SGW-69396
Revision 0

Borehole Summary Report for the Installation of Two Wells in the 200-UP-1 Operable Unit, FY23

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract 89303320DEM000030

CPCCo
Central Plateau
Cleanup Company

P.O. Box 1464
Richland, Washington 99352

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GRAM Northwest, LLC

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Terms

bgs	below ground surface
CCU	Cold Creek unit
CCUc	Cold Creek unit caliche
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CPCCo	Central Plateau Cleanup Company
cpm	counts per minute
DOW	description of work
dpm	disintegrations per minute
Ecology	Washington State Department of Ecology
HCl	hydrochloric acid
Hf1	Hanford formation unit 1
Hf2	Hanford formation unit 2
hp	horsepower
NMLS	neutron moisture logging system
NTU	nephelometric turbidity unit
OD	outer diameter
OU	operable unit
RCT	radiological control technician
Rlm	Ringold Formation member of Wooded Island lower mud unit
Rtf	Ringold Formation member of Taylor Flat
Rwie	Ringold Formation member of Wooded Island– unit E
SAP	sampling and analysis plan
SGLS	spectral gamma logging system
TD	total depth
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
VOC	volatile organic compound

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1 Introduction

This borehole summary report describes the well drilling and construction activities performed during installation of two new monitoring wells, 299-W19-127 (C9605) and 299-W19-128 (C9606), in the 200-UP-1 Groundwater Operable Unit (OU) in the 200 West Area of the Hanford Site during fiscal year 2023. Figure 1 shows the location of the 200-UP-1 OU at the Hanford Site. SGW-66826, *Description of Work for the Installation of Four Wells in the 200-UP-1 Groundwater Operable Units, FY2022* (hereinafter referred to as the description of work [DOW]), is the controlling document for installation of the two new wells. Figure 2 shows the locations of the two new monitoring wells in the 200-UP-1 OU.

Both wells were drilled, constructed, and developed by Cascade Environmental for Central Plateau Cleanup Company (CPCCo). Well drilling, construction, and development activities occurred between December 7, 2022, and May 25, 2023. GRAM Northwest, LLC provided well site geology, well drilling documentation, and well construction and development documentation services. Geophysical logging services were provided by Bay West, LLC.

The two new *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) monitoring wells were installed to support monitoring of technetium-99 and nitrate downgradient from Waste Management Area (WMA) U.

Table 1 lists the well names, well identification numbers, the Washington State Department of Ecology (Ecology) unique well tag numbers, and installation (start of drilling to completion of final development) dates for the two new wells. Appendices A and B provide well summary sheets, well construction summary reports, borehole logs, geophysical log data reports, final civil survey reports, well development and testing data sheets, and photo archive logs for the two new wells.

1.1 Drilling, Sampling, and Well Construction Activities

This section summarizes the field activities associated with installing monitoring wells 299-W19-127 (C9605) and 299-W19-128 (C9606).

1.2 General Information

All well drilling, construction, and development activities were documented in daily field activity reports, and borehole geology was recorded on borehole logs. Groundwater and soil sampling activities, as well as geophysical logging, were performed under the sampling and analysis plan (SAP) in DOE/RL-2014-27, *Sampling and Analysis Plan for Remediation Wells in the 200-UP-1 Operable Unit*, as amended by Ecology et al., 1989, *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement), Change Notice TPA-CN-0924, *Tri-Party Agreement Change Notice Form: DOE/RL-2014-27, Sampling and Analysis Plan for Remediation Wells in the 200-UP-1 Operable Unit, Rev. 2*.

1.2.1 Drilling, Sampling, and Borehole Logging

This section describes the drilling, sampling, and borehole logging activities for installing the two new monitoring wells.

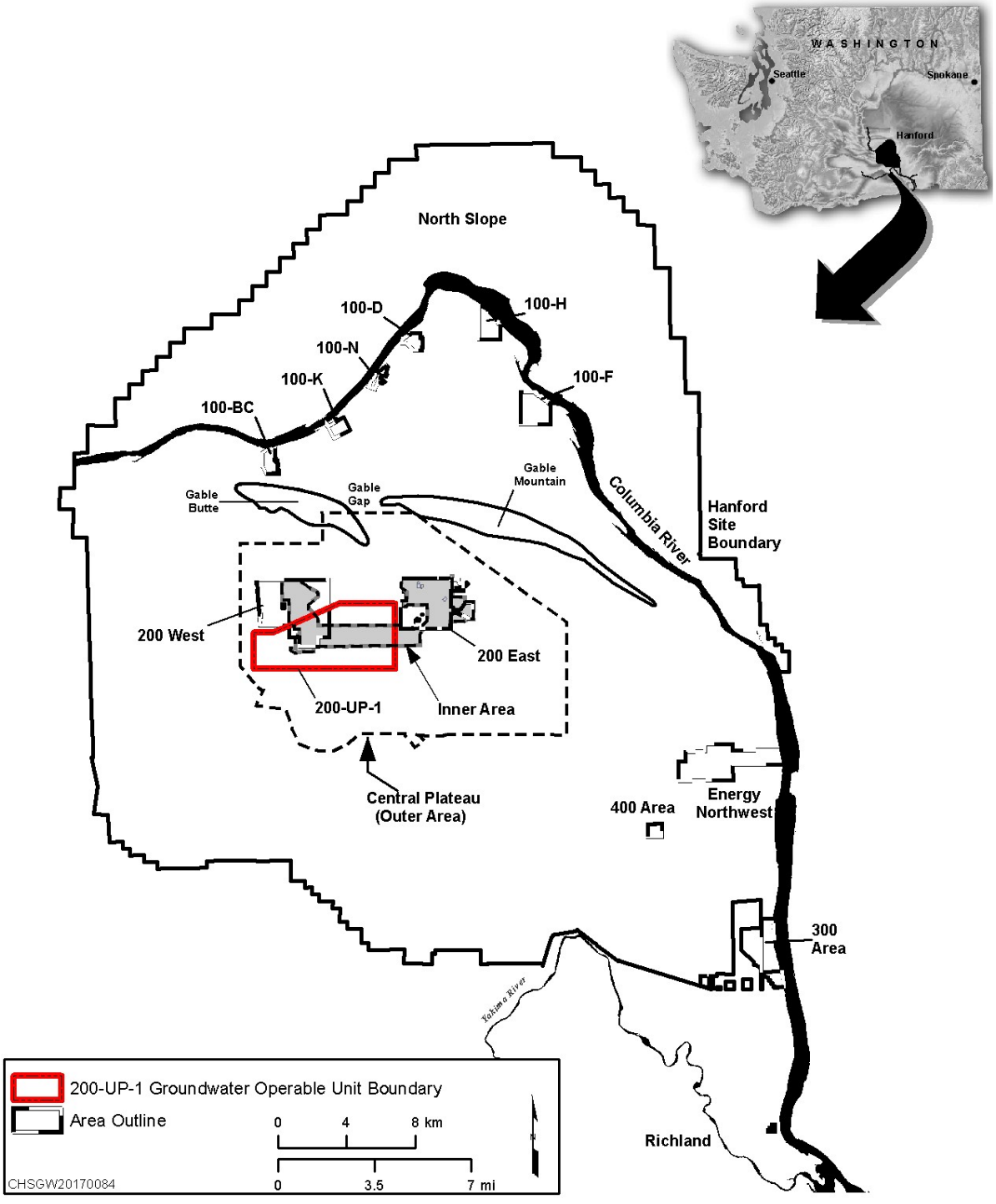

Figure 1. Hanford Site Map Showing the 200-UP-1 OU Boundary

Figure 2. Locations of the Two New Monitoring Wells in the 200-UP-1 OU

Table 1. Project Well Identification and Drilling Date Summary

Well Name	Well Identification	Well Type	Well Installation Dates		Ecology Well Tag Number
			Start	Finish	
299-W19-127	C9605	Monitoring well	12/07/2022	03/07/2023	BMS754
299-W19-128	C9606	Monitoring well	03/13/2023	05/25/2023	BMS753

Ecology = Washington State Department of Ecology

1.2.1.1 Drilling

The boreholes for wells 299-W19-127 (C9605) and 299-W19-128 (C9606) were drilled using a Prosonic™ PS600T truck-mounted sonic drilling rig operated by Cascade Environmental. Both wells were initially cased with 10 in. carbon steel temporary casing to ~39.0 m (128 ft) below ground surface (bgs). A second interval was drilled from the bottom of the 10 in. casing to 69.1 m (226.7 ft) bgs at well 299-W19-127 (C9605) and to 66.6 m (218.5 ft) bgs at well 299-W19-128 (C9606) and was cased with 9 in. carbon steel temporary casing. A third interval was drilled from the bottom of the 9 in. casing to

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100.0 m (328.0 ft) bgs at well 299-W19-127 (C9605) and to 96.8 m (317.6 ft) bgs at well 299-W19-128 (C9606) and cased with 8 in. carbon steel temporary casing. A fourth interval was drilled from the bottom of the 8 in. casing to 136.0 m (446.2 ft) bgs at well 299-W19-127 (C9605) and 125.1 m (410.5 ft) bgs at well 299-W19-128 (C9606) and cased with 6 in. carbon steel temporary casing. The borehole at well 299-W19-127 (C9605) was then advanced to a total depth (TD) of 136.1 m (446.5 ft) bgs; the borehole at well 299-W19-128 (C9606) was then advanced to a TD 125.4 m (411.4 ft) bgs (both of which were not cased).

Section 1.3 provides additional information regarding drilling.

1.2.1.2 Sampling

Sampling was conducted in accordance with the DOW (SGW-66826). Geologic grab samples were collected and archived at 1.5 m (5 ft) intervals and at major lithologic changes during the drilling of each borehole. Archive grab samples were placed in pint-size glass mason jars and plastic chip tray compartments and then labeled for storage at the Hanford Geotechnical Sample Library. Additional grab samples were obtained throughout the saturated zone every 1.5 m (5 ft) for particle-size distribution analysis (sieve analysis). The 1.5 m (5 ft) grab samples were composited per the DOW and the CPCCo well design authority's direction. Sieve analyses were run on the samples collected within the planned screened interval to determine grain-size distributions, for the selection of filter pack mesh size, and for well screen slot size for well construction. Split-spoon soil samples and groundwater samples were collected during the drilling of each of the two boreholes. Section 1.3 discusses well-specific sampling information.

1.2.1.3 Geophysical Logging

Both boreholes were logged using a spectral gamma logging system (SGLS) to detect natural and manmade gamma-emitting radionuclides and a neutron moisture logging system (NMLS) to detect soil moisture in the vadose zone. Geophysical logging was performed at each borehole through each string of temporary casing. All geophysical logging was performed by Bay West. Cesium-137 was detected intermittently from ground surface to 1.2 m (4 ft) bgs at well 299-W19-127 (C9605), with a maximum concentration of 0.90 pCi/g at ground surface. Cesium-137 was detected continuously from 0.9 to 4.3 m (3 to 14 ft) bgs at well 299-W19-128 (C9606), with a maximum concentration of ~4 pCi/g at 4 ft bgs. Appendices A and B provide the geophysical log data reports for the two new wells.

1.2.1.4 Health and Safety Screening

The health and safety screening included radiological field screening and air monitoring for volatile organic compounds (VOCs), as discussed in the following sections.

1.2.1.5 Radiological Field Screening

A radiological control technician (RCT) provided surveys twice daily (once in the morning and once in the afternoon) throughout drilling, development, and construction of well 299-W19-127 (C9605). Radiological contamination was not detected above background levels at any point during field activities at well 299-W19-127 (C9605).

An RCT provided continuous survey coverage throughout drilling, development, and construction activities at well 299-W19-128 (C9606). Elevated radiological levels above background were detected from ~20.3 to 94.5 m (70 to 310 ft) bgs and from 96.0 to 99.1 m (315 to 325 ft) bgs. The levels of contamination measured between 700 disintegrations per minute (dpm)/100 cm^2 (70 counts per minute [cpm]) to 2,000 dpm/100 cm^2 (200 cpm) above background. No archive samples were collected within these intervals.

1.2.1.6 Air Monitoring for Volatile Chemicals

An industrial hygiene technician performed atmospheric monitoring twice daily during drilling (once in the morning and once in the afternoon). The industrial hygiene technician used a photoionization detector and a multi-gas meter to monitor VOCs during drilling. Areas monitored for VOCs included the driller's breathing zone near the wellhead, the wellhead or source, any fresh drill cuttings and/or geologic samples, and any other areas of potential concern. All readings collected by the IHT at each well site were below action levels.

1.2.2 Well Construction and Development

This section provides additional details on well construction and development activities.

1.2.2.1 Screen and Casing Materials

Each well was constructed with permanent casing consisting of 4 in. Type 304/304L stainless-steel blank casing, with well screens consisting of 4 in. Type 304/304L stainless-steel, continuous vee-wire wrap with a 20-slot (0.020 in) aperture. Each well was installed with a ~0.9 m (3 ft) long, Type 304/304L stainless-steel sump with end cap. Section 1.3 provides further information on the construction materials used for each well.

1.2.2.2 Well Completion

In accordance with WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," a straightness test was conducted at each borehole prior to setting the permanent well casing.

During construction, both boreholes were backfilled to within ~0.3 m (1 ft) of the bottom of the sump with a combination of bentonite slurry and bentonite chips. The screen size and filter pack sand size used for construction were determined based on sieve analysis results, geologic borehole logs, geophysical logs, and intended well use. The wells were constructed with filter packs consisting of 12-20 mesh silica sand from the top of the bentonite backfill up to at least 0.9 m (3 ft) above the well screen. The filter packs were settled using a dual-flange surging method. Section 1.3 provides further information on the construction materials used for each well.

The annular seals for the two new wells consisted of at least 0.9 m (3.1 ft) of 0.375 in. bentonite pellets above the filter pack sand. From the top of the bentonite pellet seal to ~3.0 m (10 ft) bgs, #8 granular bentonite was used. Above 3.1 m (10.3 ft) bgs, Type IL Portland limestone cement was used up to the ground surface to provide the surface seal at wells 299-W19-127 (C9605) and 299-W19-128 (C9606).

The surface completion consists of permanent casing surrounded by a gray-painted, stainless-steel protective monument with a unique Ecology well tag number riveted to the north-facing side of the monument. The monuments have a lockable cap, and the lock hasps were positioned to face northward. Each surface completion has a 1.2 m by 1.2 m by 0.15 m (4 ft by 4 ft by 0.5 ft) concrete pad constructed around the wellhead protective monument. The wells were centered within the concrete pad with a brass surveyor's marker (stamped with the well name, well identification number, and final construction date) embedded on the northern side of the pad. The surface completion also includes four steel bollards (6 ft long and 3 in. diameter, one of which is removable) placed at the four corners of each concrete pad, with ~0.9 m (3 ft) stickup for wellhead protection. The bollards were painted yellow in accordance with ANSI Z535.1-2017, *American National Standard for Safety Colors*, for increased visibility of physical hazards. Section 1.3 provides further information on well construction.

1.2.2.3 Final Well Development

Final well development for the two new wells took place after the filter pack was surged. Each well was developed with a submersible electric pump, with the pump intake placed within the screened interval of the well. Groundwater was pumped while water quality parameters (turbidity, conductivity, dissolved oxygen, pH, and temperature) were monitored. Development was considered complete when the turbidity was measured at <5 nephelometric turbidity units (NTUs) and the remaining water quality parameters stabilized. For both wells, an In Situ LevelTROLL® 700 data logger was used to record the drawdown and recovery data during development activities. Sections 1.3.1 and 1.3.2 provide additional details. Table 2 lists the water quality data at the end of each day of development for each well. Appendices A and B provide well development and testing data sheets for each well.

1.2.2.4 Washington State Department of Ecology Well Identification

Each well received a unique Ecology well identification number that was embossed onto a stainless-steel tag and riveted to the protective monument. When the monuments were set, all identification tags were set to face toward the north. Table 1 lists the Ecology tag numbers and the associated wells.

1.3 Well-Specific Information

This section summarizes the drilling, air monitoring, sampling, geophysical logging, construction, and development activities specific to each well.

1.3.1 Well 299-W19-127 (C9605)

Drilling activities were performed at well 299-W19-127 (C9605) from December 7, 2022, to February 16, 2023. The well was constructed from February 23 to March 1, 2023; the well was developed on March 6, 2023. The borehole was drilled to a TD of 136.1 m (446.5 ft) bgs. The borehole for well 299-W19-127 (C9605) was cased with 10 in. carbon steel temporary casing to 39.0 m (128 ft). A second interval was cased with 9 in. carbon steel temporary casing from 39.0 to 69.1 m (128 to 226.7 ft) bgs. A third interval was cased with 8 in. carbon steel temporary casing from 69.1 to 100.0 m (226.7 to 328.0 ft) bgs. The fourth interval was cased with 6 in. carbon steel temporary casing from 100.0 to 136.0 m (328.0 to 446.2 ft) bgs. Drilling continued without casing from 136.0 to 136.1 m (446.2 to 446.5 ft) using a 4.85 in. outer diameter (OD) core barrel.

Sampling at well 299-W19-127 (C9605) included collecting geologic archive soil samples, five split-spoon soil samples for chemical analysis, four composited soil grab samples for sieve analysis, and eleven groundwater samples for chemical analysis. Geologic archive soil samples were collected by the field geologist at 1.5 m (5 ft) intervals from 1.5 m (5 ft) bgs to TD and at major lithology changes throughout the borehole. Samples for sieve analysis were collected as 1.5 m (5 ft) soil grab samples from within the planned screen interval and composited into 3 m (10 ft) composites per the DOW (SGW-66826) and the CPCCo well design authority's direction. Groundwater was initially measured at 80.1 m (262.7 ft) bgs on January 19, 2023. A final static water level was measured at 80.0 m (262.6 ft) bgs on March 6, 2023. Table 3 provides summary information for the samples collected for chemical analysis.

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Table 2. Well Development Data Summary

Well Name	Well Identification	Date Developed	Initial Water Level (ft bgs)	Pump Intake Depth (ft bgs)	Duration Pumped (minutes)	Average Flow Rate (gal/min)	Maximum Drawdown (ft)	Final Turbidity (NTU)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Temperature (°C)	Total Gallons Pumped
299-W19-127	C9605	3/6/2023	260.0	286.0	516	0.72	3.57	4.59	682	7.04	7.78	16.7	371.5
299-W19-128	C9606	5/22/2023	263.0	272.4	166	3.08	4.14	3.36	503	8.03	7.40	18.52	511.28
299-W19-128	C9606	5/22/2023	263.2	282.6	110	4.36	7.17	3.41	515	8.58	7.45	18.43	479.6

bgs = below ground surface
NTU = nephelometric turbidity unit

Table 3. Sample Summary for Well 299-W19-127 (C9605)

Sample Date	Sample Interval	Sample Depth (ft bgs)	Sample Medium	Sample Method	HEIS Number
1/9/2023	I-001[a]	132.0 – 134.5	Soil	Split spoon	B47TV0, B47RX8, B47RX9
1/9/2023	I-002[a]	132.0 – 134.5	Soil	Split spoon	B47TV1, B47RY0, B47RY1
1/9/2023	I-003	137.0 – 139.5	Soil	Split spoon	B47TV2[b], B47TB6, B47TB7
1/9/2023	I-004[a]	137.0 – 139.5	Soil	Split Spoon	B47TB8, B47TB9
1/9/2023	I-005[a]	142.0 – 144.5	Soil	Split spoon	B47TV4, B47TT4, B47TT5
1/19/2023	I-006	270.0	Water	Pumped	B47RY2, B47RY3, B47RY4, B47RY5, B47RY6
1/23/2023	I-007	280.3	Water	Pumped	B47RY7, B47RY8, B47RY9, B47T00, B47T01
1/24/2023	I-008	290.0	Water	Pumped	B47T02, B47T03, B47T04, B47T05, B47T06
1/30/2023	I-009	301.5	Water	Pumped	B47T07, B47T08, B47T09, B47T10, B47T11
1/31/2023	I-010	320.5	Water	Pumped	B47T12, B47T13, B47T14, B47T15, B47T16
2/7/2023	I-011	340.0	Water	Pumped	B47T17, B47T18, B47T19, B47T20
2/8/2023	I-012	360.0	Water	Pumped	B47T21, B47T22, B47T23, B47T24
2/9/2023	I-013	380.0	Water	Pumped	B47T25, B47T26, B47T27, B47T28
2/14/2023	I-014	400.0	Water	Pumped	B47T29, B47T30, B47T31, B47T32
2/16/2023	I-015	415.0	Water	Bailed	B47T33, B47T34, B47T35, B47T36
3/6/2023	Post-development	287.9	Water	Pumped	B47T41, B47T42, B47T43, B47T44

a. Sample was collected but not selected for laboratory analysis.

b. B47TV2 was collected in the field but was misplaced by the laboratory. The sample was replaced with the new HEIS number B47TV3.

bgs = below ground surface

HEIS = Hanford Environmental Information System

Geophysical logging was performed through the 10 in. temporary casing from December 13–15, 2022. SGLS was used from ground surface to 39.01 m (128.00 ft), and NMLS was used from ground surface to 39.32 m (129.00 ft) bgs. Geophysical logging was performed through the 9 in. temporary casing on January 12, 2023. SGLS was used from 38.40 to 69.80 m (126.00 to 229.00 ft), and NMLS was used from 38.10 to 69.80 m (124.99 to 229.00 ft) bgs. Geophysical logging was performed through the 8 in. temporary casing on February 2, 2023. SGLS was used from 69.19 to 100.58 m (227.00 to 330.00 ft) bgs, and NMLS was used from 69.19 to 80.54 m (227.0 to 264.25 ft) bgs. After drilling to TD, geophysical

logging was performed through the 6 in. temporary casing on February 22, 2023. SGLS was used from 99.97 to 135.03 m (328.00 to 443.00 ft) bgs.

Well construction activities were performed from February 23 to March 7, 2023. Cascade Environmental performed a straightness test with a 6.1 m (20.0 ft) long, 6.75 in. OD core barrel, which passed through the 8 in. temporary casing without binding on February 27, 2023. Well installation materials included 4 in. nominal Schedule 10S, Type 304/304L stainless-steel blanks and end cap, as well as 4 in. nominal screen. A total of 10.7 m (35.1 ft) of continuous vee-wire wrap stainless-steel screen with 20-slot (0.020 in.) apertures was used. Welded stainless-steel centralizers were placed directly above and below the screened interval, as well as at intervals of ~12.2 m (40 ft) above each previous centralizer up to the ground surface. Table 4 provides information on the well construction materials and associated depths for well 299-W19-127 (C9605), and Appendix A provides the well summary sheet depicting the final construction for this well.

Table 4. Construction Summary for Well 299-W19-127 (C9605)

Borehole Total Depth (ft bgs)	Static Water Level (ft bgs)	Stainless-Steel Permanent Casing, Screen and Well Materials			Annular Materials		
		Material	Interval (ft bgs)	Screen Slot Size (in.)	Material	Interval (ft bgs)	Mesh/Size
446.5	262.6 (3/6/2023)	6 in. stainless-steel monument	+3.00 – 2.00	N/A	Portland limestone cement	0.0 – 10.3	Type 1L
		4 in. stainless-steel blank casing	+2.0 – 255.27	N/A	Bentonite crumbles	10.3 – 246.5	#8-20
					Bentonite pellets	246.5 – 252.2	0.375 in.
		4 in. stainless-steel screen	255.27 – 290.37	0.020	Filter pack sand	252.2 – 294.6	#12-20
		4 in. stainless-steel cap	290.37 – 293.39	N/A	Bentonite chips	294.6 – 320.0	N/A
					Bentonite slurry	320.0 – 446.5	N/A

bgs = below ground surface (positive values [denoted by +] indicate measurement is above ground surface)
N/A = not applicable

Placement and surging of the filter pack sand was performed on February 27 and 28, 2023, using a dual-flange surge block. Final development activities were performed on March 6, 2023. The screened interval was developed using a 1.5 horsepower (hp) Grundfos environmental-grade submersible electric pump. The average pumping rate was 2.7 L/min (0.72 gal/min). Final development was considered complete when the measured turbidity was <5 NTU and other key parameters (specific conductance, dissolved oxygen, and pH) were stabilized within 10%. A total of 1,406 L (371.5 gal) was pumped to develop well 299-W19-127 (C9605). Table 2 provides final development data for this well, and Appendix A provides the well development and testing data sheet.

1.3.2 Well 299-W19-128 (C9606)

Drilling activities were performed at well 299-W19-128 (C9606) from March 7 to April 18, 2023. The well was constructed from April 24 to May 25, 2023; the well was developed on May 22, 2023. The borehole for well 299-W19-128 (C9606) was drilled using a Prosonic PS600T truck-mounted sonic drilling rig operated by Cascade Environmental. The borehole was initially drilled using 10 in. carbon steel temporary casing to 39.1 m (128.4 ft). A second interval was cased with 9 in. carbon steel temporary casing from 39.1 to 66.6 m (128.4 to 218.5 ft) bgs. A third interval was cased with 8 in. carbon steel temporary casing from 66.6 to 96.8 m (218.5 to 317.6 ft) bgs. The fourth interval was cased with 6 in. carbon steel temporary casing from 96.8 to 125.1 m (317.6 to 410.5 ft) bgs. Drilling continued at well 299-W19-128 (C9606) without casing from 125.1 to TD of 125.4 m (410.5 to 411.4 ft) using a 4.85 in. OD core barrel.

Sampling at well 299-W19-128 (C9606) included collecting geologic archive soil samples, one split-spoon soil sample for chemical analysis, and eight groundwater samples for chemical analysis. Geologic archive soil samples were collected by the field geologist at 1.5 m (5 ft) intervals from 1.5 m (5 ft) bgs to TD and at major lithology changes throughout the borehole, except from ~20.3 to 94.5 m (70 to 310 ft) bgs and from 96.0 to 99.1 m (315 to 325 ft) bgs due to elevated radiological readings in the cuttings. Groundwater was initially measured at 79.7 m (261.5 ft) bgs on March 27, 2023. A final static water level was measured at 80.2 m (263.2 ft) bgs on May 23, 2023. Table 5 provides summary information for the samples collected for chemical analysis.

Table 5. Sample Summary for Well 299-W19-128 (C9606)

Sample Date	Sample Interval	Sample Depth (ft bgs)	Sample Medium	Sample Method	HEIS Number
3/15/2023	I-001	118.2 – 120.7	Soil	Split spoon	B47TW5, B47TW6, B47TW7
3/28/2023	I-007	272.7	Water	Pumped	B47T62, B47T63, B4TT64, B47T65, B47T66
3/29/2023	I-008	283.5	Water	Pumped	B47T67, B47T68, B47T69, B47T70, B47T71
3/30/2023	I-009	293.3	Water	Pumped	B47T72, B47T73, B47T74, B47T75, B47T76
4/3/2023	I-010	313.2	Water	Pumped	B47T77, B47T78, B47T79, B47T80, B47T81
4/11/2023	I-011	333.4	Water	Pumped	B47T82, B47T83, B47T84, B47T85
4/12/2023	I-012	353.4	Water	Pumped	B47T86, B47T87, B47T88, B47T89
4/13/2023	I-013	372.65	Water	Pumped	B47T90, B47T91, B47T92, B47T93
4/17/2023	I-014	392.31	Water	Pumped	B47T94, B47T95, B47T96, B47T97

Notes:

Post-development sample was taken on May 22, 2023.

Split spoon samples I-002 through I-006 were not collected because the target formation top (Cold Creek unit) was observed and sampled at a shallower depth than anticipated.

bgs = below ground surface

HEIS = Hanford Environmental Information System

Geophysical logging was performed through the 10 in. temporary casing on March 15 and 16, 2023. SGLS and NMLS were both used from ground surface to 39.01 m (128.00 ft) bgs. Geophysical logging was performed through the 9 in. temporary casing on March 22, 2023. SGLS was used from 38.40 to 66.75 m (126.00 to 219.00 ft), and NMLS was used from 38.40 to 67.06 m (126.00 to 220.00 ft) bgs. Geophysical logging was performed through the 8 in. temporary casing on April 4 and 5, 2023. SGLS was used from 65.84 to 96.02 m (216.00 to 315.01 ft) bgs, and NMLS was used from 66.45 to 81.00 m (218.00 to 265.75 ft) bgs. After drilling to TD, geophysical logging was performed through the 6 in. temporary casing on April 19, 2023. SGLS was used from 94.49 to 124.97 m (310.00 to 410.00 ft) bgs. Appendix B provides the geophysical log data report for well 299-W19-128 (C9606).

Well construction activities were performed from April 24 to May 25, 2023. Cascade Environmental performed a straightness test with a 6.25 m (20.5 ft) long, 6.75 in. OD core barrel, which passed through the 8 in. temporary casing without binding on May 3, 2023. Well installation materials included 4 in. nominal Schedule 10S, Type 304/304L, stainless-steel blanks and end cap, as well as 4 in. nominal screen. A total of 9.16 m (30.05 ft) of continuous vee-wire wrap stainless-steel screen with 20-slot (0.020 in.) apertures was used. Welded stainless-steel centralizers were placed directly above and below the screened interval, as well as at 12.2 m (40 ft) intervals from the top of the screened interval to the ground surface. Table 6 provides information on the well construction materials and associated depths for well 299-W19-128, and Appendix B provides the well summary sheet depicting the final construction for this well.

Table 6. Construction Summary for Well 299-W19-128 (C9606)

Borehole Total Depth (ft bgs)	Static Water Level (ft bgs)	Stainless-Steel Permanent Casing, Screen and Well Materials			Annular Materials		
		Material	Interval (ft bgs)	Screen Slot Size (in.)	Material	Interval (ft bgs)	Mesh/Size
411.4	268.92 (5/23/2023)	6 in. stainless-steel monument	+3.52–1.55	N/A	Portland limestone cement	0.0 – 10.17	Type 1L
		4 in. stainless-steel blank casing	+ 2.19 – 258.88	N/A	Bentonite crumbles	10.17 – 253.08	#8
					Bentonite pellets	253.08 – 255.95	0.375 in.
		4 in. stainless-steel screen	258.88 – 288.93	0.020	Filter pack sand	255.95 – 292.2	#12-20
		4 in. stainless-steel cap	288.93 – 291.93	N/A	Bentonite slurry	292.2 – 367.7	N/A
					Natural fill	367.7 – 371.5	N/A
					Bentonite chips	371.5 – 384.8	N/A
					Bentonite slurry	384.8 – 411.4	N/A

Table 6. Construction Summary for Well 299-W19-128 (C9606)

Borehole Total Depth (ft bgs)	Static Water Level (ft bgs)	Stainless-Steel Permanent Casing, Screen and Well Materials			Annular Materials		
		Material	Interval (ft bgs)	Screen Slot Size (in.)	Material	Interval (ft bgs)	Mesh/Size

Note: Positive values (denoted by +) indicate that the measurement is above ground surface.
bgs = below ground surface
N/A = not applicable

Placement and surging of the filter pack sand was performed on May 8, 2023, using a dual-flange surge block. Final development at well 299-W19-128 (C9606) was performed on May 22, 2023. The screened interval was developed using a 0.75 hp environmental sampling submersible pump. The pumping rate was 11.7 L/min (3.08 gal/min) for the upper development interval and 16.5 L/min (4.36 gal/min) for the lower development interval. Final development was considered complete when the measured turbidity was <5 NTUs and all other key parameters (specific conductance, dissolved oxygen, pH, and temperature) were stabilized within 10%. A total of 3,750.9 L (990.88 gal) was pumped to develop well 299-W19-128 (C9606). Table 2 provides final development data for this well, and Appendix B provides the well development and testing data sheet.

2 Geologic Observations

This chapter summarizes the general geology of the 200-UP-1 OU and the geology encountered at each of the well sites during drilling.

2.1 Geology of the 200-UP-1 Operable Unit

The geology of the 200-UP-1 OU, as described in the DOW (SGW-66826), is summarized in this section. The local geology of the 200 West Area is composed of the Columbia River Basalt Group and its overlying sedimentary deposits. These sedimentary deposits generally include the Ringold Formation, Cold Creek unit (CCU), and the Hanford formation. The stratigraphic units are listed below in descending order:

- Surface eolian deposits, disturbed sediments/recent sand, and gravel backfill
- Hanford formation:
  - Hanford formation unit 1 (Hf1): upper gravel-dominated facies
  - Hanford formation unit 2 (Hf2): sand-dominated facies
- CCU:
  - CCU - undifferentiated: dominantly silt
  - CCU caliche (CCUc): cemented gravels and sands

- Ringold Formation:
  - Ringold Formation member of Taylor Flat (Rtf): fine-grained sediments
  - Ringold Formation member of Wooded Island – unit E (Rwie): sand and gravel
  - Ringold Formation member of Wooded Island – lower mud unit (Rlm): fine-grained sediment

Additional information regarding the geology of the 200 West Area is provided in the following:

- CP-67635, *Development of Hanford South Geoframework Model*
- ECF-HANFORD-18-0035, *Central Plateau Vadose Zone Geoframework*
- ECF-HANFORD-20-0008, *Development of Hanford Site Top of Basalt Elevation Grid*

Summaries of geologic units encountered throughout each borehole are presented in the following discussion.

2.2 Borehole Geology

This section describes the distinguishing geological characteristics of observed grab samples collected during the drilling of the two boreholes, as well as stratigraphic unit depths interpreted by the CPCCo geology subject matter expert after drilling using SGLS/NMLS data and regional stratigraphic interpretations. Field observations were made from archive grab samples of drill cuttings collected every 1.5 m (5 ft) or at major lithologic changes. Archive grab samples were collected by emptying the core barrel into stainless-steel bowls at wells 299-W19-127 (C9605) and 299-W19-128 (C9606).

2.2.1 Well 299-W19-127 (C9605)

Well 299-W19-127 (C9605) is located ~500 m (1,640 ft) west of U Plant. The borehole was drilled using a sonic drilling rig from ground surface to TD at 136.1 m (446.5 ft) bgs. Appendix A provides the borehole log, the soil photo archive log, and the geophysical log report. The major stratigraphic units observed during drilling included the Hanford formation, CCU, and Ringold Formation, with features described as follows:

- **Hanford formation (1.5 to 43.3 m [5 to 142 ft] bgs):**
  - **Hf1 (1.5 to 15.8 m [5 to 52 ft] bgs):** Beneath modern backfill, Hf1 was identified by its strongly mafic sediments and strong reaction to dilute hydrochloric acid (HCl). Sand content ranged from 20% to 80%, while gravel content ranged from 5% to 50%. Sand mafic content ranged from 20% to 60%, and gravel mafic content ranged from 60% to 100%.
  - **Hf2 (15.8 to 43.3 m [52 to 142 ft] bgs):** Hf2 was differentiated by a decrease in gravel content and increase in sand and silt. There was also an increase in natural potassium (potassium-40) and natural thorium (thorium-232) gamma emissions observed from Hf1 to Hf2. Sand content ranged from 0% to 100%, and the sand had a greater felsic content ranging from 40% to 80%, gravel ranging from 0% to 30% with a mostly mafic content, and silt ranging from 0% to 100% with more silt being identified deeper in the formation. There was generally a strong HCl reaction throughout.

- **CCU (43.3 to 47.9 m [142 to 157 ft] bgs):**
  - **CCU - undifferentiated (43.3 to 46.6 m [142 to 153 ft] bgs):** The transition to the CCU appeared to be very similar to the overlying Hf2, with 100% silt content toward the top of the CCU layer to mostly gravels toward the bottom. The HCl reaction was strong throughout.
  - **CCUc (46.6 to 47.9 m [153 to 157 ft] bgs):** The CCUc was readily identified by a change in lithology to more gravel dominance (60% to 80% gravel). There was also a noticeable increase in natural uranium (uranium-238) and natural thorium emissions from the CCU to the CCUc and a decrease in natural potassium. The CCUc was identified by more mafic sediments (sand mafic content 60% and gravel mafic content between 60% and 80%). There was no HCl reaction throughout the CCUc.
- **Ringold Formation (47.9 to 136.1 m [157 to 446.5 ft] bgs):**
  - **Rtf (47.9 to 49.4 m [157 to 162 ft] bgs):** The Rtf was gravel-dominant (with 60% gravel) and an even percentage of silt and sand. Mafic grains were dominant, with the gravel and sand both having 60% mafic content. There was no HCl reaction throughout the Rtf. At the top of the Rtf, natural uranium-238 and thorium-232 gamma emissions decreased, while natural potassium-40 increased.
  - **Rwie (49.4 to 134.1 m [162 to 440 ft] bgs):** The Rwie had a sand and gravel dominance, and mafic/felsic dominance tended to vary (although the gravel tended to be slightly more felsic-dominant, and the sand tended to be slightly more mafic-dominant). Silt was present toward the top of the formation, varying from 0% to 40% and becoming more dominant the bottom 12.2 m (40 ft) of the formation. There was little to no HCl reaction throughout the Rwie until the bottom 3.0 m (10 ft). The Rwie had relatively low levels of natural potassium-40, uranium-238, and thorium-232 gamma emissions.
  - **Rlm (134.1 to 136.1 m [440 to 446.5 ft] bgs):** The Rlm was characterized as predominantly silt (90% silt, 10% sand) with medium plasticity, no HCl reaction, and 2.5Y5/1 gray color.

A final static water level was measured at 79.9 m (262.1 ft) bgs on January 26, 2023. Appendix A provides the borehole log, the geophysical log report, and the soil archive photo log for well 299-W19-127.

2.2.2 Well 299-W19-128 (C9606)

Well 299-W19-128 (C9606) is located 535 m (1,755 ft) northwest of U Plant. The borehole was drilled using a sonic drilling rig from ground surface to TD of 125.4 m (411.4 ft) bgs. At this borehole, some of the drill cuttings had elevated radiological readings (per the RCT). The field geologist did not handle cuttings with elevated radiological readings; therefore, the geologic descriptions are less detailed from 20.3 to 94.5 m (70 to 310 ft) bgs and from 96.0 to 99.1 m (315 to 325 ft) bgs. Appendix B provides the borehole log, the soil photo archive log, and the geophysical log report. The major stratigraphic units observed during drilling were the Hanford formation, CCU, Rtf, and the Rwie, with features described as follows:

- **Hanford formation (0.61 to 39.0 m [2 to 128 ft] bgs):**
  - **Hf1 (0.61 to 15.2 m [2 to 50 ft] bgs):** Hf1 was identified by strongly mafic gravels underneath a thin initial layer of surficial Holocene backfill. Gravels were mostly dominant throughout, with sand content ranging between 10% and 90% and silt content ranging from 10% to 20%. Gravels were predominantly mafic, while the sand had higher felsic percentages. Moderate to strong HCl reactions were observed throughout.
  - **Hf2 (15.2 to 39.0 m [50 to 128 ft] bgs):** Hf2 was differentiated by a slight increase in sand content and an increase in the sand mafic component. Silt ranged from 10% to 30%, and there were generally moderate to strong HCl reactions. A sharp increase in potassium-40 and thorium-232 gamma emissions was observed at the top of Hf1.
- **CCU (39.0 to 44.8 m [128 to 147 ft] bgs):**
  - **CCU - undifferentiated (39.0 to 43.3 m [128 to 142 ft] bgs):** The CCU was observed to have higher silt content than the Hf2 and had strong HCl reactions. A brief decrease in potassium-40 emissions was noted at the top of the CCU, along with a corresponding increase in uranium-238 gamma emissions.
  - **CCUc (43.3 to 44.8 m [142 to 147 ft] bgs):** The CCUc was characterized by higher silt content and a strong HCl reaction. A precipitously sharp increase in thorium-232 and uranium-238 gamma emissions was observed at the top of the CCUc, as well as a correspondingly precipitous decrease in potassium-40 gamma emissions.
- **Ringold Formation (44.8 to 125.4 m [147 to 411.4 ft] bgs):**
  - **Rtf (44.8 to 47.5 m [147 to 156 ft] bgs):** The Rtf showed the first significant quantities of gravel mixed with silt. There continued to be a strong HCl reaction in this formation. There was a notable increase in potassium-40 gamma emissions at the top of the Rtf, as well as a decrease in uranium-238 emissions.
  - **Rwie (47.5 to 125.4 m [156 to 411.4 ft] bgs):** The Rwie continued to show significant quantities of gravel (ranging from 20% to 70%), with sand and low amounts of silt until 120.4 m (395 ft). From 120.4 to 125.4 m (395 to 411.4 ft), the silt percentage increased to 70% to 80% (with some sand). There was no HCl reaction throughout this formation, with exceptions between 89.9 to 94.5 m (295 to 310 ft) and 114.3 to 120.4 m (375 to 395 ft), where weak to strong HCl reactions were observed.

A final static water level was measured at 80.2 m (263.2 ft) bgs on May 23, 2023. Appendix B provides the borehole log, the geophysical log report, and the soil archive photo log for well 299-W19-128.

3 Waste Management

Waste generated during installation of the two new wells included drill cuttings, purgewater, and miscellaneous solid waste. Waste was managed in accordance with CERCLA and DOE/RL-2016-13, *Waste Management Plan for 200-UP-1 Groundwater Operable Unit*.

3.1 Drill Cuttings

All drill cuttings from the two new wells were collected in tip dumpsters, and water was absorbed using WaterWorks Crystals® when necessary. The drill cuttings were then placed into designated Environmental Restoration Disposal Facility roll-off boxes. Any miscellaneous solid waste associated with sampling activities was sealed in clear plastic bags and disposed in the roll-off boxes. The roll-off boxes were transported to the Environmental Restoration and Disposal Facility for disposal after project completion.

3.2 Purgewater

Purgewater was generated during well drilling, sampling, and development activities. All purgewater was collected and contained near the wellhead until it was transported to the purgewater modular storage units using purge trucks in accordance with DOE/RL-2009-80, *Investigation Derived Waste Purgewater Management Work Plan*; and DOE/RL-2011-41, *Hanford Site Strategy for Management of Investigation Derived Waste*.

4 Civil Survey

The locations for the two new wells were surveyed using a Trimble® R8 RTK global positioning system and a Trimble DiNi 12 level to measure coordinates. Washington State Plane (south zone) *North American Datum of 1983* (NAD83) (with the 1991 adjustment) was used to record the horizontal coordinates; *North American Vertical Datum of 1988* (NAVD88) was used to record the vertical survey data. Well 299-W19-127 (C9605) was surveyed on March 29, 2023, and well 299-W19-128 (C9606) was surveyed on June 1, 2023.

Table 7. Civil Survey Summary

Well Name	Well Identification	Northing[a] (m)	Easting[a] (m)	Brass Survey Marker Elevation[b] (m)	Top of Casing[b, c] Elevation (m)
299-W19-127	C9605	135110.71	567036.73	210.173	210.904
299-W19-128	C9606	135254.98	567002.55	209.737	210.481

a. Northing and easting coordinates are based on Washington State Plane coordinates (*North American Datum of 1983* [NAD83] with 1991 adjustment).

b. *North American Vertical Datum of 1988* (NAVD88) values rounded to 0.001 m.

c. Protective casing (monument).

5 Well Acceptance

The final step of the installation process is well acceptance. Well acceptance represents confirmation that the wells meet the requirements outlined in the statement of work. Well acceptance also indicates contractual completion of the finished wells.

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After the wells were completed, representatives from CPCCo and Cascade Environmental performed inspections for the new wells. Well site assessments were completed for well 299-W19-127 (C9605) on July 10, 2023, and for well 299-W19-128 (C9606) on July 11, 2023.

6 References

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Appendix A

Well Documentation for 299-W19-127 (C9605)

- Well Summary Sheet for 299-W19-127
- Well Construction Summary Report for 299-W19-127
- Borehole Log for 299-W19-127
- Geophysical Log Data Report for 299-W19-127
- Well Survey Data Report for 299-W19-127
- Well Development and Testing Data Sheet for 299-W19-127
- Photo Log for 299-W19-127

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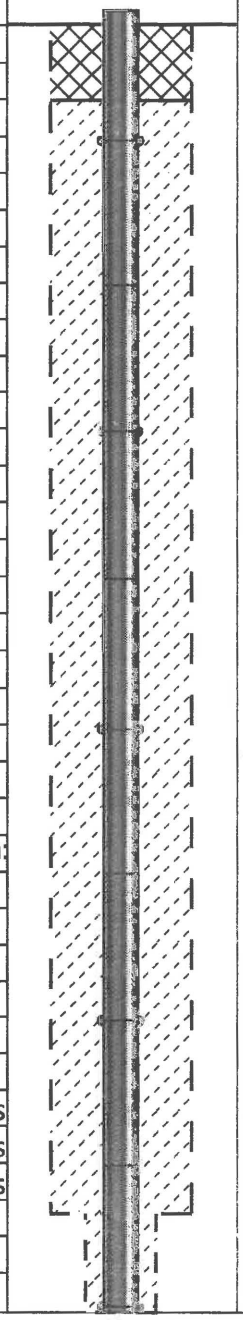
WELL SUMMARY SHEET

Page 1 of 3

Well ID: C9605	Well Name: 299-W19-127	Start Date: 12/07/2022
Project: 2 Monitoring Wells-200-UP-1 OU	Location: ~500 m West of U-Plant	End Date: 02/16/2023

CONSTRUCTION DATA

Description
Surface Completion:
4 x 4 x 0.5 ft concrete pad with
brass survey marker and protective
monument (3.0 ft ags - 2.0 ft bgs).
WA Ecology Tag #: BMS754
Construction Materials:
Type 1L Portland Cement:
0.0 ft bgs - 10.3 ft bgs
#8/12 Bentonite Crumbles:
10.3 ft bgs - 246.5 ft bgs
3/8" Bentonite Pellets:
246.5 ft bgs - 252.2 ft bgs
#12/20 Filter Pack Silica Sand
252.2 ft bgs - 294.6 ft bgs
Bentonite Chips:
294.6 ft bgs - 320.0 ft bgs
Bentonite Grout Slurry:
320.0 ft bgs - 446.5 ft bgs
Well Materials:
4.5" OD TP-304/304L Sch 10s Blank:
2.0 ft ags - 255.27 ft bgs
4.5" OD TP-304 20-slot (0.020") Screen:
255.27 ft bgs - 290.37 ft bgs
4.5" OD TP-304/304L Sump/Cap:
290.37 ft bgs - 293.39 ft bgs
Hole Dimensions:
10.5" OD Temp. Casing: 130 ft bgs
9.25" OD Temp. Casing: 226.7 ft bgs
8.20" OD Temp. Casing: 328.0 ft bgs
4.85" OD Temp. Casing: 446.5 ft bgs
ags=above ground surface
bgs= below ground surface



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
0		0 - 5 ft: Silt
		5 - 15 ft: Gravelly Sand
		15 - 20 ft: Silt
		20 - 45 ft: Sandy Gravel
25		
		45 - 55 ft: Sand
50		55 - 60 ft: Sandy Gravel
		60 - 75 ft: Gravelly Sand
75		
		75 - 100 ft: Sand
100		
		100 - 150 ft: Silt
125		
150		
		150 -160 ft: Silty Sandy Gravel
		160 - 170 ft: Silty Gravel
		170 - 180 ft: Gravel

Reported By:			
Ellen Whitney	Staff Geologist		4/18/2023
Print Name	*Title*	*Signature*	*Date*
Reviewed By:			
John L. Smoot	BTR	John L Smoot	5/3/2023
Print Name	*Title*	*Signature*	*Date*

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OR Doc Type:	WMU Code(s):

A-6003-643 (REV 2)

WELL SUMMARY CONTINUATION SHEET

Page 2 of 3

Well ID: D9605 | Well Name: 299-W19-127 | Project: 2 M Wells-200-UP-1 OU

CONSTRUCTION DATA

Surface Completion:
4 x 4 x 0.5 ft concrete pad with brass survey marker and protective monument (3.0 ft ags - 2.0 ft bgs).
WA Ecology Tag #: BMS754

Construction Materials:
Type 1L Portland Cement:
0.0 ft bgs - 10.3 ft bgs
#8/12 Bentonite Crumbles:
10.3 ft bgs - 246.5 ft bgs
3/8" Bentonite Pellets:
246.5 ft bgs - 252.2 ft bgs
#12/20 Filter Pack Silica Sand
252.2 ft bgs - 294.6 ft bgs
Bentonite Chips:
294.6 ft bgs - 320.0 ft bgs
Bentonite Grout Slurry:
320.0 ft bgs - 446.5 ft bgs

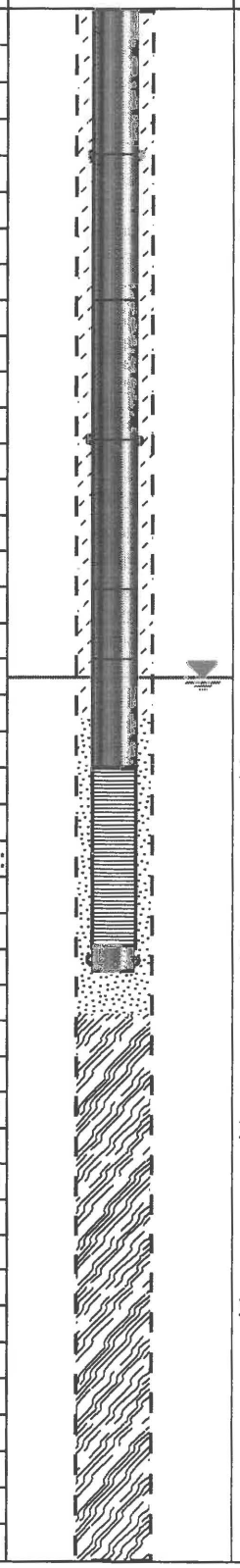
Well Materials:
4.5" OD TP-304/304L Sch 10s Blank:
2.0 ft ags - 255.27 ft bgs
4.5" OD TP-304 20-slot (0.020") Screen:
255.27 ft bgs - 290.37 ft bgs
4.5" OD TP-304/304L Sump/Cap:
290.37 ft bgs - 293.39 ft bgs

Hole Dimensions:
10.5" OD Temp. Casing: 130 ft bgs
9.25" OD Temp. Casing: 226.7 ft bgs
8.20" OD Temp. Casing: 328.0 ft bgs
4.85" OD Temp. Casing: 446.5 ft bgs

Note:
All temporary casing has been removed from the ground.

ags = above ground surface
bgs = below ground surface

Diagram



Depth in Feet

175
200
225
250
275
300
325
350

GEOLOGIC/HYDROLOGIC DATA

Graphic Log

Lithologic Description (ft bgs)

170 - 185 ft: Gravel
185 - 230 ft: Sandy Gravel
230 - 235 ft: Gravelly Sand
235 - 250 ft: Slightly Silty Gravelly Sand
250 - 255 ft: Silt
255 - 265 ft: Sand
Depth to Water = 262.1ft bgs (01/26/2023)
265 - 270 ft: Sandy Gravel
270 - 275 ft: Silty Gravel
275 - 280 ft: Sandy Gravel
280 - 290 ft: Gravel
290 - 295 ft: Gravelly Sandy Silt
295 - 320 ft: Silty Gravel
320 - 325 ft: Silty Sandy Gravel
325 - 330 ft: Silty Gravel
330 - 340 ft: Silty Sandy Gravel
340 - 365 ft: Gravelly Sandy Silt
365 - 380 ft: Silty Gravel
380 - 385 ft: Gravelly Silty Sand

