GREAT RIVER ENERGY™

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November 30, 2021

VIA ELECTRONIC MAIL

Mr. Michael Regan
Administrator
USEPA Headquarters
1200 Pennsylvania Ave N.W.
Washington, DC 20460

RE: CCR Alternative Liner Demonstration

Dear Mr. Regan:

Great River Energy is submitting the attached Alternative Liner Demonstration (ALD) for the Upstream Raise 91 CCR surface impoundment at Coal Creek Station in response to the requirements of 40 CFR 257.71(d). Due to Environmental Protection Agency's (EPA) delayed ruling on Part B applications, Great River Energy is submitting this demonstration out of an abundance of caution to meet the November 30, 2021 Part B ALD timeline.

The Part B Rule contemplated the EPA rendering decisions on applications by February 1, 2021, thereby allowing facilities with successful applications approximately 10 months (i.e., until November 30, 2021) to complete their ALD reports. See 85 Fed. Reg. 72506, 72529 (Nov. 12, 2020). The EPA has experienced unanticipated internal delays in reviewing and making decisions on the Part B Rule applications that were timely submitted on November 30, 2020. This extended delay has practically eliminated the timeframe contemplated in the Part B Rule for facilities to prepare their ALD reports. Given this, EPA has publicly pledged to "take actions to ensure that any facility approved to conduct a demonstration has the same amount of time anticipated by the current regulation to initiate and complete the demonstration after an approval."

We therefore respectfully request EPA to honor its commitment and to provide Great River Energy with 10 months to complete and/or augment this ALD report from the date that EPA approves its Part B Rule application. It is worth noting that Great River Energy submitted an extension request on September 1, 2021 to allow for additional time to complete necessary hydraulic conductivity tests, which are still in process and will not be completed until 2022 or later, as noted in that request and further discussed in this ALD. Great River Energy appreciates EPA's commitment to take this corrective action and believes it is both necessary and appropriate so as not to unfairly and inappropriately prejudice Great River Energy from being provided the time contemplated under the CCR Rule.

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Should you have any questions regarding the attached demonstration, please contact Shane Stockdill at 701-442-7010 or sstockdill@grenergy.com or Erik Heinen at 612.801.1269 or eheinen@grenergy.com.

Sincerely,

GREAT RIVER ENERGY

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GOLDER
MEMBER OF WSP

REPORT

Alternative Liner Demonstration for the Upstream Raise 91 CCR Surface Impoundment

Great River Energy - Coal Creek Station

Submitted to:

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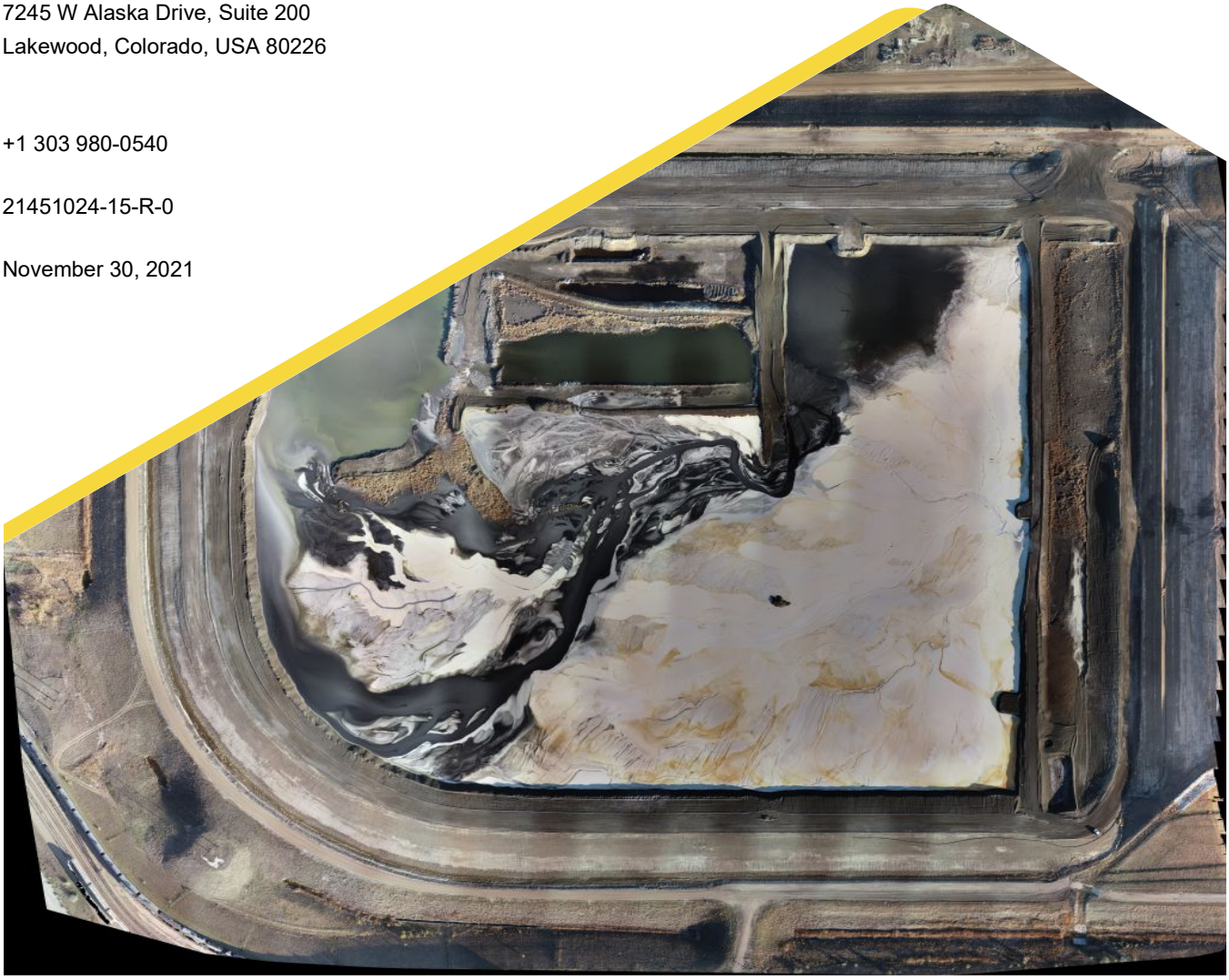
November 30, 2021



Executive Summary

Golder Associates USA Inc. (Golder), a member of WSP, has prepared this alternative liner demonstration (ALD) report for the Upstream Raise 91 coal combustion residual (CCR) surface impoundment (Upstream Raise 91) at Great River Energy's (GRE's) Coal Creek Station (CCS). This demonstration is being prepared subsequent to the application in support of submitting an ALD for Upstream Raise 91 submitted in November of 2020 (Golder 2020). This demonstration includes three primary lines of evidence:

- A characterization of the variability of site-specific soil and hydrogeology surrounding Upstream Raise 91 (Section 3.0)
- A characterization of the potential for infiltration through the composite liner system (geomembrane plus engineered low permeability soil layer) installed at Upstream Raise 91 (Section 5.0)
- A summary of the mathematical modeling performed to predict peak groundwater concentrations at the downgradient Upstream Raise 91 waste boundary assuming a theoretical contaminant release from the facility (Section 6.0)

As described in the CCR Rule (40 CFR 257.70(b)), the prescriptive liner system requires a compacted soil layer at least two feet thick with an installed hydraulic conductivity of 1 x 10^{-7} centimeters per second (cm/sec) or less overlain by a geomembrane having a minimum thickness of 30 mils (minimum thickness of 60 mils if the geomembrane is high density polyethylene [HDPE]). Upstream Raise 91 is constructed with an alternative liner consisting of a compacted low hydraulic conductivity soil layer at least two feet thick with an installed hydraulic conductivity of 1 x 10^{-7} cm/sec or less overlain by a HDPE geomembrane having a minimum thickness of 40 mils (0.040 inches). Therefore, the only difference between the alternative liner at Upstream Raise 91 and the CCR Rule's prescriptive liner is the thickness of the HDPE geomembrane component.

Site Characterization

The geologic and hydrogeologic conditions around Upstream Raise 91 that control the rate and transport of constituents potentially leaking from the surface impoundment were characterized by reviewing previously collected information (including regional and local information), performing a site investigation to evaluate subsurface conditions, and developing a site conceptual model of the potential release pathway.

The site investigation program included drilling 32 borings at a spacing of approximately 200 feet apart on-center around the facility perimeter to capture potential variability in the characteristics of materials in the vadose zone and uppermost water bearing zone. Five additional borings were also drilled and completed as monitoring wells to obtain additional information about groundwater levels and hydraulic conductivity of in situ soils. Physical testing was completed to characterize materials sampled during the site investigation program.

A review of existing site information along with the detailed site investigation program provided a detailed characterization of the heterogeneity of site subsurface conditions. The most relevant findings from this investigation are:

- The presence of soils ranging from silty clay and sandy clay till to interbedded sand lenses in the vicinity of Upstream Raise 91.
- The relatively uniform presence of clayey soils in the vadose zone between the bottom of the Upstream Raise 91 composite liner and the top of the uppermost water bearing zone.

- Confirmation of the presence of isolated coal seams in the vicinity of Upstream Raise 91 that are known conduits for the flow of groundwater in the uppermost water bearing zone.
- A relatively consistent layer of sandy soil in the lower portions of the boreholes drilled as a part of the 2021 site investigation program.
- A variable gradient beneath the facility of between 0.01 and 0.02 feet per feet (ft/ft) based on recent water level measurements.
- Laboratory and in situ (i.e., slug) hydraulic conductivity tests have been completed to help characterize the hydraulic conductivity of the near-surface native soils.
  - The results of laboratory hydraulic conductivity tests indicate that a significant portion of the native soils underlying Upstream Raise 91 are characterized by hydraulic conductivity values ranging from 5 x 10^{-8} cm/sec to 2 x 10^{-6} cm/sec.
  - Slug testing indicated hydraulic conductivities ranging from 4 x 10^{-6} cm/sec to 2 x 10^{-2} cm/sec.
  - The variation in hydraulic conductivity results between the field (i.e., slug) testing and laboratory testing reaffirms the heterogeneity of site geologic conditions in the uppermost water bearing zone.

Potential for Infiltration

The characterization of the potential for infiltration from Upstream Raise 91 focused on the engineered and constructed composite liner. Soils beneath the composite liner system that are part of the vadose zone or saturated zone are included in the modeling efforts discussed in Section 6.0. The composite liner at Upstream Raise 91 includes a geomembrane (upper layer) and soil layer (lower layer):

- The compacted low permeability soil layer at least two feet thick with an installed hydraulic conductivity of 1 x 10^{-7} cm/sec or less, and
- The HDPE geomembrane having a minimum thickness of 40 mils.

The composite liner at Upstream Raise 91 was installed in accordance with construction specifications and a Construction Quality Assurance (CQA) plan. As indicated previously in the application for an ALD, documentation of the installation indicates that the composite liner was completed in accordance with the specifications, and that both the soil layer and 40-mil geomembrane layer met or exceeded the performance specifications, indicating that the composite liner at Upstream Raise 91 will significantly limit the potential for infiltration.

Three samples of the soil layer component of the Upstream Raise 91 composite liner system were subjected to hydraulic conductivity testing in 2021. These tests use liquid from the Upstream Raise 91 sump that represents the pH and major ion composition of the Upstream Raise 91 porewater and are being run under confining pressures representative of average conditions over the life of Upstream Raise 91. Based on the current estimates for hydraulic conductivity, it may take between one and five years to pass just one pore volume of permeant through the samples and chemical equilibrium is unlikely after passing one pore volume of flow based on available research. Because of these long-projected test durations and the initial low hydraulic conductivity of the samples, composite liner infiltration rates are based on the hydraulic conductivity tests performed during liner construction, increased conservatively by a factor of 10 to reflect the potential increase in hydraulic conductivity over time due to the chemical composition of leachate from Upstream Raise 91.

Infiltration through the geomembrane layer component of the composite liner is controlled by defect size, defect frequency, and installation quality. Based on available information, the 40-mil HDPE geomembrane at Upstream Raise 91 is expected to perform similarly to a 60-mil HDPE geomembrane with a similar expected defect frequency. Despite these findings, the 40-mil HDPE geomembrane was conservatively modeled with an increased defect frequency of 25% for infiltration rate calculations.

Despite several conservative assumptions regarding the composite liner system installed at Upstream Raise 91, results of the infiltration calculations indicate that composite liners have very low infiltration rates, and that the difference in estimated infiltration rates between the alternative composite liner at Upstream Raise 91 and a prescriptive liner is insignificant.

Mathematical Model

The United States Environmental Protection Agency (USEPA) Composite Model for Leachate Migration with Transformation Products (EPACMTP) model was used to predict peak groundwater concentrations at the downgradient waste boundary assuming a potential contaminant release from Upstream Raise 91 based on the estimated infiltration rate for the existing (alternative) and prescriptive liner. Modeling was performed starting from the bottom of the composite liner system, through the vadose zone and the uppermost saturated zone and to the downgradient waste boundary. The model was run in probabilistic, Monte Carlo mode, to incorporate the range in site and source conditions.

The results from the mathematical modeling of Upstream Raise 91 with the existing alternative liner indicate that the peak concentrations of each Appendix IV constituent are predicted to be below the respective site Groundwater Protection Standards (GWPS) between the 10th and 90th percentiles (all below the GWPS at 99th percentile). Furthermore, the difference in the peak concentrations predicted at the downgradient waste boundary for the alternative composite liner at Upstream Raise 91 and the prescriptive liner was negligible for the scenarios modeled.

Arsenic, lithium, and molybdenum were predicted to only exceed the GWPS at the 100th percentile. However, each of these constituents were predicted to remain below the respective site GWPS at the 99th percentile and, consistent with USEPA (2001) guidance, probability distributions above the 90th percentile tend to be uncertain.

Based on the lines of evidence discussed in this ALD, there is no reasonable probability that the peak groundwater concentrations at the waste boundary will exceed the site-specific GWPS. Furthermore, the alternative composite liner system at Upstream Raise 91 is determined to be equally protective of human health and the environment as the prescriptive composite liner for CCR surface impoundments.

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1.0 INTRODUCTION

Golder Associates USA Inc. (Golder), a member of WSP, has prepared this alternative liner demonstration (ALD) report for the Upstream Raise 91 coal combustion residual (CCR) surface impoundment (Upstream Raise 91) at Great River Energy's (GRE's) Coal Creek Station (CCS). CCS is a 1,200-megawatt coal-fired electric generation facility owned and operated by GRE, located in McLean County, approximately 10 miles northwest of Washburn, North Dakota (Figure 1). Upstream Raise 91 is located in the south-central portion of the plant site east of the plant buildings (Figure 2) and is used as a combined dewatering and storage facility for CCR including fly ash, bottom ash, economizer ash, and flue gas desulfurization (FGD) material and will be closed with CCR in-place.

Upstream Raise 91 is constructed with an alternative liner consisting of a compacted low hydraulic conductivity soil layer at least two feet thick with an installed hydraulic conductivity of 1 x 10^{-7} centimeters per second (cm/sec) or less overlain by a high-density polyethylene (HDPE) geomembrane having a minimum thickness of 40 mils (0.040 inches).

This report includes documentation of the steps completed as part of the ALD prepared in response to the requirements promulgated in April 2015 under Title 40 of the Code of Federal Regulations (40 CFR) Part 257 (CCR Rule) (United States Environmental Protection Agency [USEPA] 2015) as well as in the rule revision entitled "A Holistic Approach to Closure Part B: Alternate Demonstration for Unlined Surface Impoundments" (the Part B Rule), which was published in the Federal Register on November 12, 2020 (USEPA 2020). As described in the CCR Rule (40 CFR 257.70(b)), the prescriptive liner system requires a compacted soil layer at least two feet thick with an installed hydraulic conductivity of 1 x 10^{-7} cm/sec or less overlain by a geomembrane having a minimum thickness of 30 mils (minimum thickness of 60 mils if the geomembrane is HDPE). Therefore, the only difference between the alternative liner at Upstream Raise 91 and the CCR Rule's prescriptive liner is the thickness of the HDPE geomembrane component.

A summary of the CCR Rule requirements for the ALD and where they are addressed in this report is found in Table 1.

Table 1: Summary of Demonstration Information

CCR Rule Citation 40 CFR Part 257	Information Requested	Where Addressed in This Demonstration
71(d)(ii)(A)	Characterization of site hydrogeology.	Section 3.0
71(d)(ii)(A)(1)	Measurements of the hydraulic conductivity in the uppermost aquifer from all monitoring wells associated with the impoundment and discussion of the methods used to obtain these measurements.	Section 3.4.1
71(d)(ii)(A)(2)	Measurements of the variability in subsurface soil characteristics collected from around the perimeter of the CCR surface impoundment to identify regions of substantially higher conductivity.	Section 3.3.2 Section 3.4
71(d)(ii)(A)(3)	Documentation that all sampling methods used are in line with recognized and generally accepted practices that can provide data at a spatial resolution necessary to adequately characterize the variability of subsurface conditions that will control contaminant transport.	Section 3.3.1
71(d)(1)(ii)(A)(4)	Explanation of how the specific number and location of samples collected are sufficient to capture subsurface variability.	Section 3.3.1
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71(d)(1)(ii)(B)	Potential for infiltration.	Section 5.0
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71(d)(1)(ii)(B)(2)	The liquid used to pre-hydrate the samples and measure long-term hydraulic conductivity.	Section 5.3.2.2
71(d)(1)(ii)(B)(3)	That samples intended to represent the hydraulic conductivity of naturally occurring soils (i.e., not mechanically compacted) are handled properly.	NA (samples are from compacted soil layer)
71(d)(1)(ii)(B)(4)	Termination criteria for hydraulic conductivity testing.	Section 5.3.2.3
71(d)(1)(ii)(C)	Mathematical model to estimate the potential for releases.	Section 6.0
71(d)(1)(ii)(C)(1)	The model relied upon in this paragraph (71(d)(1)(ii)(C)) must be well-established and validated.	Section 6.2
71(d)(1)(ii)(C)(2)	The owner or operator must use the models to demonstrate that, for each constituent in Appendix IV of this part, there is no reasonable probability that the peak groundwater concentration that may result from releases to groundwater from the CCR surface impoundment throughout its active life will exceed the groundwater protection standard at the waste boundary.	Section 6.2 Section 6.4
71(d)(1)(ii)(C)(3)	The demonstration must include the peak groundwater concentrations modeled for all constituents in Appendix IV of this part attributed both to the impoundment in isolation and in addition to background.	Section 6.2 Section 6.4

2.0 BACKGROUND

GRE manages CCR in three surface impoundments and one landfill at CCS. The location of each CCR management facility is shown in Figure 2. These CCR surface impoundments and landfill are regulated by the CCR Rule and are permitted and regulated by the North Dakota Department of Environmental Quality (NDDEQ). The four facilities are:

- Southeast Section 16 CCR Landfill (Southeast 16)
- Drains Pond System CCR Surface Impoundment (Drains Pond System)
- Upstream Raise 91 CCR Surface Impoundment (Upstream Raise 91)
- Upstream Raise 92 CCR Surface Impoundment (Upstream Raise 92)

Upstream Raise 91 and Upstream Raise 92 were designed to operate as CCR surface impoundments and will be closed with CCR in-place. No CCR was placed at Upstream Raise 92 after April 2020 and the facility is progressing through closure. The Drains Pond System is currently being used to dewater bottom ash and as a process water impoundment that is used to recycle conveyance water back to the plant. The CCR surface impoundment cells of the Drains Pond System (west and center cells) have liner systems that meet or exceed the prescriptive liner requirements outlined in 40 CFR 257.71(a)(1)(ii). Southeast 16 operates as a landfill and is used as a storage/disposal facility for CCRs that do not contain free liquid. Southeast 16 was an existing CCR landfill at the time of promulgation of the 2015 CCR Rule in which no liner system is required; however, Southeast 16 has a composite liner system that meets the requirements for new CCR landfills or lateral expansion of CCR landfills as stated in 40 CFR 257.70(a)(1).

Upstream Raise 91 is the only operating unit with an alternative liner at CCS. This report documents the ALD for this unit.

2.1 Upstream Raise 91 Site History

CCRs were originally managed in the South Ash Pond, which is a legacy facility at CCS. The South Ash Pond CCR and process water containment area was created by constructing a clay core dike around the perimeter and relying on in situ low permeability soil to act as a soil liner across the floor. This facility was put into operation in 1979 and operated intermittently from 1979 through 1990. Due to the identification of leakage from the facility, the South Ash Pond was removed from service in 1990. In the early 1990s, as part of the site corrective action to address the groundwater impacts, the South Ash Pond was closed by removal of CCRs. In-place CCRs and a portion of the underlying subsoil were excavated from the South Ash Pond and transported to an offsite landfill. After CCRs were removed from the South Ash Pond, that facility ceased to exist.

A portion of the remaining clay core dikes was salvaged, and additional soil embankments were constructed to outline the footprint of both Upstream Raise 91 and the adjacent Upstream Raise 92. A new composite liner was completed over the regraded Upstream Raise 91 floor and embankments in 1993, the specifics of which are discussed below. In addition, a composite liner was installed in the area between Upstream Raise 91 and Upstream Raise 92 in 2016 (Figures 3 and 4). This additional liner completes a continuous composite-lined area between Upstream Raise 91 and Upstream Raise 92.

2.2 Upstream Raise 91 Liner Design

The composite liner system in Upstream Raise 91 was constructed with an upper component consisting of HDPE geomembrane having a minimum thickness of 40 mils and a lower component consisting of a compacted soil layer at least two feet thick with a hydraulic conductivity less than 1 x 10^{-7} cm/sec. Construction Quality Assurance (CQA) monitoring was performed during installation of the Upstream Raise 91 composite liner system in 1993. Both the low permeability soil layer and geomembrane layer were monitored as part of these CQA programs. The CQA report for Upstream Raise 91 (referred to as Ash Pond 91 in the report) (CPA 1993) was included as part of the ALD application package (Golder 2020).

An additional seven acres of composite liner was installed in the southeast corner of Upstream Raise 91 and in the area between Upstream Raise 91 and Upstream Raise 92 in 2016 (Figure 3). Prior to composite liner construction, these areas were outside of the Upstream Raise 91 and Upstream Raise 92 CCR deposition footprint. This additional liner completes a continuous composite-lined area between Upstream Raise 91 and Upstream Raise 92. The composite liner system installed in 2016 consists of (from bottom to top): Geosynthetic Clay Liner (GCL) and a 60-mil HDPE geomembrane. Typical west-east and south north cross sections through Upstream Raise 91 are shown in Figure 4 along with details of the existing composite liner systems.

As Upstream Raise 91 construction progresses vertically, the perimeter foundation bottom ash drainage layer and fly ash shell will be raised on the north, south, and west sides. The east side is designed to buttress against the existing fly ash shell and perimeter foundation bottom ash drainage layer of Upstream Raise 92 (Figure 4). Since the east side of Upstream Raise 91 will buttress onto the west slope of Upstream Raise 92, GRE will construct a new composite liner system that meets the CCR Rule's liner requirements (either a compacted soil layer or GCL and 60-mil geomembrane) up the west slope of Upstream Raise 92 that is tied into the Upstream Raise 91 composite liner (isolating Upstream Raise 91 from Upstream Raise 92). This portion of the liner will be constructed after USEPA review of this ALD report and prior to CCR material being placed at this location.

3.0 SITE CHARACTERIZATION

As part of the ALD, 40 CFR 257.71(d)(ii)(A) requires:

> *"A characterization of the variability of site-specific soil and hydrogeology surrounding the surface impoundment that will control the rate and direction of contaminant transport from the impoundment."*

The following sections will discuss previous hydrogeologic studies, general site history, and detailed site investigation methods and results completed as a part of this ALD.

3.1 Previous Studies

Golder reviewed information from the operating record documenting the design, installation, and development of the monitoring wells and/or describing hydrogeologic conditions at the site to assess the design and location of the groundwater monitoring network. The information reviewed included:

- Braun Environmental Laboratories. 1990. Hydrogeological Analysis Annual Report, Coal Creek Station, McLean County, North Dakota. December 1990.
- Cooperative Power and United Power Associations (CPA/UPA). 1989. Application to Renew Permit SU-033 – Coal Creek Station, McLean County, North Dakota. Submitted to the North Dakota State Department of Health. February 1989.

- Environmental and Regulatory Services Division – Cooperative Power Association (ERSD/CPA). 1993. Coal Creek Station 1993 Water Quality Monitoring Report. Submitted to the North Dakota State Department of Health and Consolidated Laboratories. 1993.
- Dames & Moore. 1991. Revised Water Quality Monitoring Plan, Coal Creek Station for Cooperative Power Association. December 1991.
- Falkirk Mining Company. 1979. Land Use Analysis/Technical Examination/Environmental Assessment Record – Falkirk Coal Lease Application M-31053 (ND). Submitted to the United States Department of the Interior, July 1979. https://books.google.com/books?id=KwUyAQAAMAAJ&lpg=PP1&ots=vAdnubfhR2&dq=land%20use%20analysis%20falkirk%20M31053&pg=PT2#v=onepage&q&f=false
- United States Geological Survey (USGS). 1999. Fort Union Coal in the Williston Basin, North Dakota: A Synthesis. Chapter WS in 1999 Resource Assessment of Selected Tertiary Coal Beds and Zones in the Northern Rocky Mountains and Great Plains Region, U.S. Geological Survey Professional Paper 1625-A. https://pubs.usgs.gov/pp/p1625a/Chapters/WS.pdf

3.2 Site Geology

The area surrounding CCS is primarily characterized by the presence of mixed glacial deposits. The following sections describe the regional and site-specific geology and hydrogeology per the requirements of 40 CFR 257.71(d)(ii)(A)(*5*):

> *"A narrative description of site geological history."*

3.2.1 Regional and Site Geology

CCS and McLean County are situated at the easternmost extent of the Williston Basin, a structural and sedimentary basin (USGS 1999). The region is characterized by the presence of glacial drift, reaching thicknesses of several hundred feet, and overlying the Sentinel Butte Member, the source of commercially mined coal in the direct vicinity of CCS (Falkirk 1979). The Sentinel Butte Member is the highest strata of the Paleocene Fort Union Formation, overlying the Tongue River, Ludlow, and Cannonball Members (USGS 1999). The Sentinel Butte Member is marked by drab-gray units, separating it from the lower Tongue River Member.

The near-surface geology of CCS includes unconsolidated surficial deposits of the Coleharbor formation consisting of stratified and unstratified glacial drift. Geologic conditions are heterogeneous, with soils varying from silty clay and sandy clay till to interbedded sand lenses and discontinuous coal seams (CPA/UPA 1989).

3.2.2 Site Hydrogeology

Regional groundwater flow of the uppermost water bearing zone in the vicinity of CCS is a subtle expression of the surface topography, which is influenced by the configuration of the eroded bedrock. Based on site groundwater elevations (the most recent groundwater elevations measured around Upstream Raise 91 are shown in Figure 5), the shallow groundwater at the CCR facilities generally follows surface topography, flowing to the east and north towards Lower Samuelson Slough and Sayler Slough. Paired wells (shallow and deep) located north, and northeast of Upstream Raise 91 indicate that an upward gradient is common across the site. Therefore, the horizontal gradient beneath Upstream Raise 91 is likely to be the primary component to groundwater flow and impact from a theoretical release would likely remain in the uppermost portion of the shallow water bearing unit (Braun 1990).

3.3 Subsurface Site Investigation

As part of the ALD, the CCR Rule requires measurements of the variability of subsurface soil characteristics from around the perimeter of the impoundment, using recognized and generally accepted methods, along with a justification of the sample spacing and depth. Results of the site investigation and testing are presented in the following sections.

3.3.1 Drilling and Sampling

As a part of the characterization of site hydrogeology, 40 CFR 257.71(d)(ii)(A)(*4*) requires:

> *"Explanation of how the specific number and location of samples collected are sufficient to capture subsurface variability if:*
>
> > *(i) Samples are advanced to a depth less than the top of the groundwater table or 20 feet beneath the bottom of the nearest water body, whichever is greater, and/or*
> >
> > *(ii) Samples are spaced further apart than 200 feet around the impoundment perimeter."*

In support of the demonstration, a drilling program was executed in September 2021 to meet the requirements of the rule. Thirty-two borings were placed approximately 200 feet apart on center around the north, west, and south sides of the facility perimeter to capture potential variability in the glacial outwash underlying Upstream Raise 91. This borehole spacing satisfies CCR Rule requirements and is also adequate based on the site geologic conditions described in Section 3.2 and site observations from previous borings and excavations performed around the site. These past observations indicate that the investigation methods completed generally capture the areal extent of heterogeneous layers potentially present in the uppermost water bearing zone.

Borings were not placed on the east side of the impoundment to preserve the liner system, which is connected to the Upstream Raise 92 facility over a historic soil perimeter berm between the two facilities. The depths of the borings were selected to extend to a minimum of 20 feet beneath the bottom of the nearest surface water body, Lower Samuelson Slough (bottom elevation of approximately 1870 ft), based on the elevation of the top of the perimeter berm (1922 to 1923 ft). Locations of borings completed as part of the site investigation are shown in Figure 6.

Five monitoring wells were also installed to complement the existing monitoring well network and provide additional locations for in situ hydraulic conductivity testing required as part of the demonstration (Figure 6).

In addition to the borehole spacing and depth requirements, 40 CFR 257.71(d)(ii)(A)(*3*) requires:

> *"Documentation that all sampling methods used are in line with recognized and generally accepted practices that can provide data at a spatial resolution necessary to adequately characterize the variability of subsurface conditions that will control contaminant transport."*

Each of the 32 borings around the perimeter of Upstream Raise 91 were advanced via hollow-stem augers to a depth of 75 feet. Boreholes were logged in general accordance with industry standards and logs are included in Appendix A-1. Standard penetration testing and collection of split-spoon samples were completed at 5-foot intervals within the borings as a means of classifying subsurface soils. This testing and sampling were also completed in general accordance with industry practices.

Split-spoon samples were collected every five feet within the borings, producing approximately 15 samples per borehole within the Upstream Raise 91 berm. These samples were collected to provide additional characterization of the subsurface geology and confirmation of drilling results. Approximately one-half of the split-spoon samples were further characterized per American Society for Testing and Materials (ASTM) standards via geotechnical index testing (grain size distributions per ASTM D422 and Atterberg limits per ASTM D4318). Index testing was performed in accordance with accepted ASTM standards and allows for classification of soils via the widely used Unified Soil Classification System (USCS). Results of the material characterization are included in Appendix A-2. Selected photos corresponding to the tested soils are provided to show a representation of the soil types encountered (Appendix A-3).

3.3.2 Subsurface Site Investigation Results

A subsurface investigation was completed to partially address 40 CFR 257.71(d)(ii)(A)(2), which requires:

> *"Measurements of the variability in subsurface soil characteristics collected from around the perimeter of the CCR surface impoundment to identify regions of substantially higher conductivity."*

Boreholes completed in September 2021 serve as a basis for detailed understanding of the geologic conditions around Upstream Raise 91. Detailed stratigraphic cross sections were compiled based on boring information from current CCR monitoring wells, a boring program conducted in support of this demonstration, and historical monitoring wells and boreholes (Figure 7 to Figure 12). Historical borings within lined facility boundaries were completed prior to composite liner construction. Note that boring information has been projected to applicable sections and that historical borings may be truncated at the top of liner or current existing surface grades due to changes in site geometry since those borings were completed.

Cross Section A represents a section along the downgradient (north) boundary, Cross Section C represents a section along the upgradient (south) boundary, and Cross Section E represents a section along the west boundary of Upstream Raise 91. Cross Sections B and D are drawn through the center of Upstream Raise 91 and rely on historical information in addition to the new borings. The new borings adjacent to the facility at each of these sections allow for a detailed understanding of the local geology and minimizes the interpretation required to construct stratigraphic sections. A detailed overview of the geologic conditions at Upstream Raise 91 is described below.

- Upgradient Areas
  - Cross Section C shows the relatively consistent zone of low permeability soil used to construct the perimeter berm surrounding Upstream Raise 91. Some zones of sandier soil were noted in this berm; however, the majority of this berm consists of the clayey glacial till common at CCS.
  - Cross Section C also indicates that along the west side of Upstream Raise 91, the soils underlying the surface impoundment consist of higher permeability soils (i.e., sandier soils). Soils on the east side of the facility were observed to consist primarily of lower permeability soils (i.e., clayey soils).
  - The south ends of Cross Sections B and D as well as Cross Section C indicate the presence of isolated coal seams between approximate elevations 1880 feet and 1930 feet in the vicinity of Upstream Raise 91. Some of these coal seams are known to be conduits for the flow of groundwater in the uppermost water-bearing zone.

- A relatively consistent layer of sandy soil was observed in the lower portions of the boreholes drilled as a part of the 2021 site investigation program.

- South to North through Upstream Raise 91
  - Cross Sections B, D, and E represent the geologic conditions in the general direction of groundwater flow from southwest to northeast.
  - Cross Section E is defined by the relatively consistent zone of low permeability soil used to construct the perimeter berm surrounding Upstream Raise 91. A coal seam was noted near the toe elevation of this berm in a historic boring and is consistent with other site observations noting coal seams in the area.
  - Cross Sections B and D indicate a relatively consistent zone of low permeability soil (i.e., clayey soil) of varying thickness directly underlying the facility. This zone appears to have a thickness of at least approximately 10 feet before reaching a zone of higher permeability underlying soil.
  - Similar to Cross Section C along the upgradient side of Upstream Raise 91, Cross Sections B and E show that there is a relatively consistent layer of sandy soil in the lower portions of boreholes. The top of this zone of higher permeability soil was generally between approximate elevations of 1880 and 1895 feet.

- Downgradient Areas
  - Cross Section A represents a section through the downgradient boundary of Upstream Raise 91. As with the other cross sections, Cross Section A is defined by the relatively consistent zone of low permeability soil used to construct the perimeter berm surrounding Upstream Raise 91.
  - Coal seams were not noted in the boreholes on the north side of the facility, likely an indication of the greater amount of disturbance of this area during construction of the legacy South Ash Pond facility in this area in the late 1970s and early 1980s.
  - Cross Section A indicates a relatively consistent zone of low permeability soil (i.e., clayey soil) of varying thickness directly underlying the north side of the facility. This zone appears to have a thickness of approximately 5 feet overlying a zone of higher permeability underlying soil.
  - Similar to observations around other portions of the facility, Cross Section A shows the relatively consistent layer of sandy soil in the lower portions of boreholes. The top of this zone of higher permeability soil was generally noted to be between approximate elevations of 1865 and 1880 feet over a majority of the Cross Section A; however, a small zone of higher permeability soil was noted near the northeast corner of Upstream Raise 91, with a top elevation of approximately 1890 feet.
  - Wells downstream of Upstream Raise 91 reflect the geologic conditions noted above and are screened in intervals of lower and higher permeability soils. Cross Section D shows the location and screening interval of Monitoring Well MW-91-1, including the relation of that downgradient well to the higher permeability zones underlying Upstream Raise 91 and Lower Samuelson Slough further downgradient of Upstream Raise 91.

3.4 Site Hydraulic Conductivity

As part of the characterization of the site, in situ hydraulic conductivity testing was performed in 2021. This testing was completed to partially address 40 CFR 257.71(d)(ii)(A)(2), which requires:

> *"Measurements of the variability in subsurface soil characteristics collected from around the perimeter of the CCR surface impoundment to identify regions of substantially higher conductivity."*

In situ hydraulic conductivity testing completed in 2021 supplements previously completed laboratory hydraulic conductivity testing. A summary of the hydraulic conductivity testing procedures and results is included in this section.

3.4.1 In Situ Testing

40 CFR 257.71(d)(ii)(A)(1) requires:

> "Measurements of the hydraulic conductivity in the uppermost aquifer from all monitoring wells associated with the impoundment(s) and discussion of the methods used to obtain these measurements;"

From September 21 to September 28, 2021, Golder performed variable-head hydraulic (i.e., slug) testing at the following monitoring wells.

- MW-16-6
- MW-49
- MW-75
- MW-DP3
- MW-91-1
- MW-91-2
- MW-91-4
- MW-91-5
- MW-91-6
- MW-91-7

These wells comprise six of the seven existing monitoring wells included in the Upstream Raise 91 network along with four of the additional wells installed in 2021. Slug testing locations are shown in Figure 13. Slug testing was unable to be performed at upgradient well MW-91-3 (installed in 2021) and downgradient well MW-51 (part of the existing Upstream Raise 91 CCR monitoring network) due to inadequate available water column within these wells at the time of testing.

The data resulting from the 2021 slug tests is used to evaluate the in situ horizontal hydraulic conductivity of geologic materials isolated by the screened intervals (i.e., the uppermost water bearing unit) in support of modeling efforts discussed in more detail in Section 6.0.

3.4.1.1 In Situ Testing Equipment and Procedures

Prior to slug test initiation, Golder measured the static water level and total depth at each monitoring well with an electronic water level meter. These measurements were used to determine the maximum available water column length, an important hydraulic test design consideration. Golder designed and constructed custom polyvinyl chloride (PVC) slugs of various lengths to maximize the displacement of the water column within a given well based on available water column length within a given well and the length of other down-hole testing equipment. The slugs were constructed of off-the-shelf, 1.25-inch Schedule 40 PVC pipe and end caps affixed with stainless steel screws. The PVC slugs were fully filled with sand to eliminate buoyancy potential of the empty slugs. The slugs were completed at the top with stainless steel eye bolts and bonded washers to allow the slug to be deployed and retrieved on a length of new nylon rope used for each monitoring well. Slug testing was performed by the nearly instantaneous injection or withdrawal of the PVC slug into the water column of the monitoring well. Both falling head (i.e., slug injection) and rising head (i.e., slug withdrawal) tests were performed at each monitoring well.

Each monitoring well was tested multiple times. Upon initiation of either the slug injection or slug withdrawal, changes in the water level were monitored with an In-Situ Leveltroll 700 electronic pressure transducer and data logger set to record water levels at a rapid interval until the monitoring well had recovered to at least 70 percent of its initial static level. The rate of water level recovery to the static condition was analyzed to estimate the in situ horizontal hydraulic conductivity of geologic materials isolated by the screened intervals.

3.4.1.2 In Situ Testing Analysis Approach

Formational hydraulic conductivities were estimated by using the Hvorslev (1951) analytical methods within the AQTESOLV™ software package (Duffield 2007). This method of analysis involves fitting a straight line to the linear portion of water level recovery test data plotted on a semi-log scale. For each test analysis, a straight line was fit to the recommended head range (normalized head between 0.15 and 0.25) in general accordance with guidelines described in Butler (1998). Hydraulic conductivity was then estimated from the slope of this line.

3.4.1.3 In Situ Test Results

In general, the AQTESOLV™ analysis of the 2021 slug testing data for each of the wells tested shows a concave-upward curvature in the semi-log test response data. Based on Butler (1998), this effect is indicative of varying storage mechanisms and is likely due to well screen intervals that span variable lithologies. The variable lithologies within well screened intervals was confirmed by review of the borehole logs and well completion diagrams available for each monitoring well that was tested. The presence of variable lithologies within a well screen interval, and between wells, resulted in hydraulic conductivities ranging from 4×10^{-6} cm/sec to 2×10^{-2} cm/sec. With wells screened across multiple lithologies, the resulting hydraulic conductivity is considered a bulk value and is most representative of the lithology with the highest hydraulic conductivity. The AQTESOLV™ analysis reports for each test analyzed are presented in Appendix A-4 and the slug test results, including the lithology of the well screen interval, are summarized in Table 2.

Table 2: In Situ Hydraulic Conductivity Test Results

Location	Lithologies Within Well Screen Intervals	Hydraulic Conductivity (Geometric Mean)
MW-DP3	Fill, Coal, Clay	4×10^{-6} cm/sec
MW-91-7	Fat Clay	5×10^{-4} cm/sec
MW-91-2	Fat Clay, Coal	8×10^{-4} cm/sec
MW-75	Clayey Silt, Silty Sand	3×10^{-5} cm/sec
MW-91-4	Fat Clay, Lean Clay, Coal, Silty Clay with Sand	4×10^{-5} cm/sec
MW-16-6	Sandy Lean Clay, Coal, Lean Clay	2×10^{-2} cm/sec
MW-49	Sandy Gravelly Clay, Sandy Silt	1×10^{-3} cm/sec
MW-91-5	Fat Clay, Sandy Lean Clay, Clayey Sand, Silty Sand	3×10^{-3} cm/sec
MW-91-1	Sand with Silt and Gravel, Fat Clay	8×10^{-4} cm/sec
MW-91-6	Fat Clay, Lean Clay, Sandy Lean Clay, Silty Sand	7×10^{-5} cm/sec

3.4.2 Laboratory Hydraulic Conductivity Testing

Laboratory tests to measure saturated hydraulic conductivity have been conducted on nine relatively undisturbed (i.e., Shelby tube) samples obtained from relevant depths in boreholes drilled in and around the area occupied by Upstream Raise 91 to characterize the hydraulic conductivity of the near-surface native soils. The locations of the boreholes from which the samples were obtained are shown in Figure 14.

The results of the hydraulic conductivity tests performed on Shelby tube samples obtained from relevant depths in boreholes drilled near Upstream Raise 91 are summarized in Table 3 and indicate that native soils underlying Upstream Raise 91 are characterized by hydraulic conductivity values ranging from 5 x 10^{-8} cm/sec to 2 x 10^{-6} cm/sec.

Table 3: Laboratory Hydraulic Conductivity Test Results

Year	Borehole	Sample Depth	Soil Description	Hydraulic Conductivity
2014	DP-A	25 feet	Clayey silt, brown	9 x 10^{-8} cm/sec
2014	DP-B	15 feet	Silty clay, trace gravel, dark brown	5 x 10^{-8} cm/sec
2014	DP-C	25 feet	Clayey sand, dark brown, moist	1 x 10^{-7} cm/sec
2014	DP-D	20 feet	Sandy silty clay, dark brown, moist	2 x 10^{-6} cm/sec
2002	SW16-8	76 feet	Clay, some silt, little sand, yellowish-brown	4 x 10^{-7} cm/sec
2001	BH-8	61 feet	Clay, some sand and gravel, dark grayish-brown	8 x 10^{-8} cm/sec
1978	SAP-1	3.5 feet	Silty clay	4 x 10^{-7} cm/sec
1978	SAP-8	12.5 feet	Lean clay	2 x 10^{-7} cm/sec
1978	SAP-10	3.5 feet	Lean clay	2 x 10^{-7} cm/sec
Geometric Mean				2 x 10^{-7} cm/sec

3.4.3 Vadose Zone Testing (Soil Water Characteristic Curves)

In the early 2000s, an alternative cover demonstration project was completed at GRE's CCS to evaluate the use of site soils for use in an evapotranspiration cover system in the semi-arid North Dakota climate. As a part of this work, soil water characteristic curve (SWCC) laboratory testing was completed on site soils of varying density. The SWCC provides the relationship between soil suction and moisture content and is used to estimate soil moisture retention parameters for unsaturated flow. These tests were completed at the University of Wisconsin Geotechnics Laboratory in Madison, Wisconsin, in 2004.

The physical properties of the 2004 SWCC test specimens were compared to those of the clayey soils noted in borings at elevations corresponding to the vadose zone between the Upstream Raise 91 composite liner system and the top of the uppermost water bearing zone. Since these soils are similar, results from the site-specific SWCC test completed for Sample CC5 LPS5 were used for hydraulic parameters for the vadose zone that are required to complete mathematical modeling outlined in Section 6.0 (see Appendix A-5).

3.5 Groundwater Elevation and Hydraulic Gradient

Depths to groundwater are measured in each well during each sampling event prior to purging for sample collection and occasionally more often to obtain seasonal and year-to-year trends in how groundwater elevations vary with time. Groundwater elevations and interpolated groundwater contours from October/November 2021 groundwater levels are shown in Figure 5.

The groundwater gradient across Upstream Raise 91 was estimated from recent groundwater levels, and ranges from 0.01 to 0.02 ft/ft.

3.6 Conceptual Site Model

A conceptual site model is required to be developed to outline the stratigraphy underlying Upstream Raise 91 per 40 CFR 257.71(d)(ii)(A)(*6*). The requirements of this section are outlined in more detail below.

"Conceptual site models with cross-sectional depictions of the site environmental sequence stratigraphy"

The site conceptual model is presented as Figure 15 and is generally based on the groundwater measurements shown in Figure 5, detailed stratigraphic cross sections shown in Figures 7 through 12, and the more generalized understanding of the geologic and hydrogeologic setting as discussed in Section 3.2. As shown in Figure 15, Upstream Raise 91 generally has a stratigraphic sequence that consists primarily of silty clay and sandy clay till (primarily fine-grain soils, more than 50% of soil particles passing the Number 200 sieve) near the surface, with isolated interbedded sand lenses and discontinuous coal seams. Coarse-grain soils (less than 50% of soil particles passing the Number 200 sieve) are more prevalent at depths of between 5 feet and 20 feet below the Upstream Raise 91 composite liner system.

In addition to site environmental sequence stratigraphy, the conceptual site model is required to address six additional items, each described in more detail below and shown in Figure 15:

"(i) The relative location of the impoundment with depth of ponded water noted"

The water level in Upstream Raise 91 varies with time as more CCRs are deposited and as operational variables change (such as operational drainage piping elevations). Upstream Raise 91 is designed and has historically been operated so the depth of the impounded water at the surface of the facility is maintained between zero and six feet. This depth of impounded water is controlled to maintain adequate freeboard to containment berms.

"*(ii) Monitoring wells with screening depth noted"*

Monitoring wells are located upgradient and downgradient of Upstream Raise 91 as shown in Figure 5. These wells are screened in the uppermost water bearing zone. Upgradient monitoring wells are screened at depths ranging from 4 feet to 40 feet below ground surface (groundwater between elevations 1909 feet to 1921 feet) and downgradient monitoring wells are screened at depths ranging from 9 feet to 26 feet below ground surface (groundwater between elevations 1878 feet to 1888 feet). See Appendix B-1 for monitoring well installation details.

"(iii) Depiction of the location of other samples used in the development of the model"

Figure 7 shows the location of a majority of the samples used to create the conceptual site model cross section through Upstream Raise 91, including the 32 boreholes and 5 monitoring wells completed in 2021 as well as historic borings that were drilled in the vicinity of the facility. Additional samples of site soil were collected from

borings shown in Figure 1. Samples of the composite liner soil layer collected for chemical equilibrium hydraulic conductivity testing are shown in Figure 17.

> *"(iv) The upper and lower limits of the uppermost aquifer across the site"*

Although not technically an aquifer (per USEPA definition in the preamble to the CCR Rule (Page 21362), an aquifer generally "yields usable water"), the uppermost water bearing zone is monitored around Upstream Raise 91. The groundwater table is considered the upper limit of the uppermost water bearing zone.

Based on historical groundwater elevations from paired wells (shallow and deep) screened in the uppermost water bearing zone, the lower limit of the uppermost water bearing zone was estimated to be at a depth of approximately 40 feet below the upper limit of the uppermost water bearing zone.

> *"(v) The upper and lower limits of the depth to groundwater measured from monitoring wells if the uppermost aquifer is confined"*

The uppermost water bearing zone monitored around Upstream Raise 91 is an unconfined system.

> *"(vi) Both the location and geometry of any nearby points of groundwater discharge or recharge (e.g., surface water bodies) with potential to influence groundwater depth and flow measured around the unit."*

A surface water drainage ditch exists on the south and west sides of Upstream Raise 91 with a bottom of ditch elevation of approximately 1898 feet. The uppermost water bearing zone appears to intersect this surface water drainage in certain locations, as shown in Figure 5 and water within this ditch is commonly at elevations between 1898 feet and 1900 feet.

Lower Samuelson Slough exists at a minimum distance of approximately 360 feet downgradient of the north side of Upstream Raise 91 and has a typical elevation between approximately 1875 feet and 1880 feet. As described in Section 3.2.2, the uppermost water bearing zone in the vicinity of CCS is a subtle expression of the surface topography and that can be visualized in the location and elevation of surrounding surface water bodies.

To summarize the conceptual site model described above and shown in Figure 15, a theoretical subsurface release from Upstream Raise 91 would be expected to migrate vertically downward through the unsaturated zone to the uppermost groundwater, approximately 5 to 15 feet below the bottom of the composite liner system, before flowing downgradient. As described above, a conceptual release would likely stay in the shallow groundwater system and not migrate vertically. The downgradient wells that monitor Upstream Raise 91 are positioned along the downgradient edges of the CCR facility to detect a release if it was to occur.

4.0 BACKGROUND WATER QUALITY

The existing upgradient sampled monitoring wells (MW-DP3, MW-91-2, MW-75, MW-16-6) yield groundwater samples from the uppermost water bearing zone that represent the quality of background that has not been affected by leakage from Upstream Raise 91 as required by 40 CFR 257.91(a). At present, the groundwater monitoring system for Upstream Raise 91 remains in detection monitoring, as defined by 40 CFR 257.94. As such, groundwater at the facilities is monitored on a semi-annual basis for the parameters listed in Appendix III of the CCR Rule.

Assessment monitoring as defined in 40 CFR 257.95 has not been initiated at Upstream Raise 91. Groundwater Protection Standards (GWPS) have not been formally developed as described in 40 CFR 257.95(d)(2) and 40 CFR 257.95(h) due to the program remaining in detection monitoring. GWPS presented in this document have

been developed solely for the modeling efforts described herein and are subject to revision in the event of the facility entering an assessment monitoring program.

4.1 Upgradient Monitoring Wells

Recent groundwater elevations were reviewed to evaluate the areal extent of waters that may be flowing from the upgradient boundary of the facility, across the facility extents and through the downgradient boundary. Figure 5 shows the groundwater elevation contours based on readings from October/November 2021. As shown via these contours, groundwater upgradient from Upstream Raise 91 encompasses several existing upgradient monitoring wells monitored west and south of Upstream Raise 91 for which significant water quality information is available (MW-DP3, MW-91-2, MW-75, MW-16-6). New monitoring wells installed in 2021 upgradient of Upstream Raise 91 include MW-91-3, MW-91-4, and MW-91-7; however, water quality information for these wells is not yet available and these wells have not been incorporated into the monitoring well network.

Site variability within the area of Upstream Raise 91 results in a range of materials within the near-surface geologic units, as shown in the cross sections (Figures 7 to 12) and the monitoring well logs (Appendix B-1). Discontinuous seams of coal are located throughout the site in addition to gravel, sand, silt, and clay as described in Section 3.0. This geologic spatial variability influences the water quality variability observed in the upgradient wells as discussed via development of GWPS in Section 4.2 and background water quality distributions in Section 4.3.

4.2 Appendix IV Parameters and Site-Specific Groundwater Protection Standards

To date, the Appendix IV parameters that are required as part of an assessment monitoring program under 40 CFR 257.95 have been collected as part of the initial baseline collection period described in 40 CFR 257.94(b), and approximately once annually for ongoing confirmation. Between 12 and 17 samples have been analyzed for each Appendix IV parameter for each Upstream Raise 91 groundwater monitoring well through June 2021. In the event of a transition to assessment monitoring, a site-specific GWPS would be established for the detected Appendix IV parameters in accordance with 40 CFR 257.95(d)(2) and 40 CFR 257.95(h).

Following the procedures outlined in the site Statistical Methods Certification Revision 2 (see Appendix B-2), data from the four existing monitoring wells that are upgradient of Upstream Raise 91 were reviewed to establish site-specific GWPS for the Appendix IV parameters, shown in Table 4. These GWPS values will be used for comparison to the modeling results discussed in more detail in Section 6.0. Time-series for the Appendix IV parameters at the four existing upgradient wells are provided in Appendix B-3. Summary statistics for the pooled upgradient dataset are provided in Appendix B-4. Of the 15 Appendix IV parameters, only mercury has never been detected in the pooled upgradient dataset. The remaining parameters were detected in 4% to 100% of the collected samples in the upgradient pooled dataset.

Based on the pooled upgradient dataset, the maximum contaminant level (MCL) as indicated by 40 CFR 257.95(h)(1) or alternative specified limit indicated in 40 CFR 257.95(h)(2) were set as the GWPS for the following constituents: antimony, barium, cadmium, chromium, fluoride, mercury, molybdenum, combined radium-226 and radium-228, selenium, and thallium. For the five remaining constituents (arsenic, beryllium, cobalt, lead, and lithium), additional considerations were required.

- Arsenic, Cobalt, and Lead
  - In considering potential site-specific GWPS, the time-series (Appendix B-3) of the pooled upgradient datasets were reviewed for overarching trends that might impact the GWPS. Well MW-DP3 was installed shortly before collection of the initial CCR samples in September 2015 and exhibits behavior consistent with a “breaking-in” period following installation, as shown on the time-series plots, with high initial concentrations that quickly decrease to more stable long-term concentrations. Therefore, at MW-DP3, the first or first and second collected Appendix IV data points were censored from the dataset as visual outliers. These visual outliers were censored from the dataset and the MCL or alternative specified limit was able to be used as the site-specific GWPS for arsenic, cobalt, and lead.
- Beryllium
  - For beryllium, a number of elevated non-detect results with practical quantitation limits (PQLs) that exceed the MCL were present within the pooled upgradient dataset. The elevated non-detects were reported with qualifiers indicating instrumental quality control issues that are not reflective of the underlying data population. Therefore these values were censored from the dataset to establish a GWPS at the MCL.
- Lithium
  - Within the upgradient dataset, 39 of the 40 detected concentrations exceed the alternative specified limit of 0.04 milligrams per liter (mg/L) indicated in 40 CFR 257.95(h)(2). Additionally, non-detect values within the upgradient pooled dataset were collected at a PQL that exceeds the alternative specified limit in 40 CFR 257.95(h)(2) but were collected prior to promulgation of the alternative specified limit. The current PQL for lithium is set at 0.01 mg/L, 25% of the 0.04 mg/L limit specified in 40 CFR 257.95(h)(2). Given the distribution of values within the dataset and the percentage of non-detects (18%), the non-detects were retained within the dataset. The pooled upgradient dataset for lithium displayed a non-normal distribution, resulting in the site-specific GWPS being set at the highest value in the background as shown in Table 4.

Table 4: Site-Specific Groundwater Protection Standards - November 2021

Appendix IV Parameter	Site-Specific GWPS
Antimony (mg/L)	0.006
Arsenic (mg/L)	0.01
Barium (mg/L)	2
Beryllium (mg/L)	0.004
Cadmium (mg/L)	0.005
Chromium (mg/L)	0.1
Cobalt (mg/L)	0.006
Fluoride (mg/L)	4
Lead (mg/L)	0.015
Lithium (mg/L)	0.640
Mercury (mg/L)	0.002
Molybdenum (mg/L)	0.1
Radium-226 and Radium-228, Combined (pCi/L)	5
Selenium (mg/L)	0.05
Thallium (mg/L)	0.002

picocuries per liter (pCi/L)

The site-specific GWPS analyses discussed above are provided for information only to supplement the modeling approach discussed in Section 6.0. In the event of entering assessment monitoring, site-specific GWPS would be established for each parameter incorporating the most recent applicable water quality information, which could vary from the information presented above.

4.3 Background Groundwater Concentrations

Per 40 CFR 257.71(d)(ii)(C)(3) of the CCR Rule, the ALD must include a review of the peak groundwater concentrations at the facility's waste boundary attributed both to the impoundment in isolation and in addition to background. As discussed in more detail in Section 6.0, modeling simulations are used to predict probability distributions of peak downgradient groundwater concentrations attributed to Upstream Raise 91 in isolation. However, the evaluation of modeling results will also need to take into consideration the background water quality at the site.

As with the site GWPS values discussed in Section 4.2, the time-series (Appendix B-3) of the pooled upgradient datasets were reviewed for overarching trends that might impact the pooled distributions of upgradient values. Well MW-DP3 was installed shortly before collection of the initial CCR samples in September 2015 and exhibits behavior consistent with a "breaking-in" period following installation, as shown on the time-series plots, with high initial concentrations that quickly decrease to more stable long-term concentrations. At MW-DP3, the first or first and second collected Appendix IV data points were censored from the dataset for creating background distributions for arsenic, cobalt, lead, barium, beryllium, and cadmium.

For beryllium, a number of elevated non-detect values with PQLs that exceed the MCL were present within the pooled upgradient dataset. These values were censored from the dataset while reviewing the background distribution, as they were reported with qualifiers indicating instrumental quality control issues that are not reflective of the underlying data population.

Results for radium-226 and radium-228 collected after June 2018 were analyzed by Eurofins TestAmerica using method SW 9315 for radium-226 and method SW 9320 for radium-228. Results collected prior to June 2018 were analyzed by Intermountain Laboratories using method SM7500-Ra-B for radium-226 and the Georgia Tech method for radium-228. While both sets of methods are approved for analysis of radium-226 and radium-228, differences were noted in the handling and reporting of trace and non-detect values. For consistency and to minimize the use of non-detects within the distribution, only results collected after June 2018 were used to create the distribution presented below.

Across the dataset, non-detects were substituted with one-half of the PQL when creating distributions of the background water quality.

The distribution of water quality from upgradient background wells (Table 5) is used along with the probability distribution of water quality modeled via infiltration through the liner to calculate a probability distribution of water quality observed downgradient from Upstream Raise 91 considering both background water quality and water quality via infiltration through the composite liner system, discussed in Section 6.0.

Table 5: Summarized Appendix IV Upgradient Pooled Background Distributions

Percentile Distributions	0%	25%	50%	75%	90%	95%	100%
Antimony (mg/L)	0.0005	0.0005	0.0005	0.0010	0.0010	0.0010	0.0011
Arsenic (mg/L)	0.0010	0.0010	0.0025	0.0025	0.0032	0.0042	0.0061
Barium (mg/L)	0.0272	0.0360	0.0480	0.0612	0.1284	0.1714	0.3926
Beryllium (mg/L)	0.00025	0.00025	0.00025	0.00050	0.00050	0.00050	0.00060
Cadmium (mg/L)	0.00025	0.00025	0.00025	0.00050	0.00050	0.00068	0.00100
Chromium (mg/L)	0.0010	0.0010	0.0010	0.0010	0.0050	0.0093	0.0278
Cobalt (mg/L)	0.00050	0.00088	0.00100	0.00203	0.00280	0.00353	0.00530
Fluoride (mg/L)	0.050	0.050	0.110	0.450	0.483	0.540	0.990
Lead (mg/L)	0.00025	0.00050	0.00050	0.00100	0.00174	0.00309	0.00990
Lithium (mg/L)	0.035	0.085	0.155	0.223	0.581	0.600	0.640
Mercury (mg/L)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Molybdenum (mg/L)	0.0010	0.0010	0.0010	0.0025	0.0050	0.0095	0.0125
Radium-226 and Radium-228 Combined (pCi/L)	0.0653	0.2990	0.8840	1.1450	1.3660	1.4550	1.6800
Selenium (mg/L)	0.0010	0.0025	0.0025	0.0050	0.0139	0.0184	0.0319
Thallium (mg/L)	0.00025	0.00025	0.00038	0.00050	0.00050	0.00050	0.00070

The distribution of water quality concentrations from upgradient wells were used to establish the site-specific GWPS. For most constituents, the upgradient water quality concentrations are below the site-specific GWPS. As discussed in Section 4.2, the site-specific GWPS for lithium was set at the highest background value, which is the 100th percentile value, as shown in Table 5.

5.0 POTENTIAL FOR INFILTRATION

As part of the ALD, 40 CFR 257.71(d)(ii)(B) requires:

> *"A characterization of the potential for infiltration through any soil-based liner components and/or naturally occurring soil that control release and transport of leachate."*

The characterization of the potential for infiltration from Upstream Raise 91 focused on the engineered and constructed composite liner system. Soils beneath the composite liner system that are a part of the vadose zone or saturated zone are included as a part of the modeling efforts discussed in Section 6.0. The following sections will discuss the alternative composite liner at Upstream Raise 91, the method proposed for evaluating composite liner infiltration, sampling and testing of the soil layer component of the composite liner, modeling properties of the geomembrane component of the composite liner, and resulting infiltration rate estimates.

5.1 Upstream Raise 91 Composite Liner

The alternative liner for Upstream Raise 91 consists of a compacted low hydraulic conductivity soil layer at least two feet thick with an installed hydraulic conductivity of 1 x 10^{-7} cm/sec or less overlain by a HDPE geomembrane having a minimum thickness of 40 mils. The prescriptive liner for existing CCR surface impoundments from the CCR Rule (40 CFR 257.70(b)) requires a compacted soil layer at least two feet thick with an installed hydraulic conductivity of 1 x 10^{-7} cm/sec or less overlain by a geomembrane having a minimum thickness of 30 mils (minimum thickness of 60 mils if the geomembrane is HDPE). Thus, the only difference between the alternative liner and the prescriptive liner is the thickness of the HDPE geomembrane component (see Figure 16). Infiltration rates will be evaluated for both the Upstream Raise 91 alternative liner and the prescriptive liner to support a comparison in liner performance.

5.2 Composite Liner Infiltration

The composite liner at Upstream Raise 91 consists of a geomembrane overlying a compacted soil layer. The flow of water through a geomembrane liner is primarily advective flow through defects in the geomembrane rather than diffusive flow through the geomembrane. Defects occur primarily due to installation damage that is not identified and corrected as part of the CQA program. Infiltration through a composite liner occurs when flow passes through a defect. This infiltration rate is controlled by the size of the defect, the contact between the geomembrane and underlying soil layer of the composite liner, the properties of that underlying soil layer, and the head of water on the geomembrane. Several studies have been performed, and equations were developed to estimate infiltration rates through composite liners. One of the most commonly used equations is that proposed by Giroud (1997). This equation is semi-empirical and was developed using a small database of laboratory results. Because of this semi-empirical nature, it is only valid for the range of laboratory results used in its development. Head on liner is one of those limiting constraints, with the Giroud equation only being valid for pressure head conditions ranging from 0 to 3 meters. The head on the liner for Upstream Raise 91 will be greater than 3 meters for most of the facility's life (Section 5.5) and another method of estimating flow through the composite liner system is preferable.

The method selected to estimate infiltration rates through the composite liner at Upstream Raise 91 is that proposed by Rowe (1998), which includes a set of equations using theoretical principles that can accommodate the expected conditions at Upstream Raise 91 (i.e., composite liner system modeled, head on liner greater than 3 meters). The following equations are used for estimating infiltration through the composite liner (Rowe solution as presented in Foose 2001).

$$q = \pi \cdot k_{sat} \cdot \left(r_d^{\,2} \cdot \frac{h_t}{L_s} + 2 \cdot \frac{h_t}{L_s} \Delta_1 + 2 \cdot \frac{h_t}{L_s} \Delta_2 - \frac{2 \cdot h_w}{L_s} \Delta_2 \right) \quad \text{(eq 32)}$$

where:

- q = flow through a circular defect in a composite liner (m^3/sec)
- k_{sat} = saturated hydraulic conductivity of the soil layer (m/sec)
- h_w = head of water on top of the geomembrane (m)
- L_s = thickness of the soil layer (m)
- h_t = total head drop across composite liner ($h_w + L_s$)
- r_d = radius of defect (m)

$$\Delta_1 = \frac{-\left[R\lambda_1(r,R)K_1(\alpha R) + R\lambda_2(r,R)I_1(\alpha R)\right]}{\alpha} + \frac{r\lambda_1(r,R)K_1(\alpha r)}{\alpha} + \frac{r\lambda_2(r,R)I_1(\alpha r)}{\alpha} \quad \text{(eq 27a)}$$

$$\Delta_2 = \frac{\left[-R\lambda_1(R,r)K_1(\alpha R) - R\lambda_2(R,r)I_1(\alpha R)\right]}{\alpha} + \frac{\left[r\lambda_1(R,r)K_1(\alpha r) + r\lambda_2(R,r)I_1(\alpha r)\right]}{\alpha} \quad \text{(eq 27b)}$$

where:

- K_1 = modified Bessel function of order 1
- I_1 = modified Bessel function of order 1
- R = wetted radius (m)

$$\lambda_1(X,Y) = \frac{I_0(\alpha Y)}{K_0(\alpha X)I_0(\alpha Y) - K_0(\alpha Y)I_0(\alpha X)} \quad \text{(eq 28a)}$$

$$\lambda_2(X,Y) = \frac{K_0(\alpha Y)}{K_0(\alpha X)I_0(\alpha Y) - K_0(\alpha Y)I_0(\alpha X)} \quad \text{(eq 28b)}$$

where:

- K_0 = modified Bessel function of order 0
- I_0 = modified Bessel function of order 0

$(-h_w - L_s)\Lambda_1 - (L_s)\Lambda_2 = 0$ Solve for R (eq 29)

$$\Lambda_1 = \frac{-\alpha K_1(\alpha R) I_0(\alpha R) - \alpha K_0(\alpha R) I_1(\alpha R)}{K_0(\alpha r) I_0(\alpha R) - K_0(\alpha R) I_0(\alpha r)} \quad \text{(eq 30a)}$$

$$\Lambda_2 = \frac{-\alpha K_1(\alpha R) I_0(\alpha r) - \alpha K_0(\alpha r) I_1(\alpha R)}{K_0(\alpha R) I_0(\alpha r) - K_0(\alpha r) I_0(\alpha R)} \quad \text{(eq 30b)}$$

$$\alpha^2 = \frac{k_{sat}}{L_s T} \quad \text{(eq 31)}$$

where:

- T = Transmissivity of the interfacial zone
  - (1.6×10^{-8} m^2/s for good contact and 1×10^{-7} m^2/s for poor contact)
- $Q = q \cdot n$ (eq 33)
- Q = flow through a unit area of composite liner (m^3/yr)
- n = density of defects (# per hectare)

The following sections describe the modeling inputs as required by the Rowe solution. Section 5.3 discusses modeling inputs associated with the soil layer, Section 5.4 discusses geomembrane modeling inputs, Section 5.5 discusses hydraulic head conditions, and Section 5.6 summarizes infiltration calculation results.

5.3 Soil Layer

Both the CCR Rule's prescriptive composite liner and the existing alternative composite liner at Upstream Raise 91 include a compacted soil layer at least two feet thick with an installed hydraulic conductivity of 1×10^{-7} cm/sec or less.

Two sources of information were used to establish soil layer inputs for modeling the potential for infiltration from Upstream Raise 91: soil layer testing from CQA monitoring and current hydraulic conductivity testing with site-specific soil layer samples and leachate:

- As a part of CQA monitoring during original construction of the composite liner system, 170 Shelby tube samples were collected across the Upstream Raise 91 footprint for hydraulic conductivity testing.
- To augment this original testing, Shelby tube samples of the soil layer component of the composite liner system at Upstream Raise 91 were collected in 2021 for use in chemical equilibrium hydraulic conductivity tests performed with site-specific leachate.

These two sources of information will be used together to capture the variability of the soil layer component of the composite liner at Upstream Raise 91.

Site-specific data for the soil layer constructed at Upstream Raise 91 will be used for infiltration rate calculations. This site-specific data for the soil layer will be used for both the prescriptive composite liner system and the existing alternative composite liner system.

As a part of the characterization of the potential for infiltration, 40 CFR 257.71(d)(ii)(B)(1) requires:

> *"The location, number, depth, and spacing of samples relied upon is supported by the data collected in paragraph (d)(1)(ii)(A) of this section and is sufficient to capture the variability of saturated hydraulic conductivity for the soil-based liner components and/or naturally occurring soil*;"

The soil layer component of the composite liner at Upstream Raise 91 is an engineered layer and not a natural layer and thus the location, number, depth, and spacing of samples is based on construction specifications rather than the data collected for the site hydrogeology characterization. Information regarding sampling of the soil layer is provided in Sections 5.3.1 and 5.3.2.

5.3.1 Soil Layer CQA

CQA monitoring was performed during installation of the Upstream Raise 91 soil layer component of the composite liner system. The CQA report for Upstream Raise 91 (CPA 1993; referred to as Ash Pond 91 in the report) was included with the application for an ALD (Golder 2020) and was described in detail as a part of the application report.

CQA data obtained during installation of the composite liner system at Upstream Raise 91 included detailed information about the as-constructed hydraulic conductivity of the soil layer. The design called for a 2-foot minimum thick compacted soil layer compacted to a moisture and density specification to result in a soil layer with a hydraulic conductivity of 1×10^{-7} cm/sec or less. To evaluate the soil layer construction, index testing (grain size, Atterberg limits) was performed on the soil as well as in situ testing of moisture and density to ensure that the soil layer was constructed to design specifications. In addition, 170 Shelby tube samples were collected for hydraulic conductivity testing. These samples were collected from the 2-foot minimum thickness soil layer at a frequency and spacing to capture the variability of soil conditions across Upstream Raise 91.

Laboratory testing of the collected undisturbed samples was performed at Braun Intertec Engineering, Inc.'s geotechnical laboratory. Falling head tests were performed to estimate the hydraulic conductivity of the samples. The tests used typical water (tap water or deionized water) and were run with a four pounds per square inch (psi) confining pressure (reflective of as-built liner with overlying drainage layers and no/minimal CCR placement). The hydraulic conductivity from these tests ranged from approximately 5×10^{-9} cm/sec to 1×10^{-7} cm/sec with a geometric mean hydraulic conductivity of 2×10^{-8} cm/sec. All tests met the design hydraulic conductivity of 1×10^{-7} cm/sec or less. Summary tables of falling-head hydraulic conductivity tests conducted on Shelby tube samples taken from the soil layer for Upstream Raise 91 (CPA 1993) are included in Appendix C-1.

CQA data obtained during installation of the composite liner systems also included detailed information about the actual thickness of the soil layer. Golder evaluated the actual thickness of the soil layer for Upstream Raise 91 by comparing topographic surveys conducted immediately before and immediately after installation of the soil layer (CPA 1993). The thickness of the soil layer of the composite liner system ranged between approximately 2 and 4.5 feet with an average thickness of 2.4 feet.

5.3.2 2021 Soil Layer Sampling and Testing

Per 40 CFR 257.71(d)(1)(ii)(B), the potential for infiltration will be characterized through soil-based components of the liner system that control release and transport of leachate. In particular, the saturated hydraulic conductivity of the soil layer component of the Upstream Raise 91 composite liner system is required to be tested with liquid that reflects the pH and major ion concentration of the water contained within the CCR surface impoundment. This chemical equilibrium hydraulic conductivity testing will help determine the potential effects of site leachate on the hydraulic conductivity of the soil layer. The following sections outline the sampling and testing completed to date in response to this rule requirement.

5.3.2.1 Soil Layer Sampling

To evaluate the potential impact of Upstream Raise 91 leachate on the hydraulic conductivity of the soil layer installed at Upstream Raise 91, several samples of the soil layer were collected in August 2021. In preparation, GRE temporarily lowered the water level in Upstream Raise 91 and removed existing CCR material and protective cover at three locations (north, west, and south sides as shown in Figure 17) to expose areas of composite liner along the side slopes above normal impoundment operating levels. On August 19, 2021, Golder and GRE collected Shelby tubes (24-inch long, 3-inch diameter) from the soil layer of the composite liner system at these locations. Samples were collected via Shelby tubes to minimize the disturbance to the samples to be used for chemical equilibrium hydraulic conductivity testing. A minimum of three samples were collected at each exposed composite liner location to provide adequate soil for index testing and hydraulic conductivity testing.

Sampling of the in situ soil layer component of the composite liner system at Upstream Raise 91 was limited due to the operation of the facility and the amount of CCR already disposed. Samples could not be taken from the floor footprint and could not be taken along the side slopes lower than the operating water level. The samples collected at the three locations are intended to represent the potential change in hydraulic conductivity of the soil layer due to site-specific leachate, and results of any measured increase in hydraulic conductivity will be applied to the 170 tests conducted across the site during original liner construction (for modeling purposes). Additional discussion of the progress of this testing is included in Section 5.3.2.3.

Following collection of the samples, the composite liner was repaired.

5.3.2.2 Leachate Sampling

40 CFR 257.71(d)(ii)(B)(2) requires:

> *"The liquid used to pre-hydrate the samples and measure long-term hydraulic conductivity reflects the pH and major ion composition of the CCR surface impoundment porewater;"*

Sampling of liquid from the Upstream Raise 91 sump representative of liquid in direct contact with the composite liner system was collected from an existing sump riser on August 18, 2021. The Upstream Raise 91 sump collects water from a sand layer directly over the geomembrane and is representative of the pH and major ion composition of the CCR surface impoundment porewater. The leachate sample was shipped to Golder's geotechnical laboratory in Lakewood, Colorado, for use during the soil layer chemical equilibrium hydraulic conductivity testing and was received on August 20, 2021. A portion of the sample was also sent to Test America's Arvada, Colorado, laboratory for chemical analysis of pH and major ion concentrations. Chemistry of the sump liquid sample is included in Appendix C-2.

5.3.2.3 Soil Layer Laboratory Testing

40 CFR 257.71(d)(ii)(B) requires:

> *"All samples collected in the field for measurement of saturated hydraulic conductivity must be sent to a certified laboratory for analysis under controlled conditions and analyzed using recognized and generally accepted methodology. Facilities must document how the selected method is designed to simulate on-site conditions.*

In addition, 40 CFR 257.71(d)(ii)(B)(4) requires:

> *Any test for hydraulic conductivity relied upon includes, in addition to other relevant termination criteria specified by the method, criteria that equilibrium has been achieved between the inflow and outflow, within acceptable tolerance limits, for both electrical conductivity and pH"*

Information regarding the saturated hydraulic conductivity testing performed on the samples collected during original construction are discussed in Section 5.3.1. The samples were tested in accordance with accepted methodologies for evaluating the as-constructed soil layer. Information on the testing of the soil layer samples collected in 2021 is described below.

Soil samples (Shelby tubes) collected at Upstream Raise 91 were packaged and shipped to Golder's geotechnical laboratory in Lakewood, Colorado, and were received on August 20, 2021. Golder's Lakewood, Colorado, geotechnical laboratory equipment is calibrated and certified at least once per year by independent agencies using standards traceable to the National Institute of Standards Technology (NIST). This includes all load frames, electronic balances, transducers, load cells, dial and digital gauges, and digital indicators. The laboratory is a member of ASTM and is actively involved in sub-committees associated with updating standards. The laboratory also participates in the American Association of State Highways and Transportation Officials (AASHTO) soil proficiency sample program.

The collected samples of the soil layer of the composite liner system were extruded from Shelby tubes on August 23, 2021. Index testing (moisture content, dry density, Atterberg Limits, grain size analysis) was conducted on samples from the three locations. Results of this index testing is provided in Appendix C-3.

Three samples (one from each location) were also set up for chemical equilibrium hydraulic conductivity testing. The tests are being conducted in accordance with ASTM D5084 "Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter." The tests have been setup to represent on-site conditions by utilizing liquid from the Upstream Raise 91 sump that represents the pH and major ion composition of the Upstream Raise 91 porewater and under confining pressures representative of average conditions over the life of Upstream Raise 91. The anticipated termination criteria for these tests includes:

- Steady measured hydraulic conductivity as defined in ASTM D5084
- Steady flow ratio (incremental outflow ÷ incremental inflow) of 1 ± 0.25
- Steady pH ratio (effluent pH ÷ influent pH) and electrical conductivity ratio (effluent EC ÷ influent EC) of 1 ± 0.1; pH and electrical conductivity are used as indicators of chemical equilibrium

Due to the low hydraulic conductivity of the soil layer at Upstream Raise 91, and the likely amount of flow through samples to achieve chemical equilibrium, these chemical equilibrium hydraulic conductivity tests are projected to

be required to run for a significant amount of time. Based on the initial testing setup, an extension request was prepared and submitted to the USEPA on September 1, 2021 (Golder 2021).

As described in the extension request, the tests were not expected to be able to achieve the termination criteria outlined above by November 30, 2021 (the due date of the ALD). Testing data collected since the September 1, 2021, extension request has provided additional information (see Appendix C-4 for to-date flow measurements across samples). Summary information from the testing to-date is listed below:

- Sample W-ST-1
  - A near steady flow ratio has been achieved across the sample
  - The gradient across the sample is between 28 and 30
  - The current estimated hydraulic conductivity is approximately 7 x 10^{-10} cm/sec
  - Approximately 3 ml have passed through the sample since September 8, 2021 (approximately 3% of one pore volume)
- Sample S-ST-3
  - A near steady flow ratio has been achieved across the sample
  - The gradient across the sample is between 25 and 30
  - The current estimated hydraulic conductivity is approximately 3 x 10^{-9} cm/sec
  - Approximately 22 ml have passed through the sample since September 8, 2021 (approximately 17% of a pore volume)
- Sample N-ST-4
  - A near steady flow ratio has not yet been achieved across the sample (more flow entering the sample than leaving the sample)
  - The gradient across the sample is between 28 and 30
  - Approximately 2 ml have passed through the sample since September 8, 2021 (approximately 2% of a pore volume)
  - No estimate on hydraulic conductivity can be made since a near steady state flow ratio has not yet been achieved

5.3.2.4 Leachate Impact to Hydraulic Conductivity

In addition to the chemical equilibrium hydraulic conductivity testing described above, a literature review of pertinent research regarding the hydraulic conductivity of compacted soil liners permeated with CCR leachates (Benson et al. 2018) suggests that CCR leachates may increase the hydraulic conductivity of compacted soil liners when compared with hydraulic conductivity tests run with deionized water. Four of the soils tested by Benson et al. were classified as lean clay and fat clay (per Unified Soil Classification System methods), which is consistent with the physical classification for the soil layer constructed as part of the Upstream Raise 91 composite liner system. The average for the four clay samples and five CCR leachates was a factor of 5 (CCR

leachate hydraulic conductivity versus DI hydraulic conductivity). For three of the clayey soils, the hydraulic conductivity of samples permeated with CCR leachates was within a factor of nine times higher than the hydraulic conductivity when permeated with DI water. One sample of clayey soil was the exception, having a hydraulic conductivity when permeated with CCR leachates as much as 19 times higher than the hydraulic conductivity when permeated with DI water. In addition, the average number of pore volumes required to reach chemical equilibrium for the clayey soil samples was approximately 3.5 (ranged between 1.1 and 9.8).

Based on the current estimates for chemical equilibrium hydraulic conductivity, it may take between one and five years to pass just one pore volume of permeant through the samples, and chemical equilibrium may require that between one and ten pore volumes of permeant pass through the samples (Benson et al. 2018). Because of the long projected test durations and the initial low hydraulic conductivity of the samples, composite liner infiltration rates for ALD modeling will be based on the 170 hydraulic conductivity tests performed during liner construction (see discussion of the testing performed as part of the soil layer CQA activities, Section 5.3.1), increased conservatively by a factor of 10 to reflect the potential increase in hydraulic conductivity over time due to the chemical composition of leachate from Upstream Raise 91 (based on research by Benson et al., 2018).

5.3.3 Modeling Inputs

The inputs used in the infiltration calculation are described below based on information in Section 5.3.1 and 5.3.2:

- L_s = thickness of the soil layer (m)
  - A value of 2 feet (0.6096 m) representing the minimum thickness required and minimum thickness measured based on CQA activities at Upstream Raise 91 will be used. Using this minimum value represents a conservative assumption of soil layer thickness.
- K_{sat} = saturated hydraulic conductivity of the soil layer (m/sec)
  - The hydraulic conductivity results from 170 tests conducted during composite liner construction will be increased conservatively by a factor of 10 applied to reflect the potential increase in hydraulic conductivity over time due to the chemical composition of leachate from Upstream Raise 91.

5.4 Geomembrane

Both the CCR Rule's prescriptive composite liner and the existing alternative composite liner at Upstream Raise 91 include HDPE geomembrane over a soil layer component. The prescriptive composite liner has a 60-mil HDPE geomembrane, and the alternative liner has a 40-mil HDPE geomembrane.

This section outlines the approach used to model the performance of both geomembrane components of the composite liner systems.

5.4.1 Geomembrane CQA

CQA monitoring was performed during installation of the Upstream Raise 91 geomembrane component of the composite liner system in 1993. The CQA report for Upstream Raise 91 (referred to as Ash Pond 91 in the report) was included with the application for an ALD (Golder 2020).

The application for an ALD (Golder 2020) provided data on the as-constructed 40-mil HDPE geomembrane indicating installation in accordance with the CQA plan, geomembrane specifications, and current state of the practice. In addition, field investigations conducted during original and subsequent construction confirmed the integrity and longevity of the 40-mil HDPE geomembrane materials and the capability to produce quality welded

seams, even 20 years or more after the 40-mil geomembrane was originally installed. In fact, as outlined in the application, the 40-mil HDPE geomembrane strength (material and field seams) testing data appears comparable to, and in most cases higher than, those required for 60-mil HDPE field seams under current industry standards.

5.4.2 Geomembrane Defects

5.4.2.1 Defect Size

As indicated previously, leaks through composite liner systems are largely a result of defects, such as punctures to the geomembrane component of the liner. A circular defect size of 6 square millimeters (radius of 1.4×10^{-3} m) was identified by Rollin et al. (1999) as the middle of a range of hole sizes reported in leak detection research of geomembrane liner systems. This defect area size was also discussed in detail in the technical background of the EPACMTP model (USEPA 2003a).

5.4.2.2 Defect Frequency

The USEPA in the Industrial Waste Management Evaluation Model (USEPA 2002) developed a cumulative distribution function (CDF) of defect density for composite liner systems based on defect density data from 26 sites (composite liner systems installed with formal CQA programs). The defect density found at these sites ranged from 0 to 12.5 defects per hectare, with a median defect density of less than 1 defect per hectare.

Because the alternative composite liner at Upstream Raise 91 utilizes a 40-mil HDPE geomembrane rather than a 60-mil HDPE geomembrane, an evaluation of the potential for higher defect frequency for the thinner HDPE geomembrane was conducted. A review of the data associated with the 26 sites indicated limited information on geomembrane thickness and no correlation can be made between defect frequency and geomembrane thickness. EPRI in their evaluation of relative liner performance (EPRI 2019) also looked at the potential for increased defect and found no conclusive information supporting a higher defect frequency for a 40-mil geomembrane versus a 60-mil geomembrane.

> *"URS (Andrews and Loellen, 2008) performed a literature review and found no evidence of a correlation between GM thickness and defect frequency:*
>
> > *No report mentions, nor is there any reason to believe, that the thickness of the GM would affect the number of defects occurring in a GM in a cap or liner system immediately following installation. This necessarily assumes a proper design, an adequate cushion layer, an appropriate subgrade specification, and a properly designed and implemented maintenance plan. Except for extraordinarily thick GM[s], the causes of the defects (i.e., mechanical damage, faulty welds and seams, stones, and construction worker-derived) are significantly severe that damage would result regardless of the GM type or thickness." (Andrews and Loellen, 2008).*
>
> *Furthermore, discussion in Section 2 qualitatively observes that a thinner GM will be more flexible, potentially resulting in better contact with the substrate, than a thicker GM of the same material, which can result in reduced leakage that—conceptually—offsets increased potential for perforations."*

The information above can be summarized as follows:

- A 40-mil HDPE geomembrane will have lower strength than a specified 60-mil HDPE geomembrane. This could result in a higher defect frequency if the loads causing defects were higher than the strength of the 40-mil HDPE geomembrane and less than the strength of the 60-mil HDPE geomembrane.

- Defect frequency data used by USEPA (USEPA 2002) does not have enough information to provide any correlation between geomembrane thickness and defect frequency.
- A literature review by URS (Andrews and Loellen 2008) found no evidence of a correlation between geomembrane thickness and defect frequency.
- A thinner 40-mil HDPE geomembrane will be more flexible than a 60-mil HDPE geomembrane and may result in a better contact with the underlying soil layer and a reduced infiltration rate.

Based on the information available, the 40-mil HDPE geomembrane at Upstream Raise 91 is expected to perform similarly to a 60-mil HDPE geomembrane with a similar expected defect frequency. Despite these findings, the 40-mil HDPE geomembrane will be conservatively modeled with a higher defect frequency than the 60-mil HDPE geomembrane. The specified puncture resistance for 40-mil and 60-mil HDPE geomembrane (GSI 2019) will be used to quantify this increase in defect frequency. The puncture resistance of a 40-mil HDPE geomembrane (72 pounds) is 20% lower than the specified puncture resistance for a 60-mil textured HDPE geomembrane (90 pounds) and 33% lower than the specified puncture resistant for a 60-mil smooth HDPE geomembrane (108 pounds). For infiltration rate calculations, an increased defect frequency of 25% will be used as a conservative value.

5.4.3 Modeling Inputs

The HDPE geomembrane inputs used in the infiltration calculation are described below:

- r_d = radius of defect (m)
  - A defect area of 6 square millimeters (radius of 1.4×10^{-3} m) based on the middle of a range of hole sizes reported by Rollin et al. (1999).
- T = Transmissivity of the interfacial zone
  - 1.6×10^{-8} m^2/s for good contact reflective of the CQA oversight associated with the installation of the geomembrane at Upstream Raise 91.
- n = density of defects (# per hectare)
  - The defect frequency from 26 sites (USEPA 2002) will be used to reflect the range in potential defects in the prescriptive geomembrane.
  - For the alternative liner with a 40-mil HDPE geomembrane, the defect frequency for the 26 sites will be increased by 25% to reflect the potential for more defects in a 40-mil HDPE geomembrane versus a 60-mil HDPE geomembrane.

5.5 Upstream Raise 91 Life and Head on Liner

Upstream Raise 91 began operation in 1993/1994 as a surface impoundment with a maximum operating water level of 1918 feet. In 2015 and 2016, modifications were completed to operate the facility as an upstream raise to allow for vertical placement of CCR materials. The Upstream Raise 91 concept is shown in Figure 18. The perimeter foundation drainage layer is constructed using the relatively permeable bottom ash and also includes perforated drainage piping. This perimeter foundation acts as both a drainage layer for control of the piezometric surface within the facility as well as a structural base for subsequent upstream raises. As construction proceeds vertically upward with continued wet FGD material deposition, a perimeter bottom ash drainage layer and a

structurally competent fly ash shell are constructed on the exterior of the facility. The bottom ash drainage layer increases the factor of safety against potential slope movement by keeping the phreatic surface toward the center of the facility, while the exterior fly ash slopes provide a stable trafficking surface for haul trucks and limits erosion due to precipitation. Construction progresses in an upstream direction (toward the middle of the facility) to keep CCR over the lined footprint and at engineered slopes designed to increase stability and capacity and minimize the effects due to erosion.

In evaluating the head on the liner over the life of Upstream Raise 91, there are four distinct time periods:

- ***Impoundment Operation (22 years)***: Before being operated as an upstream raise, Upstream Raise 91 operated as a surface impoundment with a maximum water level of 1918 feet.
- ***Upstream Raise Operation (18 years)***: As an upstream raise, the piezometric surface around the perimeter will be maintained at or below elevation 1918 feet, and water contained within the center FGD pool will generally flow down and laterally toward perimeter drainage piping. The maximum design FGD material elevation is 1995 feet with a maximum ponded water elevation of 1998 feet.
- ***Crown and Closure (5 years)***: At the end of FGD deposition, the pool of impounded water over the FGD material will be pumped down and a crown placed over this area to allow for final cover placement. The phreatic surface within Upstream Raise 91 will decrease during placement of the crown and final cover via perimeter drainage piping.
- ***Post-Closure (30 years)***: Starting during the closure period and extending through the post-closure care period, Upstream Raise 91 will be actively dewatered by drawing down the water level within the FGD material via sumps.

Based on the water level and piezometric surface conditions described for these four time periods, the area weighted average hydrostatic head on the composite liner was estimated for each year over a 75-year period (initial impoundment operation through post-closure). For this estimate, it is anticipated that the facility will be dewatered by the end of the post-closure period to have a minimal head on liner and thus a minimal potential for infiltration. Figure 19 provides an estimate of the time-weighted average head on liner over the 75-year period. The average head over this period varies from approximately 0 feet to 55 feet. The time-weighted average head over the 75-year period is 19 feet.

For the mathematical modeling described in Section 6.0, a time-weighted average head of 19 feet will be used for the 75-year period of infiltration from Upstream Raise 91.

5.6 Infiltration Rate Calculations

The soil layer properties (Section 5.3), HDPE geomembrane properties (Section 5.4), and head on liner properties (Section 5.5) described above were used as inputs to Rowe's solution (see Section 5.2) to evaluate the range in infiltration rates through the composite liner system at Upstream Raise 91. To capture the input variability, the 26 possible defect frequency rates were coupled with the 170 possible soil layer saturated hydraulic conductivity values from original CQA testing performed during composite liner construction to create 4,420 possible scenarios. Percentile distributions were developed from these scenarios and are used as inputs into the modeling discussed in Section 6.0.

Two sets of infiltration rate scenarios were run. The first set is reflective of the alternative liner at Upstream Raise 91 (40-mil HDPE geomembrane overlying a compacted soil layer) based on the assumption that there was

a 25% higher defect density rate than that reported for thicker membranes. The second set is reflective of the prescriptive liner (60-mil HDPE geomembrane overlying a compacted soil layer). The percentile distributions for these two liners are shown in Table 6.

Table 6: Calculated Infiltration Rate Distributions

Percentile	Infiltration Rate (m/year)	
	Alternative Composite Liner (40-mil HDPE Geomembrane Overlying a Compacted Soil Layer)	Prescriptive Composite Liner (60-mil HDPE Geomembrane Overlying a Compacted Soil Layer)
0%	0	0
10%	0	0
25%	0	0
50%	3.0×10^{-4}	2.4×10^{-4}
75%	1.1×10^{-3}	8.4×10^{-4}
80%	1.3×10^{-3}	1.1×10^{-3}
85%	1.4×10^{-3}	1.1×10^{-3}
90%	1.7×10^{-3}	1.3×10^{-3}
95%	1.9×10^{-3}	1.5×10^{-3}
100%	4.6×10^{-3}	3.6×10^{-3}

As stated above, the only difference between the alternative liner and the prescriptive liner is the thickness of the HDPE geomembrane component, and therefore the only difference between the potential infiltration through the alternative liner and the prescriptive liner is the increased defect frequency conservatively modeled for the 40-mil HDPE geomembrane used in the alternative liner.

6.0 MATHEMATICAL MODEL TO ESTIMATE THE POTENTIAL FOR RELEASES

As part of the ALD, 40 CFR 257.71(d)(ii)(C) requires:

> *"Mathematical model to estimate the potential for releases. Owners or operators must incorporate the data collected for paragraphs (d)(1)(ii)(A) and (d)(1)(ii)(B) of this section into a mathematical model to calculate the potential groundwater concentrations that may result in downgradient wells as a result of the impoundment."*

Mathematical modeling was performed to predict peak groundwater concentrations at the downgradient waste boundary assuming a potential contaminant release from Upstream Raise 91 during the 75-year potential infiltration period (operation through the post-closure period) of the surface impoundment.

The following sections describe the conceptual model, modeling approach, input parameters, and predicted results and conclusions from the mathematical model.

6.1 Conceptual Model

A conceptual model was developed for a hypothetical contaminant release from Upstream Raise 91 to the subsurface to provide a qualitative conceptualization of the subsurface flow system and a basis for the mathematical modeling approach. The conceptual model is based on the surface impoundment design, geologic and hydrogeologic setting, and leachate constituent properties from recent and historical site characterization information, as provided in this demonstration report. Figure 15 presents the conceptual model for a hypothetical contaminant release from the Upstream Raise 91 surface impoundment and potential pathway of constituent migration.

As described above, Upstream Raise 91 was constructed with an alternative composite liner system consisting of an upper component of 40-mil HDPE geomembrane and a lower component of a compacted soil layer at least two feet thick with a hydraulic conductivity of 1 x 10^{-7} cm/sec or less. If leachate was released from Upstream Raise 91 through the composite liner, infiltrating water would be expected to migrate vertically downward through the vadose zone by unsaturated flow processes, reach the uppermost saturated zone, mix with groundwater, and flow downgradient primarily by horizontal hydraulic gradient (see Section 3.5). Dissolved constituents transported in the infiltrating water may sorb to the soil surfaces of unsaturated and saturated soils underlying the impoundment, which retards the vertical and horizontal transport of the constituents.

The vadose zone is estimated to be an average of 10 feet thick below the Upstream Raise 91 composite liner (Figure 20). The native unsaturated soils at CCS have been characterized as predominantly low permeability soils of lean clay to silty, sandy clay (approximately 80% of logged native soils; Figures 7 through 12, Section 3.3) with saturated hydraulic conductivity values ranging from 5 x 10^{-8} cm/sec to 2 x 10^{-6} cm/sec (Section 3.4.2 and Table 3). The uppermost saturated zone is heterogeneous, consisting of glacial till deposits of clay, silt, sand, and discontinuous coal seams, with saturated hydraulic conductivity values ranging from 4 x 10^{-6} cm/sec to 2 x 10^{-2} cm/sec (Section 3.4.1 and Table 2). The uppermost groundwater underlying Upstream Raise 91 flows to the east and north towards Lower Samuelson Slough and Sayler Slough, with a measured hydraulic gradient ranging from 0.01 to 0.02 ft/ft (Section 3.5).

The conceptual model for contaminant release provides the basis for the mathematical modeling approach described in Section 6.2.

6.2 Modeling Approach

As a part of the characterization of site hydrogeology, 40 CFR 257.71(d)(ii)(C)(1) requires:

> *"The models relied upon in this paragraph (d)(1)(ii)(C) must be well established and validated, with documentation that can be made available for public review."*

The purpose of mathematical modeling is to predict peak groundwater concentrations at the downgradient waste boundary assuming a potential contaminant release from Upstream Raise 91 during the 75-year potential infiltration period (operation through post-closure period) of the surface impoundment. To conduct this contaminant fate and transport modeling, Golder used the USEPA Composite Model for Leachate Migration with Transformation Products (EPACMTP). This model was developed and validated by the USEPA to simulate fate and transport of constituents leaching from waste management units through the underlying unsaturated and saturated zones. The EPACMTP was the modeling package used for the USEPA's CCR Risk Assessment (USEPA 2014).

The USEPA (USEPA 2014) applied the EPACMTP model package using a regional-based approach, i.e., database of regional climatic and hydrogeological characteristics. For this ALD for Upstream Raise 91, the EPACMTP was adapted from a regional-based approach to a site-specific approach to incorporate the site characterization, sump leachate chemistry, and infiltration information (Sections 3.0 and 5.0). This site-specific information was used to develop the model input parameters, as described in Section 6.3.

The EPACMTP accounts for the following processes which are important for contaminant fate and transport: advection, dispersion, sorption, decay, and recharge dilution in the saturated zone. The EPACMTP was used to simulate one-dimensional (vertically downward) unsaturated flow, three-dimensional groundwater flow, along with constituent transport in the area beneath and surrounding Upstream Raise 91. The estimated infiltration rates through the composite liner (Section 5.6) act as a source leaching rate term for the unsaturated flow module of EPACMTP.

Simulations were run for each of the fifteen Appendix IV constituents to predict respective peak groundwater concentrations at a hypothetical receptor well located at the downgradient waste boundary and within a contaminant plume centerline. Natural attenuation of the constituents by adsorption to soil surfaces was simulated for all the Appendix IV constituents, except lithium and radium. Lithium and radium were modeled as conservative constituents, i.e., no sorption, retardation, or decay was specified in either the unsaturated or saturated zones. This modeling approach for lithium is consistent with USEPA (2014). This is a conservative modeling approach for radium since radium isotopes are known to adsorb to soil surfaces and radioactively decay. Radium-226 and Radium-228 isotopes were modeled separately in EPACMTP by converting from measured radiation units of pCi/L to the corresponding mass per volume in mg/L, which are the required input units for the model. The model input leachate concentration distributions for each radium isotope were based on site-specific leachate chemistry data. Due to the low concentrations of radium in mg/L (average concentration of 8×10^{-11} mg/L), a multiplication factor of 1×10^{10} was applied to minimize uncertainty in model predictions at low concentrations and allow for evaluation of model results with sufficient resolution. Following the simulations in EPACMTP, the radium multiplication factor was reversed to maintain conservation of contaminant mass, and the results were converted from mg/L back to pCi/L to be able to assess the dilution between source and receptor well concentrations. All radium results are reported in pCi/L.

Given the heterogeneous hydrogeologic setting characterized for the site (Sections 3.0 and 6.1), simulations were run in probabilistic, Monte Carlo mode to incorporate site variability. Simulations include an assumed leaching source duration of 75 years to account for the initial operation through post-closure period of Upstream Raise 91 and were run over a total exposure period of 10,000 years, consistent with USEPA (2014).

40 CFR 257.71(d)(ii)(C)(2) requires:

> *"The owner or operator must use the models to demonstrate that, for each constituent in appendix IV of this part, there is no reasonable probability that the peak groundwater concentration that may result from releases to groundwater from the CCR surface impoundment throughout its active life will exceed the groundwater protection standard at the waste boundary."*

Simulations in EPACMTP were used to predict probability distributions of downgradient groundwater concentrations attributed to the Upstream Raise 91 surface impoundment in isolation. The downgradient concentrations of each of the fifteen Appendix IV constituents were evaluated assuming a release from the Upstream Raise 91 alternative liner (40-mil HDPE geomembrane overlying a compacted soil layer). For

comparison of relative liner performance, select constituents were also evaluated based on parameters for a prescriptive liner (60-mil HDPE geomembrane overlying a compacted soil layer).

40 CFR 257.71(d)(ii)(C)(*3*) requires:

> *"The demonstration must include the peak groundwater concentrations modeled for all constituents in appendix IV of this part attributed both to the impoundment in isolation and in addition to background."*

The peak groundwater concentrations were evaluated for each constituent based on the Upstream Raise 91 impoundment in isolation and in addition to background groundwater concentrations. For each constituent, the CDF of the model-predicted concentration (from Upstream Raise 91 in isolation) was added to the upgradient background groundwater concentration CDF to calculate a combined distribution of each constituent concentration for model results plus background. The addition of the CDFs was conducted using GoldSim Technology Group (GoldSim) (2021) by probabilistically sampling each distribution and adding them together for 10,000 realizations.

Simulation results were evaluated with a particular focus on the predicted concentrations of the probability distribution between the 10th and 90th percentiles, as this range is the most representative of overall scenario behavior. This is consistent with the USEPA's guidance for conducting probabilistic risk assessments and evaluating probabilistic data distributions (USEPA 2001). This guidance states that:

"[T]he extreme percentiles ("tails") of an input distribution are understandably the most uncertain part of a [distribution]… since the number of data values in these ranges are less abundant than in the center of the range. This uncertainty in the tails of the input distributions leads in turn to greater uncertainty in the tails of the calculated exposure or risk distribution, and the magnitude of this uncertainty increases rapidly at the very high percentiles. In many cases, estimates at the extreme tails, such as the 99.9th percentile, may be neither accurate nor plausible. For that reason, great care should be taken when evaluating an RME [reasonable maximum exposure] risk in the upper percentiles of the risk range. (USEPA 2001, p. 7-11)"

6.3 Model Inputs

As part of the mathematical modeling, 40 CFR 257.71(d)(ii)(C) requires:

> *"Facilities must also, where available, incorporate the national-scale data on constituent concentrations and behavior provided by the existing risk record. Application of the model must account for the full range of site current and potential future conditions at and around the site to ensure that high-end groundwater concentrations have been effectively characterized. All of the data and assumptions incorporated into the model must be documented and justified."*

The site-specific geologic, hydrogeologic, and impoundment characteristics described in Sections 3.0 and 5.0 were used to develop the model input parameters required for the simulations where possible. If site-specific properties were not available, conservative values were used from the USEPA or from literature.

The input parameters required for the modeling include contaminant source parameters, physical parameters, and chemical constituent parameters. Contaminant source parameters were based on the Upstream Raise 91 surface impoundment design, operational information, site sump leachate and national-scale impoundment porewater chemistry data, and liner infiltration calculations. Physical parameters were based on the Upstream Raise 91 surface impoundment design and site-specific geologic and hydrogeologic data collected from site investigations. Chemical constituent parameters were based on the sorption characteristics of each Appendix IV constituent.

Empirical distributions were developed and input in the model for select site-specific parameters and constituent parameters to account for site variability.

Appendix D-1 provides a summary of the input parameters used for the EPACMTP modeling, with details described below. Parameters are grouped into associated model sections of source-specific inputs, unsaturated zone inputs, saturated zone inputs, and receptor well location inputs.

6.3.1 Source-Specific Input Parameters

The source-specific input parameters are as follows:

- Waste site area of 293,663 square meters (approximately 73 acres) based on the Upstream Raise 91 waste footprint area.
- Source leachate concentration for each constituent was allowed to vary based on distributions calculated from site-specific sump leachate chemistry data (nine samples analyzed between 2018 and 2021) and site-relevant impoundment porewater chemistry data available from the USEPA's national-scale database (up to four samples analyzed) (USEPA 2010). National-scale database impoundment porewater chemistry data from North Dakota lignite coal/ash source was considered to be the most relevant to the site and was used to develop the distributions because it is the same coal/ash source type as those deposited in Upstream Raise 91. The chemistry data for site-specific sump leachate samples and national-scale porewater samples, used to calculate the distributions, are provided in Appendix D-2. The calculated leachate concentration distributions used in the model are presented in Table 7. Seven of the fifteen Appendix IV constituents have a maximum leachate concentration (100th percentile value) which is greater than the site GWPS. These seven constituents include antimony, arsenic, cadmium, lead, lithium, molybdenum, and selenium.
- Areal recharge rate outside the footprint of Upstream Raise 91 was estimated at 0.024 meters/year (m/yr) based on data from USEPA (2003b).
- Infiltration rate through the composite liner was allowed to vary from 0 to 4.6 x 10^{-3} m/yr for the Upstream Raise 91 alternative liner (assuming 25% higher defect frequency for 40-mil HDPE geomembrane than for 60-mil HDPE geomembrane) or from 0 to 3.6 x 10^{-3} m/yr for a prescriptive liner, based on Table 6 distributions. The infiltration rates were calculated from soil layer properties, HDPE geomembrane properties, and head on liner properties described in Section 5.0.
- The EPACMTP requires input of hydraulic conductivity of the composite liner soil layer (described in Section 5.3) and leak density of the geomembrane layer (described in Section 5.4.2.2). Although required by the model software, these inputs are not used for this site-specific model to estimate or replace the specified infiltration rates through the liner. Instead, the model uses the infiltration rate distributions described in the previous bullet.
- Source leaching duration of 75 years to represent the initial impoundment operation through the post-closure period of Upstream Raise 91, described in Section 5.5.
- Ponding depth of 19 feet was based on the time-weighted average head on the Upstream Raise 91 liner from the initial impoundment operation through closure period, described in Section 5.5.
- Impoundment liner depth below ground surface of 6 feet based on average depth calculated from Upstream Raise 91 design.

- Distance to nearest surface water body of 360 feet calculated from Upstream Raise 91 to Lower Samuelson Slough (Figure 5).

Table 7: Summarized Appendix IV Leachate Concentration Distributions

Percentile Distributions	0%	25%	50%	75%	90%	95%	100%
Antimony (mg/L)	0.0010	0.0010	0.0010	0.0052	0.0090	0.0115	0.0140
Arsenic (mg/L)	0.0025	0.0087	0.0270	0.0716	0.1036	0.3056	0.5990
Barium (mg/L)	0.0005	0.0390	0.1000	0.1480	0.1988	0.2760	0.3750
Beryllium (mg/L)	0.0005	0.0005	0.0005	0.0005	0.0014	0.0019	0.0025
Cadmium (mg/L)	0.0005	0.0005	0.0005	0.0013	0.0013	0.0057	0.0125
Chromium (mg/L)	0.0010	0.0010	0.0013	0.0125	0.0164	0.0242	0.0350
Cobalt (mg/L)	0.0005	0.0005	0.0005	0.0005	0.0027	0.0028	0.0028
Fluoride (mg/L)	0.2900	0.5000	1.5000	2.0000	2.0800	2.3800	2.8000
Lead (mg/L)	0.0010	0.0010	0.0010	0.0025	0.0035	0.0123	0.0250
Lithium (mg/L)	0.3200	0.3300	0.4500	0.8700	0.9600	0.9800	1.0000
Mercury (mg/L)	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Molybdenum (mg/L)	0.0020	0.2600	0.5600	0.7700	1.3160	1.4400	1.5000
Radium 226 and Radium 228 Combined (pCi/L)	0.0716	0.5355	0.6010	0.8683	1.0733	1.2067	1.3400
Selenium (mg/L)	0.0050	0.0058	0.0100	0.0250	0.0994	0.1496	0.2000
Thallium (mg/L)	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010

Note: Blue values exceed the site-specific GWPS

6.3.2 Unsaturated Zone Input Parameters

The unsaturated zone input parameters are as follows:

- Unsaturated zone saturated hydraulic conductivity was allowed to vary based on site-specific range of 5 x 10^{-8} cm/sec to 2 x 10^{-6} cm/sec (laboratory test results of native, unsaturated soils presented in Table 3, Section 3.4.2).
- Unsaturated soil moisture retention parameters (residual water content, saturated water content, alpha, and n) were based on SWCC laboratory test results from a site-specific native soil sample (CC5-LPS-5 in Appendix A-5, Section 3.4.3). This native soil sample classifies as the same soil type as other native, unsaturated soils which were laboratory-tested for saturated hydraulic conductivity (Table 3). Thus, for consistency and representation of site conditions, the site-specific unsaturated soil moisture retention parameters were applied in the model, instead of the default values provided in EPACMTP.
- Unsaturated zone thickness below ground surface of 16 feet was calculated based on an average depth of Upstream Raise 91 of 6 feet plus an area-weighted average native soil thickness of 10 feet underlying the Upstream Raise 91 composite liner (groundwater separation, Figure 20).

- Bulk density was estimated as 1.65 grams per cubic centimeters (g/cm^3), consistent with EPACMTP's built-in default value.
- Soil-water partition coefficient distributions for each constituent, to simulate reduced transport velocity due to sorption, were provided by USEPA (2014) for surface impoundments containing FGD material, consistent with the Upstream Raise 91 design.

6.3.3 Saturated Zone Input Parameters

The saturated zone input parameters are as follows:

- Effective porosity of glacial till was estimated as 0.30 (Ohio EPA 2006).
- Saturated zone thickness was estimated from site-specific groundwater elevation data from monitoring wells adjacent to Upstream Raise 91 (Section 3.6).
- Saturated zone hydraulic conductivity was allowed to vary based on the site-specific range of 4×10^{-6} cm/sec to 2×10^{-2} cm/sec (in situ slug test results presented in Table 2, Section 3.4.1).
- Isotropic hydrogeologic conditions were assumed.
- Groundwater gradient underlying Upstream Raise 91 was allowed to vary based on the site-specific range of 0.01 to 0.02 ft/ft (calculated from recent groundwater levels, described in Section 3.5).
- Retardation factor, to simulate reduced transport velocity due to sorption, was calculated from bulk density, effective porosity, and soil-water partition coefficient distributions for each constituent provided by USEPA (2014) for surface impoundments containing FGD material, consistent with Upstream Raise 91 design.
- Dispersivity (longitudinal, transverse, and vertical) were estimated to be low values, due to the model receptor well located immediately at the downgradient waste boundary and in the plume centerline.

6.3.4 Receptor Well Location Input Parameters

To monitor and evaluate the predicted groundwater concentrations at the downgradient waste boundary, a hypothetical receptor well was input in the model and located immediately at the downgradient waste boundary (0 meters longitudinal distance from the edge of waste), within a contaminant plume centerline (0 meters transverse distance from the centerline), and at the top of the water table (0.001 meters below the top of the water table). The receptor well location parameters are considered conservative for monitoring predicted concentrations.

6.4 Model Results and Conclusions

40 CFR 257.71(d)(ii)(C) requires:

> *"(2) The owner or operator must use the models to demonstrate that, for each constituent in appendix IV of this part, there is no reasonable probability that the peak groundwater concentration that may result from releases to groundwater from the CCR surface impoundment throughout its active life will exceed the groundwater protection standard at the waste boundary.*
>
> *(3) The demonstration must include the peak groundwater concentrations modeled for all constituents in appendix IV of this part attributed both to the impoundment in isolation and in addition to background."*

As described above, probabilistic Monte Carlo simulations were completed using the EPACMTP to evaluate a hypothetical contaminant release from Upstream Raise 91. Simulations were run for each of the fifteen Appendix IV constituents to predict respective peak groundwater concentrations at the downgradient waste boundary.

The model results are presented in Appendix D-3. All model results are presented in comparison to their corresponding site-specific GWPS (Table 4). In addition to Appendix D-3, the probabilistic graphs of predicted concentrations for constituents where the maximum leachate source concentration (100th percentile value) exceeds the corresponding site GWPS are also presented in this section. These seven constituents include antimony (Figure 21), arsenic (Figure 22), cadmium (Figure 23), lead (Figure 24), lithium (Figure 25), molybdenum (Figure 26), and selenium (Figure 27). Note that the model results represent predictions for a hypothetical contaminant release from the alternative liner of Upstream Raise 91 and are best compared to predictions for relative performance of a prescriptive liner.

Conclusions based on the model results are summarized below. The conclusions focus on the results of the probability distributions between the 10th and 90th percentiles, as this range is the most representative of overall scenario behavior. This is consistent with the USEPA's guidance for conducting probabilistic risk assessments and evaluating probabilistic data distributions (USEPA 2001). As described below, the simulation results indicate that the Upstream Raise 91 alternative liner will perform similar to a prescriptive liner, even with conservative modeling assumptions for the alternative liner associated with a 25% higher defect density. There was negligible difference in peak concentration predicted at the downgradient waste boundary when comparing the predicted fate and transport of select constituents for the two liner scenarios. Furthermore, the modeling results indicate there is no reasonable probability that peak groundwater concentrations of each Appendix IV constituent will exceed their corresponding site GWPS at the downgradient waste boundary.

6.4.1 Upstream Raise 91 in Isolation

Conclusions from simulation results of Upstream Raise 91 without accounting for background water quality (blue lines in Figures 21 to 27 and Appendix D-3):

- The peak concentration of each Appendix IV constituent at the downgradient waste boundary are predicted to be at relatively low concentrations, well below the respective site GWPS between the 10th and 90th percentiles, even with several conservative modeling assumptions associated with the alternative liner.
- Only slight increases in peak concentration attributable to Upstream Raise 91 are predicted above the 80th percentile of probability for select constituents including arsenic, fluoride, lithium, and molybdenum.
- Radium-226 and Radium-228 were modeled as conservative constituents (i.e., assumed no sorption or decay). Even with this overly conservative modeling approach, their combined concentrations were still about 95% less than the GWPS at the 100th percentile (maximum predicted downgradient concentration; blue line in Figure 13 in Appendix D-3). This indicates that, by accounting for natural attenuating factors (sorption and decay), Radium-226 and Radium-228 combined is likely to be significantly lower than the GWPS downgradient from Upstream Raise 91.
- Of the fifteen Appendix IV constituents, two constituents were predicted to exceed the site GWPS at the waste boundary but only at the 100th percentile where uncertainty is highest: arsenic (Figure 22) and molybdenum (Figure 26). However, each of these constituents were predicted to remain below the

respective site GWPS at the 99th percentile and, as mentioned previously, probability distributions above the 90th percentile tend to be uncertain (USEPA 2001).

6.4.2 Upstream Raise 91 with Background

Conclusions from simulation results of Upstream Raise 91 with addition of background groundwater quality (purple lines in Figures 21 to 27 and Appendix D-3):

- Water quality data from upgradient background wells were added to the model results (i.e., Upstream Raise 91 in isolation) to consider the combined effect of background water quality and water quality due to potential infiltration from Upstream Raise 91.
- The peak concentration of each Appendix IV constituent at the downgradient waste boundary (including background concentrations) are predicted to be at relatively low concentrations, well below the respective site GWPS between the 10th and 90th percentiles, even with several conservative modeling assumptions associated with the alternative liner.
- The addition of background groundwater concentrations caused the modeled lithium concentration to exceed the lithium GWPS at the 100th percentile (Figure 25), which was expected as this GWPS was developed based on this maximum background value for lithium. However, lithium was predicted to remain below the respective site GWPS at the 99th percentile and, as mentioned previously, probability distributions above the 90th percentile tend to be uncertain (USEPA 2001).
- The addition of background concentrations did not affect the outcome of the remaining fourteen constituents, i.e., the background water quality addition did not cause any exceedances apart from arsenic and molybdenum, which already exceeded their GWPSs due to the impoundment in isolation (and only at the 100th percentile).

6.4.3 Alternative Liner Comparison to Prescriptive Liner

Conclusions from comparison of alternative liner results to prescriptive liner results (red and orange lines in Figures 22, 25, and 26 and Appendix D-3) are discussed in this section. The fate and transport of arsenic, lithium, and molybdenum were simulated using the prescriptive liner properties due to their predicted exceedance of the site GWPS at the 100th percentile.

- The results of these simulations show that Upstream Raise 91's alternative liner performed similar to the CCR Rule's prescriptive liner (red lines). That is, negligible differences in peak concentrations are predicted at the downgradient waste boundary of the surface impoundment between the two liner scenarios.

Based on the probability distributions within the 10th and 90th percentile, the model results indicate that, for a potential contaminant release during the operational period of Upstream Raise 91, there is no reasonable probability that peak groundwater concentrations of each Appendix IV constituent will exceed their corresponding site GWPS at the downgradient waste boundary.

7.0 CONCLUSIONS

Per 40 CFR 257.71(d)(1)(ii), the ALD "must present evidence to demonstrate that, based on the construction of the unit and surrounding site conditions, there is no reasonable probability that operation of the surface impoundment will result in concentrations of constituents listed in Appendix IV to this part in the uppermost aquifer at levels above a GWPS." This is done through three lines of evidence:

- Characterization of Site Hydrogeology (Section 7.1)
- Characterization of the Potential for Infiltration (Section 7.2)
- Mathematical Model to Estimate the Potential for Releases (Section 7.3)

7.1 Characterization of Site Hydrogeology - 40 CFR 257.71(d)(1)(ii)(A)

The geologic and hydrogeologic conditions around Upstream Raise 91 that control the rate and transport of constituents potentially leaking from the surface impoundment were characterized by reviewing previous information (including regional and local information), performing a site investigation to evaluate subsurface conditions, and developing a site conceptual model of the potential release pathway.

As part of the ALD, the CCR Rule required documentation of the variability of subsurface soil characteristics from around the perimeter of the impoundment, including measurements of in situ hydraulic conductivity. In support of the demonstration, a site investigation program was executed in September 2021 that included drilling 32 borings at a spacing of approximately 200 feet apart on-center around the north, west, and south sides of the facility perimeter to capture potential variability in the glacial outwash soils underlying Upstream Raise 91 (see Section 3.3). These borings were advanced 20 feet below the bottom of the nearest surface water body (Lower Samuelson Slough). In addition, five additional borings were drilled and completed as monitoring wells to obtain additional information about groundwater levels and hydraulic conductivity of in situ soils (see Section 3.4.1). As part of the drilling program, split-spoon samples were collected every five feet within the borings, producing approximately fifteen samples per borehole within the Upstream Raise 91 berm.

In addition to the site investigation, Golder also reviewed regional and site-specific information from the operating record documenting the design, installation, and development of the monitoring wells and/or describing hydrogeologic conditions at the site. Based on a review of the 2021 site investigation program and a review of historical information, detailed stratigraphic cross sections were completed (see Figures 7 through 12). The detailed stratigraphic sections show the relative locations of CCR and impounded water within the facility, the locations of applicable monitoring wells (and screening depths), and the geologic conditions representative of the uppermost water bearing zone monitored as part of the CCR Rule groundwater monitoring program.

The detailed stratigraphic sections illustrate the heterogeneous conditions surrounding Upstream Raise 91, including:

- The presence of soils ranging from silty clay and sandy clay till to interbedded sand lenses in the vicinity of Upstream Raise 91.
- The relatively uniform presence of clayey soils in the vadose zone between the bottom of the Upstream Raise 91 composite liner and the top of the uppermost water bearing zone.
- Confirmation of the presence of isolated coal seams in the vicinity of Upstream Raise 91 that are known conduits for the flow of groundwater in the uppermost water-bearing zone.
- A relatively consistent layer of sandy soil in the lower portions of the boreholes drilled as a part of the 2021 site investigation program.
- A variable gradient beneath the facility of between 0.01 and 0.02 ft/ft based on recent water level measurements.

Laboratory hydraulic conductivity tests were conducted on nine relatively undisturbed (i.e., Shelby tube) samples obtained from relevant depths in boreholes to help characterize the hydraulic conductivity of the near-surface native soils (performed between 1978 and 2014). The results of laboratory hydraulic conductivity tests indicate that a significant portion of the native soils underlying Upstream Raise 91 are characterized by hydraulic conductivity values ranging from 5 x 10^{-8} cm/sec to 2 x 10^{-6} cm/sec.

Slug testing was performed in ten wells in the vicinity of Upstream Raise 91 to evaluate the in situ horizontal hydraulic conductivity of geologic materials isolated by the screened intervals. Slug testing indicated varying storage mechanisms, likely due to well screen intervals that span variable lithologies and resulting hydraulic conductivities ranging from 4 x 10^{-6} cm/sec to 2 x 10^{-2} cm/sec, likely most representative of the lithology with the highest hydraulic conductivity in that screen interval. The variation in hydraulic conductivity results between the field (i.e., slug) testing and laboratory testing reaffirms the heterogeneity of site geologic conditions in the uppermost water bearing zone.

Information from a review of regional and site-specific geologic and hydrogeologic documentation, the subsurface site investigation, and both field and laboratory testing of site-specific soils was used to develop a site conceptual model. The site conceptual model (Figure 15) is the basis for the mathematical modeling completed as a part of this demonstration of a hypothetical subsurface release from Upstream Raise 91 and indicates migration of a release vertically downward through the unsaturated zone to the uppermost water bearing zone, before flowing downgradient.

7.2 Potential for Infiltration - 40 CFR 257.71(d)(1)(ii)(B)

Due to the engineered composite liner at Upstream Raise 91, the characterization of the potential for infiltration focused on the geomembrane and soil layer components of the composite liner.

The alternative liner for Upstream Raise 91 consists of a compacted low hydraulic conductivity soil layer at least two feet thick with an installed hydraulic conductivity of 1 x 10^{-7} cm/sec or less overlain by a HDPE geomembrane having a minimum thickness of 40 mils. The only difference between this composite liner and a prescriptive liner for existing CCR surface impoundments (40 CFR 257.70(b)) is that the prescriptive liner would have a 60-mil HDPE geomembrane layer (see Figure 16).

The composite liner at Upstream Raise 91 was installed in accordance with construction specifications and a CQA plan. CQA monitoring was performed for both the soil layer and geomembrane components of the composite liner. The CQA report for Upstream Raise 91 (included with the application for an ALD, Golder 2020) indicates that construction was done in accordance with the specifications, and that both the soil layer and 40-mil geomembrane layer met or exceeded the performance specifications (soil layer hydraulic conductivity and thickness, geomembrane strength and durability), indicating that the composite liner at Upstream Raise 91 will significantly limit the potential for infiltration.

Potential infiltration rates (Section 5.0) were estimated for the composite liner at Upstream Raise 91 (40-mil HDPE geomembrane overlying a compacted soil layer) as well as for a theoretical prescriptive composite liner at Upstream Raise 91 (60-mil HDPE geomembrane overlying a compacted soil layer).

The soil layer component of this composite liner was modeled as 2 feet thick (minimum thickness from CQA data), with a saturated hydraulic conductivity based on 170 tests on undisturbed samples from the original liner construction. Since a potential exists that the leachate in Upstream Raise 91 could increase the hydraulic conductivity of the soil layer over time, samples of the Upstream Raise 91 soil layer were collected in 2021 and

set up for chemical equilibrium hydraulic conductivity testing using leachate from the Upstream Raise 91 sump as permeant. Due to the low hydraulic conductivity of the soil layer samples, testing is not completed and cannot yet be used. Because site-specific data is not yet available, the hydraulic conductivity of the 170 original soil layer tests was conservatively increased by a factor of 10 to model the potential for an increase in hydraulic conductivity due to the chemical composition of the leachate.

Infiltration through the geomembrane layer component of the composite liner is controlled by defect size, defect frequency, and installation quality. Based on the information available (Section 5.4.2.2), the 40-mil HDPE geomembrane at Upstream Raise 91 is expected to perform similarly to a 60-mil HDPE geomembrane with a similar expected defect frequency. Despite these findings, the 40-mil HDPE geomembrane was conservatively modeled with a 25 percent higher defect frequency than the 60-mil HDPE geomembrane (based on a comparison of specified puncture resistance between 40-mil and 60-mil HDPE geomembrane).

Results of the infiltration calculations indicate that composite liners have very low infiltration rates, and that the difference between the composite liner at Upstream Raise 91 and a prescriptive liner is insignificant, even with several conservative assumptions associated with the alternative liner.

7.2.1 Ongoing Chemical Equilibrium Testing

Due to the low apparent hydraulic conductivity of the soil layer being tested with site-specific leachate (see Section 5.3.2.3), and the likely amount of flow required to be permeated through samples to achieve chemical equilibrium, these ongoing tests are projected to be required to run for a significant amount of time. Based on the initial testing setup, an extension request was prepared and submitted to the USEPA on September 1, 2021 (Golder 2021). A test duration was included with the extension request suggesting testing times of 130 to 190 days based on assumptions for average sample hydraulic conductivity, gradient across the sample, sample dimensions, and an assumed number of pore volumes of flow across the samples to reach termination criteria. Additional testing data acquired since that extension request indicates that the samples have a lower hydraulic conductivity than originally expected, and between one and five years may be required to pass one pore volume of permeant through the samples. As noted in Section 5.3.2.3, chemical equilibrium may require that between one and ten pore volumes of permeant pass through the samples (Benson et. al 2018).

Based on the results from mathematical modeling, applying a conservative factor of 10 times the original soil layer hydraulic conductivity is resulting in no reasonable probability that peak groundwater concentrations at the waste boundary will exceed the site-specific GWPS. A review of the modeling results also indicates that the hydraulic conductivity of the soil layer of the Upstream Raise 91 composite liner does not significantly affect composite liner infiltration rates or fate and transport modeling results and may not warrant extended testing of the soil layer. GRE proposes to continue to run the chemical equilibrium hydraulic conductivity tests on the soil layer until six months of data is obtained (end of February 2022), at which point an evaluation will be made as to the need for this testing for a composite liner system and when testing can be stopped.

7.3 Mathematical Model to Estimate the Potential for Releases - 40 CFR 257.71(d)(1)(ii)(C)

The EPACMTP was used to predict peak groundwater concentrations at the downgradient waste boundary assuming a potential contaminant release from Upstream Raise 91. Model inputs were developed from the site hydrogeological characterization, estimates of potential infiltration, and site-specific and national-scale data on leachate. The model was run in probabilistic, Monte Carlo mode, to incorporate the range in site and source conditions.

The results from the mathematical modeling of Upstream Raise 91 indicate that the peak concentrations of each Appendix IV constituent are predicted to be below the respective site GWPS between the 10th and 90th percentiles (and all below the GWPS at 99th percentile). Furthermore, a comparison between the Upstream Raise 91 alternative liner and a prescriptive liner shows negligible differences in peak concentrations predicted at the downgradient waste boundary between the two liner scenarios. This conclusion highlights the benefit of a composite liner system consisting of a geomembrane and soil layer, such as that installed at Upstream Raise 91, to limit the potential for infiltration by using the unique characteristics of each component together. This behavior is why composite liner are preferred for containment facilities.

Arsenic, lithium, and molybdenum were predicted to only exceed the GWPS at the 100th percentile (maximum predicted downgradient concentration). However, each of these constituents were predicted to remain below the respective site GWPS at the 99th percentile and, consistent with USEPA (2001) guidance, probability distributions above the 90th percentile tend to be uncertain. These results are in-line with previous studies:

- The USEPA's Human and Ecological Risk Assessment of Coal Combustion Residuals (USEPA 2014), evaluated the 90th percentile human and ecological risks for composite-lined surface impoundments and found that "Composite-lined units present risks far below all relevant risk criteria for all constituents."
- The Electric Power Research Institute's Relative Liner Performance for Coal Combustion Product Management Sites (EPRI 2019) evaluated peak groundwater concentrations for arsenic and lithium and found that "All of the composite liners (including one with a 40-mil HDPE geomembrane) simulated in this evaluation performed similarly, with low (<0.13%) percentages of scenarios having maximum model-predicted concentrations higher than the lithium regional screening level (RSL) or arsenic MCL."

Based on the lines of evidence discussed above, there is no reasonable probability that peak groundwater concentrations at the Upstream Raise 91 waste boundary will exceed the site-specific GWPS. Furthermore, the alternative liner at Upstream Raise 91 is determined to be equally protective of human health and the environment as the prescriptive liner for CCR surface impoundments.

8.0 CERTIFICATION

This demonstration has been prepared to meet the requirements of 40 CFR 257.71(d) which lays out the requirements for an ALD for CCR surface impoundments constructed without a composite liner or alternative composite liner, as defined in 40 CFR 257.70(b) or (c).

The undersigned attest to the completeness and accuracy of the information presented in this report and certify that the demonstration meets the requirements of 40 CFR 257.71(d).

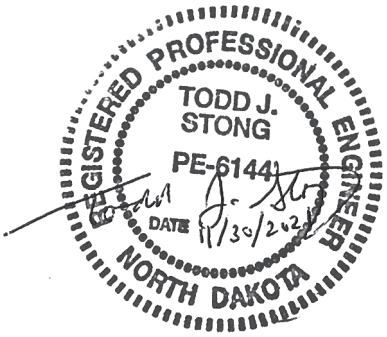
Golder Associates USA Inc.

Craig Schuettpelz, PE
Senior Engineer

Todd Stong, PE
Associate and Senior Consultant

Erin L. Hunter, PhD
Senior Project Engineer

Ryan Tolene, PG
Senior Hydrogeologist



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https://golderassociates.sharepoint.com/sites/140044/project files/6 deliverables/21451024/reports/15-r-ur91_alternative_liner_demo/15-r-0/21451024-15-r-0-ur91_alternative_liner_demo_30nov21.docx

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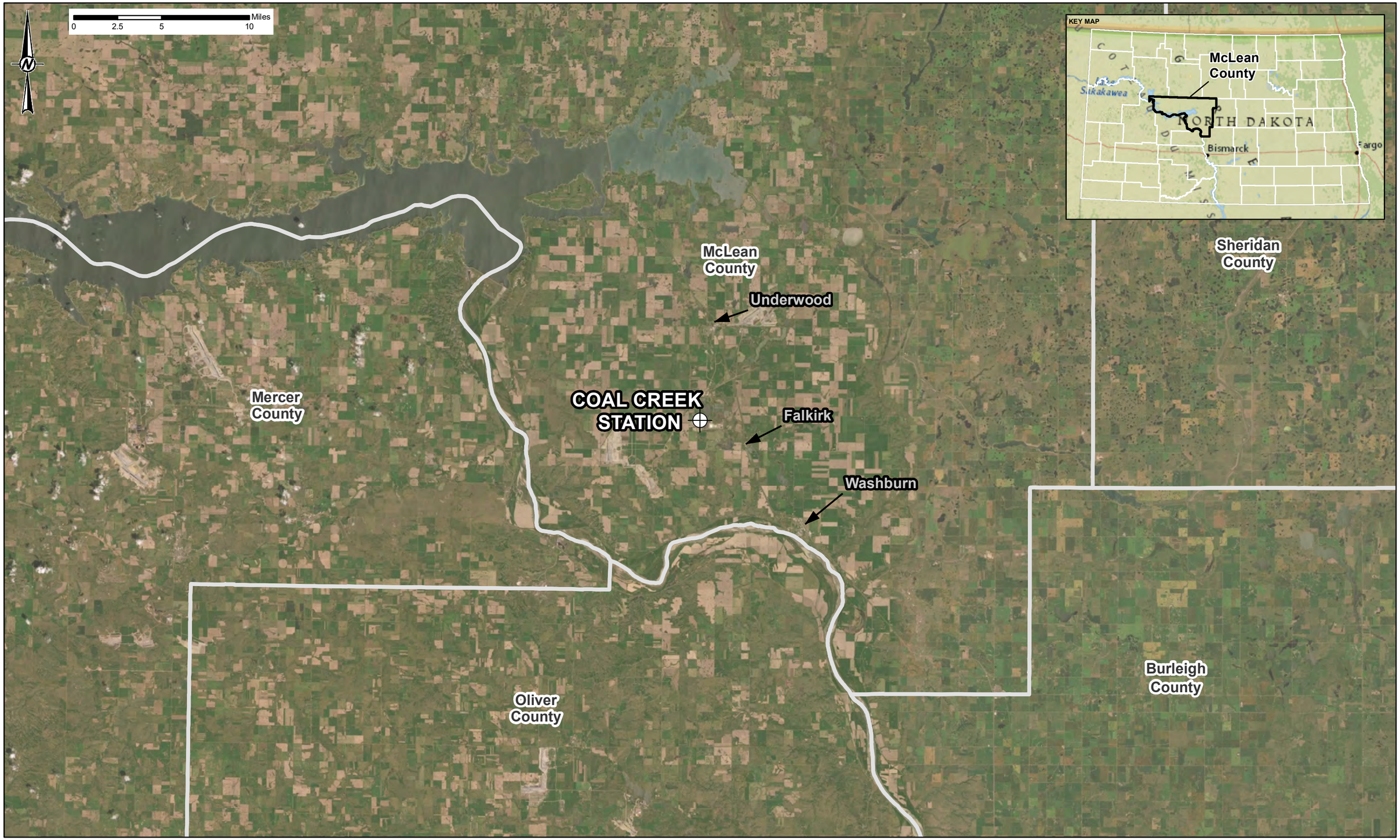
Figures



GOLDER
MEMBER OF WSP

REFERENCE(S)

BASEMAP: ESRI PROVIDED BASEMAP SERVICE, VIVID. MAXAR. IMAGERY COLLECTED 2019.
INSET BASEMAP: NATIONAL GEOGRAPHIC, ESRI, DELORME, NAVTEQ, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, IPC

COAL CREEK STATION
SITE LOCATION MAP

FIGURE 1

PATH: M:\Great River Energy\ArcMap\ReportFigures_20211115\11x17_19115185B_SiteLocationMap.mxd PRINTED ON: 2021-11-16 AT: 3:23:53 PM

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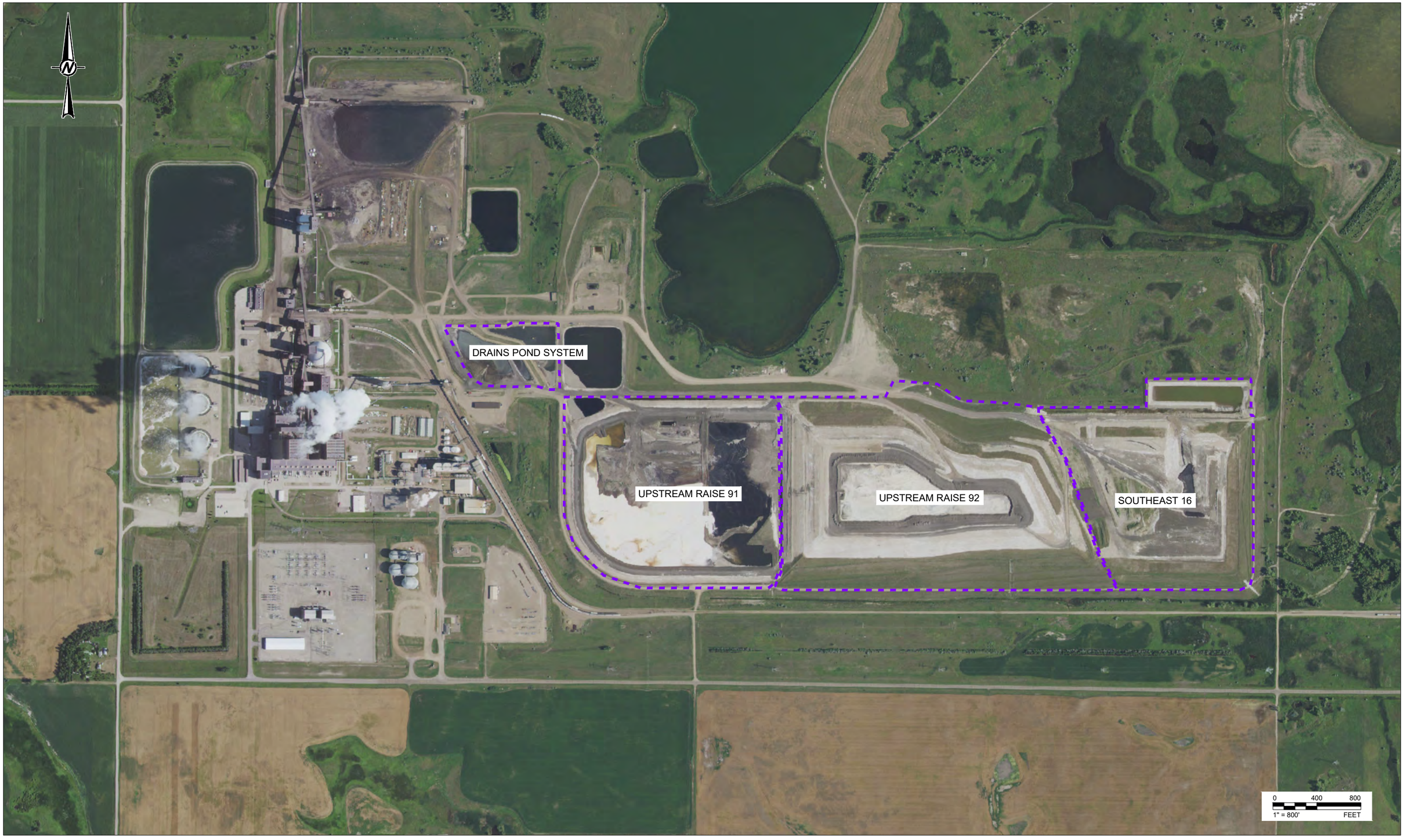

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LEGEND

EXSTING CCR FACILITIES

REFERENCE(S)

1. AERIAL IMAGERY FROM THE UNITED STATES DEPARTMENT OF AGRICULTURE NATIONAL AGRICULTURE IMAGERY PROGRAM, TAKEN 2020.

COAL CREEK STATION
CCR FACILITIES

FIGURE 2

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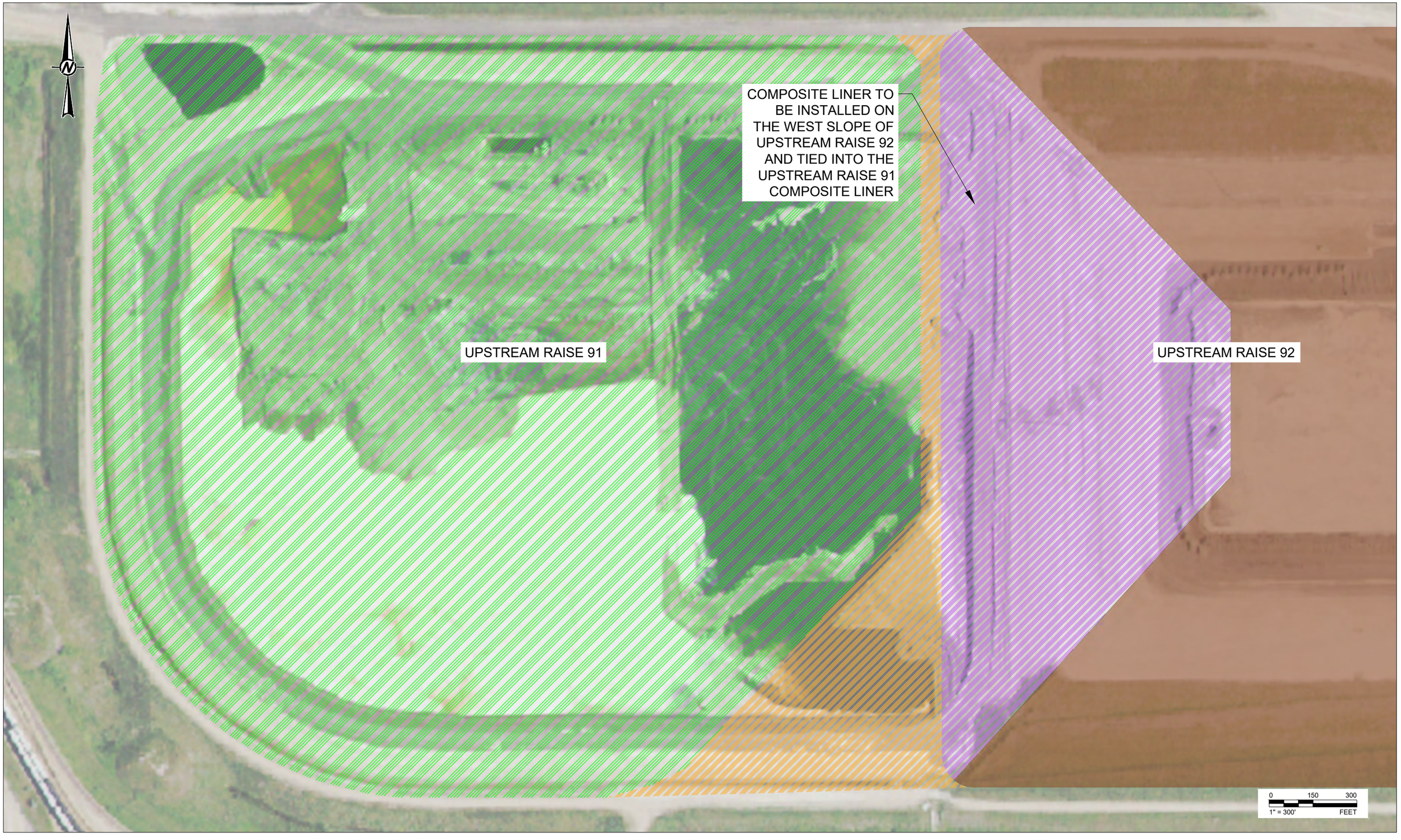

GOLDER
MEMBER OF WSP

LEGEND

- COMPOSITE LINER INSTALLED IN 1989
- COMPOSITE LINER INSTALLED IN 1993
- COMPOSITE LINER INSTALLED IN 2016
- FUTURE COMPOSITE LINER

REFERENCE(S)

1. AERIAL IMAGERY FROM THE UNITED STATES DEPARTMENT OF AGRICULTURE NATIONAL AGRICULTURE IMAGERY PROGRAM, TAKEN 2020.

COAL CREEK STATION
UPSTREAM RAISE 91/92 - COMPOSITE LINED AREAS

FIGURE 3

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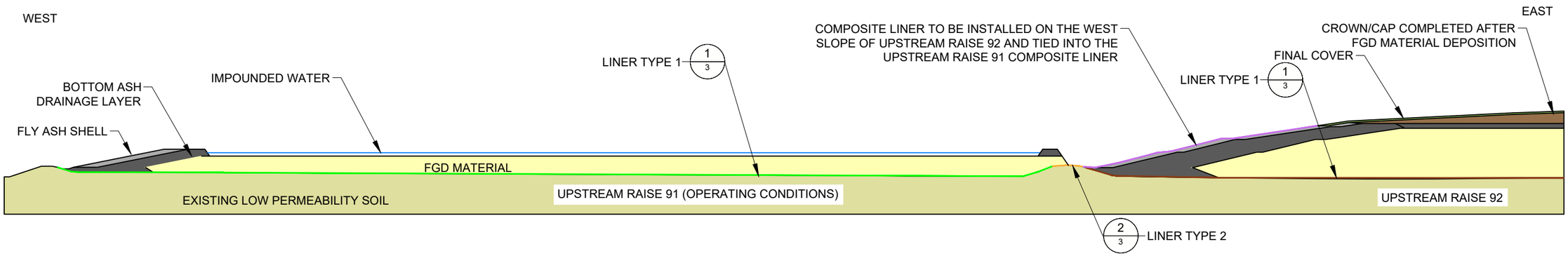
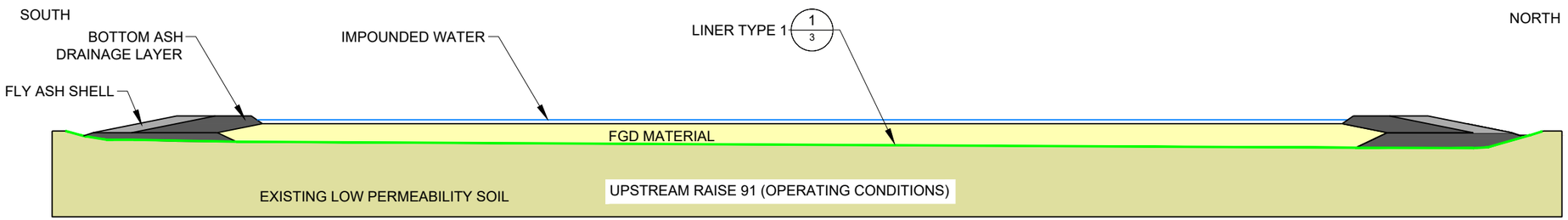
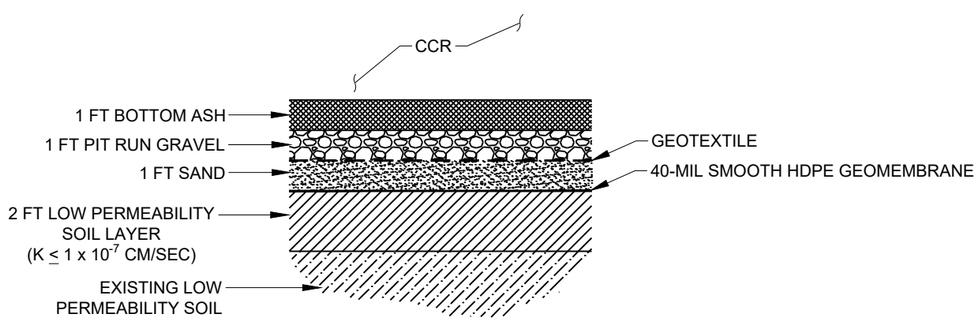


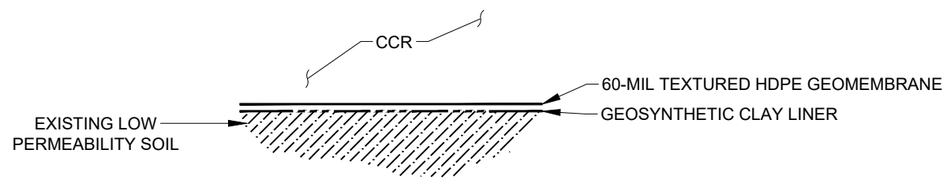
WEST-EAST SECTION
NOT TO SCALE



SOUTH-NORTH SECTION
NOT TO SCALE



SCALE N.T.S. 1/3 LINER TYPE 1



SCALE N.T.S. 2/3 LINER TYPE 2

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COAL CREEK STATION
UPSTREAM RAISE 91 - TYPICAL CROSS SECTIONS

FIGURE 4

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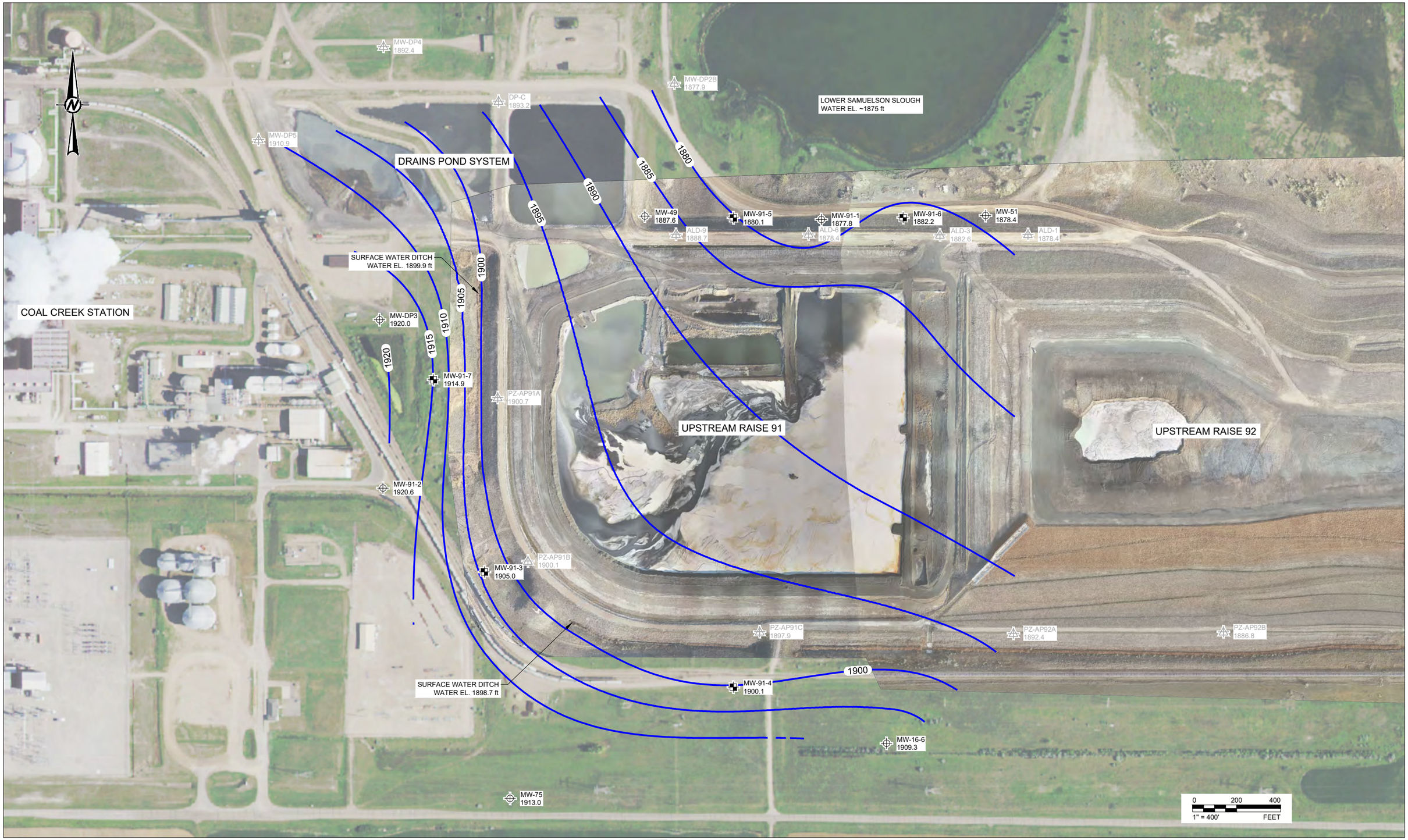

LEGEND

- MW-91-2 1920.6 — EXISTING UPSTREAM RAISE 91 MONITORING WELL LOCATION
- MW-91-4 1900.1 — 2021 SITE INVESTIGATION MONITORING WELL LOCATION
- PZ-AP92A 1892.4 — OTHER WATER LEVEL MEASUREMENT LOCATION
- INTERPRETED GROUNDWATER CONTOUR (GROUNDWATER LEVELS MEASURED OCTOBER/NOVEMBER 2021)

REFERENCE(S)

AERIAL IMAGERY TAKEN FROM UNITED STATES DEPARTMENT OF AGRICULTURE NATIONAL AGRICULTURE IMAGERY PROGRAM, TAKEN IN 2020.
ADDITIONAL AERIAL DRONE IMAGERY TAKEN OCTOBER 2021 BY GREAT RIVER ENERGY.

