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Borehole Data Package for One CY 2005 CERCLA Well 699-S20-E10, 300-FF-5 Operable Unit, Hanford Site, Washington

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March 2006

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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Summary

One new *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) groundwater monitoring well was installed in the 300-FF-5 Operable Unit (OU) in fiscal year 2005 to fulfill commitments for well installations proposed in the *Hanford Federal Facility Agreement and Consent Order* Milestone M-24-57. Well 699-S20-E10 (C4855) was drilled approximately 20 feet into the uppermost unconfined aquifer and installed upgradient of the 300 Area. This new well was installed to collect data in support of groundwater flow and contaminant transport simulations and to supplement the water quality monitoring network for the 300-FF-5 OU.

This report supplies the information obtained during drilling, characterization, and installation of the new groundwater monitoring well. This document also provides a compilation of hydrogeologic and well construction information obtained during drilling, well development, and sample collection/analysis activities.

Sediment core samples from well 699-S20-E10 were analyzed for physical properties, including grain- or particle-size distributions (PSD), and bulk and particle densities.

Estimation of aquifer recharge under natural conditions using chloride mass balance techniques from data collected on sediment samples from well 699-S20-E10 was also completed.

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1.0 Introduction

One new *Comprehensive, Environmental Response, Compensation, and Liability Act* (CERCLA) groundwater monitoring well was installed upgradient of the 300 Area within the 300-FF-5 Groundwater Operable Unit (OU) in fiscal year 2005 to fulfill commitments for a well installation proposed in *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement; Ecology et al. 1989) Milestone M-24-57.[(a)] The need for additional information to support the groundwater flow and contaminant transport simulations was identified in the *Operation and Maintenance Plan for the 300-FF-5 Operable Unit* (DOE 2002). This well will also provide needed upgradient coverage for the 300-FF-5 OU groundwater monitoring network.

This report provides the information obtained during drilling, characterization, and installation of this new CERCLA groundwater monitoring well in the 300-FF-5 OU. Sediment core samples from well 699-S20-E10 were analyzed for physical properties, including grain- or particle-size distributions (PSD), and bulk and particle densities.

Estimation of aquifer recharge under natural conditions using chloride mass balance techniques from data collected on sediment samples from well 699-S20-E10 was also completed.

1.1 New Groundwater Monitoring Well

Groundwater monitoring well 699-S20-E10 (well ID C4855) was installed between July and August 2005. The location of this well is shown on the location map in Figure 1. The new well was constructed to the specifications and requirements described in Washington Administrative Code (WAC) 173-160, *Sampling and Analysis Plan for CERCLA Well Drilling at 300-FF-5 Operable Unit, Fiscal Year 2005* (DOE 2005b), and specifications provided by Fluor Hanford, Inc. (FHI), Richland, Washington. During drilling and construction of the well, sampling and analysis activities were conducted to support field screening for radiological and chemical contaminants, to collect intact sediment split-spoon samples for geologic description and geochemical testing, digital photography, and for archival in the Hanford Geotechnical Sample Library (HGSL).

This document provides a compilation of all available geologic data, radiological logs, hydrogeologic data, and well information obtained during drilling, well construction, well development, pump installation, and sample collection activities. Appendix A contains the Well Summary Sheet, the Well Construction Summary Report, the geologist's borehole log, well development and pump installation records, and the well location and elevation survey results. Appendix B contains digital photographs of the recovered splitspoon core samples, the split-spoon chain-of-custody forms, and selected geologic descriptions of several of the core. Appendix C contains grain size distribution curves and sieve data results from core sample analysis. Appendix D contains the complete geophysical log report.

(a) Letter from EJ Murphy-Fitch (Fluor Hanford, Inc., Richland, Washington) to Distribution, "*Tentative Agreement on Tri-Party Agreement Negotiations on the Overall Strategy and Approach for Hanford Groundwater Protection, Monitoring, and Remediation (M-024),*" dated September 22, 2003.

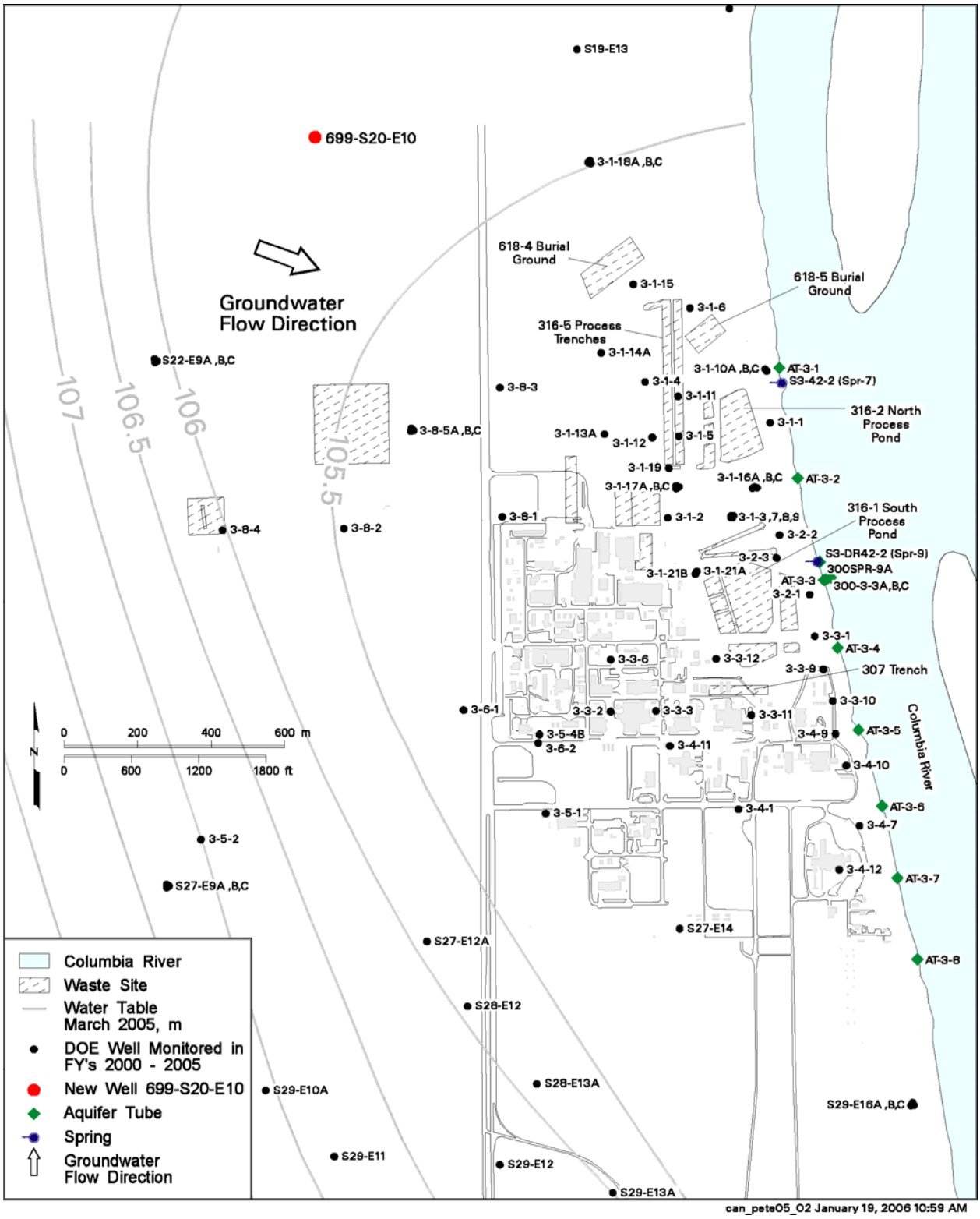

Figure 1. Map of 300-FF-5 Operable Unit Area and Location of New and Existing Wells in the Groundwater Monitoring Network

Additional well construction documentation is on file with Fluor Hanford, Inc. (FHI). Hanford Well Information System (HWIS) [http://apweb02/cfroot/rapidweb/phmc/cp/hwisapp/] contains electronic drilling and construction records for this well. In addition, the Washington State Well Record form is on file with the Washington State Department of Ecology as required per WAC 173-160.

English as well as metric units are used in this report. English units may be used to describe drilling and well completion activities because that is the system of units used by drillers to measure and report depths and well construction measurements. Conversion to metric can be done by multiplying feet by 0.3048 to obtain meters or by multiplying inches by 2.54 to obtain centimeters.

2.0 Well 699-S20-E10

Well 699-S20-E10 (well ID C4855) is located to the northwest of the 300 Area. The well is upgradient of the 300 Area and will (1) help differentiate upgradient groundwater contamination from contaminants released in the 300 Area and (2) support groundwater modeling. The new well monitors the uppermost unconfined aquifer and is screened across lower Hanford formation and upper Ringold Formation sediments.

2.1 Drilling and Sampling

Well 699-S20-E10 (well ID C4855) was drilled with a cable tool drill rig from surface to a total depth of 64.5 feet below ground surface (bgs). Temporary 8 5/8-inch outside diameter (OD) casing was used during drilling to total depth. Drilling began on July 13, 2005, and total depth was reached on July 15, 2005.

Grab samples of sediment for geologic description, digital photography, and archives were collected at approximately 5-foot intervals from ground surface to total depth. In addition, 43 nearly continuous split-spoon samples were collected from 7 to 63 feet bgs. The water table was encountered at approximately 43.63 feet bgs. The borehole log in Appendix A provides the lithologic description of sediments encountered during drilling. The composite log in Section 4.4 summarizes the lithology, hydrogeology, and presents graphic results of data collected in this well.

Sediments encountered during drilling were predominantly unconsolidated silty sandy gravel of the hydrologic unit 1 (Hanford formation) of Thorne et al. (1993) from approximately 1 foot to a depth of approximately 47 feet bgs. Above the Hanford formation are Holocene recent deposits.

The Ringold Unit 5 that lies beneath the Hanford formation, silty sandy gravel, is not easily defined in this borehole but appears to be present from approximately 48 feet to total depth (64.5 feet bgs). This approximate contact depth was defined based on a detailed evaluation of the sediment core (see Appendix B) incorporated with the other available data sets. The field geologist's detailed borehole log, along with the well construction summary report, as-built diagram, well development and pump

installation records, and well survey results are included in Appendix A. Appendix B contains the split-spoon core photographs, selected geologic description of the core, and chain-of-custody forms. A more detailed hydrogeologic interpretation of the borehole sediments is included in Section 4.4.

The borehole and drill cuttings were monitored regularly for organic vapors and radioisotope contaminants (i.e., gamma). Radioisotope monitoring revealed no detectable gamma contamination was present. Spectral gamma and neutron moisture geophysical logs were run in the temporary borehole in July by Stoller Corporation (Appendix C). Section 4.3 provides the details of this logging.

2.2 Well Completion

The permanent casing and screen were installed in well 699-S20-E10 on July 19, 2005. A 15-foot long, 4-inch inside diameter (ID), stainless steel, continuous wire-wrap 20 slot (0.02-inch slot) screen was set from 58.56 to 43.57 feet bgs. A 3-foot long, 4-inch ID stainless steel sump is attached to the bottom of the screen and extends from 61.56 to 58.56 feet bgs. The permanent well casing is 4-inch ID, stainless steel from 43.57 bgs to 2 feet above ground surface.

The screen filter pack is composed of 10–20 mesh silica sand placed from 63.25–32.18 feet bgs; the filter sand was developed with a surge block to settle the sand pack. The annular seal above the sand pack is composed of 3/8-inch bentonite pellets from 32.18–25.22 feet bgs and granular bentonite crumbles from 25.22–10.80 feet bgs. The surface seal is composed of Portland cement grout from 10.80 feet bgs to ground surface. A 4-foot by 4-foot by 6-inch concrete pad was placed around the well at the surface. A protective 6-inch-diameter well head casing with locking cap, four protective steel posts, and a brass marker stamped with the well identification number and Hanford well number were set into the concrete pad.

A borehole straightness test was completed. The vertical and horizontal coordinates of the well were surveyed by Fluor Federal Services on September 6, 2005. The horizontal position of the well was referenced to horizontal control stations established by the U.S. Army Corps of Engineers (USACE). The coordinates are Washington Coordinate System, South Zone, NAD83(91) datum. Vertical datum is NAVD88 and is based on existing USACE bench marks. Survey data are included in Table 1 and Appendix A. The static water level was measured at 43.63 feet bgs on July 25, 2005. The brass survey marker is equivalent to ground surface.

Table 1. Survey Data for New CERCLA Well 699-S20-E10

Well Name (Well ID)	Easting (meters)	Northing (meters)	Elevation (meters)	Comments
699-S20-E10 (C4855)	593124.37	117366.18		Center of casing
			120.480	Top of casing, N. edge
			119.731	Brass survey marker
			120.490	Top pump base plate, N. edge
NOTES: Horizontal Datum is NAD83 (91); Vertical Datum is NAVD88; Washington State Plane Coordinates (South Zone); surveyed September 6, 2005.				

2.3 Well Development and Pump Installation

Well 699-S20-E10 was developed on July 25, 2005, at two different intervals using a temporary, 3-horsepower submersible pump. The depth to water was measured at 46.63 feet below top of casing (btc) prior to development. A pressure transducer was installed above the pump and connected to a Hermit datalogger to monitor water level during development. A total of 1,725 gallons of water was pumped during well development and a final turbidity of 1.1 NTU was achieved. Table 2 contains the well development results, including pump intake depth, pump rate, pump run time, drawdown, final turbidity (NTU), pH, and temperature readings.

Table 2. Well Development Information for Well 699-S20-E10

Pump Rate	Pump Intake Depth (ft btc)	Pumping Run Time	Drawdown (ft)	Final Field Readings	Recovery Test Time
33.2 gpm	60.35	27 min	0.35	1.38 NTU, 17.3 C, pH = 7.89	N/A
31.6 gpm	55.25	26 min	0.34	1.10 NTU, 17.7 C, pH = 7.93	N/A

ft btc = Feet below top of casing.
gpm = Gallons per minute.
N/A = Not available.
NTU = Nephelometric turbidity unit.

A dedicated Redi-Flo-3, 0.3-horsepower Grundfos™ submersible sampling pump (model 5SQE90NE) was installed in well 699-S20-E10 on July 25, 2005. The sampling pump intake was set at 53.08 feet bgs, approximately 9.4 feet below the water table, and connected to the surface with 3/4-inch-diameter stainless steel riser pipe.

3.0 Sampling and Analysis During Drilling

This section describes the collection and planned analysis of sediment samples obtained during drilling from well 699-S20-E10.

3.1 Field Screening

The drill cuttings from the well were screened in the field for volatile organics and beta-gamma activity by radiation control technicians and site safety staff. Subsurface spectral gamma logs were also evaluated for gamma-emitting contaminants, and details are discussed in Section 4.3.

Radiation screening of cuttings revealed only natural background levels. No actions were required. Results of field screening for radiation and gases during drilling are indicated on the geologist's borehole logs in Appendix A.

3.2 Sediment Sampling

Sediment grab samples were collected from the borehole at 5-foot intervals from ground surface to total depth. The sediment samples are used for geologic description, digital photography, and for archival. The geologic descriptions of these samples are contained in the wellsite geologist's borehole log in Appendix A. The archive grab samples are contained in 1-pint glass jars, labeled by depth and well number. These jars are stored in the Hanford Geologic Sample Library (HGSL), which is located at Building 3718A/B in the 300 Area. In addition to the archived jars, a small sub-sample from each 5-foot-depth interval was placed in 1-inch by 2-inch plastic sample trays to create a digital photographic log for each well. This digital photographic log is included with the composite log in Section 4.4. These small trays do not include the larger cobbles that may have been in the interval sampled.

In addition to the grab samples, a total of 43 near continuous intact 1-foot-long split-spoon core samples were collected from 7–63 feet bgs. Sample recovery of intact core was good to poor and is summarized on the geologist borehole log in Appendix A and core logs in Appendix B. These split-spoon samples are being tested/analyzed for hydraulic parameters, moisture, and possibly other data. The available results from this testing are provided in Sections 4 and 5. High-resolution digital photographs of the open split-spoon core samples were also recorded. These core photos are available in Appendix B (including the sample chain-of-custody forms). Grain size distribution data and supporting analytical data are provided in Appendix C. All sediment sample depths and/or intervals are documented on the composite log in Section 4.4 and in the geologist's borehole logs located in Appendix A.

3.3 Geophysical Logging

A high-resolution spectral gamma-ray survey and neutron moisture survey were conducted in the borehole by Stoller Corporation to determine the presence and concentration of manmade (process) and naturally occurring gamma-emitting radionuclides, and moisture content of the surrounding sediments. Spectral gamma measurements were captured during a "move-stop-acquire" mode at a rate of 100 seconds per foot. Neutron moisture measurements were collected at 0.25-foot intervals. The geophysical logs have been evaluated and correlated to the geologic log data for each borehole and the results are presented in the composite log in Section 4.4. The detailed geophysical log data report is provided in Appendix C. The log report describes calibration requirements, data processing, contains the borehole log plots, and an interpretation of results.

Well 699-S20-E10 (C4855) was logged on July 18, 2005, using the gamma-ray tool from 61.5 feet bgs to 0.5 foot bgs inside temporary carbon steel casing with an approximate outside diameter of 8 5/8 inches. A repeat section was run from 48.5–38.5 feet bgs. The neutron moisture tool was run from near the water table at 42.5–0.25 feet bgs with a repeat interval from 41.5–31.5 feet bgs. As reported by Stoller Corporation, no manmade radionuclides were detected in the borehole.

4.0 Subsurface Characterization Results

Results from sediment sampling, physical property analysis, geologic descriptions, spectral gamma and neutron moisture logs, and well development for well 699-S20-E10 are correlated to provide an interpretation of the hydrogeologic conditions in the borehole. This section includes a discussion of the criteria used to evaluate and interpret the data. The composite log in Figure 2 illustrates the interpreted hydrogeology developed for this well.

4.1 Physical Properties

Grab samples collected at 5-foot-depth intervals are described on the geologist's borehole log located in Appendix A and selected geologic descriptions of splitspoon core are provided in Appendix B. The wellsite geologist's graphic representation of the borehole log is illustrated in the composite log (Figure 2). The sample quality and formation representativeness of the split-spoon samples is generally poor and incomplete. This is due to coarseness of the drilled formations and the inability to completely clean out the borehole between core runs

Selected core samples from well 699-S20-E10 were analyzed for physical properties, including grain- or particle-size distributions (PSD), and bulk and particle densities (all laboratory analyses performed by Ray Clayton, Michelle Valenta, and Karen Waters-Husted, PNNL). Grain-size data were generated using both wet sieve and hydrometer methods (Gee and Or 2002). Continuous functions were fit to the discrete grain-size distribution data using an Excel-Visual Basic Applications (VBA) program to generate various metrics, reported in Appendix C.

Figure 3 shows examples of grain size data and fitted functions for samples from the Hanford formation at depths of 9.5–10.5 feet bgs and 24.5–25.5 feet bgs from well 699-S20-E10 (top and middle plots, respectively). Also shown in Figure 3 (bottom plot) are grain size data for a backhoe sample collected ~14 feet below the base of the 300 Area North Process Pond (sampling for/by John Zachara and co-workers, PNNL, and sieve data provided by Jason Keller, PNNL), which is 2–3 feet above the water table at this location (Bjornstad 2004). The grain size data from the 24.5–25.5 foot depth and several other depths (see Appendix C) for well 699-S20-E10 have a multi-modal size distribution. The sample from the 9.5–10.5 foot depth, which is one of the coarsest and most well sorted from this borehole, is finer and less well sorted than the backhoe sample from the North Process Pond. This point is discussed in more detail later in this section.

Grain size metrics were computed using both mm and ϕ scales, where ϕ is defined as (Folk 1980)

$$\phi = -\log2(\text{mm}) \quad (1)$$

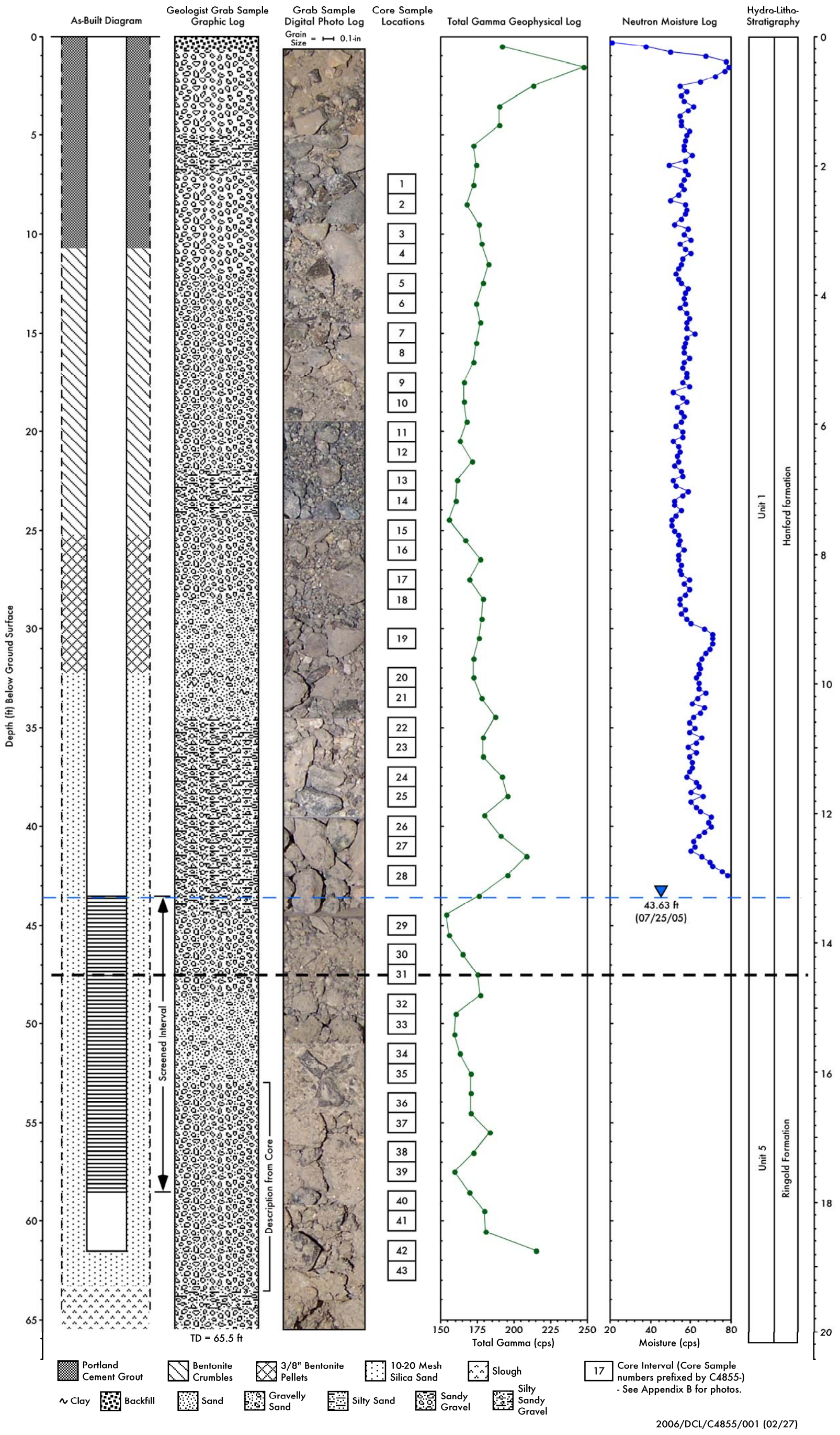

Figure 2. Hydrogeologic Interpretation for Well 699-S20-E10

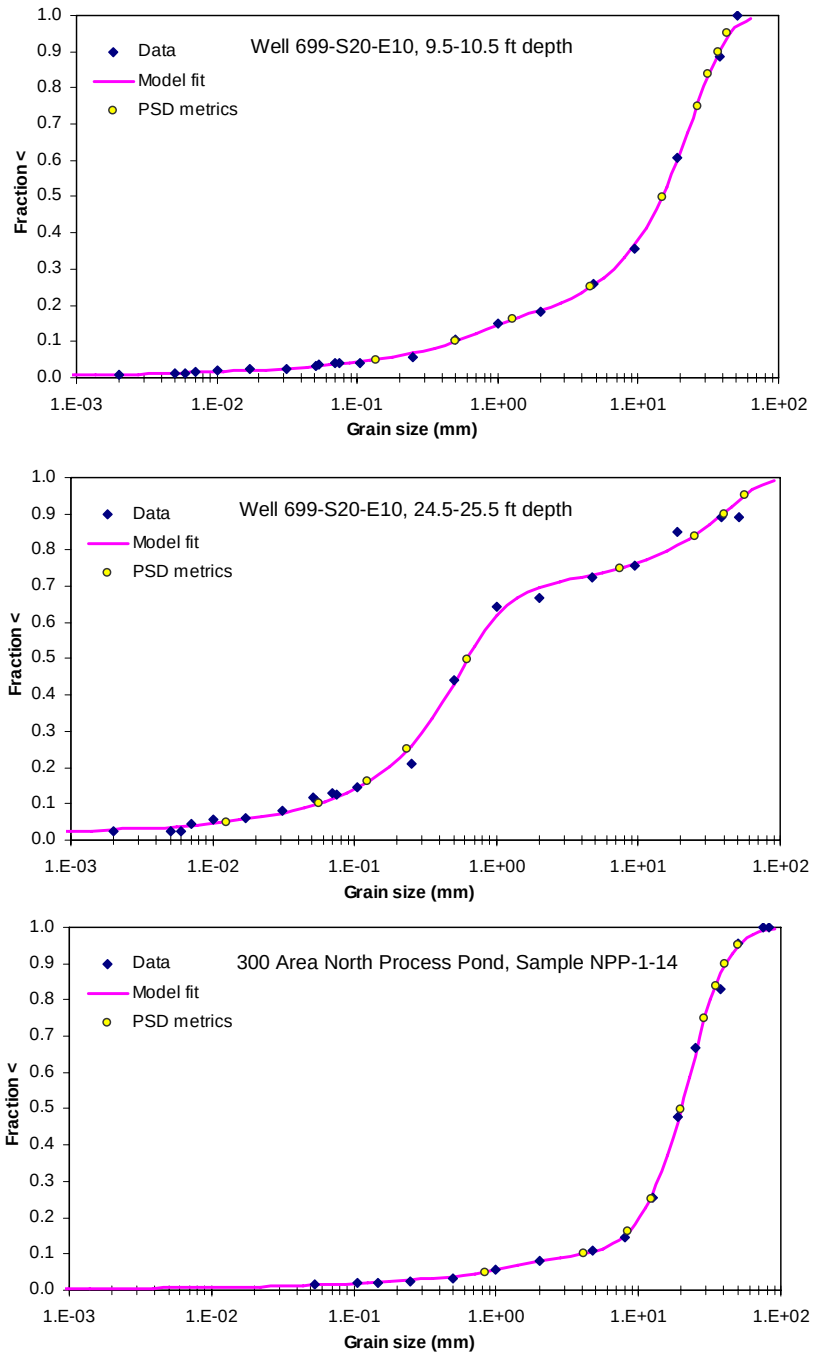

Figure 3. Grain- or Particle-Size Distribution (PSD) Data and Fitted Functions for Samples from 300 Area Well 699-S20-E10 (top and middle plots, respectively) and the North Process Pond (bottom plot). Some samples (e.g., middle plot) from well 699-S20-E10 exhibit multimodal grain size distributions which appear to be the result of the splits-spoon sampling technique. The backhoe sample from the North Process Pond is coarser and more well sorted than the samples from well 699-S20-E10.

The metrics reported in Appendix C include the inclusive graphic standard deviation, σ_{IG}, defined as

$$\sigma_{IG} = \frac{d_{16} - d_{84}}{4} + \frac{d_5 - d_{95}}{6.6} \tag{2}$$

where d is the grain diameter (in ϕ units) and the subscripts (e.g., 16, 84, etc.) refer to the weight percent of the bulk sample with grain sizes smaller than the given diameter. The inclusive graphic standard deviation is a measure of the uniformity or sorting of the grain-size distribution.

Another metric reported in Appendix C is the so-called "fredle index", *F.I.*, defined as (Lotspeich and Everest 1981)

$$F.I. = \frac{d_g}{S_o} \tag{3}$$

where *dg* is the geometric mean grain diameter (in mm) and *So* is another type of sorting index. The geometric mean diameter is defined as (Lotspeich and Everest 1981)

$$d_g = \prod_{i=1}^{j} d_i^{w_i} \tag{4}$$

where *di* is the midpoint diameter (in mm) of particles retained by a given sieve and *wi* is the weight fraction of particles retained by the sieve. *So* is defined as (Lotspeich and Everest 1981)

$$S_o = \sqrt{\frac{d_{75}}{d_{25}}} \tag{5}$$

where *d*75 and *d*25 are the grain diameters (in mm) at the 75th and 25th percentiles of the distribution. Rather than using Equation (4), the values of the *F.I.* that are reported in Appendix C were calculated with *dg* approximated by the graphic mean diameter (Folk 1980)

$$d_g \approx \frac{d_{16} + d_{50} + d_{84}}{3} \tag{6}$$

Grain-size distribution metrics reported in Appendix C were used to estimate saturated hydraulic conductivity using several methods. The simplest formula is due to Hazen (1911)

$$K_s = C d_{10}^2 \tag{7}$$

where *Ks* is the saturated hydraulic conductivity (cm/s), *C* is a constant (taken here to be 1), and *d*10 is the effective grain size (mm) for which 10% (by weight) of the particles in the sample are finer (Freeze and Cherry 1979, p. 350). Hydraulic conductivities were also computed using the well-known Kozeny-Carmen equation (Bear 1972, p. 166)

$$K_s = \left(\frac{\rho_w g}{\mu}\right)\left[\frac{n^3}{(1-n)^2}\right]\left(\frac{d_m^2}{180}\right) \quad (8)$$

where ρw and μ are the density and viscosity of water, respectively, g is the gravitational constant, n is the porosity, and dm is a representative grain size (taken here to be $d50$ [mm]).

Porosity was calculated from

$$n = 1 - \frac{\rho_b}{\rho_p} \quad (9)$$

where ρb and ρp are the bulk and particle densities, respectively.

The Hazen formula uses a single grain-size metric, $d10$, while the Kozeny-Carmen equation uses a measure of the median grain diameter, $d50$, and the porosity of the porous medium. Masch and Denny (1966) showed that the permeability of unconsolidated sands was related to both the median grain diameter, $d50$, and the inclusive graphic standard deviation, σ_{IG}, but they did not develop any predictive formulas for these relationships.

Figure 4 shows the Masch and Denny (1966) data with *Ks* plotted as a function of the median grain diameter, $d50$ (mm), and as a function of $d_{50}/\sqrt{\sigma_{IG}}$. Power function models were also fit to the data. Accounting for grain sorting increases the coefficient of determination (R^2) from 0.7053 to 0.9813. In other words, when $d50$ is used as the predictor variable, 70.5% of the variability in *Ks* is accounted for by a power function relationship between the two variables for this data set. However, when the ratio $d_{50}/\sqrt{\sigma_{IG}}$ is used as a predictor variable, 98.1% of the variability in *Ks* is accounted for by a power function relationship between the two variables. Using measures of both the mean grain diameter and grain sorting clearly results in a substantial improvement in the ability to predict *Ks* from grain size data relative to using only a measure of the median grain diameter.

In general, for unconsolidated sediments that have the same median grain diameter, but different grain-size distributions, a more poorly-sorted sample (larger σ_{IG}) should have lower porosity and lower permeability than a more well-sorted sample (small σ_{IG}). The porosity and saturated hydraulic conductivity should also both be inversely correlated with σ_{IG} or other similar measures of grain sorting.

The type of regression relationship depicted in Figure 4 is frequently referred to in the soils literature as a pedo-transfer function (PTF). Another PTF was developed for *Ks* using sediment samples from the Hanford fm, two other coarse sands, and a gravel sample, by regressing the laboratory-measured values of *Ks* from (vertically-oriented) core samples of the sediments against the ratio $d50(\text{mm})/\sigma_{IG}^2$ (Figure 5). This regression yielded a coefficient of determination, $R^2 = 0.7665$. Using the ratio $d_{50}/\sqrt{\sigma_{IG}}$ as the predictor variable for the data set shown in Figure 5 (as was done previously for the Masch and Denny data set shown in Figure 4), yielded a value of $R^2 = 0.6695$. Thus the optimal value of the exponent on

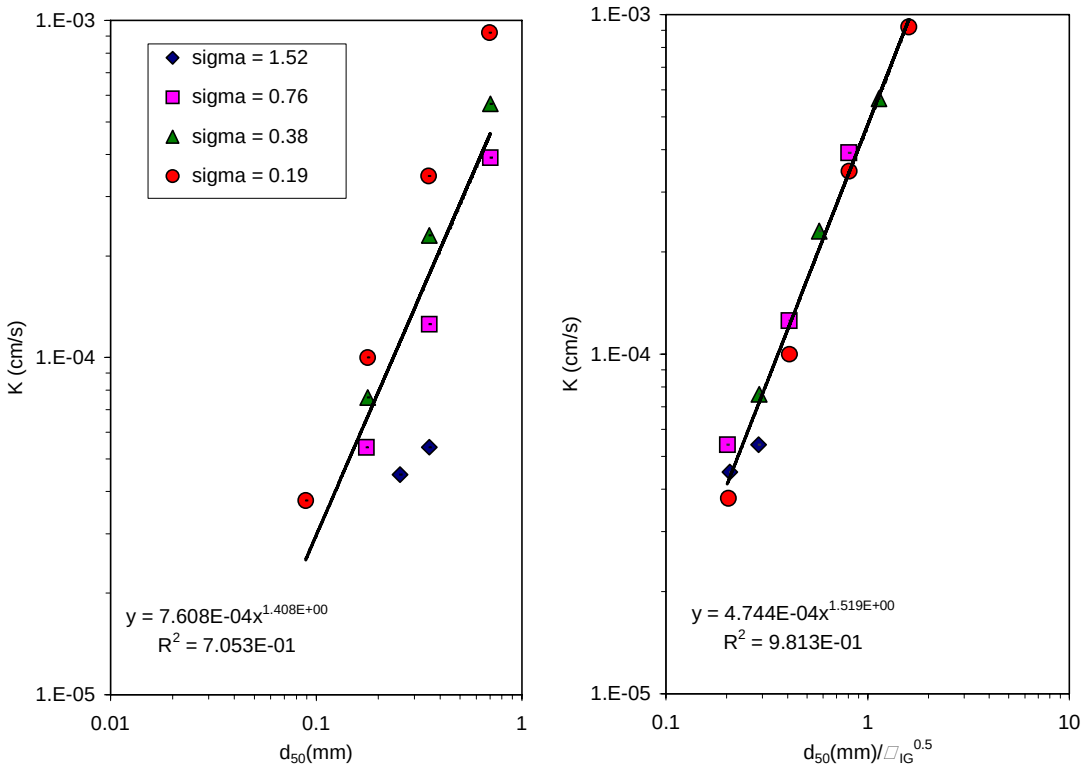

Figure 4. Saturated Hydraulic Conductivity as a Function of the Median Grain Diameter, d50, (left plot) and the Ratio $d_{50} / \sqrt{\sigma_{IG}}$ (right plot) for Data from Masch and Denny (1966)

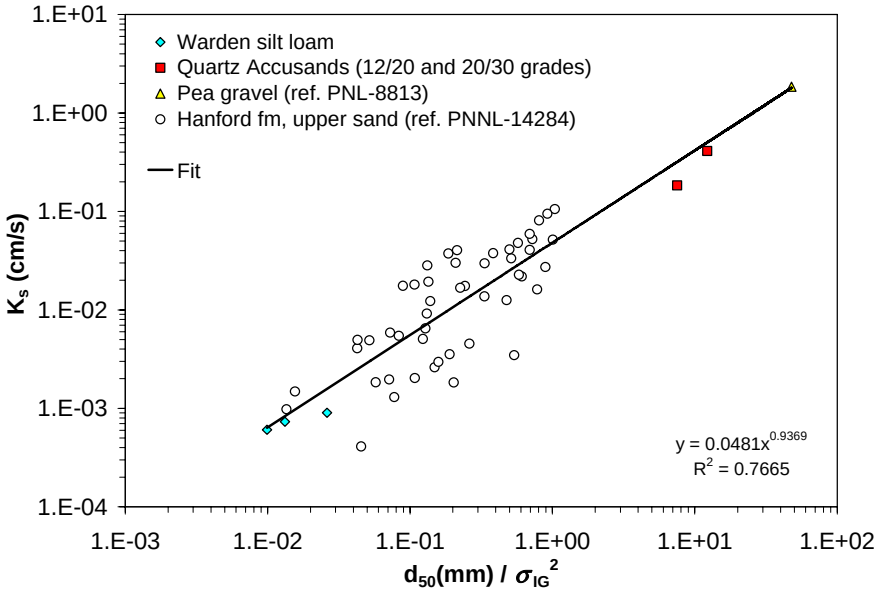

Figure 5. Pedo-Transfer Function (PTF) for Estimating (vertical) *Ks* from Grain-Size Distribution Metrics

the grain sorting coefficient appears to depend on the particular data set, or perhaps on the range of textures of the samples that are used to develop the PTF. The sediments used by Masch and Denny (1966) are relatively fine-textured in comparison to the sediment samples for which data are depicted in Figure 5.

Using the fredle index, *F.I.*, (Equation 3) as the predictor variable for the data set depicted in Figure 5 yielded a value of $R^2 = 0.6689$. Although the fredle index has been used successfully to develop PTFs for *Ks* and other hydraulic parameters based on samples collected from the Army Loop Road Site on the Hanford Central Plateau,[1] the ratio $d50(mm)/\sigma_{IG}^2$ provides better predictions of *Ks* ($R^2 = 0.7665$ vs. 0.6689) for the data set shown in Figure 5. These differences suggest that different metrics may work better as predictors of *Ks* (and/or other hydraulic or physicochemical properties) for different sites, and/or for different hydrogeologic units (e.g., Hanford vs. Ringold fm).

As a final comment regarding the use of PTFs, it should be emphasized that estimates of *Ks* (or any other hydraulic parameters) based on grain-size distributions alone do not account for structure (e.g., layering, stratification, or laminations), grain shape and orientation (e.g., spherical vs. plate-like grains), or physicochemical properties (e.g., calcite cementation) of the in situ sediments. All of these factors may affect the pore-size distributions and connectivity of the pores leading to significantly different hydraulic properties for sediment samples that might have similar grain-size distributions but different structure. This suggests that it may be better to develop PTFs for hydraulic parameters using hydraulic properties measured only on homogenized and repacked samples, rather than "undisturbed" samples, in order to minimize variability due to unaccounted for structure and/or other features noted above. Some of the features noted above and structural information is evident in the high resolution digital images of the cores from the split-spoon samples (cf. photographs in Appendix B). If this information can be quantified, and correlated with grain-size distribution metrics and other data from the bulk sample (or subsamples), then grain-size distributions and other hydraulic or physicochemical properties could potentially be estimated at much higher spatial resolution than that of the bulk sample, and at lower cost.

Table 3 contains measured densities, water contents, calculated porosities, and saturated hydraulic conductivity estimates for the samples from well 699-S20-E10. Figure 6 depicts field volumetric water content and porosity as a function of depth. Figure 7 depicts the estimated *Ks* values. With the exception of two of the deeper samples (from below the 52.5-foot depth) the Hazen formula provides the lowest estimated *Ks* values, which are similar in magnitude to K values determined from pump-test results in the Ringold Formation, while the Kozeny-Carmen equation provides the highest estimates, which are similar to K values determined from 300 Area pump test results for the Hanford formation. The PTF-based *Ks* estimates are generally intermediate in value, and show less overall variability than estimates of *Ks* computed using the other methods. The geometric mean value of the Kozeny-Carmen-based *Ks* estimates is a factor of ~8 greater than the geometric mean value of the Hazen-based *Ks* estimates. The geometric mean value of the PTF-based *Ks* estimates is a factor of ~2 greater than the geometric mean of the Hazen-based *Ks* estimates. Again, note that the PTF-based *Ks* estimates reported here strictly represent the vertical direction due to the vertical orientation of the core samples on which the *Ks* measurements were made.

[1] Personal communication with the authors from AL Ward, PNNL, Richland, Washington.

Table 3. Physical Properties and Saturated Hydraulic Conductivity Estimates for Sediment Samples from Hanford 300 Area Well 699-S20-E10

Depths				Physical Properties				Hydraulic Conductivity Estimates (cm/s)		
Top (ft, bgs)	Bottom (ft, bgs)	Mid-pt (ft, bgs)	Mid-pt (m, bgs)	Particle Density (g/cm^3)	Bulk Density (g/cm^3)	Calculated Porosity	Field Vol. Water Content	Hazen	Kozeny-Carmen	PTF
7.0	8.0	7.5	2.3	2.78	**1.14**	**0.59**	-	5.26E-02	-	8.95E-02
8.0	9.0	8.5	2.6	2.77	1.86	0.33	0.033	5.92E-03	3.80E-01	3.57E-02
9.5	10.5	10.0	3.0	2.79	**0.96**	**0.66**	-	2.47E-01	-	1.16E-01
10.5	11.5	11.0	3.4	2.80	1.78	0.36	0.036	1.28E-02	6.66E-01	3.95E-02
12.0	13.0	12.5	3.8	2.83	1.89	0.33	0.049	3.63E-03	1.37E-01	2.25E-02
13.0	14.0	13.5	4.1	2.72	1.99	0.27	0.045	2.35E-02	3.27E-01	5.38E-02
14.5	15.5	15.0	4.6	2.82	1.93	0.32	0.069	6.89E-03	1.55E-01	3.29E-02
15.5	16.5	16.0	4.9	2.80	1.85	0.34	0.065	4.06E-02	5.30E-01	6.54E-02
17.0	18.0	17.5	5.3	2.78	1.93	0.31	0.064	5.20E-04	2.30E-02	9.44E-03
18.0	19.0	18.5	5.6	2.79	1.96	0.30	0.049	2.23E-02	2.37E-01	4.97E-02
19.5	20.5	20.0	6.1	2.78	1.94	0.30	0.062	1.56E-03	2.12E-02	1.02E-02
20.5	21.5	21.0	6.4	2.75	2.05	0.25	0.053	2.19E-02	3.79E-01	6.86E-02
22.0	23.0	22.5	6.9	2.78	1.94	0.30	0.049	8.16E-04	3.26E-02	1.12E-02
23.0	24.0	23.5	7.2	2.79	1.98	0.29	0.053	5.08E-03	2.29E-01	3.54E-02
24.4	25.5	25.0	7.6	2.76	1.74	0.37	0.069	3.19E-03	2.79E-03	2.62E-03
25.5	26.5	26.0	7.9	2.82	1.91	0.32	0.050	7.16E-02	4.91E-01	6.30E-02
27.0	28.0	27.5	8.4	2.85	2.10	0.26	0.065	2.11E-02	8.53E-02	3.28E-02
28.0	29.0	28.5	8.7	2.79	1.85	0.34	0.051	1.26E-01	5.32E-01	6.57E-02
30.0	31.0	30.5	9.3	2.80	1.93	0.31	**0.005**	1.07E-02	3.28E-01	4.00E-02
32.0	33.0	32.5	9.9	2.78	1.87	0.33	0.076	3.09E-02	1.93E-01	3.86E-02
33.0	34.0	33.5	10.2	2.87	1.97	0.31	0.080	1.39E-02	1.00E-01	2.84E-02
35.5	36.5	36.0	11.0	2.70	2.07	0.23	0.061	5.18E-02	1.52E-01	5.46E-02
38.0	39.0	38.5	11.7	2.75	1.89	0.31	0.062	3.41E-02	4.41E-01	4.77E-02
40.5	41.5	41.0	12.5	2.74	1.83	0.33	0.068	8.74E-02	7.64E-01	7.05E-02
47.0	48.0	47.5	14.5	2.64	2.00	0.24	0.143	1.21E-02	1.69E-01	4.56E-02
48.5	49.5	49.0	14.9	2.73	1.92	0.30	0.137	3.98E-02	2.05E-01	4.53E-02
49.5	50.5	50.0	15.2	2.75	1.99	0.28	0.147	2.00E-02	2.88E-01	5.72E-02
52.0	53.0	52.5	16.0	2.65	2.02	0.24	0.143	2.44E-02	1.95E-01	6.04E-02
54.5	55.5	55.0	16.8	2.63	1.83	0.31	0.098	1.37E-02	2.07E-03	3.93E-03
57.0	58.0	57.5	17.5	2.65	1.97	0.26	0.146	7.20E-02	4.52E-01	8.09E-02
59.5	60.5	60.0	18.3	2.68	2.00	0.25	0.147	2.80E-02	7.51E-02	3.34E-02
			Averages[a]	2.76	1.93	0.30		1.70E-02	1.29E-01	3.34E-02

(a) Arithmetic averages of physical properties (excluding questionable values highlighted in red) and geometric mean values of hydraulic conductivity estimates.

Visual inspection (by BN Bjornstad, PNNL) of color change and basalt content of the sediment samples from well 699-S20-E10 was used to estimate the depth of the Hanford /Ringold fm contact between 47–48 feet (Appendix B). There is a noticeable shift (decrease) in overall porosity and an increase in moisture across this interval as depicted in Figure 6. The field volumetric water content values do increase significantly at depths below ~45.9 feet, but the driller's logs indicate that the water table was encountered at a depth of ~43.6 feet, so higher water contents at these depths are expected.

The volumetric water content values determined from the core samples are significantly greater than those estimated from the original geophysical logging of this well. This discrepancy could be due to differences between the diameter and thickness of the casing used for well 699-S20-E10 relative to the casing that was used for calibration of the neutron-moisture logging system (personal communication with Alan Pearson and Rick McCain, Stoller). The volumetric water content data determined from the core samples were used in conjunction with the raw neutron-moisture probe count data (obtained from Stoller's neutron-moisture logging system, NMLS) to develop a new calibration equation for the neutron-moisture probe. The volumetric water content core data and the original and revised neutron-moisture probe results are depicted in Figure 8. The elevated neutron-moisture contents just below the ground surface are not considered to be accurate, but are instead attributed to drill-pad related disturbance.

Pump test data from the Hanford Site indicate that the saturated hydraulic conductivity of the Hanford fm is generally much greater, by up to several orders of magnitude, than that of the Ringold Formation.[2] Excavations in the North and South Process Ponds within the 300 Area indicate that the lower Hanford and upper Ringold fm sediments are highly reworked (Bjornstad 2004). These factors could make the physical and hydraulic properties of sediments from these two formations less distinct from one another in the 300 Area than they might be elsewhere (e.g., beneath the Central Plateau).

The largest PTF-based (Figure 5) estimate of *Ks* from the 699-S20-E10 well samples is for the sample from the 9.5–10.5 foot depth bgs, with *Ks* = 0.116 cm/s (~100 m/d). The PTF-based *Ks* estimate for the North Process Pond sample is 0.42 cm/s (~363 m/d), a factor of ~3.6 greater than the sample from well 699-S20-E10. The grain size data for these two samples were shown previously in Figure 3 (and in Appendix C). The addition of some fine grains and possible over compaction (e.g., higher density) created during drilling may have resulted in the lower Ks values derived from the well (splitspoon) samples.

Since the PTF-based *Ks* estimates represent the vertical direction, due to the vertical orientation of the core samples on which the *Ks* measurements were made, it is reasonable to assume that *Ks* in the horizontal direction is a factor of 10 greater than the vertical *Ks* estimates, which yields *Ks* values (1,000 and 3,630 m/d) that agree well with pump test data for the Hanford formation in the 300 Area (Schalla et al. 1988).

One final comment should be made regarding the use of grain-size distribution data to estimate hydraulic and/or physiochemical properties for 300 Area sediments. As noted previously, and as depicted in Figure 3, the backhoe sample collected ~14 feet below the base of the North Process Pond is coarser and better sorted than any of the split-spoon samples from well 699-S20-E10. Furthermore, several of the samples from well 699-S20-E10 had very large cobbles in them, approaching the diameter of the core barrel (see photographs in Appendix B). These samples also may contain some pulverized and broken

[2] Personal communication to the authors from Paul Thorne, PNNL, Richland, Washington.

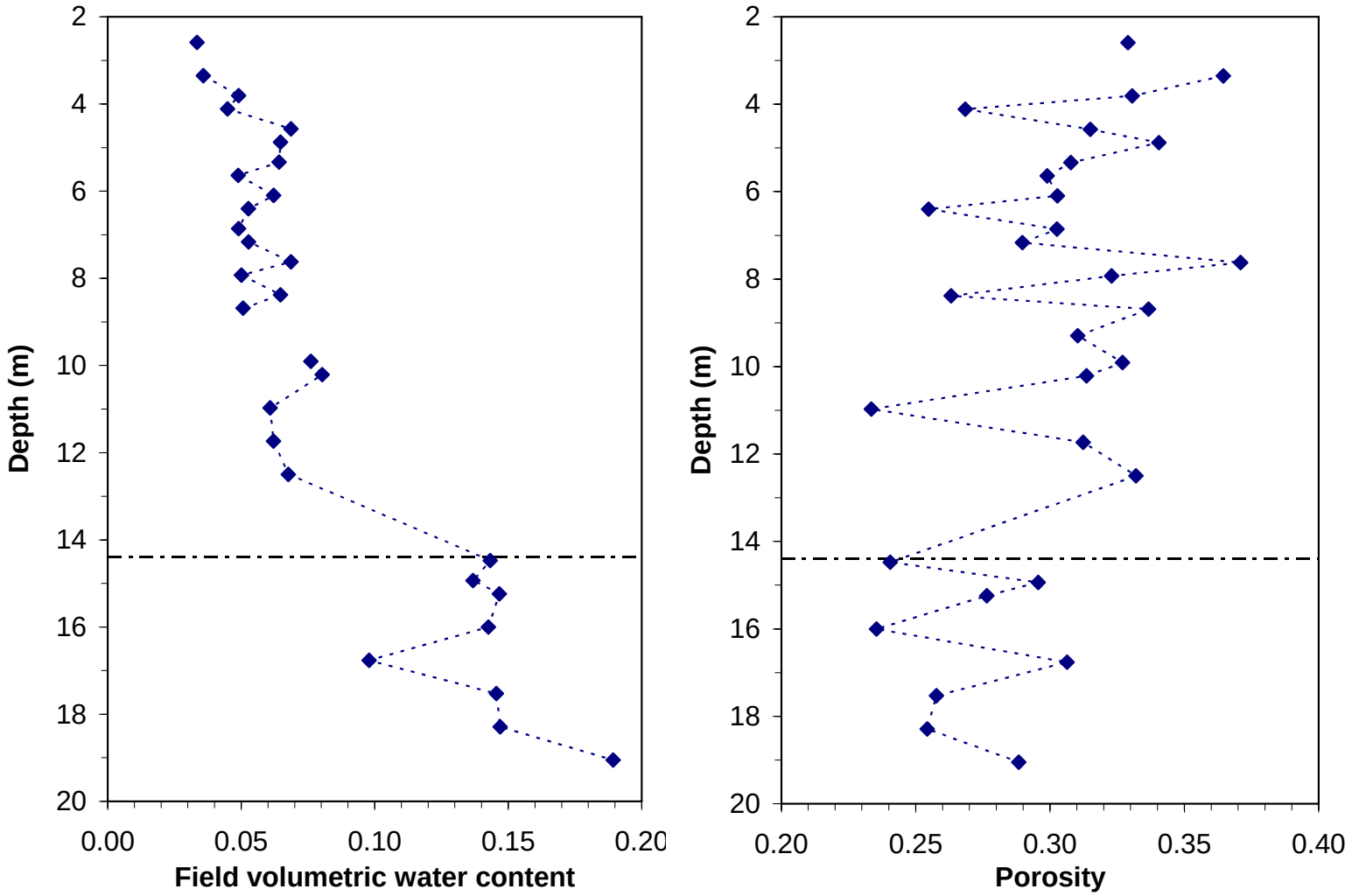

Figure 6. Field Volumetric Water Content and Porosity Values for Core Samples from Well 699-S20-E10. Dashed-dotted lines show estimated location of Hanford fm – Ringold fm contact.