A-6006-992 (REV 0)

WELL SUMMARY CONTINUATION SHEET

Well ID: D9605 | Well Name: 299-W19-127 | Project: 2 M Wells-200-UP-1 OU

CONSTRUCTION DATA

Description	Diagram
Surface Completion:	
4 x 4 x 0.5 ft concrete pad with brass survey marker and protective monument (3.0 ft ags - 2.0 ft bgs).	
WA Ecology Tag #: BMS754	
Construction Materials:	
Type 1L Portland Cement:	
0.0 ft bgs - 10.3 ft bgs	
#8/12 Bentonite Crumbles:	
10.3 ft bgs - 246.5 ft bgs	
3/8" Bentonite Pellets:	
246.5 ft bgs - 252.2 ft bgs	
#12/20 Filter Pack Silica Sand	
252.2 ft bgs - 294.6 ft bgs	
Bentonite Chips:	
294.6 ft bgs - 320.0 ft bgs	
Bentonite Grout Slurry:	
320.0 ft bgs - 446.5 ft bgs	
Well Materials:	
4.5" OD TP-304/304L Sch 10s Blank:	
2.0 ft ags - 255.27 ft bgs	
4.5" OD TP-304 20-slot (0.020") Screen:	
255.27 ft bgs - 290.37 ft bgs	
4.5" OD TP-304/304L Sump/Cap:	
290.37 ft bgs - 293.39 ft bgs	
Hole Dimensions:	
10.5" OD Temp. Casing: 130 ft bgs	
9.25" OD Temp. Casing: 226.7 ft bgs	
8.20" OD Temp. Casing: 328.0 ft bgs	
6.02" OD Temp. Casing: 446.2 ft bgs	
4.85" OD Core Barrel: 446.5 ft bgs	
Note:	
All temporary casing has been removed from the ground.	
ags = above ground surface	
bgs = below ground surface	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
375		380 - 385 ft: Gravelly Silty Sand
		385 - 390 ft: Silty Sandy Gravel
		390 - 395 ft: Silty Gravel
		395 - 400 ft: Gravelly Silty Sand
400		400 - 410 ft: Gravelly Sandy Silt
		410 - 430 ft: Silty Sand
425		430 - 435 ft: Silty Gravel
		435 - 440 ft: Gravelly Silt
		440 - 446.5 ft: Silt
450		Total Depth = 446.5 ft bgs
475		
500		
525		
550		
575		

No Logging 4/18/2023

A-6006-992 (REV 0)

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WELL CONSTRUCTION SUMMARY REPORT

JP 05/03/23

Start Date: 12/7/2022
Finish Date: 3/7/2023
Page: 1 of 1

Well ID: ~~D9605~~ C9605	Well Name: 299-W19-127	Ecology Tag #: BMS754
Location: ~500 meters West of U-Plant		Project: Install of 2/200-UP-1 OU Monitoring Wells
Drilling Company: Cascade Drilling, LP		Other Companies: GRAMNW, CPCCo, Bay West LLC
Driller: Efelito Rauch	License #: 2839	Geologist(s): Ellen Whitney, Ryan Bailey, CB Ellis Herring, Dan Charbonneaux, Kelsey Peta

TEMPORARY CASING AND DRILL DEPTH

Size (in.)	Joint Type (Wld or Thd)	Interval (ft.)	Shoe Size (OD/ID) (in.)
11.5	Thd	0.0 - 130	10.5/9.625
9.25	Thd	130 - 226.7	9.25/9.19
8.20	Thd	226.7 - 328.0	8.20/7.32
6.02	Thd	328.0 - 446.2	6.02/5.20
Not used 4/18/23			

DRILLING METHOD

Type of Drill Rig	HOLE DIAMETER (in.) / INTERVAL (ft.)		
Sonic	Diameter: 11.5	From: 0.0	To: 130
Sonic	Diameter: 9.25	From: 130	To: 226.7
Sonic	Diameter: 8.20	From: 226.7	To: 328.0
Sonic	Diameter: 6.02	From: 328.0	To: 446.2
Sonic	Diameter: 4.85	From: 446.2	To: 446.5

Total Drilled Depth: 446.5 | **Hole Dia @ TD:** 4.85 | **Total Amount of Water Added During Drilling:** ~60 gallons

COMPLETED WELL

Permanent Casing

Size & Material	Depth (ft.)	Slot Size (in.)
4.5" TP-304 sch 10s Riser	2.0 ags - 255.27	N/A
4.5" TP-304 V-Wire Screen	255.27 - 290.37	0.020
4.5" TP-304 sch 10s Sump	290.37 - 293.39	N/A
	-	
Not used 4/18/23	-	
	-	
	-	
	-	

Construction Material

Type	Intervals (ft.) Annular Seal / Filter Pack	Volume (ft^3)	Mesh Size
High Strength Concrete	0.5 ags - 0.00	25.0	N/A
Cement Grout	0.00 - 10.3	45.0	I/L
Bentonite Crumbles	10.3 - 246.5	100.7	#8-12
Bentonite Pellets	246.5 - 252.2	1.45	3/8"
Filter Pack	252.2 - 294.6	11.5	#12/20
Bentonite Chips	294.6 - 320.0	15.2	N/A
Bentonite Slurry	320.0 - 446.5	28.3	N/A
Not used 4/18/23	-		

OTHER ACTIVITIES

Well Straightness Test Results: Passed (02/27/2023)

Well Development Date: 03/01/2023	**Well Decommissioned?**	**Yes** ☐ **No** ☒
Saturated Thickness: 32.5 ft		**Date:** -
Pumping Rate (gpm): 0.72	**Description:** -	
Total Volume Purged: 108 gal	**Decommissioning Profile Attached?**	**Yes** ☐ **No** ☒
Drawdown: 3.57 ft	**Static Water Level:** 262.6	**Date:** 03/06/23

COMMENTS/REMARKS

All depths listed as below ground surface unless otherwise stated.
bgs= below ground surface, ags= above ground surface

Title: Staff Geologist

Ellen Whitney — Reported By (Print) — Signature — 4/18/2023 — Date

Title: RTR

John L. Smoot — Reviewed By (Print) — John L Smoot — Signature — 5/3/2023 — Date

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OR Doc Type:	WMU Code(s):

A-6003-658 (REV 2)

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BOREHOLE LOG

Page 1 of 24

Date: 12/7/22

Well ID: C9[illegible]05 | Well Name: 299-W19-127 | Location: ~500m W of U-Plant

Project: Installation of Two Monitoring wells in the 200 East | Reference Measure Point: BGS

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
0'			0'-5' bgs Silt. M 100% Silt, med Plasticity, no graded contact, no clumps, Slightly moist, Strong HCl rxn. 2.5 Y 4/4 (olive brown)	Sonic Drilling, 10" OD casing (OD/ID: 10.5"/9.75") CB: 8.0625"/6.875" OD/ID
5'	GS 12/7/22		5'-15' bgs ~~Gravelly~~ ~~Silt~~ (LE) 2/17 Gravelly Sand ~~Sandy Silt~~ gS 80% Sand, 20% Gravel, Sand: vf-fine (coarse) grained, fine dom, med sorted, prismoidal, subangular, 60% M / 40% F. Basalt dom w/ quartz, Slightly moist, Strong HCl rxn 2.5 Y 4/4 (olive brown). Gravel: 2-90mm, 20mm dom, poorly sorted, subangular, subdisc, 60% M / 40% F mainly basalt w/ quartzite. M: >90% basalt, F: >90% quartzite	Grab Sample @ 5' bgs 12/7/22 basalt (100%) and quartz (100%) dominant with trace mica
10'	GS 12/7/22			Grab Sample @ 10' bgs 12/7/22
15'	GS 12/7/22		@15' bgs 75% Sand 25% Gravel Sand: vf to medium grained Sand, fine dom, poorly sorted, subdisc, subangular, 80% M / 20% F, Basalt dom w 5% q + 15% feldspars. Gravel: 2-128mm, 15mm dom. All else Same as above.	Grab Sample @ 15' bgs 12/7/22 Added 3.0 gal of water.

Reported By: CB Ellis-Herring (Print Name) | Staff Geologist II (Title) | (Signature) | 12/7/22 (Date)

Reviewed By: TOLLEF WINSLOW (Affiliate) Digitally signed by TOLLEF WINSLOW (Affiliate) Date: 2023.08.22 14:33:09 -07'00' (Print Name / Title / Signature / Date)

For Office Use Only

OR Doc Type: | WMU Code(s):

A-6003-642 (REV 1)

BOREHOLE LOG (Cont.) Page 2 of 24

C9605 Date: 12/8/22

Well ID: ~~C9605~~ Well Name: 299-W19-127 Location: ~500 m NW of U-plant

CE 01.16.23

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			~~(15-20' bgs 12/6/22 Sandy~~ ~~20' bgs = 15~~ Silt (ML)	Sonic drilling, 10" casing, 8 5/8" CB
			80% Silt 20% Sand Silt: med plasticity, no graded, some clumps, NO HCl rxn, slightly moist, 2.5Y 4/3 (olive brown).	Added 30 gal of water
20'	GS 12/8/22		Sand: Vf grained sand, poorly sorted, prismoidal, angular, 80% F 20% M feldspar dom w/ basalt.	Grab Sample @ 20.0' bgs Casing @ 15.5' bgs
			(20-45' bgs)	
			@25' bgs ~~30"~~ Sandy Gravel SG 60% Sand, 40% Gravel	
25'	GS 12/8/22		Sand: f to coarse grained Sand, med dom, poorly sorted, prismoidal, subangular, 50% M 50% F felsic grains feldspar dom w/ quartz. Gravel: 5mm-60mm 30mm dom, poorly sorted, subround, spherical, 70% M 30% F Basat w/ quartzite. Slightly moist. Strong HCl rxn 2.5Y 4/1 (dark gray). M: 100% basalt, f: 100% quartzite	Grab Sample @ 25' bgs 12/8/22
30'	GS 12/8/22		@30' bgs. 60% Sand 40% Gravel Sand: Vf to med grained Sand, poorly sorted, subdisc, subangular, 60% M 40% F Basalt dom w/ quartz + fspar, dry, Strong HCl rxn. 2.5Y 4/2 (dark grayish brown) Gravel: 2-60mm 20mm dom, poorly sorted, subangular, subdisc, 80% M, 20% F, Basalt dom w/ quartzite.	Grab Sample @ 30' bgs 12/8/22
35'	GS 12/8/22		@35' bgs 50% Sand 50% Gravel Gravel: 5-60mm, 5mm dom, subround, all else same as above	Grab Sample @ 35.0' bgs Added 30 gal of water 12/8/22

Reported By: CB Ellis-Herring Print Name | Staff Geologist II Title | Signature | 12/8/22 Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

Page 3 of 24

Date: 12/8/22

Well ID: C9605 | Well Name: 299-W19-127 | Location: ~500m W of U-Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			40'bgs - 50'bgs Sandy Gravel sG 50% Sand 50% Gravel Sand: vf to medium grained sand, poorly sorted, subangular/subrounded, 60% M 40% F, Basalt dom w/ plant + fspar, wet, strong HCl rxn, ~~Gravel~~: 2.5Y 2.5/1 (black). Gravel: 2-40mm, 8mm dom, poorly sorted, subround, subprism, 60% F, 40% M, fspar dom w/ quartzite + basalt, TMP 06/01/23	Sonic Drilling Driller added 510 gal water Grab Sample @ 40.0 bgs 12/8/22 Casing @ ~25.5' bgs (Temp. casing 10" core barrel 8 5/16")
40'	GS 12/8/22			
			Sand: basalt 100% and quartz 70% dominant with some feldspar and mica. Gravel: Basalt 100% and quartzite 95% dominant with some granitoid. TMP	Grab Sample @ 45' bgs
45'	GS 12/8/22		@ 45' bgs 60% Sand 40% Gravel Sand: Vf-medium grained sand, poorly sorted, subangular, subprism, all else same as above. Gravel: 2-60mm, 15mm dom, spherical, all else same as above.	Added 2 gal water 12/8/22
			45'-55' bgs LE 01/16/23	
50'	GS 12/8/22		50'bgs - ~~55'bgs~~ Sand S 95% Sand 5% Gravel Sand: fine-coarse grained sand, well sorted, prismoidal, subangular, 50/50 M/F, mainly quartz w/ some fspar + basalt, dry, NR HCl rxn, 2.5Y 5/3 (light olive brown) Gravel 15-20mm. Ndom shape. few ~~gravels~~. 30mm dominant, snb-angular, poorly sorted 95% lithics, 100% M, basalt 100% dominant TMP 06/01/23	Grab Sample @ 50' bgs
55'	GS 12/8/22		@ 55' bgs All same as above.	Grab Sample @ 55' bgs

Reported By:

CB. Ellis-Herring — Print Name | Staff Geologist II — Title | Signature | 12/8/22 — Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.) Page 4 of 24 | Date: 12/8/22

Well ID: C9605 | Well Name: 299-W19-127 | Location: ~500m W of U-Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			SSL-60' bgs CE 12/8 Sandy Gravelly QC 4/12/23	
			60' bgs - ~~Sand Gravelly Sandy~~ Gravel	Sonic drilling
			70% Sand 30% Gravel	Casing @ ~45' bgs
			Sand: f-Coarse grained Sand, med dom, mod sorted, subpris, Subangular, 60%M 40%F Basal dom w/ quartz	Casing: 10.5" OD, CB: 8" OD
60'	GS 12/8/22		strong HCl rxn, wet. 2.5Y ~~5/3~~ 2.5 ~~Hue~~ 2.5/1 (Black) Gravel: 2-120mm,	Grab Sample @ 60' bgs 12/8/22
			20mm dom, poorly sorted, sub round discoidal, 80% Basalt w/ some quartzite + fspar (10/10)	
			QC 4/12/23	
			~~60' - 100' bgs~~ ~~SP 02/22/23~~	Grab Sample @ 65' bgs
			@ 65' bgs - 75' bgs ~~Sand~~ Gravelly Sand GS	Added 5 gal water
			90% Sand 10% gravel.	
65'	GS 12/8/22		Sand: f-Coarse grained Sand, well sorted, subpris, Subangular, 70%F 30%M. Fspar dom w/ quartz + basalt, dry, Strong HCl rxn. 2.5Y 5/3 (light olive brown).	
			Gravel: 2-40mm, Avg 15mm, poorly sorted, sub round, sub ang, Fspar dom w/ quartz + Basalt. 50% QF 50% Basalt.	
			@ 70' bgs. All is same as above.	Grab Sample @ 70' bgs 12/8/22
70'	GS 12/8/22			
			70 - 100' bgs	
			@ 75' bgs Sand, 90% Sand 10% Silt	
			Sand: vf grained sand, well sorted, discoidal, angular, 95%F 5%M mainly quartz w/ some micas (muscovite)	
			Silt: low plasticity, many small clumps,	
75'	GS CE 12/12/22 12/12/22	12/12/22	strong HCl rxn, 2.5Y 6/3 (light yellowish brown)	Grab Sample @ 75' bgs 12/12/22

Reported By: CB Ellsperring / Dan Chamberlain Staff Geologist II 12/12/22

Print Name / Title / Signature / Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

Page 5 of 24

Date: 12/12/22

Well ID: C9605 | Well Name: 299-W19-127 | Location: ~500m W of U-Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
80'	GS 12/12/22		80' bgs – ~~45~~ 100' bgs Sand S 100% Sand. vf to fine grained sand, fine dom, mod sorted, Subcris subangular, 80% F, 20% M, 50% quartz, 35% ofspar, 15% micas, w/ basalt. Mild HCl rxn, dry, 2.5Y 6/3 (light yellowish brown) Few clumps but no noteable information for silt content.	Sonic Drilling Casing @ 75.5' bgs. Grab Sample @ 80' bgs 12/12/22 (temp. casing: 10 1/2" core barrel: 8 1/16")
85'	GS 12/12/22		@ 85' bgs Sand. Strong HCl rxn, All else same as above.	Grab Sample @ 85' bgs 12/12/22
90'	GS 12/12/22		@ 90' bgs All is same as above (80'-85' bgs)	Grab Sample @ 90' bgs. 12/12/22
95'	GS 12/12/22		@ 95' bgs All is Same as above.	Grab Sample @ 95' bgs. 12/12/22

Reported By:

C.B. Ellis Herring — Print Name

Geologist — Title

Signature

12/12/22 — Date

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BOREHOLE LOG (Cont.)

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Date: 12/12/22

Well ID: C9605 | Well Name: 299-W19-127 | Location: ~500m W of U-Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			DC 4/17/23	
			100'bgs - 95-100' Sand. S	Sonic drilling.
			100% Sand. vf to fine grained sand.	Grab Sample @ 100'
			fine dom, poorly sorted, subpris,	bgs. 12/12/22
			subangular, 65% of, 35% M.	Casing @ ~90' bgs
100'	GS 12/12/22		50/50 Q/F + micas. Dry, strong	Temp. Casing: 10.5"
			HCl rxn, 2.5Y 6/2 (light brownish	core barrel: 8 1/16"
			grey).	
			100' - 150' bgs S	
			105' bgs - 115' bgs Silt. M	
105'	GS 12/12/22		100% silt. med plasticity, many	Grab Sample @
			clumps, strong HCl rxn, slightly	105' bgs. 12/13/22
			moist. 2.5Y 5/4 (olive brown).	
			@110' bgs Silt; same as above.	Grab Sample @ 110' bgs
110'	GS 12/12/22			12/13/22
			@115 Silt. Same as above	Grab Sample @ 115' bgs
115'	GS 12/12/22		+ Trace fine sand less than 5%	12/13/22
			quartz + Basalt grains. subpris, subangular	
			poorly sorted.	

Reported By:

C. Ellis-Herring — Print Name

Geologist — Title

Signature

01/16/23 — Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 12/13/22

Well ID: C9605 | Well Name: 299-W19-127 | Location: ~500m W of U-Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			120' bgs - Silt. M 100% Silt, med plasticity, many clumps, slight HCl rxn, slightly moist, 2.5 Y 5/4 (Olive brown).	Grab Sample @ 120' bgs. Sonic drilling Casing @ ~128' bgs 12/13/22 temp casing: 10 1/2" OD core barrel: 8 5/16" OD
120'	GS 12/13/22			
			@ 125' bgs. Silt. mild HCl rxn All else Same as above.	Grab Sample @ 125' bgs 12/13/22 10 1/2" casing final depth: 130.0' bgs. New casing: 9.25/8.82" OD/ID
125'	GS 12/13/22			
			@ 130' bgs. Silt. Strong HCl rxn All else Same as above.	Grab Sample @ 130' 01/09/23.
130'	GS 01/09/23			
	I-01 SS 132.0-134.5			*Drillers added water. I-01 @ 132.0-134.5' bgs 1045; 100% recovery. HEIS # B47TV0 B47RX8; B47RX9
			@ 135' bgs. Silt. wet. Very strong HCl rxn. 2.5YR 4/4 (Olive brown). med plasticity, many clumps.	I-02 HEIS; B47TV1 B47RY0; B47RY1 134.5 - 137.0' bgs
135'	GS 01/09/22			
	I-02 SS 134.5-137.0			

Reported By:

CB. Ellis-Herring — Print Name | Geologist — Title | Signature | 01/16/23 — Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 01/09/23

Well ID: C9605 | Well Name: 299-W19-127 | Location: ~500 m W of U-Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
	I-03 + I-04 SS 137.0'-139.5'		@ 140' bgs ML Silt (ML)	Sonic Drilling
			Silt 100%, high plasticity, many clumps, strong HCl rxn, 2.5 YR 4/4 (olive brown). ~~wet~~ moist	Casing @ 137.0' bgs
			CE 01/09/23	I-03 @ 137.0-139.5' bgs
140'	GS 1/09/23			1045, 100% recovery
				HEIS # B47TV2, B47TB6, B47TB7
				I-04, B47TV3,
				B47TB8, B47TB9
				Grab Sample @ 140' bgs
				*Drillers Added
				water @ ~ 141' bgs
	I-05 SS 142.0'-144.5'			I-05 @ 142.0-144.5' bgs
				100% recovery @ 1330
			CE 01/09/23	HEIS # B47TV4, B47TT4, B47TT5
145'	GS 01/09/23		@ 145' bgs. ~~moist~~ Same as above.	Grab Sample @ 145' 01/09/23
				Grab Sample @ 150' 01/09/23
150'	GS 01/09/23		@ 150' bgs. Caliche, very strong HCl rxn. All else same as above.	
				*Driller added water
			150-	Grab Sample @ 155' 01/09/23
155'	GS 01/09/23		@ 155' bgs Sandy Gravel (GS)	
			Gravel 80% Sand 20%	
			Gravel: (2-100 mm) 15mm dom, poorly sorted, subangular/subround, subdisc, 80% M 20% E	
			Basalt dom 100% w/ f spars, Basalt + Quartzite.	
			Un-Lithified Sand, 60% M (basalt) 40% fspar angular, Basalt dom. no HCl rxn. wet	

Reported By: CB. Elke Herring / Dan Chamberlain ~~Abbey~~ CE 01/16/23 Geologist 01/16/23

Print Name | Title | Signature | Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 01/09/23

Well ID: C4605 | Well Name: 299-W19-127 | Location: ~500m W of U-Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			~~155'bgs - 170'bgs~~ DC 4/17/23 ~~Slightly~~ Silty Sandy Gravel (GM) @160'bgs	Casing @ 160'bgs
			60% Gravel, 20% Sand, 20% Silt	Sonic drilling
			Gravel: 2-80 mm, 20mm dom, poorly sorted, rounded, spherical, 60% M 40% F. Basalt dom w/ quartzite.	*Driller added water
160'	GS 01/09/23		Sand: f to medium grained, poorly sorted, prismoidal, subangular, 60% M 40% F. wet, NoHCl rxn, 2.5Y 3/1 (very dark grey).	Grab Sample @ 160' bgs 01/09/23 w/ medium the dominant sand size.
				*drillers added water
			DC 4/17/23 160 – 170 bgs	
165'	GS 01/09/23		@165'bgs - Silty Gravel mG 40% Gravel, 40% Silt, 20% Sand.	Grab Sample @ 165'
			Gravel: 2-110mm (40mm dom), poorly sorted, rounded, spherical, 85% M, 15% F Basalt dom w/ quartzite.	
			Silt: med plasticity, many clumps, no HCl rxn.	
			Sand: vf to fine grained Sand, poorly sorted, subangular, subspris, 70% M 30% F Basalt dom w/ quartz + fspars.	fine dominant sand size.
170'	GS 01/09/23		CE 01/09/23 wet, 2.5Y 3/1 (very dark gray).	
			@170: Silty Gravel (SAA)	Grab Sample @ 170' "same as above"
			CE 01/09/23 170-180' bgs Gravel (G) @170'bgs Gravel - 100%	@ 175' bgs
			Gravel: 2-70mm (25mm dom), mod sorted, subdisc, subround, 80% M, 20% F. Basalt dom w/ quartzite.	CE 01/09/23
			~~170'bgs - 180'bgs Gravel~~ @175'bgs	
175'	GS 01/09/23			Grab Sample @ 175'

Reported By:

C.B. Ellis Herring / Dan Chan DC 4/17/23 Geologist — 01/16/23

Print Name / Chan Comments — Title — Signature — Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 01/11/23

Well ID: C9W005 | Well Name: 299-W19-127 | Location: ~500m W of V-Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
180'	GS 01/11/23		@ 180' bgs - Gravel G 100% Gravel: 2-105mm (35mm dom), Poorly sorted, rounded, spherical, 50% M 50% F, Basalt dom w/quartzite. 2.5 Y 3/1 (very dark gray). No HCl reaction, moist to dry.	Casing @ ~178' bgs Sonic Drilling Grab Sample @ 180' 01/11/23
			180' bgs - ~~230' bgs~~ nc 4/17/23 nc 4/17/23	
185'	GS 01/11/23		@ 185' bgs - ~~Sandy~~ Gravel SG 80% Gravel, 20% Sand Gravel: 2-80mm (30 mm dom); poorly sorted, rounded, spherical, 50/50 M/F, Basalt + quartzite. 2.5 Y 3/1 (very dark gray). Sand: vf to medium grained Sand (fine dom), poorly sorted, subangular, prismodal, 60% M, 40% F. Basalt dom grains w/quartz.	Grab Sample @ 185' 01/11/23
190' ~~195~~	GS 01/11/23		185-230' bgs @ 190' bgs Sandy Gravel SG 60% Sand, 40% Gravel ~~Sand~~ CE 01/11/23 All same as above CE 01/16/23	Grab Sample @ 190' 01/11/23
CE 01/11/23 195' 200'	GS 01/11/23		Sandy Gravel SG ~~GP 02/22/23~~ @ 195' ~~Sandy Gravel Gravelly Sand G~~ 70% Sand, 30% Gravel. CE 01/11/23 Sand: vf to medium grained Sand, ~~well~~ mod sorted, subangular, prismodal, 50/50 M/F. Quartz, Feldspars, micas, Basalt. Felsic dom, dry, 2.5 Y 6/3 (Lt yellow brown) Gravel: 2-125mm (45mm dom) Cont on next page.	Grab Sample @ 195' 01/11/23 fine dominant

Reported By:

C.B. Ellsworth / Dan Charbonneau Geologist 01/16/23

Print Name | Title | Signature | Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

Page 11 of 24

Date: 01/11/23

Well ID: C9605 | Well Name: 299-W19-127 | Location: ~500m N of WIT Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			@195' (cont) poorly sorted, rounded, subdisc, 80% M 20% F Basalt dom w/ quartzite. No HCL reaction	Casing @ 190' bgs Sonic drilling
200'	GS 01/11/23		@200' bgs -230' Sandy Gravel SG (100% Sand 40% Gravel Sand: VF to fine medium grained Sand, well sorted, Subangular, Subpris, 50/50 M/F, 70% quartz 30% Fspar. Basalt dom w/ micas. Gravel: 2-150mm (30mm dom) poorly sorted, subrnd, subpris, 50/50 M/F Basalt dom. Dry 2.5Y 5/4 (Lt olive brown). No HCL reaction.	Grab Sample @ 200' 01/11/23 with fine grain dominant
205'	GS 01/11/23		@205' bgs. Same As Above Gravel: 2-110mm	Grab Sample @ 205' 01/11/23
210'	GS 01/11/23		@210' bgs Same As Above Gravel: 2-150mm	Grab Sample @ 210' 01/11/23
215'	GS 01/11/23		@215' bgs Same As Above Quartzite dom gravels. 2-60mm (20mm dom) 70% F 30% M.	Grab Sample @ 215' 01/11/23

Reported By: CB. Ellsberry / Dan Chamberlain — Geologist — 01/16/23

Print Name — Title — Signature — Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 01/11/23

Well ID: C9605 | Well Name: 299-W19-127 | Location: ~500m W of U-Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
220	GS 01/11/23		@ 220' - 230' Sandy Gravel, SG 60% Sand 40% Gravel Sand: vf to fine grained sand, well sorted, subangular, subpris, 50/50 M/F, 70% quartz, 30% Fspar. Basalt dom w/micas. Gravel: 2-75mm (30mm dom), poorly sorted, subround, subpris, 50/50 M/F Basalt dom DRy 2.5Y 5/4 (Lt olive brwn)	Casing @ ~215' Sonic drilling Grab Sample @220' 01/11/23
225	GS 01/11/23		@225' bgs. Same as above	Grab Sample @225' 01/11/23
				9.25" OD temp. casing final depth: 226.7' bgs New temp. casing: OD/ID: 8.20/7.68"
230			@230' bgs Same AS above.	Grab Sample @230' 01/11/23
236			Gravelly Sand gS DC 1/17/23 230' bgs ~~- 250' Silty Sand (md)~~ @235 bgs - Sand 80% Silt 10% Gravel 10% Sand: vf to fine grained Sand, mod sorted, subpris, angular, 80% F 20% M (Quartz dom) Silt: low plasticity, few clumps, no HCl rxn, Slightly moist 2.5Y 4/2 (drk grayish brwn) Gravel: 2-70mm (30mm dom) rounded, Spherical/subdisc 100% F 40% M Quartzite dom	Grab Sample @235' 01/17/23 fine dominant

Reported By:

M. Ellis-Herring / Dan Charboneau Geologist 01/17/23

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BOREHOLE LOG (Cont.)

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Date: 01/17/23

Well ID: C4605 | Well Name: 299-W19-127 | Location: 450m W of U-Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			235-250' Slightly Silty Gravelly Sand (m)gs	
			~~230' bgs~~ DC 4/21/23 ~~Silty Sand @ 240'~~	Casing @ 240' bgs
			70% Sand, 15% Silt, 15% Gravel	Sonic Drilling
			Sand: vf to fine grained sand, poorly	
			sorted, Subpris/Subangular, 60% to 40% F	
240	1' GS 01/17/23		Basalt dom w/ quartz + Fspar. Slightly	
			moist. 2.5 Y 4/2 (dark grayish brown)	
			Silt: low plasticity, few clumps, No	
			HCl rxn. Gravel: 2-85mm (20mm dom),	* Drillers added
			poorly sorted, rounded, subdisc, 80% F	water.
			20% M. Quartzite dom w/ Basalt.	
			~~250~~ 240 Slightly Silty Gravelly Sand (m)gs	
			DC 4/21/23	
			CE 01/17/23	* Grab Sample
			@ 245' bgs ~~240' bgs~~ 2-110mm (40mm	@ 245' bgs
			dom) All else Same as above.	01/17/23
245	1' GS 01/17/23			
				* Drillers added
		Sample		water.
		missed	@ 250 Sample missed	
				@ 250' bgs Drillers
				Skipped grab
				Sample.
		CE 01/17/23		
250	1' GS 01/17/23			
			250-255' bgs Silt M	Grab Sample
			Saturated Silt w/ Gravel. 20-40mm	@ 255' bgs
			material ~~Sample~~ 1/17/23 too Saturated	
			for more detailed description	
			1 "Soup".	
255				

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BOREHOLE LOG (Cont.)

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Date: 01/17/23

Well ID: C4605 | Well Name: 299-W19-127 | Location: ~500 m W of Uplant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
260	16S 01/17/23		255' bgs - 265' Sand 5 @260' bgs - 90% Sand 10% Gravel Sand: Vf to fine grained Sand, poorly sorted, Subangular, Subprismoidal (60%F, 40%M (Quartz dom) w/ fspar, basalt & micas. Dry. NG HCl rxn, 2.5Y 6/2 (Lt. Brownish gray). Gravel: 2-70mm (30mm dom) poorly sorted, subangular, subpris, 50/50 M/F. Quartz, fspar, quartz, basalt. (Quartzite dom).	Casing @ ~256' ~256' bgs DC 2/20/23 fine dominant Grab Sample @260' bgs 01/17/23 Sonic drilling, 8" casing to 328.0' bgs Depth to water 262.1' bgs (01/26/23) Grab Sample @265' bgs 01/17/23
265	16S 01/17/23		@265' bgs Same as above DC 1/23/23	
270	WS 1-06 1/19/23 G.S. 1/19/23		260 265 - 270' Sandy Gravel SG 70% gravel, 20% sand, 10% silt. Gravel: 6 - 70mm, 35mm dominant, mod sorted, round to sub-round, discoidal to sub-discoidal, 70%F/30%M, quartzite (65%) and basalt (60%) dominant w/ misc. metamorphic rx & granitoids. Sand: med - v. fine, fine dominant, well sorted, 50%M/50%F, quartz (70%) and basalt (100%) dominant w/ feldspars, little mica. Silt: nonplastic, moist, weak HCl rxn, 2.5Y 5/2 grayish brown (moist)	Grab sample @ 270' bgs @270.0' bgs 1/19/23 1-06 WS HELSF B47RY2, B47RY3, B47RY4, B47RY5
275	G.S. 1/19/23 02/21/23		02/21/23 DC 2/21/23 270 - 275' Silty Sandy Gravel MG 70% gravel, 10% Sand, 20% Silt Gravel: 10mm - 40mm: 10mm dominant medium sorted, round to subround, discoidal 80%f/20%m quartzite (65%) and basalt (50%) dominate with a mix of misc. metamorphic rock and granitoids. Sand, med - v. fine, fine dominant, well sorted, 50f/50m: quartz (100) and basalt (100) dominate, silt. nonplastic, moist, weak HCl	discoidal JSP 02/21/23 275' bgs Grab sample @ 275' bgs Low plasticity JSP 1/23/23

Reported By: Ellis Herring | Dan Charbonneau | Geologist / Geologist | 01/17/23 02/21/23

Print Name: Kelsey Peterson | Title | Signature | Date

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BOREHOLE LOG (Cont.)

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Date: 01/24/23

Well ID: C9605 | Well Name: 299-W19-127 | Location: W 500 m W of W plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			2.5Y 5/1 grayish brown Sand v. fine dominant, round and spherical. KP 01/24/23 KP 1/27/23	Sonic drilling, 8" casing to 326.a' bgs.
			275 - 280 Silty, Sandy Gravel mG	
			Sandy, Gravel SG	
			70% Gravel, 20% Sand, 10% Silt	
280	G.S. 1/23/23 W.f.		Gravel: 10 mm - 80 mm. 30 mm dominant	Grab sample @ 280' bgs
	I-07 280.3' 1/23/23		Medium sorted round to sub round, discordial, 60F/40M, quartzite (70%) and (100) basalt dominate with a mix of granitoids.	I-07 water sample @ 280.3' bgs, HEIS #s: B47RY7, B47RY8, B47RY9, B47T00.
			Sand v. fine, well sorted, 60m/40f - Quartz and (90) basalt dominant,	
			Silt, non plastic, moist, weak HCL, 2.5Y 3/1 grayish brown very dark gray KP 01/24/23 KP 01/17/23	
285	G.S. 1/23/23		280 - 285 290' Gravel G	Grab sample @ 280 bgs
			85% Gravel, 5% sand, 10% Silt	
			Gravel: 10 mm - 80 mm. 30 mm dominant	
			Medium sorted, round to subround, discordial, 50F/50m, quartzite (95%)	
			and (100) Basalt (100%) dominate with some granitoids.	
			Sand v. fine well sorted, 70f/30m quartz (60)	
			and basalt (40) dominant	
			Silt low plasticity, moist, no HCL	
290	G.S. 1/23/23		2.5Y 3/1 grayish brown very dark gray KP 01/24/23 KP 1/23/23	
	WS1-08 1/24/23		285 - 290 Sandy Gravel G	Grab sample @ 290 bgs
	KP 04/17/23		80% Gravel 10% sand, 10% silt	WS1-08 water sample @ 290.0' bgs. HEIS #
			Gravel: 10 mm - 70 mm; 30 mm dominant	B47T02, B47T03,
			Medium Sorted, round to subround, discordial, 60f/40m, quartzite (60%). and Basalt (100%)	B47T04, B47T05
			dominant with some granitoids.	
			Sand fine well sorted, 60f/40m quartz (60) and basalt (40) dominant.	
	6.S @ 295' 01/25/23		Silt no plasticity, non saturated, no HCL (wet)	
295	KP 02/21/23		2.5Y/3/1 grayish brown KP 01/24/23 very dark gray	Grab sample @ 295' bgs
			290'-295' bgs Gravelly Sandy Silt gsM	
			70% Silt, 20% Sand, 10% Gravel	
			Gravel: 10 - 40 mm, 15 mm dominant,	

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Kelsey Peta	Geologist		01/25/23
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BOREHOLE LOG

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Date: 01/25/23

Well ID: C9605 | Well Name: 299-W19-127 | Location: ~ 500 m of U-plant
Project: Installation of Two Monitoring Wells in the 200-UP-1 | Reference Measure Point: BGS

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			medium sorted, round to sub-round, discoidal to sub-discoidal, 30% M/70% F, basalt (100%) and quartzite (100%) dominant	Sonic drilling 8" casing to 328.0' bgs.
	G.S. 01/25/23		Sand. Fine well-sorted, 50% M/50% F basalt (100%) and quartz (50%) dominant	
300'			with some feldspar and mica.	Grab sample @ ~~295' bgs~~ TAP 02/21/23
	W.S. 01/30/23		Silt: medium plasticity, moist, weak HCL reaction, 2.5Y 5/1 gray. TAP 04/17/23	Grab sample collected at 300' bgs and W.S. at 300' on 01/30/23
			~~295' - 300' bgs~~ 320' bgs Silty Gravel mG	I-009 B47T07, B47T08
			50% gravel, 40% silt, 10% sand	B47T09, B47T10
			Gravel: 5 - 10mm, 20mm dominant	
			moderately sorted, sub-round to sub-angular	
	G.S. @ 305' 01/30/23		discoidal to sub-discoidal, 50% M/50% F, basalt (100%) and quartzite (90%) dominant	
305'			with a mix of metamorphic rocks.	
			Sand. Fine moderately sorted, 70% M/30% F	
			basalt (100%) and quartz (60%) dominant with	
			some feldspar.	
			Silt. Low plasticity, moist, Strong HCL reaction,	
			2.5Y 3/1 very dark gray.	
			300' - 305' Silty gravel mG	
	G.S. @ 310' 01/30/23		50% gravel, 30% silt, 20% sand	Grab sample collected at 305' on 01/30/23
310'			Gravel, 10-80 mm, 30 mm dominant, moderately sorted, round to sub-round, discoidal to sub-discoidal, 90% M/60% F, basalt (90%) and quartzite (90%) dominant with a mix of metamorphic rocks. Sand fine to coarse, moderately sorted, Dominant grain size fine, sub-round, sub-discoidal 90% M/60% F, basalt (100%) and quartz (60%) dominant with some feldspar,	
			Silt: No plasticity, moist, moderately sorted, moderate HCL reaction, 2.5Y 5/1 gray.	
			305' - 310' Silty gravel mG	

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BOREHOLE LOG

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Date: 01/30/23

Well ID: C9605 | Well Name: 299-W19-127 | Location: W 500m of U-plant

Project: Installation of two monitoring wells in the 200-UP-1 | Reference Measure Point: 063

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
315'	G.S. 01/30/23		305'-310' Silty gravel mG 50% gravel, 30% silt, 20% sand Gravel, 10-80mm, 30mm dominant, moderately sorted, round to ~~sub-round~~ angular, discoidal to sub-discoidal, 40% M/60% F, basalt (90%) and quartzite (90%) dominant with a mix of metamorphic rocks. Sand fine to coarse, moderately sorted, fine dominant. 40% M/60% F basalt (100%) and quartz (60%) dominant with some feldspar. Silt, Low plasticity, low HCL reaction 2.5Y 5/1 gray. Sand: ~~A~~ rounded sub-discoidal.	Grab sample collected at 310' 01/30/23 Sonic drilling 8" casing to 328.0' bgs. Grab sample collected at 315' 01/30/23
320'	G.S. 01/30/23 W.S. 01/31/23		310'-315' Same as above 315'-320' Silty Gravel mG 70% Gravel, 20% Silt, 10% Sand Gravel: 5mm-60mm, 20mm dominant, moderately sorted, sub-round to angular, sub-discoidal, 60% M/40% F, basalt (100%) and Quartzite (90%) dominant with some metamorphic rocks. Sand. Fine moderately sorted, M 40%/60% F, basalt (100%) and quartz (50%) dominant with some mica and feldspar. Silt low plasticity moist, moderate HCL reaction, 2.5Y 3/2 very dark grayish brown.	Grab sample collected at 320' on 01/30/23 Water sample at ~~327.7~~ 320.5' bgs on 01/31/23 for 04/13/23 I-010 B47T12, B47T13, B47T14, B47T15.
325'	G.S. 01/31/23		320'-325' Silty Sandy Gravel mG Gravel 40%, Sand 40%, Silt 20% Gravel: 5mm-80mm, 20mm dominant, moderately sorted, sub-round to sub-angular, sub-discoidal, 60% M/40% F with basalt (100%) and Quartzite (90%) dominant with some mica. Silt. No plasticity, moist moderate HCL, 2.5Y 3/1 very dark gray.	Grab sample at 330' collected on 01/31/23 8.2" OD temp casing final depth: 328.0 bgs
330'	G.S. 01/31/23			

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BOREHOLE LOG

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Date: 01/30/23

Well ID: C4605 | Well Name: 299-W19-127 | Location: ~500 m W of U-plant
Project: Installation of two monitoring wells in the 200-UP-1 | Reference Measure Point: TOS

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			325'-330' Silty Gravel mG	Down sized from 8"
			60% Gravel, 40% Silt, 10% Sand	to 6" casing at
			Gravel: 5mm-160mm: 20mm dominant,	328.0' bgs. (602/5.52")
			moderately sorted, round to sub-round, sub-	
	G.S. 02/06/23		discoidal, 20% M/80% F, basalt (100%) and	Grab sample @
335'			Quartzite (95%) dominant with some granitoids.	335' on 02/06/23
			Sand: Fine to medium, moderately sorted,	
			60% M/40% F basalt (100%) and Quartz	
			(85%) dominant with some mica. Dominant	
			size sand fine, rounded, sub-discoidal.	
			Silt: Low plasticity, moist, low HCL, 2.5Y	
			4/1 dark gray.	
			330'-335' Silty Sandy Gravel msG	
	G.S. 02/07/23		60% Gravel, 20% Sand, 20% Silt	Grab sample at
340'			Gravel: 5mm-90mm, 20mm dominant,	340' on 02/07/23
	V.S. 02/07/23		moderately sorted, round to sub-round,	Water sample at
			sub-discoidal, 30% M/70% F, basalt (100%)	340' on 02/07/23
			and Quartzite (100%) dominant. Sand: fine	I-011, B47T17,
			to medium, moderately sorted, 50% M/50% F,	B47T18, B47T19
			basalt (100%) and Quartz (95%) dominant with	
			some mica. fine dominant size, sub-rounded, sub-	
			discoidal. Silt: Low plasticity, moist, low HCL, 2.5Y 5/2,	
			grayish brown.	
	G.S. 02/07/23		335-340' Silty, Sandy Gravel msG	Grab sample at
345'			40% Gravel, 30% Sand, 30% Silt, Gravel: 5mm-80mm,	345' on 02/07/23
			30mm dominant, moderately sorted, sub-round to sub-	
			angular, sub-discoidal, 60% M/40% F, Quartzite (90%)	
			and basalt (90%) dominant with some metamorphic	
			and meta conglomerate rocks mixed in. Sand:	
			fine to medium, moderately sorted, 60% F/	
			40% M basalt (100%) and Quartz (60%)	
			dominant mth some mica. Fine dominant, sub-rounded,	
			sub-discoidal. Silt: Low plasticity, moist, low	
			HCL reaction, 2.5Y 4/1, dark gray.	

Reported By:

Print Name	Title	Signature	Date
Kelsey Peta	Geologist		04/13/23

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Print Name	Title	Signature	Date
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BOREHOLE LOG

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Date: 02/01/23

Well ID: C4605 | Well Name: 299-W19-127 | Location: 500m W of U-plant

Project: Installation of two monitoring wells in the 200-UP-1 | Reference Measure Point: B65

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
350'	G.S. at 02/07/23		340'-365' Gravelly, Sandy, Silt gsM 60% Silt, 20% Gravel, 20% Sand Gravel: 5mm - 80mm: 30mm dominant moderately sorted, round to sub-angular sub-discoidal, 40% M/60% F, basalt (100%) and Quartzite (80%) dominant with some granitoids, metaconglomerates, Gneiss, and Olivine mixed in. Sand: fine to medium, moderately sorted, 50% M/50% F basalt (100%) and Quartz (100%) dominant, fine dominant size, rounded, sub-discoidal.	Sonic drilling 6" casing to 446.2' bgs Grab sample at 350' GP 02/21/23 on 02/07/23
355'	G.S. at 02/07/23		Silt: low plasticity, moist, low HLL, 2.5Y 3/1, very dark gray.	Grab Sample at 355' on 02/07/23
			345'-350' Same as above except Gravel, 5mm to 80mm and basalt (90%) dominant with some metaconglomerates Sand: Quartz (90%) dominant with some mica.	
360'	G.S. at 02/08/23 W.S. at 02/08/23		350'-355' Same as above.	Grab sample at 360' on 02/08/23 Water sample at 360' on 02/08/23 I-012 B47T21, B47T22, B47T23
			355'-360' Same as above except no Olivine in the gravel.	
			360'-365' Same as above except Gravel: 5mm - 80mm. No Gneiss and 50% M/50% F Sand: 50% M/50% F with Quartz (100%) dominant.	
365'	G.S. at 02/08/23		~~Top~~ 04/17/23 365' ~~370'~~ 380' Silty Gravel mG 45% Silt, 35% Gravel, 20% Sand Gravel: 5mm - 60mm. 25mm dominant moderately sorted, round to sub-angular sub-discoidal, 60% M/40% F, basalt (90%) and Quartzite (100%) dominant with a mix of metamorphic rocks.	Grab sample at 365' on 02/08/23

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Date: 02/07/23

Well ID: C9605 | Well Name: 299-W19-127 | Location: 500m W of U-plant
Project: Installation of two monitoring wells in the 200-UP-1 | Reference Measure Point: DGS

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			Sand: Fine to medium, moderately sorted, 60% M/40% F, basalt (100%) and Quartz (90%) dominant with some mica. Silt: Low to medium plasticity, moist, low HCL, 2.5Y 4/2, dark grayish brown.	Sonic drilling 6" casing to 446.2' bgs
	6.S. on 02/08/23		Sand: Dominant size fine, sub-angular, spherical.	Grab sample at 370' on 02/08/23
370'			370'-375' Silty Gravel mG	
			50% Silt, 30% Gravel, 20% Sand	
			Gravel: 5mm-75mm, 45mm dominant, moderately sorted, round to sub-angular, sub-discoidal, 50% M/50% F, basalt (90%) and Quartzite (90%) dominant with some metaconglomerate mixed in. Sand: Fine to medium, moderately sorted, 50% M/50% F, basalt (100%) and Quartz (90%) dominant with	
375'	6.S. on 02/08/23		some mica. Dominant size fine, sub-rounded, sub-discoidal.	
			Silt: Low plasticity, wet, low HCL, 2.5Y 4/1 dark gray.	Grab sample at 375' on 02/08/23
			375'-380' Silty Gravel mG	
			45% Silt, 35% Gravel, 20% Sand	
			Gravel: 5mm-70mm, 25mm dominant, moderately sorted, sub-round to sub-angular, sub-discoidal, 60% M/40% F, basalt (85%) and Quartzite (100%) dominant with some granitoids. Sand: Fine, moderately sorted, 50% M/50% F, basalt (100%) and Quartzite (50%) dominant with some mica. Silt: Low plasticity, moist, low HCL, 2.5Y 4/1 dark gray.	Grab sample at 380' on 02/09/23 Water Sample at 380' on 02/09/23 I-013 B47T25, B47T26, B47T23
380'	6.S. on 02/09/23 W.S. on 02/09/23		380'-385' Gravelly Silty Sand gmS	
			40% Sand, 40% Silt, 20% Gravel	
			Gravel: 10mm-60mm, 30mm dominant, moderately sorted, round to sub-round, sub-discoidal, 20% M/80% F, Quartzite	

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BOREHOLE LOG (Cont.)

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Date: 02/08/23

Well ID: C4605 | Well Name: 299-W19-127 | Location: ~~02SP~~ 02/21/23 500m W of H-plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting. Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
385	G.S. on 02/09/23		380'-385' Gravelly Silty Sand gmS Quartzite (90%.) with some metaconglomerates and basalt (50%.) and meta conglomerates (50%.). Sand: fine to coarse, round to angular, moderately sorted, 50% M/50% F basalt (100%.) and Quartz (70%.) dominant with some mica. Silt: Low plasticity, moist, low HCL, 2.5Y 4/2 dark grayish brown. Sand: Dominant size medium, sub-discoidal, sub-rounded.	Sonic drilling 6" casing to 946.2' bgs. Grab sample at 385' on 02/09/23
390'	G.S. on 02/09/23		385'-390' Silty, Sandy, Gravel ms6 35% Gravel, 35% Sand, 30% Silt Gravel: 5mm - 60mm. 30mm dominant, moderately sorted, round to sub-round, sub-discoidal, 15% M/85% F, basalt (100%.) and Quartzite (90%.) dominant with some metaconglomerates, Sand: fine to medium, moderately sorted 50% M/50% F, basalt (100%.) and Quartz (80%.), dominant with some mica. Dominant size fine, sub-angular, spherical. Silt: Low to medium plasticity, moist, low HCL, 2.5Y 4/2 dark grayish brown.	Grab sample at 02/09/23 at 390'
395'	G.S. on 02/09/23		390'-395' Silty Gravel mG 40% Gravel, 40% Silt, 20% Sand Gravel: 5 mm - 70 mm. 30 mm dominant, moderately sorted, round to sub-round, sub-discoidal, 50% M/50% F, basalt (95%.) and quartzite (90%.) dominant with a mix of granitoids, meta conglomerates, and misc metamorphic rocks. Sand: fine to medium, moderately sorted, 40% M/60% F, basalt (100%.) and Quartz (85%.) dominant with some mica and feldspar: fine dominant size, sub-angular, spherical. Silt: Low to medium plasticity moist, low HCL, 2.5Y 4/2, dark grayish brown.	Grab sample at 02/14/23 at 400'
400'	G.S. on 02/14/23 W.S. on 02/14/23			Water sample on 02/14/23 at 400' I-01A B47T29, B47T30, B47T31

Reported By:

Kelsey Peta — Print Name | Geologist — Title | Signature | 04/13/23 — Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 02/09/23

Well ID: C9605 | Well Name: 299-W19-127 | Location: 500m W of U-plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
405'	G.S. 02/14/23		395'-400' Gravelly, Silty, Sand gmS 45% Sand, 45% Silt, 10% Gravel Gravel, 5mm - 25mm, 10 mm dominant, well-sorted, round to sub-round, sub-discoidal to ~~spherical~~ discoidal, 30% M/70% F, Metaconglomerates (100%) and Quartzite (90%) dominant with some felsic meta conglomerates. Sand: fine to medium, round to sub-round, moderately sorted, 50% M/50% F, basalt (100%) and Quartz (90%) with some mica. Dominant size fine, sub-rounded, sub-discoidal. Silt: Low plasticity, moist low HCl, 2.5Y 4/3 Olive brown.	Sonic drilling 6" casing to 446.2' bgs Grab sample at 405' (100%) on 02/14/23
410'	G.S. 02/14/23		400.0' - 410.0' Gravelly Sandy, Silt gsM 55% Silt, 30% Sand, 15% Gravel Gravel: 5mm - 40mm, with 15 mm dominant, moderately sorted, round to sub-round, sub-discoidal to ~~spherical~~ discoidal, 40% M/60% F, basalt (70%) and Quartzite (90%) dominant with some granitoids and meta conglomerates. Sand: Fine, moderately sorted, 50% M/50% F, basalt (100%) and Quartz (80%) dominant with some feldspar. Silt: low plasticity, wet, no HCl, 2.5Y 4/2 dark grayish brown.	Grab sample at 410' on 02/14/23
415'	G.S. 02/14/23 W.S. 02/16/23		405' - 410.0' same as above.	Grab sample at 415' on 02/14/23 Water sample at 415' on 02/16/23 I-015 B47T33, B47T34 B47T35
420'	G.S. 02/14/23		410.0 - 415.0' Silty Sand mS 50% Sand, 45% Silt, 5% Gravel Gravel: 5mm - 30mm, 20 mm dominant, moderately sorted, sub-angular to angular, 90% M/10% F, (100%) metaconglomerates and meta conglomerates (100%) dominant. Sub-discoidal, Sand: fine moderately sorted, 50% M/50% F, basalt (100%) and Quartzite (80%) with some mica. Silt: Low plasticity, moist, low HCl reaction, 10Y 4/2 dark grayish brown.	Grab sample at 420' on 02/14/23

Reported By: Kelsey Oeta (Print Name) | Geologist (Title) | [signature] (Signature) | 04/13/23 (Date)

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 02/09/23

Well ID: C9605 | Well Name: 299-W19-127 | Location: 500m W of U-plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
425'	G.S. 02/16/23		415'-425' Silty Sand mS 55% Sand, 45% Silt Sand: Fine to medium, moderately sorted, 40% M/60% F, basalt (100%) and Quartzite (60%) with some mica and feldspar, sub-round. Dominant size fine, sub-rounded, sub-discoidal. Silt: medium plasticity, moist, low HCL, 2.5Y 5/3 light olive brown.	Sonic drilling 6" casing to 446.2 bgs Grab sample at 425' on 02/16/23
430'	G.S. at 02/16/23		420'-425' Same as above.	Grab sample at 430' on 02/16/23
			425'-430' Silty Sand mS 55% Sand, 40% Silt, 5% Gravel Sand: Fine to medium, moderately sorted, sub-round to round, 50% M/50% F, basalt (100%) and Quartz (60%) with some mica and feldspar. Dominant size fine, rounded to sub-discoidal. Silt: Medium plasticity, moist, low HCL 2.5Y 5/4 light olive brown. Gravel: 5mm - 40mm, 20mm dominant, moderately sorted, round to subround, sub-discoidal to spherical, 90% M/10% F with, red metamorphic rock (60%), and Quartzite (90%) dominant with a mix of basalt, meta conglomerates, and olivine.	
435'	G.S. at 02/16/23			Grab sample at 435' on 02/16/23
440'	G.S. 02/16/23		430-435' Silty Gravel mG 45% Gravel, 45% Silt, 10% Sand Gravel: 5mm - 60mm, 20 mm dominant, moderately sorted, round to sub-round, Sub-discoidal, 55% M/45% F, basalt (90%) and Quartzite (90%) dominant with a mix of red volcanic rock and Gneiss and granitoids. Dominant size fine, rounded, Sub-discoidal. Silt: Low plasticity, wet, medium to high HCL, 2.5Y, 5/2 grayish brown. Sand: Fine to medium, moderately sorted, subround	Grab sample at 440' on 02/16/23

Reported By:

Kelsey Peta — Print Name | Geologist — Title | Signature | 04/13/23 — Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 02/16/23

Well ID: C9605 | Well Name: 299-W19-127 | Location: ~500 m W of U-plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
445'		≡≡≡	70% M / 30% F, basalt (100%) and Quartz (90%) dominant with some mica.	Sonic drilling 6" casing to 446.2' bgs
			435'-440' Gravelly Silt gM Silt 65%, Gravel 20%, Sand 15% Silt: Low plasticity, moist in some parts and very dry in other parts, high HR 7.5YR 6/1 gray. Gravel: 6mm-80mm, 25mm dominant, round to angular sub-discoidal, 50% M / 50% F, basalt (80%) and Quartzite (90%) with a mix of granitoids and meta conglomerates. Sand: fine to medium, moderately sorted, sub-round, 60% M / 40% F, basalt (100%) and Quartz (90%) with some mica. Dominant size fine, roundedness sub-round, sub-discoidal.	Final Depth: 446.5' bgs
			440'-446.5' Silt M 90% Silt, 10% Sand Silt: Medium plasticity, moist, no HCl reaction, 2.5Y 5/1 gray, Sand: fine, moderately sorted, angular 30% M / 70% F, basalt (100%) and quartz (90%) with some mica.	