GOLDER
MEMBER OF WSP

COAL CREEK STATION
OCTOBER/NOVEMBER 2021 GROUNDWATER LEVELS

FIGURE 5

GOLDER
MEMBER OF WSP

LEGEND

- 2021 MONITORING WELL LOCATION
- 2021 BOREHOLE LOCATION

NOTE(S)

1. BOREHOLES ALD-1, ALD-3, ALD-6, AND ALD-9 WERE COMPLETED AS PIEZOMETERS.

REFERENCE(S)

AERIAL IMAGERY TAKEN FROM UNITED STATES DEPARTMENT OF AGRICULTURE NATIONAL AGRICULTURAL IMAGERY PROGRAM. TAKEN IN 2020.
ADDITIONAL AERIAL DRONE IMAGERY TAKEN MAY 2021 BY GREAT RIVER ENERGY.

COAL CREEK STATION
2021 SUBSURFACE SITE INVESTIGATION

FIGURE 6

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LOWER SAMUELSON SLOUGH

AP-24

DRAINS POND SYSTEM

ALD-32

A

MW-49

MW 91-1

MW-51

DP-A

PZ-8

ALD-13 ALD-12 ALD-11 ALD-10 ALD-9 ALD-8 ALD-7 ALD-6 ALD-5 ALD-4 ALD-2 ALD-1

P-18

ALD-3

SAP80-323

178

ALD-14

ALD-15

SAP80-319

ALD-16

COAL CREEK STATION

SAP80-334

UPSTREAM RAISE 91

UPSTREAM RAISE 92

ALD-17

B

ALD-18

GV-B6

124

125

126

SAP80-375

SAP80-245

MW 91-2

ALD-19

ALD-20

E

MW-91-3

ALD-21

C

MW-92

ALD-22

ALD-24

ALD-23

ALD-26

ALD-25

ALD-27

ALD-30

ALD-31

MW-57

GV-B4

GV-B11

PZ-AP91C

GV-B12

ALD-28

ALD-29

MW-55

MW-91-4

D

0 200 400

1" = 200' FEET

GOLDER
MEMBER OF WSP

LEGEND:

MW BOREHOLE, MONITORING WELL, OR PIEZOMETER

REFERENCE(S):

1. THE SITE AERIAL IMAGE IS FROM THE UNITED STATES DEPARTMENT OF AGRICULTURE NATIONAL AGRICULTURE IMAGERY PROGRAM AND WAS ACQUIRED IN 2019. THE LOCATION OF THE AERIAL IMAGE IS APPROXIMATE.

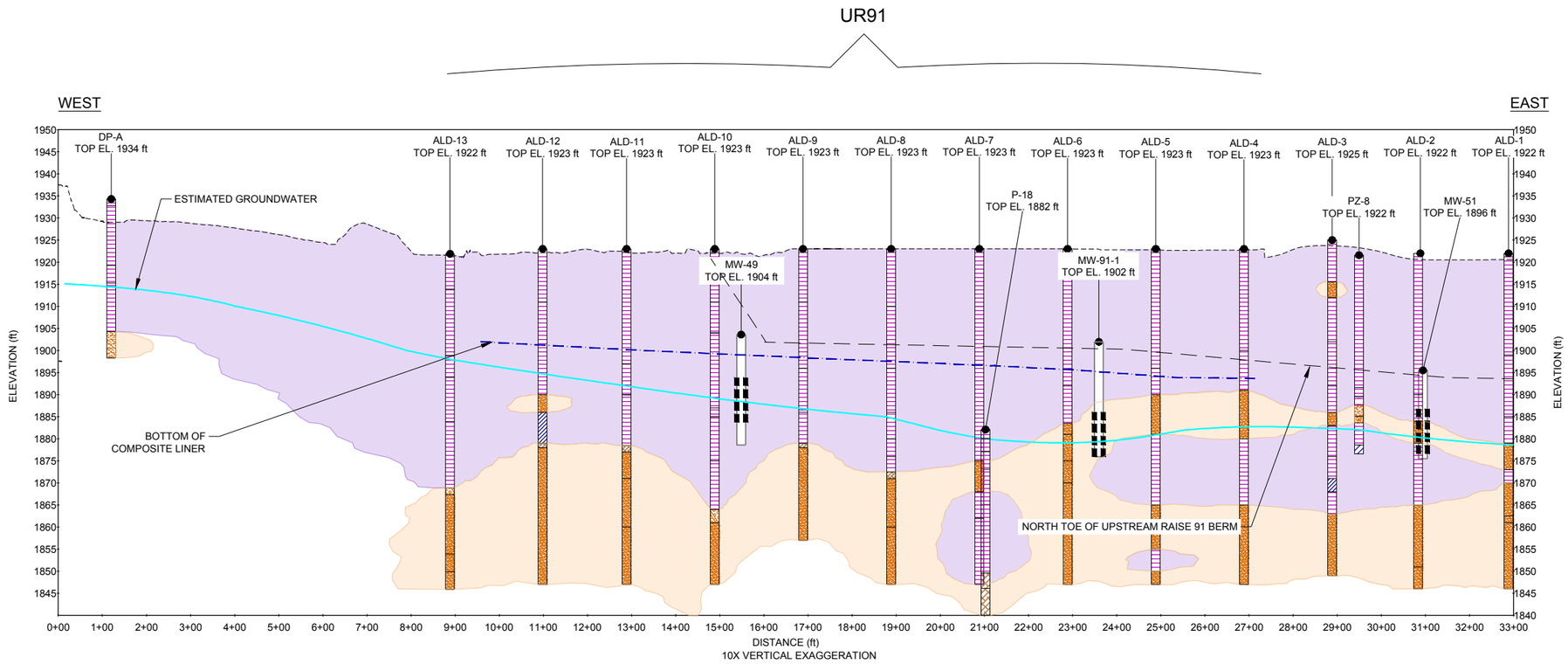
NOTE(S):

1. THE LOCATIONS OF BORINGS, WELLS, AND PIEZOMETERS ARE APPROXIMATE.

COAL CREEK STATION
LOCATION OF STRATIGRAPHIC SECTIONS

FIGURE 7

Path: \\Denvefiacad\GREAT RIVER ENERGY\COAL CREEK\99_PROJECTS\21451024\21451024(ALD) | File Name: Boring Plan_Wells_2021.dwg



GEOLOGIC LEGEND

LOW PERMEABILITY MATERIALS

CLAY | CLAY LINER | SILT | SILTSTONE/ SHALE

HIGH PERMEABILITY MATERIALS

SAND | SANDSTONE | GRAVEL

OTHER

COAL | CCR

CROSS SECTION LEGEND

- APPROXIMATE EXISTING GROUND (NOTE 6)
- APPROXIMATE GROUNDWATER ELEVATIONS (NOTE 7)
- BOTTOM OF UPSTREAM RAISE 91 COMPOSITE LINER (PROJECTED)
- DOWNSTREAM TOE OF UPSTREAM RAISE 91 BERM (PROJECTED)
- APPROXIMATE MONITORING WELL SCREEN INTERVAL

NOTES

1. HISTORIC BORING INFORMATION IS BASED ON INFORMATION PROVIDED BY GREAT RIVER ENERGY. THE ELEVATIONS OF BORINGS ARE APPROXIMATE AND BORING INFORMATION HAS BEEN PROJECTED TO APPLICABLE SECTIONS.
2. HISTORICAL BORINGS MAY BE TRUNCATED AT THE TOP OF LINER OR CURRENT EXISTING GROUND TOPOGRAPHY GRADES DUE TO CHANGES IN SITE GEOMETRY SINCE BORINGS WERE COMPLETED. BORINGS WITHIN LINED FACILITY BOUNDARIES ARE HISTORIC AND WERE COMPLETED PRIOR TO COMPOSITE LINER CONSTRUCTION.
3. BOREHOLES LABELED WITH "ALD" IDENTIFICATION WERE DRILLED IN 2021 BY TERRACON AND OBSERVED BY GOLDER. THE ELEVATIONS OF BORINGS ARE APPROXIMATE.
4. INTERPRETATION BETWEEN MATERIAL TYPE BOUNDARIES WERE DRAWN BASED ON BORING INFORMATION AND SITE OBSERVATIONS. THESE BOUNDARIES ARE SHOWN FOR INFORMATION ONLY.
5. INFORMATION FROM CONSTRUCTION QUALITY ASSURANCE DOCUMENTATION INDICATES THAT SOME LOCATIONS BELOW THE DESIGN SUBGRADE OF UPSTREAM RAISE 91 AND UPSTREAM RAISE 92 (INCLUDING SAND LENSES) WERE OVER-EXCAVATED AND BACKFILLED WITH LOW PERMEABILITY SOIL PRIOR TO CONSTRUCTION OF THE COMPOSITE LINER SYSTEM.
6. EXISTING GROUND TOPOGRAPHY, COMPOSITE LINER GRADES, AND CCR GRADES (IF APPLICABLE) ARE APPROXIMATE. EXISTING GROUND TOPOGRAPHY IS BASED ON TOPOGRAPHICAL SURVEY, SITE OBSERVATIONS, AND AERIAL IMAGERY.
7. GROUNDWATER ELEVATIONS WERE MEASURED BETWEEN OCTOBER-NOVEMBER 2021.

GOLDER
MEMBER OF WSP

COAL CREEK STATION
STRATIGRAPHIC SECTION A

FIGURE 8

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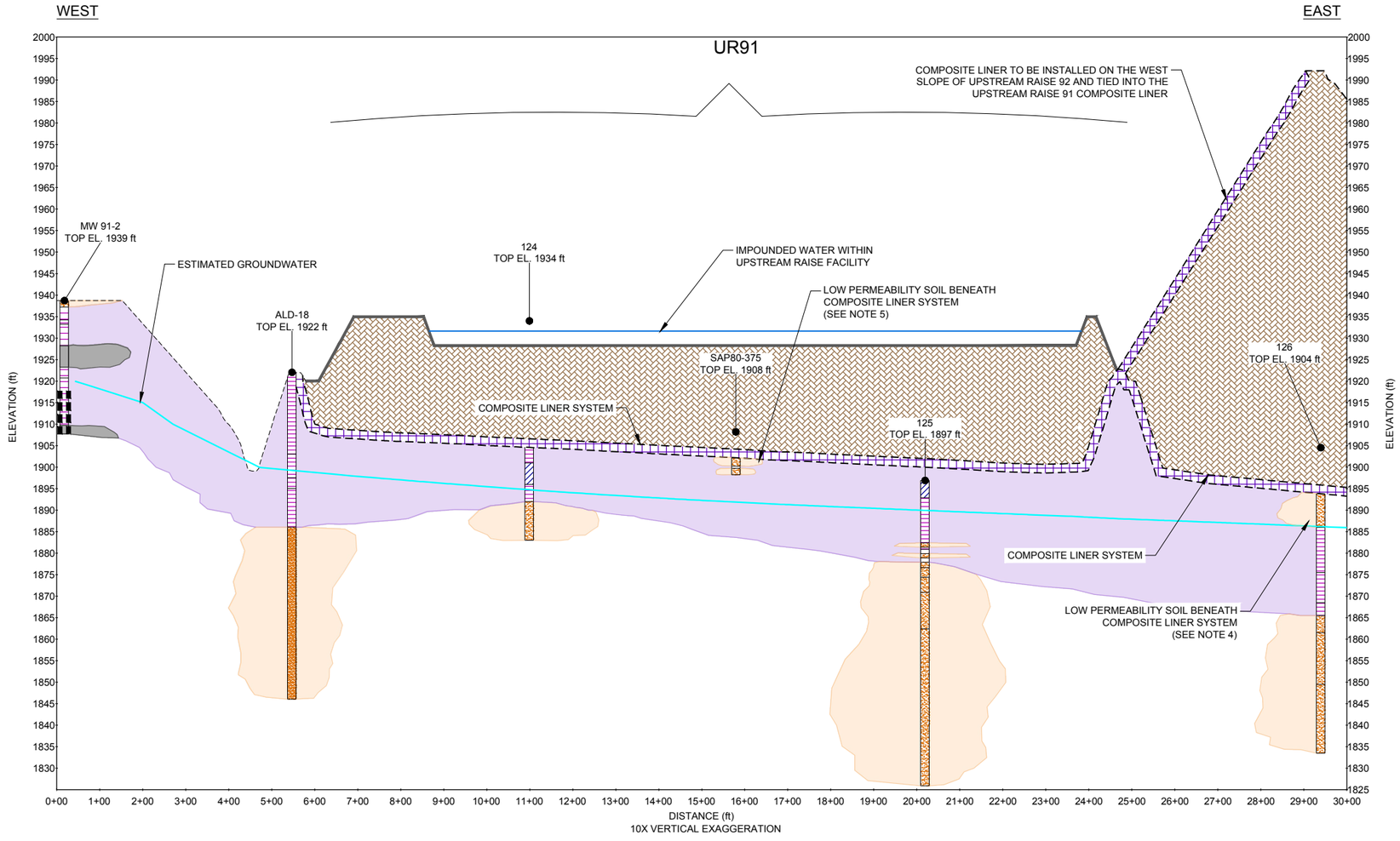


GEOLOGIC LEGEND

LOW PERMEABILITY MATERIALS

CLAY | CLAY LINER | SILT | SILTSTONE/ SHALE

HIGH PERMEABILITY MATERIALS

SAND | SANDSTONE | GRAVEL

OTHER

COAL | CCR

CROSS SECTION LEGEND

- APPROXIMATE EXISTING GROUND (NOTE 6)
- APPROXIMATE GROUNDWATER ELEVATIONS (NOTE 7)
- BOTTOM OF UPSTREAM RAISE 91 COMPOSITE LINER (PROJECTED)
- DOWNSTREAM TOE OF UPSTREAM RAISE 91 BERM (PROJECTED)
- APPROXIMATE MONITORING WELL SCREEN INTERVAL

NOTES

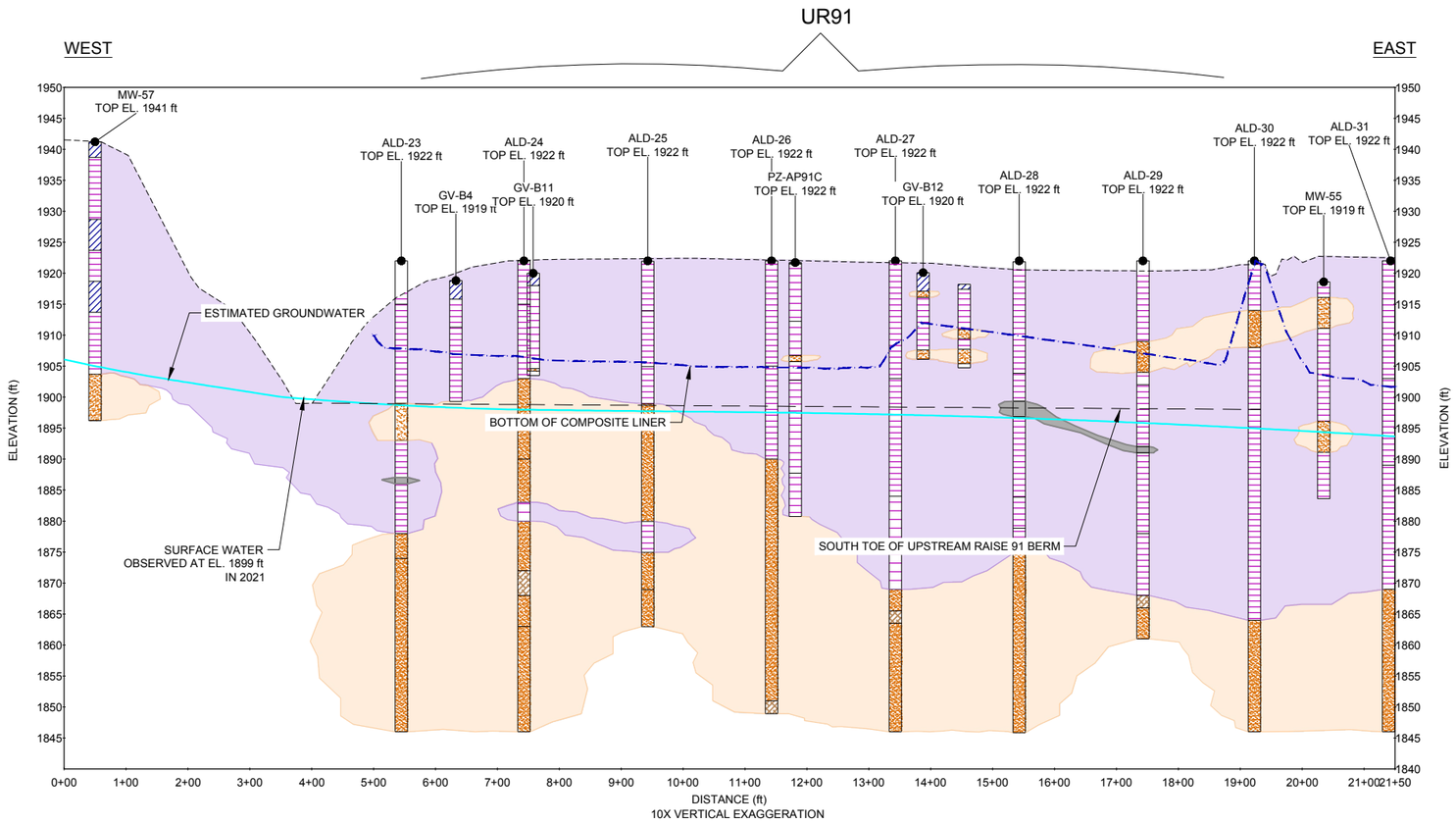
1. HISTORIC BORING INFORMATION IS BASED ON INFORMATION PROVIDED BY GREAT RIVER ENERGY. THE ELEVATIONS OF BORINGS ARE APPROXIMATE AND BORING INFORMATION HAS BEEN PROJECTED TO APPLICABLE SECTIONS.
2. HISTORICAL BORINGS MAY BE TRUNCATED AT THE TOP OF LINER OR CURRENT EXISTING GROUND TOPOGRAPHY DUE TO CHANGES IN SITE GEOMETRY SINCE BORINGS WERE COMPLETED. BORINGS WITHIN LINED FACILITY BOUNDARIES ARE HISTORIC AND WERE COMPLETED PRIOR TO COMPOSITE LINER CONSTRUCTION.
3. BOREHOLES LABELED WITH "ALD" IDENTIFICATION WERE DRILLED IN 2021 BY TERRACON AND OBSERVED BY GOLDER. THE ELEVATIONS OF BORINGS ARE APPROXIMATE.
4. INTERPRETATION BETWEEN MATERIAL TYPE BOUNDARIES WERE DRAWN BASED ON BORING INFORMATION AND SITE OBSERVATIONS. THESE BOUNDARIES ARE SHOWN FOR INFORMATION ONLY.
5. INFORMATION FROM CONSTRUCTION QUALITY ASSURANCE DOCUMENTATION INDICATES THAT SOME LOCATIONS BELOW THE DESIGN SUBGRADE OF UPSTREAM RAISE 91 AND UPSTREAM RAISE 92 (INCLUDING SAND LENSES) WERE OVER-EXCAVATED AND BACKFILLED WITH LOW PERMEABILITY SOIL PRIOR TO CONSTRUCTION OF THE COMPOSITE LINER SYSTEM.
6. EXISTING GROUND TOPOGRAPHY, COMPOSITE LINER GRADES, AND CCR GRADES (IF APPLICABLE) ARE APPROXIMATE. EXISTING GROUND TOPOGRAPHY IS BASED ON TOPOGRAPHICAL SURVEY, SITE OBSERVATIONS, AND AERIAL IMAGERY.
7. GROUNDWATER ELEVATIONS WERE MEASURED BETWEEN OCTOBER-NOVEMBER 2021.

GOLDER
MEMBER OF WSP

COAL CREEK STATION
STRATIGRAPHIC SECTION B

FIGURE 9

Path: \\Denvefacad\GREAT RIVER ENERGY\COAL CREEK99_PROJECTS\21451024\21451024ALD | File Name: Boring Sections_2021.dwg



GEOLOGIC LEGEND

LOW PERMEABILITY MATERIALS

CLAY | CLAY LINER | SILT | SILTSTONE/ SHALE

HIGH PERMEABILITY MATERIALS

SAND | SANDSTONE | GRAVEL

OTHER

COAL | CCR

CROSS SECTION LEGEND

- APPROXIMATE EXISTING GROUND (NOTE 6)
- APPROXIMATE GROUNDWATER ELEVATIONS (NOTE 7)
- BOTTOM OF UPSTREAM RAISE 91 COMPOSITE LINER (PROJECTED)
- DOWNSTREAM TOE OF UPSTREAM RAISE 91 BERM (PROJECTED)
- APPROXIMATE MONITORING WELL SCREEN INTERVAL

NOTES

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4. INTERPRETATION BETWEEN MATERIAL TYPE BOUNDARIES WERE DRAWN BASED ON BORING INFORMATION AND SITE OBSERVATIONS. THESE BOUNDARIES ARE SHOWN FOR INFORMATION ONLY.
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7. GROUNDWATER ELEVATIONS WERE MEASURED BETWEEN OCTOBER-NOVEMBER 2021.

GOLDER
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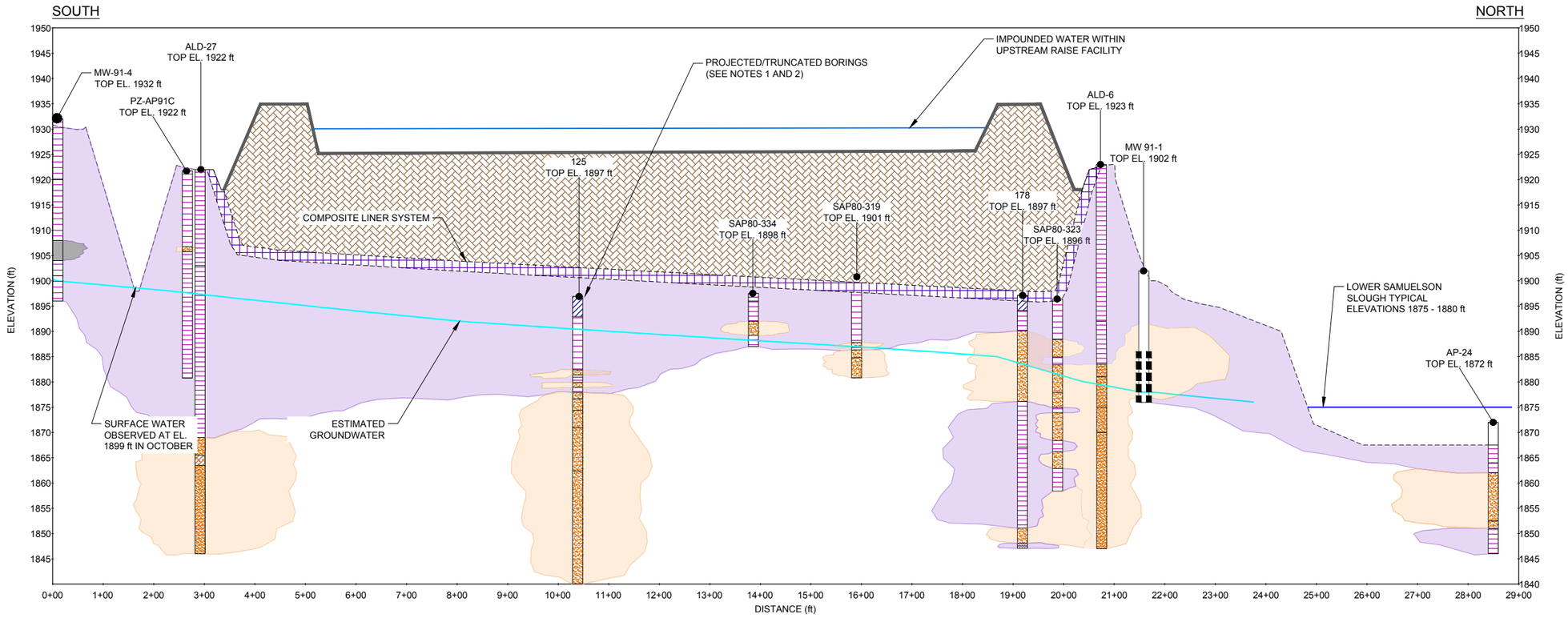
COAL CREEK STATION
STRATIGRAPHIC SECTION C

FIGURE 10

Path: \\Denver\acad\GREAT RIVER ENERGY\COAL CREEK\99_PROJECTS\21451024\21451024ALD\ | File Name: Boring Sections_2021.dwg

UR91



10X VERTICAL EXAGGERATION

GEOLOGIC LEGEND

LOW PERMEABILITY MATERIALS

CLAY | CLAY LINER | SILT | SILTSTONE/ SHALE

HIGH PERMEABILITY MATERIALS

SAND | SANDSTONE | GRAVEL

OTHER

COAL | CCR

CROSS SECTION LEGEND

- APPROXIMATE EXISTING GROUND (NOTE 6)
- APPROXIMATE GROUNDWATER ELEVATIONS (NOTE 7)
- BOTTOM OF UPSTREAM RAISE 91 COMPOSITE LINER (PROJECTED)
- DOWNSTREAM TOE OF UPSTREAM RAISE 91 BERM (PROJECTED)
- APPROXIMATE MONITORING WELL SCREEN INTERVAL

NOTES

1. HISTORIC BORING INFORMATION IS BASED ON INFORMATION PROVIDED BY GREAT RIVER ENERGY. THE ELEVATIONS OF BORINGS ARE APPROXIMATE AND BORING INFORMATION HAS BEEN PROJECTED TO APPLICABLE SECTIONS.
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4. INTERPRETATION BETWEEN MATERIAL TYPE BOUNDARIES WERE DRAWN BASED ON BORING INFORMATION AND SITE OBSERVATIONS. THESE BOUNDARIES ARE SHOWN FOR INFORMATION ONLY.
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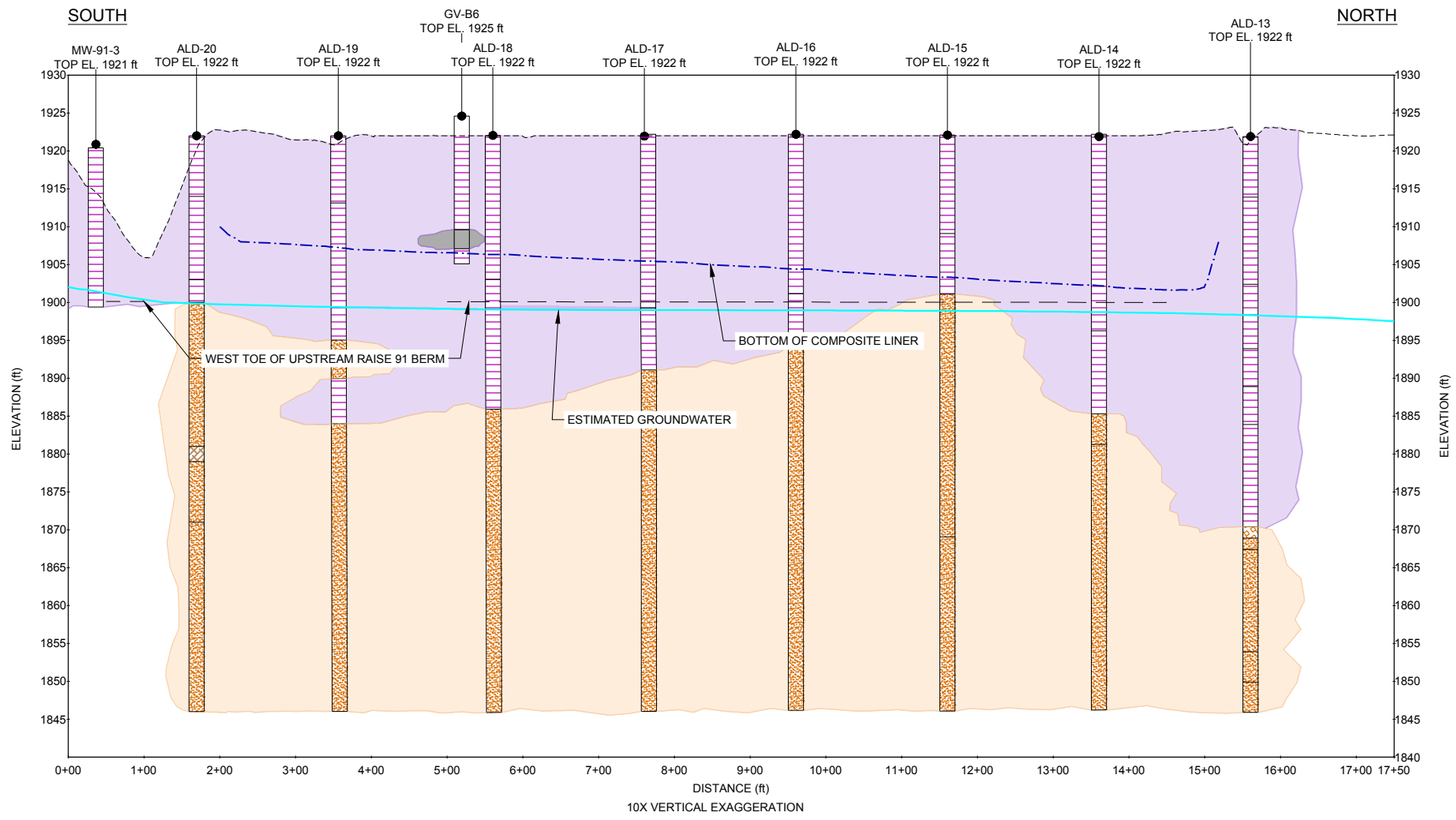
7. GROUNDWATER ELEVATIONS WERE MEASURED BETWEEN OCTOBER-NOVEMBER 2021.

GOLDER
MEMBER OF WSP

COAL CREEK STATION
STRATIGRAPHIC SECTION D

FIGURE 11

Path: \\Denvelacad\GREAT RIVER ENERGY\COAL CREEK\99_PROJECTS\21451024\21451024ALD\ | File Name: Boring Sections_2021.dwg



GEOLOGIC LEGEND

LOW PERMEABILITY MATERIALS

CLAY | CLAY LINER | SILT | SILTSTONE/ SHALE

HIGH PERMEABILITY MATERIALS

SAND | SANDSTONE | GRAVEL

OTHER

COAL | CCR

CROSS SECTION LEGEND

- APPROXIMATE EXISTING GROUND (NOTE 6)
- APPROXIMATE GROUNDWATER ELEVATIONS (NOTE 7)
- BOTTOM OF UPSTREAM RAISE 91 COMPOSITE LINER (PROJECTED)
- DOWNSTREAM TOE OF UPSTREAM RAISE 91 BERM (PROJECTED)
- APPROXIMATE MONITORING WELL SCREEN INTERVAL

NOTES

1. HISTORIC BORING INFORMATION IS BASED ON INFORMATION PROVIDED BY GREAT RIVER ENERGY. THE ELEVATIONS OF BORINGS ARE APPROXIMATE AND BORING INFORMATION HAS BEEN PROJECTED TO APPLICABLE SECTIONS.
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7. GROUNDWATER ELEVATIONS WERE MEASURED BETWEEN OCTOBER-NOVEMBER 2021.

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MEMBER OF WSP

COAL CREEK STATION
STRATIGRAPHIC SECTION E

FIGURE 12

Path: \\Denvelacad\GREAT RIVER ENERGY\COAL CREEK\99_PROJECTS\21451\0242145102421451024\ALD\ | File Name: Boring Sections_2021.dwg

DRAINS POND SYSTEM

MW-49
1 x 10^{-3} CM/SEC

MW-91-5
3 x 10^{-3} CM/SEC

MW-91-1
8 x 10^{-4} CM/SEC

MW-91-6
7 x 10^{-5} CM/SEC

MW-51
INADEQUATE WATER COLUMN TO PERFORM TEST

MW-DP3
4 x 10^{-6} CM/SEC

MW-91-7
5 x 10^{-4} CM/SEC

UPSTREAM RAISE 91

UPSTREAM RAISE 92

MW-91-2
8 x 10^{-4} CM/SEC

MW-91-3
INADEQUATE WATER COLUMN TO PERFORM TEST

MW-91-4
4 x 10^{-5} CM/SEC

MW-16-6
2 x 10^{-2} CM/SEC

MW-75
3 x 10^{-5} CM/SEC

0 200 400
1" = 200' FEET

GOLDER
MEMBER OF WSP

LEGEND

SLUG TEST LOCATION
1 x 10^{-5} CM/SEC (HYDRAULIC CONDUCTIVITY FROM SLUG TESTS)

REFERENCE(S)

AERIAL IMAGERY TAKEN FROM UNITED STATES DEPARTMENT OF AGRICULTURE NATIONAL AGRICULTURAL IMAGERY PROGRAM. TAKEN IN 2020.
ADDITIONAL AERIAL DRONE IMAGERY TAKEN MAY 2021 BY GREAT RIVER ENERGY.

COAL CREEK STATION
2021 MONITORING WELL SLUG TESTS

FIGURE 13

Path: \\Denvefiacad\GREAT RIVER ENERGY\COAL CREEK\99_PROJECTS\2145102\21451024\ALD\ | File Name: ALD Figure 13_SlugTests.dwg

GOLDER
MEMBER OF WSP

LEGEND

LOCATION OF UNDISTURBED (SHELBY TUBE) SOIL SAMPLES
(MAY HAVE BEEN OBTAINED PRIOR TO COMPOSITE LINER CONSTRUCTION)

REFERENCE(S)

AERIAL IMAGERY TAKEN FROM UNITED STATES DEPARTMENT OF AGRICULTURE NATIONAL AGRICULTURAL IMAGERY PROGRAM. TAKEN IN 2020.
ADDITIONAL AERIAL DRONE IMAGERY TAKEN MAY 2021 BY GREAT RIVER ENERGY.

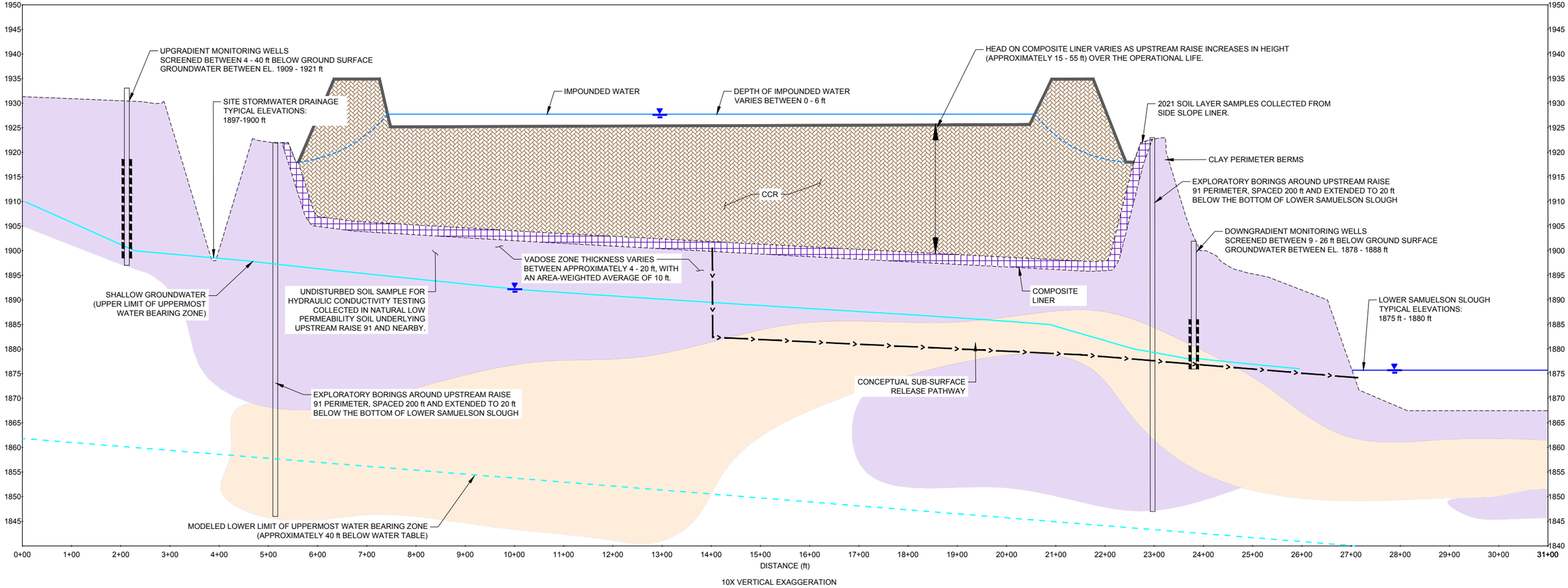
COAL CREEK STATION
LOCATION OF UNDISTURBED SAMPLES FOR LABORATORY HYDRAULIC CONDUCTIVITY TESTING

FIGURE 14

Path: \\Denver\acad\GREAT RIVER ENERGY\COAL CREEK\99_PROJECTS\2145102\4214510224\ALD\ | File Name: ALD Figure 14_UndisturbedSoil.dwg

SOUTH

NORTH



DISTANCE (ft)

10X VERTICAL EXAGGERATION

STRATIGRAPHIC LEGEND

- LOW PERMEABILITY SOIL
- HIGH PERMEABILITY SOIL
- COMPOSITE LINER

GEOLOGIC LEGEND

- APPROXIMATE EXISTING GROUND
- APPROXIMATE GROUNDWATER ELEVATIONS
- BOREHOLE AND MONITORING WELL LOCATION
- MONITORING WELL SCREEN INTERVAL

NOTE(S)

1. SUBSURFACE STRATIGRAPHY BASED ON SUBSURFACE INVESTIGATION - STRATIGRAPHIC SECTION D (FIGURE 11)
2. DOWNGRADIENT MONITORING WELLS INCLUDE: MW-49, MW-91-1, AND MW-51.
3. UPGRADIENT MONITORING WELLS INCLUDE: MW-DP3, MW-91-2, MW-75, AND MW-16-6.
4. GROUNDWATER ELEVATION LINE BASED ON OCTOBER-NOVEMBER 2021 MEASUREMENTS.

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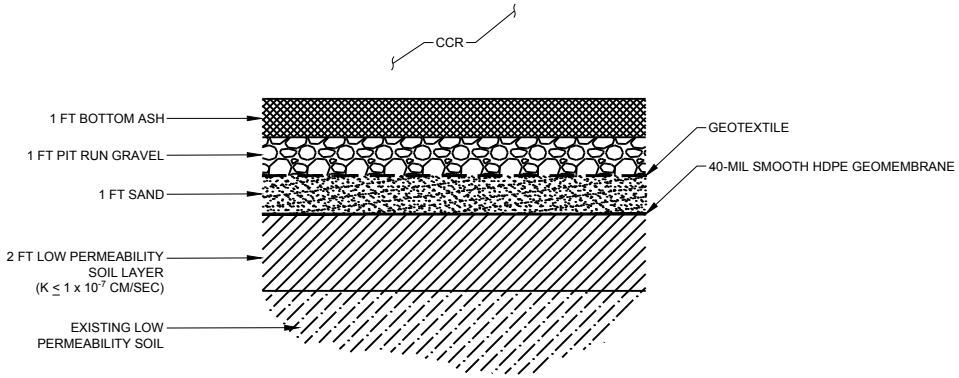
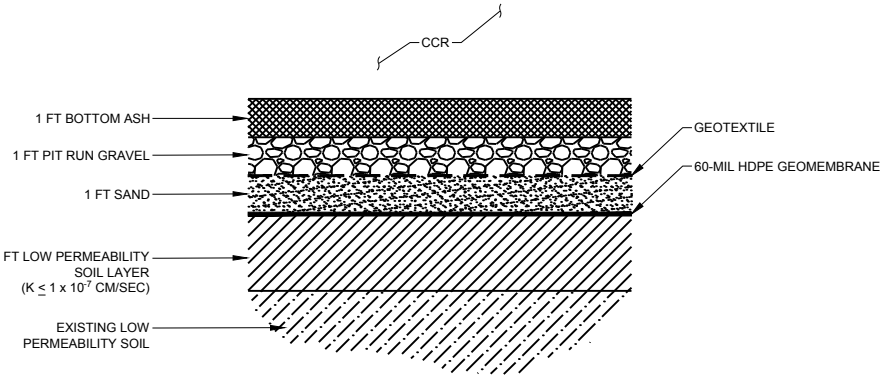
COAL CREEK STATION
RELEASE CONCEPTUAL SITE MODEL

FIGURE 15

Path: \\Denvelacad\GREAT RIVER ENERGY\COAL CREEK\99_PROJECTS\21451024\21451024ALD\ | File Name: ALD Figure 15_ReleaseConceptModel.dwg



1 ALTERNATIVE LINER AT UPSTREAM RAISE 91

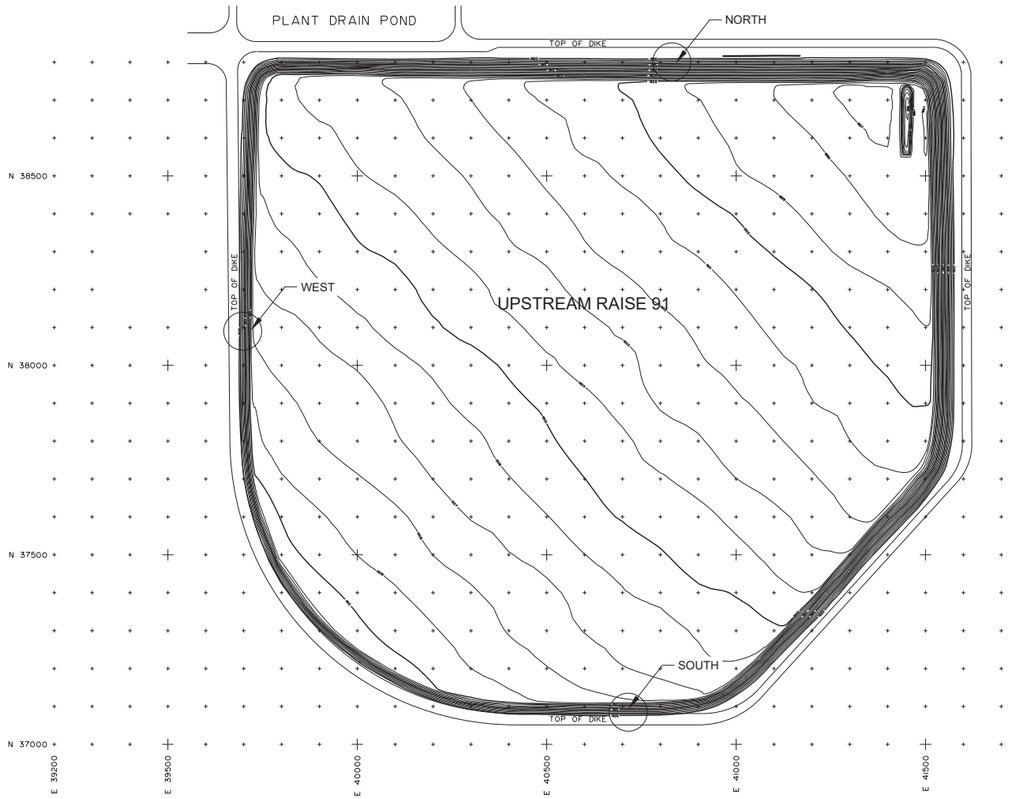


2 PRESCRIPTIVE LINER AT UPSTREAM RAISE 91

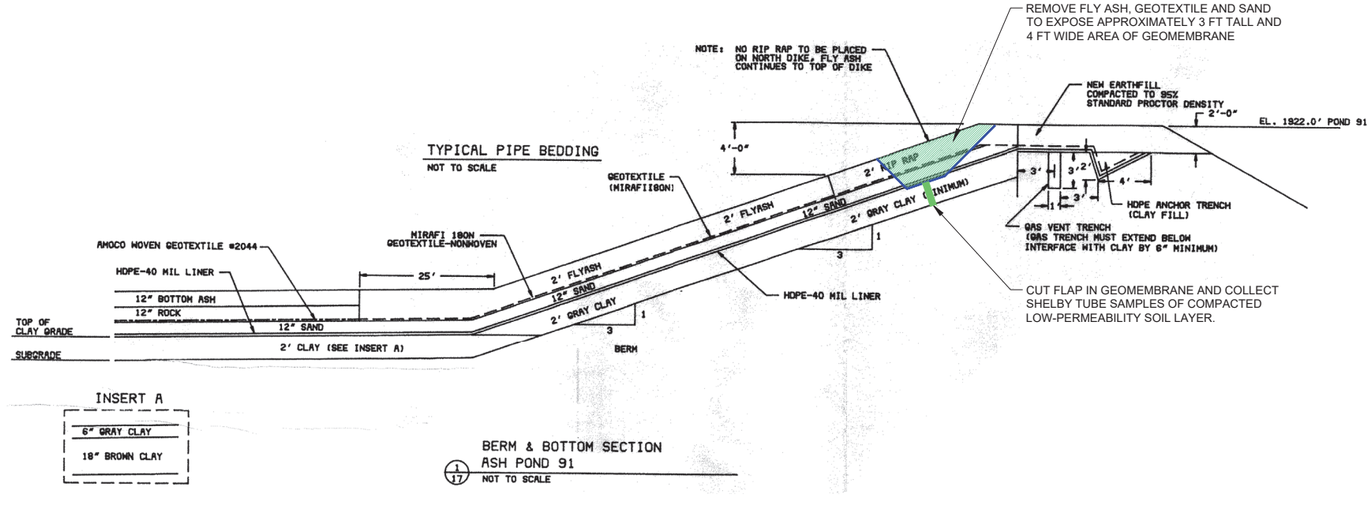
GOLDER
MEMBER OF WSP

COAL CREEK STATION
PRESCRIPTIVE AND ALTERNATIVE LINER

FIGURE 16



SCALE N.T.S. 1 SOIL LAYER SAMPLING - PLAN VIEW



SCALE N.T.S. 2 SOIL LAYER SAMPLING - SECTION

COMPOSITE LINER UNCOVERED FOR SAMPLING

SHELBY TUBE SAMPLING OF SOIL LAYER

EXTRACTED SHELBY TUBE SOIL LAYER SAMPLE

EXTRACTED SHELBY TUBE SOIL LAYER SAMPLE

GOLDER
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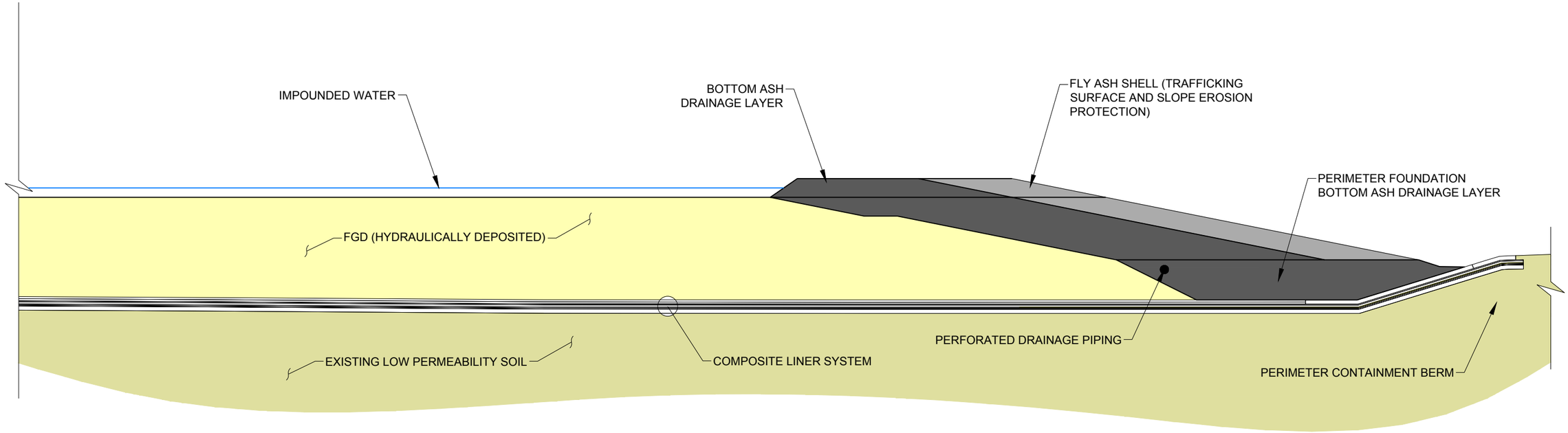
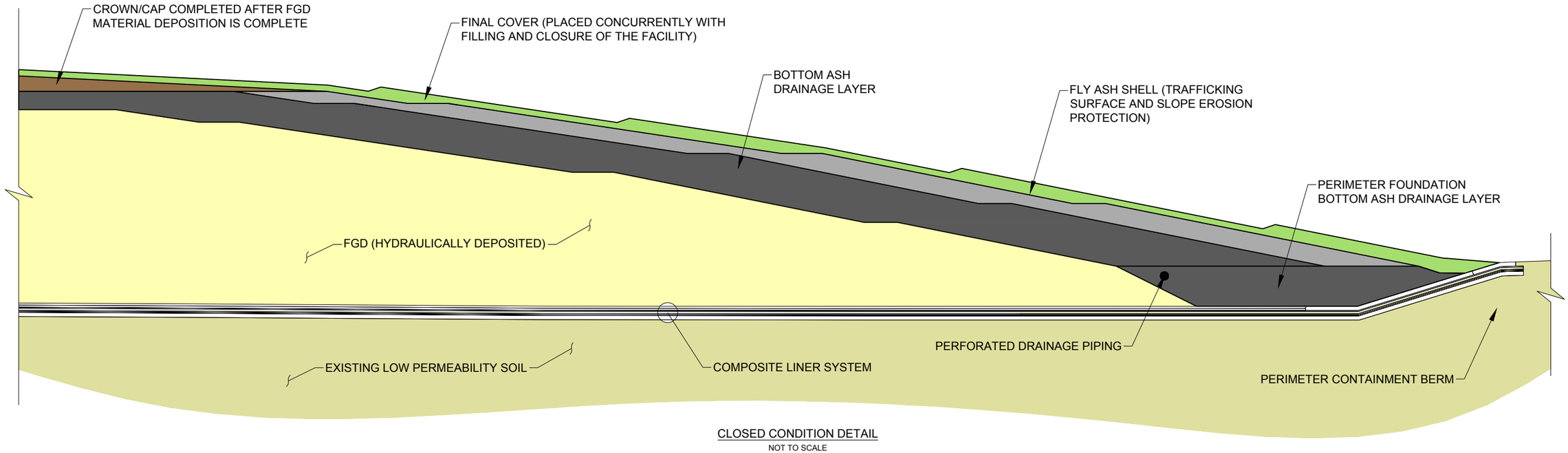
COAL CREEK STATION
2021 COMPOSITE LINER SOIL LAYER SAMPLING

FIGURE 17

Path: \\Denvertacad\GREAT RIVER ENERGY\COAL CREEK\99_PROJECTS\21451024\21451024\ALD\ | File Name: ALD Figure 17_SoilLinerSampling.dwg



OPERATING CONDTION DETAIL
NOT TO SCALE



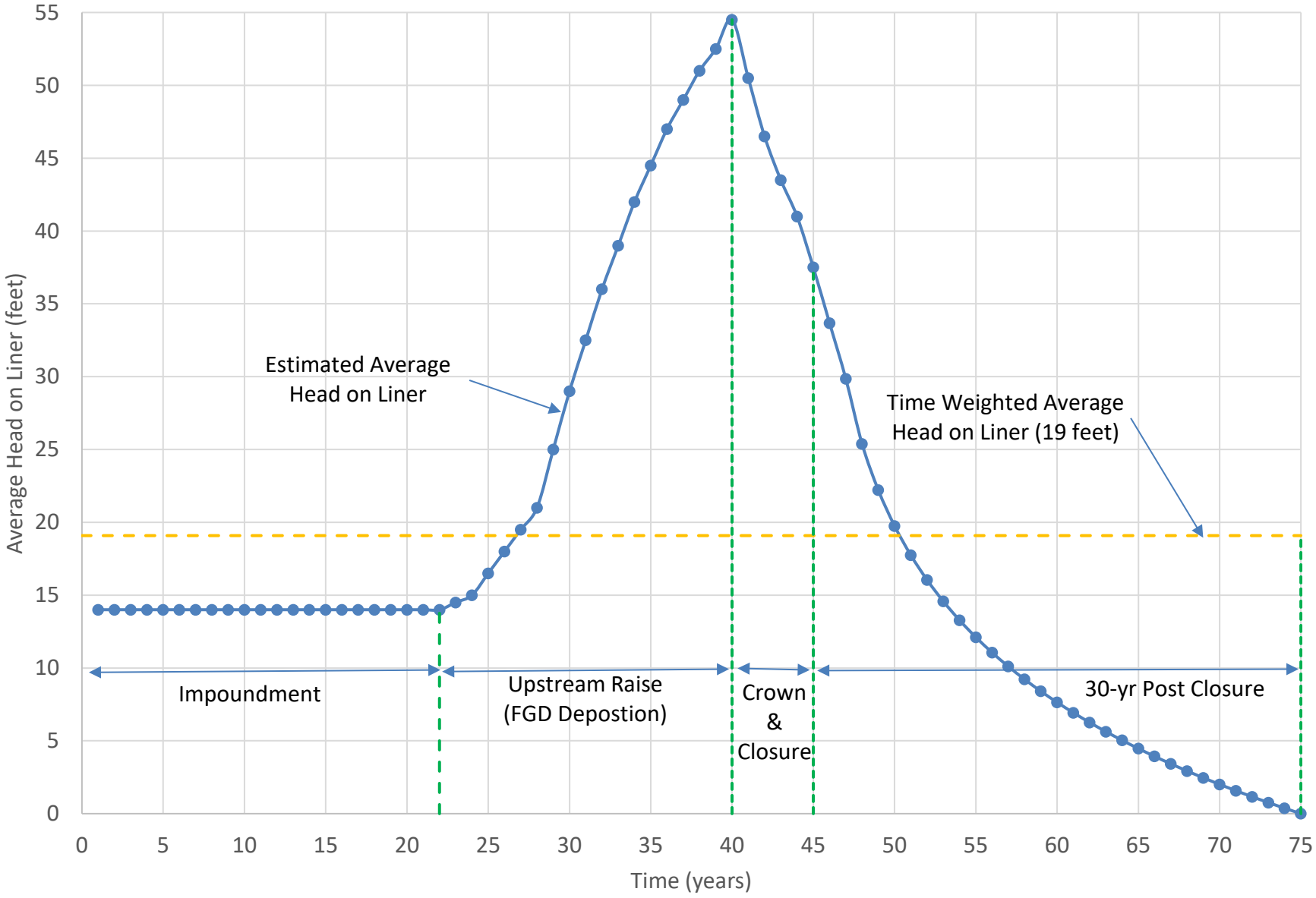
CLOSED CONDITION DETAIL
NOT TO SCALE

GOLDER
MEMBER OF WSP

COAL CREEK STATION
UPSTREAM RAISE CONCEPTUAL DESIGN CROSS SECTION

FIGURE 18

Path: \\Denvervlace\d\GREAT RIVER ENERGY\COAL CREEK\039_PROJECTS\21451024\21451024ALD\ | File Name: ALD Figure 4_18_UR CrossSections.dwg

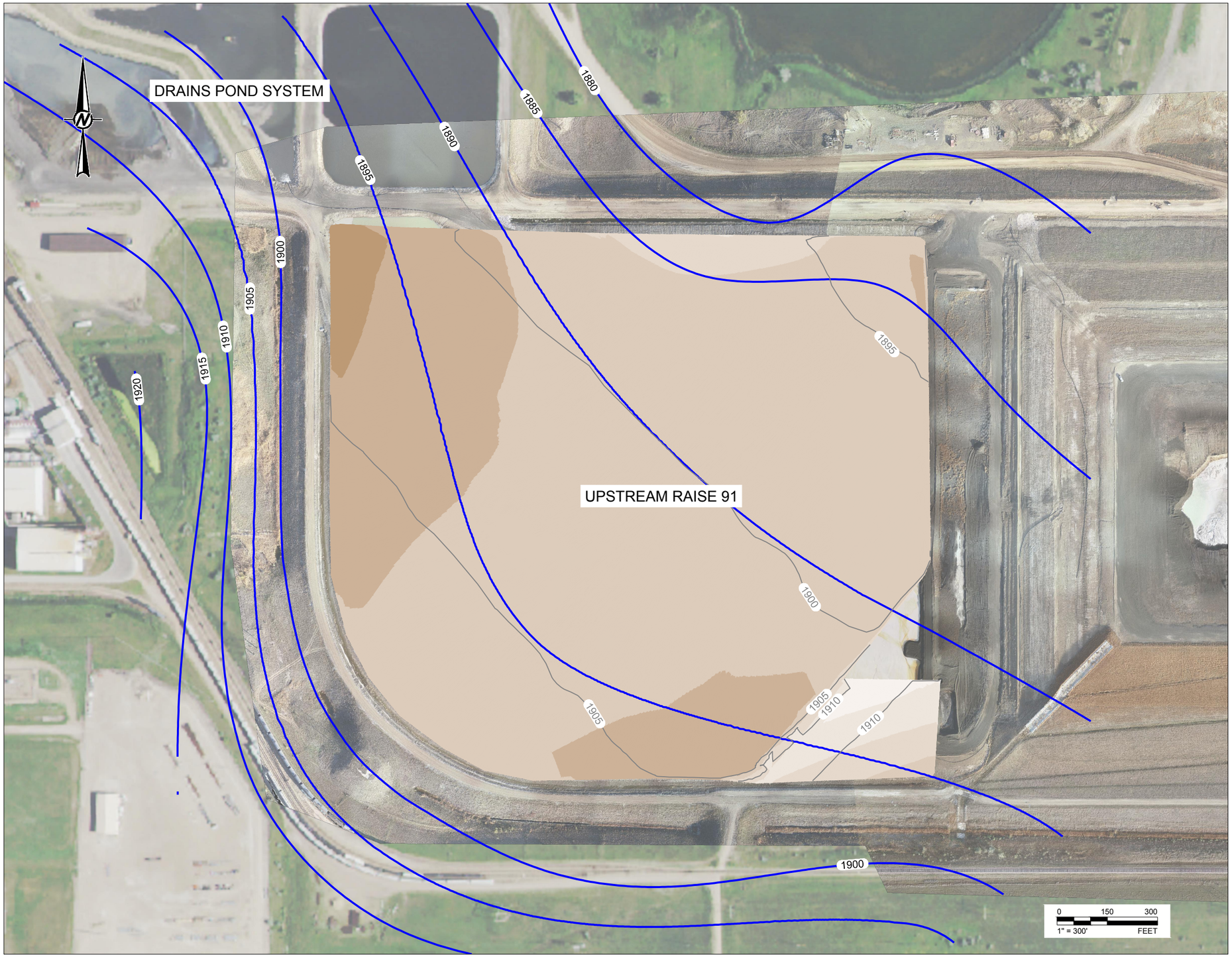


COAL CREEK STATION
AVERAGE HEAD ON UPSTREAM RAISE 91 LINER

GOLDER

FIGURE 19

https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/4 - CCR Rule Support/Alt Liner Demo/Liner Leakage/[UR91_Infiltration_Calc_16Nov21.xlsm]Hw Figure



LEGEND

INTERPRETED GROUNDWATER CONTOUR
(GROUNDWATER LEVELS MEASURED OCTOBER/NOVEMBER 2021)

BOTTOM OF UPSTREAM RAISE 91 COMPOSITE LINER

GROUNDWATER SEPARATION
(GROUNDWATER TO BOTTOM OF LINER IN FEET)

NUMBER	MINIMUM (ft)	MAXIMUM (ft)	AREA (sf)	COLOR
1	3	6	51,772	
2	6	9	597,377	
3	9	12	1,952,809	
4	12	15	106,075	
5	15	18	57,334	
6	18	21	17,593	

THE VADOSE ZONE THICKNESS VARIES BETWEEN APPROXIMATELY 4 FEET AND 20 FEET, WITH AN AREA-WEIGHTED AVERAGE OF 10 FEET.

REFERENCE(S)

AERIAL IMAGERY TAKEN FROM UNITED STATES DEPARTMENT OF AGRICULTURE NATIONAL AGRICULTURE IMAGERY PROGRAM, TAKEN IN 2020.
ADDITIONAL AERIAL DRONE IMAGERY TAKEN OCTOBER 2021 BY GREAT RIVER ENERGY.

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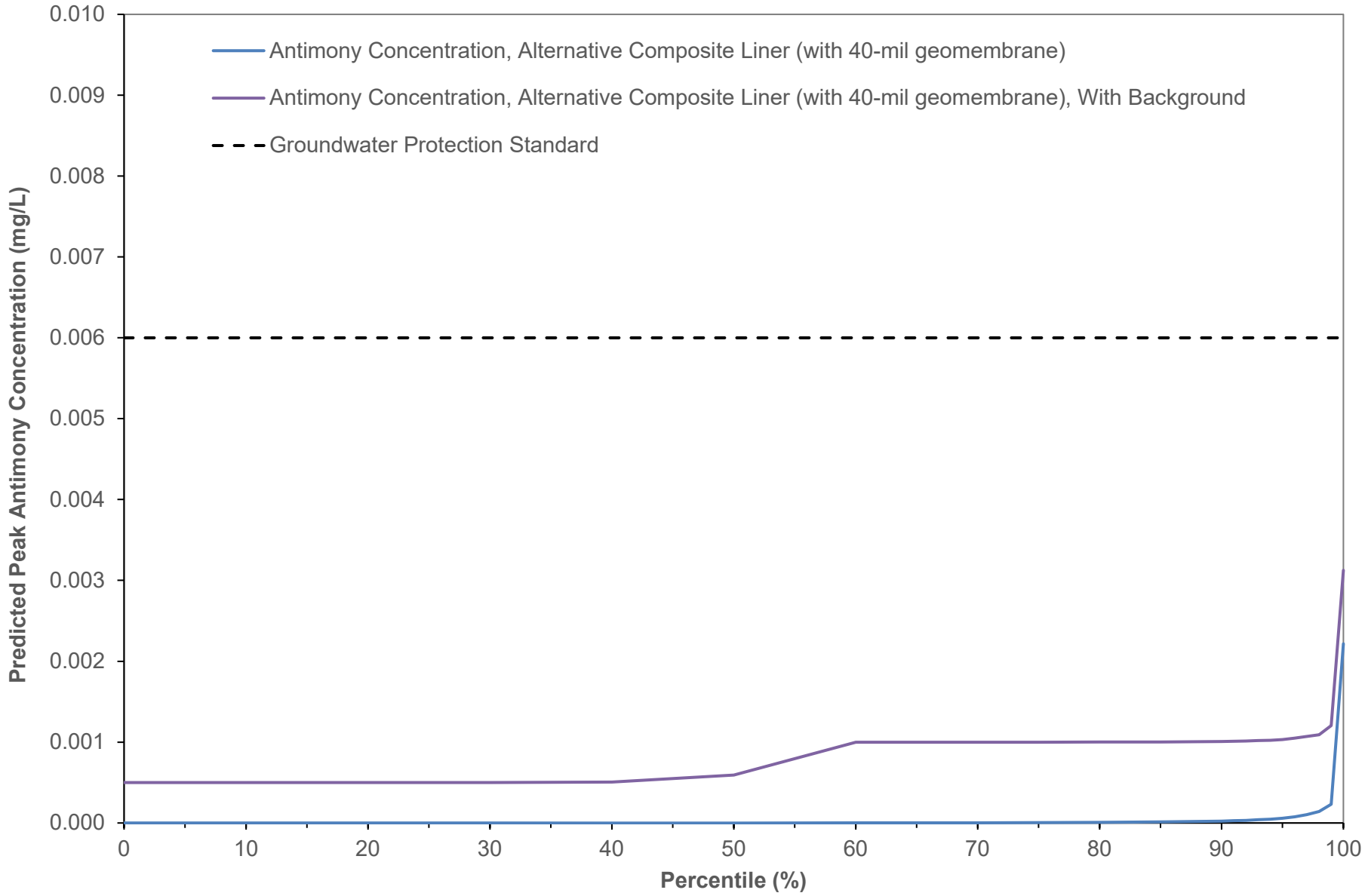
COAL CREEK STATION
GROUNDWATER SEPARATION TO BOTTOM OF COMPOSITE LINER SYSTEM

FIGURE 20

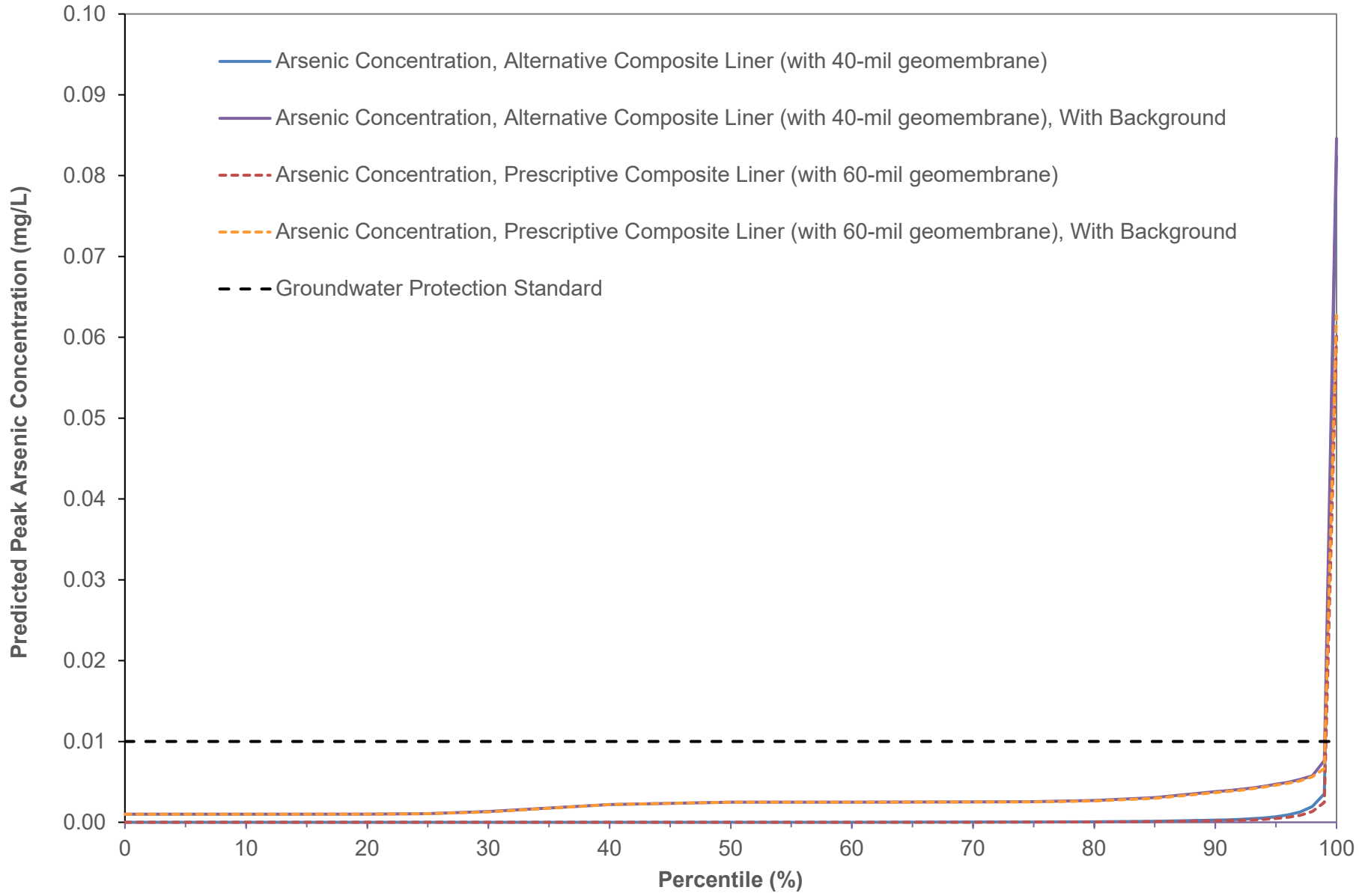


COAL CREEK STATION
Percentile Plot for Peak Antimony Concentrations at Waste Boundary

GOLDER

FIGURE 21

https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/4 - CCR Rule Support/Alt Liner Demo/Numerical Model/EPACMTP/Model Runs/[InText_Figures 21 - 27.xlsx]Fig 21_Antimony

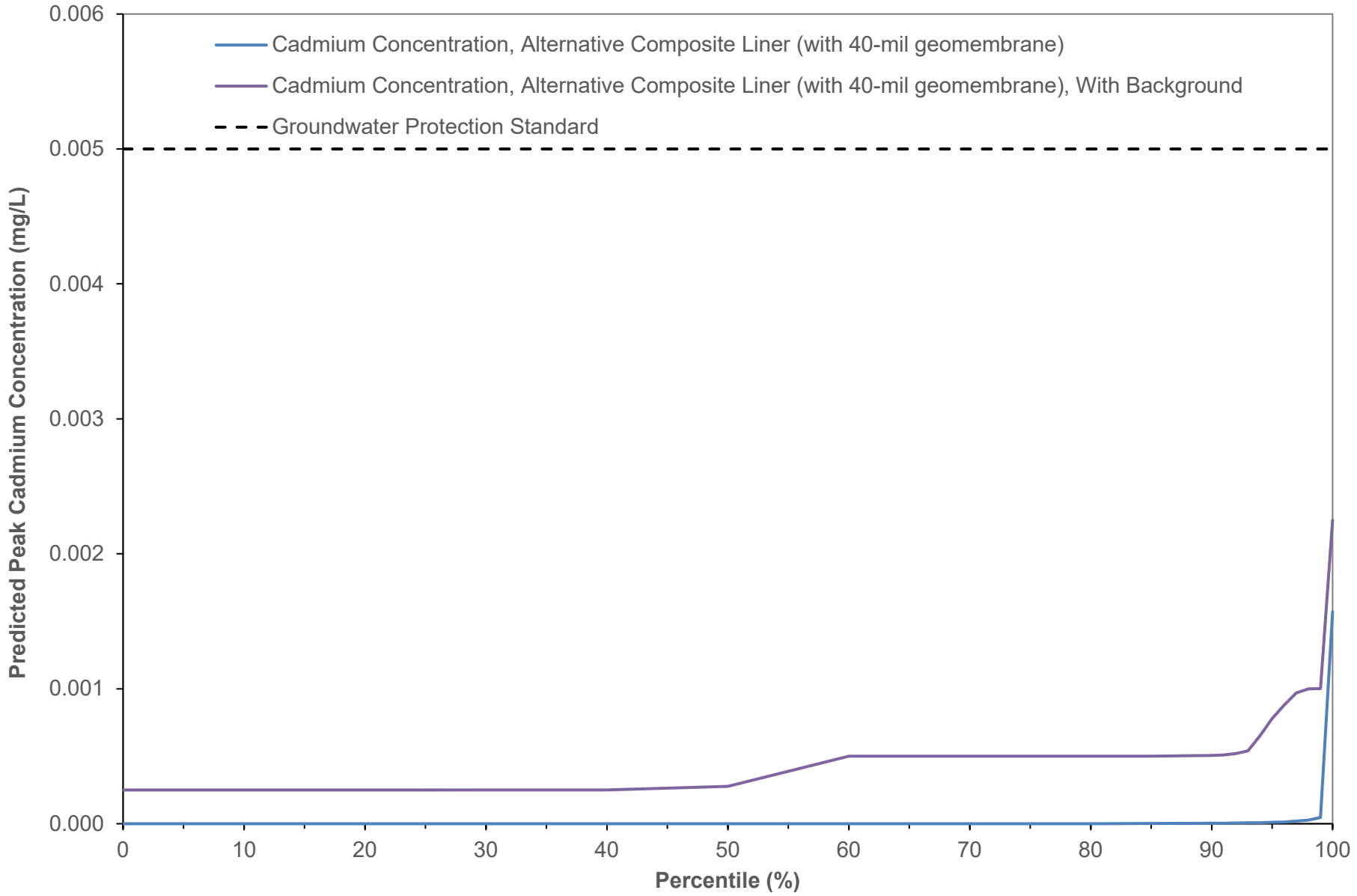


COAL CREEK STATION
Percentile Plot for Peak Arsenic Concentrations at Waste Boundary

GOLDER

FIGURE 22

https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/4 - CCR Rule Support/Alt Liner Demo/Numerical Model/EPACMTP/Model Runs/[InText_Figures 21 - 27.xlsx]Fig 22_Arsenic

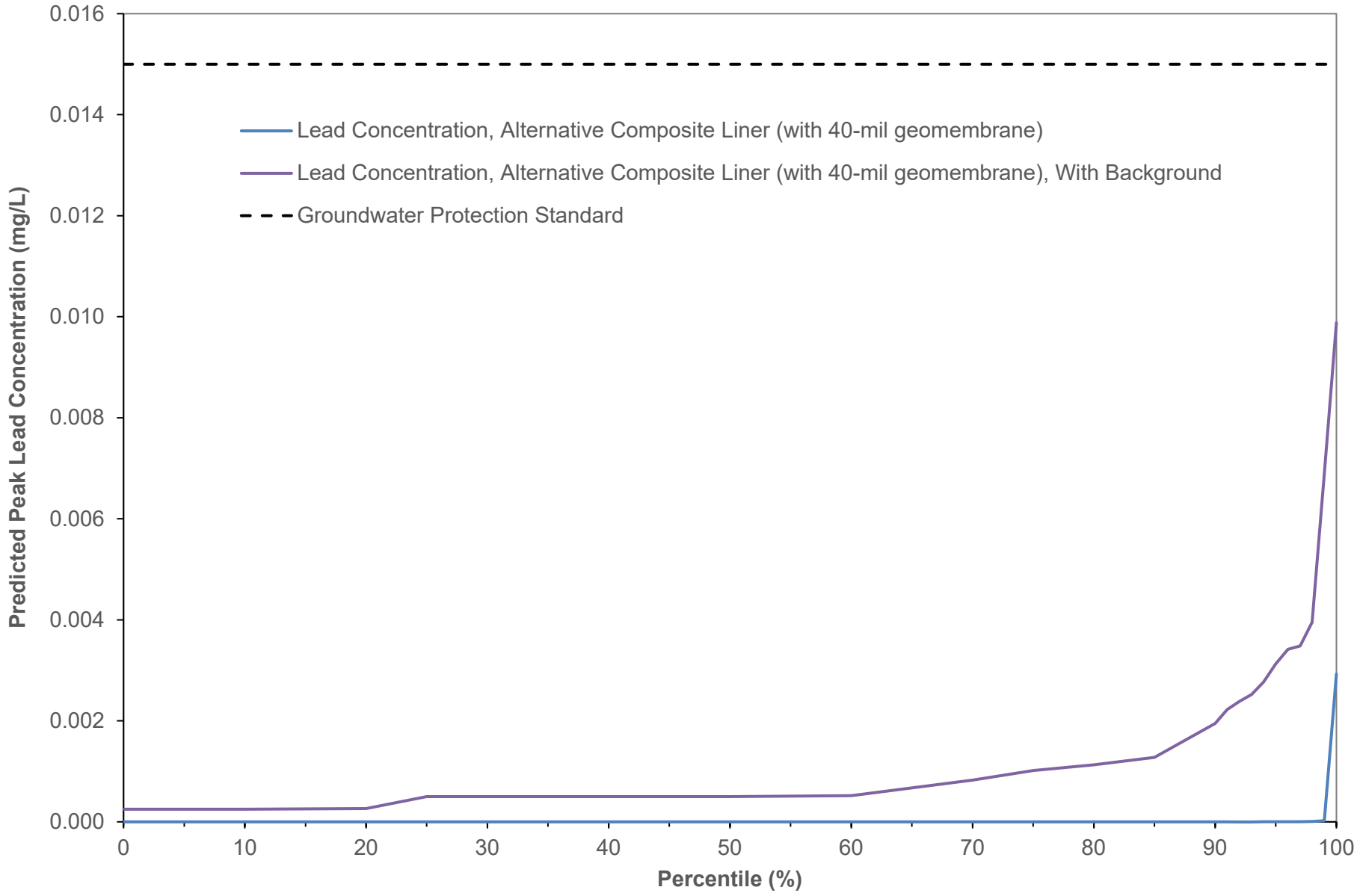


COAL CREEK STATION
Percentile Plot for Peak Cadmium Concentrations at Waste Boundary

GOLDER

FIGURE 23

https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/4 - CCR Rule Support/Alt Liner Demo/Numerical Model/EPACMTP/Model Runs/[InText_Figures 21 - 27.xlsx]Fig 23_Cadmium

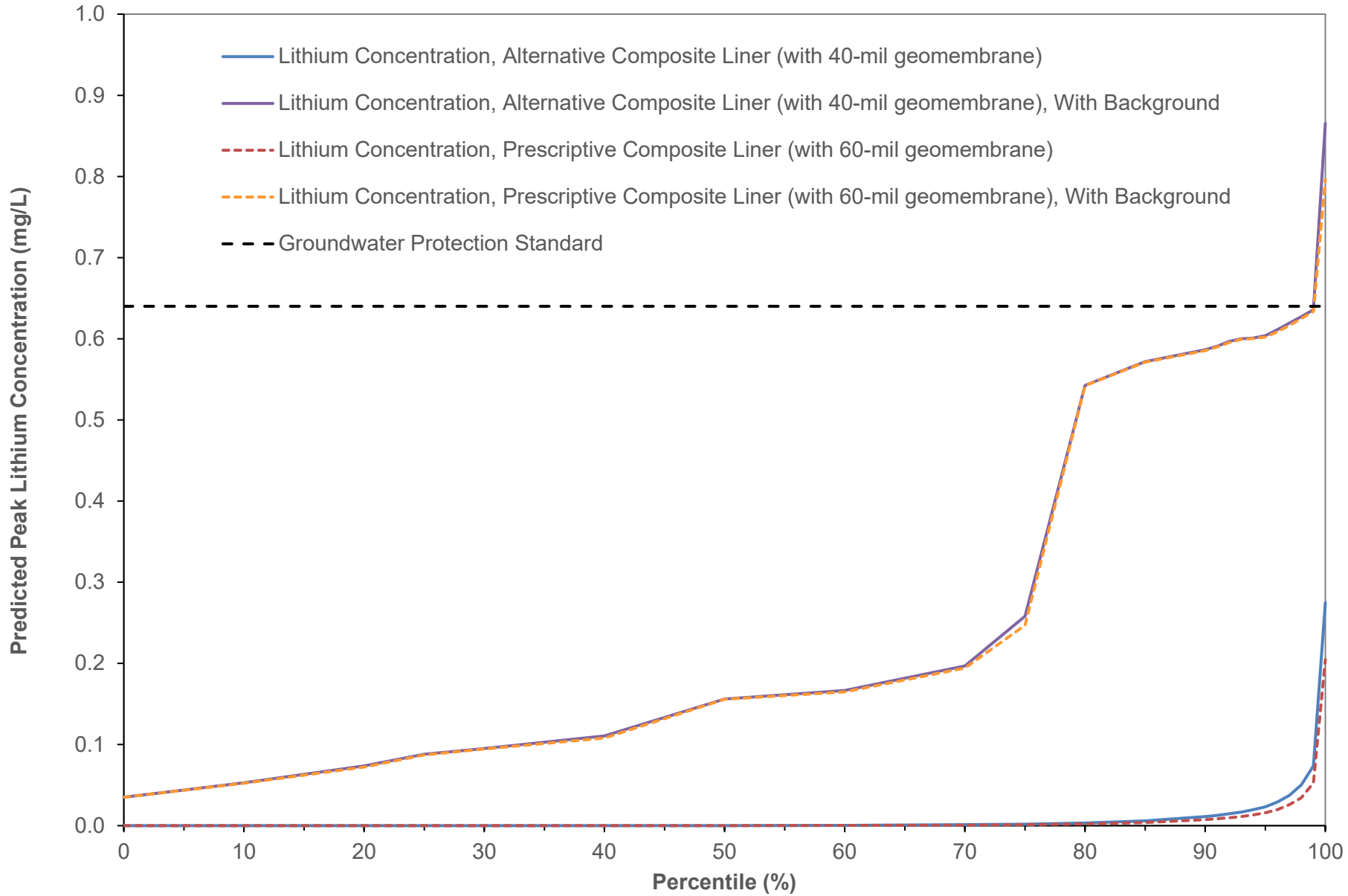


COAL CREEK STATION
Percentile Plot for Peak Lead Concentrations at Waste Boundary

GOLDER

FIGURE 24

https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/4 - CCR Rule Support/Alt Liner Demo/Numerical Model/EPACMTP/Model Runs/[InText_Figures 21 - 27.xlsx]Fig 24_Lead

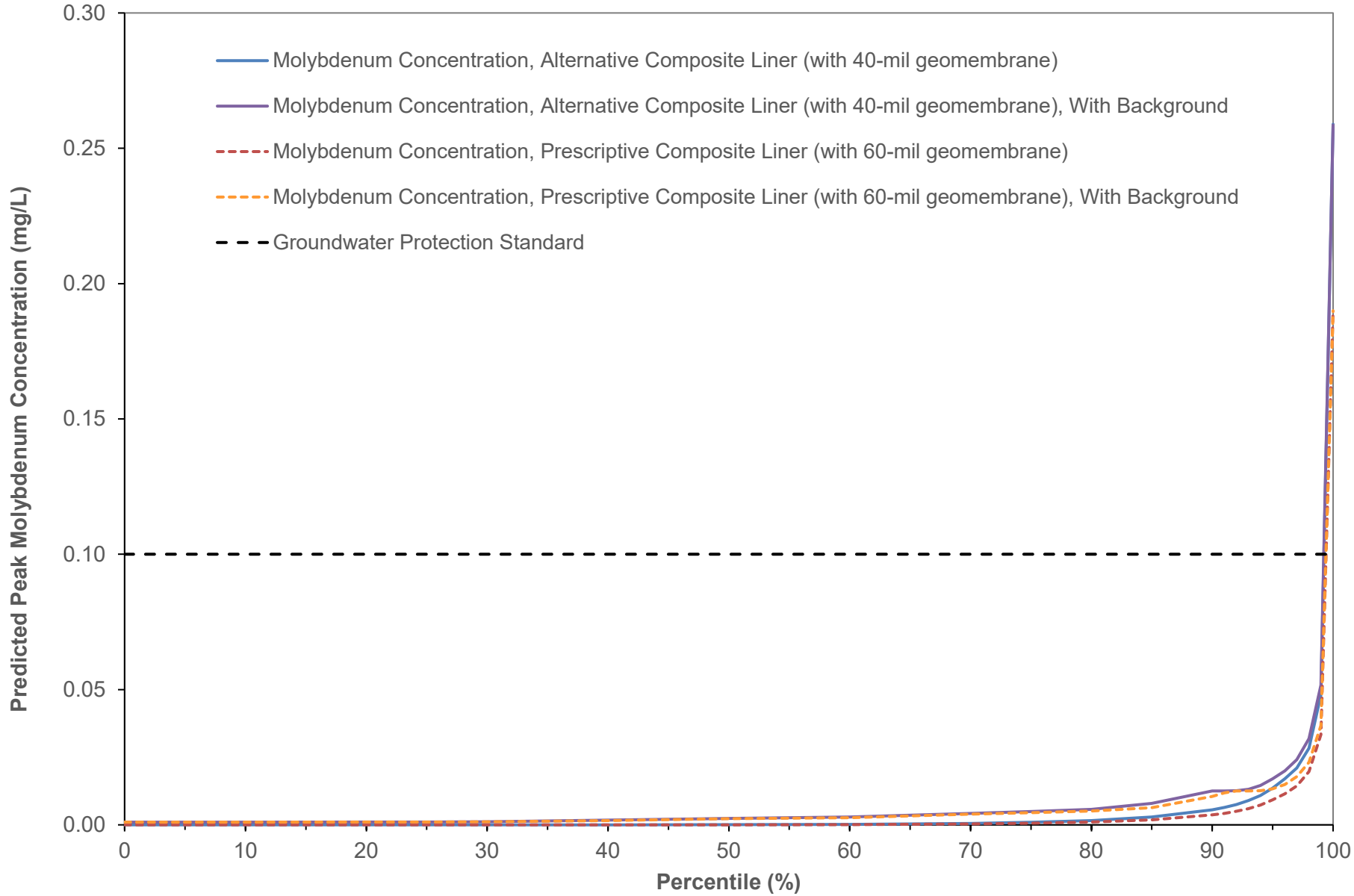


COAL CREEK STATION
Percentile Plot for Peak Lithium Concentrations at Waste Boundary

GOLDER

FIGURE 25

https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/4 - CCR Rule Support/Alt Liner Demo/Numerical Model/EPACMTP/Model Runs/[InText_Figures 21 - 27.xlsx]Fig 25_Lithium

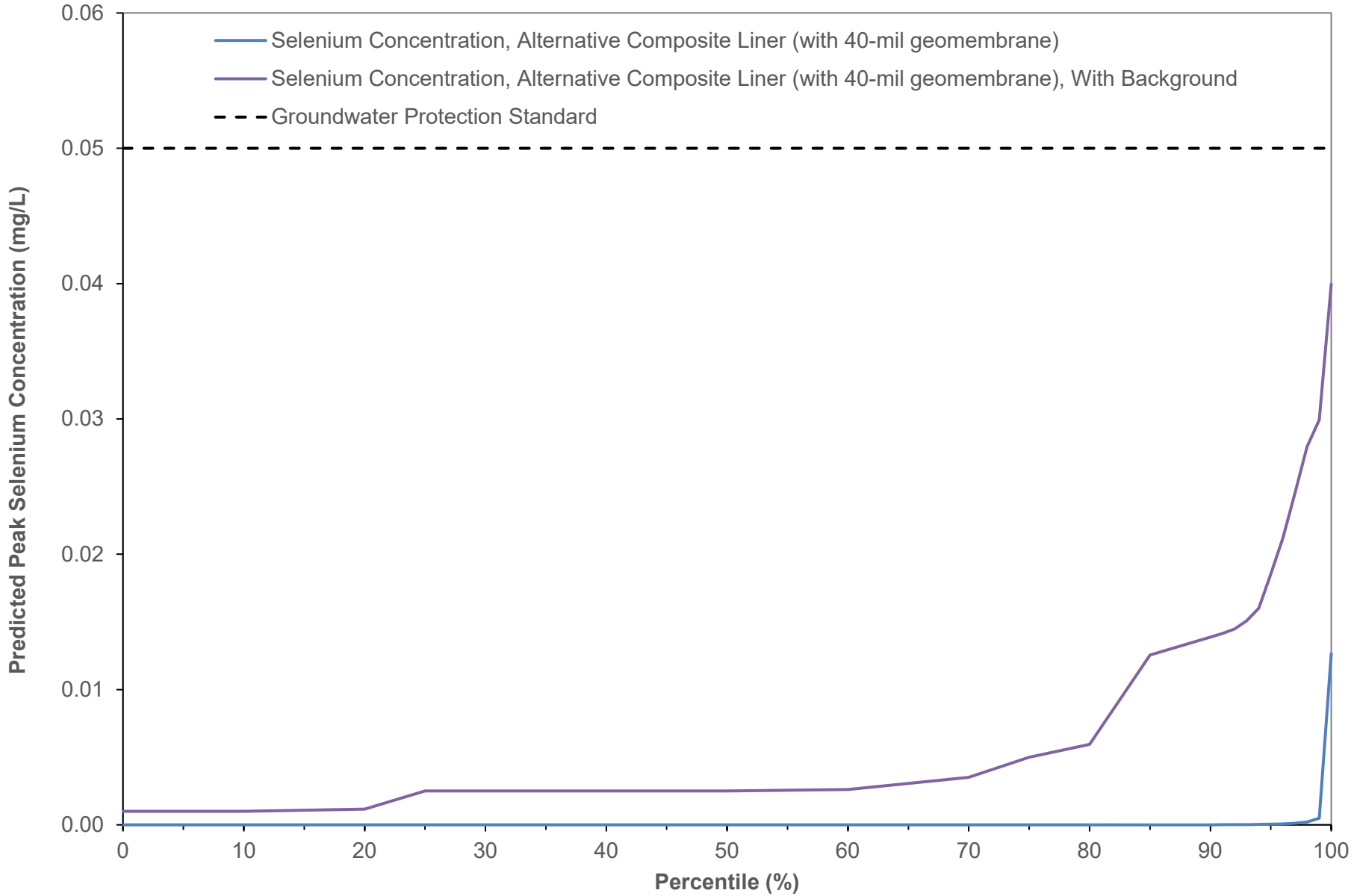


COAL CREEK STATION
Percentile Plot for Peak Molybdenum Concentrations at Waste Boundary

GOLDER

FIGURE 26

https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/4 - CCR Rule Support/Alt Liner Demo/Numerical Model/EPACMTP/Model Runs/[InText_Figures 21 - 27.xlsx]Fig 26_Moly



COAL CREEK STATION
Percentile Plot for Peak Selenium Concentrations at Waste Boundary

GOLDER

FIGURE 27

https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/4 - CCR Rule Support/Alt Liner Demo/Numerical Model/EPACMTP/Model Runs/[InText_Figures 21 - 27.xlsx]Fig 27_Selenium

APPENDIX A

Site Characterization

APPENDIX A-1

2021 Site Investigation Borehole Logs

BORING LOG NO. ALD-1

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan
Latitude: 47.3788° Longitude: -101.1379°
Surface Elev.: 1923 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.0	1923	**FILL - SANDY LEAN CLAY (CL)**, trace gravel, brown
23.0	1900	**SANDY LEAN CLAY (CL)**, trace gravel, brown to grayish brown, stiff to very stiff
37.0	1886	**LEAN CLAY WITH SAND (CL)**, brown to grayish brown, stiff, laminations of silt
43.0	1880	**CLAYEY SAND (SC)**, trace gravel, fine to medium grained, brown, medium dense, coal inclusions, iron oxide staining
49.0	1874	**SANDY LEAN CLAY (CL)**, trace gravel, brown to grayish brown, stiff
52.0	1871	

INSTALLATION DETAILS: PVC Cap; Protective casing; Auger Cuttings; PVC Riser; Bentonite; PVC Screen

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5		X	15	3-7-7 N=14		
10		X	15	3-5-7 N=12		
15		X	13	3-5-6 N=11		
20		X	15	5-6-9 N=15	36-14-22	69
25		X	17	6-5-6 N=11	35-15-20	62
30		X	18	6-8-12 N=20	37-16-21	60
35		X	18	5-7-9 N=16		
40		X	16	4-4-6 N=10	46-17-29	76
45		X	18	15-5-5 N=10	42-16-26	46
50		X	18	3-5-6 N=11	47-18-29	60

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:
Top of Casing: 1925.5

WATER LEVEL OBSERVATIONS

- *At completion of drilling*
- *After auger removal*
- *Cave in at 68'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-09-2021 | Boring Completed: 09-09-2021
Drill Rig: Mobile B-57 | Driller: Mike. R
Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-1

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1379°

Surface Elev.: 1923 (Ft.)

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), trace clay, fine to medium grained, gray		Silica sand	55			18			
59.5	1863.5								
61.0 **SANDSTONE**	1862		60			2	50/1"		
CLAYEY SAND (SC), fine to medium grained, gray, medium dense			65			18	9-12-12 N=24	34-18-16	47
		Sluff	70			18	6-10-14 N=24		
76.0	1847		75			18	9-12-14 N=26		
Boring Terminated at 76 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *At completion of drilling*
- *After auger removal*
- *Cave in at 68'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-09-2021 | Boring Completed: 09-09-2021

Drill Rig: Mobile B-57 | Driller: Mike. R

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-2

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1387°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)		DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FILL - SANDY LEAN CLAY (CL), trace gravel, brown						
			5	X	9	8-8-10 N=18		
			10	X	11	4-7-7 N=14		
			15	X	12	6-7-7 N=14		
			20	X	13	3-6-10 N=16	39-14-25	62
			25	X	13	4-7-11 N=18		
29.0	1893							
		LEAN CLAY WITH SAND (CL), brownish gray, stiff, laminations of silt	30	X	13	4-6-11 N=17	48-17-31	75
			35	X	11	3-6-9 N=15		
38.0	1884							
		CLAYEY SAND (SC), trace gravel, fine to medium grained, brown to gray, medium dense, layers of sand and gravel at 40'	40	X	14	6-8-5 N=13	42-17-25	50
43.0	1879							
		SANDY LEAN CLAY (CL), trace gravel, brown to gray, stiff to very stiff	45	X	14	6-5-7 N=12	47-18-29	64
			50	X	14	6-5-5 N=10		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-08-2021 | Boring Completed: 09-09-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-2

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1387°

Surface Elev.: 1922 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDY LEAN CLAY (CL), trace gravel, brown to gray, stiff to very stiff *(continued)*								
	57.0	1865	55		X	15	7-7-10 N=17	38-15-23	65
	SANDY FAT CLAY (CH), gray, very stiff		60		X	14	5-9-12 N=21		
			65		X	18	9-11-14 N=25	54-15-39	59
	71.0	1851	70		X	17	7-11-13 N=24		
	POORLY GRADED SAND WITH CLAY (SP-SC), fine to medium grained, gray, very dense								
	76.0	1846	75		X	18	13-26-48 N=74		
	Boring Terminated at 76 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-08-2021 | Boring Completed: 09-09-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-3

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan
Latitude: 47.3788° Longitude: -101.1395°
Surface Elev.: 1926 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.0	1926	**FILL - SANDY LEAN CLAY (CL)**, trace gravel, brown
9.5	1916.5	**FILL - POORLY GRADED SAND (SP)**, brown
13.0	1913	**FILL - SANDY LEAN CLAY (CL)**, trace gravel, brown
23.0	1903	**SANDY LEAN CLAY (CL)**, trace gravel, brown, stiff to very stiff
33.0	1893	**LEAN CLAY WITH SAND (CL)**, trace gravel, brown to grayish brown, stiff
39.0	1887	**CLAYEY SAND WITH GRAVEL (SC)**, fine to medium grained, brown, medium dense
42.0	1884	**SANDY LEAN CLAY (CL)**, trace gravel, grayish brown, stiff
49.0	1877	**LEAN CLAY WITH SAND (CL)**, trace gravel, grayish brown, very stiff gravel seam at 50'

INSTALLATION DETAILS: PVC Cap; Protective casing; Auger Cuttings; PVC Riser; Bentonite; PVC Screen

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5			18	7-11-16 N=27		
10			10	2-3-28 N=31		
15			18	4-6-7 N=13		
20			18	2-3-8 N=11	46-16-30	61
25			18	4-6-8 N=14	38-14-24	64
30			18	4-7-10 N=17		
35			18	5-6-7 N=13	47-15-32	74
40			18	10-10-12 N=22	34-22-12	15
45			18	4-5-7 N=12	47-17-30	60
50			18	5-8-10 N=18	41-14-27	73

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:
Top of Casing: 1928.4

WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 68'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-08-2021 | Boring Completed: 09-09-2021
Drill Rig: Mobile B-57 | Driller: Mike R.
Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-3

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1395°

Surface Elev.: 1926 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
54.0	1872							
SANDY SILT (ML), gray, very stiff, waterbearing		55			18	6-9-12 N=21		
57.0	1869							
FAT CLAY (CH), gray, very stiff		60			18	4-6-12 N=18	52-15-37	98
62.0	1864							
CLAYEY SAND (SC), fine to medium grained, gray, dense to medium dense		65			18	9-15-15 N=30		
		70			18	6-9-9 N=18		
76.0	1850	75			18	8-12-15 N=27		
Boring Terminated at 76 Feet								

Silica sand

Sluff

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 68'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-08-2021 | Boring Completed: 09-09-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-4

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1403°

Surface Elev.: 1923 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FILL - LEAN CLAY WITH SAND (CL), trace gravel, brown to grayish brown								
		5			10	3-3-5 N=8		
		10			10	3-6-8 N=14		
		15			14	4-6-6 N=12		
		20			10	4-5-9 N=14		
23.0	1900							
SANDY LEAN CLAY (CL), trace gravel, brown, very stiff to stiff		25			12	5-7-11 N=18	42-14-28	60
		30			12	3-5-7 N=12		
32.0	1891							
CLAYEY SAND (SC), trace gravel, fine to medium grained, brown, loose		35			12	4-3-3 N=6	30-21-9	13
36.0	1887							
SILTY SAND WITH GRAVEL (SM), fine to medium grained, brown to dark brown, medium dense								
waterbearing at 39'		40			11	4-6-9 N=15	NP	15
seams of clay								
43.0	1880							
LEAN CLAY (CL), brown to gray, very stiff to stiff, numerous laminations of silt		45			15	4-8-11 N=19	44-16-28	90
		50			13	4-7-10 N=17	46-13-33	93

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- While sampling
- At completion of drilling
- Cave in at 27'

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-08-2021 | Boring Completed: 09-08-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-4

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1403°

Surface Elev.: 1923 (Ft.)

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			55		X	17	4-4-10 N=14		
58.0	1865								
			60		X	16	8-11-14 N=25	36-18-18	41
			65		X	17	15-15-18 N=33		
			70		X	18	9-14-16 N=30		
76.0	1847		75		X	18	9-13-20 N=33		

LEAN CLAY (CL), brown to gray, very stiff to stiff, numerous laminations of silt *(continued)*

CLAYEY SAND (SC), fine to medium grained, gray, medium dense to dense

Boring Terminated at 76 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*
- *Cave in at 27'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-08-2021 | Boring Completed: 09-08-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-5

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1411°

Surface Elev.: 1923 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FILL - LEAN CLAY WITH SAND (CL), trace gravel, brown, varying amounts of sand							
		5		X	11	3-4-5 N=9		
		10		X	10	3-9-10 N=19		
		15		X	11	3-6-9 N=15		
		20		X	6	3-6-13 N=19		
27.0	1896	25		X	3	6-7-8 N=15		
	SANDY LEAN CLAY (CL), trace gravel, brown, stiff, coal inclusions	30		X	11	6-7-8 N=15	42-14-28	58
33.0	1890							
	CLAYEY SAND WITH GRAVEL (SC), fine to coarse grained, brown, medium dense, damp	35		X	11	3-6-7 N=13		
	seams of clay	40		X	11	9-14-12 N=26	26-17-9	18
42.0	1881							
	LEAN CLAY (CL), brownish gray to gray, very stiff	45		X	14	6-10-14 N=24	45-15-30	94
46.0	1877							
	FAT CLAY (CH), brownish gray to gray, very stiff, laminations of silt	50		X	11	6-9-10 N=19	65-15-50	99

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-07-2021 | Boring Completed: 09-08-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-5

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1411°

Surface Elev.: 1923 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FAT CLAY (CH), brownish gray to gray, very stiff, laminations of silt *(continued)*							
58.0	1865	55			13	10-12-15 N=27	66-14-52	98
	SILTY SAND (SM), fine to medium grained, gray, loose	60			14	2-4-4 N=8		
68.0	1855	65			18			
	FAT CLAY (CH), gray, hard, laminations of silt	70			17	12-15-21 N=36		
73.0	1850							
	CLAYEY SAND (SC), fine to medium grained, gray, dense	75			18	10-13-17 N=30		
76.0	1847							
	Boring Terminated at 76 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-07-2021 | Boring Completed: 09-08-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-6

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1419°

Surface Elev.: 1922.7 (Ft.)

DEPTH	ELEVATION (Ft.)	Stratigraphic Description
0.0	1922.7	**FILL - SANDY LEAN CLAY (CL)**, trace gravel, brown to grayish brown
31.0	1891.5	**SANDY LEAN CLAY (CL)**, trace gravel, brown, very stiff, seams of sand
39.5	1883	**CLAYEY SAND (SC)**, trace gravel, fine grained, gray, medium dense
42.0	1880.5	**SILTY SAND (SM)**, fine to medium grained, gray, loose, waterbearing, varying amounts of silt
48.0	1874.5	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine to medium grained, gray, loose

INSTALLATION DETAILS: PVC cap; Protective casing; PVC Riser; Auger cuttings; Bentonite; Silica sand; PVC screen

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5			8	4-6-7 N=13		
10			14	5-8-7 N=15		
15			16	4-6-7 N=13		
20			15	6-10-13 N=23	41-14-27	60
25			16	3-5-8 N=13	45-14-31	69
30			15	3-4-7 N=11		
35			17	7-10-10 N=20	35-13-22	59
40			18	8-8-8 N=16	27-14-13	32
45	▽		18	3-2-4 N=6	NP	16
50			18	3-4-5 N=9	NP	7

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:
Top of Casing: 1925.6

WATER LEVEL OBSERVATIONS

▽ *While sampling*

▽ *At completion of drilling*

Cave in at 43'

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-08-2021 | Boring Completed: 09-08-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-6

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1419°

Surface Elev.: 1922.7 (Ft.)

DEPTH	ELEVATION (Ft.)
53.0	1869.5
76.0	1846.5

SILTY SAND (SM), fine to medium grained, gray, loose to medium dense

Sluff

Boring Terminated at 76 Feet

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
55		18	6-7-10 N=17	NP	13
60		18	3-2-2 N=4		
65		18	2-2-5 N=7		
70		18	0-6-10 N=16		
75		18	2-2-6 N=8		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

While sampling

At completion of drilling

Cave in at 43'

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-08-2021 | Boring Completed: 09-08-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-7

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1427°

Surface Elev.: 1923 (Ft.)

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			5						
					X	7	6-4-5 N=9		
			10						
					X	12	3-7-8 N=15		
			15						
					X	14	3-7-10 N=17		
			20						
					X	12	2-4-7 N=11		
			25						
					X	8	1-1-3 N=4		
			30						
					X	13	2-3-5 N=8		
			35						
					X	14	3-5-8 N=13	44-14-30	74
			40						
					X	11	2-4-6 N=10	41-18-23	80
			45						
					X	15	3-4-4 N=8	48-14-34	77
			50						
					X	13	3-4-5 N=9	38-15-23	45

FILL - SANDY LEAN CLAY (CL), trace gravel, brown

13.0 1910

LEAN CLAY WITH SAND (CL), trace gravel, brown to grayish brown, very stiff to medium stiff to stiff, coal inclusions

48.0 1875

CLAYEY SAND (SC), gray to dark gray, loose, coal inclusions

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While sampling*

Reversed auger out

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-07-2021 | Boring Completed: 09-07-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-7

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1427°

Surface Elev.: 1923 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
CLAYEY SAND (SC), gray to dark gray, loose, coal inclusions *(continued)*						
55.0	1868	55	15	4-4-8 N=12		
SANDY LEAN CLAY (CL), gray, stiff, waterbearing seams of sand and gravel						
61.0	1862	60	14	3-4-6 N=10	32-14-18	51
LEAN CLAY WITH SAND (CL), gray, stiff		65	14	1-3-5 N=8		
		70	14	2-4-6 N=10		
76.0	1847	75	10	3-4-6 N=10	40-14-26	78
Boring Terminated at 76 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While sampling*

Reversed auger out

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-07-2021 | Boring Completed: 09-07-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-8

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1435°

Surface Elev.: 1923 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.0	1923	**FILL - SANDY LEAN CLAY (CL)**, trace gravel, brown, coal inclusions
13.0	1910	**SANDY LEAN CLAY (CL)**, trace gravel, brown to grayish brown, stiff to medium stiff
23.0	1900	**LEAN CLAY WITH SAND (CL)**, trace gravel, brown to grayish brown, medium stiff to stiff, coal inclusions
33.0	1890	**SANDY LEAN CLAY (CL)**, trace gravel, brown to grayish brown, stiff
43.0	1880	**LEAN CLAY (CL)**, gray, very stiff, laminations of silt
50.5	1872.5	**SANDSTONE**, gray
52.0	1871	

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5		11	4-5-7 N=12		
10		10	6-7-10 N=17		
15		16	3-6-7 N=13	38-18-20	68
20		15	2-2-2 N=4		
25		13	2-3-4 N=7	49-17-32	76
30		16	4-5-10 N=15	45-14-31	72
35		18	3-4-6 N=10	42-14-28	58
40		18	3-5-4 N=9	27-16-11	66
45		18	3-9-11 N=20	41-15-26	99
50		8	50/4"		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 54.5'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-07-2021 | Boring Completed: 09-07-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-8

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1435°

Surface Elev.: 1923 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		55						
					18	1-1-1 N=2	NP	22
		60						
					18	8-12-13 N=25		
		65						
					18	10-12-14 N=26		
		70						
					18	12-14-16 N=30	40-16-24	29
		75						
					18	10-12-15 N=27		

SILTY SAND (SM), fine to medium grained, gray, very loose to medium dense

63.0 / 1860

CLAYEY SAND (SC), fine to medium grained, gray, medium dense to dense, waterbearing

76.0 / 1847

Boring Terminated at 76 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 54.5'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-07-2021 | Boring Completed: 09-07-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-9

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1443°

Surface Elev.: 1923.3 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.0	1923.3	**FILL - SANDY LEAN CLAY (CL)**, trace gravel, brown to grayish brown, encountered abandoned water line at 5'
12.0	1911.5	**LEAN CLAY WITH SAND**, trace gravel, grayish brown to brown, stiff to very stiff
27.0	1896.5	**SANDY LEAN CLAY (CL)**, trace gravel, brown, stiff to medium stiff, coal inclusions, iron oxide staining
37.0	1886.5	**LEAN CLAY (CL)**, brown to grayish brown, stiff
44.0	1879.5	
45.0	1878.5	**CLAYSTONE**, off white to light gray
		CLAYEY SAND (SC), fine to medium grained, gray, medium dense

INSTALLATION DETAILS: PVC Cap; Protective casing; Auger Cuttings; Bentonite; PVC Riser; PVC Screen; Silica sand

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5		15	5-5-5 N=10		
10		18	5-8-15 N=23		
15		4	8-5-6 N=11		
20		18	6-7-9 N=16		
25		18	4-8-12 N=20	48-15-33	80
30		18	4-4-5 N=9	45-16-29	62
35		18	3-3-4 N=7		
40		18	2-4-6 N=10	45-15-30	99
45		1	50/1"		
50		18	10-12-14 N=26		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-64½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:
Top of Casing: 1925.5

WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 62'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-07-2021 | Boring Completed: 09-08-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-9

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1443°

Surface Elev.: 1923.3 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			CLAYEY SAND (SC), fine to medium grained, gray, medium dense *(continued)*							
			Sluff	55			18	10-12-13 N=25		
				60			18	9-12-14 N=26	34-18-16	30
	66.0	1857.5		65			10	12-50/4"		
			Auger Refusal at 66 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-64½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 62'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-07-2021 | Boring Completed: 09-08-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-10

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1451°

Surface Elev.: 1923 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FILL - FAT CLAY (CH), trace gravel, brown to gray, fly ash/bottom ash/coal							
			5		X	16	3-4-6 N=10		
			10		X	18	2-4-6 N=10	72-22-50	93
12.0	1911								
		FAT CLAY (CH), gray to dark gray, stiff	15		X	18	4-4-8 N=12		
19.0	1904								
		SANDY LEAN CLAY (CL), trace gravel, brown to dark gray, very stiff to stiff	20		X	18	4-8-11 N=19	40-14-26	55
			25		X	18	4-4-10 N=14		
		waterbearing gravel layer at 30'	30	▽	X	0	8-6-8 N=14		
36.0	1887		35		X	18	3-5-10 N=15	35-13-22	54
38.0	1885	**FAT CLAY (CH)**, trace gravel, pale brown to light brown, stiff, seams of sand							
		FAT CLAY (CH), grayish brown, mottled, soft, waterbearing seam of sand at 38'	40		X	18	0-0-3 N=3	55-16-39	86
			45		■				
48.0	1875								
		SANDY LEAN CLAY (CL), gray to dark gray, medium stiff to stiff	50	▽	X	18	0-3-4 N=7	34-15-19	60
		organics							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While sampling*

▽ *At completion of drilling*

▨ *Cave in at 27'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-04-2021 | Boring Completed: 09-07-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-10

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1451°

Surface Elev.: 1923 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDY LEAN CLAY (CL), gray to dark gray, medium stiff to stiff *(continued)*								
	seams of sand		55		X	18	1-3-10 N=13		
	59.0	1864							
	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM), coarse grained, brown, medium dense		60		X	15	10-10-10 N=20	NP	7
	62.0	1861							
	SILTY CLAYEY SAND (SC-SM), fine to medium grained, gray, medium dense to dense		65		X	18	10-12-12 N=24	26-21-5	27
			70		X	18	13-15-19 N=34		
	76.0	1847	75		X	18	15-18-20 N=38		
	Boring Terminated at 76 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

While sampling

At completion of drilling

Cave in at 27'

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-04-2021 | Boring Completed: 09-07-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-11

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1459°

Surface Elev.: 1923 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FILL - LEAN CLAY WITH SAND (CL), trace gravel, brown, fly ash/bottom ash/coal								
		5			15	3-5-6 N=11		
		10			12	1-1-3 N=4		
		15			18	2-4-6 N=10		
		20			18	4-8-8 N=16		
26.0	1897	25			18	4-7-9 N=16	45-14-31	80
FAT CLAY (CH), gray to dark gray, medium stiff, seams of sand		30			18	2-3-4 N=7	53-18-35	98
33.0	1890							
SANDY LEAN CLAY (CL), brown to brownish gray, medium stiff to stiff, seams of sand		35			18	2-3-4 N=7		
		40			18	3-5-7 N=12	39-12-27	62
44.5	1878.5							
46.0 **SANDSTONE**, gray, very dense	1877	45			2	50/2"		
WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM), fine to medium grained, brown, medium dense, waterbearing		50			17	4-4-10 N=14	NP	9
52.0	1871							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- While drilling
- At completion of drilling
- Cave in at 24'

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-03-2021 | Boring Completed: 09-03-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-11

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1459°

Surface Elev.: 1923 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), fine to medium grained, gray, dense		55					
				18	10-15-20 N=35		
		60					
				0			
63.0	1860						
CLAYEY SAND (SC), fine grained, gray, medium dense		65					
				18	10-13-14 N=27	27-17-10	26
		70					
				18	12-12-12 N=24		
76.0	1847	75					
				18	10-13-14 N=27		
Boring Terminated at 76 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While drilling*
- *At completion of drilling*
- *Cave in at 24'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-03-2021 | Boring Completed: 09-03-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-12

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1467°

Surface Elev.: 1923 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FILL - LEAN CLAY (CL), trace gravel, brown to gray							
12.0	1911								
		LEAN CLAY (CL), gray, stiff trace coal	5		X	15	3-4-7 N=11		
			10		X	18	3-4-6 N=10		
			15		X	18	4-6-8 N=14		
22.0	1901		20		X	18	3-5-7 N=12	45-11-34	96
		LEAN CLAY WITH SAND (CL), trace gravel, gray, stiff to medium stiff	25		X	18	5-5-9 N=14	48-12-36	83
			30	▼	X	18	2-3-4 N=7		
33.0	1890			▽					
		POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM), fine to course grained, brown, waterbearing	35		■	18			
37.0	1886								
		SANDY SILT (ML), gray, hard	40		X	18	12-16-28 N=44		
44.0	1879								
45.0	1878	**SANDSTONE**, off white to light brown, very dense	45			2	50/1"		
		SILTY SAND (SM), fine to medium grained, gray, dense	50		X	18	35-20-22 N=42		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While drilling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 35'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-02-2021 | Boring Completed: 09-03-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-12

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3788° Longitude: -101.1467°

Surface Elev.: 1923 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND (SM), fine to medium grained, gray, dense *(continued)*							
54.0	1869							
	CLAYEY SAND (SC), fine grained, gray, medium dense to dense	55			18	10-12-14 N=26	42-19-23	26
		60			18	10-14-16 N=30		
		65			18	10-12-16 N=28	49-17-32	27
		70			18	13-15-18 N=33		
76.0	1847	75			18	12-16-16 N=32		
	Boring Terminated at 76 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While drilling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 35'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-02-2021 | Boring Completed: 09-03-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-13

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3787° Longitude: -101.1475°

Surface Elev.: 1923 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FILL - FAT CLAY WITH SAND (CH), brown to dark gray, bottom ash					
8.0	1915		5	17	3-4-9 N=13		
		SANDY LEAN CLAY (CL), trace gravel, brown, stiff to very stiff	10	16	5-6-8 N=14	39-12-27	58
			15	17	2-5-11 N=16		
19.5	1903.5						
		LEAN CLAY WITH SAND (CL), gray to dark gray, stiff	20	18	3-4-5 N=9	47-15-32	82
23.0	1900						
		LEAN CLAY (CL), gray, medium stiff	25	18	2-3-3 N=6	48-16-32	87
28.0	1895						
		SANDY LEAN CLAY (CL), brownish gray, soft to very soft, waterbearing	30	18	1-1-1 N=2	38-16-22	63
			35	18	0-0-0 N=0 WOH		
38.0	1885						
		FAT CLAY WITH SAND (CH), trace gravel, gray to dark gray, medium stiff, seams of sand and gravel	40	18	2-3-3 N=6		
			45	18	2-3-3 N=6		
			50	18	1-2-2 N=4		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 43'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-02-2021 | Boring Completed: 09-02-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

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BORING LOG NO. ALD-13

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3787° Longitude: -101.1475°

Surface Elev.: 1923 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
53.0	1870							
54.5 **GRAVEL**	1868.5							
SILTY SAND (SM), trace gravel, fine to medium grained, light gray to gray, dense		55		X	18	10-20-25 N=45	NP	26
59.0	1864							
CLAYEY SAND (SC), gray, medium dense to very dense		60		X	18	11-13-15 N=28	26-16-10	27
		65		X	18	15-25-30 N=55		
		70		X	18	12-15-25 N=40		
72.0	1851							
POORLY GRADED SAND WITH SILT (SP-SM), fine to medium grained, gray, dense		75		X	18	13-16-20 N=36		
76.0	1847							
Boring Terminated at 76 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 43'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-02-2021 | Boring Completed: 09-02-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-14

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3782° Longitude: -101.1475°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FILL - SANDY LEAN CLAY (CL), trace gravel, brown							
		5			10	7-11-20 N=31		
		10			12	4-7-10 N=17		
		15			11	2-6-8 N=14		
		20			10	3-5-5 N=10	44-15-29	64
26.0	1896	25	▼		13	2-2-4 N=6	43-14-29	63
	FILL - FAT CLAY (CH), brownish gray							
		30			10	2-3-5 N=8		
31.0	1891	35	▨		11	3-3-4 N=7	40-14-26	55
	SANDY LEAN CLAY (CL), trace gravel, brown, medium stiff							
37.0	1885							
	SILTY SAND (SM), trace gravel, fine to medium grained, brown to gray, medium dense	40	▽		18	6-11-16 N=27	NP	33
41.0	1881		▽					
	CLAYEY SAND (SC), fine to medium grained, gray, dense to medium dense, lenses of clay, waterbearing at 41'	45			15	10-18-20 N=38		
		50			16	9-12-19 N=31		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 35'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-08-2021 | Boring Completed: 09-08-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

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BORING LOG NO. ALD-14

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3782° Longitude: -101.1475°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
CLAYEY SAND (SC), fine to medium grained, gray, dense to medium dense, lenses of clay, waterbearing at 41' *(continued)*		55		X	15	10-16-20 N=36	32-21-11	26
		60		X	15	11-17-19 N=36		
		65		X	15	10-14-21 N=35	55-18-37	27
		70		X	16	9-15-21 N=36	53-17-36	32
76.0	1846	75		X	18	9-12-16 N=28		
Boring Terminated at 76 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 35'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-08-2021 | Boring Completed: 09-08-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

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BORING LOG NO. ALD-15

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3777° Longitude: -101.1475°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FILL - LEAN CLAY WITH SAND (CL), brown							
			5		X	12	3-5-7 N=12		
			10		X	6	2-1-2 N=3		
13.0	1909								
		FILL - LEAN CLAY (CL), brown to dark brown	15		X	13	2-4-5 N=9		
			20		X	14	4-7-10 N=17	43-16-27	100
24.0	1898								
		SILTY SAND (SM), fine to medium grained, gray, medium dense, lenses of clay	25		X	16	6-12-15 N=27	23-20-3	43
28.0	1894								
		SILTY CLAYEY SAND (SC-SM), fine to medium grained, gray, medium dense	30		X	16	6-10-15 N=25	26-20-6	36
32.0	1890								
		CLAYEY SAND (SC), fine to medium grained, gray, medium dense to dense, lenses of clay	35	▼	X	16	7-10-12 N=22		
				▽					
			40	▨	X	17	7-11-14 N=25		
			45		X	17	10-14-17 N=31		
				▽					
			50		X	16	9-13-16 N=29		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *While sampling*
- ▽ *At completion of drilling*
- ▼ *After auger removal*
- ▨ *Cave in at 40'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-09-2021 | Boring Completed: 09-10-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-15

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3777° Longitude: -101.1475°

Surface Elev.: 1922 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), fine to medium grained, gray, medium dense to dense, lenses of clay *(continued)*		55		X	16	10-15-22 N=37	49-18-31	27
			60		X	18	10-13-18 N=31		
			65		X	18	12-17-22 N=39		
			70		X	18	11-15-17 N=32		
	76.0	1846	75		X	18	11-15-17 N=32	59-17-42	24
	Boring Terminated at 76 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 40'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-09-2021 | Boring Completed: 09-10-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

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BORING LOG NO. ALD-16

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3771° Longitude: -101.1475°

Surface Elev.: 1922 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FILL - SANDY LEAN CLAY (CL), trace gravel, brown								
	21.0	1901							
	LEAN CLAY (CL), dark gray, stiff, laminations of silt								
	28.0	1894							
	CLAYEY SAND (SC), fine to medium grained, gray, medium dense to dense, lenses of clay								
			5						
			10		X	10	3-4-5 N=9		
			15		X	11	2-4-6 N=10	44-14-30	67
			20		X	11	3-4-5 N=9	44-14-30	64
			25		X	11	3-6-6 N=12	44-16-28	99
			30		X	14	12-13-14 N=27		
			35		X	15	7-14-21 N=35	43-17-26	46
			40		X	17	7-12-14 N=26	53-19-34	46
			45		X	17	10-11-15 N=26		
			50		X	16	7-14-15 N=29		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

Reverse auger out

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-10-2021 | Boring Completed: 09-10-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-16

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3771° Longitude: -101.1475°

Surface Elev.: 1922 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), fine to medium grained, gray, medium dense to dense, lenses of clay *(continued)*		55		X	17	9-16-19 N=35		
			60		X	18	10-14-15 N=29	56-17-39	29
			65		X	18	10-15-17 N=32	59-17-42	28
			70		X	18	10-15-17 N=32		
	76.0	1846	75		X	17	13-18-32 N=50		
	Boring Terminated at 76 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

Reverse auger out

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-10-2021 | Boring Completed: 09-10-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-17

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3766° Longitude: -101.1475°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FILL - LEAN CLAY WITH SAND (CL), trace gravel, brown to gray	5	8	3-4-5 N=9		
			10	16	3-4-6 N=10		
			15	12	2-4-6 N=10		
19.5	1902.5						
		FILL - FAT CLAY (CH), gray, hard, numerous laminations of silt	20	11	2-4-6 N=10	62-17-45	98
24.5	1897.5						
		SILT WITH SAND (ML), gray, hard	25	14	11-15-19 N=34	23-21-2	82
28.0	1894						
		LEAN CLAY (CL), gray, hard	30	18	10-20-30 N=50	46-16-30	100
31.0	1891						
		CLAYEY SAND (SC), fine to medium grained, gray, medium dense to dense, waterbearining at 54', varying amounts of clay	35	16	8-12-15 N=27		
			40	18	9-15-18 N=33		
			45	18	8-16-22 N=38	53-18-35	25
			50	15	14-18-15 N=33		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*
- *Cave in at 22'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-10-2021 | Boring Completed: 09-13-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-17

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3766° Longitude: -101.1475°

Surface Elev.: 1922 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), fine to medium grained, gray, medium dense to dense, waterbearining at 54', varying amounts of clay *(continued)*		55	▽	X	18	16-20-27 N=47		
			60		X	17	11-15-18 N=33	54-18-36	27
			65		X	18	9-13-16 N=29		
			70		X	18	12-14-21 N=35	61-18-43	30
	76.0	1846	75		X	18	13-17-21 N=38		
	Boring Terminated at 76 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While sampling*

▽ *At completion of drilling*

Cave in at 22'

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-10-2021 | Boring Completed: 09-13-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-18

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3760° Longitude: -101.1475°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FILL - LEAN CLAY WITH SAND (CL), trace gravel, brown								
		5		X	9	3-4-6 N=10		
		10		X	10	2-4-5 N=9		
		15		X	13	3-6-7 N=13		
19.0	1903	20		X	15	6-13-21 N=34		
LEAN CLAY (CL), gray, hard, laminations of silt		25		X	17	10-14-18 N=32	30-22-8	99
31.0	1891	30		X	17	10-15-20 N=35	43-18-25	88
LEAN CLAY WITH SAND (CL), gray, very stiff, numerous laminations of silt		35	▽	X	17	7-12-14 N=26	46-18-28	84
36.0	1886	40		X	15	12-19-26 N=45	43-19-24	23
CLAYEY SAND (SC), fine to medium grained, gray, dense, varying amounts of clay		45		X	15	11-20-24 N=44		
		50		X	18	11-18-25 N=43	54-18-36	23

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-13-2021 | Boring Completed: 09-13-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-18

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3760° Longitude: -101.1475°

Surface Elev.: 1922 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), fine to medium grained, gray, dense, varying amounts of clay *(continued)*		55		X	18	11-16-20 N=36		
			60		X	18	11-14-18 N=32		
			65		X	18	10-15-20 N=35		
			70		X	18	10-15-18 N=33		
	76.0	1846	75		X	18	11-17-22 N=39		
	Boring Terminated at 76 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-13-2021 | Boring Completed: 09-13-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-19

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3755° Longitude: -101.1474°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			5		X	5	3-2-3 N=5		
			10		X	11	2-4-5 N=9		
			15		X	11	4-5-6 N=11	60-17-43	99
			20		X	15	10-16-21 N=37		
			25		X	16	8-15-20 N=35	42-15-27	99
			30		X	15	10-14-19 N=33		
			35		X	17	8-12-16 N=28	43-16-27	78
			40		X	18	8-12-20 N=32		
			45	▽	X	17	8-12-15 N=27		
			50		X	18	9-15-17 N=32		
16.0	1906								
27.0	1895								
32.0	1890								
38.0	1884								

FILL - FAT CLAY (CH), brown, inclusions of coal

FILL - LEAN CLAY (CL), trace gravel, gray, laminations of silt

SILTY SAND (SM), fine to medium grained, gray, dense

LEAN CLAY WITH SAND (CL), gray, very stiff

CLAYEY SAND (SC), fine to medium grained, gray, medium dense to dense, varying amounts of clay, waterbearing at 44'

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While sampling*

Reverse auger out

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-13-2021 | Boring Completed: 09-14-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-19

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3755° Longitude: -101.1474°

Surface Elev.: 1922 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), fine to medium grained, gray, medium dense to dense, varying amounts of clay, waterbearing at 44' *(continued)*		55		X	18	9-14-19 N=33	58-14-44	28
			60		X	18	8-14-20 N=34		
			65		X	18	11-17-22 N=39	56-17-39	26
			70		X	18	10-15-21 N=36		
	76.0	1846	75		X	18	11-16-20 N=36		
	Boring Terminated at 76 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While sampling*

Reverse auger out

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-13-2021 | Boring Completed: 09-14-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-20

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3750° Longitude: -101.1471°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FILL - SANDY LEAN CLAY (CL), trace gravel, brown					
8.0	1914		5	7	4-5-5 N=10		
		FILL - FAT CLAY (CH), gray, laminations of silt	10	13	2-4-6 N=10		
19.0	1903		15	15	7-12-20 N=32		
		SILT (ML), gray, very stiff, laminations of clay	20	17	9-12-16 N=28		
22.0	1900						
		CLAYEY SAND (SC), fine to medium grained, gray, dense, varying amounts of silt	25	15	17-19-27 N=46		
			30	16	9-14-17 N=31	42-18-24	27
			35	18	8-14-17 N=31	53-15-38	42
41.0	1881		40	18	11-28-22 N=50	51-18-33	33
43.0	1879	**SANDSTONE**					
		SILTY SAND (SM), fine to medium grained, gray, dense to medium dense, varying amounts of silt	45	18	12-14-17 N=31		
51.0	1871		50	16	8-13-16 N=29		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

Reverse auger out

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-14-2021 | Boring Completed: 09-14-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-20

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3750° Longitude: -101.1471°

Surface Elev.: 1922 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), fine to medium grained, gray, dense, varying amounts of clay *(continued)*		55		X	18	9-13-18 N=31		
			60		X	17	12-19-27 N=46	51-20-31	24
			65		X	15	12-19-23 N=42		
			70		X	18	9-15-20 N=35		
	76.0	1846	75		X	18	9-14-18 N=32		
	Boring Terminated at 76 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

Reverse auger out

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-14-2021 | Boring Completed: 09-14-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-21

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3745° Longitude: -101.1466°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
FILL - LEAN CLAY (CL), trace gravel, brown to grayish brown		5	11	3-4-6 N=10		
		10	7	2-2-3 N=5		
		15	14	5-10-17 N=27		
		20	15	7-14-21 N=35	47-15-32	100
24.0	1898					
FILL - SANDY LEAN CLAY (CL), gray to dark gray, laminations of silt		25	16	5-9-15 N=24	33-16-17	67
26.0	1896					
CLAYEY SAND (SC), fine to medium grained, light gray to gray, medium dense to dense, varying amounts of clay, waterbearing at 49'		30	18	7-12-16 N=28		
		35	18	8-14-27 N=41		
		40	18	8-18-17 N=35		
		45	18	7-12-17 N=29	53-15-38	29
		50	15	10-15-24 N=39		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While drilling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 41'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-14-2021 | Boring Completed: 09-15-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-21

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3745° Longitude: -101.1466°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			55		X	18	10-16-20 N=36		
			60		X	13	12-21-25 N=46	46-17-29	32
			65		X	17	9-14-21 N=35		
			70		X	18	8-13-16 N=29	60-13-47	28
			75		X	18	9-14-16 N=30		
76.0	1846								

CLAYEY SAND (SC), fine to medium grained, light gray to gray, medium dense to dense, varying amounts of clay, waterbearing at 49' *(continued)*

Boring Terminated at 76 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While drilling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 41'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-14-2021 | Boring Completed: 09-15-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-22

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3742° Longitude: -101.1460°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FILL - FAT CLAY (CH), brownish gray to gray, coal inclusions							
			5			15	5-6-8 N=14		
			10			17	3-3-6 N=9		
			15			18	2-3-4 N=7		
19.0	1903								
		LEAN CLAY (CL), brownish gray to gray, very stiff, laminations of silt	20			18	10-12-17 N=29	32-17-15	98
			25	▼		18	10-12-16 N=28		
		waterbearing seam of silt		▽					
			30			18	4-12-16 N=28	37-16-21	92
33.0	1889								
		LEAN CLAY WITH SAND (CL), brownish gray to gray, very stiff	35			18	10-15-20 N=35	45-16-29	80
38.0	1884								
		SILTY CLAYEY SAND (SC-SM), fine to medium grained, gray to dark gray, dense	40			18	10-12-18 N=30		
			45			18	14-20-28 N=48	25-18-7	24
47.0	1875								
		CLAYEY SAND (SC), fine to medium grained, gray, dense, several waterbearing seams of coal	50	▽		18	10-16-23 N=39	36-18-18	25

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *While drilling*
- ▽ *At completion of drilling*
- ▼ *After auger removal*
- ▩ *Cave in at 28*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-14-2021 | Boring Completed: 09-15-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-22

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3742° Longitude: -101.1460°

Surface Elev.: 1922 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), fine to medium grained, gray, dense, several waterbearing seams of coal *(continued)*		55		X	18	13-15-18 N=33		
			60		X	18	15-18-20 N=38		
			65		X	18	15-19-26 N=45	41-16-25	28
			70		X	18	15-19-28 N=47	63-16-47	34
	76.0	1846	75		X	18	12-15-18 N=33		
	Boring Terminated at 76 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While drilling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 28*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-14-2021 | Boring Completed: 09-15-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-23

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3740° Longitude: -101.1453°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.0	1922	**FILL - LEAN CLAY WITH SAND (CL)**, trace gravel, brown
7.0	1915	**FILL - FAT CLAY (CH)**, gray to dark gray, laminations of coal
23.0	1899	**CLAYEY SAND (SC)**, fine to medium grained, brown, very loose, waterbearing
29.0	1893	**FAT CLAY (CH)**, gray to dark brown, stiff
35.0	1887	
36.0	1886	**COAL**, black, waterbearing
		LEAN CLAY (CL), dark brown to gray, very stiff, laminations and seams of silt
44.0	1878	**CLAYEY SAND WITH GRAVEL (SC)**, fine to medium grained, gray, medium dense, 2" seam of gravel at 45'
48.0	1874	**CLAYEY SAND (SC)**, fine grained, gray, loose to very dense

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5		15	3-4-4 N=8		
10		18	4-4-8 N=12		
15		18	3-5-8 N=13		
20		8	2-2-3 N=5		
25		18	1-1-2 N=3	25-13-12	42
30		18	1-4-4 N=8	55-16-39	97
35		16	4-5-6 N=11		
40		18	5-10-13 N=23	42-15-27	99
45		15	5-6-10 N=16	24-16-8	23
50		16	5-3-4 N=7		

WATER LEVEL OBSERVATIONS: Cave in at 24'

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- While drilling
- At completion of drilling
- Cave in at 24'

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-15-2021 | Boring Completed: 09-15-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-23

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3740° Longitude: -101.1453°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), fine grained, gray, loose to very dense *(continued)*	55	▽	X	18	10-12-18 N=30		
		60		X	18	12-13-17 N=30		
		65		X	18	12-15-18 N=33		
		70		X	18	15-17-19 N=36	43-17-26	28
76.0	1846	75		X	18	15-22-29 N=51		
	Boring Terminated at 76 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

▽ *At completion of drilling*

Cave in at 24'

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-15-2021 | Boring Completed: 09-15-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-24

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3739° Longitude: -101.1445°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	Stratigraphic Description
0.0	1922	**FILL - SANDY LEAN CLAY (CL)**, trace gravel, brown
7.0	1915	**FILL - FAT CLAY (CH)**, brownish gray
19.0	1903	**SILTY SAND (SM)**, trace gravel, fine to coarse grained, brown to gray, loose to medium dense, waterbearing, varying amounts of silt, seams of clay, trace coal
32.0	1890	**POORLY GRADED SAND (SP)**, trace gravel, fine to medium grained, gray, medium dense
39.0	1883	**SANDY LEAN CLAY (CL)**, trace gravel, gray, very stiff
42.0	1880	**POORLY GRADED SAND WITH SILT (SP-SM)**, trace gravel, fine to coarse grained, brownish gray to gray, medium dense to dense

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5		9	4-4-4 N=8		
10		14	3-6-9 N=15		
15		9	2-2-3 N=5		
20		11	2-3-3 N=6	NP	39
25		13	2-5-5 N=10		
30		14	2-3-5 N=8		
35		14	3-5-9 N=14	NP	4
40		14	3-8-21 N=29	31-14-17	65
45		18	4-9-20 N=29	NP	6
50		13	7-17-18 N=35		

WATER LEVEL OBSERVATIONS: ▽ While drilling; ▽ At completion of drilling; ▨ Cave in at 24'

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-15-2021 | Boring Completed: 09-15-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-24

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3739° Longitude: -101.1445°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
POORLY GRADED SAND WITH SILT (SP-SM), trace gravel, fine to coarse grained, brownish gray to gray, medium dense to dense *(continued)*		55	18	8-9-9 N=18	NP	6
59.0	1863					
CLAYEY SAND (SC), fine to medium grained, gray, very dense to dense, seam of gravel at 60', waterbearing, seams of clay		60	9	15-50/5"		
		65	14	10-14-21 N=35		
		70	18	10-14-18 N=32		
76.0	1846	75	18	13-20-24 N=44	46-18-28	22
Boring Terminated at 76 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While drilling*
- *At completion of drilling*
- *Cave in at 24'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-15-2021 | Boring Completed: 09-15-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

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BORING LOG NO. ALD-25

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3739° Longitude: -101.1437°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FILL - LEAN CLAY WITH SAND (CL), trace gravel, brown							
8.0	1914								
		FILL - FAT CLAY (CH), brownish gray to gray, some iron oxide inclusions							
17.0	1905								
		FILL - FAT CLAY WITH SAND (CH), gray							
23.0	1899								
		SILTY SAND (SM), fine to medium grained, brown, medium dense, waterbearing							
27.0	1895								
		POORLY GRADED SAND (SP), fine to coarse grained, gray, loose, trace coal, seams of clay							
42.0	1880								
		LEAN CLAY (CL), gray, medium stiff, laminations of silt							
47.0	1875								
		WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM), fine to coarse grained, grayish brown, medium dense							

			5			11	3-6-7 N=13		
			10			12	3-5-7 N=12		
			15			11	3-5-6 N=11	56-18-38	99
			20			11	1-2-3 N=5		
			25			12	4-8-10 N=18	NP	33
			30			18	1-2-3 N=5	NP	5
			35			17	1-2-4 N=6		
			40			12	2-4-5 N=9		
			45			10	2-2-3 N=5	43-15-28	94
			50			5	6-8-11 N=19	NP	12

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-59½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

While sampling

After auger removal

Cave in at 24'

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-15-2021 | Boring Completed: 09-16-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-25

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3739° Longitude: -101.1437°

Surface Elev.: 1922 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	53.0	1869							
	CLAYEY SAND (SM), gray, medium dense, trace coal		55			7	17-50/1"	27-17-10	29
	59.0	1863							
	Auger Refusal at 59 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-59½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

While sampling

After auger removal

Cave in at 24'

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-15-2021 | Boring Completed: 09-16-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

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BORING LOG NO. ALD-26

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3739° Longitude: -101.1429°

Surface Elev.: 1922 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FILL - FAT CLAY (CH), brown to gray, trace coal		5		X	13	3-5-8 N=13		
			10		X	13	3-5-8 N=13		
			15		X	11	3-5-6 N=11		
	17.0	1905							
	LEAN CLAY (CL), brown to gray, very stiff to hard, numerous laminations of silt		20		X	14	4-8-12 N=20		
			25		X	16	3-7-11 N=18	39-14-25	100
	32.0	1890	30		X	17	12-18-40 N=58	45-14-31	85
	CLAYEY SAND (SC), fine to medium grained, light gray to gray, medium dense to dense, varying amounts of clay		35		X	16	7-8-11 N=19	34-14-20	49
			40		X	18	6-10-13 N=23		
			45		X	18	7-10-14 N=24		
			50		X	18	9-12-15 N=27		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-73'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

Reverse auger out

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-16-2021 | Boring Completed: 09-16-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-26

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3739° Longitude: -101.1429°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			55		X	18	10-14-18 N=32	49-18-31	25
			60		X	18	14-16-18 N=34		
			65		X	18	9-15-20 N=35	51-19-32	22
			70		X	18	8-12-21 N=33		
71.0	1851								
SANDSTONE 73.0	1849								

CLAYEY SAND (SC), fine to medium grained, light gray to gray, medium dense to dense, varying amounts of clay *(continued)*

Auger Refusal at 73 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-73'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

Reverse auger out

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-16-2021 | Boring Completed: 09-16-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

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BORING LOG NO. ALD-27

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3739° Longitude: -101.1421°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5		10	3-4-5 N=9		
10		11	2-2-4 N=6		
15		13	2-3-4 N=7		
19.0	1903				
20		14	3-6-19 N=25		
25		14	3-6-13 N=19		
30		15	6-12-18 N=30	44-15-29	99
35		15	6-6-13 N=19		
38.0	1884				
40		16	6-10-13 N=23	45-15-30	84
42.0	1880				
45		17	7-9-11 N=20		
50		14	5-7-11 N=18	55-14-41	48

FILL - SANDY LEAN CLAY (CL), trace gravel, brown

LEAN CLAY (CL), gray, very stiff, numerous laminations of silt, seams of coal

LEAN CLAY WITH SAND (CL), gray, very stiff

CLAYEY SAND (SC), fine to medium grained, gray, medium dense to dense, seam of sand at 51'

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

Reverse auger out

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-17-2021 | Boring Completed: 09-17-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-27

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3739° Longitude: -101.1421°

Surface Elev.: 1922 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), fine to medium grained, gray, medium dense to dense, seam of sand at 51' *(continued)*								
	56.5	1865.5	55		X	18	10-16-23 N=39	47-19-28	25
	SANDSTONE								
	58.5	1863.5							
	CLAYEY SAND (SC), fine to medium grained, light gray to gray, dense, varying amounts of clay		60		X	18	10-13-18 N=31		
			65		X	18	13-22-24 N=46		
			70		X	18	9-14-19 N=33		
	76.0	1846	75		X	18	10-13-19 N=32	56-18-38	27
	Boring Terminated at 76 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

Reverse auger out

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-17-2021 | Boring Completed: 09-17-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-28

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3739° Longitude: -101.1413°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
		FILL - SANDY LEAN CLAY (CL), trace gravel, brown
18.0	1904	
		FILL - FAT CLAY (CH), brownish gray to dark brown, laminations of silt
21.0	1901	
22.5	1899.5	**COAL**, black
		LEAN CLAY (CL), dark brown to gray, very stiff to hard
38.0	1884	
		SANDY LEAN CLAY (CL), gray, hard
43.0	1879	
		FAT CLAY (CH), gray, hard, laminations of silt
47.0	1875	
		CLAYEY SAND (SC), fine to medium grained, light gray to gray, medium dense to dense

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5			8	4-5-8 N=13		
10			13	3-5-4 N=9	28-13-15	54
15			16	2-2-4 N=6		
20			14	6-12-13 N=25	53-17-36	95
25			10	20-50/5"		
30			16	7-11-17 N=28	38-15-23	99
35			16	9-11-21 N=32		
40			17	11-13-21 N=34	34-12-22	63
45			18	10-14-18 N=32	53-16-37	97
50			18	8-9-14 N=23		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

None observed

Cave in at 29'

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-20-2021 | Boring Completed: 09-20-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-28

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3739° Longitude: -101.1413°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			55						
					X	18	8-12-16 N=28		
			60						
					X	18	10-11-16 N=27		
			65						
					X	17	10-12-16 N=28		
			70						
					X	18	11-14-17 N=31	52-16-36	26
			75						
						6	50/2"		

CLAYEY SAND (SC), fine to medium grained, light gray to gray, medium dense to dense *(continued)*

76.0 1846

Boring Terminated at 76 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

None observed

Cave in at 29'

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-20-2021 Boring Completed: 09-20-2021

Drill Rig: Mobile B-57 Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-29

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3739° Longitude: -101.1405°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)		DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FILL - SANDY LEAN CLAY (CL), trace gravel, brown						
13.0	1909							
		POORLY GRADED SAND WITH SILT (SP-SM), trace gravel, fine to medium grained, brown, loose	5		14	5-6-7 N=13		
			10		15	3-4-6 N=10		
			15		11	3-4-4 N=8	NP	12
20.0	1902							
		SANDY LEAN CLAY (CL), trace gravel, gray to dark brown, stiff	20		13	1-5-7 N=12	40-14-26	63
24.0	1898							
		FAT CLAY (CH), gray, very stiff	25		14	6-11-15 N=26	54-17-37	94
30.0	1892							
31.0	1891	**COAL**, black	30		10	17-50/4"		
		LEAN CLAY (CL), gray, hard, numerous laminations of silt, trace coal	35		18	9-18-25 N=43		
			40		18	10-16-23 N=39	39-16-23	99
44.0	1878							
		FAT CLAY (CH), dark gray, hard, numerous laminations of silt, trace coal	45		17	8-15-20 N=35		
			50		18	12-16-23 N=39	51-15-36	87

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

Reverse auger out

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-20-2021 | Boring Completed: 09-20-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-29

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3739° Longitude: -101.1405°

Surface Elev.: 1922 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FAT CLAY (CH), dark gray, hard, numerous laminations of silt, trace coal								
	54.0 *(continued)*	1868							
	SANDSTONE		55			0	50/0"		
	56.0	1866							
	CLAYEY SAND (SC), fine to medium grained, gray, dense								
	61.0	1861	60			18	10-14-18 N=32		
	Auger Refusal at 61 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

Reverse auger out

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-20-2021 | Boring Completed: 09-20-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-30

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3739° Longitude: -101.1397°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.0	1922	**FILL - SANDY LEAN CLAY (CL)**, trace gravel, brown							
			5			18	6-11-11 N=22		
8.0	1914	**SILTY SAND (SM)**, trace gravel, fine to coarse grained, brown, loose							
			10			18	2-3-3 N=6		
14.0	1908	**SANDY LEAN CLAY (CL)**, trace gravel, dark brown, medium stiff to stiff							
			15			18	1-2-3 N=5		
			20			18	2-4-5 N=9	44-17-27	62
24.0	1898	**FAT CLAY (CH)**, gray to dark gray, stiff to hard, numerous laminations of silt, waterbearing seams of coal	25			18	5-9-14 N=23		
			30	▼		14	3-4-5 N=9		
			35	▽		18	6-10-15 N=25	64-19-45	97
			40			18	10-15-24 N=39	45-14-31	100
			45			18	10-15-20 N=35		
37.0	1885	**LEAN CLAY (CL)**, gray, hard	50	▩		18	7-11-14 N=25	47-15-32	88

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *While drilling*
- ▽ *At completion of drilling*
- ▼ *After auger removal*
- ▩ *Cave in at 49'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-20-2021 | Boring Completed: 09-20-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-30

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3739° Longitude: -101.1397°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
LEAN CLAY (CL), gray, hard *(continued)*		55	18	9-12-15 N=27		
58.0	1864					
CLAYEY SAND (SC), fine to medium grained, gray, medium dense to dense, waterbearing		60	18	12-14-16 N=30	54-17-37	31
		65	18	11-12-17 N=29		
		70	18	10-17-18 N=35		
76.0	1846	75	18	12-16-18 N=34	51-18-33	27
Boring Terminated at 76 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While drilling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 49'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-20-2021 | Boring Completed: 09-20-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

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BORING LOG NO. ALD-31

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3739° Longitude: -101.1388°

Surface Elev.: 1922 (Ft.)

DEPTH	ELEVATION (Ft.)	DESCRIPTION
0	1922	**FILL - SANDY LEAN CLAY (CL)**, trace gravell, brown
19.0	1903	**SANDY LEAN CLAY (CL)**, trace gravel, brown to grayish brown, medium stiff to stiff, seam of coal at 30'
33.0	1889	**FAT CLAY (CH)**, gray to dark gray, stiff to hard, numerous laminations of silt

DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5	0	12-13-10 N=23		
10	17	12-9-10 N=19		
15	13	3-6-10 N=16		
20	13	2-2-4 N=6		
25	18	3-2-4 N=6	43-14-29	61
30	16	2-4-6 N=10	46-15-31	61
35	14	4-8-11 N=19	72-17-55	100
40	14	3-4-10 N=14		
45	17	8-14-17 N=31		
50	18	3-4-9 N=13	60-15-45	99

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- *While drilling*
- *At completion of drilling*
- *After auger removal*
- *Cave in at 31'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-20-2021 | Boring Completed: 09-21-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

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BORING LOG NO. ALD-31

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3739° Longitude: -101.1388°

Surface Elev.: 1922 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FAT CLAY (CH), gray to dark gray, stiff to hard, numerous laminations of silt *(continued)*								
	58.0	1864	55		X	18	7-11-17 N=28		
	SANDY LEAN CLAY (CL), gray, very stiff		60		X	18	10-11-14 N=25	43-19-24	60
	62.0	1860							
	CLAYEY SAND (SC), fine to medium grained, gray, medium dense to dense, varying amounts of clay		65		X	18	7-8-12 N=20		
			70	▽	X	18	7-11-15 N=26	49-20-29	39
	76.0	1846	75		X	18	9-15-17 N=32		
	Boring Terminated at 76 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *While drilling*
- ▽ *At completion of drilling*
- ▼ *After auger removal*
- *Cave in at 31'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-20-2021 | Boring Completed: 09-21-2021

Drill Rig: Mobile B-57 | Driller: Mike R.