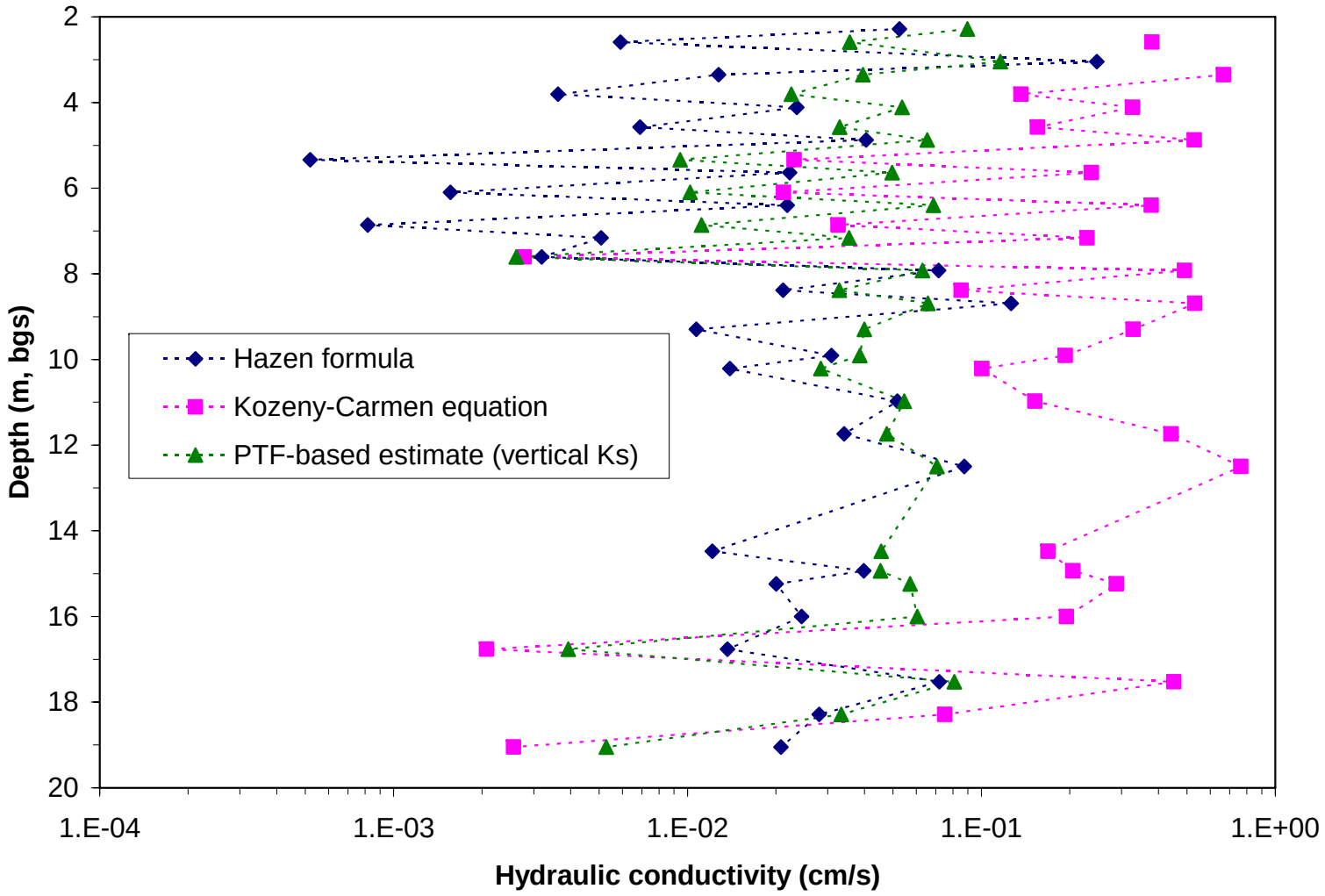

Figure 7. Estimated Values of Saturated Hydraulic Conductivity for Core Samples from Well 699-S20-E10

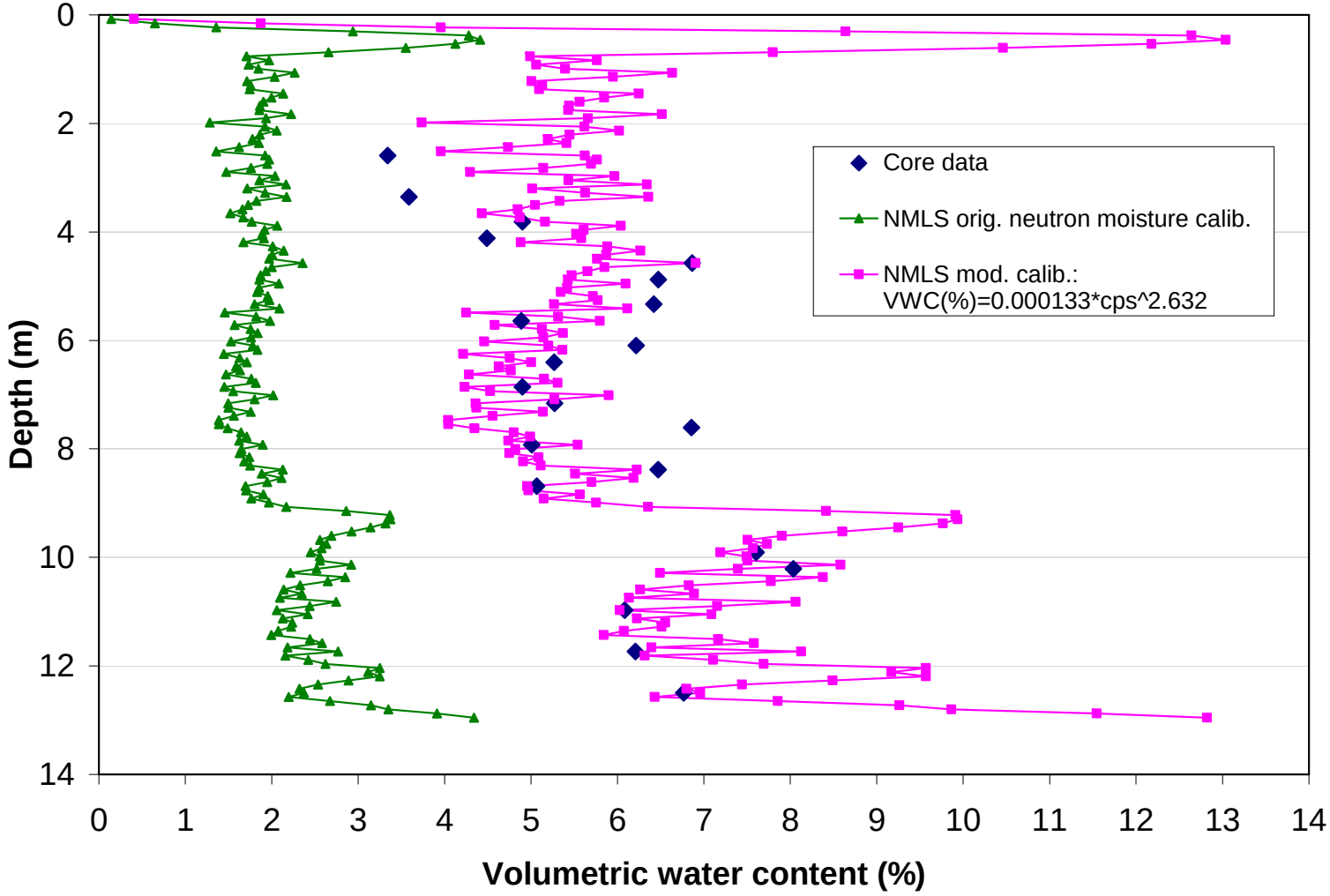

Figure 8. Original Neutron-Moisture Probe Data (from Stoller's NMSL), Core Data, and NMLS Count Data Calibrated to Core Data

clasts, and in come cases contain a large percentage of slough that could not be removed by bailing. This suggests the possibility that split-spoon samples of the gravel dominated sediments from the 300 Area (and other near-river sites) may be biased toward smaller grain sizes due to fracturing and crushing of larger clasts during splitspoon sampling. On the other hand, it is known that large volumes of effluent were disposed to the process ponds for many years and the rapid change in the water table due to the river fluctuations created a washing machine like effect. These processes could have washed out a portion of the fines in the near-saturated sediments in the vicinity of the water table. Another equally plausible possibility is that the original sediments deposited in the vicinity of the North Process Pond are actually coarser than they are at the location of well 699-S20-E10. Whatever the case may be, larger diameter core samples will be collected as part of a limited field investigation (LFI) using a sonic drilling method. Comparison of data from these larger diameter core with data from other nearby wells for which split-spoon core samples were collected should help determine if there is a split-spoon sampling bias for samples collected in the 300 Area.

The grain-size distribution data from well 699-S20-E10 have been added to a database of grain-size distribution data representing approximately 340 samples from 17 boreholes and other miscellaneous sampling locations from in and around the 300 Area. These data will be supplemented with additional data from new wells that are drilled as part of the LFI (DOE 2005a). The physical and hydraulic property data are being used to assist in the delineation of sedimentary facies and will ultimately be used for parameterization of a three-dimensional vadose zone and groundwater flow and reactive transport model for the 300 Area.

4.2 Sediment Digital Photographic Log

A digital photographic log of chip tray samples is included in the composite log for the well (Figure 2). Grab samples from the cuttings return line were collected for lithologic descriptions documented in the borehole log in Appendix A, for sediment archives, and for digital photography. The photographic log presentation, compiled from the 1-inch by 2-inch chip tray samples can provide a qualitative visual tool that can reveal changes in major lithologic intervals (i.e., grain size, color, and relative moisture). However, the interpretative value of these photographic logs is limited by the sample collection technique, discussed earlier, and sample container size. Core samples which were digitally photographed and presented in Appendix B provide a more realistic view of the sediment. Even though these core were disturbed, the digital photography did preserve the overall color, which is useful for differentiating Hanford formation sediment from Ringold Formation.

4.3 Spectral Gamma and Neutron Moisture Logging

Based on processing by Stoller Corporation, no manmade gamma-emitting radionuclides were detected in the well (details in Appendix C).

These data are used in the geology interpretation presented in Section 4.4. No discussion of the shallow gamma ray inflections less than 5 feet bgs is included because the inflections are difficult to interpret, reflecting dramatic changes due to shallow drill pad material, multiple casing strings, increased moisture, and/or recently deposited loose sediment.

For well 699-S20-E10 (C4855), the gamma log plots of the naturally occurring gamma-emitting radioisotopes (potassium, uranium, and thorium) indicate there are distinct activity changes marked by a

low reading at approximately 25 feet bgs and the increasing inflection points from approximately 26 to 42 feet bgs. These changes correlate to either lithologic features such as grain size gradations in the vadose zone and/or contrasting lithologic intervals near the water table (Figure 2).

A review of the neutron moisture log reveals a distinct moisture increase beginning at approximately 30 feet bgs and continuing sporadically to the bottom of the log (water table). No water was added to the borehole during drilling, which suggests that this moisture increase is a natural measurement. Except for a small amount of silt or clay described in the geologist's borehole log, there does not appear to be a distinguishable lithologic change to explain this moisture increase. Overall, natural moisture (as calculated by the Stoller Corp ranges from about 2% to nearly 4% throughout the vadose interval. The moisture results are viewed as qualitative for the purpose of distinguishing areas of relative moisture change. Actual moisture values derived from core sample measurements appear to be slightly higher based on the discussion and correction provided in Section 4.1.

4.4 Composite Log

A composite log has been assembled for well 699-S20-E10 using the well as-built diagram, well development information, descriptions of the sediment and the representative graphic log, the digital grab sample photographic log, and the geophysical logs. Stratigraphic contacts and key lithologic changes are identified where possible. The composite log for the new well is illustrated in Figure 2. Recent surficial Holocene sediments composed of reworked Hanford and eolian deposits overlie the area and range in thickness from one foot up to approximately 20 feet bgs.

With the exception of recent Holocene surficial deposits, the hydrogeologic Unit 1 (Hanford formation) of Thorne et al. (1993) comprises the entire vadose zone and the upper portion of the unconfined aquifer in the well. This interval is approximately 46 feet thick (from approximately 1 to 47 feet bgs), and is composed of unconsolidated sediments ranging in grain size from cobble to pebble gravel, coarse to fine grained sand, silty sand, and silt. There are no distinguishable hydrostratigraphic changes within the vadose zone. At a depth of approximately 25 feet bgs, there does appear to be a reduction in grain size that is present. A slight increase in moisture is noticeable at about 30 feet bgs based on the neutron moisture log, which may or may not be associated with the slight increase in silt or clay described in the geologist's borehole log. A zone of mixing between the Hanford and Ringold Formation sediments is interpreted between approximately 40 and 48 feet bgs.

The Ringold Formation Unit 5 contact with the overlying Hanford formation is based on a distinct change in basalt content and color at ~47 feet bgs which can be seen in core photographs (Appendix B). This coarse, silty, sandy gravel unit comprises the lower portion of the uppermost unconfined aquifer beneath the 300-FF-5 OU.

Contacts can sometimes also be identified by the inflections and general curve fitting from the spectral gamma and neutron moisture logs but no distinguishable changes are visible in the logs for this well. Where these data are useful the inflections are dashed on the respective composite logs to imply a unit boundary or contact.

The total thickness of the uppermost unconfined aquifer was not determined in new well 699-S20-E10 but more details about the aquifer thickness and groundwater conditions are available in the *Operations and Maintenance Plan for the 300-FF-5 Operable Unit* (DOE 2002).

5.0 Estimation of Recharge from Well 699-S20-E10 (C4855) Sediment Samples Using Chloride Mass Balance

Recharge, defined as infiltrating water that reaches the water table, is the primary mechanism driving the transport of wastes residing in the unsaturated zone to groundwater (Ward et al. 1997; DePaolo et al. 2004). Performance assessments of remediation and disposal alternatives are often highly sensitive to the recharge assigned for the area of interest, illustrating the importance of accurate recharge estimates. In support of efforts to reduce uncertainties in recharge estimates for the Hanford Site, sediment core samples from well 699-S20-E10 were analyzed for matric potential, water content, and pore water anions for purposes of estimating recharge conditions at the well location using the chloride mass balance (CMB) method. In addition, grab samples collected to a depth of 3.28 feet prior to construction of the drilling pad (sampling performed by Ray Clayton of PNNL) were also measured for water content and pore water anions. The estimated present day recharge rate (R) based on the data presented below is R = 1.89 mm yr^{-1}.

Matric potential was measured using the filter paper technique described in Methods of Soil Analysis, Part 4 (SSSA, 2002). Filter paper was placed in contact with the core sediment, the core was resealed, and the sample allowed to equilibrate for several days. After filter paper analysis was complete, the cores were opened for collection of moisture content and anion subsamples of approximately 100 g each. Water content was measured using standard convective oven-drying procedures described by SSSA (2002). Anion extraction followed the procedures outlined in Methods of Soil Analysis, Part 3 (ASA, 1996). The extraction of anions from the field moist sediment samples was performed by adding deionized water to the samples in a 1:1 water to soil ratio by weight. The amount of deionized water needed to obtain a 1:1 extract was determined from the separate moisture content samples. The anion sediment samples were agitated on an orbital shaker for one hour and then allowed to sit overnight. The supernatant solution was then filtered through a 0.45 μm membrane syringe filter and the filtrate collected for analyses using ion chromatography. All analysis was performed at the PNNL Radiochemical Processing Laboratory by Ray Clayton and Michelle Valenta.

The subsequent calculation of chloride concentration in the soil pore water, Cl_s (mg Cl^- L^{-1} soil solution), is:

$$Cl_s = \frac{Cl_{ext}}{w} D \tag{10}$$

where Cl_{ext} (mg Cl^- L^{-1}filtrate) is the chloride concentration in the extract, w is the gravimetric water content of the bulk sample, and D is the dilution ratio or the mass ratio of water to dry soil (1:1). The core subsamples collected for anion analysis were limited to particle diameters less than 19-mm. To correct Cl_{ext} to incorporate the bulk sample (>19-mm and <19-mm), Cl_{ext} was multiplied by the fraction of the bulk sample that is less than 19-mm. While this discussion is limited to chloride, the calculation of the concentration of other analyzed anions in the soil pore water follows the same relationship described by Equation (10).

With certain assumptions, such as piston flow chloride transport, knowing Cl_s allows for a recharge rate, R (mm yr^{-1}), to be calculated using a mass balance approach described by:

$$P \times Cl_p = R \times Cl_s \tag{11}$$

where P is the average annual precipitation (mm yr^{-1}) and Cl_p is the average chloride deposition rate, including both wet and dry fallout. Murphy et al. (1996) estimated for the Hanford Site Cl_p ranges from 0.220 to 0.230 mg L^{-1}. For this work we used the median Cl_p value of 0.225 mg L^{-1}. A P of 190 mm yr^{-1} was used following the work of Gee et al. (2005) who estimated that value for a nearby lysimeter site.

Table 4 gives the water content for the bulk samples and subsamples along with the fraction of the bulk sample with a mean particle diameter less than 19 mm. The grab samples were restricted to particle diameters less than 19 mm when collected. While the soil to a depth of approximately 0.75-meter did not visibly contain particles greater than 19-mm, the soil at depths greater than 0.75-meter is composed of gravels and cobbles (Figure 9), making the grab samples taken from the 0.75 to 1.0-meter depth interval not true bulk samples. Review of the fraction of particles less than 19 mm in diameter shows that there is not a consistent trend in gravel throughout the profile and that the profile is rather heterogeneous. Table 5 presents the suite of anion concentrations of the sample sediment pore water, corrected for bulk sample composition. Review of the depth profile of Cl_s shown in Figure 10 reveals a slight increase in Cl_s near the soil surface. This is often the case in arid regions in which chloride is concentrated near the surface due to plant transpiration or upward water movement resulting from evaporative drying. A somewhat more constant Cl_s profile exists from roughly 0.5 to 6 meters bgs before a large Cl_s bulge arises in the profile and continues to approximately 12 meters bgs, reaching a maximum Cl_s of 291 mg L^{-1}. This bulge may represent past recharge conditions or it was thought that the bulge may be the product of water table fluctuations. The chloride concentration of a groundwater sample collected soon after the well was completed does not support a fluctuating water table as the cause because the groundwater chloride was measured to be 16.2 mg L^{-1} or nearly 18 times less than the maximum measured Cl_s. Furthermore, examination of water table elevation data collected from nearby wells and spanning over 50 years does not suggest that the water table in the area fluctuated enough for groundwater to intrude into the area of the bulge. A change in recharge conditions is a plausible answer given that the well is located in an active dune in which surface conditions that control recharge, such as soil texture and vegetation, are continually changing. In addition, the occurrence of range fires that alter the vegetative community may play a role in changing recharge conditions.

To determine the value of Cl_s to apply in the calculation of recharge using Equation (11), the cumulative chloride content with depth was plotted against the cumulative water content at the same depth (Figure 11). Resulting slopes from this plot equals the inverse of Cl_s for that depth interval. The straight line segments represent times of constant recharge conditions and slope changes signify changes in recharge conditions. Included in Figure 11 are the Cl_s and calculated R for that time segment as well as the residence time represented by that Cl_s before the change in slope. Current recharge conditions are represented by the straight line segment nearest to the surface, providing an estimated R of 1.89 mm yr^{-1}. This is less than the recharge of 4.01 mm yr^{-1} estimated from CMB by Murphy et al. (1996) for a primarily grass covered stabilized dune and slightly larger than the recharge of 1.11 mm yr^{-1} estimated by Fayer and Szecsody (2004) for a dune vegetated with deep rooted shrubs. The vegetation around well 699-S20-E10 is predominately annual and perennial grasses (Figure 12) with the surface soil classified as

a Rupert Sand (Hajek 1966). As a note of interest, the *R* calculated from the straight line segment located at the depth of the Cl_s bulge, potentially representing past recharge conditions, is 0.18 mm yr^{-1}.

Table 4. Bulk Sample Water Content, Subsample Water Content, and Fraction of the Bulk Sample with a Mean Diameter Less Than 19-mm

Sample Number	Depth bgs, ft	Depth bgs, m	Bulk Sample Moisture Content g g^{-1}	Subsample Moisture Content g g^{-1}	Fraction of Bulk Sample Less Than 19-mm
C4855-0-10[(a)]	0-0.8	0-0.2	-	0.027	-
C4855-10-19[(a)]	0.8-1.6	0.2-0.5	-	0.025	-
C4855-19-26[(a)]	1.6-2.2	0.5-0.7	-	0.028	-
C4855-30-35[(a)]	2.5-2.9	0.8-0.9	-	0.027	-
C4855-38-41[(a)]	3.2-3.4	0.9-1.0	-	0.021	-
C4855-1	7-8	2.1-2.4	0.019	0.019	0.547
C4855-2	8-9	2.4-2.7	0.018	0.018	0.638
C4855-3	9.5-10.5	2.9-3.2	0.016	0.016	0.606
C4855-4	10.5-11.5	3.2-3.5	0.020	0.024	0.644
C4855-5	12-13	3.7-4.0	0.026	0.021	0.804
C4855-6	13-14	4.0-4.3	0.023	0.041	0.620
C4855-7	14.5-15.5	4.4-4.7	0.036	0.030	0.885
C4855-8	15.5-16.5	4.7-5.0	0.035	0.045	0.806
C4855-9	17-18	5.2-5.5	0.033	0.034	0.877
C4855-10	18-19	5.5-5.8	0.025	0.085	0.786
C4855-11	19.5-20.5	5.9-6.2	0.032	0.034	0.843
C4855-12	20.5-21.5	6.2-6.6	0.026	0.028	0.576
C4855-13	22-23	6.7-7.0	0.025	0.023	0.770
C4855-14	23-24	7.0-7.3	0.027	0.029	0.673
C4855-15	24.5-25.5	7.5-7.8	0.039	0.040	0.850
C4855-16	25.5-26.5	7.8-8.1	0.026	0.030	0.682
C4855-17	27-28	8.2-8.5	0.031	0.029	0.732
C4855-18	28-29	8.5-8.8	0.027	0.035	0.674
C4855-19[(a)]	30-31	9.1-9.4	0.002	0.032	0.659
C4855-20	32-33	9.8-10.1	0.041	0.039	0.785
C4855-21	33-34	10.1-10.4	0.041	0.042	0.829
C4855-22	34.5-35.5	10.5-10.8	-	-	-
C4855-23	35.5-36.5	10.8-11.1	0.029	0.035	0.638
C4855-24	37-38	11.3-11.6	-	-	-
C4855-25	38-39	11.6-11.9	0.033	0.037	0.615
C4855-26	39.5-40.5	12.0-12.3	-	-	-
C4855-27	40.5-41.5	12.3-12.6	0.037	0.047	0.616
C4855-28	42-43	12.8-13.1	-	-	-

(a) Anion moisture content sample used for *w* in the calculation of Cl_s.

Figure 9. Soil Sampling Pit Used for Collecting Near Surface (<1-m) Grab Samples. Note the abundance of gravels and cobbles beginning at a depth of approximately 0.75 meter.

To further support drainage conditions at the site, the matric potential profile is presented in Figure 13. While the matric potential data shows some scatter, the overall trend is higher (less negative) matric potential with depth, trending towards unit gradient conditions, indicating gravity drainage. The sharp decrease in matric potential above 4 meters implies potential upward water flow at the time of sampling, indicative of the dry summer conditions. This agrees with the presence of the Cl_s bulge identified near the surface.

The estimated recharge rate(s) at this site can be used as an upper boundary condition for undisturbed areas in the subsurface flow and reactive transport models that are being developed for the 300 Area in support of the record of decision regarding the 300-FF-5 OU.

Table 5. Pore Water Anion Concentrations for Well 699-S20-E10 Core Samples, Corrected for Bulk Sample Composition

Sample Number	Depth bgs, ft	Depth bgs, m	Chloride mg L^{-1}	Fluoride mg L^{-1}	Bromide mg L^{-1}	Nitrite mg L^{-1}	Nitrate mg L^{-1}	Sulfate mg L^{-1}	Phosphate mg L^{-1}
C4855-0-10	0-0.8	0-0.2	56.91	5.26	ND	13.83	146.41	129.06	93.59
C4855-10-19	0.8-1.6	0.2-0.5	60.91	5.92	ND	9.57	121.92	139.88	81.10
C4855-19-26	1.6-2.2	0.5-0.7	21.03	11.26	ND	ND	58.98	27.67	60.74
C4855-30-35[(a)]	2.5-2.9	0.8-0.9	14.28	24.98	ND	ND	37.75	127.44	19.77
C4855-38-41[(a)]	3.2-3.4	0.9-1.0	6.79	24.92	ND	ND	14.10	73.18	29.32
C4855-1	7-8	2.1-2.4	58.30	16.92	ND	ND	ND	418.52	9.11
C4855-2	8-9	2.4-2.7	31.05	25.27	ND	ND	ND	311.04	11.88
C4855-3	9.5-10.5	2.9-3.2	16.72	18.58	ND	ND	ND	154.61	11.75
C4855-4	10.5-11.5	3.2-3.5	22.43	19.64	ND	ND	ND	182.13	13.07
C4855-5	12-13	3.7-4.0	26.66	22.17	ND	ND	ND	210.84	7.30
C4855-6	13-14	4.0-4.3	14.85	19.52	ND	ND	ND	119.69	5.15
C4855-7	14.5-15.5	4.4-4.7	21.28	18.40	ND	ND	ND	221.57	4.48
C4855-8	15.5-16.5	4.7-5.0	26.93	22.08	ND	ND	26.88	462.10	6.92
C4855-9	17-18	5.2-5.5	44.56	30.24	ND	ND	ND	719.03	6.97
C4855-10	18-19	5.5-5.8	41.65	18.85	ND	ND	2.11	1049.55	8.11
C4855-11	19.5-20.5	5.9-6.2	53.20	17.89	ND	ND	ND	923.34	4.80
C4855-12	20.5-21.5	6.2-6.6	75.73	8.18	ND	ND	38.84	1040.45	2.76
C4855-13	22-23	6.7-7.0	153.19	18.49	ND	ND	13.95	1571.37	21.28
C4855-14	23-24	7.0-7.3	169.61	11.33	1.28	ND	57.44	1383.37	18.77
C4855-15	24.5-25.5	7.5-7.8	291.36	6.36	2.69	ND	ND	1018.84	4.41
C4855-16	25.5-26.5	7.8-8.1	233.51	6.17	2.08	ND	7.80	717.20	7.37
C4855-17	27-28	8.2-8.5	264.00	6.73	1.93	ND	ND	907.17	2.18
C4855-18	28-29	8.5-8.8	198.29	6.41	1.83	ND	ND	542.57	7.55
C4855-19	30-31	9.1-9.4	277.59	13.09	2.44	ND	ND	880.77	23.37
C4855-20	32-33	9.8-10.1	129.35	8.62	1.21	ND	ND	430.65	21.86
C4855-21	33-34	10.1-10.4	116.69	7.42	1.03	ND	11.45	287.44	12.32
C4855-23	35.5-36.5	10.8-11.1	89.27	8.15	ND	ND	3.94	315.25	18.15
C4855-25	38-39	11.6-11.9	54.78	7.11	ND	ND	ND	178.03	11.40
C4855-27	40.5-41.5	12.3-12.6	37.53	6.10	ND	ND	ND	159.48	1.51

ND = nondetect.
(a) Pore water concentrations not corrected for bulk sample composition.

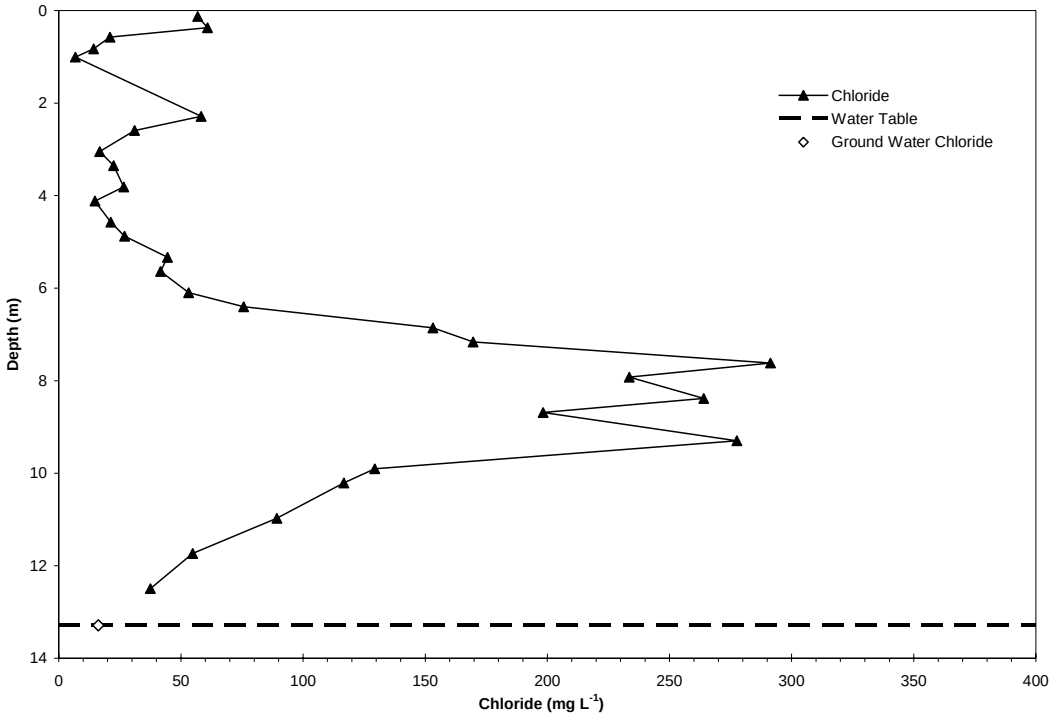

Figure 10. Pore Water Chloride Profile and Groundwater Chloride Concentration for Well 699-S20-E10

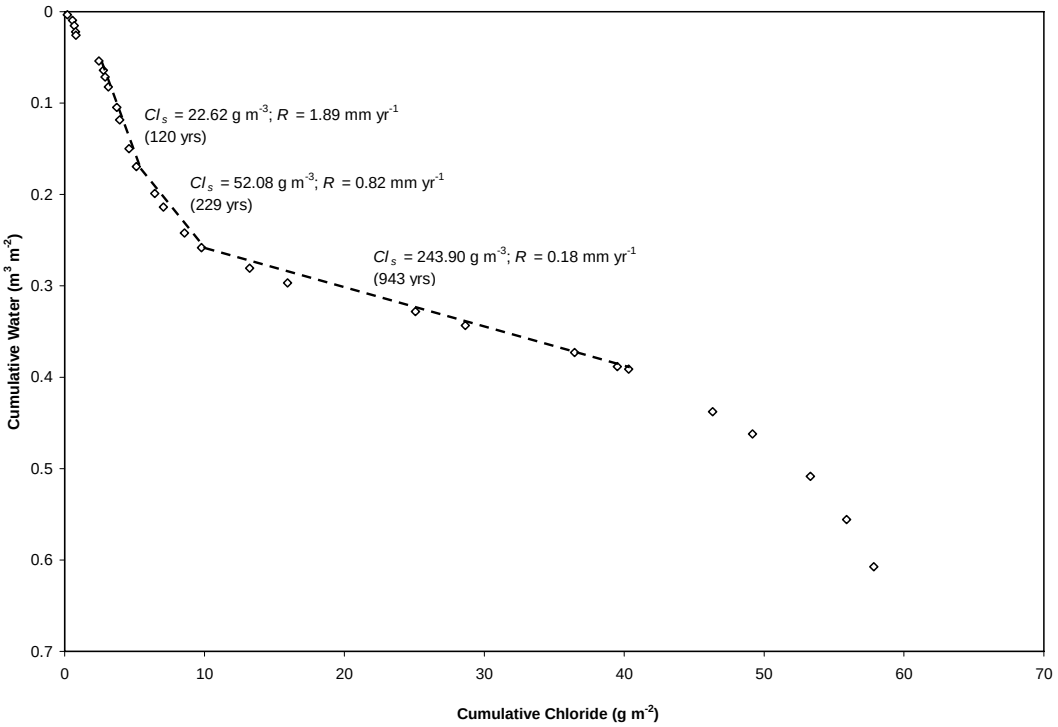

Figure 11. Cumulative Water Content and Cumulative Chloride with Increasing Depth. The straight lines indicate periods of constant recharge conditions with the slopes of each line representing Cl_s^{-1} for that time period. The number in parenthesis is the chloride residence time at each line segment break.

Figure 12. Vegetative Conditions at the Location of Well 699-S20-E10 Prior to Well Installation. Photo is taken looking south.

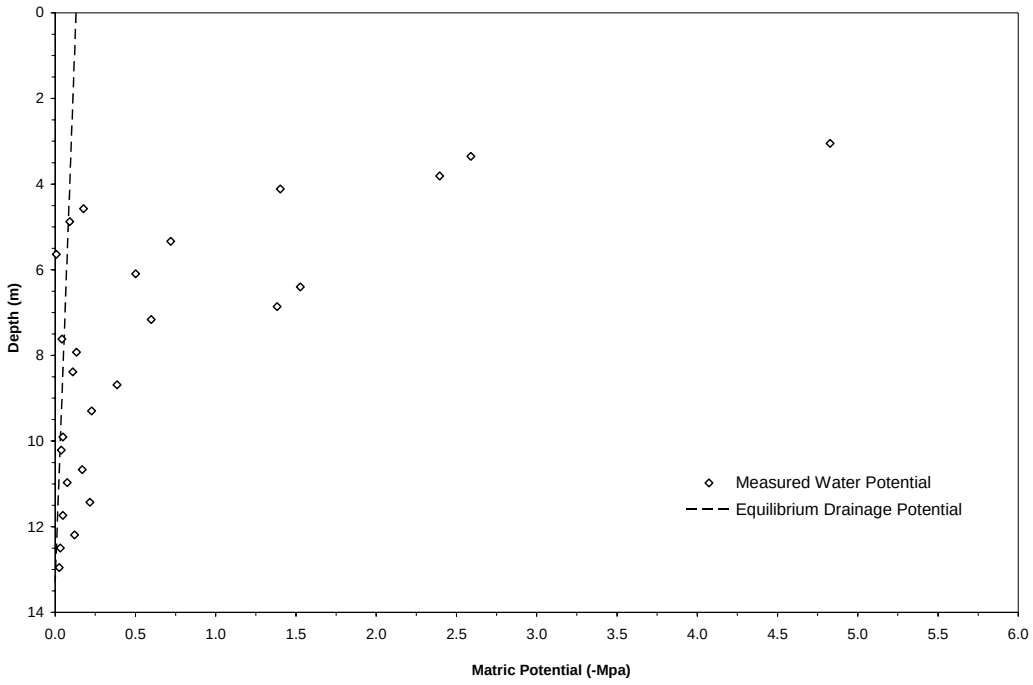

Figure 13. Matric Potential Profile for Well 699-S20-E10

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Appendix A

Geologic Logs, Well Construction, and Completion Documentation

WELL SUMMARY SHEET

Start Date: 7/12/05
Finish Date: 7/25/05
Page 1 of 2

Well ID: C4855
Well Name: 699-S20-E10
Location: 300FF-5 o.u.-m.w., NW of 300 Area
Project: 300-FF-5 Monitoring Well
Prepared By: N. Bowles
Date: 7/27/05
Reviewed By: L.D. Walker
Date: 8/4/05
Signature:
Signature:

CONSTRUCTION DATA

Description	Diagram
Protective Surface Casing: 6.5" ss set	
Temporary Drive Casing: 8 5/8" C.S., 0 → 64.5'	
Portland Cement Grout: 0' → 10.80'	
Bentonite Crumbles: 10.80' → 25.22'	
Permanent Well Casing: 4" Sch. 5 304L S.S., +2.00' → 43.57'	
3/8" Bentonite Pellets: 25.22' → 32.18'	
Colorado Silica Sand: 10-20 Mesh, 32.18' → 63.25'	
Wellscreen: 4" 304L SS., 0.020" slot, cont. wirewrap, 43.57' → 58.56'	
Tailpipe/Sump: 4" Sch. 5 304L S.S., w/ welded endcap, 58.56' → 64.56'	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
0		0' → 0.7': gravel drill pad
		0.7' → 5': gravel (G)
		5' → 7': silty sandy gravel (msG)
		7' → 12': gravel (G)
10		
		12' → 22': sandy gravel (sG)
20		
		22' → 27': silty sandy gravel (msG)
		27' → 27.5': sandy gravel (sG)
		27.5' → 28.3': sand (S)
30		28.3' → 32': slightly silty gravelly sand ((m)gS)
		32' → 34.5': sandy gravel (sG)
		34.5' → 44.5': silty sandy gravel (msG)
40		
		Water Level = 43.63' (7/25/05)
		44.5' → 48.5': sandy gravel (sG)
50		48.5' → 53': gravelly sand (gS)
		53' → 53.5': sandy gravel (sG)
		53.5' → 58': sand (S)
		58' → 58.5': gravelly sand (gS)
		58.5' → 63.5': sand (S)

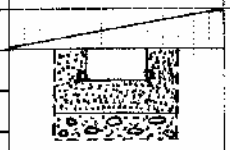
A-6003-643 (03/03)

WELL SUMMARY SHEET

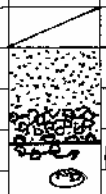
Start Date: 7/12/05
Finish Date: 7/25/05
Page 2 of 2

Well ID: C4955
Well Name: 699-S20-E10
Location: 300-FF-5 au.-M.W., NW of 300 Area
Project: 300-FF-5 Monitoring Well
Prepared By: N. Bowles
Date: 7/22/05
Reviewed By: L. D. Walker
Date: 8/4/05
Signature: N. Bowles
Signature: L. D. Walker

CONSTRUCTION DATA

Description	Diagram
Total Length of S.S. well = 63.56' Natural Backfill/Slufft: 63.25' → 64.5' Notes: - All depths are in feet below ground surface - All temporary casing was removed from ground	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description
60		63.5' → 64': silty sandy gravel (msG) 64' → TD.: sandy gravel (sG) TD = 64.5' Ringold E @ ~64'
70		

A-6003-643 (03/03)

WELL CONSTRUCTION SUMMARY REPORT

Start Date: 7/12/05
Finish Date: 7/25/05
Page 1 of 1

Well ID: C4855	Well Name: 699-S20-E10	Approximate Location: 300-FF-5 O.U. N.W. NW of 300 Area
Project: 300-FF-5 (Monitoring Well		Other Companies: FH, BSE, GRAM
Drilling Company: Blue Stars Env. (BSE)		Geologist(s): L. Brouillard, M. Caron, N. Bowles
Driller: M. Wraggis	License #: WA 1909	

TEMPORARY CASING AND DRILL DEPTH			DRILLING METHOD	HOLE DIAMETER (in.) / INTERVAL (ft)
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	~~Auger:~~ (05)	Diameter ____ From ____ to ____
8" Carb. Steel, Rev. Thd.	0' - 64.5'	8 5/8" / 7 11/16"	Cable Tool: ✓	Diameter 8 5/8" From 0' to 64.5'
	____ - ____		~~Air Rotary:~~ (05)	Diameter ____ From ____ to ____
	____ - ____		~~A.R. w/Sonic:~~ (05)	Diameter ____ From ____ to ____
	____ - ____			Diameter ____ From ____ to ____
	____ - ____			Diameter ____ From ____ to ____
*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design				Diameter ____ From ____ to ____

Drilling Fluid: Potable Water

Total Drilled Depth: 64.5'	Hole Dia @ TD: 8 5/8"	Total Amt. Of Water Added During Drilling: Unk.	
Well Straightness Test Results: Pass (7/19/05, w/ 6 5/8" x 20' L.)		Static Water Level: 43.63'	Date: 7/25/05

GEOPHYSICAL LOGGING

Sondes (type)	Interval	Date	Sondes (type)	Interval	Date
Spectral Gamma	0' - 63.4'	7/18/05		____ - ____	
Neutron Moisture	0 - 63.4'	7/18/05		____ - ____	
	____ - ____			____ - ____	

COMPLETED WELL

Size/Wt./Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
4" Sch. 5 304L SS Sump	61.56' - 58.56'	F480	-N/A-	Colo. Silica Sand	63.25' - 32.18'	19 bags	10-20
4" 304L S.S. Screen	58.56' - 43.57'	F480	0.020"	Bentonite Pellets	32.18' - 25.22'	3 buck.	3/8"
4" Sch. 5 304L S.S. Casing	43.57' - +2.00	F480	-N/A-	Bentonite Crumbles	25.22' - 10.80'	6 bags	Unk.
	____ - ____			Portland Cement Grout	10.80' - 0.0'	6 bags	-N/A-
	____ - ____				____ - ____		

OTHER ACTIVITIES

Aquifer Test:	Date:	Well Decommission:	Yes:	No:	Date:
Description:		Description:			

WELL SURVEY DATA (if applicable)

	Protective Casing Elevation:
Washington State Plane Coordinates:	Brass Survey Marker Elevation:

COMMENTS / REMARKS

Perm. Pump info: Grundfos S.S. 5 SQE3 90 (5 SQE 90 NE), set @ 53.08' bgs (intake).
Perm. Riser Pipe info: 3/4", Sch. 40 S, Type 304 S.S., NPT Thd., w/ 3/4" NPT Thd. Type 304 SS. couplers
↳ Total length of pipe = 55.44' in four pieces.

Reported By:	Title:	Signature:	Date:
N. Bowles	Geologist		7/26/05

A-6003-658 (04/03)

BOREHOLE LOG

Page 1 of 5

Date: 7-13-05

Well ID: C 4855 | Well Name: 699-S20-E10 | Location: 300-FF-5

Project: 300-FF-5 Monitoring Well | Reference Measuring Point: Ground surface

Depth (Ft.)	Sample Type No.	Sample Blows/Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
					Cable tool method uses drive barrel
0				0 – 0.7' drill pad gravel	
				0.7 – 5' Gravel (pebbles - cobbles)	
5				@ 5' – Silty sandy gravel, 20% Silt, 30% VF-C subang-subrd to angular sand (qtz, quartzite, basalt grns), pebbles - cobbles rounded to subrounded qtz, lt + basalt (color 5YR 5/1)	Drive barrel sample • 5' archive Dry
	SS #1	75%			
	SS #2	100%			
10	SS #3	40%			
	SS #4	80%		@ 7' pebbly-cobbly gravel 80% pebbles - small cobbles, 20% sand (VF-m), subrnd to angular. (clasts = 70% basalt, 30% qtz/lt)	Drive barrel sample Dry
	SS #5	95%			
	SS #6	95%			
15	SS #7	95%		@ 7 – 9' split spoon sample	split spoon samples in Lexan liners
	SS #8	95%		@ 9.5' drive barrel sample pebbly gravel. (20% subrnd-subang, m-VF sand), 80% rounded coarse to VC pebbles (mainly basalt)	#(1) 7 – 8' Dry #(2) 8 – 9' Dry • 9.5' Archive
	#9	100%			
	#10	100%			
20	#11	100%		@ 9.5 – 11.5' bgs pebbly gravel as above.	#(3) 9.5 – 10.5' Dry #(4) 10.5 – 11.5' Dry
	#12	100%			
	#13	100%		@ 12.0' drive barrel sample Sandy, pebbly gravel. (50% ang-subrnd VF-VC Sand), 50% subrnd, rnd pebbles (VF-VC) (clasts - 80% basalt, 20% qtz/lt.)	#(5) 12 – 13' #(6) 13 – 14' slightly damp
	#14	100%			
25	15	95%			
	16	95%		@ 12 – 14.5' split spoon samples	
	17	50%		@ 14.5' bgs sample from drive shoe Slightly damp sand, slightly calcareous (minor calcic specks)	Slightly damp • 14.5' archive
	18	90%			
30	19	75%		Sandy gravel (60% sand) (40% gravel)	
				@ 14.5' collect archive split spoons (14.5-15.5, 16.5-16.5)	#(7) 14.5 – 15.5 damp
	20	100%		@ 18.0' grab sample from split spoon shoe. As above sandy gravel. (60% VF-VC Sand, angular to subrnd) calcareous, more moisture than above (40% f – coarse pebbles)	#(8) 15.5 – 16.5 damp to slightly moist #(9) 17 – 18' " #(10) 18 – 19' "
	21	100%			
35	22	100%			
	23	100%			
	24	100%			• 19.5' archive (SLT moist)
38	25	100%			

Reported By: Lee Brandland | Reviewed By: L.D. Walker

Title: Hydrogeologist | Title: Geologist

Signature: L Brandland | Date: 7-14-05 | Signature: L.D. Walker | Date: 8/4/05

A-6003-641 (03/03)

BOREHOLE LOG

Page 2 of 5

Date: 7-13-05

Well ID: C4855 | Well Name: 699-S20-E10 | Location: 300-FF-5

Project: 300-FF-5 Monitoring Well | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
39					
40	26	100%		@ Grab sample from SS shoe at	
	27	100%		19.5' bgs. Sandy Gravel.	#(11) 18.5-20.5'
				(50% VF-VC angular to subround	#(12) 20.5-21.5'
	28	65%		sand, qtz + basalt), 50% pebble	
				sized clasts, 70% basalt, subround	@ 22' less moist than
45	29	30%		to rounded, some show limonitic	at 19.5' (dry-slightly moist)
				stain, 30% quartzite pebbles)	
	30	100%		Sand is not calcareous. Slightly	#(13) 22-23' slightly moist
	31	100%		indurated with clay matrix in	#(14) 23-24' slightly moist
	32	100%		some locations.	
50	33	100%		@ 22.0' bgs, Silty, sandy gravel.	@ 24.5' archive moist
	34	100%		~20% silt, 40% sand, 40%	#(15) 24.5-25.5' slightly moist
	35	100%		med-coarse subround-round pebbles	#(16) 25.5-26.5' slightly moist
	36	~100%		(pebbles 90% basalt, 10% andesitic)	
55	37	100%		sand VF-M grn, subang-subround.	#(17) 27-28 moist
	38	95%		@ 24.5', Silty, sandy gravel.	#(18) 28-29 dry-slightly moist
	39	100%		Slightly better indurated than above	
	40	95%		clay-silt bind matrix sand.	@ 29.5' archive moist
60	41	100%		(5% clay, 10% silt), 40% VF-C sand,	#(19) 30-31 Dry
	42	100%		45% fn med-coarse pebbles, fresh	#(20) 32-33' moist
	43	95%		to weathered basalt, some limonite stain,	#(21) 33-34' Moist
				rare qtz+zte (10%).	
			TD = 64.5	-drive barrel at 24.5' has	@ 34.5' archive
				moist m-vc sand, 30% basalt	
				20% qtz. May be interbedded	#(22) 34.5-35.5' slightly moist
				sand and gravel interval. Sand	#(23) 35.5-36.5' moist
				interval has dark black color from	
				high percent basalt grains.	#(24) 37-38 slightly moist
				@ 27', slightly calcareous.	#(25) 38-39 moist
				Sandy, pebbly gravel.	
				29.5-28, black, f-vc	@ archive 39.5'
				basaltic sand, distinct, may	
				be bed. Extends to 28.3, 28.2-28	#(26) 39.5-40.5' slightly moist
				is sandy gravel	#(27) 40.5-41.5' moist
				@ 29.5' collect archive sample	
				from drive barrel. Pebbly,	#(28) 42-43' top-dry to slightly moist bottom moist
				(silty) sand. 30% basaltic pebbles	
				med-coarse, 10% silt, 60% VF-C	
				sand (Grns 70% basalt, 30% Qtz)	
				angular to subrounded grns.	

NA

Reported By: Lee Brouillard | Reviewed By: L.D. Walker

Title: Hydrogeologist | Title: Geologist

Signature: [signature] Date: 7-14-05 | Signature: [signature] Date: 8/4/05

A-6003-642 (03/03)

BOREHOLE LOG

Page 3 of 5
Date: 7-14-05

Well ID: C4885 | Well Name: 699-520-E10 | Location: 300-FF-5
Project: 300-FF-5 Monitoring Well | Reference Measuring Point: Ground Surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
				@ 32'. Sandy gravel to clayey gravel. Mud-clay supported pebble clasts noted. Fine matrix is moist. Larger broken clast is andesite/~~monzonite~~ to diorite.	cuttings from drive barrel. → moist in clay matrix
				@ 34' grab from SS drive shoe. Sandy, pebbly gravel to gravelly sand. (~50% sand, 50% very fine – coarse pebbles) F-VC sand-sized grains consist of ~70% basalt, 30% qtz; qtz grains have yellow/amber staining coating grains. Some limonite weathering on basalt grns. Grns angular to subround. (Cleanout of drive barrel at 33' had vesicular red scoria clasts) and granodiorite clast).	
		NA		@ 34.5' drive barrel grab is silty, sandy pebbly gravel. (20% silt, 20% VF-VC sand, 60% F-C pebbles)	→ Slightly moist.
				@ 37' grab from SS drive shoe. as above silty, sandy, pebbly gravel (sand grains – poorly sorted, 70% basalt, 30% qtz.)	→ Slightly moist
				@ 39' grab from SS shoe. Slight color change to 5YR/5/3 more brown to color. Sand matrix is better sorted (F-VC). Limonite staining on grains more common. pebbles are quartzite + basalt). (Qtz is 40% in sand, w 60% basaltic)	→ Slightly moist
				@ ~43.5 grab from SS shoe → sandy gravel	→ Wet (Measured water table with e-tape at 43.5' bgs)
				@ 46' bgs from SS shoe. Sandy pebbly gravel (basalt ~ 70%, Qtz ~ 30% in sand matrix.	#(28) 44.5-45.5' saturated (8) 46.5' auchiver

Reported By: Lee Brandhuber | Reviewed By: L.D. Walker
Title: Hydrogeologist | Title: Geologist
Signature: [signature] | Date: 7-14-05 | Signature: [signature] | Date: 8/4/05

A-6003-642 (03/03)

BOREHOLE LOG

Page 4 of 5
Date: 7-14-05

Well ID: C4855 | Well Name: 699-520-E10 | Location: 300-FF-5

Project: 300-FF-5 Monitoring Well | Reference Measuring Point: Ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
				@ 48' from SS shoe - gravelly sand to sandy gravel. ~ 50% vF-vc sand (40% Qtz, 60% basalt), ~10% Silt, 40-50% med-coarse pebbles, basalt + quartzite	#30 46-47 saturated #31 47-48
				@ 48.5' from drive barrel. Gravelly sand. (Sand is mod sorted m-vc, subround, variegated, 70% Qtz, 30% basalt + other)	#32 48.5-49.5 #33 49.5-50.5 #34 51-52 #35 52-53 #36 53.5-54.5 #37 54.5-55.5' 54.5' = archive samples
				@ 51' from SS shoe, possibly sand - sandy gravel. Sand fraction is mod-well sort m-vc grns, 70% Qtz, 30% basalt + other. Pebbles basalt + Qtz etc.	#38 56-57' #39 57-58' #40 58.5-59.5' #41 59.5-60.5' 60.5 = archive samples
				@ 53' from SS shoe gravelly sand. 50% m-vc sand (75% Qtz, 20% basalt grains + other) pebbles of Qtz etc + basalt. Gravel fraction 45%, 5% Silt.	#42 61-62' #43 62-63' 64' = archive samples 64.4' = archive samples
		NA		53.5' (drive barrel) - SG - coarse, well-sorted sand, heterolithic cobbles to ~3" dia, well-rounded	
				53.5-56 (split spoon) - coarse sand with sparse cobbles to ~3" - S - locally silty, generally well-sorted, dominated by silica, lesser lithic clasts (incl. basalt)	
				56' (drive barrel) - well-sorted medium sand, highly siliceous, sparse pebble/cobble layers	
				56-58.5' (split spoon) - medium sand passing downward into coarse granular sand, thin pebble/cobble layers - siliceous with little mafic content - possibly Ringold? - S-	
				58' (drive barrel) gravelly sand - gS- - medium sand, 30-40% well-rounded pebbles	
				58.5-61 (split spoon) - sand - S - spare pebbles to 2"	

Reported By: Lee Brouillard / Michael E. Cunn | Reviewed By: L. D. Walker

Title: Hydrogeologist / Senior Geologist | Title: Geologist

Signature: [signature] | Date: 7-15-05 | Signature: [signature] | Date: 8/4/05

A-6003-64 (03/03)

BOREHOLE LOG

Page 5 of 5

Date: 7-15-05

Well ID: C4855 | Well Name: 699-S20-E10 | Location: 300-FF-5

Project: Monitoring Well | Reference Measuring Point: ground surface

Depth (Ft.)	Sample Type No.	Sample Blows Recovery	Graphic Log	Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level
		NA		61' (drive barrel) gravelly sand - gS - med → coarse sand, hetero lithic clasts, sub-rounded, qtz dominated, pebbles to 2", basalt + metamorphics	
				61-63.5 (split spoon) sand - S - sparse cobbles to > 4" - sand medium, well-sorted, sub-rounded clasts, silica dominated, basalt is largest part of lithic fragments, minor iron oxide (FeOx)	
				64' (drive barrel) silty, sandy gravel - sG - silt → med. sand, abundant small (~ 0.5") well-rounded pebbles - basalt + qtzite	
				64.5' (drive barrel) - sandy gravel - appears to be Ringold 'E' - fine → med sand matrix, well rounded pebbles/cobbles to ~ 2" - abundant metamorphics	
				63.4 = TD (deepest penetrated depth)	
65.5					

Reported By: Michael E. Caron | Reviewed By: L.D. Walker

Title: Senior Geologist | Title: Geologist

Signature: [signature] | Date: 7-15-05 | Signature: [signature] | Date: 8/4/05

A-6003-642 (03/03)

FIELD ACTIVITY REPORT NO. 1 - DRILLING PLAN

Page 1 of 2

Date: 7-12-05

rpose: Monitoring Well | Location: 300-FF-5

Well ID: Low C4855 | Well Name: 699-S20-E10

Drilling Co.: Blue Stem | Rig No.: 133 | Rig Make/Mod.: BUCYRUS ERIE

Casing String No. (1) 2 3 4

Casing Size: 8 5/8 OD / 7 1/16

Grade: CW 5 9/16 10

Lbs.Per Ft.:

Material: Carbon Steel

Type: Rev.-

Welded ____ (Thd)

Planned / Actual

Set At: NA / 64.5

Shoe OD/ID: 8 5/8" / 7 1/16

Reference Measuring Point: GROUND LEVEL

Drilling Method

Auger ____

Rotary ____

Tubex ____

Cable Tool ✓

Sonic ____

A.R. w/Sonic ____

Geoprobe ____

Other: ____

Circulation

Air ____ Water/Mud ____

Reverse ____ Direct ____

Vol: cfm ____

gpm ____

Pressure ____ psi N/A

Drill Pipe O.D. ____

Tool Joint Size ____

Additives ____

D.H. Hammer 22-W

Make ____

Model ____

Choke ____

Casing Hammer

Make ____

Model ____

Bit Size N/A

Type ____

Nozzles ____

Rod Size

---

g. Co. | Rig No.: | Rig Make/Mod.:

asing String No. 1 2 3 4

Casing Size ____

Grade ____

Lbs.Per Ft. ____

Material ____

Type:

Welded ____ Thd.

