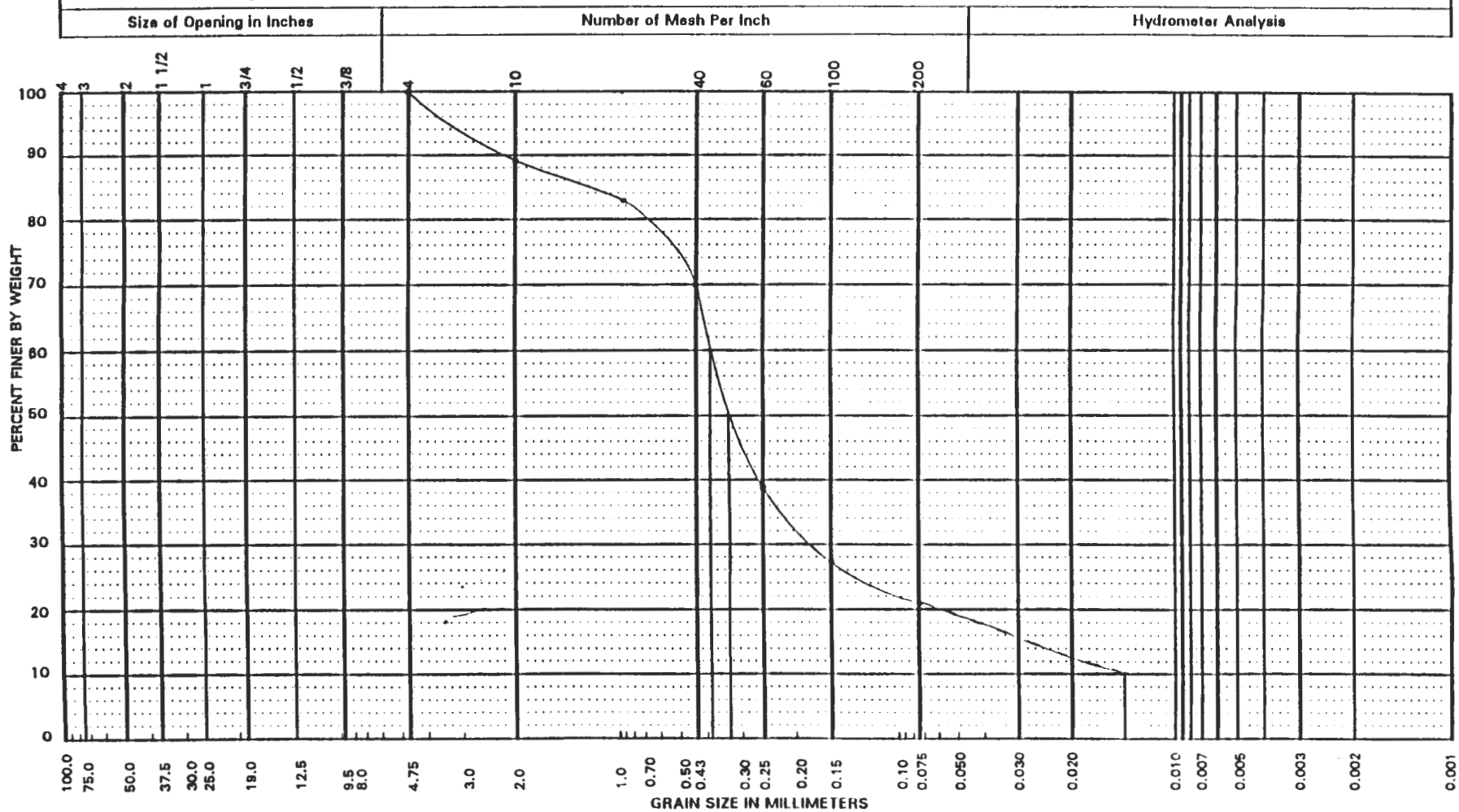
Rev. 0

GEL-07 GRAIN SIZE ANALYSIS PLOT

Sample No. 238-240 / W18-39 HEIS BORING

Page 2 of 2

Remarks Recalculated Sample Normalized to ≤#4 | 10-35.0g | #20-21.5g | #40-41.3g | #60-101.9g | #100-36.8g | #200-21.1g | PAN-69.0g ∴ U.C. = 27 50% passing = .01899" * 6 = .07795" ∴ Design = 8-16 sand w/40 slot screen



Plotted By Mark Dacrach / Mark Dacrach Date 4/18/96

Plot Checked By Edward Rafuse / Edward C. Rafuse Date 04/18/96

BD-6000-799 (04/92)

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APPENDIX D

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WELL DESIGN CALCULATIONS

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Bechtel Hanford, Inc.

CALCULATION SHEET

Originator DAMyers	**Date** 11/21/95	**Calc. No.** 0200W-CA-00006	**Rev. No.**		
Project 200 ZP 1	**Job No.**	**Checked** AJK 11/21/95	**Date**		
Subject Screen & Gravel Pack Selection			**Sheet No.** 1		

Screen and Gravel Pack Selection, Well 299-W15-33

Criteria/Calculation

1. Basis of design is the finest of four sieve analyses (HEIS No. BOGTL2)

2. Analysis done per BHI-00434.

3. 50% passing fraction equal to 1.5 mm,

4. Initial gravel pack based on 5X the 50% passing fraction
   5 X 1.5 mm = 7.5 mm = 0.3 in

   Upon further consideration of the high portion of fines reported in the sieve analyses and on the geologist log, all portions of the sieve analysis greater than the No. 4 sieve were removed.

   50% passing on revised analysis is 0.85 mm
   5 X 0.85 mm = 4.25 mm = 0.167 in

   Gravel pack selected 6 - 12 (0.132 - 0.0661 inches)

5. Screen selected is 0.70 inches, based on passing up to 10% of the selected gravel pack.

6. Uniformity coefficient is 63, indicating suitability for natural gravel pack. Pack is for stabilization of formation only.

7. Well to be developed with dual block surge as the gravel pack is settled.

8. Presence of silt lens from 232 to 236 ft below land surface will require a blank section of casing from 232 to 240 ft. (8 ft).

Bechtel Hanford, Inc.

CALCULATION SHEET

Originator L C Swanson Date 12/15/95 Calc. No. 0200W-CA-G0007 Rev. No. _____
Project 200-ZP-1 IRM Job No. _____ Checked [illegible] Date 12/15/95
Subject Screen + gravel pack selection; well 299-W15-34 Sheet No. 1 of 10

1 Gravel pack selected based on sieve analyses (see attached) using fraction ≤ #4 sieve. Quantity normalized to that fraction.

2. 50% retained is about 0.010 - 0.015 inches.

3. Gravel pack selected based on (50% retained fraction) * 5;

0.010 * 5 = 0.050 inches; 0.015 * 5 = 0.075 inches

4. Gravel pack equal to about #16 to #11, 0.0469 to 0.0661 inches.

5. Selected #8-16 Gravel pack based on formation characteristics/sieves.

6. Screen selected to retain > 90% of gravel pack which is 0.050 inches or 50 slot. Use 40 slot based on available materials.

7. Recommend no more than 5ft lifts during emplacement of gravel pack with dual-block surging while installing pack.

8. May be significant sand generated, so also recommend keeping several feet of pack in annulus and taking frequent depth measurements during emplacement. It is important that formational material does not fall into direct contact with the screen.

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Bechtel Hanford, Inc.

CALCULATION SHEET

RECORD COPY

Originator M. Darrach **Date** 3/15/96 **Calc. No.** **Rev. No.**
Project 200-ZP-1 IRM **Job No.** **Checked** **Date**
Subject Screen and Gravel Pack Selection for well 299-W15-35 **Sheet No.**

1) Sand/Gravel Pack was selected as a fcn. of attached sieve analysis normalized to that fraction ≤ #4 standard sieve for the sampled interval 230'-232'

2) 50% retained/passing is .010" with associated uniformity coefficient (D_{60}/D_{10}) of ≈10 based on curve extrapolation (allows for usage of a multiplier of 6)

3) Gravel/Sandpack selection is based upon 50% retained/passing * 6 (Handbook of Groundwater Development - Roscoe Moss, p. 255)

- ∴ .010" * 6 = .060"
- ∴ d 50 of gravel/sandpack should approximate .060" as closely as possible based upon existing inventory
- 8-16 sand is .047"(16) to .094"(8) and this most closely matches our existing inventory to the above criteria

4) Screen selection is a function of the gravel/sandpack grain size distribution and is chosen to allow ≈10% of the pack to pass through the screen during development/setting. The proper screen should be .050", but based on existing screen inventory we shall use a .040" screen

Bechtel Hanford, Inc. **CALCULATION SHEET** RECORD COPY

200-ZP-1

13.1

Originator M. Darrach **Date** 5/1/96 **Calc. No.** **Rev. No.**
Project 200-ZP-1 J.R.M. **Job No.** **Checked** **Date**
Subject Well design on 299-W15-36 Extraction Well / 200-ZP-1 J.R.M. **Sheet No.**

0044651

1) Chose the sieve analysis plot for the interval sampled from 217.5' → 219'. This sample was typical of significant water-producing intervals in the boring

2) The 50% passing size was .0118"

3) Because the calculated uniformity coefficient was large (60/10 = 18.9) a six multiplier was chosen.

4) 50% passing * 6 is .0118" * 6 = .0708"

5) the # arrived @ in (4) above should be as close to the midpoint (50% passing) of the sand/gravel pack as is possible with our existing inventory

6) The midpoint of an 8-16 sand/gravel is .0705". Based on this criterion an 8-16 sandpack is chosen in conjunction with a .040" screen

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Bechtel Hanford, Inc.

CALCULATION SHEET

RECORD COPY

16.1

Originator Mark Darrach **Date** 5/13/96 **Calc. No.** **Rev. No.**
Project 200-ZP-1 J.R.M. **Job No.** **Checked** **Date** 5/13/96
Subject Design Calculation for well # 299-W15-37 **Sheet No.** 1 of 1

0044661

1) Chose the sieve analysis plot for the interval sampled from 238'-240'. This sample is typical of the important water-producing intervals in this boring

2) The 50% passing size is .00984"

3) Because the calculated uniformity coefficient is large (60%/10% = approximately 16.6) a seven multiplier was chosen

4) 50% passing * 7 = .00984 * 7 = .069"

5) The # in (4) above should be as close to the midpoint (50% passing) of the sand/gravel pack as possible with our existing inventory

6) The midpoint of an 8-16 sand/gravel pack is .0105" assuming a linear distribution of sizes. Based on this criterion an 8-16 sandpack is chosen in conjunction with a .040" wire wrap screen

Bechtel Hanford, Inc. **CALCULATION SHEET**

RECORD COPY

Originator M. Darrack **Date** 5/21/96 **Calc. No.** _____ **Rev. No.** _____
Project 200-ZP-1 J.R.M. **Job No.** 02200X-FM-60234 **Checked** _____ **Date** _____
Subject Well Design for well # 299-W15-38 **Sheet No.** 1 of 1

0044671

1) Chose the sample taken @ 219' b.g.s. as the representative design sample

2) Normalized plot for this sample indicates a uniformity coefficient (60%/10% passing) of approximately 4.5

3) 50% passing size is .0102"

4) Based on a uniformity coefficient significantly >2 a multiplier of 7 or greater is allowable

5) 50% passing * 7 is .0102" * 7 = .0714"

6) The sand/gravel pack chosen should have its midpoint as close to the product in #5 above

7) Based on this criterion, and existing inventory, an 8-16 sandpack was chosen and should be accompanied by an .040" or .050" slot screen

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Bechtel Hanford, Inc.

CALCULATION SHEET

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13.1

Originator M. Darrach Date 5/21/96 Calc. No. Rev. No.
Project 200-ZP-1 O.R.M. Job No. Checked Date 5/28/96
Subject Well design for well #299-W15-~~389~~ MD 5/29/96 Sheet No. 1 of 1

0044681

1) Chose the sample taken from the interval 216-220.5 as the representative design sample

2) Normalized plot for this sample indicates a uniformity coefficient (60%/10% passing) of approximately 12.4

3) 50% passing size is .011"

4) Based on a uniformity coefficient significantly >2 a multiplier of 7 or greater is allowable

5) 50% passing #7 is .077

6) The sand/gravel pack chosen should have its midpoint as close to the product of #5 above

7) Based on this criterion, and existing inventory, an 8-16 sandpack was chosen and should be accompanied by a .040" or .050" slot well screen

Bechtel Hanford, Inc.

CALCULATION SHEET

020DW-CA-G0007

Originator DA Myers Date 1/17/96 Calc. No. _____ Rev. No. _____
Project 200 ZP-1 Job No. _____ Checked [illegible] Date 1/17/96
Subject Screen Selection; W 18-36 with Gravel Pack Sheet No. 1

1. Gravel pack selected based on four (4) sieve analyses (attached) using fraction ≤ #4 sieve. MASS NORMALIZED TO THAT fraction

2. 50% retained fraction ranges from 0.011 to 0.02 inches

3. Gravel Pack selected on [50% retained size] * 5

   0.011 * 5 = 0.055 to 0.02 * 5 = 0.10 inches

4. Gravel pack equal to #14 to #7, 0.0555 to 0.111

5. Selected #8-16 gravel pack based on formation's sieves

6. Screen selected to retain minimum of 90% gravel pack (ideal screen is 0.050 slot) Use .040 slot based on availability

7. Install per specification (No more than 5 ft lifts)

8. May be significant sand/silt generated at 247-250 and 218-220. Great care must be taken to assure adequate fill (>0) in annulus. Do NOT allow formation contact with screen.

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Bechtel Hanford, Inc.

CALCULATION SHEET

RECORD COPY

Originator M. Darrach **Date** 3/26/96 **Calc. No.** _____ **Rev. No.** _____
Project 200-ZP-1 JRM **Job No.** 02200X-FM-60234 **Checked** _____ **Date** _____
Subject Screen and Gravel/Sandpack Selection for well 299-W18-37 **Sheet No.** 1 of 1

1) Sand/Gravelpack was chosen as a function of attached sieve analysis normalized to that fraction < #4 standard sieve for the sampled interval 240-242'.

2) 50% retained/passing is .0102" with a uniformity coefficient (d_{60}/d_{10}) of ≈8 based upon curve extrapolation

3) Gravel/Sandpack selection is based upon 50% retained/passing * 6 (Handbook of Groundwater Development - Roscoe Moss, p. 255)

- .0102" * 6 = .0612"
- d50 of gravel/sandpack should approximate .0612" as closely as possible based upon existing inventory
- 8-16 sand is .047" to .094" in gradation and this most closely approximates the above criterion

4) Screen slot size selection is a function of the gravel/sandpack grain size distribution and is chosen to allow none of the pack through the slots. However, the slot size is chosen to approximate the fine end of the pack distribution (16 sand - .047") with out exceeding this limit. Thus, a .040" slot size is recommended based upon existing inventory

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2 of 4

Bechtel Hanford, Inc.

CALCULATION SHEET

Originator L C Swanson Date 4/8/96 Calc. No. 0200W-CA-G0012 Rev. No. NA
Project 200-ZP-1 IRM Job No. Checked [illegible] Date 4/9/96
Subject Screen + Gravel Pack Selection; Well 299-W18-38 Sheet No.

1) Gravel pack selected based on attached sieve analysis normalized to <#4 standard sieve for the interval 272-274 ft, and the high uniformity coefficient.

NORMALIZED - MATERIAL SIEVES REMOVED TO PRO BIAS [illegible]

2) 50% retained/passing is 0.25 mm;

$$U.C. \triangleq \frac{15\ mm}{0.12\ mm} \cong 125 \text{ (for full sample)}$$

3) Use multiplier of 6 (Rosa Moss, p. 255; Handbook of Groundwater Development).

$$0.25\ mm * 6 * \left(\frac{in}{25.4\ mm}\right) = 0.059 \text{ inches}$$

4) Use 3/16 gravel pack based on match to 0.059 inches from existing inventory. Range in size is 0.047 → 0.0931 inches.

5) Use 40 slot screen based on >90% retention of gravel pack and screen inventory. Place 10 ft of screen above water table, 60 ft below water-table. [illegible] 4/9/96

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Bechtel Hanford, Inc.

CALCULATION SHEET

200-ZP-1

RECORD COPY

13.1

Originator Mark Darrach **Date** 4/18/96 **Calc. No.** _____ **Rev. No.** _____
Project 200-ZP-1 JRM **Job No.** 0200X-FM-60234 **Checked** _____ **Date** _____
Subject Well design for well 299-W18-39 **Sheet No.** 1 of 1

0044640

1) During drilling of the 299-W18-39 well 3 samples were sieved and plotted. All three sieve plots justify the same design, however the plot over the interval 238'-240' was chosen for this calculation.