Project No.: M2215072

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BORING LOG NO. ALD-32

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3793° Longitude: -101.1452°

Surface Elev.: 1922 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FILL - LEAN CLAY WITH SAND (CL), trace gravel, brown								
			5		X	8	3-4-6 N=10		
			10		X	12	2-5-8 N=13		
			15		X	10	2-4-5 N=9		
			20	▨	X	14	2-3-7 N=10		
	22.0	1900							
	LEAN CLAY (CL), brown to dark brown, stiff to medium stiff		25		X	6	3-8-10 N=18		
			30		X	10	2-3-4 N=7	45-17-28	89
	33.0	1889							
	SANDY LEAN CLAY (CL), light gray to gray, stiff		35		X	14	3-4-6 N=10		
			40		X	15	3-5-5 N=10	39-12-27	59
			45		X	14	3-3-6 N=9	36-14-22	57
			50		X	15	3-4-6 N=10		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

▨ *Cave in at 21'*

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-07-2021 | Boring Completed: 09-07-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. ALD-32

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan

Latitude: 47.3793° Longitude: -101.1452°

Surface Elev.: 1922 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	53.0	1869							
	SILTY CLAYEY SAND (SC-SM), fine to medium grained, gray to dark brown, dense		55		X	14	14-14-16 N=30	24-19-5	30
	60.0	1862							
	SANDY LEAN CLAY (CL), gray, very stiff to hard		60		X	18	10-11-14 N=25		
	66.0	1856	65		X	17	8-16-20 N=36	36-12-24	54
	SILTY SAND (SM), fine to medium grained, gray, medium dense		70		X	18	10-12-14 N=26		
	76.0	1846	75		X	18	9-13-16 N=29		
	Boring Terminated at 76 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-74½'

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:

WATER LEVEL OBSERVATIONS

Cave in at 21'

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-07-2021 | Boring Completed: 09-07-2021

Drill Rig: CME 55 | Driller: Eric M.

Project No.: M2215072

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BORING LOG NO. MW-91-3

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan
Latitude: 47.3746° Longitude: -101.1478°
Surface Elev.: 1920.4 (Ft.)

DEPTH	ELEVATION (Ft.)	INSTALLATION DETAILS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		PVC Cap					
	FAT CLAY (CH), light gray to gray, very stiff to hard, numerous laminations of silt	Bentonite PVC Riser					
5			X	16	14-10-13 N=23		
10			X	18	9-10-16 N=26		
15		PVC Screen Silica sand	X	18	7-14-24 N=38		
20		Sluff	X	18	10-14-18 N=32	50-16-34	100
21.0	1899.5						
	Boring Terminated at 21 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-19½'

Abandonment Method:

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:
Top of Casing: 1923.5

WATER LEVEL OBSERVATIONS

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-14-2021 | Boring Completed: 09-14-2021
Drill Rig: Mobile B-57 | Driller: Mike R.
Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. MW-91-4

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan
Latitude: 47.3732° Longitude: -101.1435°
Surface Elev.: 1930 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.0	1930	**FILL - SANDY LEAN CLAY (CL)**, trace gravel, brown
12.0	1918	**FAT CLAY (CH)**, brownish gray to grayish brown, stiff to very stiff, numerous laminations of silt
24.0	1906	**COAL**, black
28.0	1902	**SILTY CLAY WITH SAND (CL-ML)**, gray, hard
31.0	1899	**LEAN CLAY (CL)**, gray, hard, laminations of silt
36.0	1894	***Boring Terminated at 36 Feet***

INSTALLATION DETAILS: PVC Cap; PVC Riser; Bentonite; Silica sand; PVC Screen; Sluff

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5		X	13	5-5-6 N=11		
10		X	16	2-3-3 N=6		
15		X	18	4-5-6 N=11		
20		X	18	8-12-16 N=28		
25		X	18	18-25-30 N=55	NP	28
30		X	18	14-28-31 N=59	25-21-4	81
35		X	18	10-15-20 N=35	34-17-17	100

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-34½'

Abandonment Method:

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:
Top of Casing: 1933.1

WATER LEVEL OBSERVATIONS

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-14-2021 | Boring Completed: 09-14-2021
Drill Rig: Mobile B-57 | Driller: Mike R.
Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. MW-91-5

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan
Latitude: 47.3790° Longitude: -101.1433°
Surface Elev.: 1901.3 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0	1901.3	**FILL - SANDY LEAN CLAY (CL)**, trace gravel, brown
9.5	1892	**FILL - CLAYEY SAND (SC)**, trace gravel, fine to coarse grained, brown
12.0	1889.5	**FAT CLAY (CH)**, light brown to brown, stiff
19.0	1882.5	**CLAYEY SAND (SC)**, fine to medium grained, brown to brownish gray, medium dense
26.0	1875.5	**SILTY SAND (SM)**, fine to medium grained, gray, medium dense
31.0	1870.5	***Boring Terminated at 31 Feet***

INSTALLATION DETAILS: PVC Cap; Bentonite; PVC Riser; PVC Screen; Silica sand; Sluff

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5		16	3-6-9 N=15		
10		18	3-4-3 N=7	33-18-15	31
15		18	3-5-6 N=11	50-16-34	95
20		18	4-8-10 N=18	37-14-23	35
25		18	7-11-13 N=24	30-17-13	31
30		18	9-10-14 N=24		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-29½'

Abandonment Method:

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:
Top of Casing: 1904.1

WATER LEVEL OBSERVATIONS

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-10-2021 | Boring Completed: 09-10-2021
Drill Rig: Mobile B-57 | Driller: Mike R.
Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. MW-91-6

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan
Latitude: 47.3790° Longitude: -101.1402°
Surface Elev.: 1898.1 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.0	1898.1	**SANDY LEAN CLAY (CL)**, trace gravel, brown, very stiff
9.0	1889	**SILTY SAND (SM)**, trace gravel, fine to coarse grained, brown to dark brown, medium dense
18.0	1880	**LEAN CLAY (CL)**, gray, medium stiff, laminations of silt
24.5	1873.5	**SANDY LEAN CLAY (CL)**, gray, very stiff
28.0	1870	**FAT CLAY (CH)**, gray, very stiff, numerous laminations of silt
31.0	1867	***Boring Terminated at 31 Feet***

INSTALLATION DETAILS: PVC Cap; Bentonite; PVC Riser; PVC Screen; Silica sand; Sluff

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5		18	3-6-9 N=15		
10		18	10-8-11 N=19		
15		5	3-9-6 N=15		
20		16	3-4-4 N=8	47-17-30	99
25		18	4-8-11 N=19	37-18-19	60
30		18	6-9-12 N=21		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-29½'

Abandonment Method:

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:
Top of Casing: 1901.2

WATER LEVEL OBSERVATIONS

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-10-2021 | Boring Completed: 09-10-2021
Drill Rig: Mobile B-57 | Driller: Mike R.
Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. MW-91-7

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan
Latitude: 47.3770° Longitude: -101.1487°
Surface Elev.: 1917.5 (Ft.)

DEPTH	ELEVATION (Ft.)	INSTALLATION DETAILS	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		PVC Cap							
FAT CLAY (CH), brownish gray to dark gray, stiff to very stiff, laminations of silt		Bentonite PVC Riser							
			5		X	14	4-6-7 N=13		
		Silica sand							
			10		X	18	5-7-9 N=16	63-20-43	99
		PVC Screen							
15.0	1902.5	Sluff							
16.0 **LEAN CLAY (CL)**, gray, very stiff, waterbearing at 15'	1901.5		15		X	18	7-12-15 N=27	43-15-28	98
Boring Terminated at 16 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-14½'

Abandonment Method:

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:
Top of Casing: 1920.6

WATER LEVEL OBSERVATIONS

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-14-2021 | Boring Completed: 09-14-2021
Drill Rig: Mobile B-57 | Driller: Mike R.
Project No.: M2215072

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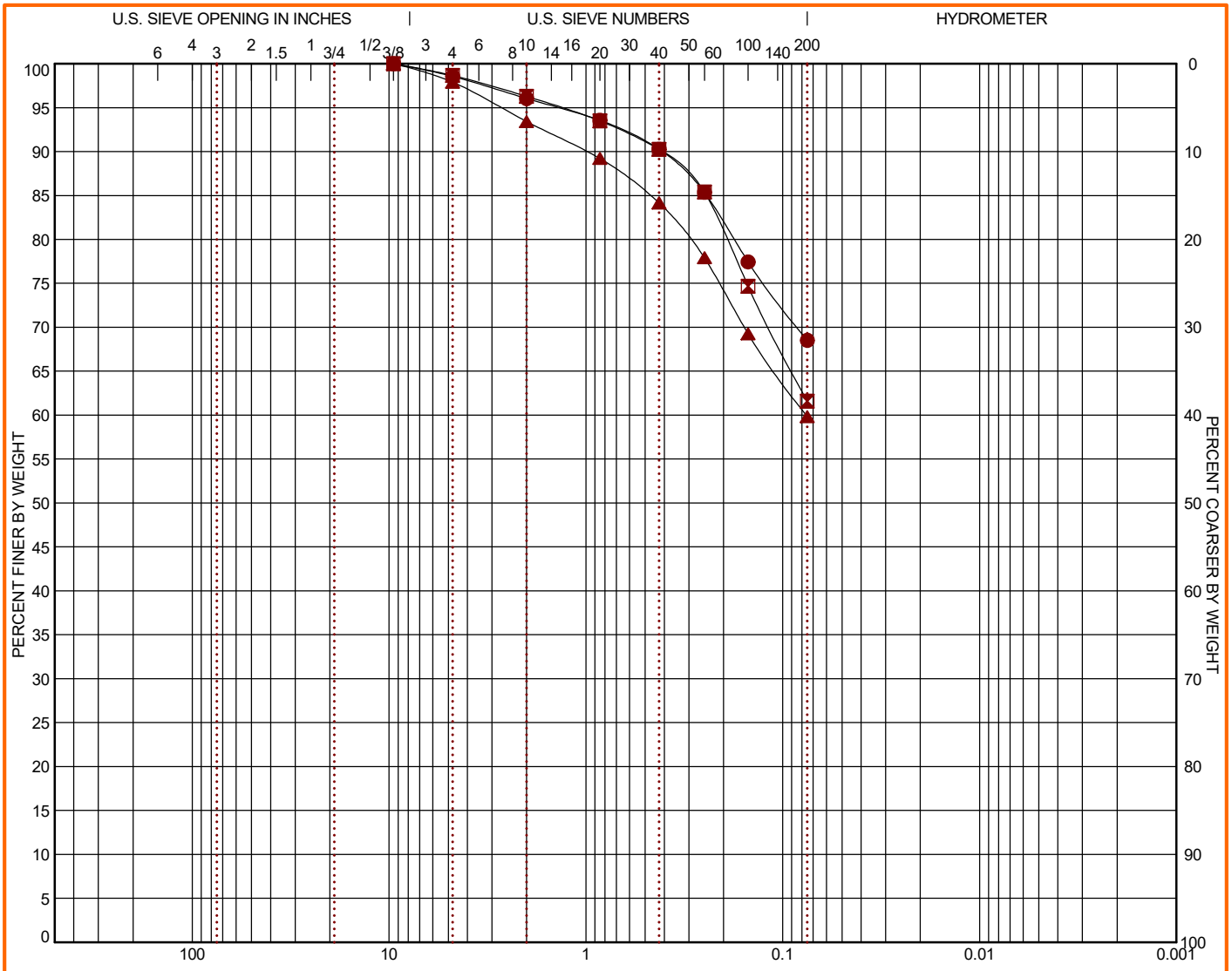
APPENDIX A-2

2021 Site Investigation Material Characterization Laboratory Test Results

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-1	19.5 - 21	0.0	1.4	30.0		68.5		CL
⊠	ALD-1	24.5 - 26	0.0	1.3	37.1		61.6		CL
▲	ALD-1	29.5 - 31	0.0	2.1	38.1		59.8		CL

GRAIN SIZE	●	⊠	▲
D_{60}			0.076
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0	3/8"	100.0	3/8"	100.0
#4	98.55	#4	98.65	#4	97.9
#10	96.03	#10	96.28	#10	93.41
#20	93.56	#20	93.49	#20	89.22
#40	90.27	#40	90.26	#40	84.15
#60	85.35	#60	85.39	#60	77.91
#100	77.44	#100	74.67	#100	69.25
#200	68.51	#200	61.6	#200	59.83

SOIL DESCRIPTION	
●	SANDY LEAN CLAY (CL)
⊠	SANDY LEAN CLAY (CL)
▲	SANDY LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

PROJECT: GRE - Coal Creek Station

SITE: 2875 3rd St SW
Underwood, North Dakota

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

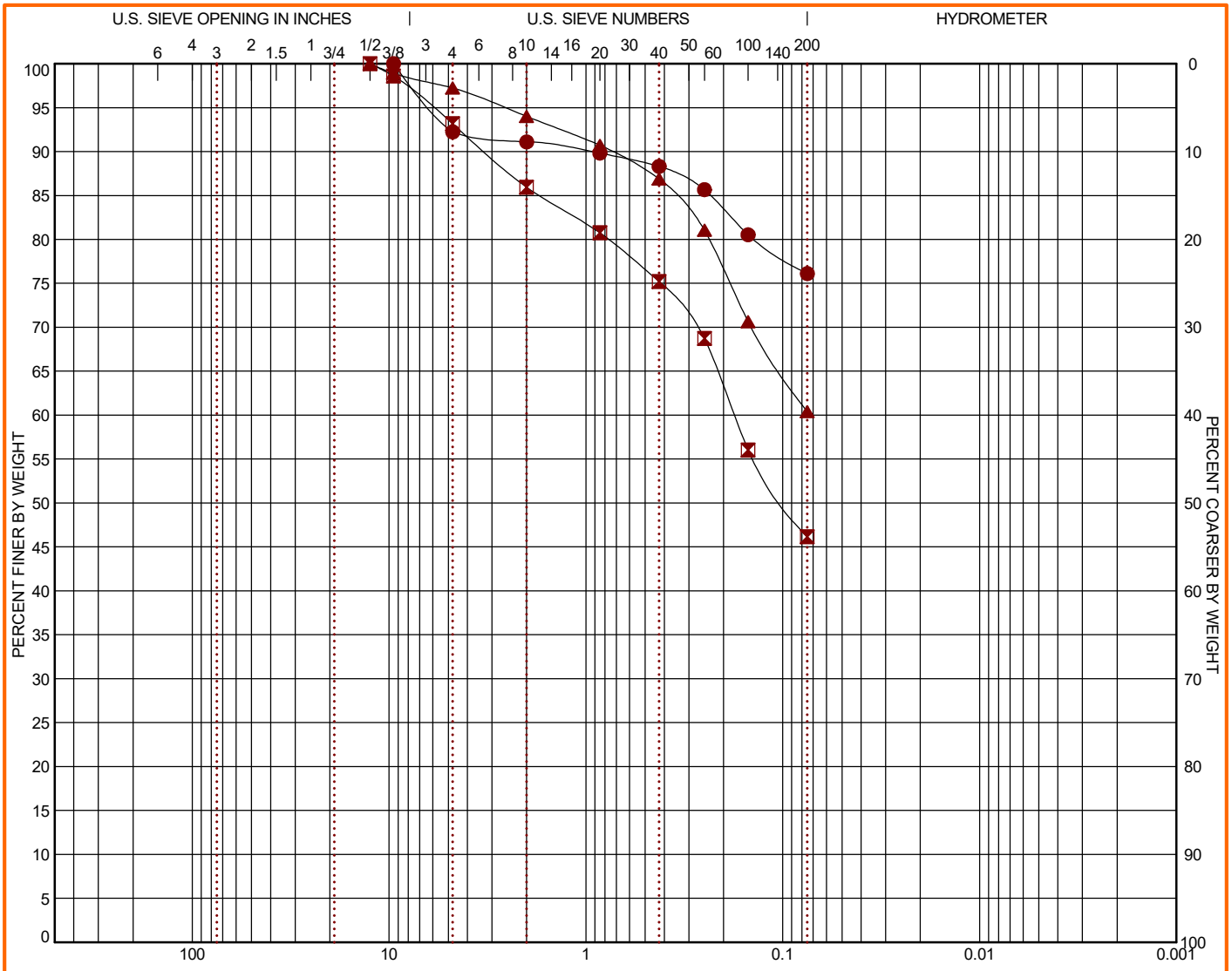
PROJECT NUMBER: M2215072

CLIENT: Golder Associates Inc
Lakewood, Colorado

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/9/21

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-1	39.5 - 41	0.0	7.8	16.1		76.1		CL
⊠	ALD-1	44.5 - 46	0.0	6.8	47.0		46.1		SC
▲	ALD-1	49.5 - 51	0.0	2.8	36.8		60.4		CL

GRAIN SIZE	●	⊠	▲
D_{60}		0.176	
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0	1/2"	100.0	1/2"	100.0
#4	92.23	3/8"	98.59	3/8"	98.9
#10	91.09	#4	93.16	#4	97.23
#20	89.82	#10	85.93	#10	94.0
#40	88.31	#20	80.75	#20	90.72
#60	85.66	#40	75.21	#40	86.89
#100	80.52	#60	68.73	#60	81.05
#200	76.11	#100	56.04	#100	70.64
		#200	46.14	#200	60.39

SOIL DESCRIPTION	
●	LEAN CLAY with SAND (CL)
⊠	CLAYEY SAND (SC)
▲	SANDY LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

PROJECT: GRE - Coal Creek Station

PROJECT NUMBER: M2215072

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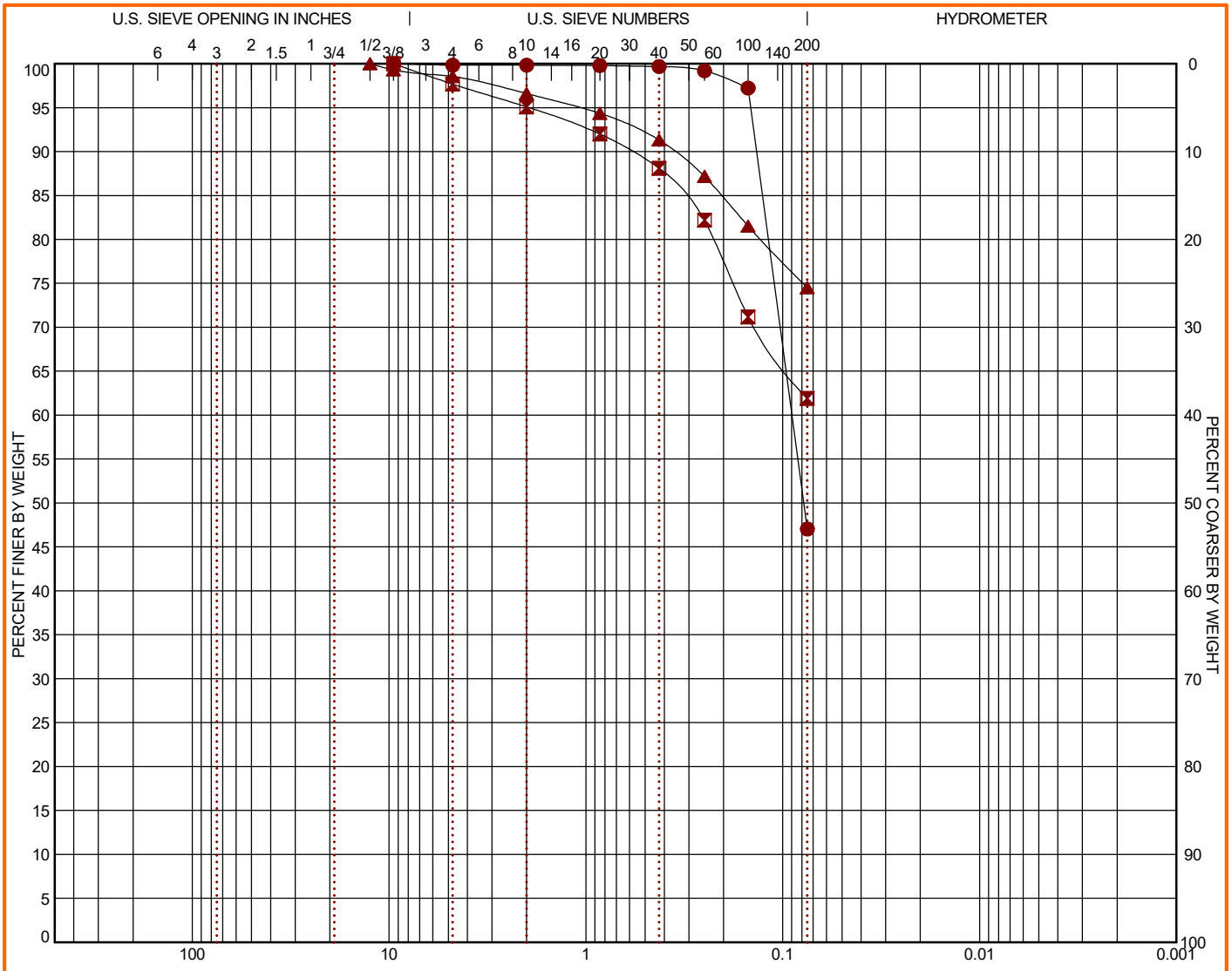
GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-1	64.5 - 66	0.0	0.2	52.8		47.0		SC
⊠	ALD-2	19.5 - 21	0.0	2.3	35.8		61.9		CL
▲	ALD-2	29.5 - 31	0.0	1.5	24.0		74.5		CL

GRAIN SIZE	●	⊠	▲
D_{60}	0.09		
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	3/8"	100.0	1/2"	100.0
#4	99.83	#4	97.67	3/8"	99.29
#10	99.83	#10	95.08	#4	98.54
#20	99.78	#20	92.01	#10	96.6
#40	99.67	#40	88.1	#20	94.36
#60	99.2	#60	82.18	#40	91.32
#100	97.22	#100	71.17	#60	87.18
#200	47.04	#200	61.89	#100	81.51
				#200	74.52

SOIL DESCRIPTION	
●	CLAYEY SAND (SC)
⊠	SANDY LEAN CLAY (CL)
▲	LEAN CLAY with SAND (CL)

REMARKS	
●	
⊠	
▲	

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GRAIN SIZE DISTRIBUTION

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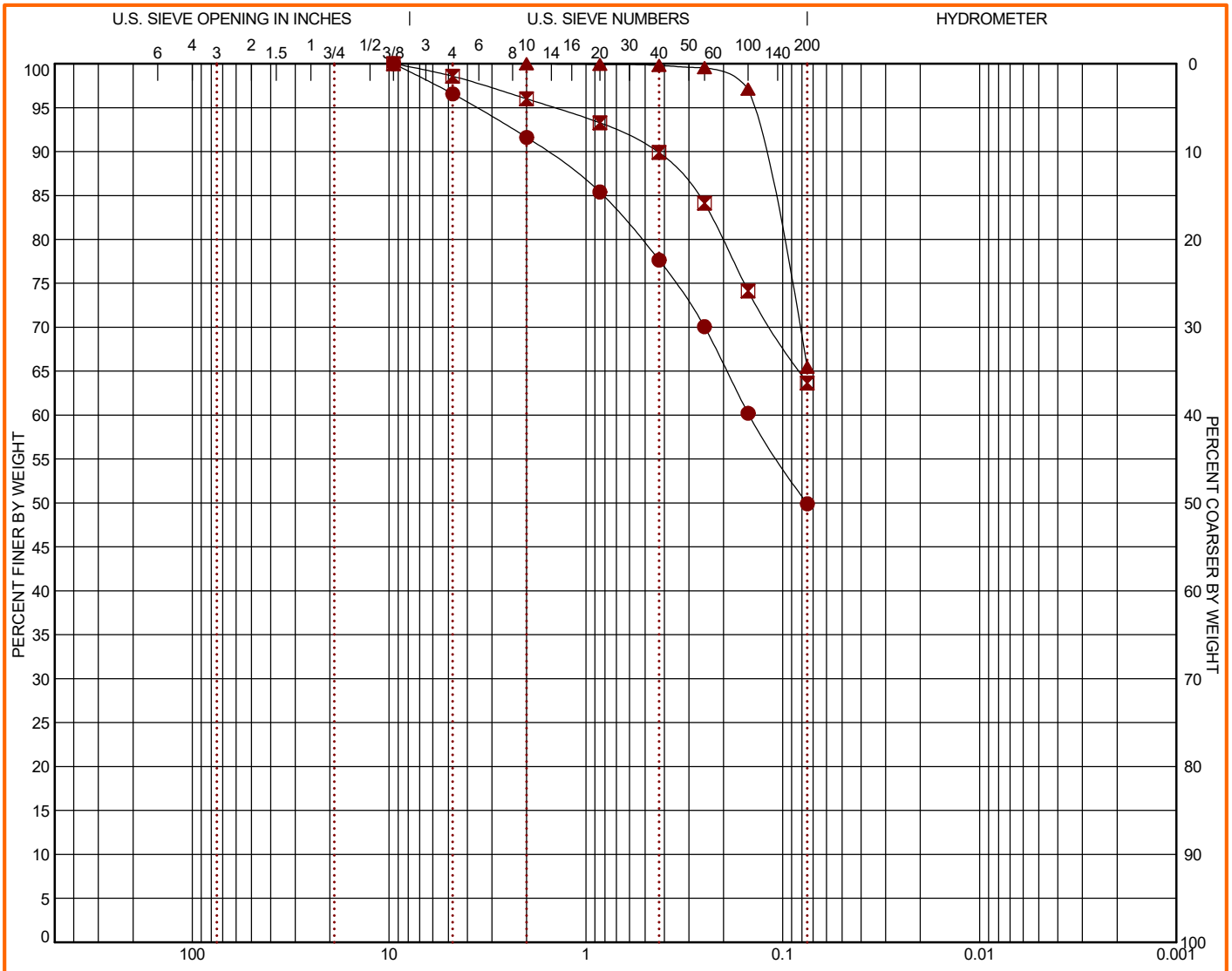

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-2	39.5 - 41	0.0	3.4	46.7		49.9		SC
⊠	ALD-2	44.5 - 46	0.0	1.4	34.9		63.7		CL
▲	ALD-2	54.5 - 56	0.0	0.0	34.5		65.5		CL

GRAIN SIZE	●	⊠	▲
D_{60}	0.148		
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	3/8"	100.0	#10	100.0
#4	96.57	#4	98.57	#20	99.92
#10	91.61	#10	96.0	#40	99.81
#20	85.4	#20	93.28	#60	99.56
#40	77.65	#40	89.89	#100	97.12
#60	70.07	#60	84.13	#200	65.45
#100	60.21	#100	74.14		
#200	49.91	#200	63.67		

SOIL DESCRIPTION	
●	CLAYEY SAND (SC)
⊠	SANDY LEAN CLAY (CL)
▲	SANDY LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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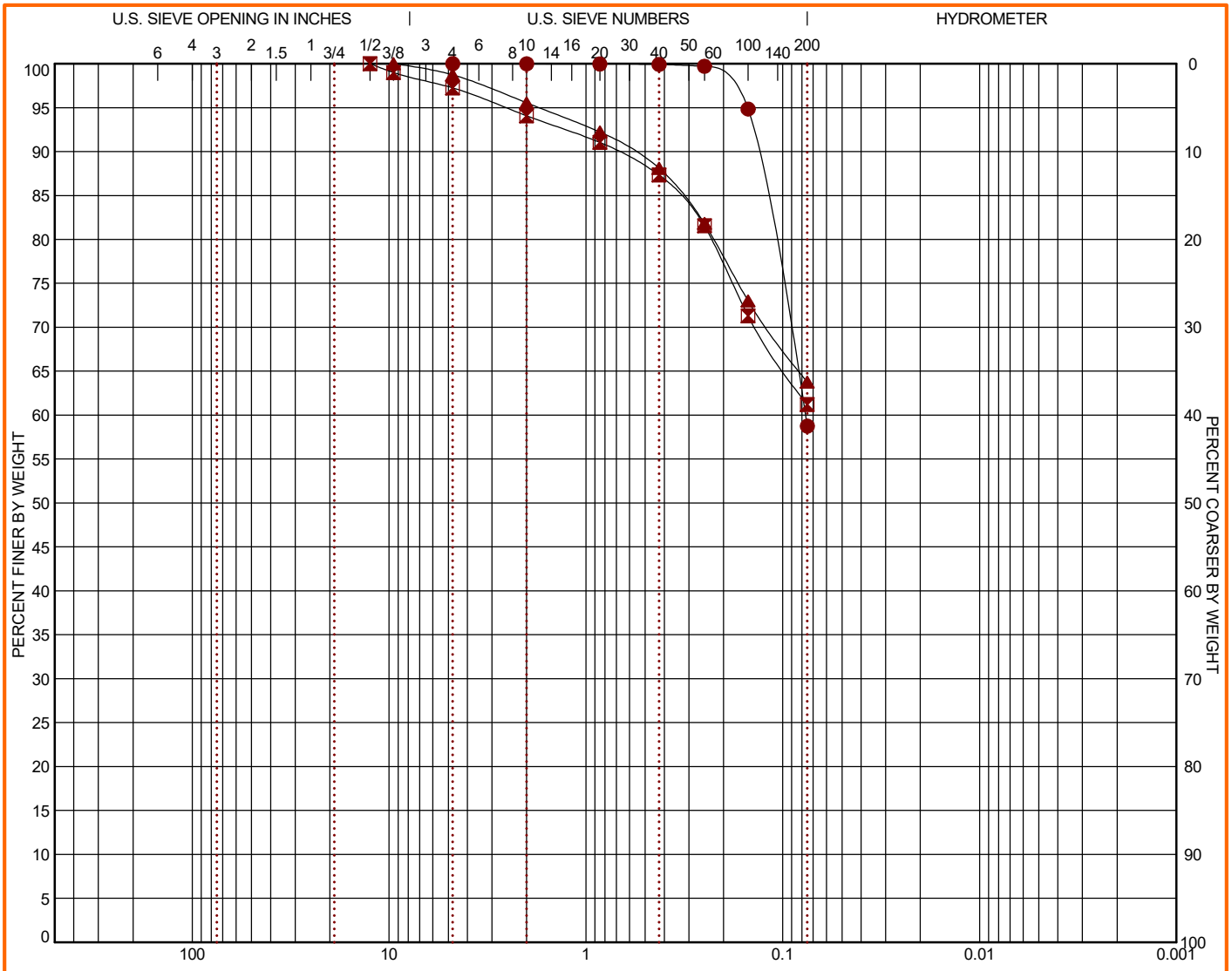

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-2	64.5 - 66	0.0	0.0	41.3		58.7		CH
⊠	ALD-3	19.5 - 21	0.0	2.8	36.0		61.2		CL
▲	ALD-3	24.5 - 26	0.0	1.3	35.0		63.8		CL

GRAIN SIZE	●	⊠	▲
D_{60}	0.077		
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
#4	100.0	1/2"	100.0	3/8"	100.0
#10	99.99	3/8"	98.99	#4	98.73
#20	99.97	#4	97.25	#10	95.54
#40	99.91	#10	94.06	#20	92.24
#60	99.71	#20	91.04	#40	88.09
#100	94.84	#40	87.34	#60	81.83
#200	58.75	#60	81.55	#100	73.0
		#100	71.29	#200	63.76
		#200	61.2		

SOIL DESCRIPTION	
●	SANDY FAT CLAY (CH)
⊠	SANDY LEAN CLAY (CL)
▲	SANDY LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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SITE: 2875 3rd St SW
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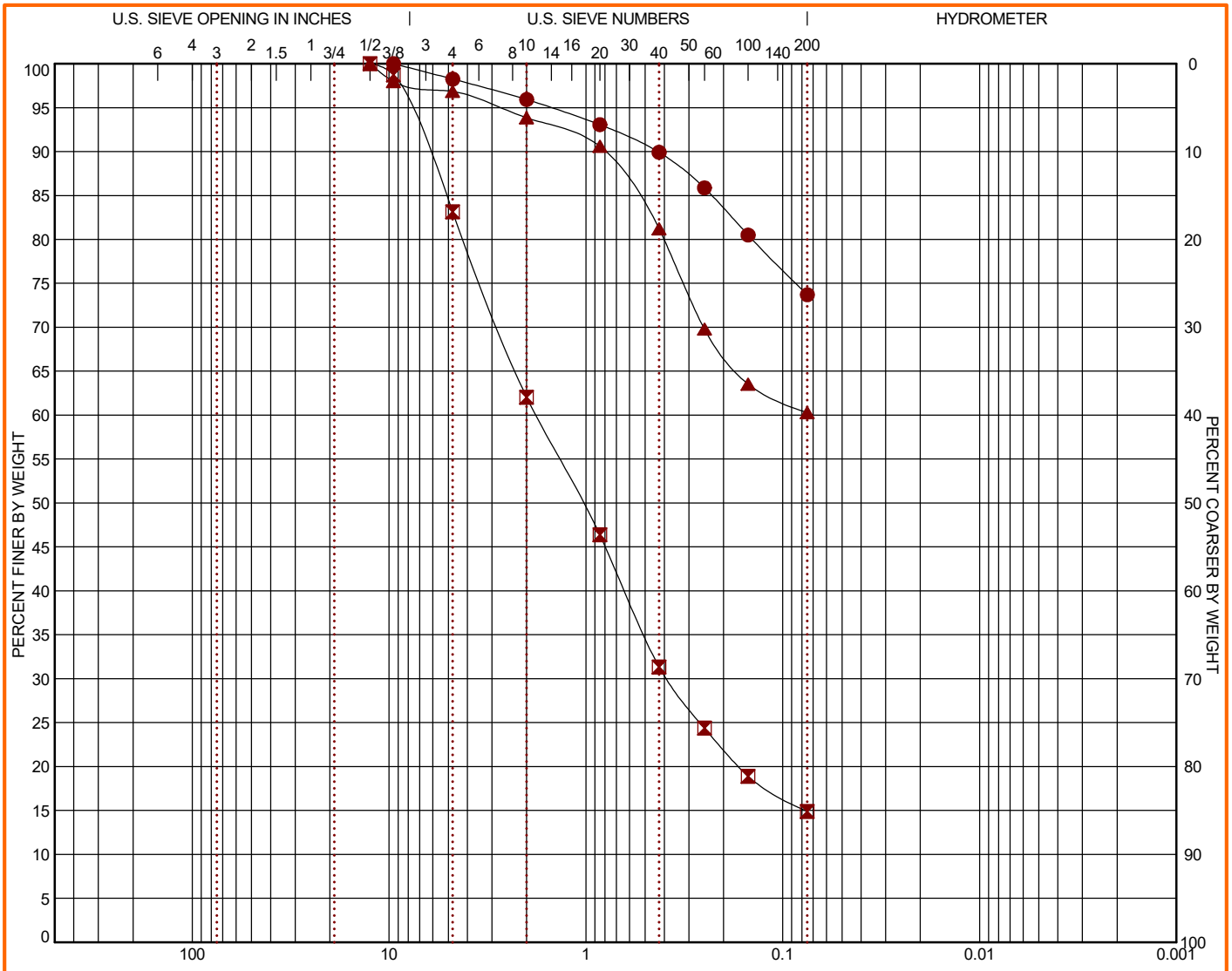
GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-3	34.5 - 36	0.0	1.8	24.5		73.7		CL
⊠	ALD-3	39.5 - 41	0.0	16.8	68.3		14.9		SC
▲	ALD-3	44.5 - 46	0.0	3.2	36.6		60.3		CL

GRAIN SIZE	●	⊠	▲
D_{60}		1.79	
D_{30}		0.384	
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	1/2"	100.0	1/2"	100.0
#4	98.25	3/8"	98.74	3/8"	97.96
#10	95.92	#4	83.15	#4	96.84
#20	93.06	#10	62.03	#10	93.84
#40	89.91	#20	46.38	#20	90.6
#60	85.87	#40	31.34	#40	81.21
#100	80.49	#60	24.37	#60	69.8
#200	73.7	#100	18.9	#100	63.53
		#200	14.9	#200	60.29

SOIL DESCRIPTION	
●	LEAN CLAY with SAND (CL)
⊠	CLAYEY SAND with GRAVEL (SC)
▲	SANDY LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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Terracon
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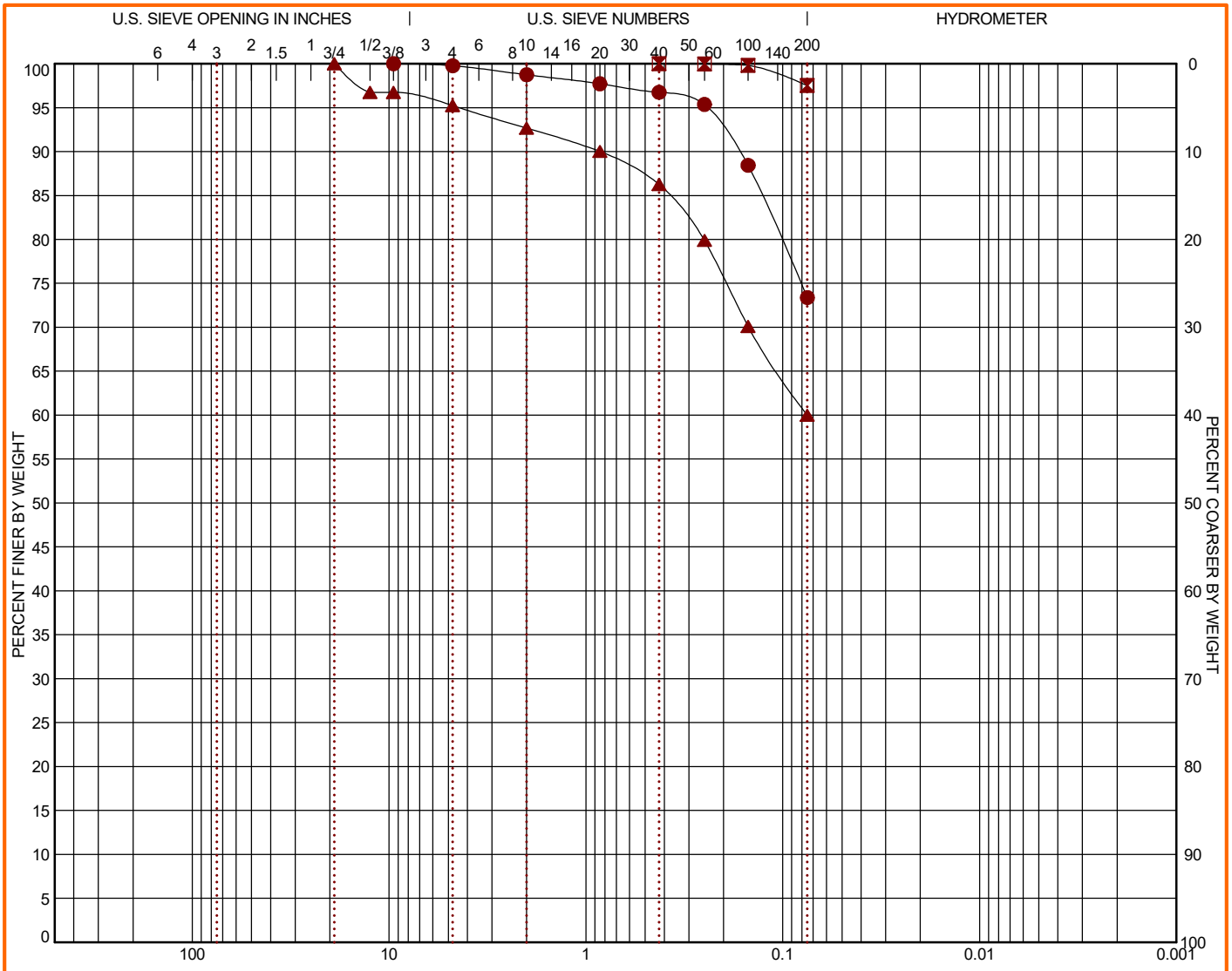

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-3	49.5 - 51	0.0	0.2	26.4		73.4		CL
⊠	ALD-3	59.5 - 61	0.0	0.0	2.5		97.5		CH
▲	ALD-4	24.5 - 26	0.0	4.8	35.3		60.0		CL

GRAIN SIZE	●	⊠	▲
D_{60}			0.075
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	#40	100.0	3/4"	100.0
#4	99.76	#60	99.96	1/2"	96.73
#10	98.74	#100	99.81	3/8"	96.73
#20	97.71	#200	97.51	#4	95.24
#40	96.74			#10	92.67
#60	95.36			#20	90.01
#100	88.43			#40	86.25
#200	73.38			#60	79.89
				#100	70.1
				#200	59.98

SOIL DESCRIPTION	
●	LEAN CLAY with SAND (CL)
⊠	FAT CLAY (CH)
▲	SANDY LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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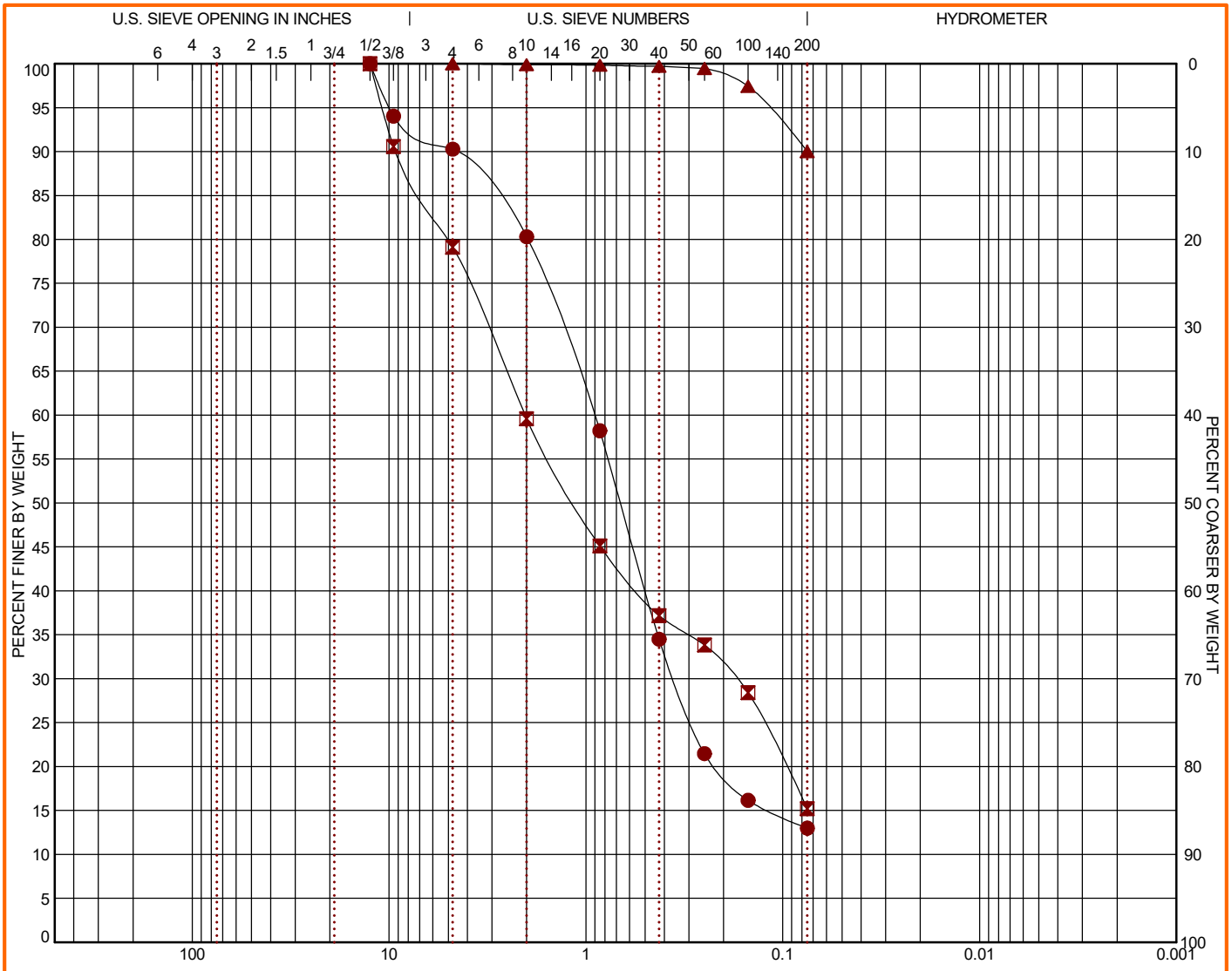

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-4	34.5 - 36	0.0	9.7	77.3		13.0		SC
⊠	ALD-4	39.5 - 41	0.0	20.9	63.9		15.2		SM
▲	ALD-4	44.5 - 46	0.0	0.0	10.0		90.0		CL

GRAIN SIZE	●	⊠	▲
D_{60}	0.911	2.036	
D_{30}	0.354	0.174	
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
1/2"	100.0	1/2"	100.0	#4	100.0
3/8"	94.03	3/8"	90.58	#10	99.89
#4	90.27	#4	79.12	#20	99.82
#10	80.3	#10	59.6	#40	99.7
#20	58.22	#20	45.12	#60	99.46
#40	34.5	#40	37.17	#100	97.43
#60	21.47	#60	33.83	#200	90.01
#100	16.16	#100	28.42		
#200	12.99	#200	15.19		

SOIL DESCRIPTION	
●	CLAYEY SAND (SC)
⊠	SILTY SAND with GRAVEL (SM)
▲	LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

PROJECT: GRE - Coal Creek Station

PROJECT NUMBER: M2215072

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Terracon
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GRAIN SIZE: USCS 1 M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/9/21

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GRAIN SIZE DISTRIBUTION

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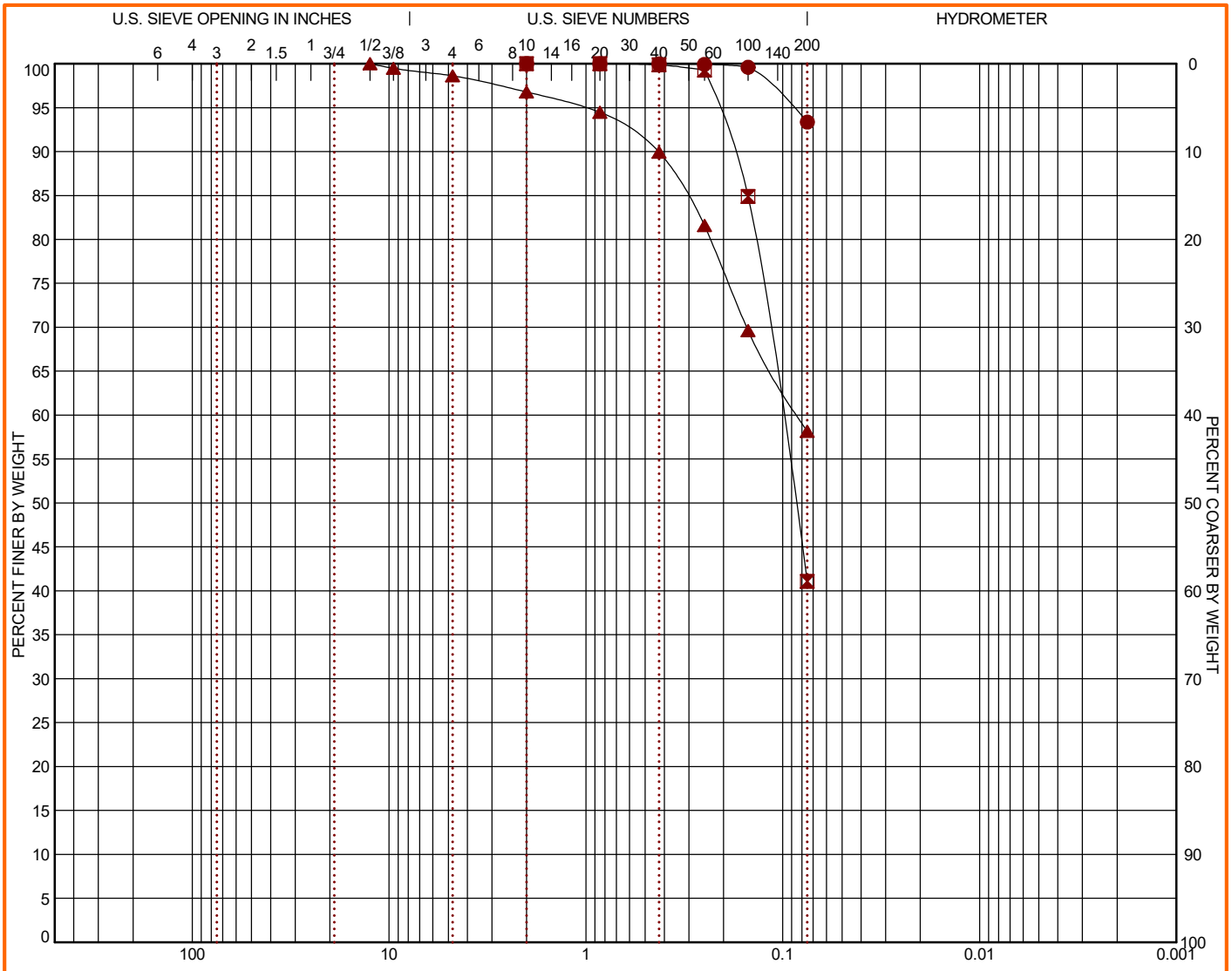


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-4	49.5 - 51	0.0	0.0	6.6		93.4		CL
⊠	ALD-4	59.5 - 61	0.0	0.0	58.9		41.1		SC
▲	ALD-5	29.5 - 31	0.0	1.4	40.5		58.2		CL

GRAIN SIZE	●	⊠	▲
D_{60}		0.101	0.084
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
#10	100.0	#10	100.0	1/2"	100.0
#20	99.98	#20	99.99	3/8"	99.47
#40	99.97	#40	99.88	#4	98.62
#60	99.92	#60	99.27	#10	96.77
#100	99.59	#100	84.88	#20	94.47
#200	93.35	#200	41.07	#40	89.92
				#60	81.59
				#100	69.62
				#200	58.15

SOIL DESCRIPTION	
●	LEAN CLAY (CL)
⊠	CLAYEY SAND (SC)
▲	SANDY LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

PROJECT: GRE - Coal Creek Station

SITE: 2875 3rd St SW
Underwood, North Dakota

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

PROJECT NUMBER: M2215072

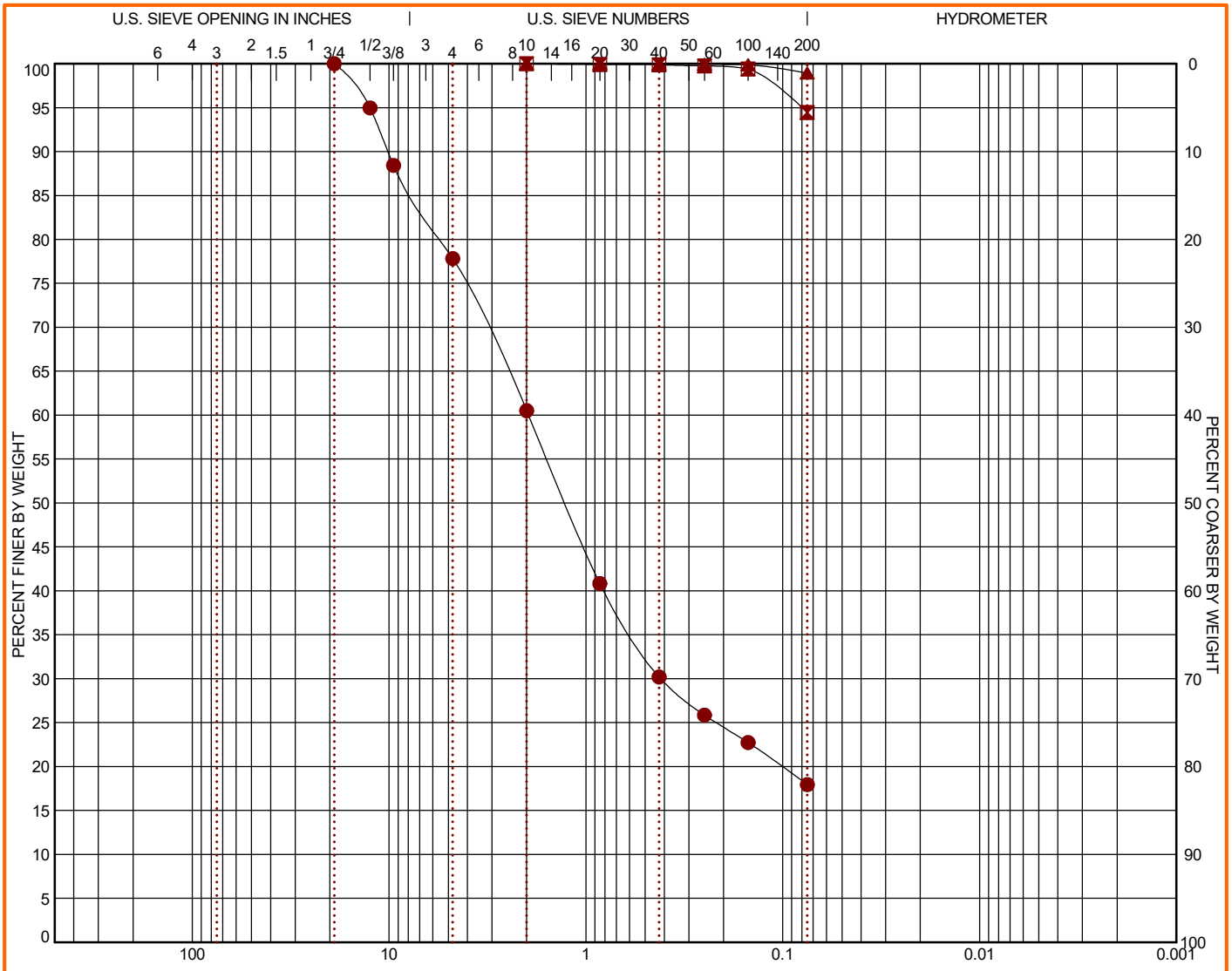
CLIENT: Golder Associates Inc
Lakewood, Colorado

GRAIN SIZE: USCS 1 M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/9/21

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT.

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-5	39.5 - 41	0.0	22.2	59.9		17.9		SC
⊠	ALD-5	44.5 - 46	0.0	0.0	5.5		94.5		CL
▲	ALD-5	49.5 - 51	0.0	0.0	1.1		98.9		CH

GRAIN SIZE	●	⊠	▲
D_{60}	1.956		
D_{30}	0.415		
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/4"	100.0	#10	100.0	#10	100.0
1/2"	94.97	#20	99.92	#20	99.98
3/8"	88.43	#40	99.87	#40	99.96
#4	77.83	#60	99.76	#60	99.93
#10	60.51	#100	99.41	#100	99.87
#20	40.84	#200	94.46	#200	98.93
#40	30.19				
#60	25.86				
#100	22.73				
#200	17.94				

SOIL DESCRIPTION	
●	CLAYEY SAND with GRAVEL (SC)
⊠	LEAN CLAY (CL)
▲	FAT CLAY (CH)

REMARKS	
●	
⊠	
▲	

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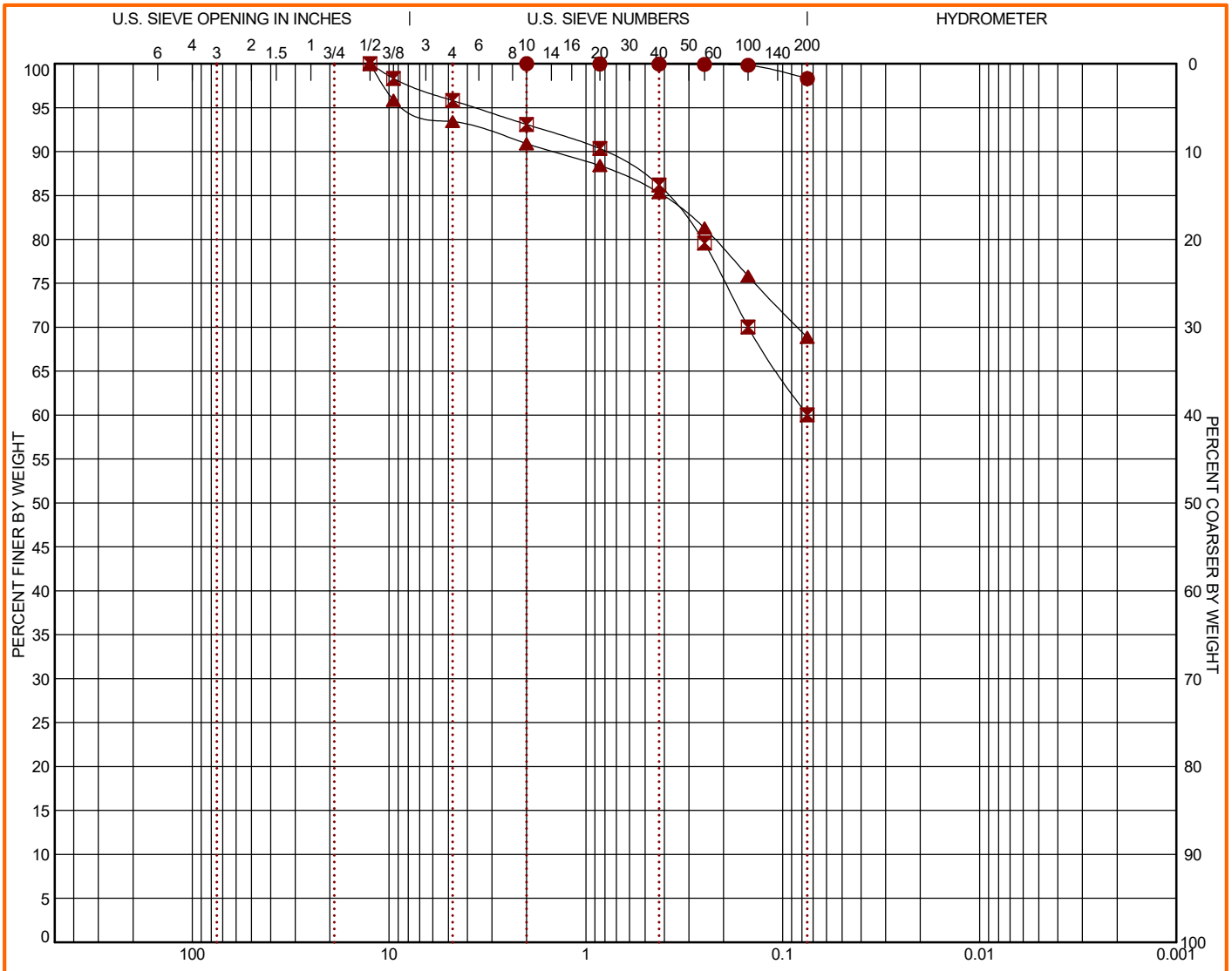

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-5	54.5 - 56	0.0	0.0	1.7		98.3		CH
⊠	ALD-6	19.5 - 21	0.0	4.2	35.8		60.0		CL
▲	ALD-6	24.5 - 26	0.0	6.6	24.6		68.9		CL

GRAIN SIZE	●	⊠	▲
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
#10	100.0	1/2"	100.0	1/2"	100.0
#20	99.97	3/8"	98.32	3/8"	95.83
#40	99.95	#4	95.8	#4	93.41
#60	99.92	#10	93.08	#10	90.9
#100	99.82	#20	90.34	#20	88.41
#200	98.29	#40	86.18	#40	85.31
		#60	79.6	#60	81.31
		#100	70.03	#100	75.82
		#200	60.02	#200	68.86

SOIL DESCRIPTION	
●	FAT CLAY (CH)
⊠	SANDY LEAN CLAY (CL)
▲	SANDY LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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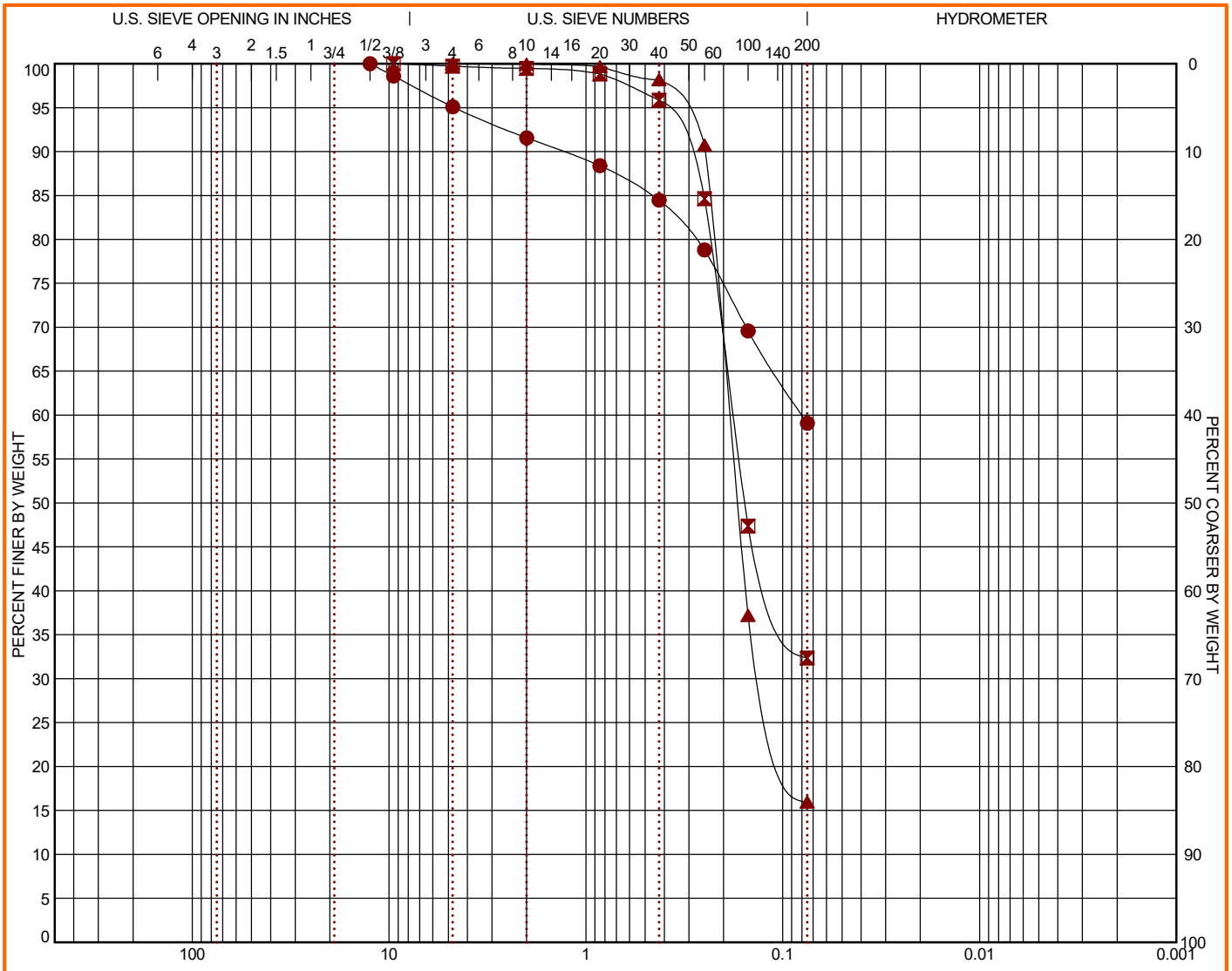

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-6	34.5 - 36	0.0	4.9	36.0		59.1		CL
⊠	ALD-6	39.5 - 41	0.0	0.3	67.4		32.4		SC
▲	ALD-6	44.5 - 46	0.0	0.0	84.0		16.0		SM

GRAIN SIZE	●	⊠	▲
D_{60}	0.08	0.178	0.186
D_{30}			0.119
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
1/2"	100.0	3/8"	100.0	#4	100.0
3/8"	98.59	#4	99.72	#10	99.94
#4	95.09	#10	99.48	#20	99.67
#10	91.55	#20	98.84	#40	98.19
#20	88.39	#40	95.83	#60	90.74
#40	84.46	#60	84.64	#100	37.21
#60	78.8	#100	47.38	#200	15.97
#100	69.58	#200	32.36		
#200	59.08				

SOIL DESCRIPTION	
●	SANDY LEAN CLAY (CL)
⊠	CLAYEY SAND (SC)
▲	SILTY SAND (SM)

REMARKS	
●	
⊠	
▲	

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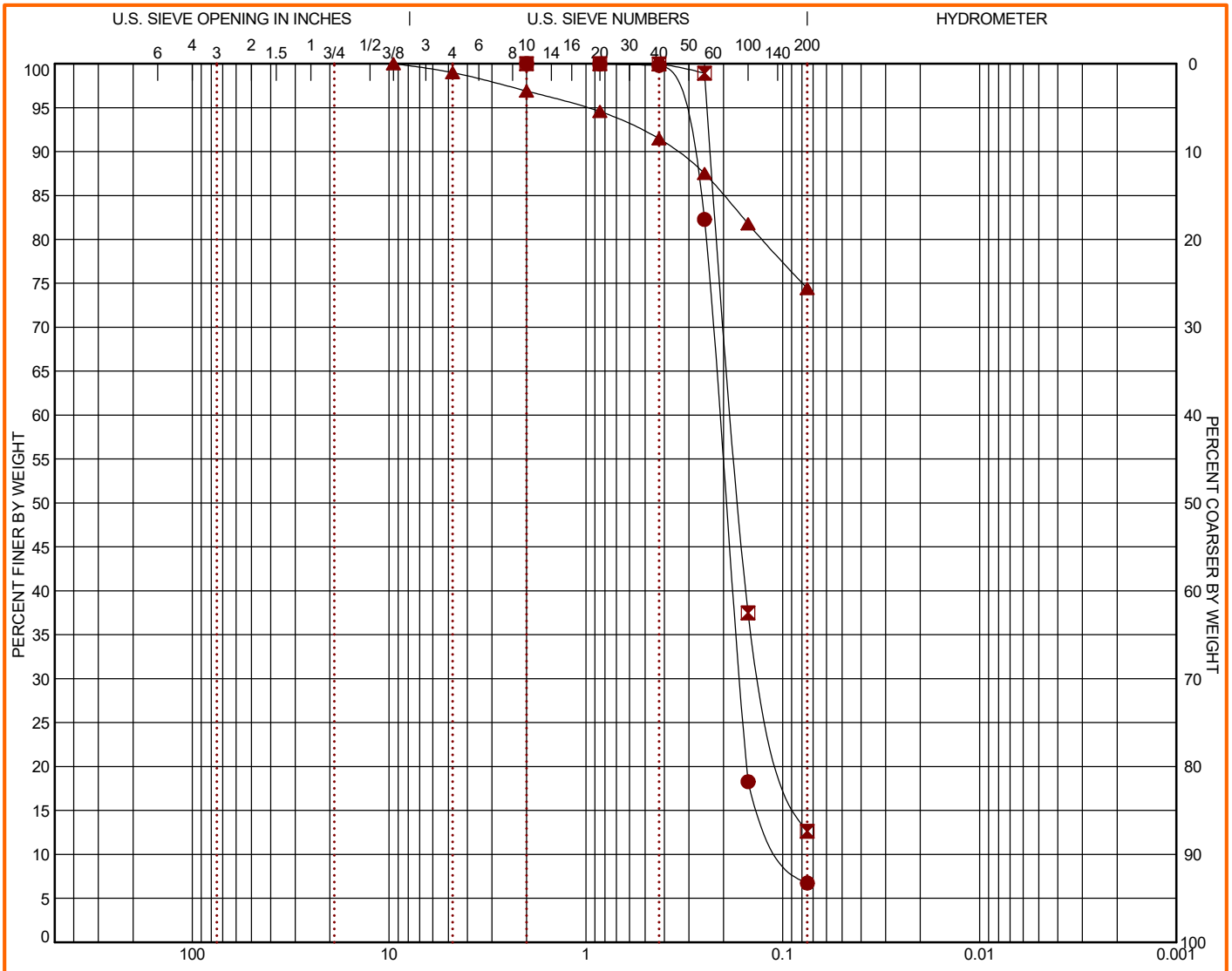

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-6	49.5 - 51	0.0	0.0	93.3		6.7		SP-SM
⊠	ALD-6	54.5 - 56	0.0	0.0	87.4		12.6		SM
▲	ALD-7	34.5 - 36	0.0	1.0	24.6		74.4		CL

GRAIN SIZE	●	⊠	▲
D_{60}	0.209	0.181	
D_{30}	0.165	0.122	
D_{10}	0.091		

COEFFICIENTS	●	⊠	▲
C_C	1.42		
C_U	2.29		

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
#10	100.0	#10	100.0	3/8"	100.0
#20	99.96	#20	99.99	#4	98.99
#40	99.8	#40	99.95	#10	96.88
#60	82.27	#60	98.93	#20	94.57
#100	18.28	#100	37.48	#40	91.46
#200	6.74	#200	12.64	#60	87.5
				#100	81.79
				#200	74.41

SOIL DESCRIPTION	
●	POORLY GRADED SAND with SILT (SP-SM)
⊠	SILTY SAND (SM)
▲	LEAN CLAY with SAND (CL)

REMARKS	
●	
⊠	
▲	

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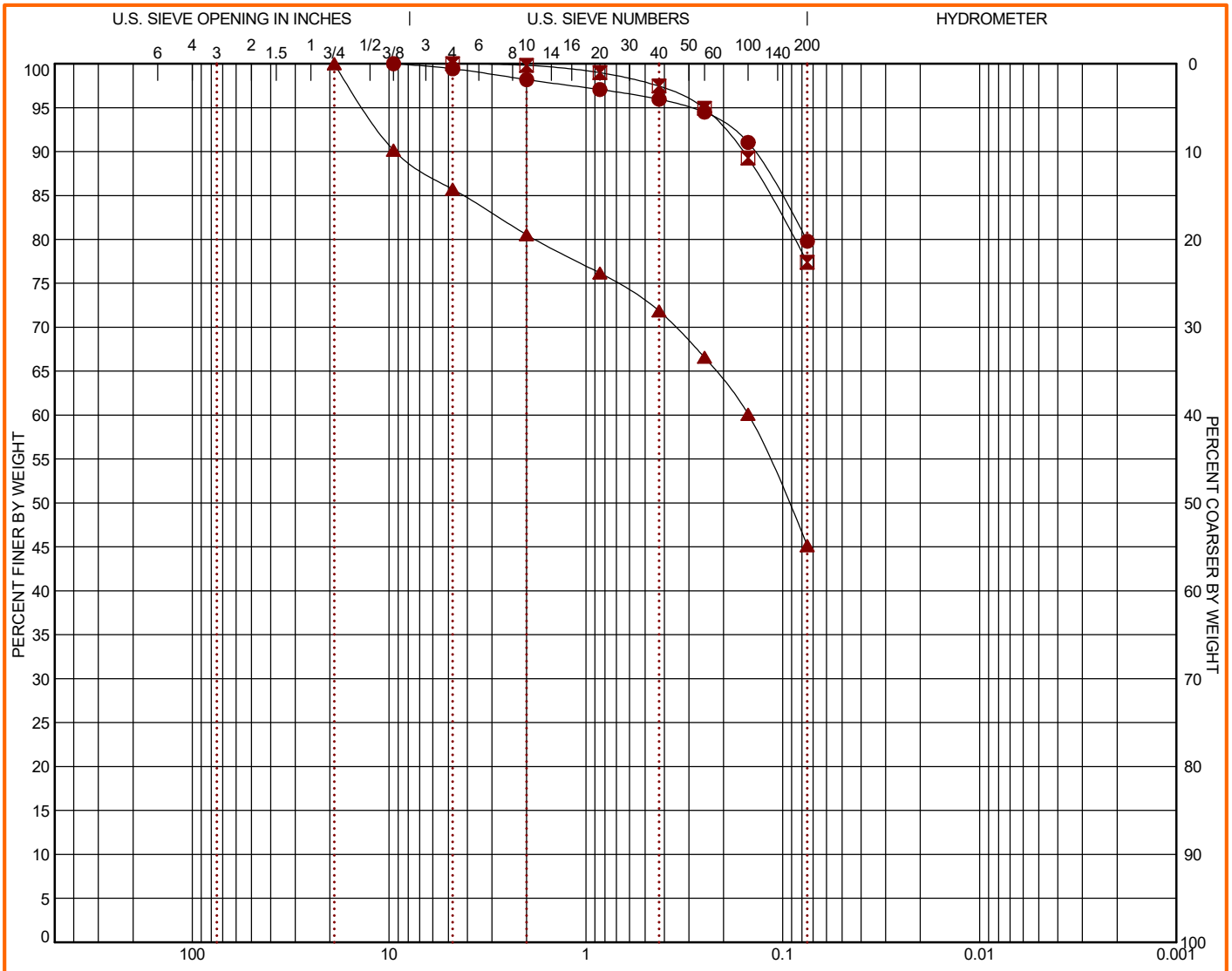

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-7	39.5 - 41	0.0	0.6	19.6		79.8		CL
⊠	ALD-7	44.5 - 46	0.0	0.0	22.6		77.4		CL
▲	ALD-7	49.5 - 51	0.0	14.3	40.6		45.1		SC

GRAIN SIZE	●	⊠	▲
D_{60}			0.149
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	#4	100.0	3/4"	100.0
#4	99.42	#10	99.81	3/8"	90.16
#10	98.19	#20	98.98	#4	85.71
#20	97.06	#40	97.45	#10	80.52
#40	95.95	#60	94.92	#20	76.18
#60	94.48	#100	89.26	#40	71.86
#100	91.04	#200	77.39	#60	66.58
#200	79.79			#100	60.1
				#200	45.14

SOIL DESCRIPTION	
●	LEAN CLAY with SAND (CL)
⊠	LEAN CLAY with SAND (CL)
▲	CLAYEY SAND (SC)

REMARKS	
●	
⊠	
▲	

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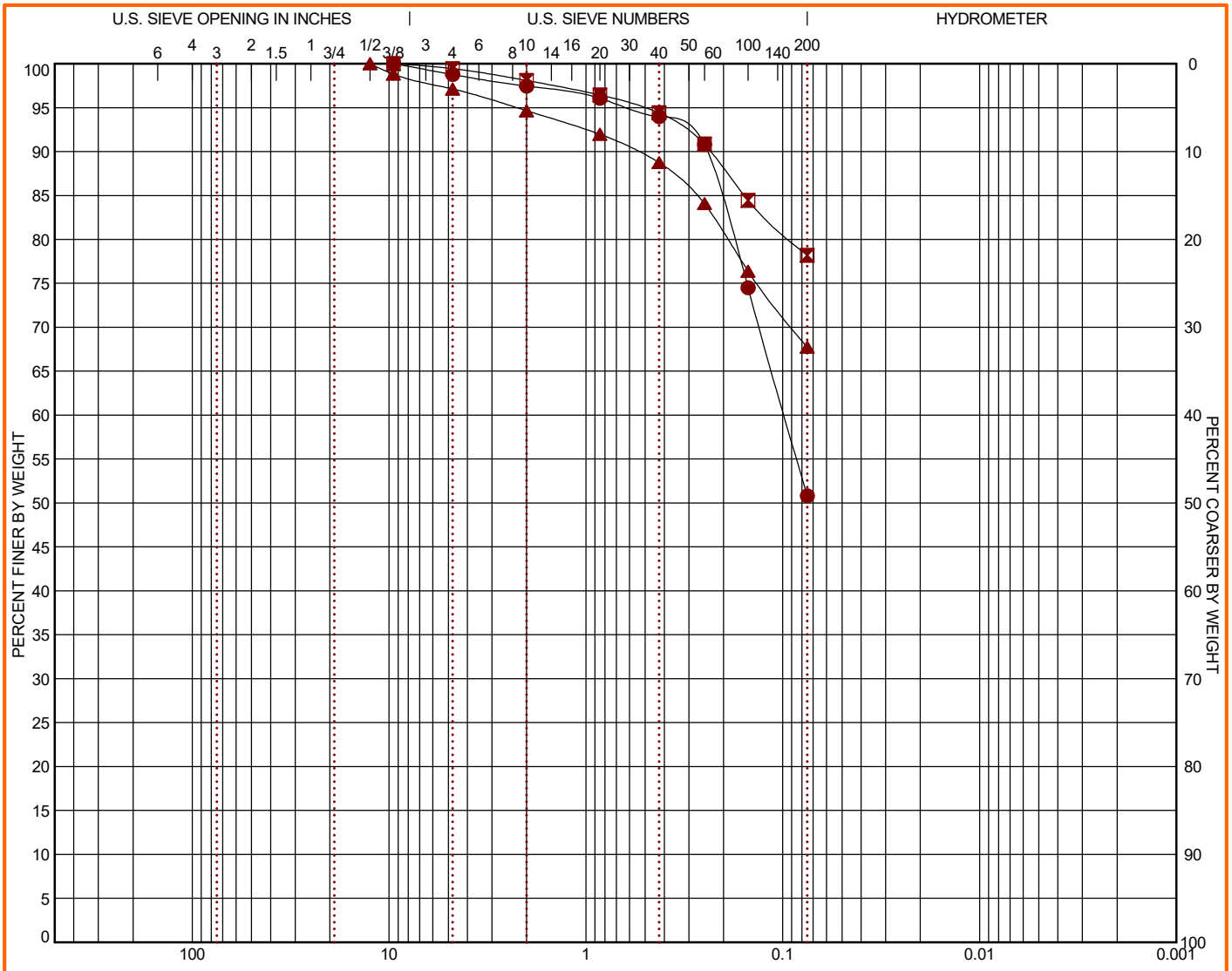

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-7	59.5 - 61	0.0	1.2	48.0		50.8		CL
⊠	ALD-7	74.5 - 76	0.0	0.6	21.2		78.2		CL
▲	ALD-8	14.5 - 16	0.0	2.9	29.4		67.7		CL

GRAIN SIZE	●	⊠	▲
D_{60}	0.098		
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	3/8"	100.0	1/2"	100.0
#4	98.77	#4	99.44	3/8"	98.81
#10	97.44	#10	98.09	#4	97.12
#20	96.07	#20	96.44	#10	94.64
#40	93.97	#40	94.4	#20	91.97
#60	90.82	#60	90.84	#40	88.74
#100	74.5	#100	84.43	#60	84.08
#200	50.81	#200	78.19	#100	76.37
				#200	67.73

SOIL DESCRIPTION	
●	SANDY LEAN CLAY (CL)
⊠	LEAN CLAY with SAND (CL)
▲	SANDY LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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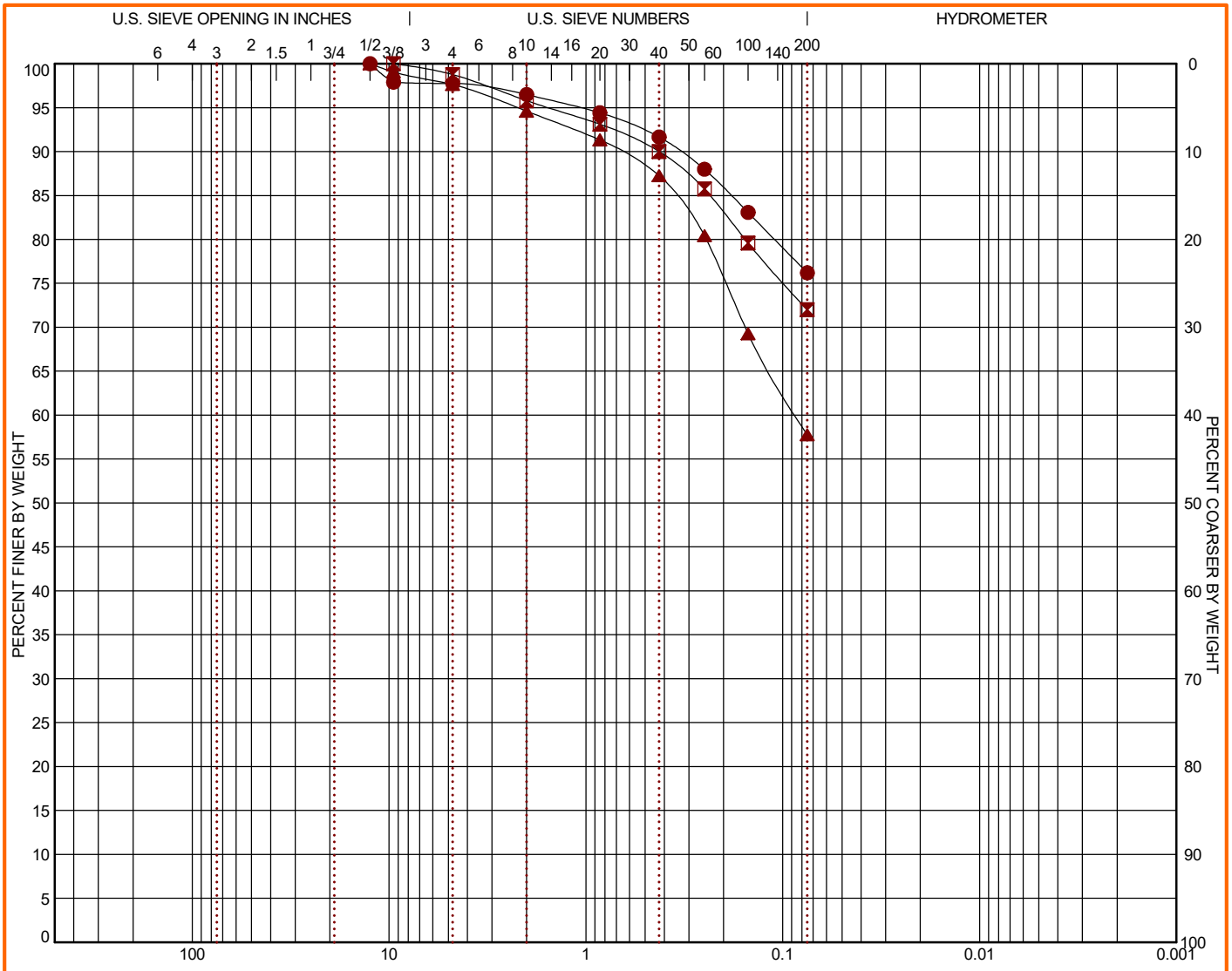

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-8	24.5 - 26	0.0	2.3	21.5		76.2		CL
⊠	ALD-8	29.5 - 31	0.0	1.2	26.8		72.0		CL
▲	ALD-8	34.5 - 36	0.0	2.4	39.9		57.8		CL

GRAIN SIZE	●	⊠	▲
D_{60}			0.086
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
1/2"	100.0	3/8"	100.0	1/2"	100.0
3/8"	97.89	#4	98.76	3/8"	99.06
#4	97.74	#10	95.79	#4	97.63
#10	96.49	#20	93.12	#10	94.59
#20	94.42	#40	90.01	#20	91.33
#40	91.65	#60	85.73	#40	87.25
#60	87.99	#100	79.58	#60	80.43
#100	83.07	#200	71.99	#100	69.28
#200	76.2			#200	57.77

SOIL DESCRIPTION	
●	LEAN CLAY with SAND (CL)
⊠	LEAN CLAY with SAND (CL)
▲	SANDY LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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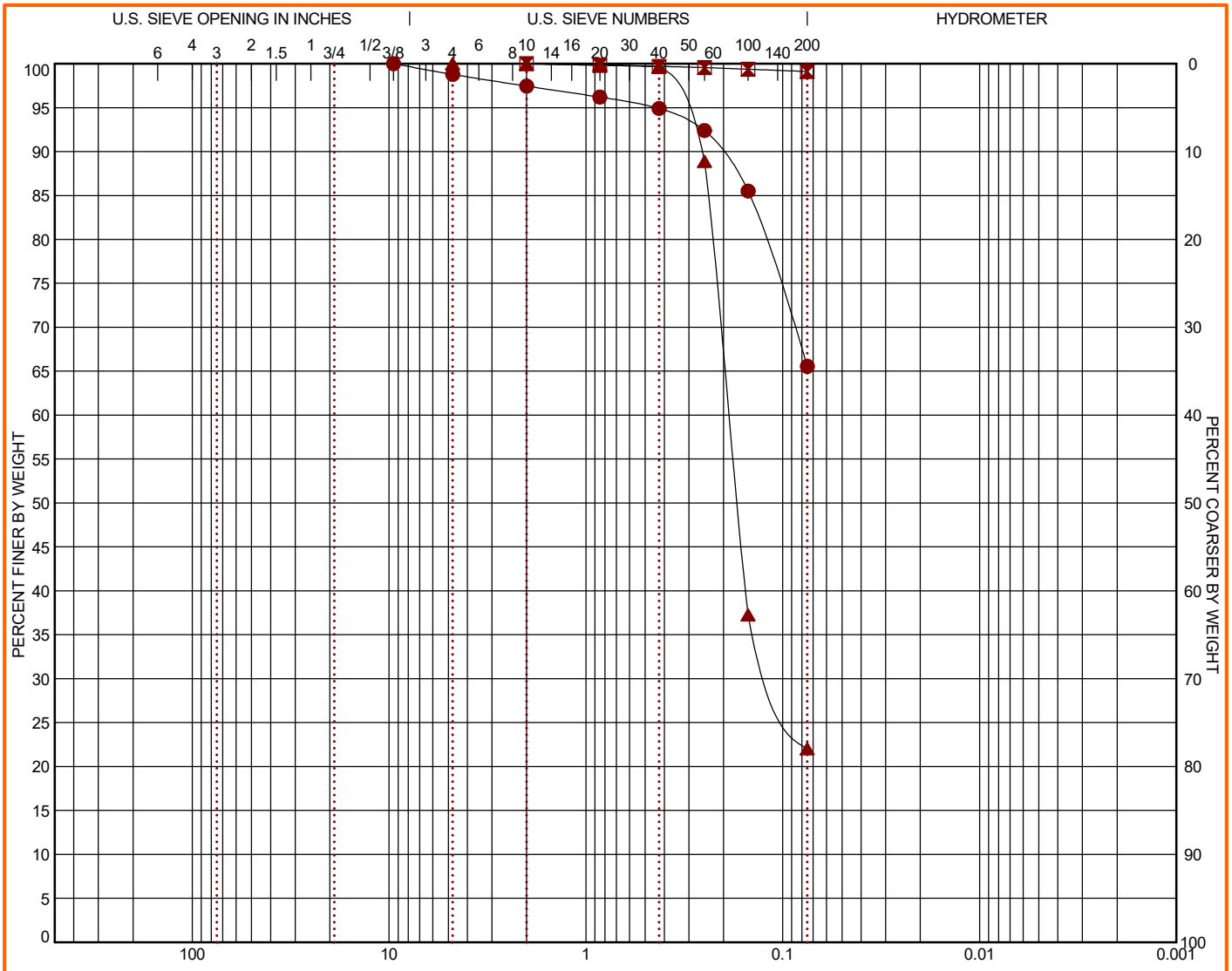

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-8	39.5 - 41	0.0	1.2	33.2		65.6		CL
⊠	ALD-8	44.5 - 46	0.0	0.0	0.9		99.1		CL
▲	ALD-8	54.5 - 56	0.0	0.0	78.0		22.0		SM

GRAIN SIZE	●	⊠	▲
D_{60}			0.188
D_{30}			0.108
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	#10	100.0	#4	100.0
#4	98.78	#20	99.81	#10	99.96
#10	97.45	#40	99.69	#20	99.91
#20	96.2	#60	99.55	#40	99.64
#40	94.9	#100	99.37	#60	88.89
#60	92.4	#200	99.11	#100	37.27
#100	85.51			#200	22.03
#200	65.56				

SOIL DESCRIPTION	
●	SANDY LEAN CLAY (CL)
⊠	LEAN CLAY (CL)
▲	SILTY SAND (SM)

REMARKS	
●	
⊠	
▲	

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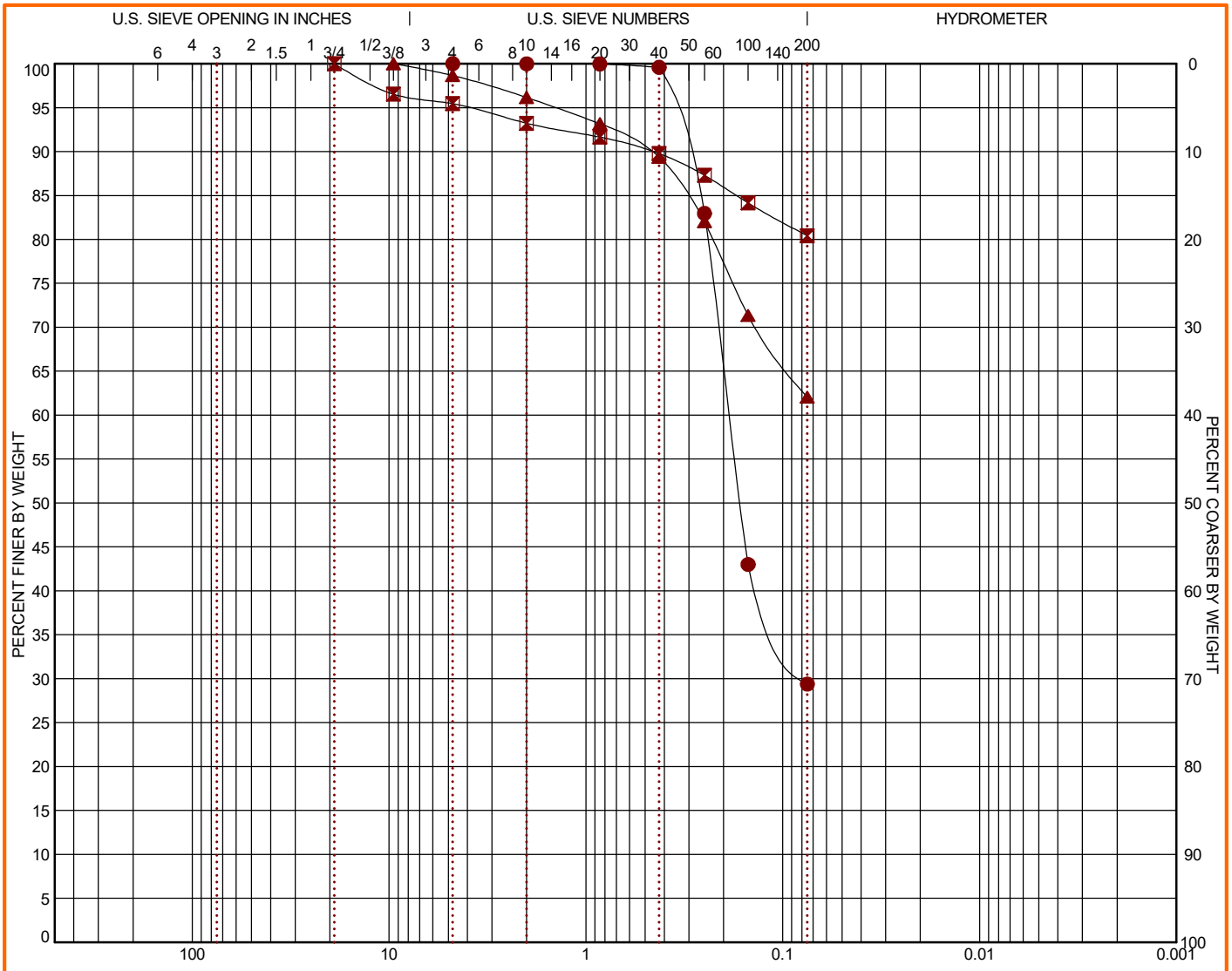

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-8	69.5 - 71	0.0	0.0	70.6		29.4		SC
⊠	ALD-9	24.5 - 26	0.0	4.5	15.0		80.4		CL
▲	ALD-9	29.5 - 31	0.0	1.4	36.6		62.1		CL

GRAIN SIZE	●	⊠	▲
D_{60}	0.186		
D_{30}	0.077		
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#4	100.0	3/4"	100.0	3/8"	100.0
#10	99.98	3/8"	96.53	#4	98.65
#20	99.97	#4	95.45	#10	96.15
#40	99.59	#10	93.21	#20	93.18
#60	82.96	#20	91.65	#40	89.37
#100	43.0	#40	89.78	#60	82.02
#200	29.39	#60	87.31	#100	71.34
		#100	84.15	#200	62.05
		#200	80.42		

SOIL DESCRIPTION	
●	CLAYEY SAND (SC)
⊠	LEAN CLAY with SAND (CL)
▲	SANDY LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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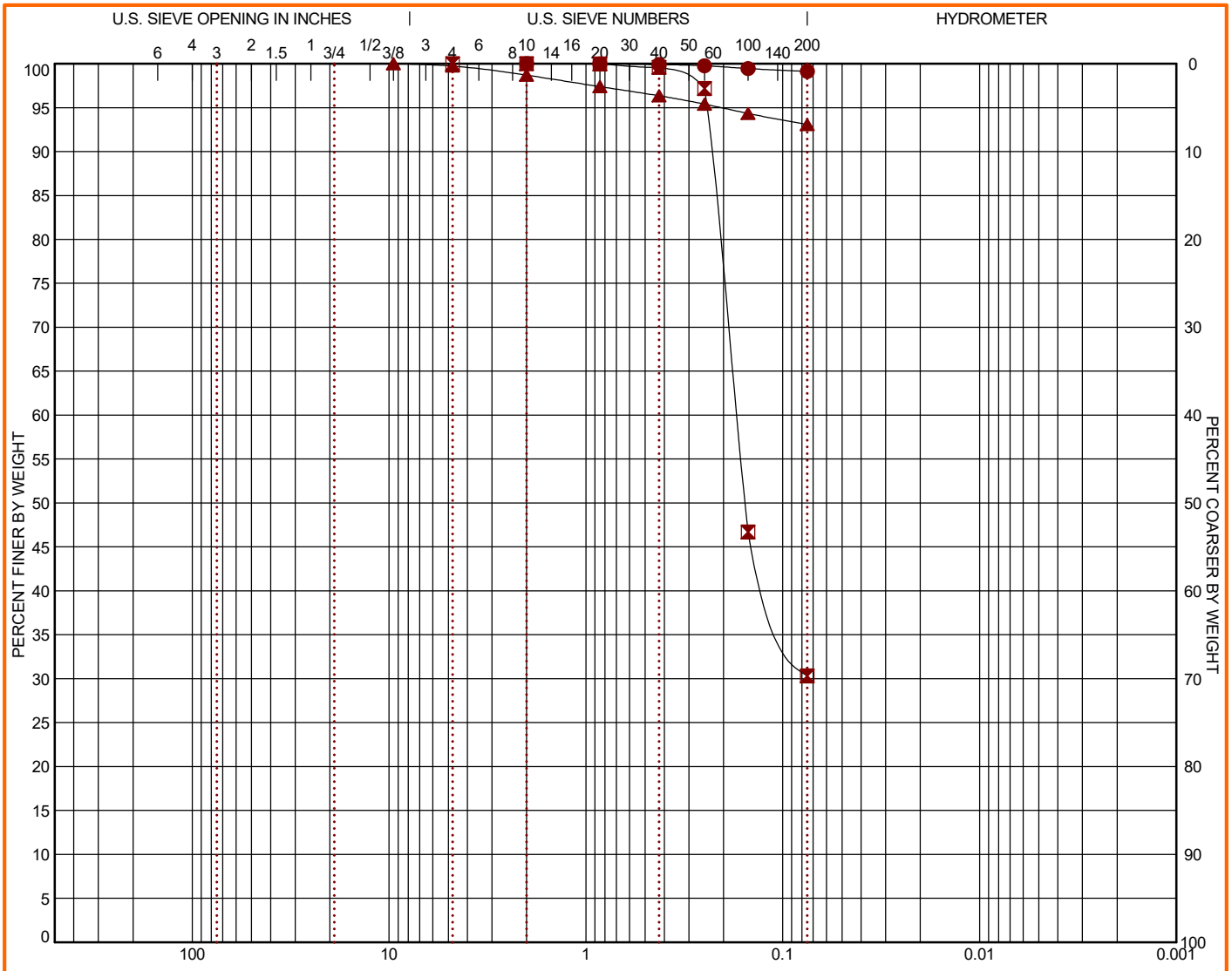


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-9	39.5 - 41	0.0	0.0	0.9		99.1		CL
⊠	ALD-9	59.5 - 61	0.0	0.0	69.7		30.3		SC
▲	ALD-10	9.5 - 11	0.0	0.3	6.7		93.1		CH

GRAIN SIZE	●	⊠	▲
D_{60}		0.172	
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
#10	100.0	#4	100.0	3/8"	100.0
#20	99.98	#10	100.0	#4	99.73
#40	99.9	#20	99.98	#10	98.7
#60	99.76	#40	99.57	#20	97.39
#100	99.45	#60	97.18	#40	96.35
#200	99.12	#100	46.7	#60	95.4
		#200	30.31	#100	94.34
				#200	93.07

SOIL DESCRIPTION	
●	LEAN CLAY (CL)
⊠	CLAYEY SAND (SC)
▲	FAT CLAY (CH)

REMARKS	
●	
⊠	
▲	

PROJECT: GRE - Coal Creek Station

PROJECT NUMBER: M2215072

SITE: 2875 3rd St SW
Underwood, North Dakota

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

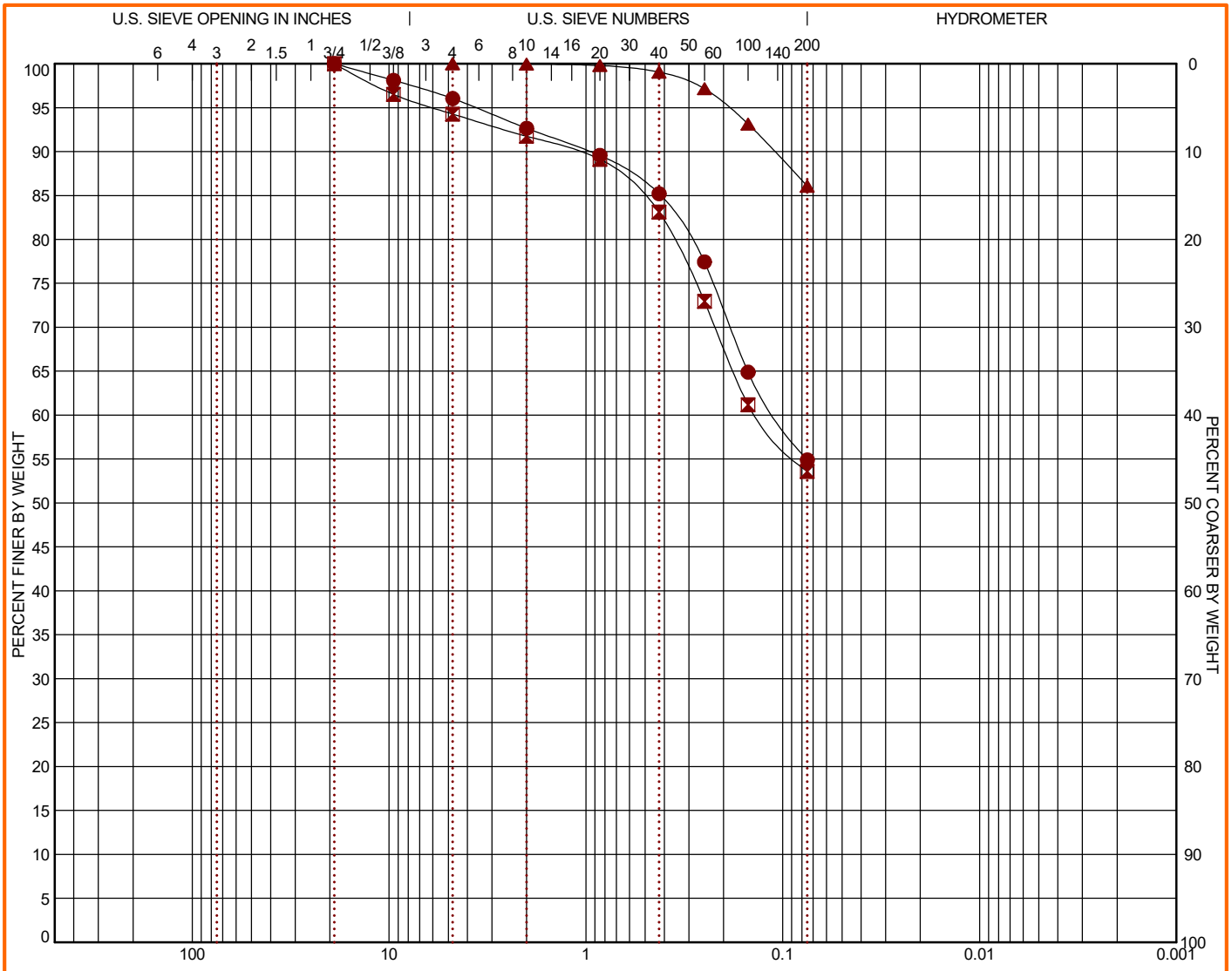
CLIENT: Golder Associates Inc
Lakewood, Colorado

GRAIN SIZE: USCS 1 M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/9/21

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT.

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-10	19.5 - 21	0.0	4.0	41.1		54.9		CL
⊠	ALD-10	34.5 - 36	0.0	5.7	40.7		53.6		CL
▲	ALD-10	39.5 - 41	0.0	0.0	13.9		86.1		CH

GRAIN SIZE	●	⊠	▲
D_{60}	0.107	0.135	
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/4"	100.0	3/4"	100.0	#4	100.0
3/8"	98.1	3/8"	96.5	#10	99.95
#4	96.03	#4	94.27	#20	99.79
#10	92.65	#10	91.74	#40	99.05
#20	89.57	#20	89.13	#60	97.17
#40	85.2	#40	83.1	#100	93.13
#60	77.44	#60	72.95	#200	86.06
#100	64.89	#100	61.17		
#200	54.9	#200	53.58		

SOIL DESCRIPTION	
●	SANDY LEAN CLAY (CL)
⊠	SANDY LEAN CLAY (CL)
▲	FAT CLAY (CH)

REMARKS	
●	
⊠	
▲	

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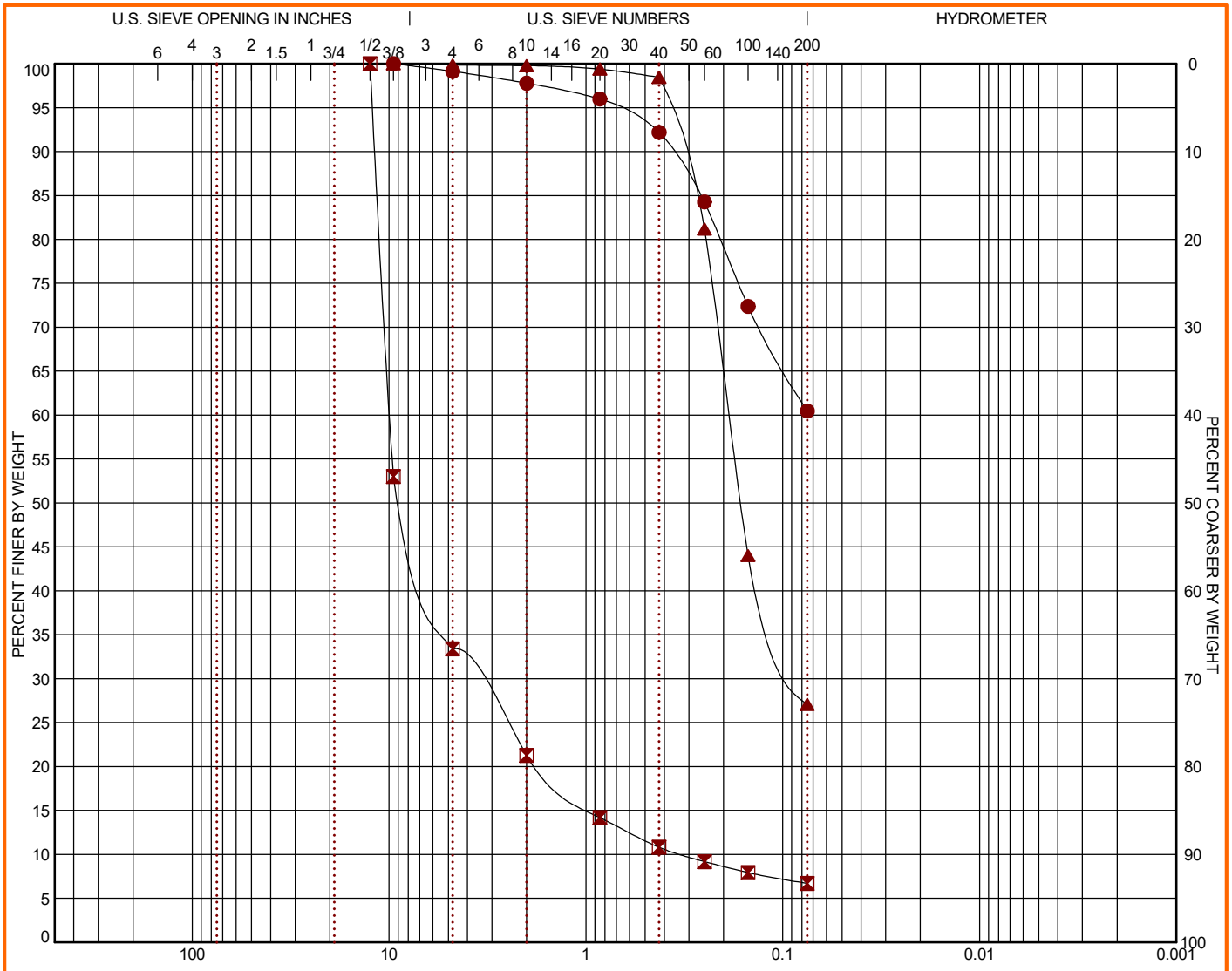

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-10	49.5 - 51	0.0	0.9	38.7		60.5		CL
⊠	ALD-10	59.5 - 61	0.0	66.6	26.7		6.7		GP-GM
▲	ALD-10	64.5 - 66	0.0	0.1	72.8		27.1		SC-SM

GRAIN SIZE	●	⊠	▲
D_{60}		9.895	0.187
D_{30}		3.726	0.085
D_{10}		0.326	

COEFFICIENTS	●	⊠	▲
C_C		4.31	
C_U		30.37	

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0	1/2"	100.0	3/8"	100.0
#4	99.13	3/8"	53.02	#4	99.86
#10	97.78	#4	33.41	#10	99.78
#20	95.98	#10	21.26	#20	99.39
#40	92.18	#20	14.19	#40	98.45
#60	84.26	#40	10.81	#60	81.17
#100	72.37	#60	9.19	#100	44.02
#200	60.46	#100	7.93	#200	27.08
		#200	6.7		

SOIL DESCRIPTION	
●	SANDY LEAN CLAY (CL)
⊠	POORLY GRADED GRAVEL with SILT and SAND (GP-GM)
▲	SILTY, CLAYEY SAND (SC-SM)

REMARKS	
●	
⊠	
▲	

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GRAIN SIZE DISTRIBUTION

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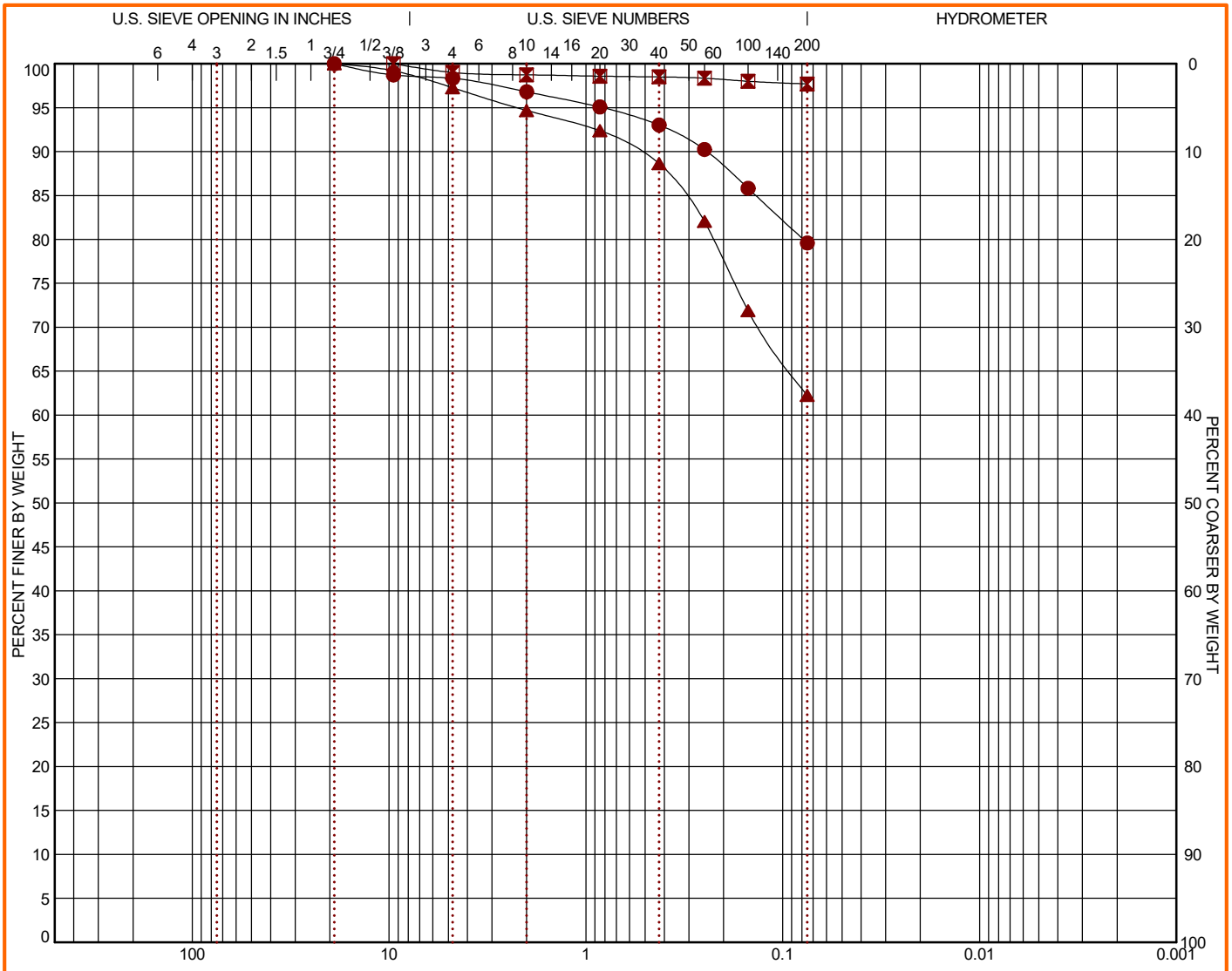

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-11	24.5 - 26	0.0	1.7	18.7		79.6		CL
⊠	ALD-11	29.5 - 31	0.0	1.0	1.3		97.7		CH
▲	ALD-11	39.5 - 41	0.0	2.7	35.0		62.3		CL

GRAIN SIZE	●	⊠	▲
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/4"	100.0	3/8"	100.0	3/4"	100.0
3/8"	98.71	#4	99.0	3/8"	99.19
#4	98.33	#10	98.73	#4	97.26
#10	96.8	#20	98.58	#10	94.67
#20	95.08	#40	98.49	#20	92.38
#40	93.01	#60	98.35	#40	88.63
#60	90.24	#100	98.0	#60	82.04
#100	85.82	#200	97.69	#100	71.88
#200	79.59			#200	62.26

SOIL DESCRIPTION	
●	LEAN CLAY with SAND (CL)
⊠	FAT CLAY (CH)
▲	SANDY LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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GRAIN SIZE DISTRIBUTION

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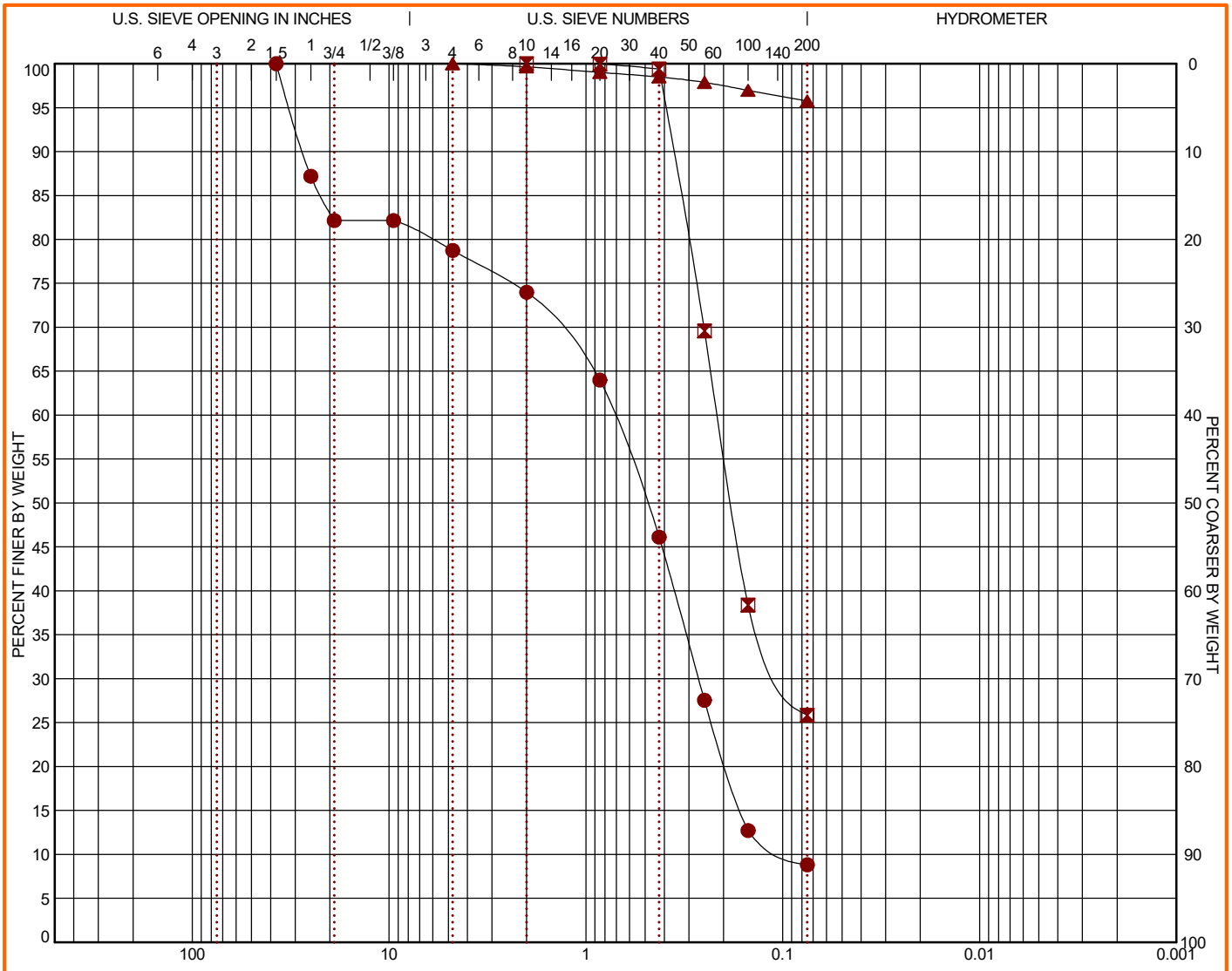

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-11	49.5 - 51	0.0	21.3	69.9		8.8		SW-SM
⊠	ALD-11	64.5 - 66	0.0	0.0	74.1		25.9		SC
▲	ALD-12	19.5 - 21	0.0	0.0	4.2		95.8		CL

GRAIN SIZE	●	⊠	▲
D_{60}	0.728	0.214	
D_{30}	0.268	0.094	
D_{10}	0.092		

COEFFICIENTS	●	⊠	▲
C_C	1.07		
C_U	7.87		

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
1 1/2"	100.0	#10	100.0	#4	100.0
1"	87.19	#20	99.95	#10	99.63
3/4"	82.14	#40	99.4	#20	99.01
3/8"	82.14	#60	69.6	#40	98.49
#4	78.74	#100	38.38	#60	97.87
#10	73.98	#200	25.86	#100	96.96
#20	63.99			#200	95.75
#40	46.12				
#60	27.55				
#100	12.72				
#200	8.82				

SOIL DESCRIPTION	
●	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
⊠	CLAYEY SAND (SC)
▲	LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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GRAIN SIZE DISTRIBUTION

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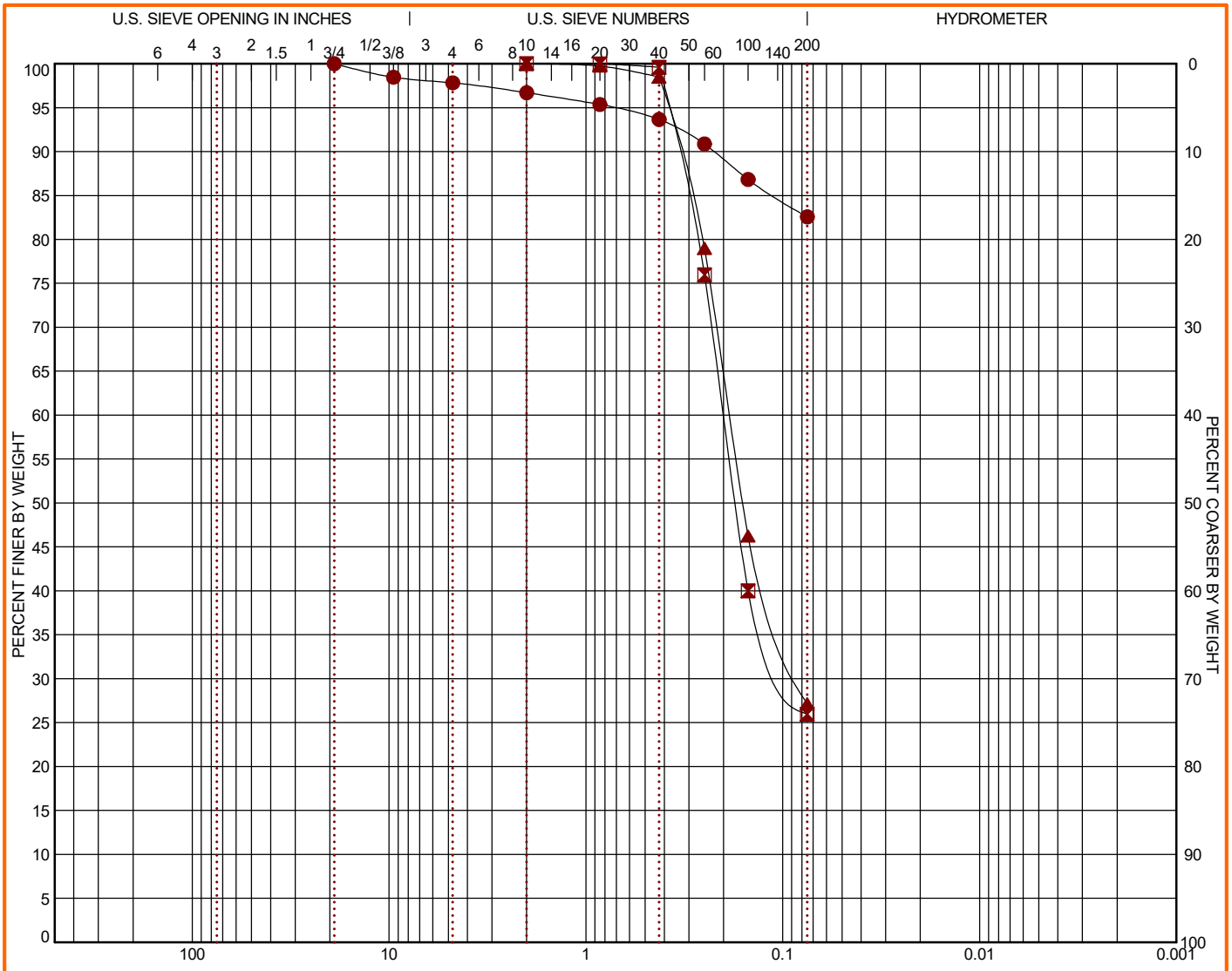

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-12	24.5 - 26	0.0	2.2	15.3		82.6		CL
⊠	ALD-12	54.5 - 56	0.0	0.0	74.0		26.0		SC
▲	ALD-12	64.5 - 66	0.0	0.0	72.9		27.1		SC

GRAIN SIZE	●	⊠	▲
D_{60}		0.199	0.186
D_{30}		0.091	0.083
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/4"	100.0	#10	100.0	#10	100.0
3/8"	98.46	#20	99.98	#20	99.74
#4	97.82	#40	99.6	#40	98.49
#10	96.69	#60	75.96	#60	78.98
#20	95.36	#100	40.0	#100	46.24
#40	93.65	#200	25.98	#200	27.14
#60	90.86				
#100	86.82				
#200	82.57				

SOIL DESCRIPTION	
●	LEAN CLAY with SAND (CL)
⊠	CLAYEY SAND (SC)
▲	CLAYEY SAND (SC)

REMARKS	
●	
⊠	
▲	

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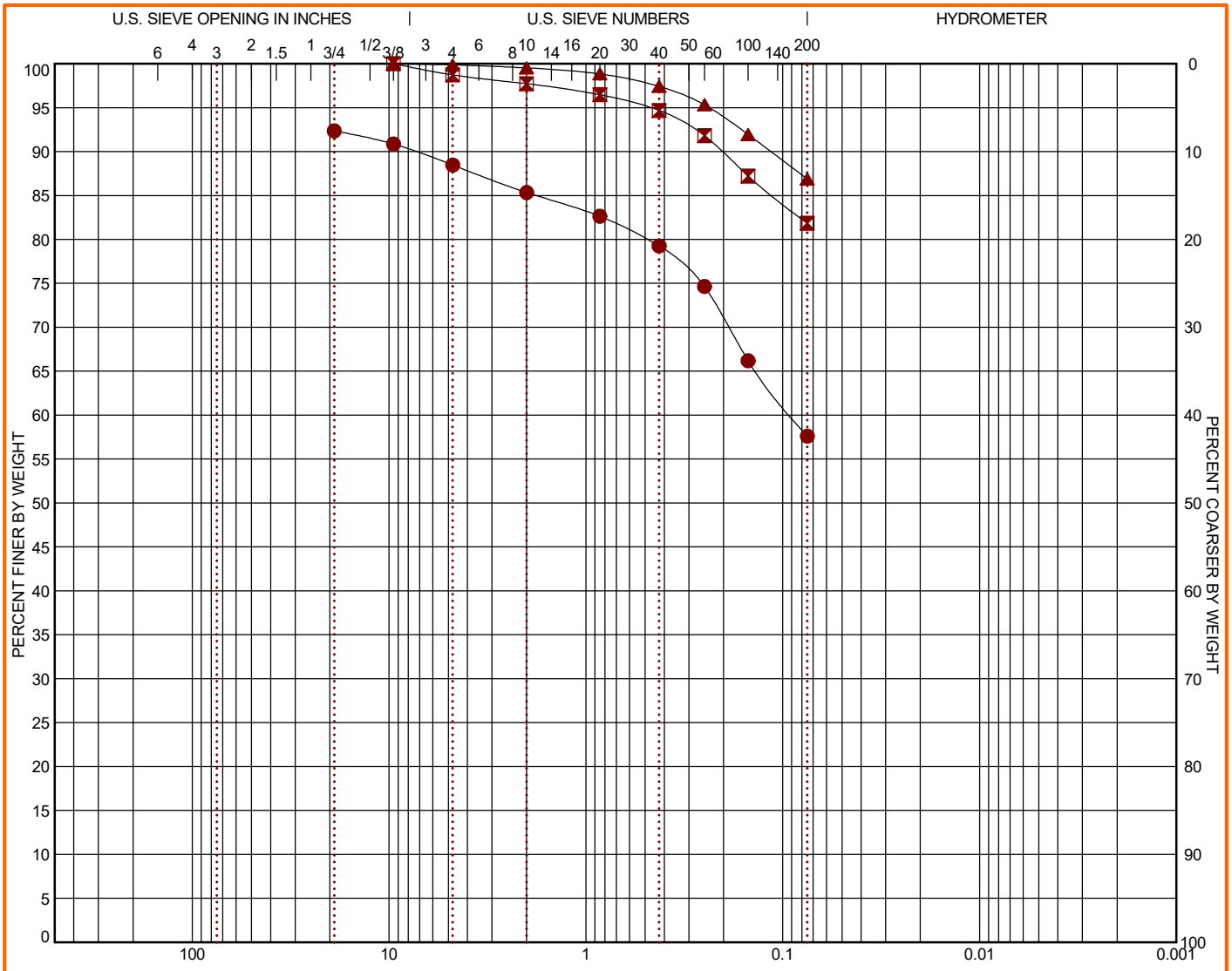

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-13	9.5 - 11		3.9	30.9		57.6		CL
⊠	ALD-13	19.5 - 21	0.0	1.3	16.9		81.8		CL
▲	ALD-13	24.5 - 26	0.0	0.1	13.0		86.9		CL

GRAIN SIZE	●	⊠	▲
D_{60}	0.091		
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/4"	92.35	3/8"	100.0	3/8"	100.0
3/8"	90.86	#4	98.72	#4	99.86
#4	88.47	#10	97.72	#10	99.52
#10	85.33	#20	96.47	#20	98.84
#20	82.64	#40	94.68	#40	97.43
#40	79.26	#60	91.82	#60	95.33
#60	74.65	#100	87.22	#100	91.94
#100	66.19	#200	81.83	#200	86.88
#200	57.61				

SOIL DESCRIPTION	
●	SANDY LEAN CLAY (CL)
⊠	LEAN CLAY with SAND (CL)
▲	LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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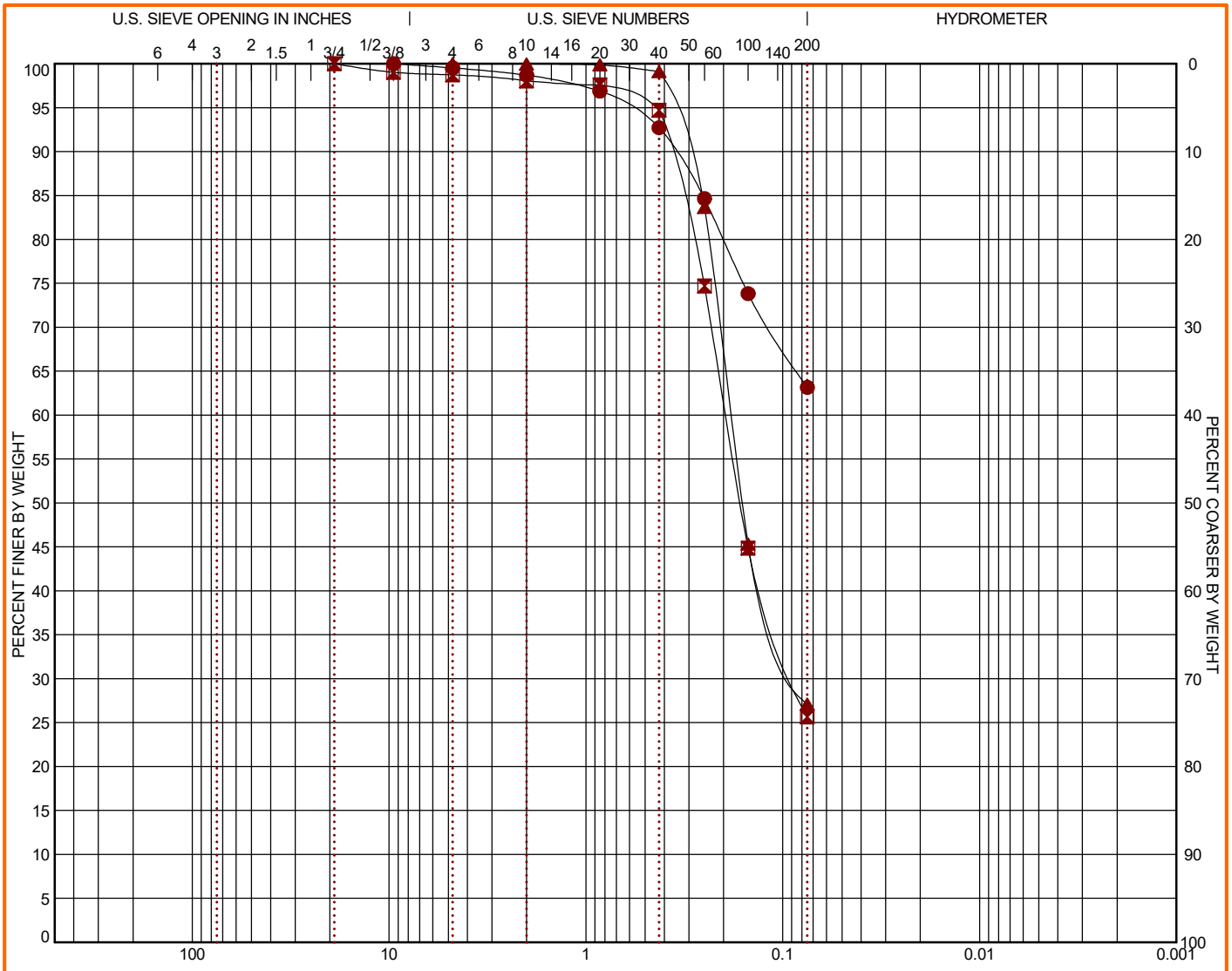

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-13	29.5 - 31	0.0	0.5	36.4		63.2		CL
⊠	ALD-13	54.5 - 56	0.0	1.3	73.1		25.7		SM
▲	ALD-13	59.5 - 61	0.0	0.0	72.9		27.1		SC

GRAIN SIZE	●	⊠	▲
D_{60}		0.194	0.182
D_{30}		0.088	0.084
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0	3/4"	100.0	#4	100.0
#4	99.51	3/8"	99.03	#10	99.97
#10	98.69	#4	98.72	#20	99.88
#20	96.88	#10	98.03	#40	99.1
#40	92.71	#20	97.58	#60	83.65
#60	84.65	#40	94.68	#100	45.34
#100	73.83	#60	74.69	#200	27.11
#200	63.16	#100	44.85		
		#200	25.67		

SOIL DESCRIPTION	
●	SANDY LEAN CLAY (CL)
⊠	SILTY SAND (SM)
▲	CLAYEY SAND (SC)

REMARKS	
●	
⊠	
▲	

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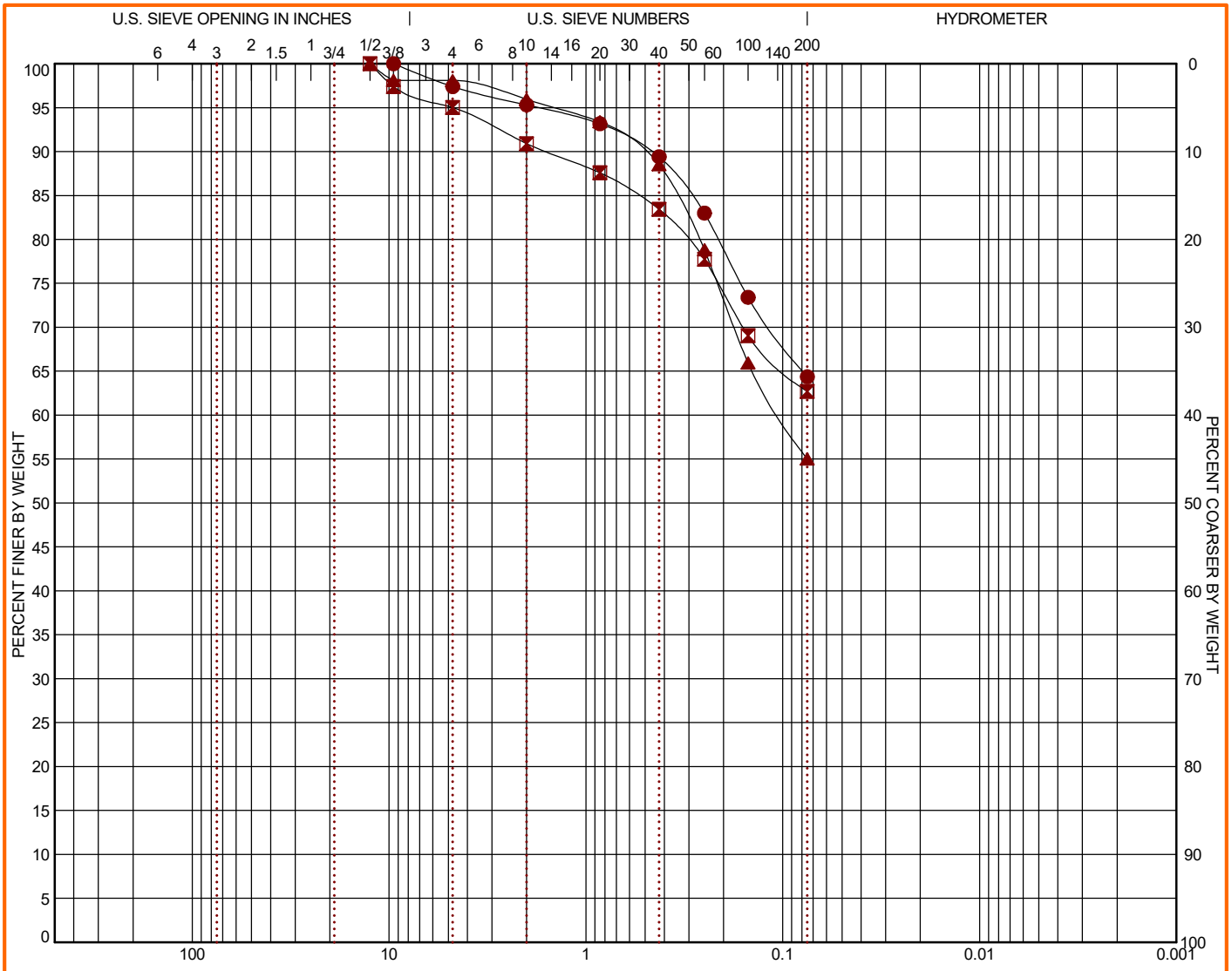

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-14	19.5 - 21	0.0	2.6	33.0		64.4		CL
⊠	ALD-14	24.5 - 26	0.0	5.0	32.3		62.7		CL
▲	ALD-14	34.5 - 36	0.0	1.9	43.1		55.0		CL

GRAIN SIZE	●	⊠	▲
D_{60}			0.103
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	1/2"	100.0	1/2"	100.0
#4	97.4	3/8"	97.4	3/8"	98.1
#10	95.31	#4	95.01	#4	98.08
#20	93.17	#10	90.9	#10	95.94
#40	89.41	#20	87.6	#20	93.4
#60	82.99	#40	83.43	#40	88.5
#100	73.4	#60	77.74	#60	78.82
#200	64.37	#100	69.03	#100	65.94
		#200	62.7	#200	55.02

SOIL DESCRIPTION	
●	SANDY LEAN CLAY (CL)
⊠	SANDY LEAN CLAY (CL)
▲	SANDY LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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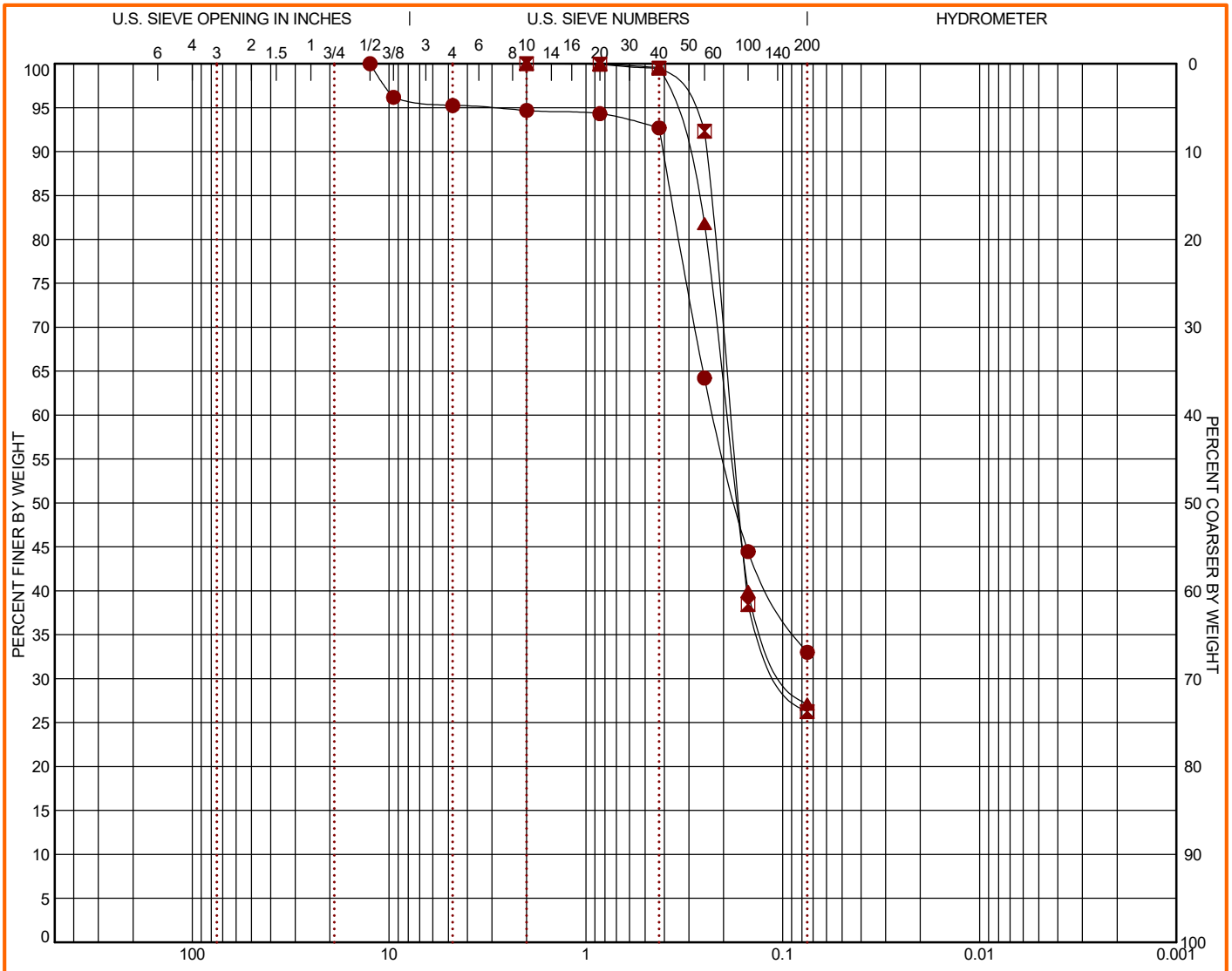

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-14	39.5 - 41	0.0	4.8	62.2		33.0		SM
⊠	ALD-14	54.5 - 56	0.0	0.0	73.7		26.3		SC
▲	ALD-14	64.5 - 66	0.0	0.0	72.9		27.1		SC

GRAIN SIZE	●	⊠	▲
D_{60}	0.224	0.184	0.192
D_{30}		0.093	0.088
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
1/2"	100.0	#10	100.0	#10	100.0
3/8"	96.17	#20	99.93	#20	99.94
#4	95.24	#40	99.5	#40	99.56
#10	94.67	#60	92.33	#60	81.79
#20	94.31	#100	38.45	#100	39.93
#40	92.69	#200	26.26	#200	27.11
#60	64.22				
#100	44.47				
#200	33.01				

SOIL DESCRIPTION	
●	SILTY SAND (SM)
⊠	CLAYEY SAND (SC)
▲	CLAYEY SAND (SC)

REMARKS	
●	
⊠	
▲	

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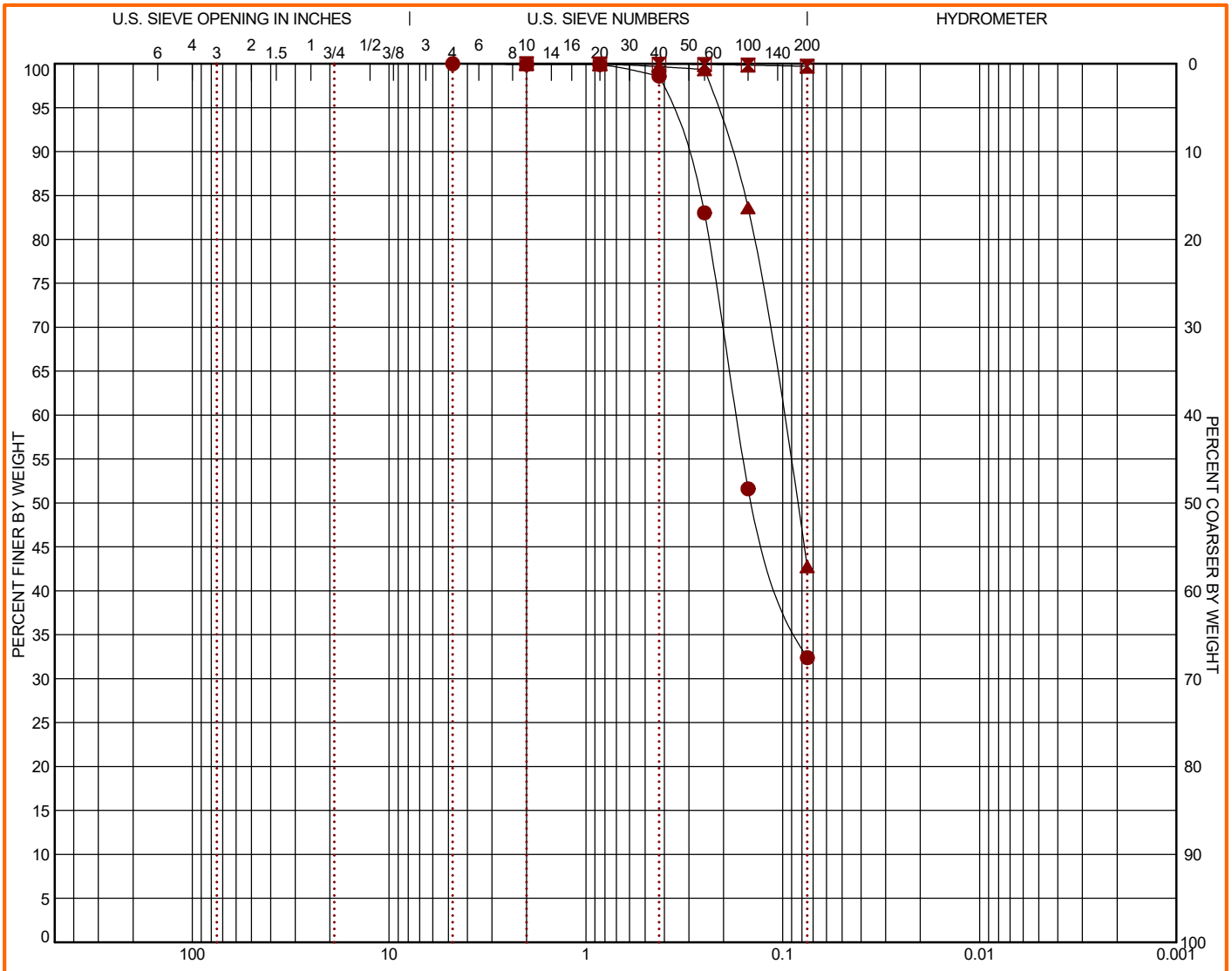
GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-14	69.5 - 71	0.0	0.0	67.6		32.4		SC
⊠	ALD-15	19.5 - 21	0.0	0.0	0.3		99.7		CL
▲	ALD-15	24.5 - 26	0.0	0.0	57.2		42.8		SM

GRAIN SIZE	●	⊠	▲
D_{60}	0.172		0.1
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
#4	100.0	#10	100.0	#10	100.0
#10	99.91	#20	99.97	#20	99.94
#20	99.88	#40	99.94	#40	99.67
#40	98.58	#60	99.91	#60	99.33
#60	83.02	#100	99.83	#100	83.6
#100	51.61	#200	99.7	#200	42.76
#200	32.39				

SOIL DESCRIPTION	
●	CLAYEY SAND (SC)
⊠	LEAN CLAY (CL)
▲	SILTY SAND (SM)