Planned / Actual

Set At: /

Shoe OD/ID ____

Reference Measuring Point: GROUND LEVEL

Drilling Method

Auger ____

Rotary ____

Tubex ____

Cable Tool ____

Sonic ____

A.R. w/Sonic N/A

Geoprobe ____

Other: ____

Circulation

Air ____ Water/Mud ____

Reverse ____ Direct ____

Vol: cfm ____

gpm ____

Pressure ____ psi

Drill Pipe O.D. ____

Tool Joint Size ____

Additives ____

D.H. Hammer

Make ____

Model ____

Choke ____

Casing Hammer

Make ____

Model ____

Bit Size

Type ____

Nozzles ____

Rod Size

Comments/Remarks:

Estimated Depth to Water

Reported By: Lee Brouillard

Name/Title: Hydrogeologist

Signature: for L. Brouillard Date: 8/4/05

A-6003-650 (04/02)

FIELD ACTIVITY REPORT - DAILY DRILLING
Continuation Page

Page 1 of 1

Date: 7-12-05

Well Name: ~~C4855~~ C4855W (699-520-E10) | Well ID: C4855

Location: 300-FF-5 | Continuation of Report No.: 1

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth
	06:00	Conduct PDD. BTR, 2 Drillers, Geologist
	12:30	Drillers completing setup of rig.
	1326	Start drilling
	1330	Remove Drive barrell - no recovery - large cobble at bottom of hole (~ 2 ft deep). Clean out hole (~6-8" pea gravel)
		Drive split spoon with sampler = 3.02', Sample + drive shoe = 2.07'
	1339	Attach split spoon sampler
	1341	Measure bottom of borehole a ~ 3'
	1342	Start drilling sample.
	1348	No recovery 3.2' - 5.5', Catalyst fingers broken
	1356	4.48' - 5.14' (4.48' casing with head = 5.14')
		1st driving casing section extended
	1400	Start driving casing
	1409	Making adjustments to make 1st casing section vertical.
	1420	Grab sample at 5' from drive barrell. (sand gravel)
	1430	Add 5.01' section of drive casing
	1449	Drive casing to 4.5' bgs. Remove drill barrell with hole sleeve.
	1450	Drive casing to 5.0' bgs
	1451	Hammer drive sampler to 7.0' bgs. Collect subs from drive hammer (Gravel)
	1503	Attach split spoon sampler
	1507	Remove split spoon. Drive from 7 - 9.5' bgs
	1510	RCT takes reading on 7' bgs sample (Gamma @ background)
	1528	Driller Leave Site
	1530	Prepare Split spoon samples
		7-8' (~75% recovery Pebbly Gravel)
		8-9' (100% recovery Pebbly Gravel - some pulverized
	1558	Backup all materials and secure drilling site.
	1600	Leave Site For Day — JB

Reported By: Lee Brouillard | Reviewed By: L. D. Walker

Title: Hydrogeologist | Date: 7-12-05 | Title: Geologist | Date: 8/4/05

Signature: Lee Brouillard | Signature: L. D. Walker

A-6003-652 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING

~~Continuation Page~~ LDW

Page 1 of 2

Date: 7-13-05

Well Name: ~~C4855~~ LDW (699-S20-E10)

Well ID: C4855

Location: 300-FF-5

Continuation of Report No.: 2

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth
	0600	Conduct PDD. ~~DRR~~, 2 Drillers, 6 Geologist
	0648	Start driving casing. (Bottom of casing at 5.0'.
	0655	Take PID reading on top of borehole (measured 0 ppm)
	0705	RCT measures gamma on borehole cuttings on shovel (@ background)
	0721	Bottom of casing at ~ 6.5' bgs. Driller is driving casing and cleaning out borehole, and making straightness on casing.
	0735	Collect drive barrel sample at 9.5' bgs
	0742	Start driving split spoon sample 9.5 – 12.0' bgs
	0810	Drive casing. Bottom of casing at 10.65' bgs
	0815	Add 5.00' casing section
	0816	Continue to drive casing. (Stickup is 5.1') with drive head
		Casing = 4.48 + 5.01 + 5.00 + 0.66 drive head = 15.15'
		15.15 – 5.1 stickup = 10.0' bottom of casing.
	0851	Grab sample from drive barrel at 12.0'
	0856	Drive split spoon from 12.0 – 14.5' bgs
	0911	Grab sample collected from drive shoe at 14.5' bgs (split spoon)
	0931	Grab sample from drive barrel at 14.5' bgs
	0941	Driving casing.
	0945	Collect split spoon 14.5 – 17.0' (Liners 14.5-15.5, 15.5-16.5')
	0959	Drive casing
	1016	Adding 5.05' casing section. Bottom of casing at 14.5'
	1024	Drive casing (total casing with head = 20.2')
	1034	Collect grab sample from drive barrel at 17.0' bgs. Shoe of SS at 17.0'
	1037	Drive SS sampler 17 – 19.5' bgs (Liners 17-18', 18-19')
	1120	Drive casing. Casing bottom at 17.2' bgs
	1132	Hammering drive barrel to 19.5' bgs
	1148	Drive SS sampler 19.5 – 22' (Liners 19.5-20.5', 20.5-21.5')
	1202	Bottom of casing at 17.5'. Start driving casing
	1235	Collect SS sampler (22-24.5') (Liners 22-23', 23-24')

Reported By: Lee Broulliard

Title: Hydrogeologist Date: 7-13-05

Signature: LD Walker for L. Broulliard

Reviewed By: L.D. Walker

Title: Geologist Date: 8/4/05

Signature: LD Walker

A-6003-52 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING

Continuation Page ~~C4855 LW~~ LW

Date: 7-13-05

Well Name: ~~C4855 LW~~ 699-S20-E10 | Well ID: C4855

Location: 300-FF-5 | Continuation of Report No.: 2

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth
	1246	Add 5.00' casing section (20.2 + 5.00 = 25.2 with Land)
	1259	Drive casing
	1314	Drive bowel archive sample at 24.5' bgs
		bottom retrieved at 24.5' (moist)
	1325	Driving split spoon sample 24.5 - 27' (24.5'-25.5' 26.5-26.5)
		Drive casing at 23' bgs
	1351	Adding 5.02 casing section (25.2 + 5.02 = 30.22' with drive head)
	1356	Will Drive SS sampler 27 - 28.5' before adding casing
	1416	27-28' Liner has black basaltic sand (moist)
		28 - 29' Liner 28 - 28.3 is black basaltic sand (moist)
		Gravel below at 28.3 - 29 is dry - (slight damp)
		Black basaltic sand seems to be retaining/transmitting moisture better.
		Drive casing at 22.5' bgs
	1439	Drive bowell sample for archive at 29.5' bgs
	1453	Retrieve SS sampler 29.5 - 31.5'
	1500	No recovery from 29.5 - 30.5, (30 - 31') sleeve.
		approximately 75% recovery. No recovery in SS shoe
	1511	Drive casing bottom at 29.5' bgs
	1519	RCT on-site to take gamma reading on cuttings pile (background)
	1530	All Leave Site for Day.

2.3

Reported By: Lee Broullard		Reviewed By: L.D. Walker	
Title: Hydrologist	Date: 7-13-05	Title: Geologist	Date 8/4/05
Signature: for L. Broullard		Signature:	

A-6003-452 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING

~~Continuation Page~~ LOW

Date: 7-14-05

Well Name: ~~C4855~~ LOW 699-S20-E10

Well ID: ~~699-S20-E10~~ LOW C4855

Location: 300-FF-5

Continuation of Report No.: 3

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth
	0600	Conduct PoD. B7R, 2 Drillers, 6 eologist.
	0656	Complete setting up for day. Start drilling with Drive casing at 29.5' bgs.
	0710	Collect drive barrel sample at 29.5' for use in archive.
	0711	HPT takes gamma reading on archive (@ bedrock)
	0715	Add 5.03' casing section (30.22 + 5.03 = 35.25' with drive head)
	0719	Start driving casing
	0726	Bottom of casing at ~ 30.5'. Drillers says there is probably a boulder at 30.5' bgs.
	0747	Drive drive casing to 32' bgs. Noted clay matrix supporting pebbles in some cuttings. Clay is moist
	0755	Start driving SS at 32' bgs
	0800	Drive SS fm 32-34.5' bgs (Liners at 32-33', 33-34')
	0826	Clean out drive barrell at 33'. Red vesicular scoria clasts seen in cuttings. Also noted granodiorite clast.
	0840	Drive casing at 33'
	0841	Drive casing ordinary sample collected at 34.5' bgs
	0848	Collect SS sample (drive 34.5'-37') (Liners 34.5-35.5, 35.5-36.5')
	0910	Drive barrel cuttings at 35.5', fragment of very Cal/carcaes (caliche?) m-c sand. Mottled appearance of yellowish calcite, quartz basaltic gravels. Add 5.0' casing
	0915	Drive casing at 35'. Hammering drive barrel.
	0924	Driving SS sampler (37-39.5') (Liners 37-38', 38-39')
	1027	Drive casing at 39.5' bgs
	1027	Split spoon sample (39.5-42') (Liners 39.5-40.5, 40.5-41.5')
	1056	Drive casing at 39.5' bgs
	1056	Split spoon sample (42-44.5) (Liners 42-43, 43-44)

Reported By: Lee Brouillard

Title: Hydrogeologist Date: 7-14-05

Signature: LD Walker for L. Brouillard

Reviewed By: L.D. Walker

Title: Geologist Date: 8/4/05

Signature: LD Walker

A-6003-652 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING
Continuation Page

2 Page ___ of 3

Date: 7-14-05

lame: ~~C4855~~ LBW 699-S20-E10 | Well ID: ~~699-S20-E10~~ LBW C4855

n: 300-FF-5 | Continuation of Report No.: 3

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth
	1105	Recovered split spoon. Material in shoe and part of bottom liner (~ 0.1 - 0.2') was wet. Water table may be at ~ 43.5'. Will check with e-tape after driving casing
	1111	poor recovery on split spoon, upper liner is empty bottom liner approx 65% recovery. Driller thinks we pushed a void ahead of split spoon at one point. Will call recovered sample 42-43' interval.
	1116	Added casing section 5.02 + 40.26 = 45.28' (with head)
	1117	Driving casing
	1118	Drive casing to 41' bgs
	1120	Drive casing at ~43.2'. Hammering drive barrel.
	1135	Remove drive barrel and cuttings to 44' bgs
	1138	Measure water in hole at 43.3'.
	1139	Will let hole sit for a few minutes and remeasure
	1228	Driller returns with Drive Cont for cuttings
	1229	Measured water in hole at 43.5'. Probe at bottom on wet sediments (water ~ 43.4')
	1230	Setting up for collecting split spoon (bottom hole at 43.5')
	1239	Retrieve split spoon (43.5 - 46) (Liners (43.5-44.5, 44.5-45.5')
	1245	No recovery in upper liner (43.5 - 44.5) 30% recovery in bottom liner (44.5 - 45.5'), but uncertain what interval this is from. Material is saturated, fines in SS sampler may have fallen out bottom.
	1252	Added 5.04 Casing Section (45.28 + 5.04 = 50.32 with head)
	1253	Drive casing
	1311	Retrieve drive barrell sample for 44.5' archive
	1325	Retrieve SS 46 - 48.5 (Liners 46-47, 47-48)
	1335	Driving casing for 45.5'
	1338	Hammering drive barrell.

ed By: Lee Brouillard | Reviewed By: L.D. Walker

hydrogeologist | Date: 7-14-05 | Title: Geologist | Date: 8/4/05

Signature: D Walker for L. Brouillard | Signature: D Walker

A-6003-62 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING
Continuation Page

3 Page __ of 3

Date: 7-14-05

lame: ~~C-4855~~ CBW 699-520-E10 Well ID: ~~699-520-E10~~ LBW C4855

on: 300-FF-5 Continuation of Report No.: 3

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth
	1355	Driving SS (48.5 - 51) (Liners 48.5 - 47.5, 49.5 - 50.5)
	1408	Drive casing at 48.5'.
	1428	Collect SS (51 - 53.5) Liners (51-52, 52-53')
	1441	Add 5.00 casing. Total casing (50.32 + 5.00 = 55.32 with head)
	1455	Complete driving casing to 52' bgs
	1505	Final drive with casing to 53.2' bgs
	1520	ICT takes Ready on Sample of 53 (bentonite seal)
	1530	Site organized at end of day. Leave Site

23

ed By: Lee Brouillard Reviewed By: L.D. Walker

hydrogeologist Date: 7-14-05 Title: Geologist Date: 8/4/05

Signature: LD Walker for L. Brouillard Signature: LD Walker

A-6003-612 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING

Page 1 of 2

Date: 7-15-05

Well ID: C4855	Well Name: 699-S20-E1D
Location: 300-FF-5 Monitoring Well	Report No.: 4

Start	Finish	Total
Time 06:00	Time 12:00	Time 06:00 11.3'
Hole Depth/Csg 53.5' / 53.5'	Hole Depth/Csg 63.4 / ~~63.4~~ 64.8'	Hole Depth/Csg 9.9' / ~~9.9~~

Reference Measuring Point: GROUND SURFACE

Casing String No. (1) 2 3 4 ____ Rod Size: 8 5/8" single wall
See Report No. 1

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)
	06:00	-POD at job site (BTR, 2 drillers, geologist)
	06:22	- water level = 43.6' bgs
06:25	06:33	- clean out borehole with drive barrel to 53.5'
06:38	06:44	- drive split spoon from 53.5 - 56' #36 = 53.5 → 54.5'; #37=54.5-55.5'
06:53	06:55	- drive casing to ~ 54.5'
06:57	07:06	- clean out borehole with drive barrel to ~ 55.5'
07:07	07:12	- add 5.00' joint of casing - tubular tally = 60.17'
07:14	07:17	- drive casing to 55.5'
07:18	07:30	- clean out borehole to 56'
07:32	07:42	- drive split spoon from 56 - 58.5' #38 = 56-57'; #39= 57-58'
07:50	07:55	- drive casing to ~56.8'
07:56	08:02	- clean out borehole to 57'
08:05	08:07	- drive casing to 57.6'
08:08	08:12	- clean out borehole to 58.5'
	08:12	- RCT am check background = 1.9k, 2k in drum
08:18	08:25	- drive split spoon from 58.5' - 61'; #40= 58.5-59.5', #41= 59.5-60.5'
08:35	08:37	- drive casing to 58.5'
08:38	08:44	- clean out borehole to 59.5'
08:45	08:50	- drive casing to 60'
08:51	08:57	- clean out borehole to 61'
09:00	09:10	- drive split spoon from 61 - 63.5'; #42=61-62', #43 = 62-63'
09:25	09:30	- add 5.00' joint of 8 5/8" casing - tubular tally = 65.17'
09:31	09:34	- drive casing to 61'
09:39	09:43	- clean out borehole to 62'

Reported By: Michael E. Cumm	Reviewed By: L.D. Walker
Title: Senior Geologist Date: 7-15-05	Title: Geologist Date: 8/4/05
Signature: MEC	Signature: LD Walker

A-6003-651 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING
Continuation Page

Date: 7-15-05

Name: C4855 | Well ID: 699-S20-E10

Action: 300-FF-5 Monitoring Well | Continuation of Report No.: 4

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth
09:45	09:47	- drive casing to 61.5'
09:48	09:53	- clean out borehole to 62.5' - no recovery
09:55	10:02	- clean out borehole to 63' - driller adds 10 gallons potable water to help with recovery
10:04	10:06	- drive casing to 62.5'
10:07	10:13	- clean out borehole to 63'
10:17	10:23	- clean out borehole to 63.5' - no recovery
10:25	10:27	- drive casing to 63.5'
10:28	10:38	- clean out borehole to 63.5' - no recovery
10:40	10:44	- clean out borehole to 63.7
10:46	10:53	- clean out borehole to 64'
	10:55	- tag bottom at 63'
10:56	10:57	- drive casing to 64'
11:02	11:06	- clean out borehole to ~ 64.3' bgs
11:07	11:11	- clean out borehole to ~ 64.5' - driller adds 20 gallons potable water - no recovery
11:12	11:23	- clean out borehole to 64.3? - no recovery
11:24	11:29	- clean out borehole to ~64.7 - no recovery
11:28	11:30	- drive casing to 64.8' -
~~Hist~~	11:51	- tag bottom at 63.4' bgs - deemed adequate for well construction - will check after logging
	12:00	- left site -

Not Used @ M

Reviewed By: Michael E. Caron, Senior Geologist, Date: 7-15-05

Reviewed By: L.D. Walker, Title: Geologist, Date: 8/4/05

Signature: MEC

Signature: LD Walker

A-6003-662 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING

Page 1 of 3

Date: 7/19/05

Well ID: 699-S20-E10 | Well Name: 48555

Location: 300-FF-5 Monitoring well | Report No.: 5

Start	Finish	Total
Time 0600	Time 1900	Time 9.0
Hole Depth/Csg 63.44' (#5) / 64.0' (#3) 62.4' 61.58' (#5) 64.98'	Hole Depth/Csg 41.85 42.45 (#5) / 44.03	Hole Depth/Csg 20.55 / 20.95

Reference Measuring Point: GROUND SURFACE

Casing String No. (1) 2 3 4 ____ Rod Size: (1) - 8 5/8" single wall

See Report No. 1

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)
0600	0620	POD (BTR, Drillers, & Geo).
0620 (#5)	0625	Tag water @ 44.45' btoc w/ 0.85' stickup = 43.5' bgs.
0625	0630	Tag bottom @ 63.25 ~~62.23~~' btoc w/ 0.85' stickup = ~~61.38'~~ 62.4' (#5) bgs.
0630	0640	Prepare to clean out hole w/ sand pump.
0640		Begin using sand pump to clean out hole. Add
	0650	10 gal. potable water - Not much returned.
0650	0705	Cont. to bail/pump w/ sand pump. ~20 gal added.
0705		Tag bottom @ 64.1' btoc w/ 0.85' stickup => 63.25' bgs.
	0710	=> if sump set @ 61.5' => 1.75' clearance. => Should be okay.
0710	0715	Begin preparations to run in SS. perm. casing. Measuring
0715		Prepare to run straightness test w/ 6 5/8" O.D. x 6 (#5) 20.1'L.
	0720	casing.
0720	0725	Run straightness test - No problems - Pass.
0725		Prepare to run stainless total of 64.03' on site (Follows
	0745	Tubular tally).
0745	0810	Moving drums, etc.
0810	0900	Drillers helper to yard for more O-rings for SS. perm. casing.
0900		Inserting permanent stainless into borehole. Set @ 61.5' bgs
	0915	(62.93' w/ 1.43' stickup), will add short piece later.
0915		Prepare to add sand/filter pack. Total of 56 bags of
	0920	10/20 mesh, Colo. silica sand on site (50 lb sacks).
0920	0925	Add sand. (#5) 2-50lb sacks of 10/20 silica sand.
0925		Gauge out drive ~~head~~ head & add new pieces (total 6.47') to
	0945	make 71.64 total casing length for backpulling. →

Reported By: N. Bowles | Reviewed By: L.D. Walker

Title: Geologist | Date: 7/19/05 | Title: Geologist | Date: 8/4/05

Signature: | Signature:

A-6003-651 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING
Continuation Page

Date: 7/19/05

Name: 699-520-E10 | Well ID: C4855

Location: 300-FF-5 OU | Continuation of Report No.: 5

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth
0945	0955	Prepare to "hammer" out casing w/ jars/drill string.
0955	1010	Pulling casing using "hammer" technique w/ jars. ~2'.
1010	1015	Add Sand — 2 sacks
1015	1020	Driller working on rig.
1020	1025	Check operation
1025	1045	Work on rig again.
1045	1055	Pull casing. ~1.25'.
1055	~~1105~~	Remove pipe added earlier. (~5.01') large drive head
	1110	staying on. Total length is 66.63' w/ 1.46' Drive head.
1110	1120	Add Sand. (2 sacks).
1120	1125	Prepare to pull (hammer out) casing.
1125	1140	Pull casing ~5'.
1140	~~1200~~	Lunch
~~1200~~	1215	Add sand. (2.5 sacks).
1215	1230	Pull casing. ~5'.
1230	1240	Add Sand (2.5 sacks).
1240	1250	Pull casing. ~5'.
1250	1255	Call Hanford weather for "Wet-Bulb" reading ⇒ 80°F ⇒ 100%
1255	1310	Add sand. (2 sacks).
1310	1325	Pull casing. ~~1.25'~~ & Temp. Remove lg. drive head for surging.
1325		Prepare to surge filterpack/formation. Casing @ ~44'
		~~Tag bottom @ 42.22' btoc ⇒ 41.12' bgs to start surging.~~ NB
	1335	Tag bottom @ 42.30' btoc to start surging.
1335	1345	Begin surging. End @ 42.45' btoc ⇒ 0.15 over 10 min.
1345		Stop temp. to discuss problems w/ surging (was supposed to
		be done over 5 - 3-ft. intervals, not entire screened
	1355	interval (~15'). Attempting to contact "Geo-BTR" to consult.
1355	—	Continue to surge until direction is given. (Start @ 42.45' btoc).
1405		Down 0.15' (@ 42.60' btoc) over 10 min. Continue.
1420	~~1415~~	Down 0.2' more (@ 42.80' btoc) over 15 min. Continue. →

Prepared By: P.S. Bowles — Geologist — Date: 7/19/05 — Signature:

Reviewed By: L.D. Walker — Title: Geologist — Date: 8/4/05 — Signature: LD Walker

FIELD ACTIVITY REPORT - DAILY DRILLING
Continuation Page

Date: 7/19/05

Name: ~~60~~-699-920-E10 | Well ID: C4855

Unit: 300-FF-5 MW. | Continuation of Report No.: 5

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth
1420		Continue Surging. Call Hanford weather for Wet-Bulb
	1425	temp ⇒ 84.0°F ⇒ 100% work.
1425		Cont. Surging.
1435		Drop another 0.1' (42.90') over 15 Min. ⇒ 0.6' total so far.
1445		Drop another 0.05' (42.95') over 10 min ⇒ 0.65' total.
~~1445~~		Stop surging for day. Driller must leave site by 3pm
	1500	To get new badge. ⇒ Clean up & secure site.
1500		Done for day. Geo leave site.

Not used

Prepared By: D. Bowles
Geologist
Date: 7/19/05
Signature:

Reviewed By: L.D. Walker
Title: Geologist
Date: 7/4/05
Signature:

A-6003-62 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING

Page 1 of 2

Date: 7/20/05

Well ID: 64855 | Well Name: 699-520-F10

Location: 300'FF-S W.W. | Report No.: 6

Start	Finish	Total
Time 0630	Time 1500	Time 8.5
Hole Depth/Csg 41.85 / 44.03	Hole Depth/Csg 10.80 / 10.65	Hole Depth/Csg 31.05 / 33.38

Reference Measuring Point: GROUND SURFACE

Casing String No. (1) 2 3 4 ____ Rod Size: (1) - 8 5/8"

See Report No. 1

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)
0620		Geo to GPP Field Offices for Monthly Safety Meeting.
0630	0800	(Monthly Safety meeting.
0800	0830	POD (BTR, Drillers, & Geo).
0830	0900	Travel to site.
0900	0930	Preparing to resume w/ surging.
0930		Begin surging @ 0930 w/ init. tag @ 41.76' (42.75') btoc (New location for tag (wet @ 41.86' (42.90') btoc). End @ 41.94' (42.94') btoc = 0.14'
	0950	
0950	1010	Continue to surge. End @ 41.94' (42.94') => 0.04' drop over 20 min. Stop.
1010		Tag inside of casing @ 62.75' (62.93' total length)
		=> ~0.18' of fines in casing (max, not taking into consideration the end cap thickness)
	1020	
1020		Prepare to cont. w/ well construction. => Add on lg.
	1025	drive head (1.46').
1025	1030	Pull casing ~ 2'. => Follow "Well Completion Lg."
1030	1035	Add Sand (2 sacks).
1035	1038	Pull casing. ~ 2.5'
1038	1040	Add Sand (2 sacks).
1040	1045	Pull casing & remove casing.
1045	1048	Add Sand (1 sack).
1048	1055	Pull & remove casing.
1055	1100	Add Sand (1 sack).
1100	1105	Pull Casing.
1105	1110	Pull casing (5.99')
1110	1114	Add 2 buckets for 3/8" Bent. Pellets (non-coated) (Cetco-Volclay / Quellgold).

Reported By: D. Bowden | Reviewed By: L.D. Walker

Title: Geologist | Date: 07/20/05 | Title: Geologist | Date: 8/4/05

Signature: D. Bowden | Signature: L.D. Walker

A-6003-681 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING
Continuation Page

Date: 7/20/05

lame: 699-S20-E10 | Well ID: C4855

.n: 300-FF-5 m.w. | Continuation of Report No.: 6

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth
1114	1116	Pull casing
1116	1120	Remove casing
1120	1122	Add 1 bucket (5 gal) of 3/8" Pellets
1122	1126	Pull casing. No more pellets ⇒ @ 25.22' to 32.18' bgs ⇒ 6.96' total.
1126	1130	Add Bentonite Crumbles (Cetco - Volclay Crumbles) 1 sack.
1130		Tag tape stuck coming out. Trying to remove.
	1135	Simult. pull & remove casing.
1135	1150	Break.
1150	1155	Add Crumbles (2 sacks).
1155	1200	Pull & remove casing.
1200	1205	Add crumbles (2 sacks).
1205	1215	Pull & remove casing ⇒ Now / sm. drive head (0.66').
1215	1225	Add crumbles ⇒ total of 1 sack (~ x0.5).
1225	1227	Pull up casing. Final crumble tag @ 10.80' bgs
	1227	⇒ Crumbles from 25.22 to 10.80' bgs.
1227		Driller's helper to town to get grout plant & grout.
1240	→	Call Hanford weather for WBGT ⇒ 80°F < A.L. ⇒ 100% work
1420	→	Call " " " " ⇒ 83°F < A.L. ⇒ 100%
1430		Helper still out collecting supplies. Driller says
	1440	no grouting today. Will cont. in morning.
1440	1500	Geo finishing up for day — Paperwork.
1500		Geo Done For Day. Leave Site.

Not used

Prepared By: M. Bowles | Geologist | Date: 7/20/05 | Signature:

Reviewed By: L.D. Walker | Title: Geologist | Date: 8/4/05 | Signature:

A-6003-612 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING

Page 1 of 2

Date: 7/21/05

Well ID: C4855 | Well Name: 699-S20-E10

Location: 300-FF-5 uzw. | Report No.: 7

Start	Finish	Total
Time 0600	Time 0930	Time 3.5
Hole Depth/Csg 10.80 / 10.65	Hole Depth/Csg 0 / —	Hole Depth/Csg ~10.80 / ~10.65

Reference Measuring Point: GROUND SURFACE

Casing String No. ① 2 3 4 ____ Rod Size: ① - 8 5/8" drive casing. See Report No. 1

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)
0600		Geo to site
0600	0630	POD (BIR, Drillers, & Geo).
0630	~~0635~~	(A) Driller determines length for last v. sm. piece of
	0635	SS. casing to add to top to make it to 2' stickup.
0635	0705	Driller to yard to cut piece down to size.
0705	0720	Preparing (B) for grouting.
0720		Mixing grout. Total of 8.94 lb sacks of Oldcastle
		Portland Type I/II Cement on site.
		Measure Prot. casing @ 4.75' long, 6 3/8" I.D. / 6 5/8" O.D
	0735	SS w/ WA. DOE Ecology tag: #AH8224.
0735	0740	Pump a total of ~3 sacks (~30 gals) (out of 7 mixed).
0740	0745	Pull casing ~5'.
0745	0750	Add grout. ~2 sacks (~20 gals)
0750	0755	Pull casing ~5'.
0755	0805	Add grout ~0.5 sacks grout (~5 gal).
0805	0810	Pull remainder of casing out.
0810	~~0815~~	(C) Top off hole to 4.5' (0') w/ 0.5 sacks (~5 gal).
	0815	Total of 6 sacks (~60 gal.) used.
0815	0825	Cleaning up pipe, etc. Add ~0.63' piece of SS. to top.
0825		Place 6" Prot. post in hole over 4" perm. casing.
		Set @ 1' above top of 4 inch ~3.0 ft above g.s.
		(Will remeasure all stickups (4" & 6") when grout
		has set up overnight. Top of 4" & 6" slightly (D) out of vertical,
	0845	(leaning), although 6" is centered over 4". ~4.75' bgs (E).

Reported By: N. Bowles | Reviewed By: L.D. Walker

Title: Geologist | Date: 7/21/05 | Title: Geologist | Date: 7/4/05

Signature: | Signature:

A-6003-651 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING
Continuation Page

Page 2 of 2
Date: 7/21/05

Name: C4855 cw 699-520-E10 | Well ID: C4855
Farm: 300-FF-5 M.W. | Continuation of Report No.: 7

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth
0845		Cleaning up grout plant & securing/stabilizing
	0915	protective casing while grout cures.
0915		Will not work with hole anymore today (grout
		must cure min. of 12 hours before continuing.
	0930	Will set temp. pump in morning for development.
		Summary: - Remove remainder of 8 5/8" drive casing.
		- Grout to ground surface (6 sacks [94-lbs]); 1 mixed sack not used in hole.
		- ~~Set~~ (NB) Add on short (0.63') piece of SS. 4" perm casing to get stick up to ~2.0'
		- Set Prot. (6") Post (6 5/8" OD / 6 3/8" ID) @ ~ 3.0' ags / 1.0 above 4", ~1.75' bgs (Total L: 4.75').
0930		Geo done at site for day. To office / Leave site.

Not Used

Reviewed By: N. Bowles
Title: Geologist
Date: 7/21/05
Signature:

Reviewed By: L.D. Walker
Title: Geologist
Date: 8/4/05
Signature:

A-6003-682 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING

Page 1 of 3

Date: 7/22/05

Well ID: C4855 | Well Name: 699-S20-E10

Location: 300-FF-5 NW. | Report No.: 8

Start	Finish	Total
Time 0600	Time 1430	Time 8.5
Hole Depth/Csg Ø / Ø	Hole Depth/Csg Ø / Ø	Hole Depth/Csg — / —

Reference Measuring Point: GROUND SURFACE

Casing String No. ~~1 2 3 4~~ (5) Rod Size: — N/A —

See Report No. 1

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)
0600		Geo to site.
0600	0630	PSD (B&R, Drillers, & Geo).
0630		Prepare for well development. Measure riser pipe (1" (3/4", galvanized) ⇒ (2 x 21.15') + (1 x 10.55') + (1 x 10.60')
		Pump (intake to top coupler) = 2.6'
		(intake to bottom) = 1.85
		Pump info: Grundfos S.S. Submers. 3HP.
		Type: 25S30-15, Mod # B05010015-P1042645.
		w/ Franklin 3HP Elect. Motor.
		Also, No check valve in pump. ⇒ will
		use Ball valve @ G.S. to stop backflow
	0705	during recovery.
0705	~~0710~~ 0710	Tag water @ 46.65' btoc (6.5" Prot. SS Casing).
		w/ 3.00' Stickup ⇒ 43.65' bgs.
0710		Helper to 200 west yard for some smaller pieces
	0900	of 1" riser pipe.
0810		Driller to BSE yard for pipe & bailer (sand pump).
0800		Tag bottom @ 63.90' btoc ⇒ 60.9' bgs (w/ 6.5" casing
	0810	@ 3.00' Stickup). ⇒ ~ 0.66' of sediment in sump.
0840		Driller return w/ 5.10' piece of 1" riser & Sand
		pump.
0840	0850	Prepare to bail out sediments w/ sand pump.
		Next Page.

Reported By: N. Bowles | Reviewed By: L.D. Walker

Title: Geologist | Date: 7/22/05 | Title: Geologist | Date: 8/4/05

Signature: | Signature:

A-6003-51 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING
Continuation Page

Date: 7/22/05

Name: 699-S20-E10 | Well ID: C4855

Location: 200 EF.5 WMW. | Continuation of Report No.: 8

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth
0830		Checking Instruments:
		- Hach Turbidity Meter 2100P Ser.#950800008453
		- Hach Standard → 564 | 47.3 | 4.85
		- Actual → 560 | 47.3 | 4.85
		- Oakton pH tester 3+:
		- Showing 7.07 on a 7.00 Standard.
		- Showing 10.05 on a 10.00 Standard.
		- Oyster Thermo 135A (conductivity)
	0845	- Showing 1413 on 1413 uS Standard.
0850		Backing on instruments. Starting @ 63.90' btoc.
	0900	Final tag @ 64.25' btoc ⇒ 61.25' bgs. ⇒ 0.31' Sed. Okay
0900	0905	Prepare to run in pump, pipe, transducer.
0905		Set transducer @ 2.65' above pump intake (just above coupler).
	0910	
0910		Run in pump and pipe. Total of 58.00' of riser pipe (2 x 26.15') + (1 x 10.60') + (1 x 5.10') ⇒ 58.00'.
		+ 2.6' (intake to coupler) pump ⇒ 60.6'
	0925	Transducer @ 2.65' above intake ⇒ 57.95'.
0925		All material in well, thickness of top coupler & landing plate = 0.25' ⇒ Pump intake @ 57.35' bgs, (3.25' Stickup Landing plate & coupler). Transducer @ 54.70' bgs ⇒ 11.05' by measurement. (water column) X(1.3).
0925	0930	Initial X_p @ 11.002' ⇒ okay.
0930		Driller notifies that electrical connection is not compatable. Need to track down another generator.
	0935	
0935	1055	Drillers helper to 200 west for new generator.
1055		Talk to BTR regarding weather conditions (lightning).
	1057	He says it is up to driller to call it.
1057		Talk to Hanford Weather. Reported lightning w/in 20 miles (reported @ 200 end).
	1059	

Prepared By: M. Bowles | Title: Geologist | Date: 7/22/05 | Signature: Mark O. Bowles

Reviewed By: L.D. Walker | Title: Geologist | Date: 8/4/05 | Signature: L.D. Walker

A-6003-652 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING
Continuation Page

Date: 7/22/05

lame: 699 - 520 - E10 | Well ID: C4855

n: 300FF-5 U.W.O. | Continuation of Report No.: 8

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth
1059	1125	Driller to town to get gas for generator.
1125	1128	Prepare to run test
1128	~~1128~~	Start #1 X_2 Init = 10.975. Logger test # ca?
	1130	Stop test. Pump not work, no water produced.
1130	1205	Driller attempting to fix problem. (wiring?).
1205	1210	Test operation. → No flow.
1210	1230	Driller to pull pump and take to town.
1230	1235	All pipe & pump out of hole.
1235		Drillers to town. Will call to follow up
	1300	with Geo. Geo gather equip. & secure things.
1300	1430	Geo leave site to office. Waiting on driller.
1430		Driller calls it for the day. Will resume Monday.

Not used (NB)

ed By: N. Bowles
Geologist
Date: 7/22/05
Signature:

Reviewed By: L.D. Walker
Title: Geologist
Date: 8/4/05
Signature: LD Walker

A-6003-612 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING

Page 1 of 3

Date: 7/25/05

Well ID: C4955 | Well Name: 699-S20-E10

Location: 300-FF-5 Inw. | Report No.: 9

Start	Finish	Total
Time 0600	Time 1130	Time 5.5
Hole Depth/Csg Ø / Ø	Hole Depth/Csg Ø / Ø	Hole Depth/Csg — / —

Reference Measuring Point: GROUND SURFACE

Casing String No. ~~1 2 3 4~~ Rod Size: -N/A-

See Report No. 1

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth (Attach applicable drawings and document straightness test results)
0600		Geo. to site.
0600	0630	POD (BTR, Drillers, & Geo).
0630	0635	Prepare for development. Test pump. => okay.
0635	0640	Tag water @ 46.63' btoc (-3' = 43.63' bgs). Bottom @ 63.9' btoc
0640		Transducer coattached @ 1.65' above pump intake.
		Inserting pump, trans., & pipe into well. All same
	0655	pipe & measurements - (see FAR for 7/22/05).
0645		Checking Instruments:
		- Aach turbidity meter. 2100P Ser.# 95080096453
		- Gelex Std. - 564 | 47.3 | 4.85
		Act. - 560 | 47.5 | 4.83
		- Oakton pH tester #:
		- showing 6.99 on 7.00 standard.
		" 10.02 " 10.00 std.
		- Orion Thermo 135 A (cond.)
	0655	~~Show~~ No Std. ("one-shots").
0655	0700	All material in hole & ready.
0700		Checking logger. Init. X_p = 10.943 (good). Preparing to
		run test. Pump intake set @ 60.35' btoc (57.35' bgs).
		Transducer @ 57.7' btoc (54.7' bgs). Intake @
	0708	13.72' below starting W.L.
0708		Start 1st test w/pump intake set @ 60.35' btoc (57.35' bgs).
		Logger test #0024, $X_{p\,init}$ = 10.940' H_2O
	p.2 →	← p.2

Reported By: N. Bowles | Reviewed By: L.D. Walker

Title: Geologist | Date: 7/25/05 | Title: Geologist | Date: 8/4/05

Signature: N. Bowles | Signature: L.D. Walker

A-6003-451 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING

Continuation Page

Date: 7/25/05

Well Name: 699-S20-E10 | Well ID: C4855

Location: 300-FF-5 West. | Continuation of Report No.: 9

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth
(from 8/8 cont'd)		Time Turb. pH Cond. Flowrate X_D Temp
		(NB) ~~0707~~ 0714 5.66(NTU) 8.04 -N/A- 33.2 gpm 10.612' 17.5°C
		0720 4.32 " 7.92 33.2 " 10.594' 17.4 "
		0726 1.64 " 7.93 33.2 " 10.600 17.5 "
		0731 1.38 " 7.89 33.2 " 10.588 17.3 "
	0735	Decide to stop test (params stable, Turb. < 5 NTU).
0735	0810	Stop test, Start recovery, recorded as Test #005
0810		Remove 5.10' piece of riser pipe, setting pump
	0817	intake @ 55.25' btoc (52.25' bgs).
0817	0820	Final Preps for 2nd test.
0820		Start 2nd Test w/ pump intake @ 55.25' btoc (52.25' bgs).
		Logger test #006, $X_{D\,limit}$ = 5.839' H_2O
		Time Turb. pH Cond. Flowrate X_D Temp.
		0825 26.1(NTU) 7.99 -N/A- 31.6 gpm 5.523 18.3°C
		0831 7.02 " 7.94 31.6 " 5.517 17.7 "
		0837 1.63 " 7.95 31.6 " 5.505 17.6 "
		0843 1.10 " 7.93 31.6 " 5.499 ~~17.6~~ 17.7°C (NB)
	0846	Decide to stop test.
0846	0818	Stop test, Start recovery, recorded as test. #007.
0818	0940	Pull temporary pump, pipe, & transducer.
0940		Tag water @ 46.65' btoc (43.65' bgs).
	0945	" bottom @ 64.16' btoc (61.16' bgs).
0945		Inspect pump (perm.), notice carbon-steel screw
	1025	that must be replaced ⇒ Driller to town to fix.
1025		Driller back w/ pump! All S.S. ⇒ okay
		Pump info: Grundfos 5 RadiFlo3, 5 SQE90 NE
		w/ 0.3 HP motor, 2 stage.
		Length (intake to coupler) = 0.8'
	P.3 ↓	

Reported By: M. Bowles | Reviewed By: L.D. Walker

Title: Geologist | Date: 7/25/05 | Title: Geologist | Date: 8/4/05

Signature: | Signature:

A-6003-652 (04/03)

FIELD ACTIVITY REPORT - DAILY DRILLING

Continuation Page

Date: 7/25/05

Well Name: 66 (NB) 699-S20-E10 | Well ID: C4855

Location: 300-FF-5 I.W. | Continuation of Report No.: 9

Time/Depth From	Time/Depth To	Description of Activities/Operations with Depth
(1025 cont'd)		Riser Pipe info: 3/4" Type 304 S.S. NPT Thd. Sch. 40S w/ 3/4 304SS NPT couplers.
		Lengths: 20.15', 20.10', 10.15', & 5.04
		Total ⇒ 55.44' of 3/4" riser pipe.
		Total length of pump string is 56.24'.
		Thickness of landing plate is ~~0.12'~~ 0.04' } 0.16' total
		→ " " top coupler is ~~0.16'~~ 0.12' }
		⇒ Intake should be set @ 53.08' bgs (3.16' stick,
	1035	when including landing plate & top coupler).
1035	1100	Inserting perm. pump string into well!
1100		All material in well. Intake set @ 53.08' bgs (NB) 9.4'
		below water level. Check for E-Tape clearance
		⇒ No problem; Tag water @ 46.67' btoc ⇒
	1105	43.63' bgs w/ (3.00' (6.5" casing) + 0.04' (landing plate)) stick.
1105	1107	Test pump. Produced 5 gallons in ~1 min ⇒ ~5 gpm.
1107	1115	Measure prot. posts ⇒ 6' Long, 3.5" O.D.
1115		Driller to continue w/ surface completion.
	1130	Geo paperwork.
1130		Geo done for day. Leave site to office.
		Not used

Reported By: W. Bowles | Reviewed By: L.D. Walker

Title: Geologist | Date: 7/25/05 | Title: Geologist | Date: 8/4/05

Signature: [signature] | Signature: [signature]

A-6003-652 (04/03)

WELL DEVELOPMENT AND TESTING DATA

Well Name:	Well ID:	Well Location:	Date:
699-S20-E10	C4855	300-FF-5 UW, NW & 300 Area	7/22/05

Reference Measuring Point (unless otherwise noted): TOP OF OUTER CASING (TOC)

Has the well been surveyed? ○ Yes ⊗ No | Does the well have a cement pad? ○ Yes ⊗ No

PART 1

STATIC WATER LEVEL:

Start of Job 46.65' btoc (43.65' bgs)

End of Job -N/A-

DEPTH TO BOTTOM:

Start of Job 63.96 btoc (60.9' bgs)

End of Job -N/A-

PART 2

WELL DEVELOPMENT DATA

Pump Model Grundfos 3HP w/ Franklin Motor

Intake Depth 60.35' btoc (NB 57.75') / -N/A-

Starting Turbidity >1000 NTU / -N/A-

Pump Start	Stop	Flow Rate
1128	1130	-N/A- (0)

Pot used (NB)

Total Pumped 0 (pump not working)

Final Turbidity -N/A-

XD SN/Range (PSI) 5217 / 20 psi

PART 3

INSTANTANEOUS SLUG TEST

Static Water Level (TOC)

Transducer Depth

Baseline Start

Injection Start

Baseline Start

Withdrawal Start

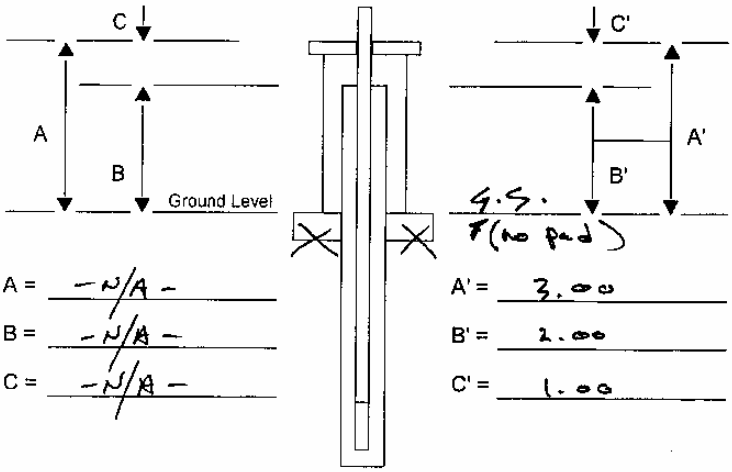
Slug Volume

XD SN/Range (PSI)

PART 4

Last Recorded Measurements Date: -N/A-

Current Measurements Date: 7/22/05



A = -N/A-

B = -N/A-

C = -N/A-

A' = 3.00

B' = 2.00

C' = 1.00

Are there any reference marks on the casing strings? ○ Yes ⊗ No

PART 5

COMMENTS:

#1 - Initial XD ~~11.002 10.996~~ (NB) H_2O

First interval w/ pump intake @ 60.35'

Logger → Test #03

↳ Failed test (pump not producing water).

→ No more development for this day (NB)

Prepared by (print name):	Signature:	Date:
N. Bowles		7/22/05
Reviewed by (print name):	**Signature:**	**Date:**
L.D. Walker		8/4/05

A-6003-644 (03/03)

WELL DEVELOPMENT AND TESTING DATA

Well Name:	Well ID:	Well Location:	Date:
699-S20-E10	C4855	300-FF-5 (NRM) - NW of 300 Area	7/25/05

Reference Measuring Point (unless otherwise noted): TOP OF OUTER CASING (TOC)

Has the well been surveyed? ○ Yes ⊗ No

Does the well have a cement pad? ○ Yes ⊗ No

PART 1

STATIC WATER LEVEL:

Start of Job	46.63' btoc (43.63' bgs)
End of Job	46.65' btoc (43.65' bgs)

DEPTH TO BOTTOM:

Start of Job	63.90' btoc (60.90' bgs)
End of Job	64.16' btoc (61.16' bgs)

PART 2

WELL DEVELOPMENT DATA

Pump Model	Grundfos 5S. 3HP w/ Franklin motor
Intake Depth	60.35' btoc / 55.25' btoc
Starting Turbidity	>1000 NTU / >1000 NTU

Pump Start	Stop	Flow Rate
0708	0735	33.2 gpm
0820	0846	31.6 gpm

Not used (NS)

Total Pumped	~900 gal / ~825 gal
Final Turbidity	1.30 NTU / 1.10 NTU
XD SN/Range (PSI)	5217/20PSI

PART 3

INSTANTANEOUS SLUG TEST

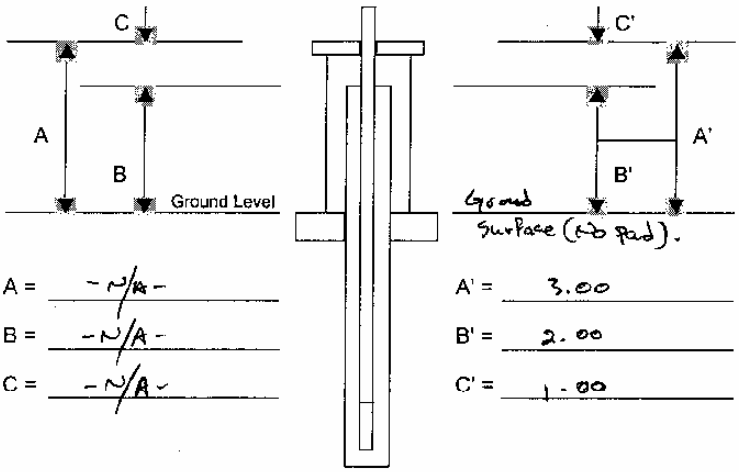
Not used (NS)

Static Water Level (TOC)	
Transducer Depth	
Baseline Start	
Injection Start	
Baseline Start	
Withdrawal Start	
Slug Volume	
XD SN/Range (PSI)	

PART 4

Last Recorded Measurements Date: -N/A-

Current Measurements Date: 7/25/05



A = -N/A-

B = -N/A-

C = -N/A-

A' = 3.00

B' = 2.00

C' = 1.00

Are there any reference marks on the casing strings? ○ Yes ⊗ No

PART 5

COMMENTS:

#1 - Init X_D = 10.940' H_{20}

First interval w/ pump intake @ 60.35' btoc
- Recorded @ test # 004
- Recovery recorded as test # 005

#2 - Init. X_D =

2nd interval w/ pump intake @ 55.25' btoc
- Recorded as test # 006
- Recovery recorded as test # 007.

Prepared by (print name): W. Bowles	Signature: W. Bowles	Date: 7/25/05
Reviewed by (print name): L.D. Walker	Signature: L.D. Walker	Date: 8/4/05

A-6003-644 (03/03)

WELL ATTRIBUTES REPORT

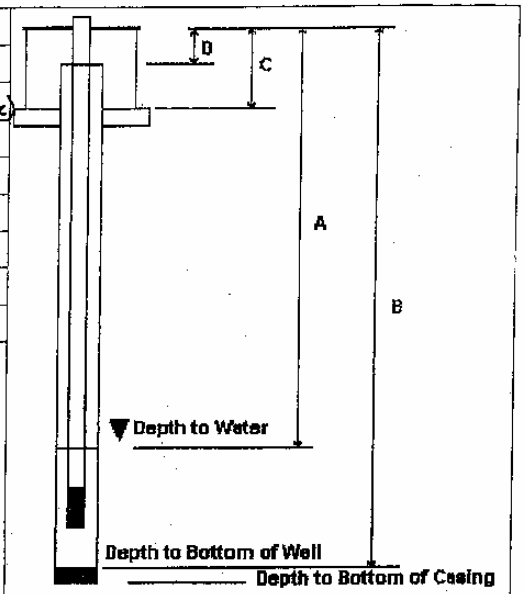
ELD ORDER NO
WELL ID C4855
WELL NAME 699-520-E10
HOST WELL ID NA

DRILL DATE 7/12/05
CONST DATE 7/25/05
CONST DEPTH 61.5' bgs

LAST INSPECTION
NORTHING
EASTING
ELEVATION

MEASUREMENT INFORMATION

		LAST	CURRENT
A	DEPTH TO WATER(ft)	46.65' btoc	46.74' (TOC)
	DEPTH TO WATER DATE	7-25-05	7-28-05
B	DEPTH TO BOTTOM(ft)	64.16' (TOC)	Not Meas.
	DEPTH TO BOTTOM DATE	7-25-05	NA
C	STICK UP(ft)	3.0' (no cement pad)	2.51'
D	REFERENCE MARK(ft)	1.0'	1.0'
	REFERENCE MARK IS TOC	☑ YES ☐ NO ☐ ND*	☑ YES ☐ NO



A DEPTH TO WATER FROM TOP OF CASING
B DEPTH TO BOTTOM OF WELL FROM TOP OF CASING
C TOP OF CASING TO GROUND SURFACE/PAD
D TOP OF CASING TO SURVEY REFERENCE MARKER

PERFORATION INFORMATION

NA

CASING SIZE	TOP	BOTTOM	CUTS/FT/ROUND

CHANGES Cement pad not in place on 7-25-05

CASING INFORMATION

SIZE	TOP	BOTTOM	MATERIAL	TYPE	CONNECTION	THICKNESS
4"	+ 2.0'	43.57'	304L SS	—	F480	Sch. 5

CHANGES

SCREEN INFORMATION

SIZE	TOP	BOTTOM	MATERIAL	TYPE	SLOT SIZE
4"	43.57'	58.56'	SS	304L	0.020-in.

CHANGES

ND* - Not Documented

1/24/2003

WELL ATTRIBUTES REPORT

FIELD ORDER NO				LAST INSPECTION	
WELL ID	C4855	DRILL DATE	7/12/05	NORTHING	
WELL NAME	699-S20-E10	CONST DATE	7/25/05	EASTING	
HOST WELL ID	NA	CONST DEPTH	61.5' bgs	ELEVATION	

LAST INSPECTION INFORMATION		CURRENT INSPECTION INFORMATION	
WELL PAD	☐ YES ☐ NO ☐ ND*	WELL PAD	☑ YES ☐ NO
BRASS SURVEY MARKER	☐ YES ☐ NO ☐ ND*	BRASS SURVEY MARKER	☑ YES ☐ NO
MARKER STAMPED WITH SURVEY DATA	☐ YES ☐ NO ☐ ND*	MARKER STAMPED WITH SURVEY DATA	☐ YES ☑ NO
MARKER STAMPED WITH WELL ID DATA	☐ YES ☐ NO ☐ ND*	MARKER STAMPED WITH WELL ID DATA	☑ YES ☐ NO
WELL LABELED WITH WELL ID	☐ YES ☐ NO ☐ ND*	WELL LABELED WITH WELL ID	☐ YES ☑ NO
WELL LABELED WITH WELL NAME	☐ YES ☐ NO ☐ ND*	WELL LABELED WITH WELL NAME	☐ YES ☑ NO
PROTECTIVE POSTS	☐ YES ☐ NO ☐ ND*	PROTECTIVE POSTS	☑ YES ☐ NO
REMOVABLE POST IN PLACE	☐ YES ☐ NO ☐ ND*	REMOVABLE POST IN PLACE	☑ YES ☐ NO
WELL LOCK	☐ YES ☐ NO ☐ ND*	WELL LOCK	☑ YES ☐ NO
WELL DAMAGED	☐ YES ☐ NO ☐ ND*	WELL DAMAGED	☐ YES ☑ NO
WELL IS DRY	☐ YES ☐ NO ☐ ND*	WELL IS DRY	☐ YES ☑ NO
PARTED CASING	☐ YES ☐ NO ☐ ND*	PARTED CASING	☐ YES ☑ NO
BENTONITE IN WELL	☐ YES ☐ NO ☐ ND*	BENTONITE IN WELL	☐ YES ☑ NO
WELL SANDED IN	☐ YES ☐ NO ☐ ND*	WELL SANDED IN	☐ YES ☑ NO
COLLAPSED CASING	☐ YES ☐ NO ☐ ND*	COLLAPSED CASING	☐ YES ☑ NO
EQUIPMENT IN WELL	☐ YES ☐ NO ☐ ND*	EQUIPMENT IN WELL	☐ YES ☑ NO
DEBRIS IN WELL	☐ YES ☐ NO ☐ ND*	DEBRIS IN WELL	☐ YES ☑ NO
LAST PUMP INFORMATION		**CURRENT PUMP INFORMATION**	
PUMP ACTIVITY PERFORMED	☐ INSTALLED ☐ REPLACED ☐ REMOVED ☐ ND*	PUMP ACTIVITY PERFORMED	☑ INSTALLED ☐ REPLACED ☐ REMOVED
PUMP TESTED	☐ YES ☐ NO ☐ ND*	PUMP TESTED	☑ YES ☐ NO
NEW PUMP	☐ YES ☐ NO ☐ ND*	NEW PUMP	☑ YES ☐ NO
ACTIVITY PEFORMED BY		ACTIVITY PEFORMED BY	Blue Star Drilling
DATE ACTIVITY PERFORMED		DATE ACTIVITY PERFORMED	7-25-05
PUMP TYPE		PUMP TYPE	Grundfos elec. Sub.
PUMP MAKE		PUMP MAKE	Grundfos
PUMP MODEL		PUMP MODEL	5 Redi-flo3
PUMP INTAKE DEPTH (ft)		PUMP INTAKE DEPTH (ft)	53'
TUBING SIZE (In)		TUBING SIZE (In)	3/4"
TUBING MATERIAL		TUBING MATERIAL	304 SS
TUBING LENGTH (ft)		TUBING LENGTH (ft)	55.44'
TUBING CONNECTION		TUBING CONNECTION	Coupling, SS

ND* - Not Documented

1/24/2003

FIELD ACTIVITY REPORT

TUBULAR GOODS TALLY

Page 1 of 1

Date: 7-12-05 to 7/21/05

Well Name: Borehole C-4855 | Well ID: 699-S20-E10

TEMPORARY				PERMANENT*						SCREEN/CAP*		
Jt. #	Length (ft.)	Jt. #	Length (ft.)	Jt. #	Length (ft.)	C	Jt. #	Length (ft.)	C	Jt. #	Length (ft.)	C
1	4.48	21		1	20.00'	C	21	~~20.00~~ (NS)		1	(Gump) 3.00	C
2	5.01	22		2	20.00'		22	~~20.~~ (NS)		2	(Scr.) 14.99	
3	5.00	23		3	4.94'		23			3		
4	5.05	24		4	0.63'		24			4		
5	5.00	25		5			25			5		
6	5.02	26		6			26			6		
7	5.03	27		7			27			7		
8	5.01	28		8			28			8		
9	5.02	29		9			29			9		
10	5.04	30		10			30			10		
11	5.00	31	Not Used	11			31	Not Used		11	Not Used	
12	5.00	32		12	Not Used		32			12		
13	5.00	33		13			33			13		
14	(32)	34		14			34			14		
15		35		15			35			15		
16	Not Used	36		16			36			16		
17		37		17			37			17		
18		38		18			38			18		
19		39		19			39			19		
20	64.66 (NS)	40		20			40			20		
Tot	65.17	Tot		Tot	45.57		Tot	———		Tot	17.99	

*Indicate those joints with centralizers with a C in the available box.
ALL Casing length shall be measured to the nearest 0.01 ft.