Reported By:

Ellen Whitney / Kelsey Peta — Print Name

Staff Geologist II / Geologist — Title

Signature

4/10/2023 / 04/13/23 — Date

A-6006-993 (REV 0)

299-W19-127 (C9605)
Log Data Report

Borehole Information

Log Date[1]	02/22/2023	Filename	C9605_HG-NM_2023-02-22	Site	200-UP-1 OU
DTW[2] (ft)	**DTW Date**	**DTW Source**	**Drill Date[3]**	**Total Depth[4] (ft)**	**Depth Datum**
264.3	01/31/2023	GRAM NW	02/16/2023	446.5	Ground Surface

New borehole drilling is commonly accomplished using a telescoping method. Geophysical logging is conducted through each casing string, often including short overlaps with previous log runs. During well completion, the temporary drill casing is removed, and the permanent casing is installed. Geophysical logging is conducted through the temporary casings so that completion materials do not affect the data. This report presents results from geophysical logging through the temporary drill casings.

Casing Information

Casing Type	Drill Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
			Outer	Inside			
Reinforced Threaded Steel	Cascade Sonic	TC[5]-NA	10.51	10.01	0.25	2.0 AGS[6]	130.0 BGS[7]
Reinforced Threaded Steel	Cascade Sonic	TC-NA	9.27	8.77	0.25	3.25 AGS	226.7 BGS
Reinforced Threaded Steel	Cascade Sonic	TC-NA	8.10	7.58	0.26	3.22 AGS	328.0 BGS
Reinforced Threaded Steel	Cascade Sonic	TC-NA	6.02	5.54	0.24	3.89 AGS	446.2 BGS

Borehole Notes

The onsite geologist provides the current borehole total depth and casing depths daily via an email report. When accessible, the logging engineers measure the casing wall thicknesses using an ultrasonic thickness gauge, the outside diameters using a circumference tape, and then calculate the inside diameters.

Those field measurements are made to compare against more detailed dimension measurements made on April 28, 2021 for the 10.51-in. casing, June 28-30, 2021 for the 8.10- and 9.27-in. casings, and December 11, 2018 for the 6.02-in. casing. For consistency between boreholes using this specific type of steel casing, the detailed measurements were used for casing corrections during data analysis and are reported in the table above.

DTW at time of logging of the third casing string was reported at 264.3 ft by the wellsite geologist, which was confirmed by the neutron moisture log data.

Logging Equipment Information

Logging System	Gamma 5Pb	Type	He-3 (CPN 503DR) (NMLS[8])
Effective Calibration Date	February 23, 2022	Serial No.	H34055445

[1] Log date, by convention, is the final date of geophysical logging.
[2] Depth to water inside casing during logging.
[3] Drill date is the date when drilling is completed prior to logging of the final casing string.
[4] Total depth is the reported depth of the borehole prior to logging of the final casing string.
[5] Temporary casing
[6] Above ground surface
[7] Below ground surface
[8] Neutron Moisture Logging System

Calibration Reference	HGLP-CC-229, Rev. 0	**Logging Procedure**	SGRP-PRO-OP-53024, Rev. 0, Change 4

Logging System	Gamma 4Mc	**Type**	He-3 (CPN 503DR) (NMLS)
Effective Calibration Date	January 24, 2022	**Serial No.**	H340207279
Calibration Reference	HGLP-CC-222, Rev. 0	**Logging Procedure**	SGRP-PRO-OP-53024, Rev. 0, Change 4

Logging System	Gamma 4Mc	**Type**	He-3 (CPN 503DR) (NMLS)
Effective Calibration Date	January 24, 2023	**Serial No.**	H340207279
Calibration Reference	HGLP-CC-241, Rev. 0	**Logging Procedure**	SGRP-PRO-OP-53024, Rev. 0, Change 4

Logging System	Gamma 1Re & 4Re	**Type**	60% Coaxial HPGe[9] (SGLS[10])
Effective Calibration Date	12/01/2022	**Serial No.**	48-TP50478A
Calibration Reference	HGLP-CC-239, Rev. 0	**Logging Procedure**	SGRP-PRO-OP-53023, Rev. 0, Change 5

Logging System	Gamma 1Ld	**Type**	60% Coaxial HPGe (SGLS)
Effective Calibration Date	02/15/2023	**Serial No.**	47-TP-32211A
Calibration Reference	HGLP-CC-251, Rev. 0	**Logging Procedure**	SGRP-PRO-OP-53023, Rev. 0, Change 5

Logging System	Gamma 4Rc	**Type**	60% Coaxial HPGe (SGLS)
Effective Calibration Date	01/19/2023	**Serial No.**	48-TP50478A
Calibration Reference	HGLP-CC-240, Rev. 0	**Logging Procedure**	SGRP PRO OP 53023, Rev. 0, Change 5

SGLS Log Run Information

Log Run	**4**	**5**	**6 Repeat**	**9**
HEIS Number	1022126	1022127	1022128	1022129
Date	12/14/2022	12/15/2022	12/15/2022	01/12/2023
Logging Engineer	McClellan/C. Meisner	McClellan/C. Meisner	Thurnau/C. Meisner	Thurnau/C. Meisner
Start Depth (ft)	0.00	113.00	105.00	126.00
Finish Depth (ft)	115.00	128.00	118.00	229.00
Count Time (sec)	100	100	100	100
Live/Real	R	R	R	R
Shield (Y/N)	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0
Log Speed (ft/min)	NA	NA	NA	NA
Pre-Verification	C9605ARe202212 14AV00CAB1	C9605ARe202212 15BV00CAB1	C9605ARe202212 15BV00CAB1	C9605DRe202301 12AV00CAB1
Start File	AD000000	BD011300	CD010500	AD012600
Finish File	AD011500	BD012800	CD011800	AD022900
Post-Verification	C9605ARe202212 14AV00CAA1	C9605ARe202212 15CV00CAA1	C9605ARe202212 15CV00CAA1	C9605DRe202301 12BV00CAA1

[9] High-purity germanium
[10] Spectral Gamma Logging System

Log Run	4	5	6 Repeat	9
Depth Return Error (in.)	HIGH 2	NA	HIGH 1/2	NA
Comments	None	None	None	None

SGLS Log Run Information

Log Run	10 Repeat	11	12 Repeat	15
HEIS Number	1022130	1022131	1022132	1022133
Date	01/12/2023	02/02/2023	02/02/2023	02/22/2023
Logging Engineer	Thurnau/C. Meisner	Thurnau/C. Meisner	Thurnau/C. Meisner	Thurnau/C. Meisner
Start Depth (ft)	150.00	227.00	255.00	328.00
Finish Depth (ft)	161.00	330.00	266.00	443.00
Count Time (sec)	100	100	100	100
Live/Real	R	R	R	R
Shield (Y/N)	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0
Log Speed (ft/min)	NA	NA	NA	NA
Pre-Verification	C9605DRe202301 12AV00CAB1	C9605DRc202302 02AV00CAB1	C9605DRc202302 02AV00CAB1	C9605ALd202302 22AV00CAB1
Start File	BD015000	AD022700	BD025500	AD032800
Finish File	BD016100	AD033000	BD026600	AD044300
Post-Verification	C9605DRe202301 12BV00CAA1	C9605DRc202302 02BV00CAA1	C9605DRc202302 02BV00CAA1	C9605ALd202302 22BV00CAA1
Depth Return Error (in.)	HIGH 3	NA	HIGH 1/2	NA
Comments	None	None	None	None

SGLS Log Run Information

Log Run	16 Repeat	NA – all below	NA – all below	NA – all below
HEIS Number	1022134			
Date	02/22/2023			
Logging Engineer	Thurnau/C. Meisner			
Start Depth (ft)	385.00			
Finish Depth (ft)	397.00			
Count Time (sec)	100			
Live/Real	R			
Shield (Y/N)	N			
MSA Interval (ft)	1.0			
Log Speed (ft/min)	NA			
Pre-Verification	C9605ALd202302 22AV00CAB1			
Start File	BD038500			
Finish File	BD039700			
Post-Verification	C9605ALd202302 22BV00CAA1			
Depth Return Error (in.)	HIGH 2			
Comments	None			

NMLS Log Run Information

Log Run	1	2	3 Repeat	7
HEIS Number	1022135	1022136	1022137	1022138
Date	12/13/2022	12/14/2023	12/14/2022	01/12/2023
Logging Engineer	Spatz/McClellan	Spatz/McClellan	Thurnau/C. Meisner	Thurnau/C. Meisner
Start Depth (ft)	0.00	98.00	95.00	124.99
Finish Depth (ft)	100.00	129.00	108.00	229.00
Count Time (sec)	15	15	15	15
Live/Real	R	R	R	R
Shield (Y/N)	N	N	N	N
MSA Interval (ft)	0.25	0.25	0.25	0.25
Log Speed (ft/min)	NA	NA	NA	NA
Pre-Verification	C9605FPb202212 13AV00CAB1	C9605FPb202212 14BV00CAB1	C9605FPb202212 14BV00CAB1	C9605DMc20230 112AV00CAB1
Start File	AD000000	BD009800	CD009500	AD012499
Finish File	AD010000	BD012900	CD010800	AD022900
Post-Verification	C9605FPb202212 13AV00CAA1	C9605FPb202212 14CV00CAA1	C9605FPb202212 14CV00CAA1	C9605DMc20230 112BV00CAA1
Depth Return Error (in.)	0	NA	0	NA
Comments	None	None	None	None

NMLS Log Run Information

Log Run	8 Repeat	13	14 Repeat	NA – all below
HEIS Number	1022139	1022140	1022141	
Date	01/12/2023	02/02/2023	02/02/2023	
Logging Engineer	Thurnau/C. Meisner	Thurnau/C. Meisner	Thurnau/C. Meisner	
Start Depth (ft)	150.00	227.00	246.00	
Finish Depth (ft)	161.00	264.25	250.00	
Count Time (sec)	15	15	15	
Live/Real	R	R	R	
Shield (Y/N)	N	N	N	
MSA Interval (ft)	0.25	0.25	0.25	
Log Speed (ft/min)	NA	NA	NA	
Pre-Verification	C9605DMc20230 112AV00CAB1	C9605DMc20230 202AV00CAB1	C9605DMc20230 202BV00CAB1	
Start File	BD015000	AD022700	BD024600	
Finish File	BD016100	AD026425	BD025000	
Post-Verification	C9605DMc20230 112BV00CAA1	C9605DMc20230 202BV00CAA1	C9605DMc20230 202BV00CAA1	
Depth Return Error (in.)	0	NA	0	
Comments	None	None	None	

Logging Operation Notes

Zero depth reference is ground surface. The maximum SGLS logging depth achieved was 443.0 ft, terminating approximately 3.2 ft above the reported casing depth. The SGLS tool unweighted at about 443.5 ft. The maximum NMLS logging depth was 264.25 ft, terminating after entering water.

Centralizers were installed on the sondes during logging. All field verification checks passed their respective acceptance criteria. SGLS verification measurements were acquired in the KUTh-118 and KTh-02 field verifiers.

Analysis Notes

Analyst	R. Spatz & A. Pope	**Date**	8/3/2023
Reference(s)	SGRP-PRO-OP-53040, Rev. 1, Chg. 2; SGRP-PRO-OP-53051, Rev. 0, Chg. 3		

Where SGLS data were acquired through a single casing, steel casing thickness corrections were applied using the thicknesses indicated in the Casing Information table. Over the following depth intervals, spectra were acquired through two overlapping casing strings and combined casing thickness corrections were applied: from 126 to 130 ft in the second-string log (0.50-in.), at 227 ft in the third-string log (0.51-in.), and at 328 ft in the fourth-string log (0.50-in.). Where spectra were acquired in open-hole conditions, no casing corrections were applied. Open-hole spectral data were collected below 226 ft during logging of the second string, and below 328 ft during logging of the third string. A water correction was applied to all SGLS data below 264.3 ft.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Radionuclide concentrations were calculated using three EXCEL templates identified as Rc_20230119_CC240_assay_HEIS, Ld_20230215_CC251_assay_HEIS, and Re_20221201_CC239_assay_HEIS. These templates employ efficiency functions and corrections for system dead time as determined by annual calibration.

Wall thickness and OD corrections were applied to the NMLS data acquired in the 0.25-in. thick by 10.51-in. OD and 9.27-in. OD casings. Corrections were also made for data acquired in the 0.26-in. thick by 8.10-in. OD casing. Integrated with the casing diameter and thickness corrections is an initial count rate correction for a sediment composition of a 50-50% ratio of basalt fragments to quartz sand (HGLP-OTH-028).

NMLS data are reported in both cps[11] and vol%[12] moisture. Count rate normalization and conversions from count rate to vol% moisture was performed using EXCEL templates identified as Pb_Cascade_Sonic_MCNP_assay_HEIS and Mc_Cascade_Sonic_MCNP_assay_HEIS. These templates also provide corrections for the steel-reinforced casing joints typical of Cascade sonic drill casings.

It is important to note that the gamma data uncertainties are reported at 2 standard deviations, and the moisture data uncertainties are reported at 1 standard deviation.

HGU[13] is an empirical unit of gamma activity used as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

General Statement about Neutron Moisture Data Presentation and Reporting

Raw neutron count rates are normalized to what is referred to as the "standard tool", as described in HGLP-OTH-028. The purpose of normalizing the count rates is to correct for the differences in response characteristics between different detectors that may be used in the same borehole. Data plots of normalized neutron count rates include an axis label to indicate that the data are normalized. Neutron count rates are loaded to HEIS-GPL as a "raw" data type.

[11] Counts per second
[12] Volume percent
[13] Hanford Gamma Unit

Calculated vol% moisture results are presented in the data plots in a dark cyan color where data were acquired in borehole environments that were within modeled calibration conditions during logging. Valid borehole environments are described in HGLP-OTH-028. Across discrete depth intervals where neutron moisture data are known or strongly suspected to have been acquired in borehole conditions outside of the modeled calibration range, vol% moisture values are still presented, but are plotted in red. Where such data occur, brief explanations are included in the log data reports.

For log runs where all neutron moisture data are collected outside of modeled calibration conditions (typically where borehole diameter is greater than 12-in. OD, or casing is dual-wall), the data will only be presented as raw count rates. Vol% moisture will therefore not be calculated or loaded to the HEIS-GPL database.

It has been observed in most borehole logs where neutron moisture data have been acquired through 12-in. OD sonic casing that the algorithm for calculating vol% moisture across thickened casing joints results in exaggerated corrections. Where this occurs, vol% results are presented in the data plots and loaded to HEIS-GPL without qualification. However, the depths where joints occur are indicated in the results section of the report.

It is ultimately incumbent on the data user to review this report as well as any qualifiers associated with the results loaded to HEIS-GPL prior to making decisions based on these results.

Results and Interpretations

Cesium-137 (^{137}Cs) was detected intermittently between ground surface and 4 ft at very low concentrations. The maximum concentration was 0.9 pCi/g found at the ground surface.

Gamma attenuation caused by the reinforced sonic casing joints results in sharp decreases in apparent concentrations and count rates in the natural potassium-40 (^{40}K) and total gamma plots, respectively. This occurs every 10 ft starting at about 8 ft and extending to total depth. No corrections have been made for the effects of the reinforced joints on the SGLS data.

Radon (^{222}Rn) gas buildup is apparent in the water inside the casing during logging of the third casing string (about 264 to 330 ft). The presence of ^{222}Rn is not an indication of manmade contamination but is derived from the decay of naturally occurring uranium. Bismuth-214 (^{214}Bi) decay gamma energies at 609 and 1764 keV are used to assay natural occurring ^{238}U concentrations. ^{222}Rn is higher in the ^{238}U decay chain than ^{214}Bi, and when ^{222}Rn gas builds up inside the casing, ^{214}Bi will also begin concentrating inside the casing. Evidence of this phenomenon presents as a divergence of the 609- and 1764-keV ^{214}Bi assays of ^{238}U concentrations. Radionuclide concentration calculations involve energy-specific corrections for both casing and water thickness. The corrections assume the ^{214}Bi is entirely within formation, not inside the casing, and therefore the calculated ^{238}U concentrations are overestimated proportional to the ^{222}Rn levels inside the casing during logging.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content generally increases as the sediment becomes finer grained.

Moisture data known or strongly suspected to be acquired in conditions outside of the modeled calibration range are plotted in red. This includes data acquired near the end of casing or in open hole, through double casing, within formations significantly disturbed by drilling, where water was added to aid drilling, or where calculated vol% moisture exceeds 35%. In this borehole, data acquired through or influenced by double casing extend from 125 to about 128.5 ft (2nd casing log), and from 227 to about 228 ft (3rd casing log). Data influenced by proximity of the detector to the bottom of casing are from about 127.5 to 129 ft (1st casing log), and from about 226.25 to 229 ft (2nd casing log). Below about 263.25 ft (3rd casing log), the proximity of the detector to water inside the casing influences the neutron count rate.

The natural gamma repeat plots indicate good repeatability, suggesting that the SGLS systems were working properly during logging. Two of the three moisture repeat plots also indicate good and consistent repeatability. The moisture repeat plot from the first casing string log shows good repeatability from 100 to 108 ft, but exhibits systematic differences in calculated moisture content from 95 to 100 ft. Over this interval, the main log and repeat log data were acquired on different days. On both days, the depth return error was zero, suggesting tracking of depth was not an issue. It is most likely that there was a slight difference in exactly where the detector was zeroed

relative to ground surface (the zero-depth reference) on each day, resulting in a slight offset in the character of the profile. This resulting difference in log character would be further compounded by slight differences in the corrections for the reinforced joint centered at about 97 ft during calculation of vol% moisture.

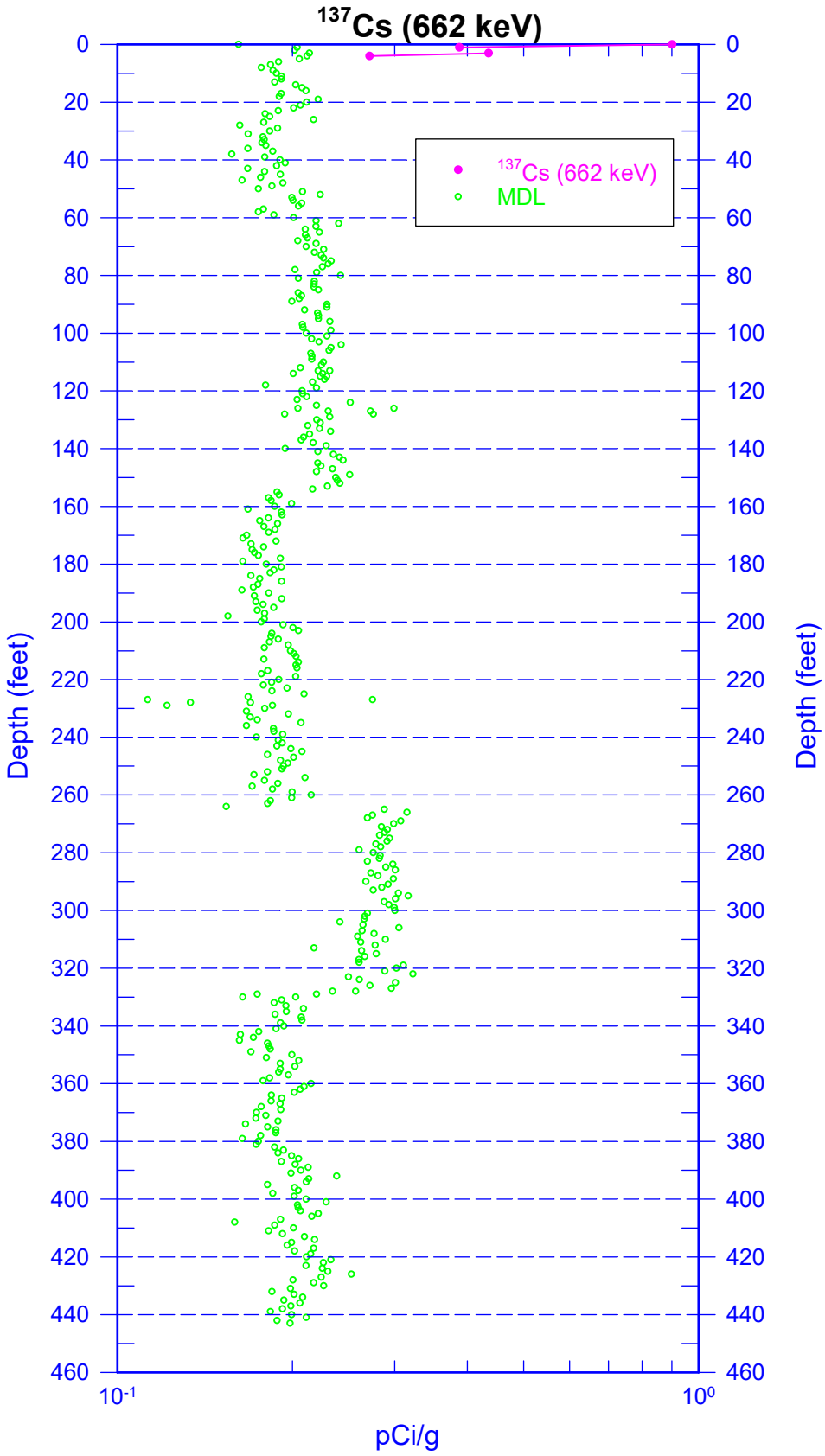
List of Log Plots

Zero depth reference is ground surface.

Manmade Radionuclides (0-460 ft)
Natural Gamma Logs (0-160 ft)
Natural Gamma Logs (150-310 ft)
Natural Gamma Logs (300-460 ft)
Combination Plot (0-460 ft)
Combination Plot (0-120 ft)
Combination Plot (120-240 ft)
Combination Plot (240-360 ft)
Combination Plot (360-480 ft)
Moisture and Total Gamma (0-160 ft)
Moisture and Total Gamma (150-310 ft)
Moisture (0-160 ft)
Moisture (150-310 ft)
Total Gamma & Hanford Gamma Unit (0-460 ft)
Repeat Section of Natural Gamma Logs (105-118 ft)
Repeat Section of Natural Gamma Logs (150-161 ft)
Repeat Section of Natural Gamma Logs (255-266 ft)
Repeat Section of Natural Gamma Logs (385-397 ft)
Moisture Repeat Section (95-108 ft)
Moisture Repeat Section (150-161 ft)
Moisture Repeat Section (246-250 ft)
Moisture with Uncertainties (0-160 ft)
Moisture with Uncertainties (150-310 ft)

Bay West
Customer-Focused Environmental & Industrial Solutions

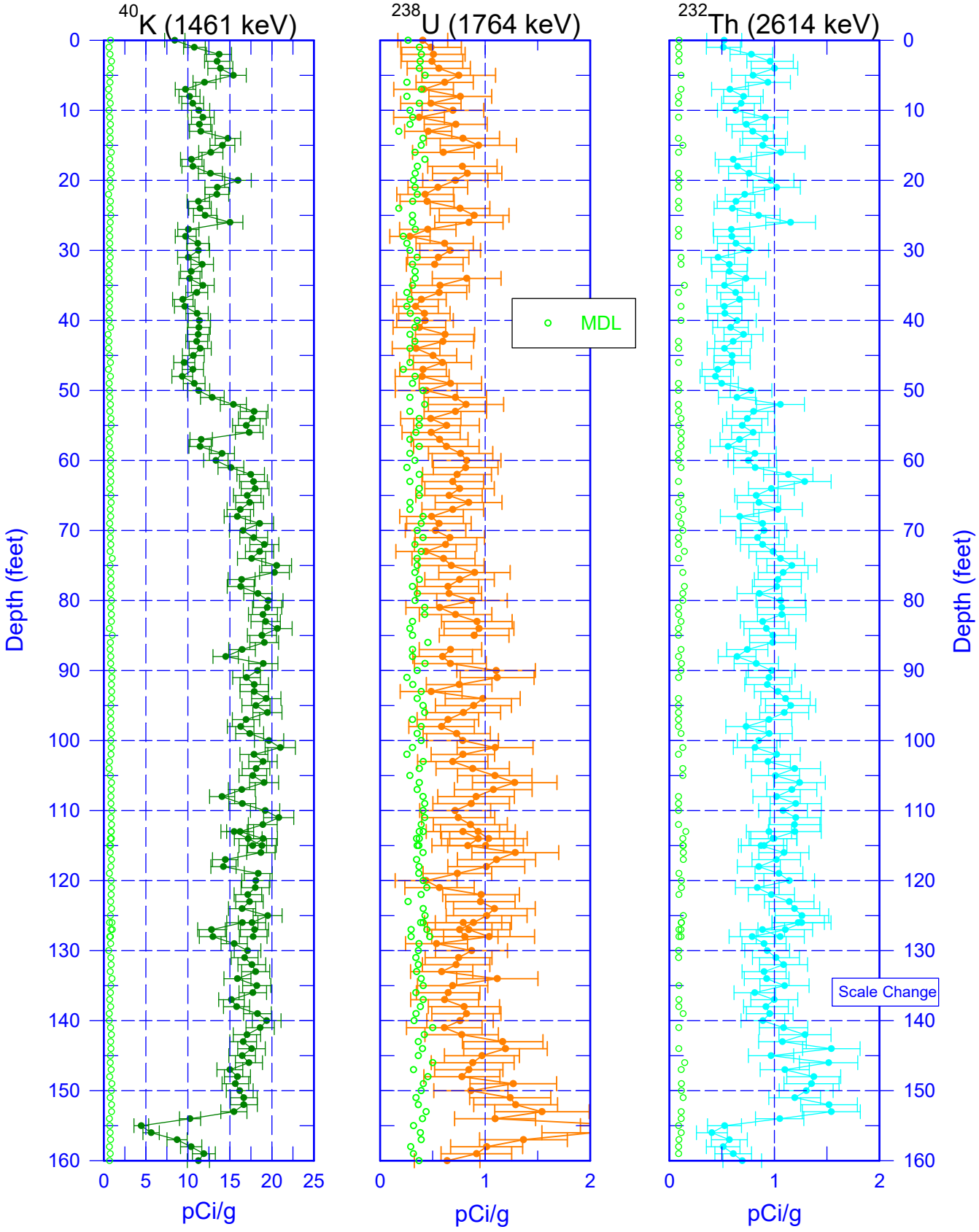
299-W19-127 (C9605)
Manmade Radionuclides



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

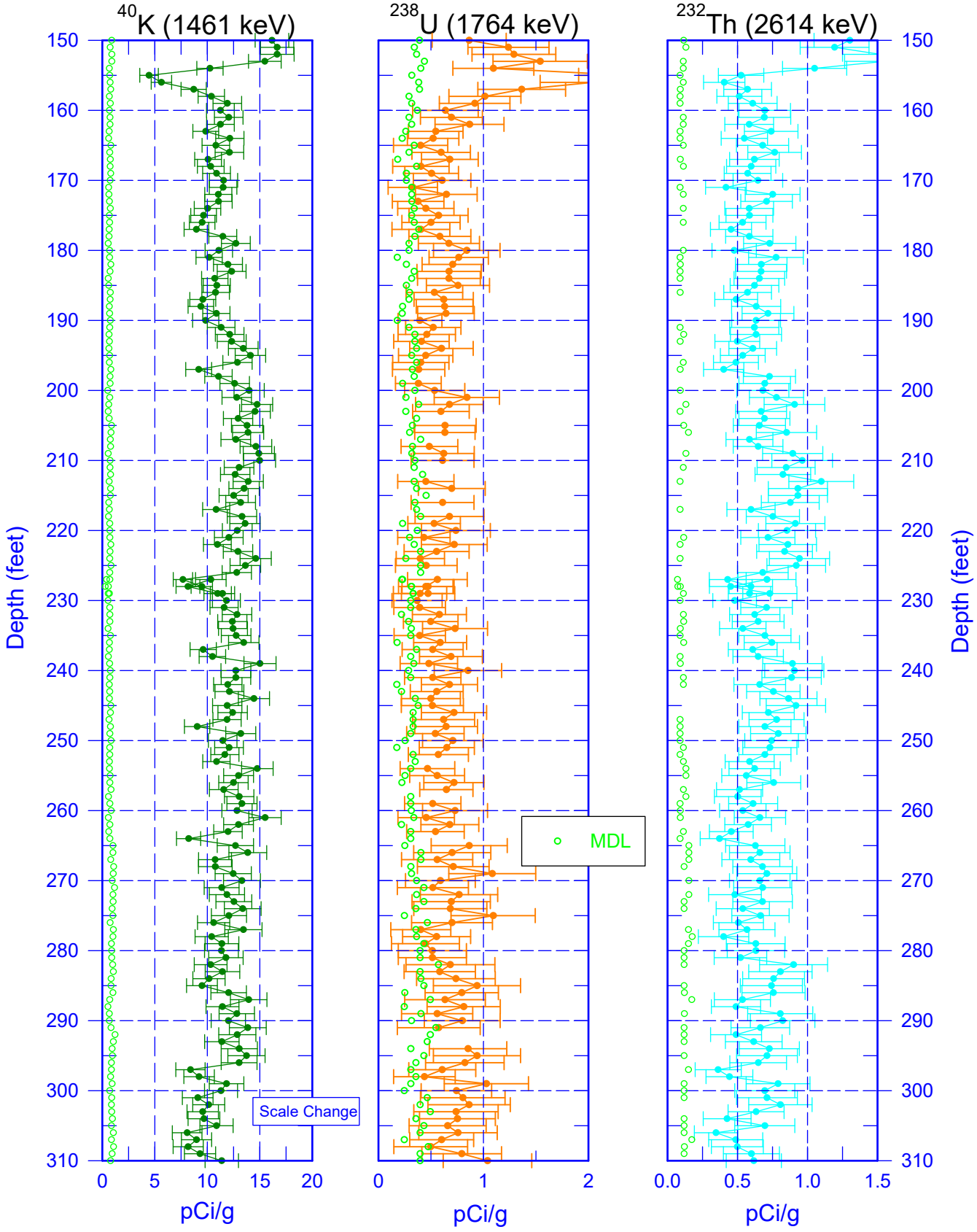
299-W19-127 (C9605)
Natural Gamma Logs



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

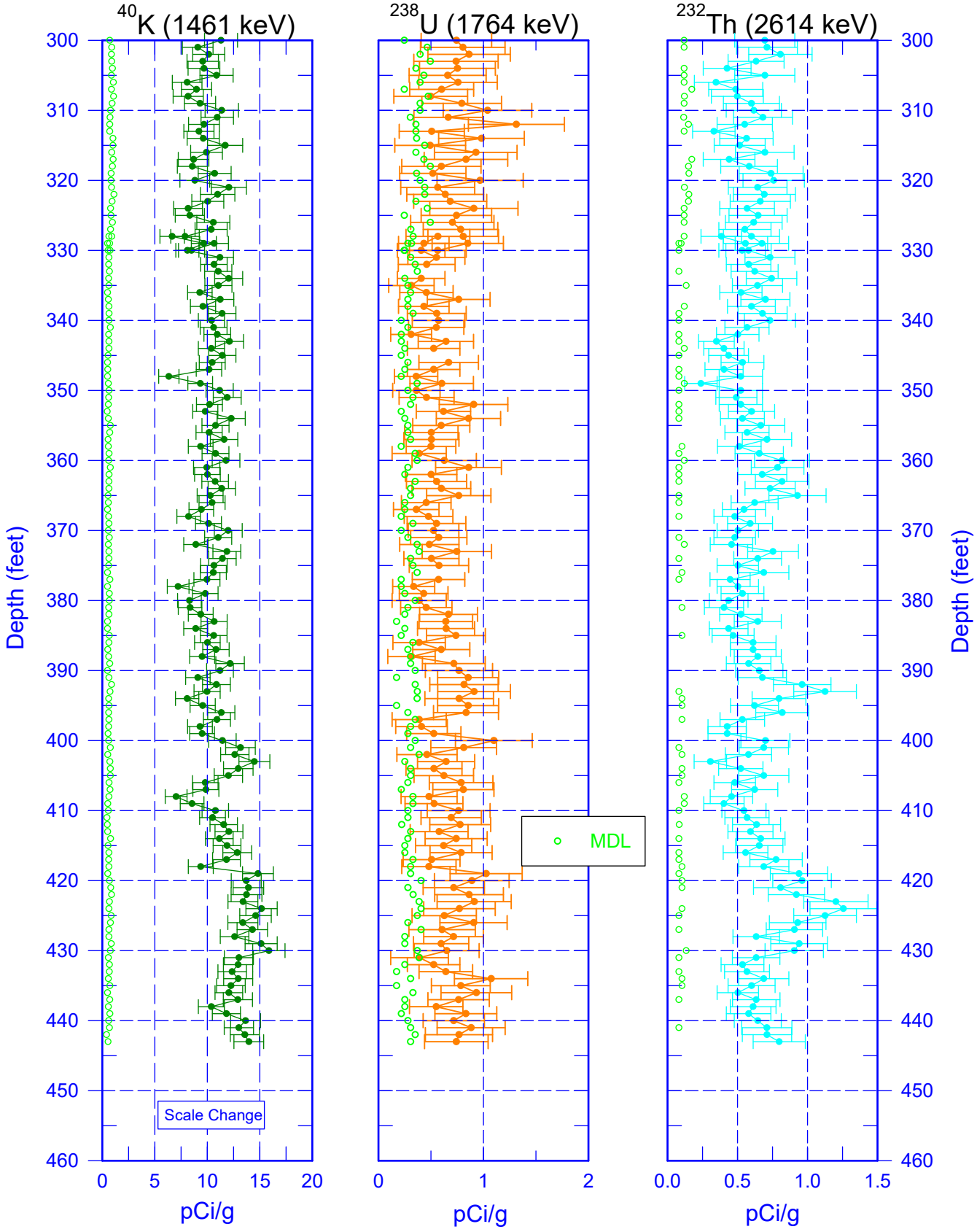
299-W19-127 (C9605)
Natural Gamma Logs



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-127 (C9605)
Natural Gamma Logs

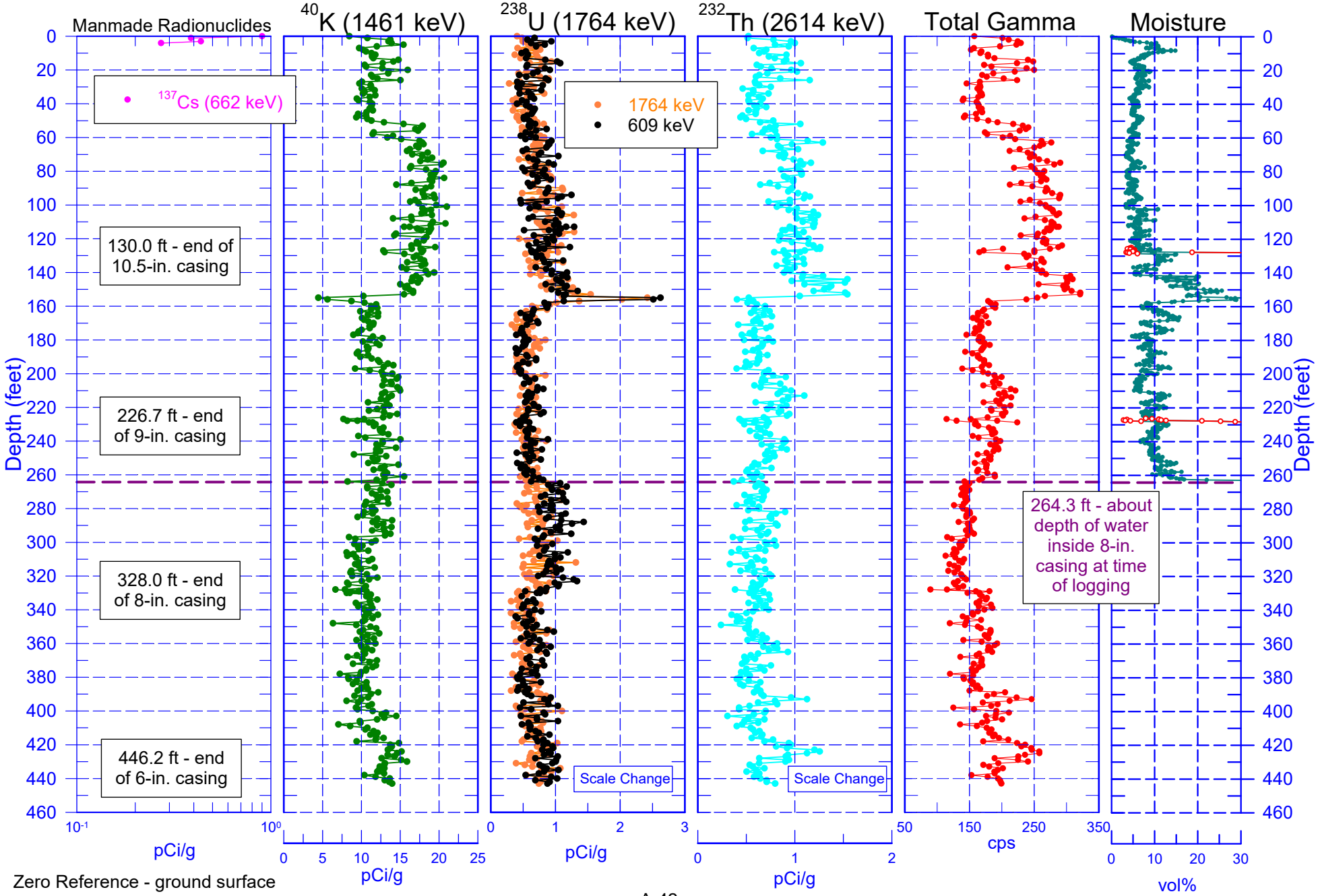


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

PROCUREMENT/CONTRACT SUBMITTAL
☐ APW ☒ AP
A ☒ Conforms to the Contract Requirements
B ☐ Minor Comments - Approved with Exceptions as Corrected
C ☐ Not Approved - Revise and Resubmit
Sign: TD Winslow Date: 08/07/23

299-W19-127 (C9605) Combination Plot



Bay West
Customer-Focused Environmental & Industrial Solutions

PROCUREMENT/CONTRACT SUBMITTAL
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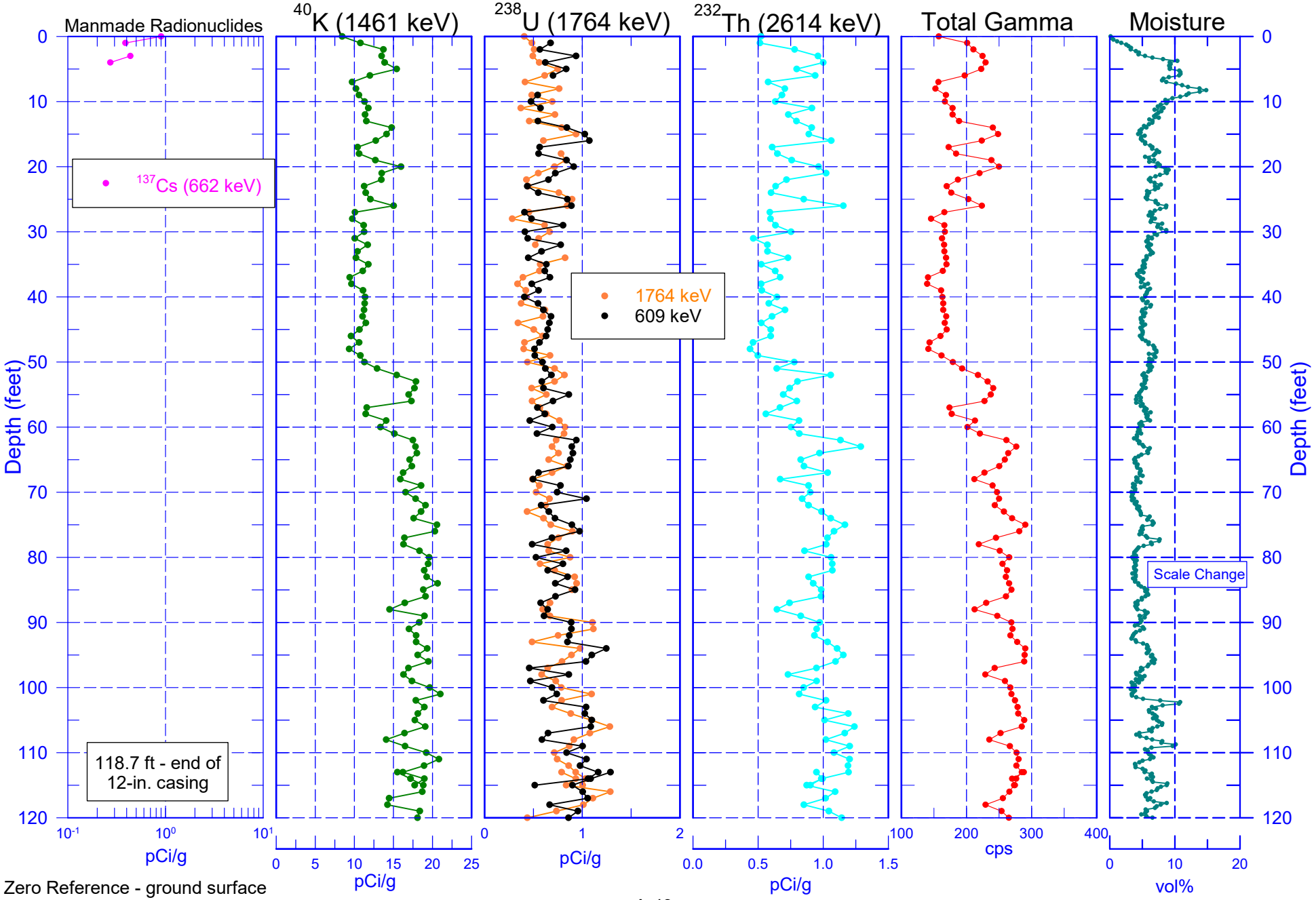
A ☒ Conforms to the Contract Requirements
B ☐ Minor Comments - Approved with Exceptions as Corrected
C ☐ Not Approved - Revise and Resubmit
Sign: TD Winslow Date 08/07/23

299-W19-127 (C9605) Combination Plot



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

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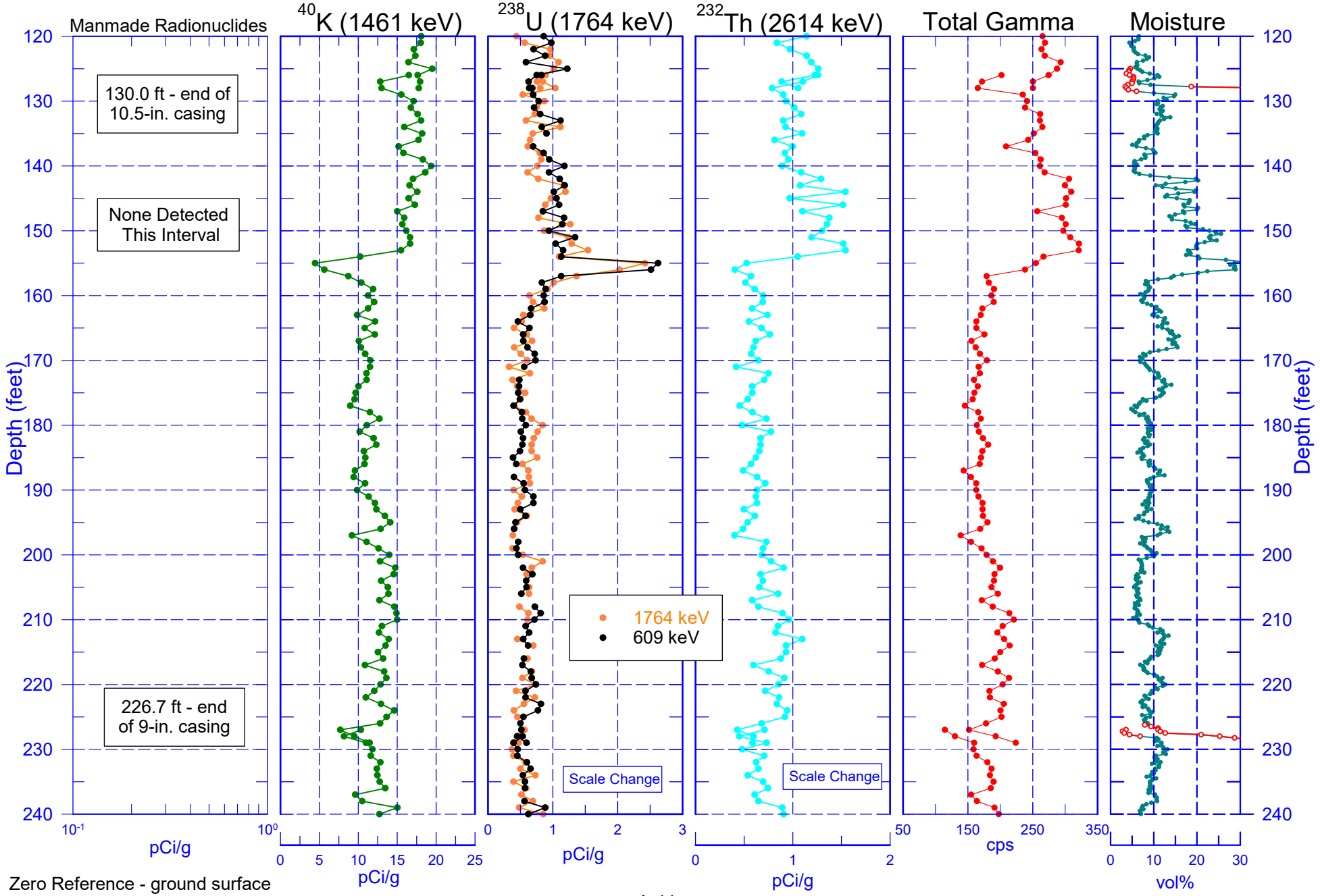
Sign: TD Winslow Date: 08/07/23