REMARKS	
●	
⊠	
▲	

PROJECT: GRE - Coal Creek Station

PROJECT NUMBER: M2215072

SITE: 2875 3rd St SW
Underwood, North Dakota

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

CLIENT: Golder Associates Inc
Lakewood, Colorado

GRAIN SIZE: USCS 1 M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/9/21

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GRAIN SIZE DISTRIBUTION

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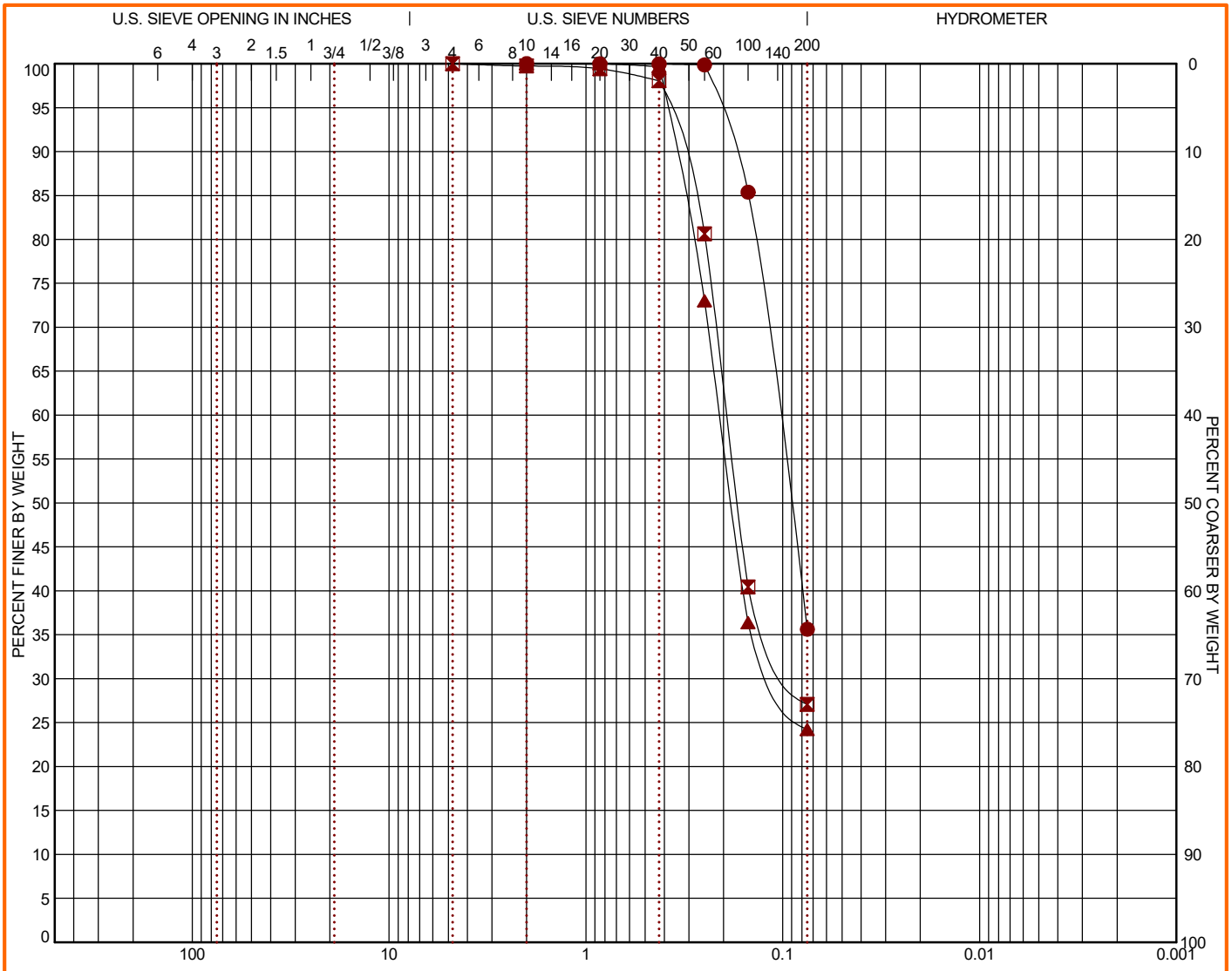

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-15	29.5 - 31	0.0	0.0	64.4		35.6		SC-SM
⊠	ALD-15	54.5 - 56	0.0	0.0	72.9		27.1		SC
▲	ALD-15	74.5 - 76	0.0	0.0	75.8		24.2		SC

GRAIN SIZE	●	⊠	▲
D_{60}	0.105	0.192	0.208
D_{30}		0.087	0.104
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#10	100.0	#4	100.0	#10	100.0
#20	99.99	#10	99.74	#20	100.0
#40	99.98	#20	99.42	#40	99.66
#60	99.86	#40	98.05	#60	73.02
#100	85.37	#60	80.64	#100	36.38
#200	35.63	#100	40.46	#200	24.22
		#200	27.07		

SOIL DESCRIPTION	
●	SILTY, CLAYEY SAND (SC-SM)
⊠	CLAYEY SAND (SC)
▲	CLAYEY SAND (SC)

REMARKS	
●	
⊠	
▲	

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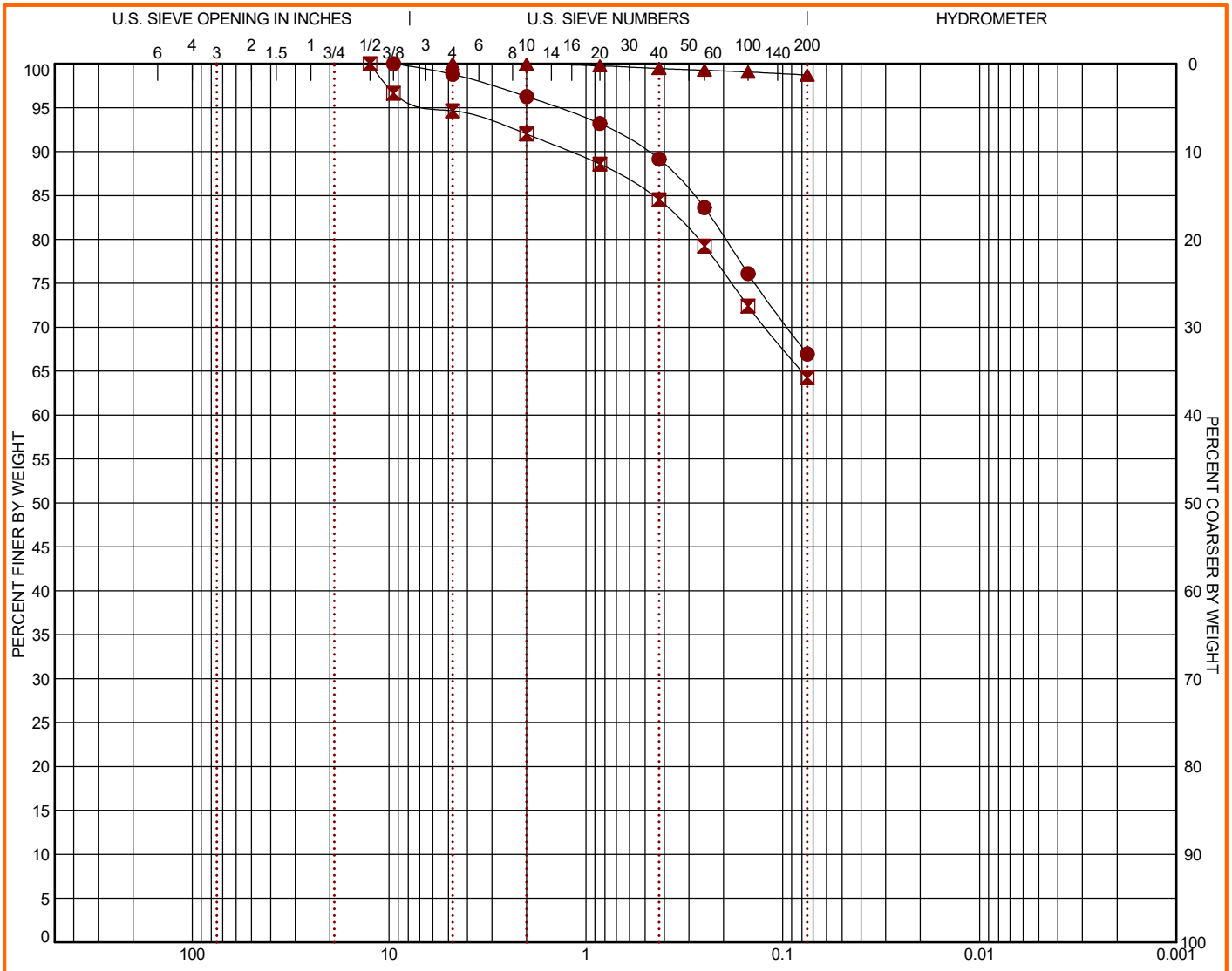

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-16	14.5 - 16	0.0	1.2	31.8		67.0		CL
⊠	ALD-16	19.5 - 21	0.0	5.3	30.4		64.2		CL
▲	ALD-16	24.5 - 26	0.0	0.0	1.3		98.7		CL

GRAIN SIZE	●	⊠	▲
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	1/2"	100.0	#4	100.0
#4	98.79	3/8"	96.65	#10	99.93
#10	96.25	#4	94.65	#20	99.76
#20	93.19	#10	91.99	#40	99.45
#40	89.15	#20	88.58	#60	99.25
#60	83.62	#40	84.52	#100	99.05
#100	76.1	#60	79.24	#200	98.7
#200	66.95	#100	72.4		
		#200	64.25		

SOIL DESCRIPTION	
●	SANDY LEAN CLAY (CL)
⊠	SANDY LEAN CLAY (CL)
▲	LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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GRAIN SIZE DISTRIBUTION

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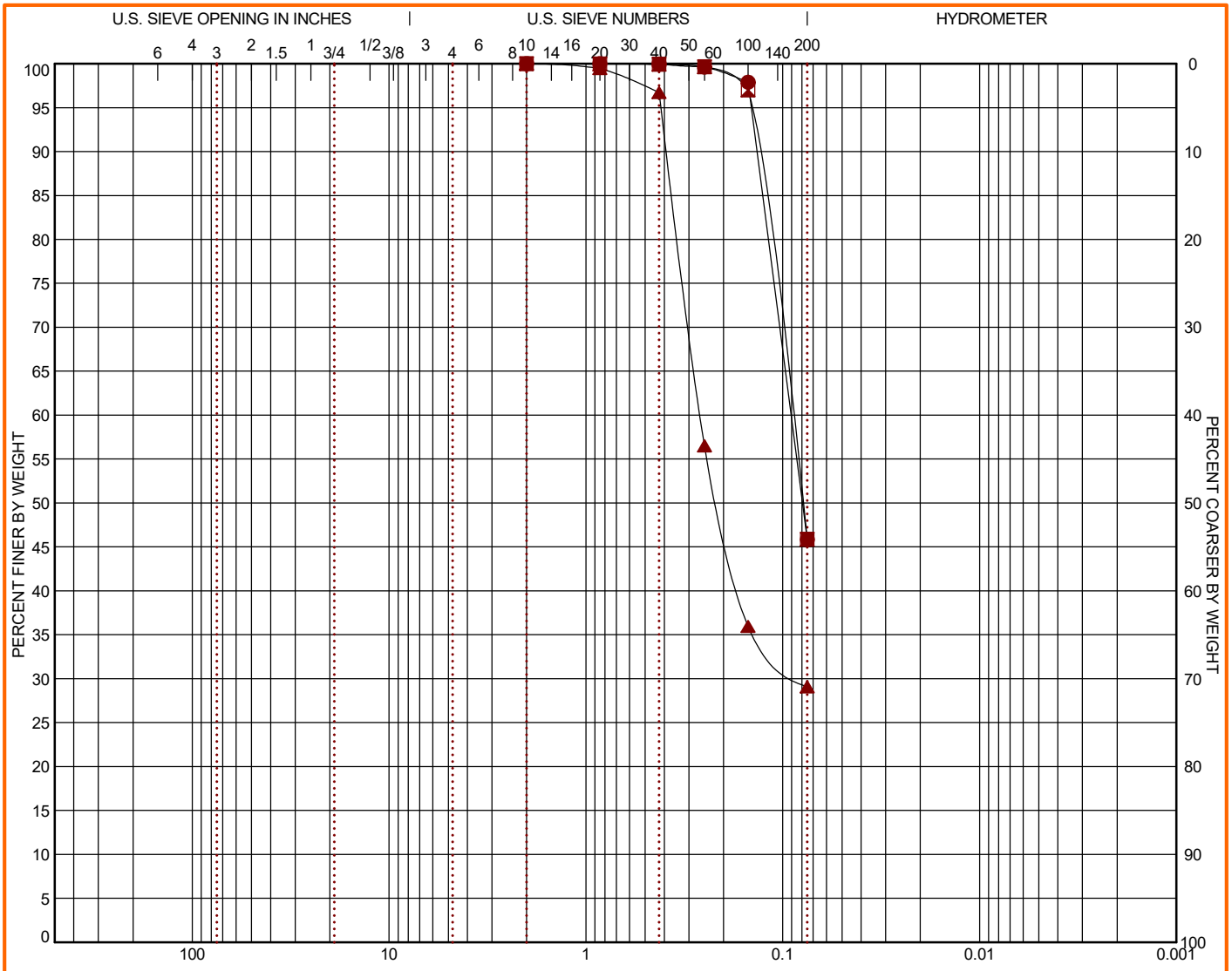

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-16	34.5 - 36	0.0	0.0	54.2		45.8		SC
⊠	ALD-16	39.5 - 41	0.0	0.0	54.1		45.9		SC
▲	ALD-16	59.5 - 61	0.0	0.0	70.9		29.1		SC

GRAIN SIZE	●	⊠	▲
D_{60}	0.091	0.091	0.262
D_{30}			0.082
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
#10	100.0	#10	100.0	#10	100.0
#20	100.0	#20	99.97	#20	99.44
#40	99.95	#40	99.94	#40	96.72
#60	99.62	#60	99.66	#60	56.51
#100	97.9	#100	97.02	#100	35.96
#200	45.83	#200	45.88	#200	29.07

SOIL DESCRIPTION	
●	CLAYEY SAND (SC)
⊠	CLAYEY SAND (SC)
▲	CLAYEY SAND (SC)

REMARKS	
●	
⊠	
▲	

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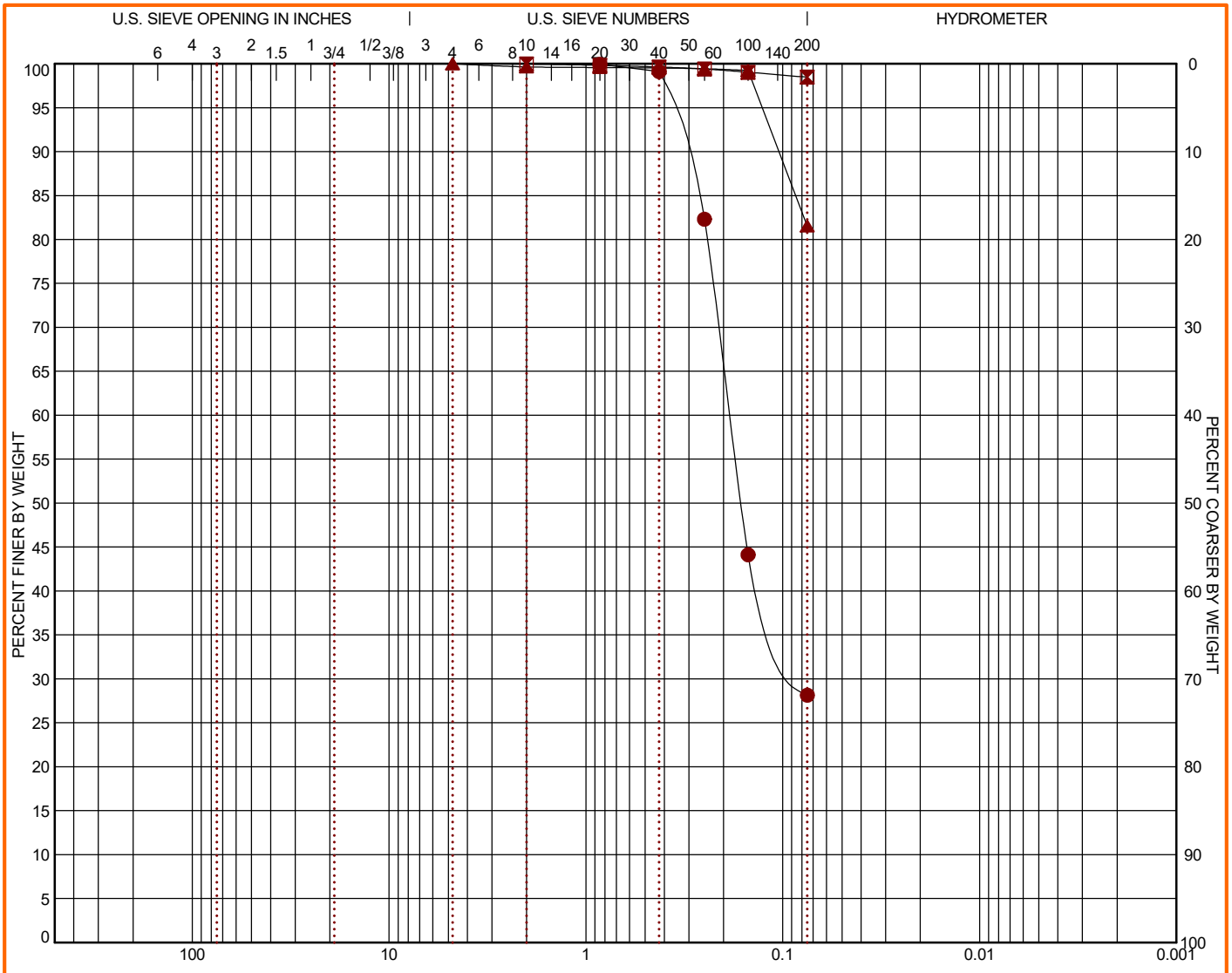

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-16	64.5 - 66			71.8		28.1		SC
⊠	ALD-17	19.5 - 21			1.5		98.5		CH
▲	ALD-17	24.5 - 26	0.0	0.0	18.5		81.5		ML

GRAIN SIZE	●	⊠	▲
D_{60}	0.185		
D_{30}	0.081		
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
#20	99.93	#10	99.96	#4	100.0
#40	99.1	#20	99.81	#10	99.64
#60	82.31	#40	99.63	#20	99.57
#100	44.13	#60	99.4	#40	99.51
#200	28.15	#100	99.03	#60	99.43
		#200	98.47	#100	99.24
				#200	81.54

SOIL DESCRIPTION	
●	CLAYEY SAND (SC)
⊠	FAT CLAY (CH)
▲	SILT with SAND (ML)

REMARKS	
●	
⊠	
▲	

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GRAIN SIZE DISTRIBUTION

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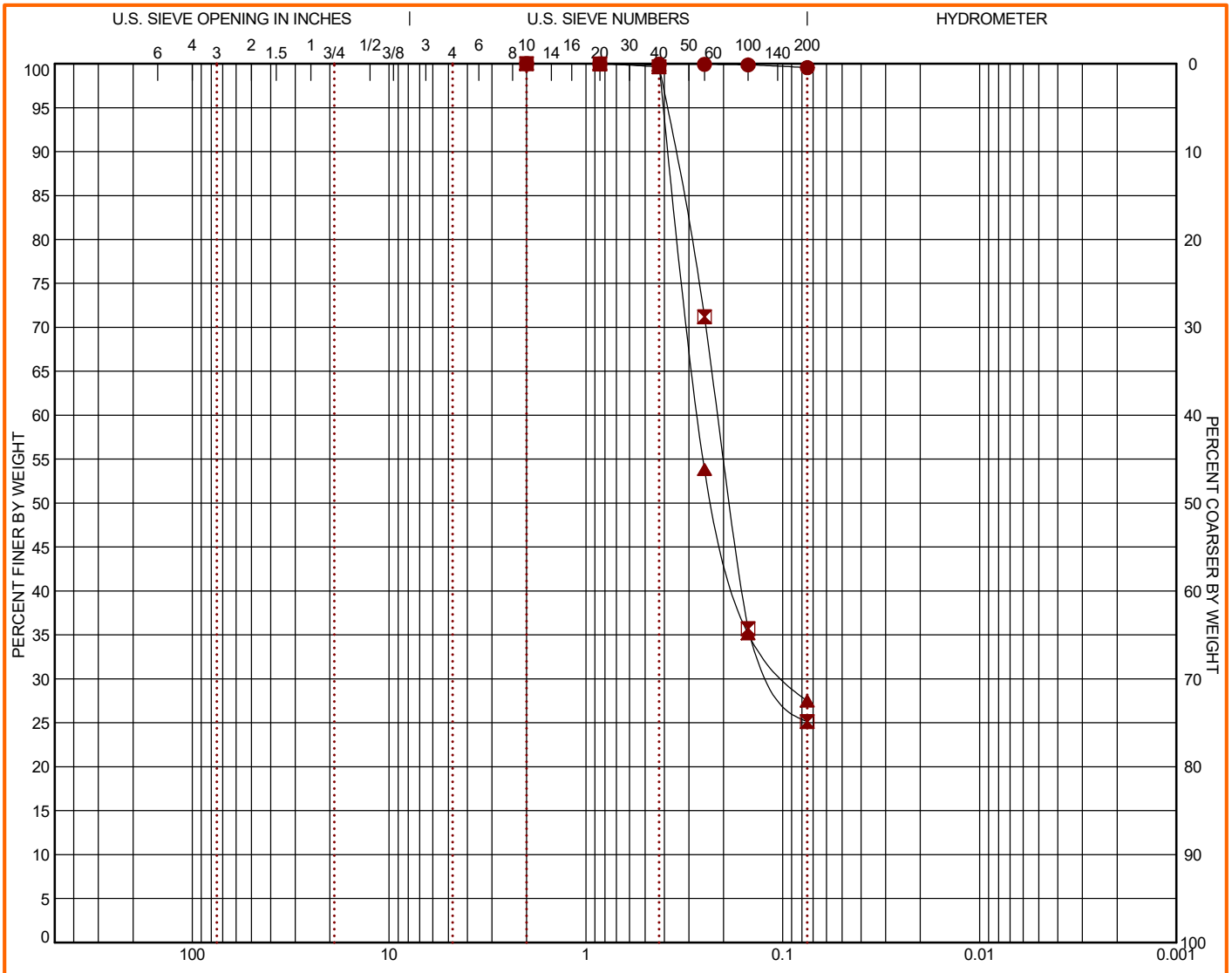

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-17	29.5 - 31	0.0	0.0	0.4		99.6		CL
⊠	ALD-17	44.5 - 46	0.0	0.0	74.9		25.1		SC
▲	ALD-17	59.5 - 61	0.0	0.0	72.5		27.5		SC

GRAIN SIZE	●	⊠	▲
D_{60}		0.213	0.268
D_{30}		0.103	0.094
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#10	100.0	#10	100.0	#10	100.0
#20	99.98	#20	99.97	#20	99.98
#40	99.95	#40	99.65	#40	99.85
#60	99.93	#60	71.21	#60	53.83
#100	99.86	#100	35.71	#100	35.13
#200	99.55	#200	25.14	#200	27.5

SOIL DESCRIPTION	
●	LEAN CLAY (CL)
⊠	CLAYEY SAND (SC)
▲	CLAYEY SAND (SC)

REMARKS	
●	
⊠	
▲	

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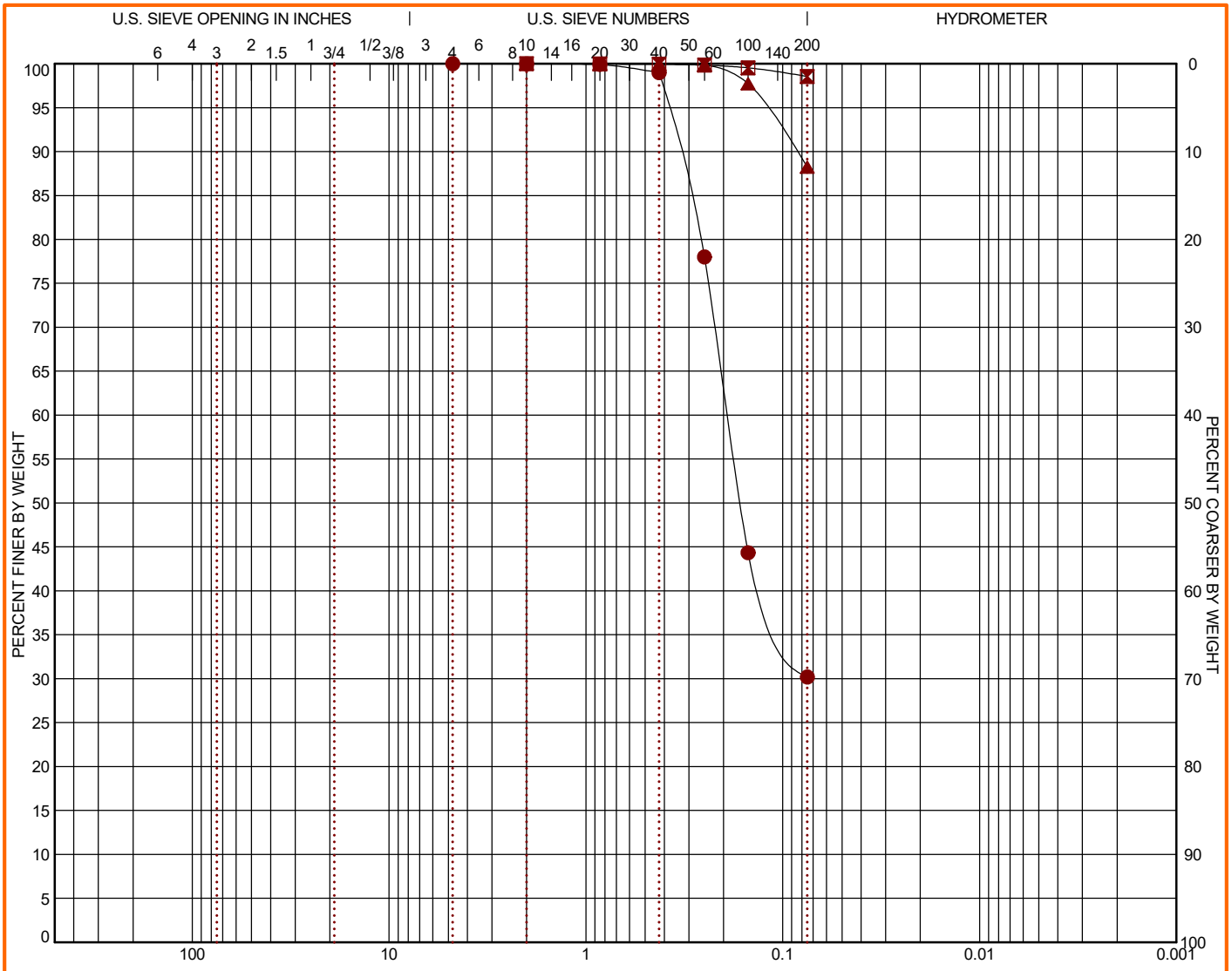

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-17	69.5 - 71	0.0	0.0	69.8		30.2		SC
⊠	ALD-18	24.5 - 26	0.0	0.0	1.5		98.5		CL
▲	ALD-18	29.5 - 31	0.0	0.0	11.8		88.2		CL

GRAIN SIZE	●	⊠	▲
D_{60}	0.19		
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
#4	100.0	#10	100.0	#10	100.0
#10	99.98	#20	99.97	#20	99.97
#20	99.92	#40	99.95	#40	99.93
#40	98.98	#60	99.83	#60	99.85
#60	78.0	#100	99.53	#100	97.72
#100	44.34	#200	98.54	#200	88.23
#200	30.19				

SOIL DESCRIPTION	
●	CLAYEY SAND (SC)
⊠	LEAN CLAY (CL)
▲	LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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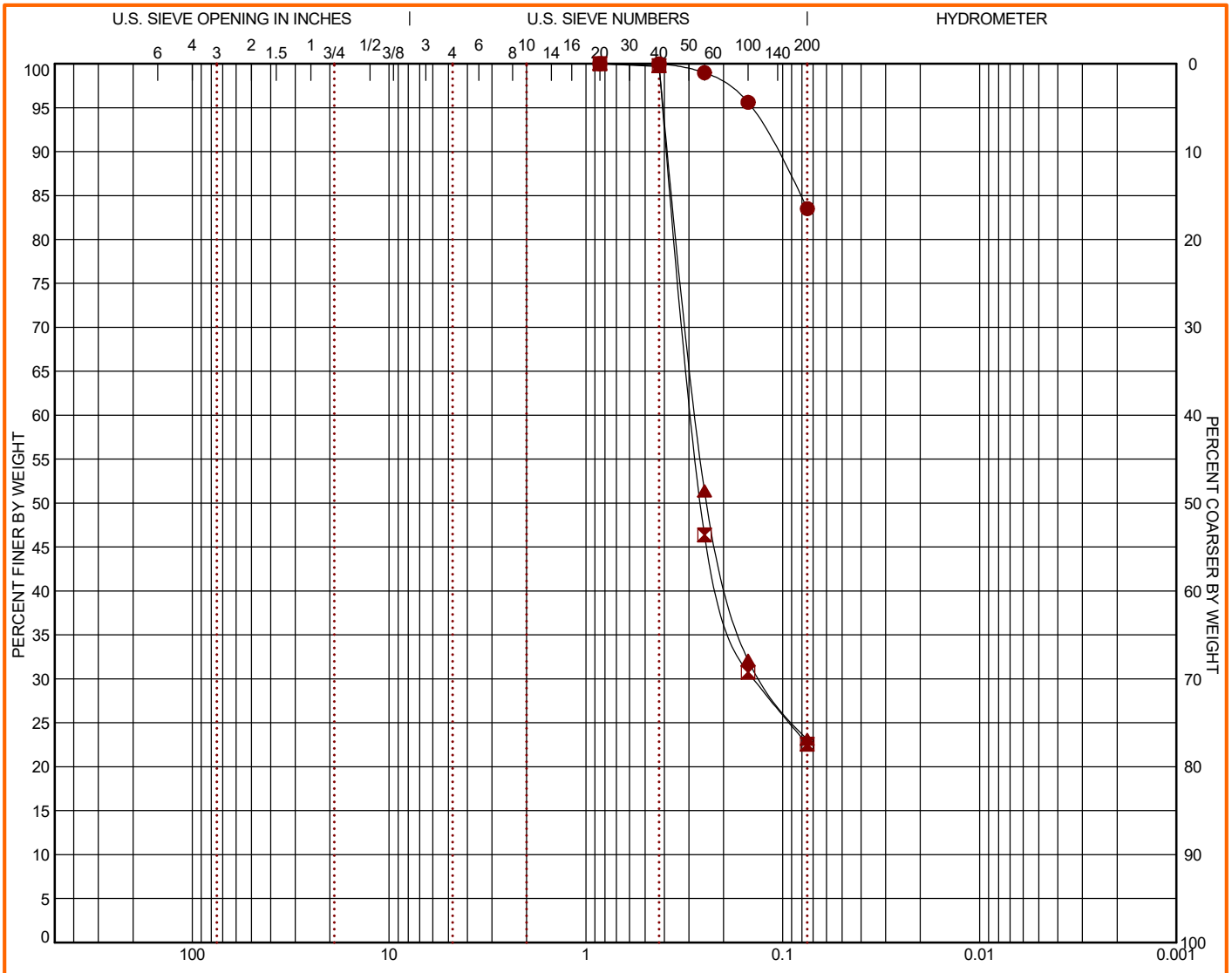

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-18	34.5 - 36	0.0	0.0	16.5		83.5		CL
⊠	ALD-18	39.5 - 41	0.0	0.0	77.4		22.6		SC
▲	ALD-18	49.5 - 51	0.0	0.0	76.9		23.1		SC

GRAIN SIZE	●	⊠	▲
D_{60}		0.286	0.275
D_{30}		0.141	0.127
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#20	100.0	#20	100.0	#20	100.0
#40	99.98	#40	99.78	#40	99.69
#60	98.98	#60	46.38	#60	51.4
#100	95.61	#100	30.77	#100	32.13
#200	83.5	#200	22.56	#200	23.12

SOIL DESCRIPTION	
●	LEAN CLAY with SAND (CL)
⊠	CLAYEY SAND (SC)
▲	CLAYEY SAND (SC)

REMARKS	
●	
⊠	
▲	

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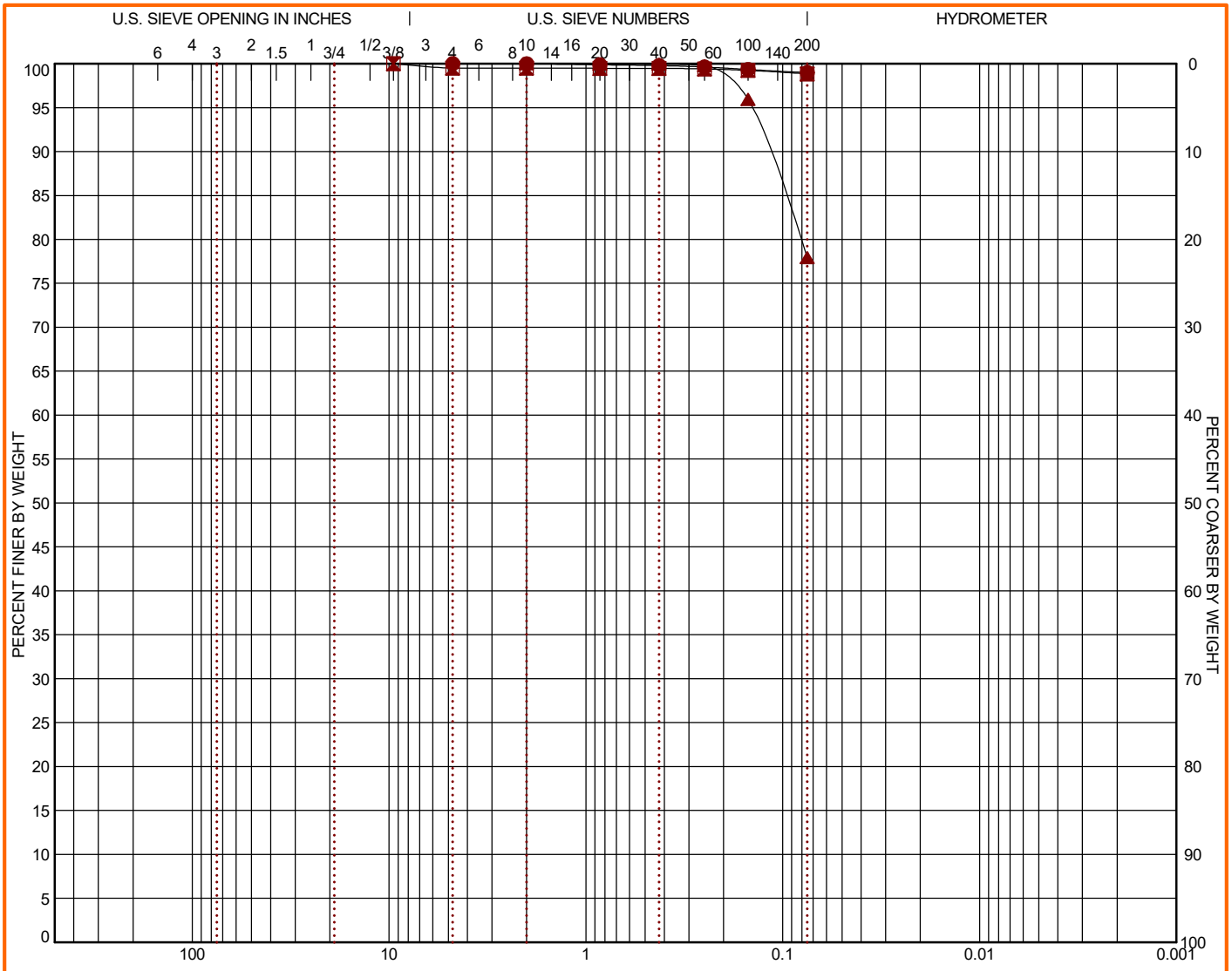

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-19	14.5 - 16	0.0	0.0	1.0		99.0		CH
⊠	ALD-19	24.5 - 26	0.0	0.5	0.6		98.8		CL
▲	ALD-19	34.5 - 36	0.0	0.0	22.1		77.9		CL

GRAIN SIZE	●	⊠	▲
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
#4	100.0	3/8"	100.0	#10	100.0
#10	99.99	#4	99.48	#20	99.97
#20	99.87	#10	99.48	#40	99.95
#40	99.78	#20	99.48	#60	99.8
#60	99.62	#40	99.47	#100	95.95
#100	99.34	#60	99.4	#200	77.92
#200	98.98	#100	99.24		
		#200	98.84		

SOIL DESCRIPTION	
●	FAT CLAY (CH)
⊠	LEAN CLAY (CL)
▲	LEAN CLAY with SAND (CL)

REMARKS	
●	
⊠	
▲	

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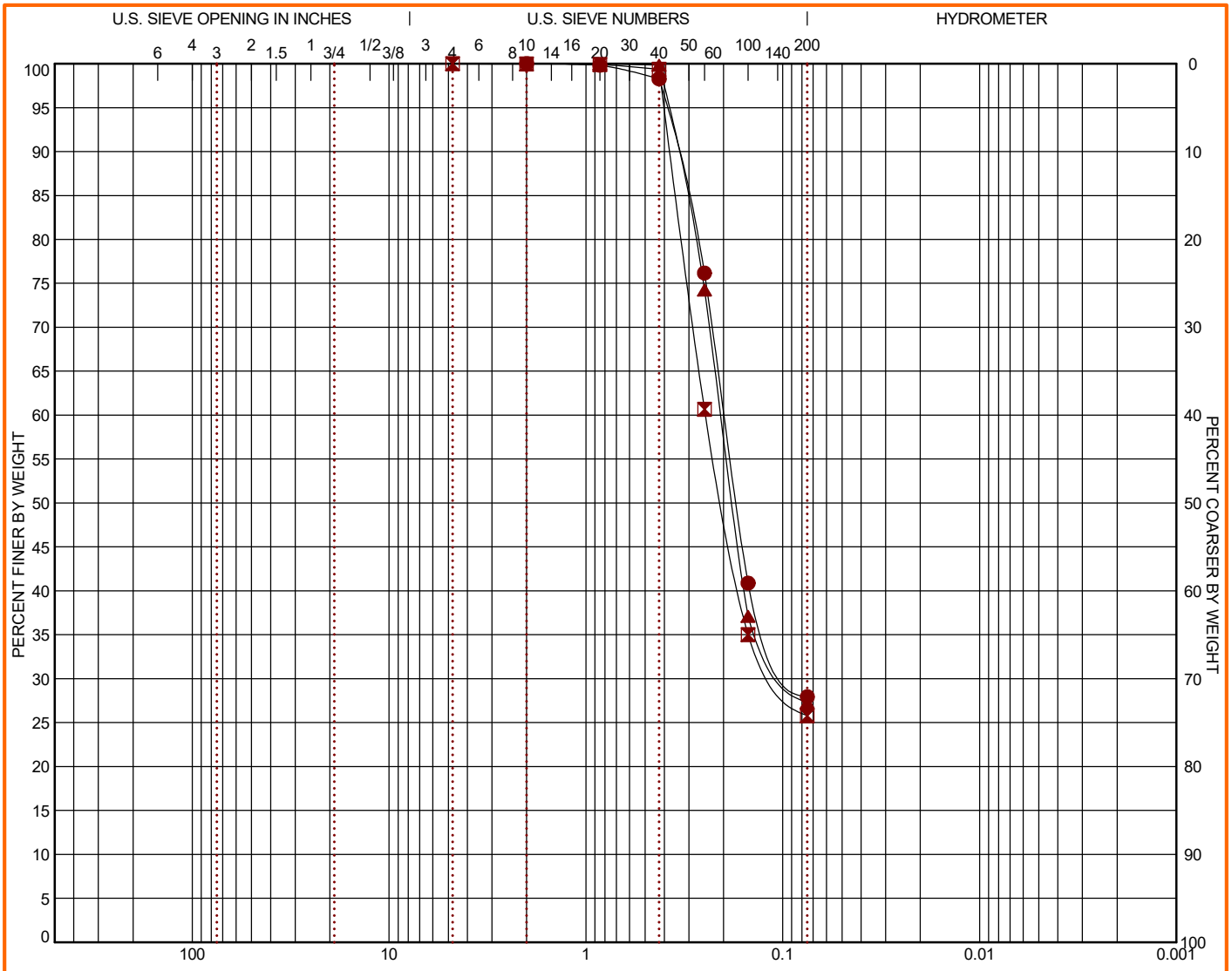

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-19	54.5 - 56	0.0	0.0	72.1		27.9		SC
⊠	ALD-19	64.5 - 66	0.0	0.0	74.2		25.8		SC
▲	ALD-20	29.5 - 31	0.0	0.0	72.7		27.3		SC

GRAIN SIZE	●	⊠	▲
D_{60}	0.198	0.247	0.206
D_{30}	0.084	0.103	0.091
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#10	100.0	#4	100.0	#20	100.0
#20	99.83	#10	99.98	#40	99.83
#40	98.27	#20	99.9	#60	74.24
#60	76.17	#40	99.37	#100	37.1
#100	40.88	#60	60.66	#200	27.3
#200	27.94	#100	35.02		
		#200	25.79		

SOIL DESCRIPTION	
●	CLAYEY SAND (SC)
⊠	CLAYEY SAND (SC)
▲	CLAYEY SAND (SC)

REMARKS	
●	
⊠	
▲	

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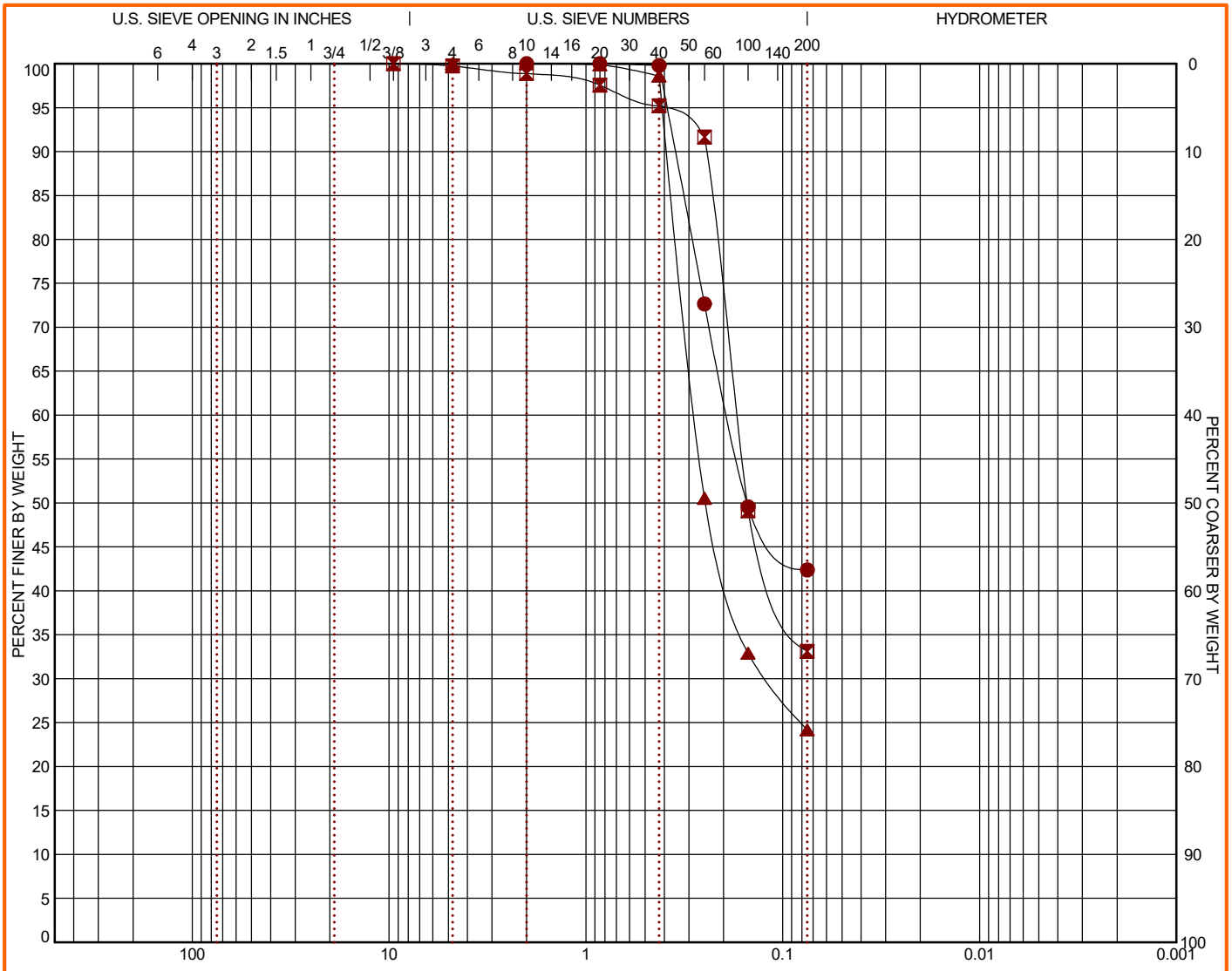
GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-20	34.5 - 36	0.0	0.0	57.6		42.4		SC
⊠	ALD-20	39.5 - 41	0.0	0.3	66.6		33.1		SC
▲	ALD-20	59.5 - 61	0.0	0.0	75.8		24.2		SC

GRAIN SIZE	●	⊠	▲
D_{60}	0.189	0.171	0.278
D_{30}			0.119
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#10	100.0	3/8"	100.0	#4	100.0
#20	100.0	#4	99.74	#10	99.99
#40	99.8	#10	98.87	#20	99.88
#60	72.66	#20	97.56	#40	98.6
#100	49.57	#40	95.22	#60	50.54
#200	42.38	#60	91.65	#100	32.9
		#100	49.12	#200	24.17
		#200	33.11		

SOIL DESCRIPTION	
●	CLAYEY SAND (SC)
⊠	CLAYEY SAND (SC)
▲	CLAYEY SAND (SC)

REMARKS	
●	
⊠	
▲	

PROJECT: GRE - Coal Creek Station

PROJECT NUMBER: M2215072

SITE: 2875 3rd St SW
Underwood, North Dakota

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

CLIENT: Golder Associates Inc
Lakewood, Colorado

GRAIN SIZE: USCS 1 M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/9/21

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GRAIN SIZE DISTRIBUTION

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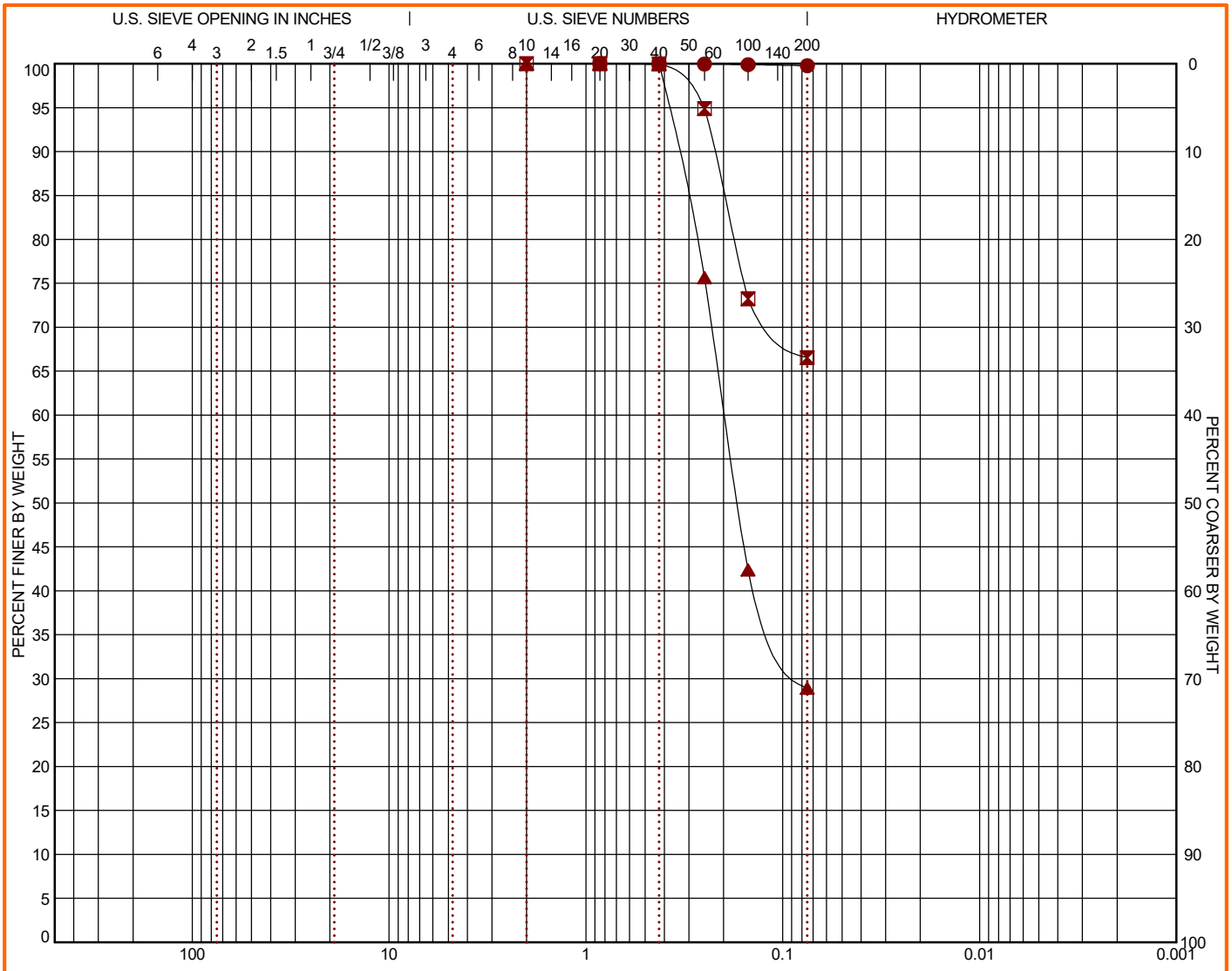

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-21	19.5 - 21	0.0	0.0	0.2		99.8		CL
⊠	ALD-21	24.5 - 26	0.0	0.0	33.5		66.5		CL
▲	ALD-21	44.5 - 46	0.0	0.0	71.1		28.9		SC

GRAIN SIZE	●	⊠	▲
D_{60}			0.197
D_{30}			0.079
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#20	100.0	#10	100.0	#10	100.0
#40	99.99	#20	100.0	#20	100.0
#60	99.96	#40	99.97	#40	99.94
#100	99.89	#60	94.88	#60	75.65
#200	99.77	#100	73.23	#100	42.37
		#200	66.55	#200	28.92

SOIL DESCRIPTION	
●	LEAN CLAY (CL)
⊠	SANDY LEAN CLAY (CL)
▲	CLAYEY SAND (SC)

REMARKS	
●	
⊠	
▲	

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GRAIN SIZE DISTRIBUTION

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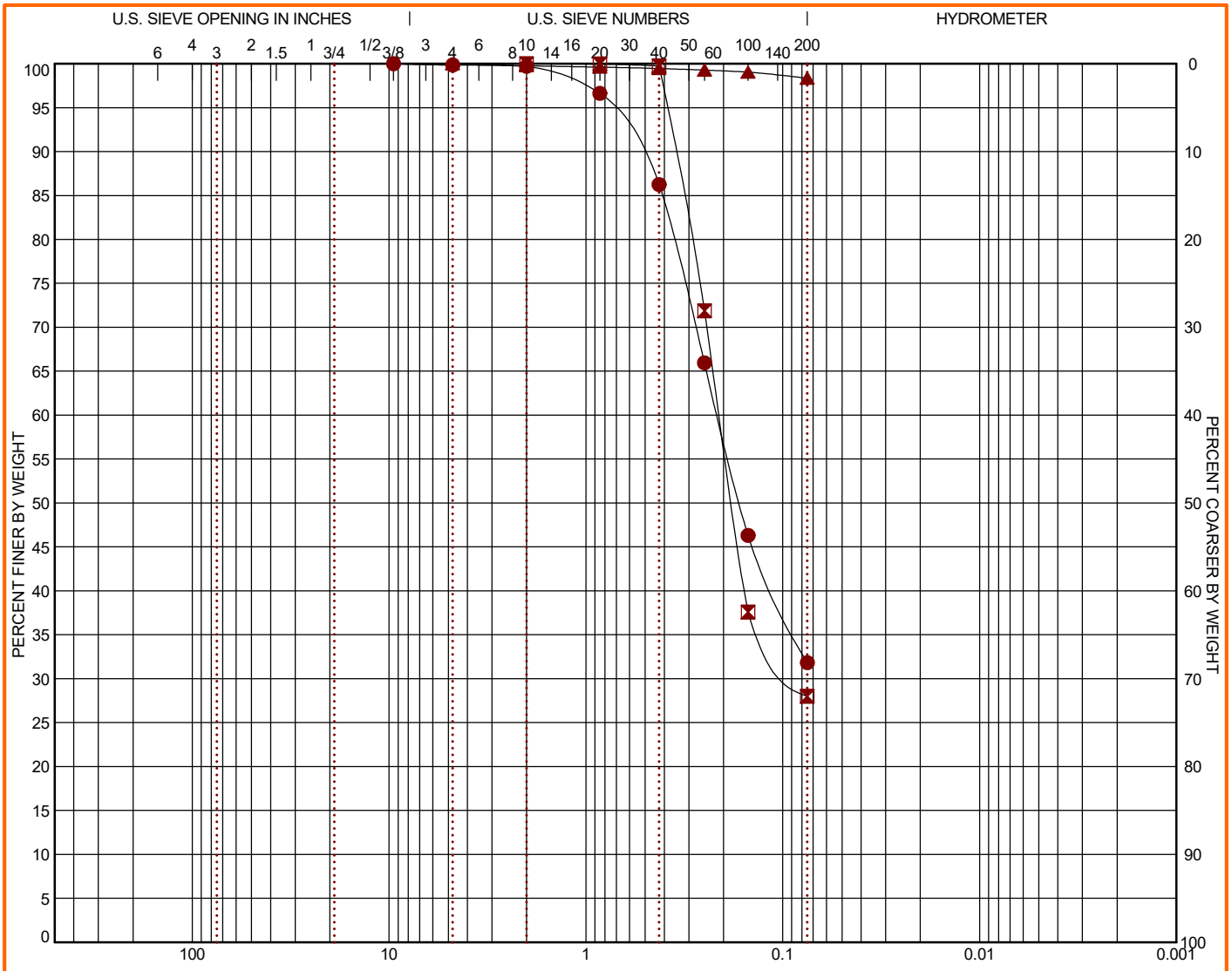

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-21	59.5 - 61	0.0	0.2	68.0		31.8		SC
⊠	ALD-21	69.5 - 71	0.0	0.0	72.0		28.0		SC
▲	ALD-22	19.5 - 21	0.0	0.0	1.7		98.3		CL

GRAIN SIZE	●	⊠	▲
D_{60}	0.214	0.209	
D_{30}		0.087	
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0	#10	100.0	#4	100.0
#4	99.85	#20	99.97	#10	99.76
#10	99.69	#40	99.74	#20	99.61
#20	96.62	#60	71.89	#40	99.45
#40	86.25	#100	37.59	#60	99.27
#60	65.95	#200	28.0	#100	99.03
#100	46.31			#200	98.34
#200	31.83				

SOIL DESCRIPTION	
●	CLAYEY SAND (SC)
⊠	CLAYEY SAND (SC)
▲	LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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GRAIN SIZE DISTRIBUTION

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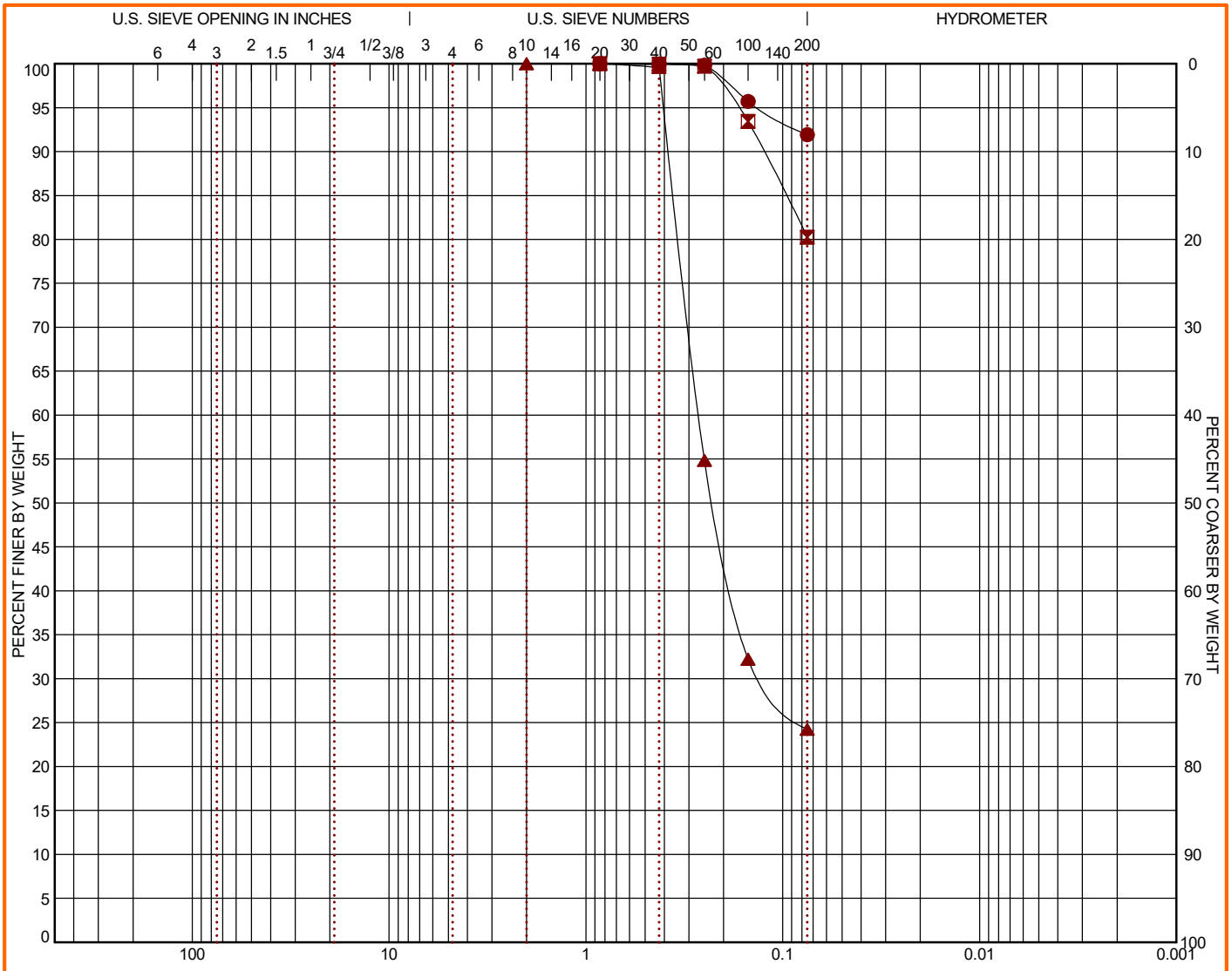

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-22	29.5 - 31	0.0	0.0	8.1		91.9		CL
⊠	ALD-22	34.5 - 36	0.0	0.0	19.7		80.3		CL
▲	ALD-22	44.5 - 46	0.0	0.0	75.8		24.2		SC-SM

GRAIN SIZE

	●	⊠	▲
D_{60}			0.266
D_{30}			0.124
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#20	100.0	#20	100.0	#10	100.0
#40	99.97	#40	99.94	#20	99.99
#60	99.83	#60	99.72	#40	99.58
#100	95.7	#100	93.42	#60	54.84
#200	91.91	#200	80.27	#100	32.22
				#200	24.24

SOIL DESCRIPTION

●	LEAN CLAY (CL)
⊠	LEAN CLAY with SAND (CL)
▲	SILTY, CLAYEY SAND (SC-SM)

REMARKS

●	
⊠	
▲	

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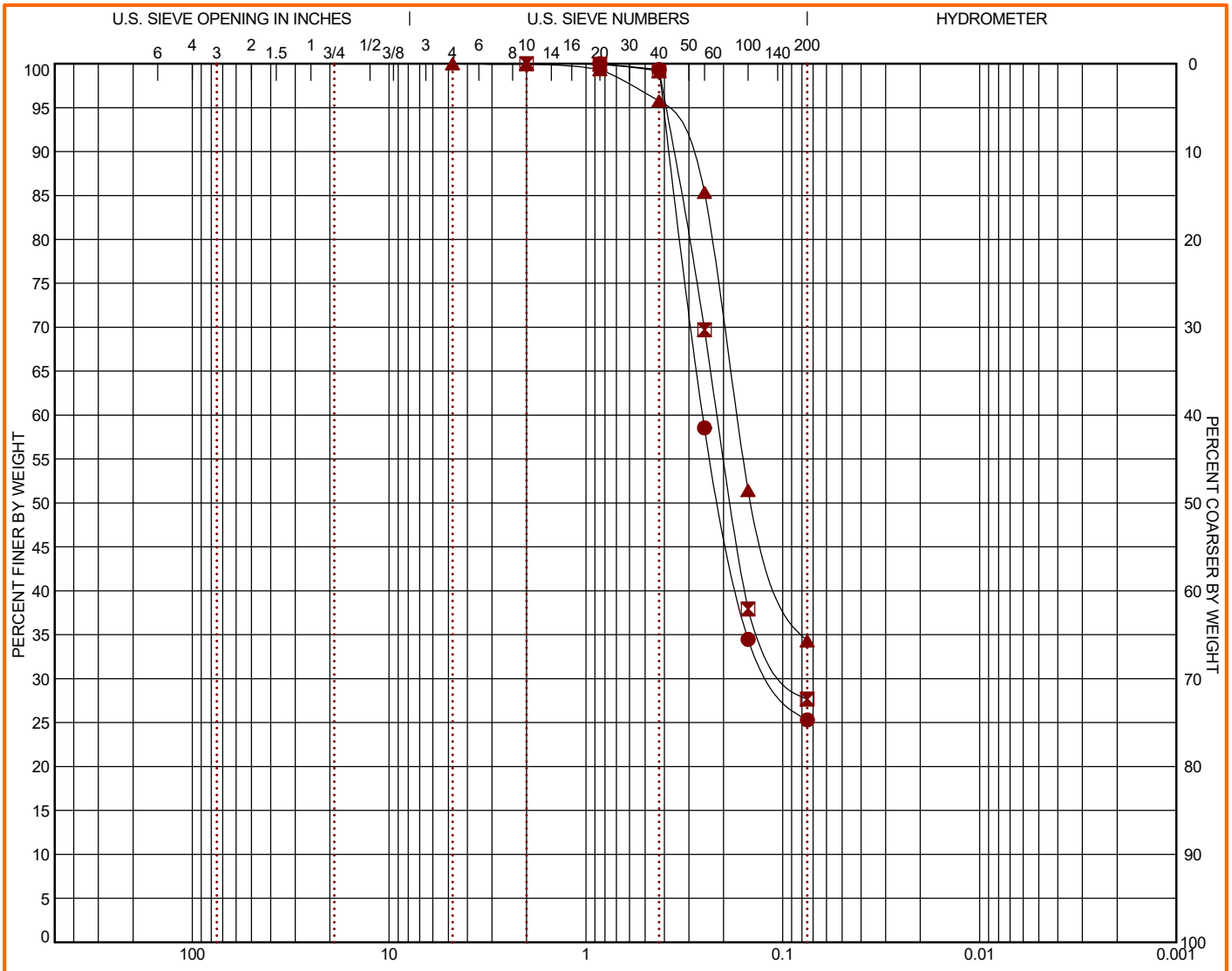

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-22	49.5 - 51	0.0	0.0	74.7		25.3		SC
⊠	ALD-22	64.5 - 66	0.0	0.0	72.3		27.7		SC
▲	ALD-22	69.5 - 71	0.0	0.0	65.7		34.3		SC

GRAIN SIZE	●	⊠	▲
D_{60}	0.255	0.214	0.171
D_{30}	0.107	0.088	
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#20	100.0	#10	100.0	#4	100.0
#40	99.35	#20	99.93	#10	99.93
#60	58.55	#40	99.19	#20	99.32
#100	34.47	#60	69.73	#40	95.77
#200	25.31	#100	37.93	#60	85.35
		#200	27.68	#100	51.43
				#200	34.31

SOIL DESCRIPTION	
●	CLAYEY SAND (SC)
⊠	CLAYEY SAND (SC)
▲	CLAYEY SAND (SC)

REMARKS	
●	
⊠	
▲	

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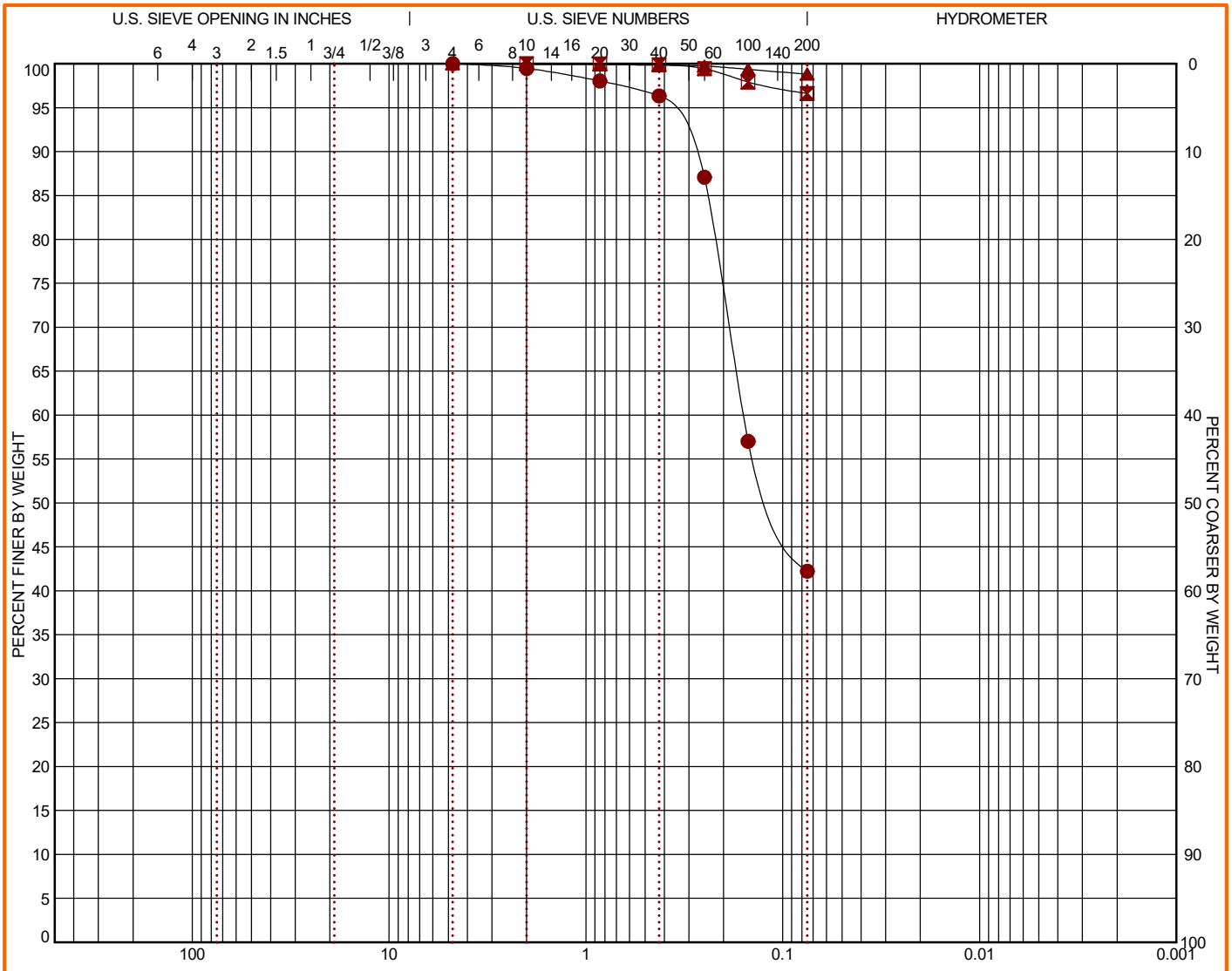

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-23	24.5 - 26	0.0	0.0	57.8		42.2		SC
⊠	ALD-23	29.5 - 31	0.0	0.0	3.4		96.6		CH
▲	ALD-23	39.5 - 41	0.0	0.0	1.2		98.8		CL

GRAIN SIZE	●	⊠	▲
D_{60}	0.158		
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#4	100.0	#10	100.0	#4	100.0
#10	99.46	#20	99.97	#10	99.92
#20	98.03	#40	99.86	#20	99.9
#40	96.33	#60	99.43	#40	99.83
#60	87.08	#100	97.92	#60	99.73
#100	57.02	#200	96.6	#100	99.35
#200	42.23			#200	98.82

SOIL DESCRIPTION	
●	CLAYEY SAND (SC)
⊠	FAT CLAY (CH)
▲	LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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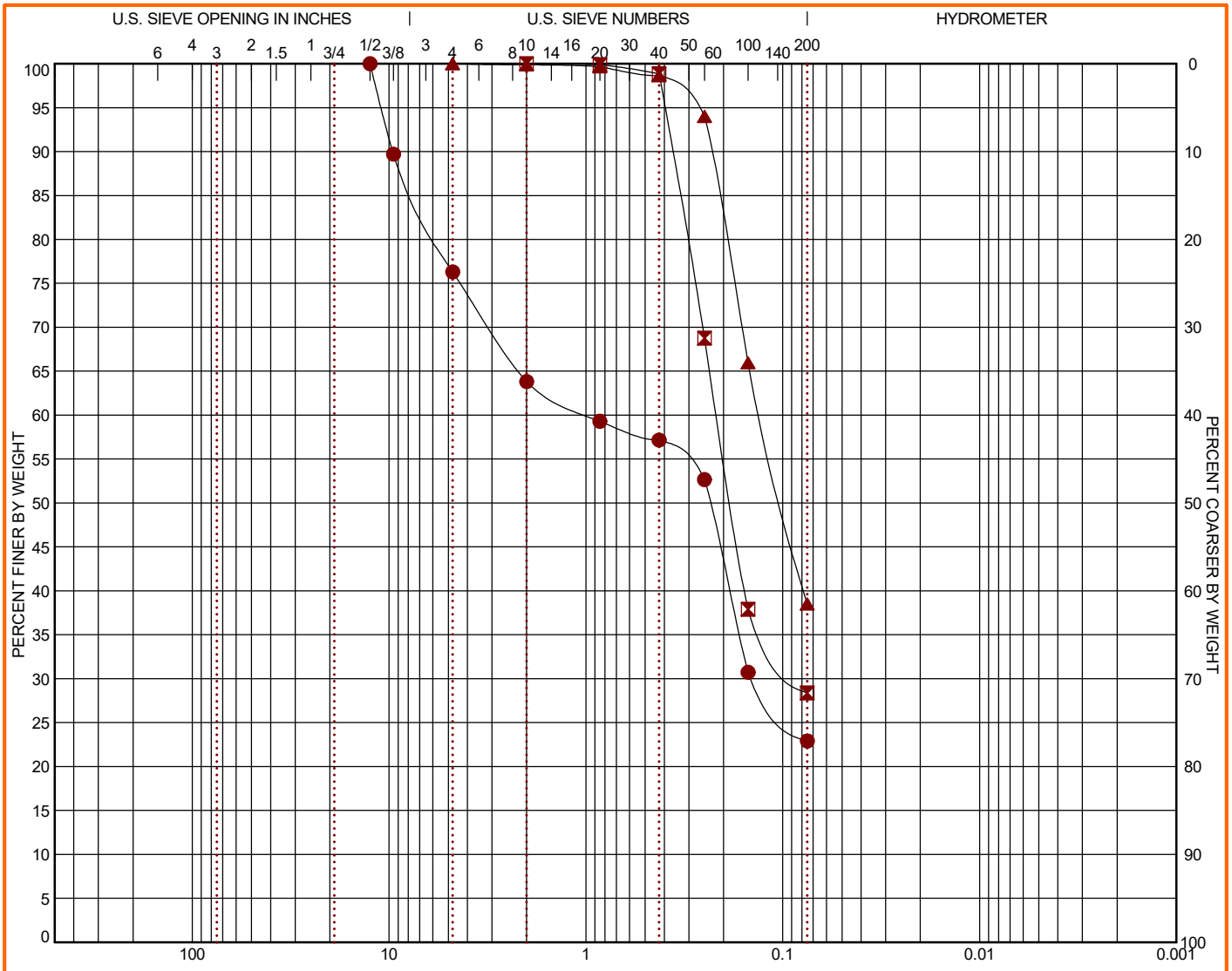

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-23	44.5 - 46	0.0	23.7	53.4		22.9		SC
⊠	ALD-23	69.5 - 71	0.0	0.0	71.6		28.4		SC
▲	ALD-24	19.5 - 21	0.0	0.0	61.5		38.5		SM

GRAIN SIZE	●	⊠	▲
D_{60}	0.97	0.216	0.129
D_{30}	0.141	0.084	
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
1/2"	100.0	#10	100.0	#4	100.0
3/8"	89.7	#20	99.88	#10	99.87
#4	76.3	#40	98.86	#20	99.66
#10	63.82	#60	68.75	#40	98.64
#20	59.3	#100	37.9	#60	93.99
#40	57.16	#200	28.37	#100	65.95
#60	52.66			#200	38.51
#100	30.73				
#200	22.92				

SOIL DESCRIPTION	
●	CLAYEY SAND with GRAVEL (SC)
⊠	CLAYEY SAND (SC)
▲	SILTY SAND (SM)

REMARKS	
●	
⊠	
▲	

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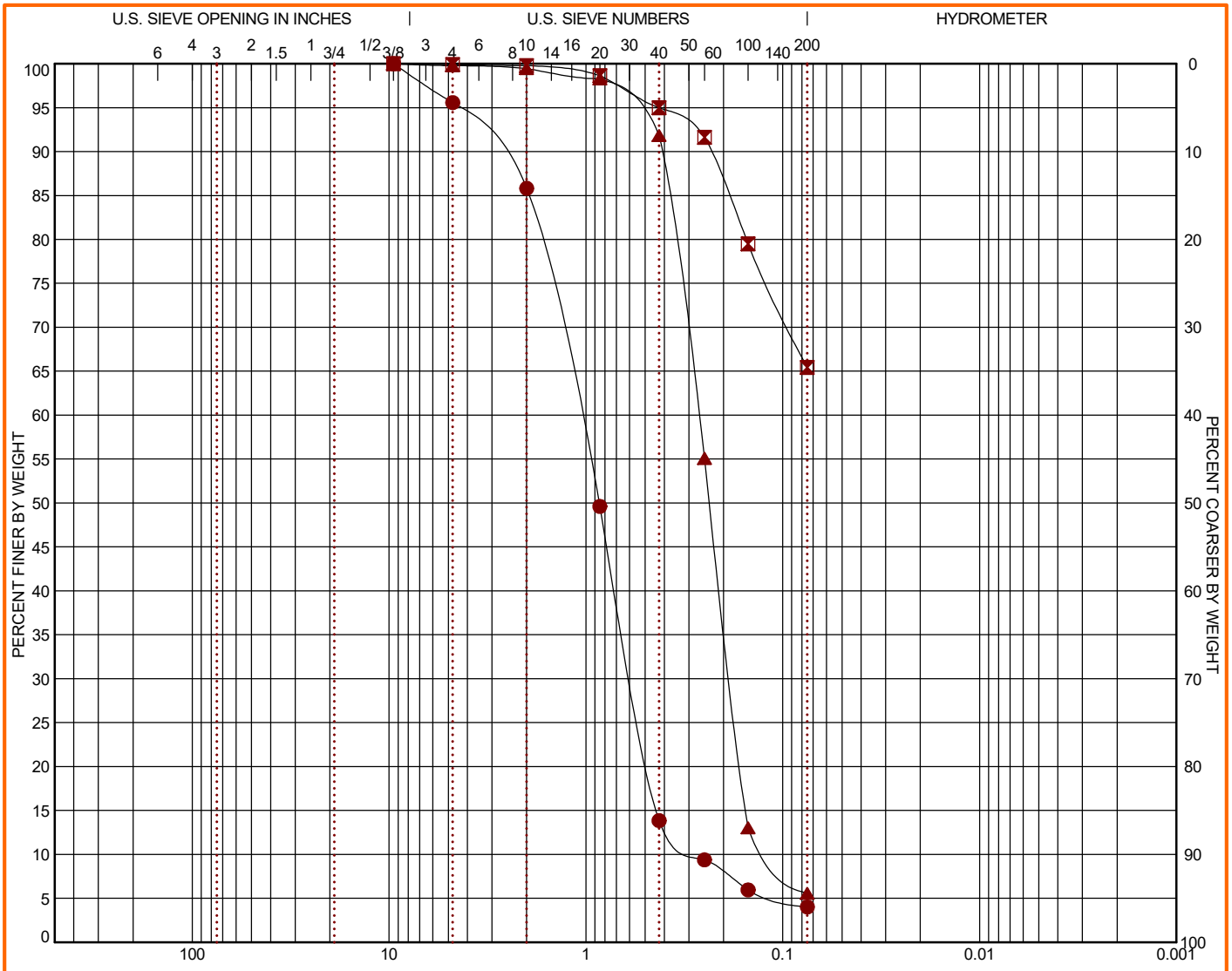

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-24	34.5 - 36	0.0	4.4	91.5		4.0		SP
⊠	ALD-24	39.5 - 41	0.0	0.1	34.5		65.4		CL
▲	ALD-24	44.5 - 46	0.0	0.2	94.2		5.6		SP-SM

GRAIN SIZE	●	⊠	▲
D_{60}	1.087		0.268
D_{30}	0.581		0.184
D_{10}	0.269		0.113

COEFFICIENTS	●	⊠	▲
C_C	1.16		1.12
C_U	4.04		2.37

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0	3/8"	100.0	3/8"	100.0
#4	95.57	#4	99.9	#4	99.79
#10	85.81	#10	99.78	#10	99.44
#20	49.61	#20	98.63	#20	98.29
#40	13.85	#40	94.97	#40	91.82
#60	9.38	#60	91.63	#60	55.08
#100	5.96	#100	79.5	#100	13.04
#200	4.03	#200	65.44	#200	5.57

SOIL DESCRIPTION	
●	POORLY GRADED SAND (SP)
⊠	SANDY LEAN CLAY (CL)
▲	POORLY GRADED SAND with SILT (SP-SM)

REMARKS	
●	
⊠	
▲	

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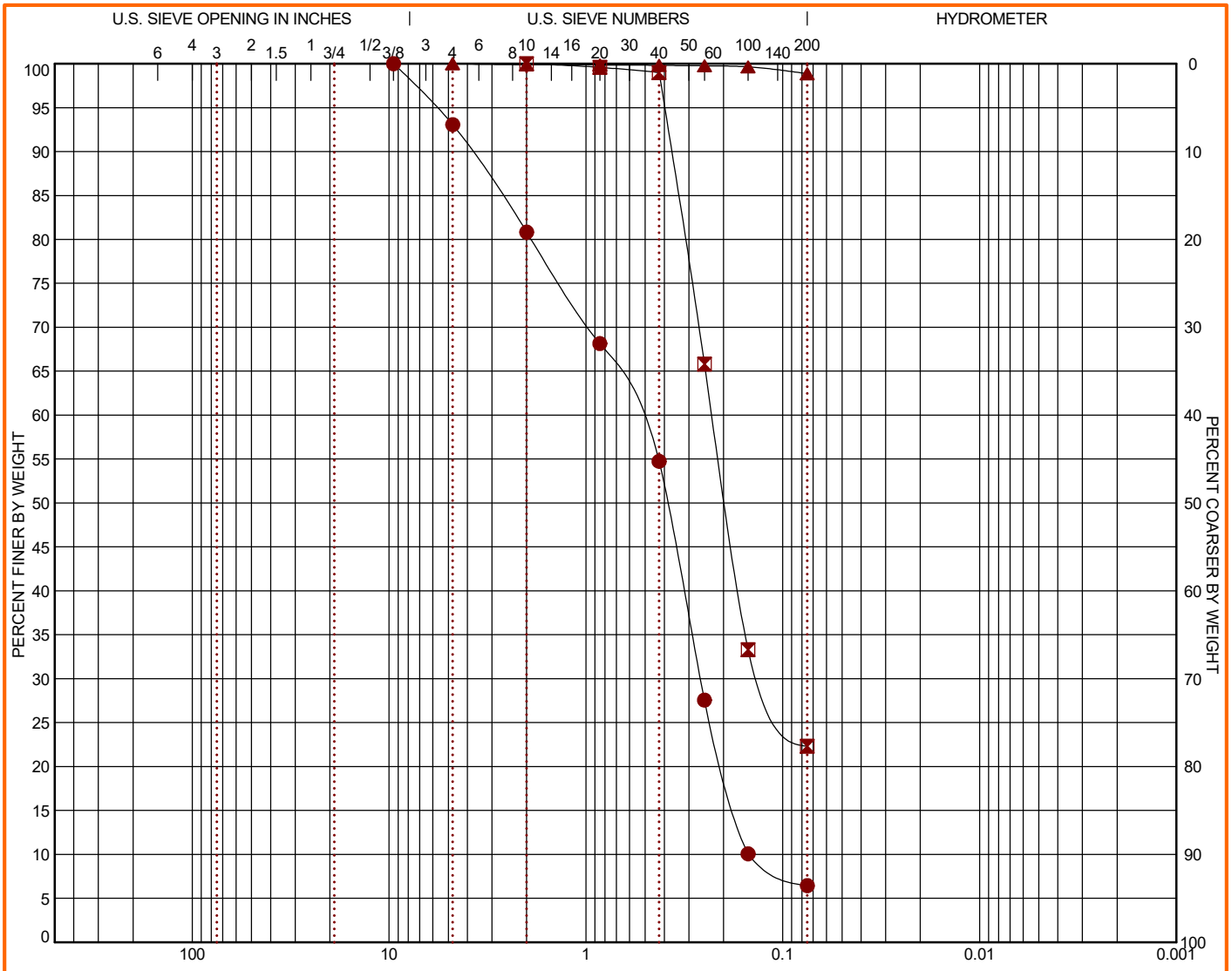

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-24	54.5 - 56	0.0	6.9	86.6		6.4		SP-SM
⊠	ALD-24	74.5 - 76	0.0	0.0	77.7		22.3		SC
▲	ALD-25	14.5 - 16	0.0	0.0	1.1		98.9		CH

GRAIN SIZE	●	⊠	▲
D_{60}	0.558	0.228	
D_{30}	0.262	0.122	
D_{10}	0.148		

COEFFICIENTS	●	⊠	▲
C_C	0.83		
C_U	3.77		

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0	#10	100.0	#4	100.0
#4	93.06	#20	99.58	#10	99.88
#10	80.83	#40	99.0	#20	99.86
#20	68.14	#60	65.8	#40	99.81
#40	54.74	#100	33.3	#60	99.76
#60	27.56	#200	22.31	#100	99.64
#100	10.07			#200	98.86
#200	6.45				

SOIL DESCRIPTION	
●	POORLY GRADED SAND with SILT (SP-SM)
⊠	CLAYEY SAND (SC)
▲	FAT CLAY (CH)

REMARKS	
●	
⊠	
▲	

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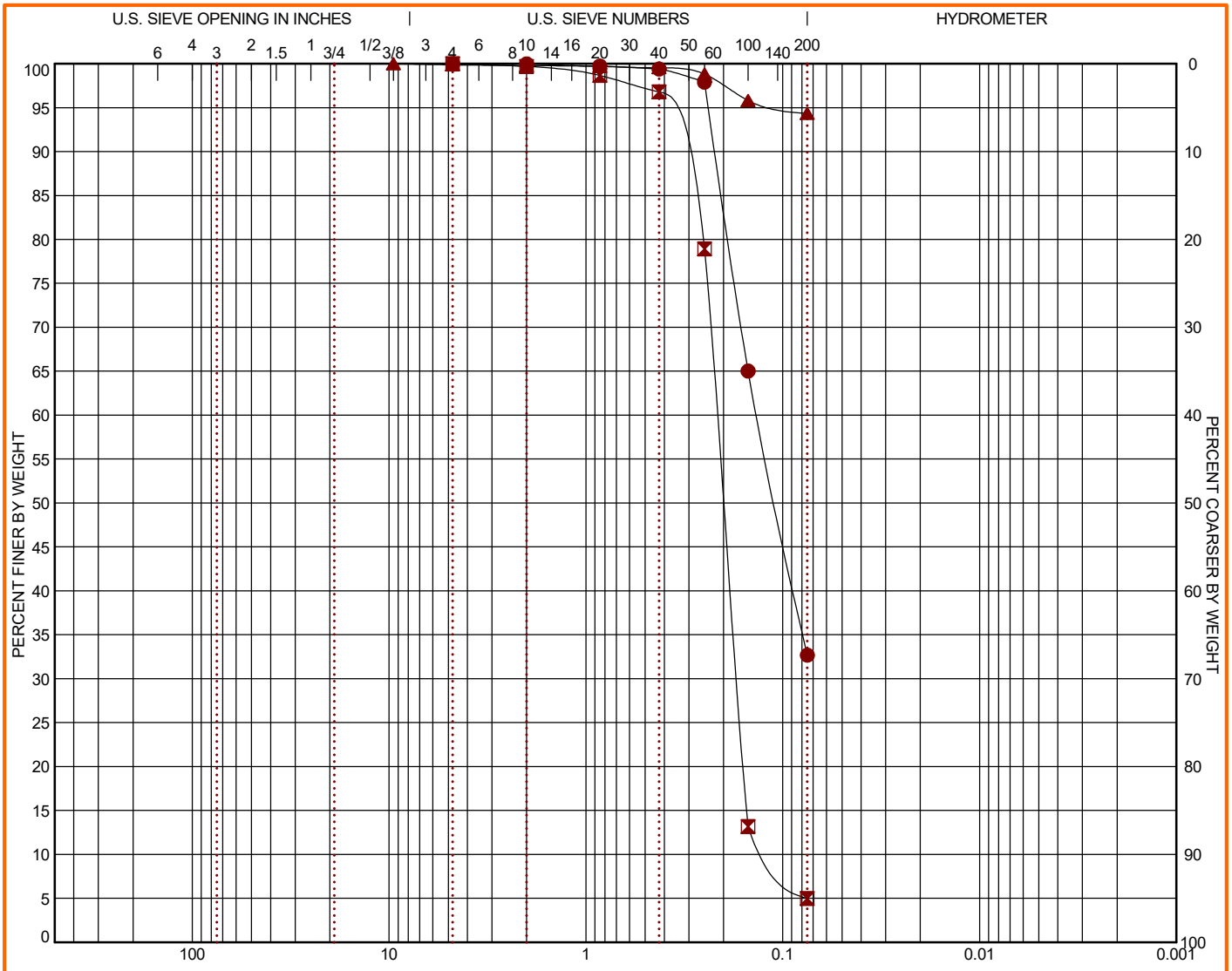

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-25	24.5 - 26	0.0	0.0	67.3		32.7		SM
⊠	ALD-25	29.5 - 31	0.0	0.0	95.0		5.0		SP
▲	ALD-25	44.5 - 46	0.0	0.1	5.5		94.3		CL

GRAIN SIZE	●	⊠	▲
D_{60}	0.135	0.216	
D_{30}		0.171	
D_{10}		0.115	

COEFFICIENTS	●	⊠	▲
C_C		1.18	
C_U		1.88	

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#4	100.0	#4	100.0	3/8"	100.0
#10	99.97	#10	99.68	#4	99.87
#20	99.73	#20	98.67	#10	99.79
#40	99.39	#40	96.78	#20	99.68
#60	97.9	#60	78.93	#40	99.53
#100	65.01	#100	13.17	#60	98.82
#200	32.68	#200	4.98	#100	95.81
				#200	94.35

SOIL DESCRIPTION	
●	SILTY SAND (SM)
⊠	POORLY GRADED SAND (SP)
▲	LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

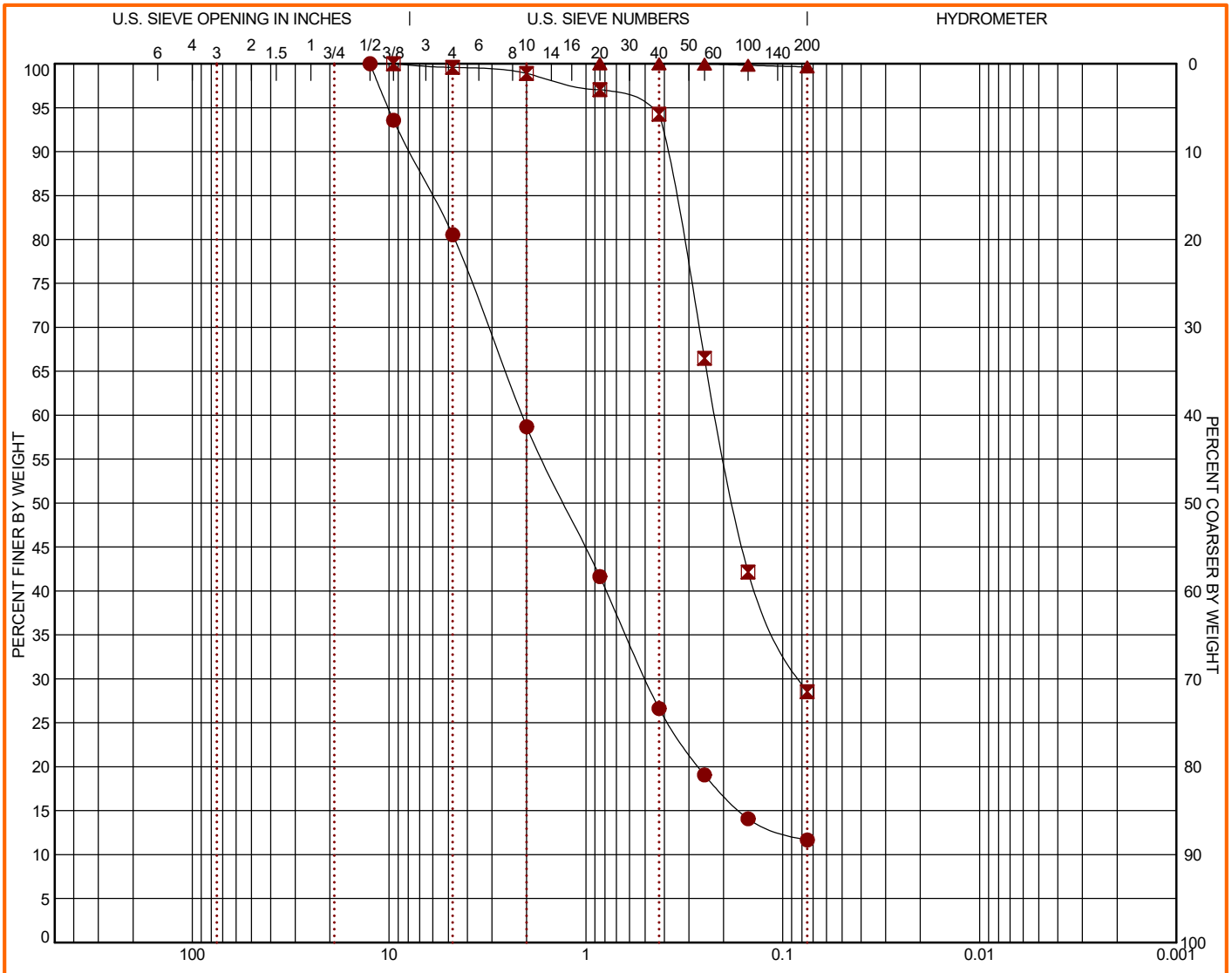
CLIENT: Golder Associates Inc
Lakewood, Colorado

GRAIN SIZE: USCS 1 M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/9/21

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT.

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-25	49.5 - 51	0.0	19.5	68.9		11.7		SW-SM
⊠	ALD-25	54.5 - 55.1	0.0	0.4	71.0		28.6		SC
▲	ALD-26	24.5 - 26	0.0	0.0	0.4		99.6		CL

GRAIN SIZE	●	⊠	▲
D_{60}	2.107	0.218	
D_{30}	0.497	0.081	
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C	2.52		
C_U	45.34		

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
1/2"	100.0	3/8"	100.0	#20	100.0
3/8"	93.56	#4	99.59	#40	99.99
#4	80.54	#10	98.9	#60	99.96
#10	58.69	#20	97.06	#100	99.82
#20	41.64	#40	94.26	#200	99.63
#40	26.63	#60	66.48		
#60	19.07	#100	42.16		
#100	14.08	#200	28.55		
#200	11.67				

SOIL DESCRIPTION	
●	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
⊠	CLAYEY SAND (SC)
▲	LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

PROJECT: GRE - Coal Creek Station

PROJECT NUMBER: M2215072

SITE: 2875 3rd St SW
Underwood, North Dakota

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

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Lakewood, Colorado

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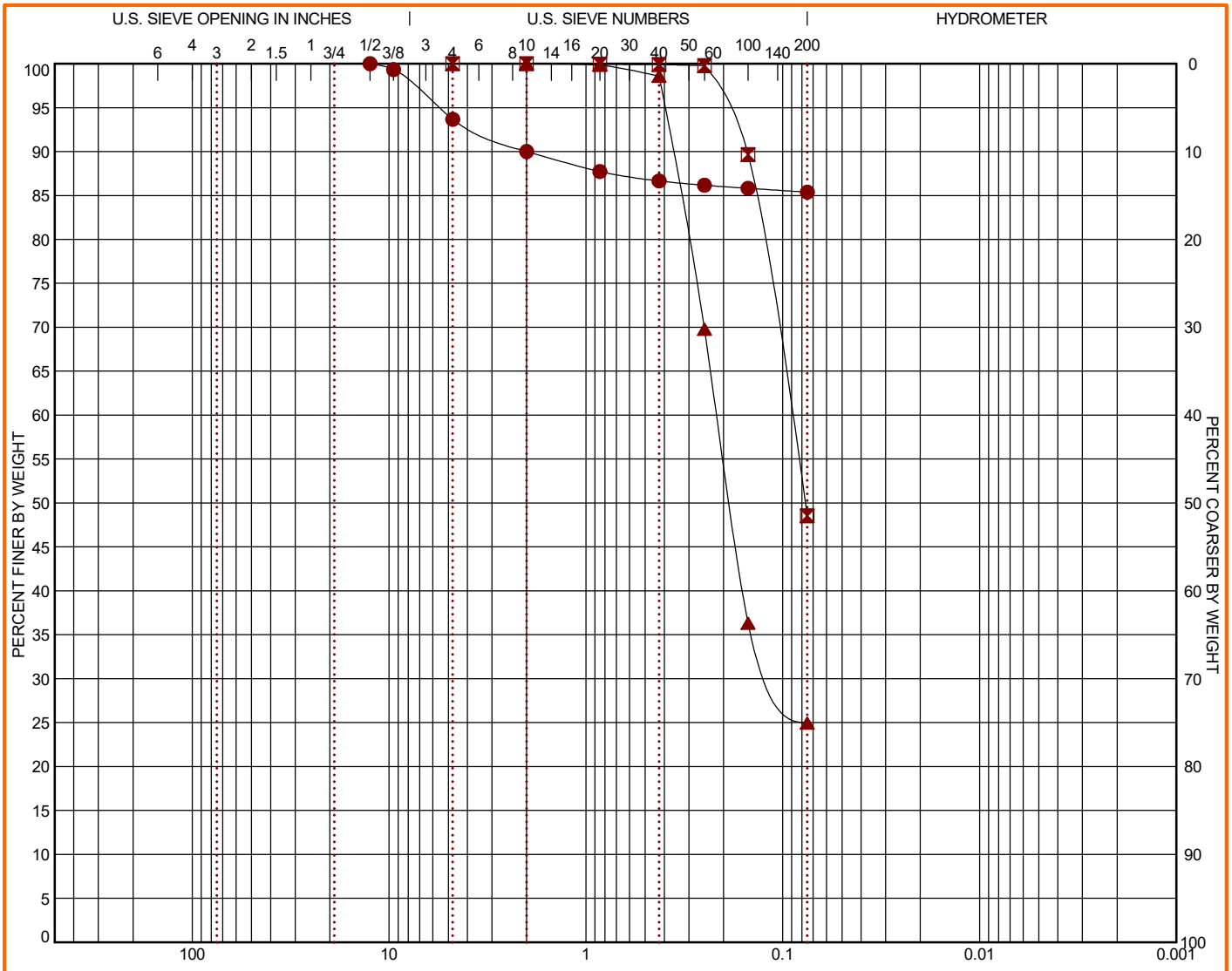

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-26	29.5 - 31	0.0	6.3	8.3		85.4		CL
⊠	ALD-26	34.5 - 36	0.0	0.0	51.5		48.5		SC
▲	ALD-26	54.5 - 56	0.0	0.0	75.0		25.0		SC

GRAIN SIZE

	●	⊠	▲
D_{60}		0.091	0.215
D_{30}			0.102
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
1/2"	100.0	#4	100.0	#10	100.0
3/8"	99.33	#10	99.99	#20	99.84
#4	93.67	#20	99.93	#40	98.57
#10	90.0	#40	99.89	#60	69.77
#20	87.73	#60	99.78	#100	36.33
#40	86.65	#100	89.65	#200	24.96
#60	86.17	#200	48.53		
#100	85.82				
#200	85.38				

SOIL DESCRIPTION

●	LEAN CLAY (CL)
⊠	CLAYEY SAND (SC)
▲	CLAYEY SAND (SC)

REMARKS

●	
⊠	
▲	

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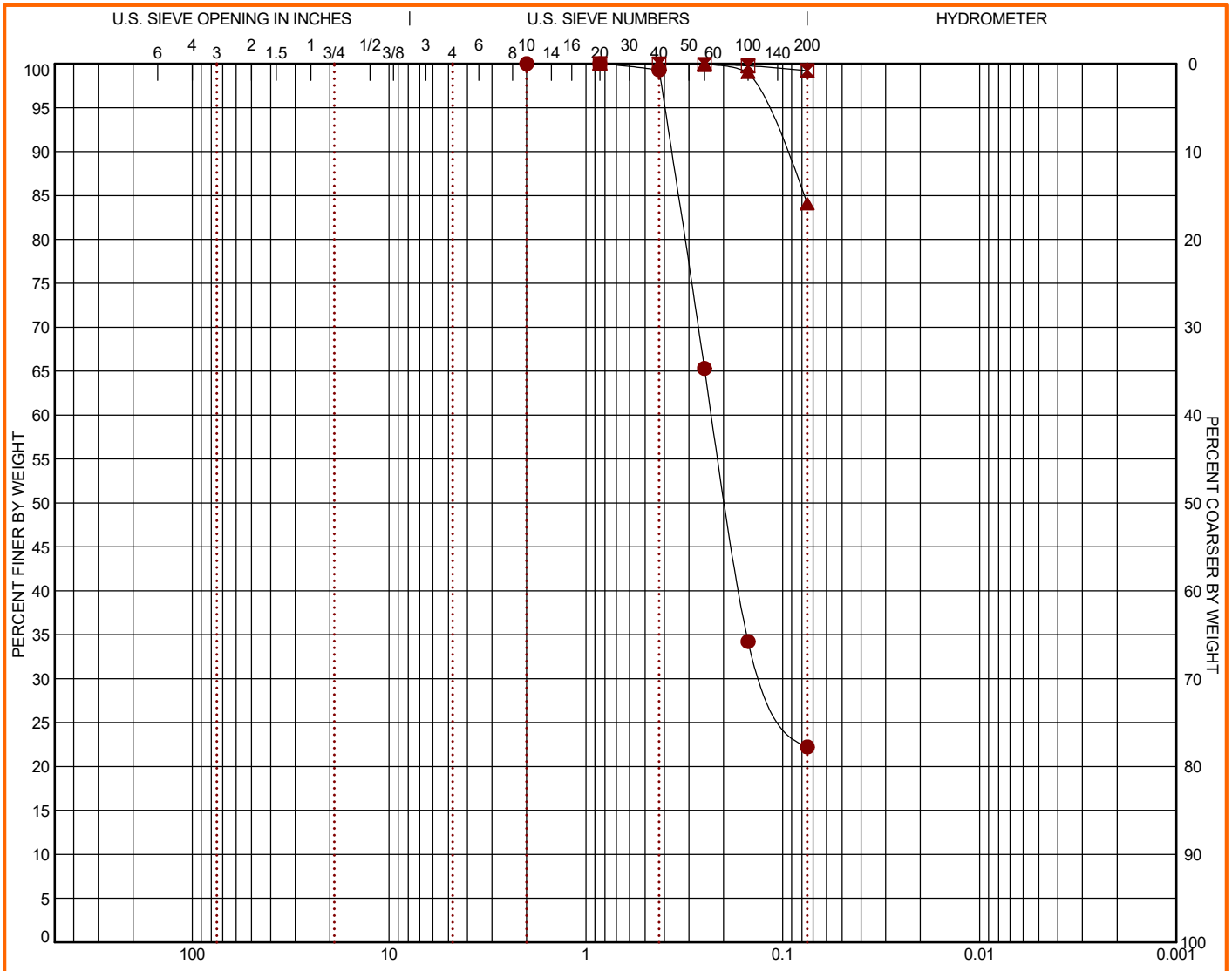

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-26	64.5 - 66	0.0	0.0	77.8		22.2		SC
⊠	ALD-27	29.5 - 31	0.0	0.0	0.8		99.2		CL
▲	ALD-27	39.5 - 41			15.9		84.1		CL

GRAIN SIZE	●	⊠	▲
D_{60}	0.229		
D_{30}	0.117		
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
#10	100.0	#20	100.0	#20	99.99
#20	99.99	#40	99.98	#40	99.98
#40	99.28	#60	99.92	#60	99.93
#60	65.32	#100	99.76	#100	98.99
#100	34.23	#200	99.21	#200	84.07
#200	22.23				

SOIL DESCRIPTION	
●	CLAYEY SAND (SC)
⊠	LEAN CLAY (CL)
▲	LEAN CLAY with SAND (CL)

REMARKS	
●	
⊠	
▲	

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GRAIN SIZE DISTRIBUTION

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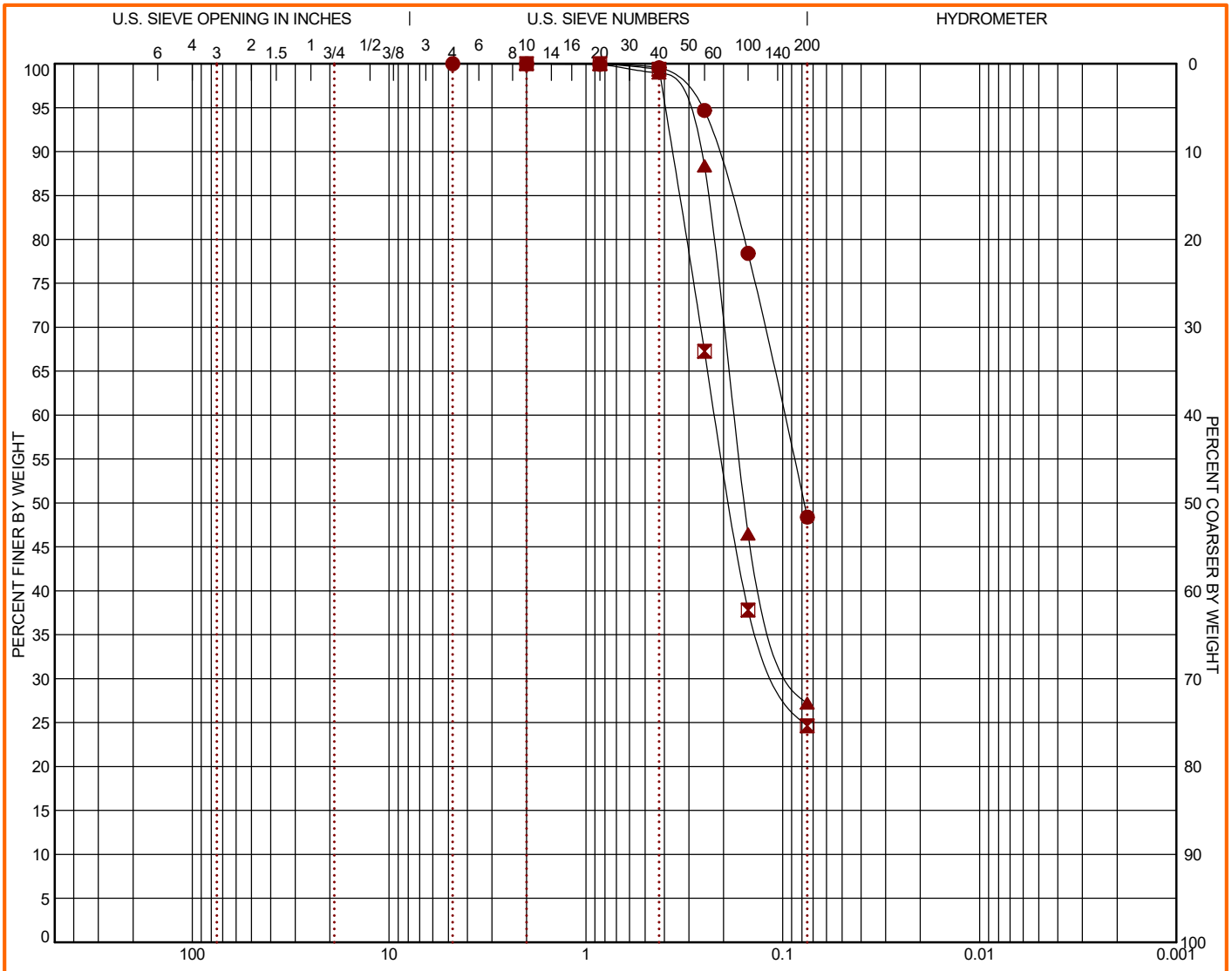

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-27	49.5 - 51	0.0	0.0	51.6		48.4		SC
⊠	ALD-27	54.5 - 56	0.0	0.0	75.4		24.6		SC
▲	ALD-27	74.5 - 76	0.0	0.0	72.8		27.2		SC

GRAIN SIZE	●	⊠	▲
D_{60}	0.098	0.22	0.177
D_{30}		0.099	0.083
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#4	100.0	#10	100.0	#10	100.0
#10	99.98	#20	99.99	#20	99.93
#20	99.92	#40	99.38	#40	98.93
#40	99.54	#60	67.28	#60	88.38
#60	94.68	#100	37.82	#100	46.47
#100	78.41	#200	24.64	#200	27.22
#200	48.39				

SOIL DESCRIPTION	
●	CLAYEY SAND (SC)
⊠	CLAYEY SAND (SC)
▲	CLAYEY SAND (SC)

REMARKS	
●	
⊠	
▲	

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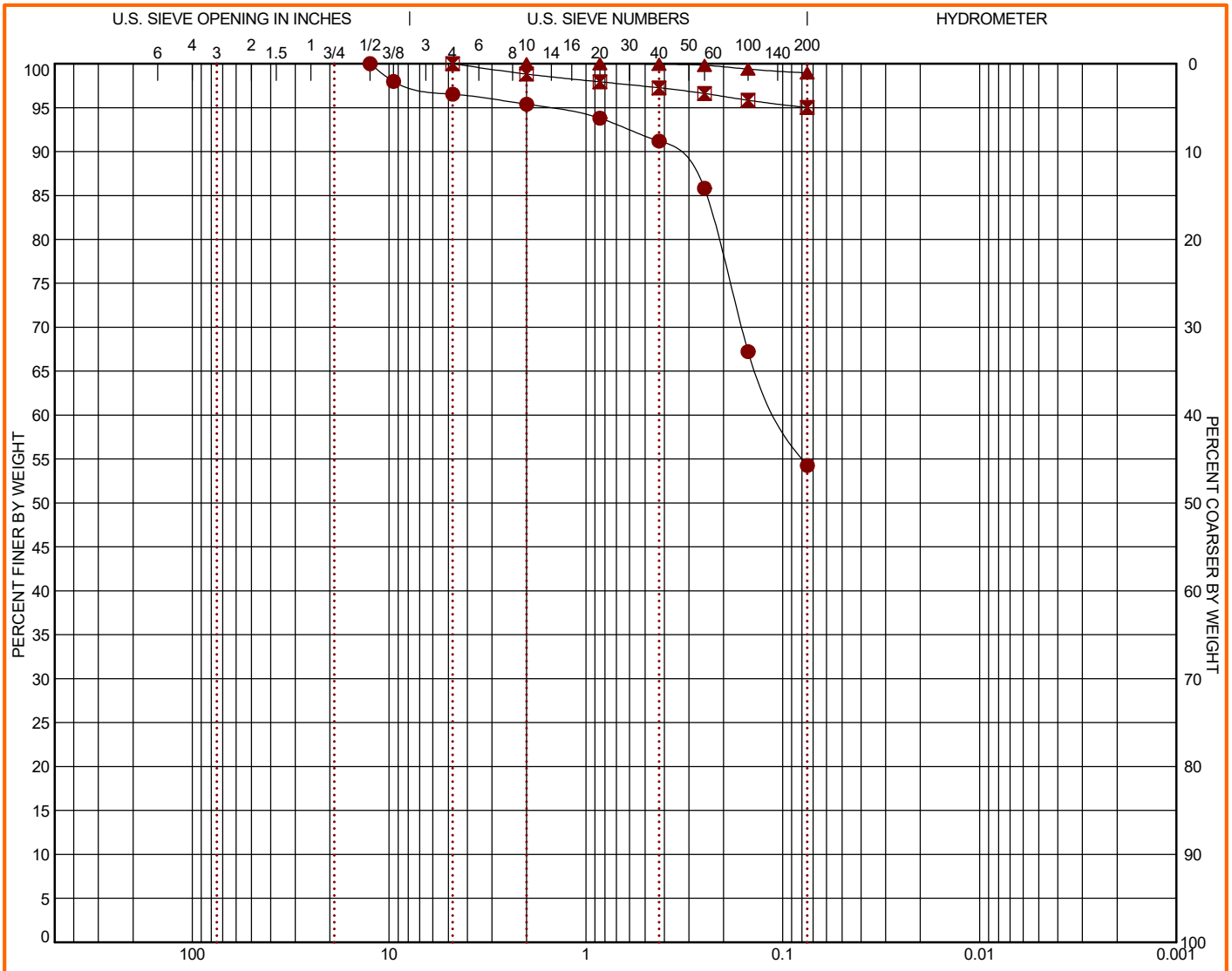

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-28	9.5 - 11	0.0	3.5	42.3		54.3		CL
⊠	ALD-28	19.5 - 21	0.0	0.0	5.0		95.0		CH
▲	ALD-28	29.5 - 31	0.0	0.0	1.1		98.9		CL

GRAIN SIZE	●	⊠	▲
D_{60}	0.102		
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
1/2"	100.0	#4	100.0	#10	100.0
3/8"	97.97	#10	98.81	#20	99.99
#4	96.53	#20	97.93	#40	99.94
#10	95.39	#40	97.25	#60	99.82
#20	93.8	#60	96.61	#100	99.38
#40	91.19	#100	95.84	#200	98.95
#60	85.82	#200	95.0		
#100	67.23				
#200	54.27				

SOIL DESCRIPTION	
●	SANDY LEAN CLAY (CL)
⊠	FAT CLAY (CH)
▲	LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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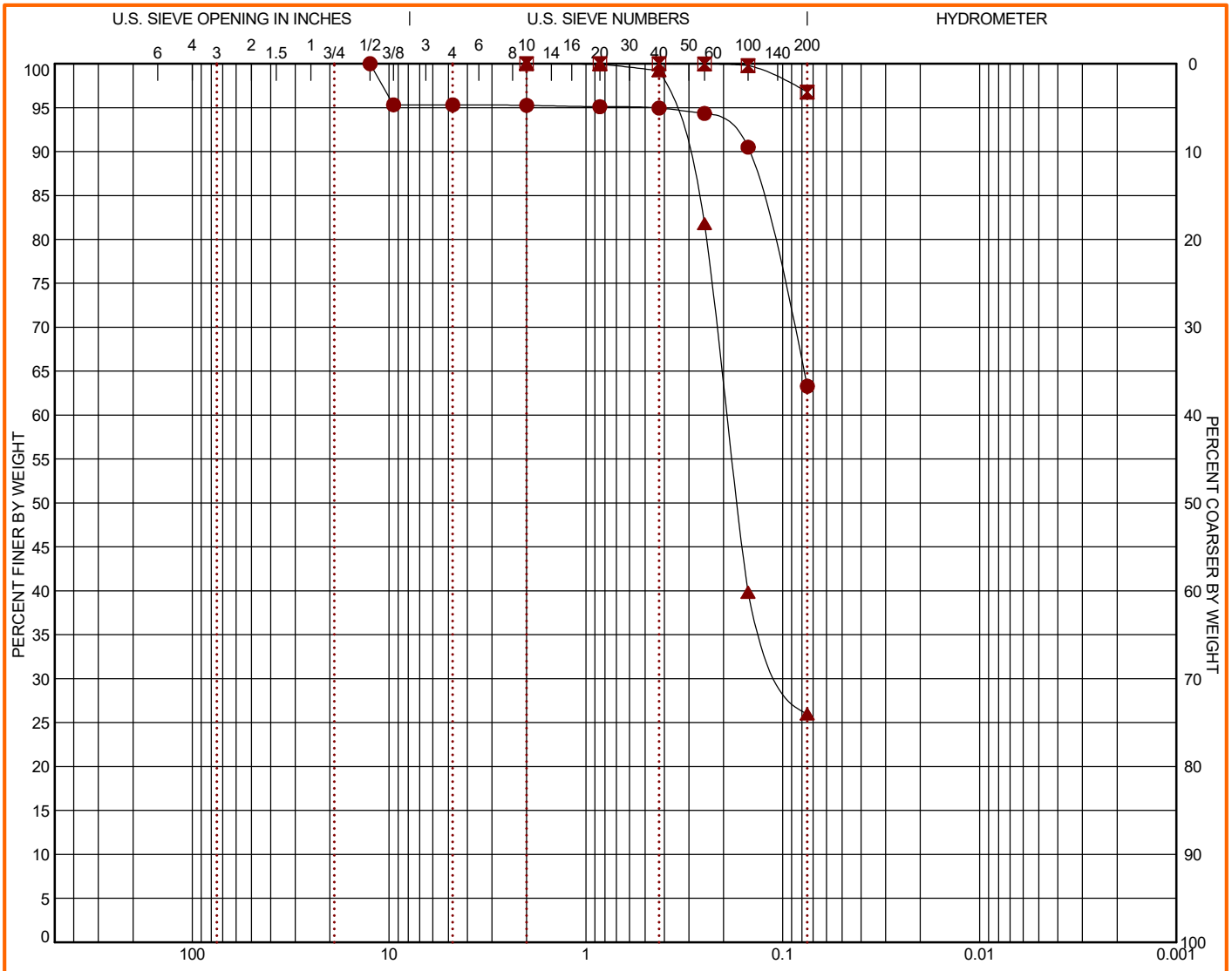

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-28	39.5 - 41	0.0	4.7	32.0		63.3		CL
⊠	ALD-28	44.5 - 46	0.0	0.0	3.2		96.8		CH
▲	ALD-28	69.5 - 71	0.0	0.0	74.0		26.0		SC

GRAIN SIZE	●	⊠	▲
D_{60}			0.192
D_{30}			0.092
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
1/2"	100.0	#10	100.0	#10	100.0
3/8"	95.31	#20	99.99	#20	99.91
#4	95.31	#40	99.99	#40	99.2
#10	95.26	#60	99.98	#60	81.79
#20	95.11	#100	99.78	#100	39.84
#40	94.95	#200	96.77	#200	25.98
#60	94.34				
#100	90.49				
#200	63.29				

SOIL DESCRIPTION	
●	SANDY LEAN CLAY (CL)
⊠	FAT CLAY (CH)
▲	CLAYEY SAND (SC)

REMARKS	
●	
⊠	
▲	

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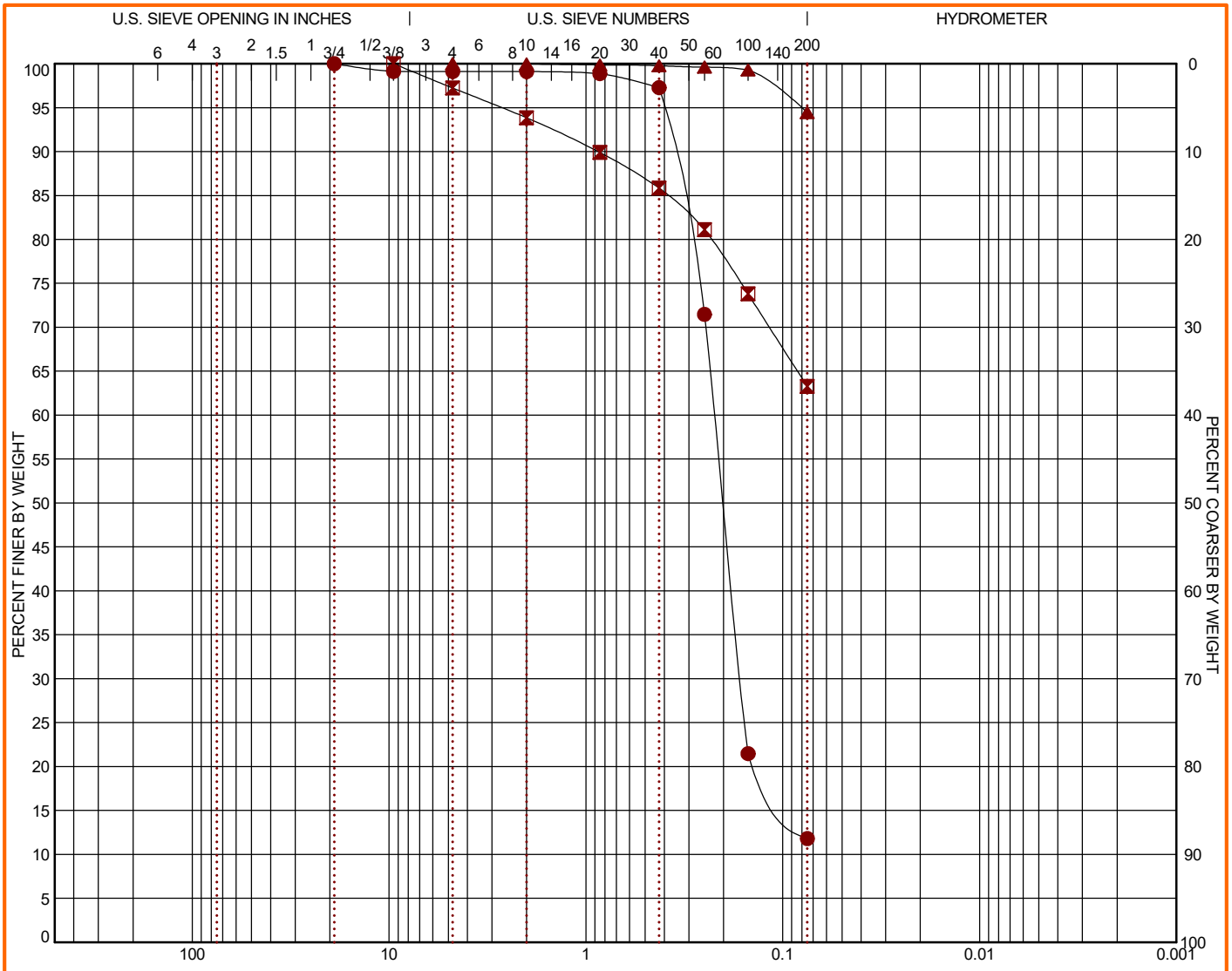

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-29	14.5 - 16	0.0	0.9	87.3		11.8		SP-SM
⊠	ALD-29	19.5 - 21	0.0	2.8	34.0		63.3		CL
▲	ALD-29	24.5 - 26	0.0	0.0	5.5		94.5		CH

GRAIN SIZE	●	⊠	▲
D_{60}	0.222		
D_{30}	0.164		
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C	1.83		
C_U	3.37		

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/4"	100.0	3/8"	100.0	#4	100.0
3/8"	99.12	#4	97.23	#10	99.97
#4	99.12	#10	93.84	#20	99.86
#10	99.11	#20	89.91	#40	99.77
#20	98.87	#40	85.83	#60	99.62
#40	97.27	#60	81.1	#100	99.28
#60	71.47	#100	73.8	#200	94.45
#100	21.47	#200	63.27		
#200	11.81				

SOIL DESCRIPTION	
●	POORLY GRADED SAND with SILT (SP-SM)
⊠	SANDY LEAN CLAY (CL)
▲	FAT CLAY (CH)

REMARKS	
●	
⊠	
▲	

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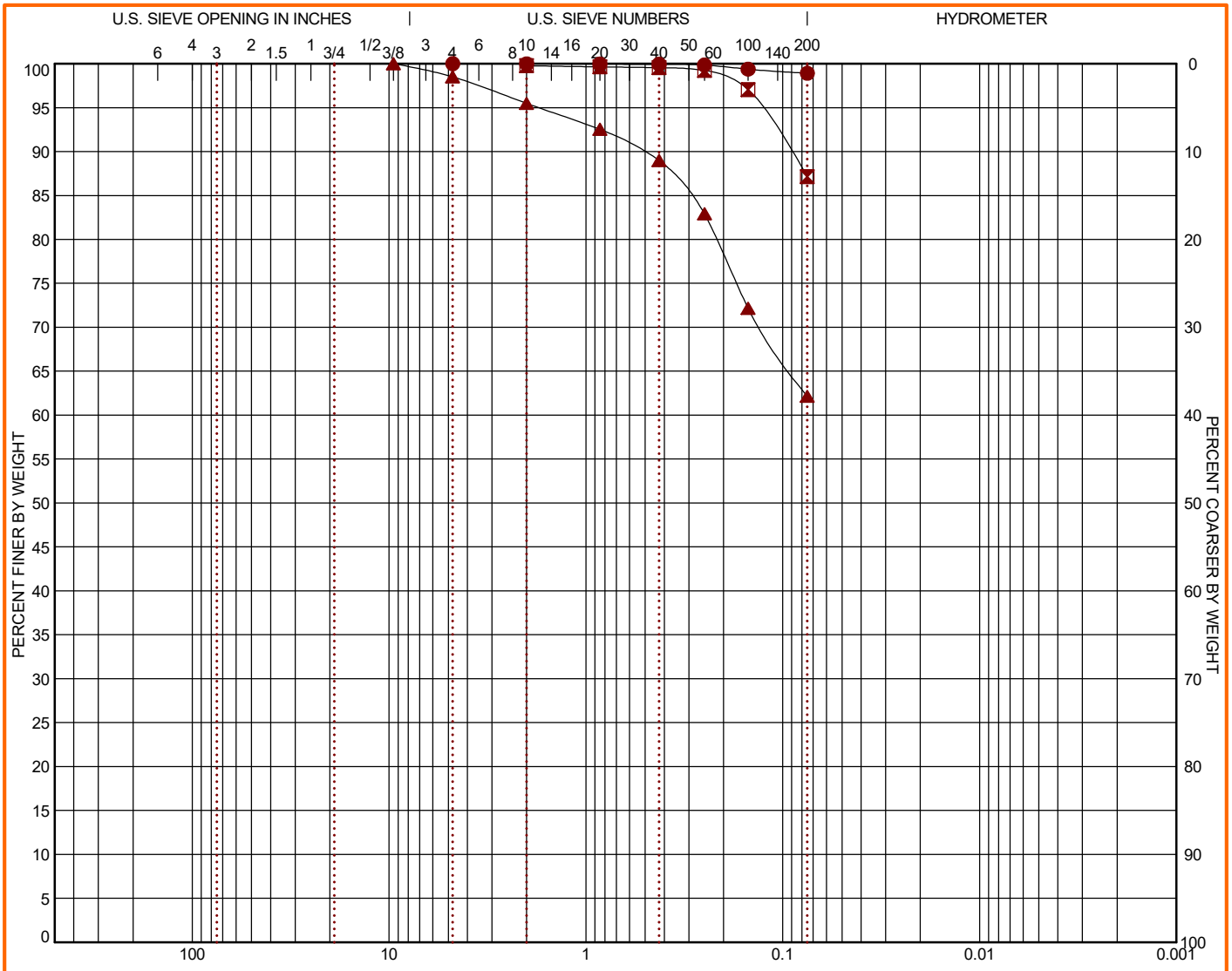

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-29	39.5 - 41	0.0	0.0	1.1		98.9		CL
⊠	ALD-29	49.5 - 51			12.6		87.2		CH
▲	ALD-30	19.5 - 21	0.0	1.5	36.4		62.1		CL

GRAIN SIZE	●	⊠	▲
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
#4	100.0	#10	99.77	3/8"	100.0
#10	99.98	#20	99.64	#4	98.5
#20	99.96	#40	99.55	#10	95.47
#40	99.95	#60	99.24	#20	92.54
#60	99.84	#100	97.05	#40	88.98
#100	99.38	#200	87.15	#60	82.91
#200	98.91			#100	72.16
				#200	62.15

SOIL DESCRIPTION	
●	LEAN CLAY (CL)
⊠	FAT CLAY (CH)
▲	SANDY LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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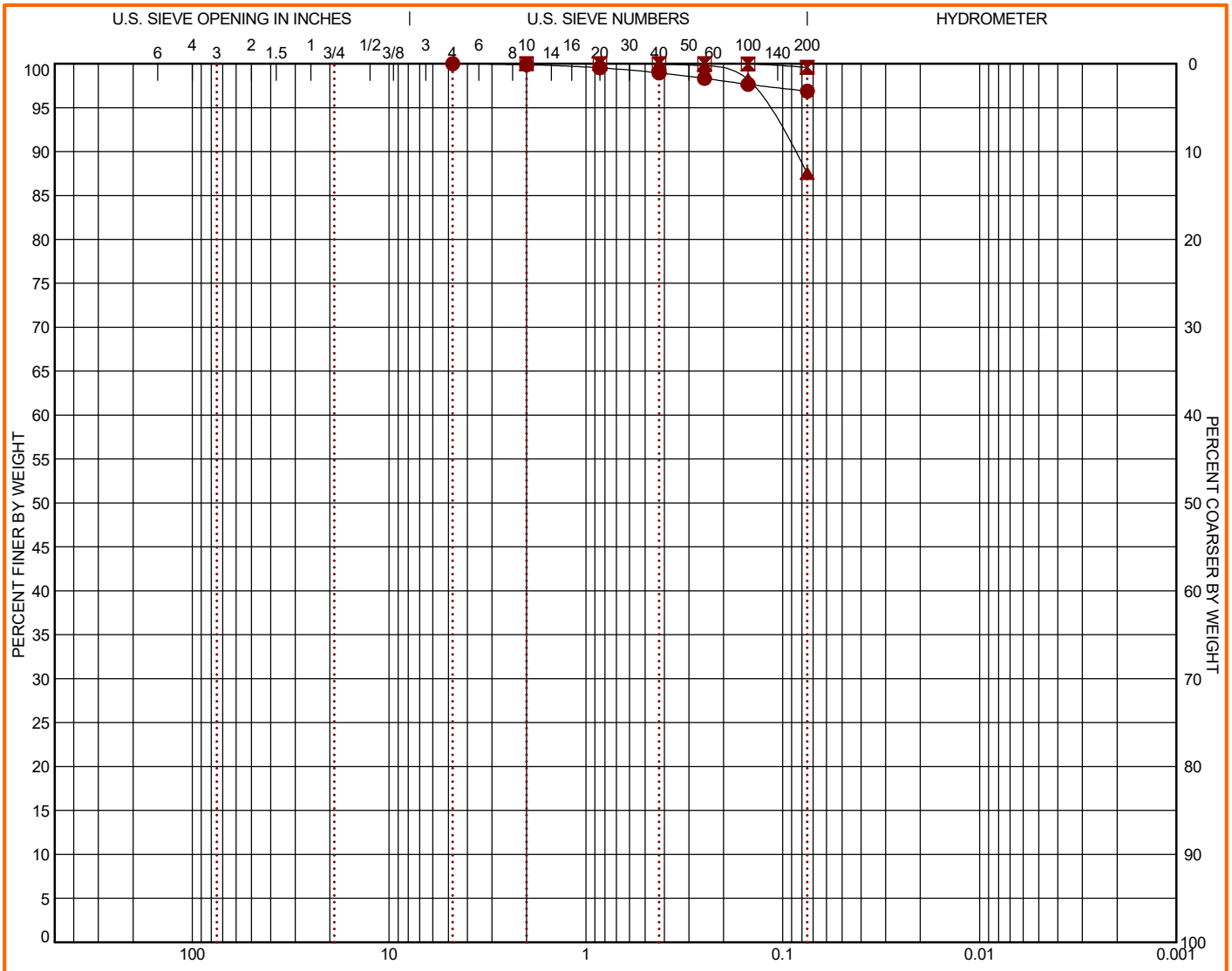

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-30	34.5 - 36	0.0	0.0	3.1		96.9		CH
⊠	ALD-30	39.5 - 41	0.0	0.0	0.4		99.6		CL
▲	ALD-30	49.5 - 51	0.0	0.0	12.5		87.5		CL

GRAIN SIZE	●	⊠	▲
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
#4	100.0	#10	100.0	#20	100.0
#10	99.88	#20	100.0	#40	99.94
#20	99.53	#40	99.99	#60	99.78
#40	98.95	#60	99.99	#100	98.18
#60	98.32	#100	99.96	#200	87.51
#100	97.65	#200	99.57		
#200	96.88				

SOIL DESCRIPTION	
●	FAT CLAY (CH)
⊠	LEAN CLAY (CL)
▲	LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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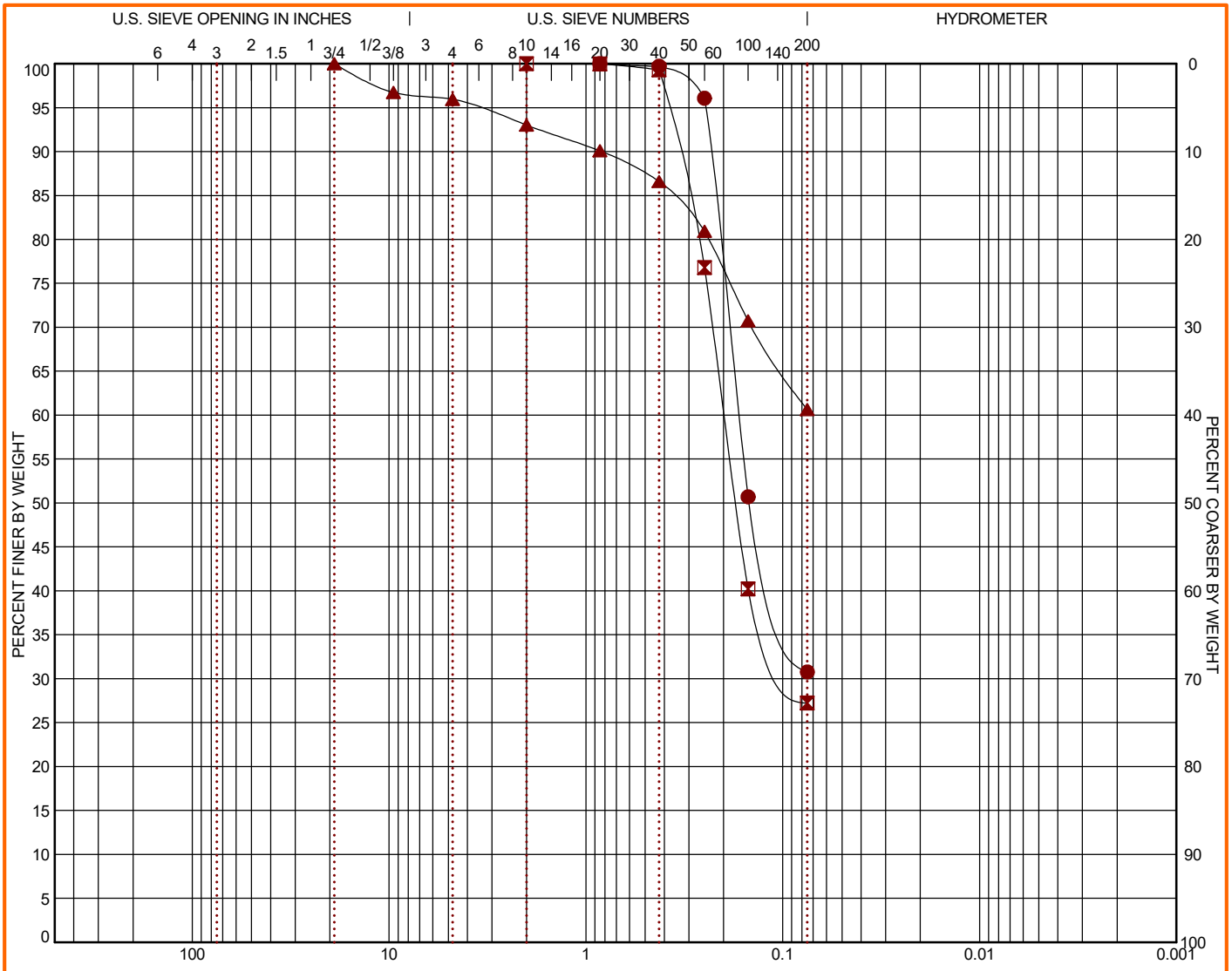


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-30	59.5 - 61	0.0	0.0	69.2		30.8		SC
⊠	ALD-30	74.5 - 76	0.0	0.0	72.8		27.2		SC
▲	ALD-31	24.5 - 26	0.0	4.1	35.3		60.6		CL

GRAIN SIZE	●	⊠	▲
D_{60}	0.167	0.198	
D_{30}		0.087	
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
#20	100.0	#10	100.0	3/4"	100.0
#40	99.72	#20	99.97	3/8"	96.72
#60	96.07	#40	99.32	#4	95.94
#100	50.7	#60	76.81	#10	93.01
#200	30.77	#100	40.21	#20	90.09
		#200	27.23	#40	86.59
				#60	80.91
				#100	70.72
				#200	60.63

SOIL DESCRIPTION	
●	CLAYEY SAND (SC)
⊠	CLAYEY SAND (SC)
▲	SANDY LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

PROJECT: GRE - Coal Creek Station

PROJECT NUMBER: M2215072

SITE: 2875 3rd St SW
Underwood, North Dakota

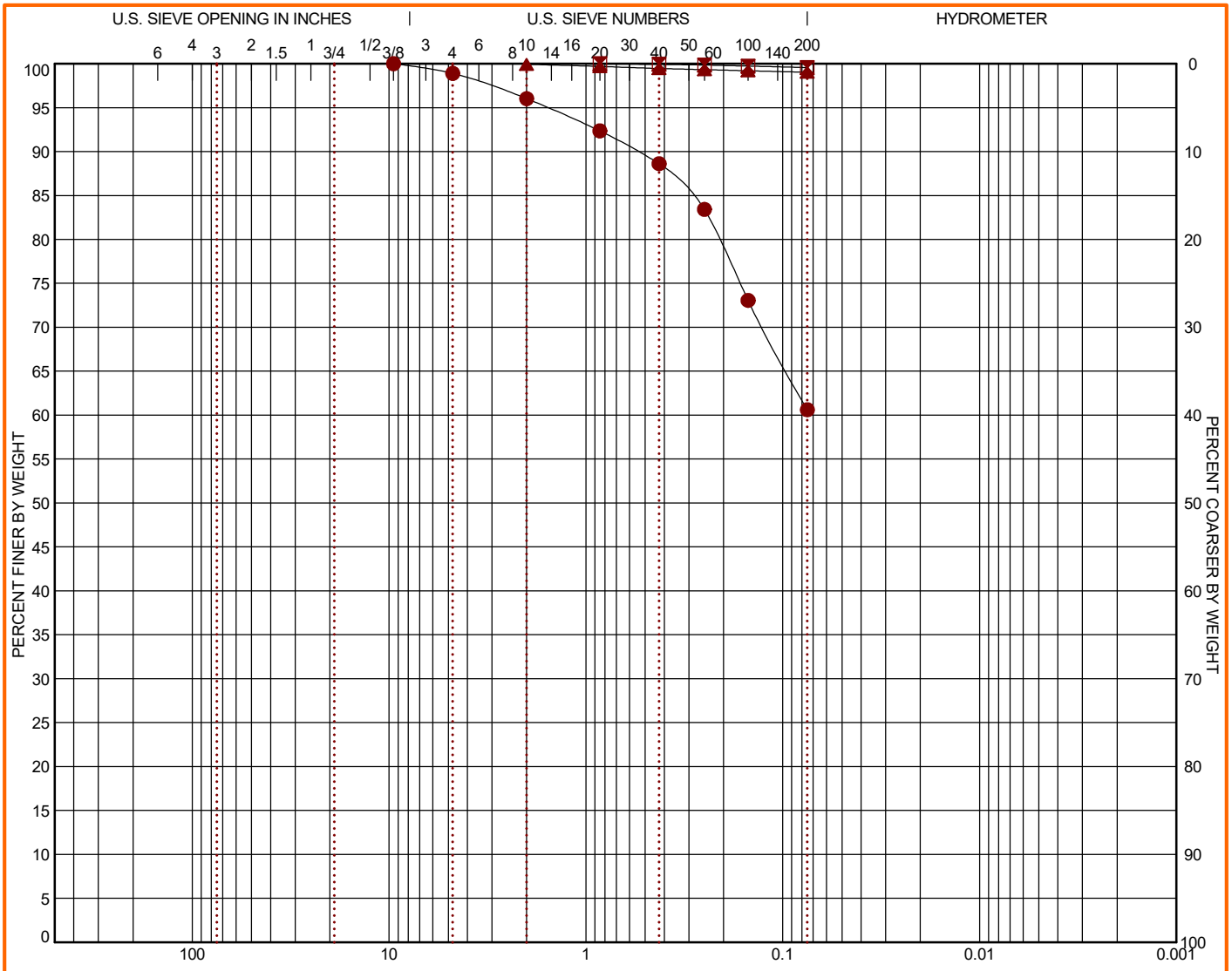
Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

CLIENT: Golder Associates Inc
Lakewood, Colorado

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/9/21

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-31	29.5 - 31	0.0	1.1	38.3		60.6		CL
⊠	ALD-31	34.5 - 36	0.0	0.0	0.4		99.6		CH
▲	ALD-31	49.5 - 51			0.9		99.0		CH

GRAIN SIZE	●	⊠	▲
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0	#20	100.0	#10	99.92
#4	98.89	#40	99.93	#20	99.69
#10	96.02	#60	99.84	#40	99.45
#20	92.35	#100	99.73	#60	99.32
#40	88.61	#200	99.56	#100	99.19
#60	83.42			#200	99.03
#100	73.06				
#200	60.61				

SOIL DESCRIPTION	
●	SANDY LEAN CLAY (CL)
⊠	FAT CLAY (CH)
▲	FAT CLAY (CH)

REMARKS	
●	
⊠	
▲	

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GRAIN SIZE DISTRIBUTION

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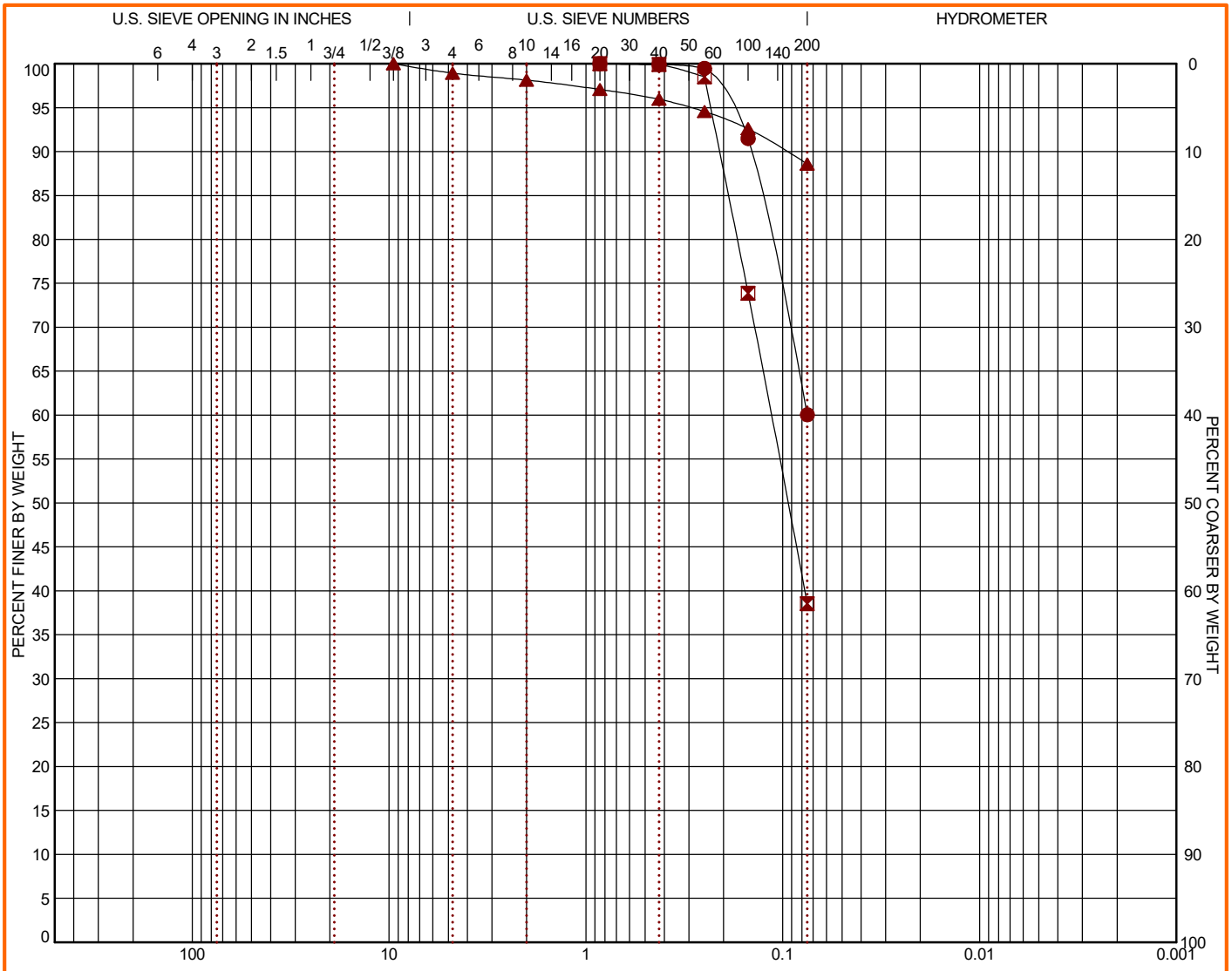

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-31	59.5 - 61	0.0	0.0	40.0		60.0		CL
⊠	ALD-31	69.5 - 71	0.0	0.0	61.5		38.5		SC
▲	ALD-32	29.5 - 31	0.0	1.1	10.3		88.6		CL

GRAIN SIZE	●	⊠	▲
D_{60}		0.114	
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#20	100.0	#20	100.0	3/8"	100.0
#40	99.91	#40	99.89	#4	98.92
#60	99.47	#60	98.5	#10	98.13
#100	91.47	#100	73.88	#20	97.07
#200	60.04	#200	38.54	#40	95.95
				#60	94.56
				#100	92.59
				#200	88.57

SOIL DESCRIPTION	
●	SANDY LEAN CLAY (CL)
⊠	CLAYEY SAND (SC)
▲	LEAN CLAY (CL)

REMARKS	
●	
⊠	
▲	

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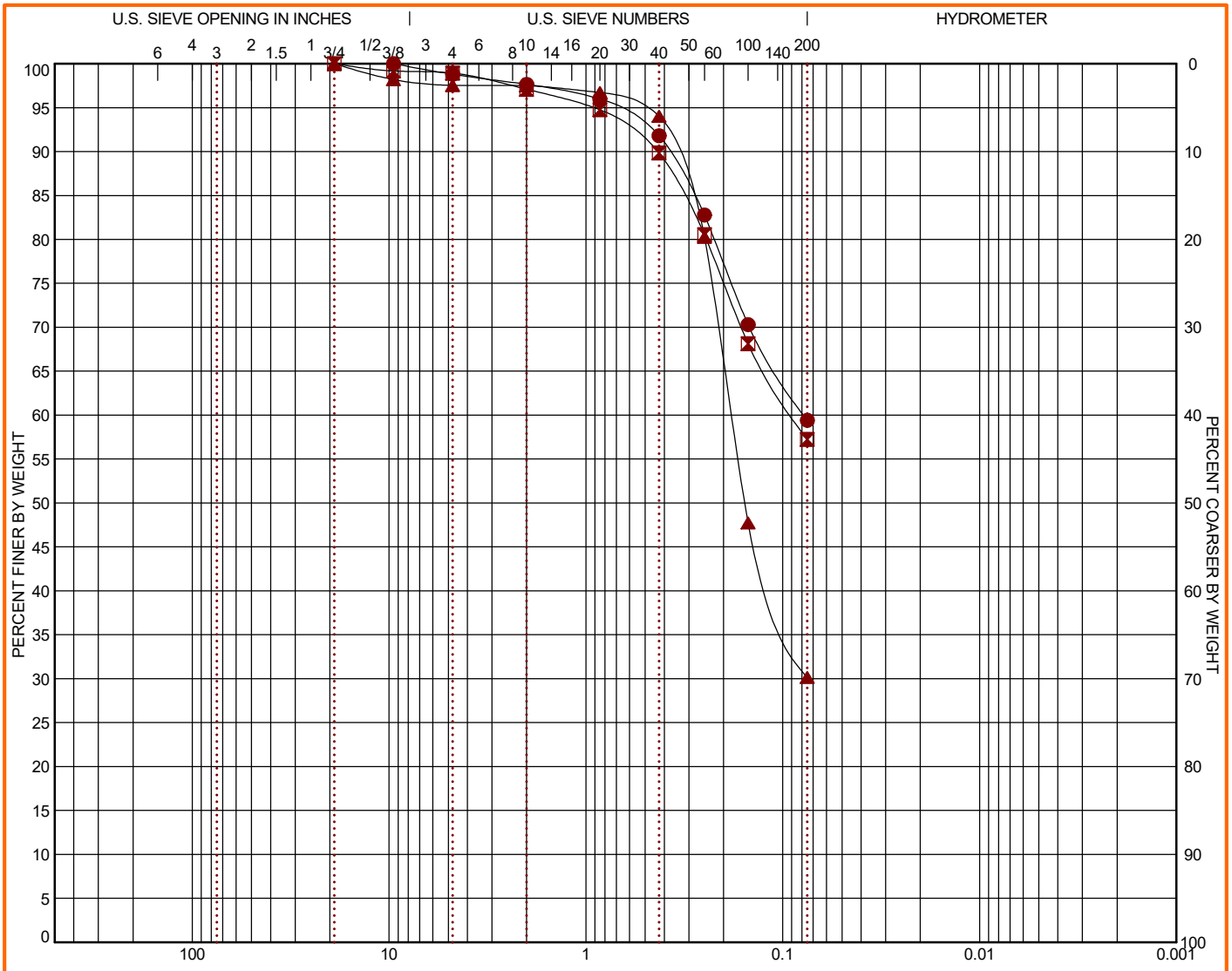
GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-32	39.5 - 41	0.0	1.2	39.4		59.4		CL
⊠	ALD-32	44.5 - 46	0.0	1.1	41.7		57.2		CL
▲	ALD-32	54.5 - 56	0.0	2.5	67.4		30.1		SC-SM