Comments/Remarks:

Permanent: 4" Sch. 5 Type 304/304L SS. (4½" O.D/4" I.D.)
Total length = 63.56'.
→ S.S. screen is 0.020" slot, cont. wire wrapped V-slot.

Temporary: O.D./I.D. 8⅝" / 7 11/16" | Permanent: O.D./I.D. 4½" / 4" | Screen: O.D./I.D. 4½" / 4"

- All temporary casing removed from ground.

Reported By: M. Bowles		Reviewed By: L.D. Walker	
Title: Geologist	Date: 7/21/05	Title: Geologist	Date: 8/4/05
Signature: M. Bowles		Signature: LD Walker	

A-6003-655 (04/03)

WELL SURVEY DATA REPORT

Project:

Prepared By: N.P. Fastabend
Company: FGG

Date Requested: 8/15/05

Requestor: L.D. Walker (FH)

Date of Survey: 9/6/05

Surveyor: N.P. Fastabend
FGG

ERC Point of Contact:

Survey Co. Point of Contact:
Grant F. Brazil (PLS)

Description of Work:
Civil Survey of Groundwater Monitoring Well C4855 / 699-S20-E10.

Horizontal Datum: NAD83(91)

Vertical Datum: NAVD88

Units: Meters

Hanford Area Designation: 600A

Coordinate System: Washington State Plane Coordinates (South Zone)

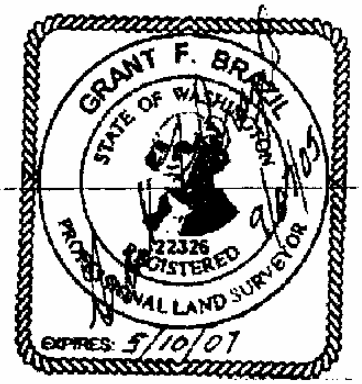
Horizontal Control Monuments:
N323 (COE) and 300-70 (FGG)

Vertical Control Monuments:
HSWB-005 (COE) and M323 (COE)

Well ID	Well Name	Easting	Northing	Elevation	
C4855	699-S20-E10	593124.37	117366.18		Center of Casing
				120.490	Top Pump Baseplate, N. Edge
				120.480	Top Casing, N. Edge
				119.731	Brass Survey Marker

Notes:

Equipment Used: Trimble GPS 5800 RTK
Trimble DiNi 12 Level



Surveyor Statement:
I, Grant F. Brazil, a Professional Land Surveyor registered in the State of Washington (Registration No. 22326), hereby certify that this report is based on a field survey performed in September, 2005 under my direct supervision, and that the data contained here is true and correct.

Original to
Distribution by DIS.

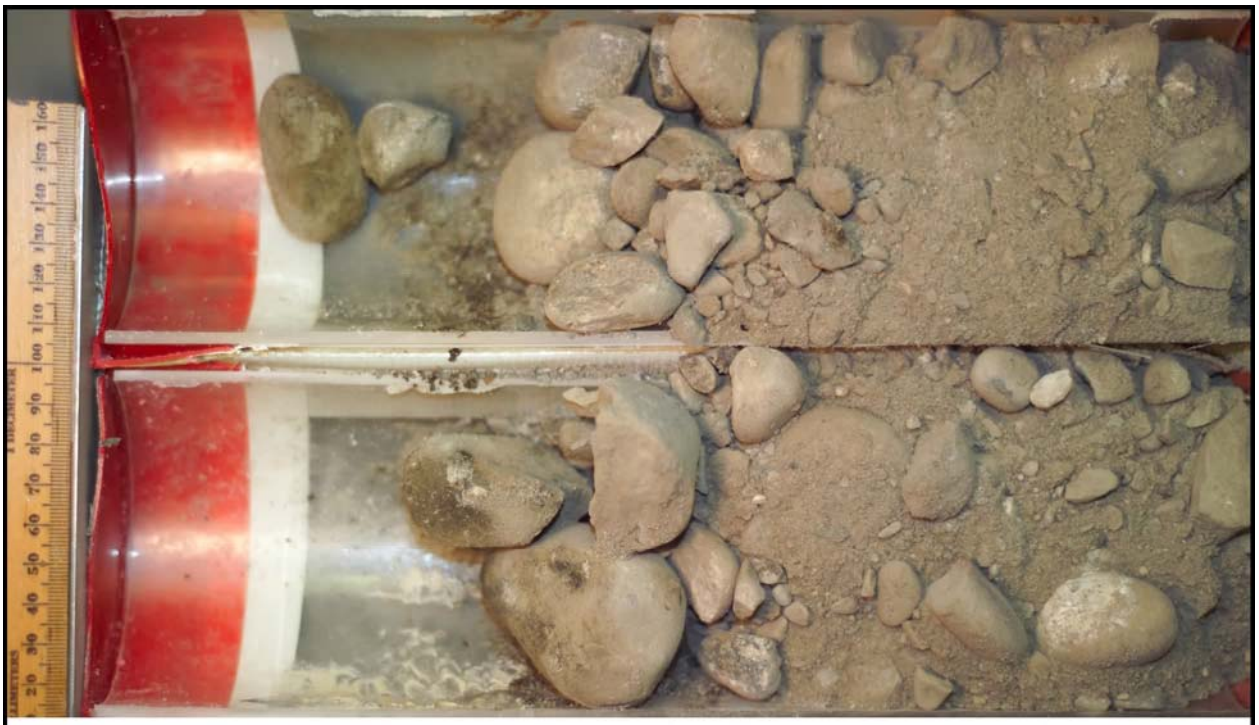
Appendix B

Core Photographs, Selected Descriptions, and Chain-of-Custody Forms

NOTE:

1) Quality of Core Photos is dependent on photographic conditions.

2) Hardcopy quality/color are dependent on the individual printer and printing software used.



UP	Borehole ID	Core Sample Number	Depth
◀	C4855	C4855-1	7' - 8'

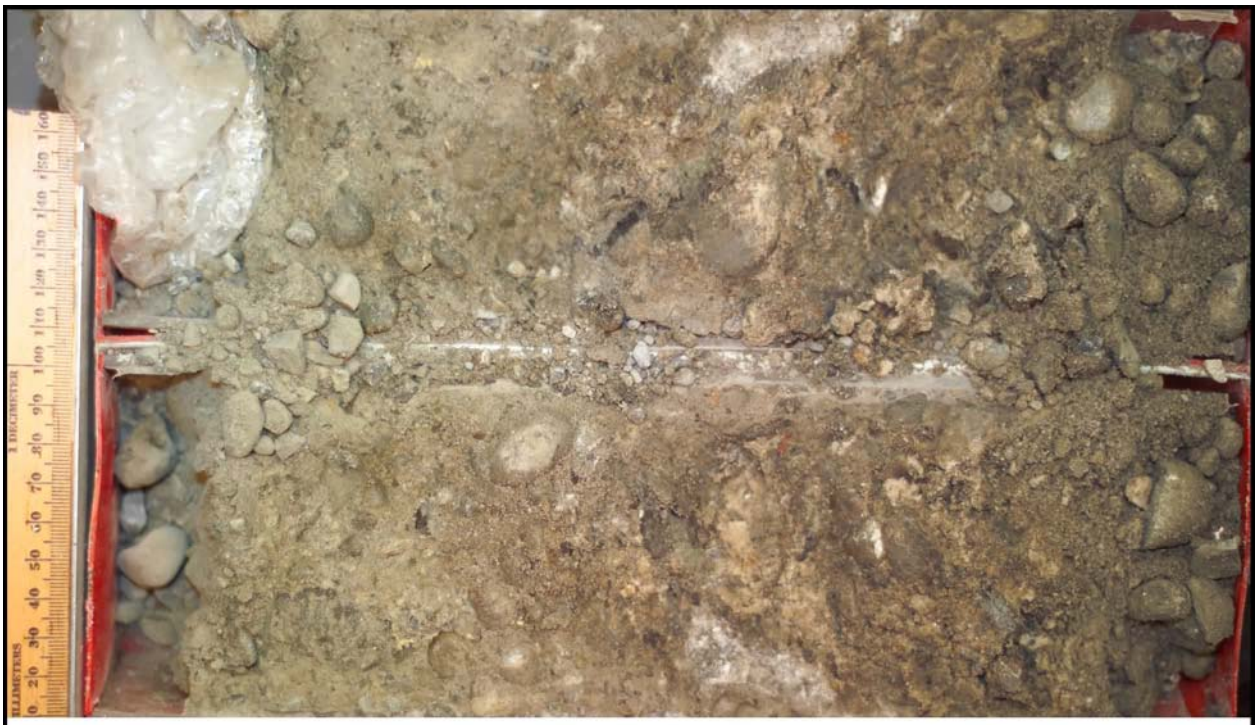
UP	Borehole ID	Core Sample Number	Depth
◀	C4855	C4855-2	8' - 9'

◄ UP	Borehole ID	Core Sample Number	Depth
	C4855	C4855-3	9.5' - 10.5'

◄ UP	Borehole ID	Core Sample Number	Depth
	C4855	C4855-4	10.5' - 11.5'

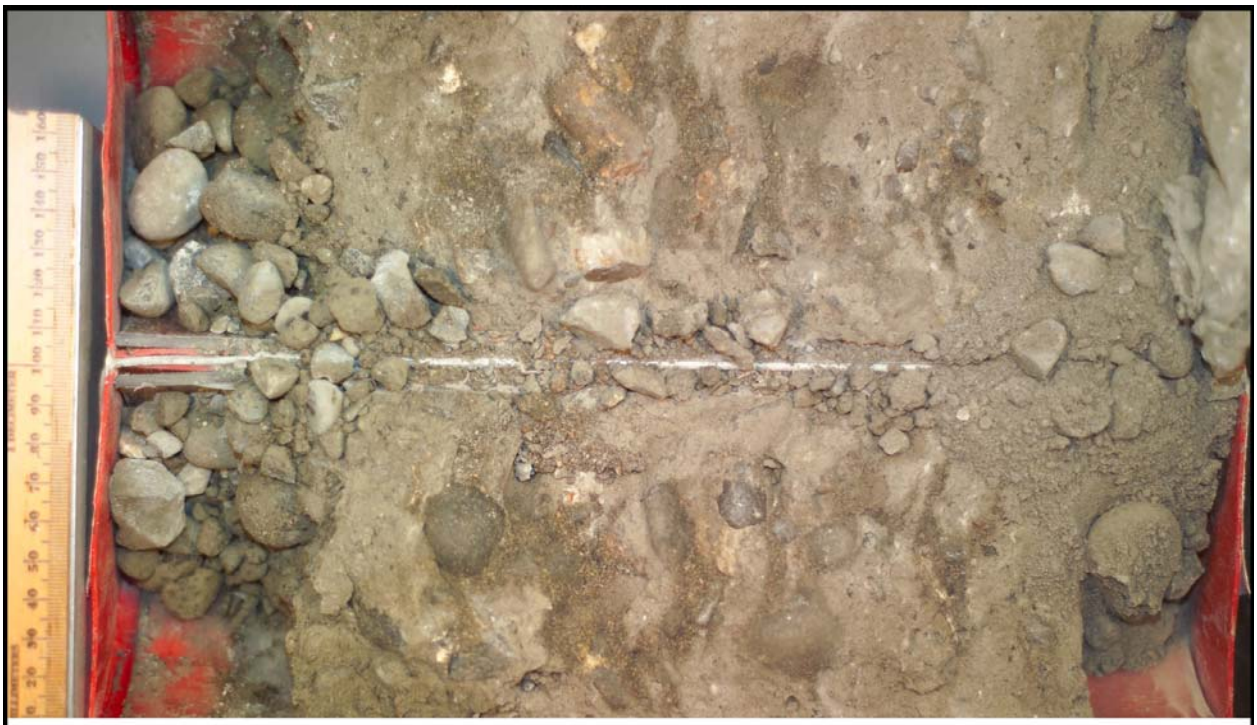
Borehole ID	Core Sample Number	Depth
◀ UP C4855	C4855-5	12' - 13'

Borehole ID	Core Sample Number	Depth
◀ UP C4855	C4855-6	13' - 14'



UP	Borehole ID	Core Sample Number	Depth
◀	C4855	C4855-7	14.5' - 15.5'

UP	Borehole ID	Core Sample Number	Depth
◀	C4855	C4855-8	15.5' - 16.5'

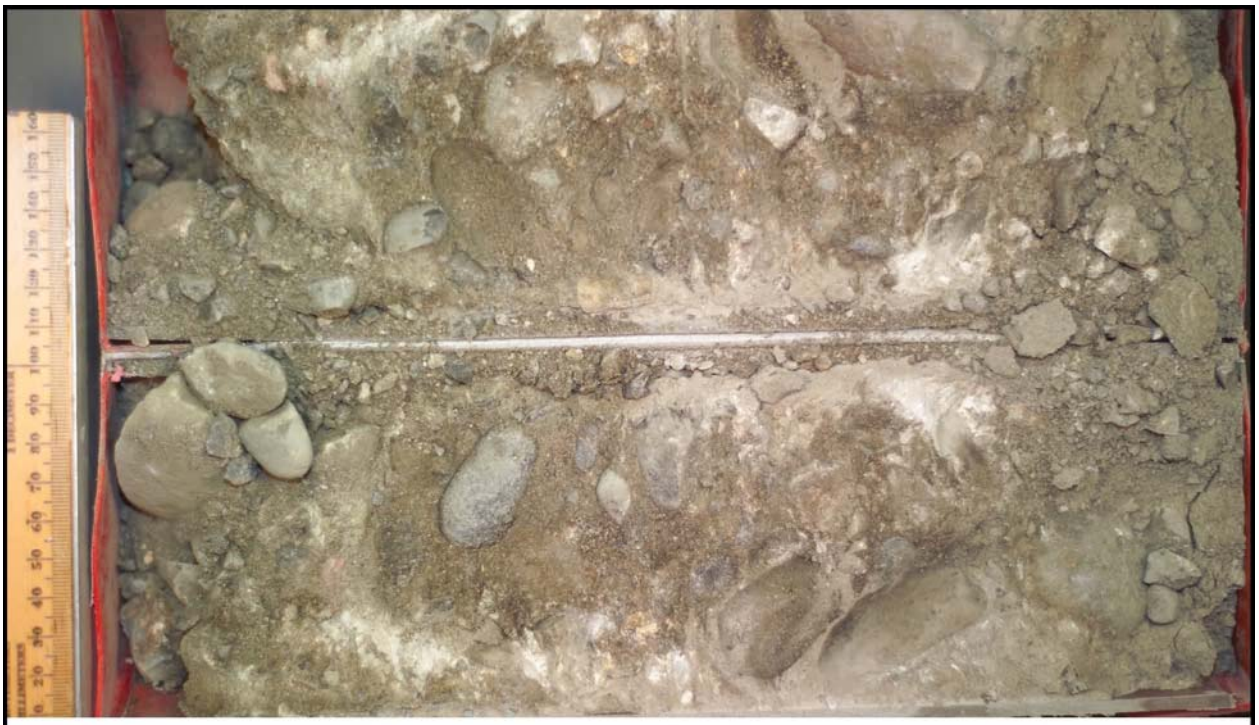


◄UP	Borehole ID	Core Sample Number	Depth
	C4855	C4855-9	17' - 18'

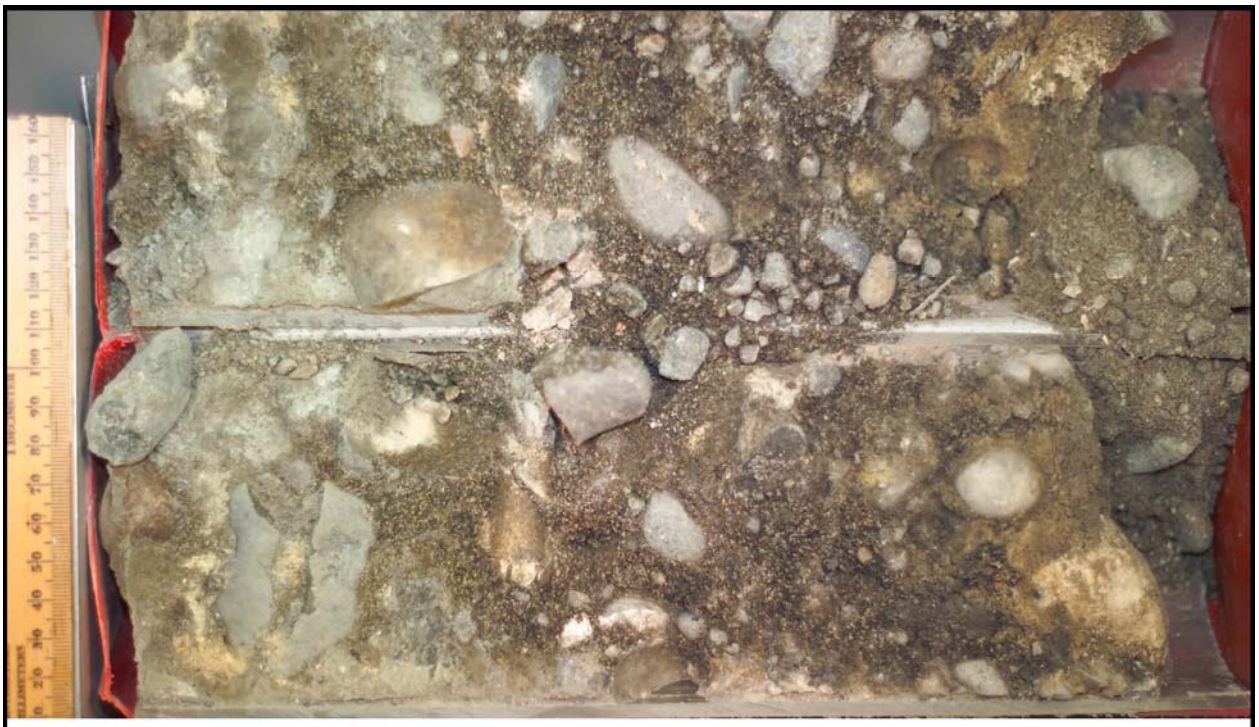
◄UP	Borehole ID	Core Sample Number	Depth
	C4855	C4855-10	18' - 19'

UP	Borehole ID	Core Sample Number	Depth
◀	C4855	C4855-11	19.5' - 20.5'

UP	Borehole ID	Core Sample Number	Depth
◀	C4855	C4855-12	20.5' - 21.5'

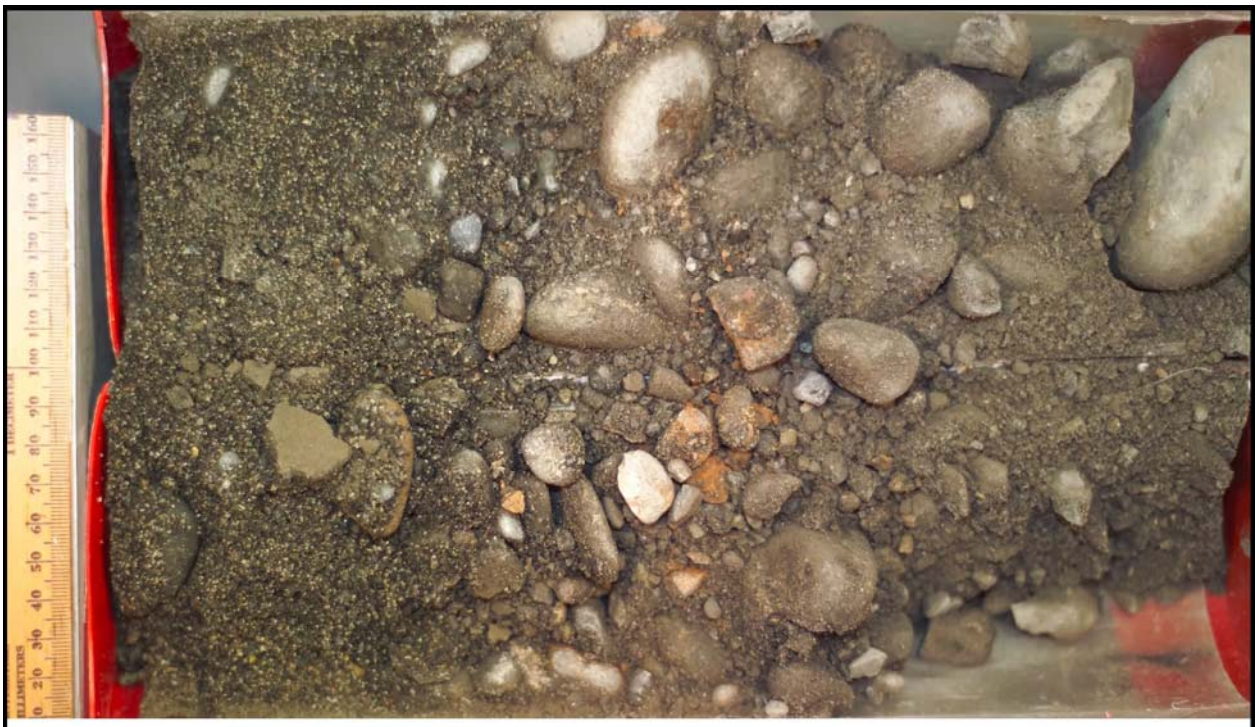


UP	Borehole ID	Core Sample Number	Depth
◀	C4855	C4855-13	22' - 23'



UP	Borehole ID	Core Sample Number	Depth
◀	C4855	C4855-14	23' - 24'

◀ UP	Borehole ID	Core Sample Number	Depth
	C4855	C4855-15	24.5' - 25.5'



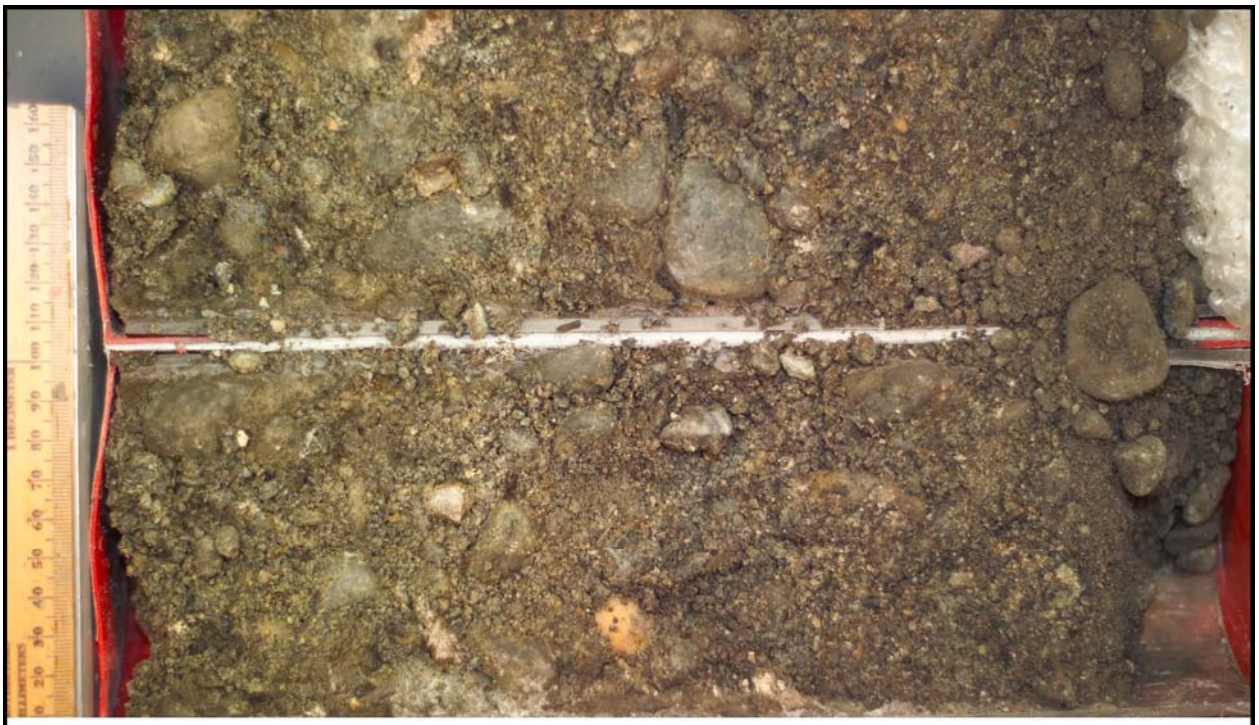
◀ UP	Borehole ID	Core Sample Number	Depth
	C4855	C4855-16	25.5' - 26.5'

UP	Borehole ID	Core Sample Number	Depth
◀	C4855	C4855-17	27' - 28'

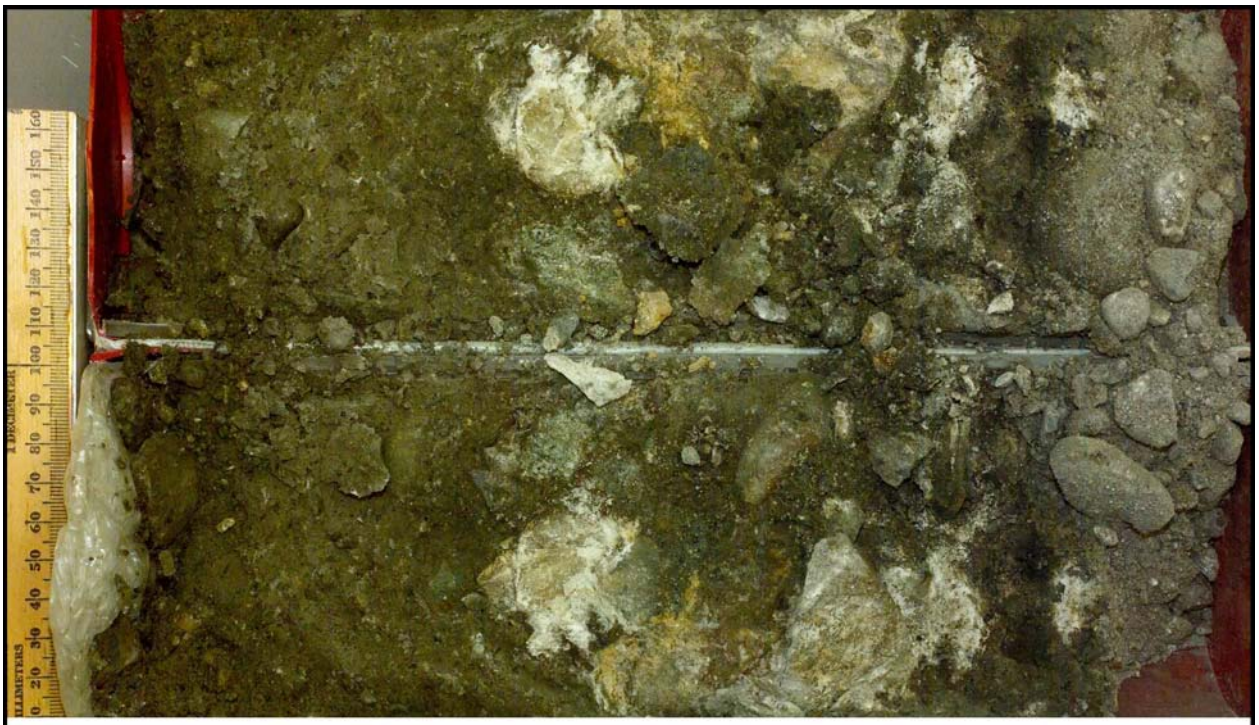
UP	Borehole ID	Core Sample Number	Depth
◀	C4855	C4855-18	28' - 29'

Borehole ID	Core Sample Number	Depth
◀ UP C4855	C4855-19	30' - 31'

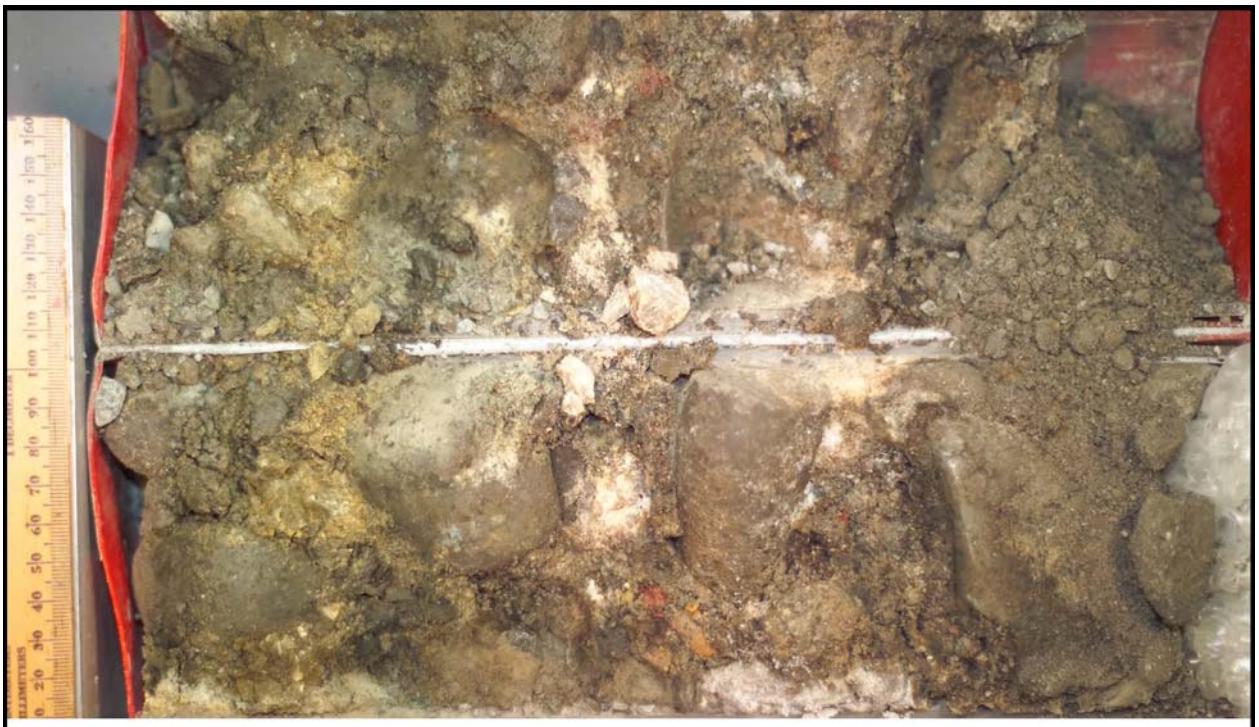
Borehole ID	Core Sample Number	Depth
◀ UP C4855	C4855-20	32' - 33'



Borehole ID	Core Sample Number	Depth
◀ UP C4855	C4855-21	33' - 34'

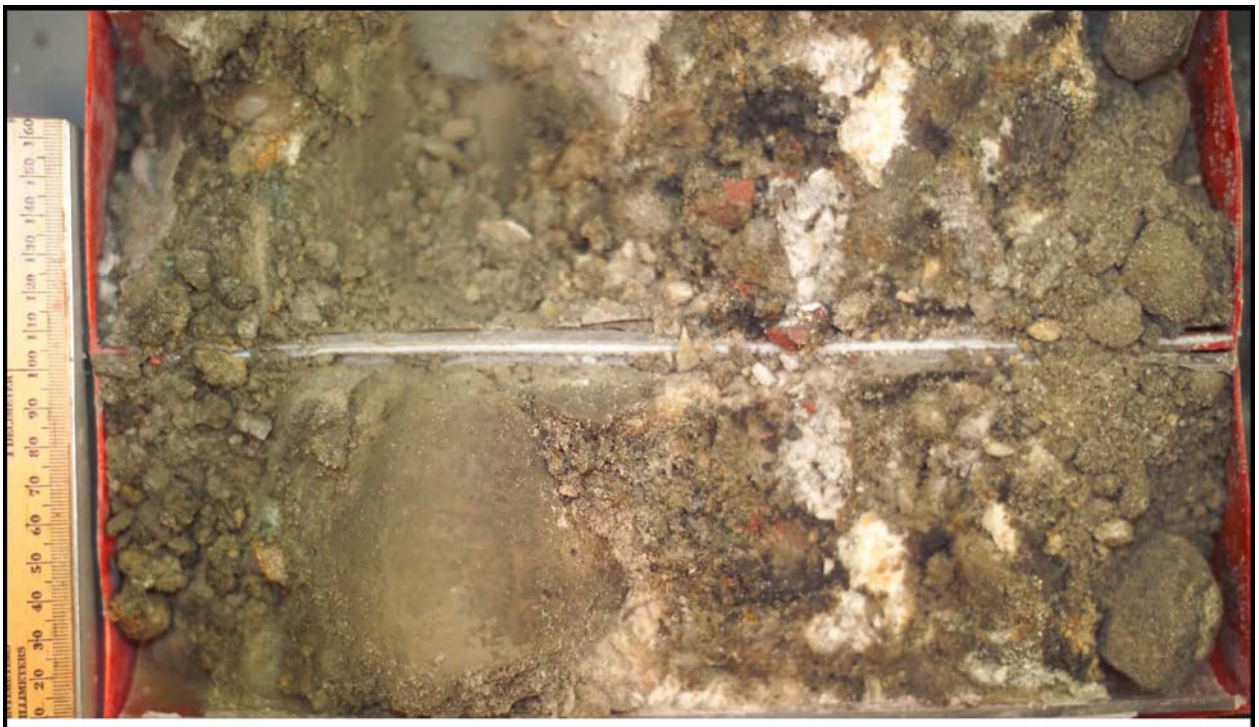


Borehole ID	Core Sample Number	Depth
◀ UP C4855	C4855-22	34.5' - 35.5'



Borehole ID	Core Sample Number	Depth
◀ UP C4855	C4855-23	35.5' - 36.5'

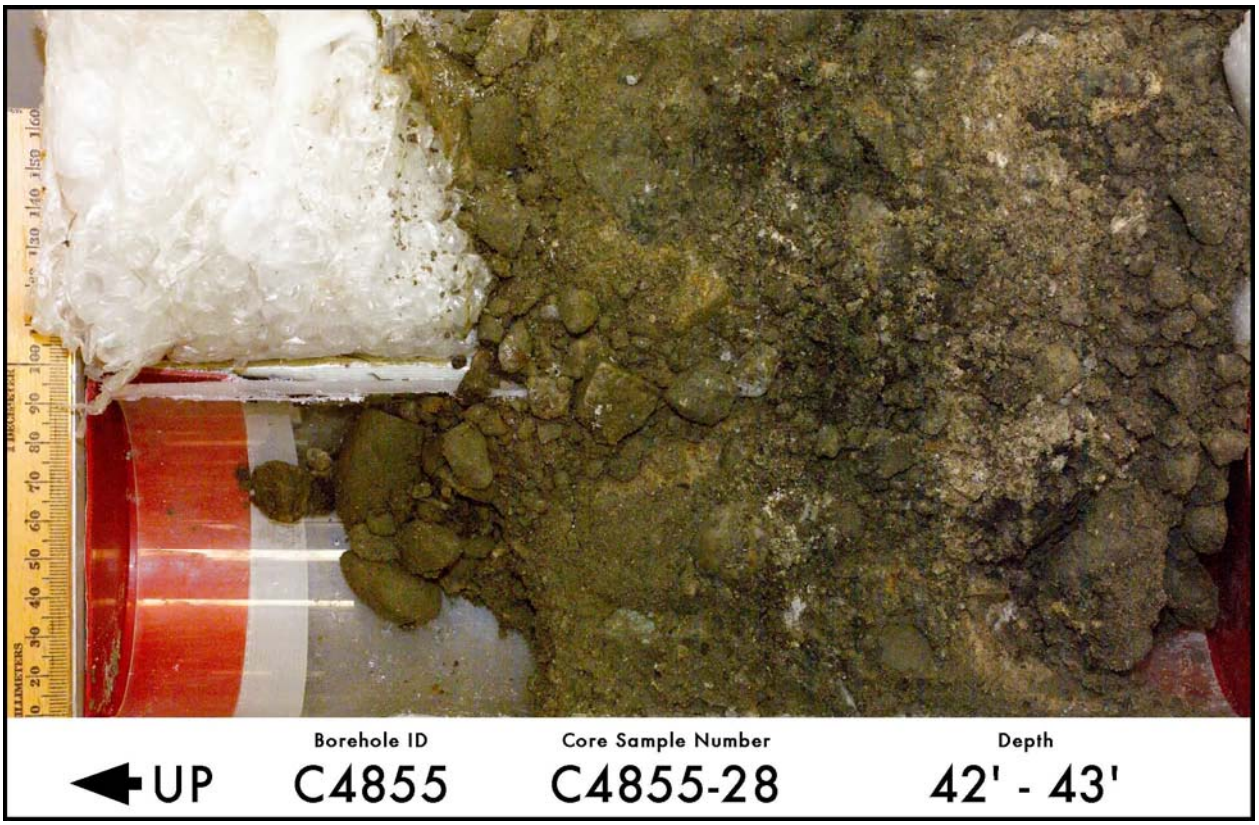
Borehole ID	Core Sample Number	Depth
◀ UP C4855	C4855-24	37' - 38'



Borehole ID	Core Sample Number	Depth
◀ UP C4855	C4855-25	38' - 39'

◀ UP	Borehole ID	Core Sample Number	Depth
	C4855	C4855-26	39.5' - 40.5'

◀ UP	Borehole ID	Core Sample Number	Depth
	C4855	C4855-27	40.5' - 41.5'



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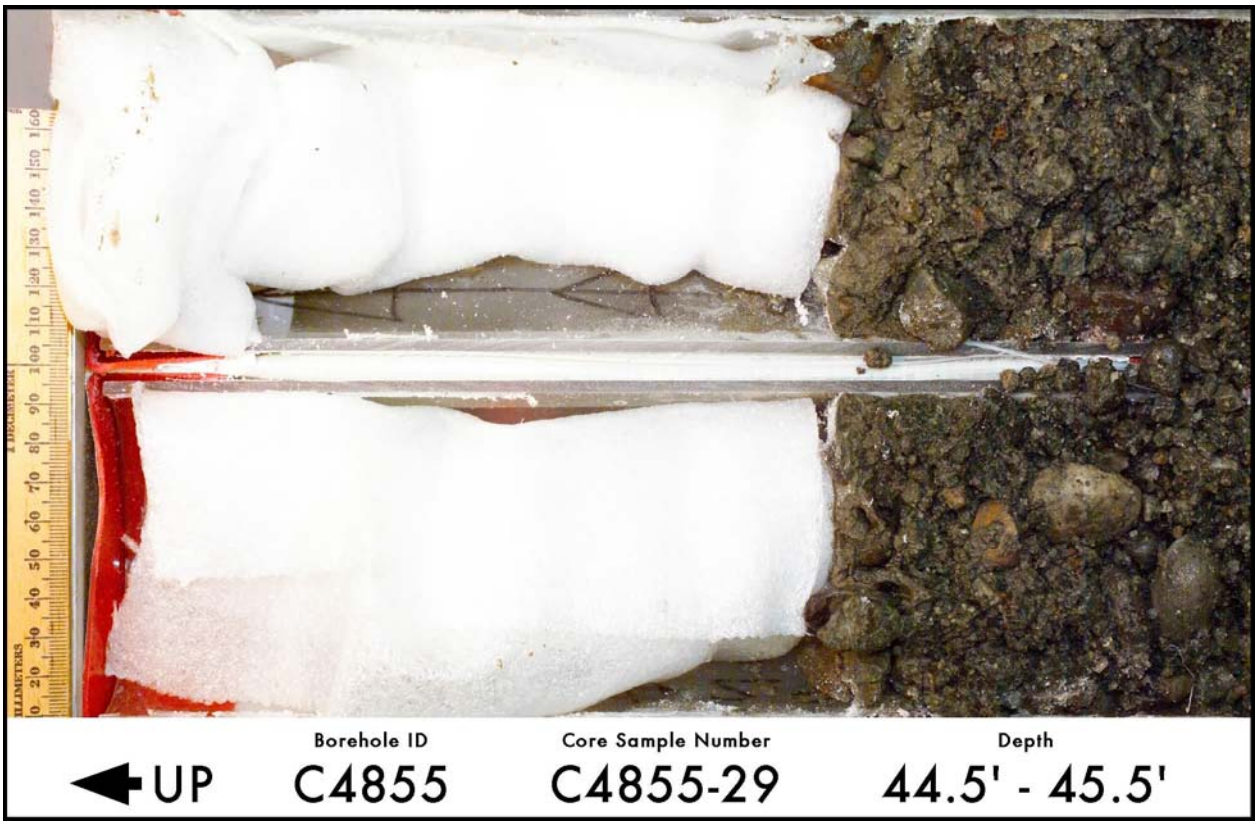

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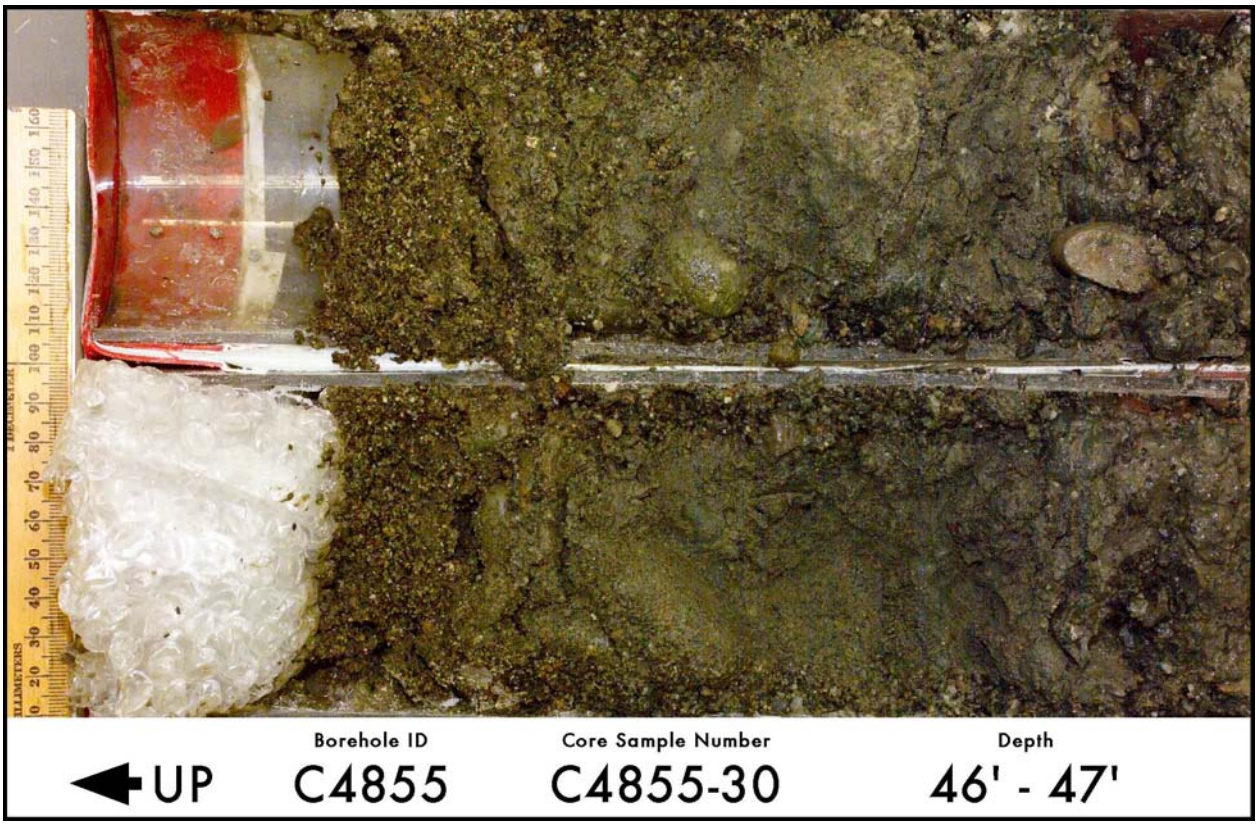
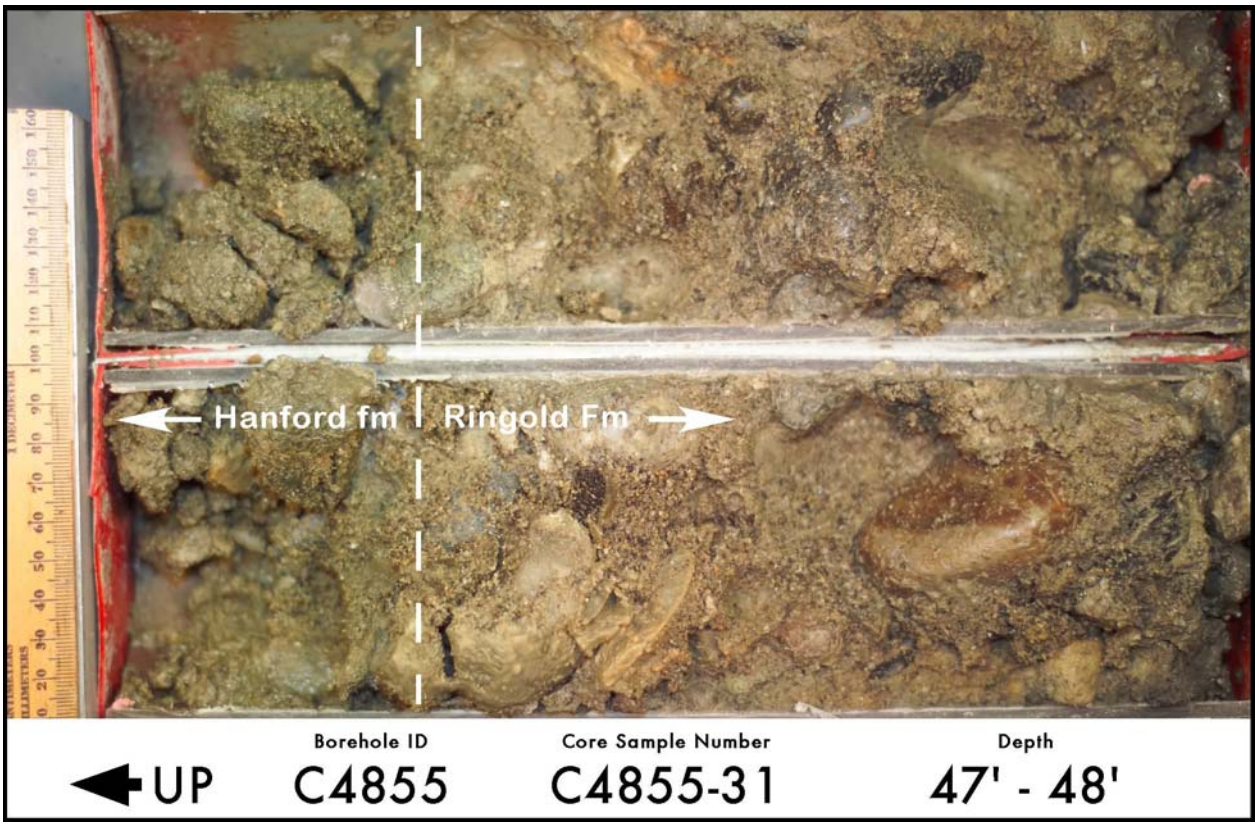


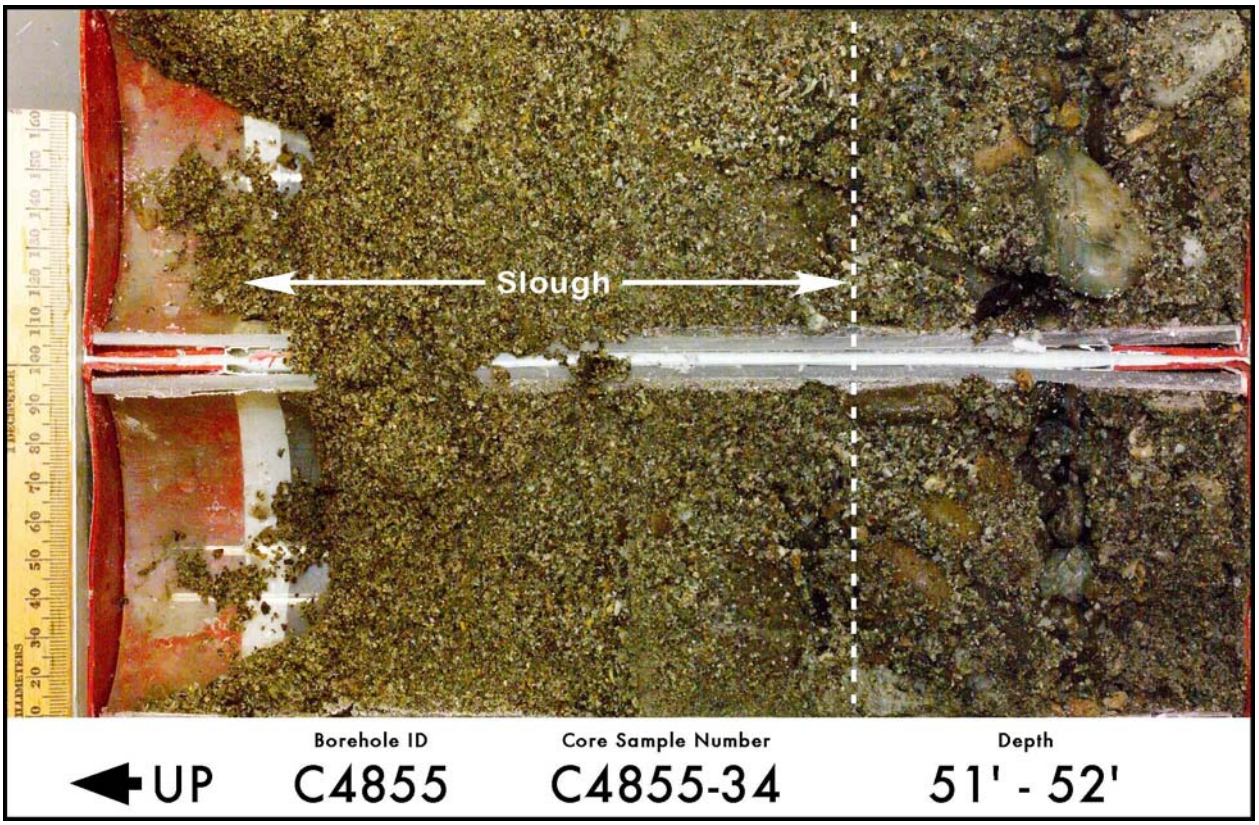
Borehole ID	Core Sample Number	Depth
◀ UP C4855	C4855-30	46' - 47'

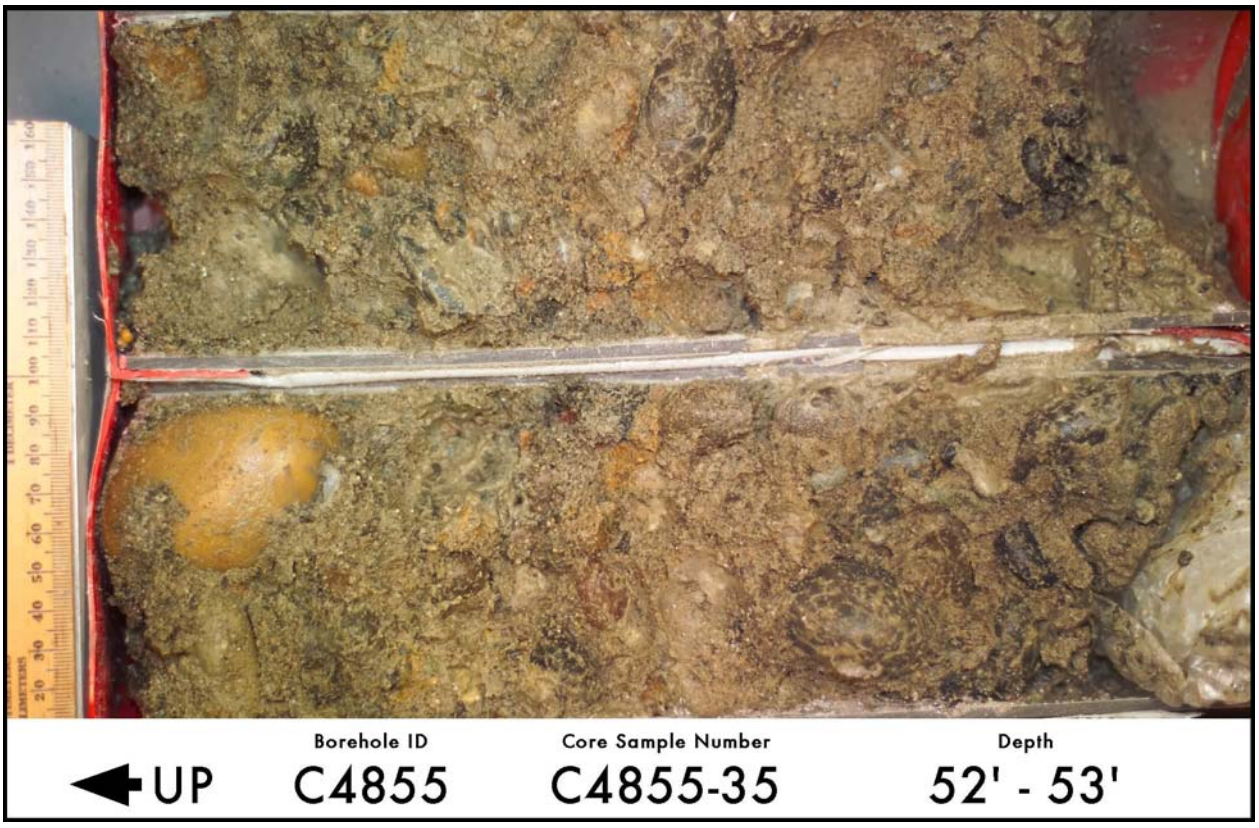


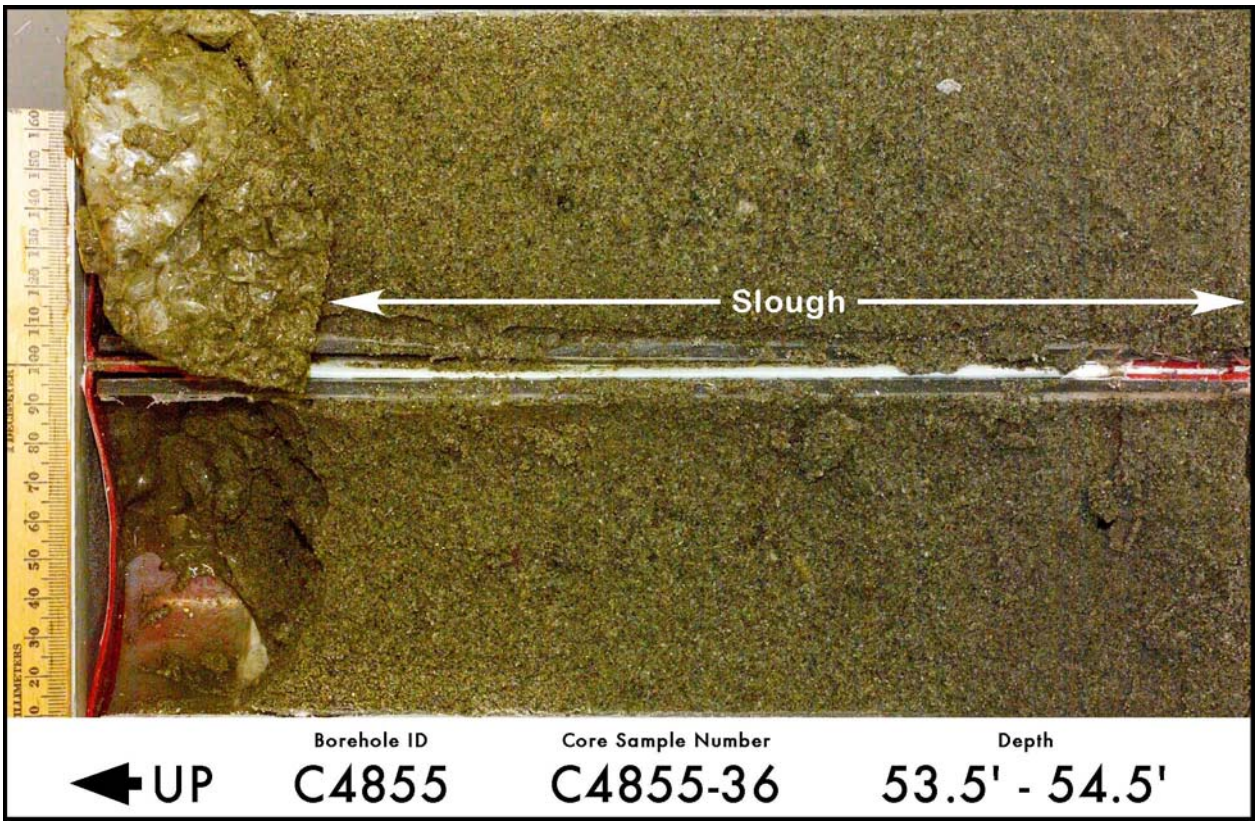
Borehole ID	Core Sample Number	Depth
◀ UP C4855	C4855-31	47' - 48'

