2024 Hydrogeology Report

Graphite Creek Project

Prepared For

Graphite One (Alaska) Inc.
471 W 36th Ave., Suite 100
Anchorage, Alaska 99503

November 2024

Prepared by

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Executive Summary

Hydrogeologic studies at the Graphite Creek Project indicate that the bedrock has relatively low permeability and storage resulting in estimated pit groundwater inflow of 125 gpm (base case) to 200 gpm (high scenario). Little water is expected from the unconsolidated sediments in the north pit wall because it is mostly above the local water table and will have the groundwater source removed as the pit is developed. Meteoric water (rain and snowmelt) is expected to be substantially greater than groundwater inflow. Water management should be accomplished by in-pit pumps rather than dewatering wells.

A pit lake will develop post-closure. The pit lake water will flow into the unconsolidated sediment when the lake rises above the level of the Kigluaik fault in the north wall. Modeling indicates a low probability that the pit lake will overflow to the surface. This assumes all upslope runoff is controlled and routed around the pit. More detailed modeling of pit lake filling is needed for permitting.

The lowlands north of the Kigluaik Fault are understood to consist of till in the moraine east of camp, glaciofluvial sediment in the area between Graphite Creek and Glacier Canyon Creek, and older fan deposits to the west of Glacier Canyon Creek. Permafrost is discontinuous to absent in the southern lowlands in the project area; transitioning to locally continuous, deep, and cold to the north, and under the moraine. The glaciofluvial sediment and fan deposits have moderately high permeability. Groundwater flow will be influenced by lack of meteoric water input in the moraine area (due to permafrost) and the large lined WMF area; deep, cold permafrost between WMF and the Imuruk Basin; and the hydraulic conductivity of somewhat deeper sedimentary units in this area.

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Abbreviations and Acronyms

95%U – estimated 95% uncertainty of an ADCP measurement as determined by QRev

ADCP – acoustic Doppler current profiler

ADVM – acoustic Doppler velocity meter

ADF&G – Alaska Department of Fish and Game

°C – degrees Celsius

CHI – Constant head injection, a type of pressure test used in hydraulic testing

COV – coefficient of variation, equal to the standard deviation divided by the mean

DTC – digital temperature cable

DGGS – Alaska Department of Geological and Geophysical Surveys

ECMWF – European Centre for Medium-Range Weather Forecasts

FF/m – fracture frequency per meter

G – gauge height, usually in feet

gpm - gallons per minute

GR4J – Genie Rural 4 Journalier (French). A rainfall and runoff model

HQ – a core drilling tool size that results in a 96 mm (3.78 in) diameter hole

HWT – casing size or core drilling tool size that allows casing installation through which HQ tools can be used

IfSAR – interferometric synthetic aperture radar

in - inches

K – hydraulic conductivity

KGE – Kling-Gupta efficiency

Km - kilometers

m – meters

m/d – m/day

m/s – meters per second

m^3/d – meters cubed per day

mamsl – meters above mean sea level

mm/yr – millimeters per year

NASA – National Aeronautics and Space Administration

NSE – Nash Sutcliffe efficiency

NOAA – National Oceanic and Atmospheric Administration

PQ – a core drilling tool size that results in a 122.6 mm (4.83 in) diameter hole

PWT – casing size or core drilling tool size that allows casing installation through which PQ tools can be used

Q – discharge, usually in ft3/s

R^2 – coefficient of determination

RQD – rock quality designation

RMS – root mean square

SPT -standard penetrometer test

SWE – snow water equivalent

SWIPS – Standard Wireline Packer System

T - transmissivity

TDX – pressure transducer

USGS – U.S. Geological Survey

VWP – vibrating wire piezometer

WMF – waste management facility

1 Introduction

The Tundra Consulting team has been assisting Graphite One (G1) with hydrogeologic assessment at the Graphite Creek Project since 2019. This report summarizes work through the 2024 field season. A variety of supporting studies are part of the program and are covered in sections of this report. This includes surficial geologic mapping and interpretation, permafrost studies, groundwater level monitoring, streamflow monitoring, and long-term climate and streamflow modeling. The report then covers hydraulic testing and definition of hydrogeologic units. All this information informs the hydrogeologic conceptual model. Finally, we will present the results of the groundwater modeling where predictions of pit inflow and post mining effects are made.

2 Goals and Objectives

The goal of the hydrogeology program is to understand the hydrogeologic system sufficiently well to support NEPA studies, permitting, and mine design at the feasibility level. The 2024 goal is to support the feasibility study.

The strategy is to use a numerical groundwater model to predict the groundwater response to mining and post mining conditions, and to perform the studies needed to provide the necessary input data and concepts.

The 2024 objective is to predict groundwater inflow to the planned pit with sufficient confidence for use in the feasibility study. The second 2024 objective is to predict pit lake behavior. Additional objectives include:

- Advancing the understanding of the hydrologic system in the greater project area for permitting requirements
- Supporting the geotechnical engineering program

3 Project Setting

The Graphite Creek Project is located on the Seward Peninsula, approximately 55 kilometers (km) north of Nome, Alaska, and 50 km southeast of Teller, Alaska. It is on the steep north-northwest facing side of the Kigluaik Mountains and on the south side of the Imuruk Basin[1]. The Imuruk Basin is a tidal lake (ABR 2024, Brailey and Tundra 2023) that is connected to a series of marine waterbodies (Grantly Harbor, Port Clarence) by the Tuksuk Channel.