299-W19-127 (C9605) Combination Plot

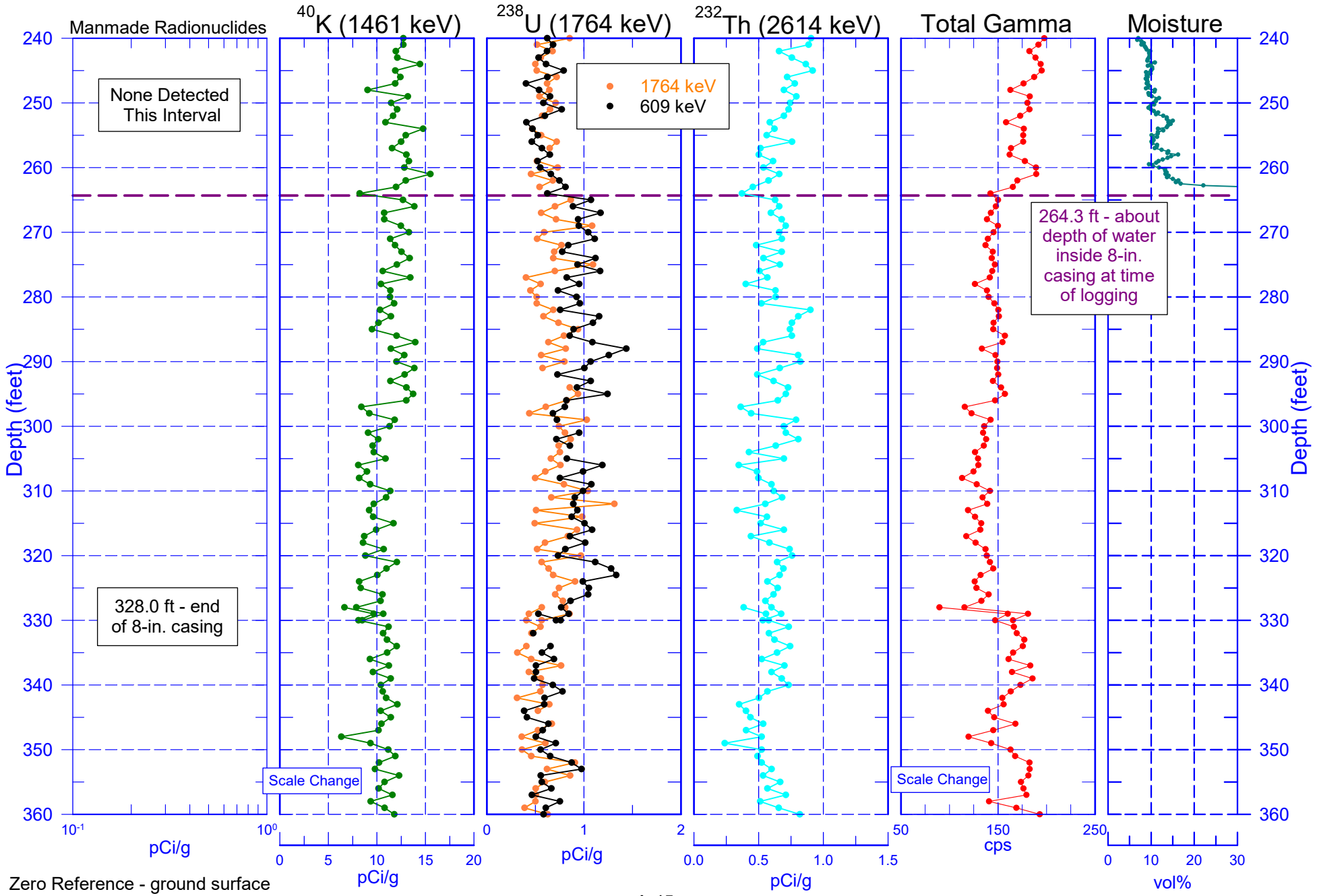


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

PROCUREMENT/CONTRACT SUBMITTAL
☐ APW ☒ AP
A ☒ Conforms to the Contract Requirements
B ☐ Minor Comments - Approved with Exceptions as Corrected
C ☐ Not Approved - Revise and Resubmit
Sign: TD Winslow Date: 08/07/23

299-W19-127 (C9605) Combination Plot

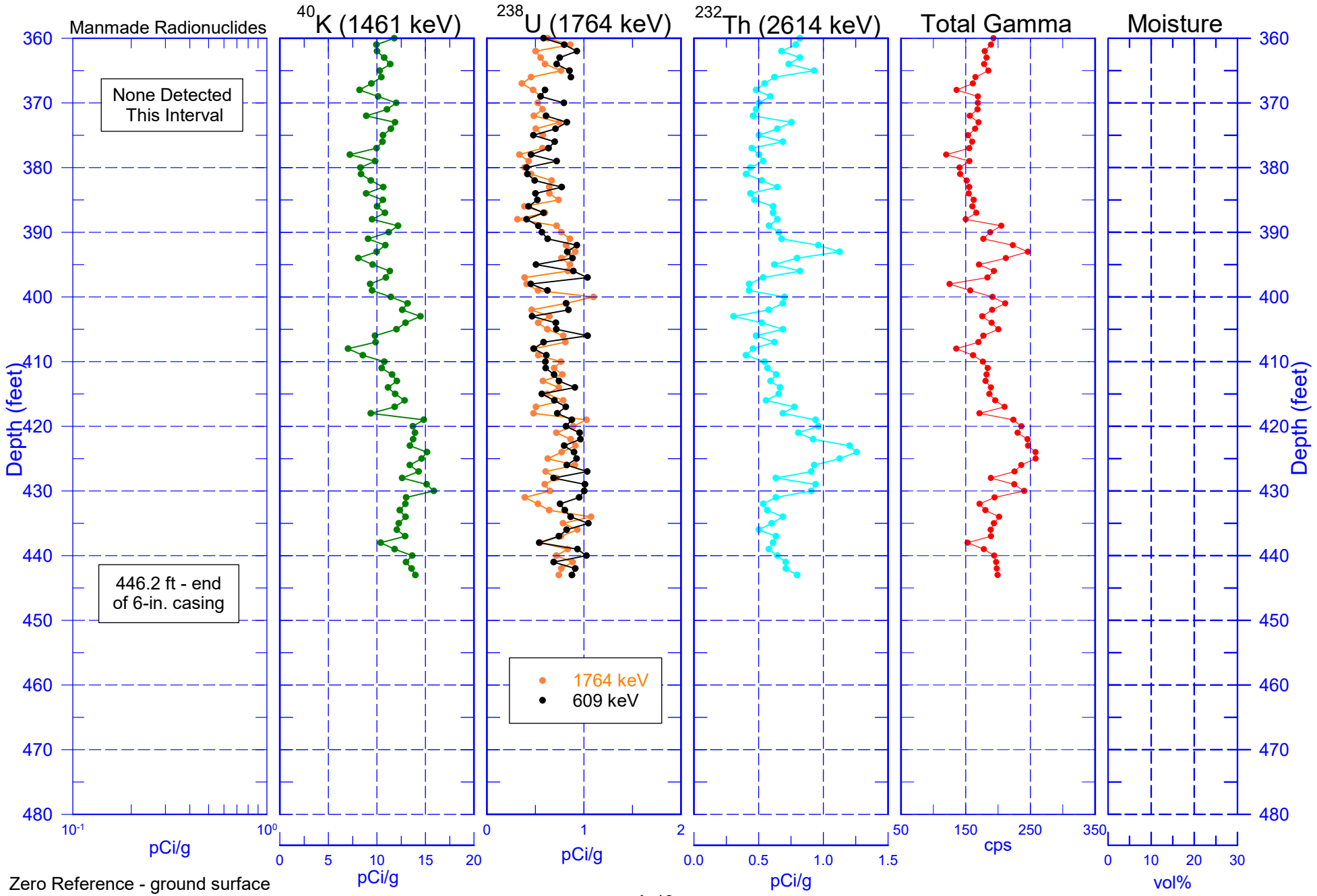


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

PROCUREMENT/CONTRACT SUBMITTAL
☐ APW ☒ AP
A ☒ Conforms to the Contract Requirements
B ☐ Minor Comments - Approved with Exceptions as Corrected
C ☐ Not Approved - Revise and Resubmit
Sign: TD Winslow Date: 08/07/23

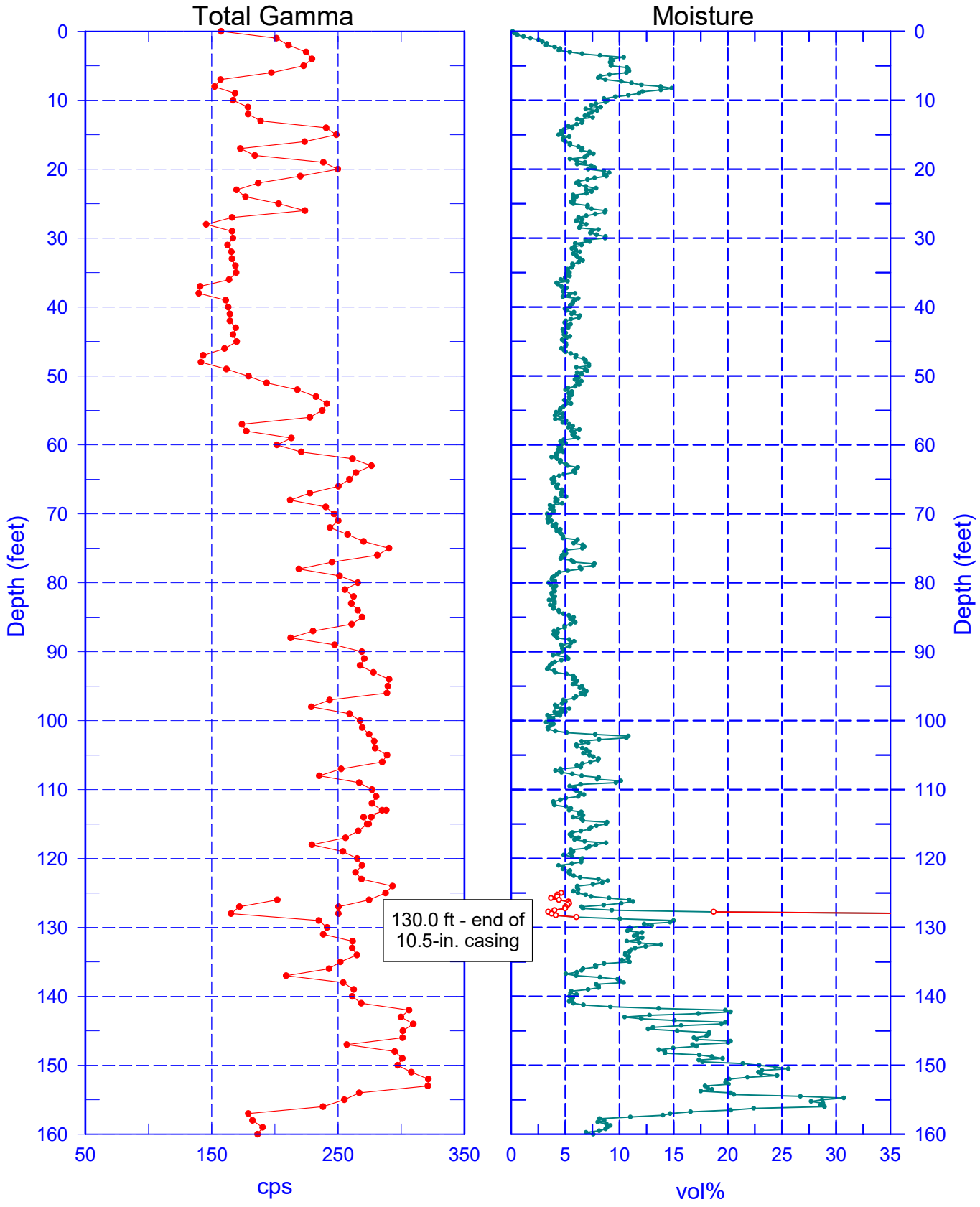
299-W19-127 (C9605) Combination Plot



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

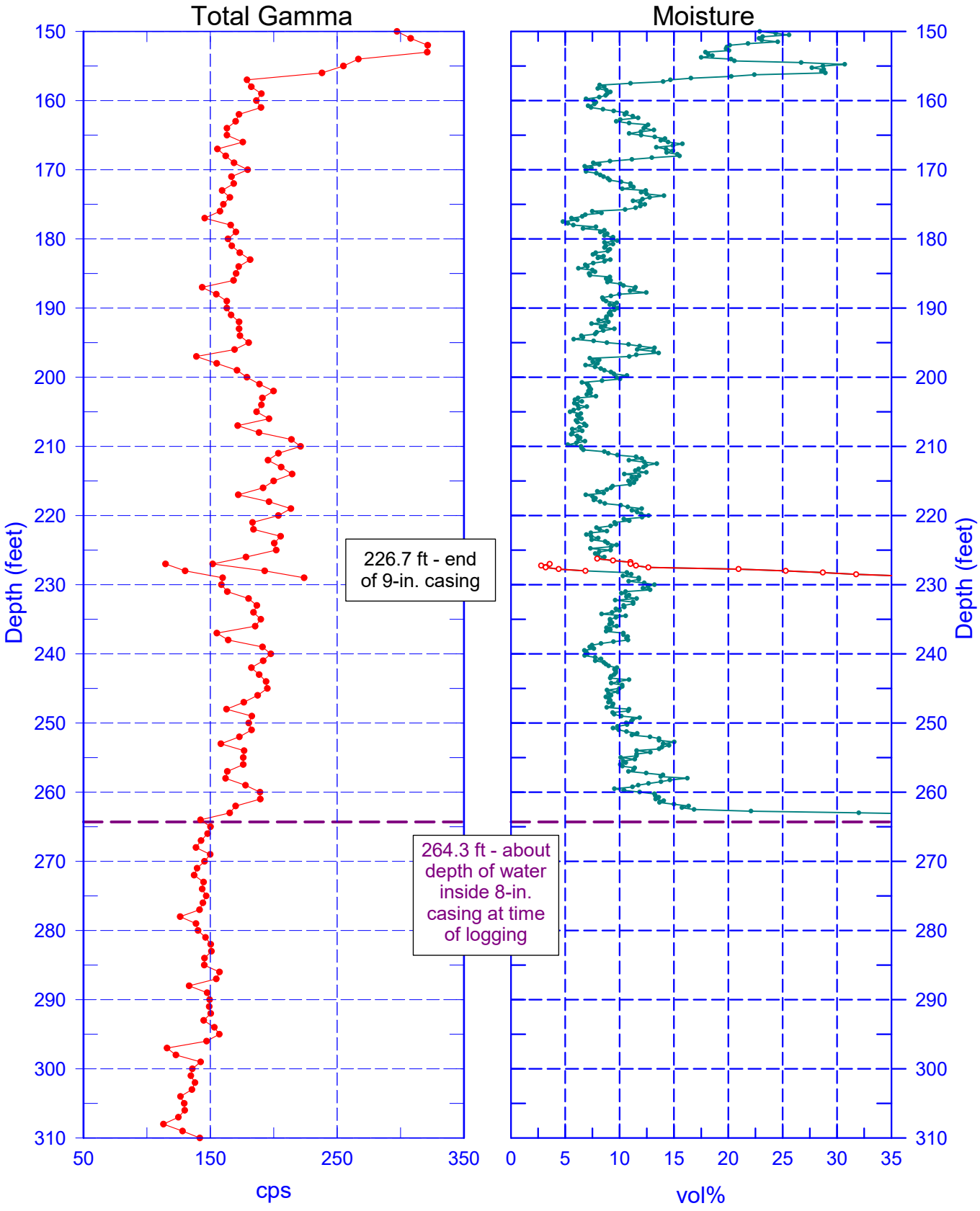
299-W19-127 (C9605)
Total Gamma & Moisture



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

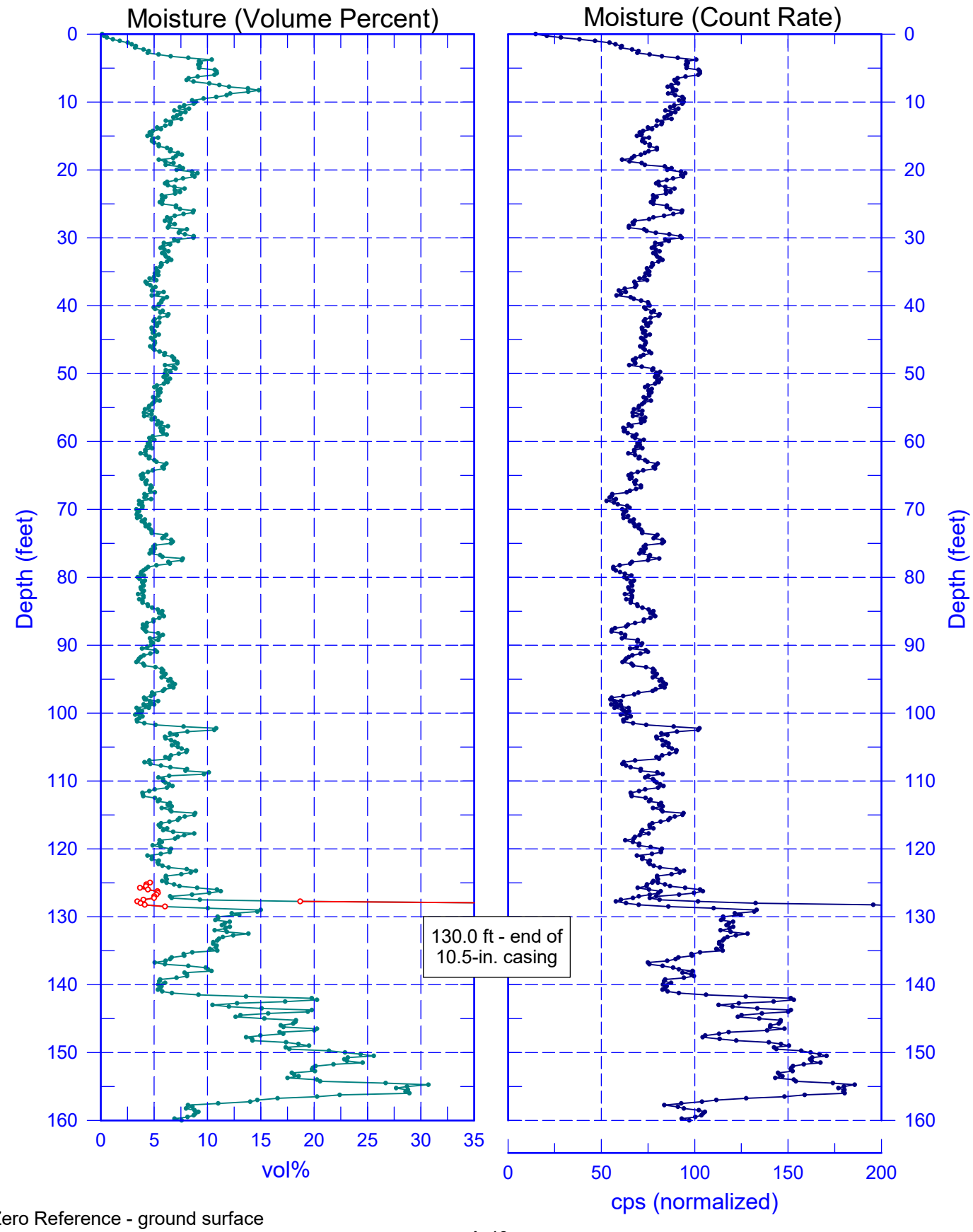
299-W19-127 (C9605)
Total Gamma & Moisture



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

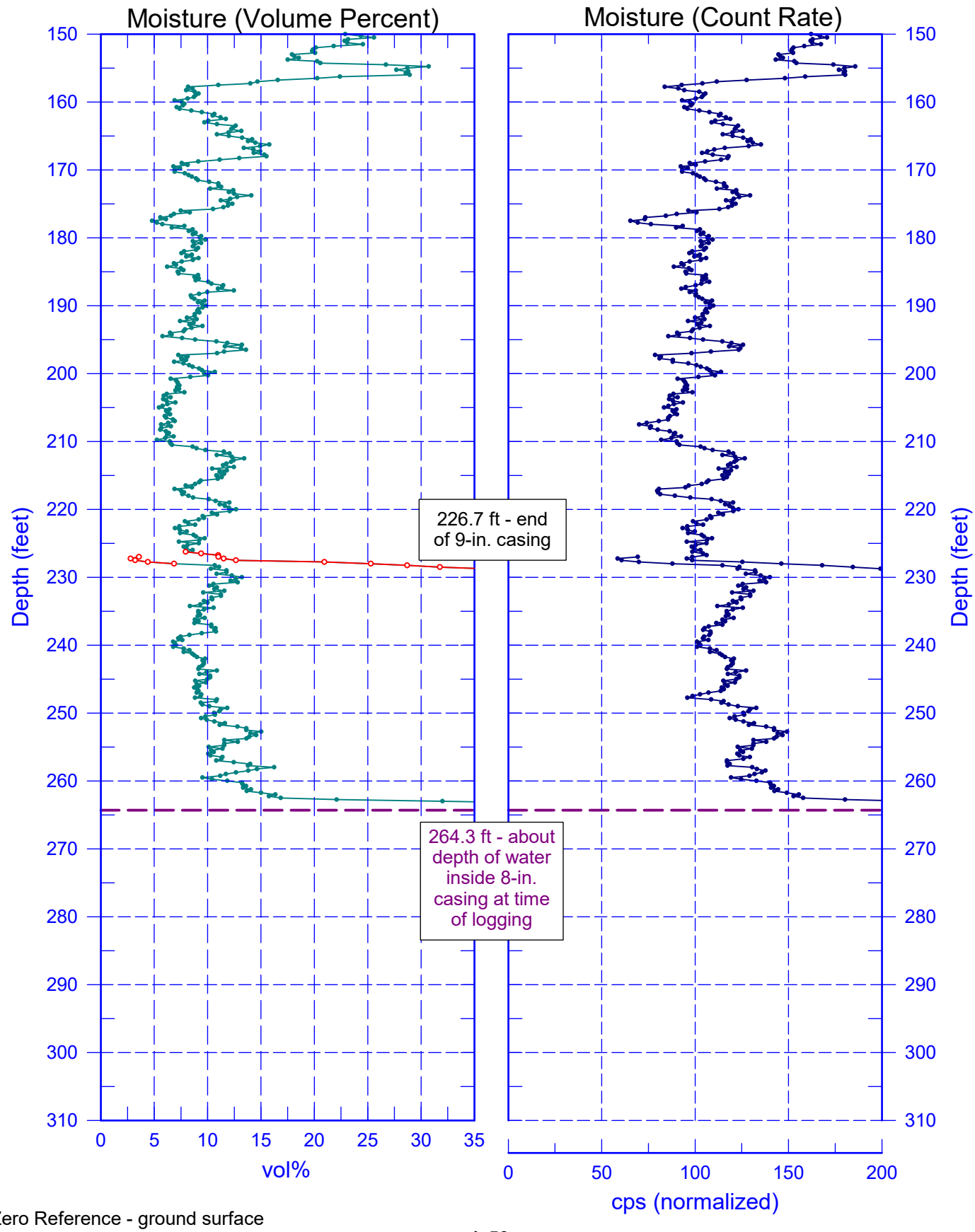
299-W19-127 (C9605)
Moisture



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-127 (C9605)
Moisture

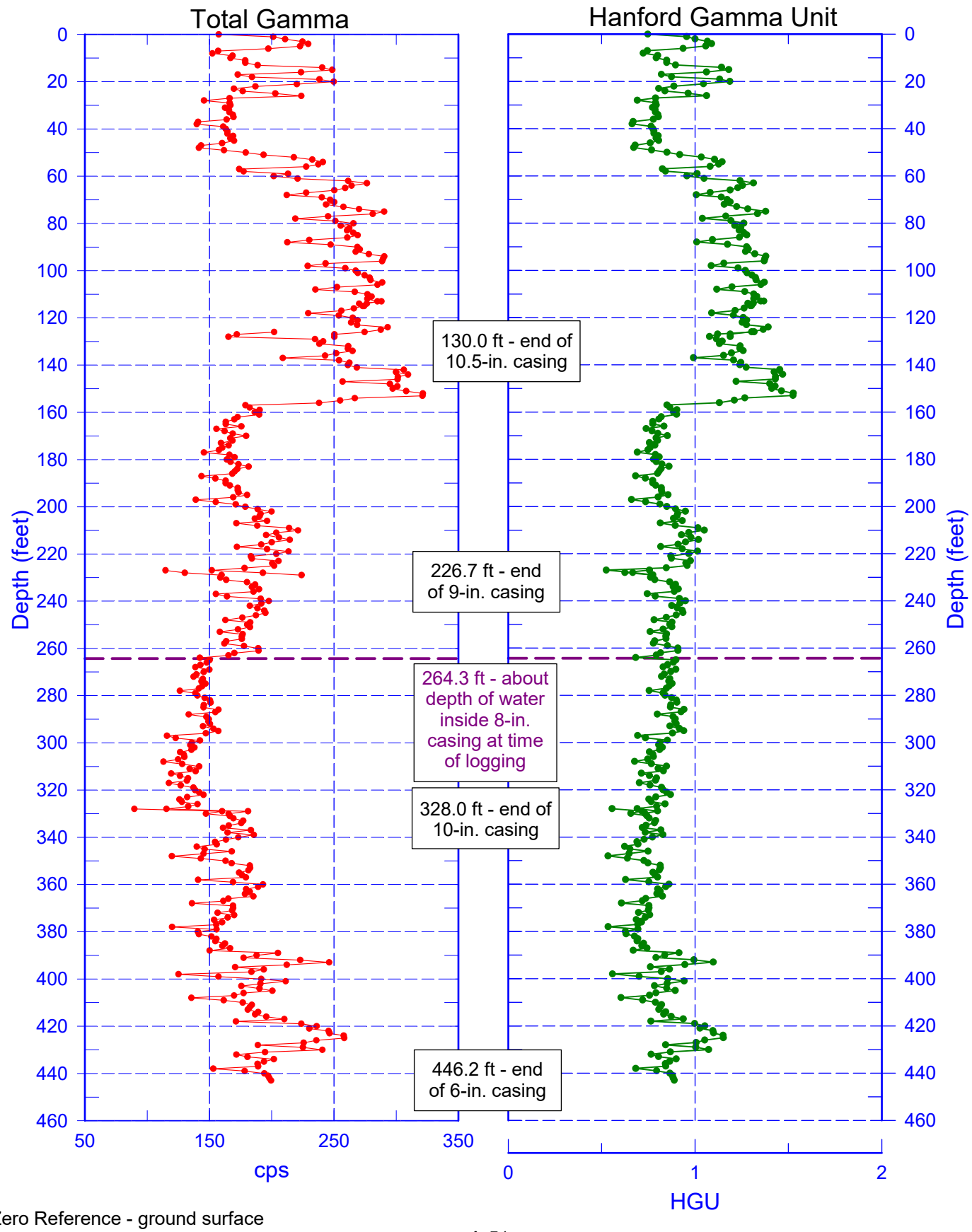


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-127 (C9605)

Total Gamma & Hanford Gamma Unit

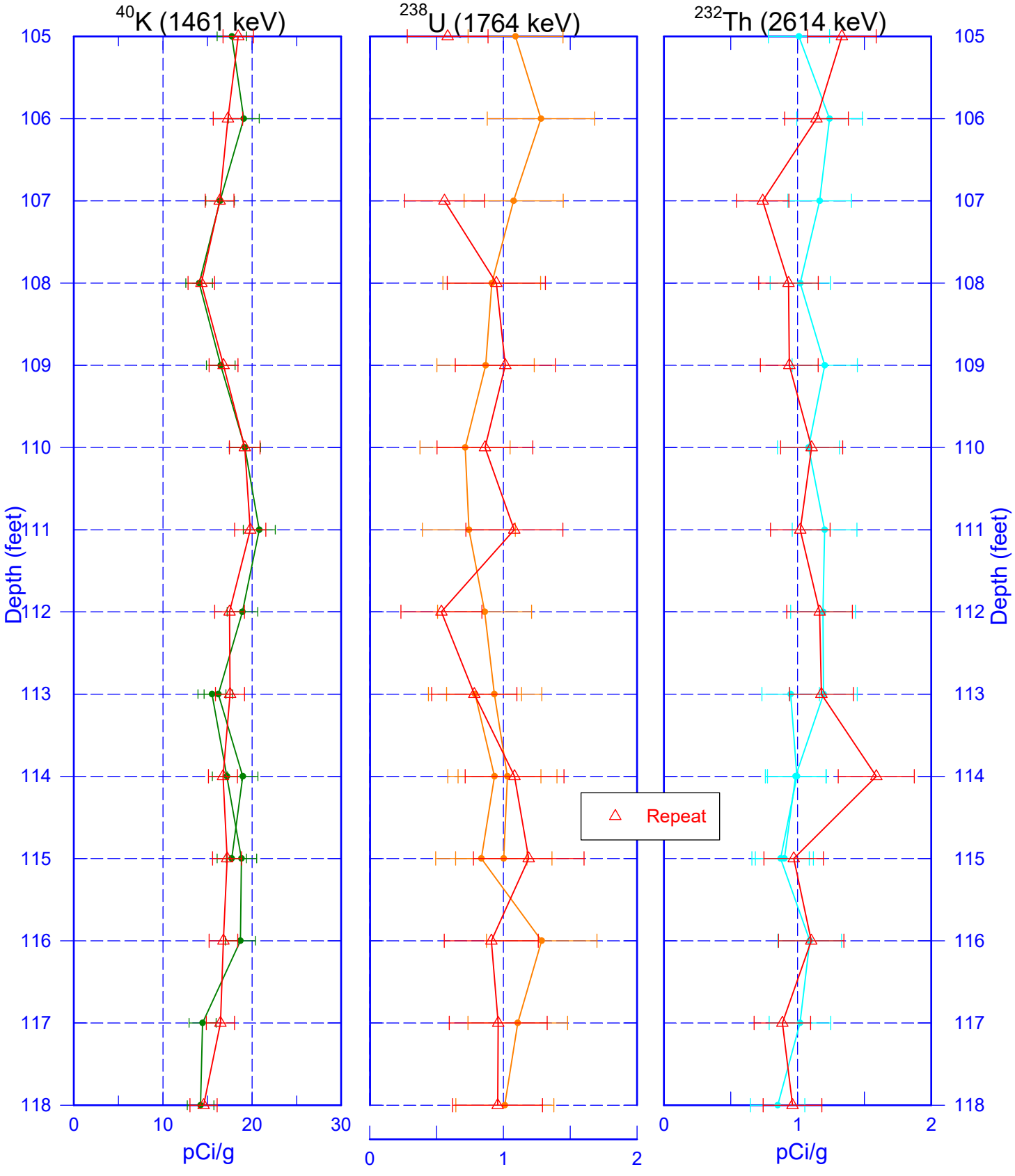


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-127 (C9605)

Repeat Section of Natural Gamma Logs

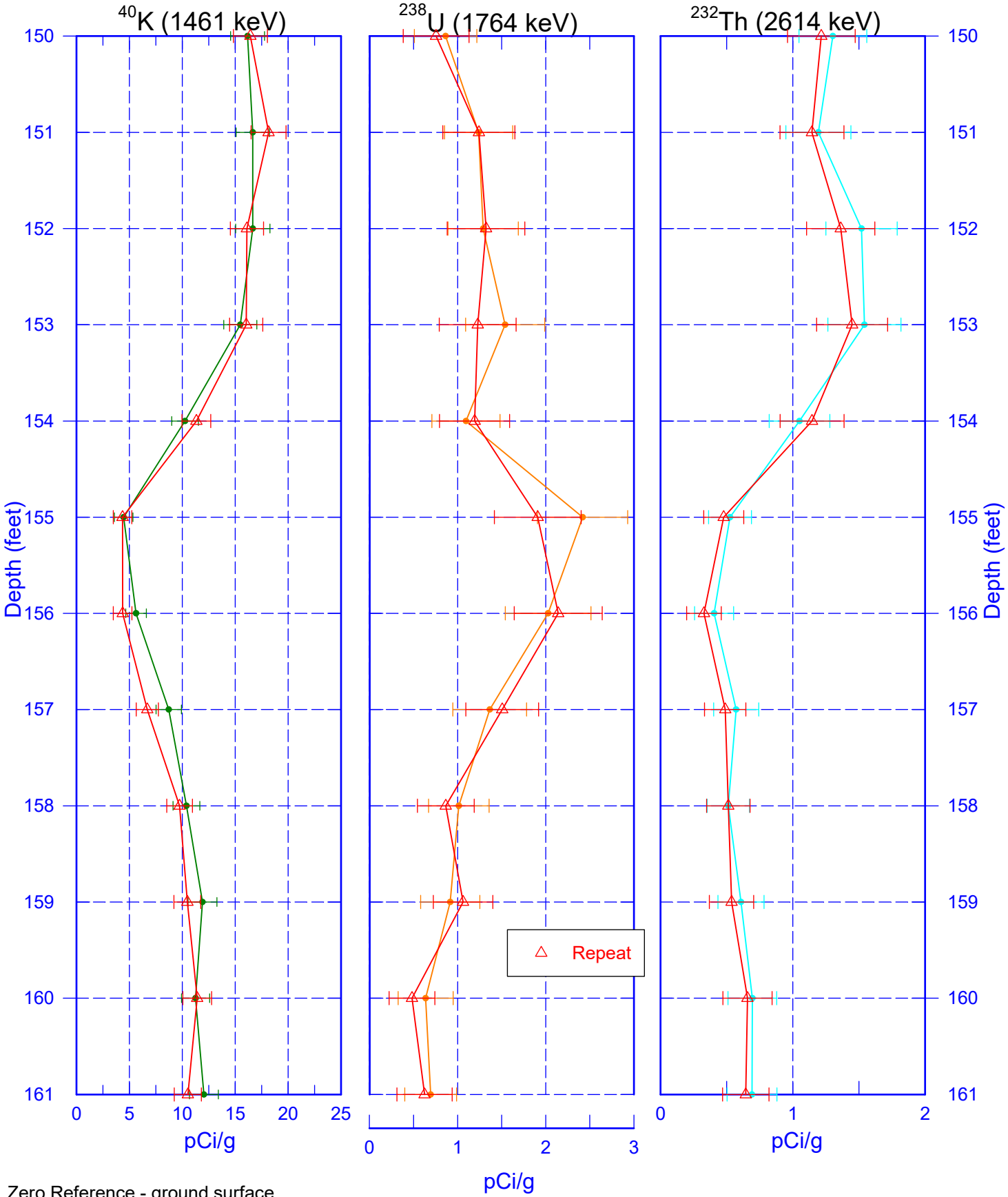


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-127 (C9605)

Repeat Section of Natural Gamma Logs

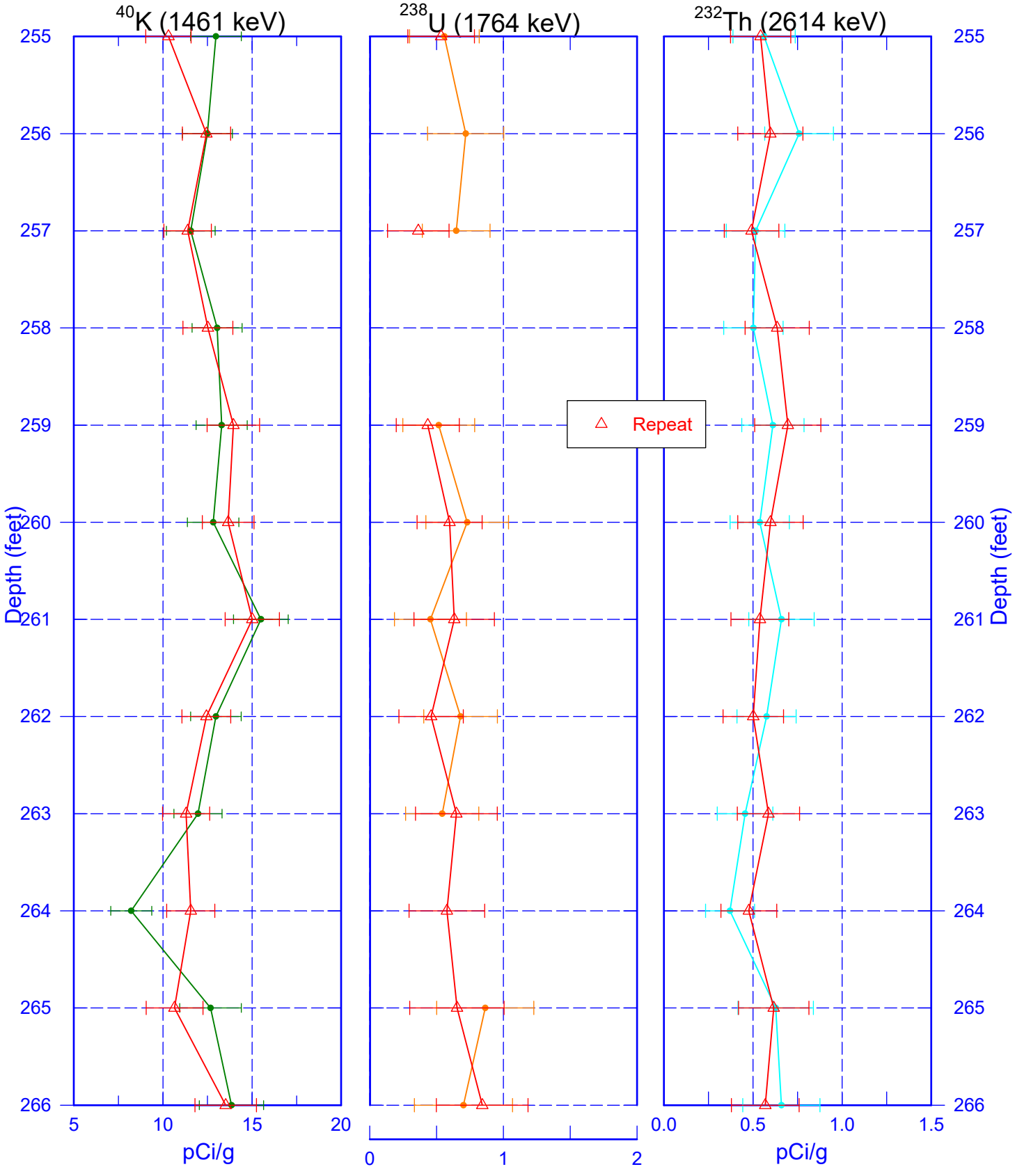


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-127 (C9605)

Repeat Section of Natural Gamma Logs

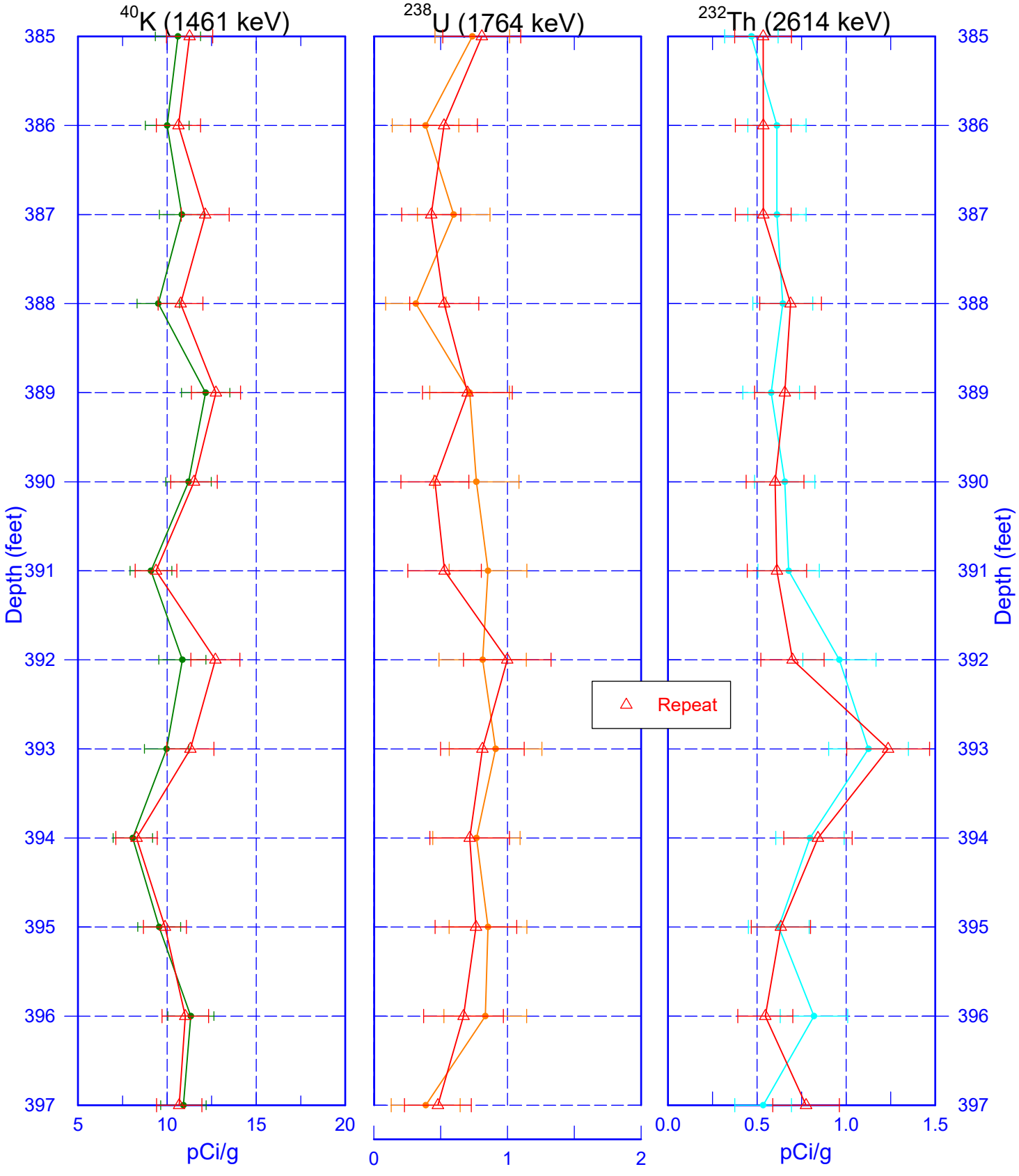


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-127 (C9605)

Repeat Section of Natural Gamma Logs

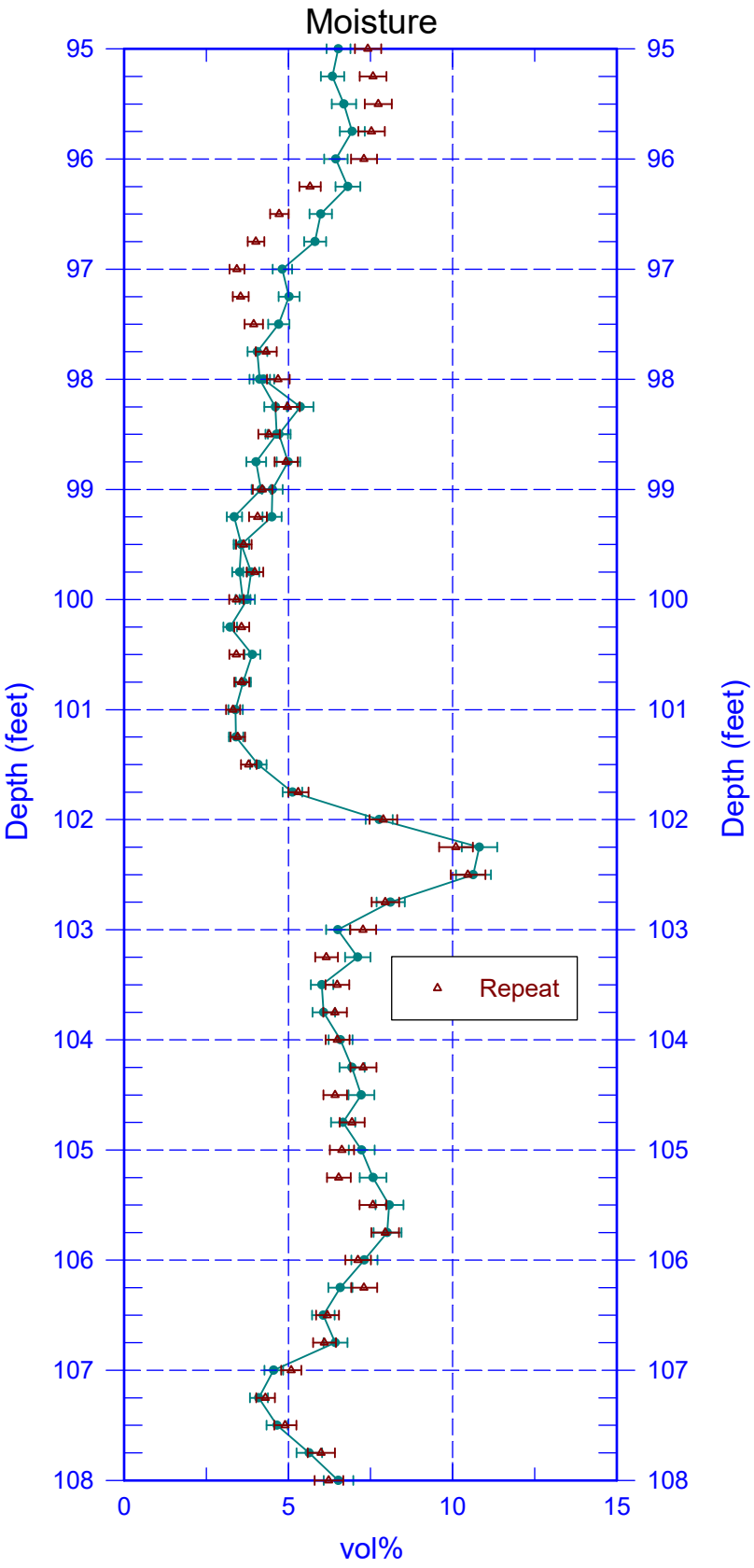


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-127 (C9605)

Moisture Repeat Section

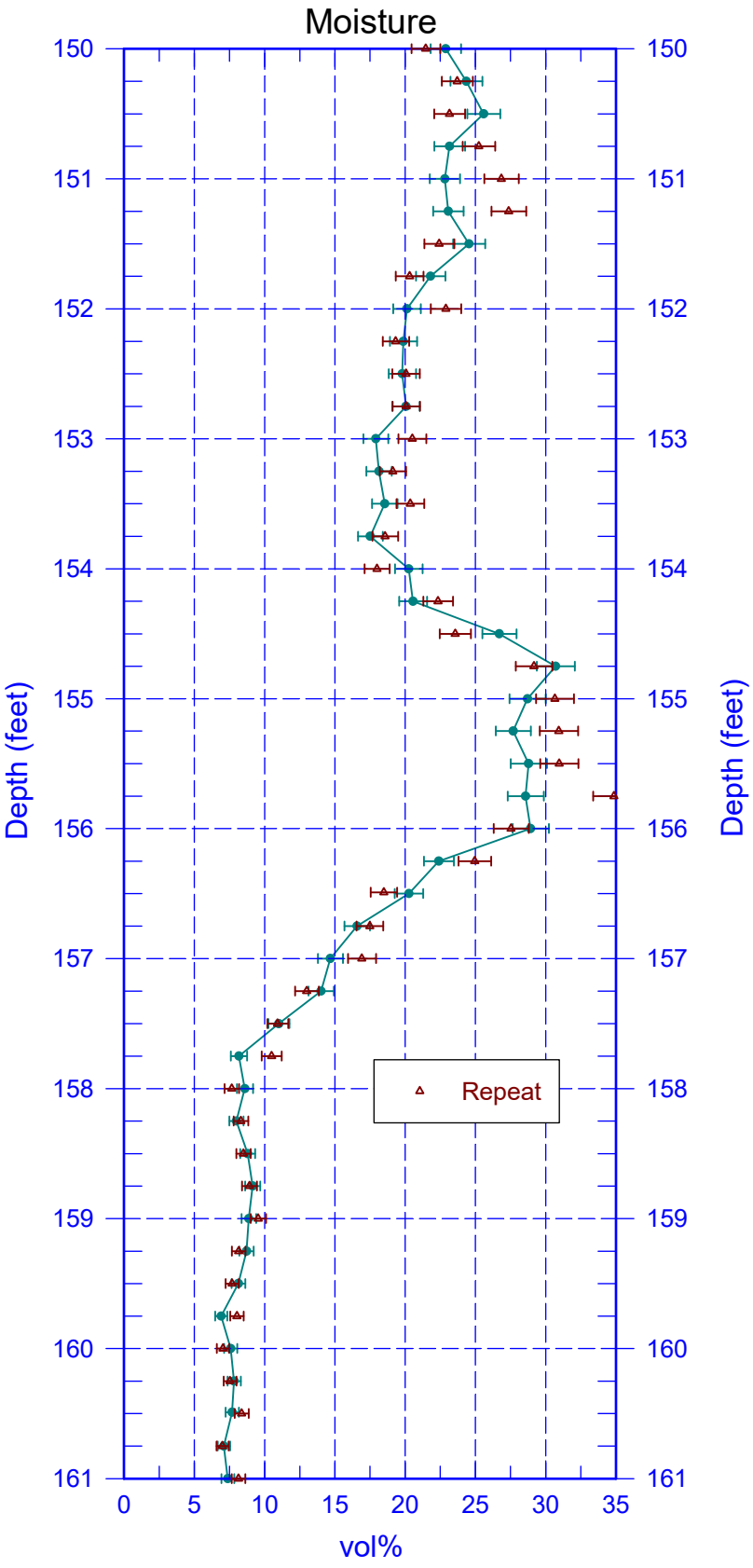


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-127 (C9605)

Moisture Repeat Section

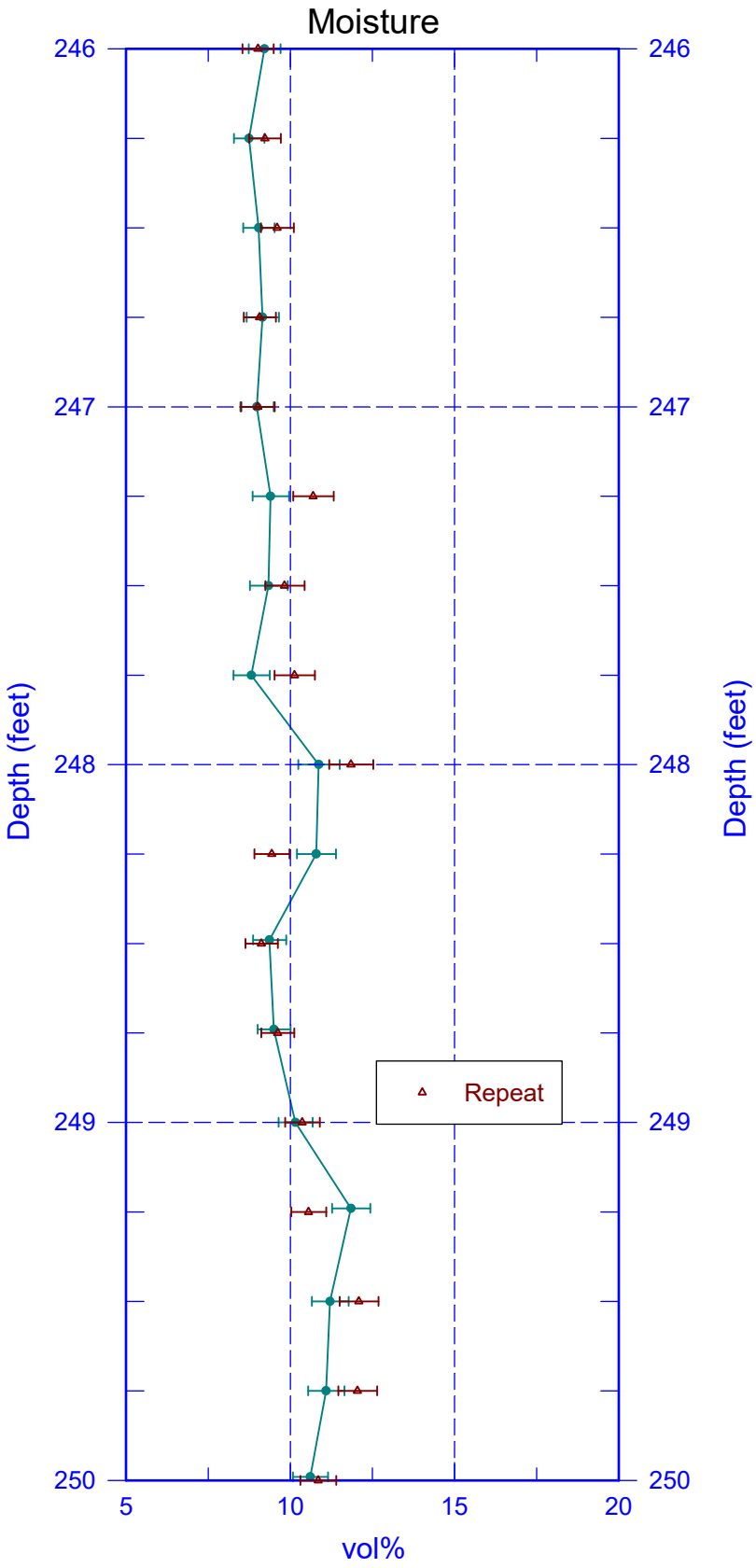


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-127 (C9605)