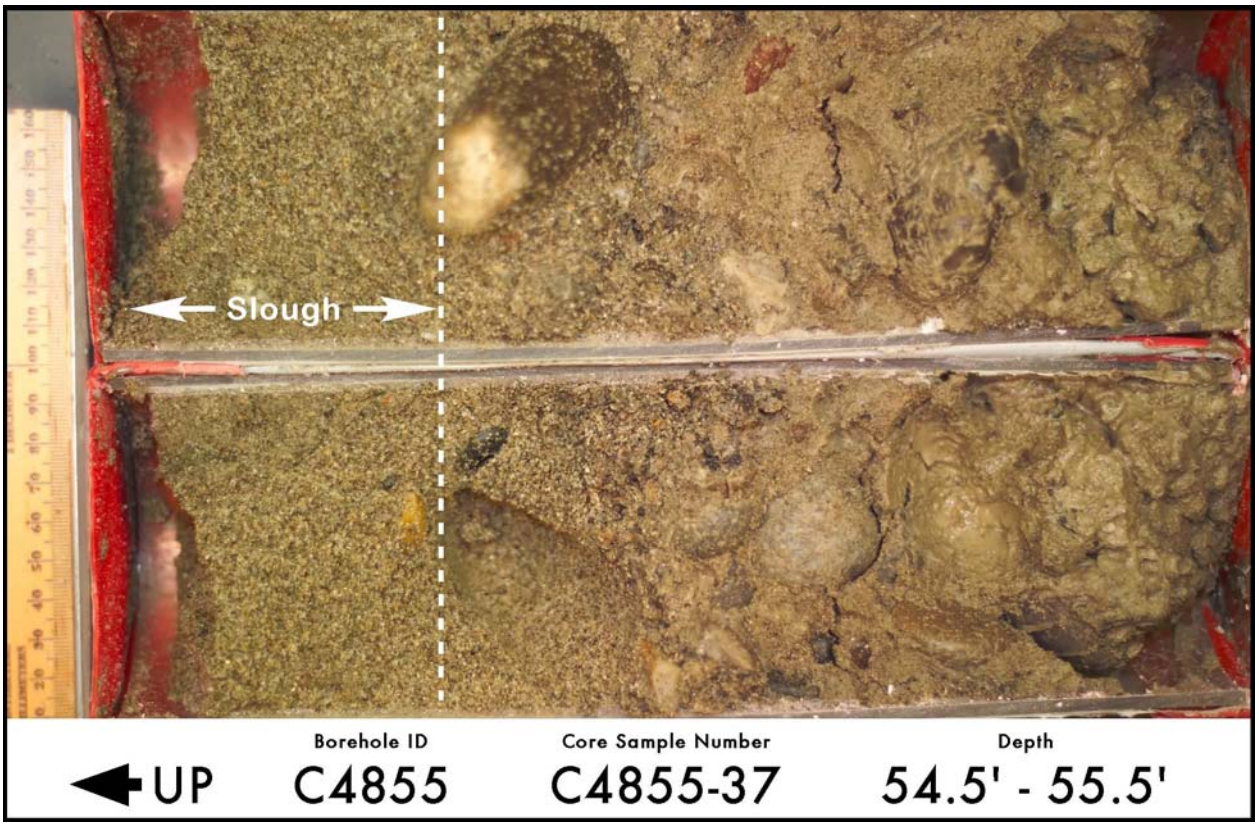
UP	Borehole ID	Core Sample Number	Depth
◀	C4855	C4855-32	48.5' - 49.5'

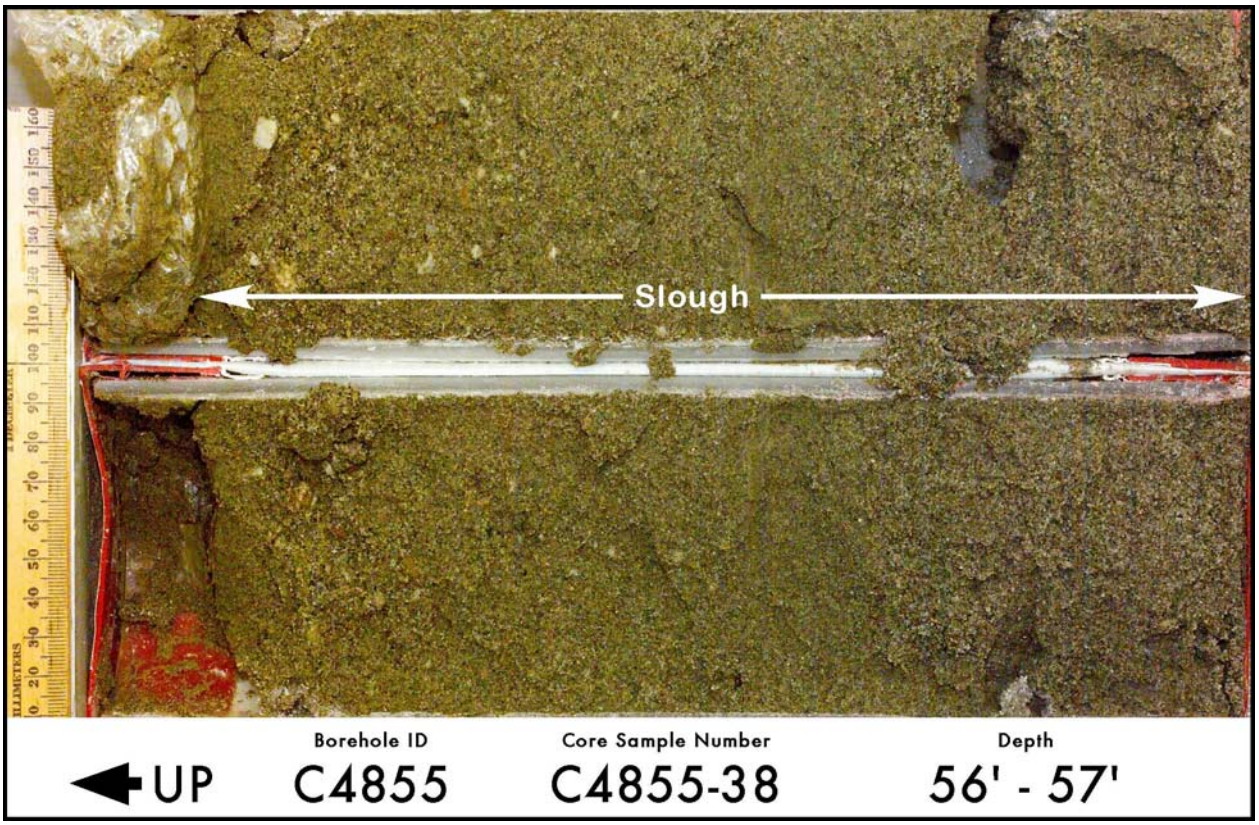
UP	Borehole ID	Core Sample Number	Depth
◀	C4855	C4855-33	49.5' - 50.5'

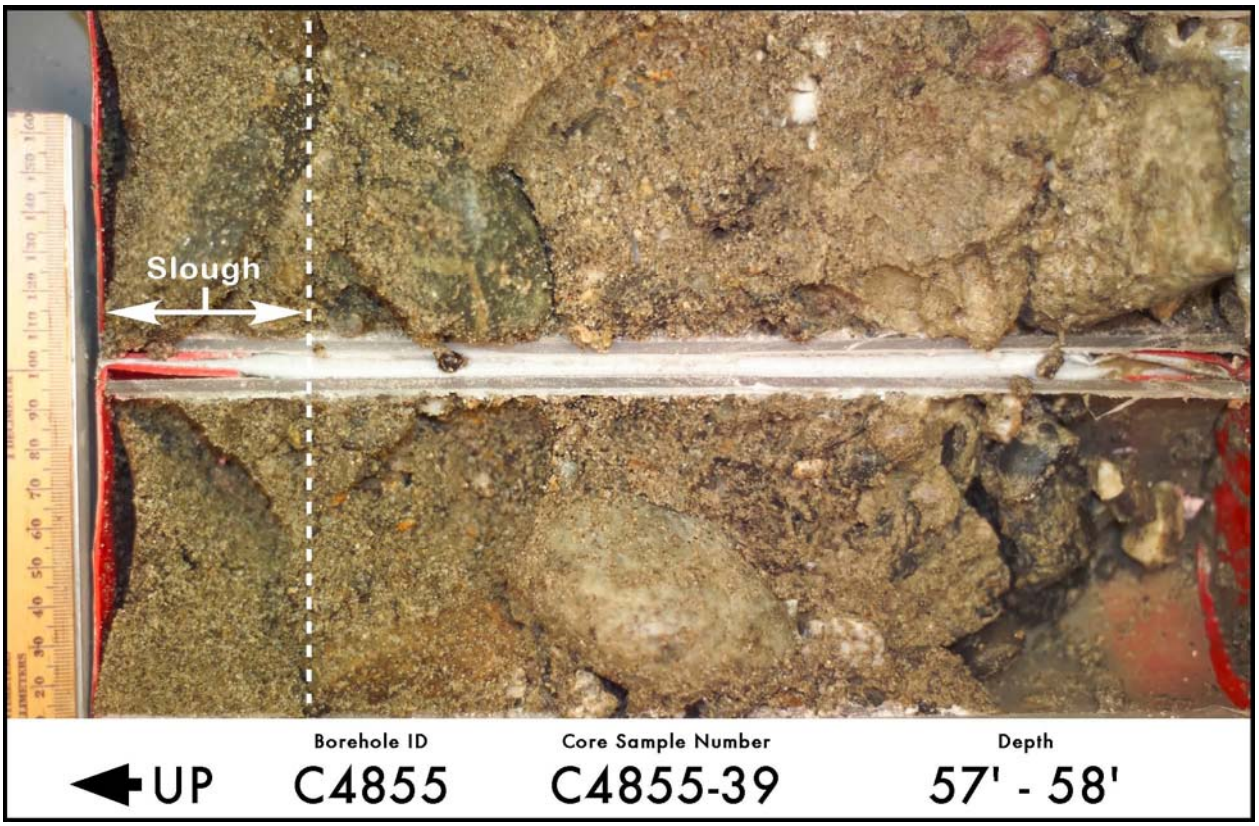

Slough
Borehole ID
Core Sample Number
Depth
UP
C4855
C4855-34
51' - 52'

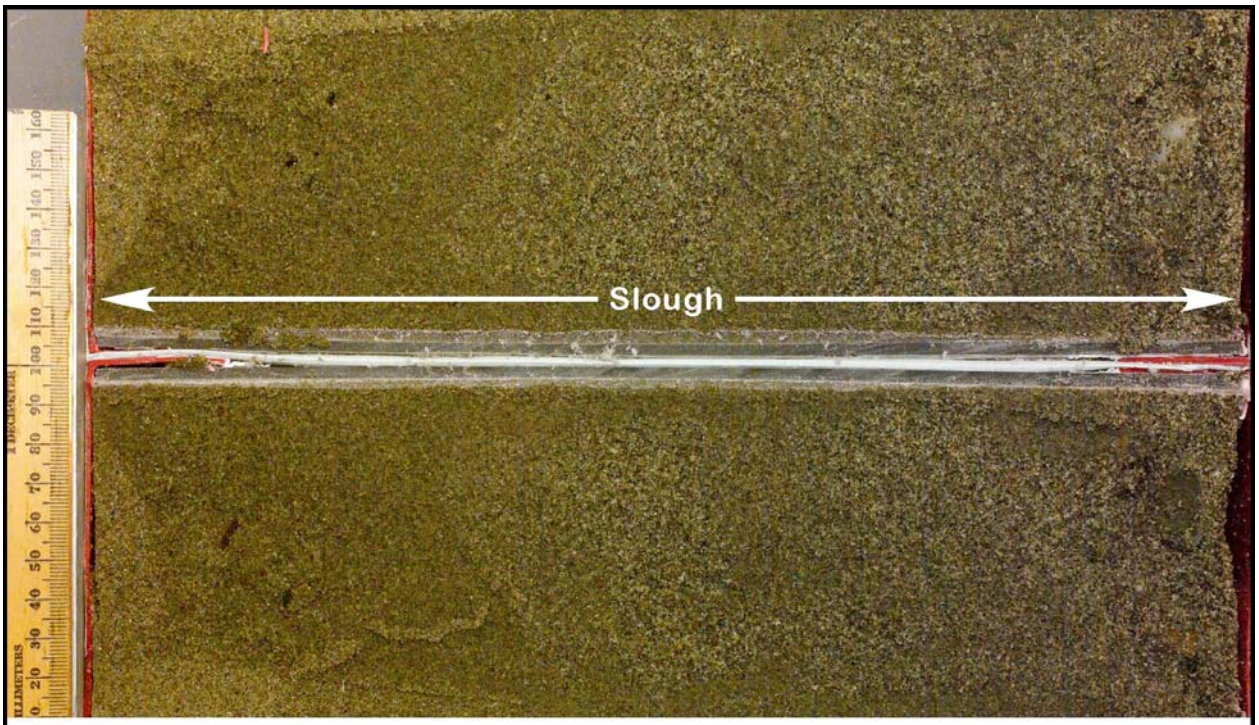

Borehole ID
Core Sample Number
Depth
UP
C4855
C4855-35
52' - 53'


Slough
Borehole ID
Core Sample Number
Depth
UP
C4855
C4855-36
53.5' - 54.5'


Slough
Borehole ID
Core Sample Number
Depth
UP
C4855
C4855-37
54.5' - 55.5'

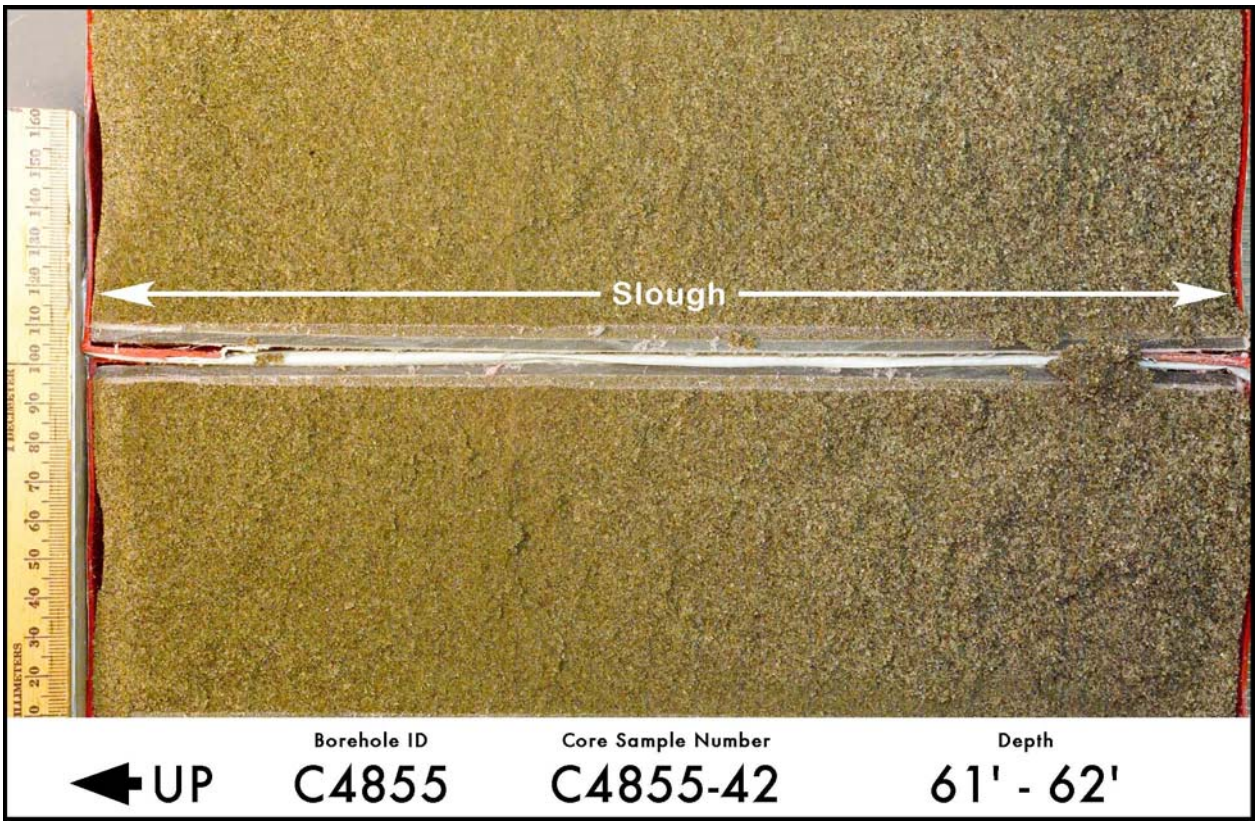

Slough
Borehole ID
Core Sample Number
Depth
UP
C4855
C4855-38
56' - 57'

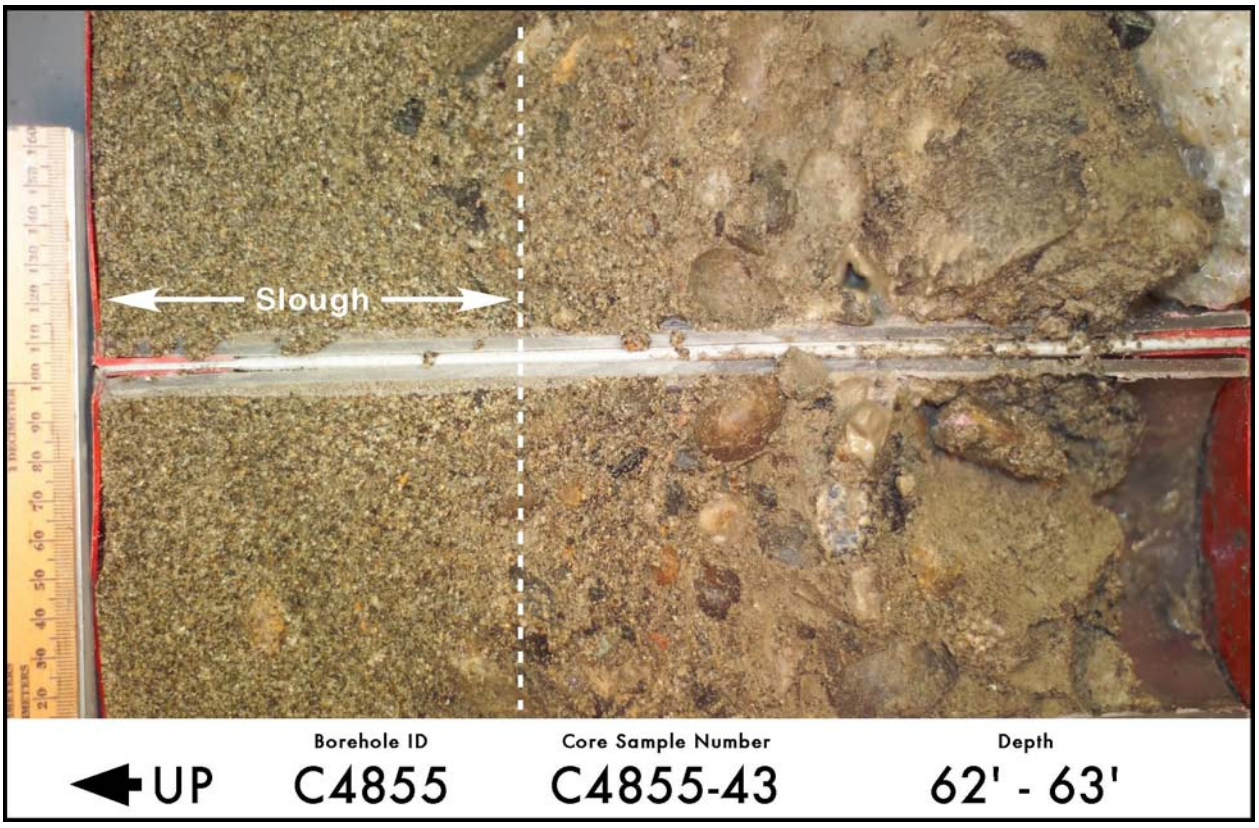

Slough
Borehole ID
Core Sample Number
Depth
UP
C4855
C4855-39
57' - 58'



Borehole ID	Core Sample Number	Depth
◀ UP C4855	C4855-40	58.5' - 59.5'

Borehole ID	Core Sample Number	Depth
◀ UP C4855	C4855-41	59.5' - 60.5'


Slough
Borehole ID
Core Sample Number
Depth
UP
C4855
C4855-42
61' - 62'


Slough
Borehole ID
Core Sample Number
Depth
UP
C4855
C4855-43
62' - 63'

699-S20-E10

Sediment Core Geological Descriptions

Pacific Northwest National Laboratory

DAILY BOREHOLE LOG

Boring/Well No C4855 (699-S20-E10) Depth 34.5 - 38.0' Date 11-15-05 Sheet 1 of 5

Location 300 Area Project RCRA Monitoring

Logged by B N Bjornstad (Print / Sign) (Print / Sign)

Reviewed by (Print / Sign) Date

Lithologic Class. Scheme Procedure Rev

Steel Tape/E-Tape / Field Indicator Equip. 1) 2)

Drilling Contractor

Driller

Rig/Method

Depth Control Point

DEPTH ( )	TIME	SAMPLES TYPE	SAMPLES ID NUMBER	CONTAMINATION INSTR.	CONTAMINATION READING	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, etc.)	H_2O ADDED	CASING	DRILLING COMMENTS (drilling rate, down time, blow counts, water level, drill fluid, etc.)
34											1' lexan cores collected with split spoon, 4" dia. Set of 11 unopened cores. Other cores from this hole were opened and sampled previously, but not logged for geology
						SM		2SG, 2.5Y4/2 (dk grayish brn), V poorly sorted, pulverized, S ≈ 70-80% basalt, lgst clast = 5cm			
35						↓					
36											
37						SM		2SG, 2.5Y3/2 (v. dk grayish brn) to 2.5Y7/2 (lt. grey), pulverized, V poorly sorted, S = 80% basalt, lgst clast = 3cm			
						↓					
38											

W = Wet, M = Moist, D = Dry

1998/DCL/PROC/DBL/001

Pacific Northwest National Laboratory	**DAILY BOREHOLE LOG**	Boring/Well No C4855	Depth 39-45.5'	Date 11-15-05	Sheet 2 of 5
		Location 300 Area	Project RCRA		

Logged by B N Bjornstad (Print / Sign) _____ (Print / Sign)

Reviewed by _____ (Print / Sign) Date _____

Lithologic Class. Scheme _____ Procedure _____ Rev ____

Steel Tape/E-Tape _____ / _____ Field Indicator Equip. 1) _____ 2) _____

Drilling Contractor _____

Driller _____

Rig/Method _____

Depth Control Point _____

DEPTH ( )	TIME	SAMPLES TYPE	SAMPLES ID NUMBER	CONTAMINATION INSTR.	CONTAMINATION READING	MOISTURE	GRAPHIC LOG C	Z	S	G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, etc.)	H_2O ADDED	CASING	DRILLING COMMENTS (drilling rate, down time, blow counts, water level, drill fluid, etc.)
39														
						SM					ZSG, 2.5Y5/2 (grayish brn), v.			
						↓					poorly sorted, msv, pulverized,			
40											S = 70% basalt, lgst clast =			
											5 cm calcareous stringers			
41														
42						SM					ZSG, 2.5Y4/2 (dk grayish brn), v.			65% recovery
						↓					poorly sorted, S = 70% basalt,			
											msv, pulverized, lgst clast = 2cm			
											50% G, 35% S, 15% mud			
43														
44														
						W					SG, loose, 70% G, 30% S,			30% recovery - sloughy?
						↓					poorly sorted msv, 2.5Y4/2,			
45											S = 60% basalt, fair rounded			
											polished R to gd clasts			

W = Wet, M = Moist, D = Dry

1998/DCL/PROC/DBL/001

Pacific Northwest National Laboratory

DAILY BOREHOLE LOG

Boring/Well No C4855 Depth 46-52' Date 11-15-05 Sheet 3 of 5

Location 300 Area Project RCRA

Logged by B N Bjornstad (Print / Sign) (Print / Sign)

Reviewed by (Print / Sign) Date

Lithologic Class. Scheme Procedure Rev

Steel Tape/E-Tape / Field Indicator Equip. 1) 2)

Drilling Contractor

Driller

Rig/Method

Depth Control Point

DEPTH ( )	TIME	SAMPLES TYPE	SAMPLES ID NUMBER	CONTAMINATION INSTR.	CONTAMINATION READING	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, etc.)	H_2O ADDED	CASING	DRILLING COMMENTS (drilling rate, down time, blow counts, water level, drill fluid, etc.)
46						W		crs sand, 50% basalt			slough
								SG, 40% G, 50% sand (mostly md), 10% mud, 2.5Y5/2 (grayish brn), msv, S = 50% basalt, bimodal			Ringold-like matrix
47											
48											
49											
50											
51						W		S, crs, well sorted, 2.5Y5/2 (grayish brn) 40% basalt			slough?
								SG, mostly well rnded, mxn basalt, msv, bimodal, S: 40% basalt, loose, 40% G, 60% S			
52											

W = Wet, M = Moist, D = Dry

1998/DCL/PROC/DBL/001

Pacific Northwest National Laboratory

DAILY BOREHOLE LOG

Boring/Well No C4855 Depth 53-59.5 Date 11-15-05 Sheet 4 of 5

Location 300 Area Project RCRA

Logged by BN Bjornstad (Print / Sign) | (Print / Sign)

Reviewed by (Print / Sign) Date

Lithologic Class. Scheme Procedure Rev

Steel Tape/E-Tape / Field Indicator Equip. 1) 2)

Drilling Contractor

Driller

Rig/Method

Depth Control Point

DEPTH ( )	TIME	SAMPLES TYPE	SAMPLES ID NUMBER	CONTAMINATION INSTR.	CONTAMINATION READING	MOISTURE	GRAPHIC LOG C Z S G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, etc.)	H_2O ADDED	CASING	DRILLING COMMENTS (drilling rate, down time, blow counts, water level, drill fluid, etc.)
53											
						W		S, md, 2.5Y5/2 (grayish brn),			slough? Ringold
								well sorted, loose, micaceous,			
54								msv 30% basalt			
55											
56						W		pebbly sand, pebbles mostly			slough? Ringold
								angular frags. of qtzite,			
								S, md, 2.5Y5/2 (grayish brn), loose,			
								25% basalt, micaceous,			
57								weak gradation			
58											
						W		S, grades from crs at base to fn			slough Ringold
								at top, few pebbles at bottom,			
59								loose, well sorted, 2.5Y5/2, S=25%			
								basalt, micaceous, msv			

W = Wet, M = Moist, D = Dry

1998/DCL/PROC/DBL/001

Pacific Northwest National Laboratory

DAILY BOREHOLE LOG

Boring/Well No C4855 Depth 61-62 Date 11-15-05 Sheet 5 of 5

Location 300 Area Project RCRA

Logged by B H Bjornstad (Print / Sign) _____ (Print / Sign)

Reviewed by _____ (Print / Sign) Date _____

Lithologic Class. Scheme _____ Procedure _____ Rev ____

Steel Tape/E-Tape _____ / _____ Field Indicator Equip. 1) _____ 2) _____

Drilling Contractor _____

Driller _____

Rig/Method _____

Depth Control Point _____

DEPTH ( )	TIME	SAMPLES TYPE	SAMPLES ID NUMBER	CONTAMINATION INSTR.	CONTAMINATION READING	MOISTURE	GRAPHIC LOG C	Z	S	G	LITHOLOGIC DESCRIPTION (particle size distribution, sorting, mineralogy, roundness, color, reaction to HCl, etc.)	H_2O ADDED	CASING	DRILLING COMMENTS (drilling rate, down time, blow counts, water level, drill fluid, etc.)
61						W					S, grades from crs at bottom to fn at top, loose, well sorted, 25% basalt, micaceous, msv, except for grading			slough Ringold
62														

W = Wet, M = Moist, D = Dry

1998/DCL/PROC/DBL/001

PNNL

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

Page 1 of 1

Collector Lee Brouillard (GRAM)	Contact/Requester	Telephone No. MSIN FAX
SAF No.	Sampling Origin	Purchase Order/Charge Code
Project Title Borehole C4855 (699-S20-E10)	Logbook No.	Ice Chest No. Temp.
Shipped To (Lab)	Method of Shipment	Bill of Lading/Air Bill No.
Protocol	Data Turnaround	Offsite Property No.

POSSIBLE SAMPLE HAZARDS/REMARKS

SPECIAL INSTRUCTIONS Hold Time Total Activity Exemption: Yes ☐ No ☐

Sample No.	Lab ID	*	Date	Time	No/Type Container	Sample Analysis	Preservative
1 (7-8')			7-12-05	1507	Poly liner		
2 (8-9')			7-12-05	1507	poly liner		
3 (9.5-10.5)			7-13-05	0735	poly (Teflon) liner		
4 (10.5-11.5)			7-13-05	0735	poly (Teflon) liner		
5 (12-13')			7-13-05	0856	"		
6 (13-14')			7-13-05	0856	"		
7 (14.5-15.5')			7-13-05	0845	"		
8 (15.5-16.5')			7-13-05	0845	"		
9 (17-18')			7-13-05	1037	"		
10 (18-19')			7-13-05	1037	"		
11 (18.5-20.5)			7-13-05	1145	"		
12 (20.5-21.5)			7-13-05	1145	"		

Relinquished By (Print / Sign)	Date/Time	Received By (Print / Sign)	Date/Time
Lee Brouillard	7-13-05/1453	B.W.E.A. Williams	7/13/05 1453
B.W.E.A. Williams	7/13/05 1505	Michelle Valenta / Michelle Valenta	7/13/05 1505

Matrix *

S = Soil	SE = Sediment	SO = Solid	SL = Sludge
W = Water	O = Oil	A = Air	DS = Drum Solid
DL = Drum Liqui	T = Tissue	WI = Wine	L = Liquid
V = Vegetation	X = Other		

FINAL SAMPLE DISPOSITION — Disposal Method (e.g., Return to customer, per lab procedure, used in process) — Disposed By — Date/Time

PNNL

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

C.O.C. #

Page of

Collector Lee Brouillard (CRAM)	Contact/Requester	Telephone No.	MSIN FAX
SAF No.	Sampling Origin	Purchase Order/Charge Code	
Project Title Borehole C4855 (699-520-E10)	Logbook No.	Ice Chest No.	Temp.
Shipped To (Lab)	Method of Shipment	Bill of Lading/Air Bill No.	
Protocol	Data Turnaround	Offsite Property No.	

POSSIBLE SAMPLE HAZARDS/REMARKS

SPECIAL INSTRUCTIONS Hold Time Total Activity Exemption: Yes ☐ No ☐

Sample No.	Lab ID	*	Date	Time	No/Type Container	Sample Analysis	Preservative
13(22-23)			7-13-05		Lexan Liner		
14(23-24)			7-13-05		"		
15(24.5-25.5)			7-13-05		"		
16(25.5-26.5)			7-13-05		"		
17(27-28)			7-13-05		"		
18(29-29)			7-13-05		"		
19(30-31)			7-13-05		"		

Relinquished By	Print	Sign	Date/Time	Received By	Print	Sign	Date/Time
Lee Brouillard		Lee Brouillard	7-13-05 1453		BRUCE A. WILLIAMS		7/13/05 1453
Relinquished By			Date/Time	Received By			Date/Time
BRUCE WILLIAMS			7/13/05 1505	Rebecca Vicente / Hanford Valley			7/13/05 1505
Relinquished By			Date/Time	Received By			Date/Time
Relinquished By			Date/Time	Received By			Date/Time

Matrix *

S = Soil		DS = Drum Solid	
SE = Sediment		DL = Drum Liqui	
SO = Solid		T = Tissue	
SL = Sludge		WI = Wine	
W = Water		L = Liquid	
O = Oil		V = Vegetation	
A = Air		X = Other	

FINAL SAMPLE DISPOSITION	Disposal Method (e.g., Return to customer, per lab procedure, used in process)	Disposed By	Date/Time

B.34

PNNL

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

C.O.C. #

Page 1 of 2

Collector Lee Brouillard Well 699-S20-E10	Contact/Requester	Telephone No. MSIN FAX
SAF No. Borehole C4955	Sampling Origin	Purchase Order/Charge Code
Project Title 300-FF-5 Monitoring Well	Logbook No.	Ice Chest No. Temp.
Shipped To (Lab)	Method of Shipment	Bill of Lading/Air Bill No.
Protocol	Data Turnaround	Offsite Property No.

POSSIBLE SAMPLE HAZARDS/REMARKS

SPECIAL INSTRUCTIONS Hold Time Total Activity Exemption: Yes ☐ No ☐

Sample No.	Lab ID	*	Date	Time	No/Type Container	Sample Analysis	Preservative
20(32-33)			7-14-05	0800			
21 (33-34')				0800			
22(34.5-35.5)				0849			
23(35.5-36.5)				0848			
24 (37-38)				0924			
25(38-38)				0924			
26(39.5-40.5)				1027			
27(40.5-41.5)				1027			
28(42-43)				1105			
29(44.5-45.5)				1245			
30(46-47)				1325			
31(47-48)				1325			

Relinquished By (Print / Sign)	Date/Time	Received By (Print / Sign)	Date/Time
Lee Brouillard / [signature]	7/14/05 1446	Bruce A. Williams / [signature]	1449 7/14/05
Bruce Williams / [signature]	7/14/05 1503	Michelle Valenta / Michelle Valenta	7/14/05 1503
Relinquished By	Date/Time	Received By	Date/Time
Relinquished By	Date/Time	Received By	Date/Time

Matrix *

S = Soil		DS = Drum Solid	
SE = Sediment		DL = Drum Liqui	
SO = Solid		T = Tissue	
SL = Sludge		WI = Wipe	
W = Water		L = Liquid	
O = Oil		V = Vegetation	
A = Air		X = Other	

FINAL SAMPLE DISPOSITION	Disposal Method (e.g., Return to customer, per lab procedure, used in process)	Disposed By	Date/Time

PNNL	CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST	C.O.C. # Page 2 of 2

Collector Lee Brouillard	Contact/Requester	Telephone No. MSIN FAX
SAF No. WELL 699-S20-E10	Sampling Origin	Purchase Order/Charge Code
Project Title Borehole C4855 300-FF-5 Monitoring well	Logbook No.	Ice Chest No. Temp.
Shipped To (Lab)	Method of Shipment	Bill of Lading/Air Bill No.
Protocol	Data Turnaround	Offsite Property No.

POSSIBLE SAMPLE HAZARDS/REMARKS

SPECIAL INSTRUCTIONS Hold Time Total Activity Exemption: Yes ☐ No ☐

Sample No.	Lab ID	*	Date	Time	No/Type Container	Sample Analysis	Preservative
32(48.5-49.5)			7-14-05	1355			
33(49.5-50.5)			7-14-05	1355			
34(51-52)			↓	1428			
35(52-53)			↓	1428			

Relinquished By (Print / Sign)	Date/Time	Received By (Print / Sign)	Date/Time
Lee Brouillard [signature]	7/14/05 1446	Bruce Williams [signature]	1449 7/14/05
Bruce Williams [signature]	7/14/05 15[illegible]	Michelle Valenta / Sathenia Valdez	7/14/05 1503

Matrix *

S = Soil		DS = Drum Solid	
SE = Sediment		DL = Drum Liquid	
SO = Solid		T = Tissue	
SL = Sludge		WI = Wipe	
W = Water		L = Liquid	
O = Oil		V = Vegetation	
A = Air		X = Other	

FINAL SAMPLE DISPOSITION	Disposal Method (e.g., Return to customer, per lab procedure, used in process)	Disposed By	Date/Time

PNNL

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

C.O.C. #

Page 1 of 1

Collector: Michael E. Caron	Contact/Requester	Telephone No. / MSIN / FAX
SAF No.	Sampling Origin	Purchase Order/Charge Code
Project Title: 300-FF-5 Monitoring Well	Logbook No.	Ice Chest No. / Temp.
Shipped To (Lab): PNNL	Method of Shipment	Bill of Lading/Air Bill No.
Protocol	Data Turnaround	Offsite Property No.

POSSIBLE SAMPLE HAZARDS/REMARKS

SPECIAL INSTRUCTIONS / Hold Time — Total Activity Exemption: Yes ☐ No ☐

Well C4508 - interval = 53.5' → 54.5'

Sample No.	Lab ID	*	Date	Time	No/Type Container	Sample Analysis	Preservative
#36			7-15-05	06:45	lexan liner	(53.5' – 54.5')	

Relinquished By (Print / Sign)	Date/Time	Received By (Print / Sign)	Date/Time
M.E. Caron	7-15-05	JW Lindberg	7/15/05
JW Lindberg	7-15-05 2345	M Valencia	7/15/05 2345

Matrix *

S = Soil		DS = Drum Solid	
SE = Sediment		DL = Drum Liquid	
SO = Solid		T = Tissue	
SL = Sludge		WI = Wine	
W = Water		L = Liquid	
O = Oil		V = Vegetation	
A = Air		X = Other	

FINAL SAMPLE DISPOSITION — Disposal Method (e.g., Return to customer, per lab procedure, used in process) / Disposed By / Date/Time

PNNL

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

COC #

Page 1 of 1

Collector: Michael E. Caron	Contact/Requester	Telephone No.	MSIN / FAX
SAF No.	Sampling Origin	Purchase Order/Charge Code	
Project Title: 300-FF-5 Monitoring Well	Logbook No.	Ice Chest No.	Temp.
Shipped To (Lab): PNNL	Method of Shipment	Bill of Lading/Air Bill No.	
Protocol	Data Turnaround	Offsite Property No.	

POSSIBLE SAMPLE HAZARDS/REMARKS

SPECIAL INSTRUCTIONS Hold Time Total Activity Exemption: Yes ☐ No ☐

Well C4588 : interval = 54.5' – 55.5'

Sample No.	Lab ID	*	Date	Time	No/Type Container	Sample Analysis	Preservative
#37			7-15-05	06:45	lexan liner	(54.5' – 55.5'	

Relinquished By (Print / Sign)	Date/Time	Received By (Print / Sign)	Date/Time
M.E. Caron	7-15-05	JWL Lindberg	7-15-05
JWL Lindberg	7-15-05 2:45	M. Valenta	7/15/05 2:45
	Date/Time		Date/Time
	Date/Time		Date/Time

Matrix *

S = Soil	SE = Sediment	SO = Solid	SL = Sludge
W = Water	O = Oil	A = Air	DS = Drum Solid
DL = Drum Liqui	T = Tissue	WI = Wine	L = Liquid
V = Vegetation	X = Other		

FINAL SAMPLE DISPOSITION	Disposal Method (e.g., Return to customer, per lab procedure, used in process)	Disposed By	Date/Time

PNNL

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

COC #

Page 1 of 1

Collector Michael E. Caron	Contact/Requester	Telephone No.	MSIN FAX
SAF No.	Sampling Origin	Purchase Order/Charge Code	
Project Title 300-FF-5 Monitoring Well	Logbook No.	Ice Chest No.	Temp.
Shipped To (Lab) PNL	Method of Shipment	Bill of Lading/Air Bill No.	
Protocol	Data Turnaround	Offsite Property No.	

POSSIBLE SAMPLE HAZARDS/REMARKS

SPECIAL INSTRUCTIONS Hold Time Total Activity Exemption: Yes ☐ No ☐

Well C4588 : interval ~~57-58~~ C
56-57

Sample No.	Lab ID	*	Date	Time	No/Type Container	56-57 Sample Analysis	Preservative
#38			7-15-05	07:45	lexan liner	(~~57.2~~ bgs)	

Relinquished By	Print	Sign	Date/Time	Received By	Print	Sign	Date/Time
	M. E. CARON		7-15-05		J.W. Lindberg		7-15-05
Relinquished By			Date/Time	Received By			Date/Time
	J.W. Lindberg		2:45 7-15-05		M. Valenta		2:45 7/15/05
Relinquished By			Date/Time	Received By			Date/Time
Relinquished By			Date/Time	Received By			Date/Time

Matrix *

S = Soil		DS = Drum Solid	
SE = Sediment		DL = Drum Liqui	
SO = Solid		T = Tissue	
SL = Sludge		WI = Wine	
W = Water		L = Liquid	
O = Oil		V = Vegetation	
A = Air		X = Other	

FINAL SAMPLE DISPOSITION	Disposal Method (e.g., Return to customer, per lab procedure, used in process)	Disposed By	Date/Time

PNNL

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

C.O.C. #

Page of

Collector Michael E. Caron	Contact/Requester	Telephone No.	MSIN FAX
SAF No.	Sampling Origin	Purchase Order/Charge Code	
Project Title 300-55-5 Monitoring Well	Logbook No.	Ice Chest No.	Temp.
Shipped To (Lab) PNNL	Method of Shipment	Bill of Lading/Air Bill No.	
Protocol	Data Turnaround	Offsite Property No.	

POSSIBLE SAMPLE HAZARDS/REMARKS

SPECIAL INSTRUCTIONS Hold Time Total Activity Exemption: Yes ☐ No ☐

Well C4588 : interval ~~58-59'~~ @ 57-58'

Sample No.	Lab ID	*	Date	Time	No/Type Container	Sample Analysis	Preservative
#39			7-15-05	07:45		(~~58-59'~~) 57-58' @	

Relinquished By	Print	Sign	Date/Time	Received By	Print	Sign	Date/Time
	M.E. Caron		7-15-05		J.W. Lindberg		7-15-05
Relinquished By	J.W. Lindberg		2:45 7-15-05	Received By	M. Valenta		2:45 7-15-05
Relinquished By			Date/Time	Received By			Date/Time
Relinquished By			Date/Time	Received By			Date/Time

Matrix *

S = Soil		DS = Drum Solid	
SB = Sediment		DL = Drum Liquid	
SO = Solid		T = Tissue	
SL = Sludge		WI = Wine	
W = Water		L = Liquid	
O = Oil		V = Vegetation	
A = Air		X = Other	

FINAL SAMPLE DISPOSITION	Disposal Method (e.g., Return to customer, per lab procedure, used in process)	Disposed By	Date/Time

PNNL

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

E.O.C. #

Page 1 of 1

Collector Michael E. Caron	Contact/Requester	Telephone No.	MSIN FAX
SAF No.	Sampling Origin	Purchase Order/Charge Code	
Project Title 300-FF-5 Monitoring Well	Logbook No.	Ice Chest No.	Temp.
Shipped To (Lab) PNNL	Method of Shipment	Bill of Lading/Air Bill No.	
Protocol	Data Turnaround	Offsite Property No.	

POSSIBLE SAMPLE HAZARDS/REMARKS

SPECIAL INSTRUCTIONS Hold Time Total Activity Exemption: Yes ☐ No ☐

Well C4588 : interval 58.5 - 59.5'

Sample No.	Lab ID	*	Date	Time	No/Type Container	Sample Analysis	Preservative
#40			7-15-05	08:30	1 x 4 oz liner	(58.5 - 59.5')	

Relinquished By	Print	Sign	Date/Time
M. E. CARON			7-15-05
Jw Lindberg			2:45 7-15-05

Received By	Print	Sign	Date/Time
Jw Lindberg			7-15-05
M. Valenta			2:45 7/15/05

Matrix *

S = Soil		DS = Drum Solid	
SE = Sediment		DL = Drum Liqui	
SO = Solid		T = Tissue	
SL = Sludge		WI = Wine	
W = Water		L = Liquid	
O = Oil		V = Vegetation	
A = Air		X = Other	

FINAL SAMPLE DISPOSITION	Disposal Method (e.g., Return to customer, per lab procedure, used in process)	Disposed By	Date/Time

PNNL

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

C.O.C. #

Page 1 of 1

Collector: Michael E. Caron	Contact/Requester	Telephone No.	MSIN / FAX
SAF No.	Sampling Origin	Purchase Order/Charge Code	
Project Title: 300-FF-5 Monitoring Well	Logbook No.	Ice Chest No.	Temp.
Shipped To (Lab): PNNL	Method of Shipment	Bill of Lading/Air Bill No.	
Protocol	Data Turnaround	Offsite Property No.	

POSSIBLE SAMPLE HAZARDS/REMARKS

SPECIAL INSTRUCTIONS Hold Time: Total Activity Exemption: Yes ☐ No ☐

Well C4588: interval 59.5 - 60.5'

Sample No.	Lab ID	*	Date	Time	No/Type Container	Sample Analysis	Preservative
#41			7-15-05	08:30	terra liner	59.5 - 60.5 ft	

Relinquished By (Print / Sign)	Date/Time	Received By (Print / Sign)	Date/Time
M.E. Caron	7-15-05	J.W. Lindberg	7-15-05
J.W. Lindberg	7-15-05 2345	M. Valenta	7/15/05 2345

Matrix *

S = Soil	SB = Sediment	SO = Solid	SL = Sludge
W = Water	O = Oil	A = Air	DS = Drum Solid
DL = Drum Liqui	T = Tissue	WI = Wine	L = Liquid
V = Vegetation	X = Other		

FINAL SAMPLE DISPOSITION: Disposal Method (e.g., Return to customer, per lab procedure, used in process) | Disposed By | Date/Time

PNNL

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

C.O.C. #

Page 1 of 1

Collector: Michael E. Caron	Contact/Requester	Telephone No.	MSIN / FAX
SAF No.	Sampling Origin	Purchase Order/Charge Code	
Project Title: 300-FF-5 Monitoring Well	Logbook No.	Ice Chest No.	Temp.
Shipped To (Lab): PNNL	Method of Shipment	Bill of Lading/Air Bill No.	
Protocol	Data Turnaround	Offsite Property No.	

POSSIBLE SAMPLE HAZARDS/REMARKS

SPECIAL INSTRUCTIONS: Hold Time — Total Activity Exemption: Yes ☐ No ☐

Well C4588: 61-62' = interval

Sample No.	Lab ID	*	Date	Time	No/Type Container	Sample Analysis	Preservative
#42	09:15		7-15-05		1 exan liner	61-62'	

Relinquished By (Print / Sign)	Date/Time	Received By (Print / Sign)	Date/Time
M.E. Caron	7-15-05	J.W. Lindberg	7-15-05
J.W. Lindberg	2:45 7-15-05	M. Valenta	2:45 7/15/05

Matrix *

S = Soil	SE = Sediment	SO = Solid	SL = Sludge
W = Water	O = Oil	A = Air	DS = Drum Solid
DL = Drum Liqui	T = Tissue	WI = Wine	L = Liquid
V = Vegetation	X = Other		

FINAL SAMPLE DISPOSITION — Disposal Method (e.g., Return to customer, per lab procedure, used in process) — Disposed By — Date/Time

PNNL

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

C.O.C. #

Page 1 of 1

Collector: Michael E. Caron	Contact/Requester	Telephone No. MSIN FAX
SAF No.	Sampling Origin	Purchase Order/Charge Code
Project Title: 300-FF-5 Monitoring Well	Logbook No.	Ice Chest No. Temp.
Shipped To (Lab): PNNL	Method of Shipment	Bill of Lading/Air Bill No.
Protocol	Data Turnaround	Offsite Property No.

POSSIBLE SAMPLE HAZARDS/REMARKS

SPECIAL INSTRUCTIONS Hold Time Total Activity Exemption: Yes ☐ No ☐

Well c4588 : interval = 62-63'

Sample No.	Lab ID	*	Date	Time	No/Type Container	Sample Analysis	Preservative
#43			7-15-05	0915	lexan liner	(62-63')	

	Relinquished By	Print	Sign	Date/Time	Received By	Print	Sign	Date/Time
1	M.E. Caron			7-15-05	J.W. Lindberg	J.W. Lindberg		7-15-05
2	J.W. Lindberg	J.W. Lindberg		2:45 7-15-05	M. Valenta	M. Valenta		2:45 7/15/05
3				Date/Time				Date/Time
4				Date/Time				Date/Time

Matrix *

S = Soil		DS = Drum Solid	
SE = Sediment		DL = Drum Liqui	
SO = Solid		T = Tissue	
SL = Sludge		WI = Wine	
W = Water		L = Liquid	
O = Oil		V = Vegetation	
A = Air		X = Other	

FINAL SAMPLE DISPOSITION: Disposal Method (e.g., Return to customer, per lab procedure, used in process) | Disposed By | Date/Time

Appendix C

Raw Data for Samples from Well 699-S20-10

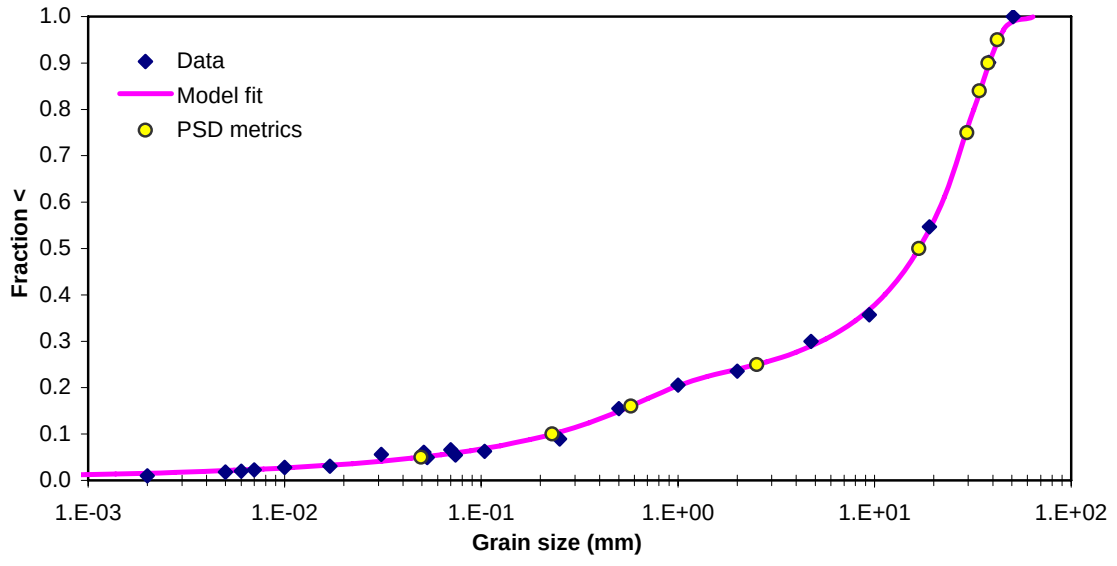
Appendix C

Raw Data for Samples from Well 699-S20-10

This appendix contains the grain-size distribution data and metrics for sediment samples from well 699-S20-E10 and North Process Pond sample NPP-1-14.