GRAIN SIZE	●	⊠	▲
D_{60}	0.078	0.089	0.182
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0	3/4"	100.0	3/4"	100.0
#4	98.8	3/8"	99.17	3/8"	98.19
#10	97.65	#4	98.93	#4	97.53
#20	95.99	#10	97.09	#10	97.5
#40	91.8	#20	94.76	#20	96.71
#60	82.78	#40	89.84	#40	94.02
#100	70.3	#60	80.53	#60	80.26
#200	59.41	#100	68.12	#100	47.73
		#200	57.23	#200	30.14

SOIL DESCRIPTION	
●	SANDY LEAN CLAY (CL)
⊠	SANDY LEAN CLAY (CL)
▲	SILTY, CLAYEY SAND (SC-SM)

REMARKS	
●	
⊠	
▲	

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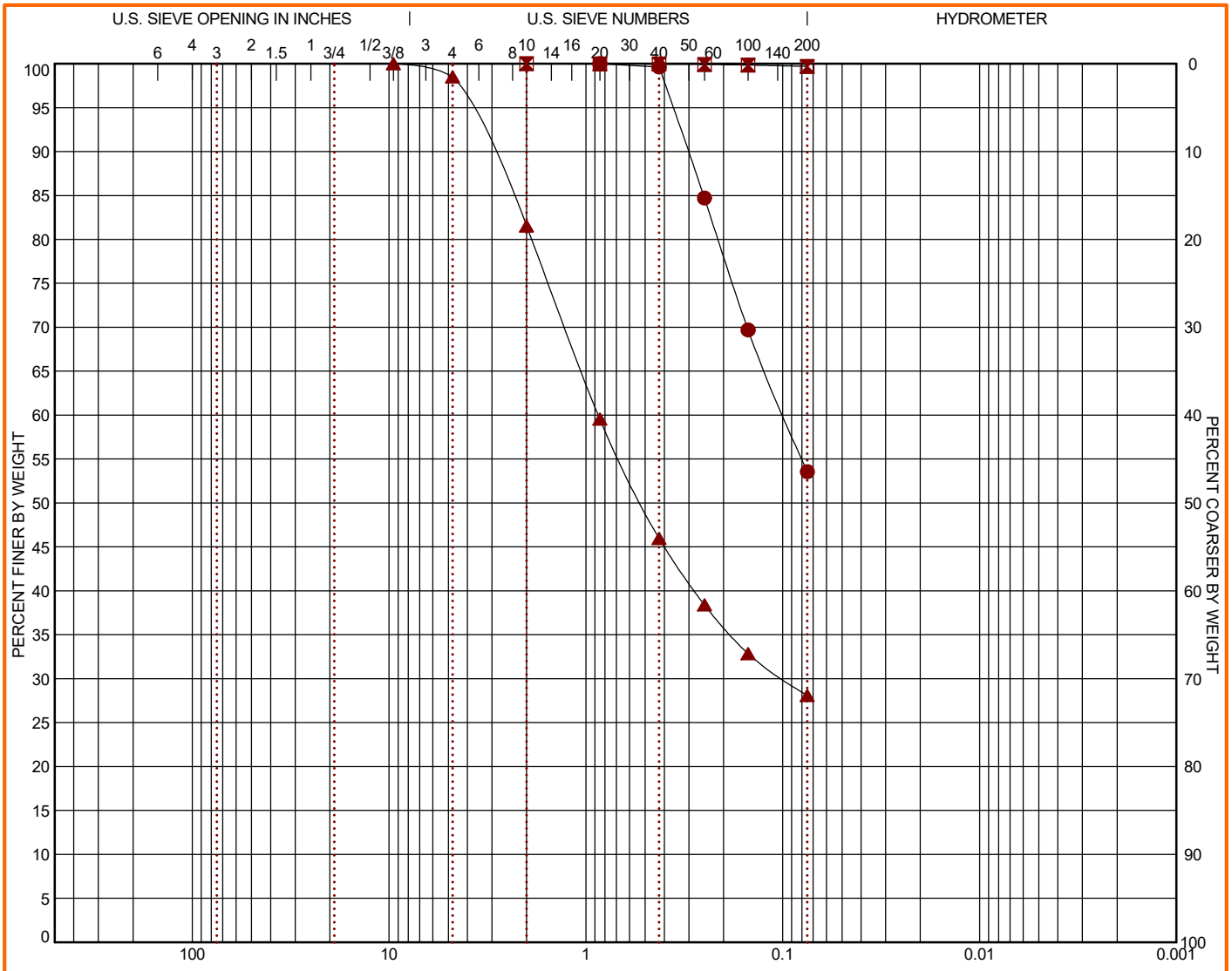
GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	ALD-32	64.5 - 66	0.0	0.0	46.4		53.6		CL
⊠	MW-91-3	19.5 - 21	0.0	0.0	0.3		99.7		CH
▲	MW-91-4	24.5 - 26	0.0	1.5	70.4		28.1		SM

GRAIN SIZE	●	⊠	▲
D_{60}	0.099		0.865
D_{30}			0.099
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#20	100.0	#10	100.0	3/8"	100.0
#40	99.63	#20	99.97	#4	98.51
#60	84.71	#40	99.95	#10	81.52
#100	69.69	#60	99.91	#20	59.55
#200	53.56	#100	99.84	#40	45.96
		#200	99.69	#60	38.41
				#100	32.85
				#200	28.09

SOIL DESCRIPTION	
●	SANDY LEAN CLAY (CL)
⊠	FAT CLAY (CH)
▲	SILTY SAND (SM)

REMARKS	
●	
⊠	
▲	

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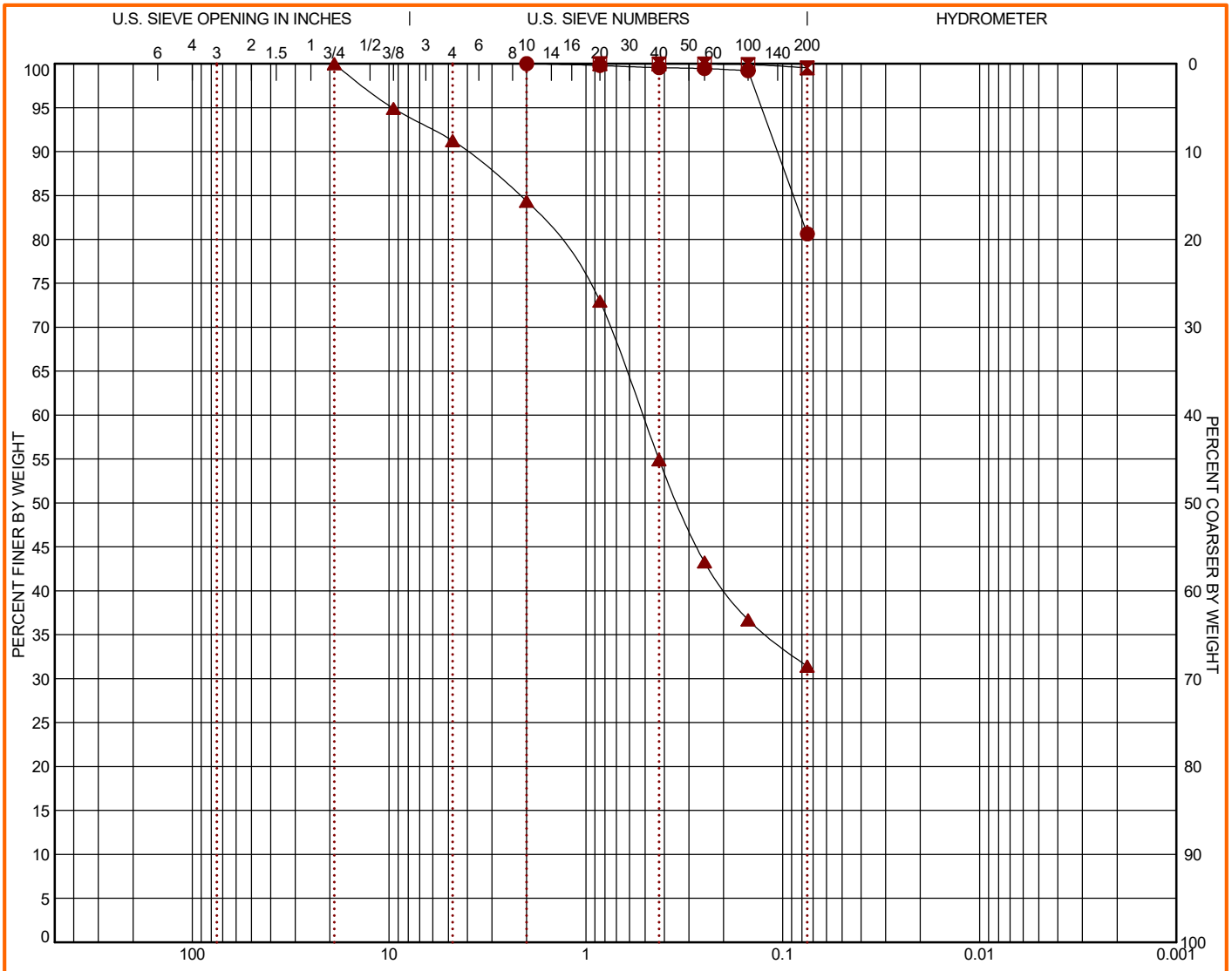
GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	MW-91-4	29.5 - 31	0.0	0.0	19.4		80.6		CL-ML
⊠	MW-91-4	34.5 - 36	0.0	0.0	0.5		99.5		CL
▲	MW-91-5	9.5 - 11	0.0	8.8	59.8		31.4		SC

GRAIN SIZE	●	⊠	▲
D_{60}			0.517
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
#10	100.0	#20	100.0	3/4"	100.0
#20	99.79	#40	99.98	3/8"	94.9
#40	99.55	#60	99.96	#4	91.24
#60	99.44	#100	99.89	#10	84.35
#100	99.2	#200	99.53	#20	72.97
#200	80.63			#40	54.92
				#60	43.28
				#100	36.7
				#200	31.42

SOIL DESCRIPTION	
●	SILTY CLAY with SAND (CL-ML)
⊠	LEAN CLAY (CL)
▲	CLAYEY SAND (SC)

REMARKS	
●	
⊠	
▲	

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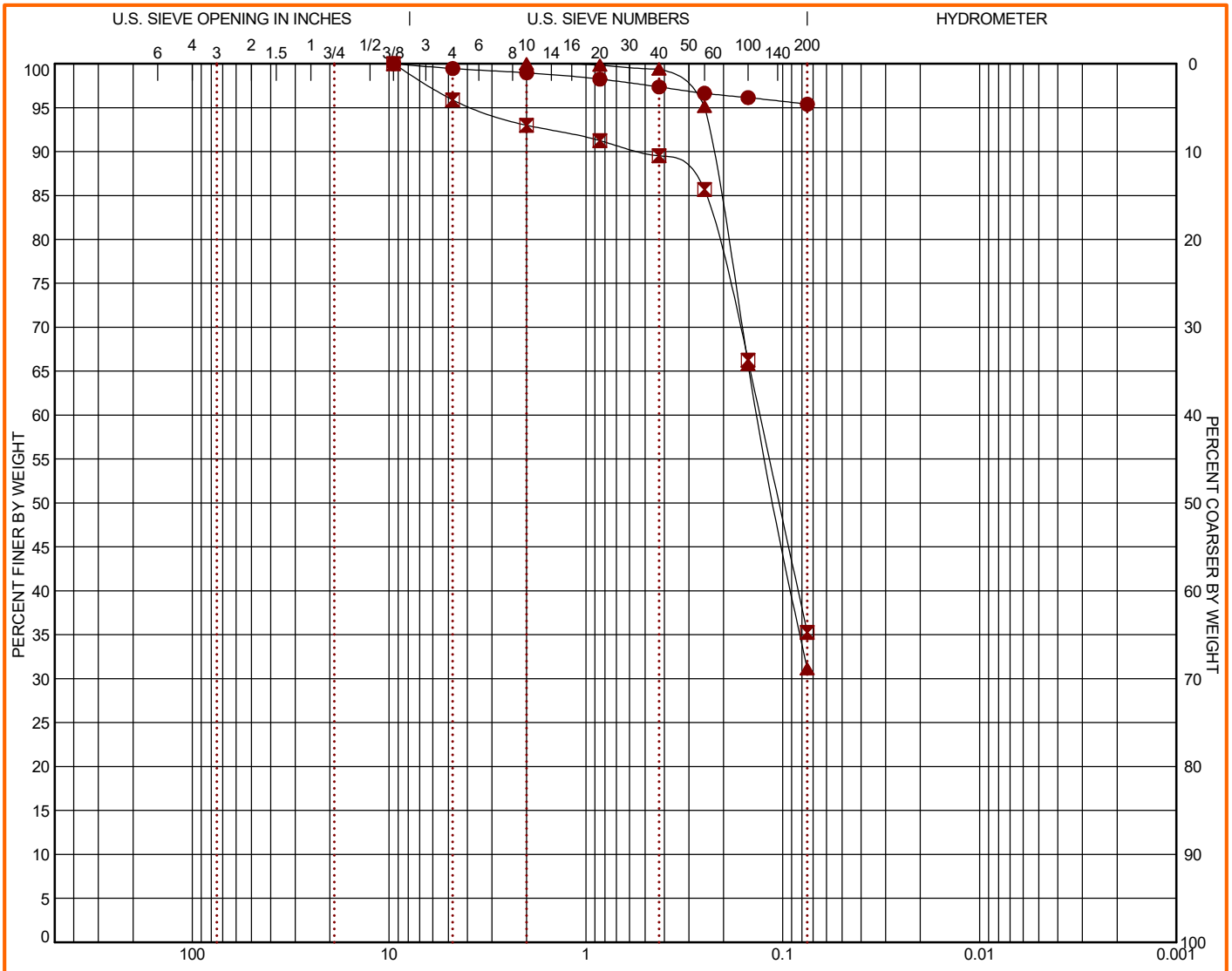
GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	MW-91-5	14.5 - 16	0.0	0.6	4.1		95.4		CH
⊠	MW-91-5	19.5 - 21	0.0	4.1	60.6		35.3		SC
▲	MW-91-5	24.5 - 26	0.0	0.0	68.9		31.1		SC

GRAIN SIZE	●	⊠	▲
D_{60}		0.13	0.134
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0	3/8"	100.0	#10	100.0
#4	99.45	#4	95.88	#20	99.85
#10	98.96	#10	92.99	#40	99.39
#20	98.24	#20	91.25	#60	95.13
#40	97.35	#40	89.51	#100	65.78
#60	96.63	#60	85.68	#200	31.12
#100	96.13	#100	66.25		
#200	95.39	#200	35.26		

SOIL DESCRIPTION	
●	FAT CLAY (CH)
⊠	CLAYEY SAND (SC)
▲	CLAYEY SAND (SC)

REMARKS	
●	
⊠	
▲	

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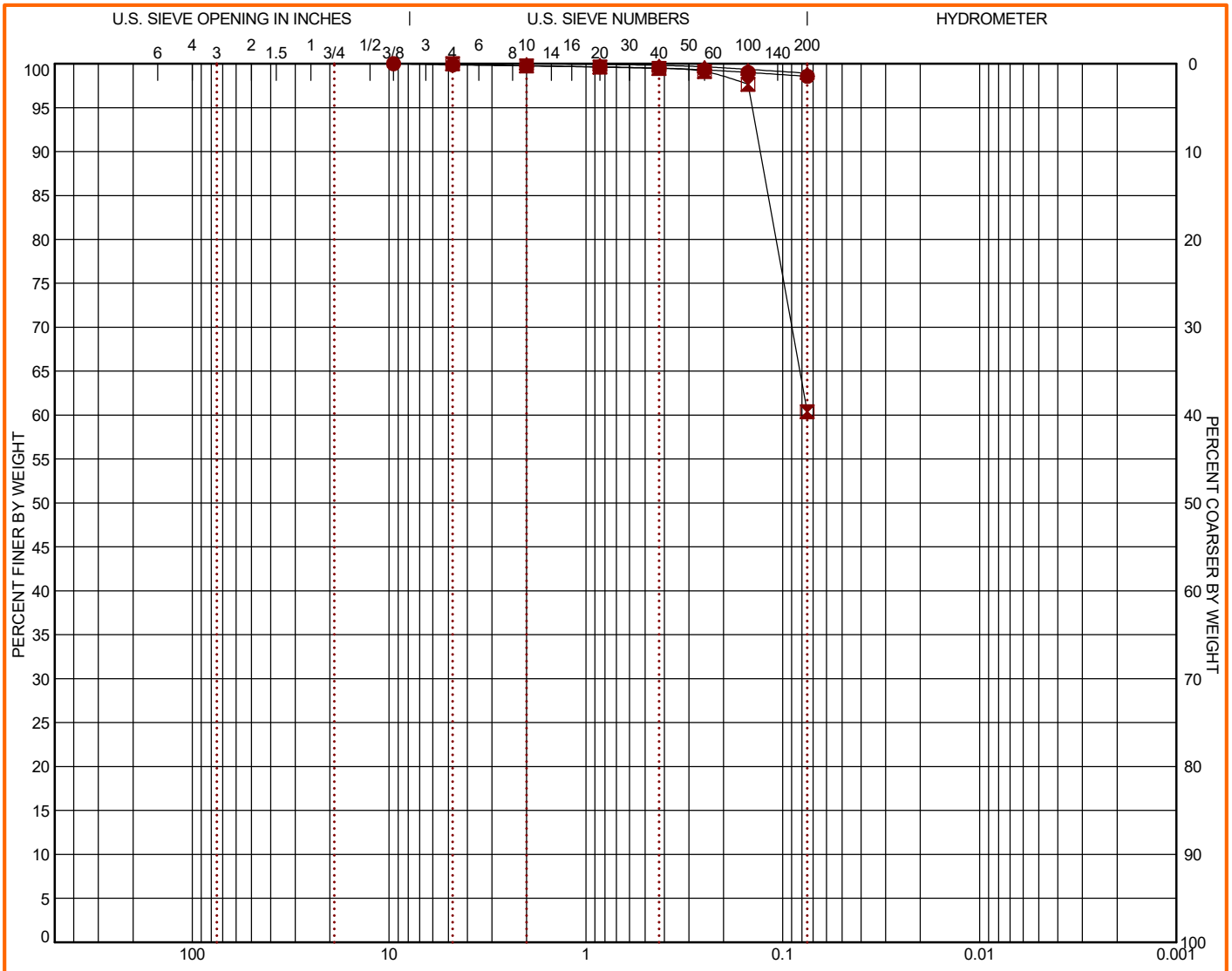

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	MW-91-6	19.5 - 21	0.0	0.1	1.3		98.6		CL
⊠	MW-91-6	24.5 - 26	0.0	0.0	39.6		60.4		CL
▲	MW-91-7	9.5 - 11	0.0	0.0	1.1		98.9		CH

GRAIN SIZE	●	⊠	▲
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0	#4	100.0	#10	100.0
#4	99.86	#10	99.76	#20	99.91
#10	99.75	#20	99.61	#40	99.81
#20	99.64	#40	99.47	#60	99.64
#40	99.5	#60	99.11	#100	99.36
#60	99.29	#100	97.66	#200	98.92
#100	99.0	#200	60.39		
#200	98.56				

SOIL DESCRIPTION	
●	LEAN CLAY (CL)
⊠	SANDY LEAN CLAY (CL)
▲	FAT CLAY (CH)

REMARKS	
●	
⊠	
▲	

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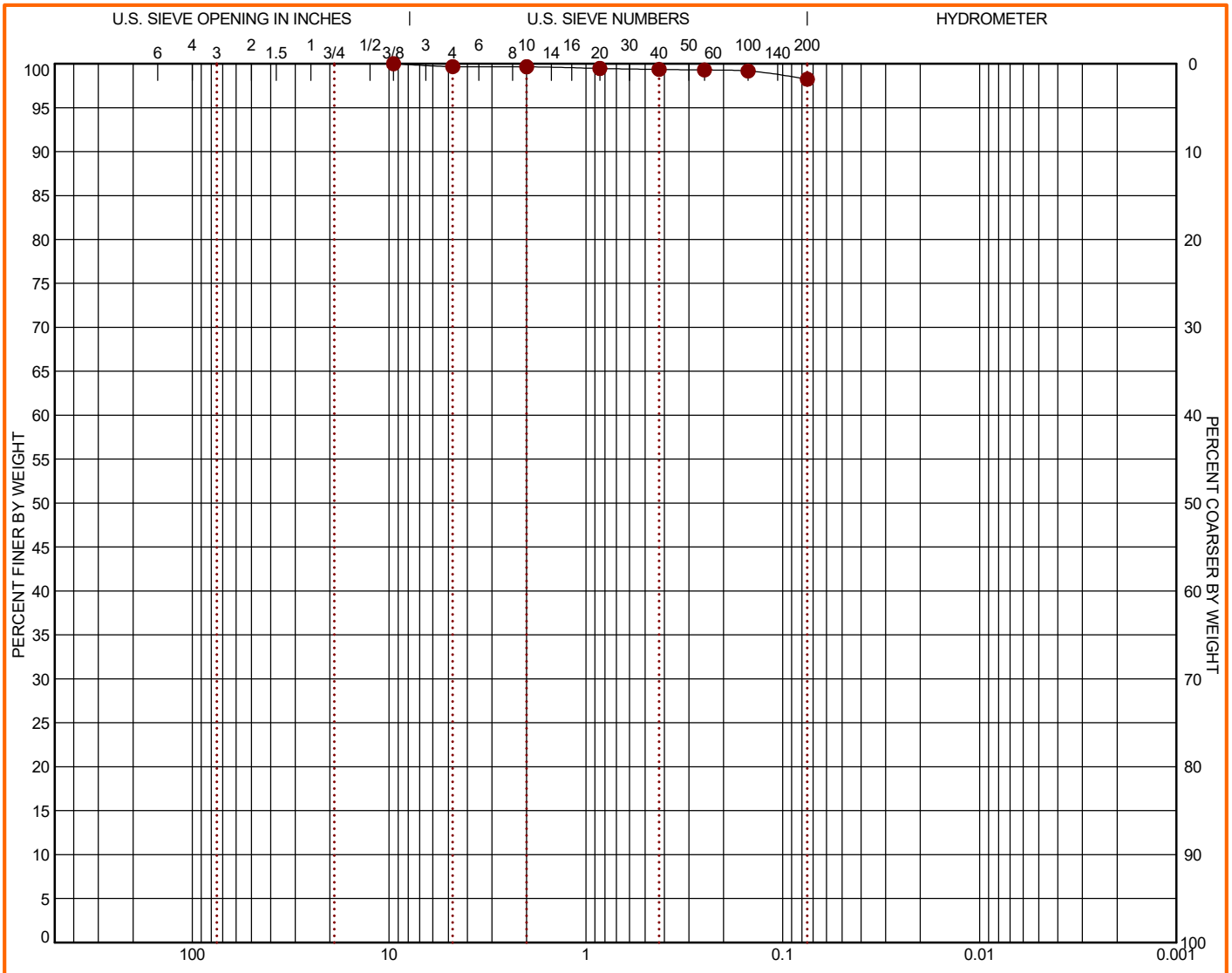
ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	MW-91-7	14.5 - 16	0.0	0.3	1.4		98.2		CL

GRAIN SIZE

	●		
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS

	●		
C_C			
C_U			

● Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0				
#4	99.66				
#10	99.65				
#20	99.46				
#40	99.35				
#60	99.29				
#100	99.17				
#200	98.23				

SOIL DESCRIPTION

●	LEAN CLAY (CL)

REMARKS

●	

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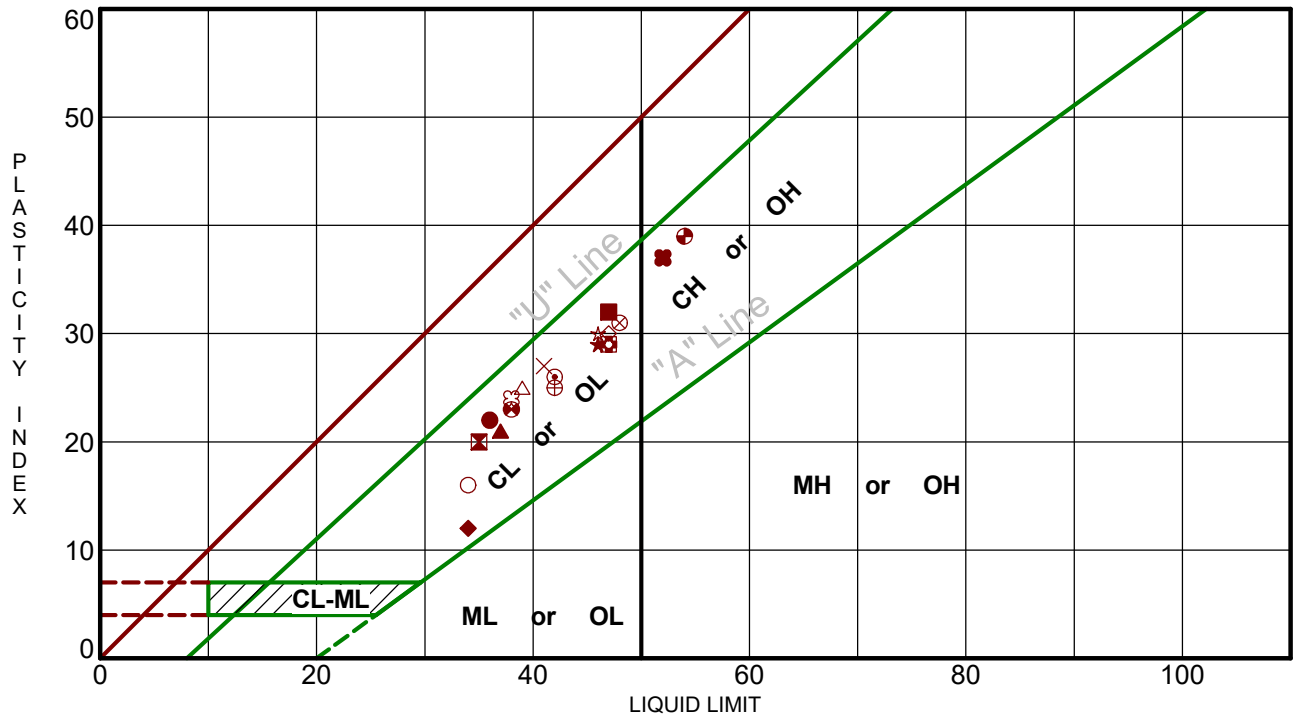
ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	ALD-1	19.5 - 21	36	14	22	68.5	CL	SANDY LEAN CLAY
⊠	ALD-1	24.5 - 26	35	15	20	61.6	CL	SANDY LEAN CLAY
▲	ALD-1	29.5 - 31	37	16	21	59.8	CL	SANDY LEAN CLAY
★	ALD-1	39.5 - 41	46	17	29	76.1	CL	LEAN CLAY with SAND
⊙	ALD-1	44.5 - 46	42	16	26	46.1	SC	CLAYEY SAND
✿	ALD-1	49.5 - 51	47	18	29	60.4	CL	SANDY LEAN CLAY
○	ALD-1	64.5 - 66	34	18	16	47.0	SC	CLAYEY SAND
△	ALD-2	19.5 - 21	39	14	25	61.9	CL	SANDY LEAN CLAY
⊗	ALD-2	29.5 - 31	48	17	31	74.5	CL	LEAN CLAY with SAND
⊕	ALD-2	39.5 - 41	42	17	25	49.9	SC	CLAYEY SAND
□	ALD-2	44.5 - 46	47	18	29	63.7	CL	SANDY LEAN CLAY
⊠	ALD-2	54.5 - 56	38	15	23	65.5	CL	SANDY LEAN CLAY
◕	ALD-2	64.5 - 66	54	15	39	58.7	CH	SANDY FAT CLAY
☆	ALD-3	19.5 - 21	46	16	30	61.2	CL	SANDY LEAN CLAY
✿	ALD-3	24.5 - 26	38	14	24	63.8	CL	SANDY LEAN CLAY
■	ALD-3	34.5 - 36	47	15	32	73.7	CL	LEAN CLAY with SAND
◆	ALD-3	39.5 - 41	34	22	12	14.9	SC	CLAYEY SAND with GRAVEL
◇	ALD-3	44.5 - 46	47	17	30	60.3	CL	SANDY LEAN CLAY
×	ALD-3	49.5 - 51	41	14	27	73.4	CL	LEAN CLAY with SAND
✖	ALD-3	59.5 - 61	52	15	37	97.5	CH	FAT CLAY

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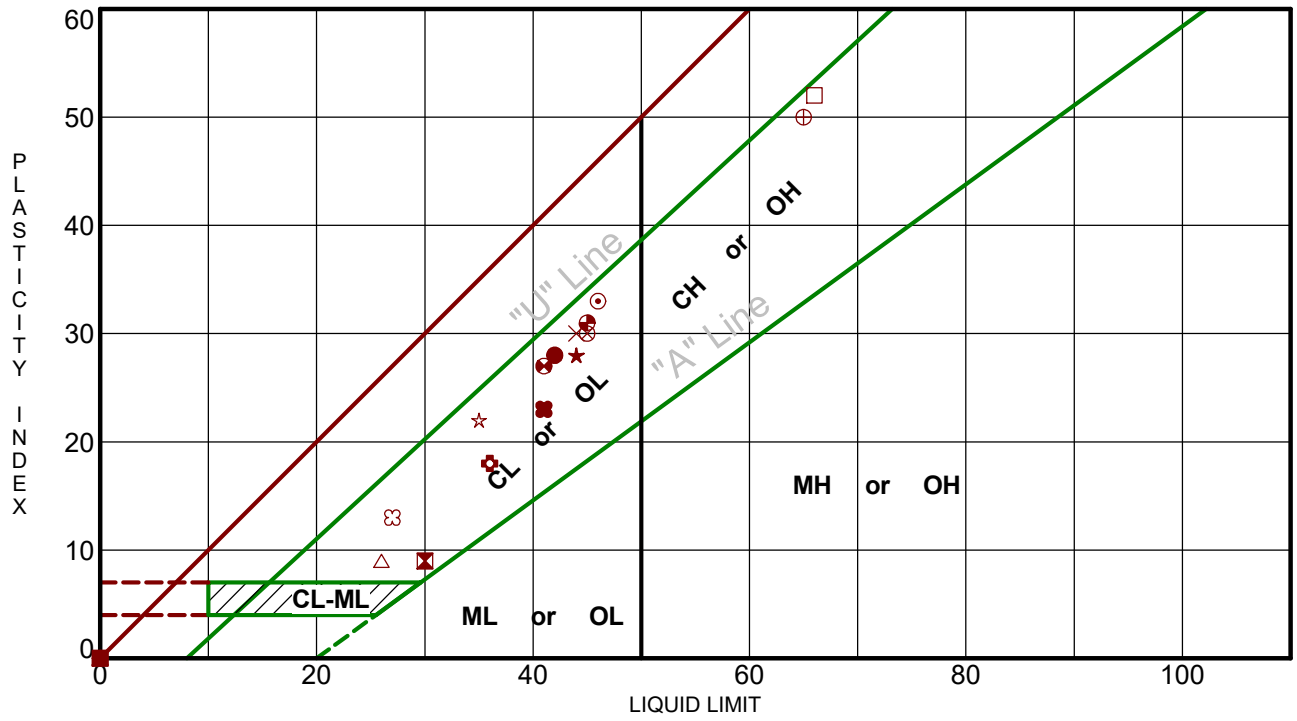
ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	ALD-4	24.5 - 26	42	14	28	60.0	CL	SANDY LEAN CLAY
⊠	ALD-4	34.5 - 36	30	21	9	13.0	SC	CLAYEY SAND
▲	ALD-4	39.5 - 41	NP	NP	NP	15.2	SM	SILTY SAND with GRAVEL
★	ALD-4	44.5 - 46	44	16	28	90.0	CL	LEAN CLAY
⊙	ALD-4	49.5 - 51	46	13	33	93.4	CL	LEAN CLAY
✿	ALD-4	59.5 - 61	36	18	18	41.1	SC	CLAYEY SAND
○	ALD-5	29.5 - 31	42	14	28	58.2	CL	SANDY LEAN CLAY
△	ALD-5	39.5 - 41	26	17	9	17.9	SC	CLAYEY SAND with GRAVEL
⊗	ALD-5	44.5 - 46	45	15	30	94.5	CL	LEAN CLAY
⊕	ALD-5	49.5 - 51	65	15	50	98.9	CH	FAT CLAY
□	ALD-5	54.5 - 56	66	14	52	98.3	CH	FAT CLAY
⊛	ALD-6	19.5 - 21	41	14	27	60.0	CL	SANDY LEAN CLAY
◕	ALD-6	24.5 - 26	45	14	31	68.9	CL	SANDY LEAN CLAY
☆	ALD-6	34.5 - 36	35	13	22	59.1	CL	SANDY LEAN CLAY
❀	ALD-6	39.5 - 41	27	14	13	32.4	SC	CLAYEY SAND
■	ALD-6	44.5 - 46	NP	NP	NP	16.0	SM	SILTY SAND
◆	ALD-6	49.5 - 51	NP	NP	NP	6.7	SP-SM	POORLY GRADED SAND with SILT
◇	ALD-6	54.5 - 56	NP	NP	NP	12.6	SM	SILTY SAND
×	ALD-7	34.5 - 36	44	14	30	74.4	CL	LEAN CLAY with SAND
✖	ALD-7	39.5 - 41	41	18	23	79.8	CL	LEAN CLAY with SAND

PROJECT: GRE - Coal Creek Station

PROJECT NUMBER: M2215072

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Underwood, North Dakota

Terracon
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Lakewood, Colorado

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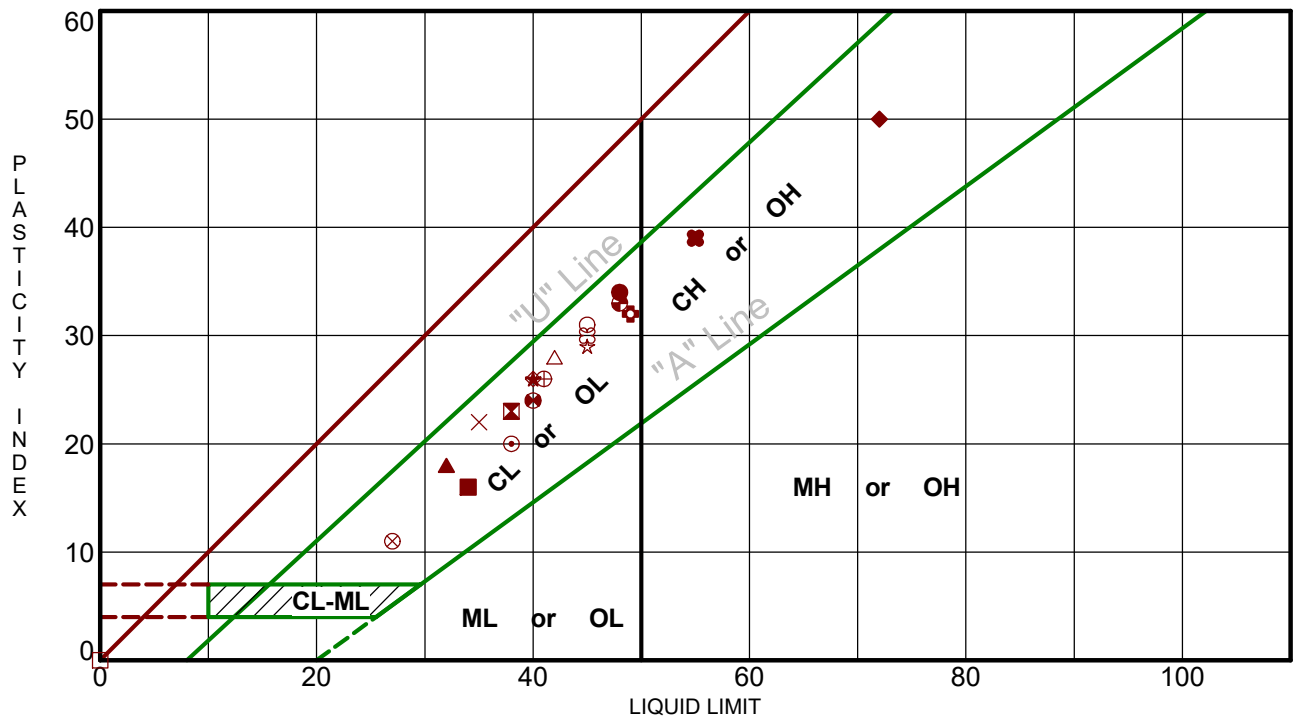
ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	ALD-7	44.5 - 46	48	14	34	77.4	CL	LEAN CLAY with SAND
⊠	ALD-7	49.5 - 51	38	15	23	45.1	SC	CLAYEY SAND
▲	ALD-7	59.5 - 61	32	14	18	50.8	CL	SANDY LEAN CLAY
★	ALD-7	74.5 - 76	40	14	26	78.2	CL	LEAN CLAY with SAND
⊙	ALD-8	14.5 - 16	38	18	20	67.7	CL	SANDY LEAN CLAY
✿	ALD-8	24.5 - 26	49	17	32	76.2	CL	LEAN CLAY with SAND
○	ALD-8	29.5 - 31	45	14	31	72.0	CL	LEAN CLAY with SAND
△	ALD-8	34.5 - 36	42	14	28	57.8	CL	SANDY LEAN CLAY
⊗	ALD-8	39.5 - 41	27	16	11	65.6	CL	SANDY LEAN CLAY
⊕	ALD-8	44.5 - 46	41	15	26	99.1	CL	LEAN CLAY
□	ALD-8	54.5 - 56	NP	NP	NP	22.0	SM	SILTY SAND
⊠	ALD-8	69.5 - 71	40	16	24	29.4	SC	CLAYEY SAND
◕	ALD-9	24.5 - 26	48	15	33	80.4	CL	LEAN CLAY with SAND
☆	ALD-9	29.5 - 31	45	16	29	62.1	CL	SANDY LEAN CLAY
✿	ALD-9	39.5 - 41	45	15	30	99.1	CL	LEAN CLAY
■	ALD-9	59.5 - 61	34	18	16	30.3	SC	CLAYEY SAND
◆	ALD-10	9.5 - 11	72	22	50	93.1	CH	FAT CLAY
◇	ALD-10	19.5 - 21	40	14	26	54.9	CL	SANDY LEAN CLAY
×	ALD-10	34.5 - 36	35	13	22	53.6	CL	SANDY LEAN CLAY
✖	ALD-10	39.5 - 41	55	16	39	86.1	CH	FAT CLAY

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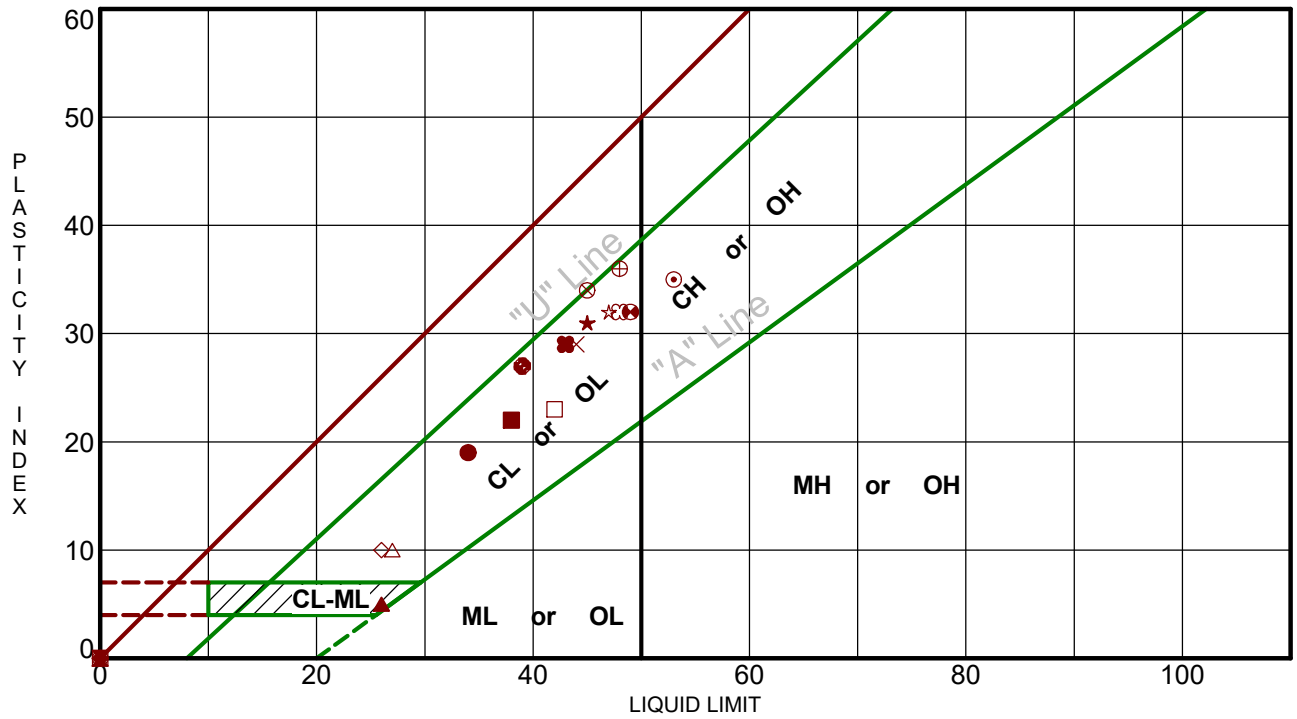

Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	ALD-10	49.5 - 51	34	15	19	60.5	CL	SANDY LEAN CLAY
⊠	ALD-10	59.5 - 61	NP	NP	NP	6.7	GP-GM	POORLY GRADED GRAVEL with SILT and SAND
▲	ALD-10	64.5 - 66	26	21	5	27.1	SC-SM	SILTY, CLAYEY SAND
★	ALD-11	24.5 - 26	45	14	31	79.6	CL	LEAN CLAY with SAND
⊙	ALD-11	29.5 - 31	53	18	35	97.7	CH	FAT CLAY
✿	ALD-11	39.5 - 41	39	12	27	62.3	CL	SANDY LEAN CLAY
○	ALD-11	49.5 - 51	NP	NP	NP	8.8	SW-SM	WELL-GRADED SAND with SILT and GRAVEL
△	ALD-11	64.5 - 66	27	17	10	25.9	SC	CLAYEY SAND
⊗	ALD-12	19.5 - 21	45	11	34	95.8	CL	LEAN CLAY
⊕	ALD-12	24.5 - 26	48	12	36	82.6	CL	LEAN CLAY with SAND
□	ALD-12	54.5 - 56	42	19	23	26.0	SC	CLAYEY SAND
⊛	ALD-12	64.5 - 66	49	17	32	27.1	SC	CLAYEY SAND
◕	ALD-13	9.5 - 11	39	12	27	57.6	CL	SANDY LEAN CLAY
☆	ALD-13	19.5 - 21	47	15	32	81.8	CL	LEAN CLAY with SAND
❀	ALD-13	24.5 - 26	48	16	32	86.9	CL	LEAN CLAY
■	ALD-13	29.5 - 31	38	16	22	63.2	CL	SANDY LEAN CLAY
◆	ALD-13	54.5 - 56	NP	NP	NP	25.7	SM	SILTY SAND
◇	ALD-13	59.5 - 61	26	16	10	27.1	SC	CLAYEY SAND
×	ALD-14	19.5 - 21	44	15	29	64.4	CL	SANDY LEAN CLAY
✖	ALD-14	24.5 - 26	43	14	29	62.7	CL	SANDY LEAN CLAY

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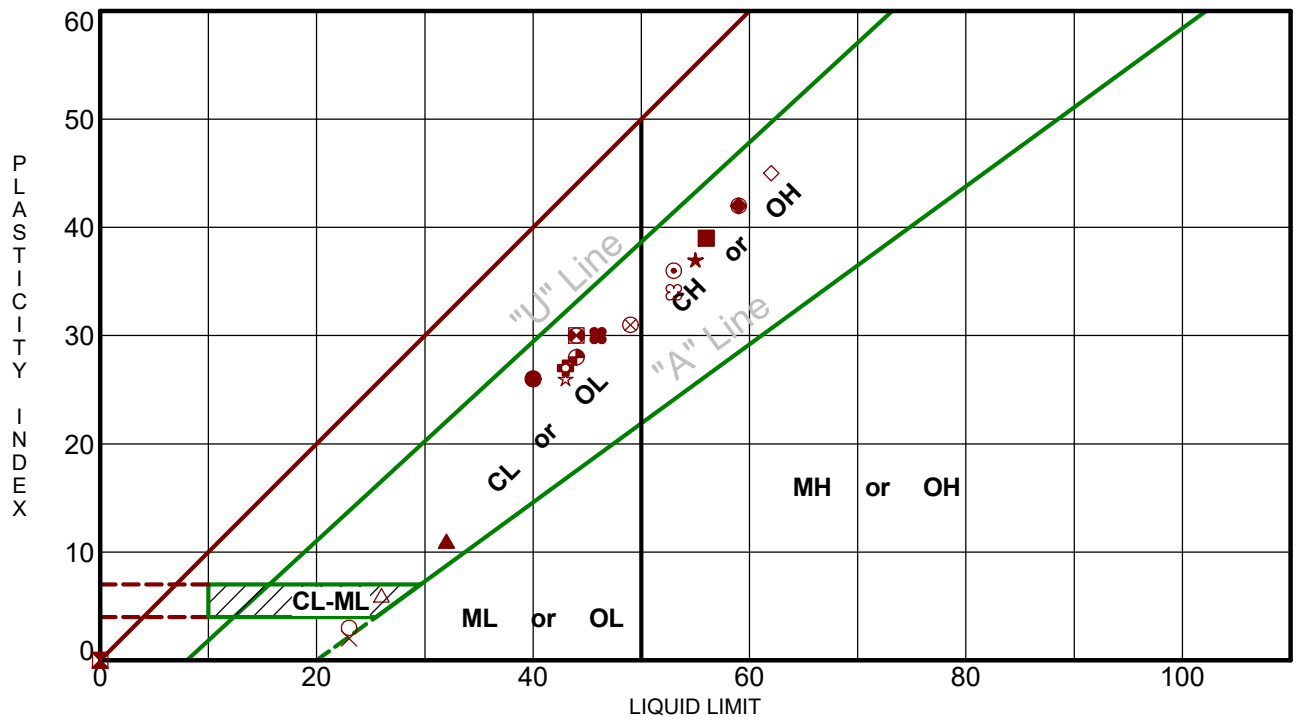

Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	ALD-14	34.5 - 36	40	14	26	55.0	CL	SANDY LEAN CLAY
⊠	ALD-14	39.5 - 41	NP	NP	NP	33.0	SM	SILTY SAND
▲	ALD-14	54.5 - 56	32	21	11	26.3	SC	CLAYEY SAND
★	ALD-14	64.5 - 66	55	18	37	27.1	SC	CLAYEY SAND
⊙	ALD-14	69.5 - 71	53	17	36	32.4	SC	CLAYEY SAND
✿	ALD-15	19.5 - 21	43	16	27	99.7	CL	LEAN CLAY
○	ALD-15	24.5 - 26	23	20	3	42.8	SM	SILTY SAND
△	ALD-15	29.5 - 31	26	20	6	35.6	SC-SM	SILTY, CLAYEY SAND
⊗	ALD-15	54.5 - 56	49	18	31	27.1	SC	CLAYEY SAND
⊕	ALD-15	74.5 - 76	59	17	42	24.2	SC	CLAYEY SAND
□	ALD-16	14.5 - 16	44	14	30	67.0	CL	SANDY LEAN CLAY
⊠	ALD-16	19.5 - 21	44	14	30	64.2	CL	SANDY LEAN CLAY
◕	ALD-16	24.5 - 26	44	16	28	98.7	CL	LEAN CLAY
☆	ALD-16	34.5 - 36	43	17	26	45.8	SC	CLAYEY SAND
✿	ALD-16	39.5 - 41	53	19	34	45.9	SC	CLAYEY SAND
■	ALD-16	59.5 - 61	56	17	39	29.1	SC	CLAYEY SAND
◆	ALD-16	64.5 - 66	59	17	42	28.1	SC	CLAYEY SAND
◇	ALD-17	19.5 - 21	62	17	45	98.5	CH	FAT CLAY
×	ALD-17	24.5 - 26	23	21	2	81.5	ML	SILT with SAND
✖	ALD-17	29.5 - 31	46	16	30	99.6	CL	LEAN CLAY

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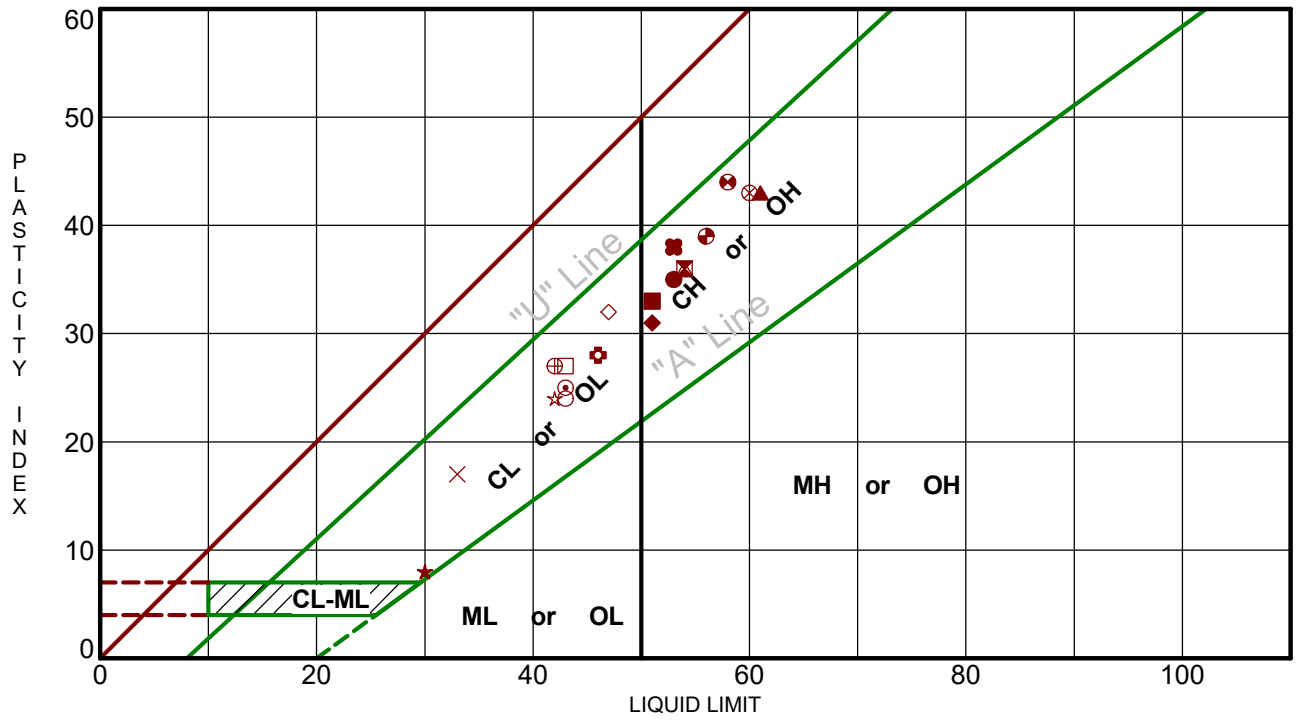

Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	ALD-17	44.5 - 46	53	18	35	25.1	SC	CLAYEY SAND
⊠	ALD-17	59.5 - 61	54	18	36	27.5	SC	CLAYEY SAND
▲	ALD-17	69.5 - 71	61	18	43	30.2	SC	CLAYEY SAND
★	ALD-18	24.5 - 26	30	22	8	98.5	CL	LEAN CLAY
⊙	ALD-18	29.5 - 31	43	18	25	88.2	CL	LEAN CLAY
✿	ALD-18	34.5 - 36	46	18	28	83.5	CL	LEAN CLAY with SAND
○	ALD-18	39.5 - 41	43	19	24	22.6	SC	CLAYEY SAND
△	ALD-18	49.5 - 51	54	18	36	23.1	SC	CLAYEY SAND
⊗	ALD-19	14.5 - 16	60	17	43	99.0	CH	FAT CLAY
⊕	ALD-19	24.5 - 26	42	15	27	98.8	CL	LEAN CLAY
□	ALD-19	34.5 - 36	43	16	27	77.9	CL	LEAN CLAY with SAND
⊠	ALD-19	54.5 - 56	58	14	44	27.9	SC	CLAYEY SAND
◕	ALD-19	64.5 - 66	56	17	39	25.8	SC	CLAYEY SAND
☆	ALD-20	29.5 - 31	42	18	24	27.3	SC	CLAYEY SAND
✿	ALD-20	34.5 - 36	53	15	38	42.4	SC	CLAYEY SAND
■	ALD-20	39.5 - 41	51	18	33	33.1	SC	CLAYEY SAND
◆	ALD-20	59.5 - 61	51	20	31	24.2	SC	CLAYEY SAND
◇	ALD-21	19.5 - 21	47	15	32	99.8	CL	LEAN CLAY
×	ALD-21	24.5 - 26	33	16	17	66.5	CL	SANDY LEAN CLAY
✖	ALD-21	44.5 - 46	53	15	38	28.9	SC	CLAYEY SAND

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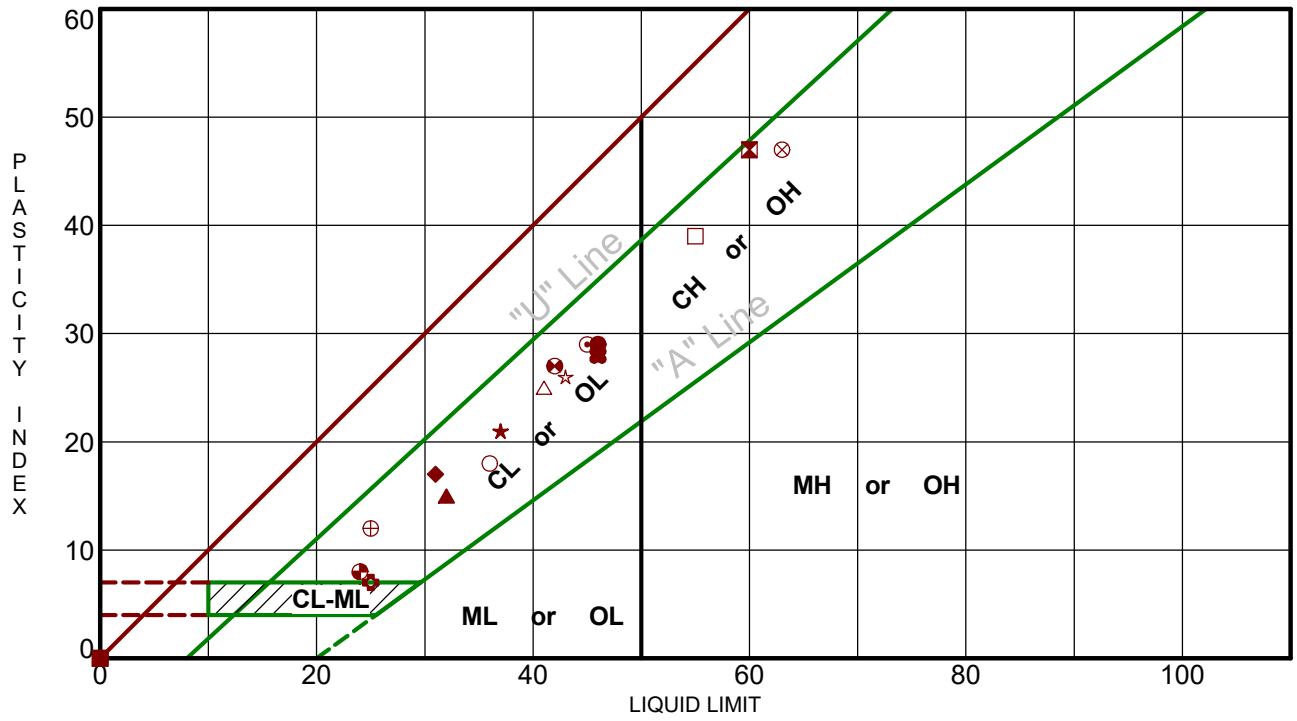

Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	ALD-21	59.5 - 61	46	17	29	31.8	SC	CLAYEY SAND
⊠	ALD-21	69.5 - 71	60	13	47	28.0	SC	CLAYEY SAND
▲	ALD-22	19.5 - 21	32	17	15	98.3	CL	LEAN CLAY
★	ALD-22	29.5 - 31	37	16	21	91.9	CL	LEAN CLAY
⊙	ALD-22	34.5 - 36	45	16	29	80.3	CL	LEAN CLAY with SAND
✿	ALD-22	44.5 - 46	25	18	7	24.2	SC-SM	SILTY, CLAYEY SAND
○	ALD-22	49.5 - 51	36	18	18	25.3	SC	CLAYEY SAND
△	ALD-22	64.5 - 66	41	16	25	27.7	SC	CLAYEY SAND
⊗	ALD-22	69.5 - 71	63	16	47	34.3	SC	CLAYEY SAND
⊕	ALD-23	24.5 - 26	25	13	12	42.2	SC	CLAYEY SAND
□	ALD-23	29.5 - 31	55	16	39	96.6	CH	FAT CLAY
⊛	ALD-23	39.5 - 41	42	15	27	98.8	CL	LEAN CLAY
◕	ALD-23	44.5 - 46	24	16	8	22.9	SC	CLAYEY SAND with GRAVEL
☆	ALD-23	69.5 - 71	43	17	26	28.4	SC	CLAYEY SAND
❀	ALD-24	19.5 - 21	NP	NP	NP	38.5	SM	SILTY SAND
■	ALD-24	34.5 - 36	NP	NP	NP	4.0	SP	POORLY GRADED SAND
◆	ALD-24	39.5 - 41	31	14	17	65.4	CL	SANDY LEAN CLAY
◇	ALD-24	44.5 - 46	NP	NP	NP	5.6	SP-SM	POORLY GRADED SAND with SILT
×	ALD-24	54.5 - 56	NP	NP	NP	6.4	SP-SM	POORLY GRADED SAND with SILT
✖	ALD-24	74.5 - 76	46	18	28	22.3	SC	CLAYEY SAND

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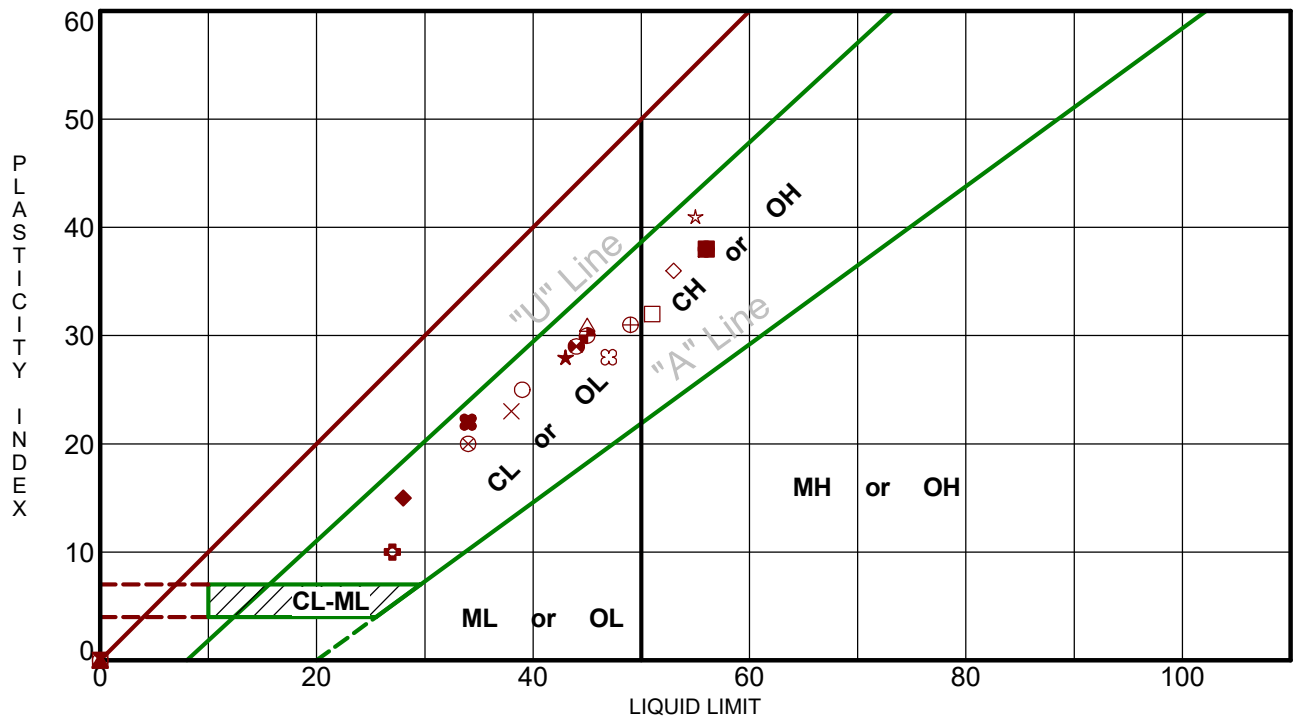

Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	ALD-25	14.5 - 16	56	18	38	98.9	CH	FAT CLAY
⊠	ALD-25	24.5 - 26	NP	NP	NP	32.7	SM	SILTY SAND
▲	ALD-25	29.5 - 31	NP	NP	NP	5.0	SP	POORLY GRADED SAND
★	ALD-25	44.5 - 46	43	15	28	94.3	CL	LEAN CLAY
⊙	ALD-25	49.5 - 51	NP	NP	NP	11.7	SW-SM	WELL-GRADED SAND with SILT and GRAVEL
✿	ALD-25	54.5 - 55.1	27	17	10	28.6	SC	CLAYEY SAND
○	ALD-26	24.5 - 26	39	14	25	99.6	CL	LEAN CLAY
△	ALD-26	29.5 - 31	45	14	31	85.4	CL	LEAN CLAY
⊗	ALD-26	34.5 - 36	34	14	20	48.5	SC	CLAYEY SAND
⊕	ALD-26	54.5 - 56	49	18	31	25.0	SC	CLAYEY SAND
□	ALD-26	64.5 - 66	51	19	32	22.2	SC	CLAYEY SAND
⊠	ALD-27	29.5 - 31	44	15	29	99.2	CL	LEAN CLAY
◕	ALD-27	39.5 - 41	45	15	30	84.1	CL	LEAN CLAY with SAND
☆	ALD-27	49.5 - 51	55	14	41	48.4	SC	CLAYEY SAND
✿	ALD-27	54.5 - 56	47	19	28	24.6	SC	CLAYEY SAND
■	ALD-27	74.5 - 76	56	18	38	27.2	SC	CLAYEY SAND
◆	ALD-28	9.5 - 11	28	13	15	54.3	CL	SANDY LEAN CLAY
◇	ALD-28	19.5 - 21	53	17	36	95.0	CH	FAT CLAY
×	ALD-28	29.5 - 31	38	15	23	98.9	CL	LEAN CLAY
✖	ALD-28	39.5 - 41	34	12	22	63.3	CL	SANDY LEAN CLAY

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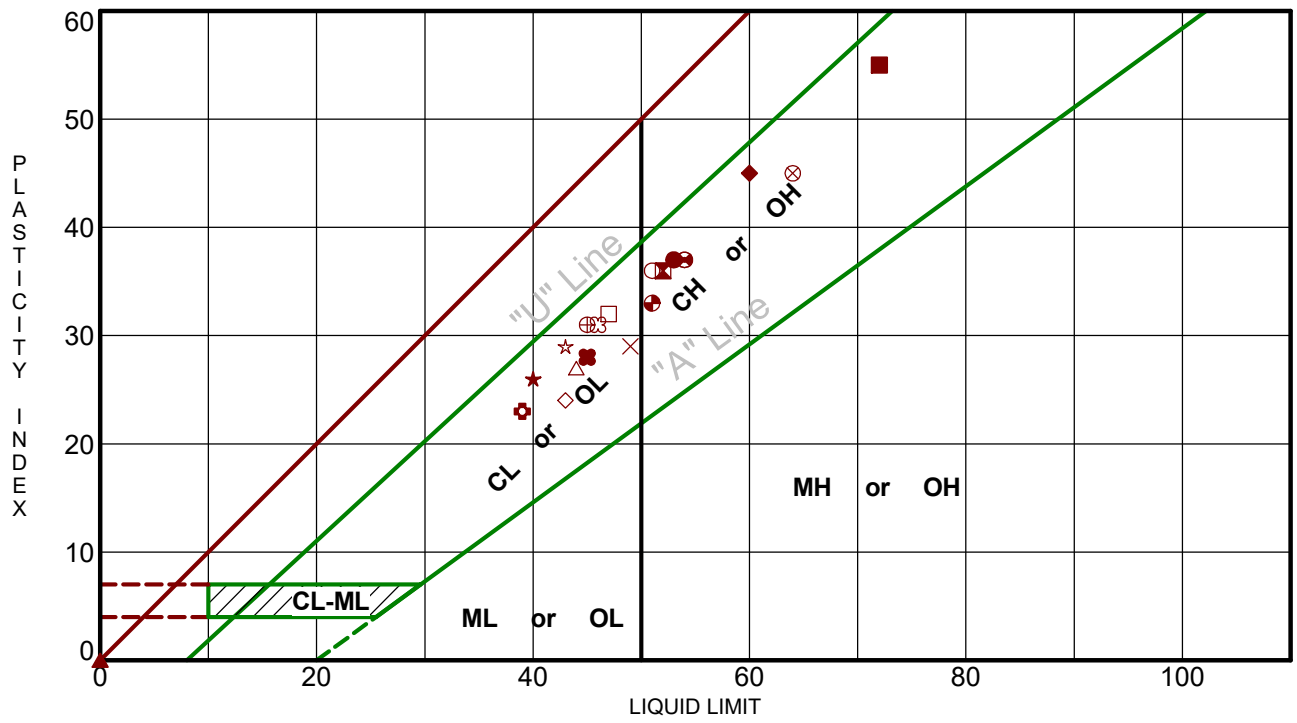

Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	ALD-28	44.5 - 46	53	16	37	96.8	CH	FAT CLAY
⊠	ALD-28	69.5 - 71	52	16	36	26.0	SC	CLAYEY SAND
▲	ALD-29	14.5 - 16	NP	NP	NP	11.8	SP-SM	POORLY GRADED SAND with SILT
★	ALD-29	19.5 - 21	40	14	26	63.3	CL	SANDY LEAN CLAY
⊙	ALD-29	24.5 - 26	54	17	37	94.5	CH	FAT CLAY
✿	ALD-29	39.5 - 41	39	16	23	98.9	CL	LEAN CLAY
○	ALD-29	49.5 - 51	51	15	36	87.2	CH	FAT CLAY
△	ALD-30	19.5 - 21	44	17	27	62.1	CL	SANDY LEAN CLAY
⊗	ALD-30	34.5 - 36	64	19	45	96.9	CH	FAT CLAY
⊕	ALD-30	39.5 - 41	45	14	31	99.6	CL	LEAN CLAY
□	ALD-30	49.5 - 51	47	15	32	87.5	CL	LEAN CLAY
⊠	ALD-30	59.5 - 61	54	17	37	30.8	SC	CLAYEY SAND
◕	ALD-30	74.5 - 76	51	18	33	27.2	SC	CLAYEY SAND
☆	ALD-31	24.5 - 26	43	14	29	60.6	CL	SANDY LEAN CLAY
✿	ALD-31	29.5 - 31	46	15	31	60.6	CL	SANDY LEAN CLAY
■	ALD-31	34.5 - 36	72	17	55	99.6	CH	FAT CLAY
◆	ALD-31	49.5 - 51	60	15	45	99.0	CH	FAT CLAY
◇	ALD-31	59.5 - 61	43	19	24	60.0	CL	SANDY LEAN CLAY
✕	ALD-31	69.5 - 71	49	20	29	38.5	SC	CLAYEY SAND
✖	ALD-32	29.5 - 31	45	17	28	88.6	CL	LEAN CLAY

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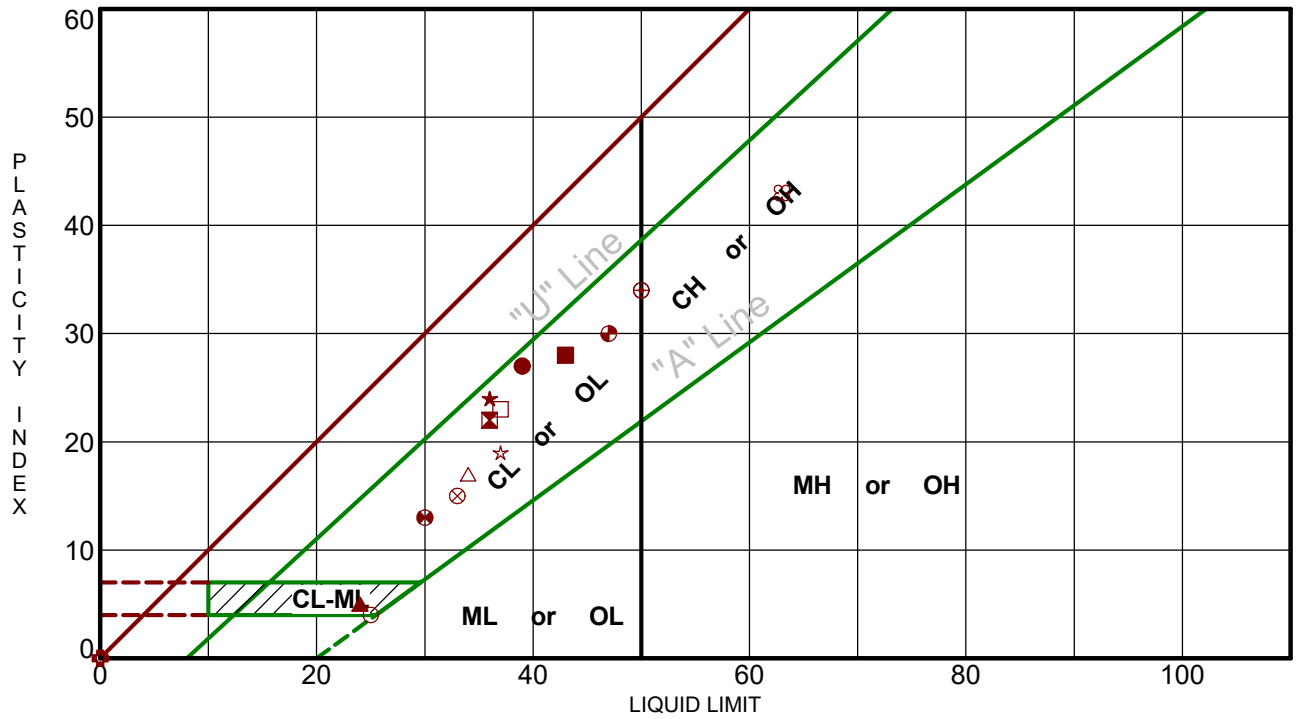


Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	ALD-32	39.5 - 41	39	12	27	59.4	CL	SANDY LEAN CLAY
⊠	ALD-32	44.5 - 46	36	14	22	57.2	CL	SANDY LEAN CLAY
▲	ALD-32	54.5 - 56	24	19	5	30.1	SC-SM	SILTY, CLAYEY SAND
★	ALD-32	64.5 - 66	36	12	24	53.6	CL	SANDY LEAN CLAY
⊙	MW-91-3	19.5 - 21	50	16	34	99.7	CH	FAT CLAY
✿	MW-91-4	24.5 - 26	NP	NP	NP	28.1	SM	SILTY SAND
○	MW-91-4	29.5 - 31	25	21	4	80.6	CL-ML	SILTY CLAY with SAND
△	MW-91-4	34.5 - 36	34	17	17	99.5	CL	LEAN CLAY
⊗	MW-91-5	9.5 - 11	33	18	15	31.4	SC	CLAYEY SAND
⊕	MW-91-5	14.5 - 16	50	16	34	95.4	CH	FAT CLAY
□	MW-91-5	19.5 - 21	37	14	23	35.3	SC	CLAYEY SAND
⊠	MW-91-5	24.5 - 26	30	17	13	31.1	SC	CLAYEY SAND
◕	MW-91-6	19.5 - 21	47	17	30	98.6	CL	LEAN CLAY
☆	MW-91-6	24.5 - 26	37	18	19	60.4	CL	SANDY LEAN CLAY
⊠	MW-91-7	9.5 - 11	63	20	43	98.9	CH	FAT CLAY
■	MW-91-7	14.5 - 16	43	15	28	98.2	CL	LEAN CLAY

PROJECT: GRE - Coal Creek Station

PROJECT NUMBER: M2215072

SITE: 2875 3rd St SW
Underwood, North Dakota

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

CLIENT: Golder Associates Inc
Lakewood, Colorado

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/9/21

APPENDIX A-3

2021 Site Investigation Photographs

UR91 ALD Photos

Photograph 1
Grey sand with clay fines, poorly graded, uniform, wet, less dense than previous increment (SC, 64.5'-66') (IMG-3930.JPG)

Photograph 2
Brown/grey lean clay, consistent grain size, moist (CL, 29.5'-31') (IMG_5768.JPG)

UR91 ALD Photos

Photograph 3
Dark brown hard clay with some gravel, trace coal, steam from the cuttings, lightt brown soft, below water ~ 45', upper portion of sample - sandy with grey, ochre, and black inclusions (ALD-3)(CL, 44.5'-46') (IMG-3892.JPG)

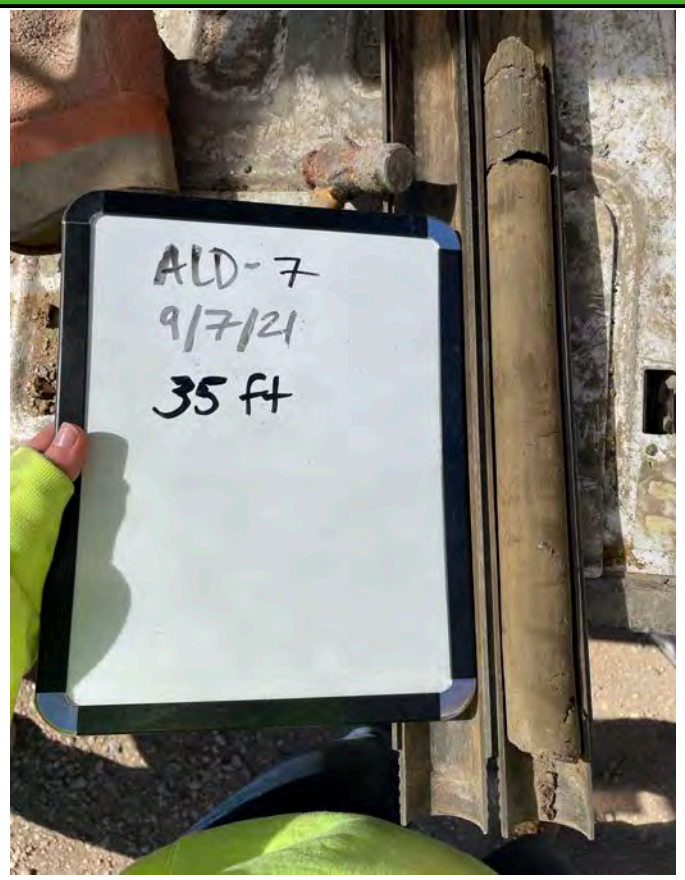
Photograph 4
Brown clay with trace sand and gravel inclusions, moist to dry (CL, 24.5'-26') (IMG_5743.JPG)

UR91 ALD Photos

Photograph 5
Grey clay, firm, homogeneous, driller hit difficult zone at 54' (CH, 54.5'-56') (IMG_5731.JPG)

Photograph 6
Brown-light brown poorly graded sand with little to no fines, very dry, fine-grained rounded sand particles (SP, 39.5'-41') (IMG-3864.JPG)

UR91 ALD Photos



Photograph 7
Brown clay with gravel inclusions and coal seams, dry to moist (CL, 34.5'-36') (IMG_5698.JPG)

Photograph 8
Grey-brown clay, smooth, moist (CH, 29.5'-31') (IMG-3823.JPG)

UR91 ALD Photos

Photograph 9
Grey clay with little to no sand or gravel, smooth, mostly dry (CH, 39'5-41') (IMG-3847.JPG)

Photograph 10
Grey poorly graded sand, fine-grained, trace gravel at top of split spoon and consistent particle size for remainder, trace clay fines (SM, 64.5'-66') (IMG-3815.JPG)

UR91 ALD Photos

Photograph 11
Grey sand with little clay, fine-grained, poorly graded (ALD-11)(SC, 64.5'-66') (IMG-3794.JPG)

Photograph 12
Brown clay with gravel and trace sand (ALD-12)(CH, 24.5'-26') (IMG-3763.JPG)

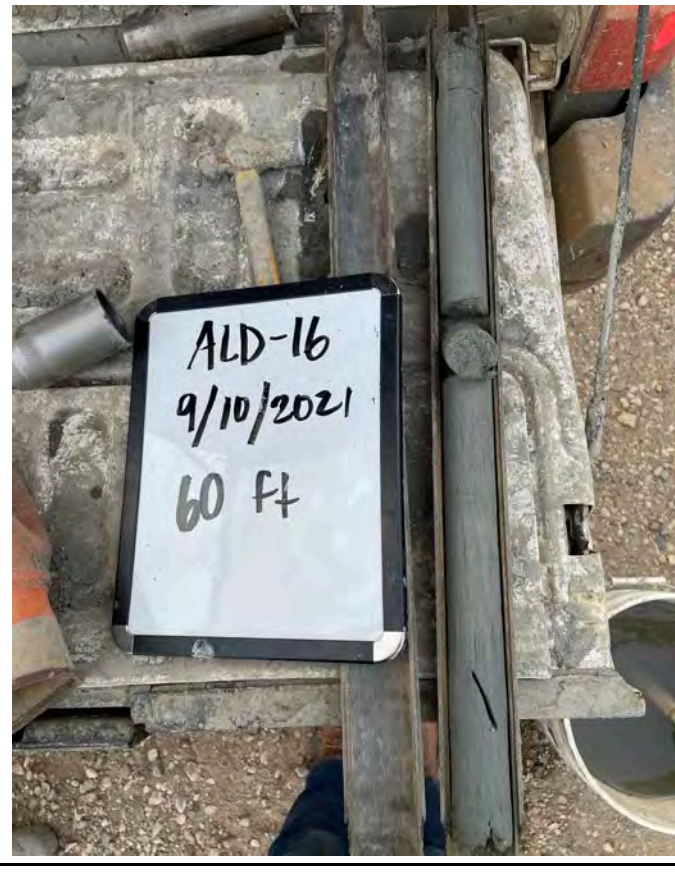
UR91 ALD Photos

Photograph 13
Grey clay, little to no sand, soft (ALD-13)(CH, 24.5'-26') (IMG-3741.JPG)

Photograph 14
Grey clayey sand with trace gravel, uniform grain size, 2" coal inclusion, wet, free water (SC, 69.5'-71')
(IMG_5818.JPG)

UR91 ALD Photos

Photograph 15
Grey clayey sand, uniform grain size (SC-SM, 29.5'-31') (IMG_5830.JPG)



Photograph 16
Grey sand, more coarse than previous samples, clay content increasing with depth, moist (SC, 59.5'-61') (IMG_5861.JPG)

UR91 ALD Photos

Photograph 17
Grey sand, poorly graded, fine-grained, little to no fines in upper 6" of split spoon, some fines in lower 12" of split spoon, wet, no free water (ML, 24.5'-26') (IMG-3958.JPG)

Photograph 18
Grey clayey sand, medium grain size, uniform, more coarse with depth, moist to wet (SC, 49.5'-51') (IMG_5909.JPG)

UR91 ALD Photos

Photograph 19
Grey sand with brown clay and coal intrusions at top of split spoon, moist (SC, 54.5'-56') (IMG_5938.JPG)

Photograph 20
Grey clay, dense, crumbly, more sitly sand particles than above samples, moist (CL, 19.5'-21') (IMG_5951.JPG)

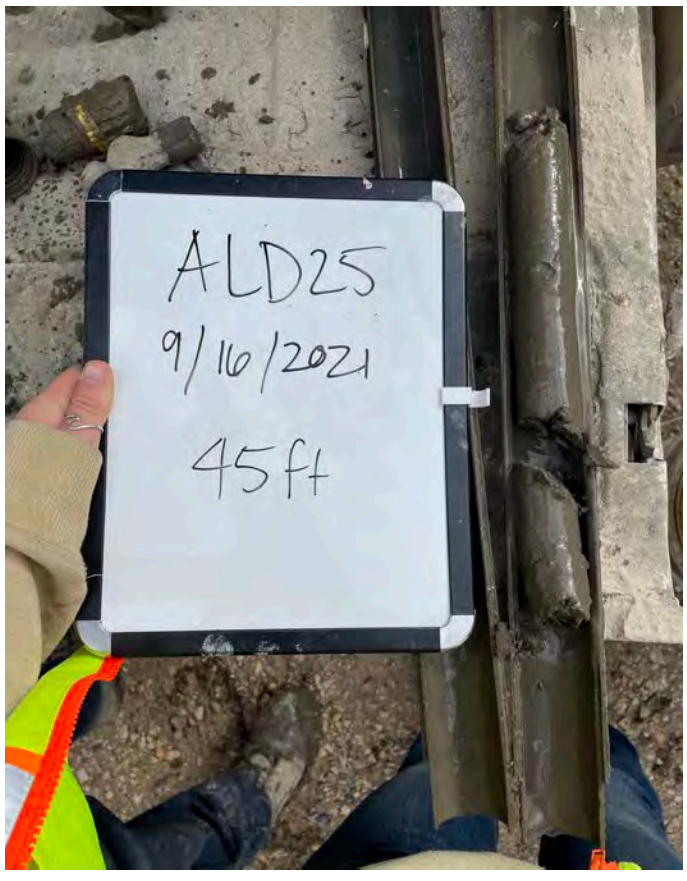
UR91 ALD Photos

Photograph 21
Grey clay to grey sand with clay, fine grained, poorly graded, crustacean shells at change from clay to sand approximately 20' below ground surface (CH, 19.5'-21') (IMG-4027.JPG)

Photograph 22
Grey clay, stiffer than previous sample but fairly soft, few larger particles (CH, 29.5'-31') (IMG-4057.JPG)

UR91 ALD Photos

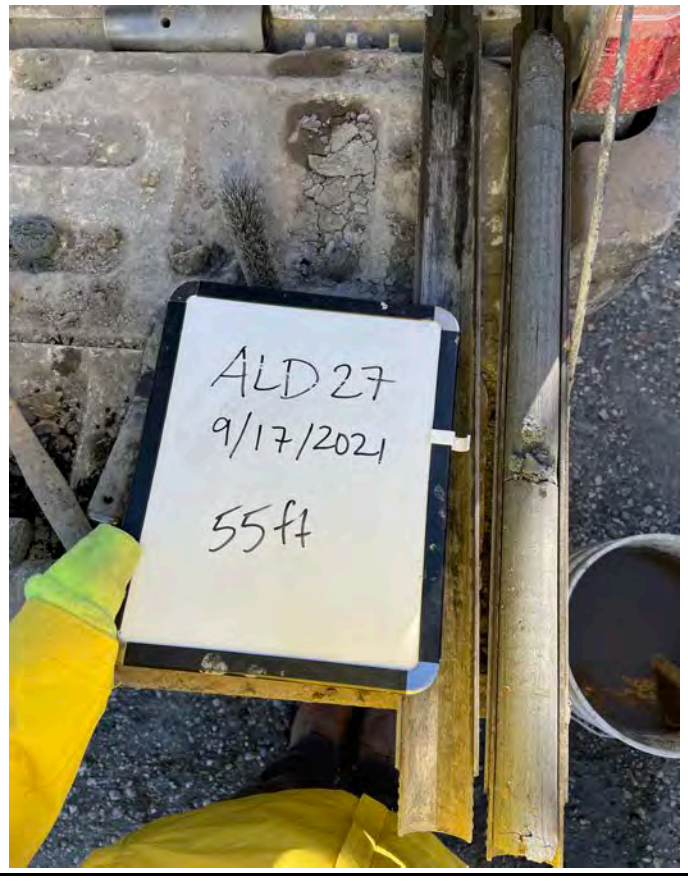
Photograph 23
Grey sand, more silty than above samples, wet (SC, 74.5'-76') (IMG_6011.JPG)



Photograph 24
Grey clay with silty sand, soft (CL, 44.5'-46') (IMG_6029.JPG)

UR91 ALD Photos

Photograph 25
Grey sand, more coarse than previous samples, moist to wet (SC, 64.5'-66') (IMG_6047.JPG)



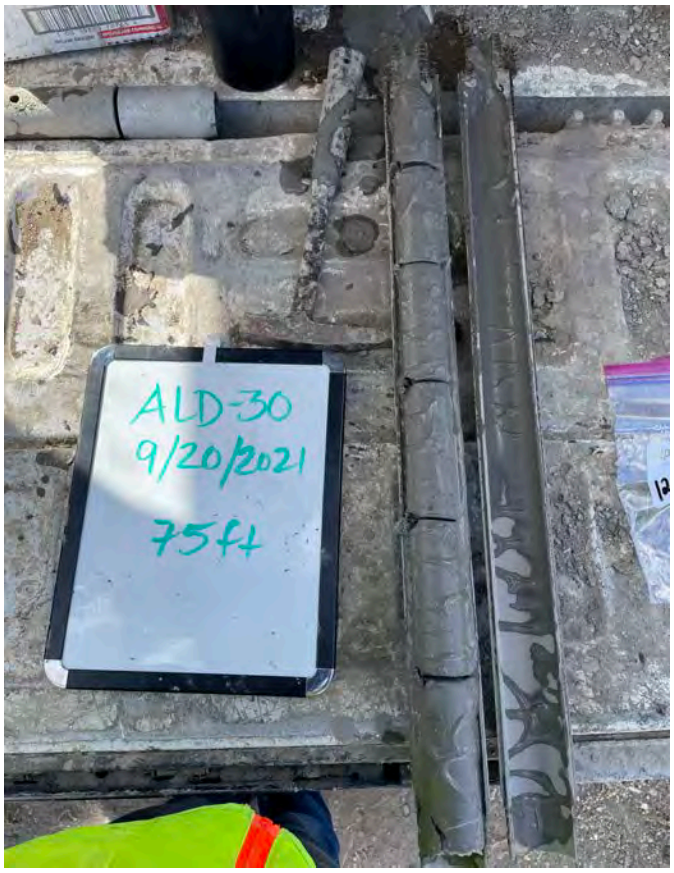
Photograph 26
Grey silty clay, dry to moist (SC, 54.5'-56') (IMG_6081.JPG)

UR91 ALD Photos

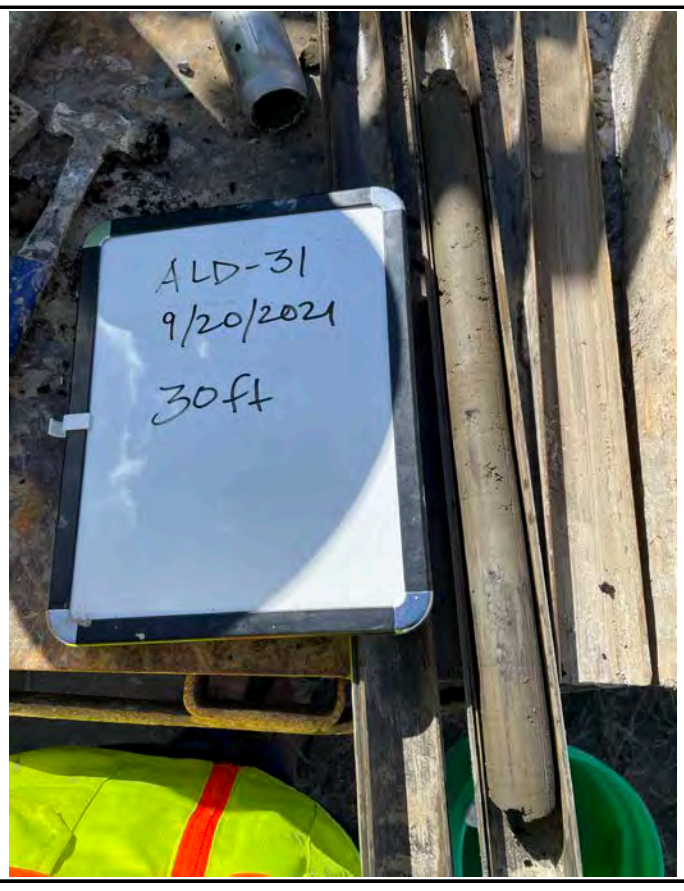
Photograph 27
Brown clayey silt with clumps of pale brown clay and coal, trace gravel and sand, spoils are brown clay (CL, 9.5'-11') (IMG_6123.JPG)

Photograph 28
Grey clay with 5-6" of gravel/sand wash mix, brown gravel and sand, wet (CL, 19.5'-21') (IMG_6148.JPG)

UR91 ALD Photos



Photograph 29
Grey clayey sand and fat clay with sand, less dense than above, wet with free water (SC, 74.5'-76')
(IMG_6177.JPG)



Photograph 30
Brown lean clay, silty, dirty, moist (CL, 29.5'-31') (IMG_6174.JPG)

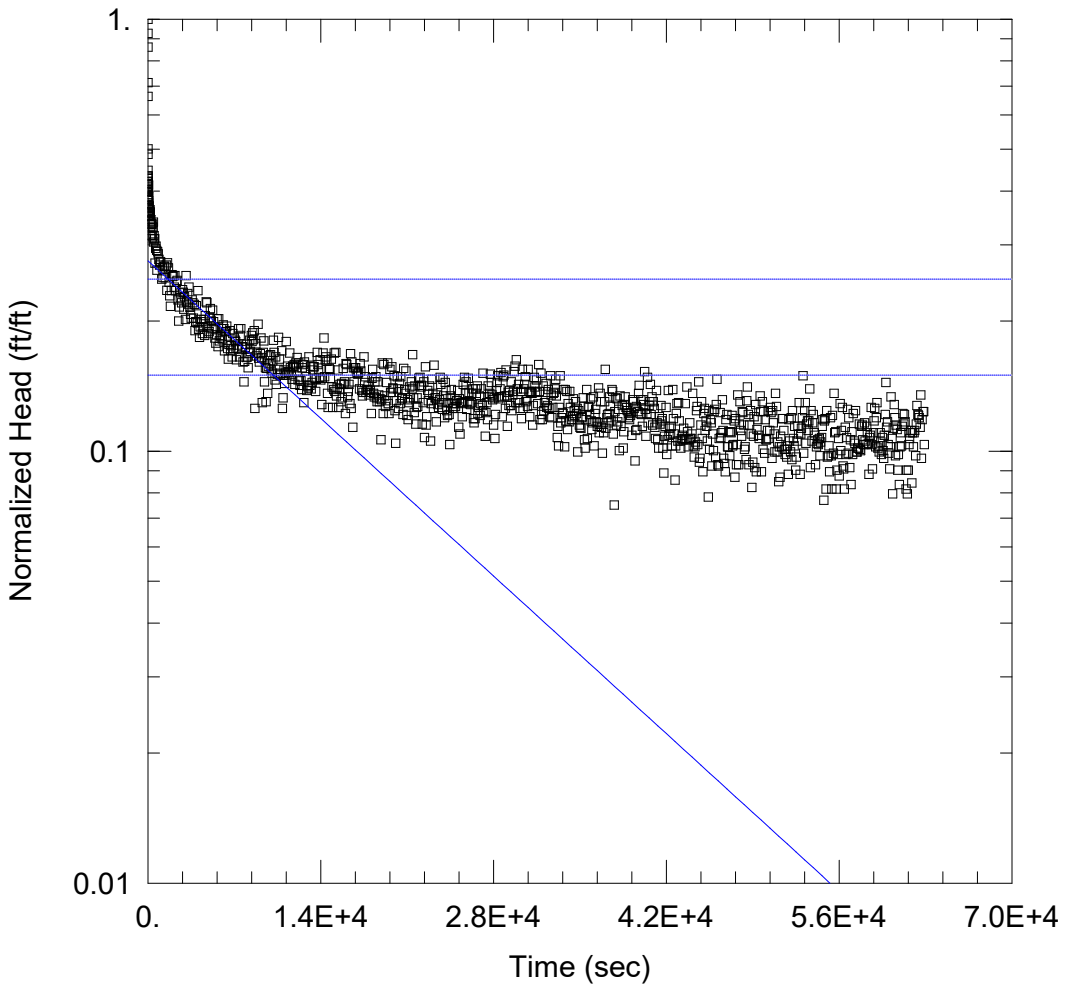
APPENDIX A-4

2021 In-Situ Hydraulic Conductivity (Slug Testing) Results

Great River Energy - Coal Creek Station
Upstream Raise 91 Alternative Liner Demonstration
Slug Testing Results Summary, September 2021

Well ID	Screened Lithology	Test ID	K - HV (cm/s)	
MW-DP3	fill, coal, clay	SI01	3.63E-06	
MW-DP3		SI02	6.16E-06	
MW-DP3		SW01	4.30E-06	
MW-DP3		SW02	2.34E-06	
		Geometric Mean of K (cm/s)	**3.87E-06**	**4E-06**
MW-91-7	fat clay	SW01	5.78E-04	
MW-91-7		SW02	4.80E-04	
MW-91-7		SW03	4.80E-04	
		Geometric Mean of K (cm/s)	**5.11E-04**	**5E-04**
MW-91-2	fat clay, coal	SI01	7.69E-04	
MW-91-2		SI02	7.74E-04	
MW-91-2		SI03	8.58E-04	
MW-91-2		SW01	8.95E-04	
MW-91-2		SW02	8.99E-04	
MW-91-2		SW03	8.66E-04	
		Geometric Mean of K (cm/s)	**8.42E-04**	**8E-04**
MW-75	clayey silt, silty sand	SI-01	3.61E-05	
MW-75		SI-02	3.23E-05	
MW-75		SW-01	2.73E-05	
MW-75		SW-02	2.61E-05	
		Geometric Mean of K (cm/s)	**3.02E-05**	**3E-05**
MW-91-4	fat clay, coal, silty clay, fat clay	SW01	8.95E-05	
MW-91-4		SW02	1.58E-05	
		Geometric Mean of K (cm/s)	**3.76E-05**	**4E-05**
MW-16-6	sandy lean clay, coal, lean clay	SW01	1.77E-02	
MW-16-6		SW02	1.35E-02	
MW-16-6		SW03	2.20E-02	
		Geometric Mean of K (cm/s)	**1.74E-02**	**2E-02**
MW-49	sandy gravelly clay, sandy silt, shale (rock)	SI01	1.32E-03	
MW-49		SI02	4.35E-04	
MW-49		SI03	5.60E-04	
MW-49		SW01	1.57E-03	
MW-49		SW02	8.42E-04	
MW-49		SW03	2.18E-03	
		Geometric Mean of K (cm/s)	**9.89E-04**	**1E-03**
MW-91-5	sandy lean clay, fat clay, clayey sand, silty sand	SW-01	3.63E-03	
MW-91-5		SW-02	2.23E-03	
MW-91-5		SW-03	4.99E-03	
		Geometric Mean of K (cm/s)	**3.43E-03**	**3E-03**
MW-91-1	sand with silt and gravel, fat clay	SW01	5.84E-04	
MW-91-1		SW02	7.65E-04	
MW-91-1		SW03	9.50E-04	
		Geometric Mean of K (cm/s)	**7.51E-04**	**8E-04**
MW-91-6	silty sand, fat clay, silt with sand	SW01	6.55E-05	
MW-91-6		SW02	7.84E-05	
MW-91-6		SW03	7.35E-05	
		Geometric Mean of K (cm/s)	**7.23E-05**	**7E-05**

Notes:
- "K" means hydraulic conductivity
- "HV" means the Hvorslev solution was used for the analysis
- cm/s means centimeters per second
- "SI" in the Test ID columns indicates a slug injection test was performed
- "SW" in the Test ID columns indicates a slug withdrawl test was performed



WELL TEST ANALYSIS

Data Set: C:\...\MWDP3_SI01_HV.aqt
Date: 10/28/21 Time: 13:57:36

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-DP3
Test Date: 9/23/2021

AQUIFER DATA

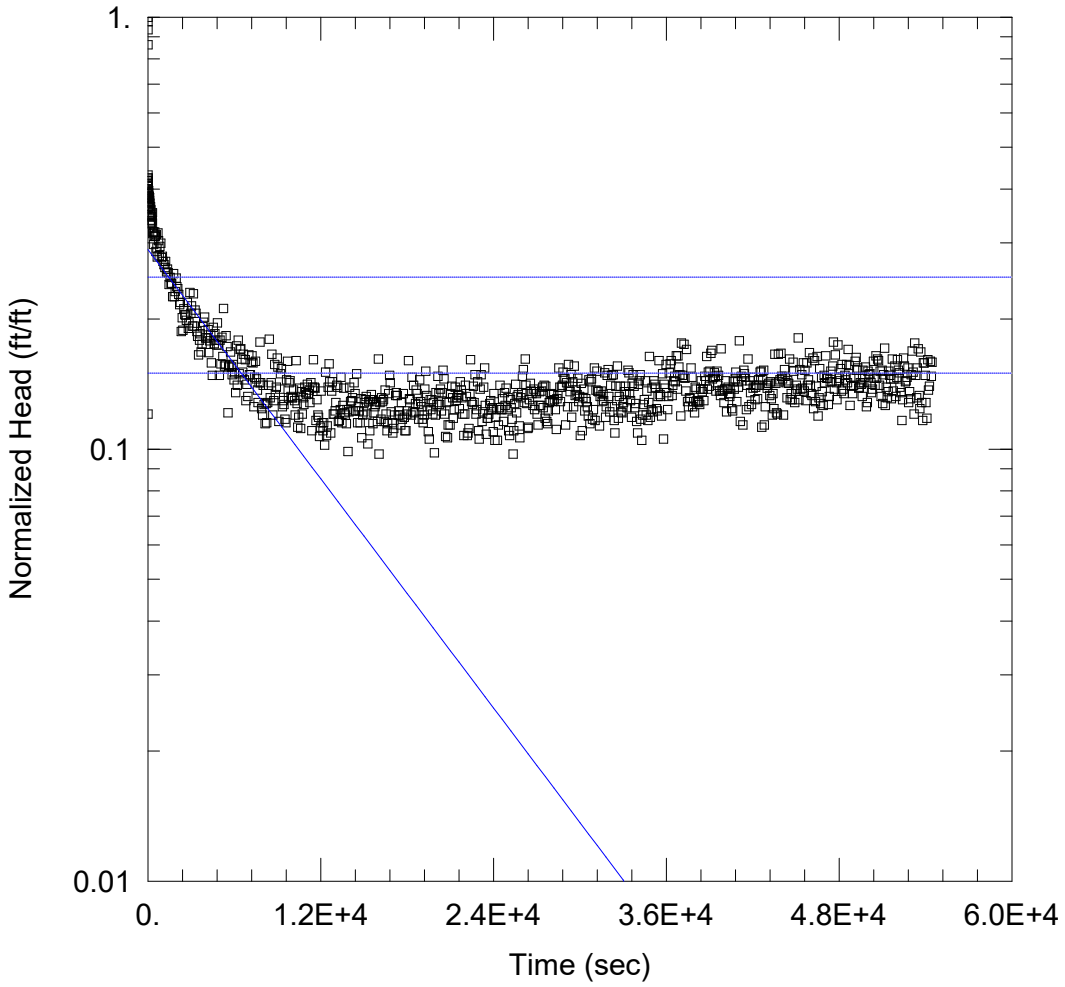
Saturated Thickness: 9.2 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-DP3)

Initial Displacement: -1.506 ft
Total Well Penetration Depth: 9.2 ft
Casing Radius: 0.083 ft
Static Water Column Height: 9.2 ft
Screen Length: 9.2 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
K = 3.628E-6 cm/sec y0 = -0.4153 ft



WELL TEST ANALYSIS

Data Set: C:\...\MWDP3_SI02_HV.aqt
Date: 10/28/21 Time: 13:57:18

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-DP3
Test Date: 9/24/2021

AQUIFER DATA

Saturated Thickness: 9.2 ft Anisotropy Ratio (Kz/Kr): 1.

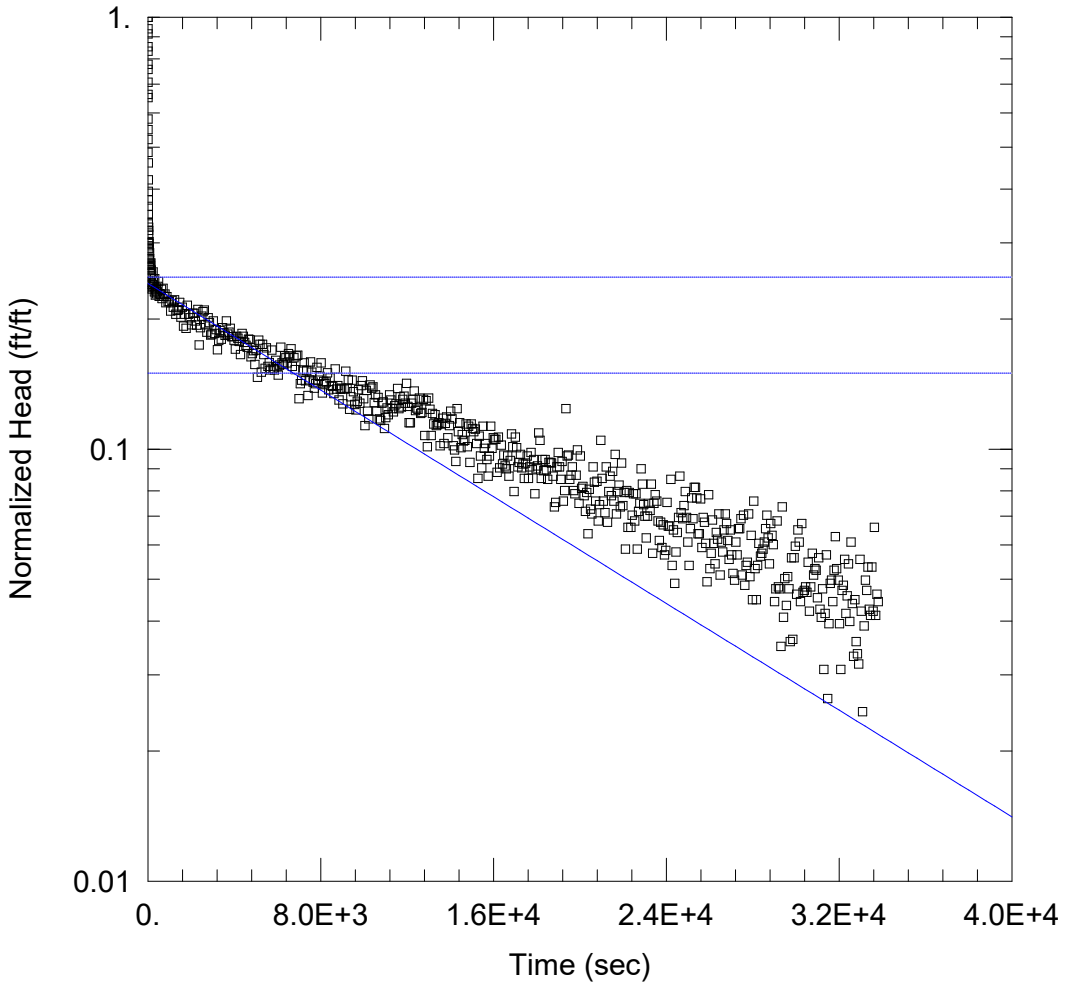
WELL DATA (MW-DP3)

Initial Displacement: -1.459 ft
Total Well Penetration Depth: 9.2 ft
Casing Radius: 0.083 ft
Static Water Column Height: 9.2 ft
Screen Length: 9.2 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 6.155E-6 cm/sec y0 = -0.4224 ft



WELL TEST ANALYSIS

Data Set: C:\...\MWDP3_SW01_HV.aqt
Date: 10/28/21 Time: 13:56:35

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-DP3
Test Date: 9/24/2021

AQUIFER DATA

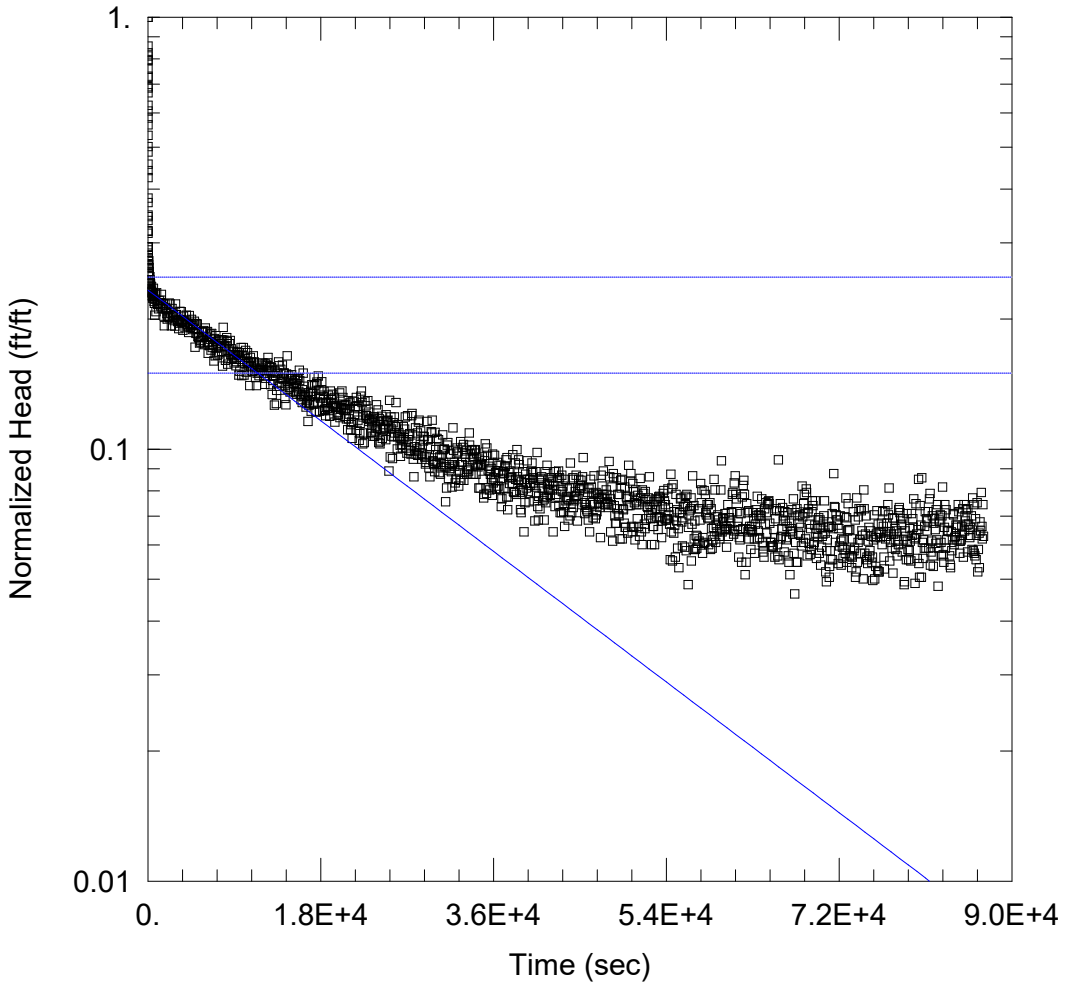
Saturated Thickness: 9.2 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-DP3)

Initial Displacement: 2.231 ft
Total Well Penetration Depth: 9.2 ft
Casing Radius: 0.083 ft
Static Water Column Height: 9.2 ft
Screen Length: 9.2 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
K = 4.298E-6 cm/sec y0 = 0.5396 ft



WELL TEST ANALYSIS

Data Set: C:\...\MWDP3_SW02_HV.aqt
Date: 10/28/21 Time: 13:57:59

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-DP3
Test Date: 9/25/2021

AQUIFER DATA

Saturated Thickness: 9.2 ft Anisotropy Ratio (Kz/Kr): 1.

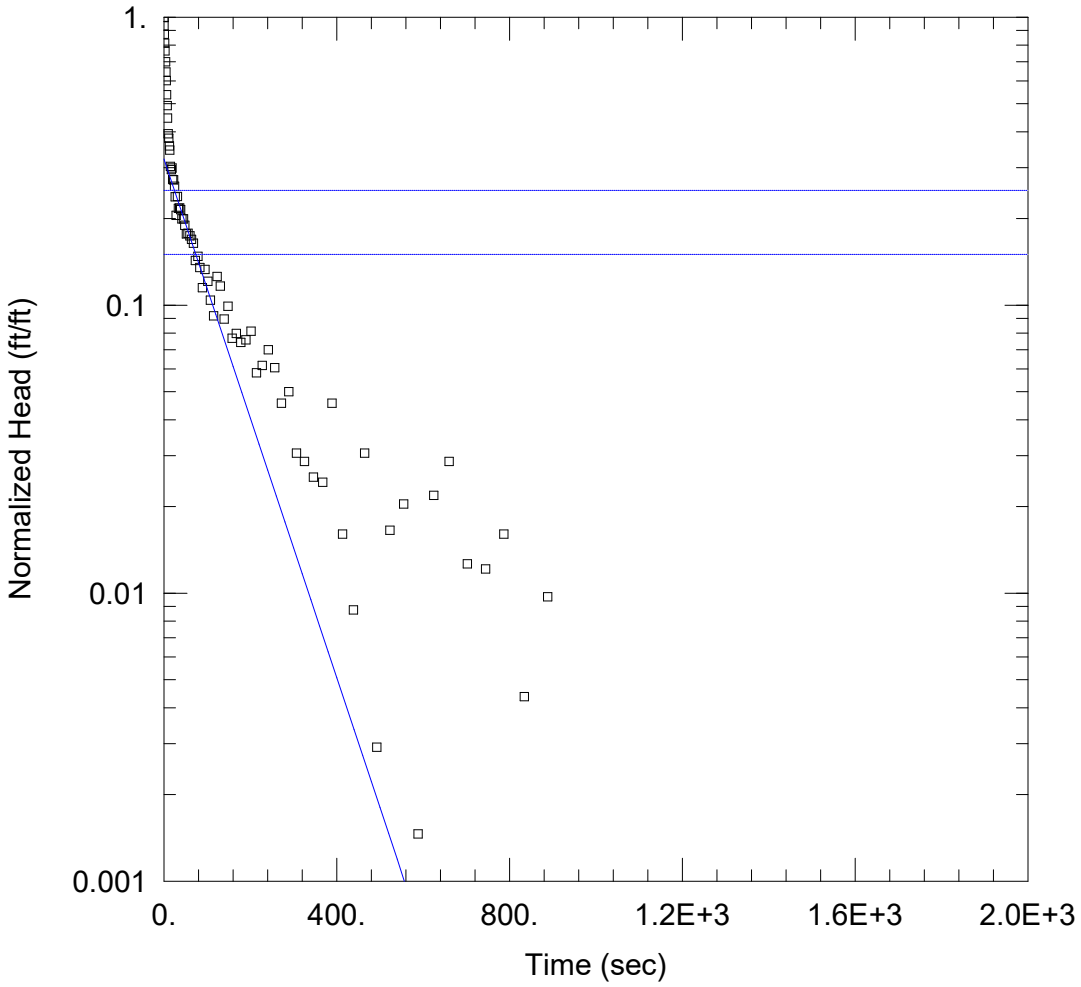
WELL DATA (MW-DP3)

Initial Displacement: 2.596 ft
Total Well Penetration Depth: 9.2 ft
Casing Radius: 0.083 ft
Static Water Column Height: 9.2 ft
Screen Length: 9.2 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 2.339E-6 cm/sec y0 = 0.6059 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW91-7_SW01_HV.aqt
Date: 10/28/21 Time: 14:17:54

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-7
Test Date: 9/26/2021

AQUIFER DATA

Saturated Thickness: 9.97 ft Anisotropy Ratio (Kz/Kr): 1.

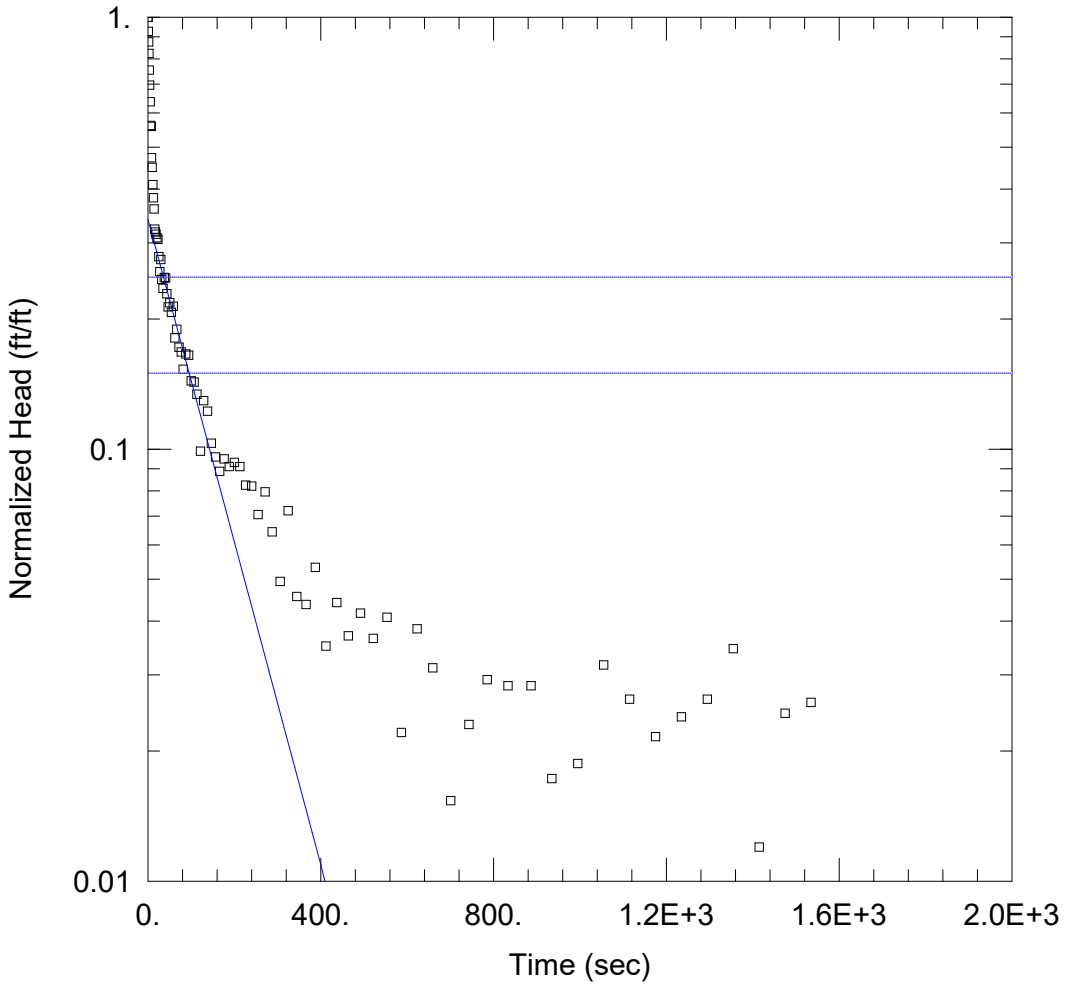
WELL DATA (MW-91-7)

Initial Displacement: 2.059 ft
Total Well Penetration Depth: 9.97 ft
Casing Radius: 0.083 ft
Static Water Column Height: 9.97 ft
Screen Length: 9.97 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.0005782 cm/sec y0 = 0.6616 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW91-7_SW02_HV.aqt
Date: 10/28/21 Time: 14:17:43

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-7
Test Date: 9/26/2021

AQUIFER DATA

Saturated Thickness: 9.97 ft Anisotropy Ratio (Kz/Kr): 1.

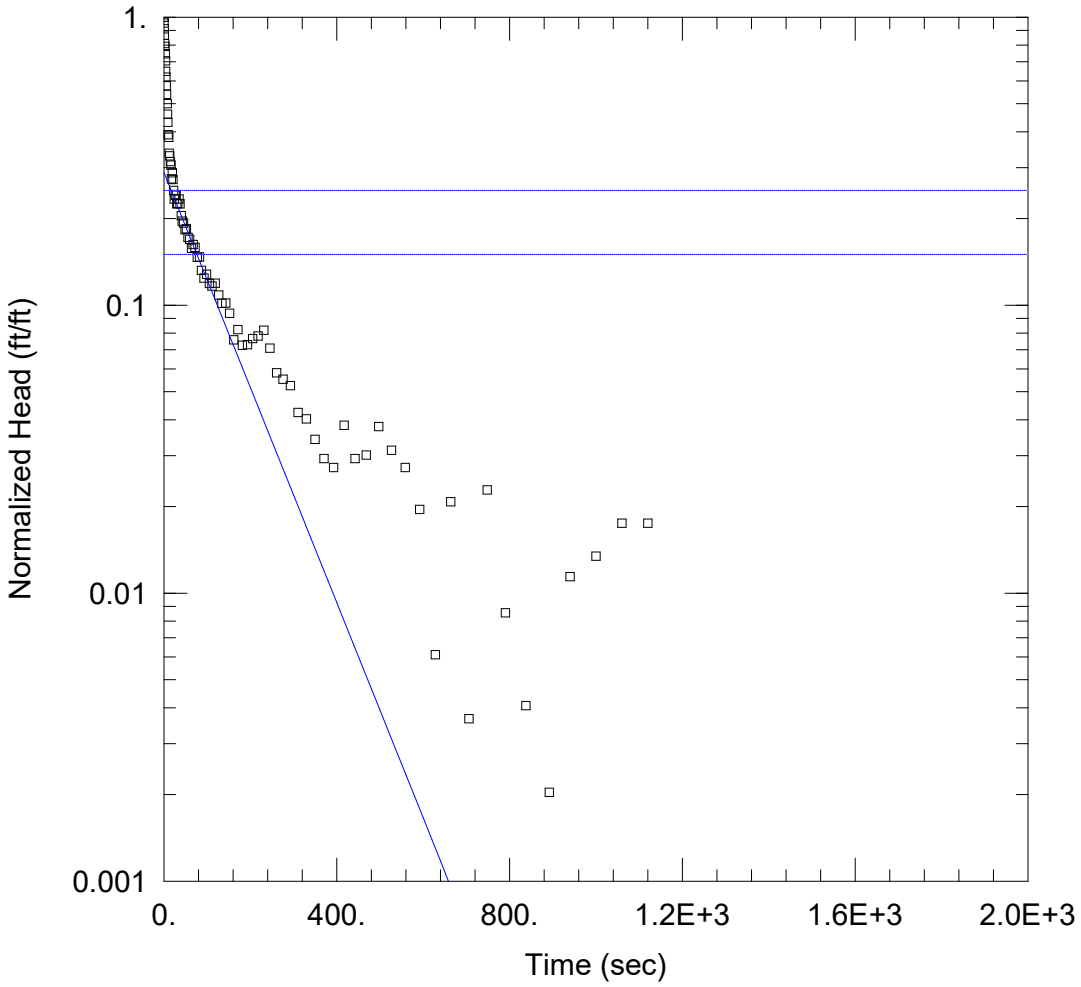
WELL DATA (MW-91-7)

Initial Displacement: 2.084 ft
Total Well Penetration Depth: 9.97 ft
Casing Radius: 0.083 ft
Static Water Column Height: 9.97 ft
Screen Length: 9.97 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.0004797 cm/sec y0 = 0.7091 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW91-7_SW03_HV.aqt
Date: 10/28/21 Time: 14:23:17

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-7
Test Date: 9/26/2021

AQUIFER DATA

Saturated Thickness: 9.97 ft Anisotropy Ratio (Kz/Kr): 1.

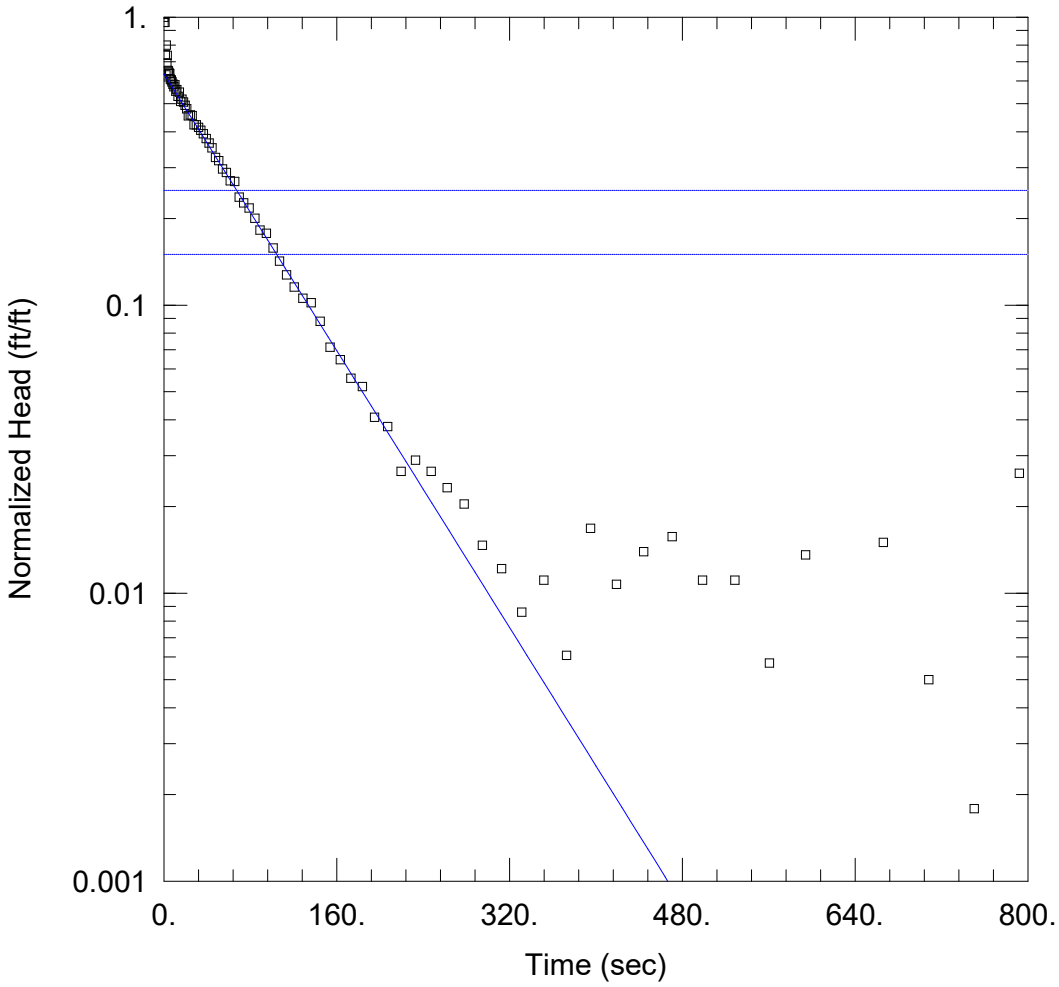
WELL DATA (MW-91-7)

Initial Displacement: 2.456 ft
Total Well Penetration Depth: 9.97 ft
Casing Radius: 0.083 ft
Static Water Column Height: 9.97 ft
Screen Length: 9.97 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.0004797 cm/sec y0 = 0.7091 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW91-2_SI01_HV.aqt
Date: 10/28/21 Time: 14:00:09

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-2
Test Date: 9/22/2021

AQUIFER DATA

Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

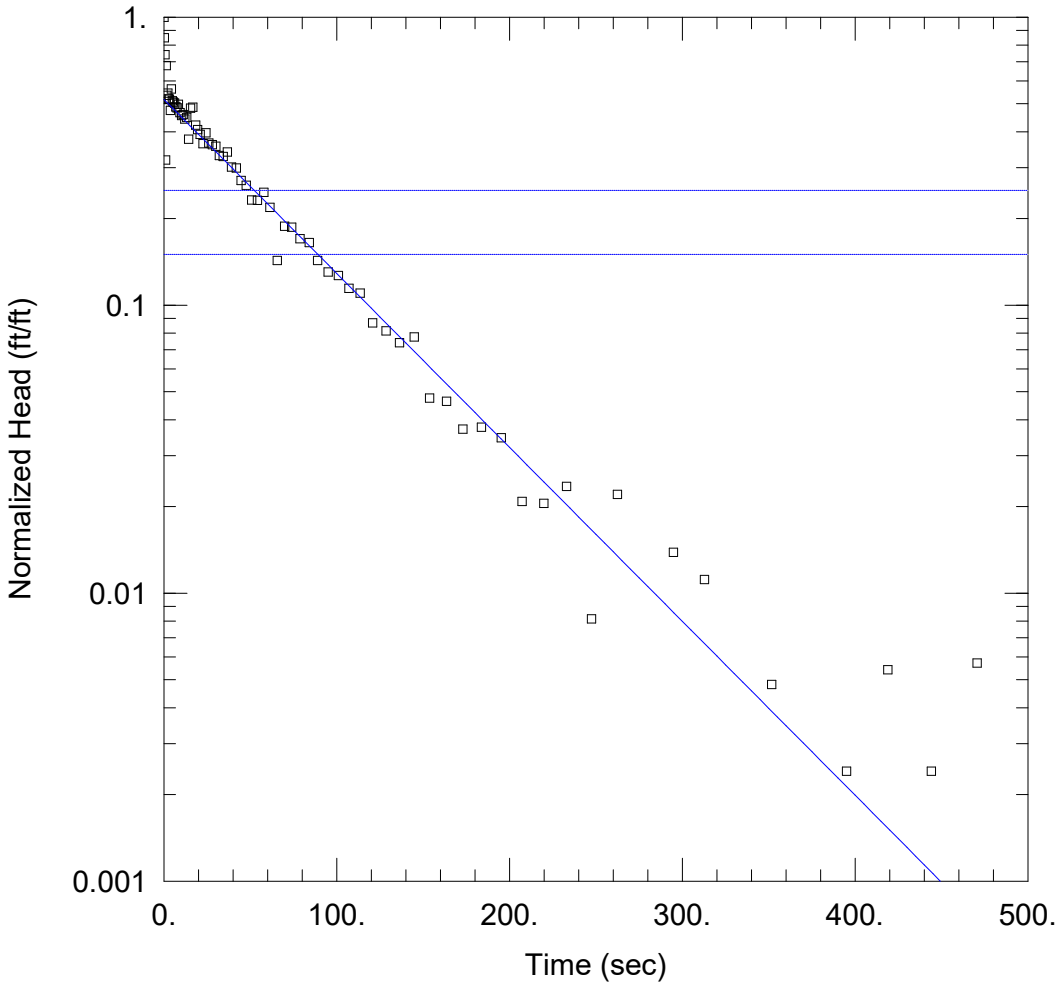
WELL DATA (MW-91-2)

Initial Displacement: -2.798 ft
Total Well Penetration Depth: 12.66 ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.66 ft
Screen Length: 10. ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.0007694 cm/sec y0 = -1.777 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW91-2_SI02_HV.aqt
Date: 10/28/21 Time: 13:59:57

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-2
Test Date: 9/22/2021

AQUIFER DATA

Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

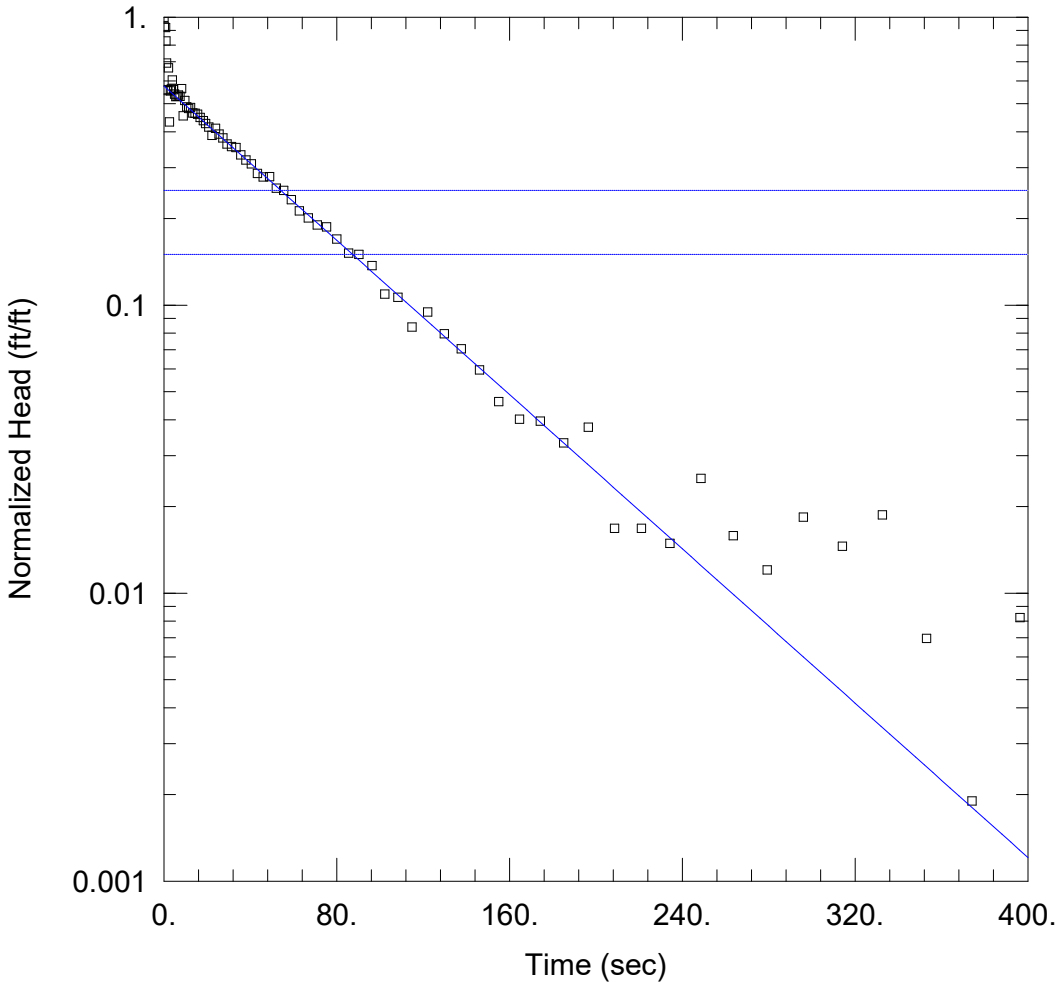
WELL DATA (MW-91-2)

Initial Displacement: -3.319 ft
Total Well Penetration Depth: 12.66 ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.66 ft
Screen Length: 10. ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.0007736 cm/sec y0 = -1.717 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW91-2_SI03_HV.aqt
Date: 10/28/21 Time: 13:59:43

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-2
Test Date: 9/22/2021

AQUIFER DATA

Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

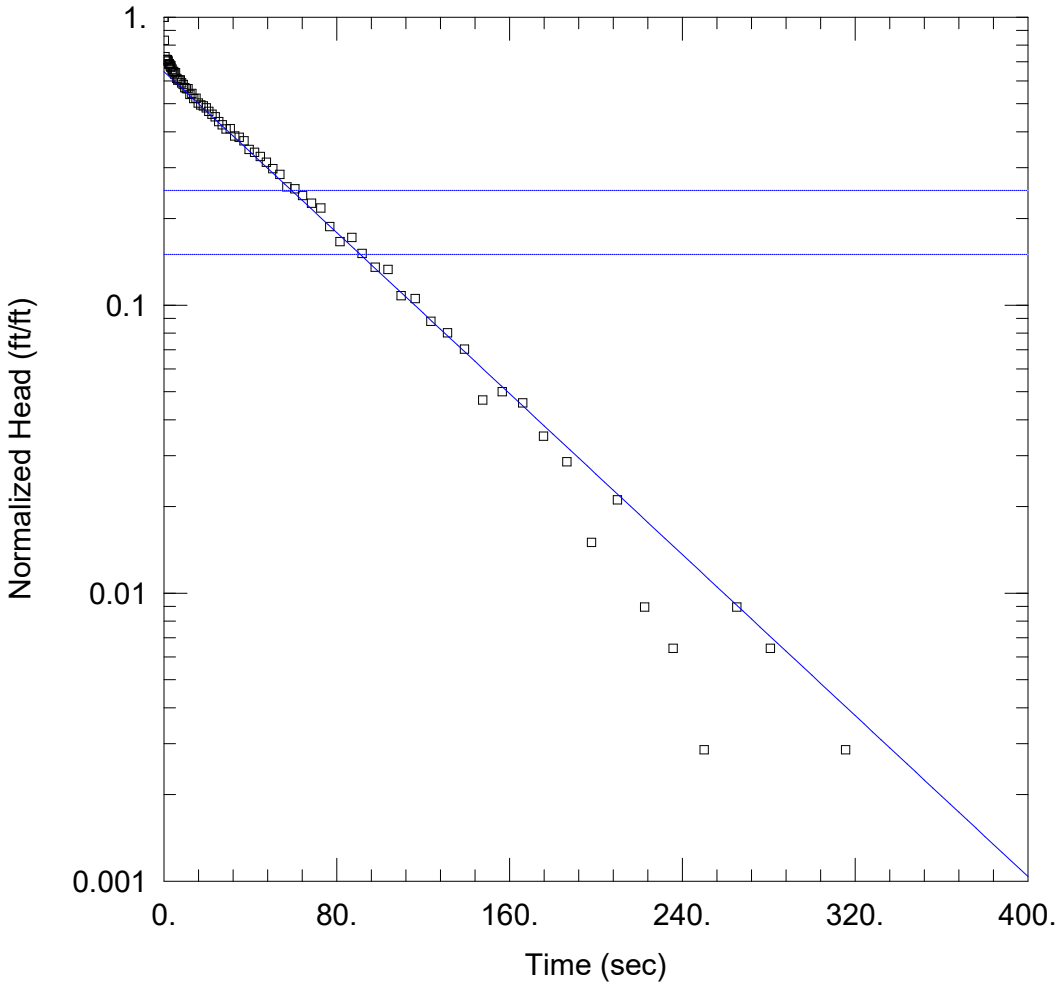
WELL DATA (MW-91-2)

Initial Displacement: -3.159 ft
Total Well Penetration Depth: 12.66 ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.66 ft
Screen Length: 10. ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.0008577 cm/sec y0 = -1.82 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW91-2_SW01_HV.aqt
Date: 10/28/21 Time: 13:59:25

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-2
Test Date: 9/22/2021

AQUIFER DATA

Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

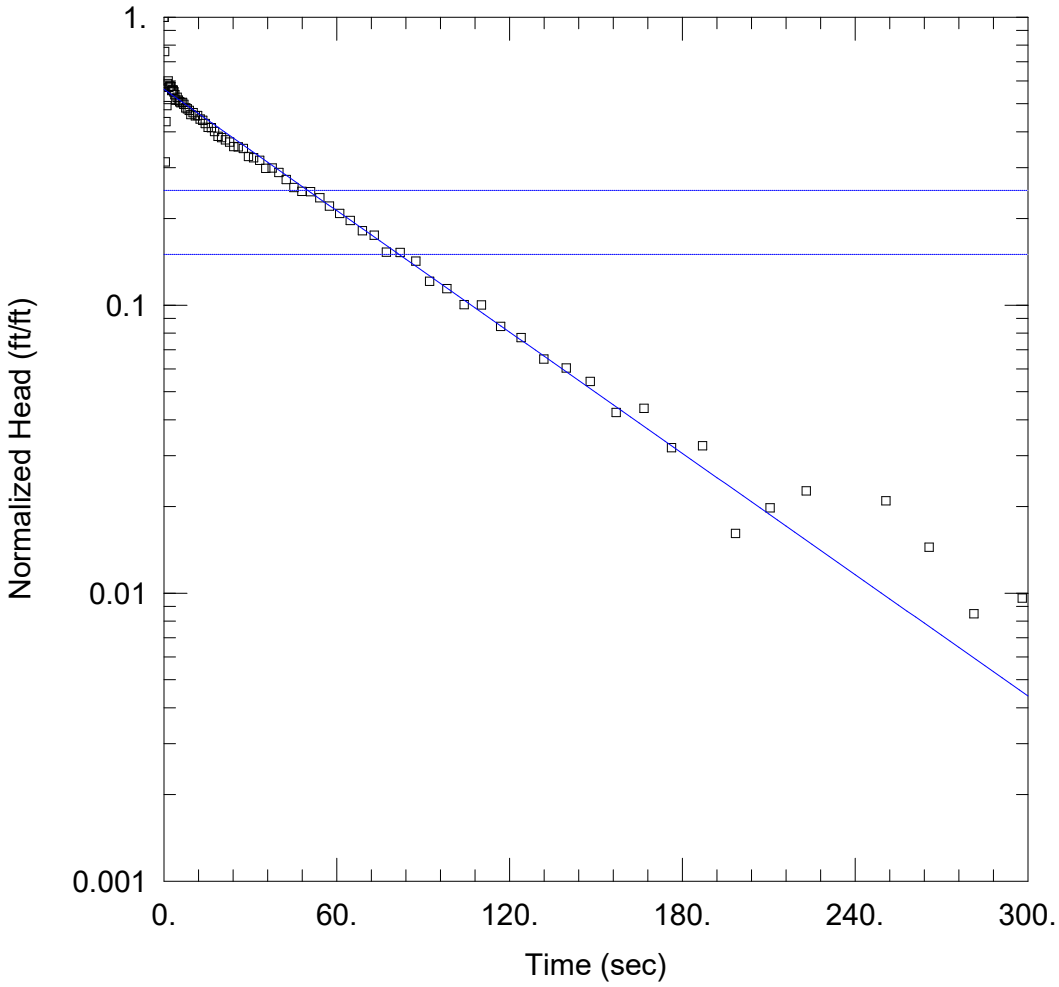
WELL DATA (MW-91-2)

Initial Displacement: 2.797 ft
Total Well Penetration Depth: 12.66 ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.66 ft
Screen Length: 10. ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.000895 cm/sec y0 = 1.809 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW91-2_SW02_HV.aqt
Date: 10/28/21 Time: 13:59:03

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-2
Test Date: 9/22/2021

AQUIFER DATA

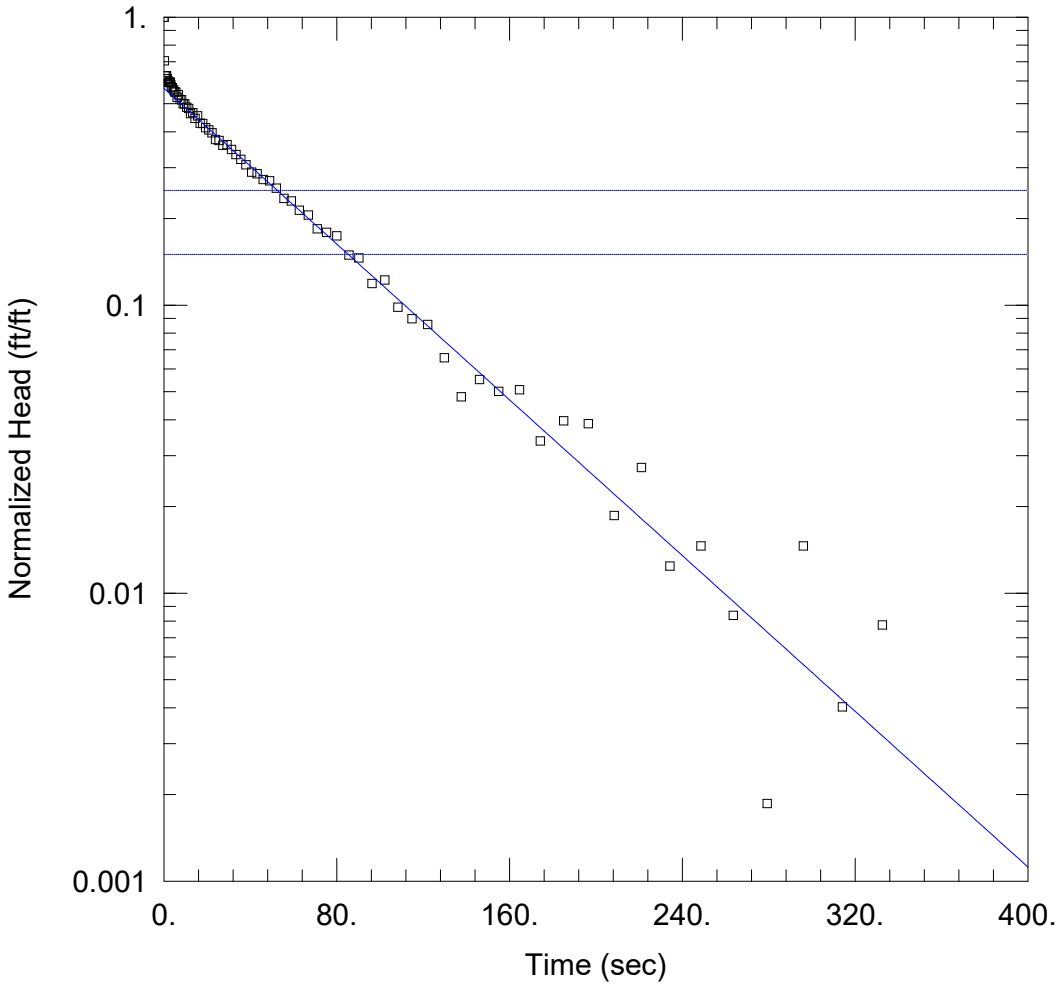
Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-91-2)

Initial Displacement: 3.536 ft
Total Well Penetration Depth: 12.66 ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.66 ft
Screen Length: 10. ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
K = 0.0008992 cm/sec y0 = 1.984 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW91-2_SW03_HV.aqt
Date: 10/28/21 Time: 14:00:25

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-2
Test Date: 9/22/2021

AQUIFER DATA

Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

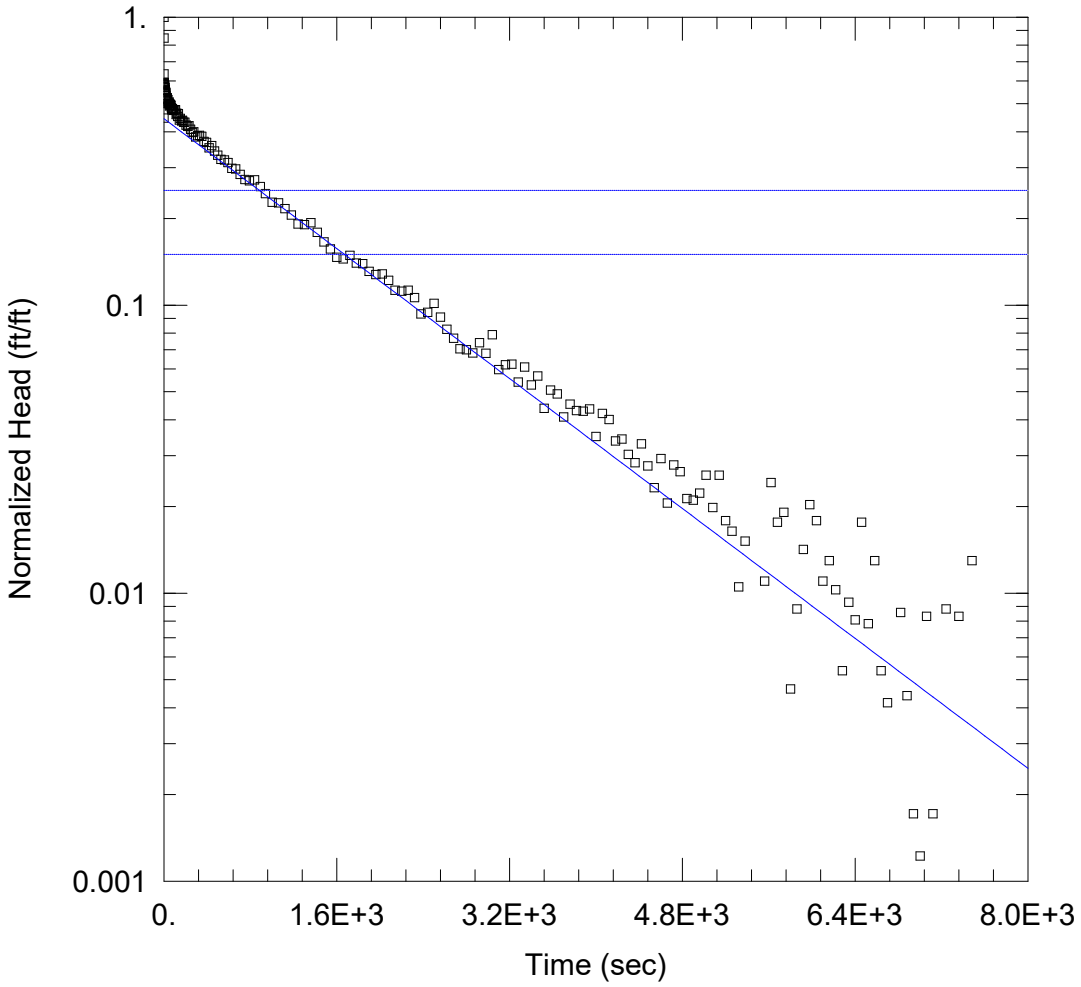
WELL DATA (MW-91-2)

Initial Displacement: 3.226 ft
Total Well Penetration Depth: 12.66 ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.66 ft
Screen Length: 10. ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.0008659 cm/sec y0 = 1.826 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW75_SI01_HV.aqt
Date: 10/28/21 Time: 14:01:42

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW75
Test Date: 9/22/2021

AQUIFER DATA

Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

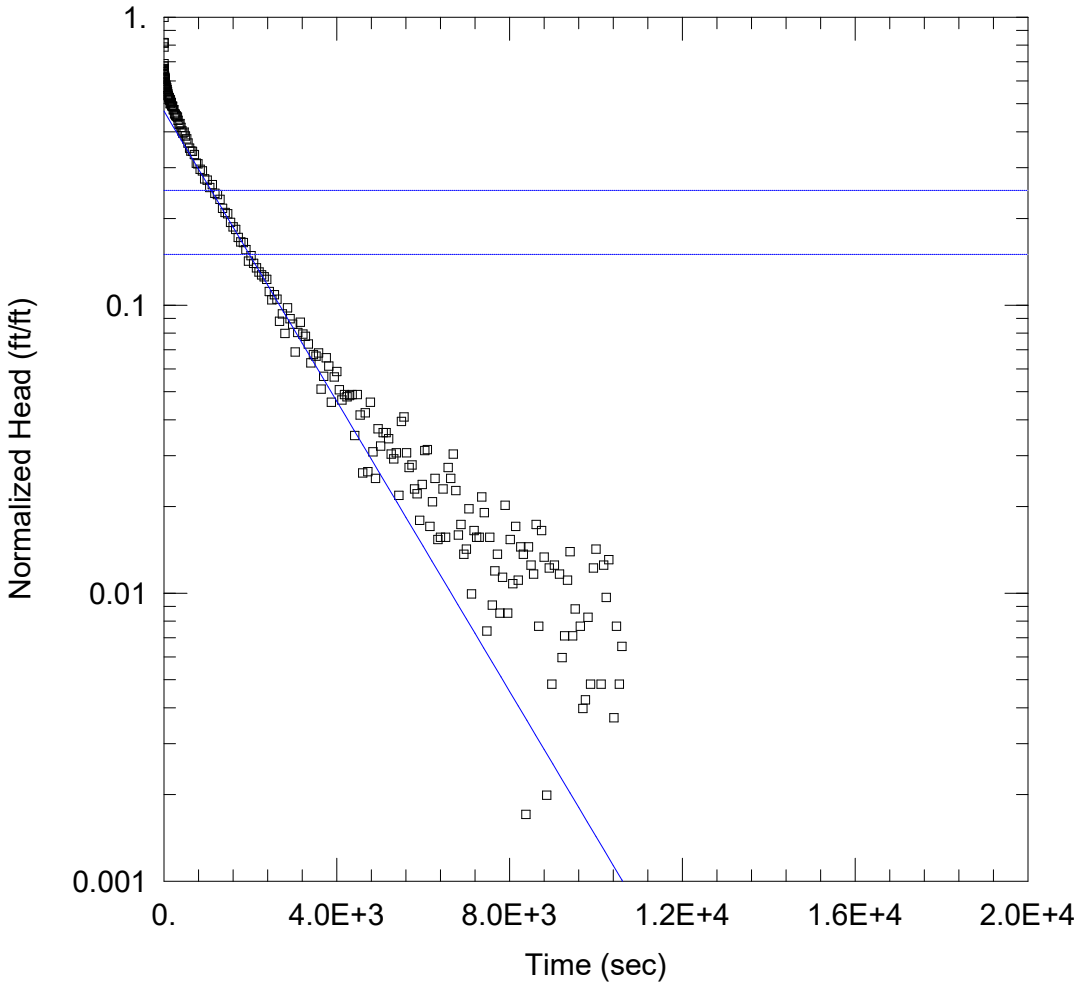
WELL DATA (MW-75)

Initial Displacement: -4.088 ft
Total Well Penetration Depth: 12.96 ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.96 ft
Screen Length: 10. ft
Well Radius: 0.29 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 3.612E-5 cm/sec y0 = -1.815 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW75_SI02_HV.aqt
Date: 10/28/21 Time: 14:01:29

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW75
Test Date: 9/22/2021

AQUIFER DATA

Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

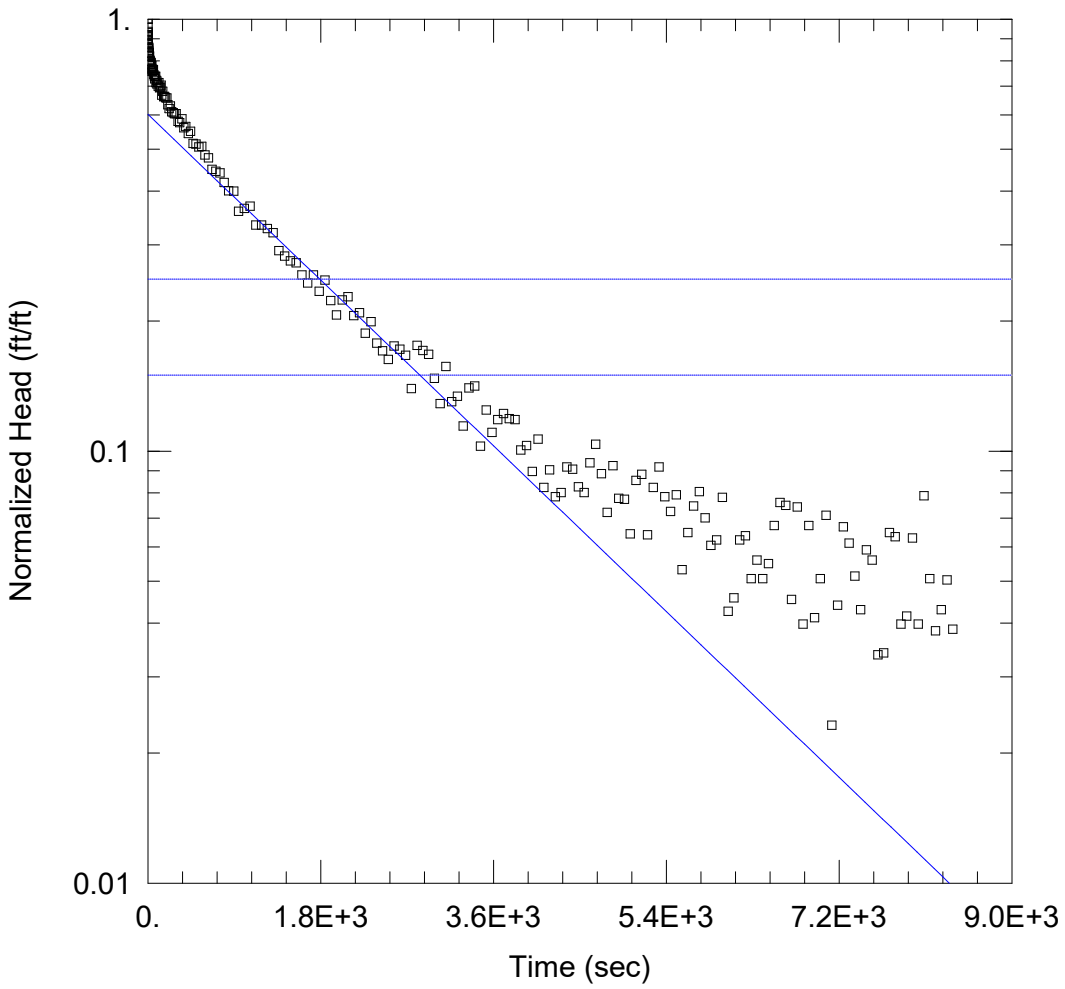
WELL DATA (MW-75)

Initial Displacement: -3.52 ft
Total Well Penetration Depth: 12.96 ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.96 ft
Screen Length: 10. ft
Well Radius: 0.29 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 3.226E-5 cm/sec y0 = -1.659 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW75_SW01_HV.aqt
Date: 10/28/21 Time: 14:01:13

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW75
Test Date: 9/22/2021

AQUIFER DATA

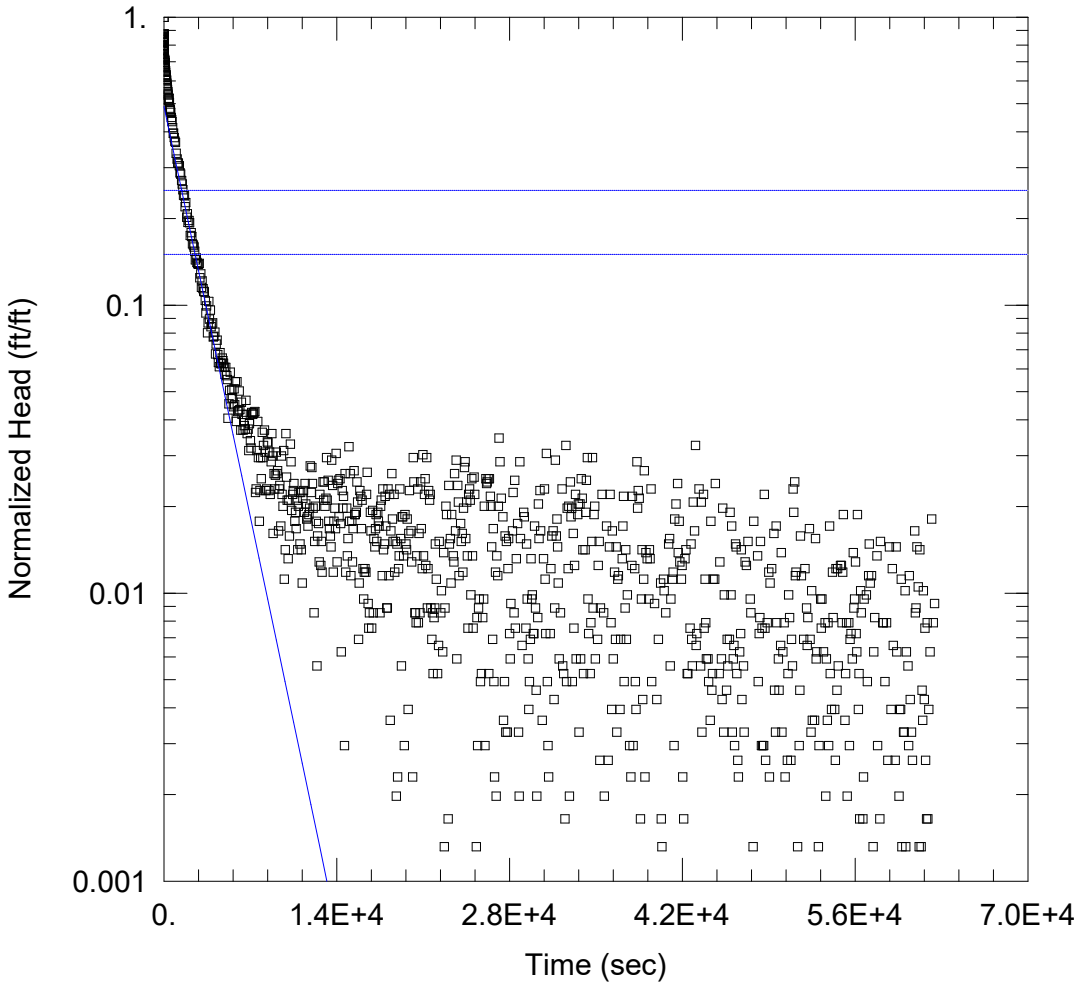
Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-75)

Initial Displacement: 2.842 ft
Total Well Penetration Depth: 12.96 ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.96 ft
Screen Length: 10. ft
Well Radius: 0.29 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
K = 2.73E-5 cm/sec y0 = 1.71 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW75_SW02_HV.aqt
Date: 10/28/21 Time: 14:01:56

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW75
Test Date: 9/22/2021

AQUIFER DATA

Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

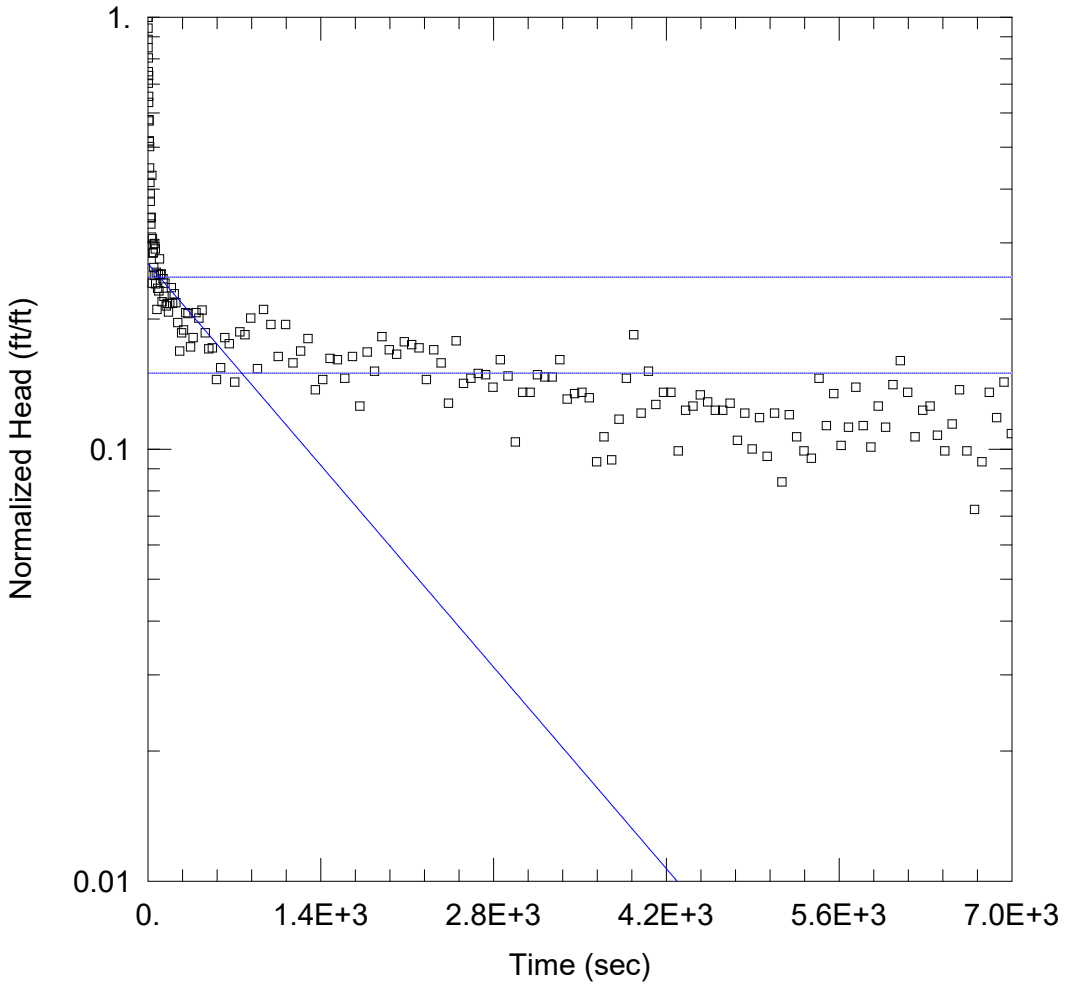
WELL DATA (MW-75)

Initial Displacement: 3.042 ft
Total Well Penetration Depth: 12.96 ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.96 ft
Screen Length: 10. ft
Well Radius: 0.29 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 2.608E-5 cm/sec y0 = 1.488 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW91-04_SW01_HV.aqt
Date: 10/28/21 Time: 14:13:45

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-4
Test Date: 9/26/2021

AQUIFER DATA

Saturated Thickness: 4.77 ft Anisotropy Ratio (Kz/Kr): 1.