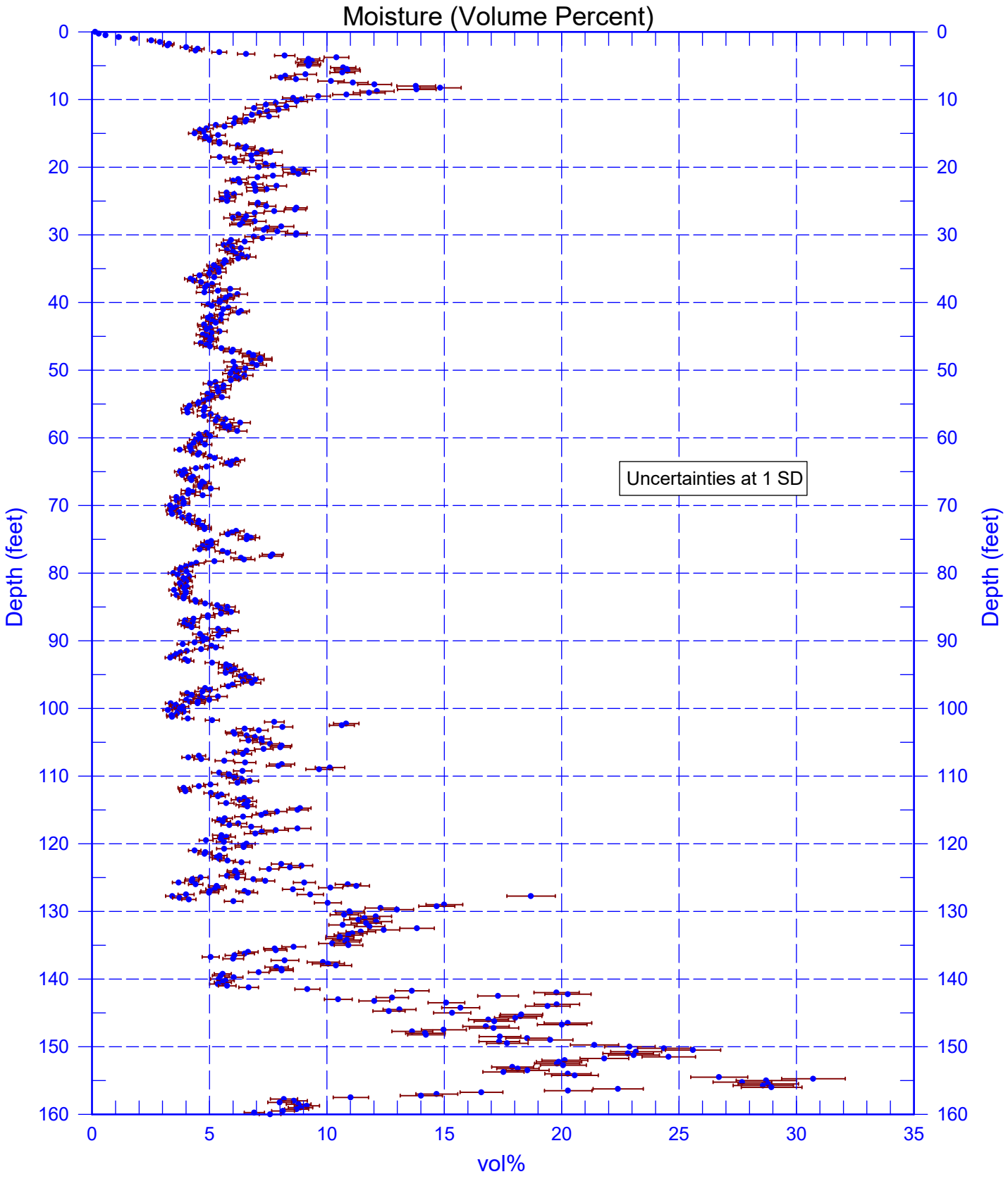
Moisture Repeat Section



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

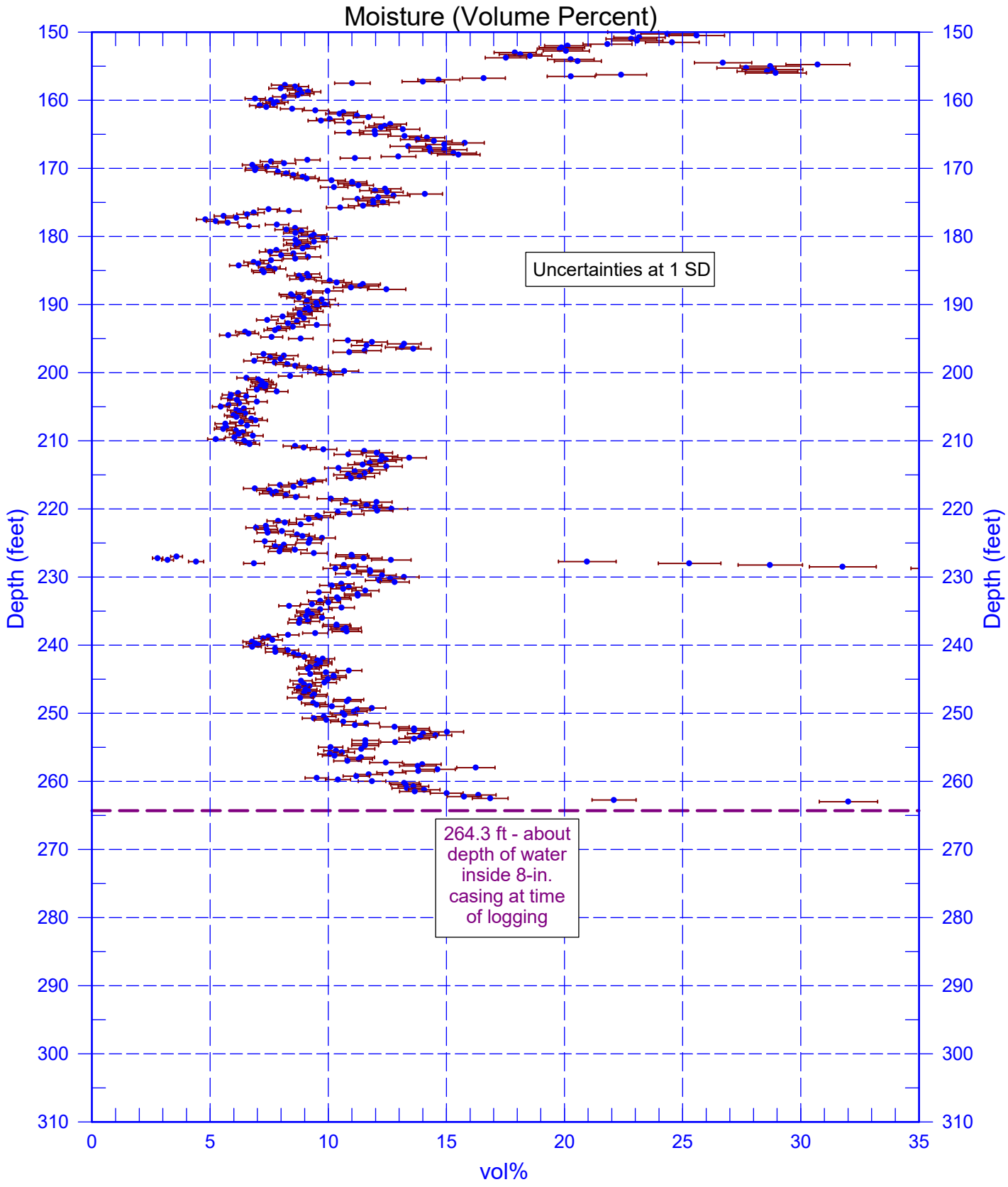
299-W19-127 (C9605)
Moisture with Uncertainties



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-127 (C9605)
Moisture with Uncertainties



Zero Reference - ground surface

WELL SURVEY DATA REPORT

Project:	**Prepared By:** Neil P. Fastabend
	Company: CPCC
Date Requested: 03/14/23	**Requestor:** Steven E. Imhoff (CPCC)
Date of Survey: 03/29/23	**Surveyor / Company:** Lawrence B. Munnell / CPCC
Description of Work: Obtained final survey coordinates (C/L Casing) and elevations of Well C9605 (299-W19-127) located west of U-Plant in 200W Area.	**Horizontal Datum:** NAD83 (91)
	Vertical Datum: NAVD88
	Units: Meters
	Hanford Area Designation: 200W

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments: Washington State Reference Network

Vertical Control Monuments: 2W-39 (CPCC) and 2W-49 (CPCC)

Well ID	Well Name	Easting	Northing	Elevation	
C9605	299-W19-127	567036.73	135110.71		Center of Casing
				210.551	Top Inner 4"Casing, N.Edge
				210.904	Top Outer Casing,N.Edge Stamped "X"
				210.173	Brass Survey Marker

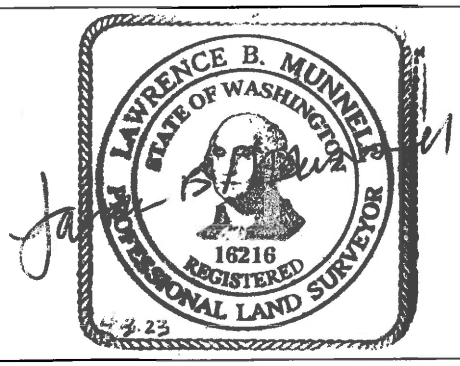
Notes:

Brass Survey Marker elevation was taken on top of domed brass cap in concrete.

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:

I, Lawrence B. Munnell, a Professional Land Surveyor registered in the State of Washington (Registration No. 16216), hereby certify this report is based on a field survey performed by me, or under my direct supervision.



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WELL DEVELOPMENT AND TESTING DATA

Well ID: C9605	Well Name: 299-W19-127	Date: 3/1/2023

Location: ~500 m West of U-plant

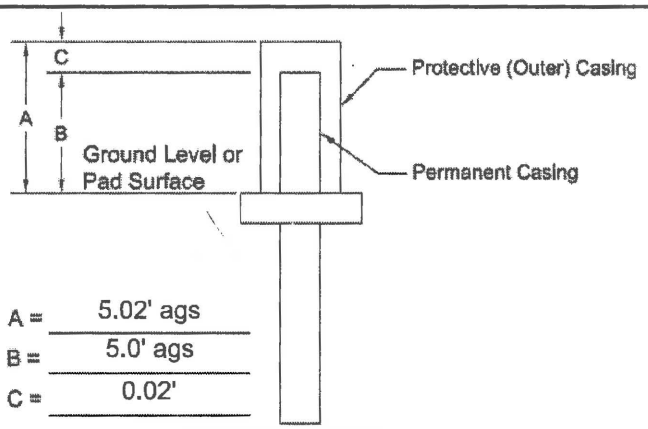
Reference Measuring Point *(unless otherwise noted)*: TOP OF OUTER CASING (TOC)

Has the well been surveyed? ○ Yes ◉ No

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

Initial Conditions

	Start of Job	End of Job
STATIC WATER LEVEL:		
Date: 03/01/2023	260.0' bgs	-
Date: 03/06/2023	-	262.6' bgs
DEPTH TO BOTTOM:		
Date: 03/01/2023	292.5' bgs	-
Date: 03/06/2023	-	293.4' bgs



A = 5.02' ags
B = 5.0' ags
C = 0.02'

Intake Depth (ft bgs)	Specific Capacity (gpm/ft)	Troll Depth (ft bwt)	Turbitidy (NTU) Initial	Turbitidy (NTU) Final	Pump Start	Pump Stop	Pumping Rate (gpm)	Maximum Drawdown (ft)
286.0' bgs	0.2	3.45	57.3	4.59	0736	1013	0.72 gpm	3.57

Total Pumped: 108 gallons

Pump Model: Grundfos 1.5 HP submersible pump

Troll Serial Number and Pressure Range (PSI and depth): In-situ Level TROLL 700-vented Serial 812103 70m/231ft 100 PSI

Comments:
- Two intervals of well development were planned based on the screen length, but there was large drawdown during development of the lower interval and insufficient water to permit development of the second interval.
- The troll depth started at 3.45' on 03/06/2023 the pump's power was set at the lowest level possible to prevent the well from being pumped dry, however, the water depth continued to decrease throughout the morning until the last measurement read -.12'. At that point the well had been developed so the pump was turned off.

Prepared By:

Kelsey Peta		05/02/23
Print Name	*Signature*	*Date*

Reviewed By:

John L. Smoot		5/3/2023
Print Name	*Signature*	*Date*

For Office Use Only

OR Doc Type:	WMU Code(s):

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Photo Archive Log for 299-W19-127 (C9605)

0 – 5 ft bgs

5 – 10 ft bgs

10 – 15 ft bgs

15 – 20 ft bgs

20 – 25 ft bgs

25 – 30 ft bgs

30 – 35 ft bgs

35 – 40 ft bgs

40 – 45 ft bgs

45 – 50 ft bgs

50 – 55 ft bgs

55 – 60 ft bgs

60 – 65 ft bgs

65 – 70 ft bgs

70 – 75 ft bgs

75 – 80 ft bgs

80 – 85 ft bgs

85 – 90 ft bgs

90 – 95 ft bgs

95 – 100 ft bgs

100 – 105 ft bgs

105 – 110 ft bgs

110 – 115 ft bgs

115 – 120 ft bgs

120 – 125 ft bgs

125 – 130 ft bgs

130 – 135 ft bgs

135 – 140 ft bgs

140 – 145 ft bgs

145 – 150 ft bgs

150 – 155 ft bgs

155 – 160 ft bgs

160 – 165 ft bgs

165 – 170 ft bgs

170 – 175 ft bgs

175 – 180 ft bgs

180 – 185 ft bgs

185 – 190 ft bgs

190 – 195 ft bgs

195 – 200 ft bgs

200 – 205 ft bgs

205 – 210 ft bgs

210 – 215 ft bgs

215 – 220 ft bgs

220 – 225 ft bgs

225 – 230 ft bgs

230 – 235 ft bgs

235 – 240 ft bgs

240 – 245 ft bgs

Photo Not Taken

245 – 250 ft bgs

250 – 255 ft bgs

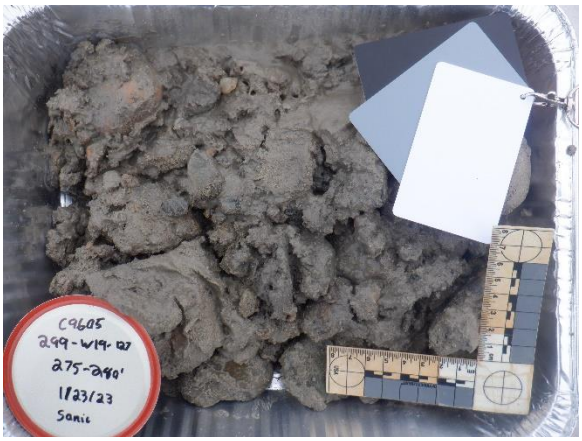
255 – 260 ft bgs

260 – 265 ft bgs

Photo Not Taken

265 – 270 ft bgs

270 – 275 ft bgs



275 – 280 ft bgs

280 – 285 ft bgs

285 – 290 ft bgs

290 – 295 ft bgs

295 – 300 ft bgs

300 – 305 ft bgs

305 – 310 ft bgs

310 – 315 ft bgs

315 – 320 ft bgs

320 – 325 ft bgs

325 – 330 ft bgs

330 – 335 ft bgs

335 – 340 ft bgs

340 – 345 ft bgs

345 – 350 ft bgs

350 – 355 ft bgs

355 – 360 ft bgs

360 – 365 ft bgs

365 – 370 ft bgs

370 – 375 ft bgs

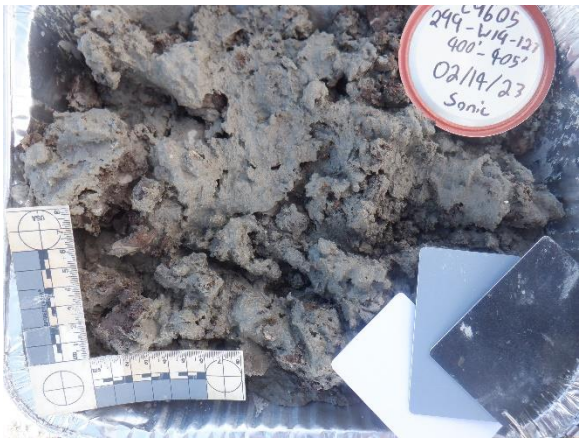
375 – 380 ft bgs

380 – 385 ft bgs

385 – 390 ft bgs

390 – 395 ft bgs

395 – 400 ft bgs



400 – 405 ft bgs

405 – 410 ft bgs

410 – 415 ft bgs

415 – 420 ft bgs

420 – 425 ft bgs

425 – 430 ft bgs

430 – 435 ft bgs

435 – 440 ft bgs

440 – 445 ft bgs

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Appendix B

Well Documentation for 299-W19-128 (C9606)

- Well Summary Sheet for 299-W19-128
- Well Construction Summary Report for 299-W19-128
- Borehole Log for 299-W19-128
- Geophysical Log Data Report for 299-W19-128
- Well Survey Data Report for 299-W19-128
- Well Development and Testing Data Sheet for 299-W19-128
- Photo Log for 299-W19-128

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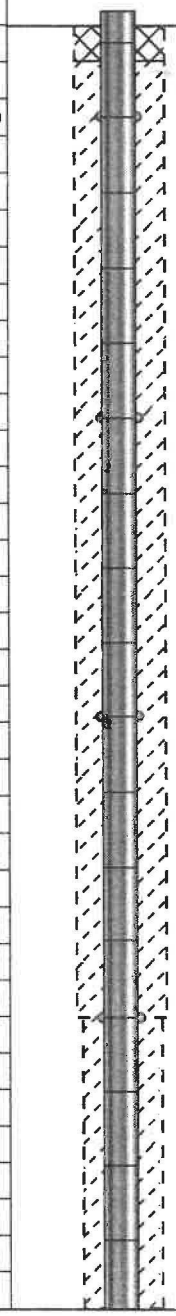
WELL SUMMARY SHEET

Well ID: C9606	Well Name: 299-W19-128	Start Date: 03/07/2023
Project: 2 Monitoring Wells 200-UP-1 OU	Location: 535 m NW of U-plant	End Date: 05/25/2023

CONSTRUCTION DATA

Description
Surface Completion:
4 x 4 x 0.5 ft concrete pad with
brass survey marker and protective
monument (3.52 ft ags - 1.55 ft bgs)
WA Ecology Tag #: BMS753
Construction Materials:
Type 1L Portland Cement:
0.0 ft bgs - 10.17 ft bgs
#8/12 Bentonite Crumbles:
10.17 ft bgs - 253.08 ft bgs
3/8" Bentonite Pellets:
253.08 ft bgs - 255.95 ft bgs
#12/20 Filter Pack Silica Sand
255.95 ft bgs - 292.2 ft bgs
Bentonite Grout Slurry:
292.2 ft bgs - 367.7 ft bgs
Natural Fill:
367.7 ft bgs - 371.5 ft bgs
Bentonite Chips:
371.5 ft bgs - 384.8 ft bgs
Bentonite Slurry:
384.8 ft bgs - 411.4 ft bgs
Well Materials:
4.5" OD TP-304/304L Sch 10s Blank:
2.19 ft ags - 258.60 ft bgs
4.5" OD TP-304 20-slot (0.020")
Screen:
258.60 ft bgs - 288.65 ft bgs
4.5" OD TP-304/304L Sump/Cap:
288.65 ft bgs - 291.65 ft bgs
Hole Dimensions:
10.5" OD Temp. Casing: 128.4 ft bgs
9.25" OD Temp Casing: 218.5 ft bgs
8.20" OD Temp Casing: 317.6 ft bgs
6.02" OD Temp Casing: 410.5 ft bgs
4.85" OD Core barrel: 411.4 ft bgs

Diagram



GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
0		0 - 5 ft: Silty Sandy Gravel
		5 - 10 ft: Sandy Gravel
		10 - 15 ft: Silty Sandy Gravel
		15 - 25 ft: Sand
25		25 - 35 ft: Gravel
		35 - 40 ft: Silty Sandy Gravel
		40 - 50 ft: Gravel
50		50 - 55 ft: Silty Gravel
		55 - 85 ft: Sandy Gravel
75		
		85 - 125 ft: Slighty Silty Sand
		Note: ags = above ground surface
100		bgs = below ground surface
125		125 - 135 ft: Silt
		135 - 140 ft: Silty Gravel
		140 - 155 ft: Silty Sandy Gravel
150		
		155 - 160 ft: Silty Gravelly Sand
		160 - 175 ft: Sandy Gravel
		175 - 185 ft: Gravel

Reported By:			
Ellen Whitney	Geologist II		10/23/2023
Print Name	*Title*	*Signature*	*Date*
Reviewed By:			
Nicholas Olivier	BTR		11/2/23
Print Name	*Title*	*Signature*	*Date*

For Office Use Only

OR Doc Type:	WMU Code(s):

A-6003-643 (REV 2)

WELL SUMMARY CONTINUATION SHEET

Well ID: C9606 | Well Name: 299-W19-128 | Project: 2 M Wells 200-UP-1 OU

CONSTRUCTION DATA

Surface Completion:
4 x 4 x 0.5 ft concrete pad with brass survey marker and protective monument (3.52 ft ags - 1.55 ft bgs) WA Ecology Tag #: BMS753

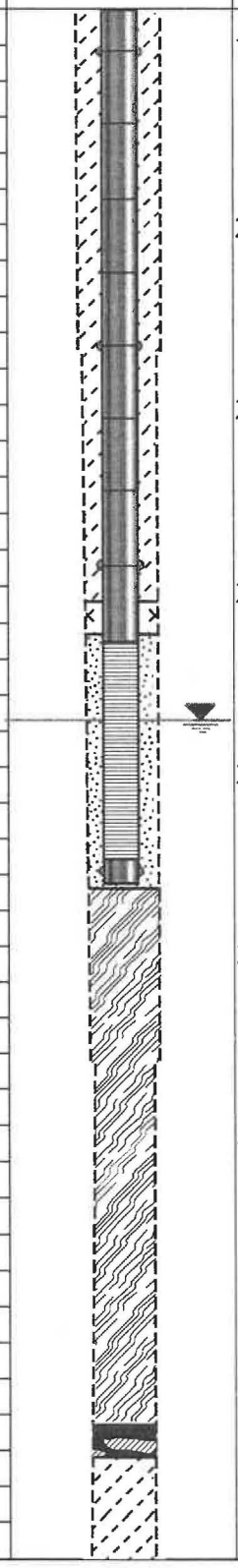
Construction Materials:
Type 1L Portland Cement:
0.0 ft bgs - 10.17 ft bgs
#8/12 Bentonite Crumbles:
10.17 ft bgs - 253.08 ft bgs
3/8" Bentonite Pellets:
253.08 ft bgs - 255.95 ft bgs
#12/20 Filter Pack Silica Sand
255.95 ft bgs - 292.2 ft bgs
Bentonite Grout Slurry:
292.2 ft bgs - 367.7 ft bgs
Natural Fill:
367.7 ft bgs - 371.5 ft bgs
Bentonite Chips:
371.5 ft bgs - 384.8 ft bgs
Bentonite Slurry:
384.8 ft bgs - 411.4ft bgs

Well Materials:
4.5" OD TP-304/304L Sch 10s Blank:
2.19 ft ags - 258.60 ft bgs
4.5" OD TP-304 20-slot (0.020") Screen:
258.60 ft bgs - 288.65 ft bgs
4.5" OD TP-304/304L Sump/Cap:
288.65 ft bgs - 291.65 ft bgs

Hole Dimensions:
10.5" OD Temp Casing: 128.4 ft bgs
9.25" OD Temp Casing: 218.5 ft bgs
8.20" OD Temp Casing: 317.6 ft bgs
6.02" OD Temp Casing: 410.5 ft bgs
4.85" OD Core barrel: 411.4 ft bgs

Note:
ags = above ground surface
bgs = below ground surface

Diagram



Depth in Feet: 175, 200, 225, 250, 275, 300, 325, 350, 375

GEOLOGIC/HYDROLOGIC DATA

Graphic Log

Lithologic Description (ft bgs)

160 - 175 ft: Sandy Gravel
175 - 185 ft: Gravel
185 - 195 ft: Sandy Gravel
195 - 200 ft: Gravelly Sand
200 - 220 ft: Sandy Gravel
220 - 225 ft: Silty Sandy Gravel
225 - 240 ft: Sandy Gravel
240 - 245 ft: Silty Sandy Gravel
245 - 270 ft: Sandy Gravel
Depth to Water = 263.2 (05/23/23)
270 - 290 ft: Silty Sandy Gravel
290 - 295 ft: Silty Gravel
295 - 305 ft: Silty Sandy Gravel
305 - 310 ft: Silty Gravel
310 - 315 ft: Silty Sandy Gravel
315 - 340 ft: Sandy Gravel
340 - 375 ft: Silty Gravel
375 - 385 ft: Silty Sandy Gravel
385 - 395 ft: Silty Gravel

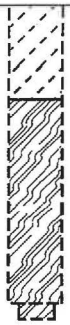
A-6006-992 (REV 0)

WELL SUMMARY CONTINUATION SHEET

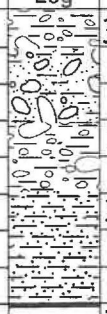
Page 3 of 3

Well ID: C9606 | Well Name: 299-W19-128 | Project: 2 M Wells 200-UP-1 OU

CONSTRUCTION DATA

Description	Diagram
Surface Completion:	
4 x 4 x 0.5 ft concrete pad with brass survey marker and protective monument (3.52 ft ags - 1.55 ft bgs)	
WA Ecology Tag #: BMS753	
Construction Materials:	
Type 1L Portland Cement:	
0.0 ft bgs - 10.17 ft bgs	
#8/12 Bentonite Crumbles:	
10.17 ft bgs - 253.08 ft bgs	
3/8" Bentonite Pellets:	
253.08 ft bgs - 255.95 ft bgs	
#12/20 Filter Pack Silica Sand	
255.95 ft bgs - 292.2 ft bgs	
Bentonite Grout Slurry:	
292.2 ft bgs - 367.7 ft bgs	
Natural Fill:	
367.7 ft bgs - 371.5 ft bgs	
Bentonite Chips:	
371.5 ft bgs - 384.8 ft bgs	
Bentonite Slurry:	
384.8 ft bgs - 411.4 ft bgs	
Well Materials:	
4.5" OD TP-304/304L Sch 10s Blank:	
2.19 ft ags - 258.60 ft bgs	
4.5" OD TP-304 20-slot (0.020") Screen:	
258.60 ft bgs - 288.65 ft bgs	
4.5" OD TP-304/304 L Sump/Cap:	
288.65 ft bgs - 291.65 ft bgs	
Hole Dimensions:	
10.5" OD Temp Casing: 128.4 ft bgs	
9.25" OD Temp Casing: 218.5 ft bgs	
8.20" OD Temp Casing: 317.6 ft bgs	
6.02" OD Temp Casing: 410.5 ft bgs	
4.85" OD Core Barrel: 411.4 ft bgs	
Note: All temporary casing has been removed from the ground.	
ags = above ground surface	
bgs = below ground surface	

GEOLOGIC/HYDROLOGIC DATA

Depth in Feet	Graphic Log	Lithologic Description (ft bgs)
375		375 - 385 ft: Silty Sandy Gravel
		385 - 395 ft: Silty Gravel
400		395 - 410 ft: Sandy Silt
		Total Depth: 411.4 ft bgs
425		
450		
475		
500		
525		
550		
575		

not used
11/1/2023

A-6006-992 (REV 0)

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WELL CONSTRUCTION SUMMARY REPORT

Start Date: 03/07/2023
Finish Date: 05/25/2023
Page: 1 of 1

Well ID: C9606	Well Name: 299-W19-128	Ecology Tag #: BMS753
Location: 535 m NW of U-plant		Project: Install of 2/200-UP-1 OU Monitoring Wells
Drilling Company: Cascade Drilling, LP		Other Companies: GRAMNW, CPCCo, Bay West LLC
Driller: Efelito Rauch	License #: 2839	Geologist(s): Ellen Whitney, Dan Charbonneaux, Mikheil Tatishvili, Samie Foster, Ryan Bailey

TEMPORARY CASING AND DRILL DEPTH

Size (in.)	Joint Type (Wld or Thd)	Interval (ft.)	Shoe Size (OD/ID) (in.)
10.5	Thd	0.0 - 128.4	10.5/9.625
9.25	Thd	128.4 - 218.5	9.25/9.19
8.20	Thd	218.5 - 317.6	8.20/7.32
6.02	Thd	317.6 - 410.5	6.02/5.20
—	—	—	—

DRILLING METHOD

Type of Drill Rig	HOLE DIAMETER (in.) / INTERVAL (ft.)		
Sonic	Diameter: 10.5	From: 0.0	To: 128.4
Sonic	Diameter: 9.25	From: 128.4	To: 218.5
Sonic	Diameter: 8.20	From: 218.5	To: 317.6
Sonic	Diameter: 6.02	From: 317.6	To: 410.5
Sonic	Diameter: 4.85	From: 410.5	To: 411.4

Total Drilled Depth: 411.4 **Hole Dia @ TD:** 4.85 **Total Amount of Water Added During Drilling:** 75 gallons

COMPLETED WELL

Permanent Casing

Size & Material	Depth (ft.)	Slot Size (in.)
4.5" TP-304 sch 10s Riser	2.2 ags - 258.60	N/A
4.5" TP-304 V-Wire Screen	258.60 - 288.65	0.020
4.5" TP-304 sch 10s Sump	288.65 - 291.65	N/A
	-	
	-	
	-	
	-	
	-	
	-	

Construction Material

Type	Intervals (ft.) Annular Seal / Filter Pack	Volume (ft.^{3})	Mesh Size
Cement Grout	0.0 - 10.17	5.1	1/L
Bentonite Crumbles	10.17 - 253.08	119.6	#8-20
Bentonite Pellets	253.08 - 255.95	1.5	3/8"
Filter Pack	255.95 - 292.2	8.25	#12/20
Bentonite Slurry	292.2 - 367.7	12.6	N/A
Natural Fill	367.7 - 371.5	5.6	N/A
Bentonite Chips	371.5 - 384.8	2.2	Medium
Bentonite Slurry	384.8 - 411.4	5.5	N/A
—	-	—	—

OTHER ACTIVITIES

Well Straightness Test Results: Passed (05/03/2023)

Well Development Date: 5/22/2023	**Well Decommissioned?**	**Yes** ☐ **No** ☒
Saturated Thickness: 28.6	—	**Date:** —
Pumping Rate (gpm): 3.08, 4.36	**Description:** —	
Total Volume Purged: 5272.77	**Decommissioning Profile Attached?**	**Yes** ☐ **No** ☒
Drawdown: 4.14, 7.17	**Static Water Level:** 263.2	**Date:** 05/23/23

COMMENTS/REMARKS

All depths listed as below ground surface unless otherwise stated.
bgs = below ground surface, ags = above ground surface.

Title: Geologist II

Ellen Whitney — **Reported By** (Print) — Signature — 10/23/2023 (Date)

Title: BTR

Nicholas Olivier — **Reviewed By** (Print) — Signature — 11/2/23 (Date)

FOR OFFICE USE ONLY

OR Doc Type:	WMU Code(s):

A-6003-658 (REV 2)

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BOREHOLE LOG

Page 1 of 21

Well ID: C9606 | Well Name: 299-N19-128 | Date: 3/13/2023

Location: 535m NW of V-plant

Project: Installation of 2 Monitoring wells 200-UP-1 OU

Reference Measure Point: Ground surface

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
0			0 – 5' bgs silty sandy Gravel (msG) Backfill material. 50% sand, 35% gravel, 15% silt. Sand: fine to v coarse, poor sort, rnd dom, sub ang, sub disc, 65% F / 35% M, F: 80% qtz, 10% v. felds, 5% mica M: basalt, orngy, 2.5y 3/3 dark olive brown (moist), mild HCl rxn. Gravel: 2mm – 130 mm, poor sort, 30 mm dom, sub rnd, sub prism, 100% basalt. Silt: coating larger clasts + in clumps strong HCl rxn	Sonic rig temp. casing: 10 3/4" core barrel: 8 3/16 / 7 5/8"
5	C9606 3/13/23			Archive @ 5' bgs
			5 – 10' bgs sandy Gravel (sG) Backfill material. 70% Gravel, 20% sand, 10% silt. Gravel: 3mm dom, mod sorting, all else same as @ 0-5' bgs. Sand: v fine to v coarse, v coarse dom, all else same as above. Silt: loose.	
10	C9606 3/13/23			Archive @ 10' bgs
			10 – 15' bgs silty sandy Gravel (msG) Sloppy + darker. 50% sand, 30% gravel, 20% silt. Clumps of dark silty sand. Sand: med – coarse, coarse dom, well sort, sub ang, sub disc, 90% F, 20% M F: 90% qtz, 10% felds trace mica, M: basalt w/ grn 2.5y 2.5/1 black, mild HCl rxn. Gravel: as described @ 5-10' bgs. Silt: highly plastic, black, mild HCl rxn / wet.	
15	C9606 3/13/23			Archive @ 15' bgs

Reported By: Ellen Whitney — Print Name | Staff Geologist II — Title | Signature | 4/26/2023 — Date

Reviewed By: TOLLEF WINSLOW (Affiliate) — Print Name | Digitally signed by TOLLEF WINSLOW (Affiliate) Date: 2023.08.22 14:28:33 -07'00' — Signature | Title | Date

For Office Use Only

OR Doc Type: | WMU Code(s):

A-6003-642 (REV 1)

BOREHOLE LOG (Cont.)

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Date: 3/13/2023

Well ID: C9606 | Well Name: 299-W19-128 | Location: 535 m NW of V-plat

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			15 - 25' bgs Sand (S)	Sonic Rig
			Dry, 90% sand, 10% silt.	temp casing 10 1/2"
			Sand: fine - med sand, med dom, v well	core barrel: 8 1/16"
			sorted, sub prism, sub rnd, 90% F/	
20	GS 3/13/23		10% M. F: 90% qtz 10% Felds trace NCa,	
			2.5 Y 5/3 light olive brown, mld	
			HCl rxn. Clumpy.	Archive @ 20' bgs
			Silt: loose + in clumps.	
			@ 20 - 25' bgs. Dry. Strong	
			HCl rxn. All else same as @ 15-20' bgs.	
			25 - 35' bgs Gravel: (G)	
			Moist. 80% Gravel, 10% sand, 10% silt.	
25	GS 3/13/23		Gravel: 2 - 90 mm, mod sorting,	Archive @ 25' bgs
			half dom 20 mm, half dom 35 mm,	
			sub rnd, prismoidal, 90% M/10% F	
			M: basalt. F: quartzite, 100%.	
			Sand: v fine to fine, fine dom, v well	
			sorted, sub ang to sub rnd, 90% F, 10% M	
			F: 65% qtz, 30% felds, 5% NCa, 2.5 Y	
			4/2 dark grayish brown.	
			Silt: highly plastic, adheres sand to	
			rocks in clumps. Strong HCl rxn.	
30	GS 3/13/23		@ 30 - 35' bgs. Dry. Gravel: 2 - 130 mm,	Archive @ 30' bgs
			poor sort, 25 mm dom, prismoidal, rnd,	
			100% basalt, black.	
			Sand: 2.5 Y 5/2 grayish brown, strong	
			HCl rxn,	
			Silt: loose, coating larger grains	
35	GS 3/13/23			Archive @ 35' bgs

Reported By:

Ellen Whitney — Print Name | Geologist II — Title | Signature | 5/25/2023 — Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 3/13/2023

Well ID: C9609 | Well Name: 299-W19-128 | Location: 535 m NW of U-plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			35 – 40' bgs silty sandy Gravel (ms G) Dry. 70% Gravel, 15% silt, 15% sand Gravel: 2–150 mm, well sorted, 25mm dom, angular, somewhat prismoidal, 100% basalt, black,	Sonic @ temp. casing: 10 1/2" core barrel: 8 1/16
40	GS 3/13/23		Sand: v fine to v coarse, poor sort, v coarse dom, sub angular, sub disc, 50% m/50% F larger clasts basalt/Mafic fines: Felsic. Specific comp unknown, vigorous HCl rxn, 2.5Y 7/1 light gray, (trace mica seen), Silt: loose + coating larger clasts, vigorous HCl rxn. Some well lithified clumps.	Archive @ 40' bgs
45	G 3/13/23		40 – 50' bgs Gravel (G) Dry. 80% Gravel, 10% silt, 10% sand, Gravel: 2–150 mm, poorly sort, 20mm dom, angular, sub disc, 85% M/ 15% F. Mafic 100% basalt. Felsic: 50% quartzite, 50% granite. Sand: sub angular to sub rnd, sub prism, 50% m/50% F, M: 100% basalt origin, F: 60% qtz, 40% felds. 2.5Y 7/1 light gray. All else same as 35–40' bgs. Vigorous HCl	Archive @ 45' bgs
50	GS 3/13/23		Silt: loose + coating larger grains	Archive @ 50' bgs
			@ 45–50' bgs. Moist. 80% gravel, 15% sand, 5% silt. Gravel: sub prism, F: 80% quartzite, 20% granite. All else same as @ 40–45' bgs Sand: sub rnd, mixed sphericity: disc leaning, All else same as 40–45' bgs vigorous HCl rxn.	
55	GS 3/13/23			Archive @ 55' bgs

Reported By:

Ellen Whitney — Print Name | Geologist II — Title | Signature | 5/25/2023 — Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 3/13/2023

Well ID: C9606 | Well Name: 299-W19-128 | Location: 535m NW of V plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			50 – 55' bgs silty Gravel (mG)	Sonic Rig
			40% Gravel, 30% Sand, 30% Silt	temp. casing 10 1/2"
			Gravel: 2–45mm, well sorted, avg 5mm,	core barrel 8 1/16"
			mostly sub angular, sub prism, 100%	
			basalt, black.	
60	GS 3/13/23		Sand: v fine to v coarse, poor sort,	
			coarse dom, sub rnd, sub prism,	Archive @ 60' bgs
			60% F / 40% M f: 70% qtz, 30% felds,	
			M: basalt origin. 2.5Y 7/1 light gray	
			vigorous HCl rxn.	
			Silt: binds clumps, coats clasts,	
			very clumpy. Vigorous HCl rxn.	
			moderate plasticity. Flury loose	
			between clumps.	
			ed 3/13/23	
65	GS 3/13/23		55 – 60 85' bgs sandy Gravel (sG)	Archive @ 65' bgs
			Moist. 55% sand, 35% Gravel, 10% Silt.	
			Gravel: 2–20mm, well sorted, 12mm	Note: due to elevated
			dom, sub disc, sub rnd, 80% M / 20% F	rad readings, soil from
			M: 100% basalt F: 100% quartzite, (2.5Y	65–325' bgs was not
			6/6 olive yellow) GLEY 1 5/N gray.	described as thoroughly
			Sand: 2.5Y 5/3 light olive brown,	by the field geologists.
			v fine to v coarse, poor sorting, v	The field geologists were
			coarse dom, sub prism + disc, sub ang,	instructed by ACT to
			50% M / 50% F, M: basalt origin 100%,	not touch the soil. Archive
70	NOT COLLECTED		F: 80% qtz, 20% feldspar,	samples were not collected.
			Silt: loose, some remolding	No Archive collected
			chunks. mod HCl rxn.	@ 70' + 75' bgs.
				Elevated radiological
			@ 60–65' bgs. Moist. 60% sand, 30% G,	readings.
			10% silt, Gravel: 2–12mm, 6mm dom,	100 counts per min
			sub prism, sub rnd to sub angular,	above background.
			Sand: sub prism, sub ang to sub rnd,	
			mod HCl rxn. All else same as	
			@ 55–60' bgs.	
75	NOT COLLECTED			
			@ 65 – 75' bgs. No sample collected.	No Archive collected
			From safe distance appears similar	@ 75–80' bgs, RAD
			to @ 60–65' bgs.	readings 70–100 cpm
			@ 75–80' bgs. No sample. Appears similar	above background

Reported By:

Ellen Whitney / Dan Chairbourn — Geologist II — 5/25/2023

Print Name — Title — Signature — Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 3/13/2023

Well ID: C9606 | Well Name: 299-W19-128 | Location: 535m NW of U-plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			possibly more silt, small rusty looking patches. (<10%) as seen from safe distance.	Sonic Rig temp. casing 10 1/2" core barrel 8 1/16"
80	NOT COLLECTED		80-85' bgs. No sample collected. Appears similar to 65-70' bgs.	No Archive collected 80-85' bgs due to elevated RAD readings. 200cpm above background.
			85 - 125' bgs (slightly silty sand?)	
85	Not COLLECTED		85 - 95' bgs. No sample collected. Appears to be slightly silty sand with occasional gravels.	No Archive collected. 85 - 90' bgs Elevated rad 150-200 cpm above background.
90	Not Collected			
95	NOT COLLECTED		90-95' bgs. No sample collected. Described above.	No Archive collected 90-95' bgs. Elevated Rad 150-200 cpm above background.

Reported By:

Ellen Whitney — Print Name | Geologist II — Title | Signature | 5/25/2023 — Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 3/14/2023

Well ID: C9606 | Well Name: 299-W19-128 | Location: 535m NW of U-plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			@95-100' bgs. No sample collected. Appears to be nearly all sand. No obvious silt or gravel.	Sonic Rig temp. casing 10½" core barrel 8 1/16"
100	NOT COLLECTED			No Archive collected @95-100' bgs. 150-200 cpm above background elevated RAD.
105	NOT COLLECTED		@100-105' bgs. No sample collected. Appears to be slightly silty sand.	No Archive collected @100-105' bgs. 150-200 cpm above background elevated RAD.
110	NOT COLLECTED		@105-110' bgs. No sample collected. Appears to be slightly silty sand.	No Archive collected @105-110' bgs. 150-200 cpm above background elevated RAD.
115	NOT COLLECTED		@110-115' bgs. No sample collected. Appears to be gravelly silty Sand.	No Archive collected @110-115' bgs. 100-150 cpm above background elevated RAD.

Reported By:

Ellen Whitney — Print Name | Geologist II — Title | [signature] — Signature | 5/25/2023 — Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 3/14/2023

Well ID: C9606 | Well Name: 299-W19-128 | Location: 535m NW of U-plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
			@ 115-119' bgs, no sample collected. Appears to be sand or silty sand. 2.5Y 5/3 light olive brown. Mild HCl rxn. No visible gravels. grab	Sonic Rig temp. casing 10 1/2" core barrel 9 1/16"
120	Not collected		@ 119-122' bgs, no sample collected. Appears to be silty sand, some caliche present. Vigorous HCl rxn. Some qtz & mica sand grains (med-coarse) visible. Identified by field geologist as CCU for purpose of collecting split-spoon @ top of CCU.	No archive collected @ 115-119' bgs, ~140 cpm above background elevated rad.
				I-01 split-spoon @ 118.2-123.2' bgs, 100% recovery, 3/15/23 @ 9:00
			@ 122-125' bgs, appears same as 119-122' bgs. No sample collected.	No archive collected @ 119-122' bgs, ~140 cpm above background elevated rad
			125 – 135' bgs Silt (M)	
125	Not collected		@ 125-130' bgs. No sample collected. Appears to be thick, moderately plastic ~~sandy~~ silt. Damp. Color: 3/2 or 2.5Y. Very dark grayish brown. >90% silt. Vigorous HCl rxn. No visible sand or gravel. Assisted determined by how sample kept shape after being discharged from drill b.t.	No archive collected @ 122-125' bgs, ~140 cpm above background elevated rad
			@ 130-135' bgs. Same as above (125-130').	No archive collected @ 125-130' bgs, ~100 cpm above background elevated rad
			@130-mt 03.20.2023	No archive collected @ 130-135' bgs, ~100 cpm above background elevated rad.
130	Not collected			19.5" TD 06/01/23
				10' 12" temporary casing set at 128.4' bgs. Borehole geophysically logged and switch to 9.25" casing
135	Not collected			

Reported By:

Dan Cherbonneaux / Matthew Rabideau — Geologist / Staff Env. Sci. — Signature — Date

Print Name — Title

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 03.20.2023

Well ID: C4606 | Well Name: 299-W19-188 | Location: 535 m NW of U-Plant.