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2) Uniformity Coefficient for this plot is .358 mm / .014 mm = 27.1. The 10% passing value was chosen as a function of visual extrapolation of the existing curve. This large U.C. value justifies use of a multiplier of 6 or greater

3) 50% passing size is .013" * 6 = .078"

4) Based on existing inventory .078" lies closest to the midpoint of the 8-16 sand. ∴ the well design should be an 8-16 sand/gravel pack with a .040" slot screen

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APPENDIX E

WELL DEVELOPMENT DATA

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BHI-00927
Rev. 0

029759

Environmental Restoration Contractor **ERC Team**

Interoffice Memorandum

Job No. 22192
Written Response Required? NO
Closes CCN: N/A
OU: N/A
TSD: N/A
ERA: N/A
Subject Code: 8420

TO: D. A. Myers H9-11

DATE: April 5, 1996

COPIES: L. C. Swanson H9-11
BHI Document Control H0-09, w/a

FROM: R. S. Edrington
Geosciences
H9-03/372-9291

SUBJECT: **ZP-1 WELL DEVELOPMENT DATA REPORT**

This report summarizes well development activities for wells 299-W15-33, 299-W15-34, 299-W15-35, 299-W18-35, and 299-W18-36. Table 1 lists the results of the individual developments and well configurations. The hydrographs from pumping and Field Activity Reports (FARs) are attached.

Table 1.

Well Development Results for ZP-1					
Well	Maximum Pump Rate (gpm)	Maximum Drawdown (ft)	Available Water* (ft)	Final Turbidity (ntu)	Total Page Volume (gal)
299-W15-33[1]	53	15.0	37	3.50	11,200
299-W15-34[2]	~65	8.2	43	3.41	10,300
299-W15-35	72	9.0	43	3.24	7,400
299-W18-35[3]	65	12.4	34	1.44	6,600
299-W18-36	55/38	12.6	46	2.16	3,800

*Available water is the amount (ft of head) above the pump intake. The pumps were placed on or just off the well bottom, the intake is 2.75' above bottom of pump.
[1] Total purgewater volume is based on drawdown on both 12/5 and 12/8.
[2] Pump rate and total purgewater volume estimated on fill time of purgewater truck due to malfunction of rotometer.
[3] W18-35 was developed before completion and later abandoned when the casing was split during completion.

Summary of Activities

299-W15-33

Two drawdowns were conducted during development. The first on December 5, 1996 pumped at 50 gpm for 41 minutes with a maximum drawdown of 13.5 ft. During the first 20 minutes of this drawdown the rotometer leaked, causing some irregularity in the pump rate. Due to purgewater truck scheduling problems the next drawdown was not scheduled until December 8, in which, the well was pumped at 53 gpm for 3.5 hours reaching a maximum drawdown of 15 ft. The final turbidity was 3.5 Nephelometric Turbidity Unit (NTU).

299-W15-34
On March 13, 1996 three drawdown tests were conducted. The first ran for 52 minutes at ~65 gpm with a resulting drawdown of 8.2 ft. Due to a malfunction of the rotometer, the pump rate was calculated based on the time it took to fill the purgewater truck. The second drawdown ran again at ~65 gpm for 50 minutes with a final turbidity of 76.7 NTU. The third and final drawdown ran for 39 minutes at a pump rate of 26 gpm resulting in a drawdown of 6 ft. The pumping was stopped after reaching a turbidity of 3.41 NTU.

299-W15-35
On March 20, 1996 two drawdown tests were conducted. The development started with approximately 6 ft of sand in the bottom of the well. Therefore, the first drawdown rate started low at 20 gpm in an effort to protect the pump, two minutes later the pumping rate was increased to 67 gpm for a total pumping time of 50 minutes. Pumping was stopped to allow the purge truck to empty. On return of the purge truck, pumping restarted at 72 gpm and stopped after 50 minutes at a drawdown of 9 ft when the turbidity reached 3.24 NTU.

299-W18-35
Before completion of this well with permanent casing two drawdown tests were conducted on December 28 & 29, 1995. The first test pumped at 65 gpm for 53 minutes on the 28th, the second for 48 minutes on the 29th, both resulting in ~12.4 ft of drawdown. The final turbidity was 1.44 NTU. Well 699-39-79 showed 0.441[1] of drawdown during development of W18-35. During completion, well 299-W18-35 bridged and the permanent casing was split. The well was later abandoned.

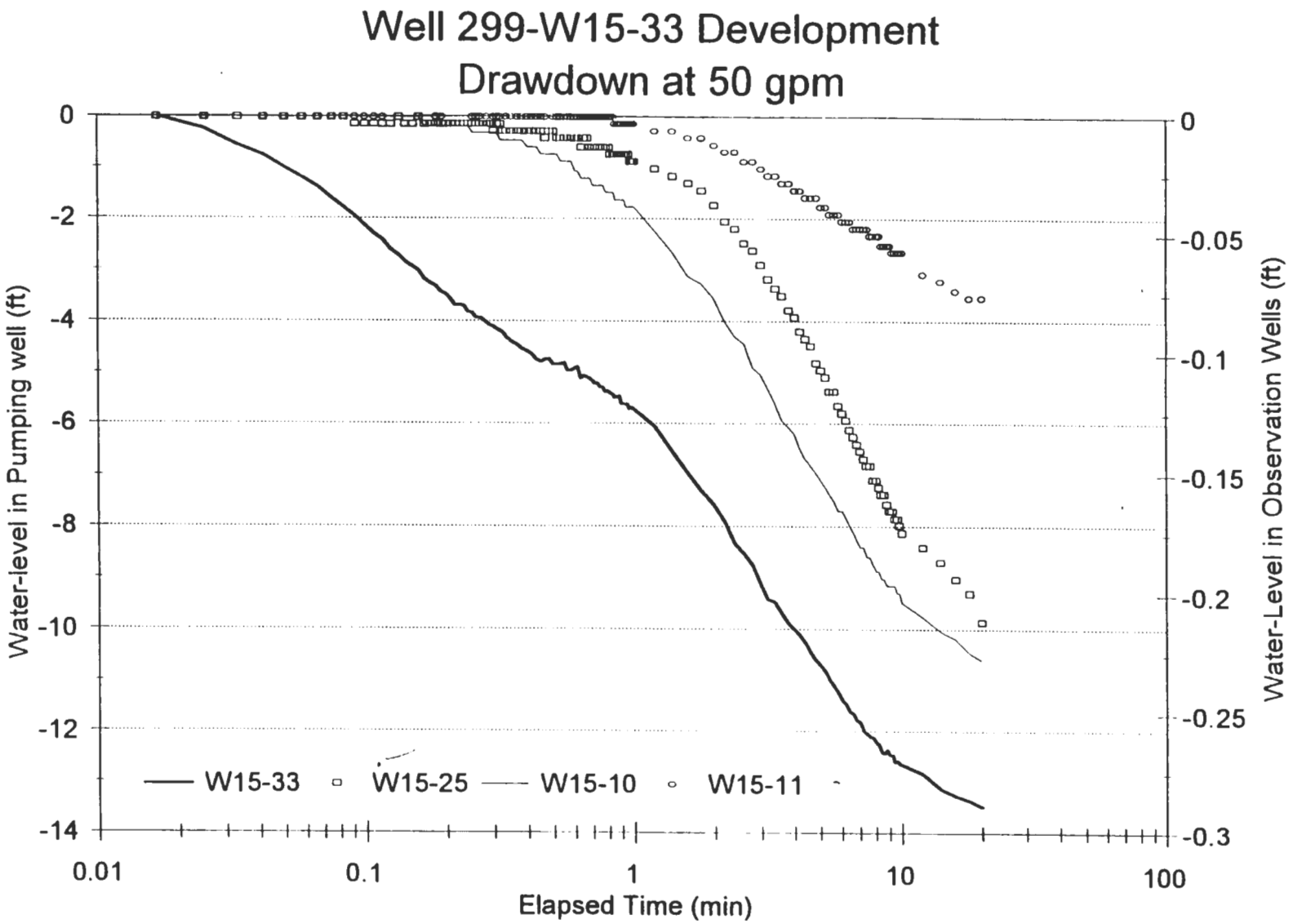
299-W18-36
Two drawdown tests were performed on January 24, 1996. Pumping the well at 55 gpm for 4 minutes resulted in a drawdown of over 10 ft. The pump rate was lowered to 38 gpm and pumping continued for an additional 49 minutes reaching a drawdown of 12.7 ft. After emptying to purgewater truck development pumping continued at 38 gpm for 44 minutes with final turbidity of 2.16 NTU.

RSE:rse

Attachment: Hydrographs of the Drawdown
Field Activity Reports (FARs)

CONCURRENCE

DATE	4/5/96
INITIAL	LCS JCB



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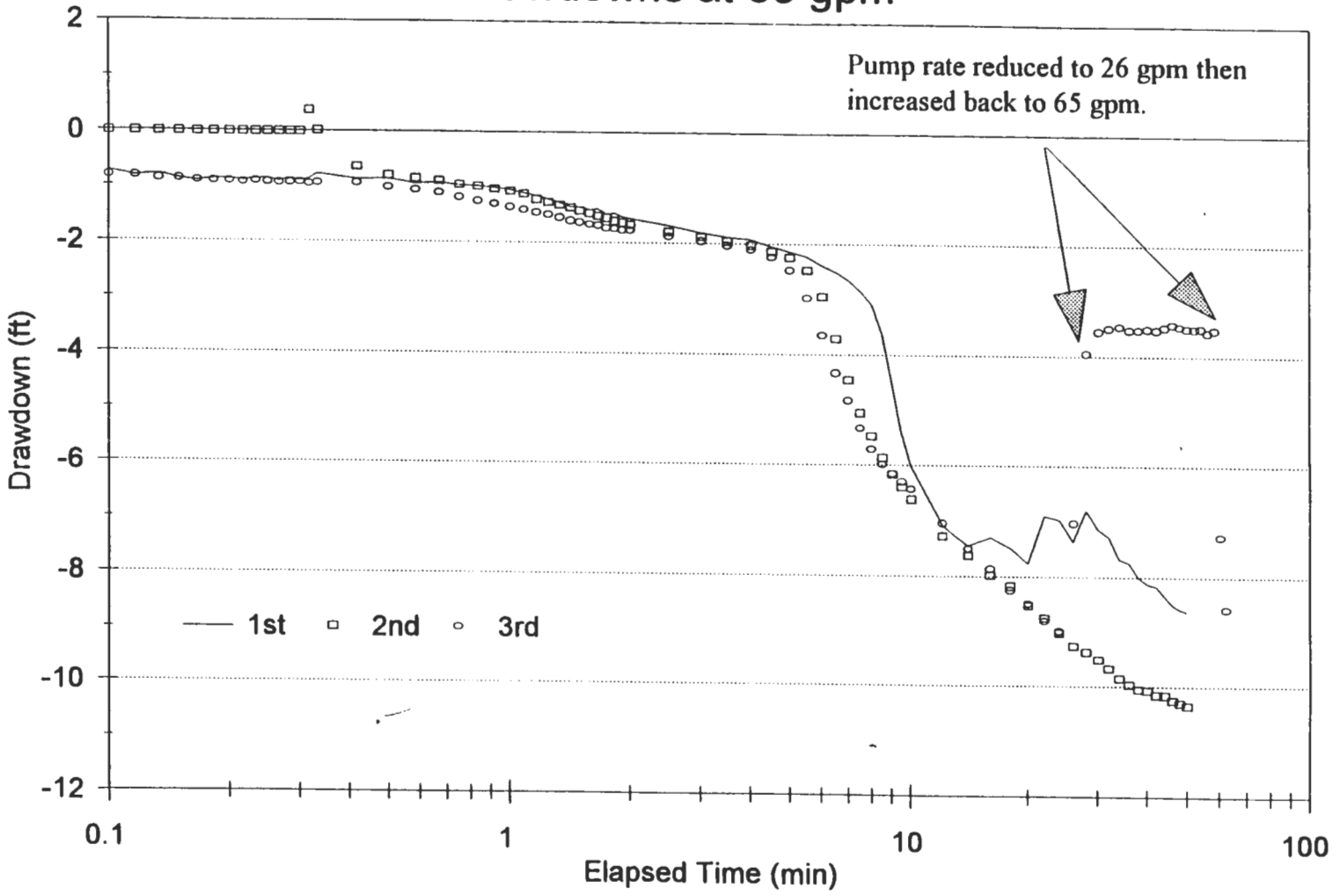
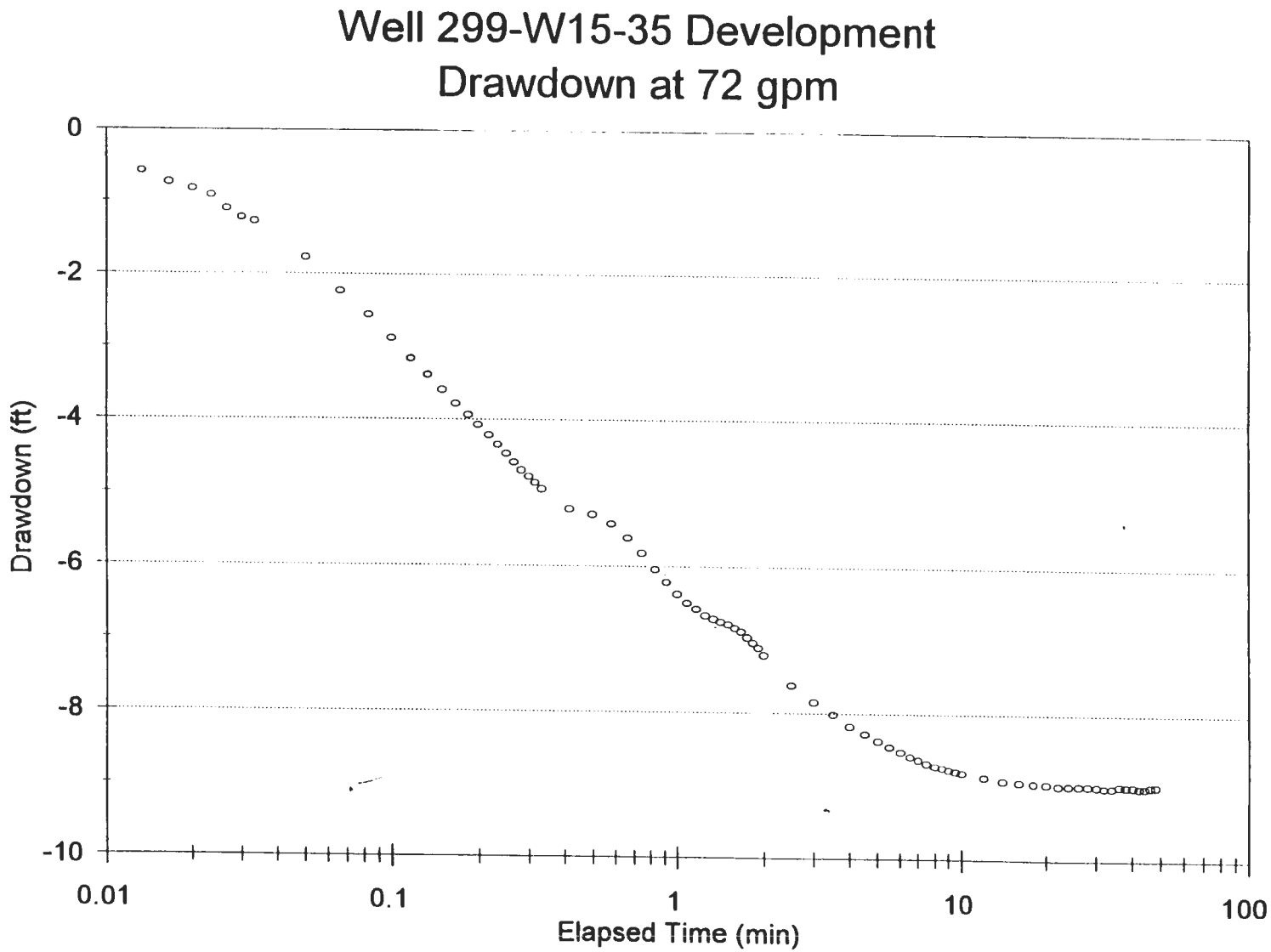
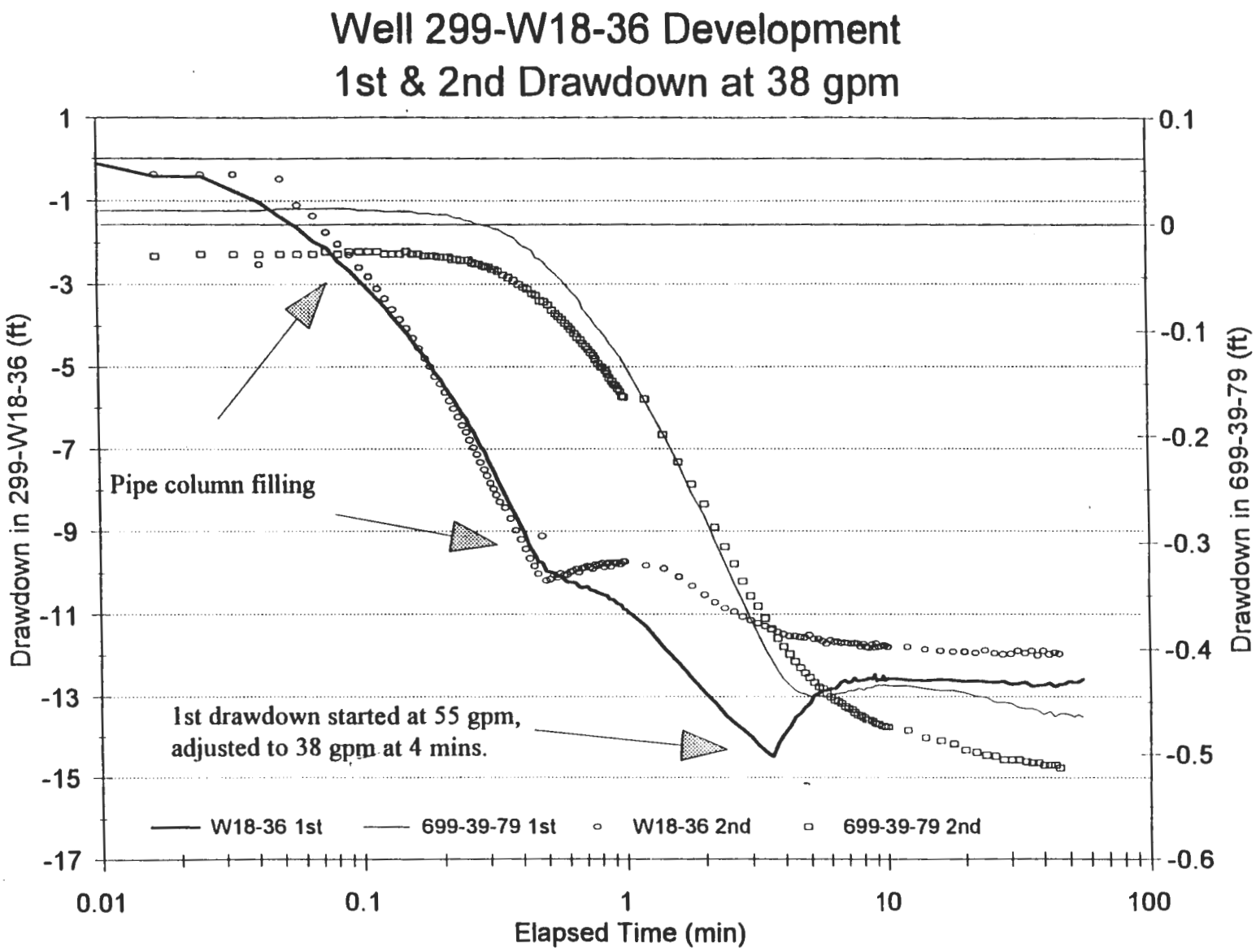
Well 299-W15-34 Development
Drawdowns at 65 gpm