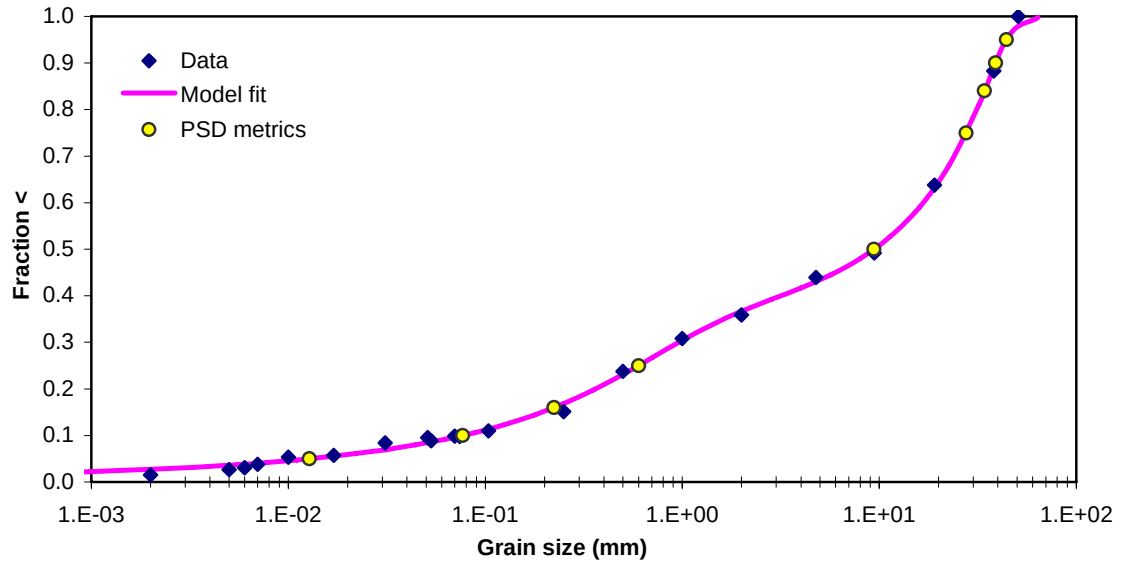
Sample data (Well 699-S20-E10, 7-8 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99999	0.00000	d5(phi)	**4.34**
		1.00000	50.80000	-5.6668	0.98983	0.00010	d10(phi)	**2.12**
		0.90133	38.10000	-5.2517	0.90475	0.00001	d16(phi)	**0.79**
		0.54676	19.05000	-4.2517	0.54120	0.00003	d25(phi)	**-1.33**
		0.35744	9.42000	-3.2357	0.36873	0.00013	d50(phi)	**-4.07**
		0.29962	4.76000	-2.2510	0.28980	0.00010	d75(phi)	**-4.88**
		0.23573	2.00000	-1.0000	0.23960	0.00001	d84(phi)	**-5.09**
		0.20547	1.00000	0.0000	0.20422	0.00000	d90(phi)	**-5.24**
		0.15519	0.50000	1.0000	0.14858	0.00004	d95(phi)	**-5.40**
		0.08968	0.25000	2.0000	0.10434	0.00021	σ_{IG}(phi)	**2.95**
		0.06297	0.10400	3.2653	0.06897	0.00004	d5(mm)	**0.05**
		0.05474	0.07400	3.7563	0.05934	0.00002	d10(mm)	**0.23**
		0.04936	0.05300	4.2379	0.05148	0.00000	d16(mm)	**0.58**
		0.06602	0.07000	3.8365	0.05794	0.00007	d25(mm)	**2.52**
		0.06094	0.05100	4.2934	0.05065	0.00011	d50(mm)	**16.85**
		0.05586	0.03100	5.0116	0.04136	0.00021	d75(mm)	**29.52**
		0.03047	0.01700	5.8783	0.03279	0.00001	d84(mm)	**34.12**
		0.02793	0.01000	6.6439	0.02699	0.00000	d90(mm)	**37.77**
		0.02285	0.00700	7.1584	0.02380	0.00000	d95(mm)	**42.11**
		0.02031	0.00600	7.3808	0.02257	0.00001	FI(mm)	**5.02**
		0.01777	0.00500	7.6439	0.02121	0.00001		
		0.01016	0.00200	8.9658	0.01573	0.00003	**SSE =**	**0.00114**



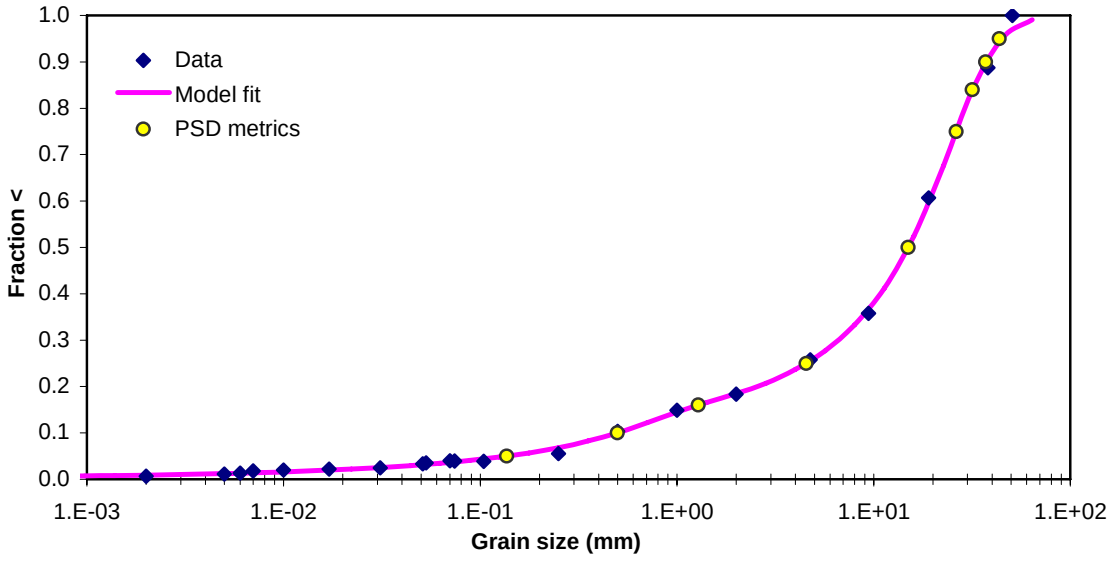
Sample data (Well 699-S20-E10, 8-9 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99999	0.00000	d5(phi)	**6.29**
		1.00000	50.80000	-5.6668	0.98305	0.00029	d10(phi)	**3.70**
		0.88285	38.10000	-5.2517	0.89010	0.00005	d16(phi)	**2.16**
		0.63761	19.05000	-4.2517	0.63172	0.00003	d25(phi)	**0.73**
		0.49186	9.42000	-3.2357	0.50031	0.00007	d50(phi)	**-3.23**
		0.43936	4.76000	-2.2510	0.43040	0.00008	d75(phi)	**-4.79**
		0.35895	2.00000	-1.0000	0.36670	0.00006	d84(phi)	**-5.09**
		0.30822	1.00000	0.0000	0.30413	0.00002	d90(phi)	**-5.28**
		0.23788	0.50000	1.0000	0.23092	0.00005	d95(phi)	**-5.47**
		0.15134	0.25000	2.0000	0.16846	0.00029	σ_{IG}(phi)	**3.60**
		0.10974	0.10400	3.2653	0.11373	0.00002	d5(mm)	**0.01**
		0.09795	0.07400	3.7563	0.09837	0.00000	d10(mm)	**0.08**
		0.08829	0.05300	4.2379	0.08571	0.00001	d16(mm)	**0.22**
		0.09886	0.07000	3.8365	0.09611	0.00001	d25(mm)	**0.60**
		0.09506	0.05100	4.2934	0.08439	0.00011	d50(mm)	**9.40**
		0.08365	0.03100	5.0116	0.06933	0.00021	d75(mm)	**27.64**
		0.05704	0.01700	5.8783	0.05536	0.00000	d84(mm)	**34.17**
		0.05323	0.01000	6.6439	0.04586	0.00005	d90(mm)	**38.95**
		0.03802	0.00700	7.1584	0.04060	0.00001	d95(mm)	**44.19**
		0.03042	0.00600	7.3808	0.03857	0.00007	FI(mm)	**2.15**
		0.02662	0.00500	7.6439	0.03633	0.00009		
		0.01521	0.00200	8.9658	0.02725	0.00014	**SSE =**	**0.00166**



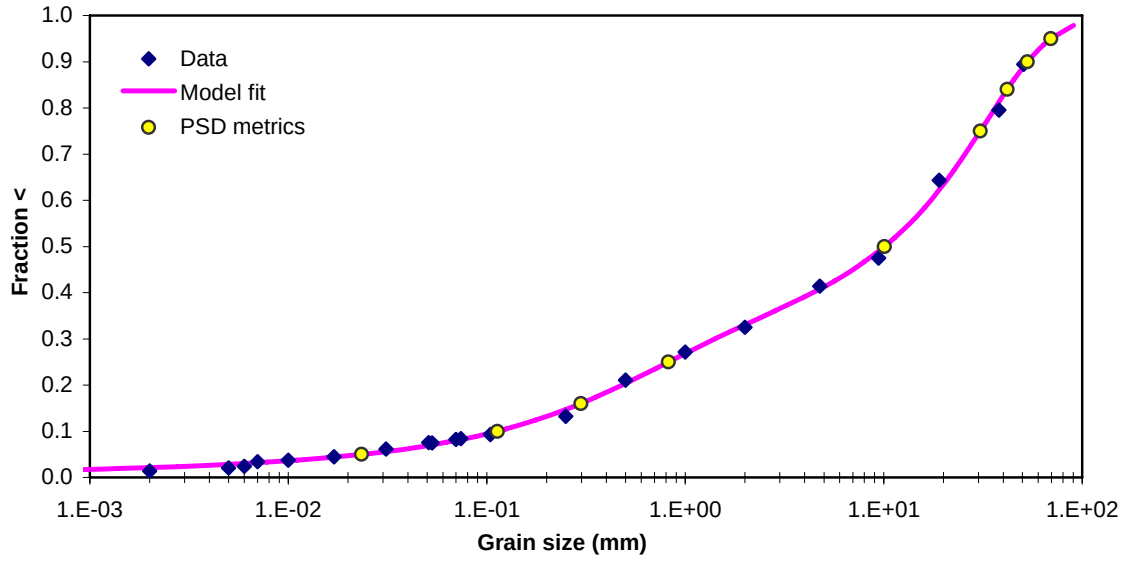
Sample data (Well 699-S20-E10, 9.5-10.5 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99923	0.00000	d5(phi)	**2.87**
		1.00000	50.80000	-5.6668	0.97076	0.00086	d10(phi)	**1.01**
		0.88686	38.10000	-5.2517	0.90784	0.00044	d16(phi)	**-0.36**
		0.60648	19.05000	-4.2517	0.59612	0.00011	d25(phi)	**-2.18**
		0.35788	9.42000	-3.2357	0.36677	0.00008	d50(phi)	**-3.91**
		0.25785	4.76000	-2.2510	0.25536	0.00001	d75(phi)	**-4.72**
		0.18363	2.00000	-1.0000	0.18471	0.00000	d84(phi)	**-4.99**
		0.14883	1.00000	0.0000	0.14493	0.00002	d90(phi)	**-5.22**
		0.10380	0.50000	1.0000	0.10034	0.00001	d95(phi)	**-5.44**
		0.05529	0.25000	2.0000	0.06836	0.00017	σ_{IG}(phi)	**2.42**
		0.03865	0.10400	3.2653	0.04377	0.00003	d5(mm)	**0.14**
		0.03918	0.07400	3.7563	0.03725	0.00000	d10(mm)	**0.50**
		0.03552	0.05300	4.2379	0.03197	0.00001	d16(mm)	**1.28**
		0.04016	0.07000	3.8365	0.03630	0.00001	d25(mm)	**4.54**
		0.03347	0.05100	4.2934	0.03143	0.00000	d50(mm)	**14.98**
		0.02454	0.03100	5.0116	0.02529	0.00000	d75(mm)	**26.30**
		0.02231	0.01700	5.8783	0.01973	0.00001	d84(mm)	**31.81**
		0.02008	0.01000	6.6439	0.01603	0.00002	d90(mm)	**37.15**
		0.01785	0.00700	7.1584	0.01402	0.00001	d95(mm)	**43.54**
		0.01339	0.00600	7.3808	0.01324	0.00000	FI(mm)	**6.66**
		0.01116	0.00500	7.6439	0.01239	0.00000		
		0.00669	0.00200	8.9658	0.00902	0.00001	**SSE =**	**0.00179**



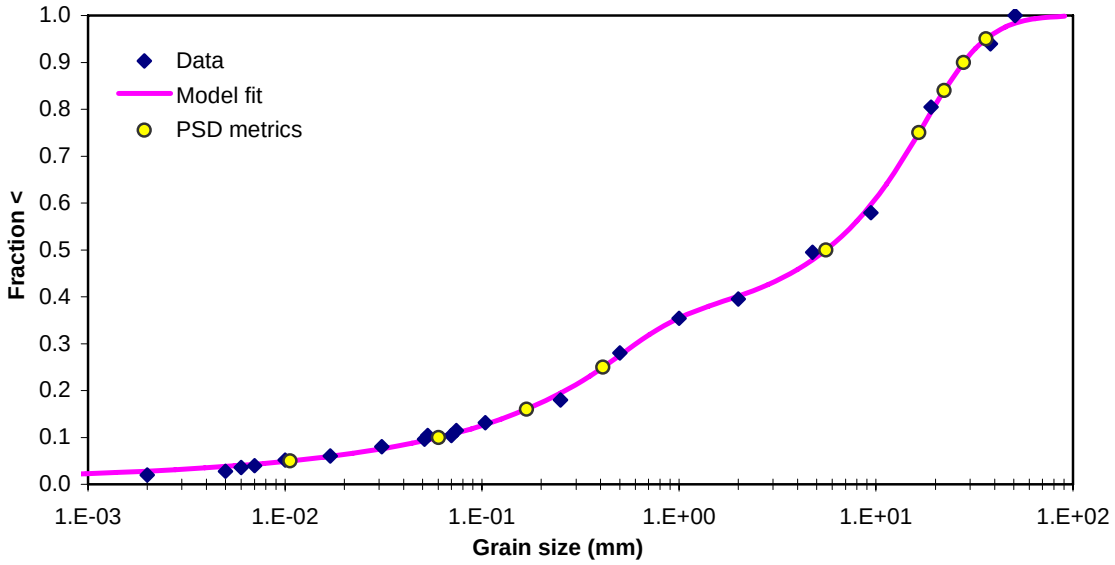
Sample data (Well 699-S20-E10, 10.5-11.5 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.98481	0.00023	d5(phi)	**5.42**
		0.89449	50.80000	-5.6668	0.88994	0.00002	d10(phi)	**3.15**
		0.79500	38.10000	-5.2517	0.81321	0.00033	d16(phi)	**1.75**
		0.64379	19.05000	-4.2517	0.62237	0.00046	d25(phi)	**0.28**
		0.47479	9.42000	-3.2357	0.48953	0.00022	d50(phi)	**-3.34**
		0.41380	4.76000	-2.2510	0.40786	0.00004	d75(phi)	**-4.94**
		0.32491	2.00000	-1.0000	0.33058	0.00003	d84(phi)	**-5.39**
		0.27163	1.00000	0.0000	0.26833	0.00001	d90(phi)	**-5.73**
		0.21100	0.50000	1.0000	0.20354	0.00006	d95(phi)	**-6.12**
		0.13245	0.25000	2.0000	0.14701	0.00021	σ_{IG}(phi)	**3.53**
		0.09304	0.10400	3.2653	0.09614	0.00001	d5(mm)	**0.02**
		0.08397	0.07400	3.7563	0.08202	0.00000	d10(mm)	**0.11**
		0.07519	0.05300	4.2379	0.07056	0.00002	d16(mm)	**0.30**
		0.08240	0.07000	3.8365	0.07996	0.00001	d25(mm)	**0.82**
		0.07553	0.05100	4.2934	0.06937	0.00004	d50(mm)	**10.10**
		0.06180	0.03100	5.0116	0.05607	0.00003	d75(mm)	**30.68**
		0.04463	0.01700	5.8783	0.04413	0.00000	d84(mm)	**41.89**
		0.03776	0.01000	6.6439	0.03626	0.00000	d90(mm)	**53.06**
		0.03433	0.00700	7.1584	0.03201	0.00001	d95(mm)	**69.52**
		0.02403	0.00600	7.3808	0.03038	0.00004	FI(mm)	**2.85**
		0.02060	0.00500	7.6439	0.02860	0.00006		
		0.01373	0.00200	8.9658	0.02154	0.00006	**SSE =**	**0.00189**



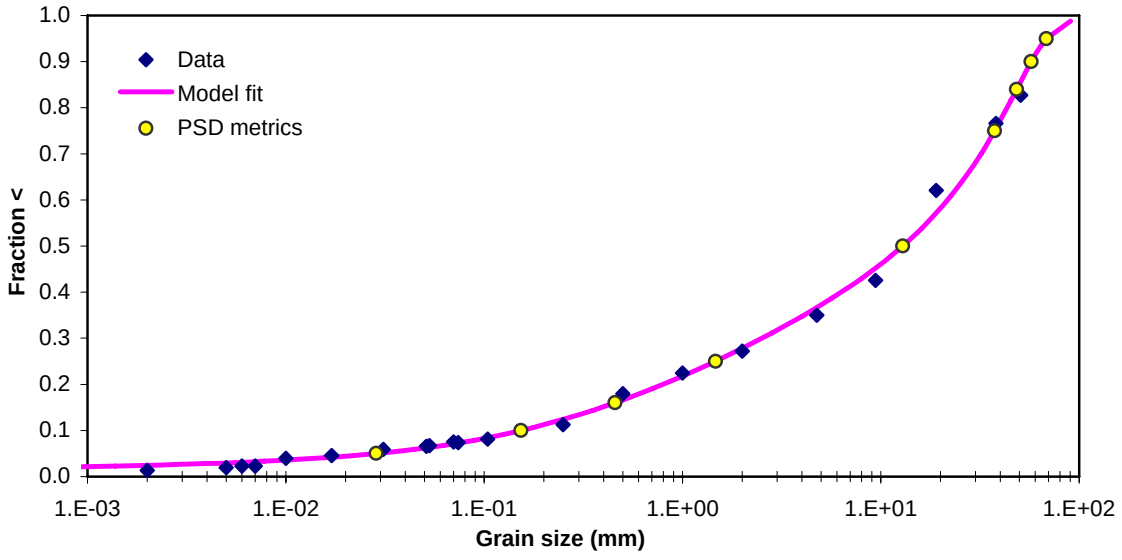
Sample data (Well 699-S20-E10, 12-13 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99902	0.00000	d5(phi)	**6.56**
		1.00000	50.80000	-5.6668	0.98338	0.00028	d10(phi)	**4.05**
		0.93957	38.10000	-5.2517	0.95698	0.00030	d16(phi)	**2.57**
		0.80442	19.05000	-4.2517	0.79375	0.00011	d25(phi)	**1.28**
		0.57972	9.42000	-3.2357	0.59594	0.00026	d50(phi)	**-2.48**
		0.49469	4.76000	-2.2510	0.47859	0.00026	d75(phi)	**-4.05**
		0.39519	2.00000	-1.0000	0.40110	0.00003	d84(phi)	**-4.47**
		0.35411	1.00000	0.0000	0.35514	0.00000	d90(phi)	**-4.80**
		0.28015	0.50000	1.0000	0.27491	0.00003	d95(phi)	**-5.18**
		0.17994	0.25000	2.0000	0.19441	0.00021	σ_{IG}(phi)	**3.54**
		0.13181	0.10400	3.2653	0.12758	0.00002	d5(mm)	**0.01**
		0.11520	0.07400	3.7563	0.10943	0.00003	d10(mm)	**0.06**
		0.10421	0.05300	4.2379	0.09464	0.00009	d16(mm)	**0.17**
		0.10429	0.07000	3.8365	0.10678	0.00001	d25(mm)	**0.41**
		0.09627	0.05100	4.2934	0.09310	0.00001	d50(mm)	**5.58**
		0.08022	0.03100	5.0116	0.07569	0.00002	d75(mm)	**16.54**
		0.06017	0.01700	5.8783	0.05971	0.00000	d84(mm)	**22.21**
		0.05215	0.01000	6.6439	0.04895	0.00001	d90(mm)	**27.84**
		0.04011	0.00700	7.1584	0.04304	0.00001	d95(mm)	**36.22**
		0.03610	0.00600	7.3808	0.04076	0.00002	FI(mm)	**1.47**
		0.02808	0.00500	7.6439	0.03826	0.00010		
		0.02006	0.00200	8.9658	0.02820	0.00007	**SSE =**	**0.00188**



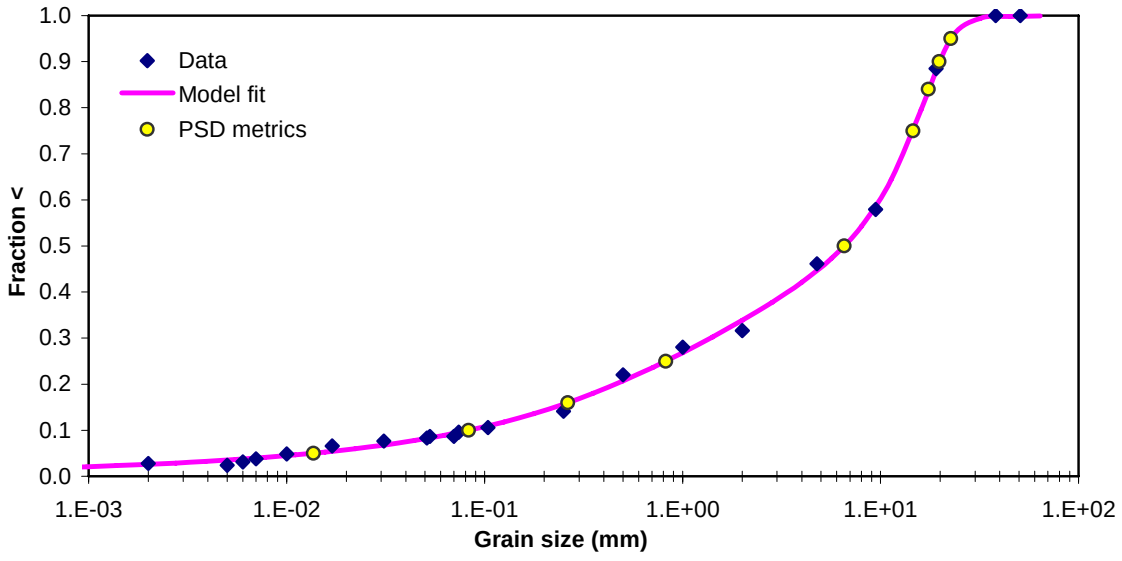
Sample data (Well 699-S20-E10, 13-14 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99272	0.00053	d5(phi)	**5.13**
		0.82676	50.80000	-5.6668	0.85725	0.00093	d10(phi)	**2.70**
		0.76602	38.10000	-5.2517	0.75486	0.00012	d16(phi)	**1.13**
		0.62042	19.05000	-4.2517	0.57174	0.00237	d25(phi)	**-0.55**
		0.42576	9.42000	-3.2357	0.45232	0.00071	d50(phi)	**-3.69**
		0.35017	4.76000	-2.2510	0.36661	0.00027	d75(phi)	**-5.23**
		0.27188	2.00000	-1.0000	0.27807	0.00004	d84(phi)	**-5.60**
		0.22443	1.00000	0.0000	0.21770	0.00005	d90(phi)	**-5.84**
		0.17946	0.50000	1.0000	0.16602	0.00018	d95(phi)	**-6.09**
		0.11231	0.25000	2.0000	0.12382	0.00013	σ_{IG}(phi)	**3.38**
		0.08135	0.10400	3.2653	0.08436	0.00001	d5(mm)	**0.03**
		0.07350	0.07400	3.7563	0.07289	0.00000	d10(mm)	**0.15**
		0.06669	0.05300	4.2379	0.06347	0.00001	d16(mm)	**0.46**
		0.07527	0.07000	3.8365	0.07121	0.00002	d25(mm)	**1.47**
		0.06545	0.05100	4.2934	0.06248	0.00001	d50(mm)	**12.88**
		0.05890	0.03100	5.0116	0.05151	0.00005	d75(mm)	**37.55**
		0.04581	0.01700	5.8783	0.04181	0.00002	d84(mm)	**48.46**
		0.03927	0.01000	6.6439	0.03559	0.00001	d90(mm)	**57.37**
		0.02291	0.00700	7.1584	0.03232	0.00009	d95(mm)	**68.35**
		0.02291	0.00600	7.3808	0.03108	0.00007	FI(mm)	**4.07**
		0.01963	0.00500	7.6439	0.02973	0.00010		
		0.01309	0.00200	8.9658	0.02441	0.00013	**SSE =**	**0.00584**



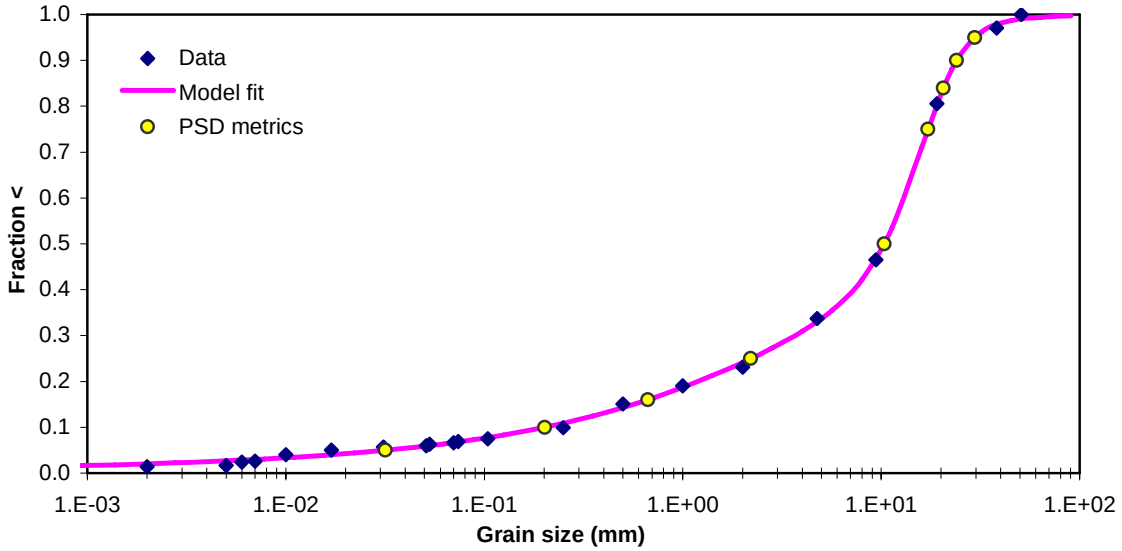
Sample data (Well 699-S20-E10, 14.5-15.5 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99977	0.00000	d5(phi)	**6.19**
		1.00000	50.80000	-5.6668	0.99875	0.00000	d10(phi)	**3.59**
		1.00000	38.10000	-5.2517	0.99715	0.00001	d16(phi)	**1.93**
		0.88489	19.05000	-4.2517	0.88355	0.00000	d25(phi)	**0.28**
		0.57903	9.42000	-3.2357	0.58527	0.00004	d50(phi)	**-2.71**
		0.46141	4.76000	-2.2510	0.44608	0.00023	d75(phi)	**-3.87**
		0.31600	2.00000	-1.0000	0.33880	0.00052	d84(phi)	**-4.13**
		0.28042	1.00000	0.0000	0.26826	0.00015	d90(phi)	**-4.30**
		0.22016	0.50000	1.0000	0.20688	0.00018	d95(phi)	**-4.50**
		0.14139	0.25000	2.0000	0.15673	0.00024	σ_{IG}(phi)	**3.13**
		0.10596	0.10400	3.2653	0.10955	0.00001	d5(mm)	**0.01**
		0.09604	0.07400	3.7563	0.09548	0.00000	d10(mm)	**0.08**
		0.08661	0.05300	4.2379	0.08360	0.00001	d16(mm)	**0.26**
		0.08668	0.07000	3.8365	0.09338	0.00004	d25(mm)	**0.82**
		0.08321	0.05100	4.2934	0.08234	0.00000	d50(mm)	**6.54**
		0.07628	0.03100	5.0116	0.06785	0.00007	d75(mm)	**14.60**
		0.06588	0.01700	5.8783	0.05413	0.00014	d84(mm)	**17.45**
		0.04854	0.01000	6.6439	0.04467	0.00001	d90(mm)	**19.74**
		0.03814	0.00700	7.1584	0.03942	0.00000	d95(mm)	**22.60**
		0.03120	0.00600	7.3808	0.03738	0.00004	FI(mm)	**1.92**
		0.02427	0.00500	7.6439	0.03513	0.00012		
		0.02774	0.00200	8.9658	0.02603	0.00000	**SSE =**	**0.00182**



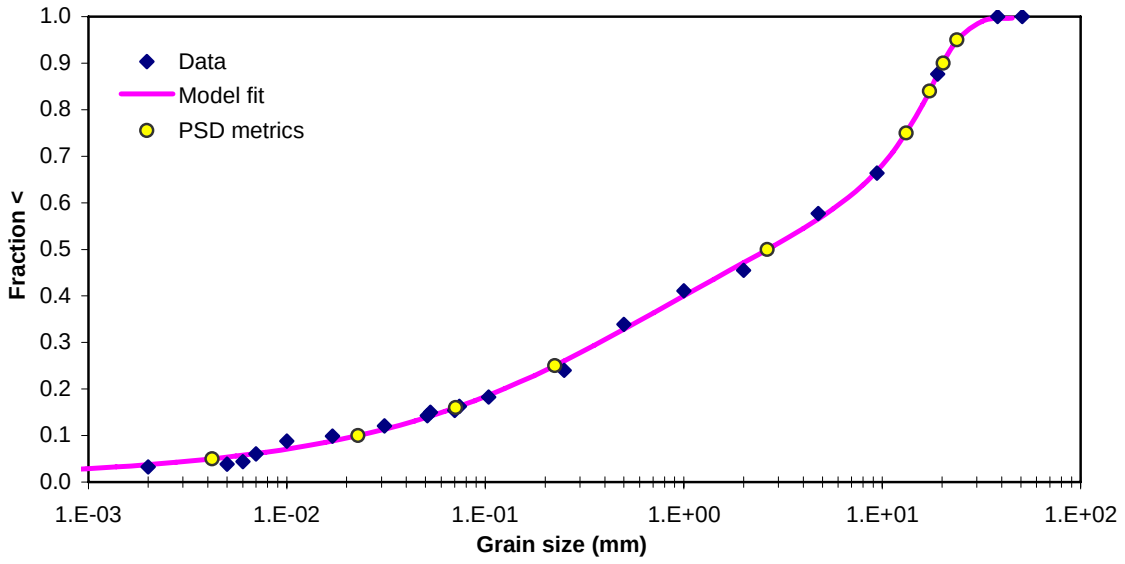
Sample data (Well 699-S20-E10, 15.5-16.5 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99782	0.00000	d5(phi)	**4.98**
		1.00000	50.80000	-5.6668	0.99002	0.00010	d10(phi)	**2.31**
		0.97059	38.10000	-5.2517	0.97790	0.00005	d16(phi)	**0.59**
		0.80570	19.05000	-4.2517	0.80436	0.00000	d25(phi)	**-1.14**
		0.46493	9.42000	-3.2357	0.46756	0.00001	d50(phi)	**-3.37**
		0.33745	4.76000	-2.2510	0.33075	0.00004	d75(phi)	**-4.10**
		0.23149	2.00000	-1.0000	0.24157	0.00010	d84(phi)	**-4.36**
		0.19059	1.00000	0.0000	0.18701	0.00001	d90(phi)	**-4.58**
		0.15079	0.50000	1.0000	0.14298	0.00006	d95(phi)	**-4.89**
		0.09903	0.25000	2.0000	0.10884	0.00010	σ_{IG}(phi)	**2.73**
		0.07475	0.10400	3.2653	0.07747	0.00001	d5(mm)	**0.03**
		0.06885	0.07400	3.7563	0.06812	0.00000	d10(mm)	**0.20**
		0.06294	0.05300	4.2379	0.06019	0.00001	d16(mm)	**0.67**
		0.06666	0.07000	3.8365	0.06672	0.00000	d25(mm)	**2.20**
		0.05951	0.05100	4.2934	0.05935	0.00000	d50(mm)	**10.36**
		0.05713	0.03100	5.0116	0.04960	0.00006	d75(mm)	**17.19**
		0.04999	0.01700	5.8783	0.04024	0.00010	d84(mm)	**20.53**
		0.04047	0.01000	6.6439	0.03370	0.00005	d90(mm)	**23.99**
		0.02619	0.00700	7.1584	0.03002	0.00001	d95(mm)	**29.58**
		0.02381	0.00600	7.3808	0.02858	0.00002	FI(mm)	**3.76**
		0.01666	0.00500	7.6439	0.02699	0.00011		
		0.01428	0.00200	8.9658	0.02044	0.00004	**SSE =**	**0.00087**



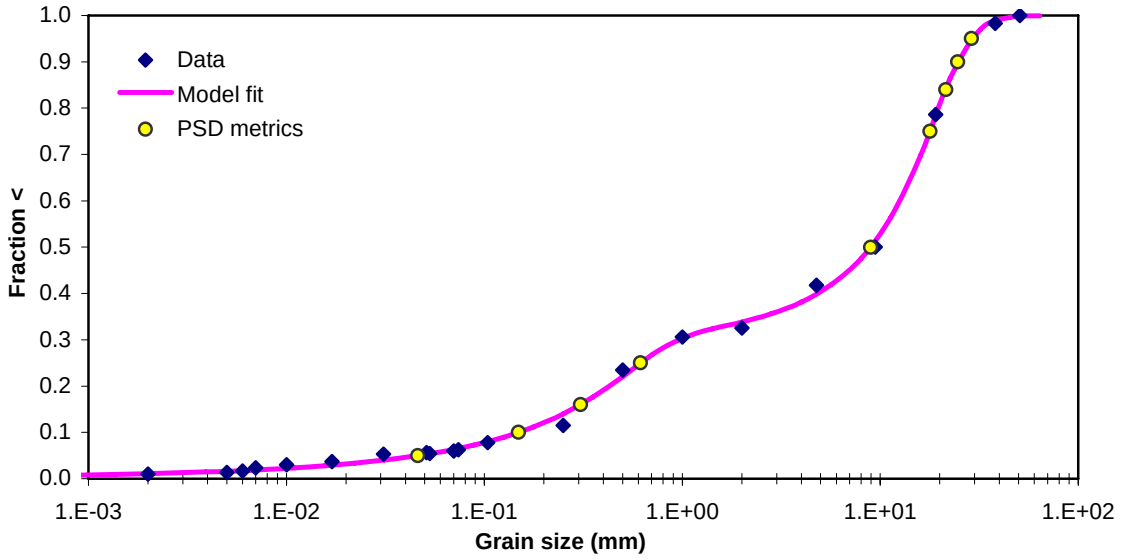
Sample data (Well 699-S20-E10, 17-18 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99941	0.00000	d5(phi)	**7.90**
		1.00000	50.80000	-5.6668	0.99757	0.00001	d10(phi)	**5.45**
		1.00000	38.10000	-5.2517	0.99507	0.00002	d16(phi)	**3.82**
		0.87687	19.05000	-4.2517	0.87603	0.00000	d25(phi)	**2.16**
		0.66364	9.42000	-3.2357	0.66890	0.00003	d50(phi)	**-1.40**
		0.57685	4.76000	-2.2510	0.56509	0.00014	d75(phi)	**-3.72**
		0.45522	2.00000	-1.0000	0.47151	0.00027	d84(phi)	**-4.11**
		0.41088	1.00000	0.0000	0.40009	0.00012	d90(phi)	**-4.34**
		0.33902	0.50000	1.0000	0.32826	0.00012	d95(phi)	**-4.57**
		0.24032	0.25000	2.0000	0.26020	0.00040	σ_{IG}(phi)	**3.87**
		0.18299	0.10400	3.2653	0.18662	0.00001	d5(mm)	**0.00**
		0.16252	0.07400	3.7563	0.16278	0.00000	d10(mm)	**0.02**
		0.14987	0.05300	4.2379	0.14199	0.00006	d16(mm)	**0.07**
		0.15405	0.07000	3.8365	0.15914	0.00003	d25(mm)	**0.22**
		0.14305	0.05100	4.2934	0.13975	0.00001	d50(mm)	**2.64**
		0.12104	0.03100	5.0116	0.11366	0.00005	d75(mm)	**13.20**
		0.09903	0.01700	5.8783	0.08850	0.00011	d84(mm)	**17.31**
		0.08803	0.01000	6.6439	0.07106	0.00029	d90(mm)	**20.31**
		0.06052	0.00700	7.1584	0.06143	0.00000	d95(mm)	**23.77**
		0.04401	0.00600	7.3808	0.05771	0.00019	FI(mm)	**0.87**
		0.03851	0.00500	7.6439	0.05362	0.00023		
		0.03301	0.00200	8.9658	0.03740	0.00002	**SSE =**	**0.00209**



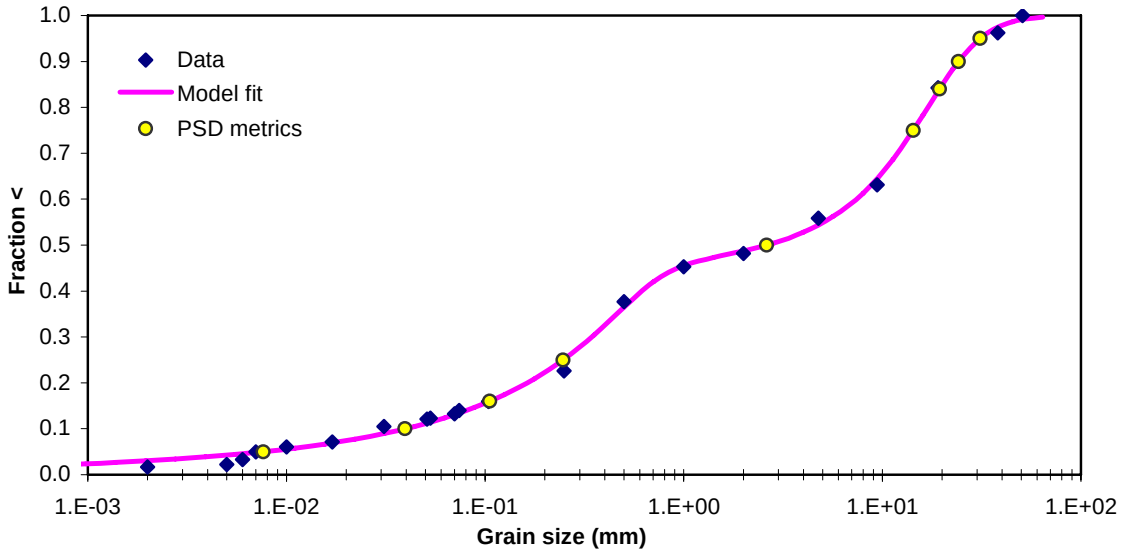
Sample data (Well 699-S20-E10, 18-19 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99999	0.00000	d5(phi)	**4.44**
		1.00000	50.80000	-5.6668	0.99818	0.00000	d10(phi)	**2.74**
		0.98290	38.10000	-5.2517	0.98875	0.00003	d16(phi)	**1.70**
		0.78608	19.05000	-4.2517	0.78242	0.00001	d25(phi)	**0.70**
		0.50024	9.42000	-3.2357	0.51245	0.00015	d50(phi)	**-3.16**
		0.41787	4.76000	-2.2510	0.39847	0.00038	d75(phi)	**-4.16**
		0.32566	2.00000	-1.0000	0.33857	0.00017	d84(phi)	**-4.42**
		0.30574	1.00000	0.0000	0.30363	0.00000	d90(phi)	**-4.62**
		0.23490	0.50000	1.0000	0.22084	0.00020	d95(phi)	**-4.85**
		0.11521	0.25000	2.0000	0.13958	0.00059	σ_{IG}(phi)	**2.94**
		0.07832	0.10400	3.2653	0.08004	0.00000	d5(mm)	**0.05**
		0.06228	0.07400	3.7563	0.06538	0.00001	d10(mm)	**0.15**
		0.05453	0.05300	4.2379	0.05399	0.00000	d16(mm)	**0.31**
		0.06015	0.07000	3.8365	0.06330	0.00001	d25(mm)	**0.62**
		0.05680	0.05100	4.2934	0.05283	0.00002	d50(mm)	**8.95**
		0.05346	0.03100	5.0116	0.04021	0.00018	d75(mm)	**17.84**
		0.03676	0.01700	5.8783	0.02942	0.00005	d84(mm)	**21.44**
		0.03007	0.01000	6.6439	0.02264	0.00006	d90(mm)	**24.64**
		0.02339	0.00700	7.1584	0.01911	0.00002	d95(mm)	**28.92**
		0.01671	0.00600	7.3808	0.01778	0.00000	FI(mm)	**1.90**
		0.01337	0.00500	7.6439	0.01636	0.00001		
		0.01002	0.00200	8.9658	0.01094	0.00000	**SSE =**	**0.00189**



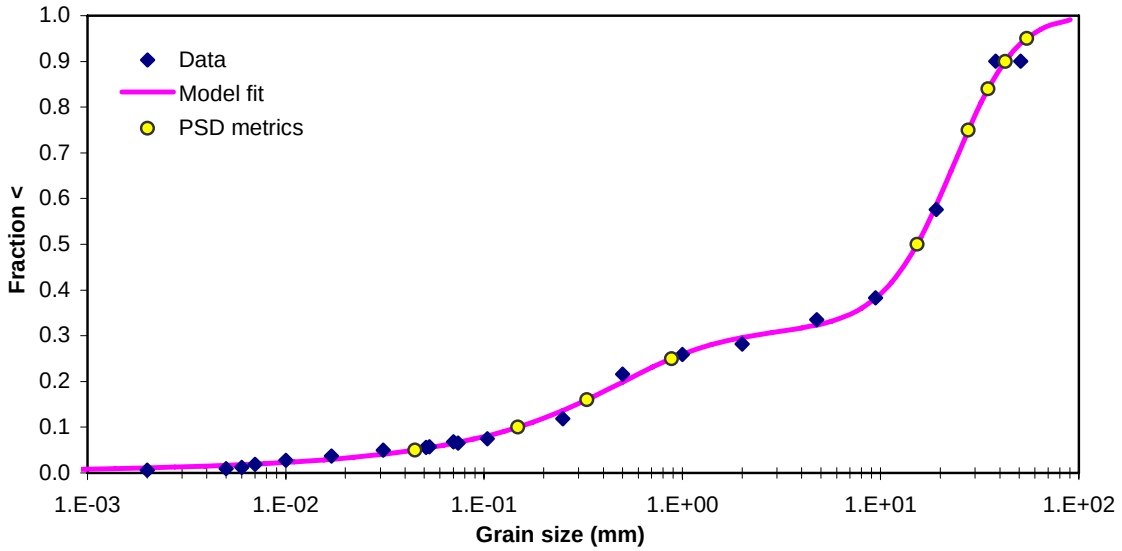
Sample data (Well 699-S20-E10, 19.5-20.5 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99966	0.00000	d5(phi)	**7.03**
		1.00000	50.80000	-5.6668	0.99163	0.00007	d10(phi)	**4.66**
		0.96264	38.10000	-5.2517	0.97473	0.00015	d16(phi)	**3.24**
		0.84281	19.05000	-4.2517	0.83481	0.00006	d25(phi)	**2.02**
		0.63102	9.42000	-3.2357	0.64455	0.00018	d50(phi)	**-1.39**
		0.55888	4.76000	-2.2510	0.54375	0.00023	d75(phi)	**-3.84**
		0.48155	2.00000	-1.0000	0.48742	0.00003	d84(phi)	**-4.28**
		0.45266	1.00000	0.0000	0.45532	0.00001	d90(phi)	**-4.59**
		0.37659	0.50000	1.0000	0.36469	0.00014	d95(phi)	**-4.95**
		0.22633	0.25000	2.0000	0.25187	0.00065	σ_{IG}(phi)	**3.70**
		0.15963	0.10400	3.2653	0.15884	0.00000	d5(mm)	**0.01**
		0.14023	0.07400	3.7563	0.13428	0.00004	d10(mm)	**0.04**
		0.12336	0.05300	4.2379	0.11453	0.00008	d16(mm)	**0.11**
		0.13229	0.07000	3.8365	0.13072	0.00000	d25(mm)	**0.25**
		0.12127	0.05100	4.2934	0.11249	0.00008	d50(mm)	**2.61**
		0.10473	0.03100	5.0116	0.08967	0.00023	d75(mm)	**14.34**
		0.07166	0.01700	5.8783	0.06917	0.00001	d84(mm)	**19.39**
		0.06063	0.01000	6.6439	0.05564	0.00002	d90(mm)	**24.17**
		0.04961	0.00700	7.1584	0.04834	0.00000	d95(mm)	**31.01**
		0.03307	0.00600	7.3808	0.04555	0.00016	FI(mm)	**0.97**
		0.02205	0.00500	7.6439	0.04249	0.00042		
		0.01654	0.00200	8.9658	0.03043	0.00019	**SSE =**	**0.00275**



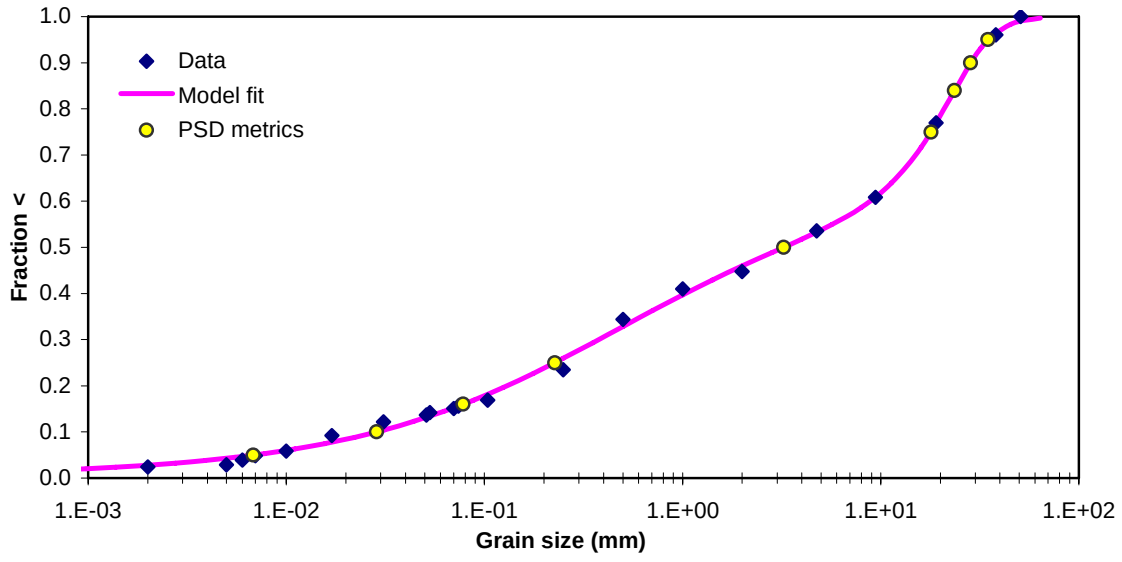
Sample data (Well 699-S20-E10, 20.5-21.5 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99383	0.00004	d5(phi)	**4.48**
		0.90071	50.80000	-5.6668	0.93828	0.00141	d10(phi)	**2.76**
		0.90071	38.10000	-5.2517	0.86954	0.00097	d16(phi)	**1.60**
		0.57634	19.05000	-4.2517	0.58485	0.00007	d25(phi)	**0.18**
		0.38275	9.42000	-3.2357	0.38193	0.00000	d50(phi)	**-3.93**
		0.33498	4.76000	-2.2510	0.32325	0.00014	d75(phi)	**-4.79**
		0.28177	2.00000	-1.0000	0.29598	0.00020	d84(phi)	**-5.12**
		0.25932	1.00000	0.0000	0.25954	0.00000	d90(phi)	**-5.41**
		0.21609	0.50000	1.0000	0.19874	0.00030	d95(phi)	**-5.77**
		0.11834	0.25000	2.0000	0.13650	0.00033	σ_{IG}(phi)	**3.23**
		0.07474	0.10400	3.2653	0.08113	0.00004	d5(mm)	**0.04**
		0.06543	0.07400	3.7563	0.06649	0.00000	d10(mm)	**0.15**
		0.05700	0.05300	4.2379	0.05494	0.00000	d16(mm)	**0.33**
		0.06822	0.07000	3.8365	0.06439	0.00001	d25(mm)	**0.88**
		0.05582	0.05100	4.2934	0.05376	0.00000	d50(mm)	**15.28**
		0.04962	0.03100	5.0116	0.04085	0.00008	d75(mm)	**27.68**
		0.03721	0.01700	5.8783	0.02978	0.00006	d84(mm)	**34.81**
		0.02791	0.01000	6.6439	0.02282	0.00003	d90(mm)	**42.48**
		0.01861	0.00700	7.1584	0.01921	0.00000	d95(mm)	**54.61**
		0.01240	0.00600	7.3808	0.01786	0.00003	FI(mm)	**3.00**
		0.00930	0.00500	7.6439	0.01640	0.00005		
		0.00620	0.00200	8.9658	0.01090	0.00002	**SSE =**	**0.00379**



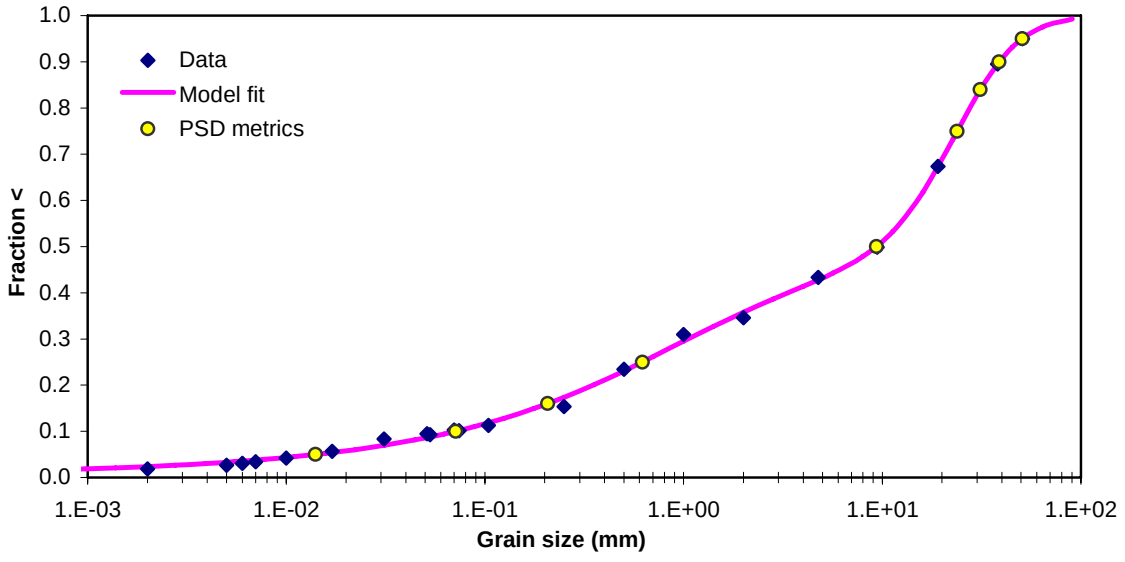
Sample data (Well 699-S20-E10, 22-23 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99945	0.00000	d5(phi)	**7.20**
		1.00000	50.80000	-5.6668	0.99018	0.00010	d10(phi)	**5.13**
		0.96021	38.10000	-5.2517	0.96495	0.00002	d16(phi)	**3.68**
		0.76962	19.05000	-4.2517	0.76855	0.00000	d25(phi)	**2.14**
		0.60807	9.42000	-3.2357	0.60909	0.00000	d50(phi)	**-1.70**
		0.53567	4.76000	-2.2510	0.53274	0.00001	d75(phi)	**-4.17**
		0.44734	2.00000	-1.0000	0.45976	0.00015	d84(phi)	**-4.56**
		0.40995	1.00000	0.0000	0.39720	0.00016	d90(phi)	**-4.83**
		0.34364	0.50000	1.0000	0.32859	0.00023	d95(phi)	**-5.12**
		0.23506	0.25000	2.0000	0.25947	0.00060	σ_{IG}(phi)	**3.93**
		0.16895	0.10400	3.2653	0.18174	0.00016	d5(mm)	**0.01**
		0.15609	0.07400	3.7563	0.15624	0.00000	d10(mm)	**0.03**
		0.14168	0.05300	4.2379	0.13403	0.00006	d16(mm)	**0.08**
		0.15093	0.07000	3.8365	0.15235	0.00000	d25(mm)	**0.23**
		0.13633	0.05100	4.2934	0.13165	0.00002	d50(mm)	**3.24**
		0.12172	0.03100	5.0116	0.10401	0.00031	d75(mm)	**17.95**
		0.09251	0.01700	5.8783	0.07782	0.00022	d84(mm)	**23.58**
		0.05843	0.01000	6.6439	0.06016	0.00000	d90(mm)	**28.39**
		0.04869	0.00700	7.1584	0.05064	0.00000	d95(mm)	**34.83**
		0.03895	0.00600	7.3808	0.04702	0.00007	FI(mm)	**1.01**
		0.02921	0.00500	7.6439	0.04309	0.00019		
		0.02434	0.00200	8.9658	0.02800	0.00001	**SSE =**	**0.00232**