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
140	Not collected		@ 135-140 Silty Gravel mtb. No sample collected. Appears to be large chunks of gravel ≈ 50-70 mm. Damp. Covered in layers of thick silt, low plasticity based on how it kept stuck coming out of drill. Basalt dominant gravel. Vigorous HCl rxn. Color: 4/3 on 2.5Y olive Brown.	No ordvm collected @ 135-140 bgs ~100 ppm above background elevated rad.
			@ 140-145 Silty Sandy Gravel smb No sample collected. Large chunks-small chunks of gravel (2-60 mm) down by ≈ 5 mm. Appears to be mostly mafic (basalt) based gravel. Unable to determine composition of sand, but appears to be coarse-medium grain distribution. Wet silt covers large gravel and coarse sand to stick. No plasticity. Strong HCl rxn. Moisture: Dry w/ exception to silt. Color: 4/1 on 2.5Y. Dark gray.	No ordvm collected @ 140-145' bgs; ~100 ppm above background elevated rad.
145	Not collected			No ordvm collected @ 145-150' bgs. ~100 ppm above background elevated rad.
			@ 145-150 Same as above (140-145).	No ordvm collected @ 150-155' bgs. ~100 ppm above background elevated rad.
			@ 150-155 Same as above (140-145)	Sonic rig Temp casing 9.25" Core Barrel 8 1/16"
150	Not collected			
155	Not collected			

Reported By:

Print Name	Title	Signature	Date
Michael Tatshuk	Staff Environmental Scientist		03.20.23

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

Page 2 of 21

Date: 08.20.2023

Well ID: C9606 | Well Name: 299-W19-128 | Location: 535m NW of U Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
160	Not collected		@ 155-160 Silty Gravelly Sand sm G No sample collected	No cuttings collected @ 155-160' bgs;
			≈ 50 cpm above background still. 2-10mm chunks of gravel.	~100 cpm above background
			Down by ≈ 10 mm. Gravel appears to be primarily composed	elevated rad.
			of basalt. >90% mafics. Unable to determine content of sand,	
			but appears to be medium-very fine grain distribution. Gravel	No cuttings collected @ 160-165' bgs
			is poorly sorted, sand is well sorted. Damp silt causes sand	~100 cpm above background
			to stick to larger grands. Low/non plasticity for silt. Moderate	elevated rad.
			HCl rxn. due to water saturation. Color: 4/2 on 2.5Y.	
			Dark grayish brown.	No cuttings collected @ 165-170' bgs.
				~100 cpm above background
165	Not collected		@ 160-165 Sandy Gravel sG No sample collected.	elevated rad.
			Gravel: 2-70 mm, dom by ≈ 10 mm. >90% mafics. Basalt dom.	
			Rounded, Subangular. Some subangular subdiscoidal. Poorly sorted.	No cuttings collected @ 170-175' bgs.
			Sand: Coarse to fine grain dist. Appears to be mostly mafics.	~100 cpm above background
			Poorly sorted sand. Trace amounts of silt <2%.	elevated rad.
			Moisture: Dry. No HCl rxn, too little silt.	
			Color: 5/1 on 10YR. Gray.	Sonic rig.
				temp casing 9.25"
			@ 165-170 same as above (160-165)	Core barrel 8 1/16"
170	Not collected		@ 170-175 Sandy Gravel sG No sample collected.	
			Gravel: 2-50 mm, ≈ 10 mm dom. 75%. mafics, 30%. felsic.	
			Mafics: Basalt dominant. felsics: Quartz to dom. Discoidal, angular.	
			Moderately sorted. Moisture: Dry.	
			Sand: >90% mafics, Basalt dom. Coarse to fine grain dist.	
			No HCl rxn. Color: 4/1 on 5Y. Dark gray.	
175	Not collected			

Reported By:

Michael Tschudin — Print Name

Staff Environmental Scientist — Title

Signature

08.20.23 — Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 03.20.2023

Well ID: CA606 | Well Name: 299-W19-128 | Location: 535 m NW of U Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
180	Not Collected		@ 175-180 Gravel G. No sample collected.	No ordnance collected @ 175-180' bgs
			Gravel: 2-70 mm. 20 mm dom. 85%. mafic, 15%. felsic.	~100 cpm above background
			Mafic: Basalt dom. Felsic: Quartzite dom. Subrounded-sub-prismoidal. Some are more rounded. Poorly sorted.	elevated rad.
			Moisture: Dry. No rxn with HCl.	No ordnance collected @ 180-185' bgs
			Sand: While there is little sand, it appears to be primarily mafic >90%. Coarse to medium grain distribution. Basalt dom.	~100 cpm above background
			Color: 4/1 on 2.5Y. Dark gray.	elevated rad.
			@ 180-185 Same as above (175-180)	No ordnance collected @ 185-190' bgs
185	Not Collected			~100 cpm above background
			@ 185-190. Sandy Gravel SG No sample collected.	elevated rad.
			Gravel: 5-60 mm, approx. 7mm dom. 75%. mafic, 25%. felsic.	No ordnance collected @ 190-195' bgs
			Mafic: Basalt dom. Felsic: Quartzite dom. Discoidal-prismoidal	~100 cpm above background
			Subangular-subrounded. Poorly sorted.	elevated rad.
			Sand: Appears to be primarily mafic, but unsure.	
			Basalt dom, trace quartz. Possibly some feldspar.	Sonic rig
			Coarse to medium grain distribution.	temp casing 9.26"
			No rxn with HCl. Moisture: Dry.	Core Barrel 8 1/16"
			Color: 4/2 on 2.5Y. Dark grayish brown.	
190	Not Collected			
			@ 190-195 Sandy Gravel SG No sample collected.	
			Gravel: 5-60 mm, approx 15mm dom. 85%. mafic, 15%. felsic.	
			Subrounded-rounded. Spheroidal-discoidal. Poorly sorted.	
			Mafic: Basalt dom. Felsic: Quartzite dom.	
			Sand: 50%. mafic, 50%. felsic. Mafic: Basalt dominant.	
			Felsic: Quartz dom, trace feldspar. Coarse to medium grain distribution. No rxn with HCl. Moisture: Dry.	
			Color: 5/3 on 2.5Y. Light olive brown.	
195	Not Collected			

Reported By:

Michael Fairchild — Print Name

Field Engineering Geologist — Title

Signature

03.20.23 — Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 03.21.2023

Well ID: C9606 | Well Name: 299-W19-128 | Location: 535 m NW of U Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy. Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
200	Not Collected		@185-200' Gravelly Sand 2S No sample collected.	No cuttings collected @185-200' bgs
			Gravel: 5-30 mm, 15 mm dom. 20% gravel, 80% sand.	~100 cpm above background levels,
			Appears to be primarily mafic (80% mafic, 20% felsic).	elevated rad.
			Mafic: Basalt dom. Felsic: Quartz to dom. Prismatic, Angular.	
			Moderately sorted.	No cuttings collected @ 200-205' bgs
			Sand: 50% mafic, 50% felsic. Coarse to fine grain	~100 cpm above background levels,
			distribution. Mafic: Basalt dom. Felsic: Quartz dom. Trace feldspar.	elevated rad.
			No rxn with HCl. Moisture: Dry.	
			Color: 5/3 on 2.5Y. Light olive brown.	
				No cuttings collected @ 205-210' bgs
205	Not Collected		@ 200-205 Sandy Gravel SG No sample collected	~100 cpm above background levels,
			Gravel: 2-65 mm, 15 mm dom. 70% gravel, 30% sand.	elevated rad.
			60% mafic, 40% felsic. Mafic: Basalt dom. Felsic: Quartz dom.	
			Trace sandstone. SR angular-SR rounded. Prismatic-spherical.	
			Poorly sorted.	No cuttings collected @ 210-215' bgs.
			Sand: 50% mafic/50% felsic. Coarse to fine grain.	~100 cpm above background levels,
			distribution. Mafic: Basalt dom. Felsic: Quartz dom.	elevated rad.
			No rxn with HCl. Moisture: Dry.	
			Color: 6/1 on 2.5Y. Gray.	Sonic rig
				temp casing 9.25"
210	Not Collected		@ 205-210. Same as above, but with wet	Core Barrel 8 1/16"
			moisture from introduction of water for drilling.	
			(200-205). When artificial moisture dries, identical	
			to above sample.	
			@ 210-215 Same as above (205-210).	~75 gal water used today
				to drill from 185-215.
215	Not Collected			

Reported By:

Print Name	Title	Signature	Date
Michael Petrosinski	Staff Environmental Scientist		03.21.2023

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 03.21.2023

Well ID: C9806 | Well Name: 299-W19-128 | Location: 535 m NW of U Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
220	Not Collected		@ 215-220 Sandy Gravel. SG No sample collected.	No ordnance collected @ 215-220' bgs.
			Gravel: 2-90 mm. Down by 5mm. 50% gravel, 50% sand.	~100 ppm above background levels.
			70% mafic, 30% felsic. Mafic: Basalt dom. Felsic: Quartzite dom.	Elevated rad.
			Precambrian-discordal. Angular-sub rounded. Poorly sorted.	JSP 01/01/23
			Sand: 80% mafic, 20% felsic. Mafic: Mica dom.	Geophysical logging @ 225'
			green color indicates possible Glauconite? Quartz and	9.25" casing set at
			Feldspar dominate Felsic. Coarse to fine grain	218.5' bgs, borehole
			distribution. Moderately sorted. No rxn with HCl.	geophysically logged and
			Moisture: Dry. Color: 6/4 on 10Y-5GY Pale Olive.	casing switched to 8.20"
225	Not Collected		@ 220-225 Silty Sandy Gravel. mg SG No sample collected.	No ordnance collected @ 220-225' bgs.
			Gravel: 2-50 mm, 20 mm dom. 75% gravel, 15% silt, 10% sand.	~100 ppm above background levels.
			70% mafic, 30% felsic. Mafic: Basalt dom. Felsic: Quartzite dom.	Elevated rad.
			Subangular-rounded, subspherical-discordal. Moderately sorted.	
			Sand: 50% mafic, 50% felsic. Mafic: Basalt dom. Felsic: Quartz dom.	
			Coarse to medium grain dist. Moderately sorted.	
			Silt: Low plasticity, clay-like. Change from coring bit.	
			No rxn with HCl. Moisture: Dry. Color: 4/1 on 2.5Y. Dark gray.	
230	Not Collected		@ 225-230 Sandy Gravel. SG No sample collected.	No ordnance collected @ 225-230' bgs.
			Gravel: 4-60 mm, 25 mm dom. 70% gravel, 30% sand.	~100 ppm above background levels.
			60% mafic, 40% felsic. Mafic: Basalt dom. Felsic: Quartzite dom.	Elevated rad.
			Subangular-rounded, spherical-discordal. Moderately sorted.	
			Sand: 50% mafic, 50% felsic. Mafic: Basalt dom. Felsic: Quartz dom.	
			Coarse to fine grain dist. Well sorted. No rxn w/ HCl	
			Moisture: Dry. Color: 6/3 on 5Y. Pale Olive.	
235	Not Collected		@ 230-235 Same as above (225-230). No sample collected.	No ordnance collected @ 230-235' bgs.
				~100 ppm above background levels.
				Elevated rad.
				Same rxg.
				temp casing 8.20"
				Core Barrel 7.01"

Reported By:

Michael Takishenki — Print Name

Staff Environmental Scientist — Title

Signature

03.21.2023 — Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 03.23.2023

Well ID: CA606 | Well Name: 299-W19-135 | Location: 533 m NW of U Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
240	Not collected		@ 235-240' Sandy Gravel. sG No Sample Collected	No cuttings collected @ 235-240' bgs
			Gravel: 2-90 mm, 5 mm dom. 70%. gravel, 30%. sand.	~150 cpm above background levels.
			60%. mafic, 40%. felsic. Mafic: Basalt dom. Felsic: Quartzite dom.	Elevated rad.
			Trace marble and sandstone. Subangular-rounded. Prismoidal-discoidal.	
			Poorly sorted.	No cuttings collected @ 240-245' bgs.
			Sand: 50%. mafic, 50%. felsic. Mafic: Basalt dom. Felsic: Quartzite dom.	~100 cpm above background levels.
			Coarse to medium grain distribution. Well sorted. No rxn w/ HCl	Elevated rad.
			Moisture: Dry. Color: 6/2 on 2.5Y. Light Brownish gray.	
				Add water for drilling @ 245-250
			@ 240-245' Silty Sandy Gravel wsG No sample collected	
245	Not collected		Gravel: 2-70, 10 mm dom. 70%. gravel, 15%. sand, 15%. silt.	No cuttings collected @ 245-250' bgs.
			70%. mafic, 30%. felsic. Mafic: Basalt dom. Felsic: Quartzite dom.	~100 cpm above background levels.
			Possible proceed further rock analyses. Prismoidal.	Elevated rad.
			Angular-sub rounded. Poorly sorted.	
			Sand: 60%-felsic, 40%. mafic. Felsic: Quartz dom. Mafic: Basalt dom.	No cuttings collected @ 250-255' bgs.
			Coarse to medium grain distribution. Moderately sorted.	~100 cpm above background levels.
			Silt: Low plasticity. Mud. No/Little change from drill.	Elevated Rad.
			No rxn w/ HCl. Color: 7/2 on 2.5Y. Light gray. Dry.	
			@ 245-250' bgs. Sandy Gravel sG No sample collected.	Sonic rig
250	Not collected		Gravel: 2-70 mm, 10 mm dom. 70%. gravel, 30%. sand.	Temp casing 8.20"
			70%. mafic, 30%. felsic. Mafic: Basalt dom. felsic: Quartzite dom.	Core barrel 7.01"
			Trace desert? Prismoidal-discoidal. Angular-sub rounded.	
			Poorly sorted.	
			Sand: 60%. felsic, 40%. mafic. felsic: Quartzite to dom, some feldspar	
			Mafics: Basalt dom. Coarse to fine grain dist.	
			Poorly sorted. No rxn with HCl. Moisture: Dry.	
			Color: 5/1 on 2.5Y. Gray.	
			@ 250-255' bgs. Sandy Gravel sG No sample collected.	
255	Not collected		Gravel: 2-50 mm. 10 mm dom. 50%. gravel, 50%. sand.	
			50%. mafic, 50%. felsic. Mafic: Basalt dom. Felsic: Quartzite dom.	
			Discoidal-equant. Angular-rounded. Moderately sorted.	
			Sand: 60%. felsic, 40%. mafic. felsic: Quartz dom Mafic: Basalt dom.	
			Coarse to medium grain distribution. Moderately sorted.	
			No rxn w/ HCl. Color: 3/3 on 2.5Y. Dark olive brown.	
			Moisture: Dry.	

Reported By:

Michael Tatarski	Staff Environmental Scientist		03.23.2023
Print Name	Title	Signature	Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 03.27.2023

Well ID: C4606 | Well Name: 299-W19-128 | Location: 535 m NW of U Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
260	Not Collected		@ 255-260' bgs. Sandy Gravel ~6 No Sample Collected.	No ordvs collected @ 255-260' bgs.
			Gravel: 2-80 mm. 7 mm dom. 75Y. gravel, 25Y. sand.	~100 cpm above background levels
			70Y. mafic, 30Y. felsic. Mafic: Basalt dom. Felsic: Quartzite dom.	Elevated rad.
			Prismoidal-discoidal. Angular-rounded. Poorly sorted.	
			Sand: 50Y. mafic, 50Y. felsic. Mafic: Basalt dom. felsic: Quartz dom.	No ordvs collected @ 260-265' bgs.
			Coarse to fine grave dist. Moderately sorted. Medium grain dom.	~50 cpm above background levels
			No rxn w/ HCl. Moisture: Dry.	Elevated rad.
			Color: 6/1 on 2.5Y. Gray.	
	Water Table Tag 03.27.23			No ordvs collected @ 265-270' bgs
			@ 260-265' bgs Sandy Gravel Same as above	~50 cpm above background levels
265	Not Collected		(255-260) except moisture: wet. No sample collected.	Elevated rad.
			@ 265-270' bgs Sandy Gravel Same as above	Water tagged @ 264.3' bgs.
			(255-260) except moisture: wet. No sample collected.	on 03/27/23
				No ordvs collected @ 270-275' bgs.
			@ 270-275' bgs. ~~Sandy~~ Silty Sandy Gravel MSG No Sample Collected	~30 cpm above background levels
			Gravel: 2-60 mm. 5-10 mm dom. 70Y. gravel, 15Y. sand, 5Y. silt.	Elevated rad.
			50Y. mafic, 50Y. felsic. Mafic: Basalt dom. felsic: Quartzite dom.	
			Discoidal-splaty-eat. Sub-angular-rounded. Poorly sorted.	Same rig
			Sand: Unable to determine M:F ratio due to muddy silt.	Temp casing 8.20"
270	Not Collected		Appears to be coarse to medium grain dist. Moderately sorted.	Core Barrel 7.01"
			Silt: No plasticity. Muddy. No HCl rxn.	
			Color: 5/1 on 2.5Y. Gray. Moisture: Wet.	
275	Not Collected			

Reported By:

Print Name	Title	Signature	Date
Michael Tatshardt	Staff Environmental Scientist		03.27.2023

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

Page 15 of 21

Date: 03.28.2023

Well ID: C9606 | Well Name: 299-W19-125 | Location: 536 m NW of U Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
280	Not Collected		@ 275-280' bgs. Silty Sandy Gravel msG. No Sample Collected.	Water tagged @ 261.4' bgs.
			60% Gravel, 20% Sand, 20% Silt. Moisture: Wet.	Pump flow @ 1.64 gpm. 03/28/23
			Gravel: 5-60 mm. 25mm dom. 60% mafic, 40% felsic. Mafic: Basalt dominant.	
			Felsic: Quartz dom. Prismoidal-discoidal. Subangular-rounded. Moderately sorted.	No advance collected @ 275-280' bgs
			Sand: 50% mafic, 50% felsic. Mafic: Basalt dom. Felsic: Quartz dom.	~100 cpm above background levels.
			Coarse to medium grain dist. Coarse dom. Well sorted.	Elevated rad.
			Silt: Low-med plasticity based on knot shape from drill bit. Mud/clay-like.	
			No HCl rxn. Color: 4/2 on 2.5Y, Dark Grayish Brown.	No advance collected @ 280-285' bgs.
				~100 cpm above background levels.
			@ 280-285' bgs. Silty Sandy Gravel msG No Sample Collected.	Elevated rad.
285	Not Collected		Same as above (275-280').	
				No advance collected @ 285-290' bgs
			@ 285-290' bgs. Silty Sandy Gravel msG No Sample Collected.	~100 cpm above background levels.
			Same as above (275-280') However, due to higher moisture	Elevated Rad.
			content, silt has lost all plasticity.	
				No advance collected @ 290-295' bgs
			@ 290'-295' bgs. Silty Gravel mG No Sample Collected.	~100 cpm above background levels.
			70% gravel, 30% silt. Moisture content: Wet.	Elevated Rad.
			Gravel: 2-70 mm, ≈40 mm dom. 70% mafic, 30% felsic.	
			Mafic: Basalt dom. Felsic: Quartz dom. Subangular-rounded.	~~Hit~~ Borehole tagged @ PFS @ 29.83 296' bgs. 03/29/23
290	Not Collected		Prismoidal-discoidal. Moderately Sorted.	
			Silt: No plasticity. Muddy. No HCl rxn due to moisture?	
			Color: 4/1 on 2.5Y. Dark Gray.	Same rig
				Temp casing 8.20"
				Core Barrel 7.01"
295	Not Collected			

Reported By:

Print Name	Title	Signature	Date
Mitchell Tahdooahnippah	Staff Environmental Scientist		03.28.2023

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

Page 16 of 21

Date: 03.30.2023

Well ID: C9606 | Well Name: 299-W19-128 | Location: 535 m NW of U Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
300	Not Collected		@ 295-300' bgs Silty Sandy Gravel msG No Sample Collected.	No volume collected @ 295-300' bgs.
			70% gravel, 20% sand, 10% silt. Moisture: Dry.	~80 cpm above background levels.
			Gravel: 2-70 mm. 10-25mm dom. 65% mafic, 35% felsic. Mafic: Basalt dom.	Elevated rad.
			Felsic: Quartzite dom. Prismoidal-discoidal. Angular-subrounded. Poorly Sorted.	
			Sand: 80% mafic, 20% felsic. Mafic: Basalt dom. felsic: Quartz dom.	No volume collected @ 300-305' bgs.
			Very coarse to Medium distribution. Coarse dominant. Moderately Sorted.	~80 cpm above background levels.
			Silt: No plasticity. Dusty. Strong HCl rxn.	Elevated Rad.
			Color: 5/1 on 5Y. Gray.	
				No volume collected @ 305-310' bgs.
			@ 300-305' bgs. Silty Sandy Gravel msG No Sample Collected.	~80 cpm above background levels.
305	Not Collected		Same as above (295-300')	Elevated Rad.
			@ 305-310' bgs. Silty Gravel mG No Sample Collected.	Rad @ background levels on
			70% gravel, 25% sand, 5% silt. Moisture: Damp.	310-315' bgs. Sample collected.
			Gravel: 4-60 mm. 5-10 mm dom. 70% mafic, 30% felsic. Mafic: Basalt dom.	
			Felsic: Quartzite dom. Spherical-discoidal. Subangular-rounded. Poorly Sorted.	Same rxn
			Sand: Very little, but appears to be 20% mafic, 80% felsic. Mafic: Basalt dom.	Temp casing 8.80"
			Felsic: Quartz dom. Medium to fine grain dist. Medium dom. Moderately sorted.	Core Barrel 7.01"
			Silt: Little/no plasticity. Muddy. Weak HCl rxn.	
			Color: 3/2 on 2.5Y. Very Dark Grayish Brown.	
310	Not Collected			
			@ 310-315' bgs. Silty Sandy Gravel. mG mSG	
			60% gravel, 15% sand, 25% silt. Moisture: Damp.	
			Gravel: 5-85 mm. 15mm dom. 65% mafic, 35% felsic. Mafic: Basalt dom.	
			Felsic: Quartzite dom. Spherical-discoidal. Subangular-rounded. Poorly sorted.	
			Sand: 20% mafic, 80% felsic. Mafic: Basalt dom. felsic: Quartz dom.	
			Feldspars present. Medium to fine grain dist. Moderately sorted.	
			Medium grain dominant.	
			Silt: High plasticity. Clay-like, but with less adhesion. No HCl rxn.	
			Color: 3/3 on 2.5Y. Very dark grayish brown.	
315	grab sample 04.03.23			
				8.20" casing set at 317.6' bgs borehole geophysically logged and casing switched to 6.02"

Reported By:

Print Name	Title	Signature	Date
M. Uael Takahashi	Staff Environmental Scientist		03.30.2023

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 04.03.2023

Well ID: C9606 | Well Name: 299-W19-128 | Location: 535 m NW of U Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
320	Not collected		@ 315-320' bgs. Sandy Gravel sG No Sample Collected.	No Arduvo Collected @ 315-320' bgs.
			60% Gravel, 40% sand. Moisture: Damp.	~100 cpm above background levels
			Gravel: 5-100 mm. 35 mm dom. 65% mafic, 35% felsic. Mafic: Basalt dom. 90%	Elevated rad.
			Felsic: Quartzite dom. 80% Prismoidal-discoidal. Angular-subrounded. Poorly Sorted.	
			Sand: 30% mafic, 70% felsic. Mafic: Basalt dom. 100% Felsic: Quartz dom. 95%	No arduvo collected @ 320-325' bgs.
			Medium to fine grain dist. Medium dom. Well sorted.	~100 cpm above background levels.
			No HCl rxn. Color: 5/2 on 2.5Y. Grayish Brown.	Elevated rad.
			@ 320'-325' bgs. Sandy Gravel sG No Sample Collected.	Rad rs at background levels for
			Same as above (315-320')	both 325-330 and 330-335. Therefore
325	Not collected		Sandy Gravel sG	sample jars and dup trays were
			@ 325'-330' bgs. ~~Silty Sandy Gravel sG~~	collected for both.
			55% gravel, 35% sand, 10% silt. Moisture: Damp.	
			Gravel: 5-100 mm. 35 mm dom. 65% mafic, 35% felsic. Mafic: Basalt dom. 100%	Water tag @ 266.3' bgs. on
			Felsic: Quartzite dom. Granitoids present. Prismoidal-discoidal. Subangular-rounded.	04/06/23
			Poorly sorted.	Arduvo @ 330' bgs
			Sand: 80% mafic, 80% felsic. Mafic: Basalt dom. 100% Felsic: Quartz dom. 90%	
			Feldspars also present. Medium to fine grain dist. Medium dom. Well sorted.	
			Silt: Low plasticity due to high sand content. Damp, no almost dry. Hits	
			No HCl rxn. Color: 4/2 on 2.5Y. Dark grayish brown.	
330	grab Sample 04-06-23		Sandy Gravel sG	
			@ 330-335' bgs. ~~Silty Sandy Gravel sG~~	Arduvo @ 335' bgs
			Same as above (325-330)	
				Same rig
				Temp casing 6.02"
				Core barrel 4.85"
335	grab Sample 04-06-23			

Reported By:

Print Name	Title	Signature	Date
Michael Tahdooahnippah	Staff Environmental Scientist		04.04.2023

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

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Date: 04.11.2023

Well ID: C9606 | Well Name: 299-W19-128 | Location: 555 m NW of U Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
340	grab sample 04-11-23		@ 335-340' bgs. Silty Sandy Gravel wet to sat SG	Rad @ background for 335-340'
			60% gravel, 30% sand, 10% silt. Moisture: Damp.	
			Gravel: 2-60 mm. 30 mm dom. 50% mafic, 50% felsic. Mafic: Basalt dom.	Rad @ background for 340-355'
			Felsic: Quartzite dom. Prismoidal-discoidal. Subangular-rounded. Poorly Sorted.	
			Sand: 30% mafic, 70% felsic. Mafic: Basalt dom. Felsic: Quartz dom.	Borehole tag @ 352.7' bgs on 04/12/23
			Medium to fine grain dist. Medium dom. Prismoidal-spheroid, subangular.	
			Well sorted.	Arduino @ 340' bgs
			Silt: No plasticity. No HCl rxn. Possibly due to moisture?	
			Color: 4/2 on 2.5Y. Dark Grayish Brown.	
345	grab sample 04-10-23		@ 340-345 Silty Sandy Gravel wet to sat mG	
			50% gravel, 20% sand, 30% silt. Moisture: Wet.	Arduino @ 345' bgs
			Gravel: 2-100 mm. 25 mm dom. 50% mafic, 50% felsic.	
			Mafic: Basalt dom. Felsic: Quartzite dom. Calcites and Olivine also present.	
			Possibly sandstone too. Prismoidal-discoidal. Angular-subrounded.	
			Poorly sorted.	
			Sand: 50% mafic, 50% felsic. Mafic: Basalt dom. Felsic: Quartzite.	
			olivine, feldspar also present. Medium to very fines grain dist.	
			Fine dom. Spherical-discoidal, Angular-subangular. Moderately sorted	
			Silt: No plasticity. Muddy. No HCl rxn due to moisture.	
350	grab sample 04-10-23		Color: 4/2 on 2.5Y. Dark Grayish Brown.	
			@ 345-350' bgs. Silty Sandy Gravel wet to sat 06.25.23 mG	Arduino @ 350' bgs
			Same as above (340-345).	
			@ 350-355' bgs Silty Sandy Gravel wet to sat 06.25.23 mG	Arduino @ 355' bgs.
			Same as above (340-345')	
				Some rxn
				Temp casing 6.02"
355	grab sample 04-10-23			Core Barrel 4.85"

Reported By:

Print Name	Title	Signature	Date
Michael Tatarski	Staff Environmental Scientist		04.11.2023

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BOREHOLE LOG (Cont.)

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Date: 04.11.2023

Well ID: C9606 | Well Name: 299-W19-128 | Location: 535 m NW of U Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
360	grab Sample 04.13.23		@ 355-360' bgs. Silty Gravel. 06.15.23 mG	Casing @ ≈ 373' bgs. Sonic.
			50%. gravel, 15%. sand, 35%. silt. Moisture: Wet.	Grab Sampling. Water @ ≈ 363' bgs.
			Gravel: 2-90 mm. 10 mm dom. 40%. mafics, 60%. felsic. Mafics: Basalt dom. 100%. Felsic: Quartzite dom. 100%.	
			Subrounded, weathered basalts also present. Majors calcite? Presumed - discarded.	Red bed @ 355-360 is at background.
			Angular - rounded. Poorly sorted.	Arodrive @ 360' bgs.
			Sand: 50%. mafics, 50%. felsic. Mafics: Basalt dom. 100%. Felsic: Quartz dom. 75%.	Red beds @ background for 360-375
			Feldspars also appear to be present. Medium to very fine grain dist.	
			Fines dominant. Prismoidal - spheroidal. Angular - subangular. Moderately sorted.	Borehole at 378.3' bgs. on 04/13/23
			Silt: No plasticity, moisture content too high. Muddy. No HCl rxn.	Casing at 378.65' bgs. on 04/13/23
			Color: 5/2 on 8.5Y. Grayish Brown.	Water @ 267.85' bgs. on 04/13/23
365	grab Sample 04.13.23		@ 360-365' bgs. Silty Gravel. 06.15.23 mG	Arodrive @ 365' bgs.
			Same as above (355-360)	
370	grab Sample 04.13.23		@ 365-370' bgs. Silty Gravel 06.15.23 mG	Arodrive @ 370' bgs.
			Same as above (355-360)	
375	grab Sample 04.13.23		@ 370-375' bgs. Silty Gravel 06.15.23 mG	Arodrive @ 375' bgs.
			Same as above (355-360)	
				Sonic rig
				Temp casing 6.08"
				Core Barrel 4.85"

Reported By:

Print Name	Title	Signature	Date
Mikhail Takhmakov	Staff Environmental Scientist		04.13.2023

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

Date: 04.17.2023

Well ID: C9606 | Well Name: 299-W19-128 | Location: 535 m NW of U Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
380	grab Sample 04.17.23		Silty Sandy Gravel @ 375-380' bgs. mxG	~~Casing @ 390~~
			60% gravel, 25% sand, 15% silt. Moisture: Damp.	~~Water @ 395~~ WL 06.15.23
			Gravel: 2-70 mm. 25mm dom. 40% mafic, 60% felsic. Mafic: Basalt dom.	~~Grab sampling.~~
			Felsic: Quartzite dom. Some smaller Quartz crystals present. Mafic Basalt	Sonic drilling.
			is weathered. Prismoidal-discoidal. Angular-rounded. Poorly Sorted.	
			Sand: 75% felsic, 25% mafic. Mafic: Basalt dom. Felsic: Quartz dom.	All samples 375-395 are
			Feldspars and Mica also present. Coarse to fine grain dist. Medium dom.	ordered.
			Prismoidal-spherical. Angular-subangular. Moderately sorted.	
			Silt: Little/no plasticity. Dry clay-like. Low HCl rxn.	Analysis @ 380' bgs
			Color: 4/1 on 2.5Y. Dark Gray.	
385	grab Sample 06.17.23		@ 380-385' bgs. Silty Sandy Gravel mxG.	
			60% gravel, 25% sand, 15% silt. Moisture content: Dry.	Analysis @ 385' bgs
			Gravel: 2-80 mm. 10mm dom. 40% mafic, 60% felsic. Mafic: Basalt dom. 100%	
			Felsic: Quartzite dom. 90% Granitoid-like sandstones also present, and composite	
			with quartzite to be the dominant mineral (felsic) in this sample.	
			Basalts are weathered. Prismoidal-discoidal. Angular-rounded. Poorly sorted.	
			Sand: 70% felsic, 30% mafic. Mafic: Basalt dom. 80% Felsic: Quartz dom. 90%	
			Feldspars and some olivine also present. Coarse to very fine grain dist.	
			Fine dominant. Discoidal-spherical. Subangular-subrounded. Moderately Sorted.	
390	grab Sample 06.17.23		Silt: No plasticity, like dust. Strong HCl rxn.	
			Color: 7/1 on 2.5Y. Light Gray.	
			@ 385-390' bgs. Silty ~~Sandy~~ Gravel not analyzed 06.23.23 mxG	
			50% gravel, 15% sand, 35% silt. Moisture content: Damp. 100%	Analysis @ 390' bgs.
			Gravel: 2-55 mm. 15mm dom. 50% mafic, 50% felsic. Mafic: Basalt dom. 90%	
			Felsic: Quartzite dom. Prismoidal-discoidal. Subangular-rounded. Moderately Sorted.	
			Sand: 30% mafic, 70% felsic. Mafic: Basalt dom. Felsic: Quartz dom. Some	
			feldspars present in sand. Coarse to fine grain dist, medium dom. Moderately	
			sorted. Discoidal-spherical. Subangular-subrounded.	
395	grab Sample 04.17.23		Silt: High plasticity. Clay-like. Weak HCl rxn.	
			Color: 5/3 on 2.5Y. Light Olive Brown.	
			@ 390-395' bgs. Silty ~~Sandy~~ Gravel not analyzed 06.23.23 mxG	Analysis @ 395' bgs.
			Same as above (385-390')	
				Screening
				Temp casing 6.02"
				Core Barrel 4.66"

Reported By:

Michael Takahashi — Print Name

Staff Environmental Scientist — Title

Signature

04.17.2023 — Date

A-6006-993 (REV 0)

BOREHOLE LOG (Cont.)

Date: 04.18.2023

Well ID: C9606 | Well Name: 299-W19-128 | Location: 535 m NW of U Plant

Depth (ft)	Sample	Graphic Log	Sample Description: Sediment Classification, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Particle Size, Reaction to HCl, Other	Comments: Depth of Casing, Drilling Method, Sampling Method, Sampler Size, Water Level, Other
400	grab Sample 04.18.23		Sandy Silt @ 395-400' bgs. sM.	Clay lnt @ 405' bgs. RCM.
			70%. silt, 30%. sand. Moisture content: Dry.	Arduro @ 400' bgs
			Sand: 35%. mafic, 65%. felsic. Mafic: Basalt dom. felsic: Quartz dom. 85%.	At 400' bgs top of RLM
			Feldspars also present. Angular-subrounded. Discoidal-spherical. Coarse	was reached. All the way
			to fine grain dist. Coarse dom. Moderately sorted.	until 410 so far, still RLM
			Silt: Very high plasticity. Clay. No HCl rxn.	clay.
			Color: 5/3 on 2.5Y. Light Olive Brown.	
				TD = 411.4' bgs
			@ 400-405' bgs. Sandy Silt sM.	
			80%. silt, 20%. sand. Moisture content: Dry.	
405	grab Sample. 04.18.23		Sand: 35%. mafic, 65%. felsic. Mafic: Basalt dom. felsic: Quartz dom. 85%.	Arduro @ 405' bgs.
			Angular-subrounded. Discoidal-Spherical. Coarse to fine grain dist.	
			Coarse dom. Moderately sorted.	
			Silt: Very high plasticity. Clay. No HCl rxn.	
			Color: 6/2 on 10Y (5GY) Light Greyish Green.	
			@ 405-410' bgs Sandy Silt sM	Arduro @ 410' bgs.
			80%. silt, 20%. sand. Moisture content: Wet (on outside) Dry inside	
			of clay. Sand: 30%. mafic, 70%. felsic. Mafic: Basalt dom. felsic:	
			Quartz dom. Angular-subangular-subrounded. Spherical. Medium to very fine	
410	grab Sample 04.18.23		grain dist. Fine dom. Well sorted.	Some rig
411.4 TD			Silt: Very high plasticity. Clay. No HCl rxn.	Temp casing 6.03"
			Color: 6/2 on 5GY. Light Greyish Green.	Core Barrel 4.85"
415				

Reported By:

Print Name	Title	Signature	Date
Michael Tabaniti	Staff Environmental Scientist		04.18.2023

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299-W19-128 (C9606)
Log Data Report

Borehole Information

Log Date[1]	04/19/2023	Filename	C9606_HG-NM_2023-04-19	Site	200-UP-1 OU
DTW[2] (ft)	**DTW Date**	**DTW Source**	**Drill Date[3]**	**Total Depth[4] (ft)**	**Depth Datum**
265.75	04/04/2023	Bay West	04/18/2023	411.4	Ground Surface

New borehole drilling is commonly accomplished using a telescoping method. Geophysical logging is conducted through each casing string, often including short overlaps with previous log runs. During well completion, the temporary drill casing is removed, and the permanent casing is installed. Geophysical logging is conducted through the temporary casings so that completion materials do not affect the data. This report presents results from geophysical logging through the temporary drill casings.

Casing Information

Casing Type	Drill Type	Stickup (ft)	Diameter (in.)		Thickness (in.)	Top (ft)	Bottom (ft)
			Outer	Inside			
Reinforced Threaded Steel	Cascade Sonic	TC[5]-NA	10.51	10.01	0.25	2.4 AGS[6]	128.4 BGS[7]
Reinforced Threaded Steel	Cascade Sonic	TC-NA	9.27	8.77	0.25	2.36 AGS	218.5 BGS
Reinforced Threaded Steel	Cascade Sonic	TC-NA	8.10	7.58	0.26	3.05 AGS	317.6 BGS
Reinforced Threaded Steel	Cascade Sonic	TC-NA	6.00	5.50	0.25	0.17 AGS	410.5 BGS

Borehole Notes

The onsite geologist provides the current borehole total depth and casing depths daily via an email report. If accessible, the logging engineers measure the casing wall thicknesses using an ultrasonic thickness gauge, the outside diameters using a circumference tape, and then calculate the inside diameter.

Those field measurements are made to compare against more detailed dimension measurements made on April 28, 2021, for the 10.51-in. casing, June 28-30, 2021 for the 8.10- and 9.27-in. casings, and December 11, 2018 for the 6.02-in. casing. For consistency between boreholes using this specific type of steel casing, the detailed measurements were used for casing corrections during data analysis and are reported in the table above.

According to the onsite geologist daily email report, DTW was measured at 276.4 ft BGS the day before logging of the third casing string commenced, and after pumping associated with a water sample. Water inside the casing was encountered at 265.75 ft BGS during neutron moisture logging of the third string.

Logging Equipment Information

Logging System	Gamma 5Pb	Type	He-3 (CPN 503DR) (NMLS[8])
Effective Calibration Date	02/07/2023	Serial No.	H34055445

[1] Log date, by convention, is the final date of geophysical logging.
[2] Depth to water inside casing during logging.
[3] Drill date is the date when drilling is completed prior to logging of the final casing string.
[4] Total depth is the reported depth of the borehole prior to logging of the final casing string.
[5] Temporary casing
[6] Above ground surface
[7] Below ground surface
[8] Neutron Moisture Logging System

Calibration Reference	HGLP-CC-242, Rev. 0	**Logging Procedure**	SGRP-PRO-OP-53024, Rev. 0, Change 4

Logging System	Gamma 5Tb	**Type**	60% Coaxial HPGe[9] (SGLS[10])
Effective Calibration Date	02/08/2023	**Serial No.**	54-TP-13441B
Calibration Reference	HGLP-CC-244, Rev. 0	**Logging Procedure**	SGRP PRO OP 53023, Rev. 0, Change 5

Logging System	Gamma 4Rc	**Type**	60% Coaxial HPGe (SGLS)
Effective Calibration Date	02/23/2023	**Serial No.**	48-TP50478A
Calibration Reference	HGLP-CC-252, Rev. 0	**Logging Procedure**	SGRP PRO OP 53023, Rev. 0, Change 5

Logging System	Gamma 4Mc	**Type**	He-3 (CPN 503DR) (NMLS)
Effective Calibration Date	01/24/2023	**Serial No.**	H340207279
Calibration Reference	HGLP-CC-241, Rev. 0	**Logging Procedure**	SGRP-PRO-OP-53024, Rev. 0, Change 4

SGLS Log Run Information

Log Run	**4**	**5 Repeat**	**6**	**7 Repeat**
HEIS Number	1022312	1022313	1022314	1022315
Date	03/16/2023	03/16/2023	03/22/2023	03/22/2023
Logging Engineer	Thurnau/Spatz	Thurnau/Spatz	Thurnau/C. Meisner	Thurnau/C. Meisner
Start Depth (ft)	0.00	44.00	126.00	209.00
Finish Depth (ft)	128.00	57.00	219.00	219.00
Count Time (sec)	100	100	100	100
Live/Real	R	R	R	R
Shield (Y/N)	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0
Log Speed (ft/min)	NA	NA	NA	NA
Pre-Verification	C9606FTb202303 16AV00CAB1	C9606FTb202303 16AV00CAB1	C9606FTb202303 22AV00CAB1	C9606FTb202303 22AV00CAB1
Start File	AD000000	BD004400	AD012600	BD020900
Finish File	AD012800	BD005700	AD021900	BD021900
Post-Verification	C9606FTb202303 16BV00CAA1	C9606FTb202303 16BV00CAA1	C9606FTb202303 22BV00CAA1	C9606FTb202303 22BV00CAA1
Depth Return Error (in.)	NA	HIGH 2	NA	HIGH 4
Comments	None	None	None	None

SGLS Log Run Information

Log Run	**12**	**13 Repeat**	**14**	**15 Repeat**
HEIS Number	1022316	1022317	1022318	1022319
Date	04/05/2023	04/05/2023	04/19/2023	04/19/2023
Logging Engineer	Thurnau/C. Meisner	Thurnau/C. Meisner	Thurnau/Spatz	Thurnau/Spatz

[9] High-purity germanium
[10] Spectral Gamma Logging System

Log Run	12	13 Repeat	14	15 Repeat
Start Depth (ft)	216.00	280.00	310.00	365.00
Finish Depth (ft)	315.01	291.00	410.00	375.00
Count Time (sec)	100	100	100	100
Live/Real	R	R	R	R
Shield (Y/N)	N	N	N	N
MSA Interval (ft)	1.0	1.0	1.0	1.0
Log Speed (ft/min)	NA	NA	NA	NA
Pre-Verification	C9606DRc202304 05AV00CAB1	C9606DRc202304 05AV00CAB1	C9606DRc202304 19AV00CAB1	C9606DRc202304 19AV00CAB1
Start File	AD021600	BD028000	AD031000	BD036500
Finish File	AD031501	BD029100	AD041000	BD037500
Post-Verification	C9606DRc202304 05BV00CAA1	C9606DRc202304 05BV00CAA1	C9606DRc202304 19BV00CAA1	C9606DRc202304 19BV00CAA1
Depth Return Error (in.)	NA	HIGH 4	NA	HIGH 1
Comments	None	None	None	None

NMLS Log Run Information

Log Run	1	2	3 Repeat	8
HEIS Number	1022320	1022321	1022322	1022323
Date	03/15/2023	03/16/2023	03/16/2023	03/22/2023
Logging Engineer	Thurnau/Spatz	Thurnau/Spatz	Thurnau/Spatz	Thurnau/C. Meisner
Start Depth (ft)	0.00	106.00	100.00	126.00
Finish Depth (ft)	108.00	128.00	113.00	220.00
Count Time (sec)	15	15	15	15
Live/Real	R	R	R	R
Shield (Y/N)	N	N	N	N
MSA Interval (ft)	0.25	0.25	0.25	0.25
Log Speed (ft/min)	NA	NA	NA	NA
Pre-Verification	C9606FPb202303 15AV00CAB1	C9606FPb202303 16BV00CAB1	C9606FPb202303 16BV00CAB1	C9606FPb202303 22AV00CAB1
Start File	AD000000	BD010600	CD010000	AD012600
Finish File	AD010800	BD012800	CD011300	AD022000
Post-Verification	C9606FPb202303 15AV00CAA1	C9606FPb202303 16CV00CAA1	C9606FPb202303 16CV00CAA1	C9606FPb202303 22BV00CAA1
Depth Return Error (in.)	HIGH 2	NA	0	NA
Comments	None	None	None	None

NMLS Log Run Information

Log Run	9 Repeat	10	11 Repeat	NA – all below
HEIS Number	1022324	1022325	1022326	
Date	03/22/2023	04/04/2023	04/04/2023	
Logging Engineer	Thurnau/C. Meisner	Thurnau/C. Meisner	Thurnau/C. Meisner	
Start Depth (ft)	210.00	218.00	260.00	
Finish Depth (ft)	220.00	265.75	265.00	

Log Run	9 Repeat	10	11 Repeat	NA – all below
Count Time (sec)	15	15	15	
Live/Real	R	R	R	
Shield (Y/N)	N	N	N	
MSA Interval (ft)	0.25	0.25	0.25	
Log Speed (ft/min)	NA	NA	NA	
Pre-Verification	C9606FPb20230322AV00CAB1	C9606DMc20230404AV00CAB1	C9606DMc20230404AV00CAB1	
Start File	BD021000	AD021800	BD026000	
Finish File	BD022000	AD026575	BD026500	
Post-Verification	C9606FPb20230322BV00CAA1	C9606DMc20230404BV00CAA1	C9606DMc20230404BV00CAA1	
Depth Return Error (in.)	HIGH 2 1/2	NA	HIGH 2	
Comments	None	None	None	

Logging Operation Notes

Zero depth reference is ground surface. The maximum SGLS logging depth achieved was 410.0 ft. terminating approximately 0.5 ft above the reported casing depth. The maximum NMLS logging depth was 265.75 ft, terminating after entering water.

Centralizers were installed on the sondes during logging. All field verification checks passed their respective acceptance criteria. SGLS verification measurements were acquired in the KUTh-115 and KTh-02 field verifiers.

Analysis Notes

Analyst	R. Spatz & A. Pope	Date	8/5/2023
Reference(s)	SGRP-PRO-OP-53040, Rev. 1, Chg. 2; SGRP-PRO-OP-53051, Rev. 0, Chg. 3		

Where SGLS data were acquired through a single casing, steel casing thickness corrections were applied using the thicknesses indicated in the Casing Information table. Over the following depth intervals, spectra were acquired through two overlapping casing strings and combined casing thickness corrections were applied: from 126 to 128.5 ft in the second-string log (0.50-in.), from 216 to 218.5 ft in the third-string log (0.51-in.), and from 310 and 317.5 ft in the fourth-string log (0.51-in.). Where spectra were acquired in open-hole conditions, no casing corrections were applied. A water correction was applied to all SGLS data below 265.75 ft.

SGLS spectra were processed in batch mode in APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Radionuclide concentrations were calculated using two EXCEL templates identified as Rc_20230223_CC252_assay_HEIS and Tb_20230208_CC244_assay_HEIS. These templates employ efficiency functions and corrections for system dead time as determined by annual calibration.

Wall thickness and OD[11] corrections were applied to the NMLS data acquired in the 0.25-in. thick by 10.51-in. OD and 9.27-in. OD casings. Corrections were also made for data acquired in the 0.26-in. thick by 8.10-in. OD casing. Integrated with the casing diameter and thickness corrections is an initial count rate correction for a sediment composition of a 50-50% ratio of basalt fragments to quartz sand (HGLP-OTH-028).

NMLS data are reported in both cps[12] and vol%[13] moisture. Count rate normalization and conversions from count rate to vol% moisture was performed using EXCEL templates identified as Pb_Cascade_Sonic_MCNP_assay_HEIS and Mc_Cascade_Sonic_MCNP_assay_HEIS. These templates also provide corrections for the steel-reinforced casing joints typical of Cascade sonic drill casings.

[11] Outside diameter
[12] Counts per second
[13] Volume percent

It is important to note that the gamma data uncertainties are reported at 2 standard deviations, and the moisture data uncertainties are reported at 1 standard deviation.

HGU[14] is an empirical unit of gamma activity used as a means to standardize gamma log response across multiple logging systems with different response characteristics. The HGU is defined in terms of measurements in the Hanford Borehole Calibration Facility, and the magnitude is selected such that 1 HGU is approximately equivalent to typical Hanford background activity, based on data from background samples as reported in *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE/RL-96-12).

General Statement about Neutron Moisture Data Presentation and Reporting

Raw neutron count rates are normalized to what is referred to as the "standard tool," as described in HGLP-OTH-028. The purpose of normalizing the count rates is to correct for the differences in response characteristics between different detectors that may be used in the same borehole. Data plots of normalized neutron count rates include an axis label to indicate that the data are normalized. Neutron count rates are loaded to HEIS-GPL as a "raw" data type.

Calculated vol% moisture results are presented in the data plots in a dark cyan color where data were acquired in borehole environments that were within modeled calibration conditions during logging. Valid borehole environments are described in HGLP-OTH-028. Across discrete depth intervals where neutron moisture data are known or strongly suspected to have been acquired in borehole conditions outside of the modeled calibration range, vol% moisture values are still presented, but are plotted in red. Where such data occur, brief explanations are included in the log data reports.

For log runs where all neutron moisture data are collected outside of modeled calibration conditions (typically where borehole diameter is greater than 12-in. OD, or casing is dual-wall), the data will only be presented as raw count rates. Vol% moisture will therefore not be calculated or loaded to the HEIS-GPL database.

It has been observed in most borehole logs where neutron moisture data have been acquired through 12-in. OD sonic casing that the algorithm for calculating vol% moisture across thickened casing joints results in exaggerated corrections. Where this occurs, vol% results are presented in the data plots and loaded to HEIS-GPL without qualification. However, the depths where joints occur are indicated in the results section of the report.

It is ultimately incumbent on the data user to review this report as well as any qualifiers associated with the results loaded to HEIS-GPL prior to making decisions based on these results.

Results and Interpretations

Cesium-137 (^{137}Cs) was detected continuously from 3 to 14 ft, with a maximum concentration of about 4 pCi/g occurring at the 4-ft depth.

Gamma attenuation caused by the reinforced sonic casing joints occurs every 10 ft, resulting in sharp decreases in apparent concentrations and count rates in the natural potassium-40 (^{40}K) and total gamma plots, respectively. In casings 1, 2, and 3, the effect starts at about 8 ft and continues downward to about 308 ft. In casing 4, the effect continues but is less pronounced, beginning at about 311 ft and extending to about 401 ft. Corrections have not been made for the effects of the reinforced casing joints on the SGLS data.

Radon (^{222}Rn) gas buildup is apparent inside the casing during logging of the second casing string from 126 to 219 ft. The presence of ^{222}Rn is not an indication of manmade contamination but is derived from the decay of naturally occurring uranium. Bismuth-214 (^{214}Bi) decay gamma energies at 609 and 1764 keV are used to assay natural occurring ^{238}U concentrations. ^{222}Rn is higher in the ^{238}U decay chain than ^{214}Bi, and when ^{222}Rn gas builds up inside the casing, ^{214}Bi will also begin concentrating inside the casing. Evidence of this phenomenon presents as a divergence of the 609- and 1764-keV ^{214}Bi assays of ^{238}U concentrations. Radionuclide concentration calculations involve energy-specific corrections for both casing and water thickness. The corrections assume the ^{214}Bi is entirely within formation, not inside the casing, and therefore the calculated ^{238}U concentrations are overestimated proportional to the ^{222}Rn levels inside the casing during logging.

[14] Hanford Gamma Unit

A mud slurry thickening with depth may have existed inside the casing between about 311 and 315 ft during logging of the third casing string. Apparent concentrations of ^{40}K, ^{232}Th, ^{238}U, and cps for Total Gamma all increase over this interval. Calculated concentrations and Total Gamma cps from the fourth casing string log data are significantly lower over the same interval, supporting this interpretation.

The neutron moisture log primarily responds to moisture present in the surrounding formation. In general, an increase in count rate reflects an increase in moisture content. Moisture content generally increases where sediment is finer grained.

Moisture data known or strongly suspected to be acquired in conditions outside of the modeled calibration range are plotted in red. This includes data acquired near the end of casing or in open hole, through double casing, within formations significantly disturbed by drilling, water added to aid drilling, or where calculated vol% moisture exceeds 35%.

In this borehole, data acquired through or influenced by double casing extend from 126 to about 129 ft (2nd casing log), and from 218 to about 219 ft (3rd casing log). Data influenced by proximity of the detector to the bottom of casing are from about 127.5 to 128 ft (1st casing log), and from about 218 to 220 ft (2nd casing log). Below about 264.75 ft (3rd casing log), the proximity of the detector to water inside the casing influences the neutron count rate.

The natural gamma and moisture repeat plots show good repeatability, indicating that the systems were working properly.

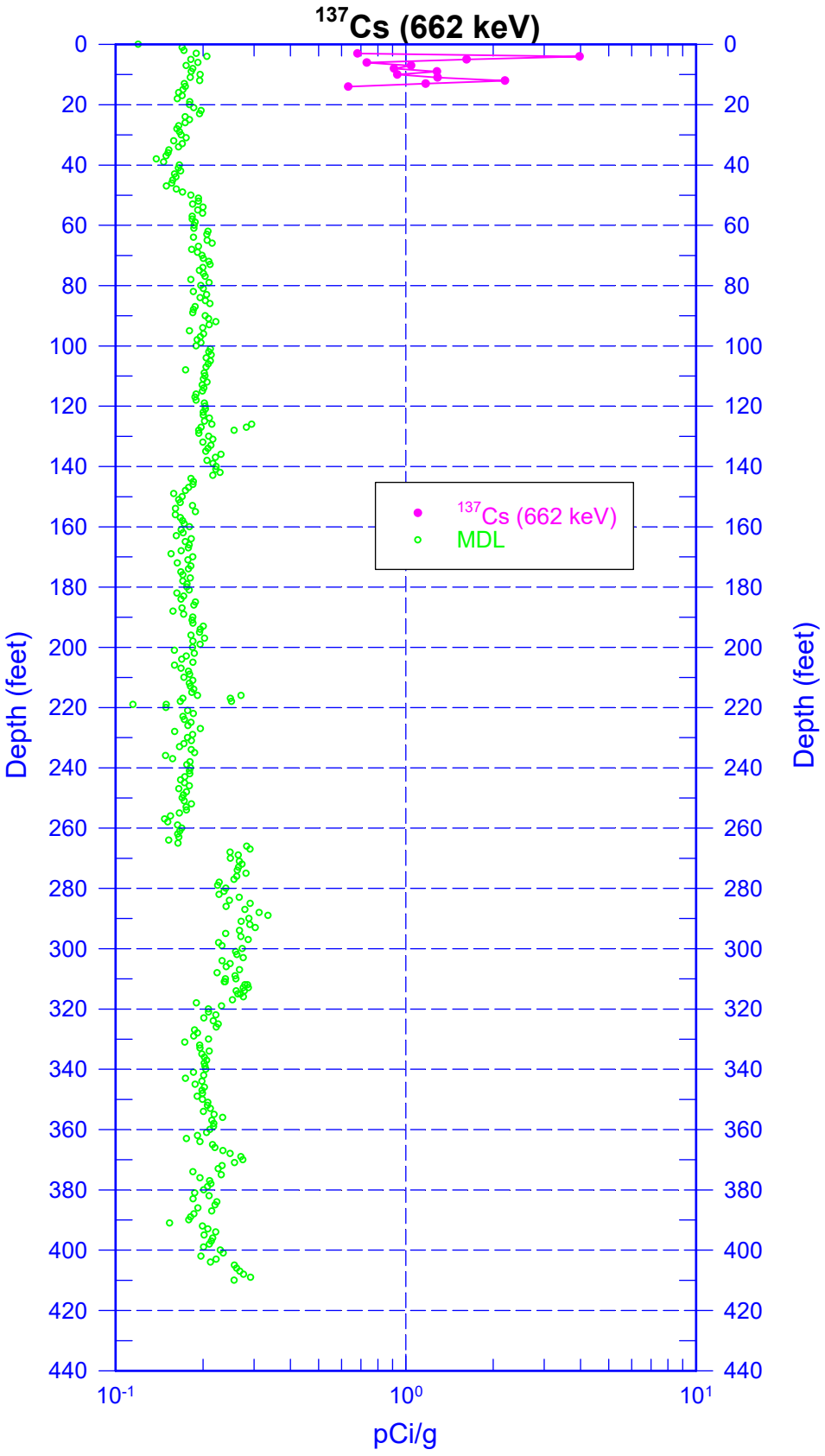
List of Log Plots

Zero depth reference is ground surface.