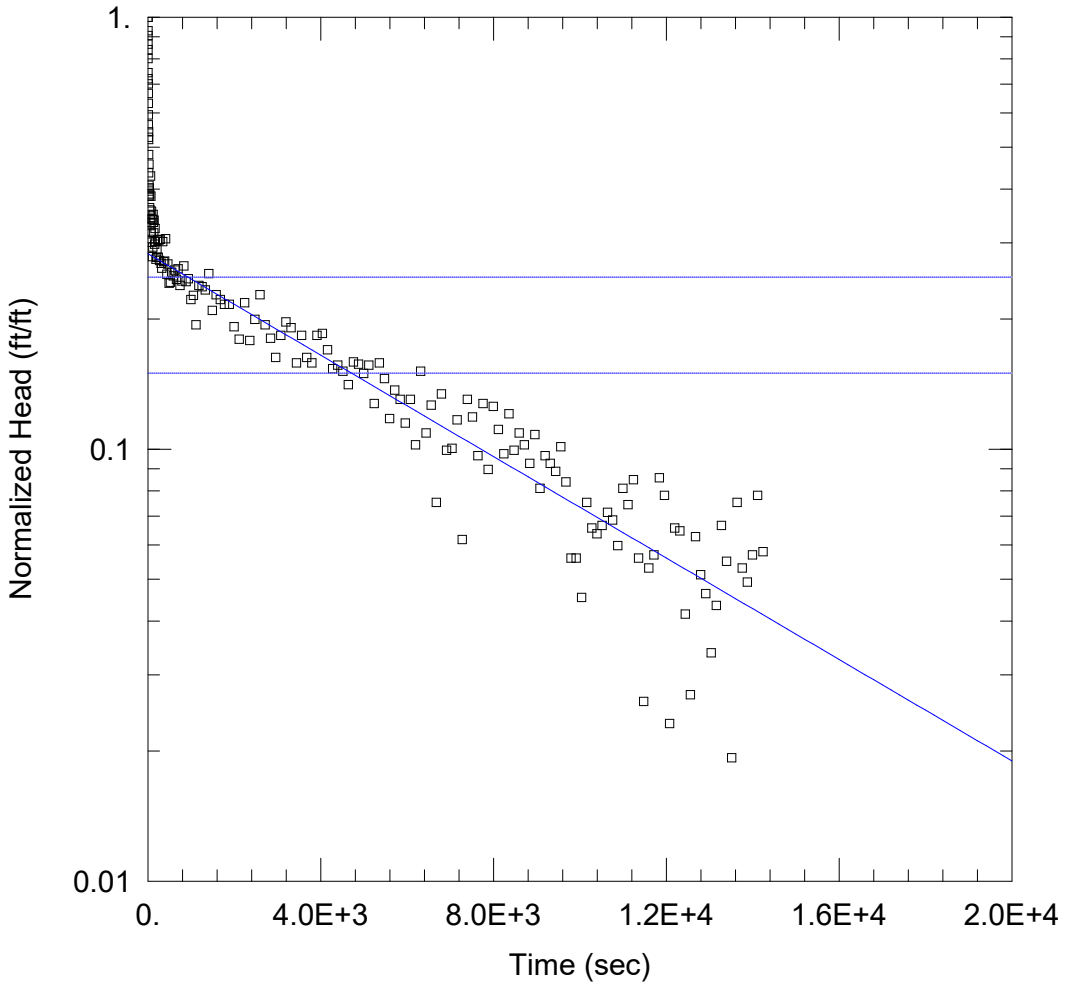
WELL DATA (MW-91-4)

Initial Displacement: 1.049 ft
Total Well Penetration Depth: 4.77 ft
Casing Radius: 0.083 ft
Static Water Column Height: 4.44 ft
Screen Length: 4.77 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 8.952E-5 cm/sec y0 = 0.2817 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW91-04_SW02_HV.aqt
Date: 10/28/21 Time: 14:14:24

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-4
Test Date: 9/27/2021

AQUIFER DATA

Saturated Thickness: 4.77 ft Anisotropy Ratio (Kz/Kr): 1.

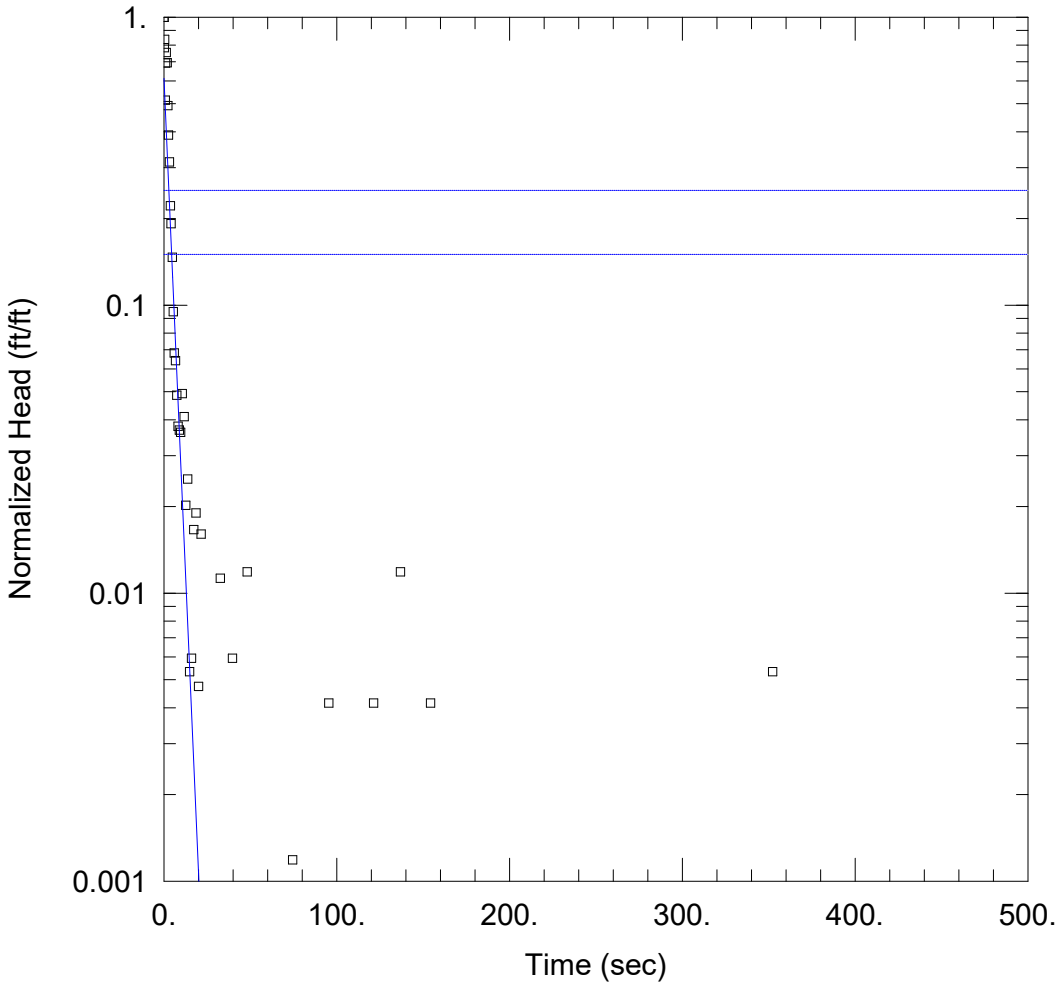
WELL DATA (MW-91-4)

Initial Displacement: 1.036 ft
Total Well Penetration Depth: 4.77 ft
Casing Radius: 0.083 ft
Static Water Column Height: 4.44 ft
Screen Length: 4.77 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 1.576E-5 cm/sec y0 = 0.2935 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW16-6_SW01_HV.aqt
Date: 10/28/21 Time: 14:03:22

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-16-6
Test Date: 9/23/2021

AQUIFER DATA

Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

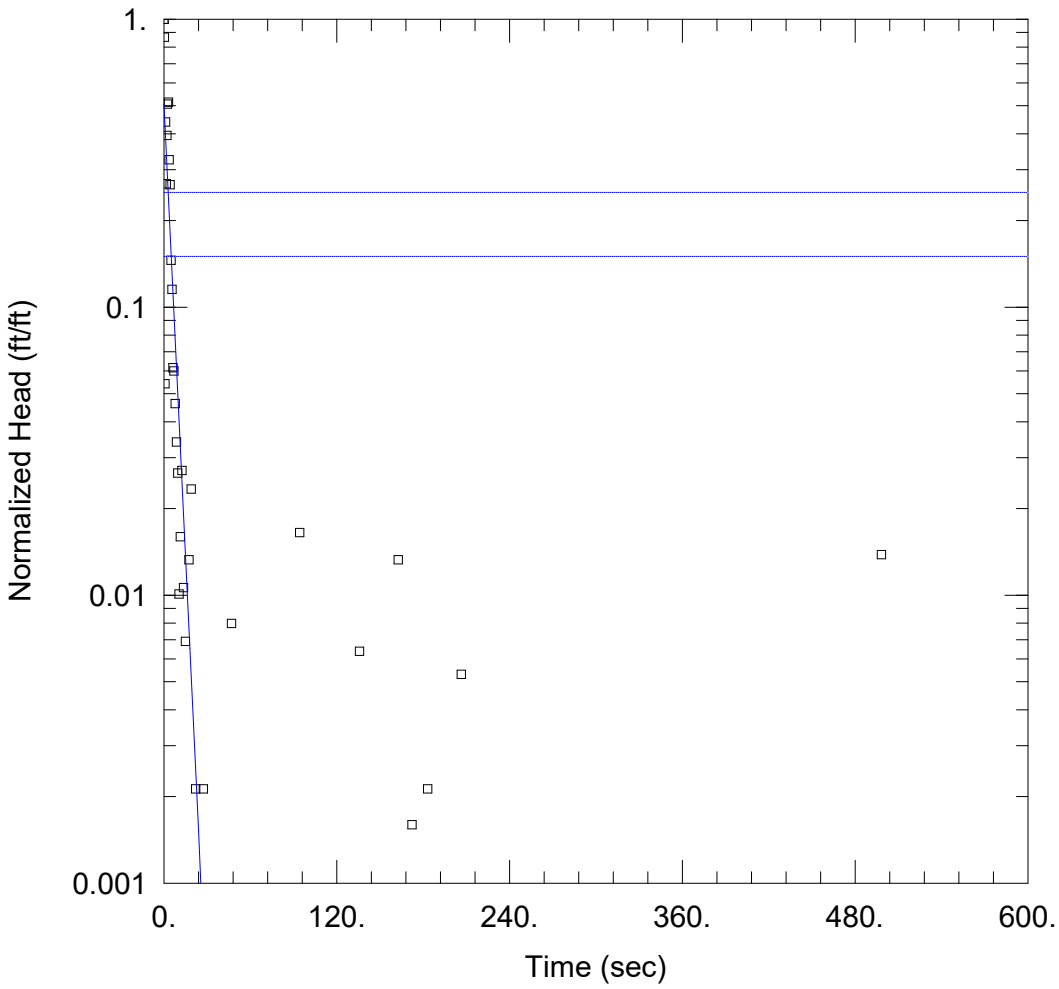
WELL DATA (MW-16-6)

Initial Displacement: 1.685 ft
Total Well Penetration Depth: 10.25 ft
Casing Radius: 0.083 ft
Static Water Column Height: 10.25 ft
Screen Length: 10. ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.01768 cm/sec y0 = 1.033 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW16-6_SW02_HV.aqt
Date: 10/28/21 Time: 14:02:42

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-16-6
Test Date: 9/23/2021

AQUIFER DATA

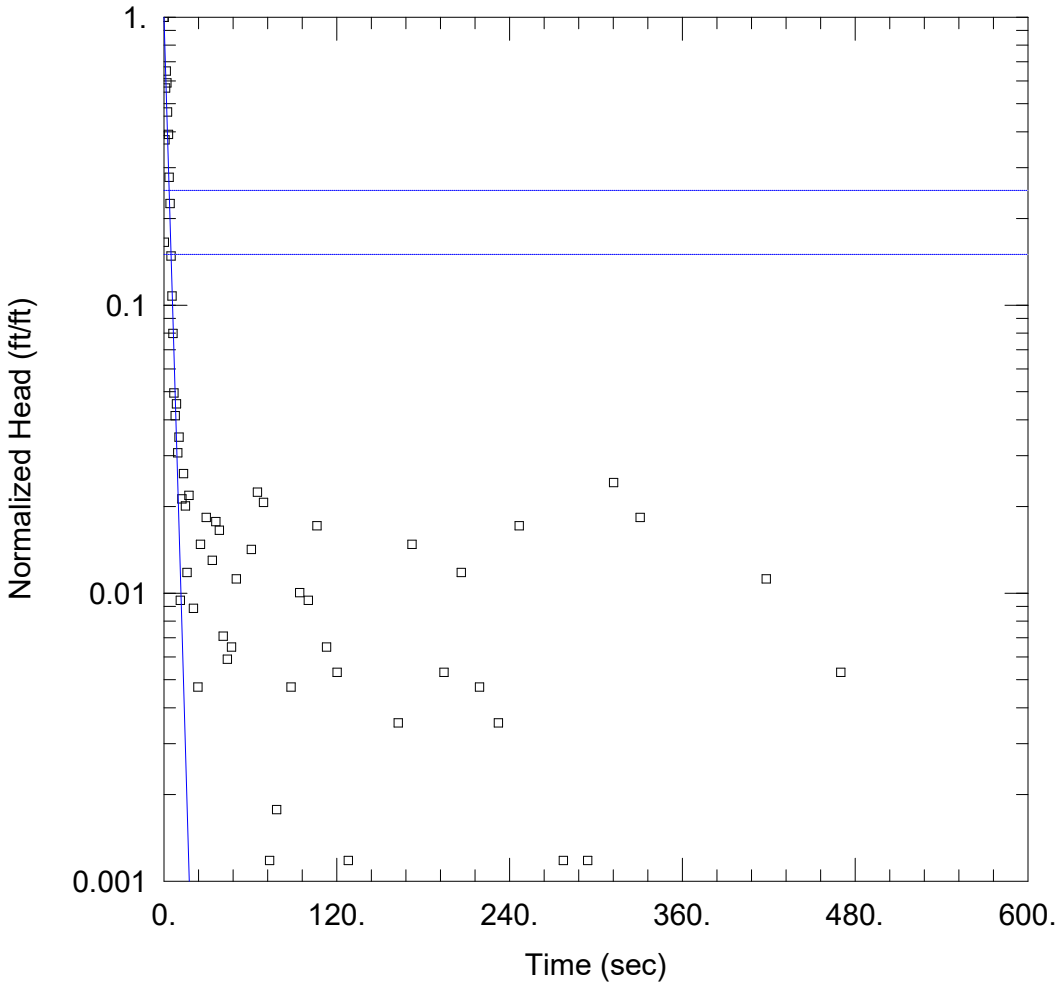
Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-16-6)

Initial Displacement: 1.882 ft
Total Well Penetration Depth: 10.25 ft
Casing Radius: 0.083 ft
Static Water Column Height: 10.25 ft
Screen Length: 10. ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
K = 0.01345 cm/sec y0 = 0.9523 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW16-6_SW03_HV.aqt
Date: 10/28/21 Time: 14:03:37

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-16-6
Test Date: 9/23/2021

AQUIFER DATA

Saturated Thickness: 10. ft Anisotropy Ratio (Kz/Kr): 1.

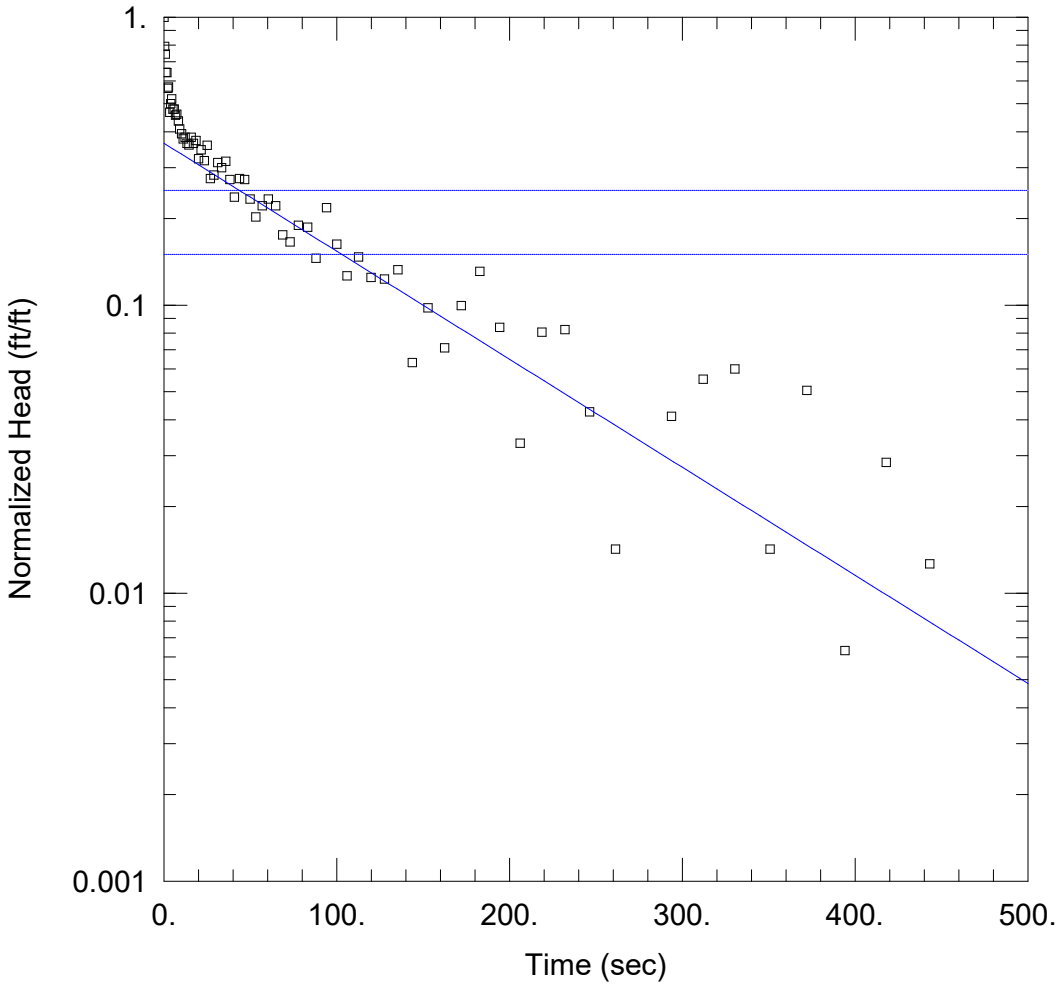
WELL DATA (MW-16-6)

Initial Displacement: 1.694 ft
Total Well Penetration Depth: 10.25 ft
Casing Radius: 0.083 ft
Static Water Column Height: 10.25 ft
Screen Length: 10. ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.02199 cm/sec y0 = 1.783 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW49_SI01_HV.aqt
Date: 10/28/21 Time: 14:05:03

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW49
Test Date: 9/22/2021

AQUIFER DATA

Saturated Thickness: 3.63 ft Anisotropy Ratio (Kz/Kr): 1.

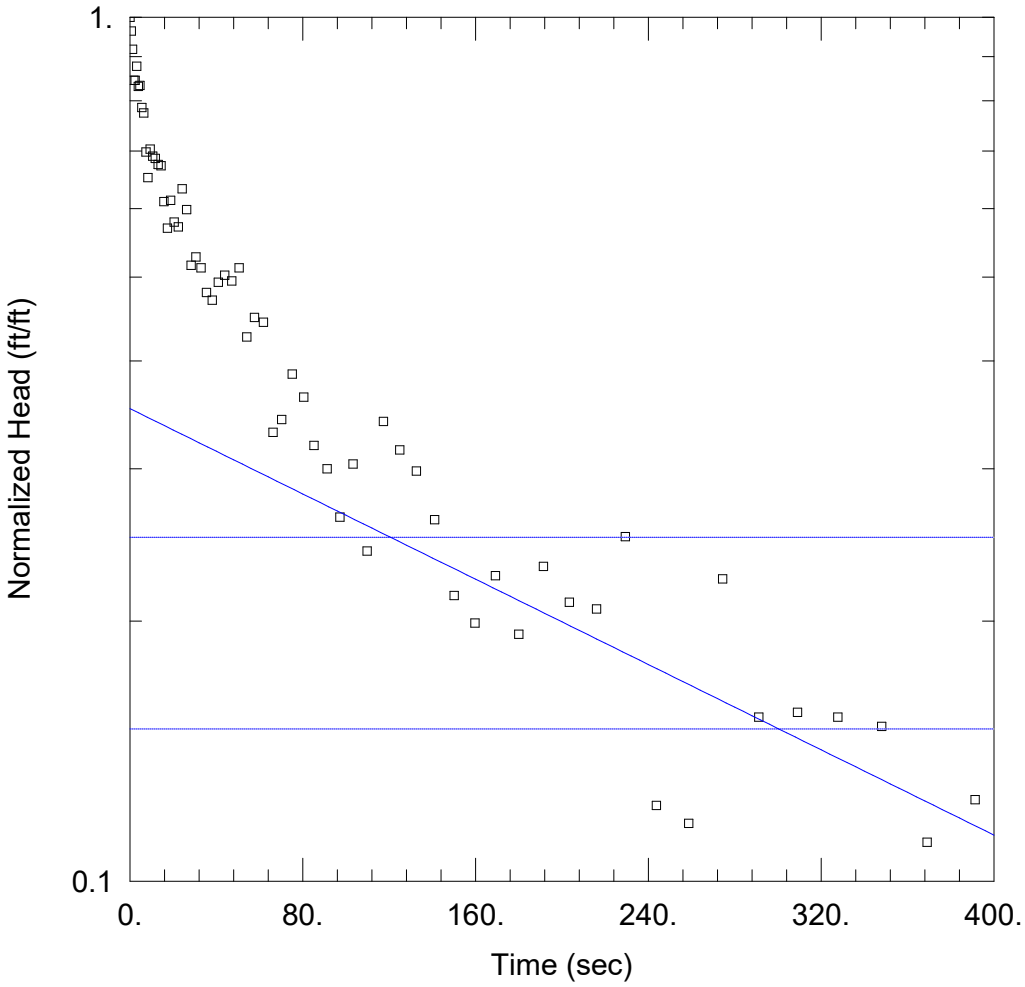
WELL DATA (MW-49)

Initial Displacement: -0.633 ft
Total Well Penetration Depth: 6.59 ft
Casing Radius: 0.083 ft
Static Water Column Height: 3.63 ft
Screen Length: 3.63 ft
Well Radius: 0.33 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.001323 cm/sec y0 = -0.2309 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW49_SI02_HV.aqt
Date: 10/28/21 Time: 14:04:50

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW49
Test Date: 9/22/2021

AQUIFER DATA

Saturated Thickness: 3.63 ft Anisotropy Ratio (Kz/Kr): 1.

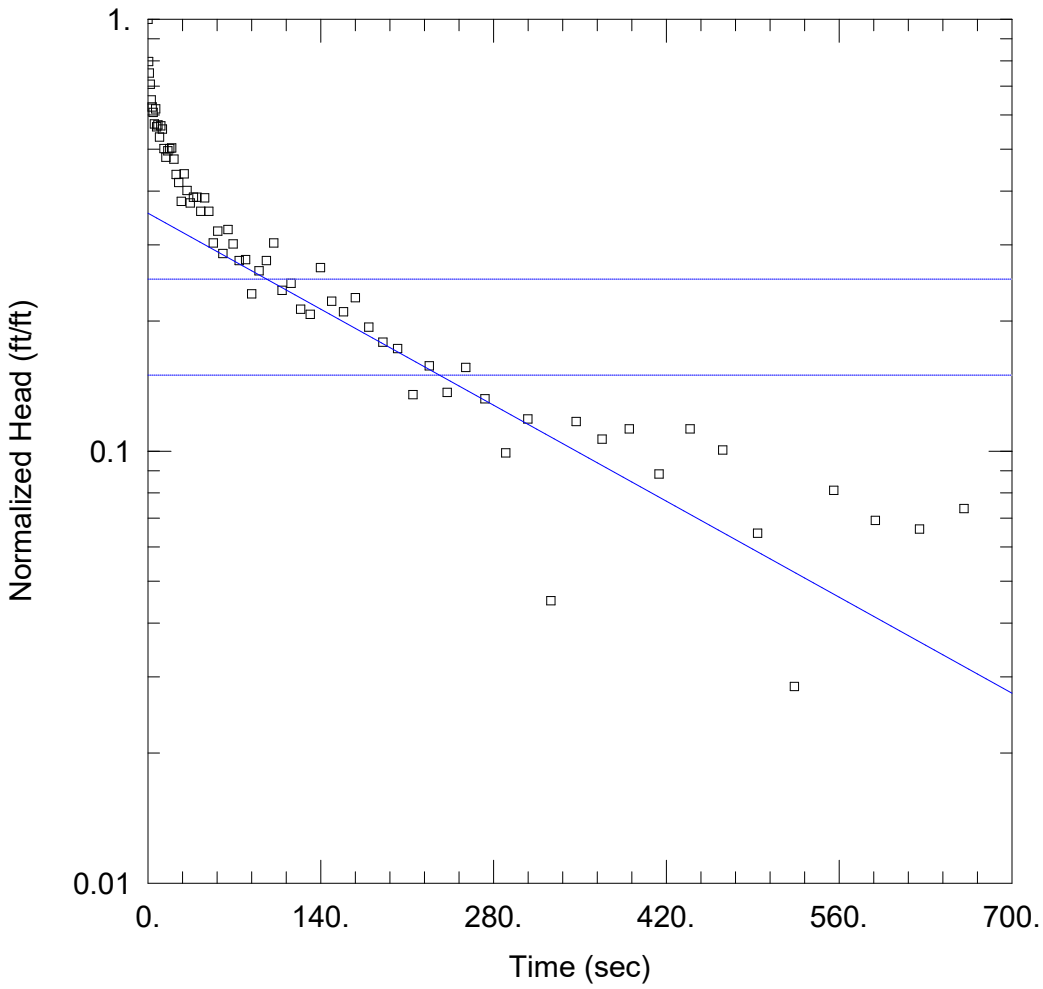
WELL DATA (MW-49)

Initial Displacement: -0.523 ft
Total Well Penetration Depth: 6.59 ft
Casing Radius: 0.083 ft
Static Water Column Height: 3.63 ft
Screen Length: 3.63 ft
Well Radius: 0.33 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.0004354 cm/sec y0 = -0.1842 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW49_SI03_HV.aqt
Date: 10/28/21 Time: 14:04:39

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW49
Test Date: 9/22/2021

AQUIFER DATA

Saturated Thickness: 3.63 ft Anisotropy Ratio (Kz/Kr): 1.

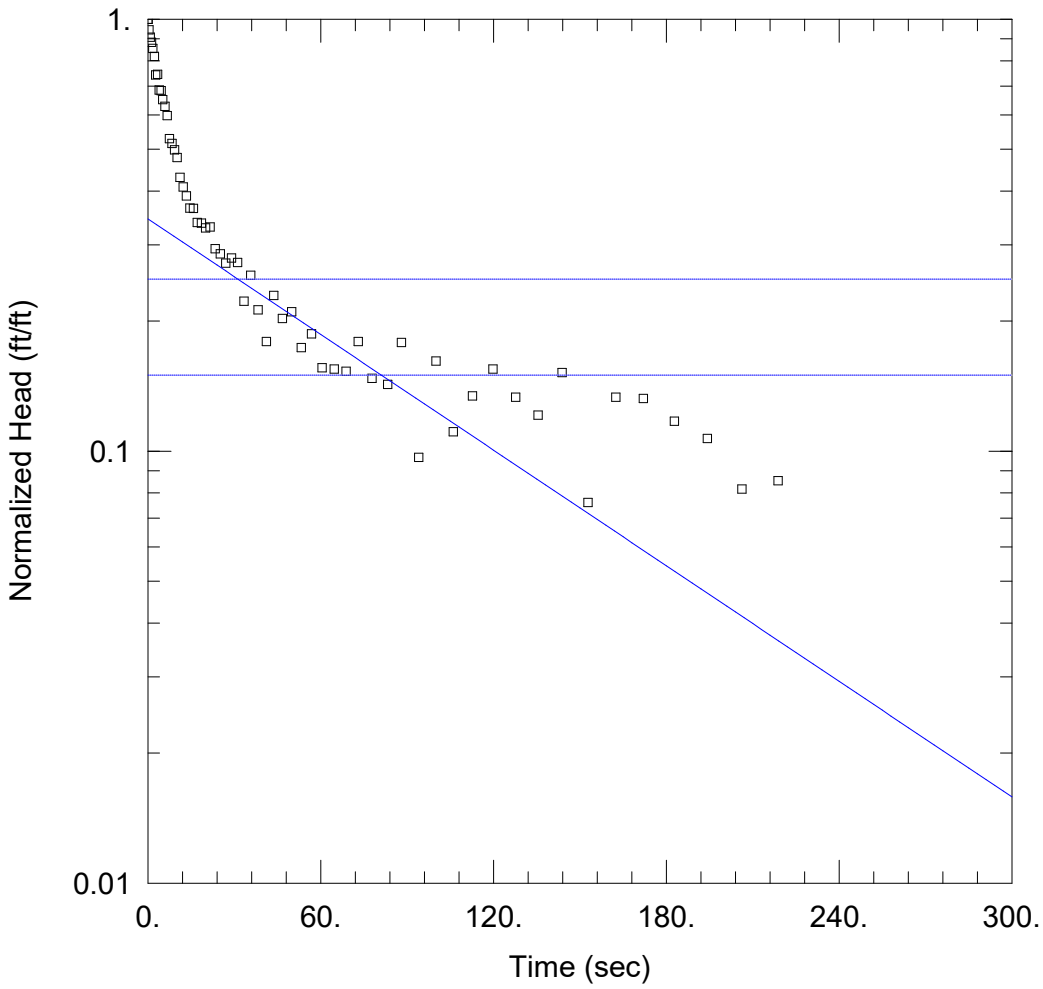
WELL DATA (MW-49)

Initial Displacement: -0.666 ft
Total Well Penetration Depth: 6.59 ft
Casing Radius: 0.083 ft
Static Water Column Height: 3.63 ft
Screen Length: 3.63 ft
Well Radius: 0.33 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.0005602 cm/sec y0 = -0.2368 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW49_SW01_HV.aqt
Date: 10/28/21 Time: 14:04:27

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW49
Test Date: 9/22/2021

AQUIFER DATA

Saturated Thickness: 3.63 ft Anisotropy Ratio (Kz/Kr): 1.

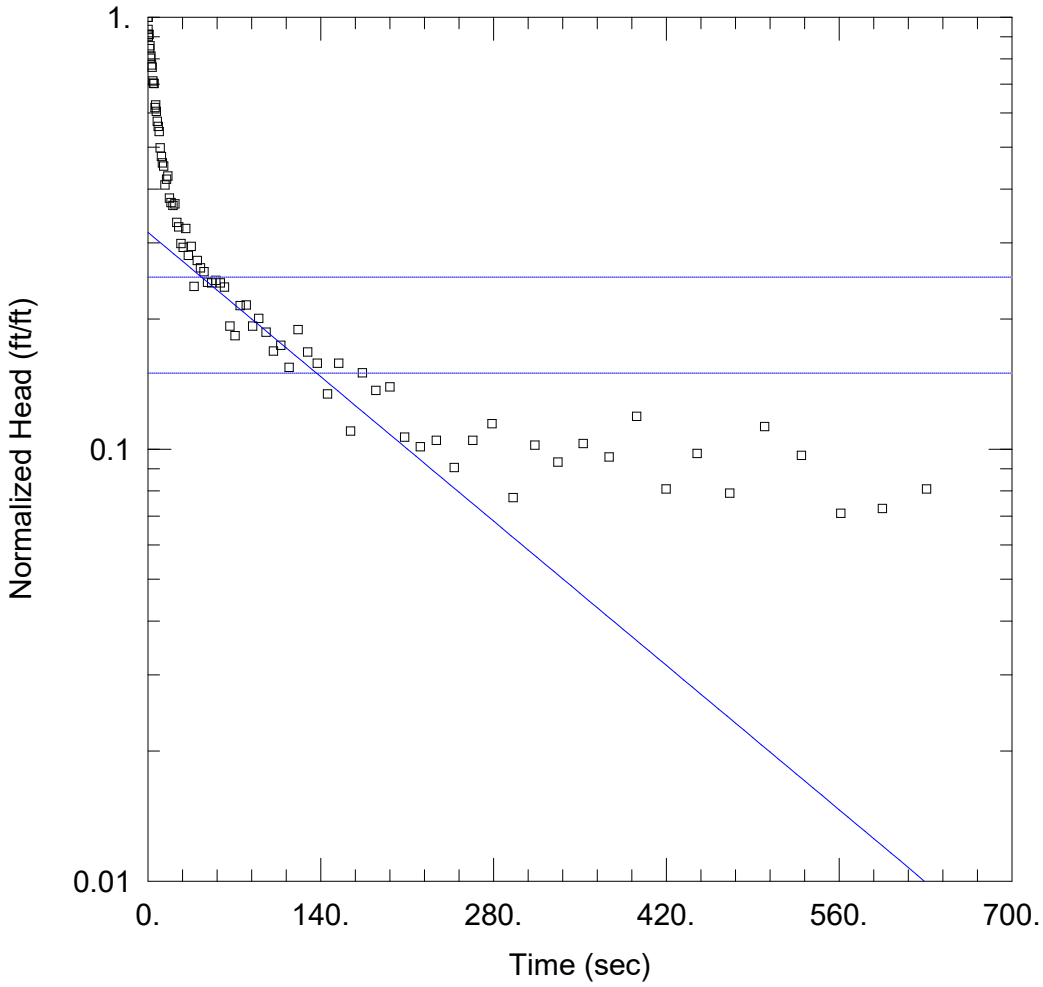
WELL DATA (MW-49)

Initial Displacement: 1.065 ft
Total Well Penetration Depth: 6.59 ft
Casing Radius: 0.083 ft
Static Water Column Height: 3.63 ft
Screen Length: 3.63 ft
Well Radius: 0.33 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.001574 cm/sec y0 = 0.3671 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW49_SW02_HV.aqt
Date: 10/28/21 Time: 14:04:15

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW49
Test Date: 9/22/2021

AQUIFER DATA

Saturated Thickness: 3.63 ft Anisotropy Ratio (Kz/Kr): 1.

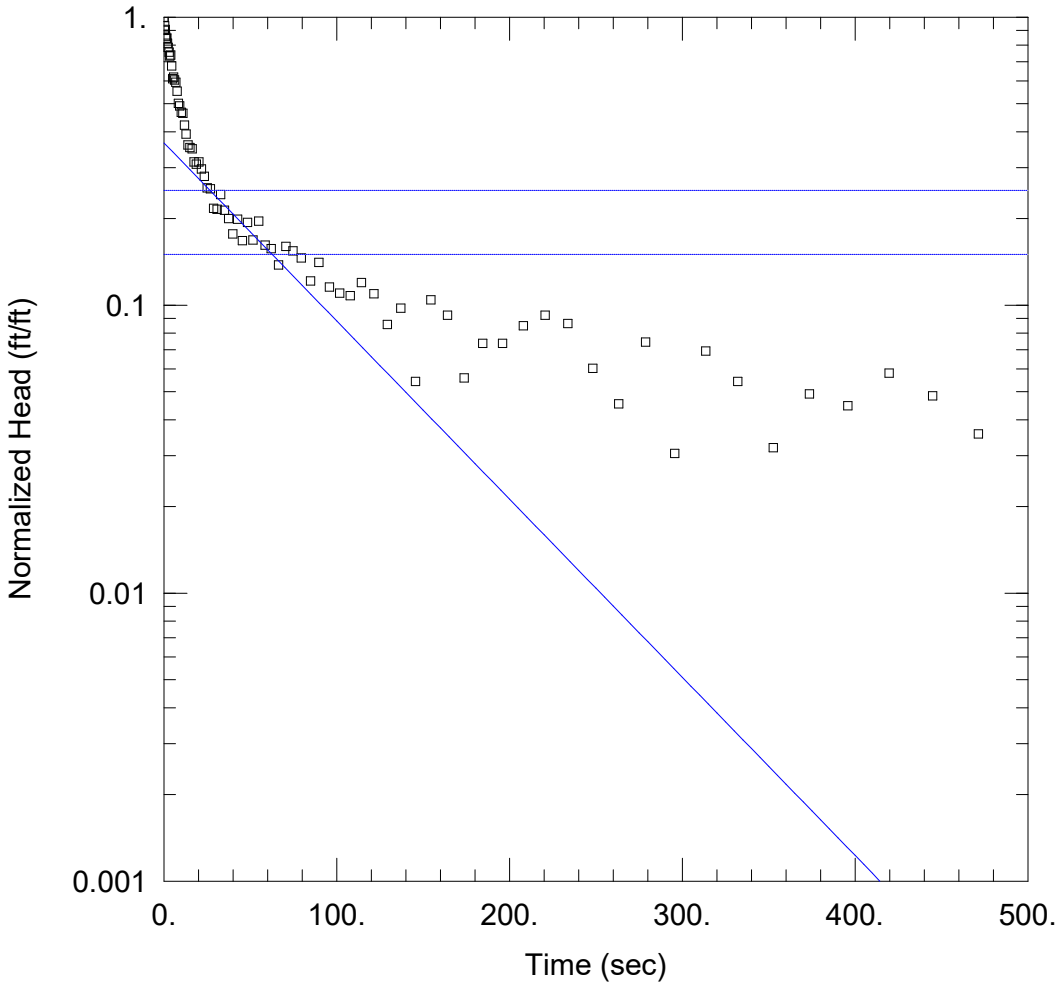
WELL DATA (MW-49)

Initial Displacement: 1.126 ft
Total Well Penetration Depth: 6.59 ft
Casing Radius: 0.083 ft
Static Water Column Height: 3.63 ft
Screen Length: 3.63 ft
Well Radius: 0.33 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.0008421 cm/sec y0 = 0.3574 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW49_SW03_HV.aqt
Date: 10/28/21 Time: 14:05:17

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW49
Test Date: 9/22/2021

AQUIFER DATA

Saturated Thickness: 3.63 ft Anisotropy Ratio (Kz/Kr): 1.

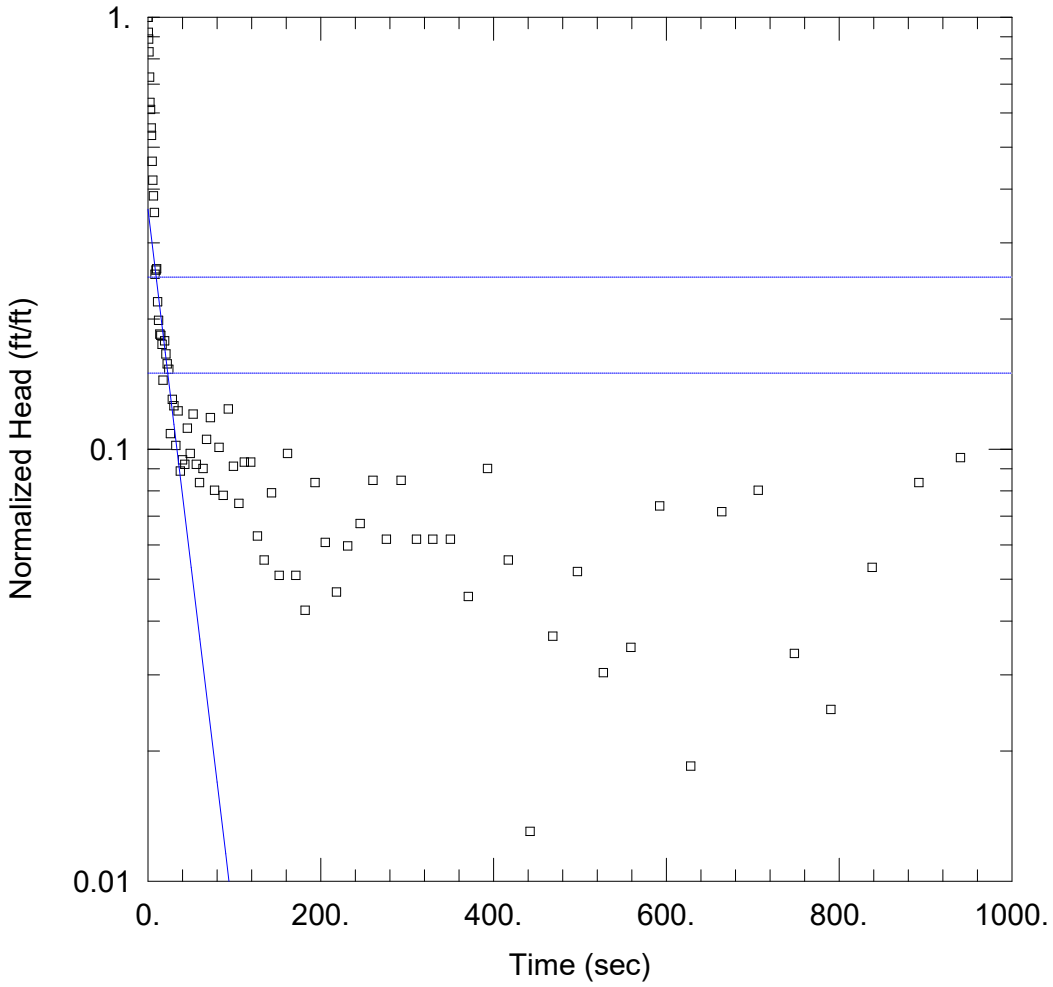
WELL DATA (MW-49)

Initial Displacement: 1.343 ft
Total Well Penetration Depth: 6.59 ft
Casing Radius: 0.083 ft
Static Water Column Height: 3.63 ft
Screen Length: 3.63 ft
Well Radius: 0.33 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.002183 cm/sec y0 = 0.4912 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW-91-5_SW01_HV.aqt
Date: 10/28/21 Time: 14:15:09

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-5
Test Date: 9/28/2021

AQUIFER DATA

Saturated Thickness: 5.85 ft Anisotropy Ratio (Kz/Kr): 1.

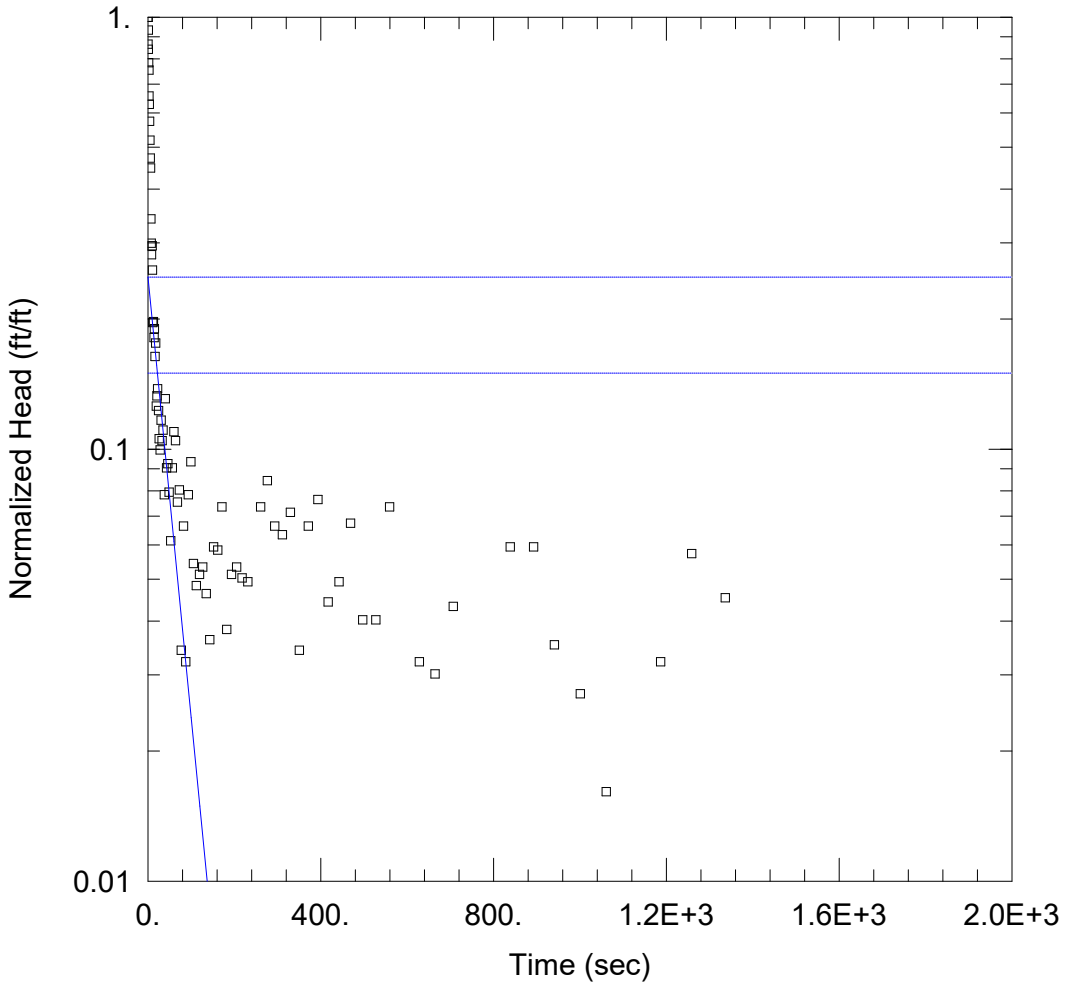
WELL DATA (MW-91-5)

Initial Displacement: 0.921 ft
Total Well Penetration Depth: 5.85 ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.85 ft
Screen Length: 5.85 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.003629 cm/sec y0 = 0.3305 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW-91-5_SW02_HV.aqt
Date: 10/28/21 Time: 14:14:59

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-5
Test Date: 9/28/2021

AQUIFER DATA

Saturated Thickness: 5.85 ft Anisotropy Ratio (Kz/Kr): 1.

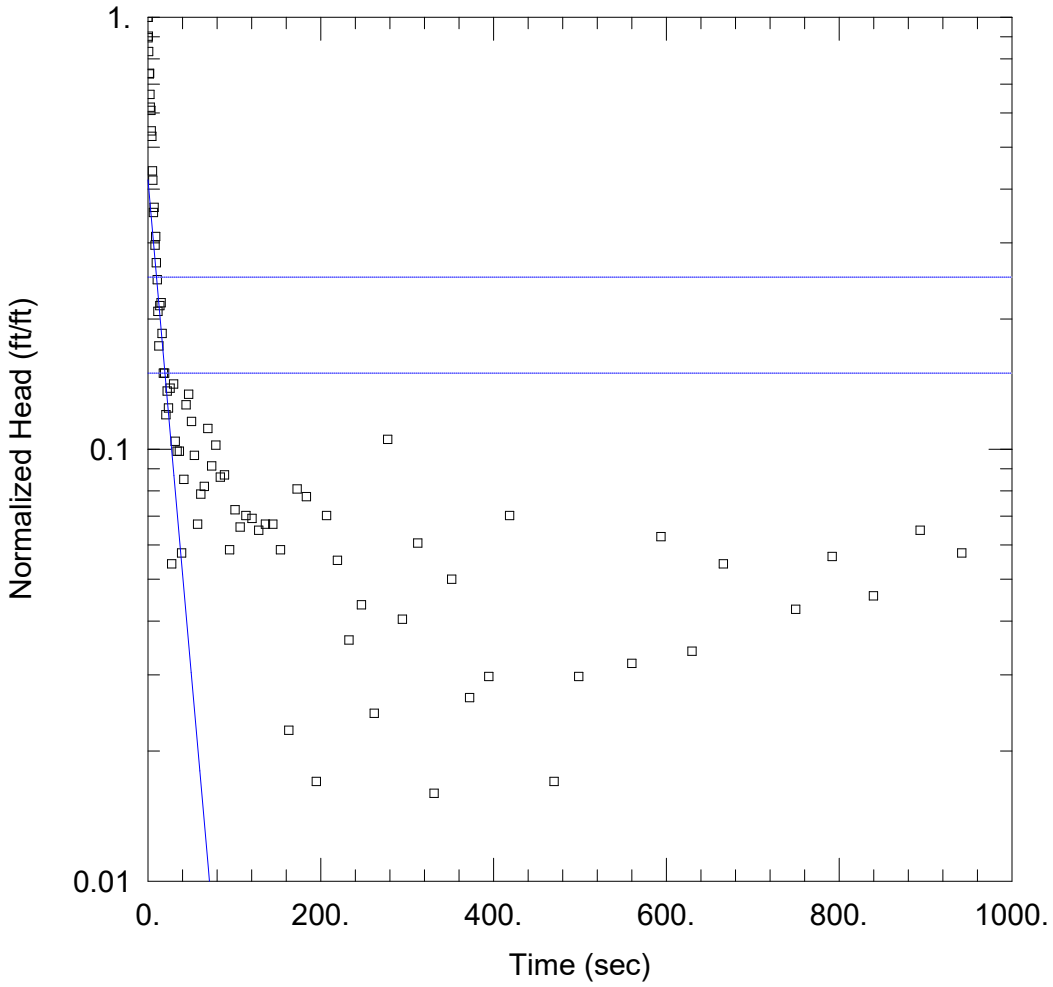
WELL DATA (MW-91-5)

Initial Displacement: 0.994 ft
Total Well Penetration Depth: 5.85 ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.85 ft
Screen Length: 5.85 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.002234 cm/sec y0 = 0.2486 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW-91-5_SW03_HV.aqt
Date: 10/28/21 Time: 14:15:19

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-5
Test Date: 9/28/2021

AQUIFER DATA

Saturated Thickness: 5.85 ft Anisotropy Ratio (Kz/Kr): 1.

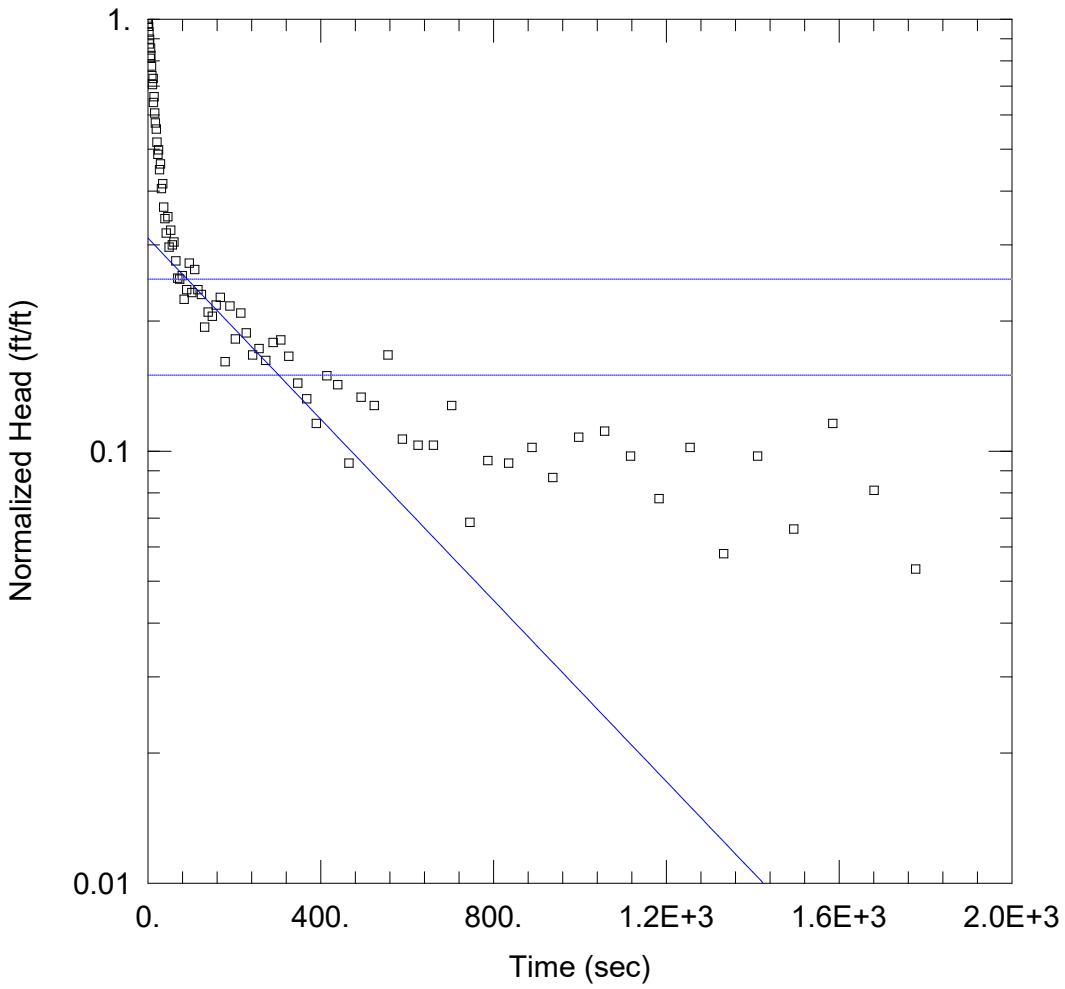
WELL DATA (MW-91-5)

Initial Displacement: 0.94 ft
Total Well Penetration Depth: 5.85 ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.85 ft
Screen Length: 5.85 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.004993 cm/sec y0 = 0.3947 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW-91-1_SW01_HV.aqt
Date: 10/28/21 Time: 14:12:45

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-1
Test Date: 9/27/2021

AQUIFER DATA

Saturated Thickness: 2.3 ft Anisotropy Ratio (Kz/Kr): 1.

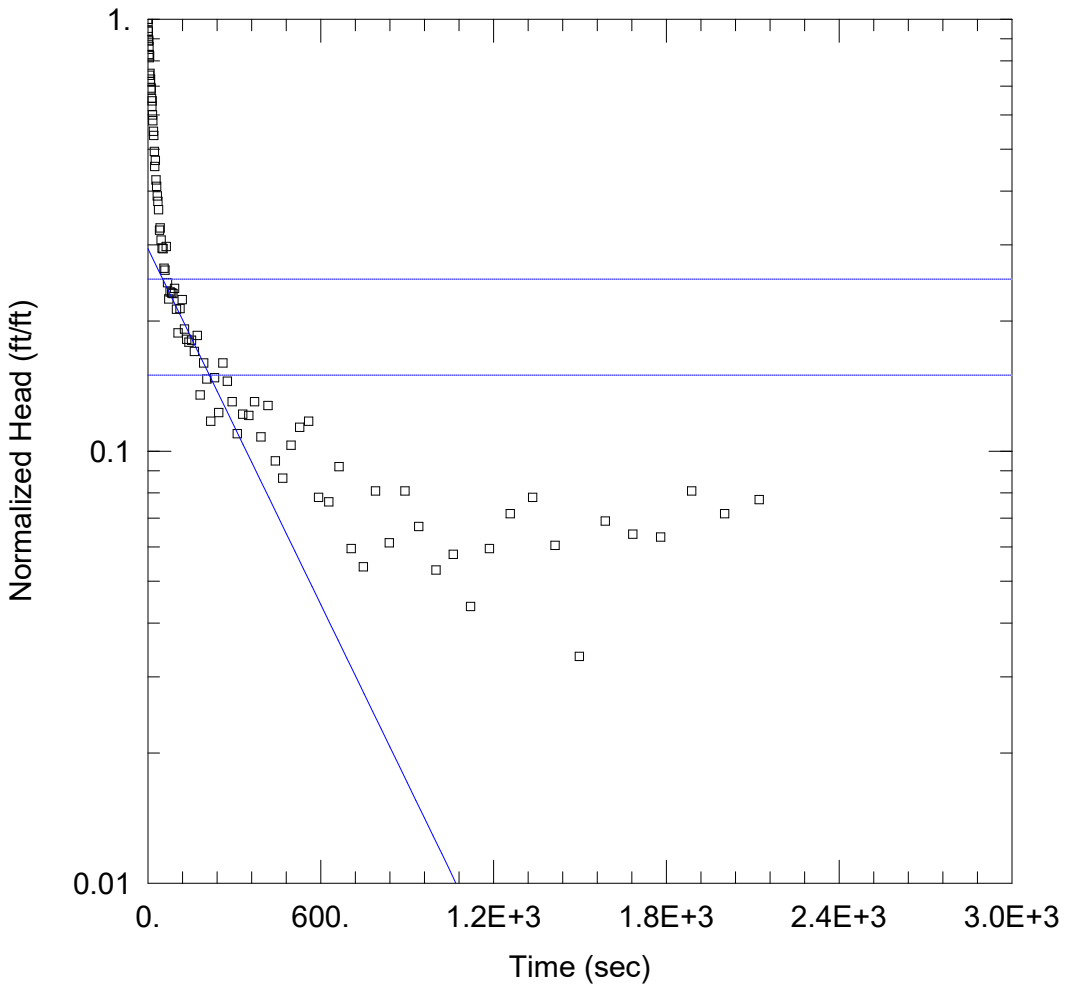
WELL DATA (MW-91-1)

Initial Displacement: 0.863 ft
Total Well Penetration Depth: 2.3 ft
Casing Radius: 0.083 ft
Static Water Column Height: 2.3 ft
Screen Length: 2.3 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.0005838 cm/sec y0 = 0.2686 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW-91-1_SW02_HV.aqt
Date: 10/28/21 Time: 14:12:31

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-1
Test Date: 9/28/2021

AQUIFER DATA

Saturated Thickness: 2.3 ft Anisotropy Ratio (Kz/Kr): 1.

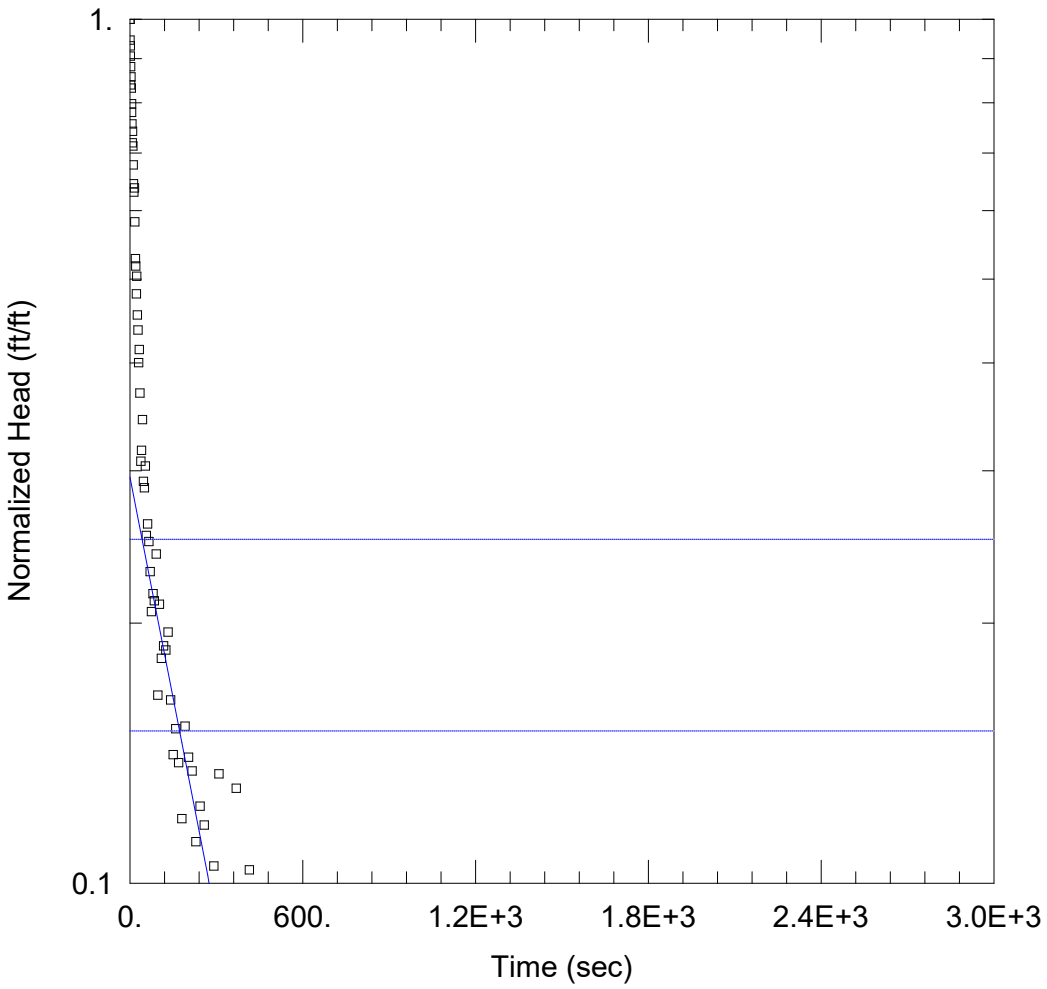
WELL DATA (MW-91-1)

Initial Displacement: 1.075 ft
Total Well Penetration Depth: 2.3 ft
Casing Radius: 0.083 ft
Static Water Column Height: 2.3 ft
Screen Length: 2.3 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.0007645 cm/sec y0 = 0.3161 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW-91-1_SW03_HV.aqt
Date: 10/28/21 Time: 14:13:11

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-1
Test Date: 9/28/2021

AQUIFER DATA

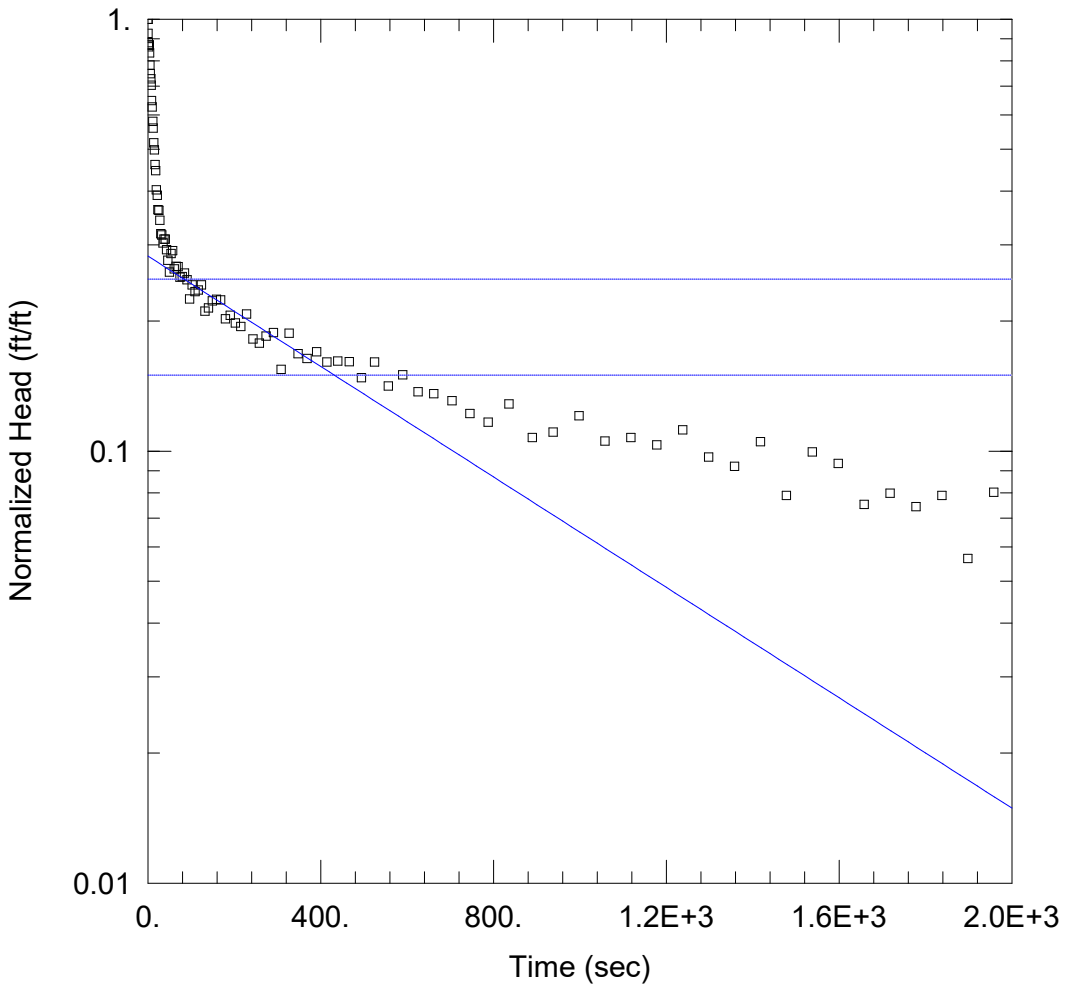
Saturated Thickness: 2.3 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-91-1)

Initial Displacement: 0.994 ft
Total Well Penetration Depth: 2.3 ft
Casing Radius: 0.083 ft
Static Water Column Height: 2.3 ft
Screen Length: 2.3 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
K = 0.0009499 cm/sec y0 = 0.2931 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW-91-6_SW01_HV.aqt
Date: 10/28/21 Time: 14:16:13

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-6
Test Date: 9/26/2021

AQUIFER DATA

Saturated Thickness: 12.49 ft Anisotropy Ratio (Kz/Kr): 1.

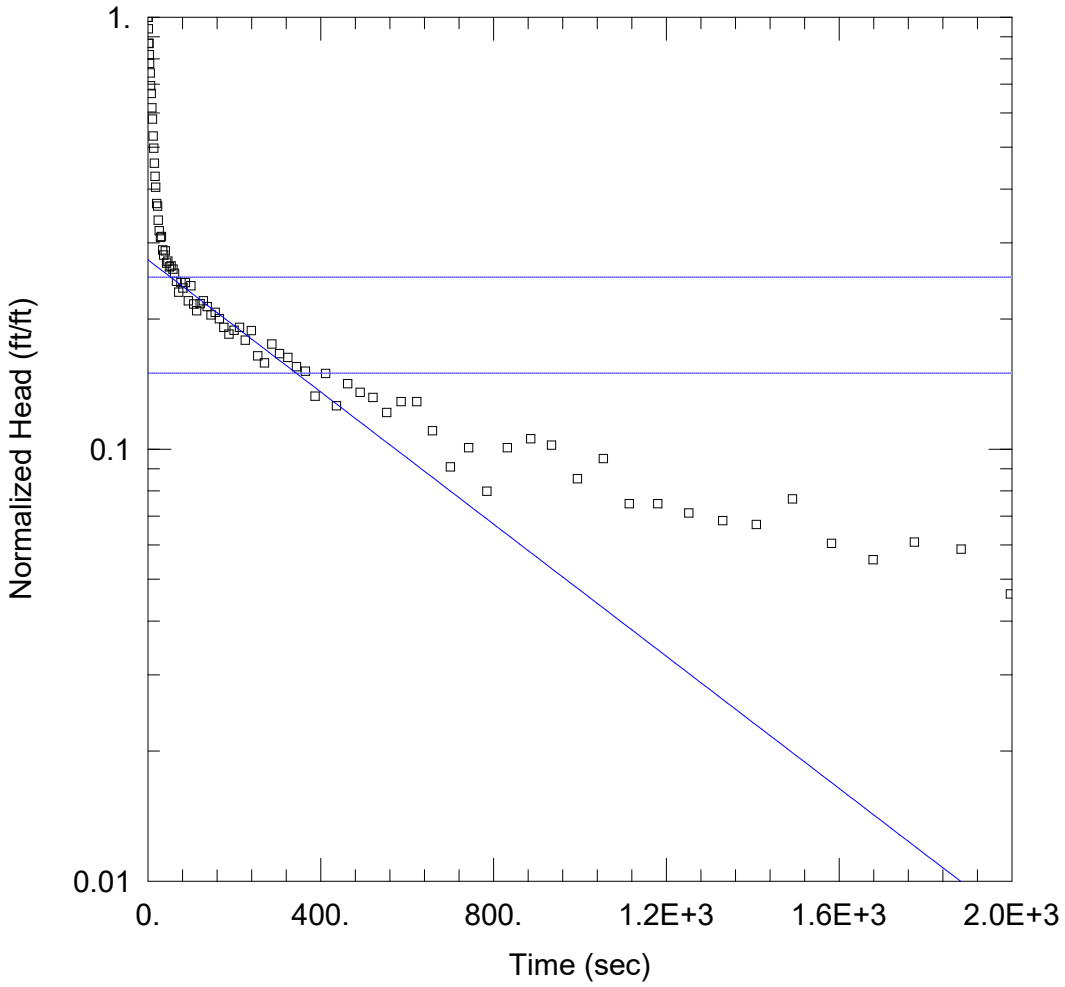
WELL DATA (MW-91-6)

Initial Displacement: 2.178 ft
Total Well Penetration Depth: 12.49 ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.49 ft
Screen Length: 12.49 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 6.553E-5 cm/sec y0 = 0.6158 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW-91-6_SW02_HV.aqt
Date: 10/28/21 Time: 14:16:02

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-6
Test Date: 9/27/2021

AQUIFER DATA

Saturated Thickness: 12.49 ft Anisotropy Ratio (Kz/Kr): 1.

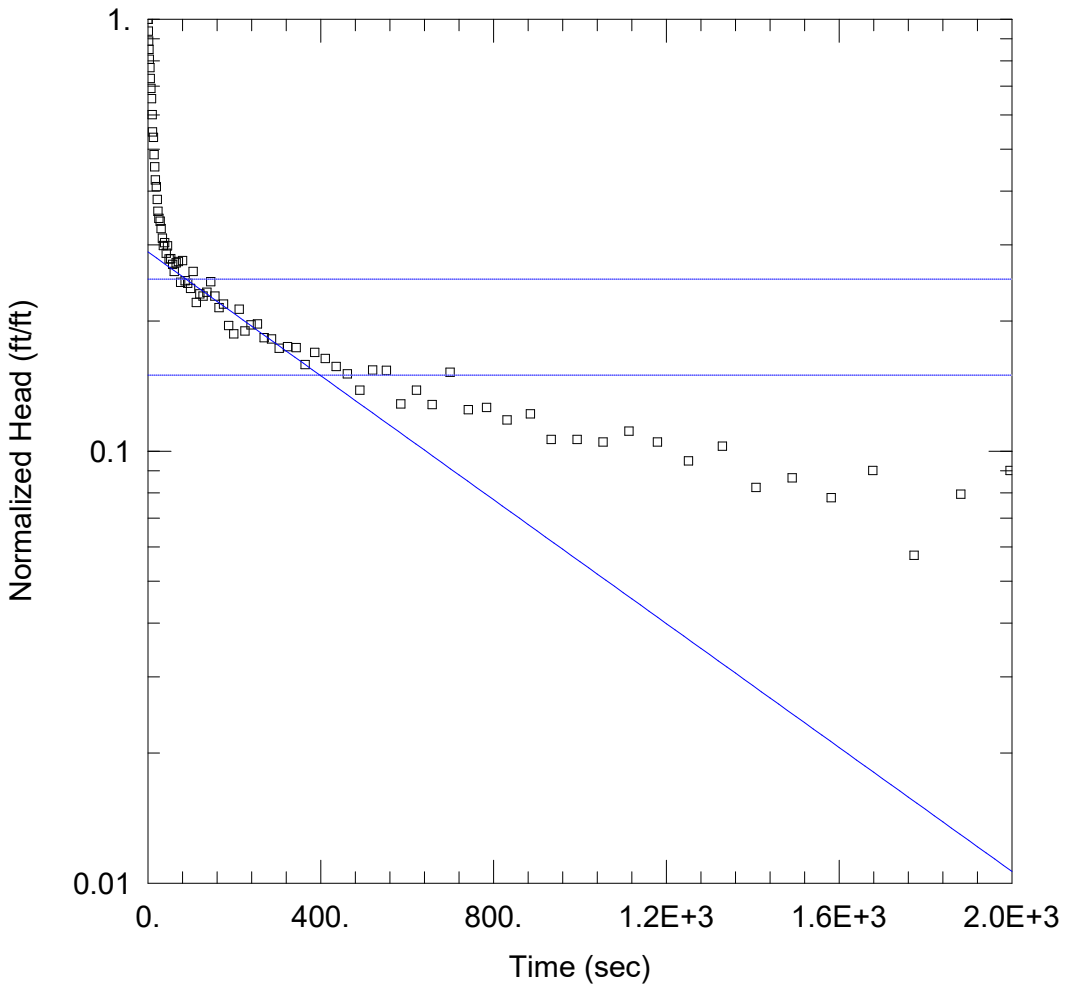
WELL DATA (MW-91-6)

Initial Displacement: 2.165 ft
Total Well Penetration Depth: 12.49 ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.49 ft
Screen Length: 12.49 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 7.843E-5 cm/sec y0 = 0.5938 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW-91-6_SW03_HV.aqt
Date: 10/28/21 Time: 14:17:03

PROJECT INFORMATION

Company: Golder Asociates Inc
Client: GRE
Project: 21451024
Location: Coal Creek Station
Test Well: MW-91-6
Test Date: 9/27/2021

AQUIFER DATA

Saturated Thickness: 12.49 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-91-6)

Initial Displacement: 2.075 ft
Total Well Penetration Depth: 12.49 ft
Casing Radius: 0.083 ft
Static Water Column Height: 12.49 ft
Screen Length: 12.49 ft
Well Radius: 0.26 ft
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 7.354E-5 cm/sec y0 = 0.6001 ft

APPENDIX A-5

Soil Water Characteristic Curve Laboratory Test Results

Soil Water Characteristic Curve Test

ASTM D 6836 - 02 (Method B, D)

Sample I.D. CC5 LPS5 **Test Date** 7/30/2004

WT of Sample Ring =	46.27	g		
WT of Sample Ring + Soil =	198.9	g		
Water Content =	19.1	%		
Diameter of Sample Ring, D =	2.4	in		
Height of Sample Ring, L =	1.0	in		
Volume, V =	2.62E-03	ft^3	74.1	cm^3
Dry Unit Weight =	107.92	pcf	1.73	Mg/m^3
Water WT =	24.48	g		
Solid WT =	128.15	g		
Add Water for saturation =	3.51	g	Sr	103.71
Saturated Water Content =	21.84	%		
Tube Area, A =	0.19	cm^2		

Applied Pressure	**Horizontal Outflow Reading**	**Water Expelled from Soil Sample**	**Suction**	**Water Content**	**Volumetric Water Content**
(psi)	(cm)	(cm^3)	(cm of water)	(%)	(%)
0	15	0.000	0.001	21.84	37.77
0.5	18.7	0.703	35.165	21.29	36.82
1	21.7	1.273	70.330	20.85	36.05
2	26.5	2.185	140.660	20.13	34.82
4	29.9	2.831	281.320	19.63	33.95
8	34	3.610	562.640	19.02	32.90
15	39.6	4.674	1054.950	18.19	31.46
30	42	5.130	2109.900	17.84	30.85
50	45.7	5.833	3516.500	17.29	29.90
90	52.7	7.163	6329.700	16.25	28.10
250	65	9.500	17582.500	14.43	24.95
		Activity	21726.00	9.86	17.05
		Meter	195840.00	5.68	9.82
		Test	782340.00	1.79	3.09

Activity Meter Test

Suction	Wt of Can	Wt of Can + Wet Soil	Wt of Can + Dry Soil	Gravimetric Water Content	Volumetric Water Content
(Mpa)	(g)	(g)	(g)	(%)	(%)
76.7	7.7995	16.4661	16.3139	1.79	3.09
19.2	8.2148	16.3898	15.9507	5.68	9.82
2.13	7.8641	14.3882	13.8026	9.86	17.05

Measured water content after test

Applied Pressure	Wt of Can	Wt of Can + Wet Soil	Wt of Can + Dry Soil	Gravimetric Water Content	Volumetric Water Content
(psi)	(g)	(g)	(g)	(%)	(%)
250	23.98	169.95	152.35	13.71	23.71

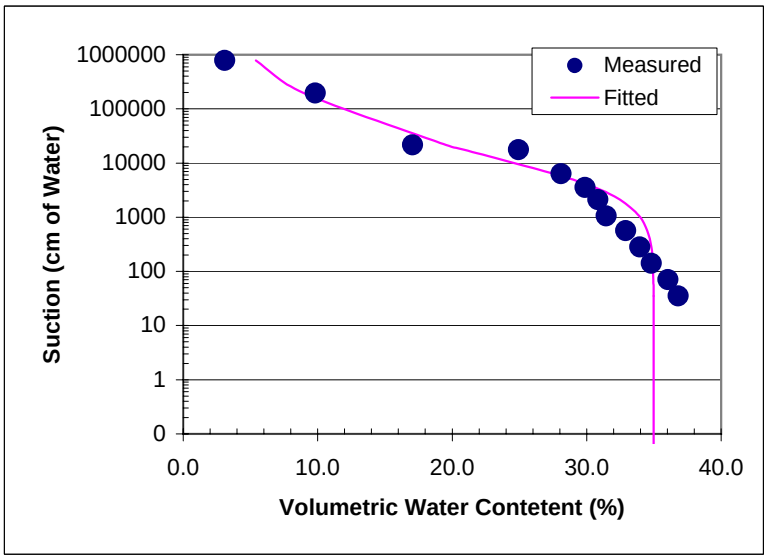
Solver Spreadsheet to fit the Van Genuchten Eqn to measured SWCC data

Sample I.D. **CC5 LPS5**

Van Genuchten Eqation :

$$\Theta = \frac{\theta - \theta_r}{\theta_s - \theta_r} = \left[\frac{1}{1+(\alpha\psi)^n}\right]^m$$

		Suction (cm)	Measured Volumetric Water Content (%)	Predicted Water Content (%)	Δ W.C. (%)	$(\Delta W.C)^2$
		0.001	37.7688	34.990	2.779	7.724
		35.165	36.8201	34.978	1.842	3.392
θ_r =	0.000	70.330	36.0509	34.961	1.090	1.188
θ_s =	34.990	140.660	34.8201	34.916	-0.096	0.009
α =	0.00021	281.320	33.9484	34.801	-0.853	0.727
n =	1.368	562.640	32.8971	34.513	-1.615	2.610
m =	0.269	1054.950	31.4612	33.909	-2.448	5.991
		2109.900	30.8459	32.477	-1.631	2.660
		3516.500	29.8972	30.620	-0.723	0.523
		6329.700	28.1023	27.543	0.560	0.313
		17582.500	24.9485	20.893	4.055	16.447
		21726.000	17.0540	19.525	-2.471	6.107
		195840.000	9.8165	8.970	0.846	0.716
		782340.000	3.0915	5.398	-2.306	5.320
					Residual =	3.84



APPENDIX B

Background Water Quality

APPENDIX B-1

Monitoring Well Borehole Logs

BORING LOG NO. MW-DP3

PROJECT: Piezometers/Well Installations

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: GRE - Coal Creek Station
McLean County, North Dakota

LOCATION: See Exhibit A-2

Latitude: 47.377698° Longitude: -101.149848°
Northing: 138647 Easting: 1839162

Surface Elev.: 1928 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.0	1928	**FILL - COAL**, black
5.0	1923	
6.0	1922	**FILL - FAT CLAY**, gray
		FILL - COAL, dark brown
		waterbearing at 10½'
12.0	1916	
		FAT CLAY (CH), brownish-gray, stiff
17.5	1910.5	
		COAL, black, waterbearing
21.0	1907	
		Boring Terminated at 21 Feet

INSTALLATION DETAILS: Steel Casing, PVC Riser, Grout, Bentonite, Silica Sand, PVC Screen, Sluff

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS
0		
		5-7-8 N=15
5		5-6-10 N=16
		3-2-3 N=5
10	▽	2-1-2 N=3
		3-5-7 N=12
15		4-5-9 N=14
20		5-7-9 N=16

WATER LEVEL OBSERVATIONS; WATER CONTENT (%); ATTERBERG LIMITS LL-PL-PI; PERCENT FINES

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" Inside Diameter, Hollow Stem Auger 0-19½'

Abandonment Method:
Boring converted to monitoring well installation.

See Exhibit A-3 for description of field procedures.

See Appendix B for explanation of symbols and abbreviations.

Notes:
Survey data provided by client.
Well developed on April 2. Pumped until water was clear.

WATER LEVEL OBSERVATIONS

▽ *Initially Encountered*

Terracon
1805 Hancock Drive
Bismarck, North Dakota

Boring Started: 4/1/2015 | Boring Completed: 4/1/2015
Drill Rig: D-90 | Driller: MR
Project No.: M2155021 | Exhibit: A-5

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2155021.GPJ TERRACON2012.GDT 4/17/15

BORING LOG NO. MW-91-7

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan
Latitude: 47.3770° Longitude: -101.1487°
Surface Elev.: 1917.5 (Ft.)

DEPTH	ELEVATION (Ft.)	INSTALLATION DETAILS	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		PVC Cap							
FAT CLAY (CH), brownish gray to dark gray, stiff to very stiff, laminations of silt		Bentonite PVC Riser							
			5		X	14	4-6-7 N=13		
		Silica sand							
			10		X	18	5-7-9 N=16	63-20-43	99
		PVC Screen							
15.0	1902.5	Sluff							
16.0 **LEAN CLAY (CL)**, gray, very stiff, waterbearing at 15'	1901.5		15		X	18	7-12-15 N=27	43-15-28	98
Boring Terminated at 16 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-14½'

Abandonment Method:

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:
Top of Casing: 1920.6

WATER LEVEL OBSERVATIONS

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-14-2021 | Boring Completed: 09-14-2021
Drill Rig: Mobile B-57 | Driller: Mike R.
Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. MW-91-2

PROJECT: Monitoring Well Installations

CLIENT: Golder Associates, Inc.
Lakewood, CO

SITE: GRE Coal Creek Station
McLean County, ND

LOCATION: See Exhibit A-2

Northing: 137705 Easting: 1839142

Surface Elev.: 1939.1 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
1.5	1937.5	**FILL - POORLY GRADED SAND WITH SILT AND GRAVEL**, dark brown
4.5	1934.5	**FILL - SANDY LEAN CLAY**, trace gravel, brown
5.5	1933.5	**ORIGINAL TOPSOIL (CL)**, dark brown, stiff
10.5	1928.5	**FAT CLAY (CH)**, brownish gray, stiff
15.5	1923.5	**COAL**, black waterbearing at 15'
18.0	1921	**FAT CLAY (CH)**, grayish-brown, stiff, silt laminations
29.0	1910	**FAT CLAY (CH)**, gray, hard, silt laminations
31.0	1908	**COAL**, black, waterbearing
		Boring Terminated at 31 Feet

INSTALLATION DETAILS: PVC Cap; Bentonite; PVC Riser; Silica Sand; PVC Screen; PVC End Cap

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS
		3-4-6 N=10
5		3-4-5 N=9
		4-5-6 N=11
10		3-3-6 N=9
		3-3-3 N=6
15		3-4-4 N=8
20		15-22-21 N=43
25		8-13-19 N=32
30		32-51-49 N=100

WATER LEVEL OBSERVATIONS: ▽ While drilling

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" ID Hollow Stem Auger 0-29½'

Abandonment Method:
Boring converted to monitoring well upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for explanation of symbols and abbreviations.

Notes:
Northing, easting and elevation provided by Golder Associates, Inc.

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 11-06-2017	Boring Completed: 11-06-2017
Drill Rig: D-90	Driller: E. Mayer
Project No.: M2175093	Exhibit: A-5

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2175093 MONITORING WELL I.GPJ TERRACON_DATATEMPLATE.GDT 12/13/17

BORING LOG NO. MW-91-3

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan
Latitude: 47.3746° Longitude: -101.1478°
Surface Elev.: 1920.4 (Ft.)

DEPTH	ELEVATION (Ft.)	INSTALLATION DETAILS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		PVC Cap					
	FAT CLAY (CH), light gray to gray, very stiff to hard, numerous laminations of silt	Bentonite PVC Riser					
5			X	16	14-10-13 N=23		
10			X	18	9-10-16 N=26		
15		PVC Screen Silica sand	X	18	7-14-24 N=38		
20		Sluff	X	18	10-14-18 N=32	50-16-34	100
21.0	1899.5						
	Boring Terminated at 21 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-19½'

Abandonment Method:

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:
Top of Casing: 1923.5

WATER LEVEL OBSERVATIONS

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-14-2021 | Boring Completed: 09-14-2021
Drill Rig: Mobile B-57 | Driller: Mike R.
Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

FOTH & VAN DYKE	Client: Cooperative Power	Scope I.D.: 89C16
	Project: Coal Creek Station	Page: 1 of 3
	Prepared by: AMC	Date: 8-30-89
	Checked by: PAD	Date: 9-1-89

REPORT - LOG OF TEST BORING

Test Boring No.: MW-75
Start Date: 7-19-89 — Location: N 36290.0, E 39715.8
Completion Date: 7-19-89 — Boring Depth: 42.0
Logged by: GKM — Surface Elevation: 1938.9

MSL ELEV	DEPTH FR LND SURF	SAMP DEPTH INTERVAL	TYPE	#	N	REC (ft)	DESCRIPTION OF MATERIAL	CLASS	LABORATORY TESTS	DRILLING AND SAMPLING NOTES
1938.9	--0	0.0 - 1.5	ss	1	14	1.4	Dk brn sandy SILT, organic, roots w/occ. thin 1/4" to 1/2" lean lt. yel gry CLAY laminae, dry, med. dense, (topsoil)	ML		4-5-9
1937.4	--1.5	1.5 - 3.0	ss	2	18	1.2	Grades to dk. brn lean CLAY w/ silt, organic, rootsd, sli moist med. dense, stiff, sli plastic	CL		6-8-10
1935.9	--3.0	3.0 - 4.5	ss	3	23	1.4	As above; boulder @ 3.5'- hard drilling	CL		3-15-8
1934.4	--4.5	4.5 - 6.0	ss	4	22	1.4	Yel-gry brn silty CLAY (4.5' - 5.0'); yel brn gravelly f-c SAND, w/silt & tr clay (5.0-5.4), dry, mottled yel gry brn silty CLAY w/fn. sand, sli moist, med. dense	CL SW CL		10-9-13
1932.9	--6.0	6.0 - 7.5	ss	5	23	1.2	Bright yel brn lean silty CLAY, tr. sand, limonite stain, med. dense, sli moist, sli plastic	CL		5-9-14
1931.4	--7.5	7.5 - 9.0	ss	6	23	1.5	As above w/increasing sand to 8.5'; olive gry to dk gry fat CLAY, stiff, plastic, waxy feel, sli moist, med. dense	CL CH		6-12-11
1929.9	--9.0	9.0-10.5	ss	7	20	1.2	As above w/ irregular lenses of yel brn clayey SILT, w/tr. sand, sli moist, med. dense	CH ML		6-8-12
1928.4	--10.5	10.5-12.0	ss	8	29	1.4	Dk gry interbedded clayey SILT & silty fat CLAY (shale) sli moist, stiff, plastic, iron stained partings	CH-MH		5-11-18
1926.9	--12.0	12.0-13.5	ss	9	27	1.5	As above - mostly silty fat CLAY (shale), sli moist	CH		7-11-16
1925.4	--13.5	13.5-15.0	ss	10	11	0.9	As above to 14.5'; @ 14.5'- blk LIGNITE, punky, soft, moist w/few hard frags.	COAL		3-5-6
1923.9	--15.0	15.0-16.5	ss	11	22	1.5	As above to 15.5'; @ 15.5'- brn-gry fat CLAY (shale) w/limonite clay stringers grades downward to dk. gry clayey SILT, med. dense, sli moist, stiff	CH MH		5-6-16
1922.4	--16.5									

DRILLING METHOD: HSA, I.D.= 3 3/4", O.D.= 7"
DRILLING CONTRACTOR: Braun

DEPTH TO WATER -
AT COMPLETION: 36.3'
LATER TIME/DEPTH: 22.3' 14 hrs later

FOTH & VAN DYKE	Client: Cooperative Power Project: Coal Creek Station Prepared by: AMC Checked by: PAD	Scope I.D.: 89C16 Page: 2 of 3 Date: 8-30-89 Date: 9-1-89

REPORT - LOG OF TEST BORING

Start Date: 7-19-89
Completion Date: 7-19-89
Logged by: GKM

Test Boring No.: MW-75
Location: N 36290.0, E 39715.8
Boring Depth: 42.0
Surface Elevation: 1938.9

MSL ELEV	DEPTH FR LND SURF	SAMP DEPTH INTERVAL	TYPE	#	N	REC (ft)	DESCRIPTION OF MATERIAL	CLASS	LABORATORY TESTS	DRILLING AND SAMPLING NOTES
1922.4	--16.5	16.5-18.0	ss	12	37	1.5	As above except more silty fat CLAY (shale) content, v. stiff, plastic, sli moist, dense, massive, conchoidal partings, minor Fe stain	CH		12-16-21
1920.9	--18.0	18.0-19.5	ss	13	29	1.5	As above w/ tr. disseminated lignite	CH		8-13-16
1919.4	--19.5	19.5-21.0	ss	14	33	1.5	As above w/0.1' layer gry SILT w/limonite stain, w/minor clay thinly laminated, w/tr. fn. sand, cohesive, stiff, v. sli plastic, dense, sli moist	ML		8-12-21
1917.9	--21.0	21.0-22.5	ss	15	28	1.5	SILT as above to 21.7'except wet; @ 21.7'- dk. gry fat CLAY (shale) w/silt, moist, med. dense, massive, v. stiff	ML CH		8-11-17
1916.4	--22.5	22.5-24.0	ss	16	48	1.5	As above to 23.0'; @ 23.0'- lt. gry to yel gry SILT w/tr. clay, dense, cohesive, wet	CH ML		9-18-30
1914.9	--24.0	24.0-25.5	ss	17	29	1.5	Silt as above to 24.5', moist; @ 24.5'-dk. gry fat CLAY (shale), sli moist	ML CH		8-12-17
1913.4	--25.5	25.5-27.0	ss	18	34	1.5	Interbedded silty CLAY & clayey SILT, moist to sli moist	ML CH ML CH		8-13-21
1911.9	--27.0	27.0-28.5	ss	19	36	1.5	As above, interbedded silty CLAY & clayey SILT, clay is leaner than above, moist	ML CH ML CH		8-16-20
1910.4	--28.5	28.5-30.0	ss	20	22	1.5	As above 2-1" wet clayey SILT layers, uniform dk. gry color	ML CH ML CH		3-8-14
1908.9	--30.0	30.0-31.5	ss	21	42	1.5	As above to 30.7'; @ 30.7'-dk.gry fn silty SAND, w/soft clay, cohesive,wet, med dense, uniform, massive, well sorted (consolidated graywacke)	ML CH SM		13-17-25
1907.4	--31.5	31.5-33.0	ss	22	62	1.5	SAND as above, wet, dense	SM		11-17-45
1905.9	--33.0									

DRILLING METHOD: HSA, I.D.= 3 3/4", O.D.= 7"
DRILLING CONTRACTOR: Braun

DEPTH TO WATER -
AT COMPLETION: 36.3'
LATER TIME/DEPTH: 22.3' 14 hrs later

FOTH & VAN DYKE

Client: Cooperative Power
Project: Coal Creek Station
Prepared by: AMC
Checked by: PAD

Scope I.D.: 89C16
Page: 3 of 3
Date: 8-30-89
Date: 9-1-89

REPORT - LOG OF TEST BORING

Start Date: 7-19-89
Completion Date: 7-19-89
Logged by: GKM

Test Boring No.: MW-75
Location: N 36290.0, E 39715.8
Boring Depth: 42.0
Surface Elevation: 1938.9

MSL ELEV	DEPTH FR LND SURF	SAMP DEPTH INTERVAL	TYPE	#	N	REC (ft)	DESCRIPTION OF MATERIAL	CLASS	LABORATORY TESTS	DRILLING AND SAMPLING NOTES
1905.9	--33.0	33.0-34.5	ss	23	38	1.5	As above, wet (appears just under saturation, but may be saturated)	SM		12-17-21
1904.4	--34.5									
1902.9	--36.0	36.0-37.5	ss	24	47	1.5	As above	SM		13-20-27
1901.4	--37.5	37.5-39.0	ss	25	47	1.5	As above	SM		11-20-27
1899.9	--39.0	39.0-40.5	ss	26	47	1.5	As above	SM		17-20-27
1898.4	--40.5	40.5-42.0	ss	27	60	1.5	As above - very dense	SM		17-23-37 Pulled augers up 5' let sit 1 hr., water level @ 37.0
1896.9	--42.0						EOB @ 42.0'			
1895.4	--43.5									
1893.9	--45.0									
1892.4	--46.5									
1890.9	--48.0									
1889.4	--49.5									

DRILLING METHOD: HSA, I.D.= 3 3/4", O.D.= 7"
DRILLING CONTRACTOR: Braun

DEPTH TO WATER -
AT COMPLETION: 36.3'
LATER TIME/DEPTH: 22.3' 14 hrs later

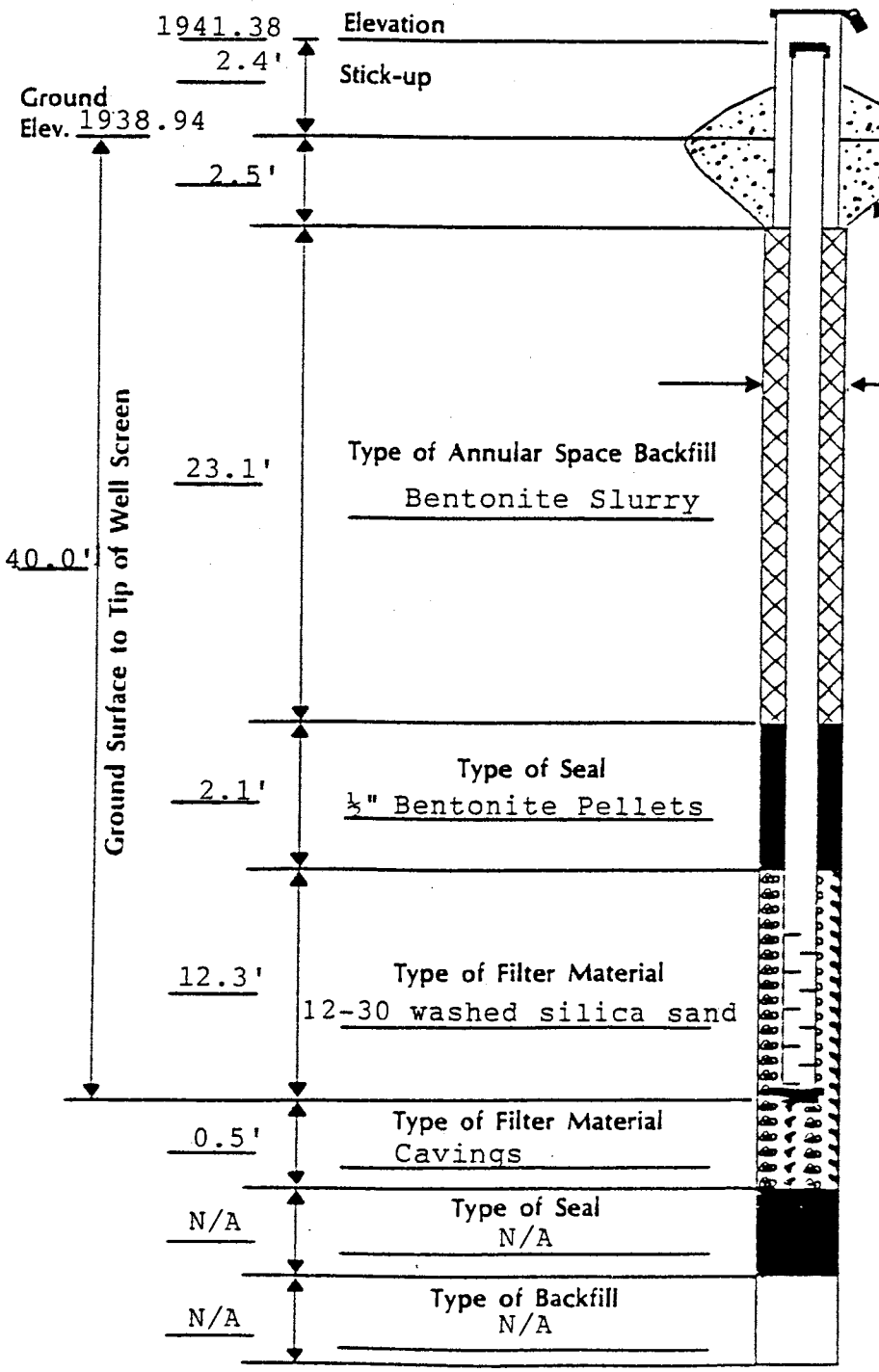
Foth & Van Dyke

Client: Cooperative Power — Scope I.D.: 89C16
Project: Coal Creek Station — Page: 1
Prepared by: GKM — Date: 7-19-89
Checked by: PAD — Date: 9-1-89

MONITORING WELL CONSTRUCTION DIAGRAM

Driller: Braun
Drilling Method: Hollow Stem Auger, I.D.=3 3/4", O.D.=7"
Coordinates: N 36290.0, E 39715.8

Well No: MW-75
Date Installed: 7-19-89 & 7-20-89



Protector Pipe:
Size: 4 inch
Material: Steel
Lock No.: Master 2106

Surface Seal Material: Quikrete

Drill Hole Diameter: 7 inch

Riser:
Diameter: 2 inch
Material: PVC
Sch.: 40
Type of Joints: flush threaded
Stenciled? no

Screen:
Diameter: 2 inch
Material: Schedule 40 PVC
Slot Size: 0.010 inch
Length: 10'

Type of Cap: flat PVC

Centralizer: Used ☐ Not Used ☒

Depth to Water From Top of Riser at Completion: 24.7'

NOTE: Not to Scale

* N/A = not applicable

BORING LOG NO. MW-91-4

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan
Latitude: 47.3732° Longitude: -101.1435°
Surface Elev.: 1930 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.0	1930	**FILL - SANDY LEAN CLAY (CL)**, trace gravel, brown
12.0	1918	**FAT CLAY (CH)**, brownish gray to grayish brown, stiff to very stiff, numerous laminations of silt
24.0	1906	**COAL**, black
28.0	1902	**SILTY CLAY WITH SAND (CL-ML)**, gray, hard
31.0	1899	**LEAN CLAY (CL)**, gray, hard, laminations of silt
36.0	1894	***Boring Terminated at 36 Feet***

INSTALLATION DETAILS: PVC Cap; PVC Riser; Bentonite; Silica sand; PVC Screen; Sluff

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5		X	13	5-5-6 N=11		
10		X	16	2-3-3 N=6		
15		X	18	4-5-6 N=11		
20		X	18	8-12-16 N=28		
25		X	18	18-25-30 N=55	NP	28
30		X	18	14-28-31 N=59	25-21-4	81
35		X	18	10-15-20 N=35	34-17-17	100

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-34½'

Abandonment Method:

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:
Top of Casing: 1933.1

WATER LEVEL OBSERVATIONS

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-14-2021 | Boring Completed: 09-14-2021
Drill Rig: Mobile B-57 | Driller: Mike R.
Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. MW-16-6

PROJECT: Monitoring Well Installations

CLIENT: Golder Asssociates, Inc
Lakewood, Colorado

SITE: GRE - Coal Creek Station
McLean County, North Dakota

LOCATION: See Exhibit A-2

Latitude: 47.37249° Longitude: -101.14037°
Northing: 136540 Easting: 1841424

Surface Elev.: 1914 (Ft.)

DEPTH		ELEVATION (Ft.)
0.3	**TOPSOIL**, dark brown	1913.5
	SANDY LEAN CLAY (CL), trace gravel, brown, soft to medium stiff	
7.5		1906.5
	COAL, very dark brown, waterbearing	
12.0		1902
	LEAN CLAY (CL), gray, very stiff	
15.0		1899
16.0	**FAT CLAY (CH)**, dark brown, very stiff, silt laminations	1898
	Boring Terminated at 16 Feet	

INSTALLATION DETAILS: Steel Casing, PVC Riser, Grout, Bentonite, Silica Sand, PVC Screen, Sluff

DEPTH (Ft.)	FIELD TEST RESULTS
	2-2-2 N=4
	2-2-3 N=5
5	2-3-4 N=7
	2-3-4 N=7
10	9-10-6 N=16
	7-9-11 N=20
15	7-9-13 N=22

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" ID HSA 0-14½'

Abandonment Method:
Boring converted to monitoring well installation.

See Exhibit A-3 for description of field procedures.

See Appendix B for explanation of symbols and abbreviations.

Notes:

Elevation, Northing and Easting provided by client.
Latitude and Longitude measured by Terracon.
Sloping concrete collar at the surface.
Three steel bollards installed around well.
Well developed July 17. Pumped water until clear (0.5 hrs).

WATER LEVEL OBSERVATIONS

- While drilling
- At completion of drilling
- After 70 hrs

Terracon
1805 Hancock Drive
Bismarck, North Dakota

Boring Started: 7/14/2015 | Boring Completed: 7/14/2015

Drill Rig: D-90 | Driller: MR

Project No.: M2155060 | Exhibit: A-9

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2155060.GPJ TERRACON2012.GDT 7/24/15

LOG OF TEST BORING NO.: MW-49

CLIENT: Cooperative Power/United Power Association
PROJECT: Coal Creek Station
PROJECT NUMBER: 87C61
LOCATION: Underwood, ND

SURFACE ELEVATION: 1903.6
BORING DEPTH: 25.0 feet
DATE: 05/20/88

MSL ELEV	DEPTH FR LND SURF	SAMP DEPTH INTERVAL	TYPE	#	N	REC (in)	DESCRIPTION OF MATERIAL	CLASS	LABORATORY TESTS	DRILLING AND SAMPLING NOTES
1903.6	0	0.0 - 1.5	SS	1	12		Lean br. sandy, gravelly CLAY, tr. silt, firm - fill	CL	NA	
1898.6	5	5.0 - 6.5	SS	2	32		Same as above	CL	NA	
1893.6	10	10.0-11.5	SS	3	20		Same as above	CL	NA	
							Grey green sandy SILT with clay, damp, soft to firm	ML	NA	
1888.6	15	15.0-16.5	SS	4	13		Fat dk. grey CLAY (shale), damp, hard to very hard	CH	NA	
1883.6	20	20.0-21.5	SS	5	8		Same as above exc. siltier, wet, firm	CH	NA	
		23.5-25.0	SS	6	10		Lean grey/green sandy CLAY w/ silt	CL	NA	
1878.6	25									EOB @ 25.0 feet
1873.6	30									
1868.6	35									
1863.6	40									
1858.6	45									
1853.6	50									
1848.6	55									

DRILLING DATA

START DATE: 05/20/88
COMPLETION DATE: 05/20/88
LOGGED BY: KAD
DRILLING METHOD: 3 1/4" ID HSA SS Samples every 5 feet
DRILLING CONTRACTOR: Great Plains Engineering Laboratory

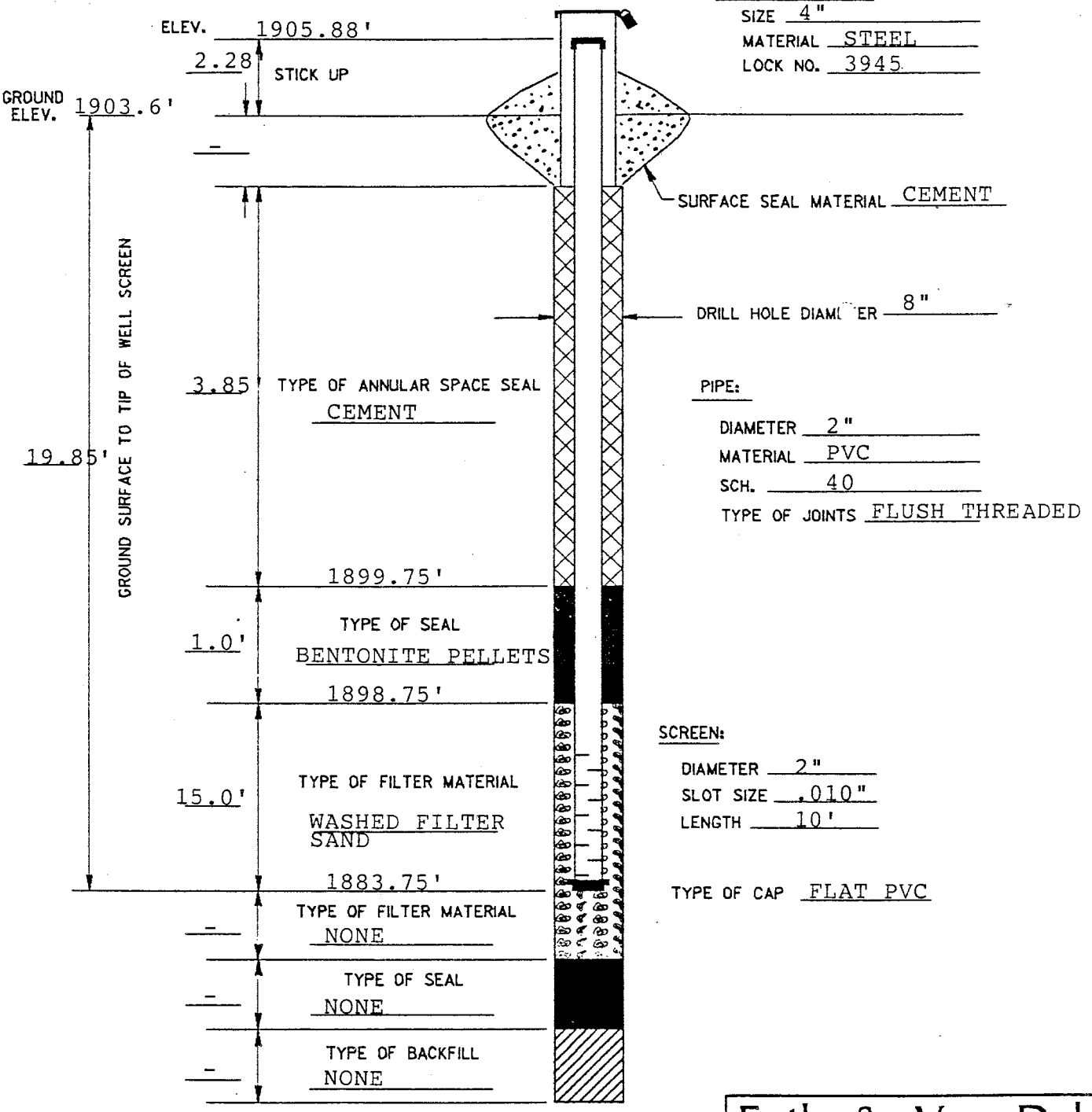
WATER LEVEL INFORMATION

DEPTH AT COMPLETION: 10.0 feet
LATER TIME/DEPTH: NA
LATER TIME/DEPTH: NA
CAVE IN DEPTH: NA
DRILLING LOSSES: NA

MONITORING WELL CONSTRUCTION DIAGRAM

WELL NO: MW-49
DATE INSTALLED: 05/20/88
DRILLER: GREAT PLAINS ENGINEERING LABORATORY
DRILLING METHOD: HOLLOW STEM AUGER

CLIENT: COOPERATIVE POWER/UNITED ASSOCIATION
PROJECT: COAL CREEK STATION
SCOPE I.D.: 87061
BY: KAD



Foth & Van Dyke
Geosciences & Environmental Management Division
Revised 3/88 By BJS
Drawn By MRS

BORING LOG NO. MW-91-5

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan
Latitude: 47.3790° Longitude: -101.1433°
Surface Elev.: 1901.3 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0	1901.3	**FILL - SANDY LEAN CLAY (CL)**, trace gravel, brown
9.5	1892	**FILL - CLAYEY SAND (SC)**, trace gravel, fine to coarse grained, brown
12.0	1889.5	**FAT CLAY (CH)**, light brown to brown, stiff
19.0	1882.5	**CLAYEY SAND (SC)**, fine to medium grained, brown to brownish gray, medium dense
26.0	1875.5	**SILTY SAND (SM)**, fine to medium grained, gray, medium dense
31.0	1870.5	***Boring Terminated at 31 Feet***

INSTALLATION DETAILS: PVC Cap; Bentonite; PVC Riser; PVC Screen; Silica sand; Sluff

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5		16	3-6-9 N=15		
10		18	3-4-3 N=7	33-18-15	31
15		18	3-5-6 N=11	50-16-34	95
20		18	4-8-10 N=18	37-14-23	35
25		18	7-11-13 N=24	30-17-13	31
30		18	9-10-14 N=24		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-29½'

Abandonment Method:

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:
Top of Casing: 1904.1

WATER LEVEL OBSERVATIONS

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-10-2021 | Boring Completed: 09-10-2021
Drill Rig: Mobile B-57 | Driller: Mike R.
Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2215072 GRE - COAL CREEK .GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

BORING LOG NO. MW-91-1

PROJECT: Monitoring Well Installations

CLIENT: Golder Associates, Inc.
Lakewood, CO

SITE: GRE Coal Creek Station
McLean County, ND

LOCATION: See Exhibit A-2

Northing: 138918 Easting: 1841128

Surface Elev.: 1901.3 (Ft.)

DEPTH		ELEVATION (Ft.)
0.3	**FILL - TOPSOIL**, dark brown	1901
1.5	**FILL - CLAYEY SAND**, brown	1900
	SANDY LEAN CLAY, brown	
7.0		1894.5
	SANDY LEAN CLAY (CL), trace gravel, brown, medium stiff	
10.5		1891
	POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM), fine to coarse grained, brown, loose to medium dense	
25.0		1876.5
26.0	**FAT CLAY (CH)**, brownish-gray, very stiff, silt laminations	1875.5
	Boring Terminated at 26 Feet	

INSTALLATION DETAILS: PVC Cap, PVC Riser, Bentonite, Silica Sand, PVC Screen, PVC End Cap

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS
		7-10-10 N=20
5		5-7-9 N=16
		2-3-3 N=6
10		3-4-4 N=8
		3-5-4 N=9
15		4-5-5 N=10
20		4-7-6 N=13
25		5-7-9 N=16

WATER LEVEL OBSERVATIONS

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" ID Hollow Stem Auger 0-24½'

Abandonment Method:
Boring converted to monitoring well upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for explanation of symbols and abbreviations.

Notes:
Northing, easting and elevation provided by Golder Associates, Inc.

WATER LEVEL OBSERVATIONS

None encountered

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 11-06-2017 | Boring Completed: 11-06-2017

Drill Rig: D-90 | Driller: E. Mayer

Project No.: M2175093 | Exhibit: A-4

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2175093 MONITORING WELL I.GPJ TERRACON_DATATEMPLATE.GDT 12/13/17

BORING LOG NO. MW-91-6

PROJECT: GRE - Coal Creek Station

CLIENT: Golder Associates Inc
Lakewood, Colorado

SITE: 2875 3rd St SW
Underwood, North Dakota

LOCATION See Exploration Plan
Latitude: 47.3790° Longitude: -101.1402°
Surface Elev.: 1898.1 (Ft.)

DEPTH	ELEVATION (Ft.)	Description
0.0	1898.1	**SANDY LEAN CLAY (CL)**, trace gravel, brown, very stiff
9.0	1889	**SILTY SAND (SM)**, trace gravel, fine to coarse grained, brown to dark brown, medium dense
18.0	1880	**LEAN CLAY (CL)**, gray, medium stiff, laminations of silt
24.5	1873.5	**SANDY LEAN CLAY (CL)**, gray, very stiff
28.0	1870	**FAT CLAY (CH)**, gray, very stiff, numerous laminations of silt
31.0	1867	***Boring Terminated at 31 Feet***

INSTALLATION DETAILS: PVC Cap; Bentonite; PVC Riser; PVC Screen; Silica sand; Sluff

DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
5		18	3-6-9 N=15		
10		18	10-8-11 N=19		
15		5	3-9-6 N=15		
20		16	3-4-4 N=8	47-17-30	99
25		18	4-8-11 N=19	37-18-19	60
30		18	6-9-12 N=21		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
3¼" HSA, 0-29½'

Abandonment Method:

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were provided by others.

Notes:
Top of Casing: 1901.2

WATER LEVEL OBSERVATIONS

Terracon
1805 Hancock Dr PO Box 2084
Bismarck, ND

Boring Started: 09-10-2021 | Boring Completed: 09-10-2021
Drill Rig: Mobile B-57 | Driller: Mike R.
Project No.: M2215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL M2215072 GRE - COAL CREEK.GPJ TERRACON_DATATEMPLATE.GDT 11/10/21

LOG OF TEST BORING NO.: MW-51

CLIENT: Cooperative Power/United Power Association
PROJECT: Coal Creek Station
PROJECT NUMBER: 87C61
LOCATION: Underwood, ND

SURFACE ELEVATION: 1895.5
BORING DEPTH: 20.0 feet
DATE: 05/20/88

MSL ELEV	DEPTH FR LND SURF	SAMP DEPTH INTERVAL	TYPE	#	N	REC (in)	DESCRIPTION OF MATERIAL	CLASS	LABORATORY TESTS	DRILLING AND SAMPLING NOTES
1895.5	0	0.0 - 1.5	SS	1	15	18	Lean sandy CLAY with silt and org., med. dense - fill	CL	NA	
1890.5	5	5.0 - 6.5	SS	2	9	18	Same as above without roots plus tr. gravel, loose - fill	CL	NA	
1885.5	10	10.0-11.5	SS	3	16	18	Grey green silty f SAND, tr. clay, wet, med. dense	SM	NA	
1880.5	15	15.0-16.5	SS	4	10	18	Br. gravelly SAND with silt, tr. clay, very wet, loose	SM	NA	
		18.0-19.5	SS	5	16	10	Lean sandy CLAY with silt	CL	NA	
1875.5	20									EOB @ 20.0 feet
1870.5	25									
1865.5	30									
1860.5	35									
1855.5	40									
1850.5	45									
1845.5	50									
1840.5	55									

DRILLING DATA

START DATE: 05/20/88
COMPLETION DATE: 05/20/88
LOGGED BY: KAD
DRILLING METHOD: 3 1/4" ID HSA SS Samples every 5 feet
DRILLING CONTRACTOR: Midwest Testing

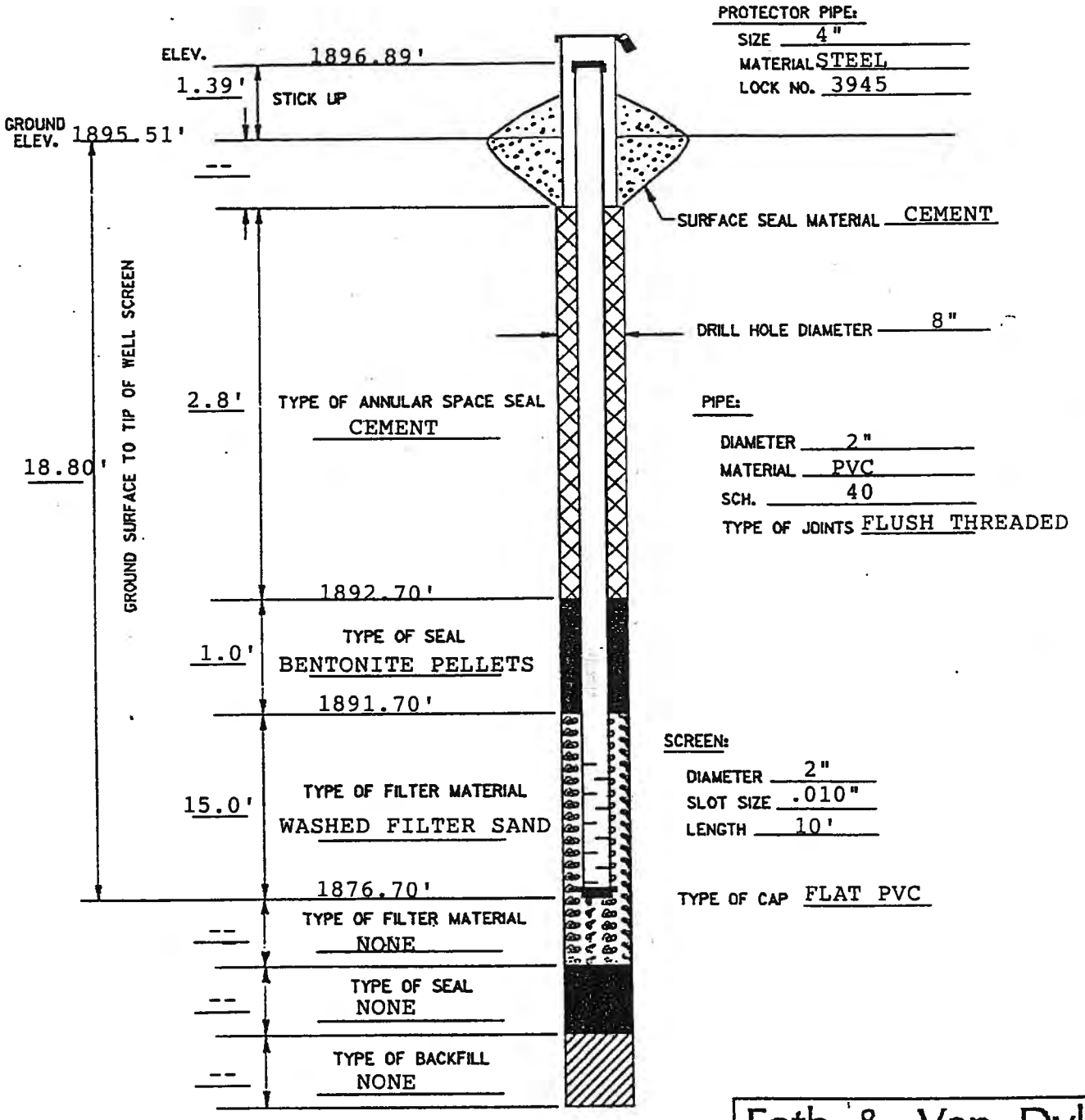
WATER LEVEL INFORMATION

DEPTH AT COMPLETION: 9.4 feet
LATER TIME/DEPTH: NA
LATER TIME/DEPTH: NA
CAVE IN DEPTH: NA
DRILLING LOSSES: NA

MONITORING WELL CONSTRUCTION DIAGRAM

WELL NO: MW-51
DATE INSTALLED: 5/20/88
DRILLER: MIDWEST TESTING
DRILLING METHOD: HOLLOW STEM AUGER

CLIENT: COOPERATIVE POWER/ UNITED POWER ASSOCIATION
PROJECT: COAL CREEK STATION
SCOPE I.D.: 87C61
BY: KAD



Foth & Van Dyke
Geosciences & Environmental Management Division
Revised 3/88 By BJS
Drawn By MRS .

APPENDIX B-2

Statistical Methods Certification Revision 2

GOLDER
MEMBER OF WSP

REPORT

Coal Combustion Residuals Groundwater Statistical Method Certification, Revision 2

Great River Energy - Coal Creek Station

Submitted to:

GREAT RIVER ENERGY

Great River Energy
Coal Creek Station
2875 Third Street SW, Underwood, North Dakota

Submitted by:

Golder Associates USA Inc.
7245 W Alaska Drive, Suite 200, Lakewood, Colorado, USA 80226

+1 303 980-0540

21451024C-10-R-0

November 29, 2021

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TABLES

Table 1: CCR Constituent List 2

1.0 INTRODUCTION

Golder Associates USA Inc. (Golder), a member of WSP, prepared this revision to the Coal Combustion Residuals (CCR) Groundwater Statistical Method Certification Report on behalf of Great River Energy (GRE) to certify that the statistical methodology to be employed at GRE's Coal Creek Station (CCS) is appropriate and meets the requirements of the United States Environmental Protection Agency's (USEPA's) CCR Rule, 40 Code of Federal Regulations (CFR) Part 257.93 (USEPA 2015).

1.1 Purpose

The CCR Rule establishes specific requirements for statistical analysis of groundwater monitoring networks in 40 CFR 257.93 (Groundwater Sampling and Analysis Requirements). Per 40 CFR 257.93(f), owners or operators of CCR units must select a statistical method to evaluate groundwater monitoring data for the constituents specified in Appendix III and Appendix IV of the CCR Rule. This report serves as the documentation of the required certification of the selected statistical methodology in accordance with 40 CFR 257.93(f)(6).

This document may be periodically revised based on a review of changes to guidance documents provided by the USEPA or other governing entities, changes to the facility groundwater monitoring plan, as well as revisions to the language of the rule itself. A revision history is provided in Section 5.0.

1.2 Site Background

CCS is located in McLean County, approximately 10 miles northwest of Washburn, North Dakota. CCS has four CCR facilities regulated under the CCR Rule. The CCR units include the following:

- Drains Pond System CCR Surface Impoundment (Drains Pond System)
- Upstream Raise 91 CCR Surface Impoundment (Upstream Raise 91)
- Upstream Raise 92 CCR Surface Impoundment (Upstream Raise 92)
- Southeast Section 16 CCR Landfill (Southeast 16)

1.3 Constituents

Baseline samples (a minimum of eight) are collected for each well within the system and analyzed for both Appendix III and Appendix IV constituent lists associated with the CCR Rule (Table 1). Additionally, the following field parameters are recorded: pH, specific conductivity, turbidity, and temperature. Following collection of baseline samples, semi-annual detection monitoring samples are analyzed for the Appendix III constituent list and field parameters. If assessment monitoring is required, samples will be analyzed for the Appendix IV constituent list in accordance with CCR Rule requirements. During the baseline period and all subsequent samples collected as part of the CCR sampling program, metals will be analyzed as total recoverable metals (i.e., samples will not be filtered).

The statistical analyses described in the following sections will be performed for each of the Appendix III constituents listed in Table 1 during detection monitoring, and for the Appendix IV constituents in the event of assessment monitoring. Apart from field pH, statistical analysis will not be conducted on field constituents (specific conductivity, turbidity, and temperature). There is a high potential for false positive results with field measurements due to sample collection inconsistency (e.g., changes in field conditions and sampling personnel), equipment calibration variability, and other causes of measurement variability.

Table 1: CCR Constituent List

Appendix III Constituents
Boron
Calcium
Chloride
Fluoride
pH (Field)
Sulfate
Total Dissolved Solids (TDS)

Appendix IV Constituents
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Radium-226 and -228 Combined
Selenium
Thallium

2.0 STATISTICAL METHODOLOGY

The purpose of groundwater monitoring in conjunction with the CCR Rule is to determine if the regulated CCR units are impacting groundwater. To determine if an impact has occurred, recent groundwater data from each well will undergo statistical analysis. The statistical methodology outlined within this document was selected in accordance with 40 CFR 257.93 of the CCR Rule and the *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (Unified Guidance, USEPA 2009). Additional consideration was given to recommendations prepared by the Electric Power Research Institute (EPRI) (2015).

Baseline diagnostic tests will be conducted using baseline samples collected at each well. Statistical analysis will be conducted using Sanitas Technologies (Sanitas) (2014) or similar statistical analysis software.

During detection monitoring, comparative statistical analysis will be performed after each monitoring event to identify whether concentrations are potentially statistically significant in comparison to baseline values. The results will be reported annually. If assessment monitoring is conducted, comparative statistical analysis will be conducted following the collection of the specified number of samples.

The baseline data for all constituents, as determined by the monitoring program, will be reviewed periodically (approximately every two to three years based on a semi-annual sampling frequency during detection monitoring) to determine if recent results that are not statistically significant in comparison to baseline values can be incorporated into an updated baseline period (specifics of the baseline update procedure are discussed in depth in Section 2.2.6).

2.1 Intrawell Methodology

Intrawell statistics (comparing compliance data to baseline data within a single well) were identified as an appropriate method for groundwater monitoring at CCS. This method is based on the following factors outlined in the Unified Guidance (USEPA 2009). The Unified Guidance provides procedures for both interwell and intrawell methods: “Groundwater detection monitoring involves either a comparison between different monitoring stations (i.e., downgradient compliance wells versus upgradient wells) or a contrast between past and present data within a given station (i.e., intrawell comparisons)” (USEPA 2009). The Unified Guidance further identifies circumstances in which intrawell comparison may be preferred over interwell comparison. Two situations where intrawell statistics may be preferable to interwell statistics are where spatial variability is present, and where legacy impacts not stemming from current facilities or handling practices are known to have occurred. Across the monitoring units, CCS has both spatial variability and historical impacts from legacy units.

2.1.1 Spatial Variability

The Unified Guidance indicates that where spatial variability is evident, “the statistical approach would need to be modified so that distinct wells are treated as individual populations with statistical testing being conducted separately at each one (i.e., intrawell comparisons)” (USEPA 2009). Per the Unified Guidance, “Confounding results stemming from spatial variability can be eliminated” through the use of intrawell statistics (USEPA 2009). Specifically, the Unified Guidance notes that “substantial differences in mean concentration levels can *invalidate* interwell, upgradient-to-downgradient comparisons and point instead toward *intrawell* tests” (USEPA 2009, original emphasis included).

Due to the heterogeneity of the glacial geology at CCS, spatial variability is displayed throughout the groundwater monitoring networks. Use of intrawell statistics allows comparisons to be made on a per well basis, which avoids comparisons being made between differing geologic/geochemical conditions. The Unified Guidance identifies spatial variability as “statistically identifiable differences in mean and/or variance levels (but usually means) across the well field (i.e., spatial non-stationarity) (USEPA 2009).” Upgradient conditions were compared using statistical processes to determine spatial variability.

Three statistical lines of evidence demonstrated the geochemical spatial variability across the site. Side-by-side box plots of the Appendix III parameters for the upgradient wells at each facility were reviewed. The Unified Guidance notes that side-by-side box plots “can be further employed to screen for possible spatial variation in mean levels” (USEPA 2009). Further, “the extent to which apparent differences in mean levels seem to be real rather than chance fluctuations can be examined” through the comparison of side-by-side box plots (USEPA 2009). The side-by-side box plots display variable water quality at each facility.

Analysis of variance (ANOVA) testing provides further confirmation of upgradient spatial variability, as described in the Unified Guidance (USEPA 2009). Determination of the distribution for ANOVA testing is based on the residuals, or the calculated difference between the observed values and the values predicted by the ANOVA model. ANOVA testing was conducted for data collected from the upgradient locations. For each of the seven Appendix III parameters, either variation (in the case of parametric ANOVA tests for parameters with residuals exhibiting normal or transform-normal distributions) or difference (for non-parametric ANOVA tests for parameters with residuals exhibiting non-normal distributions) is indicated at the 5% significance levels (α = 95%). The Appendix III parameters exhibit ANOVA significance between upgradient wells, indicating statistically significant geochemical spatial variability. As noted by the Unified Guidance, “substantial differences among the mean levels at a set of uncontaminated sampling locations [such as the tested upgradient wells] are suggestive of natural

spatial variability" (USEPA 2009). ANOVA evaluation of the upgradient wells identified significant difference between well means or medians. The Unified Guidance indicates that pooling should not occur among well means or medians determined to be significantly different using ANOVA (USEPA 2009) and therefore interwell statistical analyses are not recommended in this situation.

A major ion trilinear diagram (Piper diagram) developed from water chemistry results collected from the upgradient wells in the CCR groundwater program for each of the four CCR monitoring units (Upstream Raise 91, Upstream Raise 92, Southeast 16, and the Drains Pond System), shows the variability in water types across the site in upgradient wells.

As recommended by the Unified Guidance, the evidence of spatial variability amongst the upgradient wells has driven the selection of an intrawell statistical approach for each of the site facilities.

2.1.2 Historical Impacts

In addition to the identification and evaluation of spatial variability discussed above, the Unified Guidance indicates that intrawell testing is also useful when there are historical impacts. "Another advantage using intrawell background is that a *reasonable baseline* for tests of future observations can be established at historically contaminated wells. In this case, the intrawell background can be used to track the onset of even more extensive contamination in the future" (USEPA 2009, original emphasis included).

Past CCR depositional facilities are known to have impacted the subsurface hydrology. Those facilities have been removed and new facilities with engineered lining systems constructed. The use of intrawell statistics allows future potential changes in water chemistry to be more readily tracked in relation to current CCR facilities at CCS.

2.2 Methodology for Baseline Diagnostic Tests

2.2.1 Initial Data Review and Non-detect Handling

Initially, data will be plotted on time-series graphs to assess the temporal variability of the data and to visually screen for potential outliers. Temporal variability can be caused by seasonality, changes to the monitored system, changes to the analytical method, recalibration of instruments, and anomalies in the sampling method (USEPA 2009).

Non-detect (ND) values are results where the constituent is not detected at a concentration above the Practical Quantitation Limit (PQL). The PQL is the lowest concentration that can be reliably measured within the specified limits of precision and accuracy during routine laboratory operating conditions. ND values will be managed following the approach recommended by the Unified Guidance (USEPA 2009):

- For sample populations with less than 15% ND, direct substitution of the NDs with ½ the PQL.
- For sample populations with greater than 15% but less than or equal to 50% ND, the Kaplan-Meier approach will be used to estimate the mean and standard deviation of the population.
- For sample populations with greater than 50% ND, non-parametric approaches will be used to assess the data, with direct substitution of the NDs with the PQL.

2.2.2 Data Distribution

Parametric statistical tests are based on the assumption that the data are normally-distributed or can be transformed to a normal distribution. The distribution of the data will be tested for normality using the Shapiro-Wilk

normality test with at 95% confidence level (or the Shapiro-Francia test when there are more than 50 results within the dataset). Each constituent from each well will be analyzed separately. Datasets found to be non-normal will be tested for other distributions using the “Ladder of Powers” described by the Unified Guidance and transformed accordingly. Following transformation, parametric statistical methods will be performed on the normally or transform-normally distributed data. Non-parametric statistics will be used for datasets that do not show normal or transform-normal distributions, or for populations with greater than 50% ND.

2.2.3 Outlier Analysis

In accordance with the Unified Guidance, data points will be identified as outliers if the value was an “extreme, unusual-looking measurement’ and ‘inconsistent with the distribution of the remaining measurements.” The Unified Guidance recommends testing for outliers within baseline data, but cautions against removal of outliers, unless a likely error or specific discrepancy can be identified, such as recordkeeping errors, unusual procedures or conditions during sampling or at the laboratory, inconsistent sample turbidity, or values significantly outside the range of other results. In accordance with the Unified Guidance, apparent outliers will be periodically revisited even if initially removed due to the propensity of groundwater chemistry to change over time.