W1534WD WB1 RSF


Well 299-W15-35 Development
Drawdown at 72 gpm
Drawdown (ft)
0
-2
-4
-6
-8
-10
0.01
0.1
1
10
100
Elapsed Time (min)



W1836WD WB1 RSE

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FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 2

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
3/20/96	299-W15-35	—	—	—	1

Purpose: Well Development Extraction Well for ZP-1 P+T

Reference: —

Location: Due West of Steam plant NE of Effluent 200 W

HISTORICAL DATA

Construction Depth: ~260 bgs

Casing Size / Type / Set At:

Casing Perforations Schedule / Interval:

Well Screen(s) Type: 40 Slot — Interval: 206.15-256.2 (8-16 SAND)

Last Recorded Depth-to-Water: 210.2 (3/15/96)

Last Recorded Depth-to-Bottom: 256.2 bgs

Current Depth-to-Water:

Current Depth-to-Bottom: 251.0 bgs

PUMP SYSTEM CONFIGURATION

	Pre-Maintenance	Post-Maintenance
Pump Type	Submersible	
Pump Model	7.5hp Grundfos	
Tubing Size/Type	2" Galvanized	
Length-Bottom of Tubing to Pump Intake	—	
Tubing Length	—	
Length-Top of Tubing to Reference Point	—	
Pump Intake Set at (Depth)	2.75' above bottom	

Reference/Measuring Point: TOP of Casing TOC or below ground surface (bgs)

Start Time:
End Time:
Time:
Contract Time:
Total Time:

Personnel:
R. Edrington
D. Amos
E. Rafuse
M. Wrapir
D. Garcia Jr.

Materials Used:
Hermithrit IRB-700
XD 4079

Description of Operations/Remarks

0900 - Arrive on Site. Water crew retrieving SAND pump - line came undone. - TALK to Ed Rafuse and leave site to gas up truck.
0905 - 200 EAST GAS STATION - Fill up truck, 25.6 gal (330.1 miles) 12.9 mpg.
0915 - Return to Site. SAND Pump back on line, but water crew working on rig - throttle problem.
0935 - SAND Pumping well again.
1012 - TAG Bottom @ 251' - Approx. 5' of SAND still on bottom
1017 - Decision made by Ed + Olin to Set pump 1' off bottom and pumping SAND out. preparing to install pump.
1147 - Pump on bottom - Ref XD @ 0 @ 10.90'
1149 - Start Pump, test #0, 1 - 20 gpm Initial
1151 - Pump Rate increased (ball Valve wide open) - 50+ gpm - Rotometer stuck.
1209 - Rotometer showing 67 gpm
1219 - TURBIDITY = 22.1 NTU - Water very clear w/ SAND particles, No fines

Report By: Roberts Edrington
Title: Field Hydrogeologist
Signature: Roberts Edrington

Reviewed By:
Title:
Date:
Signature:

FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 1

Page 2 of 2

Continuation of Shift 3/20/96 (Date)	Well/Excavation No.	Operable Unit No. ZP-1

Description of Operations/Remarks

1239 - Pump shut off : shutoff test #0 ; turbidity = 9.97 NTU
1241 - Purge truck leaves site to dump - lowering pump to new bottom
1336 - Ref O XD @ 17.19'.
1340 - Purge truck Returns.
1341 - Start Pump, start test #1 : Pump dropping dramatically, ; Pump flow holding @ 7 gpm. Pump bottom down ~ 4 ft
1351 - Turbidity = 128, drawdown @ 8.86'
1406 - Turbidity = 5.43 NTU (still some sand in sample, sinks to bottom of vial.
1421 - turbidity = 3.24 NTU, drawdown = 8.98'
1429 - Pump Shut off, test #1, step 1
1439 - Step test #1
1445 - leave site

Report By: Robert S. Edrington (Print) (Sign) Date: 3/27/96

Title: Field Hydrogeologist / CHT

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FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 2

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
3/13/96	299-W15-34	—			2

Purpose: Well development on 299-W15-34

Reference:

Location: 200 West Due East of Steam Plant and North of Z-plant

HISTORICAL DATA

Construction Depth: ~263' bgs

Casing Size	Type	Set At
8"	CS	—

Casing Perforations Schedule: — Interval:

Well Screen(s) Type: 40 slot SS Interval: ~210 to 260 bgs

Last Recorded Depth-to-Water: —

Last Recorded Depth-to-Bottom: —

Current Depth-to-Water: 209.80' bgs

Current Depth-to-Bottom: 255.50' bgs

PUMP SYSTEM CONFIGURATION

	Pre-Maintenance	Post-Maintenance
Pump Type	Submersible	
Pump Model	7.5 hp Grundfos	
Tubing Size/Type	2" Galvanized	
Length-Bottom of Tubing to Pump Intake	4.16'	
Tubing Length	248.59'	
Length-Top of Tubing to Reference Point	0.00'	
Pump Intake Set at (Depth)	252.75'	

Reference/Measuring Point: Casing stickup = 3.50' Below Ground Surface (BGS)

Start Time:
End Time:
Time:
Contract Time:
Total Time:

Personnel:

Materials Used: Hermit IKB-700, XD 4079 - W15-1, XD 4988 - Replaced, XD 2430 - W15-34

Pump - 6.91' overall, 2.75' bottom to intake corr

Description of Operations/Remarks

0730 - Arrive on Site, Read + Sign HASP
0735 - SWL = 209.80' bgs, TAG = 255.50' bgs
0745 - WATERD personnel starting pump installation. xd taped to pipe
0907 - stop test #0, Baseline for W15-1
0912 - Start #1, Baseline for both wells; Hermit IKB-700 Input 1 XD 4079 Ref 0 @ 4.80', well W15-1; Input 2 XD 4988 Ref 0 @ 24.56'
0916 - stop test #1, set test #2
0920 - start Pump and test #2
0932 - Pump Shut off - No flow - flowmeter (Rotameter) installed Backwards
- Also discover XD wrong size for depth replace w/ 50#
1007 - Reset test #2 w/ XD 2430, Ref 0 @ 44.85'
1014 - Restart test #2 at 50 gpm
1055 - Drawdown (ds) 8.2 in pumping well; no drawdown in W15-1
TURBIDITY = 584 NTU
1106 - Pump Shut off - Stop #1 test #2; Purge truck full, leave to dump.

Report By: Robert S. Edrington
Title: Lead Field Hydrogeologist
Signature: Robert S. Edrington

Reviewed By:
Title:
Date:
Signature:

FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 2

Page 2 of 2

Continuation of Shift 3/13/96 (Date) | Well/Excavation No. 299-W15-34 | Operable Unit No. ZP-1

Description of Operations/Remarks

1155 - Purge truck Returns to site. - Stop test#2
1158 - Pump Restart, test#3 - Pump Rate = 50 gpm
1228 - TURBIDITY = 177 NTU ; d_s = 7.15'
1248 - TURBIDITY = 76.7 NTU ; Pump Shut off Step#1 test#3
Purge truck full - leaves to dump.
1344 - Purge truck Returns to Site ; Start Pump Step#2 test#3.
1408 - TURBIDITY = 32.2 NTU ; Pump Rate Reduced down to 26 gpm
Note: Discovered that Flowmeter stuck at 50 gpm - Calculate flowrate actually 65 gpm
1422 - TURBIDITY = 7.51 NTU
1432 - TURBIDITY = 6.14 NTU
1443 - TURBIDITY = 3.41 NTU ; Increased pump Rate back to 65 gpm.
1446 - d_s = 6.1
1447 - Shut down pump Step#3 test#3.
1454 - Stop test#3 Input 1 4.81' Input 2 47.32'
1521 - XDs Removed, leave site.
1544 - Arrive @ 3190 Suite A.

Report By: Robert S. Edrington (Print) Robert S. Edrington (Sign) Date: 3/13/96

Title: Lead Field Hydrogeologist / CH2

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FIELD ACTIVITY REPORT

Report 1 of 2

Purpose Removing transducers, preparing for well Development

Page 1 of 1

Date	Well/Excavation No.	Rig Type	Contract/Work Order No.	Start Card No.
3/12/96				

Operable Unit/Project: ZP-1

Location: ZP-1

Reference:

Activity: Pull transducers from wells at 299-W15-33 and surrounding observation wells.

PERSONNEL:

FTL:

Geologist:

Driller:

Helper:

HPT: Pump Dimensions 7.5hp

SSO: 6.91' overall (including nipple on top)

Other: 275' bottom to centerline intake

TIME: Start: _____ Finish: _____

DELAYS/EXPLANATIONS:

Description of Operations/Remarks

1425 - Arrive at well Cluster W15-25, 33, 10 + 11
1520 - All XD's pulled
1527 - After talking to M. Darrach arrive at W15-34. Ed Rafuse to meet at well.
1545 - Ed setting E-TAPE to tag W15-1.
1551 - W15-1 SWL = 217.02' TOC
1607 - Distance between W15-1 and W15-34 is 200'
1614 - Hermit IKB-700, Input 1 XD 4079FE Well W15-1 Ref @ 5.06'
Delay start for 1700hr test #0 1in 15min.
1624 Leave Site
1651 Arrive 3190 Suite A Geo. W. Way.

Report By: Robert S. Edrington (Print) [signature] (Sign) Date: 3/13/96

Title/Company: Lead Field Hydrogeologist / CHI

FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 3

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
1/24/96	299-W18-36 (~~W18-35~~)	Smeal 5T			

Purpose	Reference	Location
monitor well development	BHI-EE-01 Manual	West of "Z" Plant

HISTORICAL DATA

Construction Depth	268.5 bgs.
Casing Size / Type / Set At	8 / OCS / 218'
Casing Perforations Schedule / Interval	— NA —
Well Screen(s) Type / Interval	218-268.5, SS304 40s/lot
Last Recorded Depth-to-Water	N/A
Last Recorded Depth-to-Bottom	268.5 bgs
Current Depth-to-Water	219.21
Current Depth-to-Bottom	

PUMP SYSTEM CONFIGURATION

	Pre-Maintenance	Post-Maintenance
Pump Type	Grundfos subm.	NA
Pump Model	7.5 Hp.	
Tubing Size/Type	2" Galv.	
Length-Bottom of Tubing to Pump Intake	2.5	
Tubing Length	262.6	
Length-Top of Tubing to Reference Point	-0-	
Pump Intake Set at (Depth)	265.1	

Reference/Measuring Point: — TOC —

Start Time	End Time	Time	Contract Time	Total Time
NA				

Personnel
M. Faurote
B. Strode
Brandon, helper & Teamster
E. Rafuse.

Materials Used
NA

Description of Operations/Remarks

using E-tape ET-15 (due 2/6/96) stick up 2.3
265.7, so below TOC 268.0, intakes 2.8' up.
1210 HCS: SWL 214.05 in W39-79
using Hermit 2K-674
input 1: S/N 5117 (factory cal), 20 psi unit; 36.869 @ ref=0
2: S/N 5260 (" "), 5 psi unit; 5.429 @ ref=0
1222
Start test 0, step 0 @ Lin 1 @ 1 min interval (Baseline)
test 1, step 0, set up @ log cycle for 10 min intervals
1243 Start T1, S0 - drawdown - flow rate @ 55 gpm.
@ 30 sec., 10' drawdown
1247 Change flow rate from 55 gpm to 38 gpm
1253 drawdown @ -12.572'
1257 NTU = 81.6
1312 NTU = 58.2
1334 NTU = 9.77, drawdown @ 12.679'

Report By: J.M. Faurote
Title: Geologist
Signature: JMFaurote

Reviewed By: Robert S. Edrington
Title: Lead Field Hydrogeologist
Date: 1/29/96
Signature: [signature]

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report N

Page 2 of 2

Continuation of Shift 1/24/96 (Date)	Well/Excavation No. 299-W18-35	Operable Unit No. ZP-1

Description of Operations/Remarks

1338: Step test - Test 1, step 1 - recovery - will go dump the purgewater and return w/ the truck - then start again.
1439 - Purge truck returns
1442 Step test, now Test 1, step 2 - drawdown again - @ 35 gpm.
1446 - NTU = 39.6
1500 - NTU = 9.41
1525 - NTU = 2.16
1526 Step test, T0', S3' - pseudo recovery, hose left underwater in truck.

N/A

Report By: J.M. Faurote, J.M. Faurote (Print) (Sign) Date: 1/24/96

Title: Geologist

A-6001-123.1 (03/9

FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 2

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
12/29/95	16-35 299-~~W15-34~~	NA	NA		

Purpose	Reference	Location
Monitor Well Development	BHI-EE-01 Manual	200 W

HISTORICAL DATA

Construction Depth		
Casing Size	Type	Set At
Casing Perforations Schedule		Interval
Well Screen(s) Type		Interval

Last Recorded Depth-to-Water	Last Recorded Depth-to-Bottom
220.54	272.5
Current Depth-to-Water	**Current Depth-to-Bottom**
monitored	Construction depth

PUMP SYSTEM CONFIGURATION

	Pre-Maintenance	Post-Maintenance
Pump Type	As previously described	
Pump Model		
Tubing Size/Type		
Length-Bottom of Tubing to Pump Intake		
Tubing Length		
Length-Top of Tubing to Reference Point		
Pump Intake Set at (Depth)		

Reference/Measuring Point: TOC

Start Time
End Time
Time NA
Contract Time
Total Time

Personnel: M. Faurote, B. Strode, E. Rafuse, G. Thomas, D. Garcia, Jr.

Materials Used: NA

Description of Operations/Remarks

Start 0630
ICY, 2" snow in 200 W
0753 Arrive on-site - absolutely no-one there, pump rig is gone.
0830 Testing supposed to start now, but nothing on-site - will wait awhile longer
0849 RCT Arrives to do AM survey - she has no clue.
0855 Went to find crew.
0920 Crew found at W15-33, told us purge truck will arrive at 1030 Hrs. Headed for next job - 699-34-61 figuring had plenty of time, to pull pump due to bad weather
0958 Arrive site, warm equip., set up rig
1036 Call from E. Rafuse - they are ready - button up site, leave
1054 Arrive 299-W15-34 - Safety meeting
1104 Step test: Test 1, Step 2 - drawdown @ 65 gpm
1110 NTU = 5.26 - with 3 ft of mud/sand/silt in bottom of well.
1136 NTU = 1.44

Report By: J.M. Faurote
Title: Geologist
Signature: JMFaurote

Reviewed By: Robert Edrington
Title: Lead Field Hydrogeologist
Date: 1/31/96
Signature: [signature]

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report #

Continuation of Shift	Well/Excavation No.	Operable Unit No.
12/29/95 (Date)	299-W15-34 16-35	2P-1

Description of Operations/Remarks

1152 Step test : Test 1, step 3 - Recovery (purgetruck ~ 95% full.)
1206 Depart for well 699-34-61
1515 Hydrostar removed : large dent immediately below top of 4" casing - may have to flatten it before can insert the fuzzy packer. Found another hang-up somewhere from 20 to 30 feet below the top. Hydrostar pipe couplings would hang - even coming out of the hole. Clean site. Proceed to fuel the rigs, then return to town.