Manmade Radionuclides (0-440 ft)
Natural Gamma Logs (0-160 ft)
Natural Gamma Logs (150-310 ft)
Natural Gamma Logs (300-460 ft)
Combination Plot (0-440 ft)
Combination Plot (0-120 ft)
Combination Plot (120-240 ft)
Combination Plot (240-360 ft)
Combination Plot (360-480 ft)
Moisture and Total Gamma (0-160 ft)
Moisture and Total Gamma (150-310 ft)
Moisture (0-160 ft)
Moisture (150-310 ft)
Total Gamma & Hanford Gamma Unit (0-440 ft)
Repeat Section of Natural Gamma Logs (44-57 ft)
Repeat Section of Natural Gamma Logs (209-219 ft)
Repeat Section of Natural Gamma Logs (280-291 ft)
Repeat Section of Natural Gamma Logs (365-375 ft)
Moisture Repeat Section (100-113 ft)
Moisture Repeat Section (210-220 ft)
Moisture Repeat Section (260-265 ft)
Moisture with Uncertainties (0-160 ft)
Moisture with Uncertainties (150-310 ft)

Bay West
Customer-Focused Environmental & Industrial Solutions

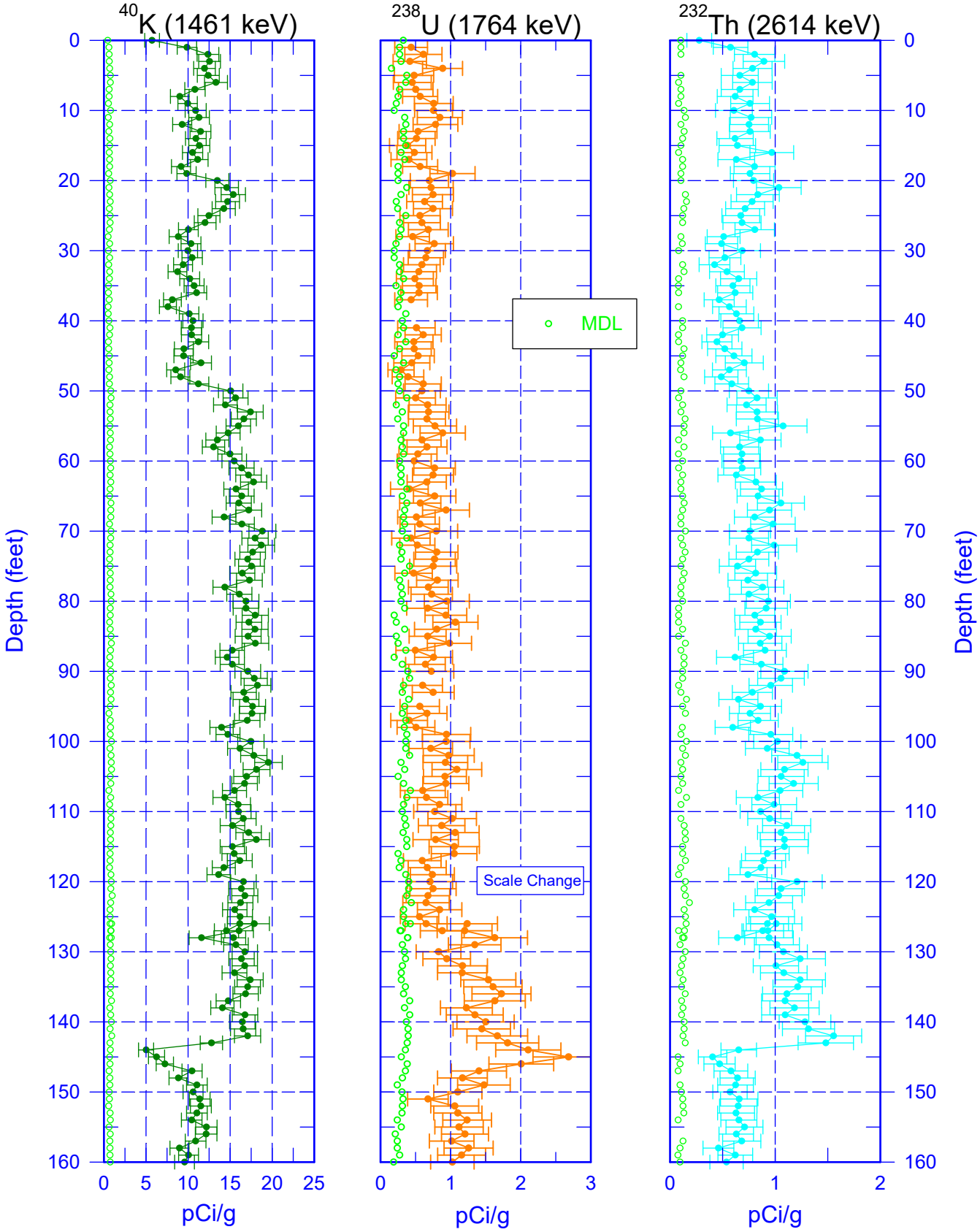
299-W19-128 (C9606)
Manmade Radionuclides



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

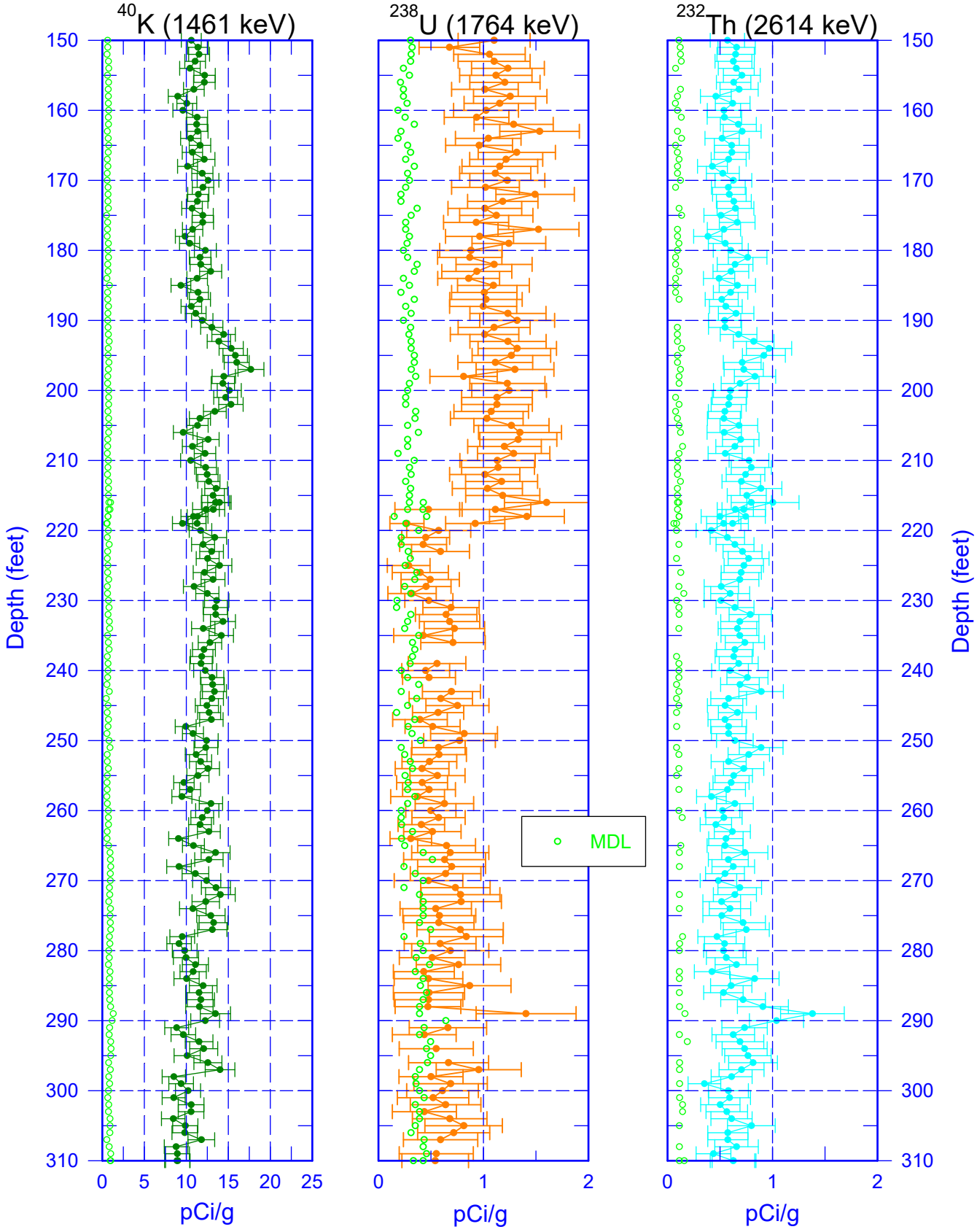
299-W19-128 (C9606)
Natural Gamma Logs



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

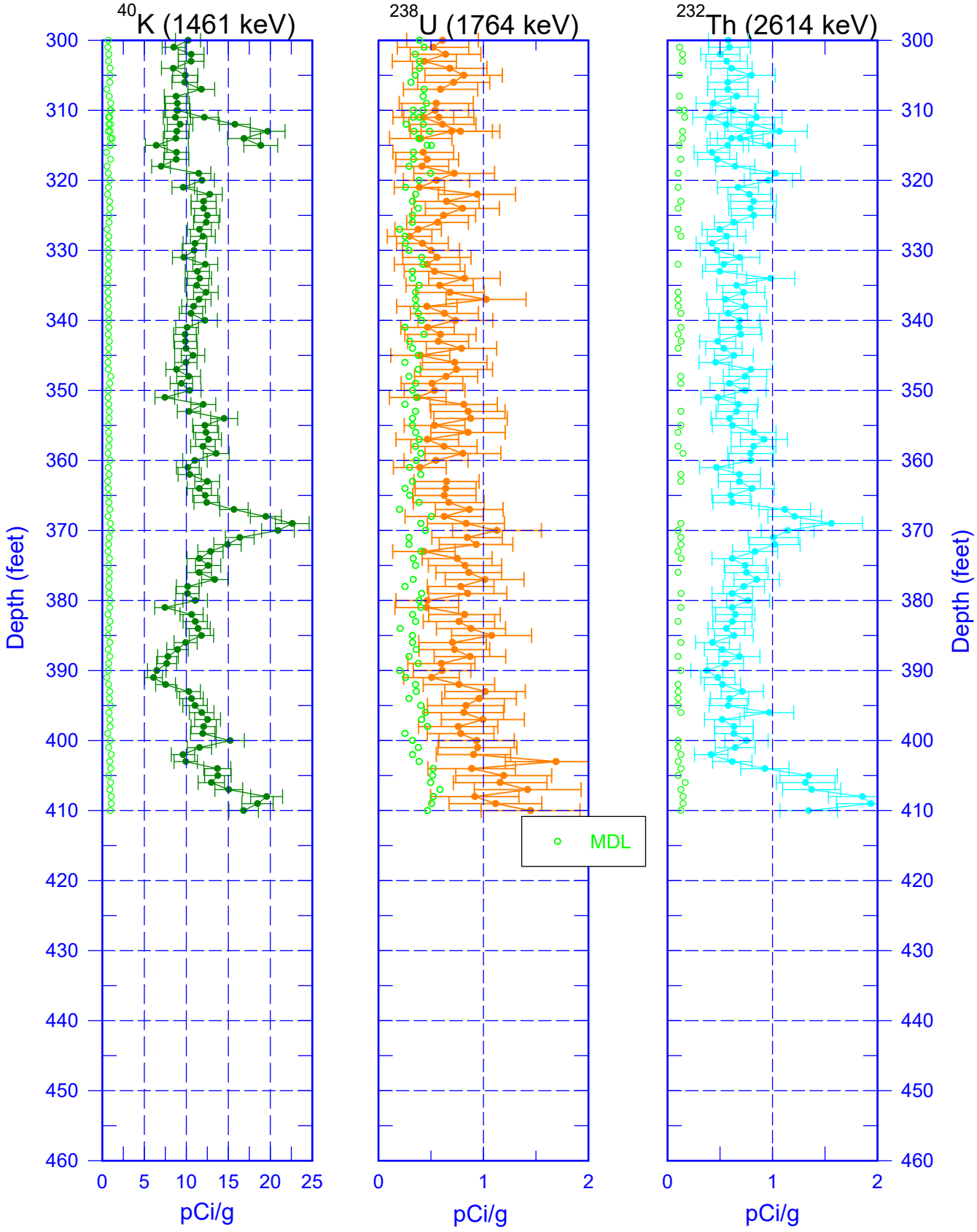
299-W19-128 (C9606)
Natural Gamma Logs



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

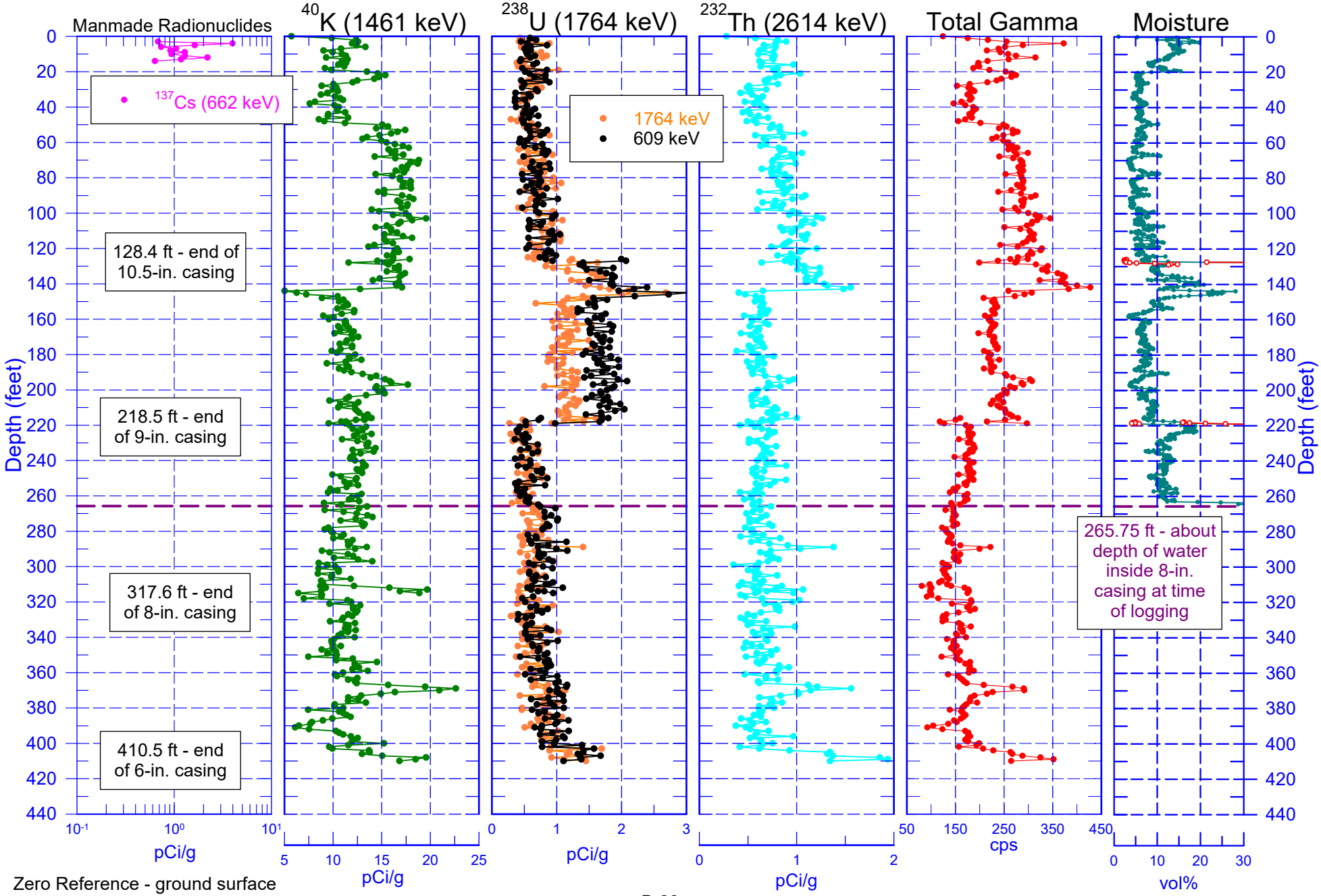
299-W19-128 (C9606)
Natural Gamma Logs



Zero Reference - ground surface

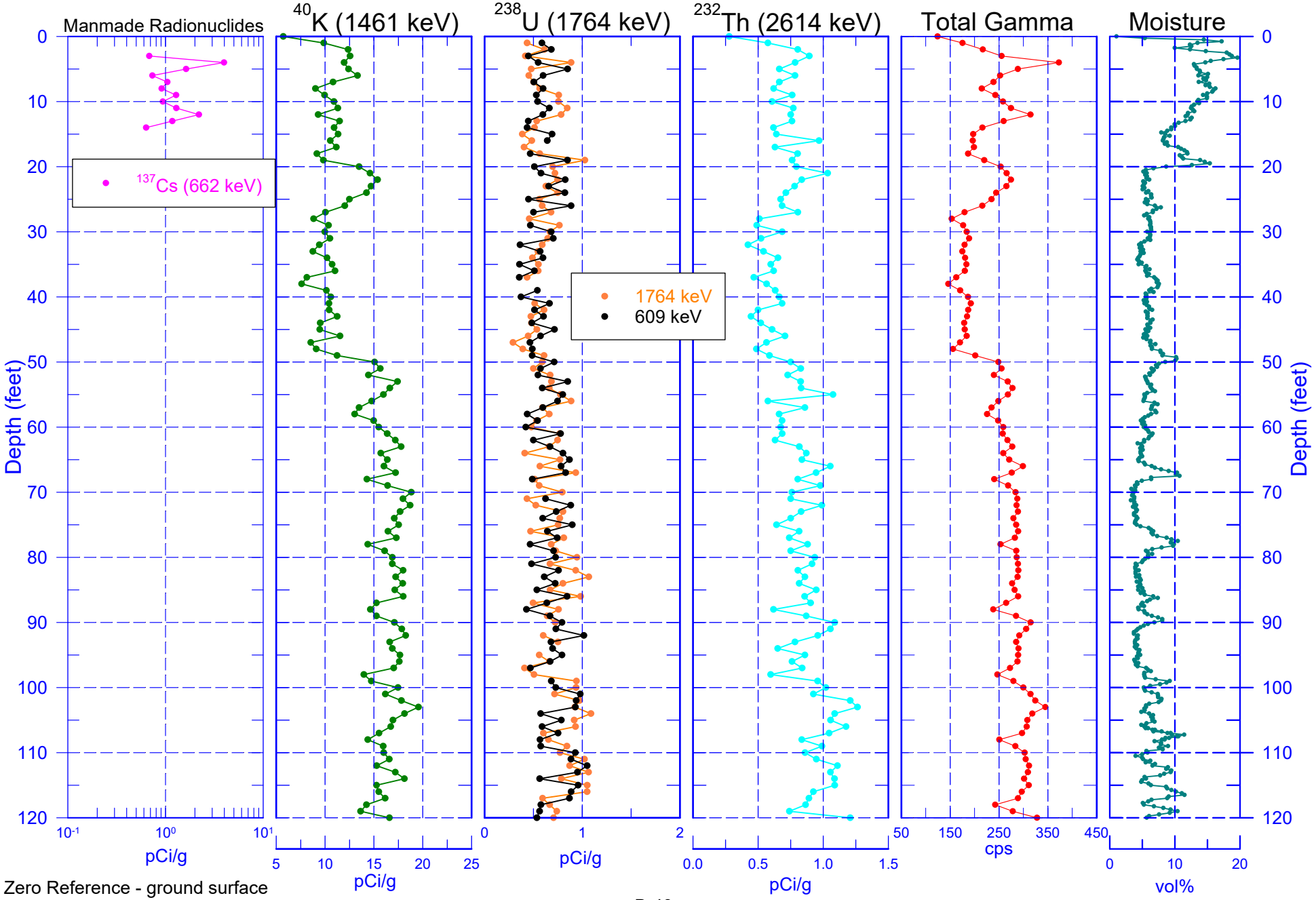
Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-128 (C9606) Combination Plot



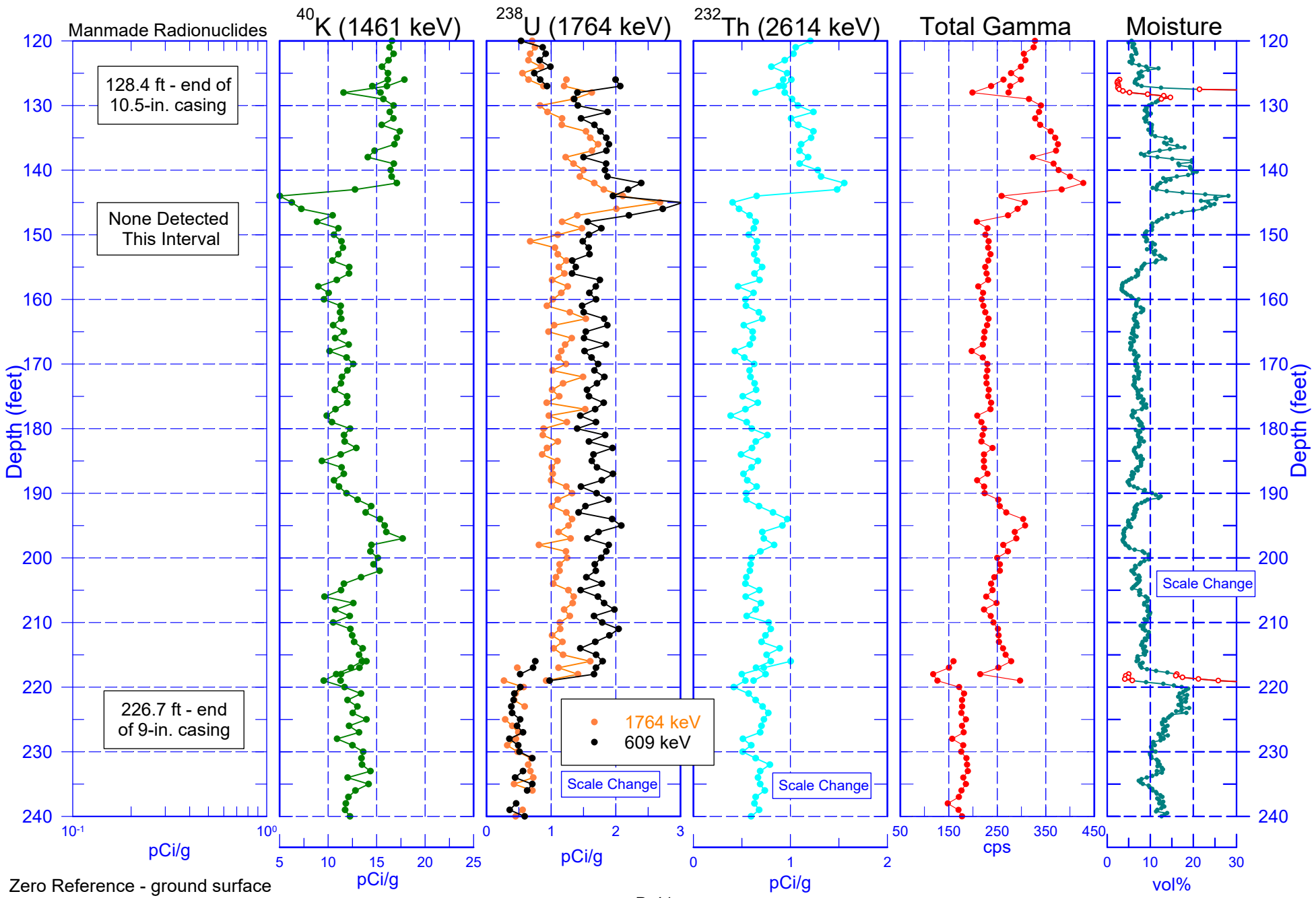
Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-128 (C9606) Combination Plot



Bay West
Customer-Focused Environmental & Industrial Solutions

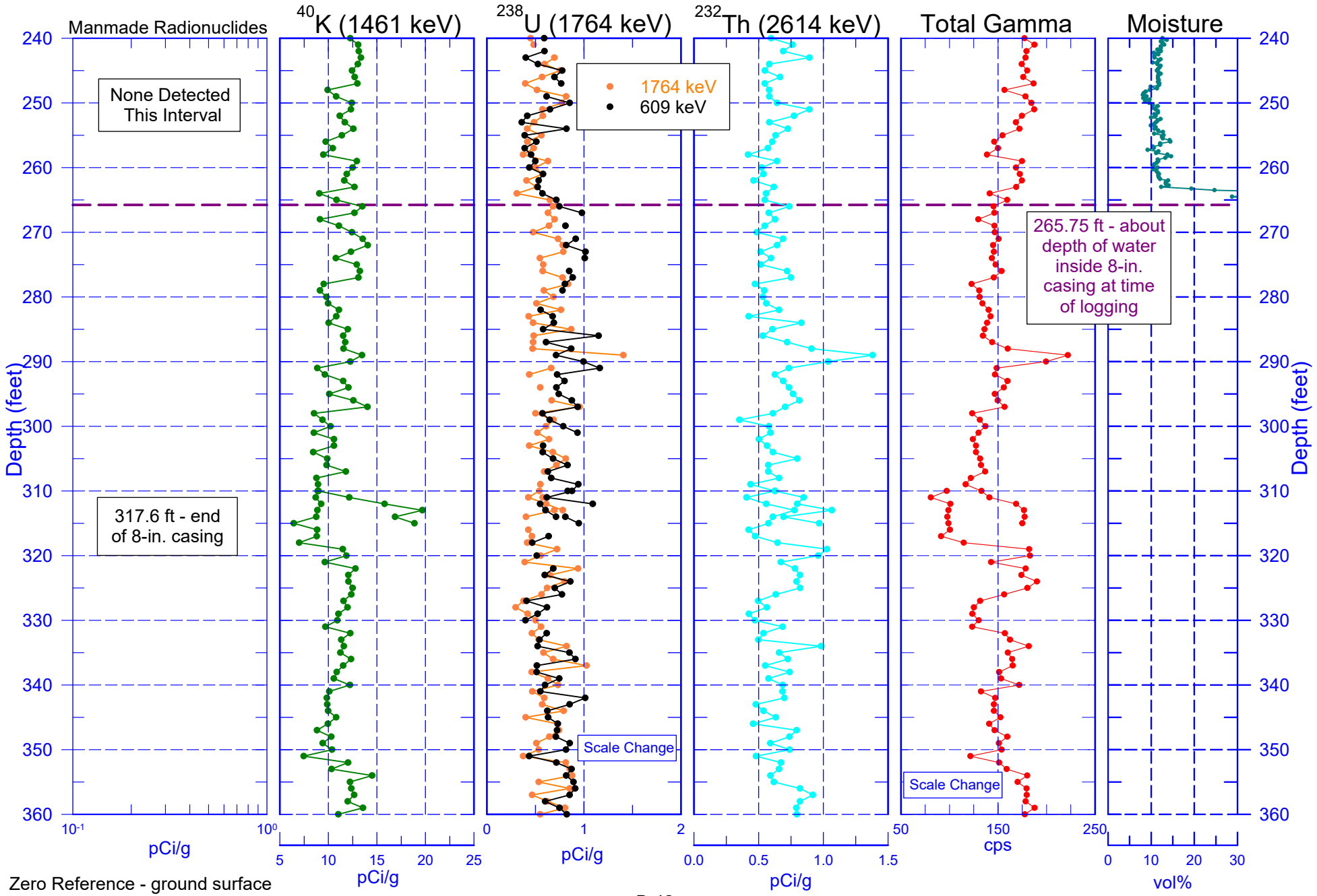
299-W19-128 (C9606) Combination Plot



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

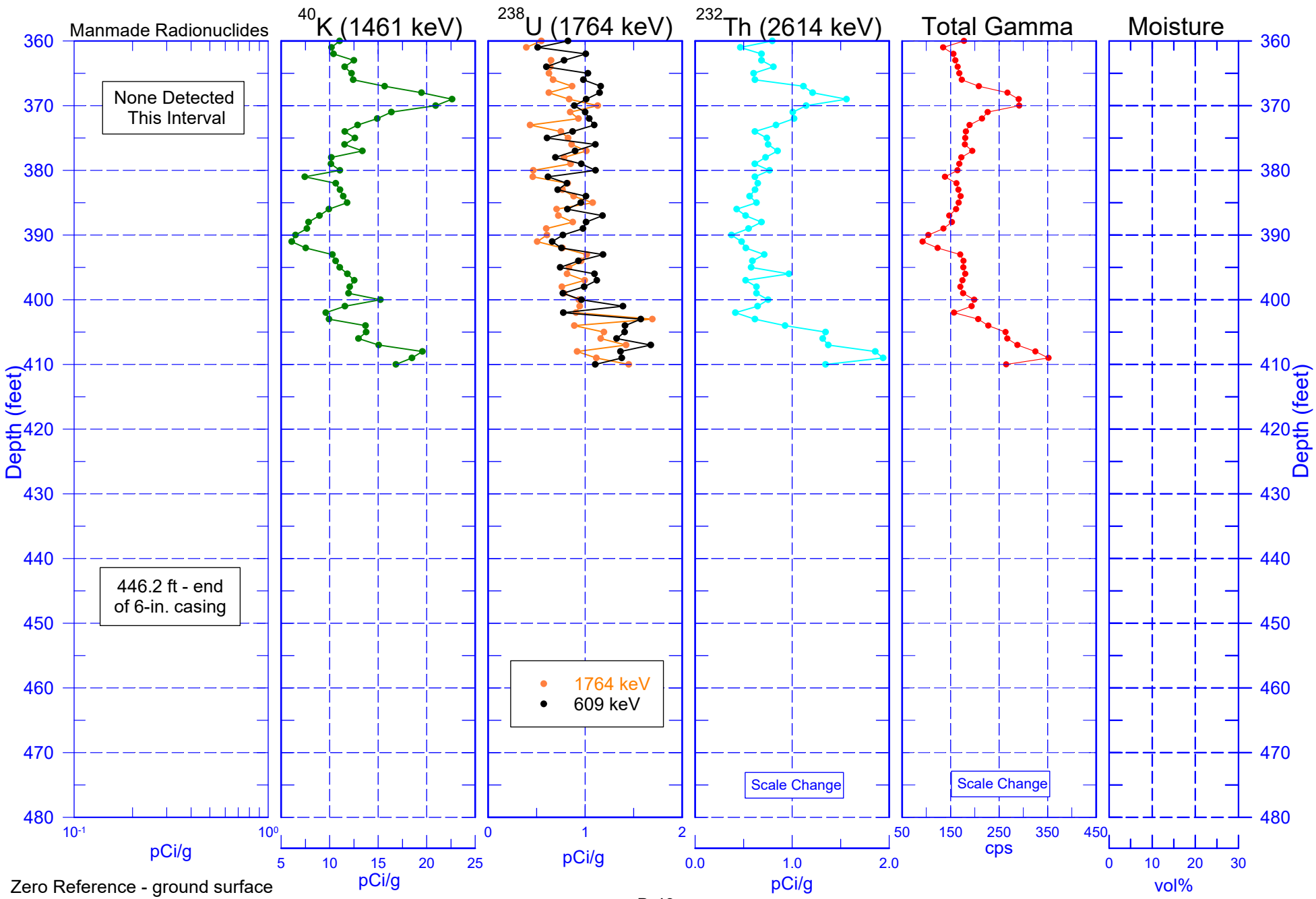
299-W19-128 (C9606) Combination Plot



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

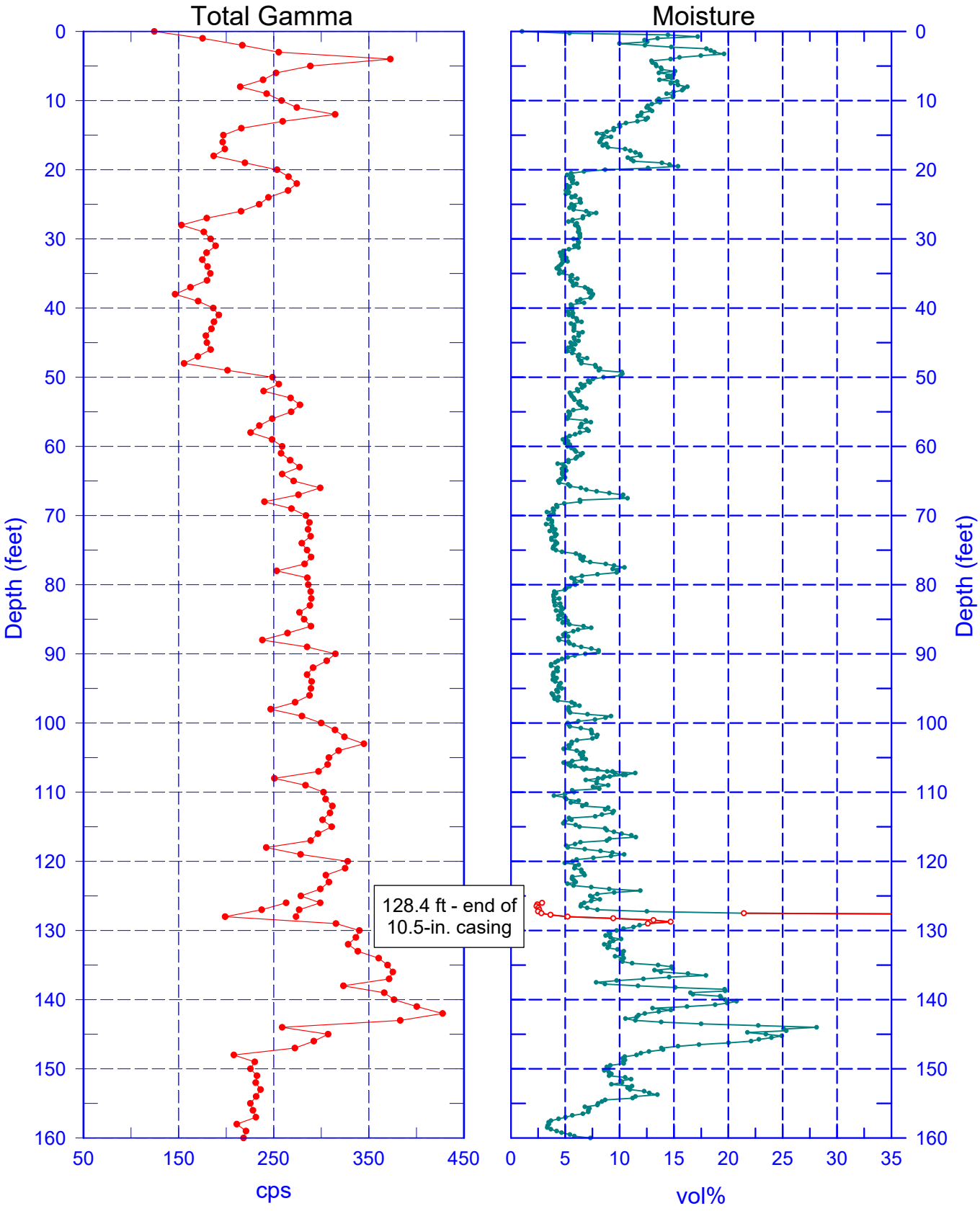
299-W19-128 (C9606) Combination Plot



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-128 (C9606)
Total Gamma & Moisture

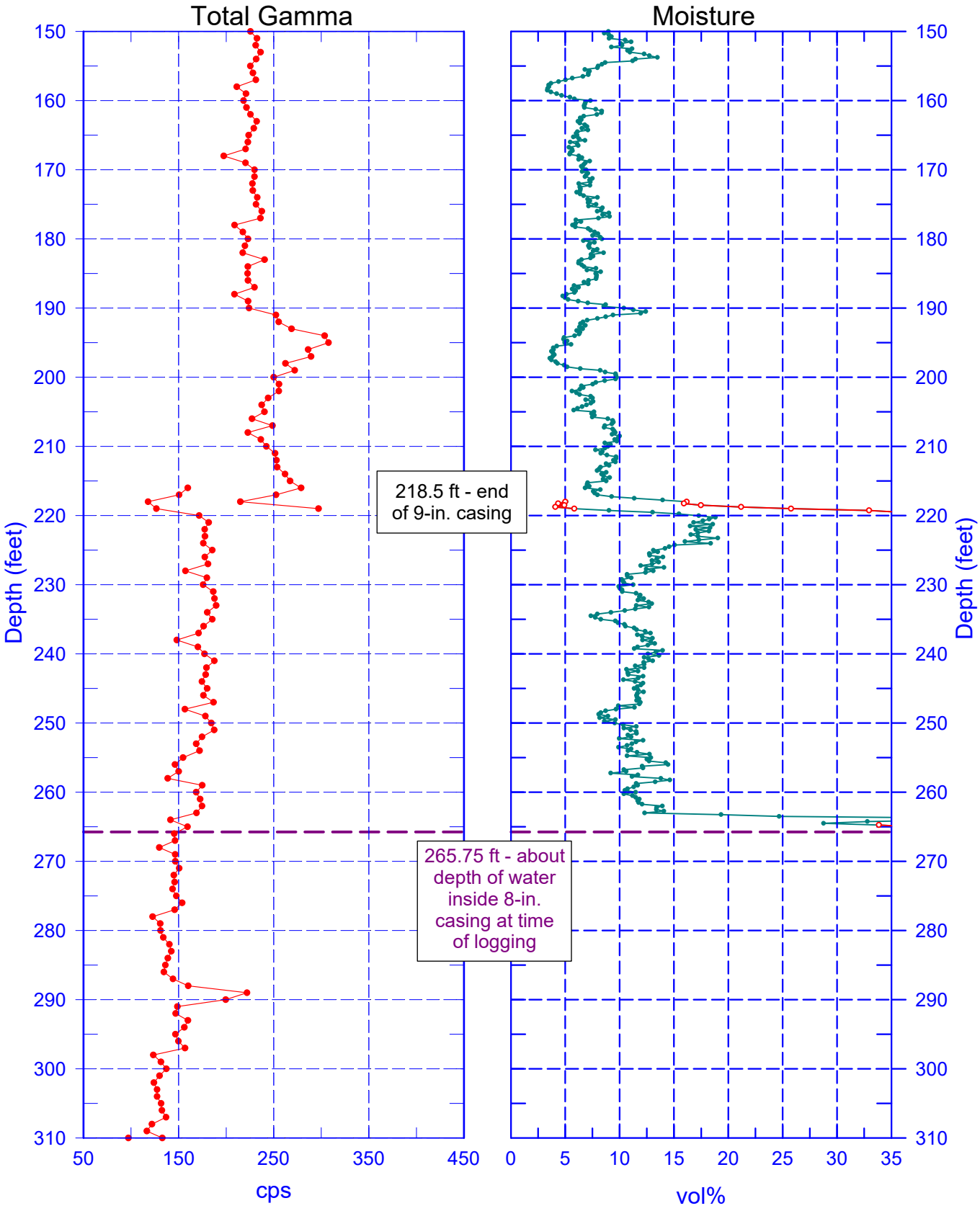


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-128 (C9606)

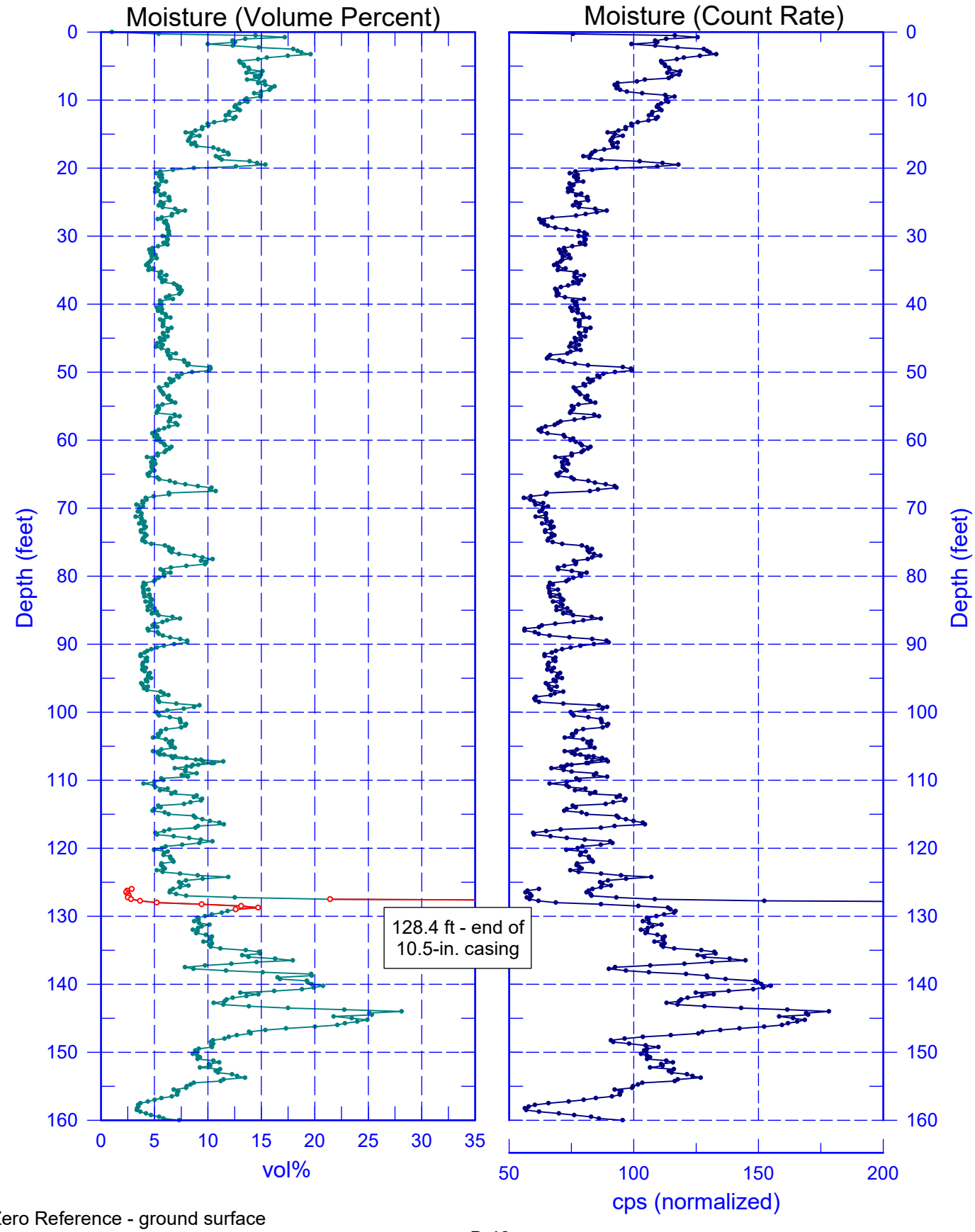
Total Gamma & Moisture



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

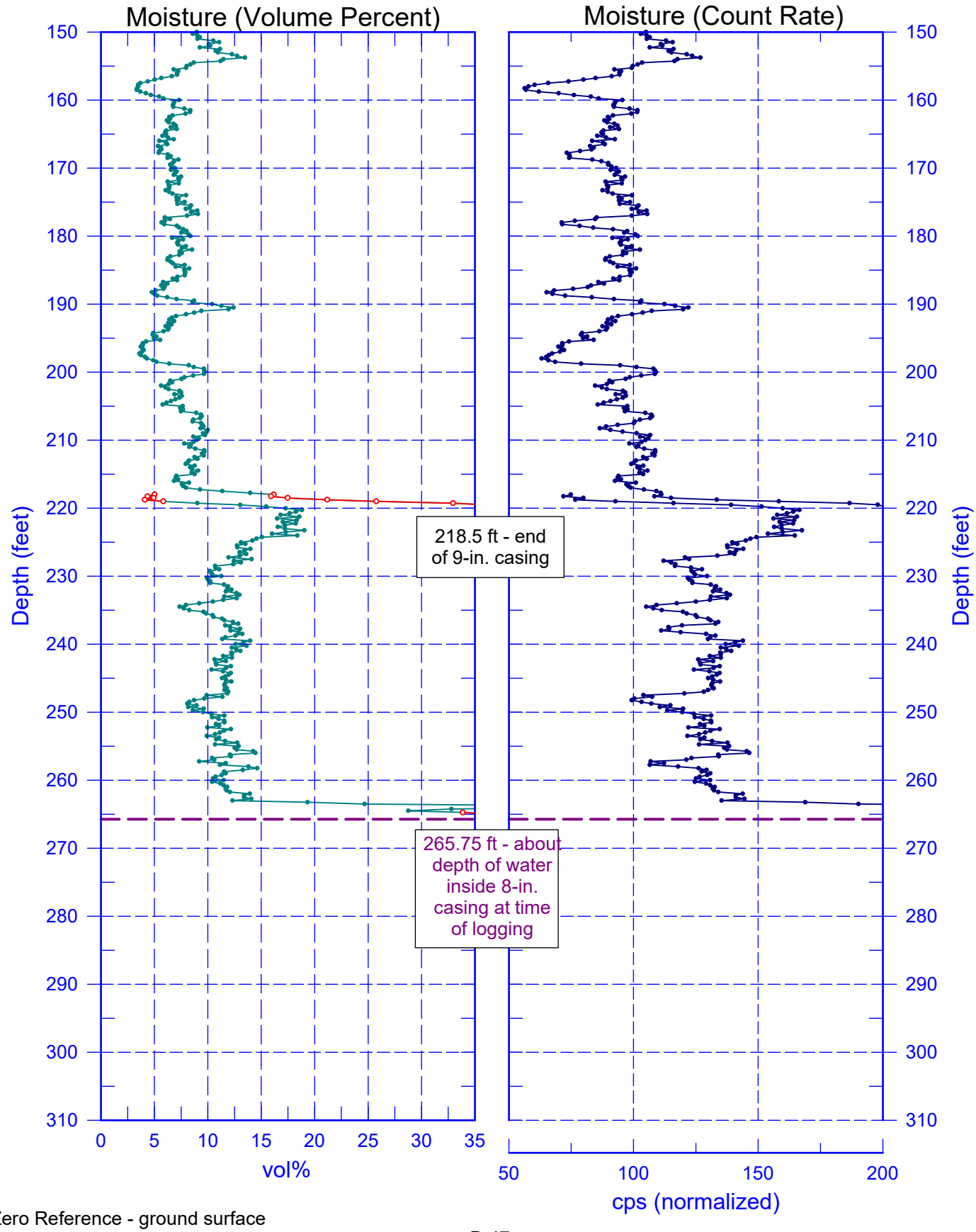
299-W19-128 (C9606)
Moisture



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-128 (C9606)
Moisture

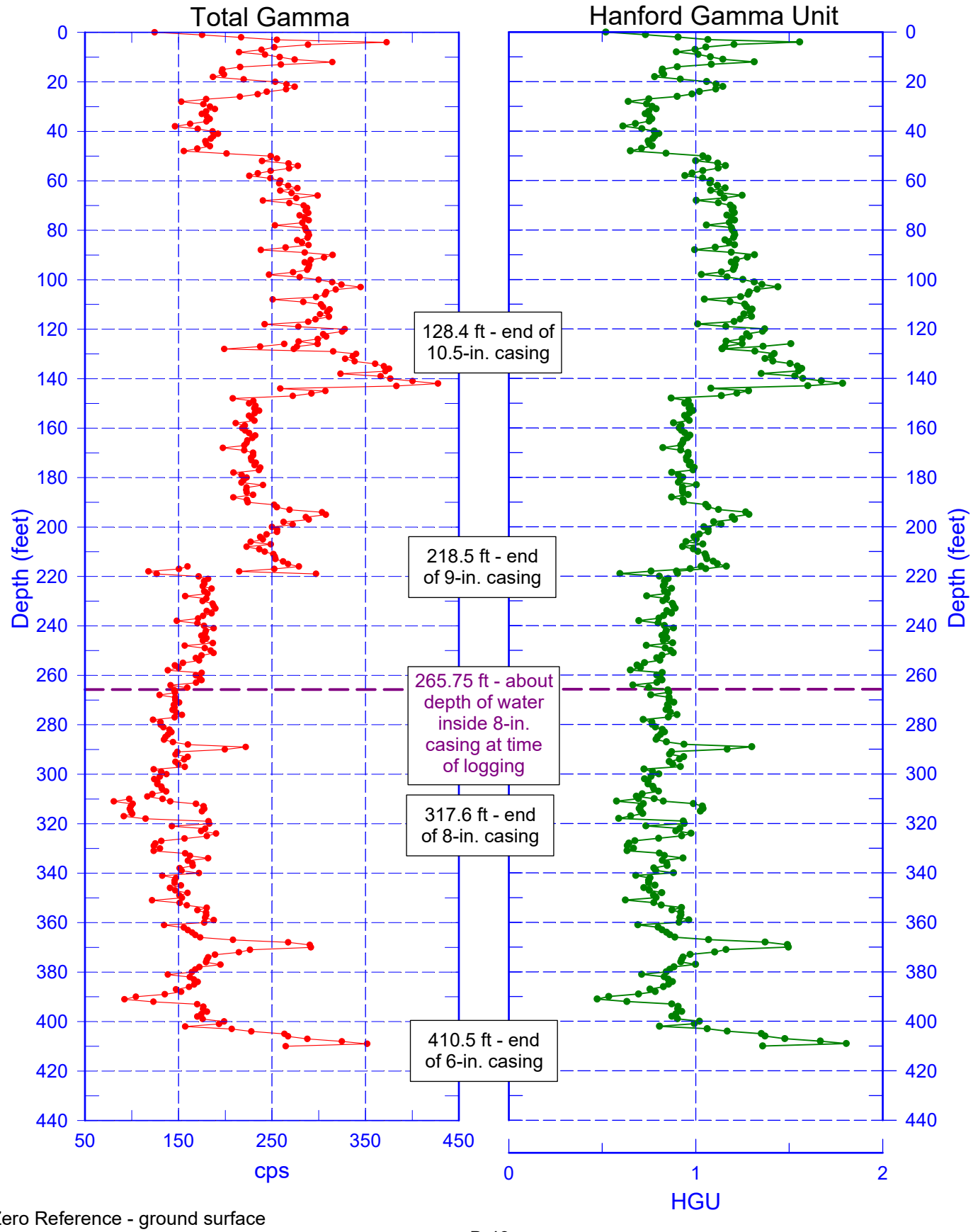


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-128 (C9606)

Total Gamma & Hanford Gamma Unit

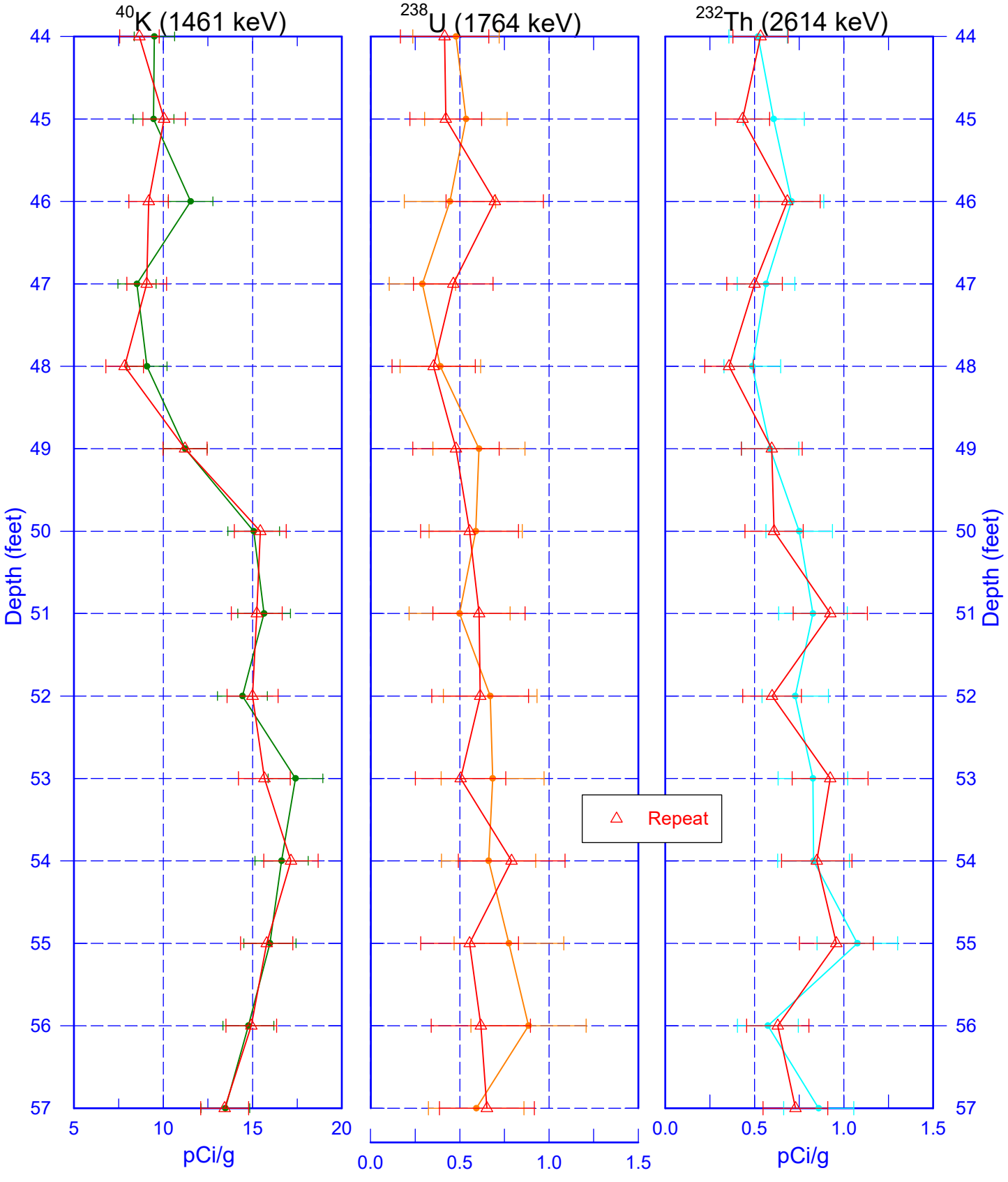


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-128 (C9606)