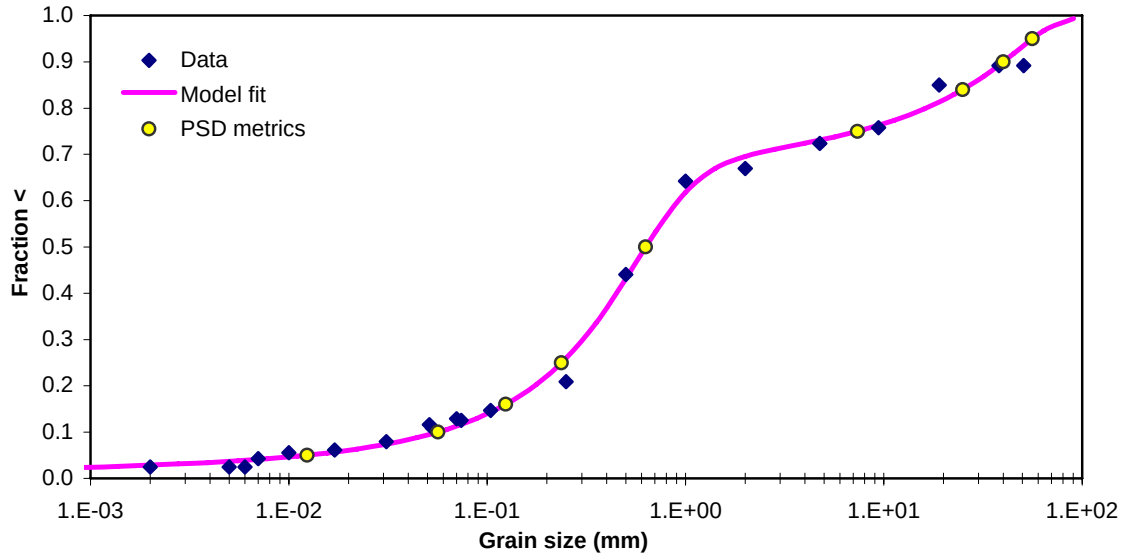
Sample data (Well 699-S20-E10, 23-24 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99487	0.00003	d5(phi)	**6.15**
		0.94966	50.80000	-5.6668	0.95019	0.00000	d10(phi)	**3.81**
		0.89487	38.10000	-5.2517	0.89575	0.00000	d16(phi)	**2.27**
		0.67347	19.05000	-4.2517	0.67235	0.00000	d25(phi)	**0.69**
		0.49890	9.42000	-3.2357	0.50123	0.00001	d50(phi)	**-3.22**
		0.43306	4.76000	-2.2510	0.42783	0.00003	d75(phi)	**-4.57**
		0.34551	2.00000	-1.0000	0.35796	0.00015	d84(phi)	**-4.96**
		0.30996	1.00000	0.0000	0.29491	0.00023	d90(phi)	**-5.28**
		0.23409	0.50000	1.0000	0.23046	0.00001	d95(phi)	**-5.66**
		0.15335	0.25000	2.0000	0.17347	0.00040	σ_{IG}(phi)	**3.60**
		0.11264	0.10400	3.2653	0.11818	0.00003	d5(mm)	**0.01**
		0.10147	0.07400	3.7563	0.10167	0.00000	d10(mm)	**0.07**
		0.09274	0.05300	4.2379	0.08780	0.00002	d16(mm)	**0.21**
		0.10254	0.07000	3.8365	0.09921	0.00001	d25(mm)	**0.62**
		0.09494	0.05100	4.2934	0.08634	0.00007	d50(mm)	**9.34**
		0.08355	0.03100	5.0116	0.06962	0.00019	d75(mm)	**23.82**
		0.05696	0.01700	5.8783	0.05407	0.00001	d84(mm)	**31.13**
		0.04177	0.01000	6.6439	0.04357	0.00000	d90(mm)	**38.79**
		0.03418	0.00700	7.1584	0.03784	0.00001	d95(mm)	**50.73**
		0.03038	0.00600	7.3808	0.03564	0.00003	FI(mm)	**2.19**
		0.02658	0.00500	7.6439	0.03323	0.00004		
		0.01899	0.00200	8.9658	0.02367	0.00002	**SSE =**	**0.00131**



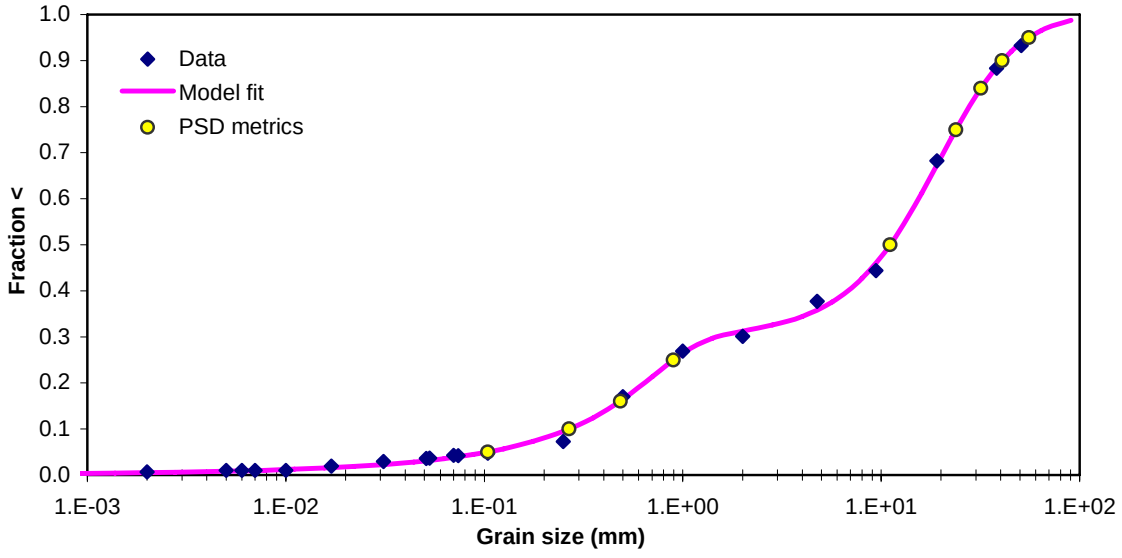
Sample data (Well 699-S20-E10, 24.5-25.5 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99640	0.00013	d5(phi)	**6.34**
		0.89182	50.80000	-5.6668	0.93561	0.00096	d10(phi)	**4.15**
		0.89182	38.10000	-5.2517	0.89274	0.00000	d16(phi)	**3.01**
		0.85001	19.05000	-4.2517	0.81315	0.00136	d25(phi)	**2.08**
		0.75775	9.42000	-3.2357	0.76294	0.00003	d50(phi)	**0.67**
		0.72362	4.76000	-2.2510	0.73080	0.00005	d75(phi)	**-2.88**
		0.66968	2.00000	-1.0000	0.69550	0.00067	d84(phi)	**-4.65**
		0.64200	1.00000	0.0000	0.61826	0.00056	d90(phi)	**-5.32**
		0.44070	0.50000	1.0000	0.43096	0.00009	d95(phi)	**-5.81**
		0.20890	0.25000	2.0000	0.25999	0.00261	σ_{IG}(phi)	**3.75**
		0.14669	0.10400	3.2653	0.14295	0.00001	d5(mm)	**0.01**
		0.12551	0.07400	3.7563	0.11644	0.00008	d10(mm)	**0.06**
		0.10886	0.05300	4.2379	0.09664	0.00015	d16(mm)	**0.12**
		0.12857	0.07000	3.8365	0.11277	0.00025	d25(mm)	**0.24**
		0.11633	0.05100	4.2934	0.09468	0.00047	d50(mm)	**0.63**
		0.07959	0.03100	5.0116	0.07376	0.00003	d75(mm)	**7.37**
		0.06122	0.01700	5.8783	0.05665	0.00002	d84(mm)	**25.02**
		0.05510	0.01000	6.6439	0.04624	0.00008	d90(mm)	**40.07**
		0.04286	0.00700	7.1584	0.04091	0.00000	d95(mm)	**56.04**
		0.02449	0.00600	7.3808	0.03893	0.00021	FI(mm)	**1.54**
		0.02449	0.00500	7.6439	0.03678	0.00015		
		0.02449	0.00200	8.9658	0.02860	0.00017	**SSE =**	**0.00809**



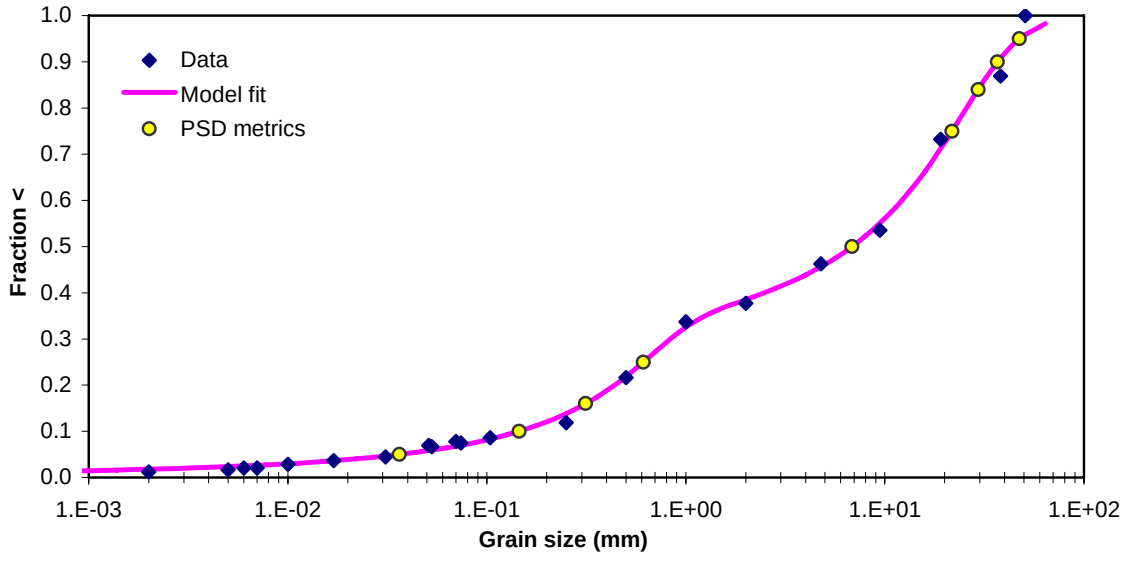
Sample data (Well 699-S20-E10, 25.5-26.5 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99060	0.00009	d5(phi)	**3.27**
		0.93240	50.80000	-5.6668	0.93845	0.00004	d10(phi)	**1.90**
		0.88290	38.10000	-5.2517	0.88562	0.00001	d16(phi)	**1.04**
		0.68241	19.05000	-4.2517	0.67257	0.00010	d25(phi)	**0.16**
		0.44374	9.42000	-3.2357	0.46035	0.00028	d50(phi)	**-3.47**
		0.37700	4.76000	-2.2510	0.35812	0.00036	d75(phi)	**-4.57**
		0.30139	2.00000	-1.0000	0.31257	0.00013	d84(phi)	**-4.99**
		0.26919	1.00000	0.0000	0.26452	0.00002	d90(phi)	**-5.35**
		0.16997	0.50000	1.0000	0.16397	0.00004	d95(phi)	**-5.79**
		0.07291	0.25000	2.0000	0.09491	0.00048	σ_{IG}(phi)	**2.88**
		0.04765	0.10400	3.2653	0.05000	0.00001	d5(mm)	**0.10**
		0.04176	0.07400	3.7563	0.03963	0.00000	d10(mm)	**0.27**
		0.03685	0.05300	4.2379	0.03181	0.00003	d16(mm)	**0.48**
		0.04254	0.07000	3.8365	0.03819	0.00002	d25(mm)	**0.90**
		0.03600	0.05100	4.2934	0.03103	0.00002	d50(mm)	**11.08**
		0.02945	0.03100	5.0116	0.02268	0.00005	d75(mm)	**23.80**
		0.01963	0.01700	5.8783	0.01585	0.00001	d84(mm)	**31.79**
		0.00982	0.01000	6.6439	0.01173	0.00000	d90(mm)	**40.73**
		0.00982	0.00700	7.1584	0.00966	0.00000	d95(mm)	**55.41**
		0.00982	0.00600	7.3808	0.00890	0.00000	FI(mm)	**2.81**
		0.00982	0.00500	7.6439	0.00809	0.00000		
		0.00654	0.00200	8.9658	0.00510	0.00000	**SSE =**	**0.00168**



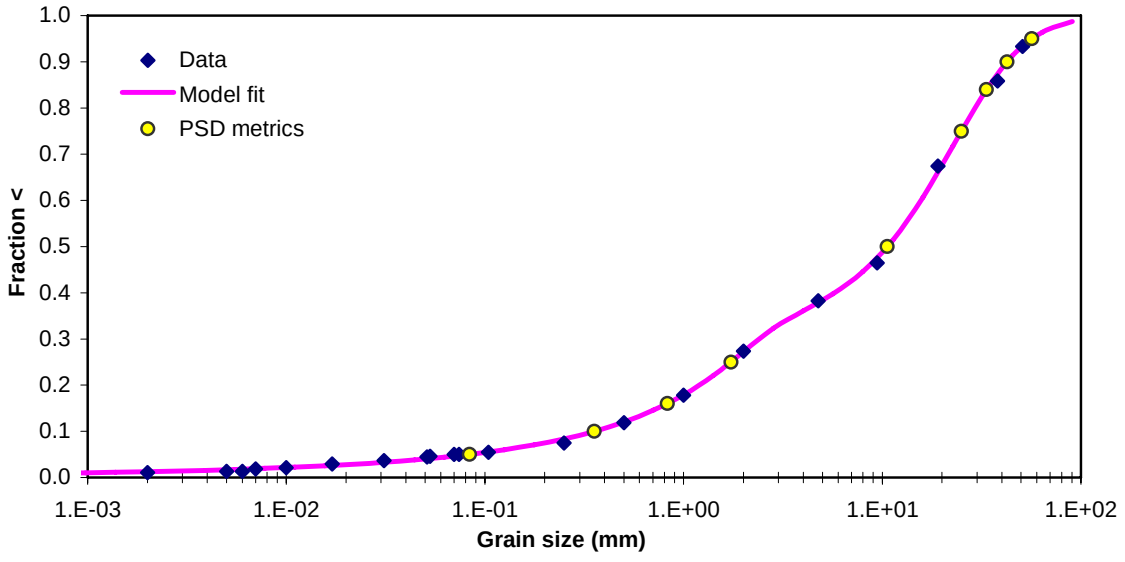
Sample data (Well 699-S20-E10, 27-28 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99743	0.00003	d5(phi)	**4.78**
		1.00000	50.80000	-5.6668	0.96013	0.00159	d10(phi)	**2.78**
		0.86895	38.10000	-5.2517	0.90826	0.00154	d16(phi)	**1.67**
		0.73221	19.05000	-4.2517	0.71125	0.00044	d25(phi)	**0.71**
		0.53557	9.42000	-3.2357	0.55017	0.00021	d50(phi)	**-2.77**
		0.46244	4.76000	-2.2510	0.45612	0.00004	d75(phi)	**-4.44**
		0.37733	2.00000	-1.0000	0.38539	0.00007	d84(phi)	**-4.88**
		0.33735	1.00000	0.0000	0.32583	0.00013	d90(phi)	**-5.20**
		0.21611	0.50000	1.0000	0.21849	0.00001	d95(phi)	**-5.56**
		0.11911	0.25000	2.0000	0.13827	0.00037	σ_{IG}(phi)	**3.20**
		0.08602	0.10400	3.2653	0.08317	0.00001	d5(mm)	**0.04**
		0.07463	0.07400	3.7563	0.06977	0.00002	d10(mm)	**0.15**
		0.06701	0.05300	4.2379	0.05933	0.00006	d16(mm)	**0.31**
		0.07782	0.07000	3.8365	0.06787	0.00010	d25(mm)	**0.61**
		0.06963	0.05100	4.2934	0.05827	0.00013	d50(mm)	**6.83**
		0.04506	0.03100	5.0116	0.04662	0.00000	d75(mm)	**21.78**
		0.03686	0.01700	5.8783	0.03648	0.00000	d84(mm)	**29.43**
		0.02867	0.01000	6.6439	0.02994	0.00000	d90(mm)	**36.79**
		0.02048	0.00700	7.1584	0.02644	0.00004	d95(mm)	**47.32**
		0.02048	0.00600	7.3808	0.02511	0.00002	FI(mm)	**2.04**
		0.01638	0.00500	7.6439	0.02365	0.00005		
		0.01229	0.00200	8.9658	0.01790	0.00003	**SSE =**	**0.00486**



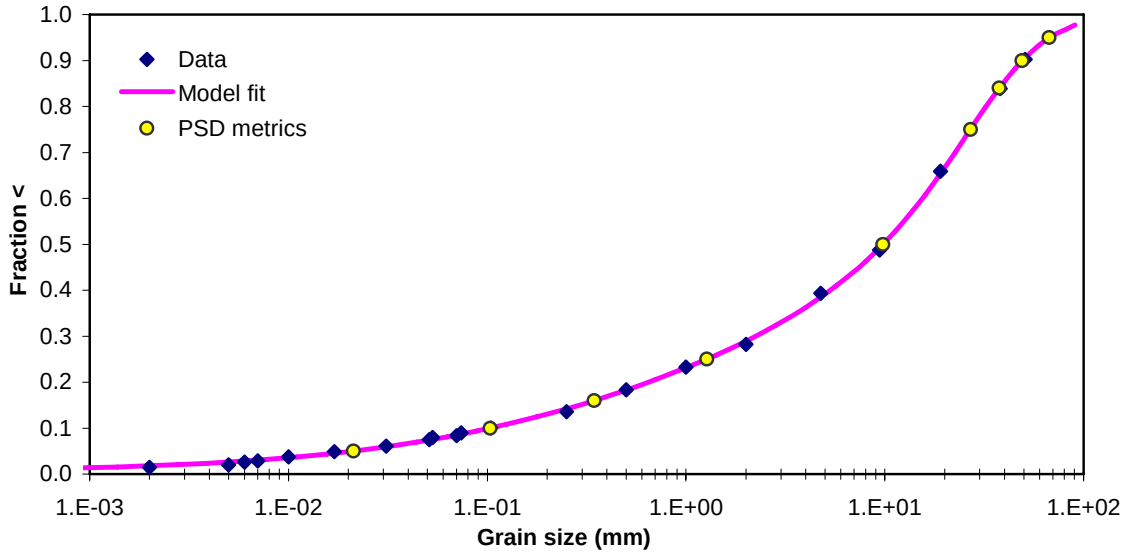
Sample data (Well 699-S20-E10, 28-29 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99122	0.00039	d5(phi)	**3.58**
		0.93347	50.80000	-5.6668	0.93393	0.00000	d10(phi)	**1.49**
		0.85821	38.10000	-5.2517	0.87483	0.00028	d16(phi)	**0.27**
		0.67429	19.05000	-4.2517	0.66012	0.00020	d25(phi)	**-0.79**
		0.46494	9.42000	-3.2357	0.47542	0.00011	d50(phi)	**-3.41**
		0.38281	4.76000	-2.2510	0.37896	0.00001	d75(phi)	**-4.65**
		0.27354	2.00000	-1.0000	0.27211	0.00000	d84(phi)	**-5.06**
		0.17815	1.00000	0.0000	0.17882	0.00000	d90(phi)	**-5.41**
		0.11916	0.50000	1.0000	0.12010	0.00000	d95(phi)	**-5.83**
		0.07458	0.25000	2.0000	0.08356	0.00008	σ_{IG}(phi)	**2.76**
		0.05482	0.10400	3.2653	0.05512	0.00000	d5(mm)	**0.08**
		0.04975	0.07400	3.7563	0.04742	0.00001	d10(mm)	**0.36**
		0.04590	0.05300	4.2379	0.04113	0.00002	d16(mm)	**0.83**
		0.05018	0.07000	3.8365	0.04629	0.00002	d25(mm)	**1.73**
		0.04489	0.05100	4.2934	0.04048	0.00002	d50(mm)	**10.62**
		0.03697	0.03100	5.0116	0.03307	0.00002	d75(mm)	**25.03**
		0.02905	0.01700	5.8783	0.02624	0.00001	d84(mm)	**33.43**
		0.02113	0.01000	6.6439	0.02163	0.00000	d90(mm)	**42.45**
		0.01849	0.00700	7.1584	0.01909	0.00000	d95(mm)	**56.69**
		0.01320	0.00600	7.3808	0.01810	0.00002	FI(mm)	**3.94**
		0.01320	0.00500	7.6439	0.01702	0.00001		
		0.01056	0.00200	8.9658	0.01266	0.00001	**SSE =**	**0.00121**



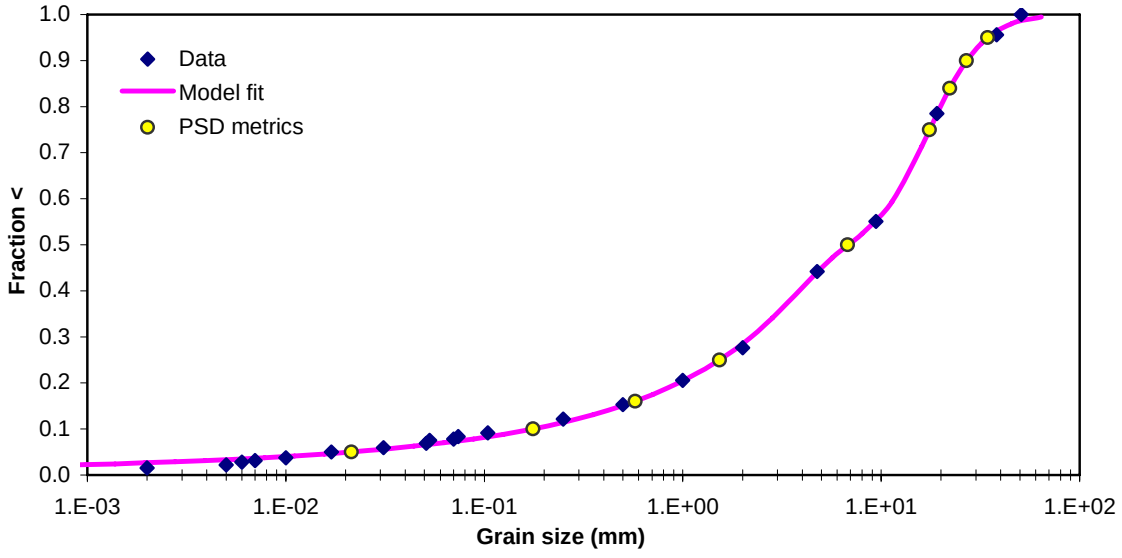
Sample data (Well 699-S20-E10, 30-31 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.98308	0.00029	d5(phi)	**5.56**
		0.90203	50.80000	-5.6668	0.90661	0.00002	d10(phi)	**3.27**
		0.83890	38.10000	-5.2517	0.84283	0.00002	d16(phi)	**1.54**
		0.65856	19.05000	-4.2517	0.65330	0.00003	d25(phi)	**-0.35**
		0.48747	9.42000	-3.2357	0.49251	0.00003	d50(phi)	**-3.29**
		0.39342	4.76000	-2.2510	0.38466	0.00008	d75(phi)	**-4.76**
		0.28240	2.00000	-1.0000	0.28926	0.00005	d84(phi)	**-5.24**
		0.23276	1.00000	0.0000	0.23115	0.00000	d90(phi)	**-5.62**
		0.18318	0.50000	1.0000	0.18278	0.00000	d95(phi)	**-6.07**
		0.13568	0.25000	2.0000	0.14199	0.00004	σ_{IG}(phi)	**3.45**
		0.10003	0.10400	3.2653	0.10020	0.00000	d5(mm)	**0.02**
		0.08951	0.07400	3.7563	0.08682	0.00001	d10(mm)	**0.10**
		0.07986	0.05300	4.2379	0.07516	0.00002	d16(mm)	**0.34**
		0.08379	0.07000	3.8365	0.08478	0.00000	d25(mm)	**1.27**
		0.07512	0.05100	4.2934	0.07390	0.00000	d50(mm)	**9.80**
		0.06068	0.03100	5.0116	0.05927	0.00000	d75(mm)	**27.02**
		0.04912	0.01700	5.8783	0.04522	0.00002	d84(mm)	**37.67**
		0.03756	0.01000	6.6439	0.03563	0.00000	d90(mm)	**49.09**
		0.02889	0.00700	7.1584	0.03042	0.00000	d95(mm)	**67.14**
		0.02600	0.00600	7.3808	0.02844	0.00001	FI(mm)	**3.46**
		0.02023	0.00500	7.6439	0.02629	0.00004		
		0.01445	0.00200	8.9658	0.01804	0.00001	**SSE =**	**0.00065**



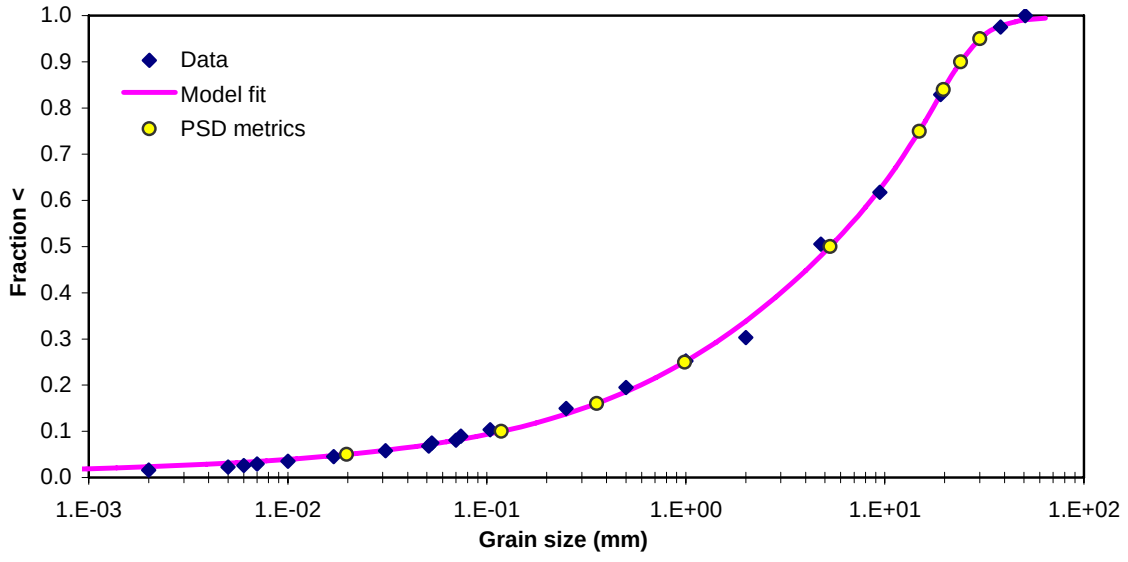
Sample data (Well 699-S20-E10, 32-33 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99922	0.00000	d5(phi)	**5.55**
		1.00000	50.80000	-5.6668	0.98655	0.00018	d10(phi)	**2.51**
		0.95562	38.10000	-5.2517	0.96385	0.00007	d16(phi)	**0.79**
		0.78478	19.05000	-4.2517	0.78389	0.00000	d25(phi)	**-0.62**
		0.55083	9.42000	-3.2357	0.55118	0.00000	d50(phi)	**-2.76**
		0.44191	4.76000	-2.2510	0.44119	0.00000	d75(phi)	**-4.13**
		0.27655	2.00000	-1.0000	0.28529	0.00008	d84(phi)	**-4.47**
		0.20573	1.00000	0.0000	0.20411	0.00000	d90(phi)	**-4.75**
		0.15305	0.50000	1.0000	0.15063	0.00001	d95(phi)	**-5.10**
		0.12168	0.25000	2.0000	0.11414	0.00006	σ_{IG}(phi)	**2.93**
		0.09145	0.10400	3.2653	0.08291	0.00007	d5(mm)	**0.02**
		0.08323	0.07400	3.7563	0.07384	0.00009	d10(mm)	**0.18**
		0.07552	0.05300	4.2379	0.06617	0.00009	d16(mm)	**0.58**
		0.07840	0.07000	3.8365	0.07249	0.00004	d25(mm)	**1.53**
		0.06900	0.05100	4.2934	0.06535	0.00001	d50(mm)	**6.77**
		0.05959	0.03100	5.0116	0.05590	0.00001	d75(mm)	**17.51**
		0.05018	0.01700	5.8783	0.04674	0.00001	d84(mm)	**22.12**
		0.03763	0.01000	6.6439	0.04022	0.00001	d90(mm)	**26.90**
		0.03136	0.00700	7.1584	0.03650	0.00003	d95(mm)	**34.36**
		0.02823	0.00600	7.3808	0.03503	0.00005	FI(mm)	**2.91**
		0.02195	0.00500	7.6439	0.03339	0.00013		
		0.01568	0.00200	8.9658	0.02652	0.00059	**SSE =**	**0.00151**



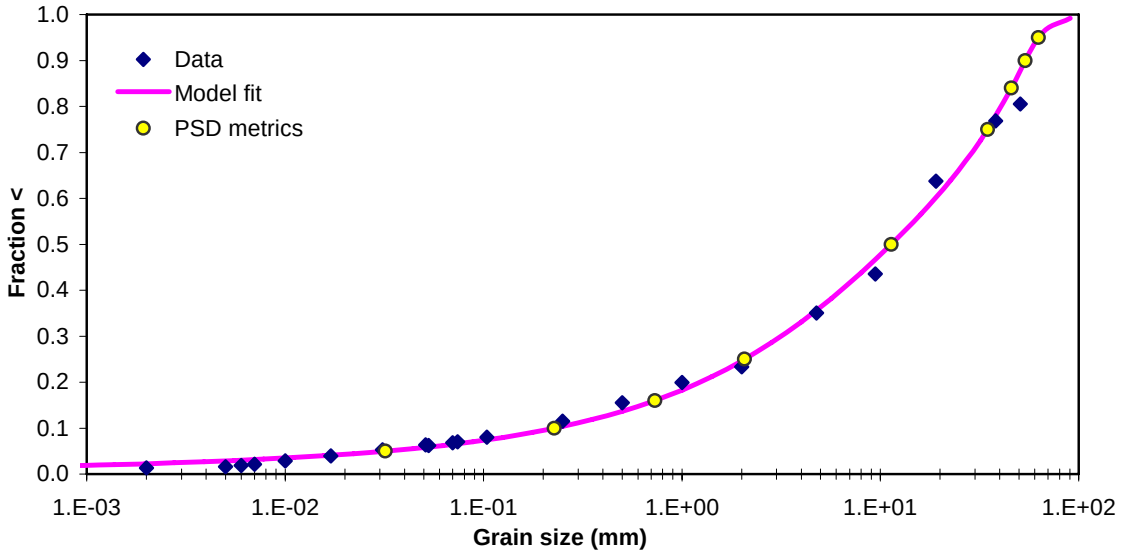
Sample data (Well 699-S20-E10, 33-34 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99797	0.00000	d5(phi)	**5.66**
		1.00000	50.80000	-5.6668	0.99032	0.00009	d10(phi)	**3.08**
		0.97513	38.10000	-5.2517	0.97761	0.00001	d16(phi)	**1.49**
		0.82904	19.05000	-4.2517	0.82893	0.00000	d25(phi)	**0.02**
		0.61717	9.42000	-3.2357	0.62398	0.00005	d50(phi)	**-2.41**
		0.50552	4.76000	-2.2510	0.47945	0.00068	d75(phi)	**-3.90**
		0.30289	2.00000	-1.0000	0.33836	0.00126	d84(phi)	**-4.30**
		0.25232	1.00000	0.0000	0.25152	0.00000	d90(phi)	**-4.59**
		0.19502	0.50000	1.0000	0.18559	0.00009	d95(phi)	**-4.91**
		0.14944	0.25000	2.0000	0.13725	0.00015	σ_{IG}(phi)	**3.05**
		0.10372	0.10400	3.2653	0.09494	0.00008	d5(mm)	**0.02**
		0.08961	0.07400	3.7563	0.08273	0.00005	d10(mm)	**0.12**
		0.07465	0.05300	4.2379	0.07251	0.00000	d16(mm)	**0.36**
		0.08093	0.07000	3.8365	0.08091	0.00000	d25(mm)	**0.99**
		0.06798	0.05100	4.2934	0.07143	0.00001	d50(mm)	**5.31**
		0.05827	0.03100	5.0116	0.05906	0.00000	d75(mm)	**14.88**
		0.04532	0.01700	5.8783	0.04740	0.00000	d84(mm)	**19.71**
		0.03561	0.01000	6.6439	0.03936	0.00001	d90(mm)	**24.02**
		0.02914	0.00700	7.1584	0.03488	0.00003	d95(mm)	**30.02**
		0.02590	0.00600	7.3808	0.03315	0.00005	FI(mm)	**2.18**
		0.02266	0.00500	7.6439	0.03122	0.00007		
		0.01619	0.00200	8.9658	0.02341	0.00005	**SSE =**	**0.00270**



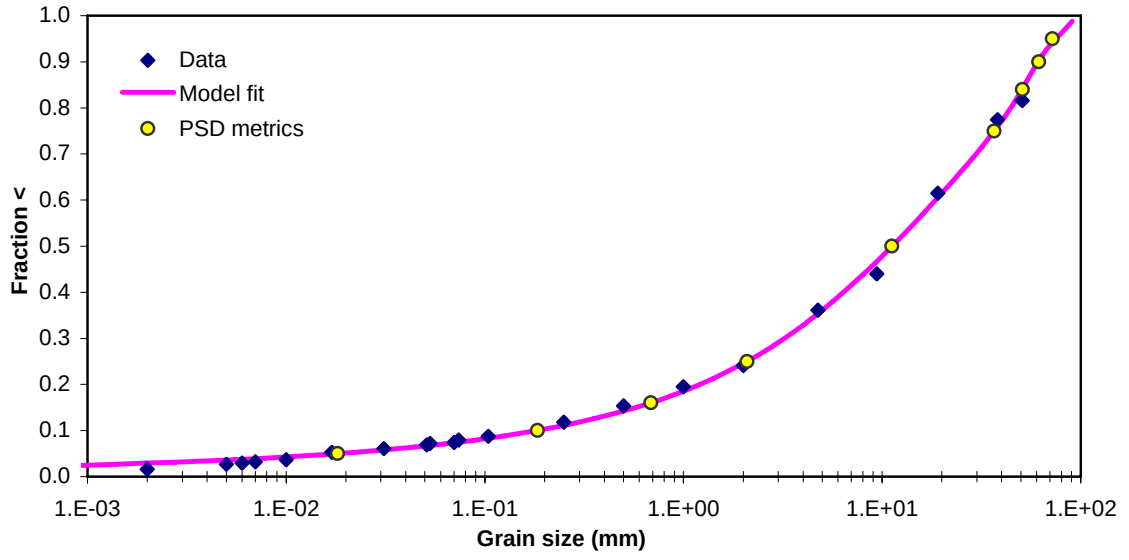
Sample data (Well 699-S20-E10, 35.5-36.5 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99378	0.00019	d5(phi)	**4.97**
		0.80543	50.80000	-5.6668	0.87873	0.00000	d10(phi)	**2.14**
		0.76842	38.10000	-5.2517	0.77832	0.00010	d16(phi)	**0.45**
		0.63767	19.05000	-4.2517	0.60179	0.00129	d25(phi)	**-1.05**
		0.43531	9.42000	-3.2357	0.46652	0.00097	d50(phi)	**-3.50**
		0.35061	4.76000	-2.2510	0.35625	0.00003	d75(phi)	**-5.12**
		0.23351	2.00000	-1.0000	0.24639	0.00017	d84(phi)	**-5.51**
		0.19932	1.00000	0.0000	0.18279	0.00027	d90(phi)	**-5.75**
		0.15495	0.50000	1.0000	0.13674	0.00033	d95(phi)	**-5.97**
		0.11486	0.25000	2.0000	0.10370	0.00012	σ_{IG}(phi)	**3.15**
		0.08014	0.10400	3.2653	0.07474	0.00003	d5(mm)	**0.03**
		0.07007	0.07400	3.7563	0.06627	0.00001	d10(mm)	**0.23**
		0.06222	0.05300	4.2379	0.05910	0.00001	d16(mm)	**0.73**
		0.06849	0.07000	3.8365	0.06500	0.00001	d25(mm)	**2.07**
		0.06322	0.05100	4.2934	0.05834	0.00002	d50(mm)	**11.35**
		0.05269	0.03100	5.0116	0.04952	0.00001	d75(mm)	**34.72**
		0.03952	0.01700	5.8783	0.04102	0.00000	d84(mm)	**45.72**
		0.02898	0.01000	6.6439	0.03501	0.00004	d90(mm)	**53.80**
		0.02107	0.00700	7.1584	0.03160	0.00011	d95(mm)	**62.66**
		0.01844	0.00600	7.3808	0.03025	0.00014	FI(mm)	**4.70**
		0.01581	0.00500	7.6439	0.02876	0.00017		
		0.01317	0.00200	8.9658	0.02254	0.00044	**SSE =**	**0.00447**



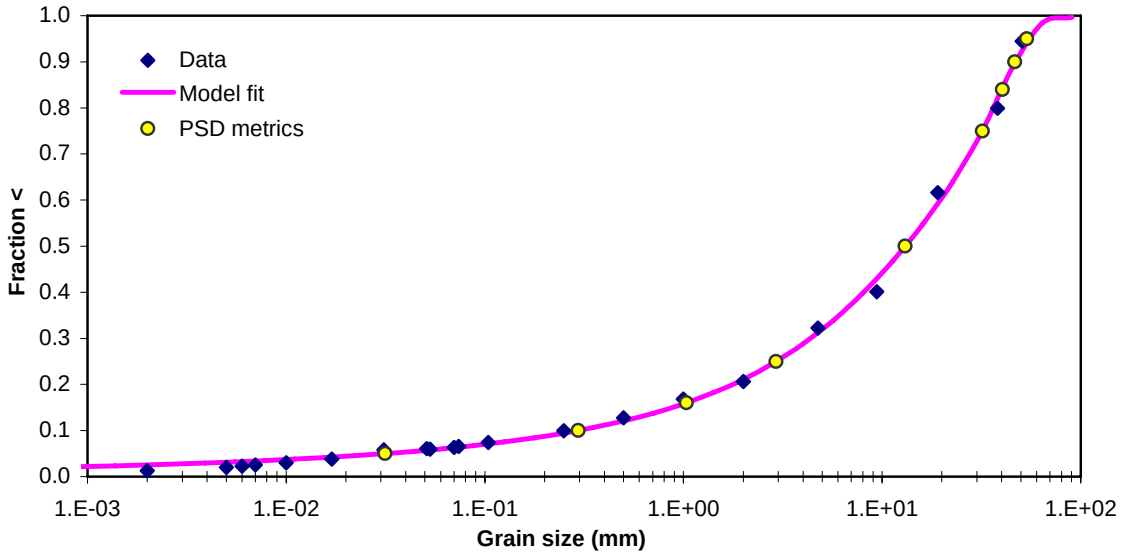
Sample data (Well 699-S20-E10, 38-39 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99237	0.00017	d5(phi)	**5.78**
		0.81543	50.80000	-5.6668	0.83903	0.00028	d10(phi)	**2.44**
		0.77419	38.10000	-5.2517	0.75955	0.00021	d16(phi)	**0.54**
		0.61467	19.05000	-4.2517	0.60463	0.00010	d25(phi)	**-1.06**
		0.43979	9.42000	-3.2357	0.46743	0.00076	d50(phi)	**-3.49**
		0.36138	4.76000	-2.2510	0.35377	0.00006	d75(phi)	**-5.20**
		0.24096	2.00000	-1.0000	0.24554	0.00002	d84(phi)	**-5.67**
		0.19468	1.00000	0.0000	0.18522	0.00009	d90(phi)	**-5.94**
		0.15322	0.50000	1.0000	0.14201	0.00013	d95(phi)	**-6.17**
		0.11805	0.25000	2.0000	0.11083	0.00005	σ_{IG}(phi)	**3.36**
		0.08774	0.10400	3.2653	0.08298	0.00002	d5(mm)	**0.02**
		0.07928	0.07400	3.7563	0.07466	0.00002	d10(mm)	**0.18**
		0.07214	0.05300	4.2379	0.06755	0.00002	d16(mm)	**0.69**
		0.07404	0.07000	3.8365	0.07341	0.00000	d25(mm)	**2.09**
		0.06875	0.05100	4.2934	0.06679	0.00000	d50(mm)	**11.22**
		0.06082	0.03100	5.0116	0.05789	0.00001	d75(mm)	**36.67**
		0.05289	0.01700	5.8783	0.04913	0.00001	d84(mm)	**50.96**
		0.03702	0.01000	6.6439	0.04281	0.00003	d90(mm)	**61.42**
		0.03173	0.00700	7.1584	0.03916	0.00006	d95(mm)	**71.95**
		0.02909	0.00600	7.3808	0.03771	0.00007	FI(mm)	**5.00**
		0.02644	0.00500	7.6439	0.03609	0.00009		
		0.01587	0.00200	8.9658	0.02921	0.00053	**SSE =**	**0.00276**



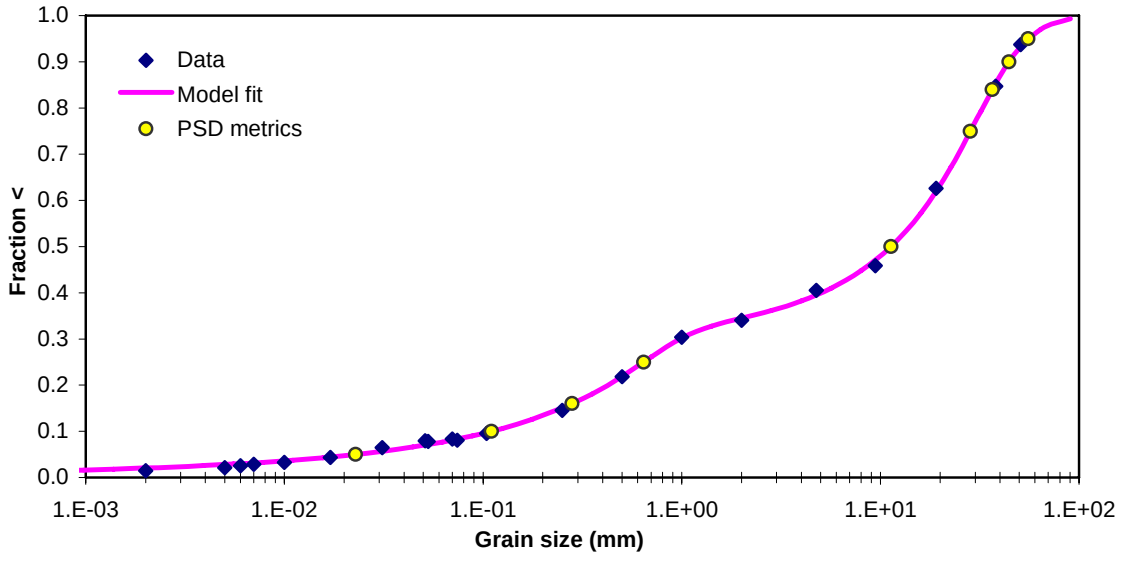
Sample data (Well 699-S20-E10, 40.5-41.5 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99765	0.00001	d5(phi)	**4.99**
		0.94458	50.80000	-5.6668	0.93269	0.00014	d10(phi)	**1.76**
		0.79931	38.10000	-5.2517	0.81623	0.00029	d16(phi)	**-0.05**
		0.61618	19.05000	-4.2517	0.59213	0.00058	d25(phi)	**-1.55**
		0.40100	9.42000	-3.2357	0.42994	0.00084	d50(phi)	**-3.71**
		0.32245	4.76000	-2.2510	0.31246	0.00010	d75(phi)	**-5.00**
		0.20622	2.00000	-1.0000	0.21105	0.00002	d84(phi)	**-5.34**
		0.16822	1.00000	0.0000	0.15786	0.00011	d90(phi)	**-5.54**
		0.12768	0.50000	1.0000	0.12077	0.00005	d95(phi)	**-5.74**
		0.09949	0.25000	2.0000	0.09437	0.00003	σ_{IG}(phi)	**2.95**
		0.07399	0.10400	3.2653	0.07092	0.00001	d5(mm)	**0.03**
		0.06564	0.07400	3.7563	0.06393	0.00000	d10(mm)	**0.30**
		0.05961	0.05300	4.2379	0.05794	0.00000	d16(mm)	**1.03**
		0.06326	0.07000	3.8365	0.06287	0.00000	d25(mm)	**2.93**
		0.06073	0.05100	4.2934	0.05730	0.00001	d50(mm)	**13.08**
		0.05820	0.03100	5.0116	0.04980	0.00007	d75(mm)	**31.99**
		0.03796	0.01700	5.8783	0.04241	0.00002	d84(mm)	**40.39**
		0.03036	0.01000	6.6439	0.03706	0.00004	d90(mm)	**46.65**
		0.02530	0.00700	7.1584	0.03397	0.00008	d95(mm)	**53.57**
		0.02277	0.00600	7.3808	0.03274	0.00010	FI(mm)	**5.50**
		0.02024	0.00500	7.6439	0.03136	0.00012		
		0.01265	0.00200	8.9658	0.02549	0.00016	**SSE =**	**0.00278**



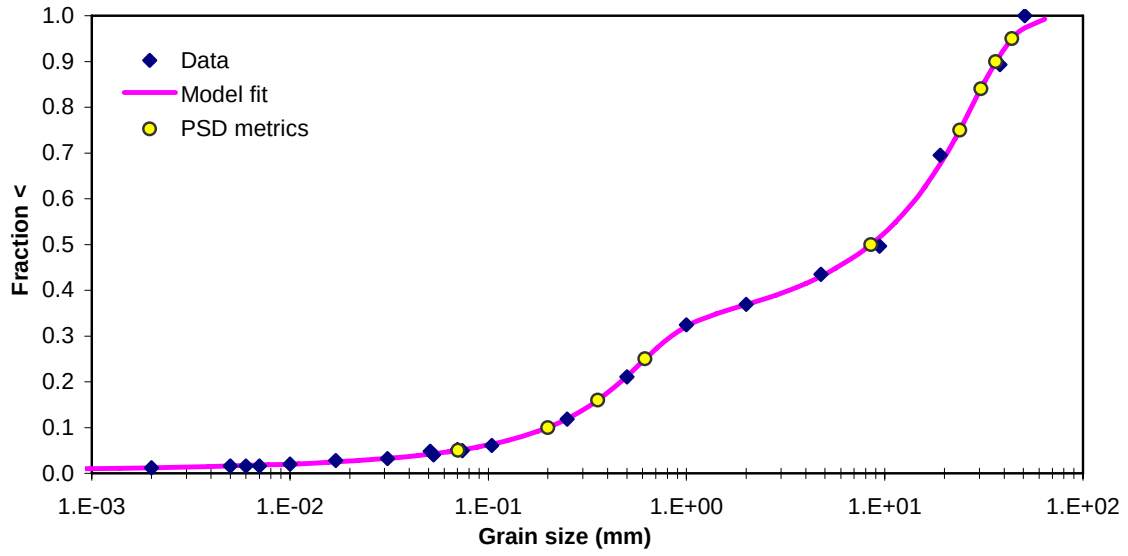
Sample data (Well 699-S20-E10, 47-48 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99584	0.00002	d5(phi)	**5.45**
		0.93731	50.80000	-5.6668	0.93297	0.00002	d10(phi)	**3.18**
		0.84714	38.10000	-5.2517	0.85357	0.00004	d16(phi)	**1.84**
		0.62639	19.05000	-4.2517	0.61883	0.00006	d25(phi)	**0.63**
		0.45865	9.42000	-3.2357	0.47015	0.00013	d50(phi)	**-3.50**
		0.40541	4.76000	-2.2510	0.39530	0.00010	d75(phi)	**-4.83**
		0.34021	2.00000	-1.0000	0.34495	0.00002	d84(phi)	**-5.19**
		0.30378	1.00000	0.0000	0.30165	0.00000	d90(phi)	**-5.47**
		0.21813	0.50000	1.0000	0.21875	0.00000	d95(phi)	**-5.79**
		0.14542	0.25000	2.0000	0.15070	0.00003	σ_{IG}(phi)	**3.46**
		0.09526	0.10400	3.2653	0.09728	0.00000	d5(mm)	**0.02**
		0.08081	0.07400	3.7563	0.08301	0.00000	d10(mm)	**0.11**
		0.07806	0.05300	4.2379	0.07144	0.00004	d16(mm)	**0.28**
		0.08312	0.07000	3.8365	0.08093	0.00000	d25(mm)	**0.64**
		0.07951	0.05100	4.2934	0.07023	0.00009	d50(mm)	**11.32**
		0.06505	0.03100	5.0116	0.05672	0.00007	d75(mm)	**28.42**
		0.04337	0.01700	5.8783	0.04442	0.00000	d84(mm)	**36.59**
		0.03253	0.01000	6.6439	0.03619	0.00001	d90(mm)	**44.38**
		0.02891	0.00700	7.1584	0.03170	0.00001	d95(mm)	**55.50**
		0.02530	0.00600	7.3808	0.02998	0.00002	FI(mm)	**2.42**
		0.02168	0.00500	7.6439	0.02808	0.00004		
		0.01446	0.00200	8.9658	0.02052	0.00004	**SSE =**	**0.00076**



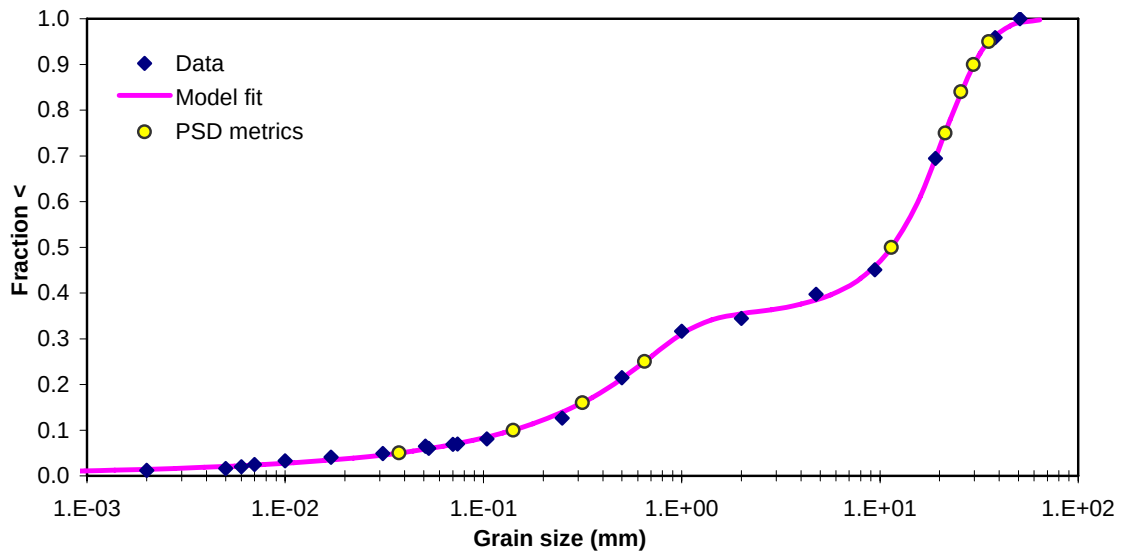
Sample data (Well 699-S20-E10, 48.5-49.5 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99956	0.00000	d5(phi)	**3.83**
		1.00000	50.80000	-5.6668	0.97436	0.00066	d10(phi)	**2.33**
		0.89305	38.10000	-5.2517	0.91461	0.00046	d16(phi)	**1.48**
		0.69469	19.05000	-4.2517	0.67567	0.00036	d25(phi)	**0.69**
		0.49661	9.42000	-3.2357	0.51612	0.00038	d50(phi)	**-3.09**
		0.43494	4.76000	-2.2510	0.43039	0.00002	d75(phi)	**-4.58**
		0.36916	2.00000	-1.0000	0.36830	0.00000	d84(phi)	**-4.93**
		0.32416	1.00000	0.0000	0.32110	0.00001	d90(phi)	**-5.18**
		0.21097	0.50000	1.0000	0.21211	0.00000	d95(phi)	**-5.45**
		0.11872	0.25000	2.0000	0.11920	0.00000	σ_{IG}(phi)	**3.01**
		0.06113	0.10400	3.2653	0.06341	0.00001	d5(mm)	**0.07**
		0.04973	0.07400	3.7563	0.05144	0.00000	d10(mm)	**0.20**
		0.04027	0.05300	4.2379	0.04262	0.00001	d16(mm)	**0.36**
		0.05214	0.07000	3.8365	0.04980	0.00001	d25(mm)	**0.62**
		0.04813	0.05100	4.2934	0.04174	0.00004	d50(mm)	**8.50**
		0.03209	0.03100	5.0116	0.03249	0.00000	d75(mm)	**23.88**
		0.02808	0.01700	5.8783	0.02491	0.00001	d84(mm)	**30.54**
		0.02005	0.01000	6.6439	0.02025	0.00000	d90(mm)	**36.32**
		0.01604	0.00700	7.1584	0.01782	0.00000	d95(mm)	**43.85**
		0.01604	0.00600	7.3808	0.01691	0.00000	FI(mm)	**2.11**
		0.01604	0.00500	7.6439	0.01592	0.00000		
		0.01203	0.00200	8.9658	0.01207	0.00000	**SSE =**	**0.00197**



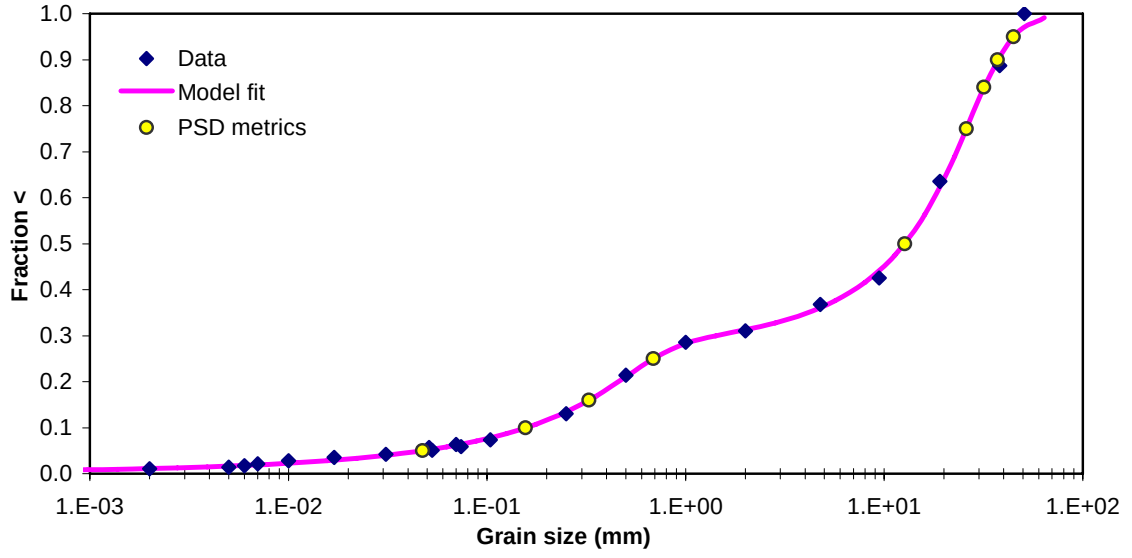
Sample data (Well 699-S20-E10, 49.5-50.5 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99986	0.00000	d5(phi)	**4.74**
		1.00000	50.80000	-5.6668	0.99116	0.00008	d10(phi)	**2.82**
		0.95864	38.10000	-5.2517	0.96367	0.00003	d16(phi)	**1.66**
		0.69399	19.05000	-4.2517	0.69172	0.00001	d25(phi)	**0.62**
		0.45085	9.42000	-3.2357	0.45809	0.00005	d50(phi)	**-3.52**
		0.39756	4.76000	-2.2510	0.38464	0.00017	d75(phi)	**-4.42**
		0.34418	2.00000	-1.0000	0.35432	0.00010	d84(phi)	**-4.68**
		0.31618	1.00000	0.0000	0.31058	0.00003	d90(phi)	**-4.89**
		0.21494	0.50000	1.0000	0.21284	0.00000	d95(phi)	**-5.15**
		0.12672	0.25000	2.0000	0.13899	0.00015	σ_{IG}(phi)	**3.08**
		0.08122	0.10400	3.2653	0.08441	0.00001	d5(mm)	**0.04**
		0.06958	0.07400	3.7563	0.07045	0.00000	d10(mm)	**0.14**
		0.05998	0.05300	4.2379	0.05936	0.00000	d16(mm)	**0.32**
		0.06918	0.07000	3.8365	0.06844	0.00000	d25(mm)	**0.65**
		0.06511	0.05100	4.2934	0.05823	0.00005	d50(mm)	**11.44**
		0.04883	0.03100	5.0116	0.04563	0.00001	d75(mm)	**21.38**
		0.04069	0.01700	5.8783	0.03452	0.00004	d84(mm)	**25.64**
		0.03255	0.01000	6.6439	0.02732	0.00003	d90(mm)	**29.68**
		0.02442	0.00700	7.1584	0.02348	0.00000	d95(mm)	**35.42**
		0.02035	0.00600	7.3808	0.02203	0.00000	FI(mm)	**2.18**
		0.01628	0.00500	7.6439	0.02045	0.00002		
		0.01221	0.00200	8.9658	0.01428	0.00000	**SSE =**	**0.00078**