NA

Report By: J.M. Faurote (Print) JM Faurote (Sign) Date: 12/29/95

Title: Geologist

A-6001-123.1 (03/9

FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 2

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
1/28/95		Jmeal 5T	5308		

Purpose	Reference	Location
Monitor well development - ZP injection, Remove pumps for velocity meter work	BHI-EE-01 Manual	200 West & 600 Areas

HISTORICAL DATA

Construction Depth: ~~drilldepth=271'~~ 268.9 (bgs)

Casing Size	Type	Set At
8"	OCS	0-218'

Casing Perforations Schedule	Interval
NA	

Well Screen(s) Type	Interval
SS304, 40slot	218-268.9 bgs

Last Recorded Depth-to-Water	Last Recorded Depth-to-Bottom
NA	NA

Current Depth-to-Water	Current Depth-to-Bottom
220.54	272.5

PUMP SYSTEM CONFIGURATION

	Pre-Maintenance	Post-Maintenance
Pump Type	Subm.	
Pump Model	7.5 Hp Grundfos	
Tubing Size/Type	2" Galv.	
Length-Bottom of Tubing to Pump Intake	2.5'	NA
Tubing Length	2520'	
Length-Top of Tubing to Reference Point	-0-	
Pump Intake Set at (Depth)	254.5	

Reference/Measuring Point: TOC

Start Time: NA
End Time:
Time:
Contract Time:
Total Time:

Personnel: M. Faurote, B. Strode

Materials Used: NA

Description of Operations/Remarks

0743 Arrive ZP-1 injection well - still Surgeing - E. Rafuse will call when ready.
0754 Get pump setting rig, proceed to 699-59-58
0821 Arrive on-site - safety meeting, then set up rig.
0823 Pull pump - for velocity meter work
0939 Pump & tubing out & wrapped, clean site, proceed to 6-34-61
1032 Call from E. Rafuse - he's ready now. finish moving equipment onto 6-34-61, then go to ZP-injection well.
1100 Depart for injection well
1118 Arrive @ ZP-1 injection well. SWL this Am @ 218.0
bot. pump 253.6, intake 250.9 bot well 268.9 (bgs)
stickup is 3.6', pump is 5.2' long.
Well contains ~ 3' fill (sand, from surgeing in the sand pack.)
* intakes are 18' (approx) off bottom, geo decision to keep the pump away from the sand infill.

Report By: J.M. Faurote
Title: Geologist
Signature: JM Faurote

Reviewed By: Robert S. Edrington
Title: Lead Field Hydrogeologist
Date: 1/31/95
Signature: Robert S. Edrington

FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report I

Page 2 of 2

Continuation of Shift 12/28/95 (Date)

Well/Excavation No. 299-W15-34

Operable Unit No.

Description of Operations/Remarks

1130 SWL=213.89 in well 699-39-79 using XD S/N 5260 (due: factory c.
a 5 psi unit and Hermit 2K-192
1143 SWL@ 220.54 in W15-34 (inj well)
XD 5901 (factory cal) a 50 psi unit as input 2 [All baro's currently in use
Hermit 2K-192 let XD's hang for awhile
input 1: 50 psi, S/N 5901, 48.395 @ ref=0 } distance between wells is
input 2: 5 psi, S/N 5260, 4.531 @ ref=0 } 73 ft
1202 H2O 'D' departs to get generator.
1205 Test 0, step 0, on Lin 1 @ 10 min - Baseline start
1236 Generator on-site - The rotometer is broken - looking for a new
manifold
1259 Manifold assembled, ready to start.
1301 Stop Test 0 Step 0
Start Test 1, step 0 on Log cycle @ 10 min intervals
~1min Throttled back - ~20 gpm 4' drawdown - open valve
Valve wide open -
@ 2.4 min showing -7.550' drawdown @ 65 gpm
@ 7.8 min, drawdown = 9.914'
@ 8 min 10.024', with -39-79 showing -0.441'
@ 30 min, 11.774' drawdown.
@ 48 min 12.404' drawdown - steady at Q=65 gpm.
1354: Step test - Test 1, step 1 - RECOVERY NTU Criteria never approached-dirty
1358

N.A

Report By: J.M. Faurote (Print) / J.M. Faurote (Sign) Date: 12/28/95

Title: Geologist

A-6001-123.1 (03/9

FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 1

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
12/8/95	299-W19-~~34~~ 22	Smeal 5T	5308		

Purpose	Reference	Location
well Maintenance	BHI-EE-01 Manual	UP-1 Pump & Treat

HISTORICAL DATA			PUMP SYSTEM CONFIGURATION	Pre-Maintenance	Post-Maintenance
Construction Depth			Pump Type		
Casing Size	Type	Set At	Pump Model	Hydrostar	
Casing Perforations Schedule		Interval	Tubing Size/Type		
Well Screen(s) Type N/A		Interval	Length-Bottom of Tubing to Pump Intake		NA
			Tubing Length		
Last Recorded Depth-to-Water	Last Recorded Depth-to-Bottom		Length-Top of Tubing to Reference Point		
			Pump Intake Set at (Depth)		
Current Depth-to-Water 238.26'	Current Depth-to-Bottom no tag		Reference/Measuring Point TOC		

	Personnel	Materials Used
Start Time ____ End Time ____ Time N/A Contract Time ____ Total Time ____	M. Faurote B. Strode L. Johnson - RCT	NA

Description of Operations/Remarks

0738 Arrive ZP-1 well W15-33 - Start data logger for development pumping by WATER D'Corp. Q @ 53 gpm - took awhile to deice some equipment

0801 Well W22-22 - has hydrostar, tag SWL @ 238.26', could not find bottom with a 300' E-tape. Used tape ET-15 (due 4/96)

0806 Arrive W19-34, prepare to remove pump. RCT setting up zones. Gather all possible equipment - Safety and Pre-job meeting

0848 A. Rizzo & B. Fahlberg report W19-25 is not producing H_2O - after checking, it may be that the intakes are right at SWL. They went to find 2 to 5 feet of 1½ inch pipe. Zones set, dress in lab coats, booties & surgeon gloves. Then pull pump.

1249 3 Hp pump removed, registered 4000 cpm. - Bagged and stored in UP-1 RMA. Installed a 3/4 HP pump, used existing tubing. Then dressed down and dropped the zones.

1320 Remove 10" pipe from W19-25. Add 2.0 ft. pump motor on bottom - to town

Report By J.M. Faurote	Reviewed By Robert S. Edrington
Title Geologist	Title Lead Field Hydrogeologist Date 1/31/96
Signature JMFaurote	Signature Robert S. Edrington

FIELD ACTIVITY REPORT - DRILLING

Page 1 of 2

Date	Well No.	Rig Model	Rig No.	Report No.
08 Dec 95	B2653	pump (well development) rig	318	16/0200W-FM-60182

Purpose	Location
Cecil's Extraction Well 200-BP-1	150' NW of 231 Z Building

Casing Size	Set At	Type	Shoe Size	Casing Start Depth	Casing End Depth	Start Time	End Time	Contractor Time	Total Time
11.75	206.8	CS	12.25	206.8	206.8	0630	1400	0.5	7½
				Depth Started 266.2	Depth Ended 266.2				

Reference/Measuring Point	Total Shift Footage
Ground Surface	0

Depth (feet) From	Depth (feet) To	Description of Operations/Remarks
		0630 - Crew at site; prep everything to run well development test
		0730 Pump truck at site - waiting for Bret Strong and Mike Fournier at site
		0820 - Mike Fournier at site - prepares everything to run test.
		0830 - Truck drive at site w/ backup generator
		0845 - Start test; run pump at 53 gpm w/ 15.03' drawdown and holding
NA		0925 - Run first test using NTU meter
		Time NTU result
		9:25 26.1
		9:35 11.1
		9:40 6.80
		9:45 5.10
		0950 - Truck filled - 3200 gallons
		1000 - Use 3500 gallon tank - that fills within 45 minutes - still pumping at ≅ 51 gpm.
		1145 - Take NTU reading from 3rd tank.
		Time NTU
		1150 16.7
		1205 3.5

Report By Edward C. Rafuse
Title Field Coordinator
Signature Edward C. Rafuse

Reviewed By
Title Date
Signature

BHI-EE-017 (12/94)

FIELD ACTIVITY REPORT - DRILLING
CONTINUATION PAGE

Date	Well No.	Continuation of Report No.
08 DEC 95	299-W15-33	16

Depth (feet) From	Depth (feet) To	Description of Operations/Remarks
		1215- Well Development Completed
		1300- Crew Clears Site
		1400- Geo. Leaves Site
		Summary:
		Development 53 gpm = 15.03'
		51 gpm = 14.00'
		Purge Tanks (3) - 3250
		2400
		+ 3450
		Total = 9100 gallons
NA		

Report By: Edward C. LaFuse
Title: Field Coordinator
Signature: Edward C. LaFuse

Reviewed By:
Title: Date:
Signature:

BHI-EE-018 (12/94)

FIELD ACTIVITY REPORT - WELL SERVICES

029759

Page 1 of 2

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
12/5/95	199H3-2A	Smeal 5T	5308		

Purpose	Reference	Location
Production test	~~BHI-EE-01~~ Manual	100HR3 H

HISTORICAL DATA		PUMP SYSTEM CONFIGURATION	Pre-Maintenance	Post-Maintenance
Construction Depth				
Casing Size / Type / Set At		Pump Type	Subm.	
		Pump Model	30 Hp Grundfos	
Casing Perforations Schedule / Interval		Tubing Size/Type	3" Galv.	
		Length-Bottom of Tubing to Pump Intake	17.77	
Well Screen(s) Type / Interval		Tubing Length	30.00	
Last Recorded Depth-to-Water: 42.51	Last Recorded Depth-to-Bottom: 52.70	Length-Top of Tubing to Reference Point	-0-	
		Pump Intake Set at (Depth)	47.77	
Current Depth-to-Water	Current Depth-to-Bottom	Reference/Measuring Point: TOC		

Start Time	End Time	Time	Contract Time	Total Time	Personnel	Materials Used
					M. Faurote B. Strode	-

Description of Operations/Remarks

0756 Arrive on-site 100HR3-H, well 199-H3-2A; Safety meeting
Attach all hoses, ready for purge water truck.
0817 Purge water truck arrives
0827 Ready to go, 3" Ball Valve is frozen - must thaw
Stop Baseline @ 0823
Start test 2, Step 0 @ 0837 flow @ ~ 265 gpm.
0838 Sample taken, 199-H3-2A, #1
0841 drawdown @ 1.668'
0845 Sample Taken 199-H3-2A, #2
0846 ~~Step~~ test 2, step 0, purge truck is full.
Step test - Test 2, step 1 = Recovery
0905 Still recovering, will wait ~10 more minutes
0919 Stop tests - pull the pump.
0955 30HP out, hydrostar reinstalled - preparing to move to #4-12C

Report By: J.M. Faurote
Title: Geologist
Signature: JM Faurote

Reviewed By: Robert S. Edrington
Title: Lead Hydrogeologist Field Date: 1/11/96
Signature: [signature]

FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

029759

Continuation of Report

Page 2 of 2

Continuation of Shift 12/5/95 (Date)	Well/Excavation No. 199-H4-12C	Operable Unit No. 100HR3 H

Description of Operations/Remarks

1025: All equipment moved onto site, preparing to remove Hydrostar
1050 Hydrostar removed
1054 SWL @ 37.28', bottom @ 85.11' using ETAPE EI-15 (due 2/96)
3Hp pump is 1.82 to inlets, 3.23 overall w/ 0.47' nipple/reducer to 1¼"
1112 found broken wire, mus effect a splice before proceeding.
1153 Pump installed
using Hermit 2K-192
input 1: well 12C, 10PSI, S/N 4987 (due 7/25/96); 18.681' @ ref=0, SWL @ 37.
" 2: " 12B 5PSI S/N 5260 (due factory); 7.885' @ ref=0, SWL@37.
" 3: " 12A, 5PSI, S/N 5016 (due 7/25/96); 7.520' @ ref=0, SWL@37
1210 Delay start test 3 step 0, Baseline @ Lin 1 on 10 min.
1237 Arrive on-site well 299-W15-33 - prepare to datalog the developme
1301 Install 50 psi XD S/N 2430 (due 9/6/96) in well W15-33, this will
be input 1 on Hermit 2K-626 for the Water'D' Development.
This is 41.933' @ ref=0 (REFER TO PREVIOUS FAR for setup)
Stickup = 4.08', SWL @ 219.01
The well W15-33 contains a 7.5 Hp pump w/ 2" riser pipe. The pump
bottom is ~258' BTOC, and intakes ~2.3' above the bottom!
1350 Stop test - Baseline
1351 Start Test 1 step 0, drawdown as log cycle on 10 min interval
1355 ~~Stop test 1~~ let test run while repair rotometer leaks!
1412 Step test, Test 1, step 1 - drawdown - at 50 gpm.
1414 7.563' drawdown @ 2 min!
1417 10.687' [illegible] @ 5 min!
1419 [illegible] 1 min!
1433 Step Test, Test 1, step 2 - Recovery - awaiting return of purge truck
1525 Received word - will not pump any more today due to purge
truck unable to unload ~~[illegible]~~ at 3P-1 Phase 1 P&T facility
1534 Depart for offices

Report By: J.M. Faurote / J.M. Faurote (Print) (Sign) Date: 12/5/95

Title: Geologist

A-6001-123.1 (03/9

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

029759

Continuation of Report

Page 2 of 2

Continuation of Shift (Date)	Well/Excavation No.	Operable Unit No.
12/4/95	299-ZP ~~inject~~ extraction Well	HR3H ZP-1

Description of Operations/Remarks

1410 Gave Rick McCain 2 ea 40 ml VOA bottles, he will run the hexavalent Chromium analyses on Samples A0509824 & A0509766 from well 199-H4-10

1413 Off to ZP-1 Using tape ET-15 (due 2/12/96)

1430 Arrive well 299-W15-31A to install Transducer(s) for upcoming well development of W15-33 (the new extraction well). Will also duce wells W15-10, 11 & 25 for the same test.

SWL 220.78 in W15-31A

1557 install S/N 4044 (a 10 psi unit) due 9/6/96 into W15-31A

1607 W15-25 SWL @ 217.41 ft USING XD 4079 (due 9/6/96) Input 2

1628 W15-10 SWL @ 218.33

1638 W15-11 SWL = 220.53

Will set XD in W15-33 tomorrow AM

* SET BASELINE ON LIN 1 @ 10 MIN. intervals

Hermit 2K-626

Input 1 Well W15-31A XD 4044, 10 PSI, due 9/16/96 8.928 @ ref=0

2 Well W15-25 XD 4079, 10 PSI, due 9/16/96 1.218 @ ref=0

3 Well W15-10 XD 4324, 10 PSI, due 4/7/96 16.846 @ ref=0

4 Well W15-11 XD 4988, 10 PSI, due 7/26/96 12.354 @ ref=0

1 Well W15-33 12.376 (Cable is stretching

6 Baro 301016 S/N due 7/26/96 (located @ well W15-25) 14.512

1650 Start Test @ step 0 at Lin 1 BASELINE

RJE X2.307

Note: Page 1 of this ~~FAR~~ ~~RJE~~ pertains to HR-3 Activities and is not included in this Memo Attachment.

RJE

Report By: J.M. Faurote / JM Faurote (Print) (Sign) Date: 12/4/95

Title: Geologist

E-25

A-6001-123.1 (03/9

FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 2

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
5/26/95	299-W15-30	NA	NA		

Purpose	Reference	Location
Step testing @ 50, 75 & 100 gpm cc: D.A. Meyers	BHI-EE-01 Manual	West of 'Z' plant

HISTORICAL DATA

Construction Depth	265.
Casing Size / Type / Set At	8" ø CS / 218.08
Casing Perforations Schedule / Interval	NA
Well Screen(s) Type / Interval	SS304, 20 slot, 218.08-258.0
Last Recorded Depth-to-Water	222.32
Last Recorded Depth-to-Bottom	265.
Current Depth-to-Water	
Current Depth-to-Bottom	

PUMP SYSTEM CONFIGURATION

	Pre-Maintenance	Post-Maintenance
Pump Type	Submn.	NA
Pump Model	30 Hp Grundfos	
Tubing Size/Type	3" Galvanized	
Length-Bottom of Tubing to Pump Intake	5.81'	
Tubing Length		
Length-Top of Tubing to Reference Point	-0-	
Pump Intake Set at (Depth)		

Reference/Measuring Point: TOC

Start Time	Personnel	Materials Used
End Time	B. Strode, M. Faurote	NA
Time NA	NA	
Contract Time		
Total Time		

Description of Operations/Remarks

Start 0630

0728 Arrive on-site, connect discharge hoses to manifold, assemble control boxes, etc.

0743 Waiting for purgewater trucks

0816 Purge trucks on site

0828 Stop test 0, Step 0 - Baseline
Set up test 1, step 0 - Drawdown is excessive, v. dirty

0843 Step test - test 1, step 1 - Switched to a 5-40 gpm rotameter because the well is NOT making H_2O

0851 have adjusted the flow rate to 22.5 gpm - it shows drawdown currently @ 16 feet, and dropping - the H_2O is extremely turbid
@ 14 min into test, @ 22.5 gpm, drawdown is 18.5 ft.