Repeat Section of Natural Gamma Logs

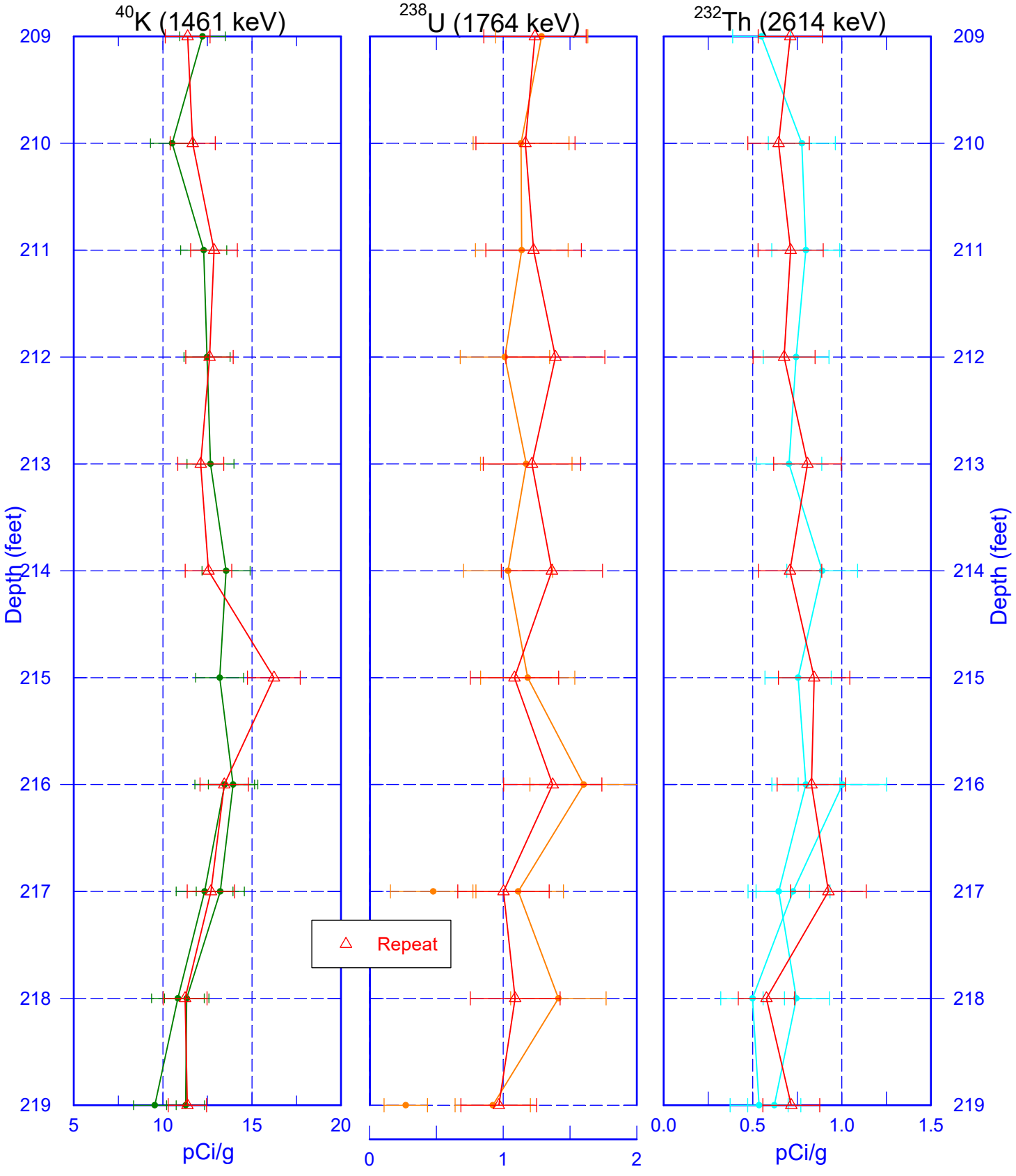


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-128 (C9606)

Repeat Section of Natural Gamma Logs

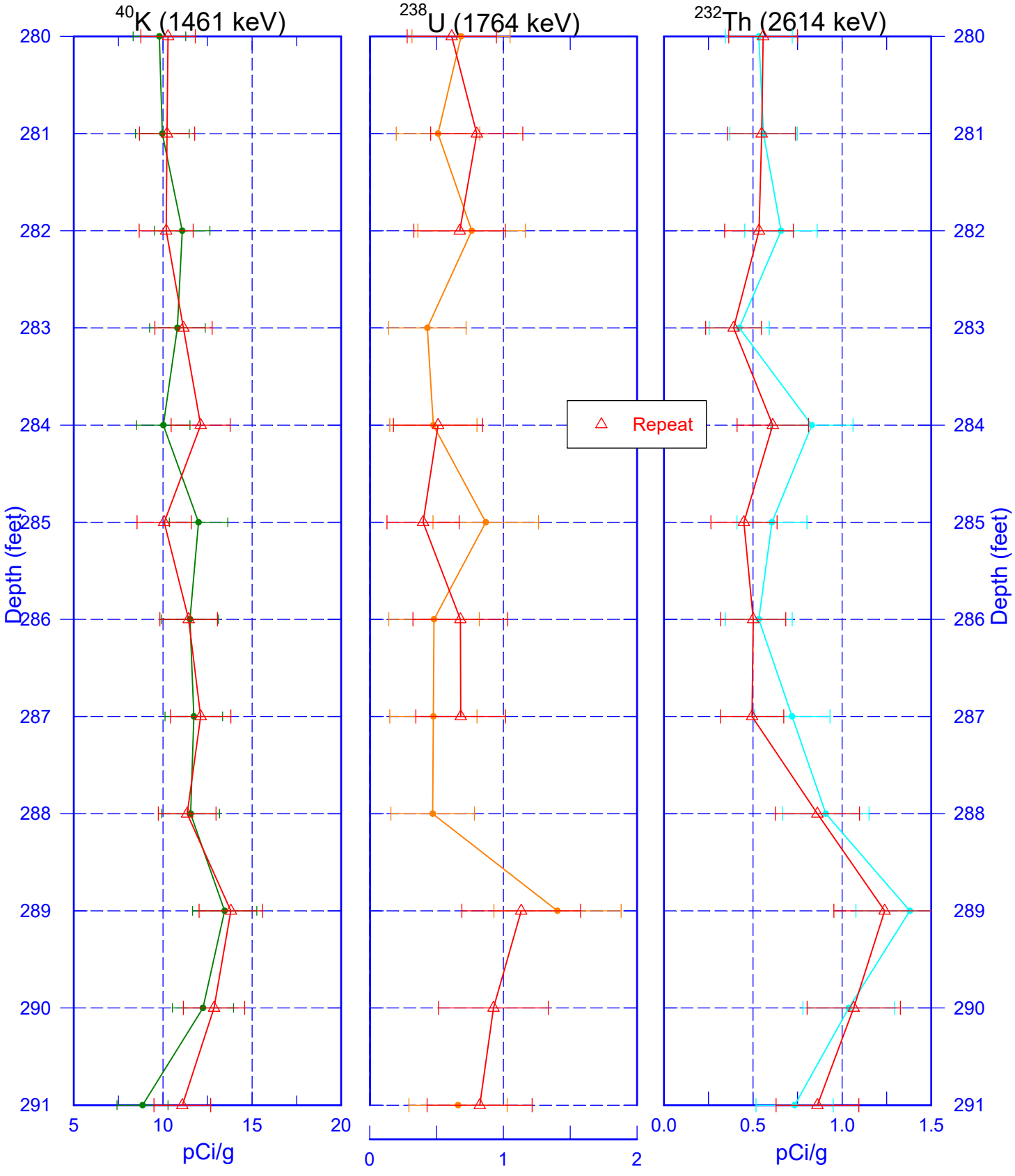


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-128 (C9606)

Repeat Section of Natural Gamma Logs

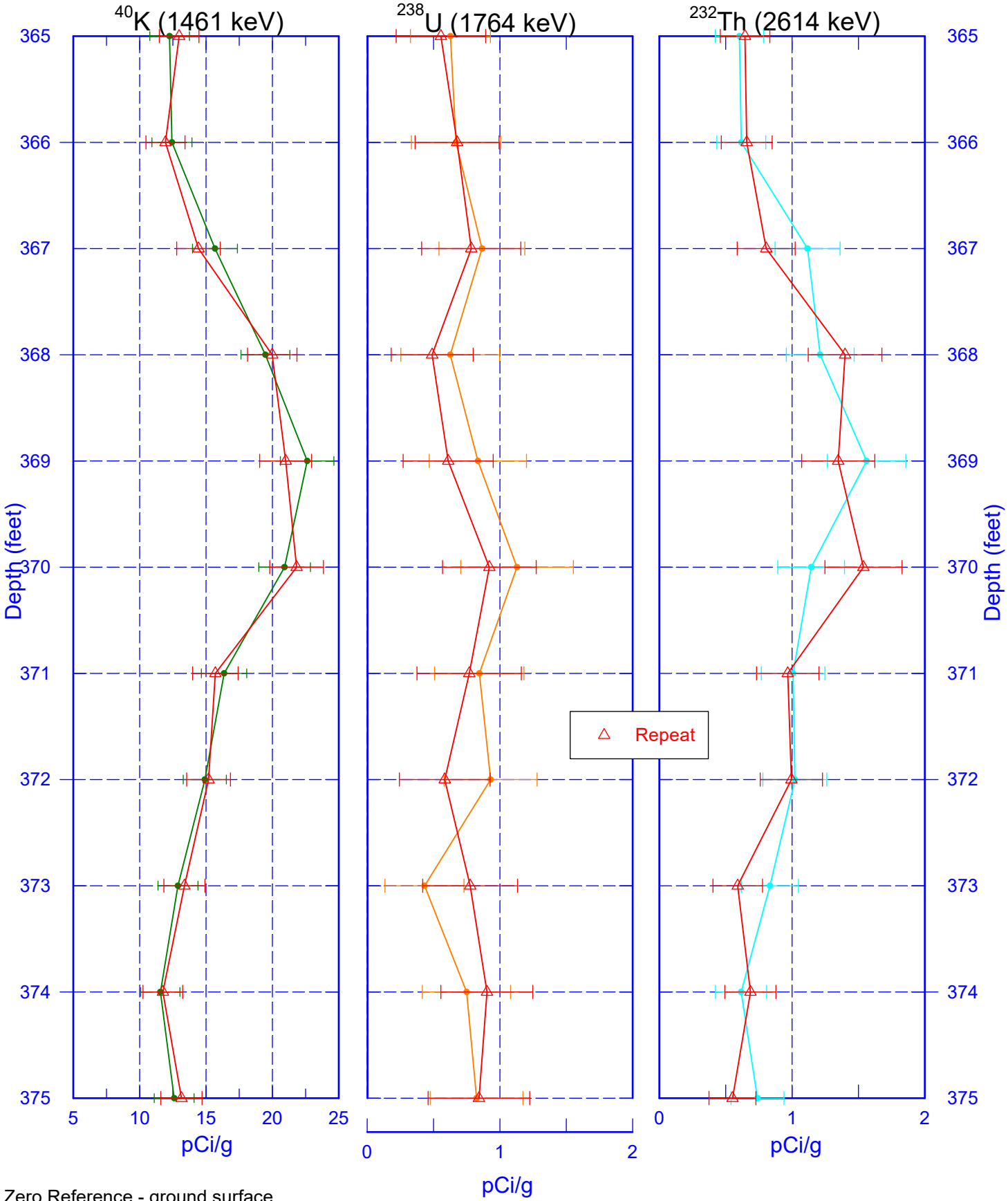


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-128 (C9606)

Repeat Section of Natural Gamma Logs

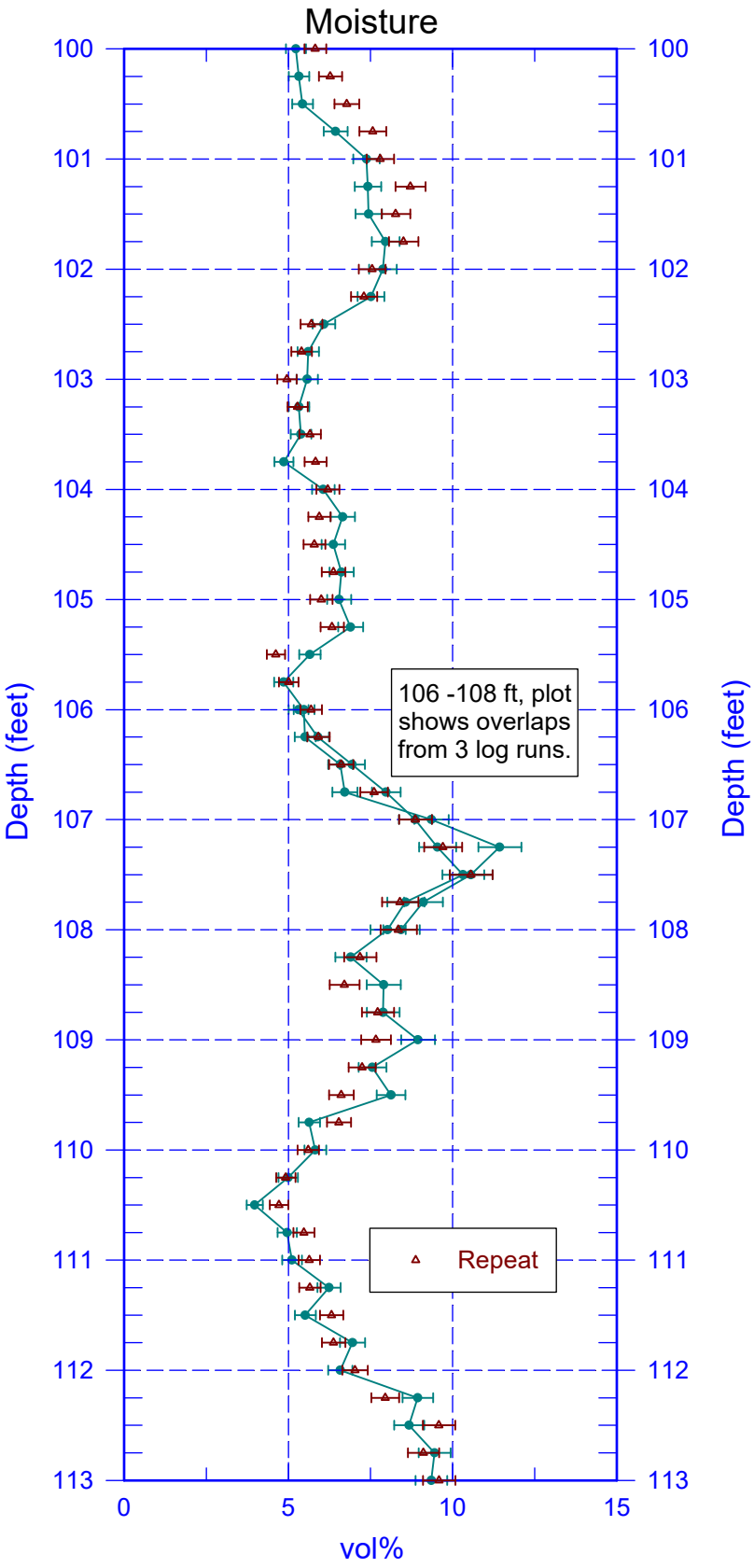


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-128 (C9606)

Moisture Repeat Section

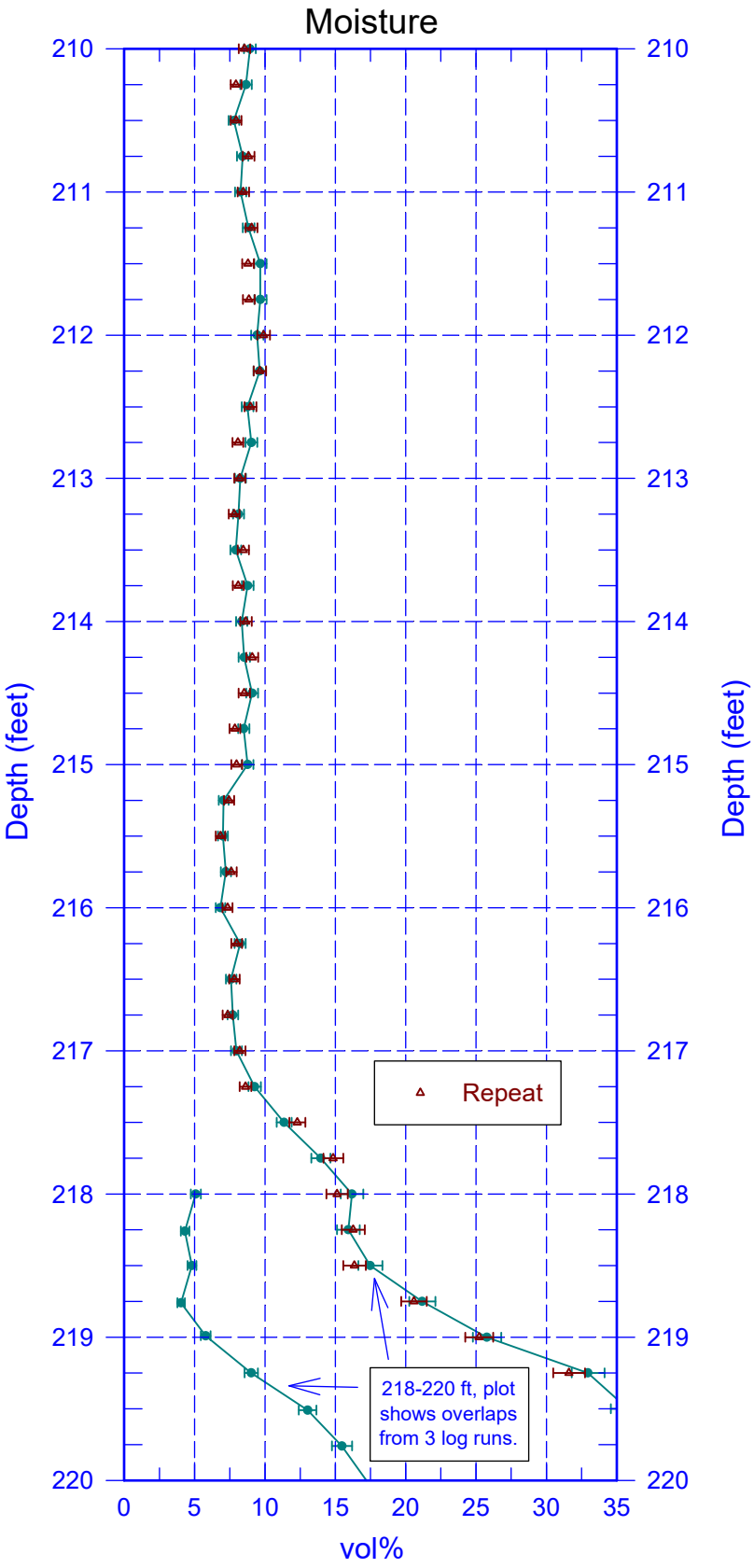


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-128 (C9606)

Moisture Repeat Section

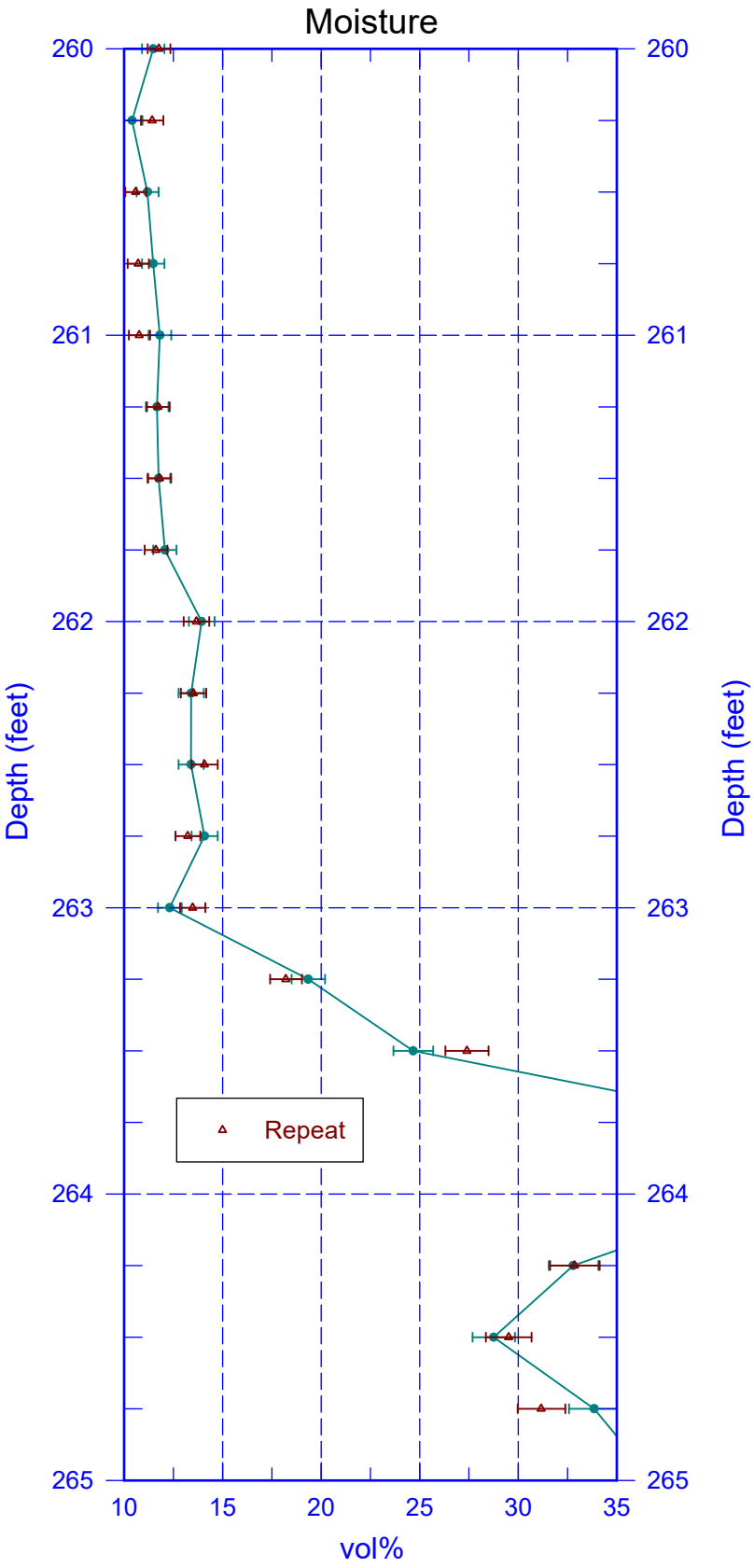


Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-128 (C9606)

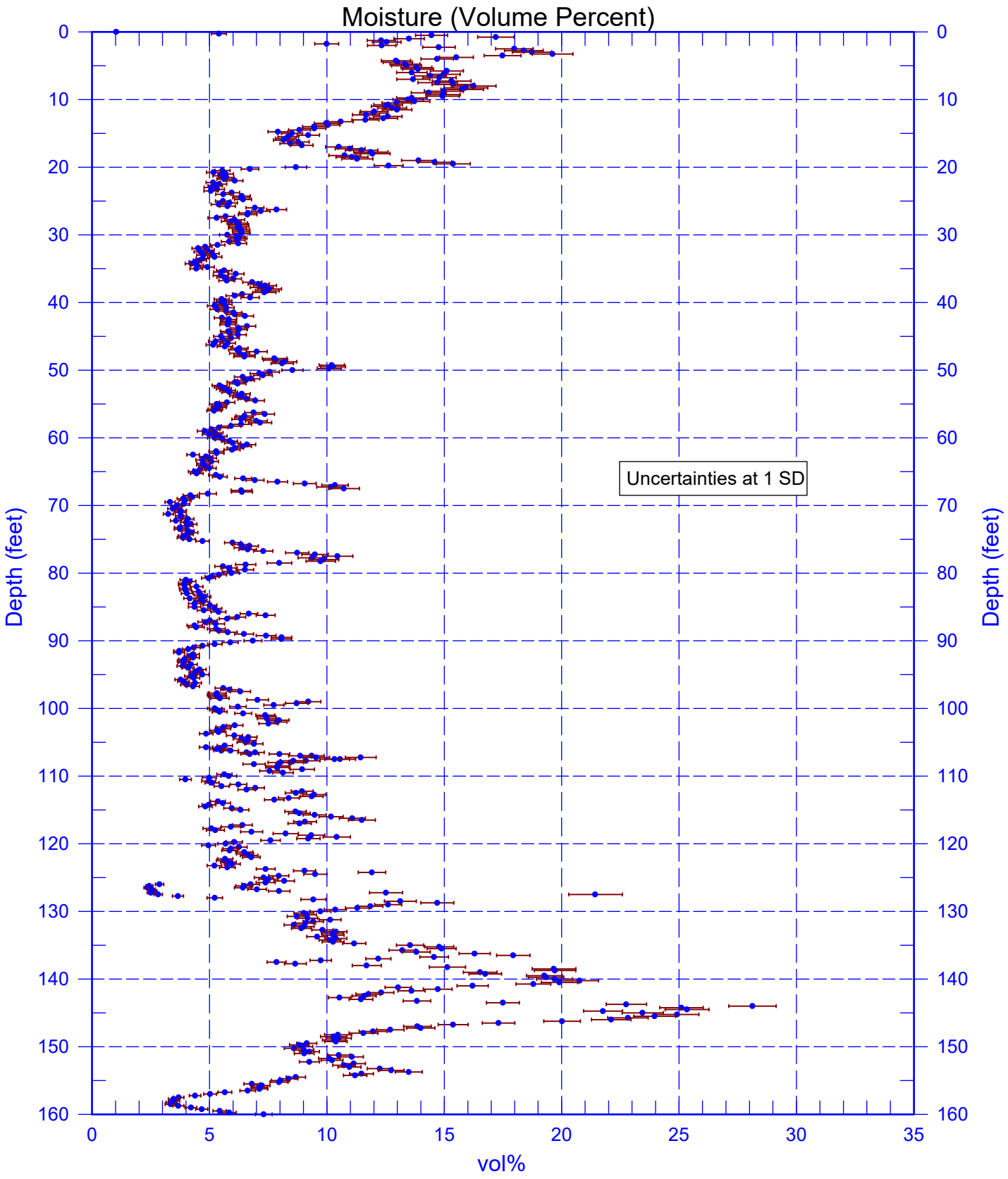
Moisture Repeat Section



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

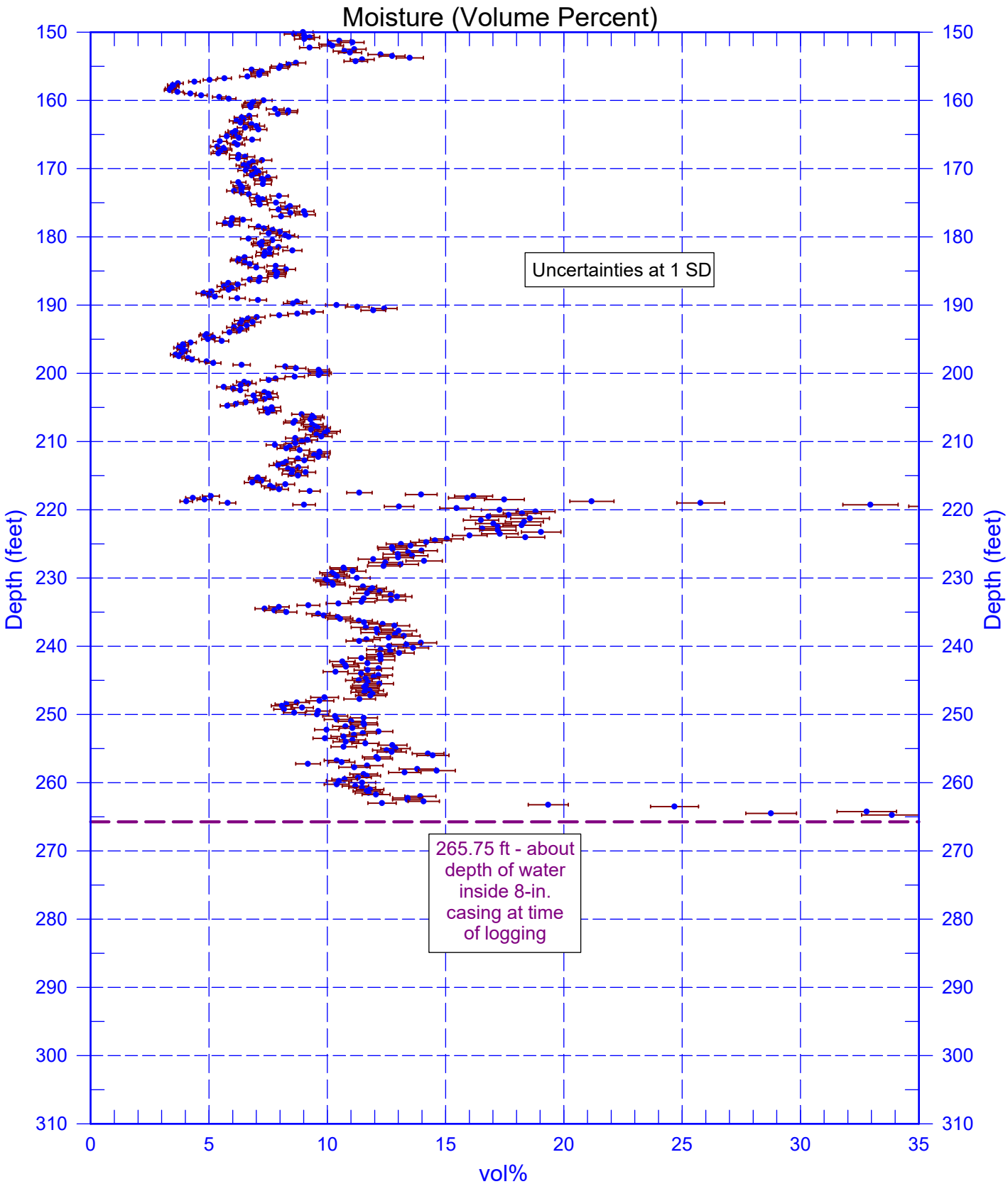
299-W19-128 (C9606)
Moisture with Uncertainties



Zero Reference - ground surface

Bay West
Customer-Focused Environmental & Industrial Solutions

299-W19-128 (C9606)
Moisture with Uncertainties



Zero Reference - ground surface

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WELL SURVEY DATA REPORT

Project:	**Prepared By:** Neil P. Fastabend
	Company: CPCC
Date Requested: 05/25/23	**Requestor:** Steven E. Imhoff (CPCC)
Date of Survey: 06/01/23	**Surveyor / Company:** Lawrence B. Munnell / CPCC
Description of Work: Obtained final survey coordinates (C/L Casing) and elevations of Well C9606 (299-W19-128) located west of U-Plant in 200W Area.	**Horizontal Datum:** NAD83 (91)
	Vertical Datum: NAVD88
	Units: Meters
	Hanford Area Designation: 200W

Coordinate System: Washington State Plane Coordinates (South Zone)

Horizontal Control Monuments:
Washington State Reference Network

Vertical Control Monuments:
2W-170 (CPCC) and 2W-49 (CPCC)

Well ID	Well Name	Easting	Northing	Elevation	
C9606	299-W19-128	567002.55	135254.98		Center of Casing
				210.175	Top Inner 4"Casing, N.Edge
				210.481	Top Outer Casing,N.Edge Stamped "X"
				209.737	Brass Survey Marker

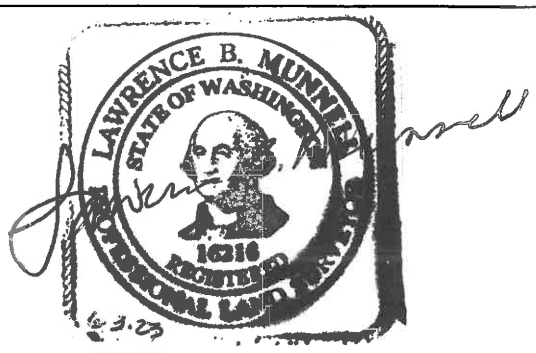
Notes:

Brass Survey Marker elevation was taken on top of domed brass cap in concrete.

Equipment Used: Trimble R8 RTK GPS
Trimble DiNi 12 Level

Surveyor Statement:

I, Lawrence B. Munnell, a Professional Land Surveyor registered in the State of Washington (Registration No. 16216), hereby certify this report is based on a field survey performed by me, or under my direct supervision.



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WELL DEVELOPMENT AND TESTING DATA

Well ID: C9606	Well Name: 299-W19-128	Date: 5/30/23
Location: 535 m NW of U Plant		

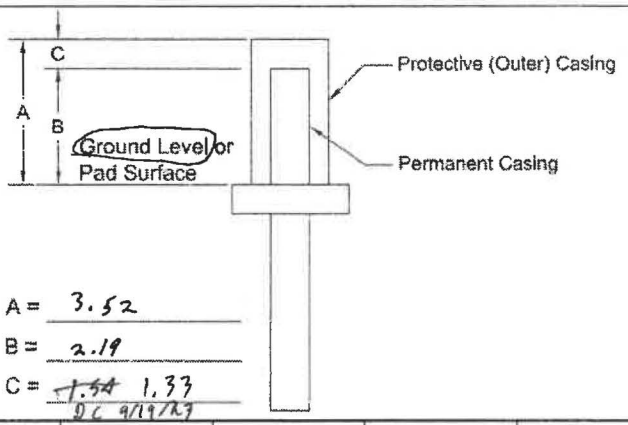
Reference Measuring Point *(unless otherwise noted)*: TOP OF OUTER CASING (TOC)

Has the well been surveyed? ◯Yes ⊗No

Does the well have a cement pad? ◉Yes ◯No

Initial Conditions

Date	Start of Job	End of Job
STATIC WATER LEVEL:		
Date: 5/11/23	263.01 ft bgs	Not used per 5/30/23
Date: 5/22/23	Not used per 5/30/23	263.20 ft bgs
DEPTH TO BOTTOM:		
Date: 5/11/23	298.0 ft Top of well casing	Not used per 5/30/23
Date: 5/22/23	Not used per 5/30/23	298.0 ft Top of Well Casing



A = 3.52

B = 2.19

C = ~~1.54~~ 1.33 DC 9/19/23

Intake Depth (ft bgs)	Specific Capacity (gpm/ft)	Troll Depth (ft bwt)	Turbidity (NTU) Initial	Turbidity (NTU) Final	Pump Start	Pump Stop	Pumping Rate (gpm)	Maximum Drawdown (ft)
5/11/23 285.64	.013	284.64	Over the Limit	Over the Limit	7:20	14:59	.38 gal/min	26.44
5/15/23 285.74	.073	284.54	Over the Limit	277	7:29	15:14	7:29 to 9:55 1.72 gal/min	26.18
—	—	—	—	—	—	—	9:55 to 12:55 1.32 gal/min	—
—	—	—	—	—	—	—	12:55 to 15:14 1.20 gal/min	—
5/16/23 286.14	.13	284.94	Over the Limit	~~975~~ 773 per 5/30/23	8:27	15:00	2.85 gal/min	23.03
5/17/23 285.54	.33	284.34	Over the Limit	975	8:10	15:00	8:10 to 10:27 4.17 gal/min	12.63

Total Pumped: 5,272.77 gal

Pump Model: Grundfos 5SQE-320 .75 HP Model BD P2 2144

Troll Serial Number and Pressure Range *(PSI and depth)*: S/N: ~~41756~~ & 17365 Range 21m/69ft 2.9psi

Comments: bgs = below ground surface

Prepared By:

Samie Foster / Dan Charbonneaux
Print Name

Samie Foster 9/14/2023
Signature / Dan 9/19/23

Reviewed By:

Nicholas Olivier
Print Name

10/25/23
Signature / Date

For Office Use Only

OR Doc Type:	WMU Code(s):

WELL DEVELOPMENT AND TESTING DATA

Well ID: C9606	Well Name: 299-W19-128	Date: 5/30/23
Location: 535 m NW of U Plant		

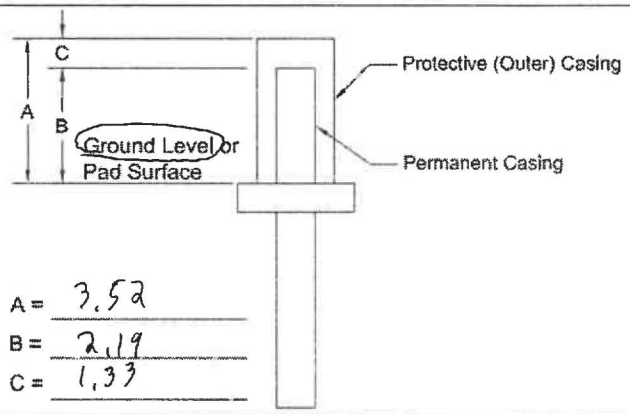
Reference Measuring Point *(unless otherwise noted)*: TOP OF OUTER CASING (TOC)

Has the well been surveyed? ◯ Yes ⊗ No

Does the well have a cement pad? ◉ Yes ◯ No

Initial Conditions

Date	Start of Job	End of Job
STATIC WATER LEVEL:		
Date:	Not Used SF 5/30/23	
Date:		
DEPTH TO BOTTOM:		
Date:	Not Used SF 5/30/23	
Date:		



A = 3.52
B = 2.19
C = 1.33

Intake Depth (ft bgs)	Specific Capacity (gpm/ft)	Troll Depth (ft bwt)	Turbitidy (NTU) Initial	Turbitidy (NTU) Final	Pump Start	Pump Stop	Pumping Rate (gpm)	Maximum Drawdown (ft)
—	—	—	—	—	—	—	14:27 to 15:00 7.5 gal/min	—
5/22/23 272.35	.74	271.4	16.8	3.36	9:25	13:19	3.08	4.14
5/22/23 282.6	.61	281.65	17.5	3.41	13:28	15:18	4:36	7:17
		Not Used SF 5/30/23						

Total Pumped: Not Used SF 5/30/23

Pump Model:

Troll Serial Number and Pressure Range *(PSI and depth)*: —

Comments:

Not Used SF 5/30/23

Prepared By:

Samie Foster / Dan Charbann cwx — *Print Name*

9/19/23 — *Signature / Date*

Reviewed By:

Nicholas Olivier — *Print Name*

10/25/23 — *Signature / Date*

For Office Use Only

OR Doc Type:	WMU Code(s):

Photo Archive Log for 299-W19-128 (C9606)

0 – 5 ft bgs

5 – 10 ft bgs

10 – 15 ft bgs

15 – 20 ft bgs

20 – 25 ft bgs

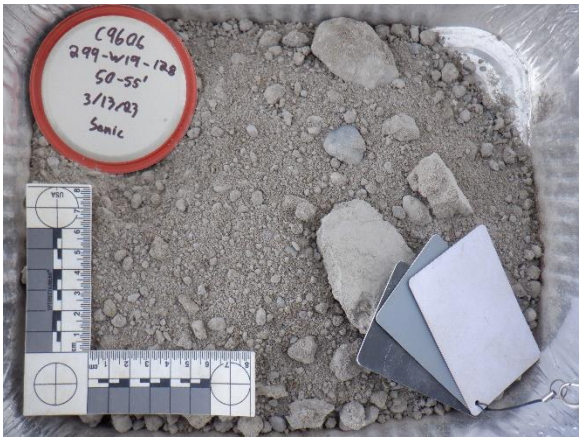
25 – 30 ft bgs

30 – 35 ft bgs

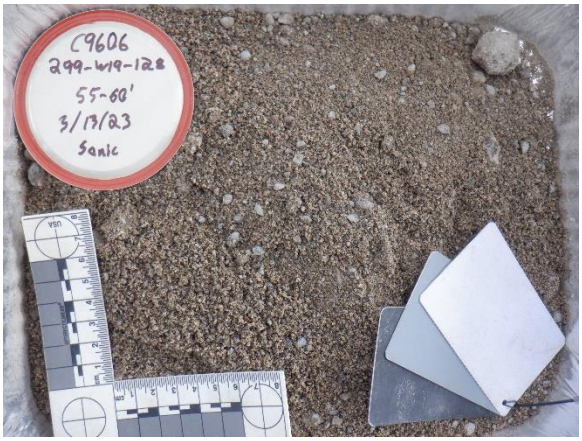
35 – 40 ft bgs

40 – 45 ft bgs

45 – 50 ft bgs



50 – 55 ft bgs



55 – 60 ft bgs

60 – 65 ft bgs

Photo not collected; elevated rad

65 – 70 ft bgs

Photo not collected; elevated rad

70 – 75 ft bgs

Photo not collected; elevated rad

75 – 80 ft bgs

Photo not collected; elevated rad

80 – 85 ft bgs

Photo not collected; elevated rad

85 – 90 ft bgs

Photo not collected; elevated rad

90 – 95 ft bgs

Photo not collected; elevated rad

95 – 100 ft bgs

Photo not collected; elevated rad

100 – 105 ft bgs

Photo not collected; elevated rad

105 – 110 ft bgs

Photo not collected; elevated rad

110 – 115 ft bgs

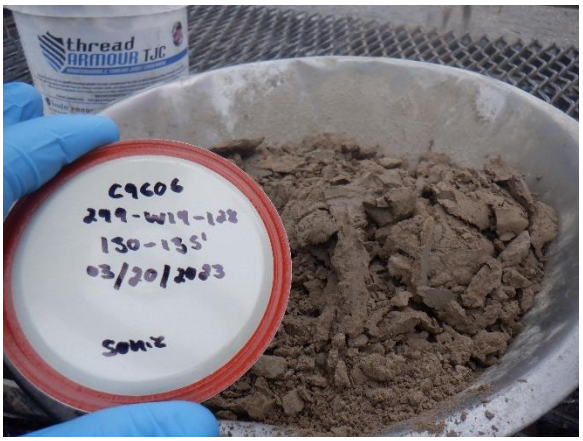
Photo not collected; elevated rad

115 – 120 ft bgs

Photo not collected; elevated rad

120 – 125 ft bgs

125 – 130 ft bgs



130 – 135 ft bgs

135 – 140 ft bgs

140 – 145 ft bgs

145 – 150 ft bgs

150 – 155 ft bgs

155 – 160 ft bgs

160 – 165 ft bgs

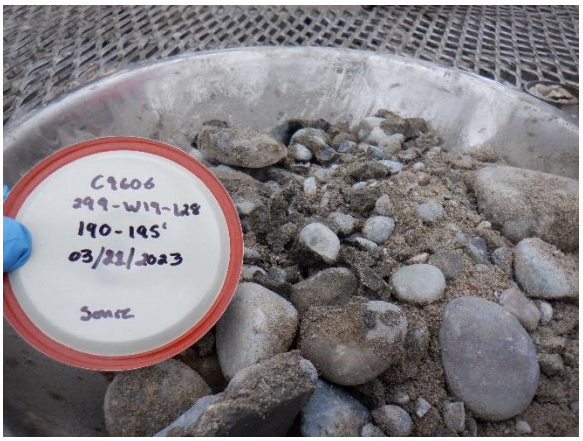
165 – 170 ft bgs

170 – 175 ft bgs

175 – 180 ft bgs

180 – 185 ft bgs

185 – 190 ft bgs



190 – 195 ft bgs

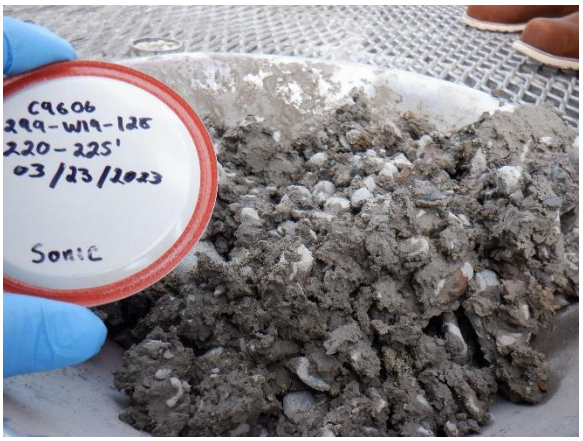
195 – 200 ft bgs

200 – 205 ft bgs

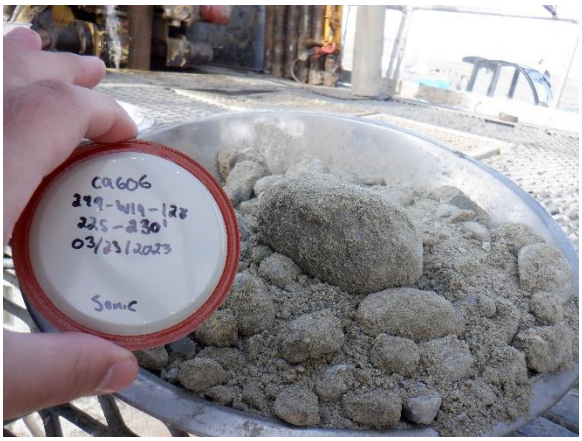
205 – 210 ft bgs

210 – 215 ft bgs

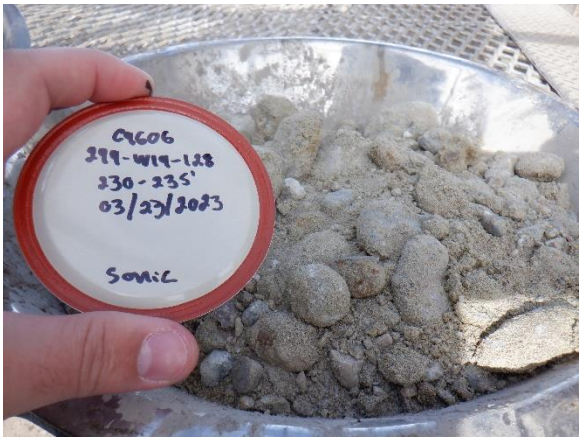
215 – 220 ft bgs



220 – 225 ft bgs



225 – 230 ft bgs



230 – 235 ft bgs

235 – 240 ft bgs

240 – 245 ft bgs

245 – 250 ft bgs

250 – 255 ft bgs

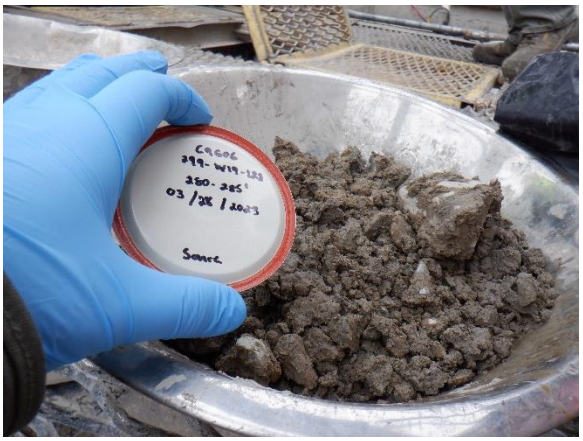
255 – 260 ft bgs

260 – 265 ft bgs

265 – 270 ft bgs

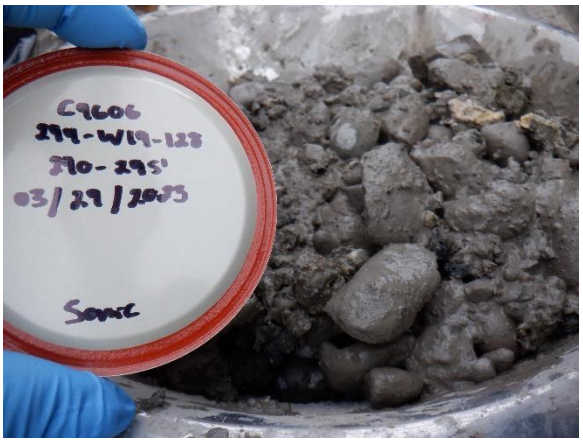
270 – 275 ft bgs

275 – 280 ft bgs



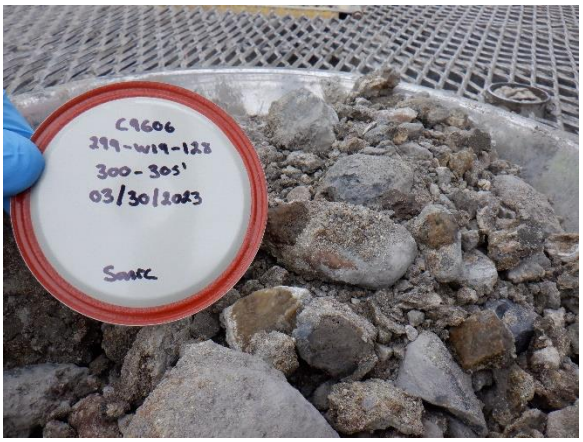
280 – 285 ft bgs

285 – 290 ft bgs



290 – 295 ft bgs

295 – 300 ft bgs



300 – 305 ft bgs

305 – 310 ft bgs

310 – 315 ft bgs

315 – 320 ft bgs

320 – 325 ft bgs

325 – 330 ft bgs

330 – 335 ft bgs

335 – 340 ft bgs

340 – 345 ft bgs

345 – 350 ft bgs

350 – 355 ft bgs

355 – 360 ft bgs

360 – 365 ft bgs

365 – 370 ft bgs

370 – 375 ft bgs

375 – 380 ft bgs

380 – 385 ft bgs

385 – 390 ft bgs

390 – 395 ft bgs

395 – 400 ft bgs

400 – 405 ft bgs

405 – 410 ft bgs

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