Outliers will be evaluated and identified through visual inspection and the USEPA-recommended Dixon’s Test for statistical outliers (or Rosner’s Test when there are greater than 25 samples). Dixon’s Test and Rosner’s Test assume that all data values, except the suspected outlier, are normally distributed or can be transformed to fit a normal distribution. Consequently, visual inspection of concentrations over time is important in screening for outliers. The effect of removing outliers from the baseline data will usually be to lower statistical limit (SL) (due to a reduction in the standard deviation of the dataset), resulting in a more conservative SL and improving the odds of detecting increasing concentration levels.

Outliers will be managed as follows:

- Any suspected outliers identified through statistical analysis or visual methods will be reviewed (i.e., through evaluation of the associated analytical report, laboratory narrative, associated laboratory quality assurance/quality control information, and/or field notes) before removal from the dataset to determine if any systematic or systemic errors were responsible for the noted anomalous readings. Rejected data points will not be included in the baseline dataset.
- The rationale for the removal of any outliers will be documented. The majority of outliers will likely be isolated values that can be attributed to inconsistent sampling or analytical chemistry methodology resulting in laboratory contamination or other anomalies.
- If an outlier is removed, the normality test (Section 2.2.2) will be re-run to determine if the dataset is normally-distributed or transform-normal without the outlier.

2.2.4 Trend Analysis

Most statistical tests assume concentrations do not demonstrate temporal correlation. The Sen’s Slope methodology is an intrawell statistical analysis of increases or decreases in measured concentrations over time measured by calculating the slope of the linear relationship of concentration levels and time. Sen’s Slope Methodology is paired with the Mann-Kendall test to determine the statistical significance of the calculated Sen’s Slope. The methodology involves examining all possible pairs of measurements in the dataset and scoring each pair to determine if a trend exists. The test will be conducted using a target confidence level of 99%.

If temporal trends are identified within the dataset, the data will be adjusted to account for the trends, the time period used for the baseline statistics will be reassessed, and/or an alternative statistical method will be used to establish a limit. In the case of downward trends, no adjustments may be considered appropriate and a particular constituent may not be considered for statistical analysis until further data is collected.

2.2.5 Seasonality

Seasonal temporal variability can mask changes in groundwater chemistry. Time-series plots will be observed for visual signs of seasonality and, once enough data has been collected at each well, the data will be evaluated for seasonal variations using the Kruskal-Wallis test. The Kruskal-Wallis test is an intrawell evaluation performed individually for each constituent at each well and requires at least three occurrences of each prospective season with results to calculate the statistic. Datasets are analyzed for seasonality with two seasons assumed per calendar year based on site observations, with seasonal start dates set on April 1 and October 1. Datasets that are found to have seasonality will be deseasonalized in accordance with the method described in the Unified Guidance for subsequent statistical analysis.

2.2.6 Updating the Baseline Period

The Unified Guidance recommends updating the baseline period every two to three years when sampling frequency is semi-annual, or every four to eight collected samples. A baseline update will include a review of any revisions to federal and state regulations and USEPA statistical guidance documents that may have been promulgated since the previous baseline statistical analysis. The baseline period for a specific constituent will not be considered for an update if verified statistically significant increases (SSIs) have been identified for that constituent unless a successful alternative source demonstration has been made.

Prior to inclusions of more recent data in an updated baseline period, a Wilcoxon Rank-Sum test will be conducted. The Wilcoxon Rank-Sum test, also referred to as the Mann-Whitney test, determines if measurements from one population are statistically significantly higher or lower than another population. The test is non-parametric, namely the data being tested are not assumed to fit a specific distribution, such as a normal distribution. When the baseline period is updated in the future, the Wilcoxon Rank-Sum test will be used to compare data from the current baseline period with the more recent data that are intended to be reclassified and included in the updated baseline period. The test will be conducted at a 95 to 99 percent confidence level. If the two datasets are drawn from the same population, then the results of the test support updating the prior baseline data set with the recent data. After the new data are incorporated into the dataset, the baseline diagnostic tests outlined in Section 2.2 will be conducted.

If the Wilcoxon Rank-Sum test detects a significant difference between two sample populations, additional data review will be necessary. The data will be reviewed to determine whether a gradual trend or other change not stemming from a release from the facility has occurred that was not detected during comparative statistical analysis. At the time of the baseline update, some earlier baseline data might need to be removed from the updated baseline period. Removal of earlier baseline data ensures that future statistical analysis is based on current groundwater conditions, rather than on outdated measurements of groundwater chemistry. Additionally, in cases where an SSI was identified and a successful alternative source demonstration was conducted, exclusion of some data points might be appropriate in order to update the baseline dataset. Alternatively, outliers identified in the previous baseline period (as described in Section 2.2.3) will be re-incorporated into the dataset and reevaluated as potential outliers during the baseline update unless the outlier(s) were removed due to sampling, laboratory, or other determinant error.

3.0 DETECTION MONITORING

3.1 Statistical Limits

Either a parametric or non-parametric method will be used to generate the baseline SL for each constituent. The statistical method may vary between constituents and will be selected based on the percent of ND values in the baseline period and the baseline data distribution for each constituent at each well, in accordance with the Unified Guidance (USEPA 2009).

For those constituent-well pairs where concentrations of a given analyte are normally or transform-normally distributed and have equal to or greater than 50% detections, either intrawell parametric prediction limits (PLs) or Shewhart-CUSUM (cumulative summation) control charts will be used.

For detection monitoring, intrawell parametric PLs compare individual compliance measurements to a baseline limit. The general equation for an intrawell parametric PL based on normal or transform normal populations is given as:

$$PL = \bar{x}_{BG} + \kappa s_{BG}$$

Where the PL is calculated using the mean ($\bar{x}$) and standard deviation (s) of the baseline dataset, and κ is a multiplier based on the number of compliance observations as part of the retesting scheme. If used, PLs would be calculated using a 1-of-2 retesting scheme.

The Unified Guidance notes that Shewhart-CUSUM control charts use two separate evaluation procedures. The Shewhart portion is similar to a parametric PL, comparing compliance measurements to a baseline limit. The CUSUM portion of the test analyzes new measurements against prior compliance measurements. The mean ($\bar{x}$) and standard deviation (s) of the baseline dataset are used to calculate the SL, by the following equation:

$$SL = \bar{x}_{BG} + hs_{BG}$$

Per the Unified Guidance, h is the standardized control limit.

Where the concentrations of a given constituent-well pair are not normally or transform-normally distributed, or contain less than or equal to 50% detections, a non-parametric PL limit will be used. The non-parametric limit will be assigned as the highest detected value (excluding outliers) or the highest PQL, whichever is greater.

In the case of increasing trends within the baseline period, the data will be adjusted to account for the trends where a source other than the facility can be identified and/or an alternative statistical method will be used to establish a limit. In the case of downward trends, no adjustments may be considered appropriate, and a constituent-well pair may not be considered for statistical analysis until further data is collected; therefore, the trend test will serve as the alternative method for constituents with decreasing trend until the trend stabilizes.

3.2 Comparative Statistical Analysis

Comparative statistical analysis will be conducted following each detection monitoring event. For both Shewhart-CUSUM limits and non-parametric PLs, the comparative statistical analysis will consist of a comparison of detection monitoring results (the recent analytical results for each monitoring event performed after the baseline data period) to the SL calculated from the baseline data.

The following definitions will be used in discussion of the comparative statistical analysis:

- Elevated CUSUM – occurs when the calculated CUSUM value is greater than the Shewhart-CUSUM limit established by the baseline statistical analysis, but the analytical result does not exceed the Shewhart-CUSUM limit. An elevated CUSUM is an indication that concentrations are gradually increasing and that analytical results may exceed the Shewhart-CUSUM limit in the future. For elevated CUSUMs in the case of two-tailed analysis for field-measured pH, the CUSUM value may also be below the lower Shewhart-CUSUM limit established by the baseline statistical analysis
- Potential Exceedance – is defined as an initial elevated CUSUM or an initial analytical result that exceeds the parametric PL, the Shewhart-CUSUM limit, or the non-parametric SL established by the baseline statistical analysis. Confirmatory resampling will determine if the potential exceedance is a false-positive or a verified statistically significant increase (SSI). Non-detect results that exceed either the parametric PL, the Shewhart-CUSUM limit, or the non-parametric SL are not considered potential exceedances.
- False-positive – is defined as an analytical result that exceeds the SL that can clearly be attributed to laboratory error, changes in analytical precision, or is invalidated through confirmatory re-sampling. False-positives are not used in calculation of any subsequent CUSUMs.
- Confirmatory re-sampling – is designated as the next scheduled sampling event.
- Verified SSI – is interpreted as two consecutive exceedances (the original sample and the confirmatory re-sample for analytical results, two consecutive elevated CUSUMs, or a combination of an analytical result above the SL and an elevated CUSUM in either event order) for the same constituent at the same well.

The detection monitoring program has been developed to identify potential SSIs over baseline values for the Appendix III constituents. This determination will be made within 90 days of receiving the finalized laboratory analytical report(s) for each sampling event and completion of data quality review as necessary to address questions concerning the validity of sampling methods or laboratory analyses. A potential exceedance will not be considered a verified SSI until confirmatory re-sampling is performed. Confirmatory re-sampling will occur during the next regularly scheduled sampling event.

3.3 Alternative Source Demonstrations and Initiating Assessment Monitoring

If a verified SSI is identified in a downgradient well for an Appendix III constituent as part of the detection monitoring program, GRE will establish an assessment monitoring program meeting the requirements of 40 CFR 257.95 of the CCR Rule. Alternatively, GRE may demonstrate that a source other than the regulated CCR facilities caused the verified SSI, or that the verified SSI was a result of an error in sampling, analysis, statistical evaluation, or natural variability in the groundwater quality that failed to be captured during baseline data collection (40 CFR 257.94(e)(2)). A report documenting the alternative source demonstration (ASD) will be certified by a Professional Engineer registered in the state of North Dakota. A copy of the report will be placed in the Site's Operating Record within 90 days of the SSI determination. If a successful demonstration is made and documented, GRE will continue with the detection monitoring program. If, after 90 days, a successful ASD is not made, GRE will initiate an assessment monitoring program as described in Section 4.0.

4.0 ASSESSMENT MONITORING

An assessment monitoring program will be initiated in the event of a verified SSI of an Appendix III constituent in a downgradient well, unless a successful demonstration is made that an alternative source affected the

groundwater chemistry, or that the verified SSI was a result of an error in sampling, analysis, statistical evaluation, or natural variability in the groundwater quality that was not captured during the baseline data collection period. Assessment monitoring samples will be analyzed for the Appendix IV constituent list in accordance with CCR Rule requirements, including at least one annual sample for the complete Appendix IV constituent list and at least two semi-annual samples for detected Appendix IV parameters based on the annual sample results. At a minimum, three samples will be collected for detected Appendix IV parameters with one sample collected for the complete Appendix IV parameter list annually.

The statistical comparisons used in assessment monitoring require baseline diagnostic tests to be completed prior to comparative statistics. Baseline diagnostic tests for assessment monitoring mirror those for detection monitoring and are discussed in further detail in Section 2.2, Section 4.2.1, and Section 4.2.2.

4.1 Establishment of Groundwater Protection Standards

The assessment monitoring program will comply with 40 CFR 257.95. Within 90 days of triggering the assessment monitoring program, GRE will sample and analyze each well in the affected monitoring network for the Appendix IV constituents listed in Table 1. Groundwater protection standards (GWPS) will be established for each detected Appendix IV constituent. Per the CCR Rule (40 CFR 257.95(h)), the GWPS must fall within one of the following categories:

- For constituents for which a maximum contaminant level (MCL) has been established by the USEPA (40 CFR 141.62 and 141.66), the MCL for that constituent will be the GWPS, per 40 CFR 257.95(h)(1).
- For the following constituents, the following alternative limits apply, per 40 CFR 257.95(h)(2):
  - Cobalt – 0.006 milligrams per liter (mg/L)
  - Lead – 0.015 mg/L
  - Lithium – 0.04 mg/L
  - Molybdenum – 0.1 mg/L
- For constituents where the upgradient baseline concentration is higher than the levels identified in 40 CFR 257.95(h)(1) and 40 CFR 257.95(h)(2), an SL determined from the baseline data (derivation described below) will be the GWPS per 40 CFR 257.95(h)(3).

For those constituents where the upgradient baseline concentration is higher than the MCL or levels designated in 40 CFR 257.95(h)(2), the GWPS will be determined through statistical methods. The Unified Guidance provides two acceptable approaches for conducting statistical evaluations using non-MCL or specified limit based GWPS: a tolerance interval approach or a prediction interval approach. The Unified Guidance recommends using a tolerance interval approach over a prediction interval approach if the background (or historical) dataset is normally distributed, transform-normally distributed, or has a sufficient number of background (or historical) observations for a non-parametric tolerance interval. For this program, a tolerance interval approach will be the primary method used for determining the site-specific GWPS levels.

Per the Unified Guidance, a tolerance interval is “a concentration range designed to contain a pre-specified proportion of the underlying population from which the statistical sample is drawn.” A tolerance limit is a one-sided tolerance interval. The Unified Guidance recommends “an upper tolerance limit (UTL) based on both the background sample size and sample variability” for the site-specific GWPS. Tolerance limits will be produced

using data collected from multiple upgradient wells that can be “reasonably combined”, giving a pooled background data set (USEPA 2009). Tolerance limits are defined with two coefficients, representing the portion of the population that the interval is intended to cover (the coverage, γ) and the degree of confidence that the interval reaches the coverage (the confidence level, 1-α). A coverage of 95% (γ = 0.95) and a confidence of 95% (α = 0.05) will be used. For background datasets with a normal distribution, the formula for the UTL serving as the GWPS is as follows:

$$UTL = \bar{x} + \tau_{(n,0.95,0.95)} \cdot s$$

Within the equation, n is the number of background measurements, $\bar{x}$ is the background sample mean, s is the background sample deviation, and τ is a tolerance factor based on the number of background measurements, n, with a coverage of 95% and confidence of 95%. Tabulated τ values are available in Table 17-3 in Appendix D of the Unified Guidance (USEPA 2009).

For background datasets with non-normal distributions, particularly for cases with a significant portion of non-detect observations, a non-parametric tolerance interval approach will be used. The UTL for the non-parametric tolerance limit will be set at the highest detected value (excluding outliers) or the highest PQL, whichever is greater.

If tolerance intervals cannot be used to calculate the GWPS (for example, small non-normal datasets or a dataset with a high percentage of non-detects), then a prediction interval (or PL) method will be used. For assessment monitoring, the Unified Guidance suggests using a prediction interval for a future mean for normal or transform normal datasets and a prediction interval for a future median for data with a high percent of NDs or non-normally distributed data.

A facility-wide GWPS based on the pooling of upgradient well data is preferred; however, the Unified Guidance recognizes that an intrawell approach resulting in the development of well-specific GWPS may be required if there are individual well spatial differences that need to be considered. If data review indicates an intrawell approach is more appropriate, well-specific tolerance or PLs will be developed based on the historical data for a given well.

4.2 Comparative Statistics

To determine if Appendix IV constituents have statistically exceeded the associated GWPS, the approaches discussed in the following sections will be used.

4.2.1 Maximum Contaminant Levels and Specified Limits Based GWPS

For those constituents with upgradient baseline concentrations below the maximum contaminant levels (MCLs) or pre-defined GWPS limits specified in 40 CFR 257.95(h)(2), a confidence interval approach will be used for determining compliance. Per recommendations provided by the Unified Guidance and detailed by EPRI (2015), a confidence interval statistically defines the upper and lower bound (the upper and lower confidence limit) of the true mean associated with a groundwater population. The Unified Guidance recommends confidence intervals for assessment monitoring. A confidence interval statistically defines the confidence range and the upper and lower bound of a true mean, median, or other statistical measure of a compliance monitoring dataset. Confidence intervals identify statistically significant levels (SSLs) through comparison against a fixed standard, namely the GWPS defined as the MCL or the limits specified in 40 CFR 257.95(h)(2).

The specific type of confidence interval will be based on three factors:

1) the detection frequency of compliance data

2) the distribution of the compliance data

3) if the compliance data displays a statistically significant trend

Prior to constructing confidence intervals, initial data review will be conducted on the compliance data for determining the percentage of ND (i.e., the detection frequency). Substitution of ND will be handled using the recommendations provided by the Unified Guidance, based on the percentage of ND within the dataset, as described below:

- For sample populations with less than 15% ND, direct substitution of the NDs with ½ the PQL will be used for estimating the mean and standard deviation of the population for construction of the parametric confidence interval if the dataset is normal or transform normal.
- For sample populations with greater than 15% but less than or equal to 50% ND, the Kaplan-Meier approach will be used to estimate the mean and standard deviation of the population for construction of the parametric confidence interval if the dataset is normal or transform normal.
- For sample populations with greater than 50% ND, non-parametric confidence intervals on the median will be used to assess the data, with direct substitution of the NDs with the PQL.

Following initial data review of the compliance data, the distribution of the data will be tested for normality using the Shapiro-Wilk normality test with a 95% confidence level. Each constituent from each well will be analyzed separately. Datasets found to be non-normal will be tested for other distributions using the 'Ladder of Powers' described by the Unified Guidance and transformed accordingly. Following transformation, parametric statistical methods will be performed on the normally or transform-normally distributed data. Non-parametric statistics will be used for datasets that do not show normal or transform-normal distributions, or for populations with greater than 50% ND.

A parametric confidence interval around the mean will be used if the compliance dataset has less than 50% ND and is normally distributed or transform-normally distributed. A confidence (α) of 95% will be used for calculating the Upper Confidence Limit (UCL) and Lower Confidence Limit (LCL) of the compliance data. To calculate a confidence interval around the mean, a minimum of four independent compliance samples are required.

A non-parametric confidence interval around the median will be used for datasets that do not show normal or transform-normal distributions, or for populations with greater than 50% ND. To calculate a non-parametric confidence interval around the median, a minimum of three independent compliance samples are required. However, additional samples will increase the confidence (α) of the tests.

For determination of SSLs, the LCL is of primary interest. A confidence interval will only be considered statistically above the associated GWPS if both the UCL and LCL exceed the GWPS. If only the UCL exceeds the GWPS while the LCL remains below the GWPS, the results of the test are considered inconclusive. The Unified Guidance recommends results of this category to be interpreted as "in compliance" and not consider the results to represent an SSL. If both the UCL and LCL are below the GWPS, the data are considered not statistically significant.

Confidence intervals will only be constructed on data that do not display statistically significant trends. Compliance data will be tested for trends using the Sen's Slope methodology (as described in Section 2.2.4) prior to constructing confidence intervals. If the compliance dataset is found to display a statistically significant trend, a

confidence band will be constructed around the estimated trend line. Per the Unified Guidance, a confidence band is “essentially a continuous series of confidence intervals estimated along every point of the trend.”

4.2.2 Background-Based GWPS

If a tolerance interval approach is used for a GWPS, a confidence interval approach will be used for determining compliance, similar to the approach for constituents with GWPS set at the MCL or pre-defined GWPS limits. Confidence intervals will be compared to the upper tolerance interval to identify SSLs. Confidence intervals will be calculated following the steps detailed in Section 4.2.1. To calculate a confidence interval, at least four independent compliance samples are required. A confidence interval will only be considered statistically above the associated GWPS if both the upper and lower confidence limits exceed the GWPS defined by the tolerance interval.

If a prediction interval approach is used for a GWPS, compliance data will not be assessed with confidence intervals. For comparisons to a parametric prediction interval for future means, a minimum of four compliance measurements are averaged to compare to the GWPS, with statistical significance occurring when the calculated comparative mean is greater than the GWPS. For comparisons to non-parametric prediction intervals for future medians, the median of at least three measurements will be calculated and compared to the GWPS, with statistical significance occurring when the calculated comparative median is greater than the GWPS.

4.3 Returning to Detection Monitoring, Assessment Monitoring ASDs, and Assessment of Corrective Measurements

If the concentrations of constituents listed in Appendix III and Appendix IV of the rule are shown to be at or below baseline SLs derived from detection monitoring statistical approaches for two consecutive sampling events, GRE will return to detection monitoring. This determination of baseline values is based on the statistical evaluation procedure established for detection monitoring (Section 3.0).

If the concentrations of any of the Appendix III and Appendix IV constituents are above baseline SLs, but the Appendix IV constituents are below the established GWPS, GRE will continue with assessment monitoring. If one or more Appendix IV constituents are detected at statistically SSLs above the established GWPS, GRE will place a notification of the exceedance in the Site Operating Record and follow the course of action outlined in 40 CFR 257.95(g) of the CCR Rule.

As an alternative, GRE may demonstrate that a source other than the regulated CCR facilities caused the SSL, or that the SSL was a result of an error in sampling, analysis, statistical evaluation, or natural variability in the groundwater quality that failed to be captured during baseline data collection (40 CFR 257.95(g)(3)(ii)). A report documenting the ASD will be certified by a Professional Engineer registered in the state of North Dakota. A copy of the report will be placed in the Site’s Operating Record within 90 days of the SSL determination. If a successful demonstration is made and documented, the owner or operator must continue monitoring in accordance with the assessment monitoring program pursuant to 40 CFR 257.95 and may return to detection monitoring if the constituents in Appendix III and Appendix IV are at or below background as described above. If, within 90 days, a successful ASD has not been made, GRE will initiate an assessment of corrective measures (ACM) within 90 days in accordance with 40 CFR 257.96. The ACM will be completed within 90 days of being initiated unless a demonstration is made for additional time to complete the assessment. This demonstration will be certified by a Professional Engineer registered in the state of North Dakota.

5.0 REVISION HISTORY

A history of revisions to this document:

Revision 0 – Published October 12, 2017.

Revision 1 – Published March 8, 2019. Revised to reflect:

1) Updates to the CCR Rule published in the Federal Register on July 30, 2018.
2) New CCR unit naming convention (Upstream Raise to Upstream Raise 92 and Ash Pond 91 to Upstream Raise 91).
3) Removal of calendar dates associated with the initial collection of background samples to not conflict with baseline sample collection dates for any future wells added to the program.

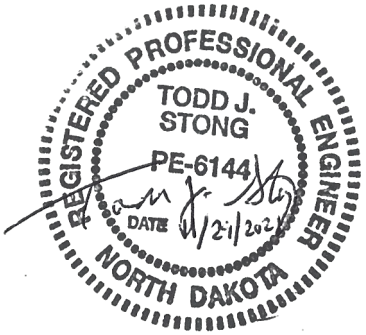
Revision 2 – Published November 17, 2021. Revised to reflect:

1) Correction to seasonality testing approach used for baseline establishment and baseline update.
2) Expansion of assessment monitoring statistical approach.
3) Minor grammatical and terminology corrections changed for increased clarity.

6.0 CERTIFICATION

Based upon the review described in this report, the undersigned certifies that the statistical methodology presented herein is appropriate for evaluating groundwater monitoring data associated with the regulated CCR facilities at CCS and meet the requirements of 40 CFR 257.93.

Golder Associates USA Inc.



Todd Stong, P.E.
Associate and Senior Consultant

Erin L. Hunder, PhD
Senior Project Engineer

TS/ELH/mb

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https://golderassociates.sharepoint.com/sites/140044/project files/6 deliverables/21451024c/reports/10-r-ccr_stats_cert_rev2/10-r-0/21451024c-10-r-0-ccr_stats_cert_rev2_29nov21.docx

7.0 REFERENCES

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Sanitas (Sanitas Technologies). 2014. Sanitas User Guide, Version 9.5.

USEPA (United States Environmental Protection Agency). 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance*, Office of Resource Conservation and Recovery, EPA-R-09-007, March 2009.

USEPA. 2015. Code of Federal Regulations Title 40 Part 257: Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities. April 17, 2015.

USEPA. 2018. Code of Federal Regulations Title 40 Part 257: Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals form Electric Utilities; Amendments to the National Minimum Criteria (Phase One, Part One). July 30, 2018.

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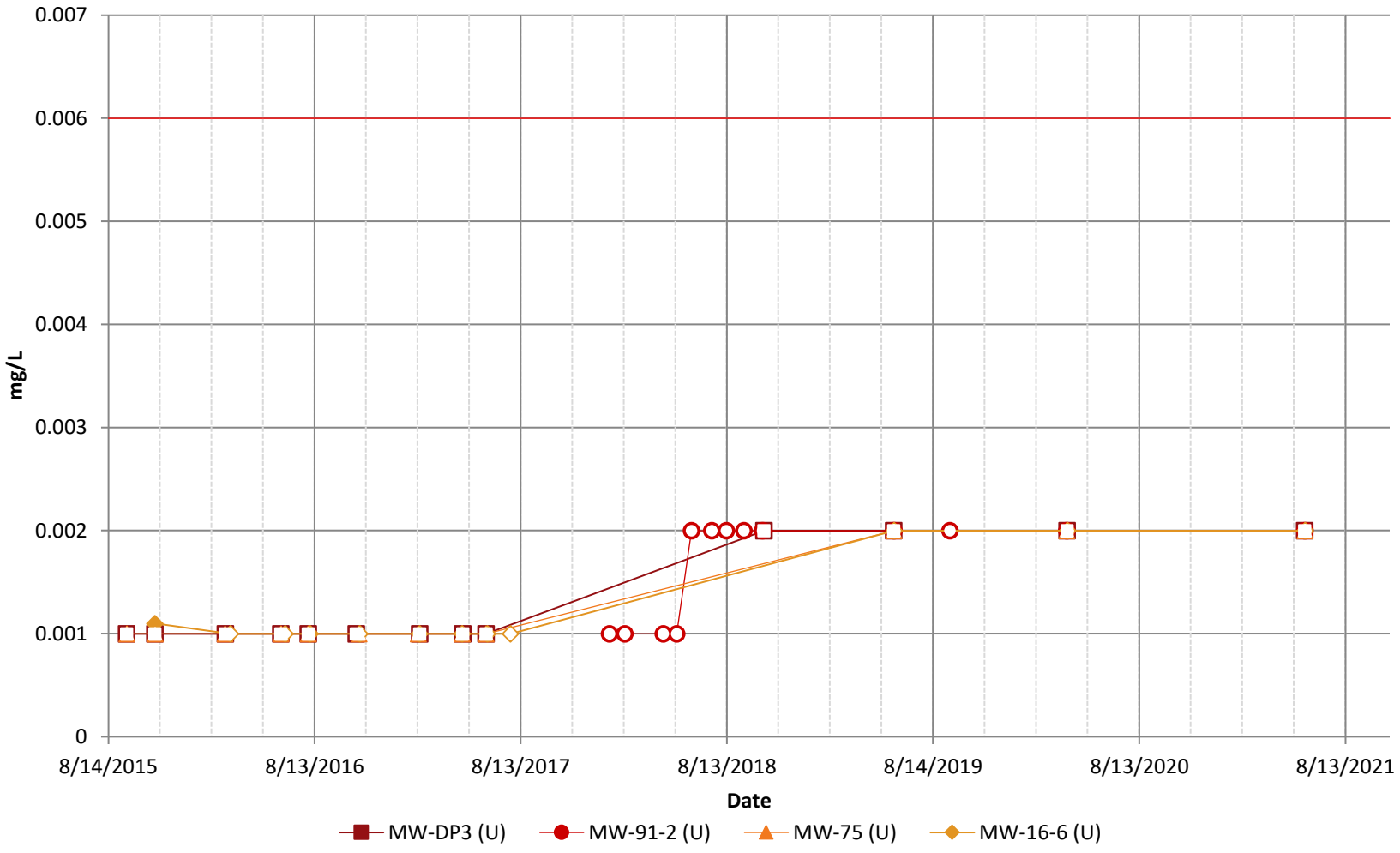
APPENDIX B-3

Upgradient Monitoring Wells
Appendix IV Time Series Graphs

https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/6 - Water Quality/Time Series/[TimeSeries - UR 91 - Up Only - ApplV Only.xlsm]UR91-1



Non-detects are plotted at the practical quantitation limit with an open symbol.

Figure UR91-1

Groundwater Antimony Concentrations

Great River Energy - Coal Creek Station

Upstream Raise 91 Upgradient Groundwater Analysis

FINAL

11/24/2021

Denver, Colorado, USA

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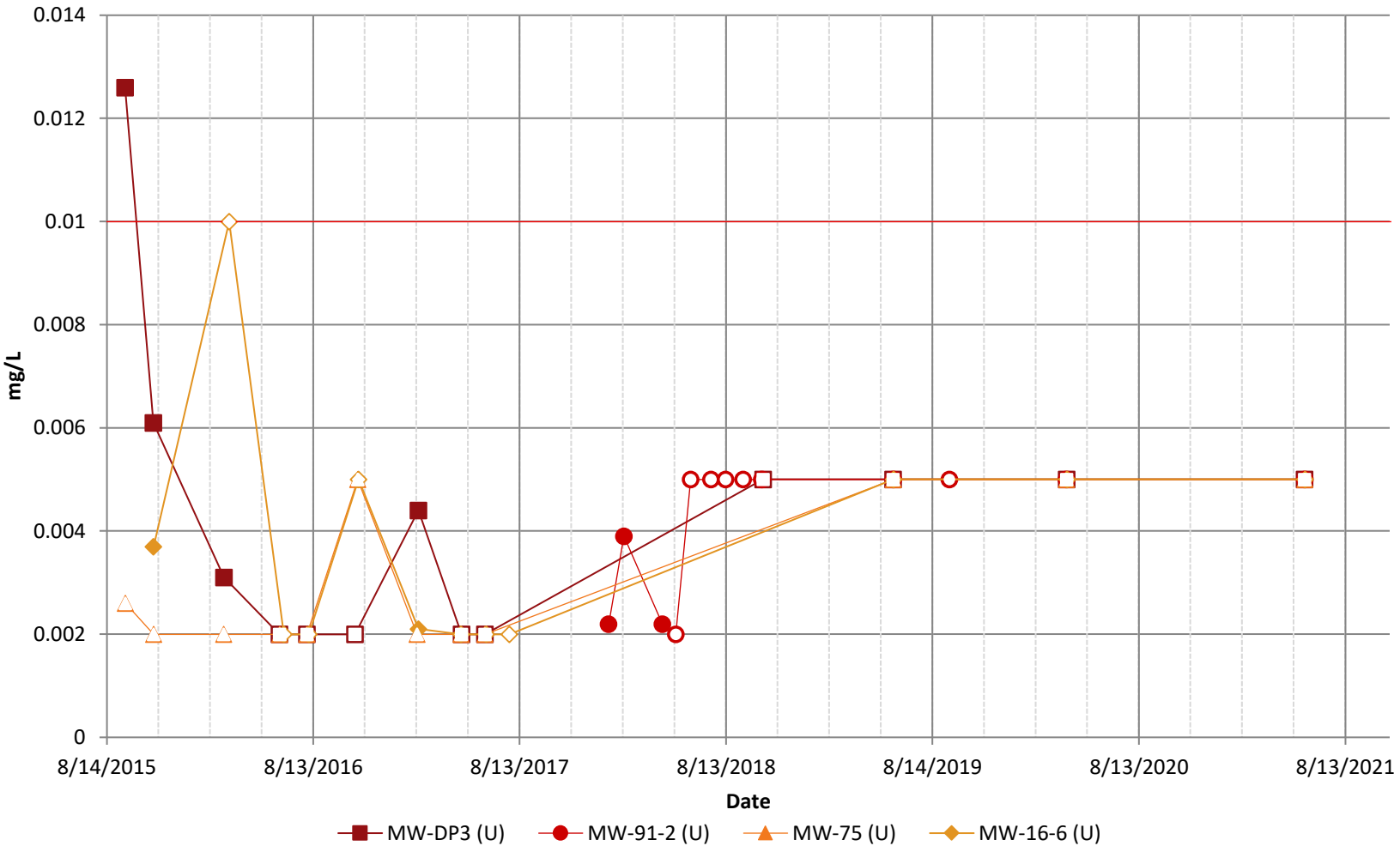
https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/6 - Water Quality/Time Series/[TimeSeries - UR 91 - Up Only - ApplV Only.xlsm]UR91-2



Non-detects are plotted at the practical quantitation limit with an open symbol.

Figure UR91-2

Groundwater Arsenic Concentrations

Great River Energy - Coal Creek Station

Upstream Raise 91 Upgradient Groundwater Analysis

FINAL

11/24/2021

Denver, Colorado, USA

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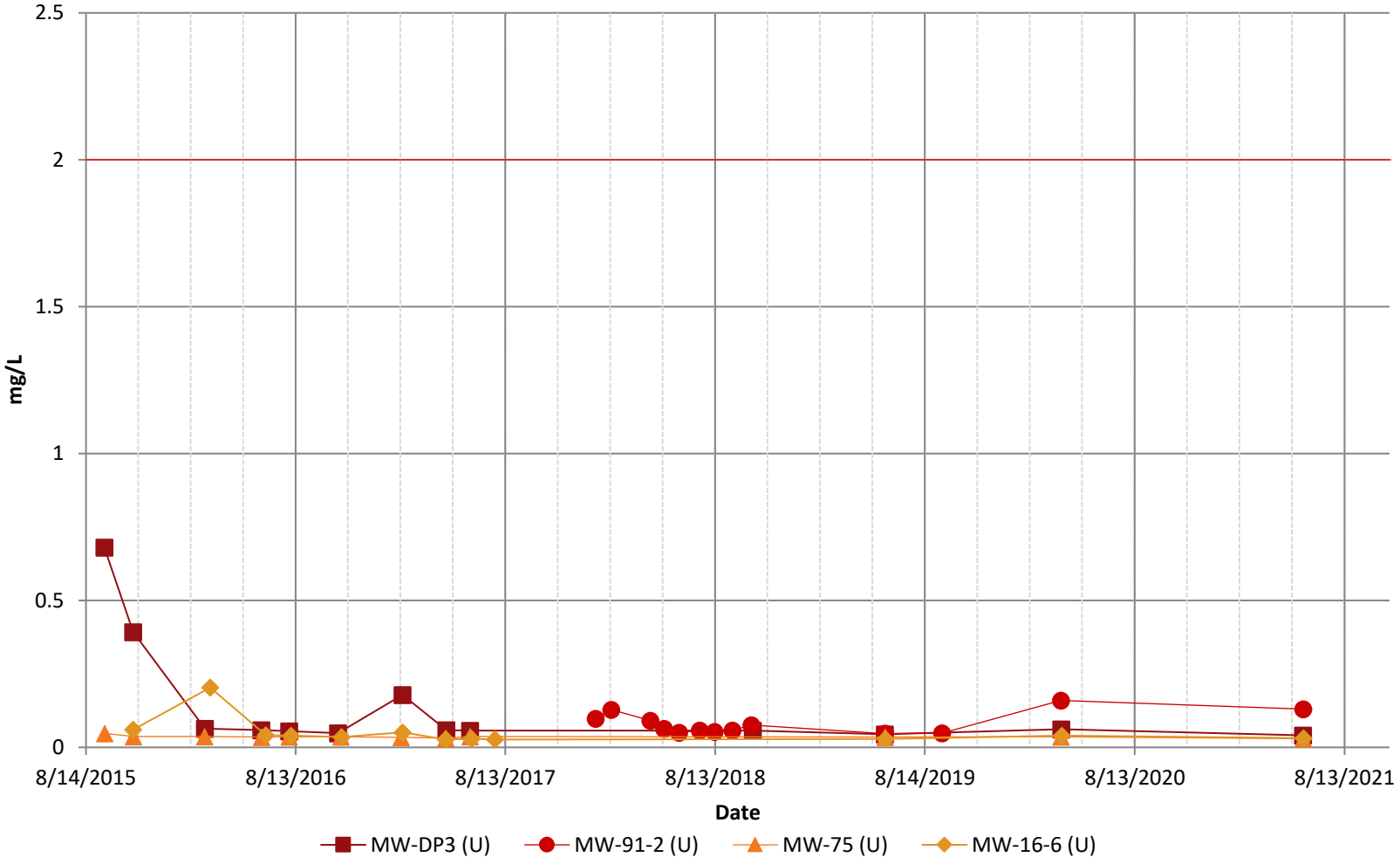
https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/6 - Water Quality/Time Series/[TimeSeries - UR 91 - Up Only - AppIV Only.xlsm]UR91-3



Non-detects are plotted at the practical quantitation limit with an open symbol.

Figure UR91-3

Groundwater Barium Concentrations

Great River Energy - Coal Creek Station

Upstream Raise 91 Upgradient Groundwater Analysis

FINAL

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Denver, Colorado, USA

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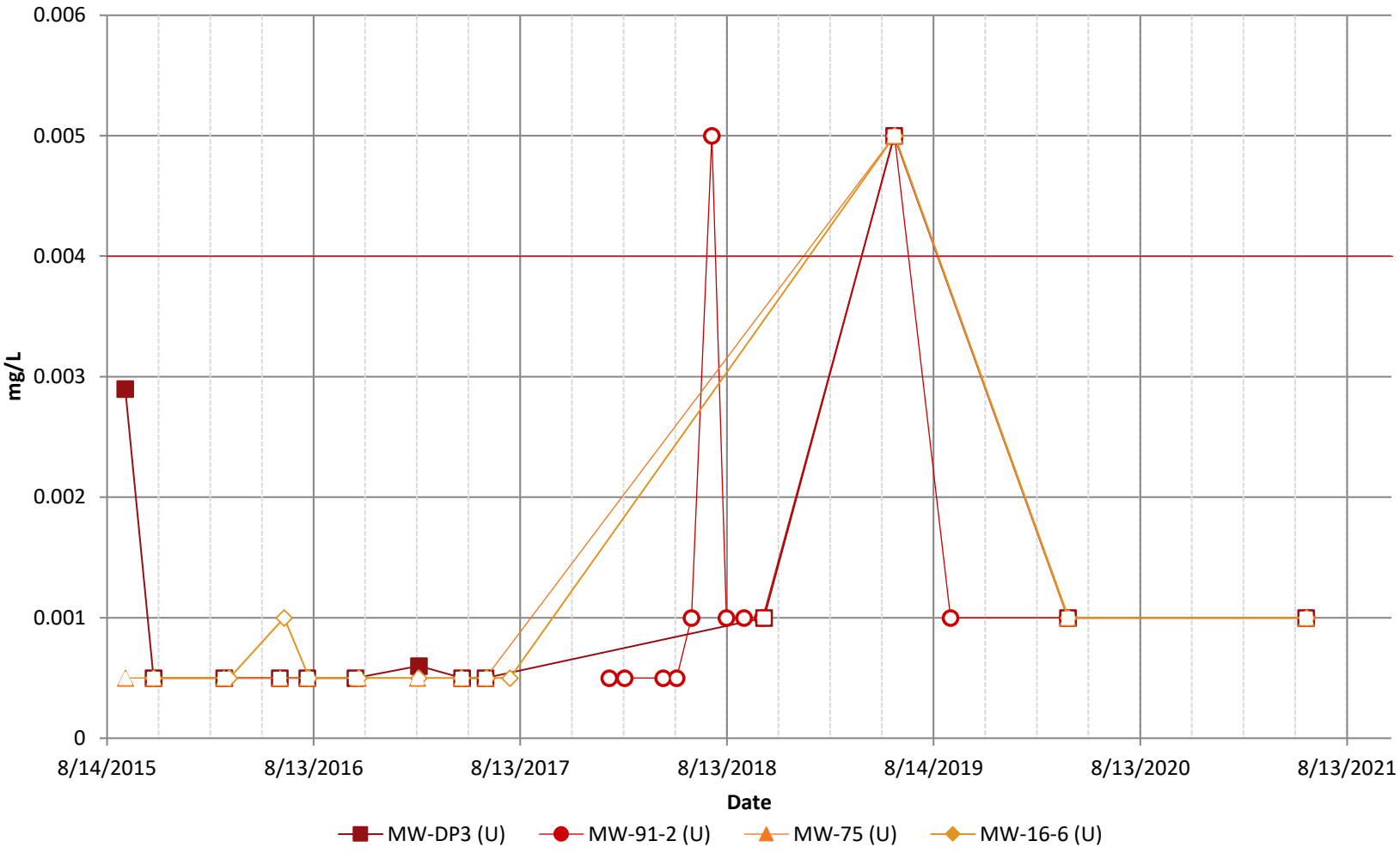
https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/6 - Water Quality/Time Series/[TimeSeries - UR 91 - Up Only - AppIV Only.xlsm]UR91-4



Non-detects are plotted at the practical quantitation limit with an open symbol.

Figure UR91-4

Groundwater Beryllium Concentrations

Great River Energy - Coal Creek Station

Upstream Raise 91 Upgradient Groundwater Analysis

FINAL

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Denver, Colorado, USA

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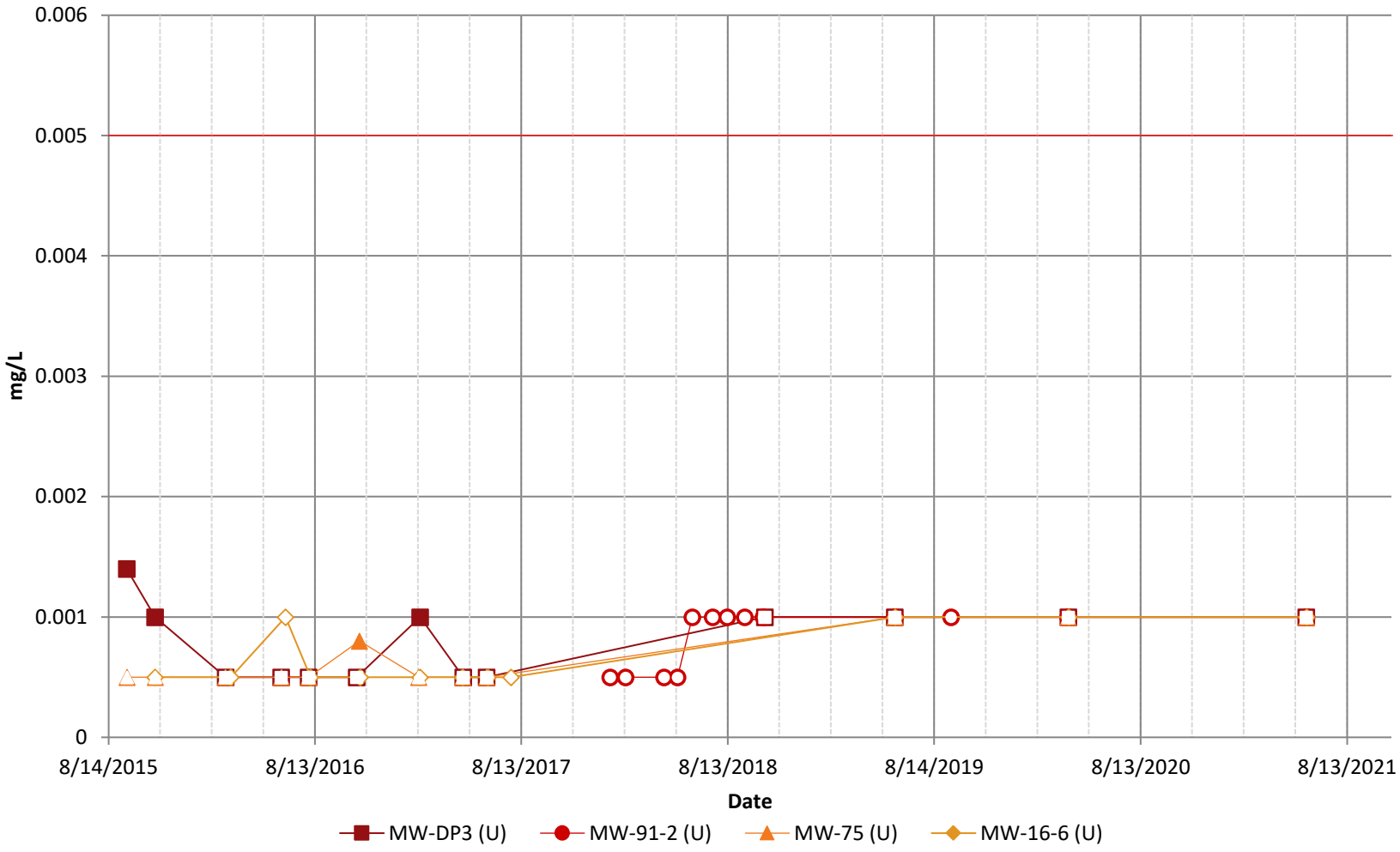
https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/6 - Water Quality/Time Series/[TimeSeries - UR 91 - Up Only - AppIV Only.xlsm]UR91-5



Non-detects are plotted at the practical quantitation limit with an open symbol.

Figure UR91-5

Groundwater Cadmium Concentrations

Great River Energy - Coal Creek Station

Upstream Raise 91 Upgradient Groundwater Analysis

FINAL

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Denver, Colorado, USA

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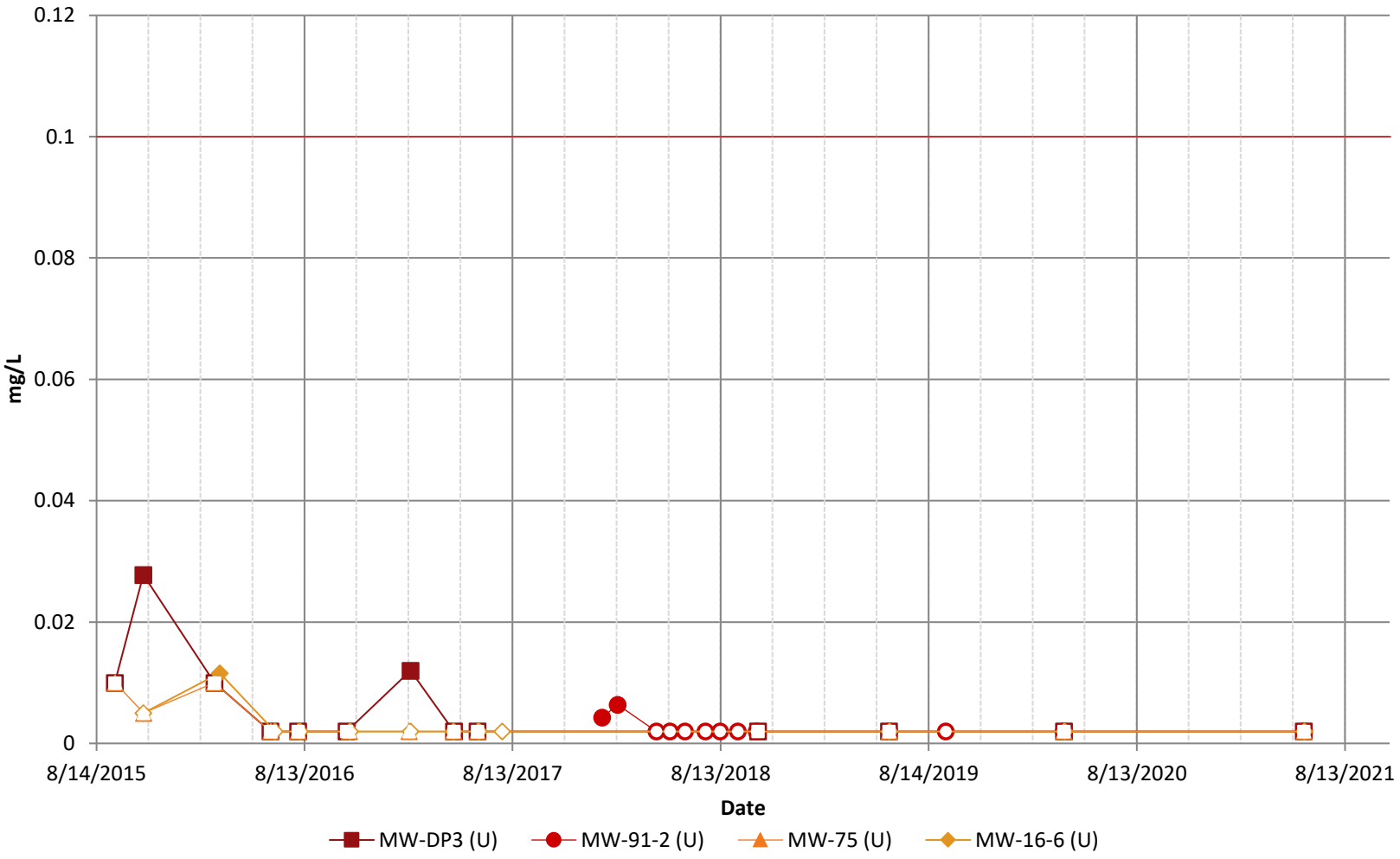
https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/6 - Water Quality/Time Series/[TimeSeries - UR 91 - Up Only - AppIV Only.xlsm]UR91-6



Non-detects are plotted at the practical quantitation limit with an open symbol.

Figure UR91-6

Groundwater Chromium Concentrations

Great River Energy - Coal Creek Station

Upstream Raise 91 Upgradient Groundwater Analysis

FINAL

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Denver, Colorado, USA

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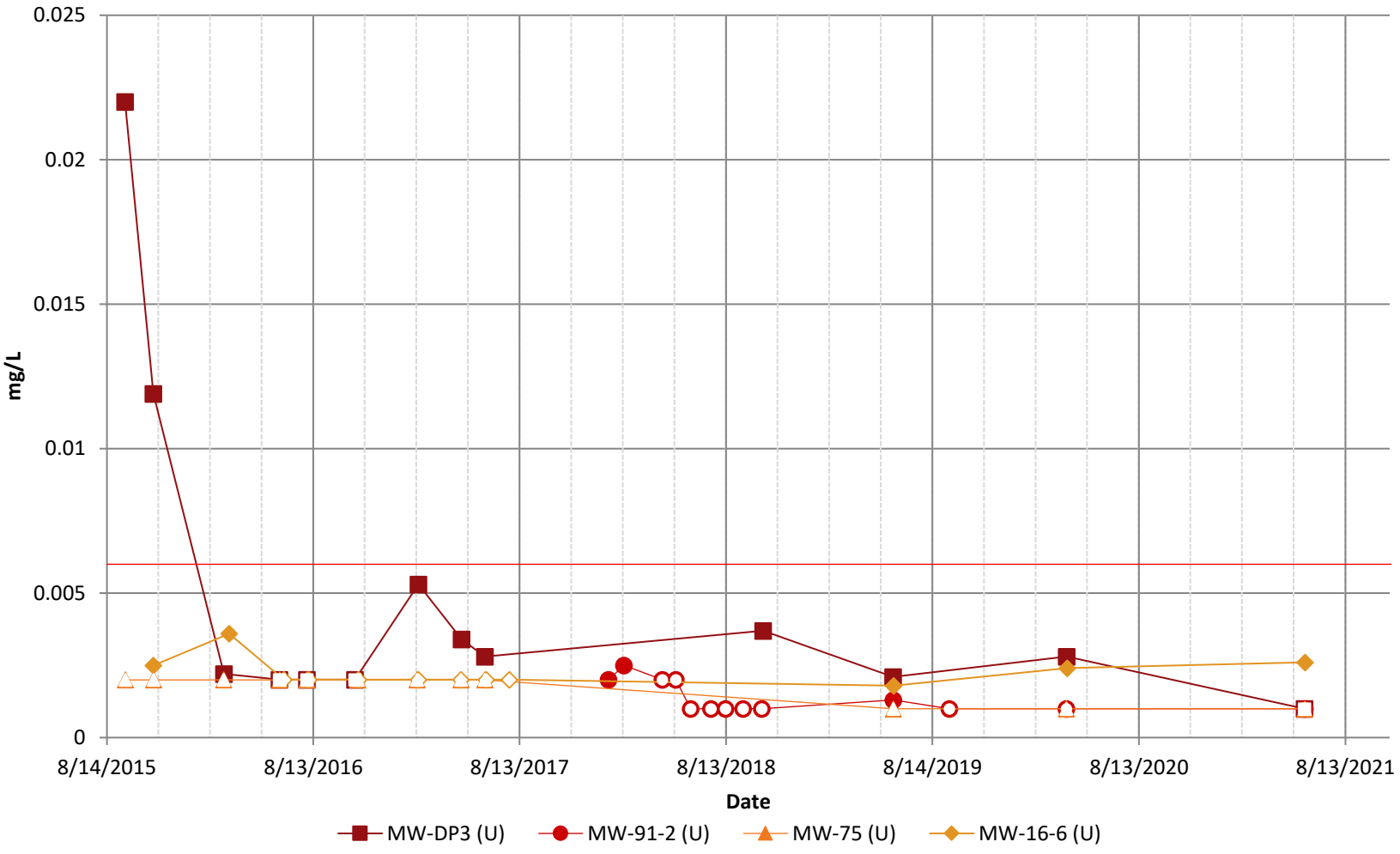
https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/6 - Water Quality/Time Series/[TimeSeries - UR 91 - Up Only - AppIV Only.xlsm]UR91-7



Non-detects are plotted at the practical quantitation limit with an open symbol.

Figure UR91-7

Groundwater Cobalt Concentrations

Great River Energy - Coal Creek Station

Upstream Raise 91 Upgradient Groundwater Analysis

FINAL

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Denver, Colorado, USA

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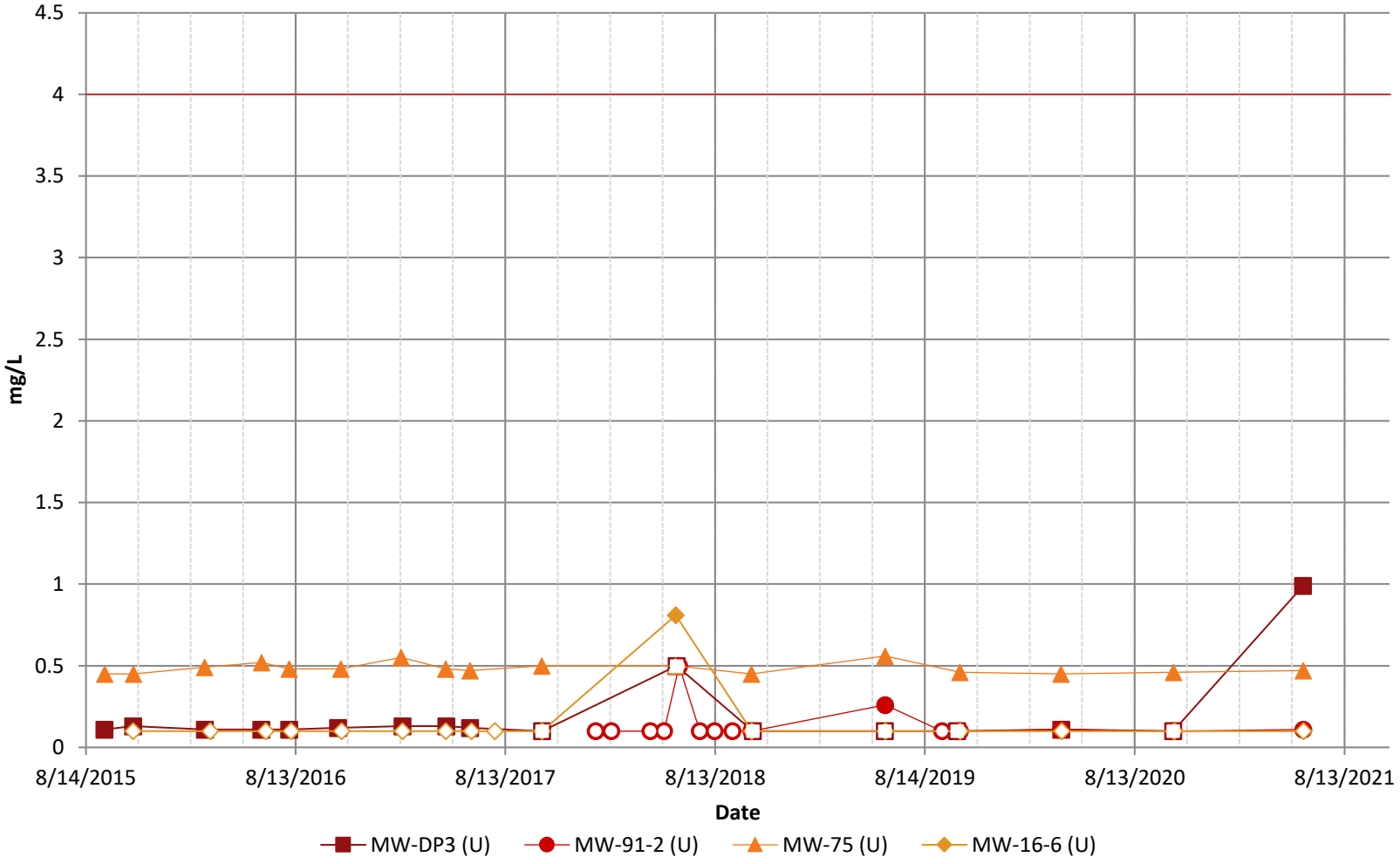
https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/6 - Water Quality/Time Series/[TimeSeries - UR 91 - Up Only - AppIV Only.xlsm]UR91-8



Non-detects are plotted at the practical quantitation limit with an open symbol.

Figure UR91-8

Groundwater Fluoride Concentrations

Great River Energy - Coal Creek Station

Upstream Raise 91 Upgradient Groundwater Analysis

FINAL

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Denver, Colorado, USA

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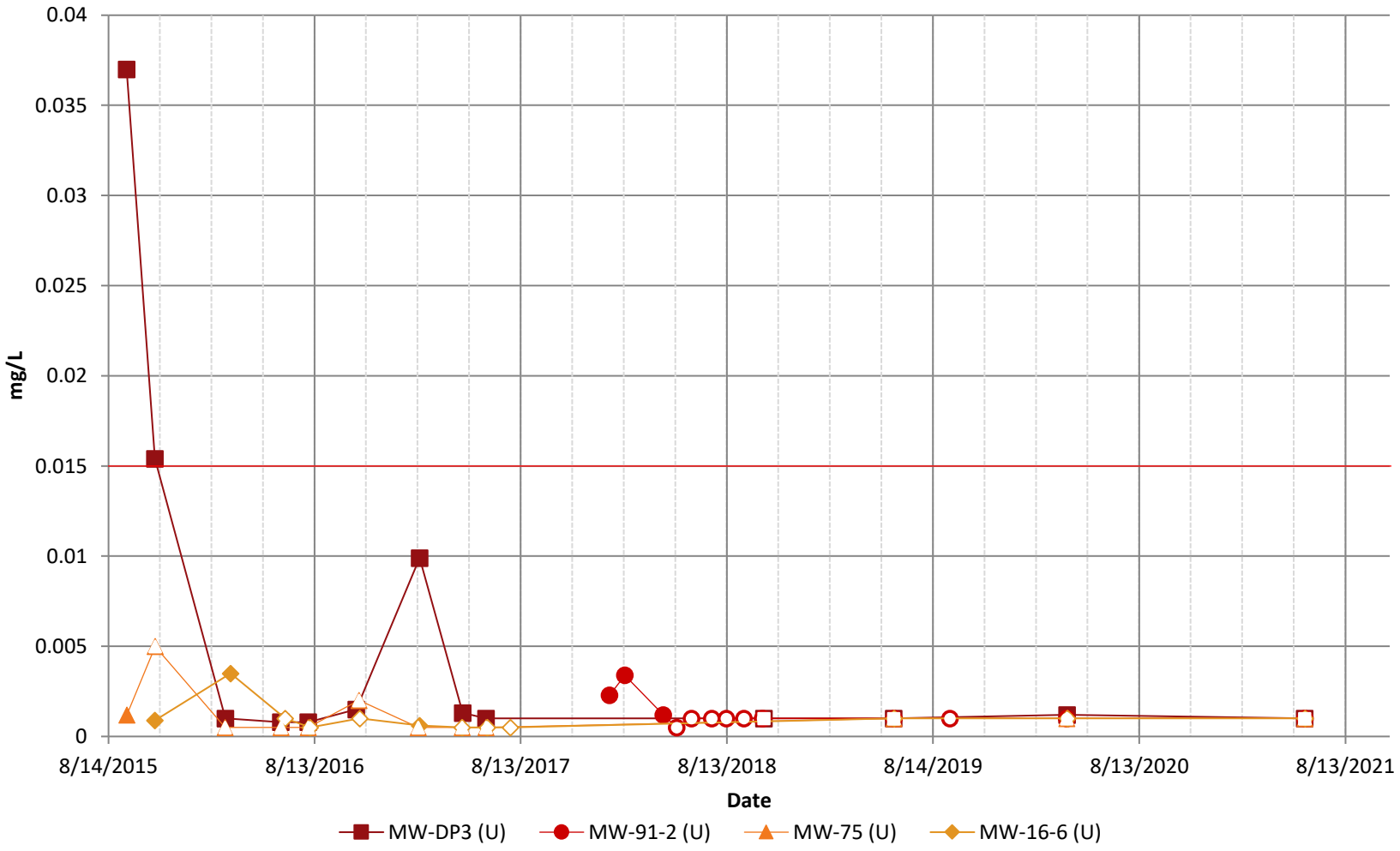
https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/6 - Water Quality/Time Series/[TimeSeries - UR 91 - Up Only - AppIV Only.xlsm]UR91-9



Non-detects are plotted at the practical quantitation limit with an open symbol.

Figure UR91-9

Groundwater Lead Concentrations

Great River Energy - Coal Creek Station

Upstream Raise 91 Upgradient Groundwater Analysis

FINAL

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Denver, Colorado, USA

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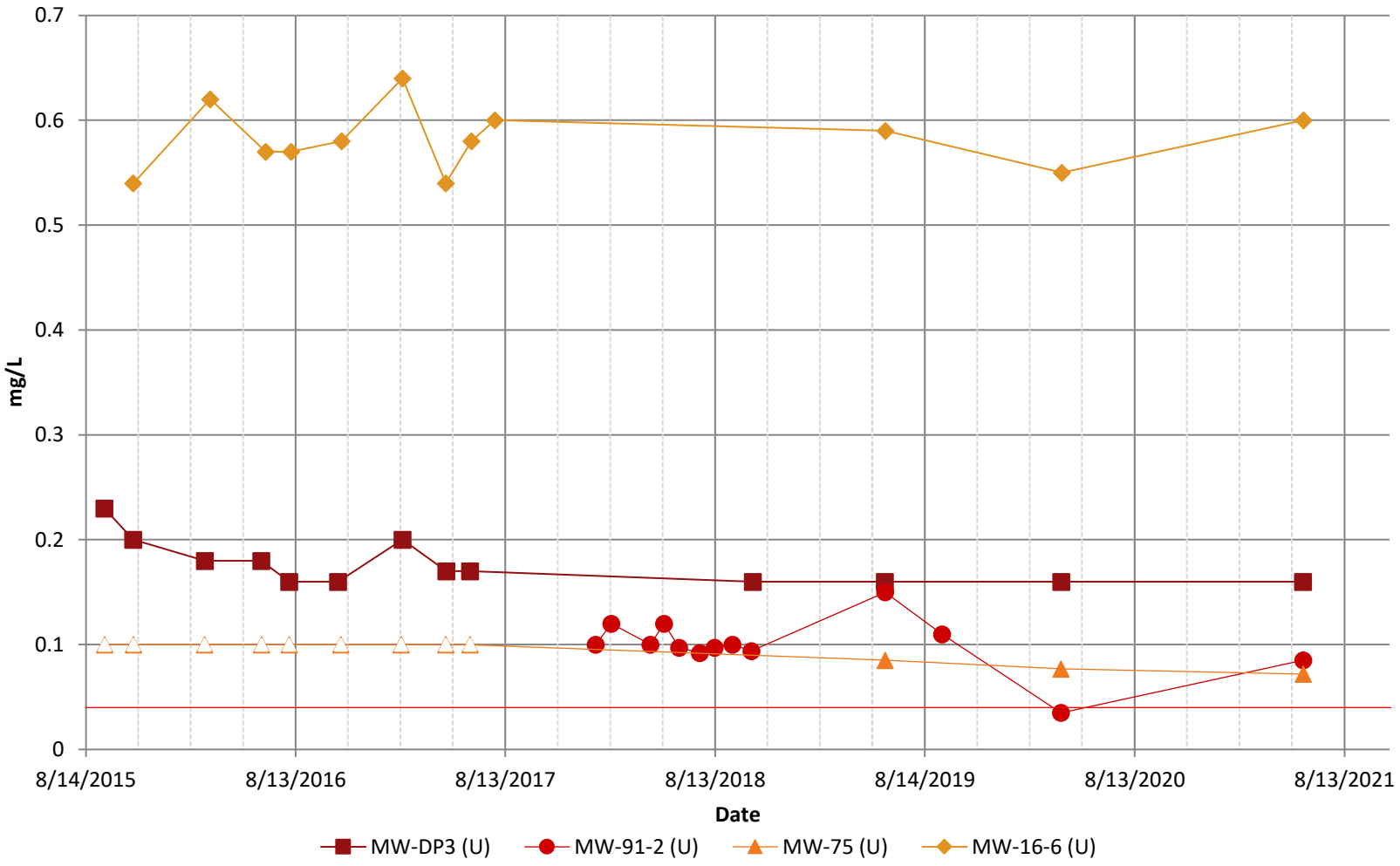
https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/6 - Water Quality/Time Series/[TimeSeries - UR 91 - Up Only - AppIV Only.xlsm]UR91-10



Non-detects are plotted at the practical quantitation limit with an open symbol.

Figure UR91-10

Groundwater Lithium Concentrations

Great River Energy - Coal Creek Station

Upstream Raise 91 Upgradient Groundwater Analysis

FINAL

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Denver, Colorado, USA

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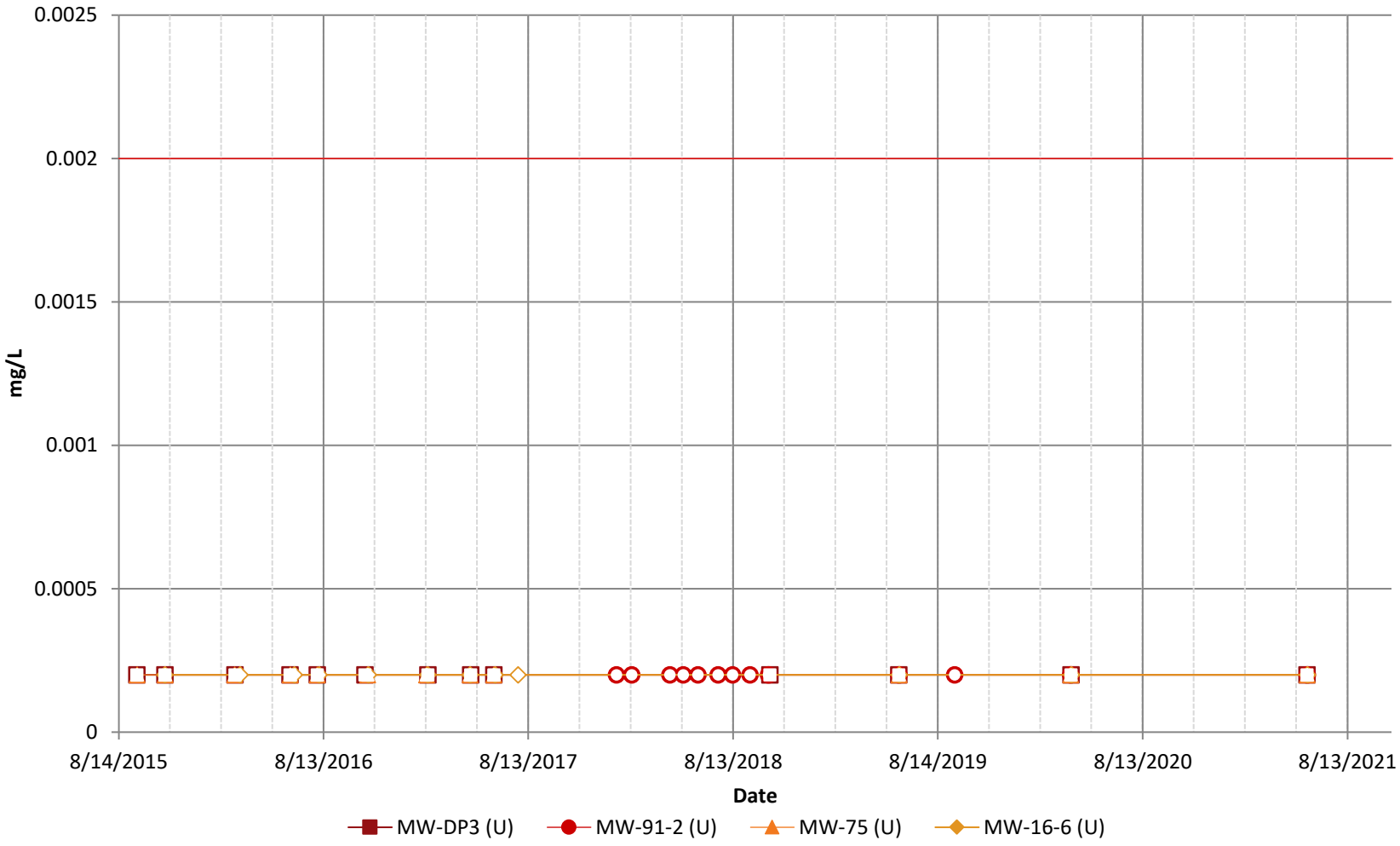
https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/6 - Water Quality/Time Series/[TimeSeries - UR 91 - Up Only - AppIV Only.xlsm]UR91-11



Non-detects are plotted at the practical quantitation limit with an open symbol.

Figure UR91-11

Groundwater Mercury Concentrations

Great River Energy - Coal Creek Station

Upstream Raise 91 Upgradient Groundwater Analysis

FINAL

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Denver, Colorado, USA

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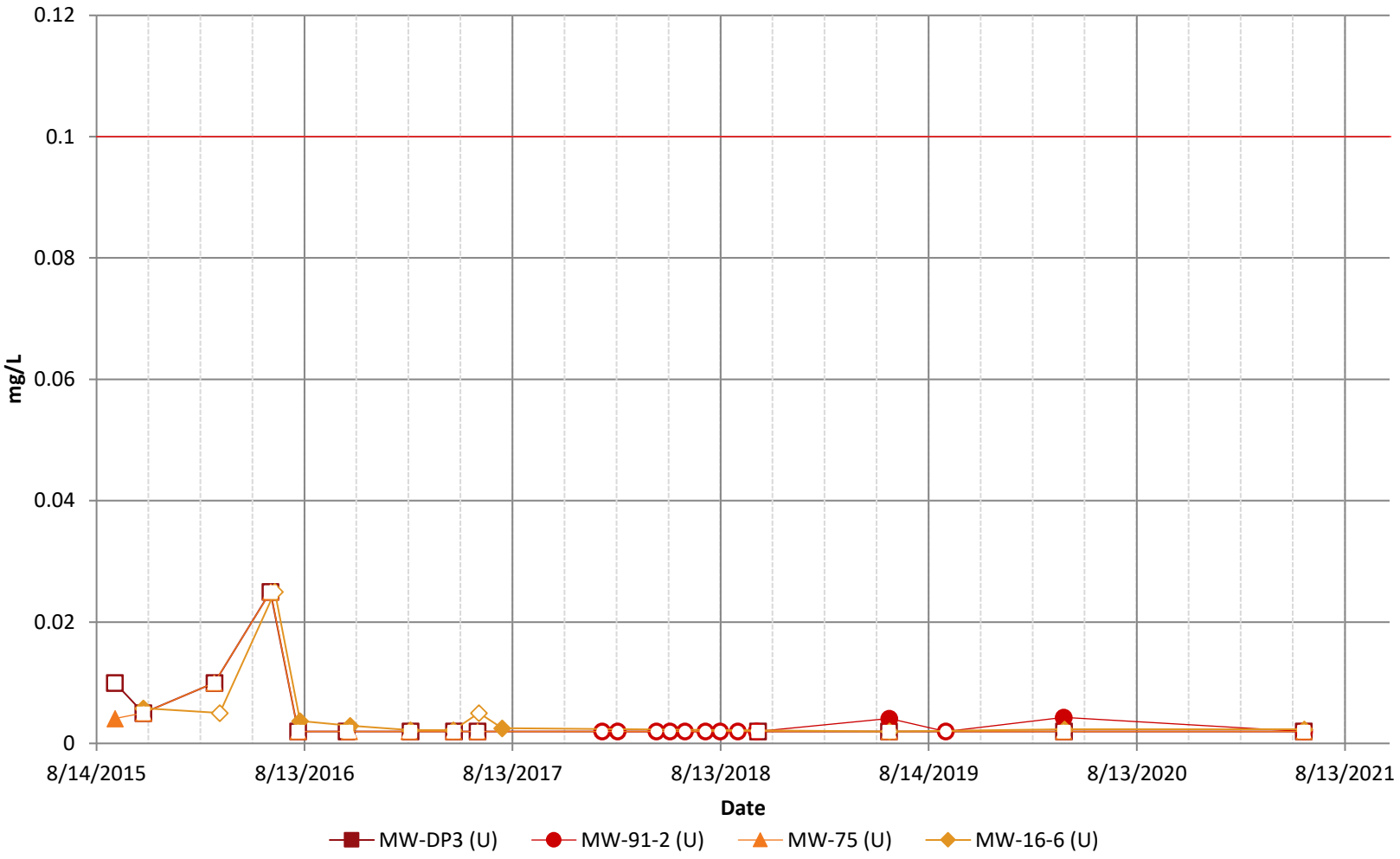
https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/6 - Water Quality/Time Series/[TimeSeries - UR 91 - Up Only - AppIV Only.xlsm]UR91-12



Non-detects are plotted at the practical quantitation limit with an open symbol.

Figure UR91-12

Groundwater Molybdenum Concentrations

Great River Energy - Coal Creek Station

Upstream Raise 91 Upgradient Groundwater Analysis

FINAL

11/24/2021

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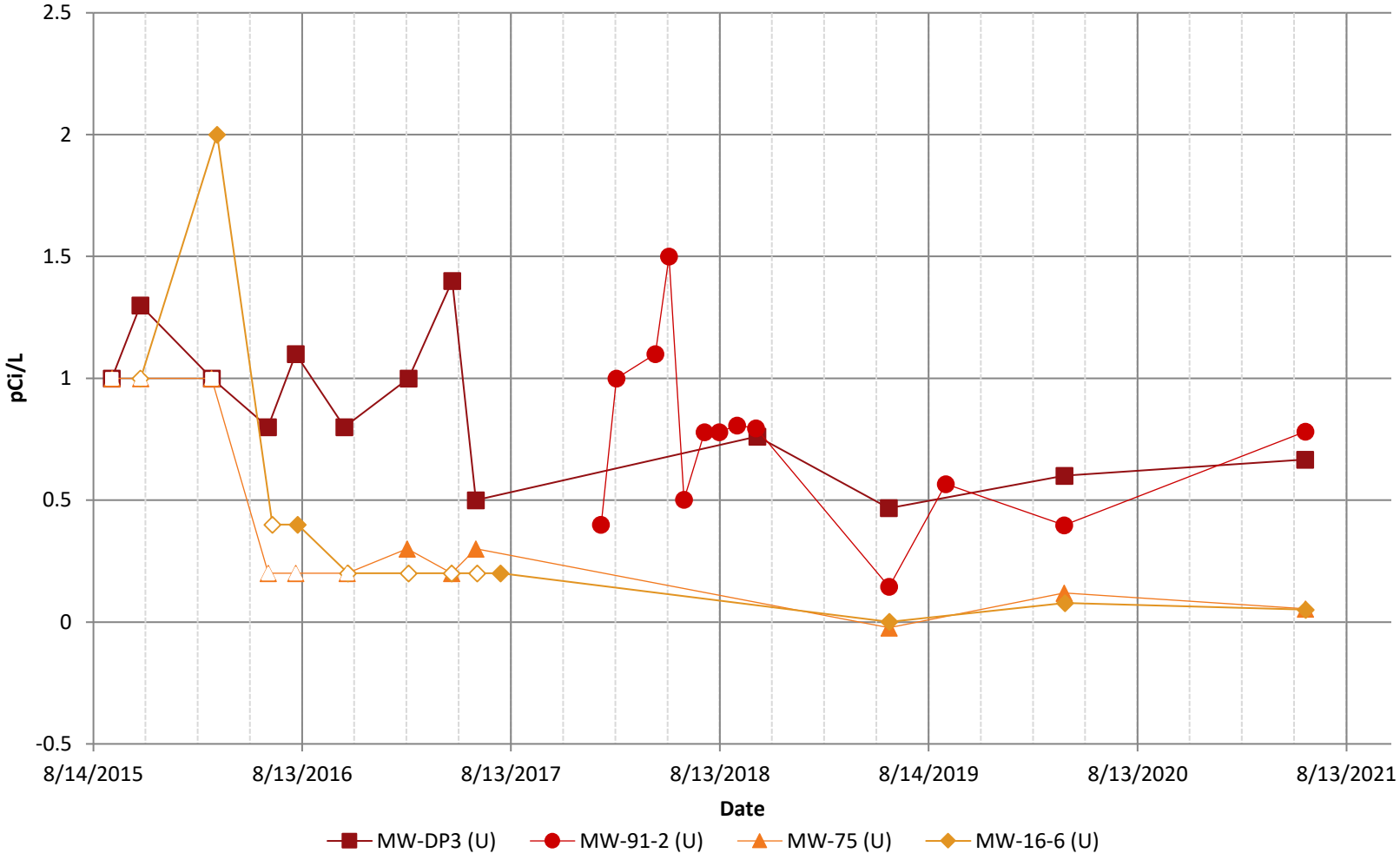
https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/6 - Water Quality/Time Series/[TimeSeries - UR 91 - Up Only - AppIV Only.xlsm]UR91-13



Non-detects are plotted at the practical quantitation limit with an open symbol.

Figure UR91-13

Groundwater Radium 226 Concentrations

Great River Energy - Coal Creek Station

Upstream Raise 91 Upgradient Groundwater Analysis

FINAL

11/24/2021

Denver, Colorado, USA

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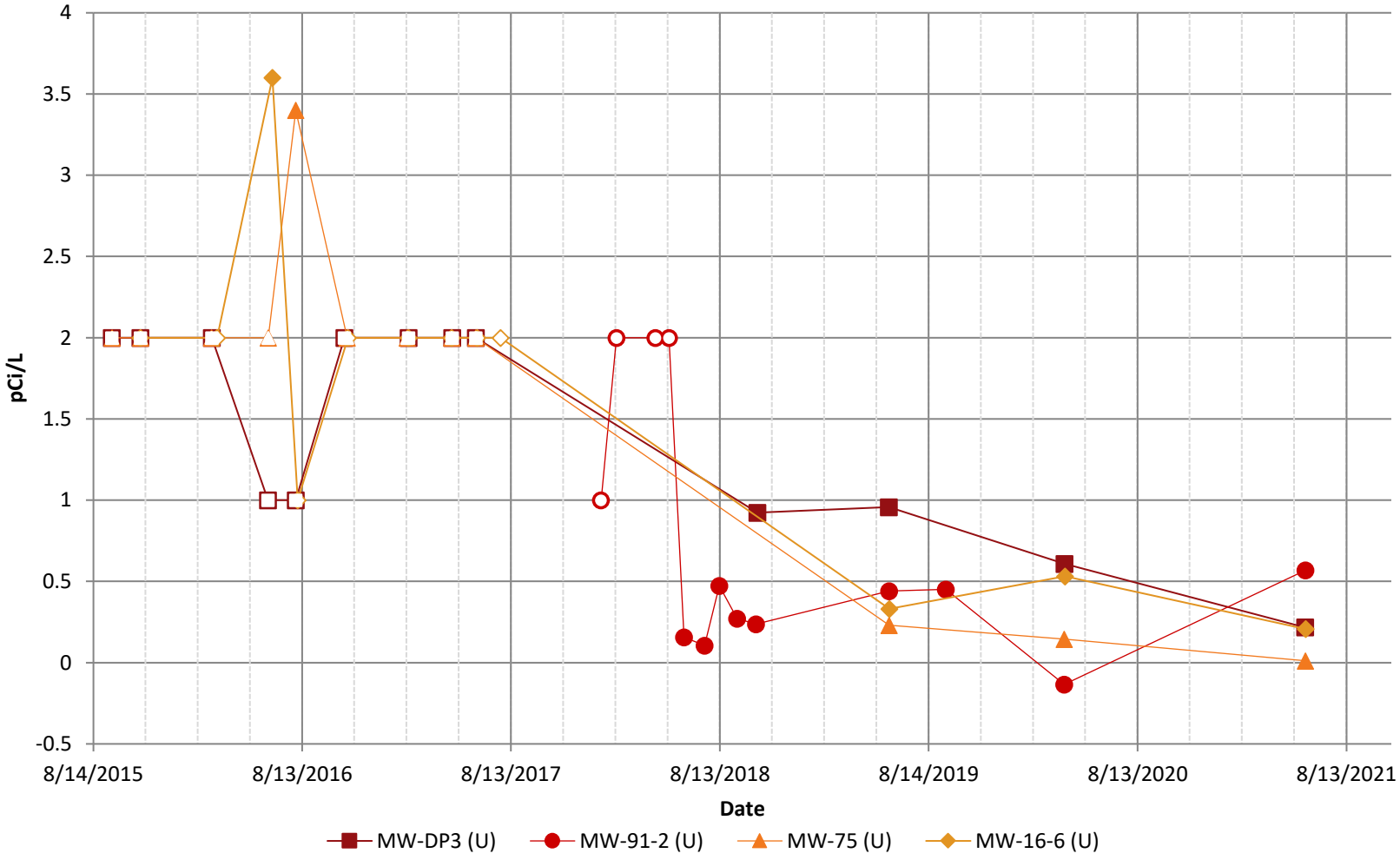
https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/6 - Water Quality/Time Series/[TimeSeries - UR 91 - Up Only - AppIV Only.xlsm]UR91-14



Non-detects are plotted at the practical quantitation limit with an open symbol.

Figure UR91-14

Groundwater Radium 228 Concentrations

Great River Energy - Coal Creek Station

Upstream Raise 91 Upgradient Groundwater Analysis

FINAL

11/24/2021

Denver, Colorado, USA

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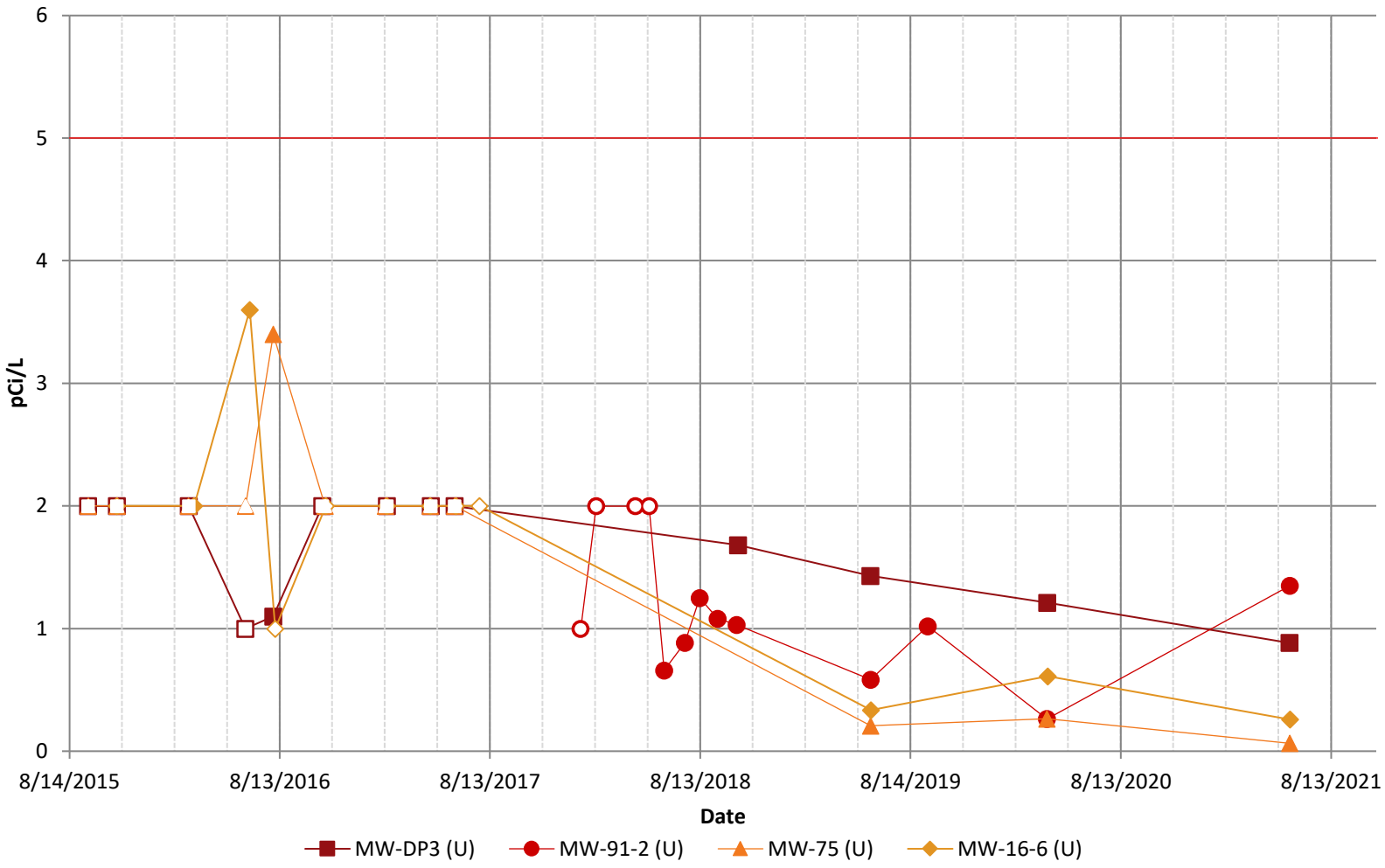
https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/6 - Water Quality/Time Series/[TimeSeries - UR 91 - Up Only - AppIV Only.xlsm]UR91-15



Non-detects are plotted at the practical quantitation limit with an open symbol.

Figure UR91-15

Groundwater Radium 226 + Radium 228 Concentrations

Great River Energy - Coal Creek Station

Upstream Raise 91 Upgradient Groundwater Analysis

FINAL

11/24/2021

Denver, Colorado, USA

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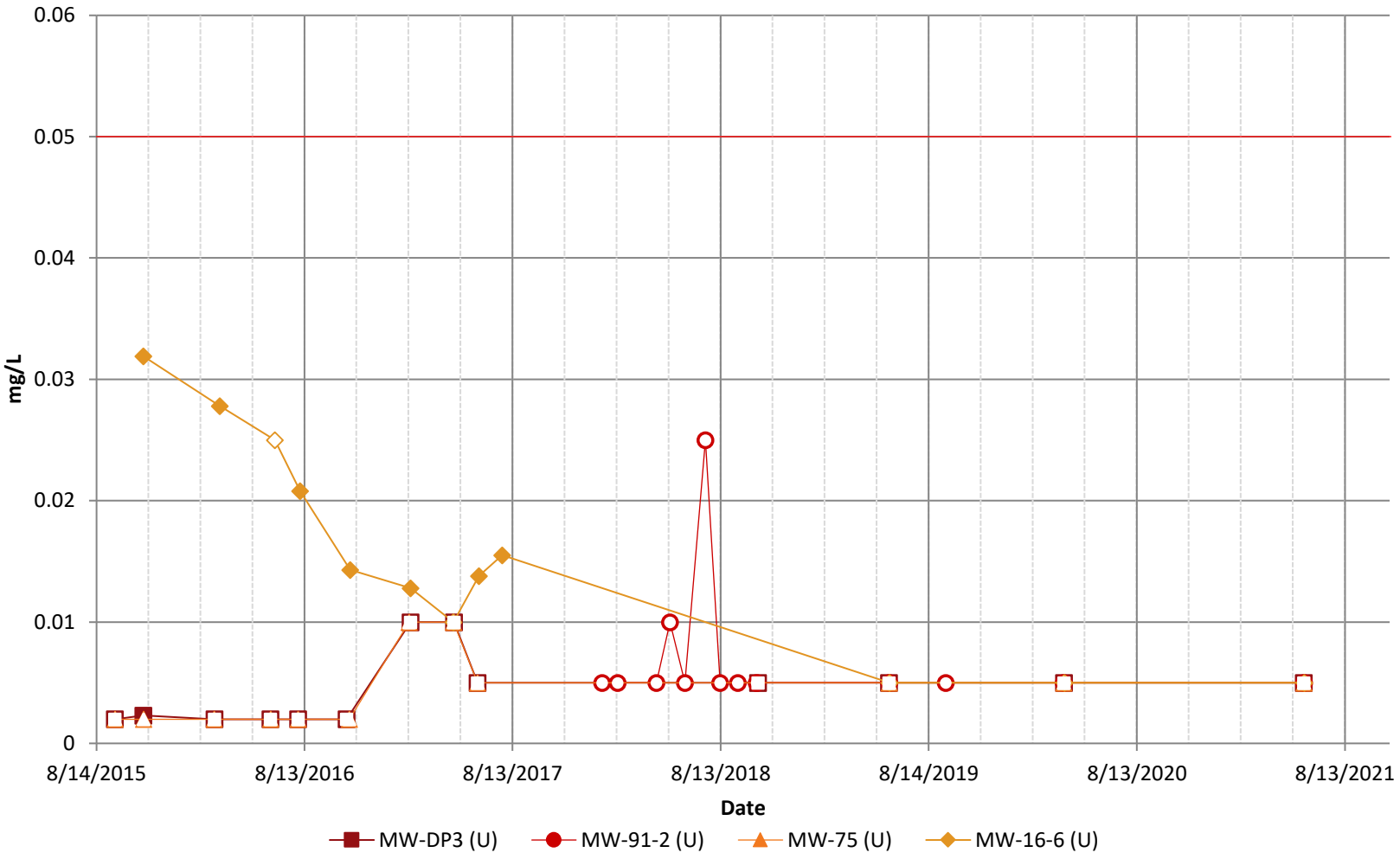
https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/6 - Water Quality/Time Series/[TimeSeries - UR 91 - Up Only - AppIV Only.xlsm]UR91-16



Non-detects are plotted at the practical quantitation limit with an open symbol.

Figure UR91-16

Groundwater Selenium Concentrations

Great River Energy - Coal Creek Station

Upstream Raise 91 Upgradient Groundwater Analysis

FINAL

11/24/2021

Denver, Colorado, USA

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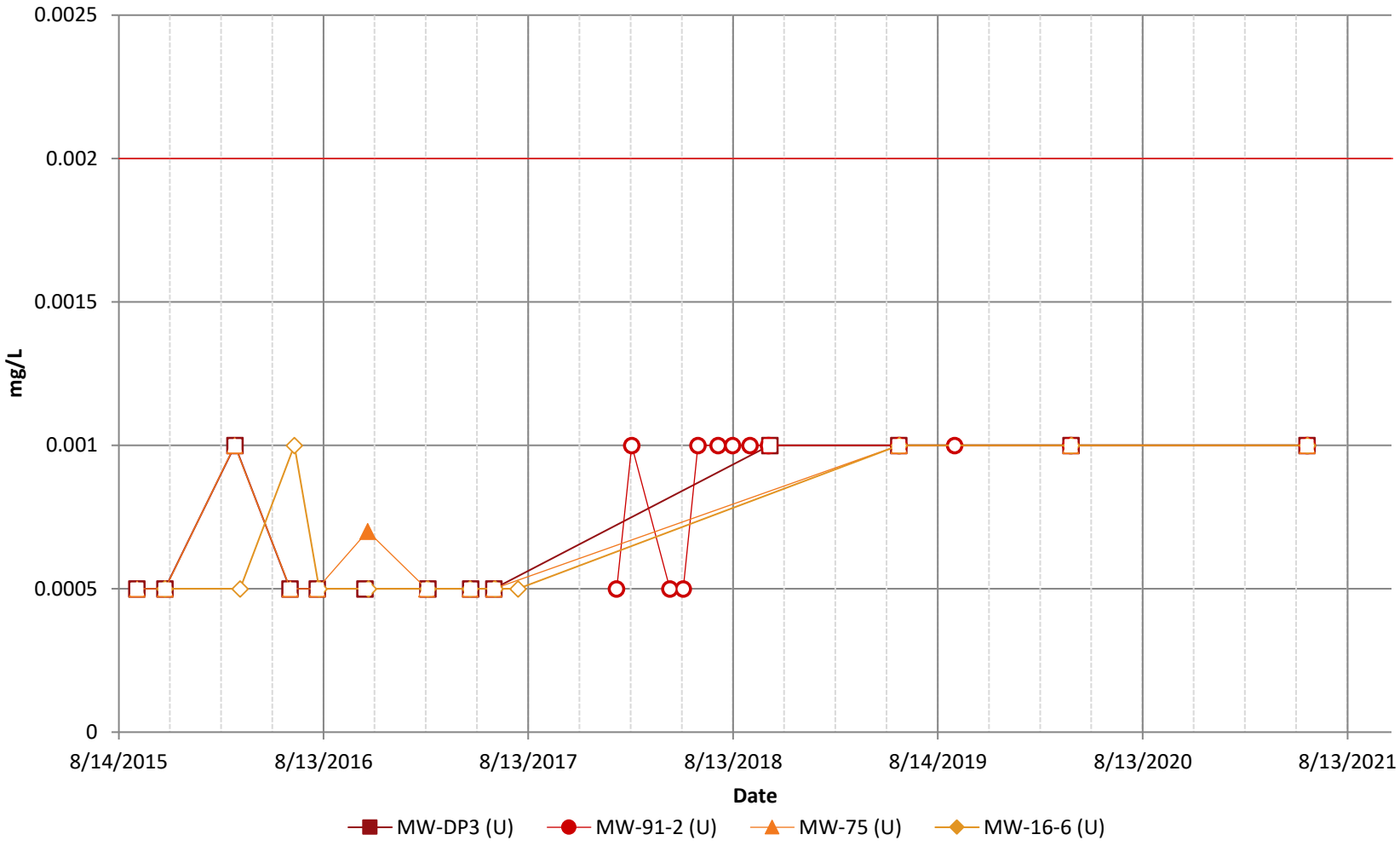
https://golderassociates.sharepoint.com/sites/140044/Project Files/5 Technical Work/6 - Water Quality/Time Series/[TimeSeries - UR 91 - Up Only - AppIV Only.xlsm]UR91-17



Non-detects are plotted at the practical quantitation limit with an open symbol.

Figure UR91-17

Groundwater Thallium Concentrations

Great River Energy - Coal Creek Station

Upstream Raise 91 Upgradient Groundwater Analysis

FINAL

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APPENDIX B-4

Summary Statistics of Upgradient Monitoring Wells

Upstream Raise 91 Upgradient Pooled - MW-DP3, MW-75, MW-91-2, and MW-16-6

Parameter	Units	Primary MCL or Specified RSL	Earliest CCR Sample	Most Recent CCR Sample	Number of Samples	Number of Non-detects	Percent of Non-detects	Min	Max	Mean	Median	Standard Deviation	Which is Greater: MCL or RSL, or MAX?	Baseline Data Distribution	GWPS to be set Using	Type of Tolerance Interval	Site-Specific GWPS Value
Appendix IV																	
Antimony, Total	mg/L	0.006	9/15/2015	6/3/2021	49	47	96%	0.0010	0.0020	0.0014	0.0010	0.0005	MCL or RSL	NA	MCL or RSL	NA	0.006
Arsenic, Total	mg/L	0.01	9/15/2015	6/3/2021	49	40	82%	0.0020	0.0126	0.0039	0.0039	0.0021	MAX	NA	MCL or RSL	NA	0.01
Barium, Total	mg/L	2	9/15/2015	6/3/2021	49	0	0%	0.0272	0.6800	0.0788	0.0488	0.1070	MCL or RSL	Non-Normal	MCL or RSL	NA	2
Beryllium, Total	mg/L	0.004	9/15/2015	6/3/2021	49	47	96%	0.0005	0.0050	0.0011	0.0005	0.0012	MAX	NA	MCL or RSL	NA	0.004
Cadmium, Total	mg/L	0.005	9/15/2015	6/3/2021	49	45	92%	0.0005	0.0014	0.0007	0.0005	0.0003	MCL or RSL	NA	MCL or RSL	NA	0.005
Chromium, Total	mg/L	0.1	9/15/2015	6/3/2021	49	44	90%	0.0020	0.0278	0.0038	0.0020	0.0045	MCL or RSL	NA	MCL or RSL	NA	0.1
Cobalt, Total	mg/L	0.006	9/15/2015	6/3/2021	49	33	67%	0.0010	0.0220	0.0026	0.0020	0.0033	MAX	NA	MCL or RSL	NA	0.006
Fluoride	mg/L	4	9/15/2015	6/3/2021	65	35	54%	0.10	0.99	0.24	0.11	0.21	MCL or RSL	NA	MCL or RSL	NA	4
Lead, Total	mg/L	0.015	9/15/2015	6/3/2021	49	32	65%	0.0005	0.0370	0.0023	0.0010	0.0056	MAX	NA	MCL or RSL	NA	0.015
Lithium, Total	mg/L	0.04	9/15/2015	6/3/2021	49	9	18%	0.035	0.640	0.236	0.160	0.203	MAX	Non-Normal	Tolerance Interval	Non-Parametric	0.640
Mercury, Total	mg/L	0.002	9/15/2015	6/3/2021	49	49	100%	0.0002	0.0002	0.0002	0.0002	0	MCL or RSL	NA	MCL or RSL	NA	0.002
Molybdenum, Total	mg/L	0.1	9/15/2015	6/3/2021	49	39	80%	0.0020	0.0250	0.0044	0.0020	0.0057	MCL or RSL	NA	MCL or RSL	NA	0.1
Radium-226 + Radium-228	pCi/L	5	9/15/2015	6/3/2021	49	27	55%	0.0653	3.60	1.54	2.00	0.76	MCL or RSL	NA	MCL or RSL	NA	5
Selenium, Total	mg/L	0.05	9/15/2015	6/3/2021	49	41	84%	0.0020	0.0319	0.0076	0.0050	0.0073	MCL or RSL	NA	MCL or RSL	NA	0.05
Thallium, Total	mg/L	0.002	9/15/2015	6/3/2021	49	47	96%	0.0005	0.0010	0.0007	0.0005	0.0002	MCL or RSL	NA	MCL or RSL	NA	0.002

Notes:
MCL: EPA Maximum Contaminant Level
RSL: EPA Regional Screening Level
GWPS: Groundwater Protection Standard
NA: Not applicable
Normality was not tested for parameters with greater than 50% non-detects
For summary statistics, non-detect values have been reported at the practical quantitation limit.
Site-specific GWPS are presented for discussion purposes only. In the event of entering assessment monitoring, site-specific GWPS would be formally established.

APPENDIX C

Potential for Infiltration

APPENDIX C-1

Low-Permeability Soil Layer Hydraulic Conductivity Test Results

Table 1: Upstream Raise 91 (Ash Pond 91) Low-Permeability Soil Layer Hydraulic Conductivity Test Results

Sample	Northing (ft)	Easting (ft)	Elevation (ft amsl)	Soil Classification	Hydraulic Conductivity (cm/sec)
CLB-CC-314	37258	40240	1908.1	CH	1.8E-08
CLB-CC-312	37392	40039	1908.4	CH	2.1E-08
CLB-CC-313	37551	39820	1908.7	CH	2.1E-08
CLB-CC-315	37462	40321	1906.4	CH	1.5E-08
CLB-CC-316	37615	40085	1907	CH	4.5E-08
CLB-CC-317	37769	39859	1907	CH	1.5E-08
CLB-CC-318	37610	40413	1905.3	CH	1.4E-08
CLB-CC-320	37734	40211	1905.7	CH	1.1E-08
CLB-CC-325	37315	39973	1909.7	CH	3.4E-08
CLB-CC-326	37180	40330	1908.7	CH	1.5E-08
CLB-CC-327	37335	40463	1907.3	CL	1.9E-08
CLB-CC-328	37387	40190	1908.4	CH	1.7E-08
CLB-CC-329	37422	39979	1909.3	CH	4.6E-08
CLB-CC-330	37622	39849	1908.9	CH	1.4E-08
CLB-CC-331	37573	40097	1908.2	CH	3.7E-08
CLB-CC-332	37526	40337	1907	CH	9.5E-08
CLB-CC-333	37483	40538	1906.4	CH	3.2E-08
CLB-CC-334	37801	39793	1908.4	CH	3.5E-08
CLB-CC-335	37748	40044	1907.5	CH	1.7E-08
CLB-CC-336	37694	40314	1906.4	CH	2.1E-08
CLB-CC-337	37627	40616	1905.1	CL	2.6E-08
CLS-CC-342	38765	40182	1901.3	CL	1.3E-08
CLS-CC-354	38768	40464	1900.9	CL	1.3E-08
CLS-CC-353	38700	41517	1897.5	CL	1.5E-08
CLS-CC-345	38506	41521	1896.8	CL	1.4E-08
CLS-CC-346	38753	41072	1898.5	CL	1.6E-08
CLS-CC-347	38760	40876	1899	CL	1.6E-08
CLS-CC-348	38107	41531	1899.7	CL	1.3E-08
CLS-CC-349	38737	39730	1906.4	CL	2.4E-08
CLS-CC-350	38203	41533	1900.9	CL	1.7E-08
CLS-CC-352	38782	39976	1904.9	CH	1.7E-08
CLS-CC-356	37364	41191	1905	CL	1.0E-08
CLS-CC-357	38768	41169	1900.2	CL	1.0E-08
CLS-CC-358	37595	41397	1904.8	CL	2.9E-08
CLS-CC-359	38587	39725	1910.1	CL	2.3E-08
CLS-CC-360	38781	40561	1906.2	CL	3.7E-08
CLS-CC-361	38783	40474	1908.1	CL	1.2E-08
CLS-CC-362	38784	41471	1905.2	CL	1.3E-08
CLS-CC-364	38676	39706	1914.2	CL	2.4E-08
CLS-CC-365	38598	41552	1909.3	CL	1.3E-08
CLS-CC-366	38400	41556	1909.8	CL	3.0E-08
CLS-CC-367	38777	41376	1906.5	CL	2.4E-08
CLS-CC-369	37726	41533	1911.9	CL	1.0E-08
CLS-CC-371	38001	41572	1916.2	CL	1.0E-08
CLB-CC-392	37258	40993	1904.2	CL	1.5E-08
CLB-CC-393	37412	41139	1902.7	CL	2.7E-08
CLB-CC-394	37364	40927	1904.2	CL	1.1E-08
CLB-CC-395	37493	41045	1902.9	CL	1.1E-08

Table 1: Upstream Raise 91 (Ash Pond 91) Low-Permeability Soil Layer Hydraulic Conductivity Test Results

Sample	Northing (ft)	Easting (ft)	Elevation (ft amsl)	Soil Classification	Hydraulic Conductivity (cm/sec)
CLB-CC-396	37972	40399	1903.3	CL	1.4E-08
CLB-CC-397	38025	40104	1904.6	CL	2.3E-08
CLB-CC-398	38061	39856	1905.9	CL	2.3E-08
CLB-CC-399	37209	40596	1907	CL	1.6E-08
CLB-CC-400	37375	40731	1905.4	CL	1.5E-08
CLB-CC-401	37556	40853	1903.9	CL	1.4E-08
CLB-CC-402	37830	40000	1906.4	CL	3.1E-08
CLB-CC-403	37950	39800	1906.6	CL	1.4E-08
CLB-CC-407	37432	41294	1913.9	CL	1.7E-08
CLB-CC-408	37200	41077	1915.5	CL	1.6E-08
CLB-CC-411	37160	40581	1907.7	CL	2.5E-08
CLB-CC-423	37325	40670	1906.4	SC	2.6E-08
CLB-CC-413	37516	40775	1904.9	CL	1.5E-08
CLB-CC-414	37144	40783	1906.8	CL	1.5E-08
CLB-CC-424	37299	40861	1905.9	CL	1.2E-08
CLB-CC-425	37438	40932	1904.5	CL	1.4E-08
CLB-CC-417	37600	41010	1903.4	CL	9.4E-09
CLB-CC-418	37190	40965	1905.8	CL	1.0E-08
CLB-CC-419	37337	41070	1904.5	CL	1.0E-08
CLB-CC-420	37484	41175	1903.3	CL	1.7E-08
CLB-CC-430	37995	40833	1901.1	CL	1.6E-08
CLB-CC-431	37963	41018	1900.7	CL	1.6E-08
CLB-CC-432	37910	41240	1899.5	CL	1.7E-08
CLB-CC-433	37865	41450	1898.8	CL	1.6E-08
CLB-CC-434	38115	40708	1901.3	CL	2.6E-08
CLB-CC-435	38157	40503	1902.4	CL	1.7E-08
CLB-CC-436	38192	40278	1903.5	CL	1.8E-08
CLB-CC-437	38227	40077	1903.9	CL	1.0E-08
CLB-CC-438	38264	39851	1904.9	CL	2.6E-08
CLB-CC-439	38260	40736	1900	CL	1.2E-08
CLB-CC-440	38288	40543	1901.3	CL	1.5E-08
CLB-CC-441	38322	40332	1902.3	CL	1.8E-08
CLB-CC-442	38353	40125	1903.2	CL	1.5E-08
CLB-CC-443	38391	39895	1904	CL	8.2E-09
CLB-CC-444	37664	41338	1900.3	CL	2.2E-08
CLB-CC-445	37700	41169	1901	CL	3.1E-08
CLB-CC-446	37746	40951	1901.7	CL	1.3E-08
CLB-CC-447	38550	39818	1903.7	CL	1.6E-08
CLB-CC-448	38518	40018	1903.1	CL	1.8E-08
CLB-CC-449	38479	40225	1902.2	CL	1.1E-08
CLB-CC-450	38431	40459	1901.3	CL	1.0E-08
CLB-CC-451	38381	40701	1900.2	CL	1.3E-08
CLB-CC-453	38192	39823	1906.6	CL	1.5E-08
CLB-CC-454	38157	40016	1905.8	CL	1.5E-08
CLB-CC-455	38118	40188	1905	CL	1.2E-08
CLB-CC-456	38079	40385	1904.4	CL	1.9E-08
CLB-CC-457	38040	40587	1904.4	CL	1.4E-08
CLB-CC-458	38136	40645	1902.7	CL	2.6E-08

Table 1: Upstream Raise 91 (Ash Pond 91) Low-Permeability Soil Layer Hydraulic Conductivity Test Results

Sample	Northing (ft)	Easting (ft)	Elevation (ft amsl)	Soil Classification	Hydraulic Conductivity (cm/sec)
CLB-CC-459	38184	40402	1903.6	CL	4.7E-08
CLB-CC-460	38220	40218	1904.4	CL	1.7E-08
CLB-CC-461	38258	40044	1905.2	CL	1.5E-08
CLB-CC-462	38295	39831	1905.9	CL	2.4E-08
CLB-CC-463	38411	39832	1905.2	CL	1.3E-08
CLB-CC-464	38369	40060	1904.4	CL	1.2E-08
CLB-CC-465	38332	40235	1903.7	CL	1.4E-08
CLB-CC-466	38293	40430	1902.8	CL	3.4E-08
CLB-CC-467	38242	40671	1901.9	CL	5.6E-08
CLB-CC-468	37582	41284	1902.3	CL	1.2E-08
CLB-CC-469	37626	41076	1903.1	CL	1.7E-08
CLB-CC-470	37651	40870	1904.1	CL	9.3E-09
CLB-CC-471	37676	40644	1904.9	CL	3.2E-08
CLB-CC-472	37888	40690	1903.7	CL	2.5E-08
CLB-CC-473	38761	40887	1903	CL	2.4E-08
CLB-CC-474	37831	41087	1902.1	CL	1.2E-08
CLB-CC-475	37792	41303	1901.2	CL	1.1E-08
CLB-CC-476	37760	41460	1900.6	CL	1.2E-08
CLB-CC-477	38020	40724	1902.9	CL	1.4E-08
CLB-CC-478	37993	40902	1902.3	CL	1.6E-08
CLB-CC-479	37960	41119	1901.4	CL	1.4E-08
CLB-CC-480	37922	41333	1900.3	CL	1.5E-08
CLB-CC-481	37896	41466	1899.9	CL	1.5E-08
CLB-CC-496	38707	39840	1903.1	CL	4.2E-08
CLB-CC-494	38692	40044	1902.3	CL	3.3E-08
CLB-CC-497	38692	40044	1902.3	CL	4.2E-08
CLB-CC-498	38671	40233	1901.1	CL	4.3E-08
CLB-CC-502	38177	40802	1900.4	CL	2.0E-08
CLB-CC-503	38140	41032	1899.6	CL	2.2E-08
CLB-CC-504	38106	41242	1898.5	SC	2.5E-08
CLB-CC-505	38088	41425	1897.8	CL	2.5E-08
CLB-CC-506	38470	40184	1903.2	CL	9.1E-09
CLB-CC-518	38504	40006	1903.8	CL	1.1E-08
CLB-CC-508	38543	39797	1904.8	CL	2.3E-08
CLB-CC-509	38647	39806	1904.3	CL	6.7E-08
CLB-CC-510	38613	39990	1903.4	SC	2.0E-08
CLB-CC-511	38584	40176	1902.7	CL	1.0E-07
CLB-CC-512	38567	40518	1900	CL	9.0E-09
CLB-CC-513	38542	40701	1899	CL	3.5E-08
CLB-CC-514	38334	40761	1900	CL	1.8E-08
CLB-CC-515	38309	40956	1898.9	CL	7.9E-09
CLB-CC-516	38283	41112	1898.4	CL	1.9E-08
CLB-CC-517	38253	41287	1897.6	CL	1.1E-08
CLB-CC-519	38450	41412	1896	CL	2.1E-08
CLB-CC-520	38477	41204	1897	CL	1.3E-08
CLB-CC-521	38496	41029	1897.7	CL	1.2E-08
CLB-CC-522	38520	40833	1898.5	CL	8.6E-09
CLB-CC-523	38681	40655	1898.7	SC	3.6E-08

Table 1: Upstream Raise 91 (Ash Pond 91) Low-Permeability Soil Layer Hydraulic Conductivity Test Results

Sample	Northing (ft)	Easting (ft)	Elevation (ft amsl)	Soil Classification	Hydraulic Conductivity (cm/sec)
CLB-CC-524	38670	40791	1898.1	CL	1.4E-08
CLB-CC-525	38652	40980	1897.1	CL	1.1E-08
CLB-CC-526	38653	41158	1896.4	CL	4.8E-09
CLB-CC-527	38619	41340	1895.4	CL	1.2E-08
CLB-CC-533	38509	40197	1903.4	CL	1.5E-08
CLB-CC-534	38474	40419	1902.3	CL	1.8E-08
CLB-CC-535	38431	40626	1901.5	CL	1.3E-08
CLB-CC-536	38391	40844	1900.6	CL	1.6E-08
CLB-CC-537	38356	41054	1899.7	CL	1.5E-08
CLB-CC-538	38322	41252	1898.9	CL	2.6E-08
CLB-CC-539	38294	41436	1898.3	CL	1.1E-08
CLB-CC-540	38177	40733	1902.1	CL	1.9E-08
CLB-CC-541	38144	40930	1901.3	CL	7.4E-09
CLB-CC-542	38114	41132	1900.5	CL	8.2E-09
CLB-CC-543	38082	41346	1899.6	CL	1.1E-08
CLB-CC-544	38492	41401	1896.4	CL	1.7E-08
CLB-CC-545	38512	41211	1898.1	CL	8.3E-09
CLB-CC-546	38548	41001	1898.9	CL	1.5E-08
CLB-CC-547	38577	40790	1900	CL	1.5E-08
CLB-CC-548	38609	40570	1900.7	CL	9.6E-09
CLB-CC-549	38636	40360	1901.7	CL	1.6E-08
CLB-CC-550	38659	40181	1902.3	CL	8.4E-09
CLB-CC-551	38699	41202	1897.2	CL	1.3E-08
CLB-CC-552	38708	40966	1898.4	CL	1.2E-08
CLB-CC-553	38726	40728	1899.4	CL	1.8E-08
CLB-CC-554	38736	40515	1900.5	CL	1.0E-08
				Geometric Mean	1.7E-08

Notes:

Hydraulic conductivity tests performed on undisturbed samples collected from the liner in Shelby tubes.

Hydraulic conductivity results from falling head tests performed by Braun Intertec.

Reference: Cooperative Power Association, 1993 "Final Construction Report, Evaporation Pond 93 and Ash Pond 91"

APPENDIX C-2

Sump Liquid Chemistry Laboratory Results

eurofins | Environment Testing America

ANALYTICAL REPORT

Eurofins TestAmerica, Denver
4955 Yarrow Street
Arvada, CO 80002
Tel: (303)736-0100

Laboratory Job ID: 280-152116-1
Client Project/Site: Coal Creek Station - CCR - Appendix IV

For:
Great River Energy
12300 Elm Creek Blvd
Maple Grove, Minnesota 55369

Attn: David Christianson

Authorized for release by:
9/7/2021 11:12:33 AM

Dylan Bieniulis, Project Manager I
(303)736-0138
Dylan.Bieniulis@Eurofinset.com

LINKS

Review your project results through TotalAccess

Have a Question? Ask The Expert

Visit us at: www.eurofinsus.com/Env

The test results in this report meet all 2003 NELAC, 2009 TNI, and 2016 TNI requirements for accredited parameters, exceptions are noted in this report. This report may not be reproduced except in full, and with written approval from the laboratory. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

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Definitions/Glossary

Client: Great River Energy
Job ID: 280-152116-1
Project/Site: Coal Creek Station - CCR - Appendix IV

Qualifiers

Metals

Qualifier	Qualifier Description
4	MS, MSD: The analyte present in the original sample is greater than 4 times the matrix spike concentration; therefore, control limits are not applicable.

General Chemistry

Qualifier	Qualifier Description
HF	Field parameter with a holding time of 15 minutes. Test performed by laboratory at client's request.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Job ID: 280-152116-1

Laboratory: Eurofins TestAmerica, Denver

Narrative

CASE NARRATIVE

Client: Great River Energy

Project: Coal Creek Station - CCR - Appendix IV

Report Number: 280-152116-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

RECEIPT

The samples were received on 08/20/2021; the samples arrived in good condition, properly preserved and on ice. The temperature of the coolers at receipt was 4.1 C.

The requested radiochemistry analyses are reported under report number 280-152116-2. All other requested analyses are repor under report number 280-152116-1.

TOTAL METALS (ICP)

Sample SUMP-UR91 (280-152116-1) was analyzed for Total Metals (ICP) in accordance with EPA SW846 6010D. The samples were prepared on 08/27/2021 and analyzed on 08/27/2021 and 08/30/2021.

Boron failed the recovery criteria high, and Sodium failed the recovery criteria low for the MS of sample SUMP-UR91 (280-152116-1) in batch 280-548277. Sodium failed the recovery criteria high, and Boron and Calcium failed the recovery criteria low for the MSD of sample SUMP-UR91 (280-152116-1) in batch 280-548277. Refer to the QC report for details.

The presence of the '4' qualifier indicates analytes where the concentration in the unspiked sample exceeded four times the spiking amount. Refer to the QC report for details.

Sample SUMP-UR91 (280-152116-1)[10X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

TOTAL RECOVERABLE METALS (ICPMS)

Sample SUMP-UR91 (280-152116-1) was analyzed for total recoverable metals (ICPMS) in accordance with EPA SW-846 Method 6020A. The samples were prepared on 08/27/2021 and analyzed on 08/30/2021 and 08/31/2021.

The presence of the '4' qualifier indicates analytes where the concentration in the unspiked sample exceeded four times the spiking amount. Refer to the QC report for details.

Sample SUMP-UR91 (280-152116-1)[5X] required dilution prior to analysis due to the nature of the sample matrix. The reporting limits have been adjusted accordingly.

Job ID: 280-152116-1 (Continued)

Laboratory: Eurofins TestAmerica, Denver (Continued)

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

TOTAL MERCURY
Sample SUMP-UR91 (280-152116-1) was analyzed for total mercury in accordance with EPA SW-846 Methods 7470A. The samples were prepared and analyzed on 08/21/2021.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

ALKALINITY
Sample SUMP-UR91 (280-152116-1) was analyzed for Alkalinity in accordance with SM20 2320B. The samples were analyzed on 08/24/2021.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

TOTAL DISSOLVED SOLIDS
Sample SUMP-UR91 (280-152116-1) was analyzed for total dissolved solids in accordance with SM20 2540C. The samples were analyzed on 08/26/2021.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

FLUORIDE
Sample SUMP-UR91 (280-152116-1) was analyzed for fluoride in accordance with SM20 4500 F C. The samples were analyzed on 08/26/2021.

Sample SUMP-UR91 (280-152116-1)[2X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

CORROSIVITY (PH)
Sample SUMP-UR91 (280-152116-1) was analyzed for corrosivity (pH) in accordance with EPA SW-846 Method 9040B. The samples were analyzed on 08/24/2021.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

ANIONS (28 DAYS)
Sample SUMP-UR91 (280-152116-1) was analyzed for anions (28 days) in accordance with EPA SW-846 Method 9056A (28 Days). The samples were analyzed on 08/28/2021 and 09/02/2021.

Samples SUMP-UR91 (280-152116-1)[10X] and SUMP-UR91 (280-152116-1)[50X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Detection Summary

Client: Great River Energy
Job ID: 280-152116-1
Project/Site: Coal Creek Station - CCR - Appendix IV

Client Sample ID: SUMP-UR91 — Lab Sample ID: 280-152116-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Boron	29000		100		ug/L	1		6010D	Total/NA
Calcium	500000		200		ug/L	1		6010D	Total/NA
Iron	740		100		ug/L	1		6010D	Total/NA
Lithium	450		20		ug/L	1		6010D	Total/NA
Magnesium	200000		200		ug/L	1		6010D	Total/NA
Potassium	280000		3000		ug/L	1		6010D	Total/NA
Sodium	2200000		10000		ug/L	10		6010D	Total/NA
Antimony	0.014		0.010		mg/L	5		6020A	Total Recoverable
Arsenic	0.027		0.0050		mg/L	1		6020A	Total Recoverable
Barium	0.10		0.0010		mg/L	1		6020A	Total Recoverable
Chromium	0.0022		0.0020		mg/L	1		6020A	Total Recoverable
Molybdenum	0.28		0.0020		mg/L	1		6020A	Total Recoverable
Selenium	0.0058		0.0050		mg/L	1		6020A	Total Recoverable
pH adj. to 25 deg C	8.7	HF	0.1		SU	1		9040B	Total/NA
Temperature	18.0	HF	1.0		Degrees C	1		9040B	Total/NA
Chloride	900		30		mg/L	10		9056A	Total/NA
Sulfate	7100		250		mg/L	50		9056A	Total/NA
Alkalinity	130		10		mg/L	1		SM 2320B	Total/NA
Bicarbonate Alkalinity as CaCO3	79		10		mg/L	1		SM 2320B	Total/NA
Carbonate Alkalinity as CaCO3	54		10		mg/L	1		SM 2320B	Total/NA
Total Dissolved Solids (TDS)	12000		200		mg/L	1		SM 2540C	Total/NA
Fluoride	2.8		0.20		mg/L	2		SM 4500 F C	Total/NA

This Detection Summary does not include radiochemical test results.

Method Summary

Client: Great River Energy
Job ID: 280-152116-1
Project/Site: Coal Creek Station - CCR - Appendix IV

Method	Method Description	Protocol	Laboratory
6010D	Metals (ICP)	SW846	TAL DEN
6020A	Metals (ICP/MS)	SW846	TAL DEN
7470A	Mercury (CVAA)	SW846	TAL DEN
9040B	pH	SW846	TAL DEN
9056A	Anions, Ion Chromatography	SW846	TAL DEN
SM 2320B	Alkalinity	SM	TAL DEN
SM 2540C	Solids, Total Dissolved (TDS)	SM	TAL DEN
SM 4500 F C	Fluoride	SM	XEN CC
3005A	Preparation, Total Recoverable or Dissolved Metals	SW846	TAL DEN
3010A	Preparation, Total Metals	SW846	TAL DEN
7470A	Preparation, Mercury	SW846	TAL DEN

Protocol References:

SM = "Standard Methods For The Examination Of Water And Wastewater"

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL DEN = Eurofins TestAmerica, Denver, 4955 Yarrow Street, Arvada, CO 80002, TEL (303)736-0100

XEN CC = Eurofins Xenco, Corpus Christi, 1733 N. Padre Island Drive, Corpus Christi, TX 78408, TEL (361)289-2471

Sample Summary

Client: Great River Energy
Project/Site: Coal Creek Station - CCR - Appendix IV

Job ID: 280-152116-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
280-152116-1	SUMP-UR91	Water	08/19/21 11:10	08/20/21 09:35

Method: 6010D - Metals (ICP)

Client Sample ID: SUMP-UR91
Date Collected: 08/19/21 11:10
Date Received: 08/20/21 09:35
Lab Sample ID: 280-152116-1
Matrix: Water

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	29000		100		ug/L		08/27/21 08:28	08/27/21 17:33	1
Calcium	500000		200		ug/L		08/27/21 08:28	08/27/21 17:33	1
Iron	740		100		ug/L		08/27/21 08:28	08/27/21 17:33	1
Lithium	450		20		ug/L		08/27/21 08:28	08/27/21 17:33	1
Magnesium	200000		200		ug/L		08/27/21 08:28	08/27/21 17:33	1
Potassium	280000		3000		ug/L		08/27/21 08:28	08/27/21 17:33	1
Sodium	2200000		10000		ug/L		08/27/21 08:28	08/30/21 15:53	10

Method: 6020A - Metals (ICP/MS) - Total Recoverable

Client Sample ID: SUMP-UR91
Date Collected: 08/19/21 11:10
Date Received: 08/20/21 09:35
Lab Sample ID: 280-152116-1
Matrix: Water

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	0.014		0.010		mg/L		08/27/21 08:28	08/31/21 15:30	5
Arsenic	0.027		0.0050		mg/L		08/27/21 08:28	08/30/21 13:31	1
Barium	0.10		0.0010		mg/L		08/27/21 08:28	08/30/21 13:31	1
Beryllium	ND		0.0010		mg/L		08/27/21 08:28	08/30/21 13:31	1
Cadmium	ND		0.0010		mg/L		08/27/21 08:28	08/30/21 13:31	1
Chromium	0.0022		0.0020		mg/L		08/27/21 08:28	08/30/21 13:31	1
Cobalt	ND		0.0010		mg/L		08/27/21 08:28	08/30/21 13:31	1
Lead	ND		0.0010		mg/L		08/27/21 08:28	08/30/21 13:31	1
Molybdenum	0.28		0.0020		mg/L		08/27/21 08:28	08/30/21 13:31	1
Selenium	0.0058		0.0050		mg/L		08/27/21 08:28	08/30/21 13:31	1
Thallium	ND		0.0010		mg/L		08/27/21 08:28	08/30/21 13:31	1

Method: 7470A - Mercury (CVAA)

Client Sample ID: SUMP-UR91
Date Collected: 08/19/21 11:10
Date Received: 08/20/21 09:35
Lab Sample ID: 280-152116-1
Matrix: Water

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.20		ug/L		08/21/21 15:50	08/21/21 20:36	1

General Chemistry

Client Sample ID: SUMP-UR91
Date Collected: 08/19/21 11:10
Date Received: 08/20/21 09:35
Lab Sample ID: 280-152116-1
Matrix: Water

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
pH adj. to 25 deg C	8.7	HF	0.1		SU			08/24/21 13:43	1
Temperature	18.0	HF	1.0		Degrees C			08/24/21 13:43	1
Chloride	900		30		mg/L			08/28/21 14:47	10
Sulfate	7100		250		mg/L			09/02/21 16:17	50
Alkalinity	130		10		mg/L			08/24/21 14:45	1
Bicarbonate Alkalinity as CaCO3	79		10		mg/L			08/24/21 14:45	1
Carbonate Alkalinity as CaCO3	54		10		mg/L			08/24/21 14:45	1
Total Dissolved Solids (TDS)	12000		200		mg/L			08/26/21 16:34	1
Fluoride	2.8		0.20		mg/L			08/26/21 10:06	2

Method: 6010D - Metals (ICP)

Lab Sample ID: MB 280-547793/1-A
Matrix: Water
Analysis Batch: 548122

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 547793

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Boron	ND		100		ug/L		08/27/21 08:28	08/27/21 17:27	1
Calcium	ND		200		ug/L		08/27/21 08:28	08/27/21 17:27	1
Iron	ND		100		ug/L		08/27/21 08:28	08/27/21 17:27	1
Lithium	ND		20		ug/L		08/27/21 08:28	08/27/21 17:27	1
Magnesium	ND		200		ug/L		08/27/21 08:28	08/27/21 17:27	1
Potassium	ND		3000		ug/L		08/27/21 08:28	08/27/21 17:27	1
Sodium	ND		1000		ug/L		08/27/21 08:28	08/27/21 17:27	1

Lab Sample ID: LCS 280-547793/2-A
Matrix: Water
Analysis Batch: 548122

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 547793

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Boron	1000	990		ug/L		99	86 - 110
Calcium	50000	50200		ug/L		100	90 - 111
Iron	10000	10100		ug/L		101	89 - 115
Lithium	1000	952		ug/L		95	90 - 112
Magnesium	50000	49600		ug/L		99	90 - 113
Potassium	50000	49200		ug/L		98	89 - 114
Sodium	50000	51800		ug/L		104	90 - 115

Lab Sample ID: 280-152116-1 MS
Matrix: Water
Analysis Batch: 548122

Client Sample ID: SUMP-UR91
Prep Type: Total/NA
Prep Batch: 547793

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Boron	29000		1000	29900	4	ug/L		117	87 - 113
Calcium	500000		50000	536000	4	ug/L		77	75 - 125
Iron	740		10000	10600		ug/L		99	75 - 125
Lithium	450		1000	1530		ug/L		109	89 - 114
Magnesium	200000		50000	247000		ug/L		96	75 - 125
Potassium	280000		50000	331000	4	ug/L		108	76 - 125

Lab Sample ID: 280-152116-1 MS
Matrix: Water
Analysis Batch: 548277

Client Sample ID: SUMP-UR91
Prep Type: Total/NA
Prep Batch: 547793

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Sodium	2200000		50000	2220000	4	ug/L		9	75 - 125

Lab Sample ID: 280-152116-1 MSD
Matrix: Water
Analysis Batch: 548122

Client Sample ID: SUMP-UR91
Prep Type: Total/NA
Prep Batch: 547793

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Boron	29000		1000	28800	4	ug/L		10	87 - 113	4	20
Calcium	500000		50000	521000	4	ug/L		47	75 - 125	3	20
Iron	740		10000	10300		ug/L		95	75 - 125	3	20
Lithium	450		1000	1490		ug/L		104	89 - 114	3	20

Method: 6010D - Metals (ICP) (Continued)

Lab Sample ID: 280-152116-1 MSD
Matrix: Water
Analysis Batch: 548122

Client Sample ID: SUMP-UR91
Prep Type: Total/NA
Prep Batch: 547793

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Magnesium	200000		50000	239000		ug/L		80	75 - 125	3	20
Potassium	280000		50000	320000	4	ug/L		85	76 - 125	3	20

Lab Sample ID: 280-152116-1 MSD
Matrix: Water
Analysis Batch: 548277

Client Sample ID: SUMP-UR91
Prep Type: Total/NA
Prep Batch: 547793

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Sodium	2200000		50000	2290000	4	ug/L		158	75 - 125	3	20

Method: 6020A - Metals (ICP/MS)

Lab Sample ID: MB 280-547788/1-A
Matrix: Water
Analysis Batch: 548253

Client Sample ID: Method Blank
Prep Type: Total Recoverable
Prep Batch: 547788

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.0050		mg/L		08/27/21 08:28	08/30/21 13:23	1
Barium	ND		0.0010		mg/L		08/27/21 08:28	08/30/21 13:23	1
Beryllium	ND		0.0010		mg/L		08/27/21 08:28	08/30/21 13:23	1
Cadmium	ND		0.0010		mg/L		08/27/21 08:28	08/30/21 13:23	1
Chromium	ND		0.0020		mg/L		08/27/21 08:28	08/30/21 13:23	1
Cobalt	ND		0.0010		mg/L		08/27/21 08:28	08/30/21 13:23	1
Lead	ND		0.0010		mg/L		08/27/21 08:28	08/30/21 13:23	1
Molybdenum	ND		0.0020		mg/L		08/27/21 08:28	08/30/21 13:23	1
Selenium	ND		0.0050		mg/L		08/27/21 08:28	08/30/21 13:23	1
Thallium	ND		0.0010		mg/L		08/27/21 08:28	08/30/21 13:23	1

Lab Sample ID: MB 280-547788/1-A
Matrix: Water
Analysis Batch: 548412

Client Sample ID: Method Blank
Prep Type: Total Recoverable
Prep Batch: 547788

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	ND		0.0020		mg/L		08/27/21 08:28	08/31/21 15:23	1

Lab Sample ID: LCS 280-547788/2-A
Matrix: Water
Analysis Batch: 548253

Client Sample ID: Lab Control Sample
Prep Type: Total Recoverable
Prep Batch: 547788

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Arsenic	0.0400	0.0368		mg/L		92	85 - 117
Barium	0.0400	0.0381		mg/L		95	85 - 118
Beryllium	0.0400	0.0373		mg/L		93	80 - 125
Cadmium	0.0400	0.0371		mg/L		93	85 - 115
Chromium	0.0400	0.0387		mg/L		97	84 - 121
Cobalt	0.0400	0.0381		mg/L		95	85 - 120
Lead	0.0400	0.0377		mg/L		94	85 - 118
Molybdenum	0.0400	0.0376		mg/L		94	85 - 119
Selenium	0.0400	0.0390		mg/L		97	77 - 122
Thallium	0.0400	0.0372		mg/L		93	85 - 118

Method: 6020A - Metals (ICP/MS)

Lab Sample ID: LCS 280-547788/2-A
Matrix: Water
Analysis Batch: 548412

Client Sample ID: Lab Control Sample
Prep Type: Total Recoverable
Prep Batch: 547788

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	0.0400	0.0345		mg/L		86	85 - 115

Lab Sample ID: 280-152116-1 MS
Matrix: Water
Analysis Batch: 548253

Client Sample ID: SUMP-UR91
Prep Type: Total Recoverable
Prep Batch: 547788

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Arsenic	0.027		0.0400	0.0642		mg/L		94	85 - 117
Barium	0.10		0.0400	0.144		mg/L		100	85 - 118
Beryllium	ND		0.0400	0.0454		mg/L		113	80 - 125
Cadmium	ND		0.0400	0.0363		mg/L		91	85 - 115
Chromium	0.0022		0.0400	0.0394		mg/L		93	84 - 121
Cobalt	ND		0.0400	0.0370		mg/L		91	85 - 120
Lead	ND		0.0400	0.0362		mg/L		89	85 - 118
Molybdenum	0.28		0.0400	0.324	4	mg/L		100	85 - 119
Selenium	0.0058		0.0400	0.0474		mg/L		104	77 - 122
Thallium	ND		0.0400	0.0344		mg/L		86	85 - 118

Lab Sample ID: 280-152116-1 MS
Matrix: Water
Analysis Batch: 548412

Client Sample ID: SUMP-UR91
Prep Type: Total Recoverable
Prep Batch: 547788

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	0.014		0.0400	0.0525		mg/L		97	85 - 115

Lab Sample ID: 280-152116-1 MSD
Matrix: Water
Analysis Batch: 548253

Client Sample ID: SUMP-UR91
Prep Type: Total Recoverable
Prep Batch: 547788

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Arsenic	0.027		0.0400	0.0666		mg/L		100	85 - 117	4	20
Barium	0.10		0.0400	0.144		mg/L		101	85 - 118	0	20
Beryllium	ND		0.0400	0.0467		mg/L		116	80 - 125	3	20
Cadmium	ND		0.0400	0.0360		mg/L		90	85 - 115	1	20
Chromium	0.0022		0.0400	0.0400		mg/L		95	84 - 121	2	20
Cobalt	ND		0.0400	0.0377		mg/L		93	85 - 120	2	20
Lead	ND		0.0400	0.0364		mg/L		90	85 - 118	1	20
Molybdenum	0.28		0.0400	0.322	4	mg/L		95	85 - 119	1	20
Selenium	0.0058		0.0400	0.0476		mg/L		104	77 - 122	0	20
Thallium	ND		0.0400	0.0348		mg/L		87	85 - 118	1	20

Lab Sample ID: 280-152116-1 MSD
Matrix: Water
Analysis Batch: 548412

Client Sample ID: SUMP-UR91
Prep Type: Total Recoverable
Prep Batch: 547788

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Antimony	0.014		0.0400	0.0516		mg/L		95	85 - 115	2	20

Method: 7470A - Mercury (CVAA)

Lab Sample ID: MB 280-547261/1-A
Matrix: Water
Analysis Batch: 547322

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 547261

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.20		ug/L		08/21/21 15:50	08/21/21 19:47	1

Lab Sample ID: LCS 280-547261/2-A
Matrix: Water
Analysis Batch: 547322

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 547261

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	5.00	5.01		ug/L		100	84 - 120

Lab Sample ID: LCSD 280-547261/3-A
Matrix: Water
Analysis Batch: 547322

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 547261

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Mercury	5.00	4.77		ug/L		95	84 - 120	5	15

Method: 9040B - pH

Lab Sample ID: LCS 280-547621/4
Matrix: Water
Analysis Batch: 547621

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
pH adj. to 25 deg C	7.00	7.0		SU		100	99 - 101

Method: 9056A - Anions, Ion Chromatography

Lab Sample ID: MB 280-547961/6
Matrix: Water
Analysis Batch: 547961

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	ND		3.0		mg/L			08/27/21 11:05	1
Sulfate	ND		5.0		mg/L			08/27/21 11:05	1

Lab Sample ID: LCS 280-547961/4
Matrix: Water
Analysis Batch: 547961

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	100	97.8		mg/L		98	90 - 110
Sulfate	100	98.9		mg/L		99	90 - 110

Lab Sample ID: LCSD 280-547961/5
Matrix: Water
Analysis Batch: 547961

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Chloride	100	97.8		mg/L		98	90 - 110	0	10
Sulfate	100	98.9		mg/L		99	90 - 110	0	10

Method: 9056A - Anions, Ion Chromatography (Continued)

Lab Sample ID: MRL 280-547961/3
Matrix: Water
Analysis Batch: 547961

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	5.00	4.78		mg/L		96	50 - 150
Sulfate	5.00	ND		mg/L		95	50 - 150

Lab Sample ID: MB 280-548093/6
Matrix: Water
Analysis Batch: 548093

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	ND		3.0		mg/L			08/28/21 11:35	1

Lab Sample ID: LCS 280-548093/4
Matrix: Water
Analysis Batch: 548093

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	100	97.7		mg/L		98	90 - 110

Lab Sample ID: LCSD 280-548093/5
Matrix: Water
Analysis Batch: 548093

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Chloride	100	97.8		mg/L		98	90 - 110	0	10

Lab Sample ID: MRL 280-548093/3
Matrix: Water
Analysis Batch: 548093

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	5.00	4.88		mg/L		98	50 - 150

Lab Sample ID: 280-152116-1 MS
Matrix: Water
Analysis Batch: 548093

Client Sample ID: SUMP-UR91
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Chloride	900		500	1380		mg/L		97	80 - 120

Lab Sample ID: 280-152116-1 MSD
Matrix: Water
Analysis Batch: 548093

Client Sample ID: SUMP-UR91
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Chloride	900		500	1410		mg/L		102	80 - 120	2	20

Method: 9056A - Anions, Ion Chromatography (Continued)

Lab Sample ID: 280-152116-1 DU
Matrix: Water
Analysis Batch: 548093

Client Sample ID: SUMP-UR91
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
Chloride	900			868		mg/L				3	15

Lab Sample ID: MB 280-548604/6
Matrix: Water
Analysis Batch: 548604

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	ND		3.0		mg/L			09/02/21 11:42	1
Sulfate	ND		5.0		mg/L			09/02/21 11:42	1

Lab Sample ID: LCS 280-548604/4
Matrix: Water
Analysis Batch: 548604

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Chloride			100	98.6		mg/L		99	90 - 110		
Sulfate			100	100		mg/L		100	90 - 110		

Lab Sample ID: LCSD 280-548604/5
Matrix: Water
Analysis Batch: 548604

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Chloride			100	98.5		mg/L		98	90 - 110	0	10
Sulfate			100	100		mg/L		100	90 - 110	0	10

Lab Sample ID: MRL 280-548604/3
Matrix: Water
Analysis Batch: 548604

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec. Limits		
Chloride			5.00	5.12		mg/L		102	50 - 150		
Sulfate			5.00	5.06		mg/L		101	50 - 150		

Method: SM 2320B - Alkalinity

Lab Sample ID: MB 280-547622/5
Matrix: Water
Analysis Batch: 547622

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Alkalinity	ND		10		mg/L			08/24/21 13:15	1
Bicarbonate Alkalinity as CaCO3	ND		10		mg/L			08/24/21 13:15	1
Carbonate Alkalinity as CaCO3	ND		10		mg/L			08/24/21 13:15	1

Method: SM 2320B - Alkalinity (Continued)

Lab Sample ID: LCS 280-547622/4
Matrix: Water
Analysis Batch: 547622

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Alkalinity			200	206		mg/L		103	89 - 109		

Method: SM 2540C - Solids, Total Dissolved (TDS)

Lab Sample ID: MB 280-547893/2
Matrix: Water
Analysis Batch: 547893

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids (TDS)	ND		10		mg/L			08/26/21 16:34	1

Lab Sample ID: LCS 280-547893/1
Matrix: Water
Analysis Batch: 547893

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Total Dissolved Solids (TDS)			502	498		mg/L		99	88 - 114		

Lab Sample ID: LCSD 280-547893/25
Matrix: Water
Analysis Batch: 547893

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Total Dissolved Solids (TDS)			502	505		mg/L		101	88 - 114	1	20

Method: SM 4500 F C - Fluoride

Lab Sample ID: MB 560-188400/3
Matrix: Water
Analysis Batch: 188400

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	ND		0.10		mg/L			08/26/21 10:06	1

Lab Sample ID: LCS 560-188400/4
Matrix: Water
Analysis Batch: 188400

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Fluoride			0.800	0.759		mg/L		95	85 - 115		

Metals

Prep Batch: 547261

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-152116-1	SUMP-UR91	Total/NA	Water	7470A	
MB 280-547261/1-A	Method Blank	Total/NA	Water	7470A	
LCS 280-547261/2-A	Lab Control Sample	Total/NA	Water	7470A	
LCSD 280-547261/3-A	Lab Control Sample Dup	Total/NA	Water	7470A	

Analysis Batch: 547322

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-152116-1	SUMP-UR91	Total/NA	Water	7470A	547261
MB 280-547261/1-A	Method Blank	Total/NA	Water	7470A	547261
LCS 280-547261/2-A	Lab Control Sample	Total/NA	Water	7470A	547261
LCSD 280-547261/3-A	Lab Control Sample Dup	Total/NA	Water	7470A	547261

Prep Batch: 547788

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-152116-1	SUMP-UR91	Total Recoverable	Water	3005A	
MB 280-547788/1-A	Method Blank	Total Recoverable	Water	3005A	
LCS 280-547788/2-A	Lab Control Sample	Total Recoverable	Water	3005A	
280-152116-1 MS	SUMP-UR91	Total Recoverable	Water	3005A	
280-152116-1 MSD	SUMP-UR91	Total Recoverable	Water	3005A	

Prep Batch: 547793

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-152116-1	SUMP-UR91	Total/NA	Water	3010A	
MB 280-547793/1-A	Method Blank	Total/NA	Water	3010A	
LCS 280-547793/2-A	Lab Control Sample	Total/NA	Water	3010A	
280-152116-1 MS	SUMP-UR91	Total/NA	Water	3010A	
280-152116-1 MSD	SUMP-UR91	Total/NA	Water	3010A	

Analysis Batch: 548122

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-152116-1	SUMP-UR91	Total/NA	Water	6010D	547793
MB 280-547793/1-A	Method Blank	Total/NA	Water	6010D	547793
LCS 280-547793/2-A	Lab Control Sample	Total/NA	Water	6010D	547793
280-152116-1 MS	SUMP-UR91	Total/NA	Water	6010D	547793
280-152116-1 MSD	SUMP-UR91	Total/NA	Water	6010D	547793

Analysis Batch: 548253

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-152116-1	SUMP-UR91	Total Recoverable	Water	6020A	547788
MB 280-547788/1-A	Method Blank	Total Recoverable	Water	6020A	547788
LCS 280-547788/2-A	Lab Control Sample	Total Recoverable	Water	6020A	547788
280-152116-1 MS	SUMP-UR91	Total Recoverable	Water	6020A	547788
280-152116-1 MSD	SUMP-UR91	Total Recoverable	Water	6020A	547788

Analysis Batch: 548277

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-152116-1	SUMP-UR91	Total/NA	Water	6010D	547793
280-152116-1 MS	SUMP-UR91	Total/NA	Water	6010D	547793
280-152116-1 MSD	SUMP-UR91	Total/NA	Water	6010D	547793

QC Association Summary

Client: Great River Energy
Project/Site: Coal Creek Station - CCR - Appendix IV

Job ID: 280-152116-1

Metals

Analysis Batch: 548412

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-152116-1	SUMP-UR91	Total Recoverable	Water	6020A	547788
MB 280-547788/1-A	Method Blank	Total Recoverable	Water	6020A	547788
LCS 280-547788/2-A	Lab Control Sample	Total Recoverable	Water	6020A	547788
280-152116-1 MS	SUMP-UR91	Total Recoverable	Water	6020A	547788
280-152116-1 MSD	SUMP-UR91	Total Recoverable	Water	6020A	547788

General Chemistry

Analysis Batch: 188400

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-152116-1	SUMP-UR91	Total/NA	Water	SM 4500 F C	
MB 560-188400/3	Method Blank	Total/NA	Water	SM 4500 F C	
LCS 560-188400/4	Lab Control Sample	Total/NA	Water	SM 4500 F C	

Analysis Batch: 547621

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-152116-1	SUMP-UR91	Total/NA	Water	9040B	
LCS 280-547621/4	Lab Control Sample	Total/NA	Water	9040B	

Analysis Batch: 547622

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-152116-1	SUMP-UR91	Total/NA	Water	SM 2320B	
MB 280-547622/5	Method Blank	Total/NA	Water	SM 2320B	
LCS 280-547622/4	Lab Control Sample	Total/NA	Water	SM 2320B	

Analysis Batch: 547893

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-152116-1	SUMP-UR91	Total/NA	Water	SM 2540C	
MB 280-547893/2	Method Blank	Total/NA	Water	SM 2540C	
LCS 280-547893/1	Lab Control Sample	Total/NA	Water	SM 2540C	
LCSD 280-547893/25	Lab Control Sample Dup	Total/NA	Water	SM 2540C	

Analysis Batch: 547961

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
MB 280-547961/6	Method Blank	Total/NA	Water	9056A	
LCS 280-547961/4	Lab Control Sample	Total/NA	Water	9056A	
LCSD 280-547961/5	Lab Control Sample Dup	Total/NA	Water	9056A	
MRL 280-547961/3	Lab Control Sample	Total/NA	Water	9056A	

Analysis Batch: 548093

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-152116-1	SUMP-UR91	Total/NA	Water	9056A	
MB 280-548093/6	Method Blank	Total/NA	Water	9056A	
LCS 280-548093/4	Lab Control Sample	Total/NA	Water	9056A	
LCSD 280-548093/5	Lab Control Sample Dup	Total/NA	Water	9056A	
MRL 280-548093/3	Lab Control Sample	Total/NA	Water	9056A	
280-152116-1 MS	SUMP-UR91	Total/NA	Water	9056A	
280-152116-1 MSD	SUMP-UR91	Total/NA	Water	9056A	
280-152116-1 DU	SUMP-UR91	Total/NA	Water	9056A	

QC Association Summary

Client: Great River Energy
Job ID: 280-152116-1
Project/Site: Coal Creek Station - CCR - Appendix IV

General Chemistry

Analysis Batch: 548604

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-152116-1	SUMP-UR91	Total/NA	Water	9056A	
MB 280-548604/6	Method Blank	Total/NA	Water	9056A	
LCS 280-548604/4	Lab Control Sample	Total/NA	Water	9056A	
LCSD 280-548604/5	Lab Control Sample Dup	Total/NA	Water	9056A	
MRL 280-548604/3	Lab Control Sample	Total/NA	Water	9056A	

Lab Chronicle

Client: Great River Energy
Job ID: 280-152116-1
Project/Site: Coal Creek Station - CCR - Appendix IV

Client Sample ID: SUMP-UR91
Lab Sample ID: 280-152116-1
Date Collected: 08/19/21 11:10
Matrix: Water
Date Received: 08/20/21 09:35

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3010A			50 mL	50 mL	547793	08/27/21 08:28	PNS	TAL DEN
Total/NA	Analysis	6010D		1			548122	08/27/21 17:33	LMT	TAL DEN
Total/NA	Prep	3010A			50 mL	50 mL	547793	08/27/21 08:28	PNS	TAL DEN
Total/NA	Analysis	6010D		10			548277	08/30/21 15:53	LMT	TAL DEN
Total Recoverable	Prep	3005A			50 mL	50 mL	547788	08/27/21 08:28	PNS	TAL DEN
Total Recoverable	Analysis	6020A		1			548253	08/30/21 13:31	LMT	TAL DEN
Total Recoverable	Prep	3005A			50 mL	50 mL	547788	08/27/21 08:28	PNS	TAL DEN
Total Recoverable	Analysis	6020A		5			548412	08/31/21 15:30	LMT	TAL DEN
Total/NA	Prep	7470A			30 mL	50 mL	547261	08/21/21 15:50	NK	TAL DEN
Total/NA	Analysis	7470A		1			547322	08/21/21 20:36	NK	TAL DEN
Total/NA	Analysis	9040B		1			547621	08/24/21 13:43	ECC	TAL DEN
Total/NA	Analysis	9056A		10	10 mL	10 mL	548093	08/28/21 14:47	CJ	TAL DEN
Total/NA	Analysis	9056A		50	10 mL	10 mL	548604	09/02/21 16:17	SPG	TAL DEN
Total/NA	Analysis	SM 2320B		1			547622	08/24/21 14:45	ECC	TAL DEN
Total/NA	Analysis	SM 2540C		1	5 mL	100 mL	547893	08/26/21 16:34	SVC	TAL DEN
Total/NA	Analysis	SM 4500 F C		2	50 mL	50 mL	188400	08/26/21 10:06	LR	XEN CC

Laboratory References:

TAL DEN = Eurofins TestAmerica, Denver, 4955 Yarrow Street, Arvada, CO 80002, TEL (303)736-0100

XEN CC = Eurofins Xenco, Corpus Christi, 1733 N. Padre Island Drive, Corpus Christi, TX 78408, TEL (361)289-2471

Accreditation/Certification Summary

Client: Great River Energy
Job ID: 280-152116-1
Project/Site: Coal Creek Station - CCR - Appendix IV

Laboratory: Eurofins TestAmerica, Denver

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
North Dakota	State	R-034	01-08-22

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
6010D	3010A	Water	Boron
6010D	3010A	Water	Calcium
6010D	3010A	Water	Iron
6010D	3010A	Water	Lithium
6010D	3010A	Water	Magnesium
6010D	3010A	Water	Potassium
6010D	3010A	Water	Sodium
9040B		Water	Temperature
SM 2320B		Water	Bicarbonate Alkalinity as CaCO3
SM 2320B		Water	Carbonate Alkalinity as CaCO3

Laboratory: Eurofins Xenco, Corpus Christi

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	Identification Number	Expiration Date
Louisiana	NELAP	05094	06-30-22
Oklahoma	State	2021-016	08-31-21
Texas	NELAP	T104704210-21-28	03-31-22
USDA	US Federal Programs	P330-18-00314	10-31-21

TestAmerica Eurofins Denver
4955 Yarrow Street
Arvada, CO 80002
Phone (303) 736-0100 Fax (303) 431-7171

Chain of Custody Record

280-152116 Chain of Custody

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Client Information	Sampler: Ryan Johnson / Colby Nordstrom	Lab PM: Bieniulis, Dylan T.	COC No: COC_CCR App-IV-custom-8-19-2021
Client Contact: David Christianson	Phone: 701-442-7757	E-Mail: dylan.bieniulis@testamericainc.com	Page: Page 1 of 1
Company: Great River Energy			Job #:
Address: 2875 3rd ST SW	Due Date Requested:		
City: Underwood	TAT Requested (days): Standard turn around as stated in quote (15 days, Radchem 22 days)		
State, Zip: ND, 58576	PO #: 6180507		
Phone: 701-442-7757(Tel)	WO #:		
Email: DChristianson@GREnergy.com	Project #: 28018198		
Project Name: Coal Creek Station - CCR	SSOW#:		
Site: Appendix IV			

Analysis Requested

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	pH - 9040B	Anions - 9056A_28D - Chloride and Sulfate	2540C_Calcd - TDS	App IV Metals - 6010D, 6020A, 7470A	Ap IV Rad - 9315_Ra226, 9320_Ra228, Ra226Ra228_GFPC	4500_F_C - Fluoride	2320B - Alkalinity (Total, Bicarb, Carb)	6010C - Total Na, Mg, K, and Fe						Total Number of containers	Special Instructions/Note:
			Preservation Code:				N	N	N	D	D	N	N	D							
Sump-UR91	8/19/21	11:10	G	W	N	N	N	N	N	D	D	N	N	D						7	See note below

1-Plastic 500 mL - presereved with Nitric Acid, 1-Plastic 500 mL - unpreserved, 1-Plastic 1 L - unpreserved, 2-Plastic 1 L - preserved with Nitric Acid, 2-Plastic 250 mL - unpreserved

Preservation Codes:

A - HCL	M - Hexane
B - NaOH	N - None
C - Zn Acetate	O - AsNaO2
D - Nitric Acid	P - Na2O4S
E - NaHSO4	Q - Na2SO3
F - MeOH	R - Na2S2O3
G - Amchlor	S - H2SO4
H - Ascorbic Acid	T - TSP Dodecahydrate
I - Ice	U - Acetone
J - DI Water	V - MCAA
K - EDTA	W - pH 4-5
L - EDA	Z - other (specify)

Other:

Possible Hazard Identification
■ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ■ Archive For 1 Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by:		Date:	Time:	Method of Shipment:		
Relinquished by: David Christianson	Date/Time: 8/19/2021 14:45	Company: Great River Energy	Received by:	Date/Time: 8/20/21 0935	Company: ETDEN	
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company	
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company	

Custody Seals Intact: ☒ Yes ☐ No | Custody Seal No.: 1659110

Cooler Temperature(s) °C and Other Remarks: 3.1 CF+1.0 IR11

Ver: 08/04/2016

ORIGIN ID:BISA (701) 442-7757
DAVID CHRISTIANSON
GREAT RIVER ENERGY
2875 3RD ST SW

UNDERWOOD, ND 58576
UNITED STATES US

SHIP DATE: 19AUG21
ACTWGT: 47.00 LB
CAD: 253185636/INET4400
DIMS: 26x14x14 IN

BILL SENDER

TO **DYLAN BIENIULIS**
TEST AMERICA EUROFINS
4955 YARROW ST

ARVADA CO 80002

(303) 736-0188

INV:
PO:

REF: ENVIRONMENTAL SAMPLES

DEPT:

ofins

3.1

1659110

FedEx Express

TRK# 0201 **7745 8434 4174**

FRI - 20 AUG 10:30A
PRIORITY OVERNIGHT

XH LAAA

80002
CO-US DEN

Part # 156297-435 RRDB2 EXP 05/22

280-152116 Waybill

Eurofins TestAmerica, Denver
4955 Yarrow Street
Arvada, CO 80002
Phone: 303-736-0100 Fax: 303-431-7171

Chain of Custody Record

eurofins | Environment Testing America

Client Information (Sub Contract Lab)	Sampler:	Lab PM: Bieniulis, Dylan T	Carrier Tracking No(s):	COC No: 280-581973.1
Client Contact: Shipping/Receiving	Phone:	E-Mail: Dylan.Bieniulis@Eurofinset.com	State of Origin: North Dakota	Page: Page 1 of 1
Company: Eurofins Xenco		Accreditations Required (See note): State Program - North Dakota		Job #: 280-152116-1
Address: 1733 N. Padre Island Drive, ,	Due Date Requested: 9/12/2021			
City: Corpus Christi	TAT Requested (days):			
State, Zip: TX, 78408				
Phone: 361-289-2471(Tel) 361-289-2673(Fax)	PO #:			
Email:	WO #:			
Project Name: Coal Creek Station - CCR - Appendix IV	Project #: 28018198			
Site:	SSOW#:			

Analysis Requested

Preservation Codes:

A - HCL	M - Hexane
B - NaOH	N - None
C - Zn Acetate	O - AsNaO2
D - Nitric Acid	P - Na2O4S
E - NaHSO4	Q - Na2SO3
F - MeOH	R - Na2S2O3
G - Amchlor	S - H2SO4
H - Ascorbic Acid	T - TSP Dodecahydrate
I - Ice	U - Acetone
J - DI Water	V - MCAA
K - EDTA	W - pH 4-5
L - EDA	Z - other (specify)

Other:

Sample Identification - Client ID (Lab ID)	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	4500_F_C/ Fluoride	Total Number of containers	Special Instructions/Note:
			Preservation Code:						
SUMP-UR91 (280-152116-1)	8/19/21	11:10 Central		Water			X	1	

Note: Since laboratory accreditations are subject to change, Eurofins TestAmerica places the ownership of method, analyte & accreditation compliance upon out subcontract laboratories. This sample shipment is forwarded under chain-of-custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analysis/tests/matrix being analyzed, the samples must be shipped back to the Eurofins TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to Eurofins TestAmerica attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said complicance to Eurofins TestAmerica.