@0844 STEPPED The Test.

* The initial test resulted in maximum drawdown (38') with an unknown pumping rate - somewhere around 50 gpm - very dirty

Report By: J.M. Faurote	Reviewed By: Robert S. Edrington
Title: Geologist	Title: LEAD Hydrogeologist Date: 6/5/95
Signature: JM Faurote	Signature: Robert S. Edrington

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No.

Page 2 of 2

Continuation of Shift 5/26/95 (Date) | Well/Excavation No. 299-W15-30 | Operable Unit No. ZP-1

Description of Operations/Remarks

* (cont'd) The water is extremely silty. Changed one rotometer from 20 to 100 gpm to a 5 to 40 gpm. When step the test, the Q was adjusted to 23 gpm, ~~but~~ JMF

0936 drawdown is ~18.9' and the H2O remains quite turbid

0958 Dave Meyers relays information - keep pumping at this rate until the H2O cleans up.....

1005 Normal power fluctuations of ~0.5 Hz cause deviation of Q from 16 to 23 gpm., Q tends to remain ~18 gpm

1058 drawdown @ 13.251' at Q=18; may be able to step this one time later. Turbidity still in the upper hundreds, or higher

1112 Q @ 18, drawdown @ 13.051'

1130 Purgewater truck #1 is full, switch trucks - Q appears to be 17 gpm. Will hold truck 1 until I can get a phone - with the drawdown steadily becoming less and less, we may step the test - if I release the truck I may not get it back.

1154 Step test, Test 1, step 2, adjust rate - Q = 33 gpm

@ 1 min, dd = 17.456'
2 " , " 21.512'
3 " , " 23.565'
4 " , " 24.680' readjust Q to 33, bleeds off to 30
5 " , " 25.769' NTU = 187.
10 " , " 31.085'

1225 NTU = 99.3

1241 @ 47 min, drawdown is 31.085', Q has faded to 29 gpm

1249 NTU = 38.1

1315 May have to stop testing, the 1st purgewater truck hasn't returned. Teamster informs that HPT just now pulled up at the tanks. Will have to stop the test now..... NTU = 16.7

1430 NTU = 17.1, Step test, Test 1, step 4 - Recovery Pumped 9400 gallons. Download data, then depart to well 6-52-54 for flowmeter work. Relayed data to D.A. Meyers

Report By: J.M. Faurote (Print) / J.M. Faurote (Sign) Date: 5/26/95

Title: Geologist

A-6001-123.1 (03/93)

FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 3

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
4/10/96	299-W15-30	Pump Setting	Water D		3

Purpose: Re-development ZP-1 Wells

Reference:

Location:

HISTORICAL DATA		PUMP SYSTEM CONFIGURATION	Pre-Maintenance	Post-Maintenance
Construction Depth				
Casing Size / Type / Set At		Pump Type		
		Pump Model		
Casing Perforations Schedule / Interval		Tubing Size/Type		
		Length-Bottom of Tubing to Pump Intake		
Well Screen(s) Type / Interval		Tubing Length		
Last Recorded Depth-to-Water	Last Recorded Depth-to-Bottom	Length-Top of Tubing to Reference Point		
		Pump Intake Set at (Depth)		
Current Depth-to-Water	Current Depth-to-Bottom	Reference/Measuring Point		

SEE PREVIOUS FAR

Start Time
End Time
Time
Contract Time
Total Time

Personnel:
RS Edrington - CHI
B. Rahuse - BHI
M. Wraspir - Water D
D. Gracia - Water D
J. Moore - Water D

Materials Used:

Description of Operations/Remarks

0700 - Arrive on Site - Water D personnel and Ed Rahuse waiting. Now Attaching new Rotameter
0716 - XD (37.987/-0.236) + (9.365/-0.148)
0718 - Start Pump - Drawing down will adjust to 40 gpm (Initial rate 58 gpm) both Rotameters within ± 3 gpm
0723 - Stop pump - ball valve adjusted to 40 gpm
0732 - Start pump (test #3),
0734 - ds -4.941/0.440
0740 - ds => -26.603/0.622
0753 - ds = 29.928/0.653
0805 - turbidity = 42.3 NTU. ds = 30.685/0.681
0825 - ds = 30.480/0.715, TURBIDITY = 55.3 NTU
0840 - TURBIDITY = 68.8 NTU
0841 - Shutdown pump (Stop #1)
0857 - Disconnect XD in W15-30 and remove from well - Removing pump

Report By: RS Edrington
Title: Field Hydrogeologist
Signature: [signature]

Reviewed By:
Title:
Date:
Signature:

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FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 2

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
6-15-95	299N-15-31A	—	—	—	

Purpose	Reference	Location
Production testing 2P-1	BHI-EE-01 Manual	West from DFP

HISTORICAL DATA		PUMP SYSTEM CONFIGURATION	Pre-Maintenance	Post-Maintenance
Construction Depth		Pump Type		
Casing Size / Type / Set At		Pump Model		
Casing Perforations Schedule / Interval		Tubing Size/Type		
Well Screen(s) Type / Interval		Length-Bottom of Tubing to Pump Intake		
		Tubing Length		
Last Recorded Depth-to-Water: 221.	Last Recorded Depth-to-Bottom	Length-Top of Tubing to Reference Point		
		Pump Intake Set at (Depth)		
Current Depth-to-Water: 221.05	Current Depth-to-Bottom: Not Available	Reference/Measuring Point: TOC		

Start Time	End Time	Time	Contract Time	Total Time	Personnel	Materials Used
		NA			B. Strode G. Kelty	NA

Description of Operations/Remarks

0725 - on site - check generator and manifold
0750 - purge tankers on site - Stop test 0 step 0 on Hermit 2K-676
0757 - Start test #1 step #0 Log x10 // Start pumping at 16 GPM
Ref at Start is +2.499

Drawdown @	T-1 = 1.876	@ T-20	-13.004	NTU = >1000
	T-2 1.454	@ T-30	-14.169	Rate = 14 GPM
	T-3 .409	@ T-40	-14.988	
	T-4 -1.127	@ T-50	-15.800	NTU = >1000
	T-5 -3.054	@ T-60	-18.358	
	T-6 -7.103	@ T-90	-18.450	NTU = >1000
	T-7 -9.559	@ T-120	-19.132	
0805 Rate = 14 GPM	T-8 -10.327			
	T-9 -10.838			
	T-10 -11.146			

NA

Report By: Bart A. Strode	Reviewed By: Robert S. Edrington
Title: Hydrological Technician	Title: Lead Field Hydrogeologist — Date: 6/17/95
Signature: Bart A. Strode	Signature: Robert S. Edrington

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No.

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Continuation of Shift 6/15/95 (Date) | Well/Excavation No. 299-W15-31A | Operable Unit No. ZP-1

Description of Operations/Remarks

0935 D. Bowers on-site, sampling
1045 L.C. Swanson & D.A. Myers arrive on-site
1120 > 100 NTU, time drawdown @ Q=14 gpm
Since test start: 190 -19.126'
210 -18.981'
220 -19.787'
230 -20.417'
240 -20.562'
1210 80 NTU, drawdown = 20.820'
1230 T=270, 20.940' drawdown ; 67 NTU
1250 NTU = 63
1310 SWL = 245.81', YD slipped approx 2' downhole
1330 T=320, 23.289' drawdown, NTU = 79 Q still @ 10 gpm
1405 discharge clouded up (silt?), drawdown = -17.7', E-tape tag @ 239.85'
1410 " cleared " , " -19.6' , " " 241.6'
1413 " clear , " 20.0' , " " 242.1'
1416 NTU = 89 , " 20.5' , " " 242.7'
1420 NTU = 71 , " 20.97' , 243.6'
1424 _____ , " 21.1' , " " 243.8'
1427 Shutdown test , " 25.99' , " " 247.9'
1432 Recovery → , 13.6' , 235
" , 6.2' , 230
" , 3.32' , 226
@ T= 5.5 min , 2.2' , 225
T= 8.4 , 1.7' , 221
T= 10.0 , 0.6' , 220

N/A

Report By: J.M. Faurote / J.M. Faurote (Print) (Sign) Date: 6/19/95

Title: Geologist

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 5

Page 2 of 3

Continuation of Shift 4/10/96 (Date) | Well/Excavation No. 299-W15-31A | Operable Unit No. ZP-1

Description of Operations/Remarks

0920 - leave site
0923 - Arrive Drill site 299-W18-37?
0944 - Arrive back @ W15-30 to shut down Recovery and pull XDs
0947 - Stop test #3.
1002 - Arrive 299-W15-31A; SWL = 222.36' TOC; D-T-B = 255.36+0.28 = 255.64' TOC
stickup = 2.71' Above pad.
1018 - Water'd personnel on Site to set up. Coming from Decon pad
1029 - Installing 7.5 HP pump
1042 - leave Site; go to Drill Site
1057 - Arrive back on site @ 299-W15-31A - still installing pump.
1116 - Pump in place; Intake 252.89' TOC; Landing plate to Coupling 0.91'
1131 - Start test #4 XD 5901 Ref. Ø 31.115
1132 - Pump on - Not recording drawdown - will drawdown well and adjust pump Rate. start at 10 gpm "bumped" up 10 gpm Steps up to 40 gpm
1143 - @ 40 gpm drawdown below transducer
1144 - Shut off pump. Landing plate to Coupling 0.25'. Pump intake now @ 253.55'
1148 - Pump on; Adjusting to ~30 gpm. 18.6' drawdown; Water very dirty
1155 - Pump off
1201 - Start pump (test #4) 30 gpm
1203 - 13.1' ds; Water very dirty
1205 - 15.4' ds; Water light Brown.
1208 - 17.4' ds No change in water color
1212 - 18.04' ds
1224 - 18.7' ds
1234 - 19.0' ds
1255 - 19.164' ds; turbidity = 52.1 NTU
1303 - leave site to go to Drill Site.
1334 - Shutoff pump (Step #4) ds = 19.164'; TURBIDITY = 39.3 NTU

Report By: Robert S. Edrington (Print) [signature] (Sign) Date: 4/10/96

Title: Field Hydrogeologist / CHT

A-6001-123.1 (03/93)

FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 3

Page 3 of 3

Continuation of Shift 4/10/96 (Date)	Well/Excavation No. 299-W18-31A + W18-37	Operable Unit No. ZP-1

Description of Operations/Remarks

1343 - Ed Refuse Call: Pull pump and get ready for W18-37
1347 - Coupling 0.24' Above landing plate/TOC
1400 - Pulling Pump; Stop test #4; XD stuck - will pull with pump
1432 - XD and pump out of hole.
1433 - Leave Site for Well 299-W18-37
1441 - Arrive @ W18-37
1445 - SWL = 219.64' TOC; Stickup = 0.72' Above ground surface;
D-T-B = 256.70 + 0.28 = 256.98' TOC
1517 - Re-tag bottom with heavier tape @ 259.20' TOC.
Pump to be put in hole and will pump first thing tommorrow.
1522 - Leave Site for Sigma I; water D personnel installing
pump; will download Hermit tonight.

Report By: Robert S. Edrington (Print) Robert S. Edrington (Sign) Date: 4/10/96

Title: Field Hydrogeologist / CHI

A-6001-123.1 (03/93)

9713540.1927

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FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 3

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
4/9/96	299-W15-33	Pump Setting	WH-1	WU327	2

Purpose: Re-development of ZP-1 Pump and treat Wells

Reference:

Location: ZP-1

HISTORICAL DATA		PUMP SYSTEM CONFIGURATION	W15-33	W15-30
Construction Depth			~~Pre-Maintenance~~	~~Post-Maintenance~~
Casing Size / Type / Set At		Pump Type	Submersible	
		Pump Model	7.5 hp Grundfos	
Casing Perforations Schedule / Interval		Tubing Size/Type	2" Galvanized	
Well Screen(s) Type / Interval		Length-Bottom of Tubing to Pump Intake	2.53'	3.15
		Tubing Length	253.96	
Last Recorded Depth-to-Water	Last Recorded Depth-to-Bottom	Length-Top of Tubing to Reference Point	1.39'	2.12'
		Pump Intake Set at (Depth)	262.83' TOC	264.33'
Current Depth-to-Water: 219.40' TOC	Current Depth-to-Bottom: —	Reference/Measuring Point: TOP of Casing (TOC)		

Start Time:
End Time:
Time:
Contract Time:
Total Time:

Personnel:
RS Edrington - CHE
E. Rafuse - BHI
J. Jimenez - BHI
O. Amos - Water D.
D. Garcia - Water D
M. Wraspir - Water D

Materials Used:

Description of Operations/Remarks

0705 - Arrive on Site @ 299-W15-33.
0709 - Stop test #0
0711 - W15-33 SWL = 219.40' TOC Ref 0 input 2 @ 32.613'
0713 - W15-25 SWL = 218.57' TOC Ref 0 input 1 @ 6.028; O. Amos on Site
0717 - Start Pump (test #1); Initial flowrate = 56 gpm; Pump starts ahead of Hermit.
0719 - drawdown = 9.661'
0723 - Flowrate 55 gpm; O. Amos leaves Site.
0729 - J. Jimenez on Site
0737 - Turbidity = 29.2 NTU
0738 - Plan of the Day Meeting w/ J. Jimenez, he leaves site afterwards
0757 - Drawdown 33-20.866'/25-0.480'; Turbidity = 29.5 NTU
0803 - O. Amos on Site
0817 - Purge truck full/stop Pump (Step #1); turbidity = 20.5 ntu; drawdown = 20.945/0.450
0822 - Purge truck leaves site, as does rest of Water D personnel
0823 - Leave Site to sign in on Site Specific Safety Plan

Report By: Robert S. Edrington
Title: Lead Field Hydrogeologist
Signature:

Reviewed By:
Title:
Date:
Signature:

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 2

Page 2 of 3

Continuation of Shift 4/9/96 (Date) | Well/Excavation No. 299-W15-33 | Operable Unit No. ZP-1

Description of Operations/Remarks

0853 - Return to site, as does J. Jimenez and C. Amos; M Wagspir
0913 - C. Amos leaves site
0916 - Purgewater truck returns; Ed Rahure on site
0918 - Restart pump / step #2; initial flowrate 56 gpm
0920 - d_2 = -9.125
0924 - d_2 = 14.153 flowrate 54 gpm. Ed Rahure leaves site
0938 - d_2 = 21.150'/0.504; turbidity = 17.2 NTU, flowrate = 53 gpm
0958 - d_2 = 21.276'/0.573'; turbidity = 11.5 NTU; 53 gpm
1016 - d_2 = 21.071/0.619; turbidity = 10.7 NTU; 51 gpm
1020 - Pump off; Next purgewater truck arrives
1024 - Restart pump, Initial rate 55 gpm
1034 - Turbidity = 13.0 NTU
1044 - Turbidity = 18.6 NTU
1050 - d_2 - 22.489'/0.693'
1104 - d_2 - 22.615'/0.731'; turbidity = 10.4 NTU; 55 gpm
1118 - Turbidity = 7.95
1126 - Pump shutoff - Turbidity = 6.85 - switching purge trucks
1128 - Pump restarted, initial pump rate 55 gpm.
1140 - Turbidity = 19.2 NTU
1153 - Turbidity = 32.8 NTU
1155 - d_2 - 23.750'/0.833'
1214 - d_2 23.608/0.876; Turbidity = 5.80 NTU
1221 - d_2 23.498/0.901, turbidity = 9.65 NTU
1227 - turbidity = 7.03 NTU
1230 - turbidity = 6.80 NTU.
1232 - turbidity = 6.56 NTU
1233 - turbidity = 4.85 NTU; Pump shutoff (step #3)
1240 - leave site to get information on next well
1314 - Arrive well 299-W15-30 SWL = 277.31' TOC; D.T.B = 266.80' TOC
stickup = 2.52' +0.28 267.08'

Report By: Robert S. Edrington (Print) Robert S. Edrington (Sign) Date: 4/9/96

Title: Lead Field Hydrogeologist / CH2

A-6001-123.1 (03/93)

FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 2

Page 3 of 3

Continuation of Shift 4/9/96 (Date) | Well/Excavation No. 299-W15-30 | Operable Unit No. ZP-1

Description of Operations/Remarks

1324 - leave to go back to W15-33
1325 - Arrive W15-33 to shutdown tests and Remove XD's
1332 - Stop test #1 / Step #3 ; Remove XD
1340 - leave W15-33
1344 - Arrive W15-30
1351 - W15-16 SWL = 226.52' TOC, Stick 2.31' above pad
D-T-B 239.98' TOC
1418 - Water D personnel arrive on Site ; place trailer into position
1420 - Call from C. Swanson - pump at 10 gpm on W15-30
Should get ≈ 13 ft drawdown ± 3 ft
ON W15-30 pump 20 gpm.
1422 - Water D personnel leave Site
1441 - Water D personnel arrive back on Site with generator, Pump Rig and Pump truck.
1454 - Installing 7.5 hp Grundfos submersible pump.
1529 - Ed Ratigan on Site
1543 - Hermit 2K-192. test #2 Setup
Input 1: XD 4079 Well W15-16 Ref 0 = 9.514'
Input 2: XD 5901 Well W15-30 Ref 0 = 38.224'
2.12' Top landing plate to Coupling
1546 - Start pump (test #2) - Initial flowrate 20 gpm
1550 - 10.166 ds flowrate 21 gpm
1556 - ds = -10.370
1600 - 0.278 -10.528
1604 - Step #1 - Increase Rate to 30 gpm
1604 - ds 15.319 / 0.362'
1615 - 16.706 / 0.399'
1616 - Step #2 - Increased flowrate to 40 gpm
1619 - Ds = 0.474 / 23.577 1623 - 26.0 ds / .505'
1631 - Ds = .529 / 29.156
1632 - Stop pump / Step #3 1639 - Leave Site.