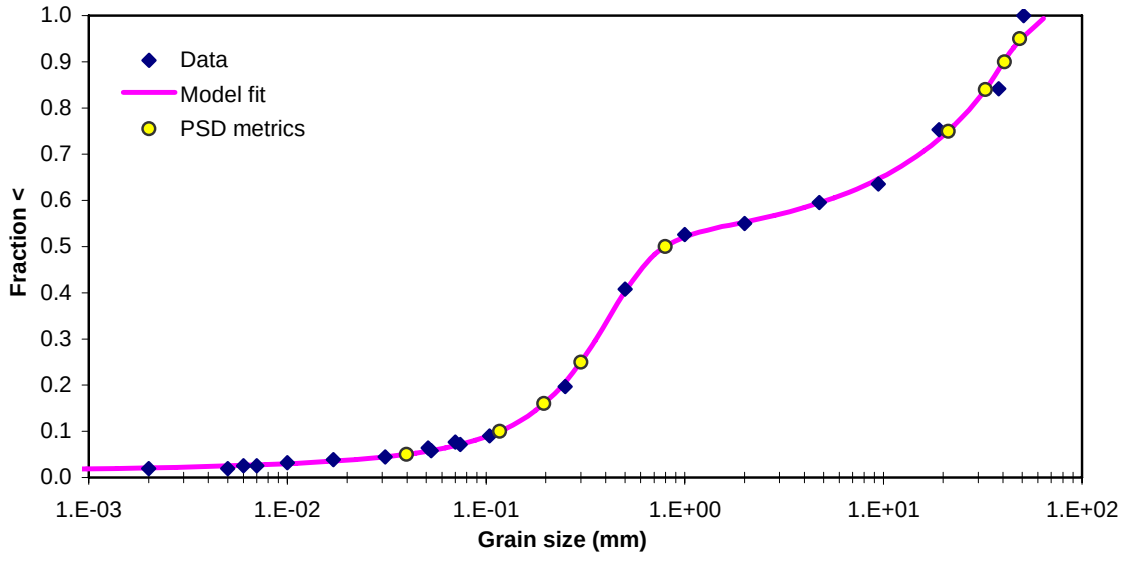
Sample data (Well 699-S20-E10, 52-53 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99938	0.00000	d5(phi)	**4.40**
		1.00000	50.80000	-5.6668	0.97165	0.00080	d10(phi)	**2.68**
		0.88664	38.10000	-5.2517	0.90769	0.00044	d16(phi)	**1.62**
		0.63558	19.05000	-4.2517	0.62182	0.00019	d25(phi)	**0.54**
		0.42546	9.42000	-3.2357	0.44100	0.00024	d50(phi)	**-3.66**
		0.36812	4.76000	-2.2510	0.36053	0.00006	d75(phi)	**-4.70**
		0.31028	2.00000	-1.0000	0.31279	0.00001	d84(phi)	**-4.99**
		0.28539	1.00000	0.0000	0.28309	0.00001	d90(phi)	**-5.22**
		0.21374	0.50000	1.0000	0.21049	0.00001	d95(phi)	**-5.48**
		0.13021	0.25000	2.0000	0.13471	0.00002	σ_{IG}(phi)	**3.15**
		0.07377	0.10400	3.2653	0.07815	0.00002	d5(mm)	**0.05**
		0.05870	0.07400	3.7563	0.06412	0.00003	d10(mm)	**0.16**
		0.05085	0.05300	4.2379	0.05317	0.00001	d16(mm)	**0.33**
		0.06365	0.07000	3.8365	0.06212	0.00000	d25(mm)	**0.69**
		0.05658	0.05100	4.2934	0.05206	0.00002	d50(mm)	**12.66**
		0.04244	0.03100	5.0116	0.03988	0.00001	d75(mm)	**25.96**
		0.03536	0.01700	5.8783	0.02940	0.00004	d84(mm)	**31.82**
		0.02829	0.01000	6.6439	0.02277	0.00003	d90(mm)	**37.22**
		0.02122	0.00700	7.1584	0.01931	0.00000	d95(mm)	**44.70**
		0.01768	0.00600	7.3808	0.01801	0.00000	FI(mm)	**2.43**
		0.01415	0.00500	7.6439	0.01661	0.00001		
		0.01061	0.00200	8.9658	0.01124	0.00000	**SSE =**	**0.00194**



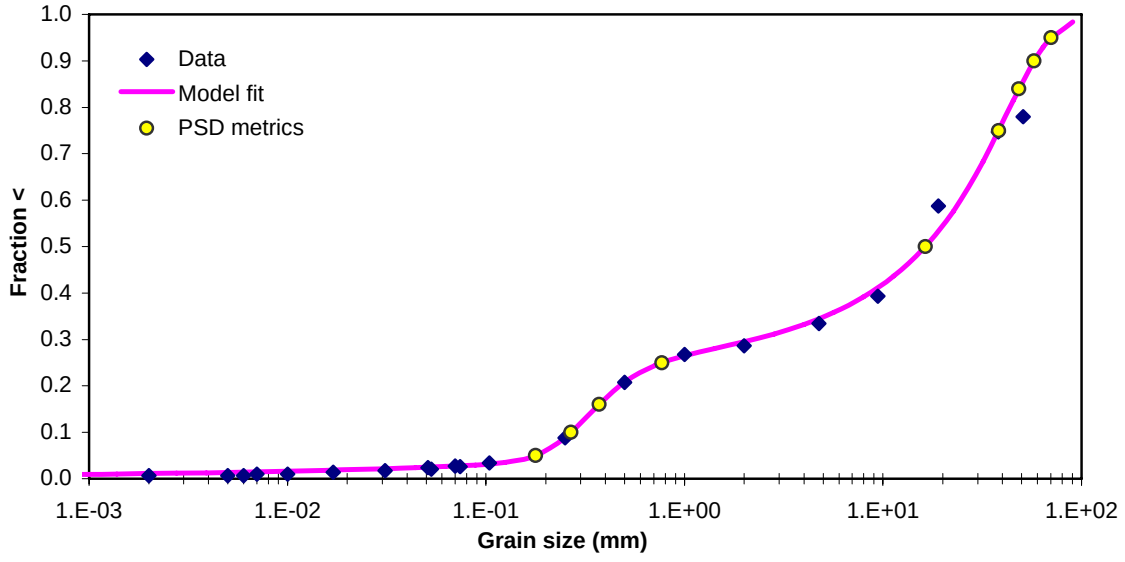
Sample data (Well 699-S20-E10, 54-55 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99997	0.00000	d5(phi)	**4.65**
		1.00000	50.80000	-5.6668	0.96148	0.00148	d10(phi)	**3.10**
		0.84146	38.10000	-5.2517	0.88096	0.00156	d16(phi)	**2.35**
		0.75276	19.05000	-4.2517	0.73236	0.00042	d25(phi)	**1.74**
		0.63522	9.42000	-3.2357	0.64630	0.00012	d50(phi)	**0.33**
		0.59536	4.76000	-2.2510	0.59473	0.00000	d75(phi)	**-4.41**
		0.55008	2.00000	-1.0000	0.55285	0.00001	d84(phi)	**-5.03**
		0.52582	1.00000	0.0000	0.52094	0.00002	d90(phi)	**-5.35**
		0.40813	0.50000	1.0000	0.40321	0.00002	d95(phi)	**-5.60**
		0.19675	0.25000	2.0000	0.20597	0.00009	σ_{IG}(phi)	**3.40**
		0.08984	0.10400	3.2653	0.09104	0.00000	d5(mm)	**0.04**
		0.07123	0.07400	3.7563	0.07125	0.00000	d10(mm)	**0.12**
		0.05814	0.05300	4.2379	0.05810	0.00000	d16(mm)	**0.20**
		0.07701	0.07000	3.8365	0.06871	0.00007	d25(mm)	**0.30**
		0.06417	0.05100	4.2934	0.05687	0.00005	d50(mm)	**0.80**
		0.04492	0.03100	5.0116	0.04455	0.00000	d75(mm)	**21.20**
		0.03850	0.01700	5.8783	0.03542	0.00001	d84(mm)	**32.65**
		0.03209	0.01000	6.6439	0.03012	0.00000	d90(mm)	**40.73**
		0.02567	0.00700	7.1584	0.02743	0.00000	d95(mm)	**48.53**
		0.02567	0.00600	7.3808	0.02641	0.00000	FI(mm)	**1.33**
		0.01925	0.00500	7.6439	0.02531	0.00004		
		0.01925	0.00200	8.9658	0.02091	0.00000	**SSE =**	**0.00390**



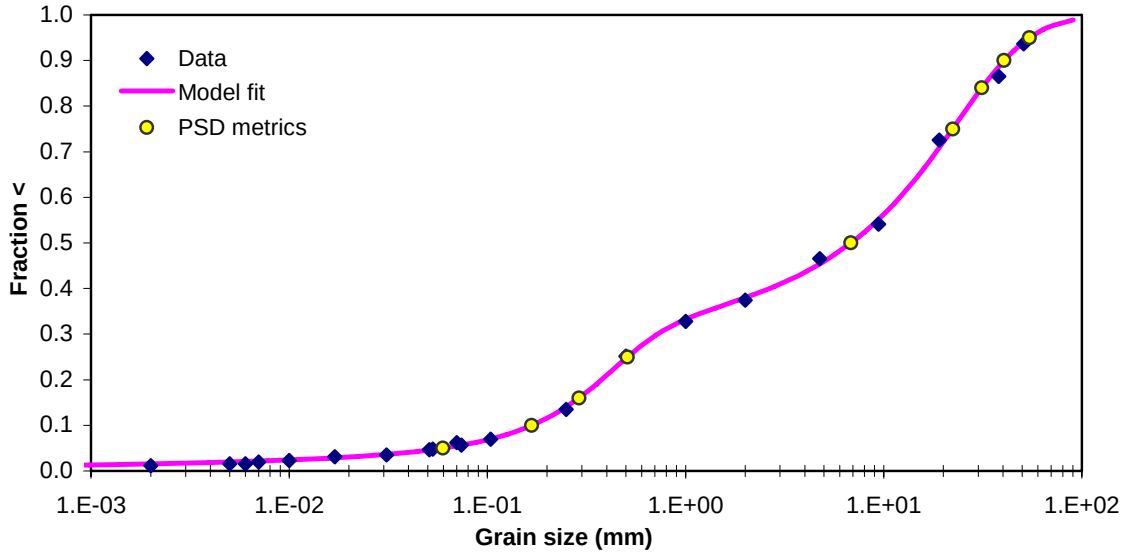
Sample data (Well 699-S20-E10, 57-58 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99022	0.00096	d5(phi)	**2.49**
		0.77940	50.80000	-5.6668	0.85791	0.00308	d10(phi)	**1.90**
		0.74689	38.10000	-5.2517	0.74815	0.00000	d16(phi)	**1.43**
		0.58772	19.05000	-4.2517	0.53311	0.00298	d25(phi)	**0.38**
		0.39298	9.42000	-3.2357	0.41152	0.00034	d50(phi)	**-4.03**
		0.33477	4.76000	-2.2510	0.34463	0.00010	d75(phi)	**-5.26**
		0.28657	2.00000	-1.0000	0.29484	0.00007	d84(phi)	**-5.60**
		0.26768	1.00000	0.0000	0.26494	0.00001	d90(phi)	**-5.85**
		0.20772	0.50000	1.0000	0.20806	0.00000	d95(phi)	**-6.13**
		0.08840	0.25000	2.0000	0.08847	0.00000	σ_{IG}(phi)	**3.06**
		0.03428	0.10400	3.2653	0.03166	0.00001	d5(mm)	**0.18**
		0.02590	0.07400	3.7563	0.02783	0.00000	d10(mm)	**0.27**
		0.02102	0.05300	4.2379	0.02513	0.00002	d16(mm)	**0.37**
		0.02748	0.07000	3.8365	0.02734	0.00000	d25(mm)	**0.77**
		0.02404	0.05100	4.2934	0.02485	0.00000	d50(mm)	**16.34**
		0.01717	0.03100	5.0116	0.02160	0.00002	d75(mm)	**38.28**
		0.01374	0.01700	5.8783	0.01841	0.00002	d84(mm)	**48.38**
		0.01030	0.01000	6.6439	0.01610	0.00003	d90(mm)	**57.60**
		0.01030	0.00700	7.1584	0.01476	0.00002	d95(mm)	**70.17**
		0.00687	0.00600	7.3808	0.01423	0.00005	FI(mm)	**3.08**
		0.00687	0.00500	7.6439	0.01363	0.00005		
		0.00687	0.00200	8.9658	0.01110	0.00004	**SSE =**	**0.00780**



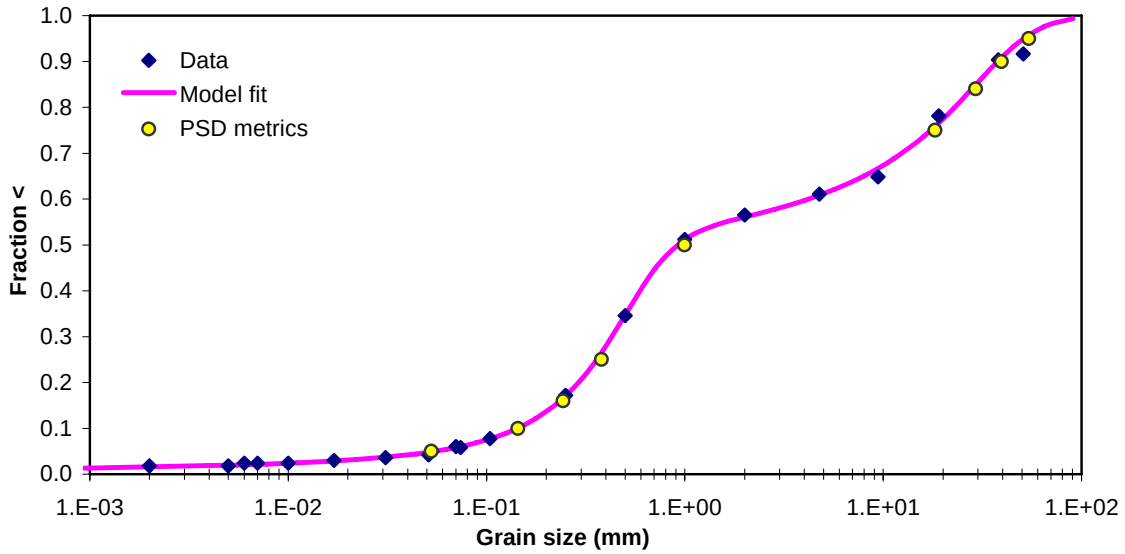
Sample data (Well 699-S20-E10, 59.5-60.5 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99264	0.00054	d5(phi)	**4.07**
		0.93668	50.80000	-5.6668	0.94045	0.00001	d10(phi)	**2.58**
		0.86503	38.10000	-5.2517	0.88745	0.00050	d16(phi)	**1.79**
		0.72535	19.05000	-4.2517	0.70808	0.00030	d25(phi)	**0.97**
		0.54122	9.42000	-3.2357	0.55159	0.00011	d50(phi)	**-2.77**
		0.46577	4.76000	-2.2510	0.45424	0.00013	d75(phi)	**-4.48**
		0.37467	2.00000	-1.0000	0.37977	0.00003	d84(phi)	**-4.96**
		0.32817	1.00000	0.0000	0.33245	0.00002	d90(phi)	**-5.34**
		0.25166	0.50000	1.0000	0.24714	0.00002	d95(phi)	**-5.77**
		0.13500	0.25000	2.0000	0.14039	0.00003	σ_{IG}(phi)	**3.18**
		0.06947	0.10400	3.2653	0.07020	0.00000	d5(mm)	**0.06**
		0.05694	0.07400	3.7563	0.05652	0.00000	d10(mm)	**0.17**
		0.04804	0.05300	4.2379	0.04691	0.00000	d16(mm)	**0.29**
		0.06189	0.07000	3.8365	0.05470	0.00005	d25(mm)	**0.51**
		0.04642	0.05100	4.2934	0.04598	0.00000	d50(mm)	**6.83**
		0.03481	0.03100	5.0116	0.03634	0.00000	d75(mm)	**22.29**
		0.03095	0.01700	5.8783	0.02866	0.00001	d84(mm)	**31.22**
		0.02321	0.01000	6.6439	0.02394	0.00000	d90(mm)	**40.42**
		0.01934	0.00700	7.1584	0.02147	0.00000	d95(mm)	**54.41**
		0.01547	0.00600	7.3808	0.02052	0.00003	FI(mm)	**1.93**
		0.01547	0.00500	7.6439	0.01950	0.00002		
		0.01160	0.00200	8.9658	0.01537	0.00001	**SSE =**	**0.00181**



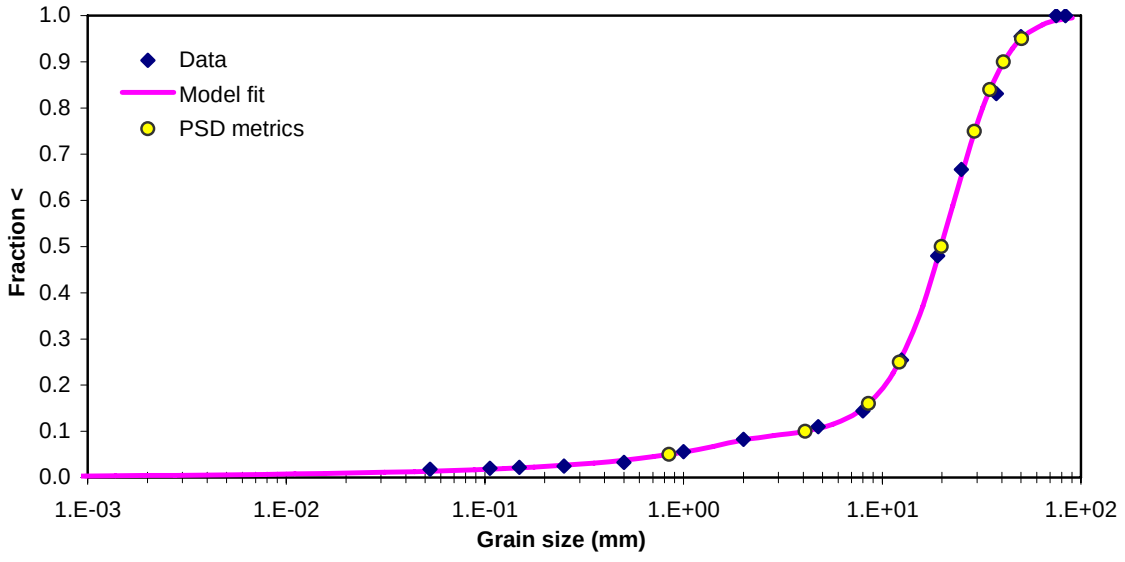
Sample data (Well 699-S20-E10, 62-63 ft depth)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	100.00000	-6.6439	0.99562	0.00019	d5(phi)	**4.25**
		0.91608	50.80000	-5.6668	0.94967	0.00056	d10(phi)	**2.79**
		0.90379	38.10000	-5.2517	0.90157	0.00000	d16(phi)	**2.04**
		0.78122	19.05000	-4.2517	0.76562	0.00024	d25(phi)	**1.40**
		0.64848	9.42000	-3.2357	0.66714	0.00035	d50(phi)	**0.01**
		0.61056	4.76000	-2.2510	0.60800	0.00001	d75(phi)	**-4.19**
		0.56527	2.00000	-1.0000	0.56054	0.00002	d84(phi)	**-4.87**
		0.51199	1.00000	0.0000	0.51186	0.00000	d90(phi)	**-5.30**
		0.34614	0.50000	1.0000	0.34707	0.00000	d95(phi)	**-5.76**
		0.17223	0.25000	2.0000	0.17041	0.00000	σ_{IG}(phi)	**3.24**
		0.07757	0.10400	3.2653	0.07693	0.00000	d5(mm)	**0.05**
		0.05809	0.07400	3.7563	0.06025	0.00000	d10(mm)	**0.14**
		0.04979	0.05300	4.2379	0.04894	0.00000	d16(mm)	**0.24**
		0.06013	0.07000	3.8365	0.05808	0.00000	d25(mm)	**0.38**
		0.04209	0.05100	4.2934	0.04787	0.00003	d50(mm)	**1.00**
		0.03608	0.03100	5.0116	0.03703	0.00000	d75(mm)	**18.24**
		0.03007	0.01700	5.8783	0.02886	0.00000	d84(mm)	**29.21**
		0.02405	0.01000	6.6439	0.02408	0.00000	d90(mm)	**39.43**
		0.02405	0.00700	7.1584	0.02165	0.00001	d95(mm)	**54.21**
		0.02405	0.00600	7.3808	0.02074	0.00001	FI(mm)	**1.46**
		0.01804	0.00500	7.6439	0.01975	0.00000		
		0.01804	0.00200	8.9658	0.01585	0.00000	**SSE =**	**0.00146**



Sample data (300 Area North Process Pond backhoe sample NPP-1-14 from Zachara et al.)

%<	size(μm)	fraction<	size(mm)	size(phi)	pred frac<	resid^2	PSD metric	Value
		1.00000	83.50000	-6.3837	0.99338	0.00004	d5(phi)	**0.24**
		1.00000	75.00000	-6.2288	0.98945	0.00111	d10(phi)	**-2.03**
		0.95430	50.00000	-5.6439	0.94914	0.00003	d16(phi)	**-3.09**
		0.83130	37.50000	-5.2288	0.87127	0.00160	d25(phi)	**-3.61**
		0.66680	25.00000	-4.6439	0.65555	0.00013	d50(phi)	**-4.31**
		0.47970	19.00000	-4.2479	0.47318	0.00004	d75(phi)	**-4.86**
		0.25460	12.50000	-3.6439	0.25888	0.00002	d84(phi)	**-5.12**
		0.14450	8.00000	-3.0000	0.15021	0.00003	d90(phi)	**-5.35**
		0.11020	4.75000	-2.2479	0.10575	0.00002	d95(phi)	**-5.65**
		0.08260	2.00000	-1.0000	0.08118	0.00000	σ_{IG}(phi)	**1.40**
		0.05620	1.00000	0.0000	0.05505	0.00000	d5(mm)	**0.84**
		0.03280	0.50000	1.0000	0.03766	0.00002	d10(mm)	**4.09**
		0.02500	0.25000	2.0000	0.02674	0.00000	d16(mm)	**8.52**
		0.02170	0.14900	2.7466	0.02111	0.00000	d25(mm)	**12.20**
		0.01980	0.10600	3.2379	0.01822	0.00000	d50(mm)	**19.80**
		0.01780	0.05300	4.2379	0.01372	0.00002	d75(mm)	**29.11**
							d84(mm)	**34.73**
							d90(mm)	**40.77**
							d95(mm)	**50.24**
							FI(mm)	**13.60**
							SSE =	**0.00307**



Appendix D

Geophysical Logs Data Results

Hanford Office

DOE-EM/GJ940-2005

699-S20-E10 (C4855)
Log Data Report

Borehole Information:

Borehole: 699-S20-E10 (C4855)			Site: 300-FF-5		
Coordinates (WA St Plane)		GWL[1] (ft): 43.4		GWL Date: 07/18/05	
North (m)	East (m)	Drill Date	TOC[2] Elevation (ft)	Total Depth (ft)	Type
Not available	Not available	07/05	Not available	64	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	1.0	8 5/8	7 5/8	1/2	1.0	64

Borehole Notes:

The logging engineer measured the casing with a caliper and steel tape. Measurements are rounded to the nearest 1/16 in.

Logging Equipment Information:

Logging System:	Gamma 4E		Type: SGLS (70%) SN: 34TP40587A
Effective Calibration Date:	12/21/04	Calibration Reference:	DOE/EM-GJ854-2005
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Logging System:	Gamma 4M		Type: NML SN: H340207279
Effective Calibration Date:	03/24/05	Calibration Reference:	DOE/EM-GJ856-2005
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2 Repeat			
Date	07/18/05	07/18/05			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	61.5	48.5			
Finish Depth (ft)	0.5	38.5			
Count Time (sec)	100	100			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
ft/min	N/A[3]	N/A			
Pre-Verification	DE851CAB	DE851CAB			

Log Run	1	2 Repeat			
Start File	DE851000	DE851062			
Finish File	DE851061	DE851072			
Post-Verification	DE851CAA	DE851CAA			
Depth Return Error (in.)	- 1	0			
Comments	Fine gain adjustment after file -051.	No fine gain adjustment.			

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2 Repeat			
Date	07/18/05	07/18/05			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	42.5	41.5			
Finish Depth (ft)	0.25	31.5			
Count Time (sec)	N/A	N/A			
Live/Real	R	R			
Shield (Y/N)	N	N			
Sample Interval (ft)	0.25	0.25			
ft/min	1.0	1.0			
Pre-Verification	DM012CAB	DM012CAB			
Start File	DM012000	DM012070			
Finish File	DM012069	DM012210			
Post-Verification	DM012CAA	DM012CAA			
Depth Return Error (in.)	- 1	0			
Comments	None	None			

Logging Operation Notes:

Logging was conducted with a centralizer placed over the sonde. Logging data acquisition is referenced to ground surface. Repeat sections were collected in this borehole to evaluate SGLS and NMLS performance.

Analysis Notes:

Analyst:	Henwood	Date:	08/01/05	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre-run and post-run verifications for each logging system were performed for each day's logging event. The acceptance criteria were met for both logging systems.

A casing correction for 0.5-in.-thick steel casing was applied to the log data.

SGLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with an EXCEL worksheet template identified as G4Eapr05.xls using efficiency functions and corrections for casing, water, and dead time as determined from annual calibrations. No correction for dead time was necessary. A correction for water was applied to the data below 43 ft.

NMLS log spectra were processed in batch mode using APTEC SUPERVISOR to determine count rates. The volume fraction of water was calculated in EXCEL, using parameters determined from analysis of recent calibration data. Logging was terminated just above groundwater level of 43.4 ft.

Log Plot Notes:

Separate log plots are provided for the man-made radionuclides (^{137}Cs, ^{235}U and ^{234}Pa) that were thought to possibly exist in the area, naturally occurring radionuclides (^{40}K, ^{238}U, ^{232}Th [KUT]), a combination of man-made, KUT, and moisture, total gamma plotted with dead time, and total gamma plotted with moisture. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, casing corrections, or water corrections. Repeat log sections are also included.

Results and Interpretations:

No man-made radionuclides were detected in this borehole. A plot of man-made radionuclides for ^{137}Cs, ^{235}U, and ^{234}Pa are included for the logged interval. The plot indicates the MDLs at each depth interval.

The repeat sections indicate good agreement for the naturally occurring KUT and moisture.

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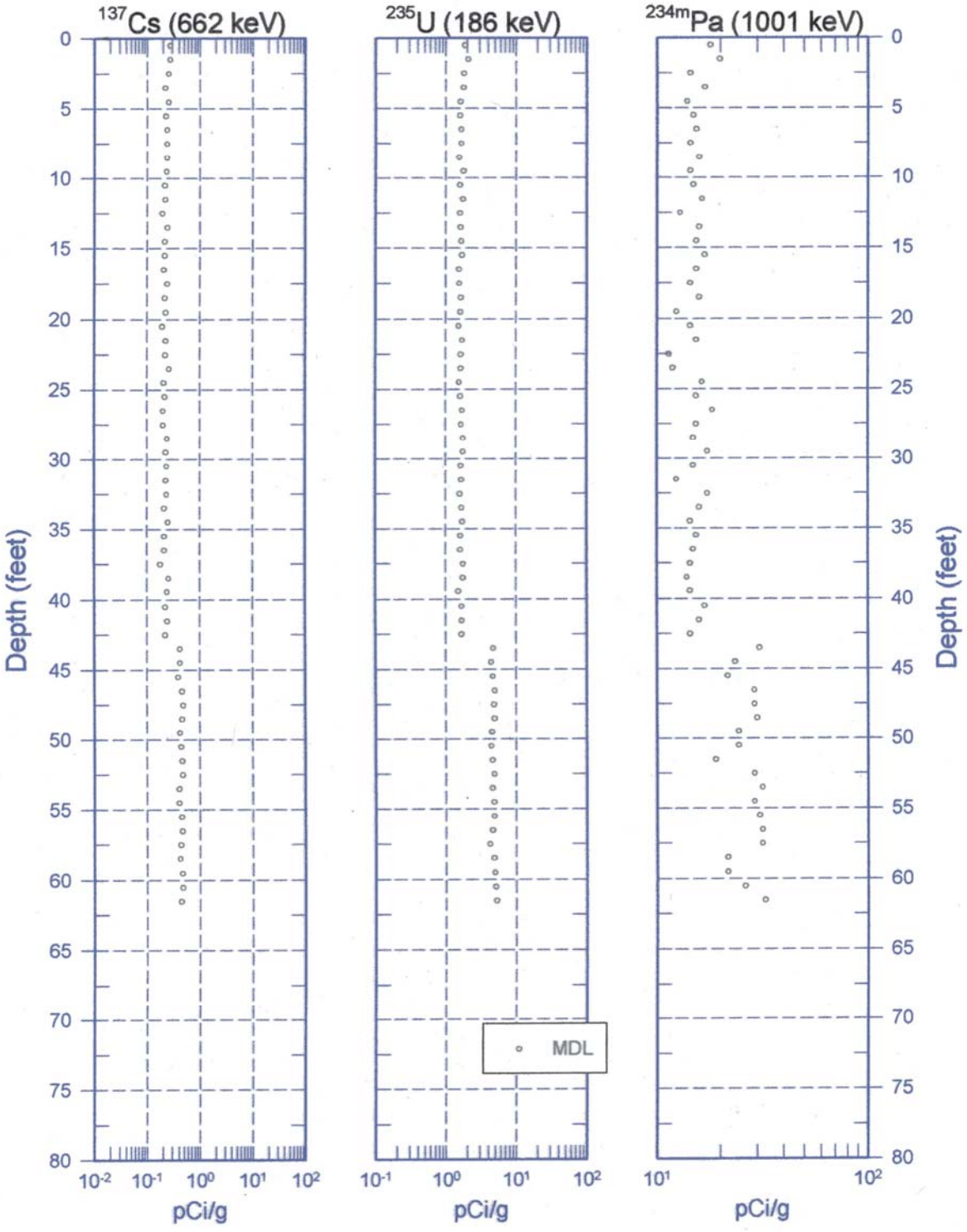
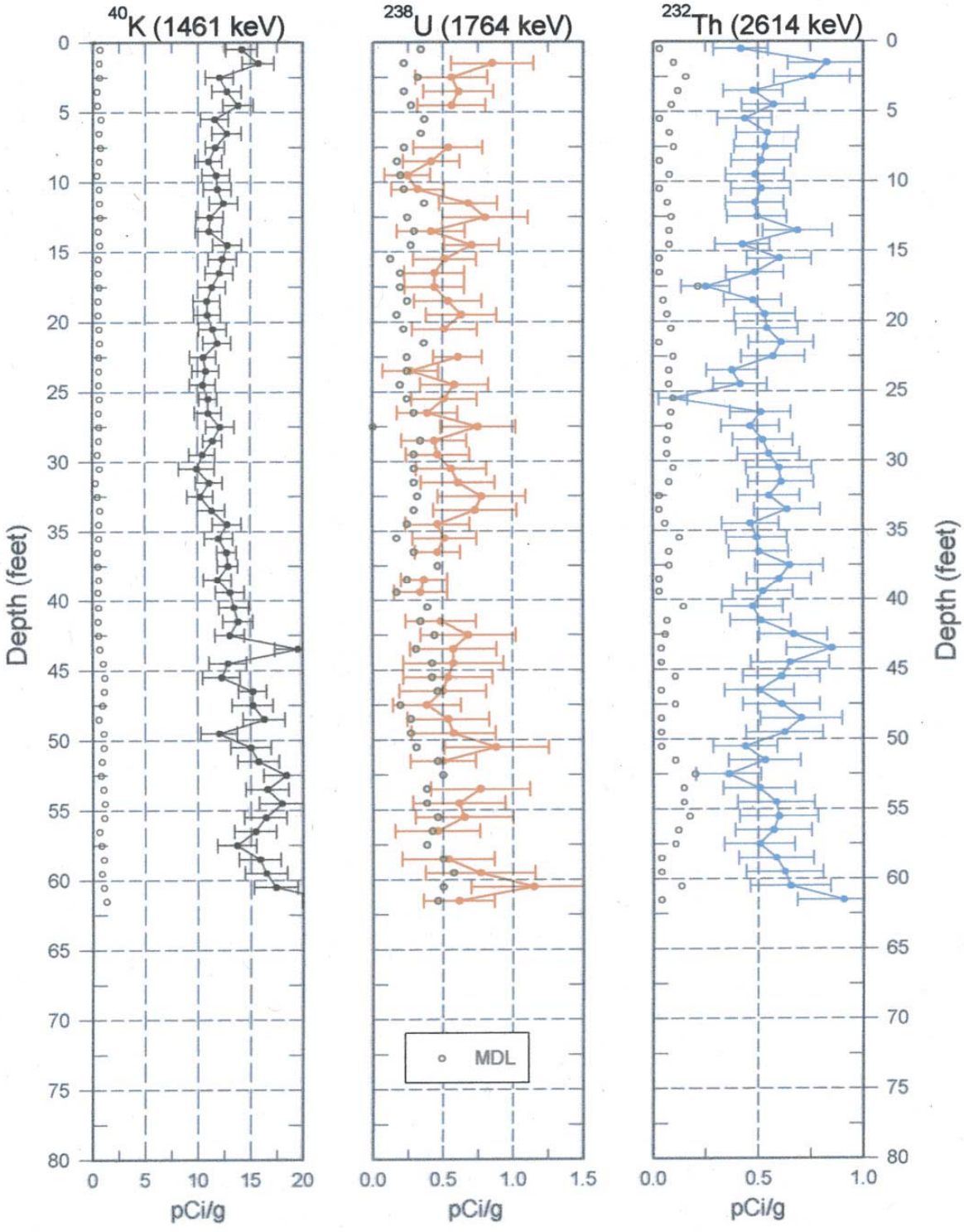
[1] GWL – groundwater level
[2] TOC – top of casing
[3] N/A – not applicable

699-S20-E10 (C4855)
Man-Made Radionuclides

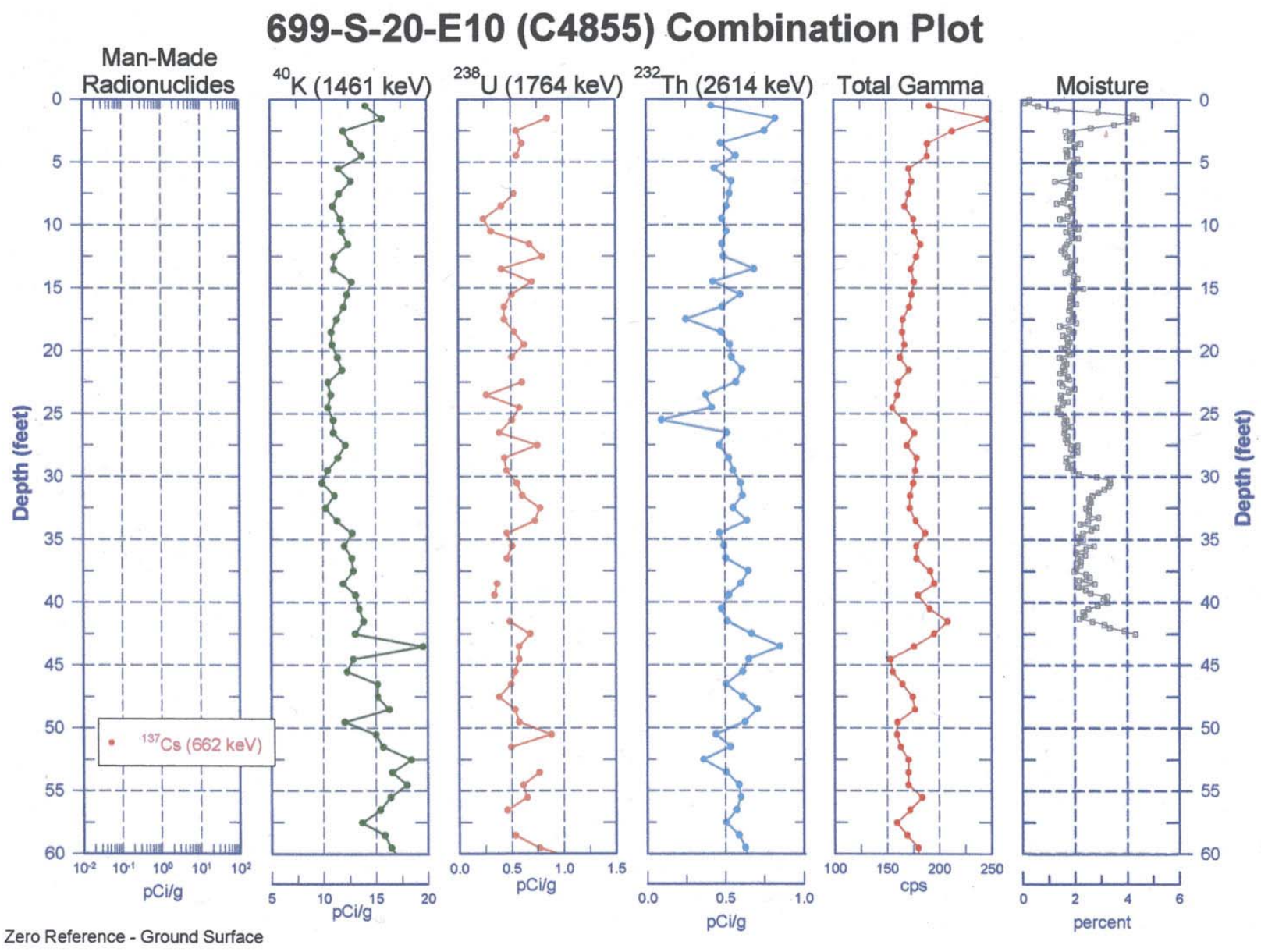


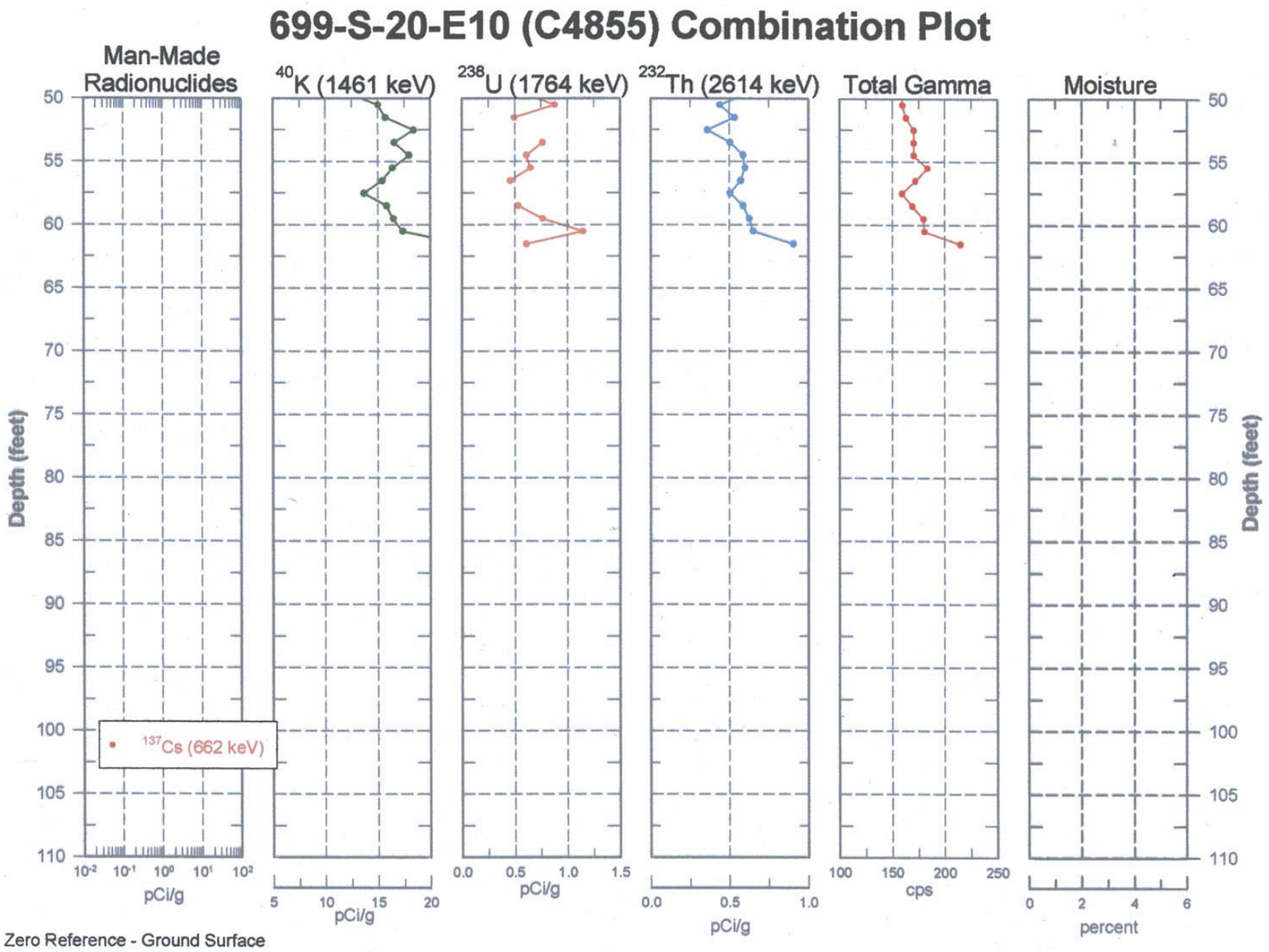
Zero Reference - Ground Surface

699-S20-E10 (C4855)
Natural Gamma Logs

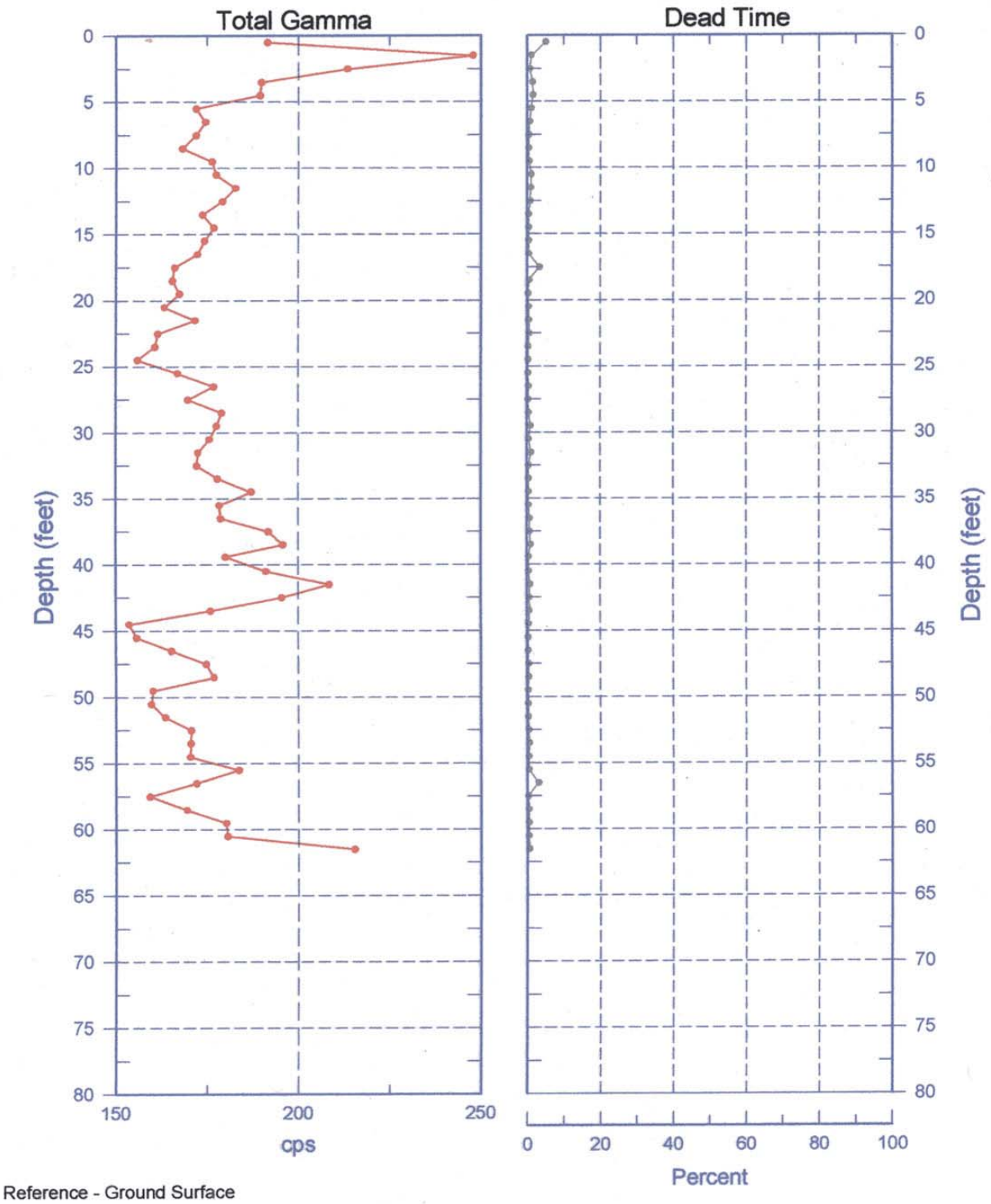


Zero Reference = Ground Surface


699-S-20-E10 (C4855) Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Moisture
Depth (feet)
137Cs (662 keV)
pCi/g
pCi/g
pCi/g
pCi/g
cps
percent
Zero Reference - Ground Surface

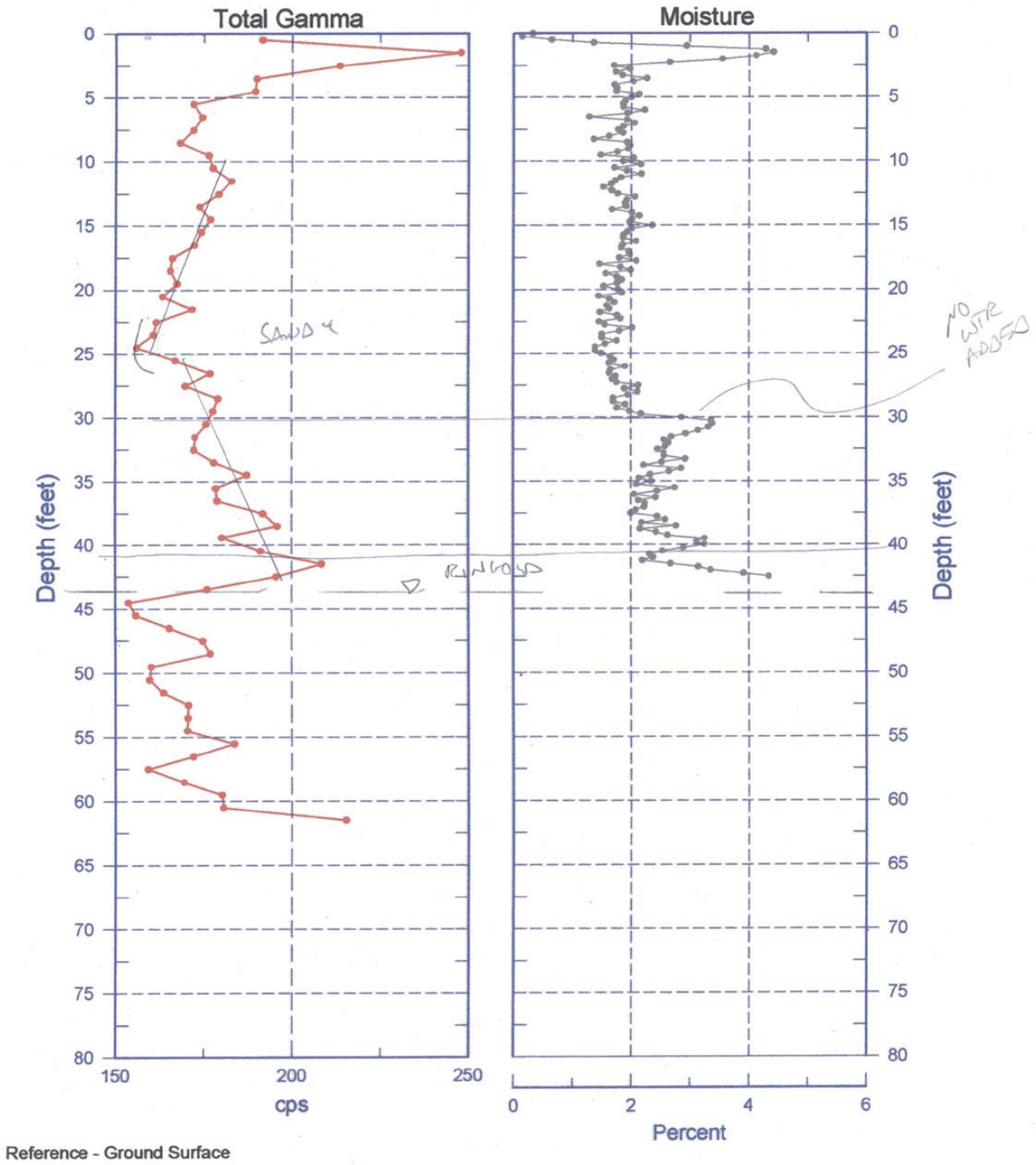

699-S-20-E10 (C4855) Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Moisture
Depth (feet)
137Cs (662 keV)
pCi/g
cps
percent
Zero Reference - Ground Surface

699-S20-E10 (C4855)
Total Gamma & Dead Time



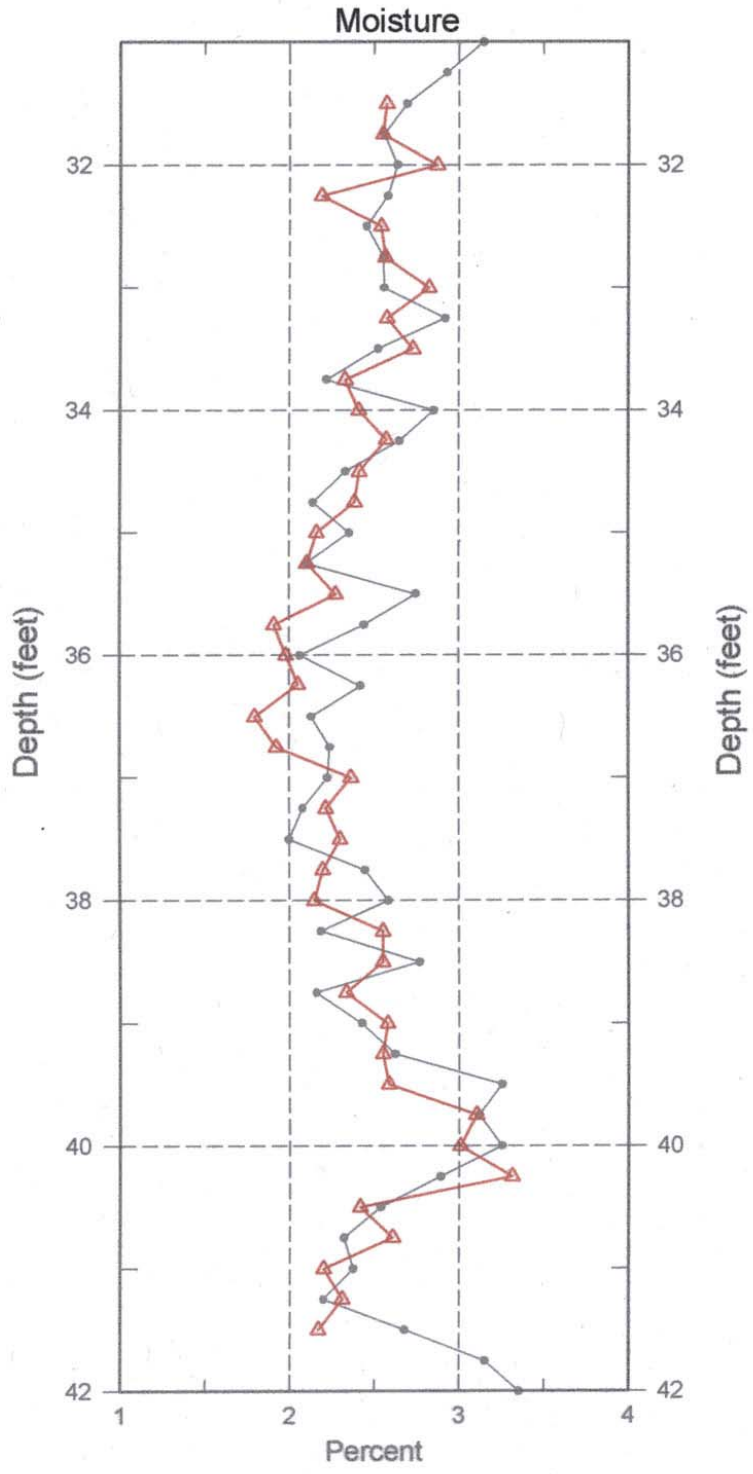
Reference - Ground Surface

699-S20-E10 (C4855)
Total Gamma & Moisture



Reference - Ground Surface

699-S20-E10 (C4855)
Moisture Repeat Section



Reference - Ground Surface

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