Possible Hazard Identification	Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
Unconfirmed	☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months
Deliverable Requested: I, II, III, IV, Other (specify) Primary Deliverable Rank: 2	Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:

	Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
1	[signature]	8-23-21 1332	ETGDEN	[signature]	08/24/2021 1054	EK
2	Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
3	Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:	Cooler Temperature(s) °C and Other Remarks:

37 AG TR-10 R8

Login Sample Receipt Checklist

Client: Great River Energy

Job Number: 280-152116-1

Login Number: 152116
List Number: 1
Creator: Rystrom, Joshua R

List Source: Eurofins TestAmerica, Denver

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Login Sample Receipt Checklist

Client: Great River Energy

Job Number: 280-152116-1

Login Number: 152116
List Number: 2
Creator: Forrester, Caitlyn D

List Source: Eurofins Xenco, Corpus Christi
List Creation: 08/24/21 12:31 PM

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	Check done at department level as required.

eurofins | Environment Testing America

ANALYTICAL REPORT

Eurofins TestAmerica, Denver
4955 Yarrow Street
Arvada, CO 80002
Tel: (303)736-0100

Laboratory Job ID: 280-152116-2
Client Project/Site: Coal Creek Station - CCR - Appendix IV

For:
Great River Energy
12300 Elm Creek Blvd
Maple Grove, Minnesota 55369

Attn: David Christianson

Authorized for release by:
9/22/2021 12:13:16 PM

Dylan Bieniulis, Project Manager I
(303)736-0138
Dylan.Bieniulis@Eurofinset.com

LINKS

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The test results in this report meet all 2003 NELAC, 2009 TNI, and 2016 TNI requirements for accredited parameters, exceptions are noted in this report. This report may not be reproduced except in full, and with written approval from the laboratory. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

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Definitions/Glossary

Client: Great River Energy
Job ID: 280-152116-2
Project/Site: Coal Creek Station - CCR - Appendix IV

Qualifiers

Rad

Qualifier	Qualifier Description
U	Result is less than the sample detection limit.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Job ID: 280-152116-2

Laboratory: Eurofins TestAmerica, Denver

Narrative

CASE NARRATIVE

Client: Great River Energy

Project: Coal Creek Station - CCR - Appendix IV

Report Number: 280-152116-2

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

Any minimum detectable concentration (MDC), critical value (DLC), or Safe Drinking Water Act detection limit (SDWA DL) is sample-specific unless otherwise stated elsewhere in this narrative. Radiochemistry sample results are reported with the count date/time applied as the Activity Reference Date.

RECEIPT

The samples were received on 08/20/2021; the samples arrived in good condition, properly preserved and on ice. The temperature of the coolers at receipt was 4.1 C.

The requested radiochemistry analyses are reported under report number 280-152116-2. All other requested analyses are repor under report number 280-152116-1.

RADIUM-226 (GFPC)

Sample SUMP-UR91 (280-152116-1) was analyzed for Radium-226 (GFPC) in accordance with SW 846 9315. The samples were prepared on 08/25/2021 and analyzed on 09/16/2021.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

RADIUM-228

Sample SUMP-UR91 (280-152116-1) was analyzed for Radium-228 in accordance with 9320. The samples were prepared on 08/25/2021 and analyzed on 09/16/2021.

Radium-228 was detected in method blank MB 160-524081/24-A at a level that was above the minimum detectable concentration but below the requested limit. Refer to the QC report for details.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

RADIUM-226/RADIUM-228 (GFPC)

Sample SUMP-UR91 (280-152116-1) was analyzed for Radium-226/Radium-228 (GFPC) in accordance with 9315/9320. The samples were analyzed on 09/21/2021.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Detection Summary

Client: Great River Energy
Job ID: 280-152116-2
Project/Site: Coal Creek Station - CCR - Appendix IV

Client Sample ID: SUMP-UR91 **Lab Sample ID: 280-152116-1**

No Detections.

This Detection Summary does not include radiochemical test results.

Method Summary

Client: Great River Energy
Job ID: 280-152116-2
Project/Site: Coal Creek Station - CCR - Appendix IV

Method	Method Description	Protocol	Laboratory
9315	Radium-226 (GFPC)	SW846	TAL SL
9320	Radium-228 (GFPC)	SW846	TAL SL
Ra226_Ra228	Combined Radium-226 and Radium-228	TAL-STL	TAL SL
PrecSep_0	Preparation, Precipitate Separation	None	TAL SL
PrecSep-21	Preparation, Precipitate Separation (21-Day In-Growth)	None	TAL SL

Protocol References:

None = None

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

TAL-STL = TestAmerica Laboratories, St. Louis, Facility Standard Operating Procedure.

Laboratory References:

TAL SL = Eurofins TestAmerica, St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

Sample Summary

Client: Great River Energy
Project/Site: Coal Creek Station - CCR - Appendix IV

Job ID: 280-152116-2

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
280-152116-1	SUMP-UR91	Water	08/19/21 11:10	08/20/21 09:35

Method: 9315 - Radium-226 (GFPC)

Client Sample ID: SUMP-UR91
Date Collected: 08/19/21 11:10
Date Received: 08/20/21 09:35

Lab Sample ID: 280-152116-1
Matrix: Water

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.298	U	0.355	0.356	1.00	0.584	pCi/L	08/25/21 12:41	09/16/21 21:24	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*80.8*		*40 - 110*	*08/25/21 12:41*	*09/16/21 21:24*	*1*

Method: 9320 - Radium-228 (GFPC)

Client Sample ID: SUMP-UR91
Date Collected: 08/19/21 11:10
Date Received: 08/20/21 09:35

Lab Sample ID: 280-152116-1
Matrix: Water

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.278	U	0.400	0.401	1.00	0.669	pCi/L	08/25/21 13:37	09/16/21 11:50	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*80.8*		*40 - 110*	*08/25/21 13:37*	*09/16/21 11:50*	*1*
Y Carrier	*84.9*		*40 - 110*	*08/25/21 13:37*	*09/16/21 11:50*	*1*

Method: Ra226_Ra228 - Combined Radium-226 and Radium-228

Client Sample ID: SUMP-UR91
Date Collected: 08/19/21 11:10
Date Received: 08/20/21 09:35

Lab Sample ID: 280-152116-1
Matrix: Water

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Combined Radium 226 + 228	0.576	U	0.535	0.536	5.00	0.669	pCi/L		09/21/21 20:26	1

Method: 9315 - Radium-226 (GFPC)

Lab Sample ID: MB 160-524072/24-A
Matrix: Water
Analysis Batch: 527397

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 524072

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.08951	U	0.238	0.238	1.00	0.429	pCi/L	08/25/21 12:41	09/16/21 23:02	1

Carrier	*MB %Yield*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*79.8*		*40 - 110*	*08/25/21 12:41*	*09/16/21 23:02*	*1*

Lab Sample ID: LCS 160-524072/1-A
Matrix: Water
Analysis Batch: 527396

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 524072

Analyte			Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits		
Radium-226			11.3	11.32		1.46	1.00	0.372	pCi/L	100	75 - 125		

Carrier	*LCS %Yield*	*LCS Qualifier*	*Limits*
Ba Carrier	*77.2*		*40 - 110*

Method: 9320 - Radium-228 (GFPC)

Lab Sample ID: MB 160-524081/24-A
Matrix: Water
Analysis Batch: 527396

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 524081

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.5380		0.312	0.316	1.00	0.473	pCi/L	08/25/21 13:37	09/16/21 12:06	1

Carrier	*MB %Yield*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*79.8*		*40 - 110*	*08/25/21 13:37*	*09/16/21 12:06*	*1*
Y Carrier	*86.7*		*40 - 110*	*08/25/21 13:37*	*09/16/21 12:06*	*1*

Lab Sample ID: LCS 160-524081/1-A
Matrix: Water
Analysis Batch: 527452

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 524081

Analyte			Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits		
Radium-228			9.33	7.639		1.01	1.00	0.555	pCi/L	82	75 - 125		

Carrier	*LCS %Yield*	*LCS Qualifier*	*Limits*
Ba Carrier	*77.2*		*40 - 110*
Y Carrier	*82.2*		*40 - 110*

QC Association Summary

Client: Great River Energy
Job ID: 280-152116-2
Project/Site: Coal Creek Station - CCR - Appendix IV

Rad

Prep Batch: 524072

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-152116-1	SUMP-UR91	Total/NA	Water	PrecSep-21	
MB 160-524072/24-A	Method Blank	Total/NA	Water	PrecSep-21	
LCS 160-524072/1-A	Lab Control Sample	Total/NA	Water	PrecSep-21	

Prep Batch: 524081

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
280-152116-1	SUMP-UR91	Total/NA	Water	PrecSep_0	
MB 160-524081/24-A	Method Blank	Total/NA	Water	PrecSep_0	
LCS 160-524081/1-A	Lab Control Sample	Total/NA	Water	PrecSep_0	

Lab Chronicle

Client: Great River Energy
Job ID: 280-152116-2
Project/Site: Coal Creek Station - CCR - Appendix IV

Client Sample ID: SUMP-UR91
Lab Sample ID: 280-152116-1

Date Collected: 08/19/21 11:10
Matrix: Water

Date Received: 08/20/21 09:35

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	PrecSep-21			750.55 mL	1.0 g	524072	08/25/21 12:41	MJ	TAL SL
Total/NA	Analysis	9315		1			527396	09/16/21 21:24	ANW	TAL SL
Total/NA	Prep	PrecSep_0			750.55 mL	1.0 g	524081	08/25/21 13:37	MJ	TAL SL
Total/NA	Analysis	9320		1			527452	09/16/21 11:50	ANW	TAL SL
Total/NA	Analysis	Ra226_Ra228		1			528293	09/21/21 20:26	MLK	TAL SL

Laboratory References:

TAL SL = Eurofins TestAmerica, St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

Accreditation/Certification Summary

Client: Great River Energy
Job ID: 280-152116-2
Project/Site: Coal Creek Station - CCR - Appendix IV

Laboratory: Eurofins TestAmerica, St. Louis

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
North Dakota	State	R-207	06-30-22

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
9315	PrecSep-21	Water	Radium-226
Ra226_Ra228		Water	Combined Radium 226 + 228

TestAmerica Eurofins Denver
4955 Yarrow Street
Arvada, CO 80002
Phone (303) 736-0100 Fax (303) 431-7171

Chain of Custody Record

280-152116 Chain of Custody

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Client Information	Sampler: Ryan Johnson / Colby Nordstrom	Lab PM: Bieniulis, Dylan T.	COC No: COC_CCR App-IV-custom-8-19-2021
Client Contact: David Christianson	Phone: 701-442-7757	E-Mail: dylan.bieniulis@testamericainc.com	Page: Page 1 of 1
Company: Great River Energy			Job #:
Address: 2875 3rd ST SW	Due Date Requested:		
City: Underwood	TAT Requested (days): Standard turn around as stated in quote (15 days, Radchem 22 days)		
State, Zip: ND, 58576	PO #: 6180507		
Phone: 701-442-7757(Tel)	WO #:		
Email: DChristianson@GREnergy.com			
Project Name: Coal Creek Station - CCR	Project #: 28018198		
Site: Appendix IV	SSOW#:		

Analysis Requested

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	pH - 9040B	Anions - 9056A_28D - Chloride and Sulfate	2540C_Calcd - TDS	App IV Metals - 6010D, 6020A, 7470A	Ap IV Rad - 9315_Ra226, 9320_Ra228, Ra226Ra228_GFPC	4500_F_C - Fluoride	2320B - Alkalinity (Total, Bicarb, Carb)	6010C - Total Na, Mg, K, and Fe	Total Number of containers	Special Instructions/Note:
			Preservation Code:				N	N	N	D	D	N	N	D		
Sump-UR91	8/19/21	11:10	G	W	N	N	N	N	N	D	D	N	N	D	7	See note below

1-Plastic 500 mL - presereved with Nitric Acid, 1-Plastic 500 mL - unpreserved, 1-Plastic 1 L - unpreserved, 2-Plastic 1 L - preserved with Nitric Acid, 2-Plastic 250 mL - unpreserved

Preservation Codes:

A - HCL	M - Hexane
B - NaOH	N - None
C - Zn Acetate	O - AsNaO2
D - Nitric Acid	P - Na2O4S
E - NaHSO4	Q - Na2SO3
F - MeOH	R - Na2S2O3
G - Amchlor	S - H2SO4
H - Ascorbic Acid	T - TSP Dodecahydrate
I - Ice	U - Acetone
J - DI Water	V - MCAA
K - EDTA	W - pH 4-5
L - EDA	Z - other (specify)

Other:

Possible Hazard Identification
■ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐ Radiological

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return To Client ☐ Disposal By Lab ■ Archive For 1 Months

Deliverable Requested: I, II, III, IV, Other (specify)

Special Instructions/QC Requirements:

Empty Kit Relinquished by:		Date:	Time:	Method of Shipment:		
Relinquished by: David Christianson	Date/Time: 8/19/2021 14:45	Company: Great River Energy	Received by:	Date/Time: 8/20/21 0935	Company: ETA DEN	
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company	
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company	

Custody Seals Intact: ☒ Yes ☐ No | Custody Seal No.: 1659110

Cooler Temperature(s) °C and Other Remarks: 3.1 CF+1.0 IR11

Ver: 08/04/2016

ORIGIN ID:BISA (701) 442-7757
DAVID CHRISTIANSON
GREAT RIVER ENERGY
2875 3RD ST SW

UNDERWOOD, ND 58576
UNITED STATES US

SHIP DATE: 19AUG21
ACTWGT: 47.00 LB
CAD: 253185636/INET4400
DIMS: 26x14x14 IN

BILL SENDER

TO **DYLAN BIENIULIS**
TEST AMERICA EUROFINS ofins
4955 YARROW ST

3.1
1659110

ARVADA CO 80002

(303) 736-0188 REF: ENVIRONMENTAL SAMPLES
INV:
PO: DEPT:

FedEx Express

FRI - 20 AUG 10:30A
TRK# 0201 7745 8434 4174 PRIORITY OVERNIGHT

XH LAAA

80002
CO-US DEN

Part # 156297-435 RRDB2 EXP 05/22

280-152116 Waybill

Eurofins TestAmerica, Denver
4955 Yarrow Street
Arvada, CO 80002
Phone: 303-736-0100 Fax: 303-431-7171

Chain of Custody Record

eurofins | Environment Testing America

Client Information (Sub Contract Lab)	Sampler:	Lab PM: Bieniulis, Dylan T	Carrier Tracking No(s):	COC No: 280-581974.1
Client Contact: Shipping/Receiving	Phone:	E-Mail: Dylan.Bieniulis@Eurofinset.com	State of Origin: North Dakota	Page: Page 1 of 1
Company: TestAmerica Laboratories, Inc.		Accreditations Required (See note): State Program - North Dakota		Job #: 280-152116-2
Address: 13715 Rider Trail North,	Due Date Requested: 9/21/2021			
City: Earth City	TAT Requested (days):			
State, Zip: MO, 63045				
Phone: 314-298-8566(Tel) 314-298-8757(Fax)	PO #:			
Email:	WO #:			
Project Name: Coal Creek Station - CCR - Appendix IV	Project #: 28018198			
Site:	SSOW#:			

Analysis Requested

Preservation Codes:

A - HCL	M - Hexane
B - NaOH	N - None
C - Zn Acetate	O - AsNaO2
D - Nitric Acid	P - Na2O4S
E - NaHSO4	Q - Na2SO3
F - MeOH	R - Na2S2O3
G - Amchlor	S - H2SO4
H - Ascorbic Acid	T - TSP Dodecahydrate
I - Ice	U - Acetone
J - DI Water	V - MCAA
K - EDTA	W - pH 4-5
L - EDA	Z - other (specify)

Other:

Sample Identification - Client ID (Lab ID)	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	9315_Ra226/PrecSep_21 Standard Target List	9320_Ra228/PrecSep_0 Standard Target List	Ra226Ra228_GFPC	Total Number of containers	Special Instructions/Note:
			Preservation Code:								
SUMP-UR91 (280-152116-1)	8/19/21	11:10 Central		Water			X	X	X	2	

Note: Since laboratory accreditations are subject to change, Eurofins TestAmerica places the ownership of method, analyte & accreditation compliance upon out subcontract laboratories. This sample shipment is forwarded under chain-of-custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analysis/tests/matrix being analyzed, the samples must be shipped back to the Eurofins TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to Eurofins TestAmerica attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said complicance to Eurofins TestAmerica.

Possible Hazard Identification	Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
Unconfirmed	☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months
Deliverable Requested: I, II, III, IV, Other (specify) Primary Deliverable Rank: 2	Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:

	Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
1	FE	8/23/21 1330		FE		
2	Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
3	Relinquished by:	Date/Time:	Company	Received by	8/24/21 09:25	EDA SA
4				Received by:	Date/Time:	Company

Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:	Cooler Temperature(s) °C and Other Remarks:

Login Sample Receipt Checklist

Client: Great River Energy

Job Number: 280-152116-2

Login Number: 152116
List Number: 1
Creator: Rystrom, Joshua R

List Source: Eurofins TestAmerica, Denver

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Login Sample Receipt Checklist

Client: Great River Energy

Job Number: 280-152116-2

Login Number: 152116
List Number: 3
Creator: Korrinhizer, Micha L

List Source: Eurofins TestAmerica, St. Louis
List Creation: 08/24/21 05:46 PM

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	N/A	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Tracer/Carrier Summary

Client: Great River Energy
Job ID: 280-152116-2
Project/Site: Coal Creek Station - CCR - Appendix IV

Method: 9315 - Radium-226 (GFPC)

Matrix: Water **Prep Type: Total/NA**

		Percent Yield (Acceptance Limits)
		Ba
Lab Sample ID	Client Sample ID	(40-110)
280-152116-1	SUMP-UR91	80.8
LCS 160-524072/1-A	Lab Control Sample	77.2
MB 160-524072/24-A	Method Blank	79.8

Tracer/Carrier Legend

Ba = Ba Carrier

Method: 9320 - Radium-228 (GFPC)

Matrix: Water **Prep Type: Total/NA**

		Percent Yield (Acceptance Limits)	
		Ba	Y
Lab Sample ID	Client Sample ID	(40-110)	(40-110)
280-152116-1	SUMP-UR91	80.8	84.9
LCS 160-524081/1-A	Lab Control Sample	77.2	82.2
MB 160-524081/24-A	Method Blank	79.8	86.7

Tracer/Carrier Legend

Ba = Ba Carrier

Y = Y Carrier

APPENDIX C-3

Soil Layer Index Testing Results

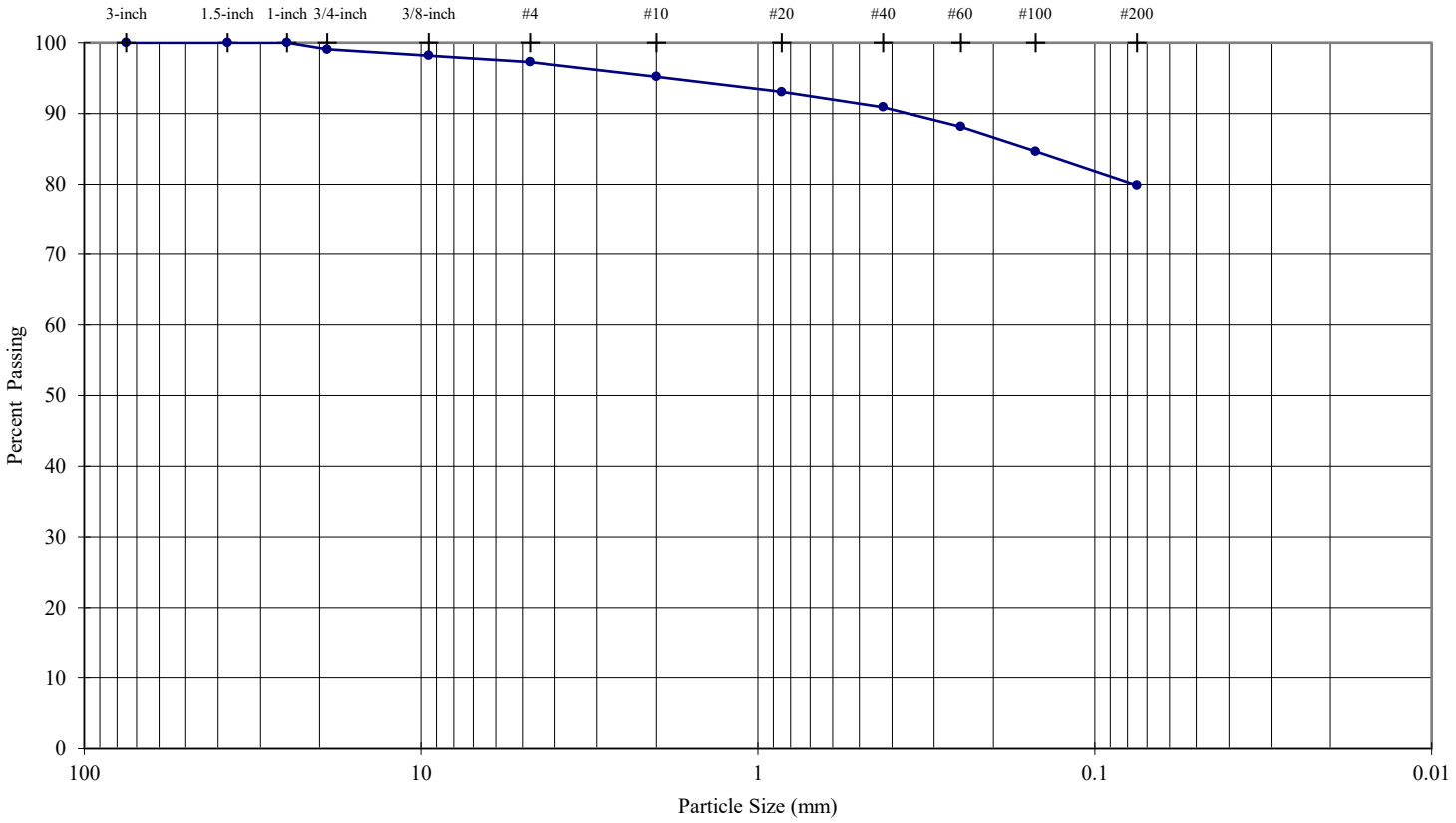
GOLDER
MEMBER OF WSP

September-21 **21451024.007**

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

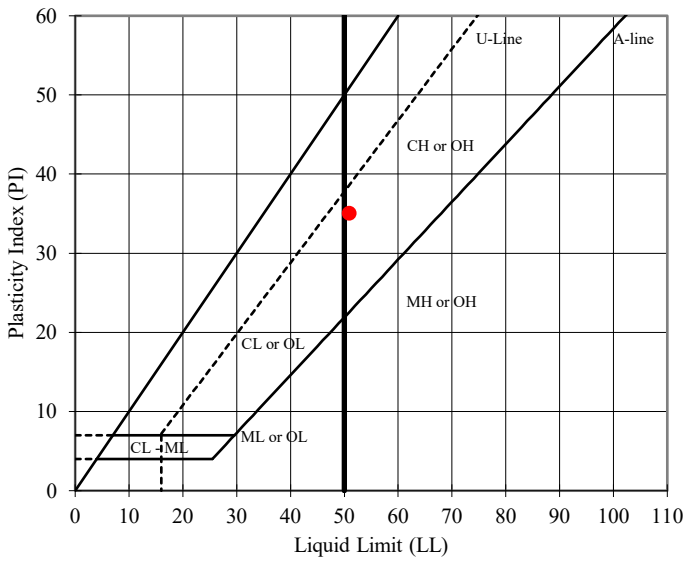
PROJECT NAME: **GRE/CCS 2021/ND**
SAMPLE ID: **W-ST-1** DEPTH (ft): **0 - 2**
TYPE: **Shelby Tube**



Sieve Analysis (Initial Separation on No. 4 Sieve)

Sieve	Particle Size (mm)	% Passing
3-inch	75.0	**100.0**
1.5-inch	37.5	**100.0**
1-inch	25.0	**100.0**
3/4-inch	19.0	**99.1**
3/8-inch	9.5	**98.2**
#4	4.75	**97.3**
#10	2.0	**95.2**
#20	0.850	**93.1**
#40	0.425	**90.9**
#60	0.250	**88.1**
#100	0.150	**84.7**
#200	0.075	**79.8**

Description	Percentage
Coarse Gravel	**0.95**
Fine Gravel	**1.77**
Coarse Sand	**2.08**
Medium Sand	**4.31**
Fine Sand	**11.07**
Silt or Clay Fines	**79.82**



USCS Description (ASTM D 2487):

Fat clay with sand, dark olive brown, dry

LL	PL	PI	SpG
51	**16**	**35**	**2.77**

As-Received Moisture Content (%): --

USCS Group Symbol: CH

Notes: 0 particles were removed from particle size analysis sample prior to testing
Particle size analysis sample was not mechanically dispersed; hydrometer test was not performed
Sample prepared for Atterberg Limits testing by the dry method
Material retained on No. 40 sieve removed from Atterberg Limits sample by sieving
Plastic Limit test performed by hand rolling. Method A Liquid Limit test performed using mechanical device

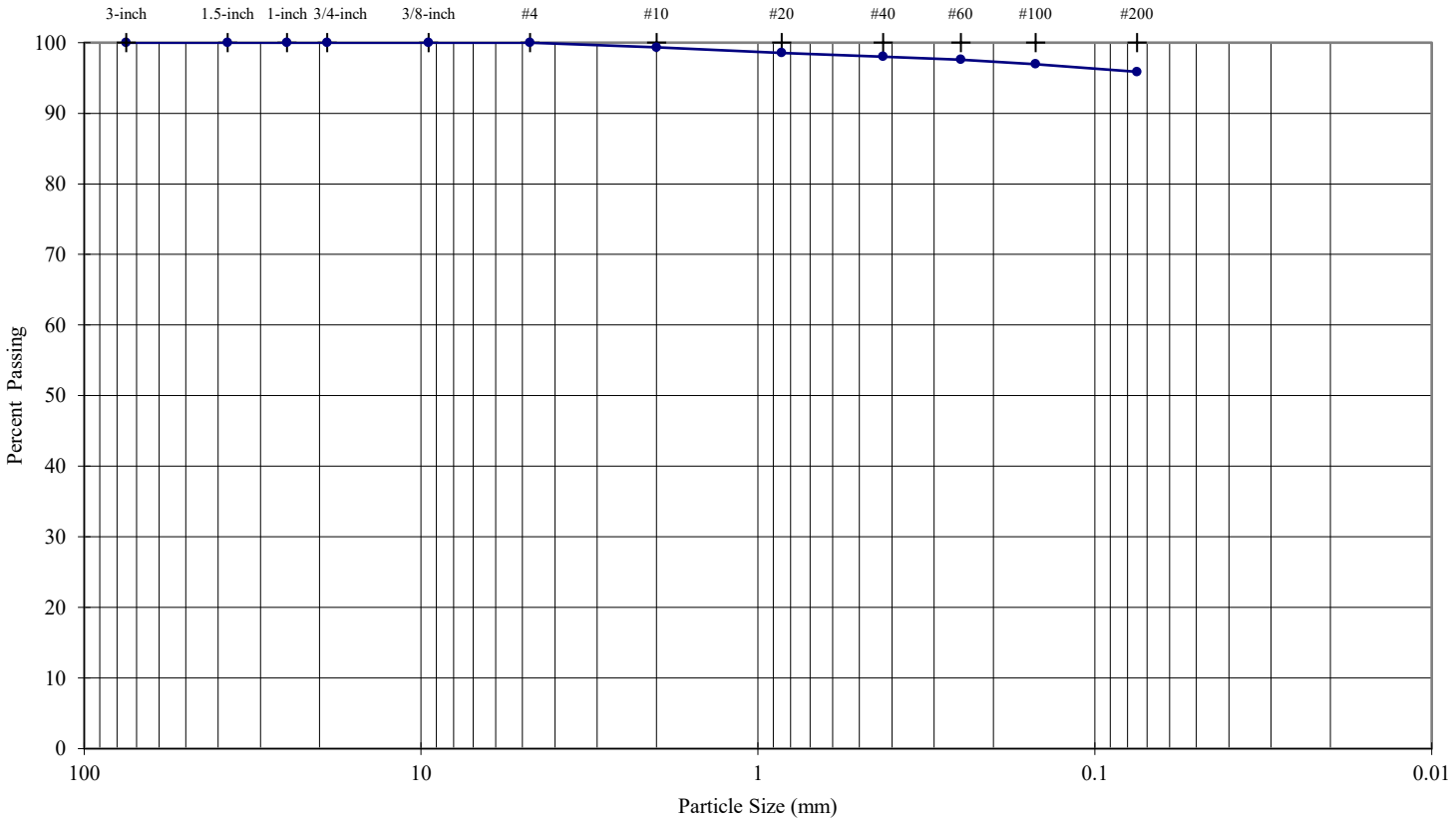
TECH	KAS
DATE	21-Sep-2021
REVIEW	PRH

September-21 **21451024.007**

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

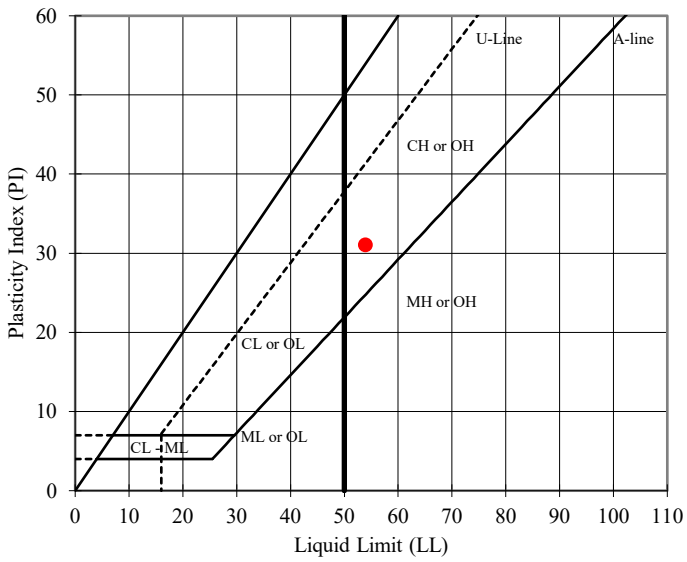
PROJECT NAME: **GRE/CCS 2021/ND**
SAMPLE ID: **S-ST-3** DEPTH (ft): **--**
TYPE: **Shelby Tube**



Sieve Analysis (Initial Separation on No. 4 Sieve)

Sieve	Particle Size (mm)	% Passing
3-inch	75.0	**100.0**
1.5-inch	37.5	**100.0**
1-inch	25.0	**100.0**
3/4-inch	19.0	**100.0**
3/8-inch	9.5	**100.0**
#4	4.75	**100.0**
#10	2.0	**99.3**
#20	0.850	**98.6**
#40	0.425	**98.0**
#60	0.250	**97.6**
#100	0.150	**96.9**
#200	0.075	**95.9**

Description	Percentage
Coarse Gravel	**0.00**
Fine Gravel	**0.00**
Coarse Sand	**0.68**
Medium Sand	**1.30**
Fine Sand	**2.14**
Silt or Clay Fines	**95.87**



USCS Description (ASTM D 2487):

Fat clay, dark gray, dry

LL	PL	PI	SpG
54	**23**	**31**	**2.75**

As-Received Moisture Content (%): **#DIV/0!**

USCS Group Symbol: CH

Notes: 0 particles were removed from particle size analysis sample prior to testing
Particle size analysis sample was not mechanically dispersed; hydrometer test was not performed
Sample prepared for Atterberg Limits testing by the dry method
Material retained on No. 40 sieve removed from Atterberg Limits sample by sieving
Plastic Limit test performed by hand rolling. Method A Liquid Limit test performed using mechanical device

TECH	LS
DATE	21-Sep-2021
REVIEW	PRH

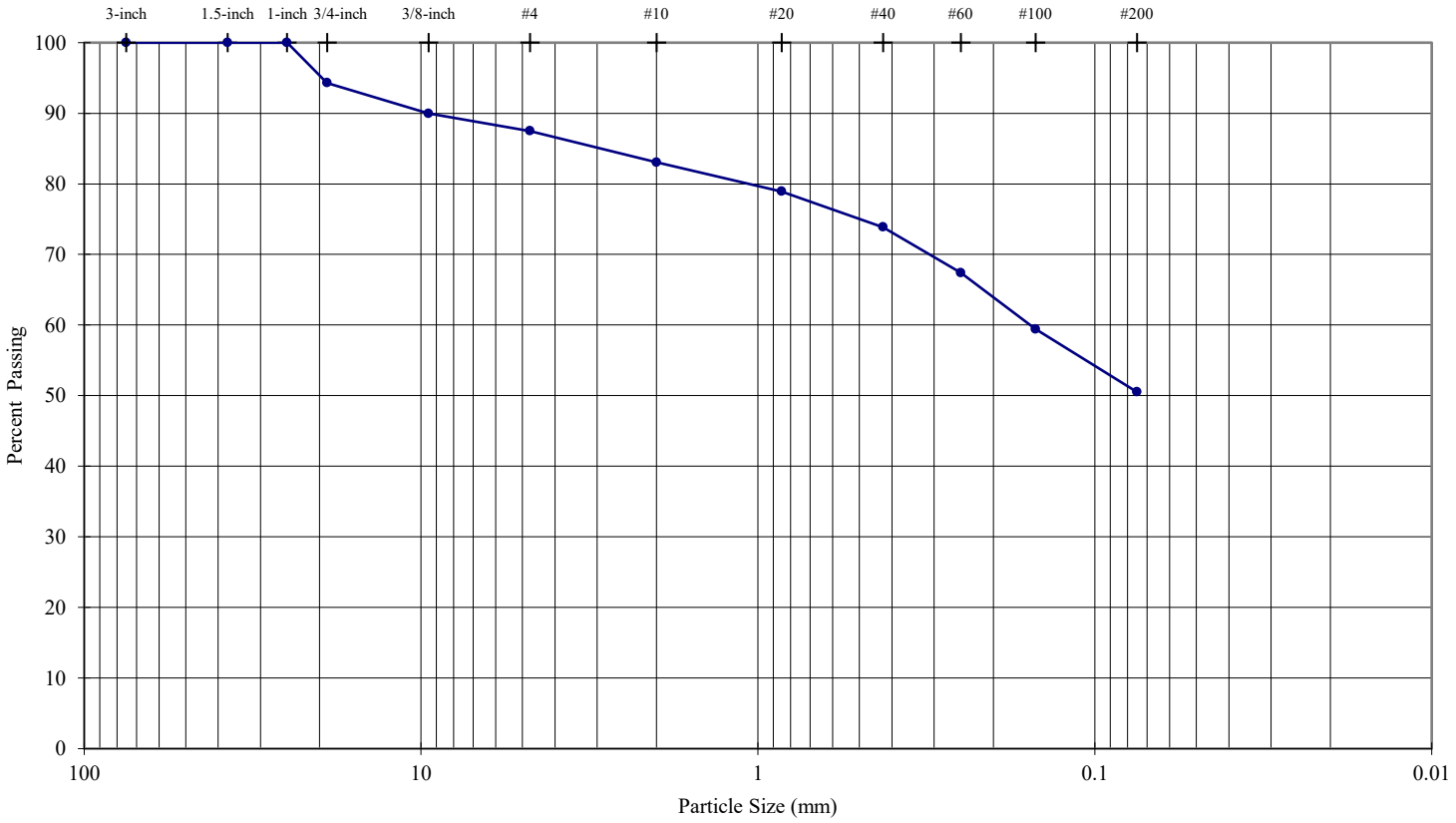
GOLDER
MEMBER OF WSP

September-21 **21451024.007**

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

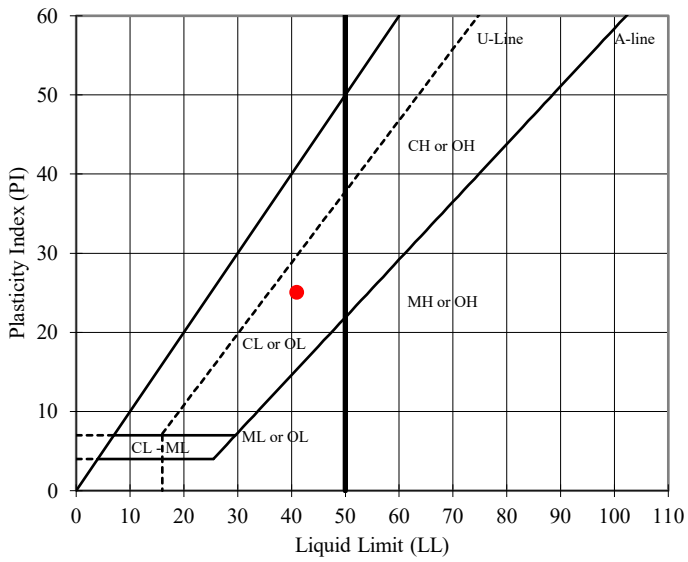
PROJECT NAME: **GRE/CCS 2021/ND**
SAMPLE ID: **N-ST-04** DEPTH (ft): **0 - 2**
TYPE: **Shelby Tube**



Sieve	Particle Size (mm)	% Passing
3-inch	75.0	**100.0**
1.5-inch	37.5	**100.0**
1-inch	25.0	**100.0**
3/4-inch	19.0	**94.3**
3/8-inch	9.5	**90.0**
#4	4.75	**87.5**
#10	2.0	**83.0**
#20	0.850	**78.9**
#40	0.425	**73.9**
#60	0.250	**67.4**
#100	0.150	**59.4**
#200	0.075	**50.5**

Sieve Analysis (Initial Separation on No. 4 Sieve)

Description	Percentage
Coarse Gravel	**5.71**
Fine Gravel	**6.79**
Coarse Sand	**4.46**
Medium Sand	**9.16**
Fine Sand	**23.36**
Silt or Clay Fines	**50.52**



USCS Description (ASTM D 2487):

Sandy lean clay, very dark grayish brown, dry

LL	PL	PI	SpG
41	**16**	**25**	**2.78**

As-Received Moisture Content (%): --

USCS Group Symbol: CL

Notes: 0 particles were removed from particle size analysis sample prior to testing
Particle size analysis sample was not mechanically dispersed; hydrometer test was not performed
Sample prepared for Atterberg Limits testing by the dry method
Material retained on No. 40 sieve removed from Atterberg Limits sample by sieving
Plastic Limit test performed by hand rolling. Method A Liquid Limit test performed using mechanical device

TECH	LS
DATE	21-Sep-2021
REVIEW	PRH

APPENDIX C-4

Soil Layer Permeability Testing Results (To-Date)

GOLDER
MEMBER OF WSP

11/24/2021

FLEXIBLE WALL TRIAXIAL PERMEABILITY
ASTM D 5084
METHOD C, FALLING HEAD W/INCREASING TAIL WATER PRESSURE

PROJECT NUMBER	**21451024**
SAMPLE ID	**W-ST-1**
SAMPLE TYPE	**Intact**

TIME FUNCTION			READINGS			TIME IN MINUTES & SECONDS						VOLUME		PERMEABILITY
DATE	HOUR	MIN	Inflow (cc)	Outflow (cc)	Temp.	dt (min)	dt (sec)	dt, acc (sec)	Head (cm)	(H1/H2) (inc.)	Gradient	Inflow (cc)	Outflow (cc)	@ 20 Degrees C (cm/sec)
8-Sep-2021	*16*	*40*	*8.3*	*23.9*	*20.1*	0.0	0.0	0	226.29		29.70			
9-Sep-2021	*16*	*11*	*8.4*	*23.9*	*20.1*	1411.0	84660	84660	226.19	1.00	29.68	0.10	0.00	
10-Sep-2021	*16*	*22*	*8.5*	*23.8*	*20.1*	1451.0	87060	171720	226.00	1.00	29.66	0.10	0.10	
11-Sep-2021	*10*	*56*	*8.7*	*23.8*	*20.1*	1114.0	66840	238560	225.80	1.00	29.63	0.20	0.00	
13-Sep-2021	*6*	*36*	*8.9*	*23.7*	*20.1*	2620.0	157200	395760	225.46	1.00	29.59	0.20	0.15	
14-Sep-2021	*7*	*58*	*9.0*	*23.6*	*20.1*	1522.0	91320	487080	225.32	1.00	29.57	0.10	0.05	
15-Sep-2021	*11*	*36*	*9.2*	*23.6*	*20.1*	1658.0	99480	586560	225.12	1.00	29.54	0.20	0.00	
16-Sep-2021	*11*	*37*	*9.3*	*23.5*	*20.1*	1441.0	86460	673020	224.93	1.00	29.52	0.05	0.15	
17-Sep-2021	*15*	*29*	*9.3*	*23.4*	*20.1*	1672.0	100320	773340	224.83	1.00	29.51	0.05	0.05	
20-Sep-2021	*12*	*47*	*9.6*	*23.2*	*20.1*	4158.0	249480	1022820	224.34	1.00	29.44	0.30	0.20	Steady State Flow Not Yet
25-Sep-2021	*12*	*11*	*10.7*	*22.4*	*20.1*	1574.0	94440	94440	222.49	1.00	29.20	0.15	0.05	Achieved
26-Sep-2021	*14*	*23*	*10.7*	*22.3*	*20.1*	1572.0	94320	188760	222.44	1.00	29.19	0.00	0.10	
28-Sep-2021	*10*	*55*	*10.8*	*22.2*	*20.1*	2672.0	160320	349080	222.15	1.00	29.15	0.15	0.15	
29-Sep-2021	*16*	*0*	*10.9*	*22.1*	*20.1*	1745.0	104700	453780	222.00	1.00	29.13	0.10	0.05	
1-Oct-2021	*9*	*0*	*11.3*	*22.1*	*20.1*	2460.0	147600	601380	221.62	1.00	29.08	0.40	0.00	
3-Oct-2021	*15*	*41*	*11.3*	*21.9*	*20.1*	3281.0	196860	798240	221.42	1.00	29.06	0.00	0.20	
5-Oct-2021	*11*	*51*	*11.5*	*21.8*	*20.1*	2650.0	159000	957240	221.13	1.00	29.02	0.20	0.10	
7-Oct-2021	*14*	*30*	*11.6*	*21.7*	*20.1*	3039.0	182340	1139580	220.88	1.00	28.99	0.10	0.15	
8-Oct-2021	*16*	*20*	*11.6*	*21.6*	*20.1*	1550.0	93000	1232580	220.79	1.00	28.97	0.00	0.10	
11-Oct-2021	*13*	*24*	*12.0*	*21.5*	*20.1*	4144.0	248640	1481220	220.30	1.00	28.91	0.40	0.10	
16-Oct-2021	*13*	*51*	*13.3*	*20.1*	*20.1*	3249.0	194940	194940	217.77	1.00	28.58	0.15	0.20	7.6E-10
18-Oct-2021	*9*	*20*	*13.4*	*20.0*	*20.1*	2609.0	156540	351480	217.52	1.00	28.55	0.15	0.10	6.8E-10
22-Oct-2021	*13*	*20*	*13.7*	*19.8*	*20.1*	6000.0	360000	711480	217.04	1.00	28.48	0.30	0.20	5.9E-10
25-Oct-2021	*9*	*39*	*13.9*	*19.6*	*20.1*	4099.0	245940	957420	216.69	1.00	28.44	0.15	0.20	6.1E-10
29-Oct-2021	*14*	*0*	*14.2*	*19.4*	*20.1*	6021.0	361260	1318680	216.16	1.00	28.37	0.30	0.25	6.5E-10
1-Nov-2021	*16*	*7*	*14.4*	*19.2*	*20.1*	4447.0	266820	1585500	215.77	1.00	28.32	0.25	0.15	6.4E-10
11-Nov-2021	*16*	*41*	*2.8*	*23.3*	*20.1*	4440.0	266400	266400	231.05	1.00	30.32	0.20	0.10	4.5E-10
14-Nov-2021	*17*	*25*	*3.2*	*23.1*	*20.1*	4364.0	261840	528240	230.47	1.00	30.25	0.40	0.20	9.2E-10
16-Nov-2021	*11*	*16*	*3.3*	*22.9*	*20.1*	2511.0	150660	678900	230.18	1.00	30.21	0.10	0.20	8.0E-10

***PERMEABILITY REPORTED AS 6.6E-10 cm/sec**

GOLDER
MEMBER OF WSP

11/24/2021

FLEXIBLE WALL TRIAXIAL PERMEABILITY
ASTM D 5084
METHOD C, FALLING HEAD W/INCREASING TAIL WATER PRESSURE

PROJECT NUMBER	**21451024**
SAMPLE ID	**S-ST-3**
SAMPLE TYPE	**Intact**

TIME FUNCTION			READINGS			TIME IN MINUTES & SECONDS						VOLUME		PERMEABILITY
DATE	HOUR	MIN	Inflow (cc)	Outflow (cc)	Temp.	dt (min)	dt (sec)	dt, acc (sec)	Head (cm)	(H1/H2) (inc.)	Gradient	Inflow (cc)	Outflow (cc)	@ 20 Degrees C (cm/sec)
8-Sep-2021	*16*	*39*	*4.0*	*20.4*	*20.1*	0.0	0.0	0	227.05		29.80			
9-Sep-2021	*16*	*10*	*4.4*	*19.9*	*20.1*	1411.0	84660	84660	226.18	1.00	29.68	0.45	0.45	4.3E-09
10-Sep-2021	*16*	*21*	*4.9*	*19.4*	*20.1*	1451.0	87060	171720	225.25	1.00	29.56	0.45	0.50	4.5E-09
11-Sep-2021	*10*	*57*	*5.2*	*19.1*	*20.1*	1116.0	66960	238680	224.62	1.00	29.48	0.35	0.30	4.0E-09
13-Sep-2021	*6*	*36*	*6.0*	*18.3*	*20.1*	2619.0	157140	395820	223.01	1.01	29.27	0.80	0.85	4.3E-09
14-Sep-2021	*7*	*57*	*6.5*	*17.8*	*20.1*	1521.0	91260	487080	222.04	1.00	29.14	0.50	0.50	4.5E-09
15-Sep-2021	*11*	*35*	*7.1*	*17.3*	*20.1*	1658.0	99480	586560	221.01	1.00	29.00	0.60	0.45	4.4E-09
16-Sep-2021	*11*	*37*	*7.5*	*16.8*	*20.1*	1442.0	86520	673080	220.18	1.00	28.90	0.35	0.50	4.1E-09
17-Sep-2021	*15*	*28*	*8.0*	*16.3*	*20.1*	1671.0	100260	773340	219.16	1.00	28.76	0.50	0.55	4.4E-09
20-Sep-2021	*12*	*47*	*9.1*	*15.0*	*20.1*	4159.0	249540	1022880	216.77	1.01	28.45	1.15	1.30	4.2E-09
25-Sep-2021	*12*	*10*	*12.1*	*11.8*	*20.1*	1572.0	94320	94320	210.78	1.00	27.66	0.40	0.50	4.2E-09
26-Sep-2021	*14*	*24*	*12.4*	*11.3*	*20.1*	1574.0	94440	188760	210.00	1.00	27.56	0.30	0.50	3.7E-09
28-Sep-2021	*10*	*54*	*13.1*	*10.6*	*20.1*	2670.0	160200	348960	208.58	1.01	27.37	0.70	0.75	4.0E-09
29-Sep-2021	*16*	*1*	*13.6*	*10.1*	*20.1*	1747.0	104820	453780	207.61	1.00	27.25	0.50	0.50	4.2E-09
1-Oct-2021	*9*	*4*	*14.5*	*9.6*	*20.1*	2463.0	147780	601560	206.34	1.01	27.08	0.85	0.45	3.9E-09
3-Oct-2021	*15*	*41*	*15.1*	*8.6*	*20.1*	3277.0	196620	798180	204.73	1.01	26.87	0.65	1.00	3.8E-09
5-Oct-2021	*11*	*51*	*15.8*	*8.0*	*20.1*	2650.0	159000	957180	203.42	1.01	26.70	0.70	0.65	3.8E-09
7-Oct-2021	*14*	*29*	*16.5*	*7.1*	*20.1*	3038.0	182280	1139460	201.96	1.01	26.50	0.65	0.85	3.7E-09
8-Oct-2021	*16*	*21*	*16.7*	*6.7*	*20.1*	1552.0	93120	1232580	201.27	1.00	26.41	0.25	0.45	3.4E-09
11-Oct-2021	*13*	*25*	*17.8*	*5.7*	*20.1*	4144.0	248640	1481220	199.28	1.01	26.15	1.10	0.95	3.8E-09
16-Oct-2021	*13*	*50*	*14.0*	*9.4*	*20.1*	3248.0	194880	194880	206.63	1.01	27.12	0.90	1.00	4.3E-09
18-Oct-2021	*9*	*21*	*14.6*	*8.7*	*20.1*	2611.0	156660	351540	205.32	1.01	26.94	0.65	0.70	3.9E-09
22-Oct-2021	*13*	*19*	*16.3*	*7.1*	*20.1*	5998.0	359880	711420	202.10	1.02	26.52	1.65	1.65	4.2E-09
25-Oct-2021	*9*	*39*	*17.3*	*6.0*	*20.1*	4100.0	246000	957420	200.06	1.01	26.25	1.05	1.05	3.9E-09
29-Oct-2021	*14*	*1*	*18.8*	*4.9*	*20.1*	6022.0	361320	1318740	197.52	1.01	25.92	1.50	1.10	3.3E-09
1-Nov-2021	*16*	*14*	*20.0*	*4.6*	*20.1*	4453.0	267180	1585920	196.06	1.01	25.73	1.15	0.35	2.6E-09
5-Nov-2021	*7*	*36*	*21.3*	*3.9*	*20.1*	5242.0	314520	314520	194.11	1.01	25.47	1.30	0.70	3.0E-09
8-Nov-2021	*14*	*42*	*22.4*	*3.0*	*20.1*	4746.0	284760	599280	192.17	1.01	25.22	1.15	0.85	3.4E-09
11-Nov-2021	*16*	*40*	*23.5*	*2.0*	*20.1*	4438.0	266280	865560	190.12	1.01	24.95	1.10	1.00	3.8E-09
14-Nov-2021	*17*	*20*	*25.3*	*0.6*	*20.1*	4360.0	261600	1127160	187.00	1.02	24.54	1.80	1.40	6.0E-09
16-Nov-2021	*11*	*12*	*25.6*	*0.3*	*20.1*	2512.0	150720	1277880	186.42	1.00	24.46	0.30	0.30	2.0E-09

***PERMEABILITY REPORTED AS | 3.4E-09 | cm/sec**

GOLDER
MEMBER OF WSP

11/24/2021

FLEXIBLE WALL TRIAXIAL PERMEABILITY
ASTM D 5084
METHOD C, FALLING HEAD W/INCREASING TAIL WATER PRESSURE

PROJECT NUMBER	**21451024**
SAMPLE ID	**N-ST-4**
SAMPLE TYPE	**Intact**

TIME FUNCTION			READINGS			TIME IN MINUTES & SECONDS						VOLUME		PERMEABILITY
DATE	HOUR	MIN	Inflow (cc)	Outflow (cc)	Temp.	dt (min)	dt (sec)	dt, acc (sec)	Head (cm)	(H1/H2) (inc.)	Gradient	Inflow (cc)	Outflow (cc)	@ 20 Degrees C (cm/sec)
8-Sep-2021	*16*	*40*	*3.7*	*21.2*	*20.1*	0.0	0.0	0	228.13		30.45			
9-Sep-2021	*16*	*12*	*3.9*	*21.2*	*20.1*	1412.0	84720	84720	227.98	1.00	30.43	0.15	0.00	
10-Sep-2021	*16*	*22*	*4.0*	*21.2*	*20.1*	1450.0	87000	171720	227.84	1.00	30.41	0.15	0.00	
11-Sep-2021	*10*	*55*	*4.2*	*21.3*	*20.1*	1113.0	66780	238500	227.69	1.00	30.39	0.20	0.00	
13-Sep-2021	*6*	*35*	*4.5*	*21.2*	*20.1*	2620.0	157200	395700	227.35	1.00	30.34	0.30	0.05	
14-Sep-2021	*7*	*58*	*4.7*	*21.2*	*20.1*	1523.0	91380	487080	227.16	1.00	30.32	0.20	0.00	
15-Sep-2021	*11*	*37*	*4.9*	*21.2*	*20.1*	1659.0	99540	586620	226.96	1.00	30.29	0.20	0.00	
16-Sep-2021	*11*	*36*	*5.0*	*21.2*	*20.1*	1439.0	86340	672960	226.81	1.00	30.27	0.10	0.05	
17-Sep-2021	*15*	*30*	*5.1*	*21.1*	*20.1*	1674.0	100440	773400	226.67	1.00	30.25	0.10	0.05	
20-Sep-2021	*12*	*46*	*5.4*	*21.0*	*20.1*	4156.0	249360	1022760	226.28	1.00	30.20	0.30	0.10	
25-Sep-2021	*12*	*12*	*12.5*	*14.4*	*20.1*	1576.0	94560	94560	212.98	1.00	28.42	0.15	0.05	
26-Sep-2021	*14*	*21*	*12.4*	*14.3*	*20.1*	1569.0	94140	188700	212.93	1.00	28.42	0.00	0.10	
28-Sep-2021	*10*	*56*	*12.6*	*14.2*	*20.1*	2675.0	160500	349200	212.64	1.00	28.38	0.20	0.10	
29-Sep-2021	*15*	*58*	*12.7*	*14.1*	*20.1*	1742.0	104520	453720	212.44	1.00	28.35	0.10	0.10	
1-Oct-2021	*8*	*58*	*13.1*	*14.2*	*20.1*	2460.0	147600	601320	212.15	1.00	28.31	0.40	0.00	
3-Oct-2021	*15*	*40*	*13.1*	*14.0*	*20.1*	3282.0	196920	798240	211.95	1.00	28.29	0.00	0.20	Steady State Flow Not Yet Achieved
5-Oct-2021	*11*	*50*	*13.4*	*14.0*	*20.1*	2650.0	159000	957240	211.66	1.00	28.25	0.25	0.05	
7-Oct-2021	*14*	*31*	*13.4*	*13.8*	*20.1*	3041.0	182460	1139700	211.47	1.00	28.22	0.05	0.15	
8-Oct-2021	*16*	*19*	*13.4*	*13.8*	*20.1*	1548.0	92880	1232580	211.42	1.00	28.22	0.00	0.05	
11-Oct-2021	*13*	*23*	*13.9*	*13.7*	*20.1*	4144.0	248640	1481220	210.88	1.00	28.14	0.50	0.05	
16-Oct-2021	*13*	*52*	*14.7*	*12.9*	*20.1*	3251.0	195060	195060	209.32	1.00	27.94	0.10	0.00	
18-Oct-2021	*9*	*19*	*14.8*	*12.8*	*20.1*	2607.0	156420	351480	209.13	1.00	27.91	0.10	0.10	
22-Oct-2021	*13*	*21*	*15.1*	*12.7*	*20.1*	6002.0	360120	711600	208.74	1.00	27.86	0.30	0.10	
25-Oct-2021	*9*	*38*	*15.3*	*12.6*	*20.1*	4097.0	245820	957420	208.45	1.00	27.82	0.15	0.15	
29-Oct-2021	*14*	*0*	*15.5*	*12.4*	*20.1*	6022.0	361320	1318740	208.06	1.00	27.77	0.25	0.15	
1-Nov-2021	*15*	*48*	*15.9*	*12.3*	*20.1*	4428.0	265680	1584420	207.62	1.00	27.71	0.35	0.10	
5-Nov-2021	*7*	*37*	*16.2*	*12.2*	*20.1*	5269.0	316140	316140	207.23	1.00	27.66	0.30	0.10	
8-Nov-2021	*14*	*43*	*16.4*	*12.1*	*20.1*	4746.0	284760	600900	206.89	1.00	27.61	0.25	0.10	
11-Nov-2021	*16*	*43*	*16.6*	*12.0*	*20.1*	4440.0	266400	867300	206.60	1.00	27.57	0.20	0.10	
14-Nov-2021	*17*	*20*	*16.8*	*11.9*	*20.1*	4357.0	261420	1128720	206.30	1.00	27.53	0.20	0.10	
16-Nov-2021	*11*	*19*	*16.9*	*11.8*	*20.1*	2519.0	151140	1279860	206.11	1.00	27.51	0.10	0.10	

***PERMEABILITY REPORTED AS N/A cm/sec**

APPENDIX D

Mathematical Model

APPENDIX D-1

Model Inputs Summary

Appendix D1: Summarized Model Input Parameters

Parameter	Value	Unit	Reference
Source-Specific Inputs			
Waste Site Area	293663	m^2	UR-91 waste footprint area
Leachate Concentration	Empirical distribution for each Constituent	mg/L	Table 7 of this report
Areal Recharge Rate	0.024	m/yr	Table A.14 in USEPA (2003b)
Infiltration Rate through Liner	Empirical distribution for each Liner Type	m/yr	Table 6 and Section 5.6 of this report
Ponding Depth	5.8	m	19 feet. Time-weighted average head on liner from initial operation through post-closure period (Section 5.5 of this report)
Hydraulic Conductivity of the Liner	0.0315	m/yr	1E-7 cm/sec (Section 5.3 of this report)
Source Leaching Duration	75	yr	Initial operation through post-closure period of UR-91 (Section 5.5 of this report)
Impoundment Liner Depth Below Ground Surface	1.8	m	6 feet. UR-91 design
Leak Density for Composite Liner	Empirical distribution for each Liner Type	defects/hectare	Section 5.4 of this report
Distance to nearest surface water body	110	m	360 feet. Distance from UR-91 to Lower Samuelson Slough
Unsaturated Zone Inputs			
Saturated Hydraulic Conductivity	Empirical distribution	cm/hr	Laboratory testing of native site soils (Table 3 and Section 3.4.2 of this report)
van Genuchten alpha (moisture retention parameter)	0.00021	1/cm	SWCC testing of native site soils (Appendix A5, Section 3.4.3 of this report)
van Genuchten n (beta moisture retention parameter)	1.37	--	
Residual Water Content	0	--	
Saturated Water Content	0.35	--	
Unsaturated Zone Thickness Below Ground Surface	4.9	m	16 feet. Area-weighted average thickness of native soils
Bulk Density	1.65	g/cm^3	Estimated, typical value
Soil-Water Partition Coefficient, Kd	Empirical distribution for each Constituent	cm^3/g	Table H-3-4 in USEPA (2014)
Saturated Zone Inputs			
Effective Porosity	0.30	--	Glacial till from Ohio EPA (2006)
Saturated Zone Thickness	12.4	m	Calculated from site groundwater monitoring wells
Saturated Hydraulic Conductivity	Empirical distribution	m/yr	In situ testing of uppermost saturated zone (Table 2 and Section 3.4.1 of this report)
Anisotropy Ratio	1	--	Assumed isotropic
Groundwater Gradient	Distribution between 0.01 and 0.02	m/m	Calculated from site groundwater data (Section 3.5 of this report)
Retardation Factor	Empirical distribution for each Constituent	--	Calculated from bulk density, effective porosity, and Kd distributions in Table H-3-4, USEPA (2014)
Longitudinal Dispersivity	1	m	Estimated based on 10% of small field scale (Xu and Eckstein 1995)
Transverse Dispersivity	0.1	m	Estimated, 10% of longitudinal dispersivity (Gelhar et al. 1992)
Vertical Dispersivity	0.01	m	Estimated, 10% of transverse dispersivity (Gelhar et al. 1992)
Receptor Well Location Inputs			
Well downgradient distance from edge of waste	0	m	
Well distance from plume centerline	0	m	
Well depth below water table	0.001	m	

Note:

m^2 = square meter

mg/L = milligram per liter

m = meter

yr = year

cm/hr = centimeter per hour

-- = unitless

g/cm^3 = grams per cubic centimeter

SWCC = Soil Water Characteristic Curve

Lithium and radium were each modeled as a conservative constituent, i.e., no sorption, retardation, or decay in the unsaturated or saturated zones

Additional model parameters were calculated from the input values

APPENDIX D-2

Leachate Water Quality

Appendix D2: Leachate Concentrations Used for Model Input Distributions

Data Source	Sample ID	Sample Date	Analyte	Result	Unit	Detect
CCS Site-Specific	Sump-UR91	11/5/2018	Antimony	0.0052	mg/L	Y
CCS Site-Specific	Sump-NW-SW16	10/21/2019	Antimony	0.0035	mg/L	Y
CCS Site-Specific	Sump-N-AP92	10/31/2019	Antimony	0.001	mg/L	N
CCS Site-Specific	Sump-SE-SW16	12/18/2019	Antimony	0.001	mg/L	N
CCS Site-Specific	Sump-SE-SW16	4/22/2020	Antimony	0.001	mg/L	N
CCS Site-Specific	Sump-UR91	6/21/2021	Antimony	0.0078	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	6/21/2021	Antimony	0.001	mg/L	N
CCS Site-Specific	Sump-UR91	8/19/2021	Antimony	0.014	mg/L	Y
CCS Site-Specific	Sump-N-AP92	9/1/2021	Antimony	0.001	mg/L	N
CCS Site-Specific	Sump-UR91	11/5/2018	Arsenic	0.11	mg/L	Y
CCS Site-Specific	Sump-NW-SW16	10/21/2019	Arsenic	0.0087	mg/L	Y
CCS Site-Specific	Sump-N-AP92	10/31/2019	Arsenic	0.0025	mg/L	N
CCS Site-Specific	Sump-SE-SW16	12/18/2019	Arsenic	0.0025	mg/L	N
CCS Site-Specific	Sump-SE-SW16	4/22/2020	Arsenic	0.015	mg/L	Y
CCS Site-Specific	Sump-UR91	6/21/2021	Arsenic	0.042	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	6/21/2021	Arsenic	0.013	mg/L	Y
CCS Site-Specific	Sump-UR91	8/19/2021	Arsenic	0.027	mg/L	Y
CCS Site-Specific	Sump-N-AP92	9/1/2021	Arsenic	0.0025	mg/L	N
Regional Data	CYSB-1	---	Arsenic	0.0716	mg/L	Y
Regional Data	CYSB-1	---	Arsenic	0.078	mg/L	Y
Regional Data	CYSB-2	---	Arsenic	0.0414	mg/L	Y
Regional Data	CYSB-2	---	Arsenic	0.599	mg/L	Y
CCS Site-Specific	Sump-UR91	11/5/2018	Barium	0.034	mg/L	Y
CCS Site-Specific	Sump-NW-SW16	10/21/2019	Barium	0.053	mg/L	Y
CCS Site-Specific	Sump-N-AP92	10/31/2019	Barium	0.037	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	12/18/2019	Barium	0.0005	mg/L	N
CCS Site-Specific	Sump-SE-SW16	4/22/2020	Barium	0.13	mg/L	Y
CCS Site-Specific	Sump-UR91	6/21/2021	Barium	0.21	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	6/21/2021	Barium	0.11	mg/L	Y
CCS Site-Specific	Sump-UR91	8/19/2021	Barium	0.1	mg/L	Y
CCS Site-Specific	Sump-N-AP92	9/1/2021	Barium	0.039	mg/L	Y

Appendix D2: Leachate Concentrations Used for Model Input Distributions

Data Source	Sample ID	Sample Date	Analyte	Result	Unit	Detect
Regional Data	CYSB-1	---	Barium	0.148	mg/L	Y
Regional Data	CYSB-1	---	Barium	0.375	mg/L	Y
Regional Data	CYSB-2	---	Barium	0.154	mg/L	Y
Regional Data	CYSB-2	---	Barium	0.0419	mg/L	Y
CCS Site-Specific	Sump-UR91	11/5/2018	Beryllium	0.0025	mg/L	N
CCS Site-Specific	Sump-NW-SW16	10/21/2019	Beryllium	0.0005	mg/L	N
CCS Site-Specific	Sump-N-AP92	10/31/2019	Beryllium	0.0005	mg/L	N
CCS Site-Specific	Sump-SE-SW16	12/18/2019	Beryllium	0.0005	mg/L	N
CCS Site-Specific	Sump-SE-SW16	4/22/2020	Beryllium	0.0005	mg/L	N
CCS Site-Specific	Sump-UR91	6/21/2021	Beryllium	0.0011	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	6/21/2021	Beryllium	0.0005	mg/L	N
CCS Site-Specific	Sump-UR91	8/19/2021	Beryllium	0.0005	mg/L	N
CCS Site-Specific	Sump-N-AP92	9/1/2021	Beryllium	0.0005	mg/L	N
CCS Site-Specific	Sump-UR91	11/5/2018	Cadmium	0.0005	mg/L	N
CCS Site-Specific	Sump-NW-SW16	10/21/2019	Cadmium	0.0005	mg/L	N
CCS Site-Specific	Sump-N-AP92	10/31/2019	Cadmium	0.0005	mg/L	N
CCS Site-Specific	Sump-SE-SW16	12/18/2019	Cadmium	0.0005	mg/L	N
CCS Site-Specific	Sump-SE-SW16	4/22/2020	Cadmium	0.0005	mg/L	N
CCS Site-Specific	Sump-UR91	6/21/2021	Cadmium	0.0005	mg/L	N
CCS Site-Specific	Sump-SE-SW16	6/21/2021	Cadmium	0.0005	mg/L	N
CCS Site-Specific	Sump-UR91	8/19/2021	Cadmium	0.0005	mg/L	N
CCS Site-Specific	Sump-N-AP92	9/1/2021	Cadmium	0.0005	mg/L	N
Regional Data	CYSB-1	---	Cadmium	0.00125	mg/L	N
Regional Data	CYSB-1	---	Cadmium	0.0125	mg/L	N
Regional Data	CYSB-2	---	Cadmium	0.00125	mg/L	N
Regional Data	CYSB-2	---	Cadmium	0.00125	mg/L	N
CCS Site-Specific	Sump-UR91	11/5/2018	Chromium	0.001	mg/L	N
CCS Site-Specific	Sump-NW-SW16	10/21/2019	Chromium	0.035	mg/L	Y
CCS Site-Specific	Sump-N-AP92	10/31/2019	Chromium	0.014	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	12/18/2019	Chromium	0.001	mg/L	N

Appendix D2: Leachate Concentrations Used for Model Input Distributions

Data Source	Sample ID	Sample Date	Analyte	Result	Unit	Detect
CCS Site-Specific	Sump-SE-SW16	4/22/2020	Chromium	0.001	mg/L	N
CCS Site-Specific	Sump-UR91	6/21/2021	Chromium	0.017	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	6/21/2021	Chromium	0.001	mg/L	N
CCS Site-Specific	Sump-UR91	8/19/2021	Chromium	0.0022	mg/L	Y
CCS Site-Specific	Sump-N-AP92	9/1/2021	Chromium	0.001	mg/L	N
Regional Data	CYSB-1	---	Chromium	0.00373	mg/L	Y
Regional Data	CYSB-1	---	Chromium	0.0125	mg/L	N
Regional Data	CYSB-2	---	Chromium	0.00125	mg/L	N
Regional Data	CYSB-2	---	Chromium	0.00125	mg/L	N
CCS Site-Specific	Sump-UR91	11/5/2018	Cobalt	0.0005	mg/L	N
CCS Site-Specific	Sump-NW-SW16	10/21/2019	Cobalt	0.0027	mg/L	Y
CCS Site-Specific	Sump-N-AP92	10/31/2019	Cobalt	0.0005	mg/L	N
CCS Site-Specific	Sump-SE-SW16	12/18/2019	Cobalt	0.0005	mg/L	N
CCS Site-Specific	Sump-SE-SW16	4/22/2020	Cobalt	0.0005	mg/L	N
CCS Site-Specific	Sump-UR91	6/21/2021	Cobalt	0.0028	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	6/21/2021	Cobalt	0.0005	mg/L	N
CCS Site-Specific	Sump-UR91	8/19/2021	Cobalt	0.0005	mg/L	N
CCS Site-Specific	Sump-N-AP92	9/1/2021	Cobalt	0.0005	mg/L	N
CCS Site-Specific	Sump-UR91	11/5/2018	Fluoride	0.78	mg/L	Y
CCS Site-Specific	Sump-NW-SW16	10/21/2019	Fluoride	1.7	mg/L	Y
CCS Site-Specific	Sump-N-AP92	10/31/2019	Fluoride	1.6	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	12/18/2019	Fluoride	0.29	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	4/22/2020	Fluoride	0.32	mg/L	Y
CCS Site-Specific	Sump-UR91	6/21/2021	Fluoride	2.1	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	6/21/2021	Fluoride	0.32	mg/L	Y
CCS Site-Specific	Sump-UR91	8/19/2021	Fluoride	2.8	mg/L	Y
CCS Site-Specific	Sump-N-AP92	9/1/2021	Fluoride	1.5	mg/L	Y
Regional Data	CYSB-1	---	Fluoride	2	mg/L	N
Regional Data	CYSB-1	---	Fluoride	1	mg/L	N
Regional Data	CYSB-2	---	Fluoride	0.5	mg/L	N

Appendix D2: Leachate Concentrations Used for Model Input Distributions

Data Source	Sample ID	Sample Date	Analyte	Result	Unit	Detect
Regional Data	CYSB-2	---	Fluoride	2	mg/L	N
CCS Site-Specific	Sump-UR91	11/5/2018	Lead	0.001	mg/L	N
CCS Site-Specific	Sump-NW-SW16	10/21/2019	Lead	0.001	mg/L	N
CCS Site-Specific	Sump-N-AP92	10/31/2019	Lead	0.001	mg/L	N
CCS Site-Specific	Sump-SE-SW16	12/18/2019	Lead	0.001	mg/L	N
CCS Site-Specific	Sump-SE-SW16	4/22/2020	Lead	0.001	mg/L	N
CCS Site-Specific	Sump-UR91	6/21/2021	Lead	0.0038	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	6/21/2021	Lead	0.001	mg/L	N
CCS Site-Specific	Sump-UR91	8/19/2021	Lead	0.001	mg/L	N
CCS Site-Specific	Sump-N-AP92	9/1/2021	Lead	0.001	mg/L	N
Regional Data	CYSB-1	---	Lead	0.0025	mg/L	N
Regional Data	CYSB-1	---	Lead	0.025	mg/L	N
Regional Data	CYSB-2	---	Lead	0.0025	mg/L	N
Regional Data	CYSB-2	---	Lead	0.0025	mg/L	N
CCS Site-Specific	Sump-UR91	11/5/2018	Lithium	0.68	mg/L	Y
CCS Site-Specific	Sump-NW-SW16	10/21/2019	Lithium	1	mg/L	Y
CCS Site-Specific	Sump-N-AP92	10/31/2019	Lithium	0.87	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	12/18/2019	Lithium	0.32	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	4/22/2020	Lithium	0.32	mg/L	Y
CCS Site-Specific	Sump-UR91	6/21/2021	Lithium	0.45	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	6/21/2021	Lithium	0.33	mg/L	Y
CCS Site-Specific	Sump-UR91	8/19/2021	Lithium	0.45	mg/L	Y
CCS Site-Specific	Sump-N-AP92	9/1/2021	Lithium	0.95	mg/L	Y
CCS Site-Specific	Sump-UR91	11/5/2018	Mercury	0.0002	mg/L	N
CCS Site-Specific	Sump-NW-SW16	10/21/2019	Mercury	0.0002	mg/L	N
CCS Site-Specific	Sump-N-AP92	10/31/2019	Mercury	0.0002	mg/L	N
CCS Site-Specific	Sump-SE-SW16	12/18/2019	Mercury	0.0002	mg/L	N
CCS Site-Specific	Sump-SE-SW16	4/22/2020	Mercury	0.0002	mg/L	N
CCS Site-Specific	Sump-UR91	6/21/2021	Mercury	0.0002	mg/L	N
CCS Site-Specific	Sump-SE-SW16	6/21/2021	Mercury	0.0002	mg/L	N

Appendix D2: Leachate Concentrations Used for Model Input Distributions

Data Source	Sample ID	Sample Date	Analyte	Result	Unit	Detect
CCS Site-Specific	Sump-UR91	8/19/2021	Mercury	0.0002	mg/L	N
CCS Site-Specific	Sump-N-AP92	9/1/2021	Mercury	0.0002	mg/L	N
CCS Site-Specific	Sump-UR91	11/5/2018	Molybdenum	0.085	mg/L	Y
CCS Site-Specific	Sump-NW-SW16	10/21/2019	Molybdenum	0.98	mg/L	Y
CCS Site-Specific	Sump-N-AP92	10/31/2019	Molybdenum	0.27	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	12/18/2019	Molybdenum	0.002	mg/L	N
CCS Site-Specific	Sump-SE-SW16	4/22/2020	Molybdenum	1.5	mg/L	Y
CCS Site-Specific	Sump-UR91	6/21/2021	Molybdenum	0.23	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	6/21/2021	Molybdenum	1.4	mg/L	Y
CCS Site-Specific	Sump-UR91	8/19/2021	Molybdenum	0.28	mg/L	Y
CCS Site-Specific	Sump-N-AP92	9/1/2021	Molybdenum	0.26	mg/L	Y
Regional Data	CYSB-1	---	Molybdenum	0.77	mg/L	Y
Regional Data	CYSB-1	---	Molybdenum	0.56	mg/L	Y
Regional Data	CYSB-2	---	Molybdenum	0.71	mg/L	Y
Regional Data	CYSB-2	---	Molybdenum	0.58	mg/L	Y
CCS Site-Specific	Sump-UR91	11/5/2018	Radium-226	0.0468	pCi/L	Y
CCS Site-Specific	Sump-NW-SW16	10/21/2019	Radium-226	-0.0303	pCi/L	Y
CCS Site-Specific	Sump-SE-SW16	12/18/2019	Radium-226	0.145	pCi/L	Y
CCS Site-Specific	Sump-UR91	6/21/2021	Radium-226	0.401	pCi/L	Y
CCS Site-Specific	Sump-SE-SW16	6/21/2021	Radium-226	0.171	pCi/L	Y
CCS Site-Specific	Sump-UR91	8/19/2021	Radium-226	0.298	pCi/L	Y
CCS Site-Specific	Sump-N-AP92	9/1/2021	Radium-226	0.0344	pCi/L	Y
CCS Site-Specific	Sump-UR91	11/5/2018	Radium-228	0.367	pCi/L	Y
CCS Site-Specific	Sump-NW-SW16	10/21/2019	Radium-228	0.102	pCi/L	Y
CCS Site-Specific	Sump-SE-SW16	12/18/2019	Radium-228	0.481	pCi/L	Y
CCS Site-Specific	Sump-UR91	6/21/2021	Radium-228	0.934	pCi/L	Y
CCS Site-Specific	Sump-SE-SW16	6/21/2021	Radium-228	0.788	pCi/L	Y
CCS Site-Specific	Sump-UR91	8/19/2021	Radium-228	0.278	pCi/L	Y
CCS Site-Specific	Sump-N-AP92	9/1/2021	Radium-228	0.804	pCi/L	Y

Appendix D2: Leachate Concentrations Used for Model Input Distributions

Data Source	Sample ID	Sample Date	Analyte	Result	Unit	Detect
CCS Site-Specific	Sump-UR91	11/5/2018	Selenium	0.005	mg/L	N
CCS Site-Specific	Sump-NW-SW16	10/21/2019	Selenium	0.033	mg/L	Y
CCS Site-Specific	Sump-N-AP92	10/31/2019	Selenium	0.025	mg/L	N
CCS Site-Specific	Sump-SE-SW16	12/18/2019	Selenium	0.005	mg/L	N
CCS Site-Specific	Sump-SE-SW16	4/22/2020	Selenium	0.025	mg/L	N
CCS Site-Specific	Sump-UR91	6/21/2021	Selenium	0.0093	mg/L	Y
CCS Site-Specific	Sump-SE-SW16	6/21/2021	Selenium	0.01	mg/L	Y
CCS Site-Specific	Sump-UR91	8/19/2021	Selenium	0.0058	mg/L	Y
CCS Site-Specific	Sump-N-AP92	9/1/2021	Selenium	0.005	mg/L	N
Regional Data	CYSB-1	---	Selenium	0.2	mg/L	Y
Regional Data	CYSB-1	---	Selenium	0.01	mg/L	N
Regional Data	CYSB-2	---	Selenium	0.0203	mg/L	Y
Regional Data	CYSB-2	---	Selenium	0.116	mg/L	Y
CCS Site-Specific	Sump-UR91	11/5/2018	Thallium	0.001	mg/L	N
CCS Site-Specific	Sump-NW-SW16	10/21/2019	Thallium	0.001	mg/L	N
CCS Site-Specific	Sump-N-AP92	10/31/2019	Thallium	0.001	mg/L	N
CCS Site-Specific	Sump-SE-SW16	12/18/2019	Thallium	0.001	mg/L	N
CCS Site-Specific	Sump-SE-SW16	4/22/2020	Thallium	0.001	mg/L	N
CCS Site-Specific	Sump-UR91	6/21/2021	Thallium	0.001	mg/L	N
CCS Site-Specific	Sump-SE-SW16	6/21/2021	Thallium	0.001	mg/L	N
CCS Site-Specific	Sump-UR91	8/19/2021	Thallium	0.001	mg/L	N
CCS Site-Specific	Sump-N-AP92	9/1/2021	Thallium	0.001	mg/L	N

Notes:

CCS site-specific data compiled from Coal Creek Station (CCS) sump leachate chemistry data

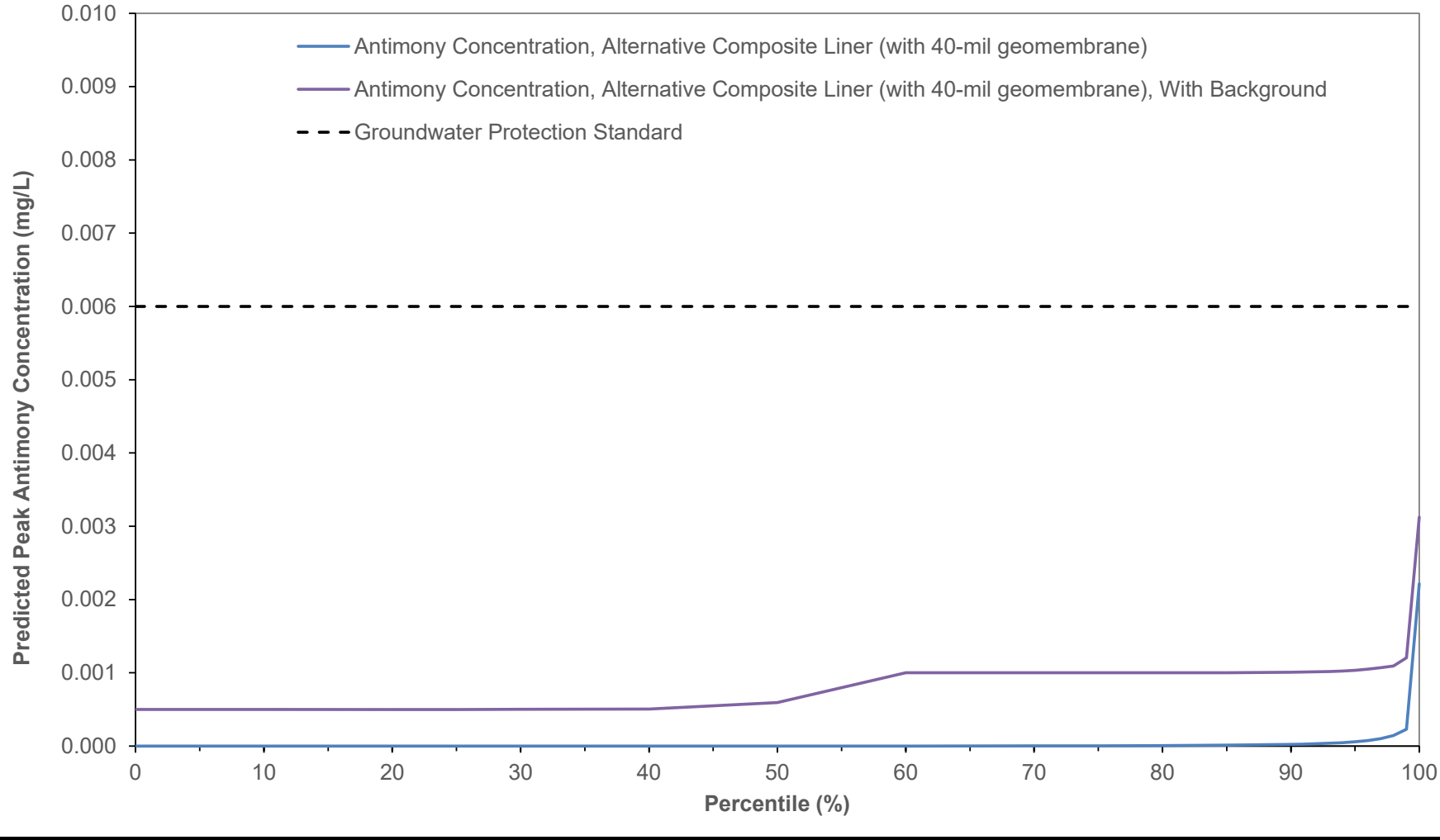
Regional data compiled from USEPA (2010), using porewater data from site CY (North Dakota Lignite)

--- : Unknown sample date

Non-detect values are reported at half of the laboratory Practical Quantitation Limit (PQL)

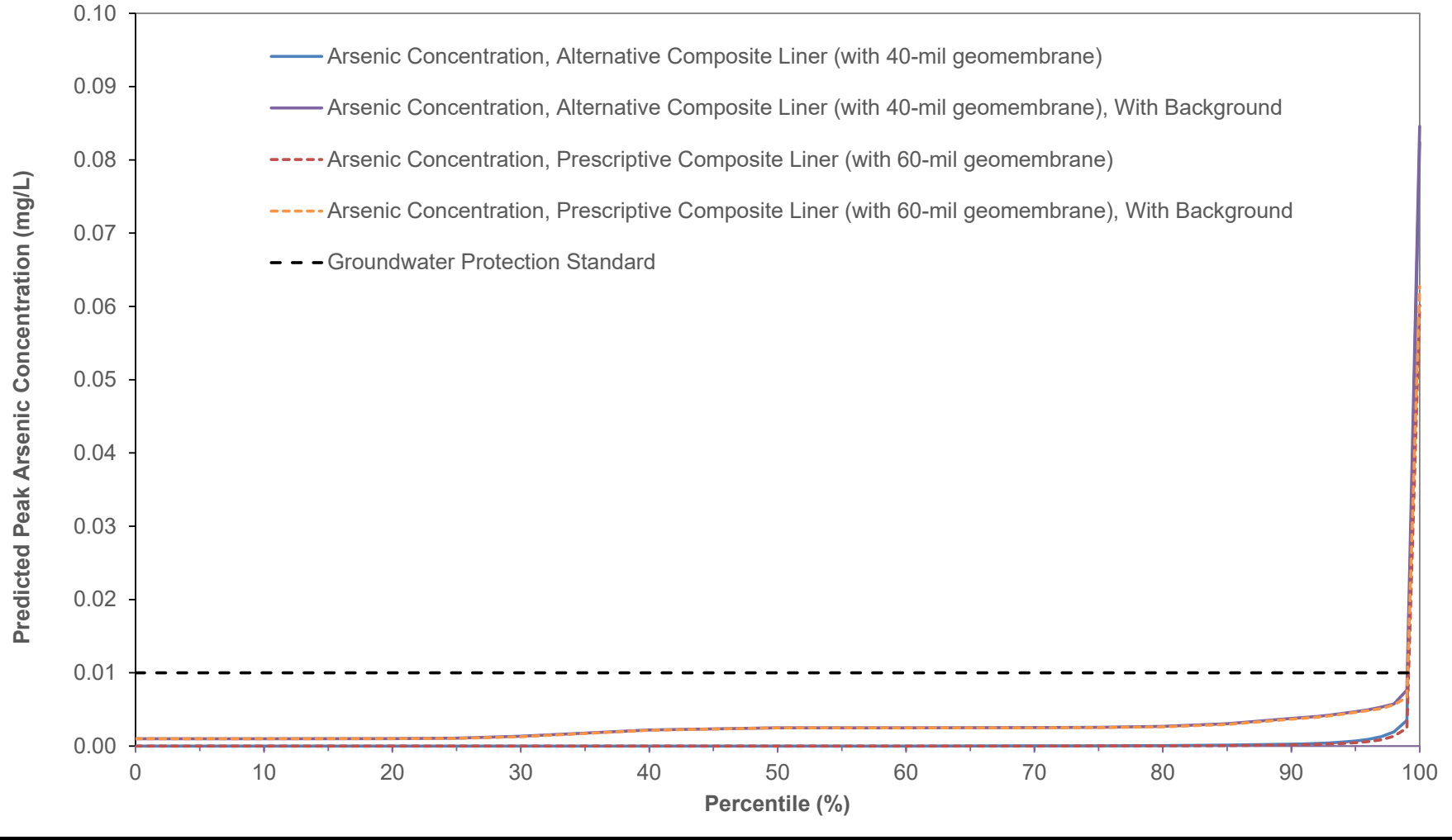
APPENDIX D-3

Model Results



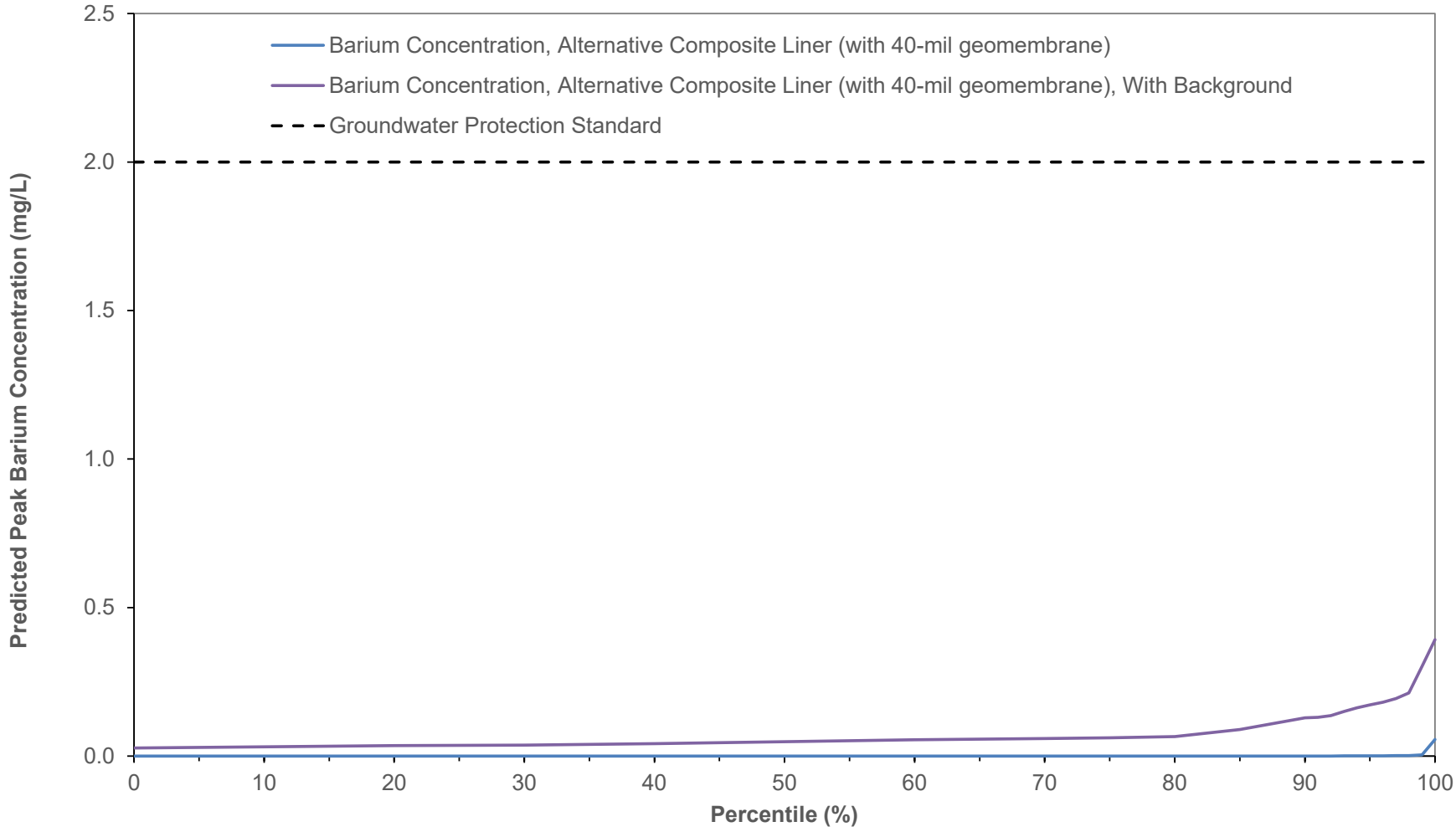
GOLDER
MEMBER OF WSP

Title	**Percentile Plot for Peak Antimony Concentrations at Waste Boundary**		
Project Name	Alternative Liner Demonstration	Project No. 21451024	FIGURE 1
Client Name	Great River Energy - Coal Creek Station	Date 11/29/2021	



GOLDER
MEMBER OF WSP

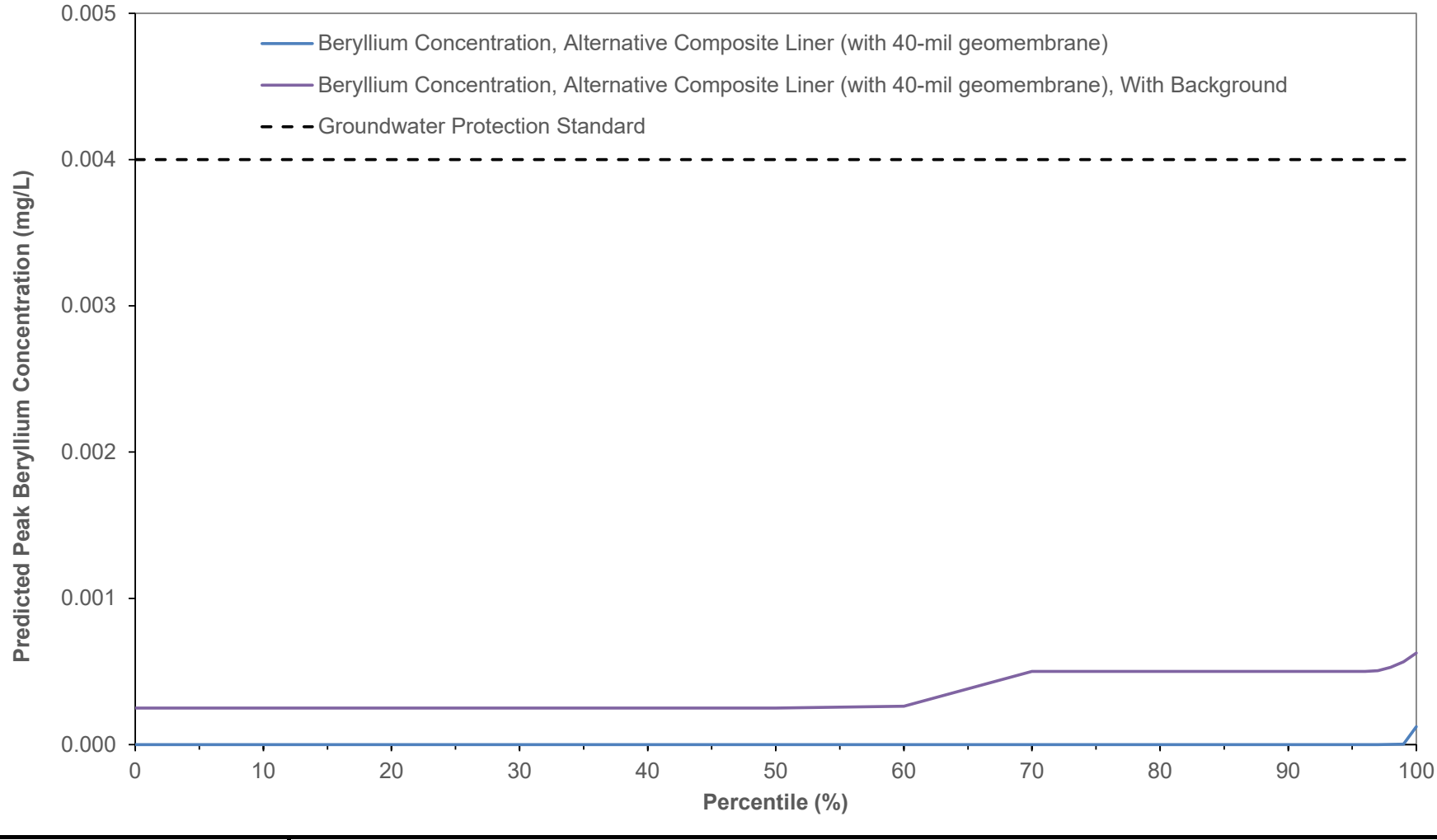
Title	**Percentile Plot for Peak Arsenic Concentrations at Waste Boundary**		
Project Name	Alternative Liner Demonstration	Project No. 21451024	FIGURE 2
Client Name	Great River Energy - Coal Creek Station	Date 11/29/2021	



GOLDER
MEMBER OF WSP

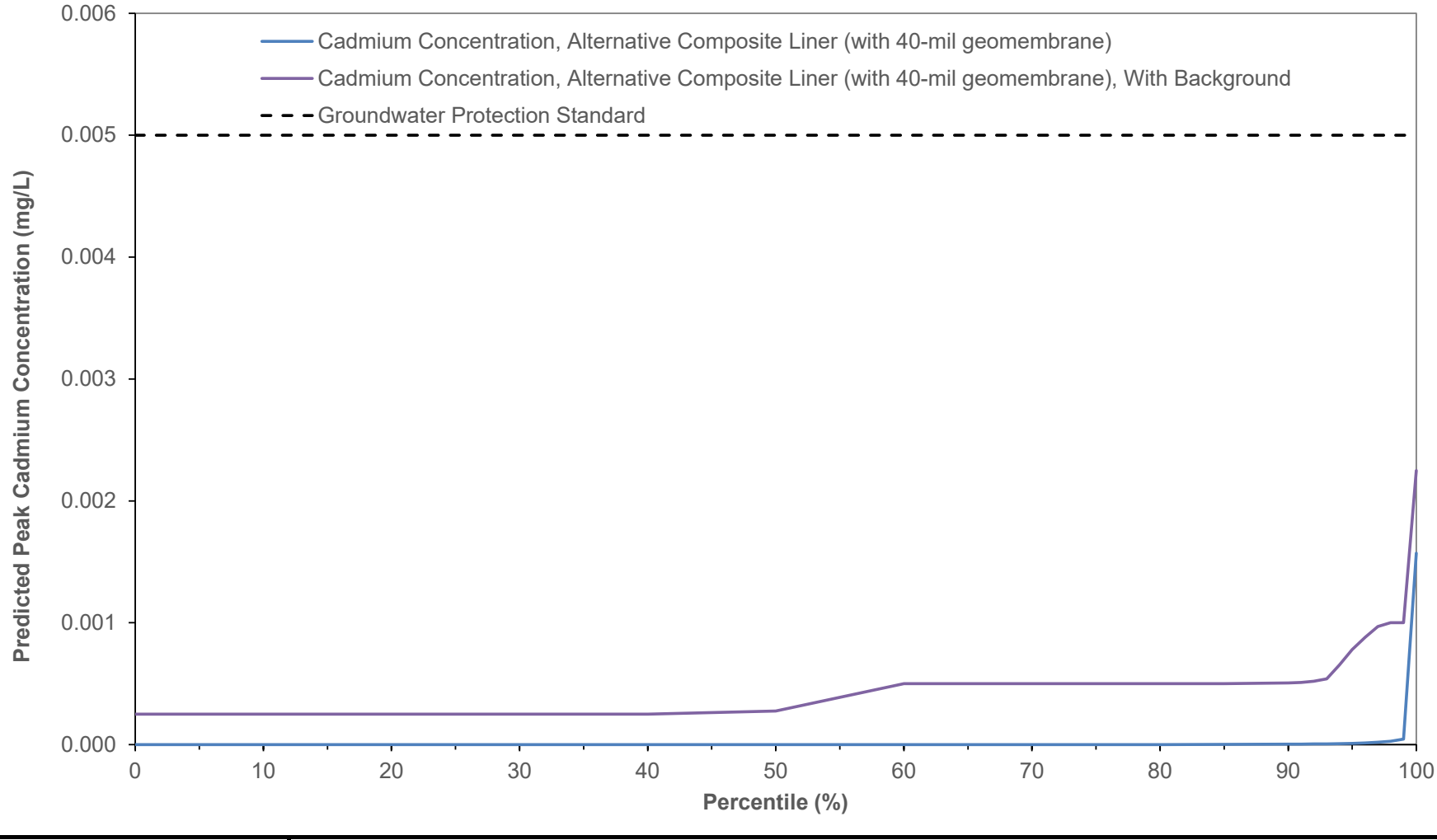
Title: **Percentile Plot for Peak Barium Concentrations at Waste Boundary**

Project Name	Alternative Liner Demonstration	Project No. 21451024	FIGURE 3
Client Name	Great River Energy - Coal Creek Station	Date 11/29/2021	



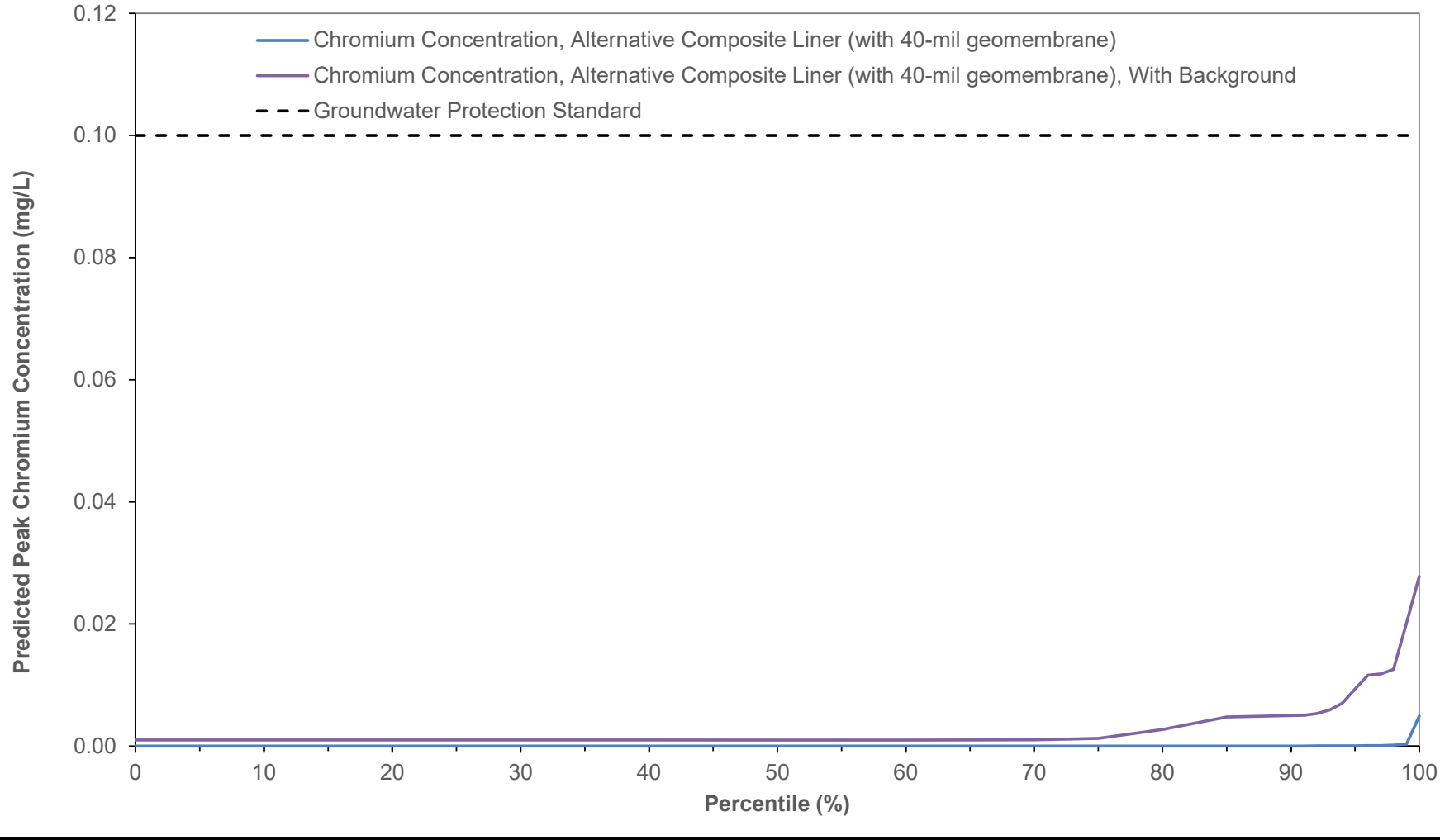
GOLDER
MEMBER OF WSP

Title	**Percentile Plot for Peak Beryllium Concentrations at Waste Boundary**		
Project Name	Alternative Liner Demonstration	Project No. 21451024	FIGURE 4
Client Name	Great River Energy - Coal Creek Station	Date 11/29/2021	



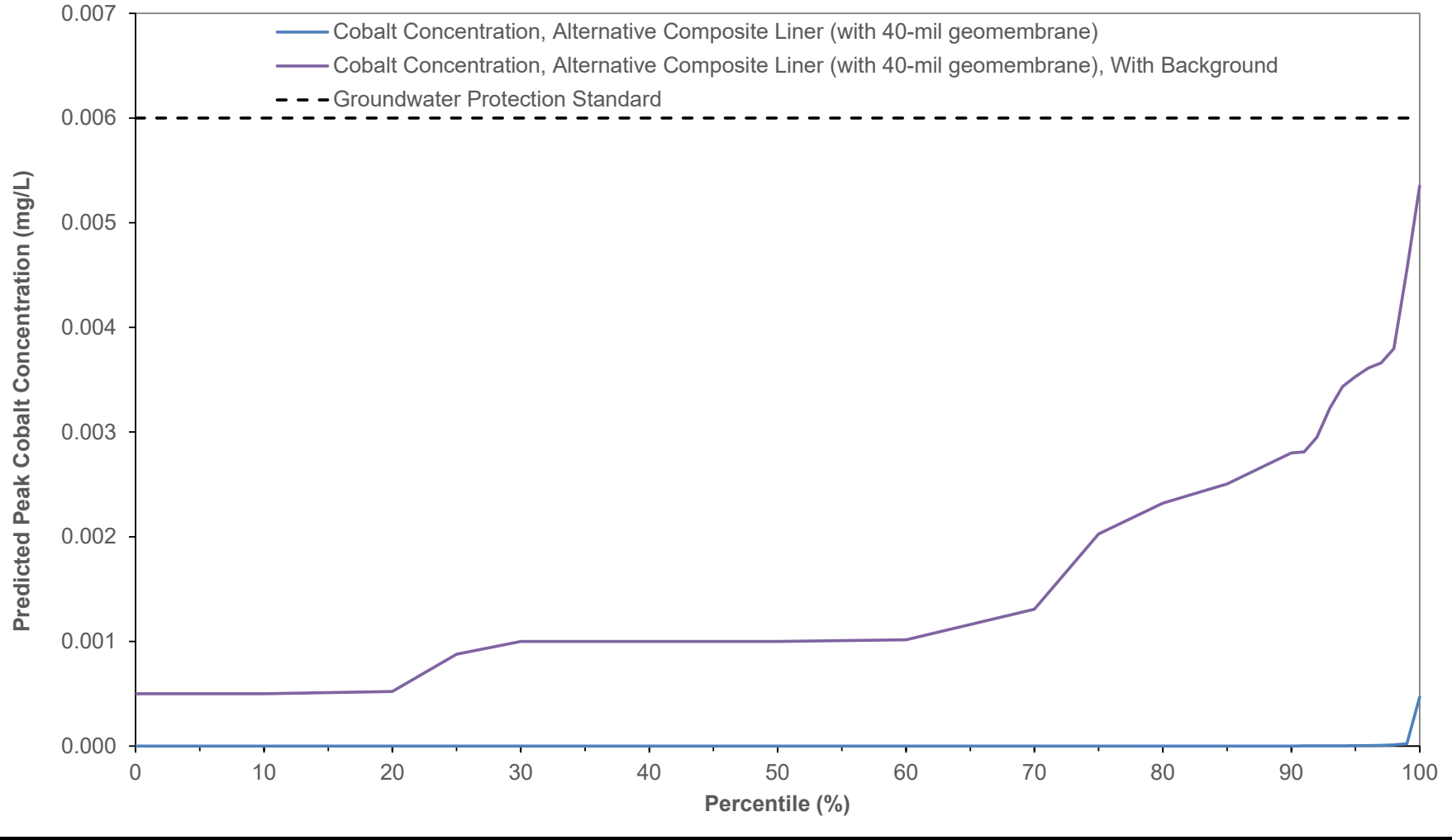
GOLDER
MEMBER OF WSP

Title	**Percentile Plot for Peak Cadmium Concentrations at Waste Boundary**		
Project Name	Alternative Liner Demonstration	Project No. 21451024	FIGURE 5
Client Name	Great River Energy - Coal Creek Station	Date 11/29/2021	



GOLDER
MEMBER OF WSP

Title	**Percentile Plot for Peak Chromium Concentrations at Waste Boundary**		
Project Name	Alternative Liner Demonstration	Project No. 21451024	FIGURE 6
Client Name	Great River Energy - Coal Creek Station	Date 11/29/2021	



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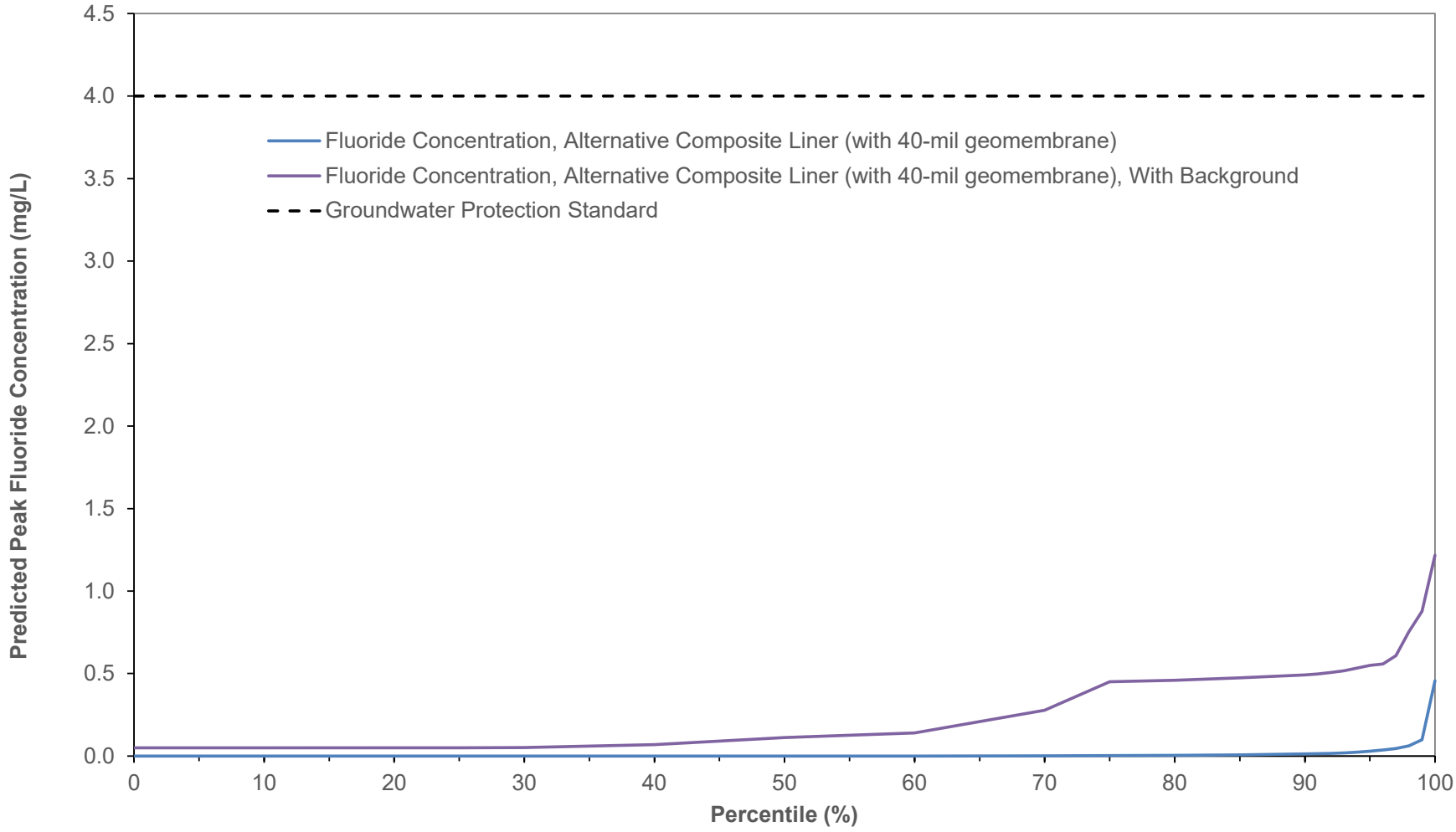
Title	**Percentile Plot for Peak Cobalt Concentrations at Waste Boundary**		
Project Name	Alternative Liner Demonstration	Project No. 21451024	FIGURE 7
Client Name	Great River Energy - Coal Creek Station	Date 11/29/2021	



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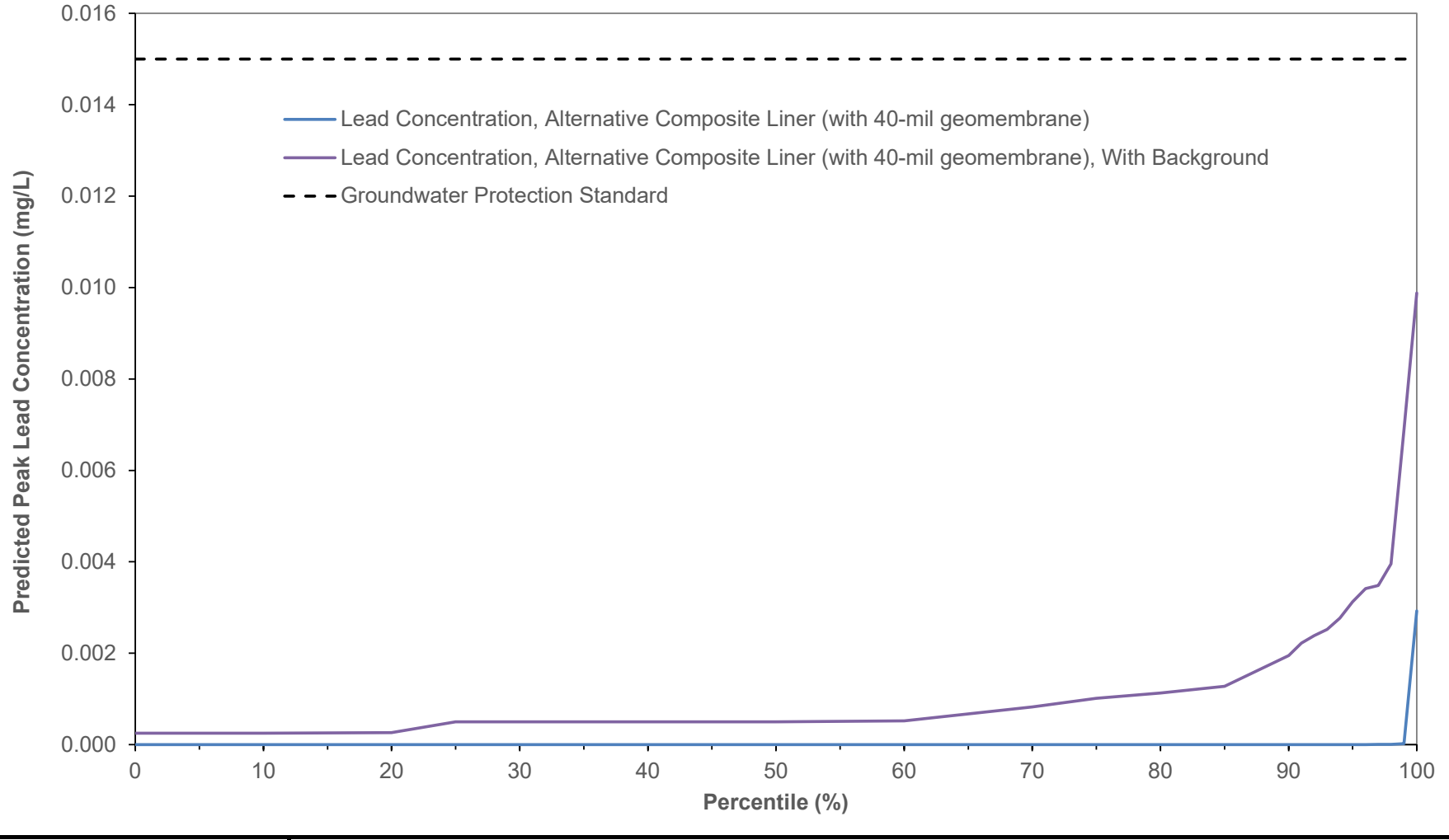
Title: **Percentile Plot for Peak Fluoride Concentrations at Waste Boundary**

Project Name	Alternative Liner Demonstration	Project No.	21451024
Client Name	Great River Energy - Coal Creek Station	Date	11/29/2021

FIGURE
8



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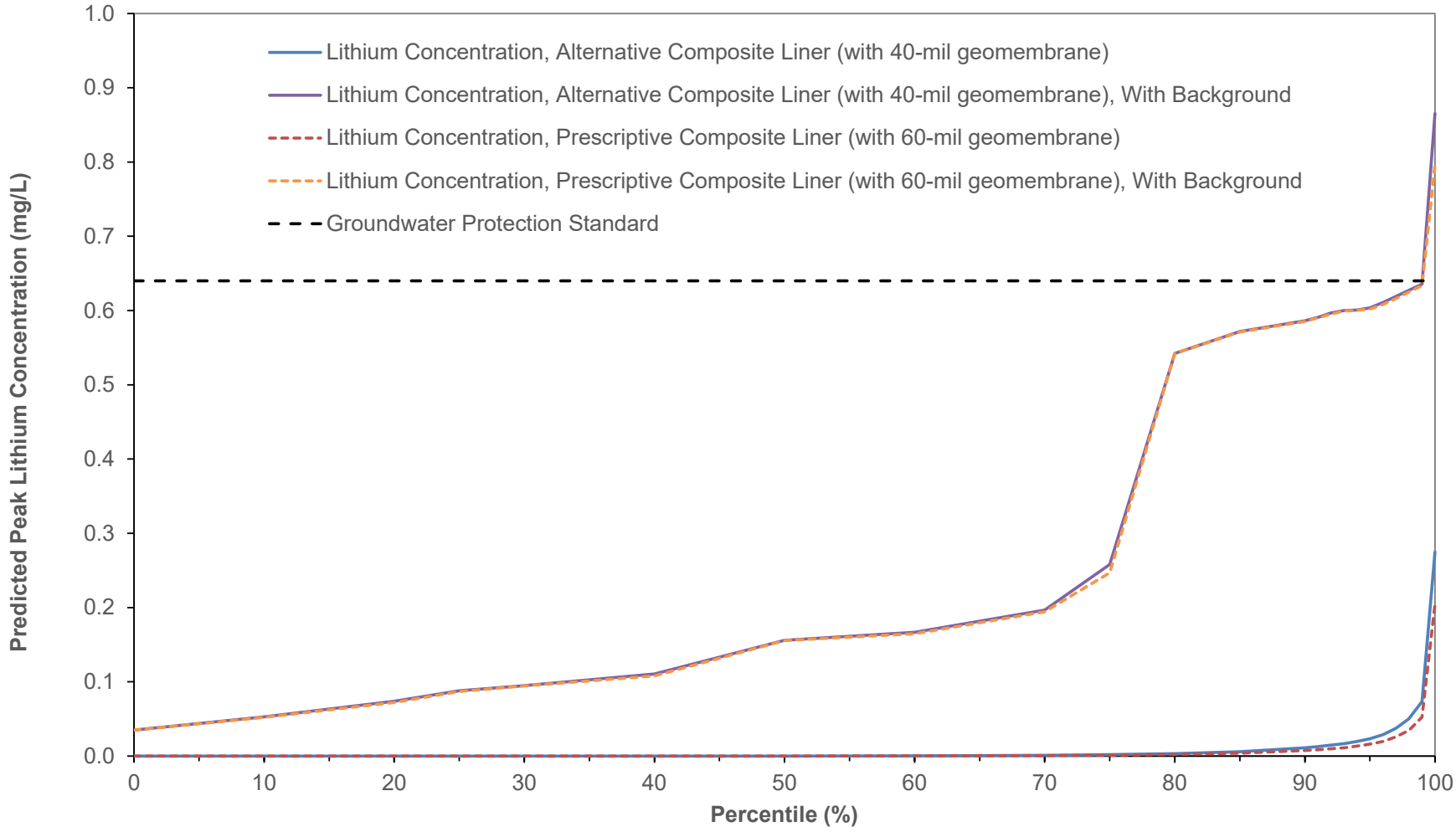
Title	**Percentile Plot for Peak Lead Concentrations at Waste Boundary**		
Project Name	Alternative Liner Demonstration	Project No. 21451024	FIGURE 9
Client Name	Great River Energy - Coal Creek Station	Date 11/29/2021	



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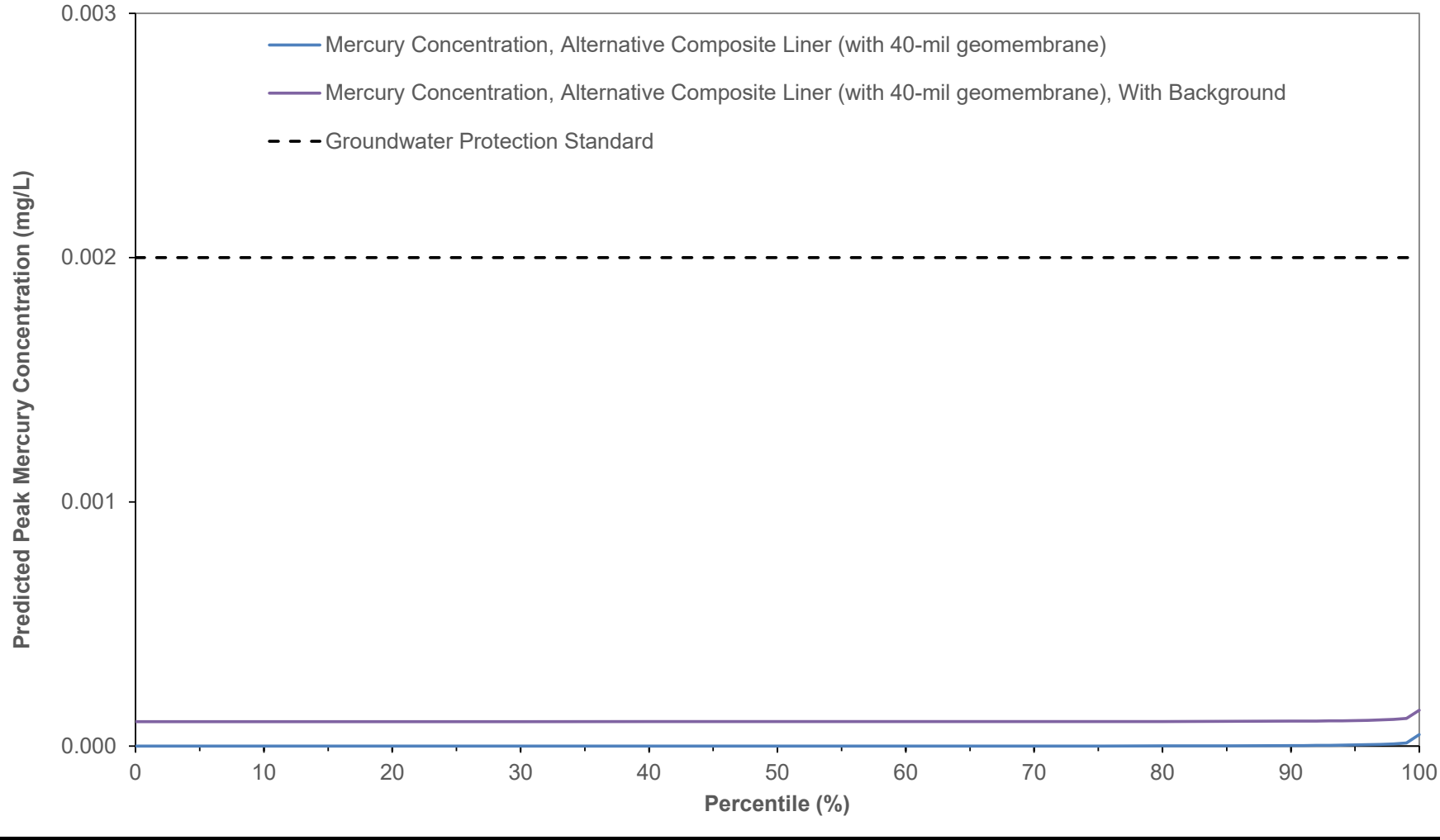
Title	**Percentile Plot for Peak Lithium Concentrations at Waste Boundary**		
Project Name	Alternative Liner Demonstration	Project No. 21451024	FIGURE 10
Client Name	Great River Energy - Coal Creek Station	Date 11/29/2021	



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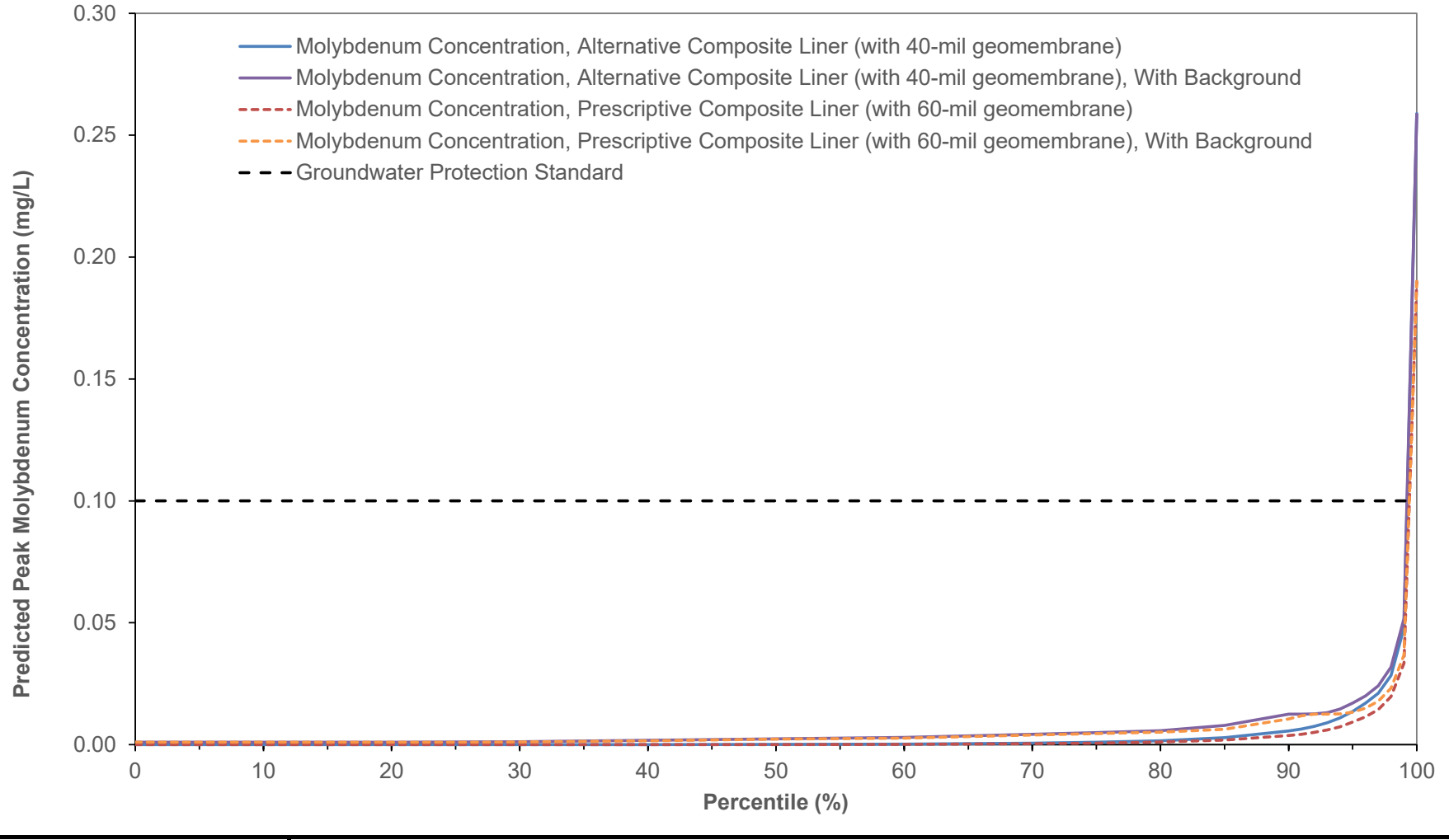
Title: **Percentile Plot for Peak Mercury Concentrations at Waste Boundary**

Project Name	Alternative Liner Demonstration	Project No. 21451024	FIGURE 11
Client Name	Great River Energy - Coal Creek Station	Date 11/29/2021	



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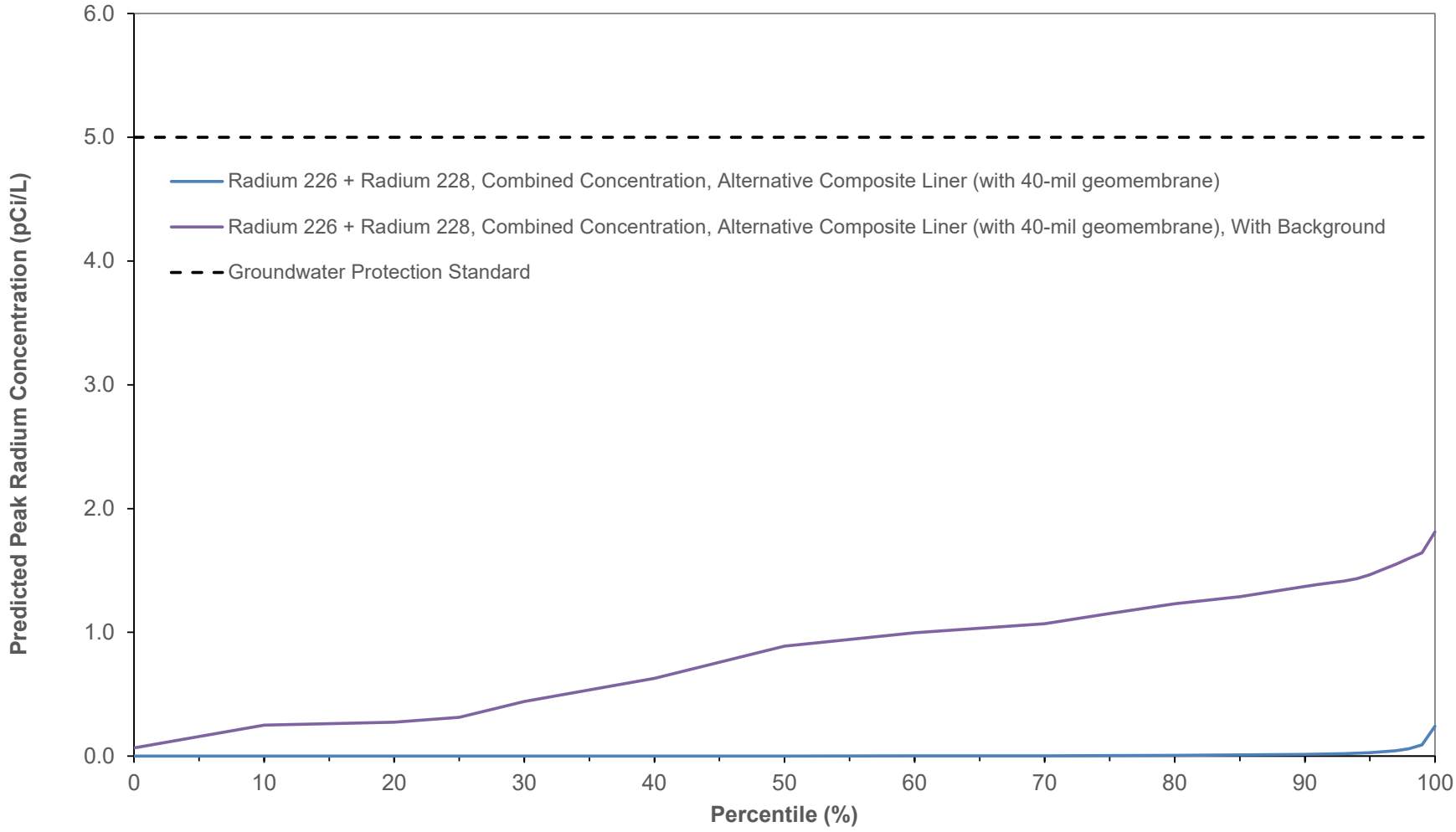
Title	**Percentile Plot for Peak Molybdenum Concentrations at Waste Boundary**		
Project Name	Alternative Liner Demonstration	Project No. 21451024	FIGURE 12
Client Name	Great River Energy - Coal Creek Station	Date 11/29/2021	



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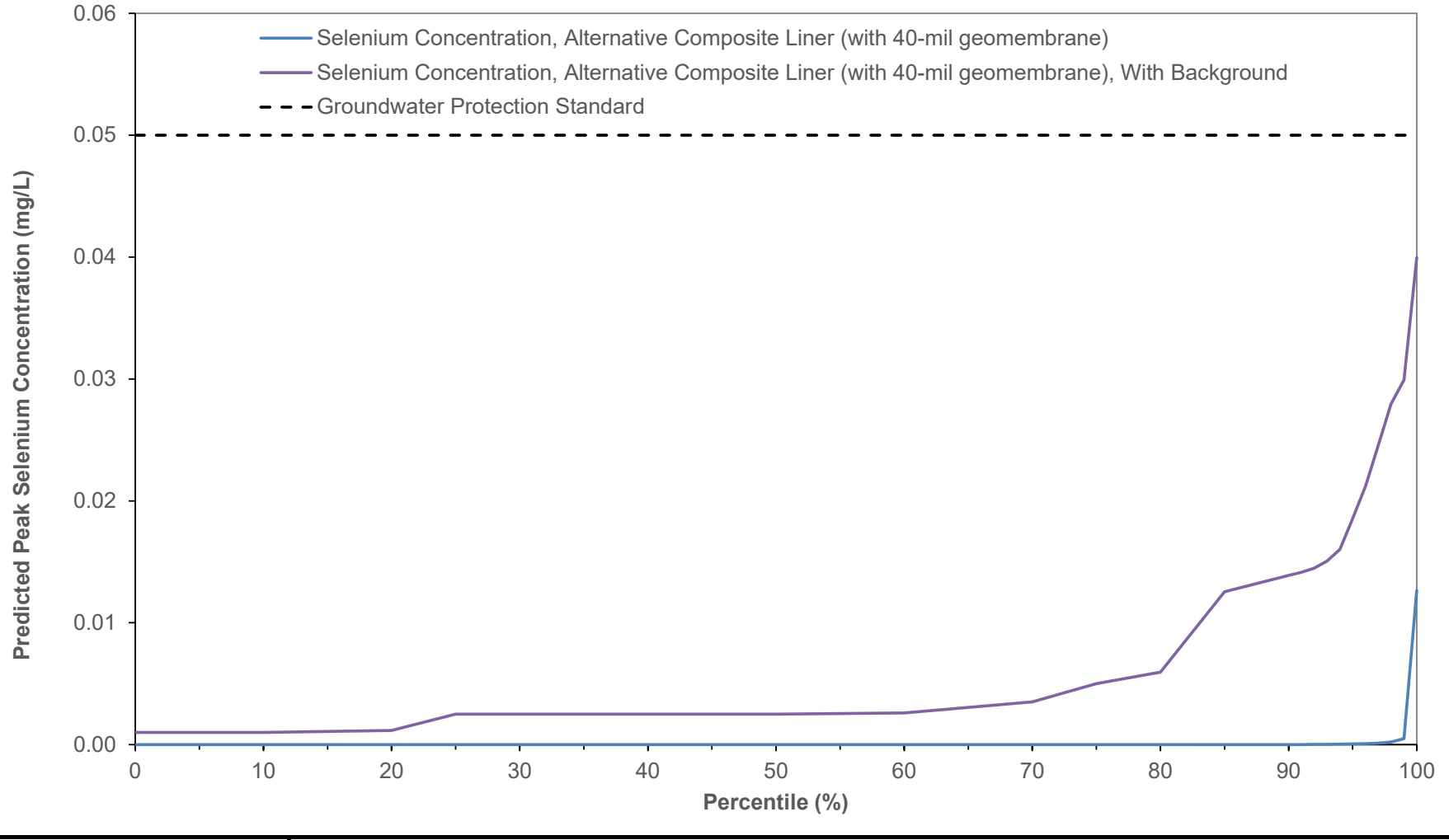
Title	**Percentile Plot for Peak Radium Isotope Concentrations at Waste Boundary**		
Project Name	Alternative Liner Demonstration	Project No. 21451024	FIGURE 13
Client Name	Great River Energy - Coal Creek Station	Date 11/29/2021	



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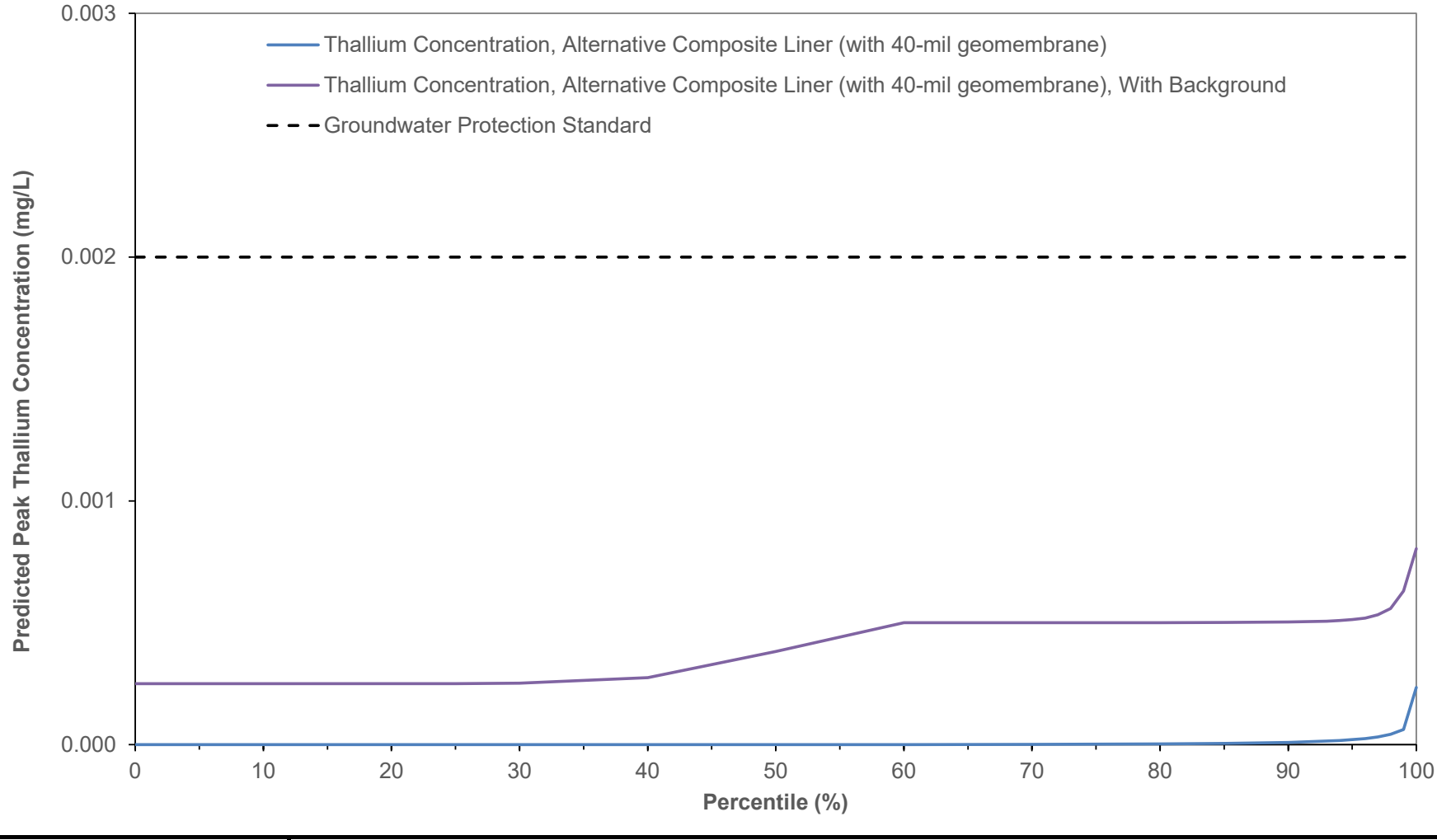
Title: **Percentile Plot for Peak Selenium Concentrations at Waste Boundary**

Project Name	Alternative Liner Demonstration	Project No. 21451024	FIGURE 14
Client Name	Great River Energy - Coal Creek Station	Date 11/29/2021	



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Title: **Percentile Plot for Peak Thallium Concentrations at Waste Boundary**

Project Name	Alternative Liner Demonstration	Project No. 21451024	FIGURE 15
Client Name	Great River Energy - Coal Creek Station	Date 11/29/2021	

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