Report By: Robert S. Edrington (Print) [signature] (Sign) Date: 4/9/96

Title: Lead Field Hydrogeologist

A-6001-123.1 (03/93)

FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 3

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
4/8/96	299-W15-34	Pump Setting	Water D	WU 327	1

Purpose	Reference	Location
Re-development ZP-1 Production Wells	—	ZP-1

HISTORICAL DATA

Construction Depth

Casing Size Type Set At

Casing Perforations Schedule Interval

Well Screen(s) Type Interval

Last Recorded Depth-to-Water | Last Recorded Depth-to-Bottom

Current Depth-to-Water 213.54' | Current Depth-to-Bottom 259.86'

Reference/Measuring Point: Top of casing (TOC) Stickup 2.88' above pad

PUMP SYSTEM CONFIGURATION

	W15-34 Pre-Maintenance	W15-33 Post-Maintenance
Pump Type	Submersible	Submersible
Pump Model	7.5hp Grundfos	7.5hp Grundfos
Tubing Size/Type	2" Galvanized	2" Galvanized
Length-Bottom of Tubing to Pump Intake	2.53'	2.53'
Tubing Length	253.96	261.77'
Length-Top of Tubing to Reference Point	0.00	1.43
Pump Intake Set at (Depth)	256.49	262.87'

Start Time
End Time
Time
Contract Time
Total Time

Personnel
M. Wrapir - Water D
D. Garcia - Water D
E. Rafuse - BHE
R. Edrington - CHE

Materials Used
Pump - 5.9 overall, 2.75' bottom to Intake
Hermit IKC-773
Transducer-5901GL

Description of Operations/Remarks

0715 - Arrive UP-1 - Assist Brent and Mike, also pickup equipment
0738 - Arrive at well 299-W15-34
0747 - Scale 213.54' TOC - D-T-B = 259.58 + 0.28 = 259.86' TOC
0789 - Crew preparing to put pump in well
0752 - Ed Rafuse on Site, leaves Site @ 0757
0800 - Start installing pump
0819 - E. Rafuse back on Site.
0847 - Pump in place 0.62' off bottom
0906 - XD (5901G) XD Ref 0 @ 22.42
0909 - Pump Started (67 gpm) - D. Amos on Site 0912
0924 - Drawdown 8.19'
0925 - Go to UP-1 for turbidity meter
0934 - Return to Site w/ turbidity meter - D. Amos + D. Garcia off site.
0938 - TURBIDITY = 10.8 NTU w/ fine sand in bottom of vial. ds = 9.96'
0950 - TURBIDITY = 18.3 NTU - increased amount of fine sand

Report By Robert S. Edrington
Title Field Hydrogeologist
Signature

Reviewed By
Title Date
Signature

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 1

Page 2 of 7

Continuation of Shift 4/8/96 (Date) | Well/Excavation No. 299-W15-34/33 | Operable Unit No. ZP-1

Description of Operations/Remarks

0955- Drawdown - 10.79'
0958- Turbidity = 583 NTU, less fine sands still some extra fine sands on bottom of vial.
0959- ds = 10.89' - Pump shut off so purgewater trench commenced
1001- Purgewater trench leaves site, take turbidity meter back to up-1
1038- Return to site, Ed not here; Mo informs me that development is over will pull pump.
1043- C. Amos on site; talking to Mo; leave 1045
1046- Stop test; pulling transducer
1047- D. Garcia on site
1051- Pulling pump
1057- Purge trench + Ed on site.
1125- Pump out of well
1129- SWL = 23.60, DT-B = 259.42 + 0.28 = 259.70'
1134- Leave site, move to 299-W15-33 site for setup
1136- Arrive W15-33 SWL = 219.32' TOC stickup = 2.595' above pad
P-T-B = 265.34 + 0.28 = 265.62 => very soft tag.
1156- W15-25 SWL = 218.50' TOC; D-T-B = 233.50 + 0.28 = 233.78' TOC
stickup = 3.83' above pad. Note: Peaker came out of well w/ a coat of silt
1224- Water D personnel arrive at Decon Pad - Adjacent to W15-25.
1234- Attempting to put pipe trailer into position
1242- trailer in position; Ed Rafuse on site. Water D personnel discussing trailer-tanker-pump rig alignment
1247- teamster + Diller leave in pump rig
1254- T+D return towing generator, now discussing placement for something
1301- Ed Rafuse leaves site.
1305- Rig up - Installing Pump.
1349- Pump on bottom; Intake @ 262.87' TOC; Ed Rafuse on site.
1350- Installing XD 5931 into W15-33

Report By: Robert S. Edrington (Print) (Sign) Date: 4/8/96

Title: Field Hydrogeologist / CH2

A-6001-123.1 (03/93)

FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 1

Page 3 of 3

Continuation of Shift 4/8/96 (Date)

Well/Excavation No. 299-W15-33

Operable Unit No. ZP-1

Description of Operations/Remarks

1356- XD in Place Hermit Setup as follows

Hermit 2K-192	Input 1	Input 2
Well	W15-25	W15-33
XD	4079FE	59016L
Ref D	6.106	21.265

1400- Coupling to landing plate 1.43' 3psi
1401- Start (foot #2) Pump Initial Pump Rate 68 gpm
1402- 1.8 min Drawdown 8.147
1403- 2.0 min -9.550
1405- 16.185' drawdown; BeJmong on Site
1412- lower XD (water below XD); Stop off Pump.
1415- Ref D @ ~~32.251~~ 32.329
1417- Step #1 - Restart Pump - delay between ~~XD~~ stopping and pump actually starting. (56 gpm)
1421- Go to get turbidity meter from UP-1
1441- Return with turbidity meter - Drawdown 19.274' @ 55 gpm
dz = 0.26 in W15-25
1445- Turbidity = 53.6 NTU
1457- 55.7 NTU dz W15-33 = 19.306' W15-25 = 0.319'; Rotameter Reading 52 gpm.
1507- 49.6 NTU, Stop Pump; Step #2; Coupling/landing Plate 1.39' Δ0.04'
1510- Purge water truck leaves site
1512- Leave Site

Report By: Robert S. Edrington (Print) (Sign) Date: 4/8/96

Title: Field Hydrogeologist

A-6001-123.1 (03/93)

9713540.1930

BHI-00927
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FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 2

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
5/8/96	277-W15-36	—	—	WW301	10

Purpose: Well Development ZP-1 Extraction Well

Reference:

Location: ZP-1 New Extraction Well

HISTORICAL DATA		PUMP SYSTEM CONFIGURATION	Pre-Maintenance	Post-Maintenance
Construction Depth		Pump Type	7.5HP Submersible	
Casing Size / Type / Set At		Pump Model	Grundfos	
Casing Perforations Schedule / Interval		Tubing Size/Type	2" Galvanized	
Well Screen(s) Type / Interval	#40 Slot	Length-Bottom of Tubing to Pump Intake	3.15'	
		Tubing Length	254.66'	
Last Recorded Depth-to-Water	208.68 bgs	Length-Top of Tubing to Reference Point	0.00	
Last Recorded Depth-to-Bottom	261.20 TOC	Pump Intake Set at (Depth)	257.81'	
Current Depth-to-Water	211.62 TOC	Reference/Measuring Point	Stickup - 3.1' ags TOP of Casing (toc) or Below ground Surface (bgs)	
Current Depth-to-Bottom				

Start Time:
End Time:
Time:
Contract Time:
Total Time:

Personnel:
E. Refuse - BHI
J. Moore - H2OD
M. Wrasyir - H2OD
B. Jackson - H2OD
R. Edrington - CHF

Materials Used:

Description of Operations/Remarks

1032 - Arrived on Site Pump still being installed.
1113 - Pump is place, 0.64 off bottom
1128 - SWL = 211.62' TOC
1139 - Hermit 2K-674 Input 1 XD 4950GC Ref. 0 @ 40.985
1142 - Start pump (test #1); Plan-o-the-Day meeting
1144 - dd = 18.391 - water muddy
1146 - dd = 27.087 - water still muddy.
1150 - dd = 34.640 - water translucent yet brown. 65gpm
1159 - dd = 37.378 - brown but clearing - 65gpm
1205 - dd = 37.409 - 65gpm
1212 - dd = 37.359 - 65gpm
1216 - dd = 37.378 - 55 gpm - Rotameter has been stuck
1220 - Stop pumping (Step #1) turbidity = 148 NTU; Based on the time it took to fill tank average flow rate = 63.5 gpm.
1335 - Truck returns to Site.

Report By: Robert S. Edrington
Title: Leadfield Hydrogeologist
Signature: Robert S. Edrington

Reviewed By:
Title:
Date:
Signature:

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 10

Page 2 of 2

Continuation of Shift 5/8/96 (Date) | Well/Excavation No. 299-W15-36 | Operable Unit No. EP-1

Description of Operations/Remarks

1338 (1251 on Datalogger Clock) - Start Pump (Step #2) Initial pump Rate 64 gpm
1340 - 63 gpm - dd = 19.351
1345 - dd = 34.307, 55 gpm
1354 - dd = 37.529, 55 gpm
1359 - 55 NTU, dd = 38.037; 55 gpm.
1411 - 40.9 NTU
1413 - Pump Stop. dd = 37.761
1415 - Purge truck leaves site to empty.
1505 - Truck Returns
1507. Start Pump (Step #3) - Set at 50 gpm
1510 - dd = 17.467; gpm = 50
1517 - dd = 24.664
1522 - dd = 26.134, 50 gpm; turbidity = 23.1 NTU
1531 - 26.367; turbidity = 28.5 NTU
1536 - dd 27.058
1547 - Turbidity = 15.3 NTU, dd = 27.240. 50 gpm
1549 - Shutoff Pump (Step #4), turbidity = 12.8 NTU
1551 - Purge truck leaves site.
1555 - leave Site for Sigma I.

Report By: Robert S. Edrington (Print) (Sign) Date: 5/8/96

Title: Lead Field Hydrogeologist / CHE

A-6001-123.1 (03/93)

FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 1

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
5/9/96	299-W15-36			WU301	11

Purpose: Well Development ZP-1 Extraction Well

Reference:

Location: ZP-1 Extraction Site Phase III

HISTORICAL DATA

Construction Depth

Casing Size / Type / Set At

Casing Perforations Schedule / Interval

Well Screen(s) Type / Interval: 40 5/.755

Last Recorded Depth-to-Water: 214.62 (5/8/96)

Last Recorded Depth-to-Bottom: 261.20 TOC

Current Depth-to-Water: —

Current Depth-to-Bottom: —

PUMP SYSTEM CONFIGURATION

	Pre-Maintenance	Post-Maintenance
Pump Type	7.5HP Submersible	
Pump Model	Grundfos	
Tubing Size/Type	2" Galvanized	
Length-Bottom of Tubing to Pump Intake	3.15	
Tubing Length	254.66	
Length-Top of Tubing to Reference Point	0.00	
Pump Intake Set at (Depth)	257.81	

Reference/Measuring Point: TOP of Casing (toc)

Start Time:
End Time:
Time:
Contract Time:
Total Time:

Personnel:
E. Rutuse - BHI
M. Wraspir - water D
J. Moore - water D
R. Edrington - CHI

Materials Used:

Description of Operations/Remarks

0639 - Arrive on Site
0641 - Start Pump; initial Pump Rate 55 gpm
0659 - TURBIDITY = 73 NTU
0711 - TURBIDITY = 17 NTU
0726 - Pump off
0727 - Pump back on
0833 - Pump off Step test #1
0848 - Pump on; start test #2
0934 - Shutoff Pump
0942 - Truck Arrives - Full Truck leaves
0944 - Start Pump. 55 gpm
1032 - OPEN Valve Rate goes to 55 gpm
1049 - Shut off Pump (Step #
1057 - Shut off test #2. Data logger time 1:14 slow
1108 - Leave Site

Time	Turbidity (NTU)		
0717	13.2	1023	6.02
0745	13.7	1029	5.12
0801	9.71	1031	4.16
0823	6.39		
0831	5.43		
0833	7.39		
0900	11.5		
0921	8.5		
0928	8.2		
0934	10.7		
1000	10.5		

Report By: Robert S. Edrington
Title: Lead Field Hydrogeologist
Signature: Robert S. Edrington

Reviewed By:
Title: Date:
Signature:

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FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 2

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
5/20/96	299-W15-37	Pump Setting	WATER D	WW3/4	2

Purpose: Well Development ZP-1 Extraction Site.

Reference:

Location: ZP-1 Extraction Site. Phase III

HISTORICAL DATA

Construction Depth: ——

Casing Size / Type / Set At: N/A

Casing Perforations Schedule / Interval: N/A

Well Screen(s) Type / Interval: #40 Slot SS 205.4 - 255.4 bgs

Last Recorded Depth-to-Water: 204.8 bgs

Last Recorded Depth-to-Bottom: 255.4' bgs

Current Depth-to-Water: 206.36 TOC

Current Depth-to-Bottom: ——

PUMP SYSTEM CONFIGURATION

	Pre-Maintenance	Post-Maintenance
Pump Type	7.5 HP Submersible	
Pump Model	Grundfos	
Tubing Size/Type	2" Galvanized	
Length-Bottom of Tubing to Pump Intake	3.15'	
Tubing Length	~~255 TOC~~ 251.85	
Length-Top of Tubing to Reference Point	1.0	
Pump Intake Set at (Depth)	~251.25' TOC	

Reference/Measuring Point: Casing Stickup 1.4' above ground
TOP of Casing (TOC) or Below ground Surface (bgs)

Start Time: ——
End Time: ——
Time: ——
Contract Time: ——
Total Time: ——

Personnel:
RS Edrington - CHI
M. Wraspir - WATER D
J. Moore - WATER D
B. Jackson - WATER D
E. Rafuse - BHI

Materials Used:
Hermit 2K-674
XD-4950

Description of Operations/Remarks

0707 - Arrive on Site; E. Rafuse and Water D crew leave to get pipe + pump
0750 - Pump Rig w/ pipe trailer arrive on Site
0800 - SWL = 206.36 toc
0815 - Fueling and servicing Rig
0835 - Installing pump
0930 - Pump in place on bottom; Intake ~251.25' TOC
0944 - Start Hermit 2K-674 Input 1 XD4950 Ref 0 @ 39.808
0945 - Start Pump (Step #1 / Test 0) - ballvalve wide open
0947 - drawdown = 28.891
0949 - Stop pump → drawdown below transducer, water very muddy
0952 - Pump on ⇒ will "Rawhide" well until clean up (mudwise)
0954 - Pump off
0958 - Pump on
1004 - Pump off. difficult to get a feel for pump rate due to the sand and mud being pumped. Pump has dropped 1' from start.

Report By: Robert S. Edrington
Title: Field Hydrogeologist
Signature: Robert S. Edrington

Reviewed By:
Title: Date:
Signature:

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 12

Page 2 of 2

Continuation of Shift 5/20/96 (Date)	Well/Excavation No. 299-W15-37	Operable Unit No. ZP-1

Description of Operations/Remarks

1008 - Start Pump (Step #2); initial pump Rate 40 gpm
1010 - Drawdown 21.162; 1011 - Drawdown (dd) = 26.271'
1012 - dd = 28.884'
1017 - dd = 37.947' pump Rate @ 37 gpm
1020 - Pump off
1022 - Start pump (Step #3); pump rate @ 34 gpm
1024 - dd = 20.339; 1045 - turbidity = 86.2 NTU dd = 34.889
1100 - dd = 34.430; turbidity = 690 NTU => pumping sand
1125 - Turbidity = 126 NTU; dd = 33.752; Flowrate 34 gpm
1130 - Pump off to switch to other tanker
1131 - Pump on; Rotometer flowing free at 34 gpm
1236 - Turbidity = 119 NTU; dd = 35.623'
1250 - dd = 35.667; Turbidity = 27 NTU
1314 - Pump off; dd = 35.240'; Turbidity = 30.3 NTU; Pump back on
1350 - dd = 36.603'; Turbidity = 33.4 NTU
1415 - 9.44 NTU; dd = 36.616
1430 - 9.0 NTU; dd = 36.138
1441 - Pump off; 9.28 NTU
1442 - Pump on
1515 - Turbidity = 13.1 NTU
1530 - 8.49 NTU; flowrate 31 gpm
1545 - 8.64 NTU; Rate = 31 gpm; dd = 35.944
1605 - 9.64 NTU
1620 - 6.88 NTU
1623 - Stop pump (Step #4)
1625 - leave site

Report By: Robert S. Edrington (Print) (Sign) Date: 5/20/96

Title: Field Hydrogeologist / CHI

A-6001-123.1 (03/93)

FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 1

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
5/21/96	299-W5-37	Pump Setting	Water D	WW314	13

Purpose: Well Development ZP-1 Extraction Site

Reference: —

Location: ZP-1 Extraction Site

HISTORICAL DATA

Construction Depth

Casing Size / Type / Set At

Casing Perforations Schedule / Interval

Well Screen(s) Type / Interval: #40 5/16 SS 205.4 - 255.4 bgs

Last Recorded Depth-to-Water: 206.36 TOC 5/20

Last Recorded Depth-to-Bottom: 255.4 bgs

Current Depth-to-Water: 206.42 TOC

Current Depth-to-Bottom: —

PUMP SYSTEM CONFIGURATION

	Pre-Maintenance	Post-Maintenance
Pump Type	7.5HP Submersible	
Pump Model	Grundfos	
Tubing Size/Type	2" Galvanized	
Length-Bottom of Tubing to Pump Intake	3.15'	
Tubing Length	257.85	
Length-Top of Tubing to Reference Point	0.0	
Pump Intake Set at (Depth)	~252.25 TOC	

Reference/Measuring Point: Top of Casing (TOC) Stick up 1.4' Above ground

Start Time: —
End Time: —
Time: —
Contract Time: —
Total Time: —

Personnel:
RS Edrington - CHI
E. Rafuse - BHI
J. Moore - Water D.

Materials Used:
Horn # 2K-674
XD-4950

Description of Operations/Remarks

0650 - Arrive on Site
0653 - Stop test #0; Ref 0 @ 40.167
0655 - Start Pump; (test #1/Step #0); initial pump rate 35 gpm
0658 - dd = 20.251'; 0700 - dd = 24.292, 48.4 NTU
0702 - dd = 26.793'; 0725 - 33.552' TURBIDITY = 8.86 NTU
0755 - dd = 33.947', TURBIDITY = 4.07 NTU
0827 - Stop pump; (Step #1)
0845 - Stop test #1
0850 - SWL = 206.42' TOC
0855 - Leave Site

Report By: Robert S. Edrington
Title: Field Hydrogeologist
Signature: [signature]

Reviewed By: —
Title: — Date: —
Signature: —

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FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 2

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
5/23/96	299-W15-38		318		14

Purpose	Reference	Location
Monitor well development	BHI-EE-01 Manual	2P-1

HISTORICAL DATA

Construction Depth: 227.7

Casing Size	Type	Set At
4"	SS304	227.7

Casing Perforations Schedule: NA — Interval

Well Screen(s) Type: 40 slot SS304 — bgs Interval: 205-225.4

Last Recorded Depth-to-Water	Last Recorded Depth-to-Bottom
204.6 bgs	225.4 bgs

Current Depth-to-Water	Current Depth-to-Bottom
Same as above	Same as above

PUMP SYSTEM CONFIGURATION

	Pre-Maintenance	Post-Maintenance
Pump Type	Subm.	NA
Pump Model	7.5 Hp Grundfos	
Tubing Size/Type	2" Galv.	
Length-Bottom of Tubing to Pump Intake	3.11	
Tubing Length	220	
Length-Top of Tubing to Reference Point	-0-	
Pump Intake Set at (Depth)	223.11	

Reference/Measuring Point: TOC

Start Time: ____
End Time: ____
Time: ____
Contract Time: ____
Total Time: ____

Personnel: M. Faurote, B. Strode, M. Wrospir, E. Rafuse

Materials Used: 10 @ 21, 1 @ 10, 1 pump

225.9
+2.0 stickup 227.7 1.8' off bottom

Description of Operations/Remarks

0700 Start

1019 Arrive on site W15-38. Short safety meeting, pump is 5.9' long, 3.11 from top of pump, or 2.79' up from bottom. (225.9 - 2.79 = 223.11 intakes)

1030 E. Rafuse on-site - covers plan of day and safety.
using XD 4988 (due 9/15/96) - ~.5' above top of pump.

1045 Commence installing the pump. Will use Hermit 2K-192, and the XD will be input 1

1120 Pump installed, assembling manifold. 1.41' from plate to bottom of coupling. (assume .12'/coupling.)

1126 Start baseline - Line 1 min intervals. 13.262' @ ref = 0

1136 Stop baseline
Set up test 1, step 0, on log cycles @ 10 min.

1138 H_2O to surface, pump dropped to .35' above plate - H_2O is V. muddy. throttling down, no H_2O over the XD.

1145 finally adjust rate to ~15 gpm, with ~4.5' H_2O over the XD
0.21' from plate to coupling, has dropped 1.20' since beginning

Report By: J. M. Faurote
Title: Geologist
Signature: JM Faurote

Reviewed By: ____
Title: ____ Date: ____
Signature: ____

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report N 14

Page 2 of 2

Continuation of Shift 5/23/96 (Date)	Well/Excavation No. 299-W15-38	Operable Unit No. ZP-1

Description of Operations/Remarks

1157 Have to replace the turbidity meter must go to 100N - departing now
1239 Return to drillsite, take turbidity reading NTU = 2.51
1241 NTU = 2.45, development complete
1243 Step test - Test 1, step 1 - pseudorecovery
1245 Stop recovery - data appears useless. secure site, equipment, return to town

NA

Report By: J.M. Faurote / JM Faurote (Print) (Sign) Date: 5/30/96

Title: Geologist

A-6001-123.1

FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 2

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
5/30/96	299-W15-39			WA 397	15

Purpose: Well Development ZP-1 Monitoring Well

Reference:

Location: ZP-1 Phase III Monitoring well

HISTORICAL DATA

Construction Depth: 223' bgs

Casing Size: 4" Type: SS Set At: 220.32' bgs

Casing Perforations Schedule: N/A 220.0' Interval bgs

Well Screen(s) Type: #40 Slot SS Interval: 199.60-219.6 bgs

Last Recorded Depth-to-Water:

Last Recorded Depth-to-Bottom:

Current Depth-to-Water: 198.92' bgs

Current Depth-to-Bottom: 218.45' bgs

PUMP SYSTEM CONFIGURATION

	Pre-Maintenance	Post-Maintenance
Pump Type	7.5hp Submersible	
Pump Model	Grundfos	
Tubing Size/Type	2" Galvanized	
Length-Bottom of Tubing to Pump Intake	3.15	
Tubing Length	216.38'	
Length-Top of Tubing to Reference Point	1.85'	
Pump Intake Set at (Depth)	215.40 bgs	

Reference/Measuring Point: Total Stickup = 2.28' above grade TOP of Casing (TOC) or Below Ground Surface (bgs)

Start Time:
End Time:
Time:
Contract Time:
Total Time:

Personnel: RS Edrington - CHI; M. Darach - ITH; D. Amos - Water D; J. Moore - Water D; Brandon - Water D

Materials Used: Pump 5.9' 1.275' bottom to intake

Description of Operations/Remarks

0935- Arrive on Site. Water D just finished pouring Enviroplug. preparing to pour seal
1002- Pouring Seal. Breakdown drill Rig
1034- Rig off Site.
1039- setting up pump Rig.
1053- SWL = 199.22' TOC with Stickup of 0.30
1059- D-T-B = 218.45' TOC
1109- Installing Pump - XD4950 Attached to pipe 0.45' Above top of pump.
1143- Pump on bottom; Riser pipe coupling 1.85' Above toc.
1198' additional Casing Added to casing
1146- Hermit 2K674, XD4950 Ref OD 12.877.
1152- Start test #0 - Pump does Start
1153- Step #1 - Pump No Start
1154- Shut generator off check fuses
1155- Checking all electrical systems

Report By: Robert S. Edrington
Title: Field Hydrogeologist
Signature:

Reviewed By:
Title: Date:
Signature:

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 15

Page 2 of 2

Continuation of Shift	Well/Excavation No.	Operable Unit No.
5/30/96 (Date)	299-W15-39	ZP-1

Description of Operations/Remarks

Call in to Olin - 1201 - Crew taking ~~lunch~~ lunch.
1233 - Going to pull pump and check wire for breaks.
1320 - Pump out of well - Short in wire near pump - Bad Plug
1345 - Olin Amos Decides that we will pump tommorrow.
1348 - Leave Site.

Report By: Robert S. Edmiston (Print) (Sign) Date: 5/30/96

Title: Field Hydrogeologist / CHI

A-6001-123.1 (03/93)

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FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 2

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
5/31/96	299-W15-39	Pump Setting	WATERD	WU 397	16

Purpose: Well Development ZP-1 Monitoring Well

Reference: ——

Location: ZP-1 Phase II + III Pump + Treat

HISTORICAL DATA

Construction Depth: 223' bgs

Casing Size: 4" Type: SS Set At: 220.02' bgs

Casing Perforations Schedule: — Interval

Well Screen(s) Type: #40 Slot SS Interval: 199.6-219.6 bgs

Last Recorded Depth-to-Water: 198.92 bgs 5/30/96

Last Recorded Depth-to-Bottom: 218.15' bgs 5/30/96

Current Depth-to-Water: ——

Current Depth-to-Bottom: 219.64* bgs

PUMP SYSTEM CONFIGURATION

	Pre-Maintenance	Post-Maintenance
Pump Type	7.5 hp Submersible	—
Pump Model	Grundfos	—
Tubing Size/Type	2" Galvanized	2" Galvanized
Length-Bottom of Tubing to Pump Intake	3.15	3.15
Tubing Length	216.38	216.38
Length-Top of Tubing to Reference Point	1.85	0.36
Pump Intake Set at (Depth) bgs ⇒	218.25.40	216.89 bgs

Reference/Measuring Point: Total Stickup = 2.28' above GRADE

below ground Surface (bgs) or Top of Casing (toc)

Start Time: ——
End Time: ——
Time: ——
Contract Time: ——
Total Time: ——

Personnel:
RS Edrington - CHI
O. Amos - WATERD
M. Barnach - ITH
J. Moore - WATERD.

Materials Used:
Hermit 2K-674
XD-4950
7.5 hp Grundfos 5.9'/2.75' bottom to intake

*D-T-B based on pump drop of 1.49'

Description of Operations/Remarks

0645-Arrive on Site; waiting for Purgewater truck.
0658- Setup Hermit, Note: While installing pump after Electrical problems yesterday, with crew turned pump on to check it, this cleaned out bottom and lowered pump 1.49'- coupling only 0.36' above toc

Hermit Setup
test#0 - 1 input
XD 4950 Ref Log 14.259

0700 - Start Pump (test#0/step#0).
0701 - 3.618' dd, flowrate @ 18 gpm
0715 - Step#1, adjust flow to 32 gpm (3.7' dd)
0720 - 7.481' dd
0730 - 7.531' dd; TURBIDITY = 1.54 NTU
0745 - Step#2. 45 gpm
0747 - 11.086' dd
0800 - Step#3: Initially @ 56 gpm but drawdown below XD
0802 - Adjusted to 50 gpm - 13.5' dd
0803 - 13.352' dd

Report By: Robert S. Edrington
Title: Field Hydrogeologist
Signature: [signature]

Reviewed By: ——
Title: —— Date: ——
Signature: ——

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 16

Page 2 of 2

Continuation of Shift 5/31/96 (Date)	Well/Excavation No. 299-W15-39	Operable Unit No. ZP-1

Description of Operations/Remarks

0810 - 13.340' dd
0814 - Step #4; Shutoff pump
0835 - Stop test #2
0913 - Retrieve XD
0915 - Leave Site

Report By: Robert S. Edrington (Print) (Sign) Date: 5/31/96

Title: Field Hydrogeologist / CHT

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BHI-00927
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FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 3

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
4/11/96	299-W18-37			WU327	4

Purpose: Re-development/development of ZP-1 Production/Injection Wells

Reference:

Location: ZP-1 Injection Well Site

HISTORICAL DATA

Construction Depth

Casing Size | Type | Set At

Casing Perforations Schedule | Interval

Well Screen(s) Type | Interval

Last Recorded Depth-to-Water | Last Recorded Depth-to-Bottom

Current Depth-to-Water | Current Depth-to-Bottom

PUMP SYSTEM CONFIGURATION

	W18-37 Pre-Maintenance	Post-Maintenance
Pump Type	Submersible	
Pump Model	7.5HP Grundfos	
Tubing Size/Type	2" Galvanized	
Length-Bottom of Tubing to Pump Intake	3.15	
Tubing Length	263.86	
Length-Top of Tubing to Reference Point	0.84	
Pump Intake Set at (Depth)	266.17' TOC	

Reference/Measuring Point: TOP of Casing (TOC)

Stickup W18-37 = 0.72' Above Ground

Start Time
End Time
Time
Contract Time
Total Time

Personnel:
RS Edrington - CHI
ERafuse - BHI
M. Wraspir - WatorD
D. Garcia - WatorD
D. Amos - WatorD

Materials Used:
Ref 0 = ~~38.738~~ XU 5901
39.032 SWL = 220.12' TOC

Description of Operations/Remarks

0812 - Arrive on Site.
0824 - Hermit Setup test #5 Input 1 XD 5901 SWL 220.12' TOC at Ref 0 @ 39.032'.
0831 - Start Pump (test #5); Initial pump rate 40gpm
0835 - drawdown = 21.308'
0842 - 25' drawdown - open pump wide open
0846 - drawdown 39.032' - Below transducer will continue to pump
0849 - Shutoff pump
0853 - Pump back on - wide open - 60gpm
0857 - Pump off: Call from G.G. Kelly => IRA go on UP-1 Development Data Package, Need it by next Friday.
0903 - Pump back on. - Initial Rate 64gpm
0909 - Pump off
0913 - Pump on.
0919 - Pump off

Report By: Robert S. Edrington
Title: Lead Field Hydrogeologist
Signature: [signature]

Reviewed By:
Title: Date:
Signature:

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 4

Page 2 of 3

Continuation of Shift 4/11/96 (Date) | Well/Excavation No. 299-W18-37 | Operable Unit No. ZP-1

Description of Operations/Remarks

0926 - Pump ON - Initial Rate 60 gpm
0935 - Pump off
0942 - Stop test #5, Remove transducer
0949 - Pulling Pump.
1019 - Pump out of well - Preparing to bailer.
1104 - bailer "Deconned and on site
1109 - D-T-B - 261.78 TOC
1114 - bailing
1130 - bailing Stops for Lunch.
1200 - Back to bailing
1215 - D-T-B = 262.75' TOC
1240 - D-T-B = 265.5' TOC
1320 - D-T-B = 267.65' TOC
1336 - D-T-B = 268.92' TOC ; bailing finished
1402 - SWL = 219.82' TOC
1406 - Installing pump
1454 - Pump on bottom ; Intake @ 266.17' TOC ; 0.84 TOC to Coupling
1504 - Hermit test #6 Setup : XD 5301 ; XD Ref @ 45.526
1505 - Start Pump (test #6) ; initial flowrate 60 gpm
1509 - Drawdown = 31.553 (13.573 Available)
1511 - 37.415' ds
1512 - 40.1' ds
1517 - 45.5' ds => Shut Pump off
1521 - Pump back on
1523 - Adjust to 50 gpm ; 24.193 ds
1525 - ds = 29.725'
1532 - Pump off - ball valve adjusted to 40 gpm
1541 - Pump Start (test #6/Step 1) ; 45 gpm
1549 - Turbidity = 92.7 NTU
1555 - 29.567 ds ; 26.3 NTU ; 44 gpm

Report By: Robert S. Edmiston (Print) [signature] (Sign) Date: 4/11/96

Title: Lead Field Hydrogeologist - CHI

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 4

Page 3 of 3

Continuation of Shift 4/11/96 (Date)

Well/Excavation No. 299-W18-37

Operable Unit No. ZP-1

Description of Operations/Remarks

1600 - ds = 30.891'
1614 - Turbidity = 25.8 NTU. ds 33.586'
1625 - ds = 33.791; Turbidity = 9.73 NTU.
1627 - Pump off (Step #2)
1631 - Cleared site.

Report By: Roberts Edrington (Print) (Sign) Date: 4/11/96

Title: Lead Field Hydrogeologist

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FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 2

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
4/12/96	299-W15-37+38	Pump Setting	Water D	WU 327	5

Purpose: Development of ZP-1 New Injection Wells

Reference:

Location: ZP-1 Injection Well Site

HISTORICAL DATA	
Construction Depth	
Casing Size / Type / Set At	
Casing Perforations Schedule / Interval	
Well Screen(s) Type / Interval	
Last Recorded Depth-to-Water	Last Recorded Depth-to-Bottom
Current Depth-to-Water	Current Depth-to-Bottom

PUMP SYSTEM CONFIGURATION	W15-37 ~~Pre-Maintenance~~	W15-38 ~~Post-Maintenance~~
Pump Type	submersible	Submersible
Pump Model	7.5HP Grundfos	7.5HP Grundfos
Tubing Size/Type	2" Galvanized	2" Galvanized
Length-Bottom of Tubing to Pump Intake	3.15 ~~2.75~~'	3.15 ~~2.75~~
Tubing Length	268.86	272.40'
Length-Top of Tubing to Reference Point	0.84	1.10
Pump Intake Set at (Depth)	266.17' toc	274.45' toc

Reference/Measuring Point: TOP of Casing (TOC)

Stickup: W15-37 - 0.72' Above ground surface; W15-38 - 1.06' Above ground surface

Start Time:
End Time:
Time:
Contract Time:
Total Time:

Personnel:
RS Edrington - CHI
G. Rafuse - BHI
M. Wrasper - Water D
D. Garcia - Water D
O. Arias - Water D

Materials Used:
XD 5901GL
Hermit 2K-192

Description of Operations/Remarks

0700 - Step test #6; Pump actually started 2 minutes later @ 45gpm
0720 - ds = 28.291'
0725 - 29.079' ds
0730 - R. Edrington Arrives on Site
0735 - Turbidity = 6.41'; ds 29.961'
0758 - Turbidity = 10.1 NTU; ds = 32.498', flow rate ≈ 43gpm
0800 - Turbidity = 7.07 NTU; ds = 33.901', Flow rate 43gpm
0813 - Turbidity = 5.16 NTU; Stop pumping (Step #4); ds = 33.775'
0826 - Stop test #6; 0.75' toc to coupling
0835 - Pulling pump.
0908 - Pump out; Water D personnel taking pump + pipe + XD to decon.
Final D-T-B = 268.92 + 0.28 = 269.20 toc, SWL = 219.90' toc
0918 - leave site for 299-W15-38
0933 - SWL = 216.64' toc Stick up = 1.06'
0935 - D-T-B = 273.98 + 0.28 = 274.26' toc

Report By: Robert S. Edrington
Title: Lead Field Hydrogeologist
Signature: Robert S. Edrington

Reviewed By:
Title: Date:
Signature:

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 5

Page 2 of 2

Continuation of Shift 4/12/96 (Date) | Well/Excavation No. W18-38 | Operable Unit No. ZP-1 (Injection Site)

Description of Operations/Remarks

0951 - Water D personnel on Site w/ Pump + Pipe
1003 - Add 1.88' to casing Stickup Now = 2.94'; New D-T-B=277.20'
Installing Pump. Casing added to make it easier for pump installation.
1103 - Pump in place on bottom; Pump intake @ 274.45' TOC
1123 - Input #1 XD 5901 Ref 0 @ 55.315'
1124 - Start test #7 and Pump
1126 - ds = 11.695 ⇒ water like chocolate milk
1128 - ds = 13.823 ⇒ water still chocolate - non-translucent
1132 - ds = 15.762' still dirty.
1134 - ds = 16.091' can see float in Potometer: 61 gpm.
1139 - ds = 16.402'; 61gpm
1144 - ds = 16.708'; 61gpm
1149 - ds = 16.944; 61gpm; turbidity = 115 NTU
1159 - ds = 16.692, 59gpm; turbidity = 65.9 NTU
1214 - ds = 17.417; turbidity = 69.3 NTU
1217 - Stop pump; Step #1; Purgewater truck leaves to empty.
1325 - Purgewater truck on Site
1328 - Step #2; Pump Restart; Initial Rate 60gpm
1331 - 61gpm; ds 14.769'
1340 - ds = 17.118'; 61gpm
1348 - ds = 17.527'; 59gpm; turbidity = 63 NTU
1358 - ds = 17.764; 59gpm; 55.8 NTU
1415 - ds = 18.063; 58gpm; 53 NTU
1422 - Step #3, Stop Pump, ds = 18.158'; turbidity = 52.9
1427 - Teamster on Site, takes Purgewater truck to empty.
1443 - Stop test #7; O. Amos informs me that we are finished for the day. Will continue Monday morning.
1446 - Leave Site for Sigma I

Report By: Robert S. Edrington (Print) (Sign) Date: 4/12/96

Title: Lead Field Hydrogeologist / CHE

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FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 2

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
07/15/96	299-W18-38	Pump Setting	W.J.D.	W1327	6

Purpose	Reference	Location
Development of ZP-1 New Injection Well		ZP-1 Injection Site

HISTORICAL DATA		PUMP SYSTEM CONFIGURATION (W18-33)	~~Pre-Maintenance~~	Post-Maintenance
Construction Depth		Pump Type	Submersible	
Casing Size / Type / Set At		Pump Model	7.5 hp Grundfos	
Casing Perforations Schedule / Interval		Tubing Size/Type	2" Galvanized	
Well Screen(s) Type / Interval		Length-Bottom of Tubing to Pump Intake	3.15	
		Tubing Length	272.40	
Last Recorded Depth-to-Water: 221.78'	Last Recorded Depth-to-Bottom: 277.20' TOC	Length-Top of Tubing to Reference Point	1.10	
		Pump Intake Set at (Depth)	274.45' TOC	
Current Depth-to-Water	Current Depth-to-Bottom	Reference/Measuring Point: Stickup - 2.14' above ground surface TOP OF CASING		

Start Time	End Time	Time	Contract Time	Total Time

Personnel: D. Garcia, E. Rafuse, R. Edrington, J. Jimenez

Materials Used: XD-RF 0 @ 55.315

Description of Operations/Remarks

0655 - Start Pump; 60 gpm
0750 - Truck full Stop pump; turbidity = 33.1 NTU; truck left
0847 - Purgewater truck returns.
0854 - Start Pump (test #8): initial pump rate 64 gpm
0854 - ds 12.184'
0857 - 60 gpm; ds = 14.958'
0905 - ds 17.953 60 gpm; turbidity = 32.8 NTU.
0930 - 57 gpm; ds = 18.631'; turbidity = 24.6 NTU
0947 - ds 18.709'; turbidity = 22.6 NTU.
0948 - Step #1 Stop Pump. Purgewater truck leaves to empty
1040 - Truck returns
1043 - Step #2; pump started initial pump rate 62 gpm
1054 - 58 gpm; ds - 18.016'; turbidity = 26.5 NTU.
1101 - 58 gpm; ds - 18.520'
1115 - turbidity = 22.9 NTU.

Report By	Reviewed By
Robert S. Edrington	
Title: Lead Field Hydrogeologist	Title: Date:
Signature: Robert S. Edrington	Signature:

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 60

Page 2 of 2

Continuation of Shift 4/15/96 (Date)

Well/Excavation No. 299-W18-38

Operable Unit No. ZP-1

Description of Operations/Remarks

1125 - dt = 18.946; turbidity = 26.9 NTU; 56gpm
1132 - dt = 19.025; 56gpm; turbidity = 28.7 NTU
1139 - Pump shut off; turbidity = 23.1 NTU
1236 - Purgewater truck arrives
1237 - Start Pump (Step #3), initial pumprate = 60gpm
1301 - turbidity = 22.8 NTU.
1311 - turbidity = 22.8 NTU
1320 - turbidity = 22.7 NTU.
1322 - dt 19.167.
1330 - dt = 19.230; turbidity = 23.4
1334 - Pump shut off; turbidity = 27.1
1428 - Purgewater truck Returns
1432 - Pump started; initial rate = 60gpm
1436 - 55gpm - 14.442' dt
1457 - 15.9 NTU; dt 17.338'
1509 - 15.9 NTU; dt 17.622'; flowrate 54gpm
1523 - 14.8 NTU
1532 - 13.8 NTU
1533 - Pump shut off (Step #4)
1537 - Leave site

Report By: Robert S. Edrington (Print) [signature] (Sign) Date: 4/15/96

Title: Lead Field Hydrogeologist / CHT

A-6001-123.1 (03/93)

FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 2

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
4/16/96	299-W18-38	Pump Setting	WAKER D	WU327	7

Purpose: DEVELOPMENT of ZP-1 New Injection Well

Reference:

Location: ZP-1 Injection Site

HISTORICAL DATA

Construction Depth

Casing Size | Type | Set At

Casing Perforations Schedule | Interval

Well Screen(s) Type | Interval

Last Recorded Depth-to-Water: 221.75' TOC

Last Recorded Depth-to-Bottom: 277.20' TOC

Current Depth-to-Water: —

Current Depth-to-Bottom: —

PUMP SYSTEM CONFIGURATION

	Pre-Maintenance	Post-Maintenance
Pump Type	Submersible	
Pump Model	7.5hp Grundfos	
Tubing Size/Type 2" Galvanized	~~3.75~~ MSE	
Length-Bottom of Tubing to Pump Intake	~~277.40~~ MSE 3.15	
Tubing Length	272.40	
Length-Top of Tubing to Reference Point	1.10	
Pump Intake Set at (Depth)	274.45' TOC	

Reference/Measuring Point: Stickup - 2.44' above ground surface
TOP of Casing (TOC)

Start Time:
End Time:
Time:
Contract Time:
Total Time:

Personnel:
R. Edrington - CHE
E. Kilcupe - BHI
D. Garcia - H2OD

Materials Used:

Description of Operations/Remarks

0700 - Pump on @ 55 gpm, Not Recording drawdown, Step test #8
0715 - turbidity = 14.3 NTU
0725 - turbidity = 10.4 NTU
0730 - turbidity = 9.19 NTU
0745 - turbidity = 8.63 NTU
0755 - turbidity = 9.93 NTU.
0757 - Pump shut off; truck leaves to empty.
0857 - Purge water Truck returns
0900 - Pump ON.
0905 - Turbidity = 75.3 NTU
0915 - Turbidity = 7.83 NTU
0925 - Turbidity = 7.35 NTU
0935 - Turbidity = 7.30 NTU
1004 - Pump off; Truck leaves to empty.
1102 - Truck on Site; 1107 Pump ON.

Report By: Robert S. Edrington
Title: Lead Field Hydrogeologist
Signature: Robert S. Edrington

Reviewed By:
Title:
Date:
Signature:

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 7

Page 2 of 2

Continuation of Shift 4/16/96 (Date)	Well/Excavation No. 299-W18-38	Operable Unit No. (WU 327) ZP-1

Description of Operations/Remarks

1117 - turbidity = 11.4 NTU
1127 - turbidity = 6.22 NTU
1143 - turbidity > 5.09 NTU
1153 - turbidity = 5.38 NTU
1154 - Pump shut off.
1159 - Purge truck off site
1207 - Remove Geoscience Rotometer from manifold
1212 - Leave site

Report By: Robert S. Edrington (Print) (Sign) Date: 4/16/96

Title: Lead Field Hydrogeologist / CHI

A-6001-123.1 (03/93)

FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 2

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
5/6/96	299-W18-39	Pump Setting	WATER-D	WU353	8

Purpose: Well Development - ZP-1 Injection Site

Reference: —

Location: ZP-1 Injection Site Phase III

HISTORICAL DATA

Construction Depth:

Casing Size: 6" Type: CS Set At:

Casing Perforations Schedule: — Interval:

Well Screen(s) Type: 40S/6TSS Interval: 174.5-254.5

Last Recorded Depth-to-Water: 206.71 (5/3/96) Last Recorded Depth-to-Bottom: —

Current Depth-to-Water: Current Depth-to-Bottom: 255.0'

PUMP SYSTEM CONFIGURATION

	Pre-Maintenance	Post-Maintenance
Pump Type	7.5 hp Submersible	
Pump Model	Grundfos	
Tubing Size/Type	2" Galvanized	
Length-Bottom of Tubing to Pump Intake	3.15"	
Tubing Length	248.93	
Length-Top of Tubing to Reference Point	0.0	
Pump Intake Set at (Depth)	252.08'	

Reference/Measuring Point: TOP of CASING (TOC) stickup 2.1' Above pad.

Start Time: End Time: Time: Contract Time: Total Time:

Personnel:
E. Robison - BHI
M. Wrasspir - WATER D
J. Moore - WATER D

Materials Used:
XD-4950 GC
Hermit 2K-674

Description of Operations/Remarks

	Time	gpm	dd
0735 - START Pump and Stop hermit (Step#1)			
0815 - Pumpoff, Truck off site to empty	0745	68	20.101
0950 - Purgewater Truck back on site	0750	69	20.874
0955 - Start pump - 68 gpm (Step#2)	0755	69	21.350
1025 - RS Edington on Site - TURBIDITY = 40.9 NTU	0758	69	21.585
1030 - Stop pumping, truck leaves Site to empty	0810	69	22.508
1120 - Purgewater Truck back on Site	Step#2		
1122 - Pump Started (Step#3)	1005	68	21.314
1129 - Tamp Rotometer discover it to be stuck,	1020	68	22.265
drops down to 61 gpm	1030	68	22.367
1132 - TURBIDITY = 63.5 NTU.			
1147 - TURBIDITY = 23.5 NTU.			
1157 - TURBIDITY = 54 NTU; Pump Shutoff; purgewater truck leaves			
1339 - Purgewater Truck Returns.			
1340 - Pump ON. (No Step) - 61 gpm			

Report By: Robert S. Edington
Title: Lead Field Hydrogeologist
Signature: [signature]

Reviewed By:
Title: Date:
Signature:

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FIELD ACTIVITY REPORT
SHIFT CONTINUATION SHEET

Continuation of Report No. 8

Page 2 of 2

Continuation of Shift 5/6/96 (Date)

Well/Excavation No. 299-W18-39

Operable Unit No. ZP-1

Description of Operations/Remarks

1350 - TURBIDITY = 30 NTU.
1355 - TURBIDITY = 29.0 NTU
1400 - TURBIDITY = 25.4 NTU
1410 - Turbidity = 18.8 NTU
1415 - Pump off. TURBIDITY = 22.0 NTU
1416 - Purge truck leaves to empty.
1507 - Purge truck Returns
1508 - Start Pump (Step #4)
1523 - TURBIDITY = 14.2 NTU
1534 - TURBIDITY = 14.9 NTU
1541 - Turbidity = 15.5 NTU; STOP Pump
1544 - Purge truck leaves site.
1545 - RS Edrington leaves.

Report By: Robert S. Edrington (Print) (Sign) Date: 5/6/96

Title: Lead Field Hydrogeologist CHI

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FIELD ACTIVITY REPORT - WELL SERVICES

Page 1 of 1

Date	Well No.	Rig Type/Model	Rig No.	Contract/Work Order No.	Report No.
05/07/96	299-W18-39	Pump Service	WATER D	LL1353	9

Purpose: Well Development ZP-1 Injection Well

Reference:

Location: ZP-1 Injection Site for Phase III

HISTORICAL DATA

Construction Depth: —

Casing Size / Type / Set At: —

Casing Perforations Schedule / Interval: —

Well Screen(s) Type / Interval: #40 Slot SS 194.5 - 254.5

Last Recorded Depth-to-Water: 206.71 (5/3/96)

Last Recorded Depth-to-Bottom: 255.0' (5/6/96)

Current Depth-to-Water: 206.66' TOC

Current Depth-to-Bottom: —

PUMP SYSTEM CONFIGURATION

	Pre-Maintenance	Post-Maintenance
Pump Type	7.5 Hp Submersible	
Pump Model	Grundfos	
Tubing Size/Type	2" Galvanized	
Length-Bottom of Tubing to Pump Intake	3.15'	
Tubing Length	248.93'	
Length-Top of Tubing to Reference Point	0.00	
Pump Intake Set at (Depth)	252.08'	

Reference/Measuring Point: TOP of Casing (TOC) Stickup = 2.1' Above Pad

Start Time:
End Time:
Time:
Contract Time:
Total Time:

Personnel:
E. Rafuse - BHI
M. Weaspir - H2OD
J. Moore - H2OD
R. Edrington - CHI

Materials Used:
HERMIT 2K-674
XD-4950GC

Description of Operations/Remarks

0654 - Arrive on Site. Waiting for Purge truck to Arrive
0710 - Purgewater truck Arrives on Site
0712 - Start pump; initial pump rate at 64gpm
0732 - pump rate @ 62gpm
0742 - Pump off; Truck leaves to empty
0837 - Truck returns on Site; Pump ON @ 62gpm
0907 - Pump off; truck leaves to empty
1002 - Truck Returns; Pump on @ 62gpm
1032 - Pump off; truck leaves Site to empty
1100 - Ed Rafuse informs RS Edrington that well is being accepted as developed by BHI
1110 - Stop test #0, SWL = 206.66 XD @ 40.897 (-0.163); Total of 10,000 gallons pumped during development.
Final Turbidity = 9.5 NTU
1118 - XD out of hole; leave Site

Time	TURBIDITY (NTU)
0732	9.65
0742	8.6
0857	10
0907	10.3
1017	9.8
1022	8.29
1027	11.6
1032	9.6

Report By: RS Edrington
Title: Lead Field Hydrogeologist
Signature: [signature]

Reviewed By:
Title:
Date:
Signature:

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