The Kigluaik Mountains are a gneiss dome and the bedrock in the project area is very high-metamorphic grade schist. The north side of the Kigluaik Mountains is bordered by the Kigluaik Fault, a normal fault that dips at approximately 45^{o} to the north northwest near the ground surface. The relative movement on the fault is Kigluaik Mountains up and the basin on the north down. The basin-fill is unconsolidated sediments. The depth to bedrock is unknown, but likely hundreds of meters. The near-surface

[1] The Imuruk Basin is the official name of the waterbody north of the project. There is another waterbody roughly 130 km northeast of the project area that is named Imuruk Lake. In this report “Imuruk Basin” will refer to the waterbody and “basin” will refer to the large lowland area within which the Imuruk Basin sits.

sediments to the north of the fault are a combination of glacial, alluvial, and subordinate colluvial deposits.

4 Surficial Geology

The hardrock hosts the orebody and is the focus of G1's team of geologists. The surficial geology (specifically the near surface unconsolidated sediment north of the Kigluaik Fault) is a large part of the hydrogeologic system and the groundwater model domain. It will form the top two-thirds of the north pit wall, and will host the other mine facilities. Tundra has developed a preliminary surficial geology map for this area, originally based on the map of Kaufman et al. (1989). Modifications are based on drilling, limited surface mapping, and interpretation of LIDAR maps and associated imagery. Geotechnical drilling in 2024 focused on the footprint of the proposed waste management facility (WMF) and provided data for the first three-dimensional Leapfrog model of the sediments.

4.1 Goals

The goal of the preliminary surficial geologic mapping was to define geologic units and their distribution as the basis for hydrogeologic units to be used in the numerical groundwater model. An additional goal was to support geotechnical investigations.

4.2 Data

The following data sources were used to develop the surface map and subsurface model for sediments:

- Drilling
  - Diamond drilling – Core drilling in the sediments has produced mixed results. In exploration and resource holes; the objective is hardrock data. Consequently, production has generally been emphasized over data collection in the sedimentary part of the hole. These holes generally have limited useful information collected from the sedimentary portion of the hole. Dual purpose holes (geotechnical and resource objectives) were focused on recovery of the sediments with better results. However, fine sediments tend to be washed away, presenting a challenge to interpretation. Out of 11 holes drilled, difficult drill resulted in the abandonment of 5 holes including one pair of wells.
  - Geotechnical diamond drilling – In 2024, a diamond drill was used for geotechnical drilling. Various techniques were used to maximize recovery. Results were variable, but with good results at times. Seven holes were drilled 4 shallow and 3 into groundwater.
  - Sonic drilling – This technique was used in 2021 and 2022 with good results. However, the rig was generally not capable of reaching the depth objective of many of the holes. Eleven sonic holes were drilled including two nested wells and one that was completed as the camp water well.
  - Sumps – Sumps were dug for cutting control at many drill sites not located in wetlands. The geology was recorded at some locations.
- Pits – Six pits were dug by an excavator in 2023. These were formally logged and sampled by Knight Piésold Consulting (KP). These were located north of 23GCT015 and extended down to the saddle.
- Road cuts and drill pads have been mapped. These have proved somewhat problematic as many of the roads are not cut sufficiently deep to be representative of the primary sedimentary materials.

4.3 Results

The 2024 preliminary surficial geology map is shown in Figure 4-1 and the map units are shown in Table 4-1. The lowland geology was modeled in Leapfrog and is shown in Figure 4-2, Figure 4-3, and Figure 4-4. Additional map units are recognized in the subsurface and are also shown in Table 4-1.

4.4 Surficial Geologic Conceptual Model

Three-dimensional modeling of the lowlands is driven by the input needs of the numerical groundwater model. Given the sparce available data at depth, the geologic model is influenced by our understanding of the surficial geologic processes in the area. Our current conceptual model includes the following elements:

- The eastern project area is dominated by sediments from the early Wisconsin equivalent (Salmon Lake Glaciation, Kaufman et al., 1989) Cobblestone Glacier. Sediment from older glacial events may be preserved at depth.
- The western project area was not covered by glacially related sediment from the Wisconsin equivalent glacial period (Kaufman et al. 1989). Old alluvial fans and solifluction deposits of Kaufman et al. (1989) are found at the surface in this area. These deposits likely predate the early Wisconsin glacial deposits, but deposition likely continued up to modern times.
- Recent stream alluvium in the fan deposit areas are recent deposits of the long-term fan forming process. Fan deposits are likely formed by long periods of small-scale stream activity punctuated by rare debris flows that reach far beyond the mountain front. This unit is thought to be dominated by debris flow deposits with subordinate and discontinuous fluvial deposits to the south with the ratio of fluvial to debris flow deposits increasing to the north.
- When the Cobblestone Glacier advanced beyond the mountain, there likely were numerous meltwater streams flowing subglacially, in front of, and to the side of the glacier.
- A substantial portion of the Cobblestone meltwater is thought to have drained from the west side of the glacier forming the glaciofluvial deposits we see in the project area.
- The Cobblestone glacier had a prolonged near maximum advance that resulted in the prominent lateral moraine. At some point, a lateral moraine was also deposited along the mountain front. Only limited remnants remain.
- Over compacted glaciofluvial sediment is recognized in the subsurface. It is not known whether these are deposits from the recent (early Wisconsin equivalent) period and were subsequently overridden and compacted by the glacier or if they are deposits preserved from an earlier glacial period.
- We have mapped the sediment north of the Cobblestone moraine as outwash. Kaufman et al. (1989) mapped this as older drift (pre-Wisconsin equivalent). Currently, there is no direct evidence for either interpretation.
- The silt-cover unit of Kaufman et al. (1989) is recognized near the Imuruk Basin. This unit is found below 20 to 25 m elevation. This unit has well developed polygonal ground and other permafrost and ground-ice related features.

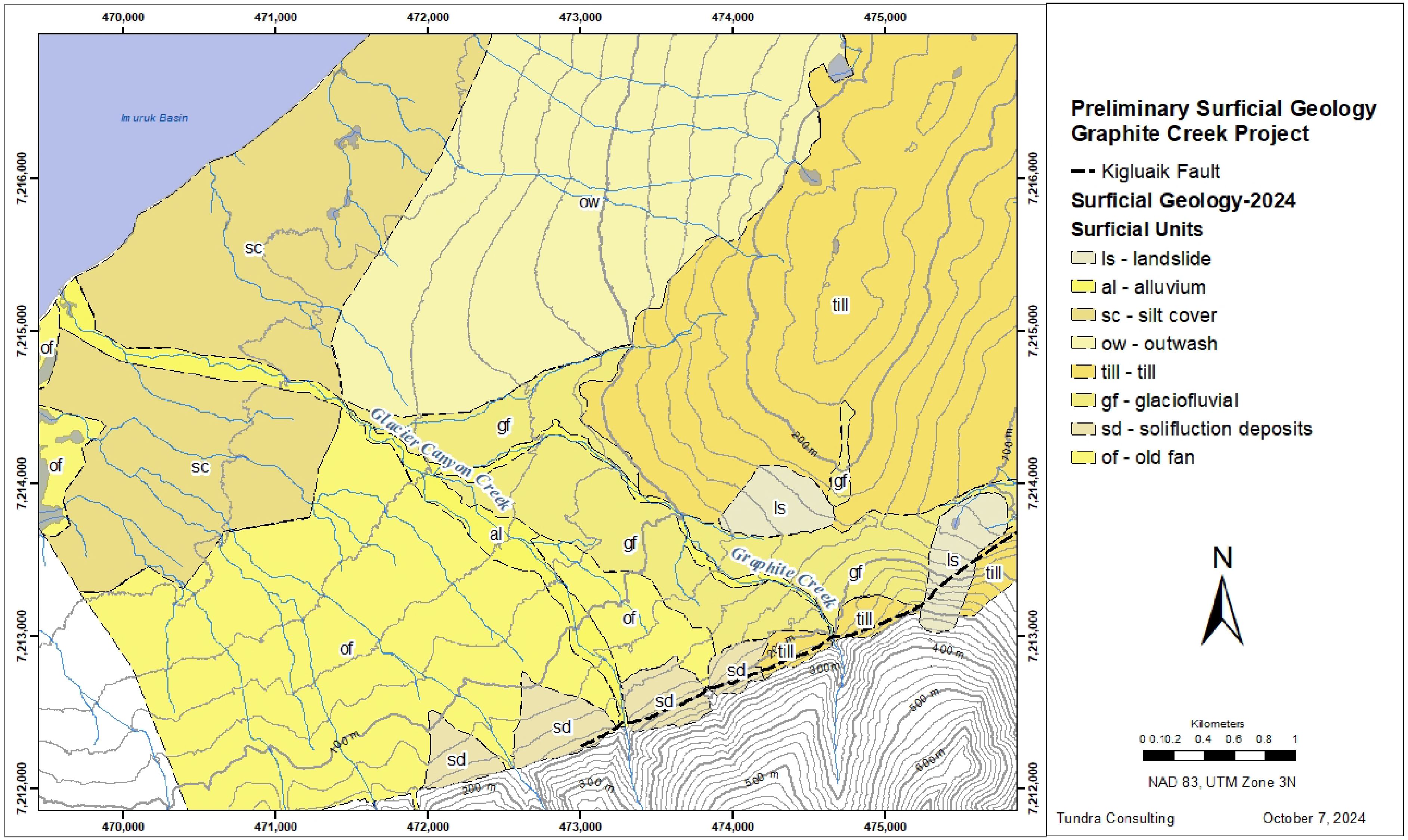


Figure 4-1. Preliminary surficial geology map

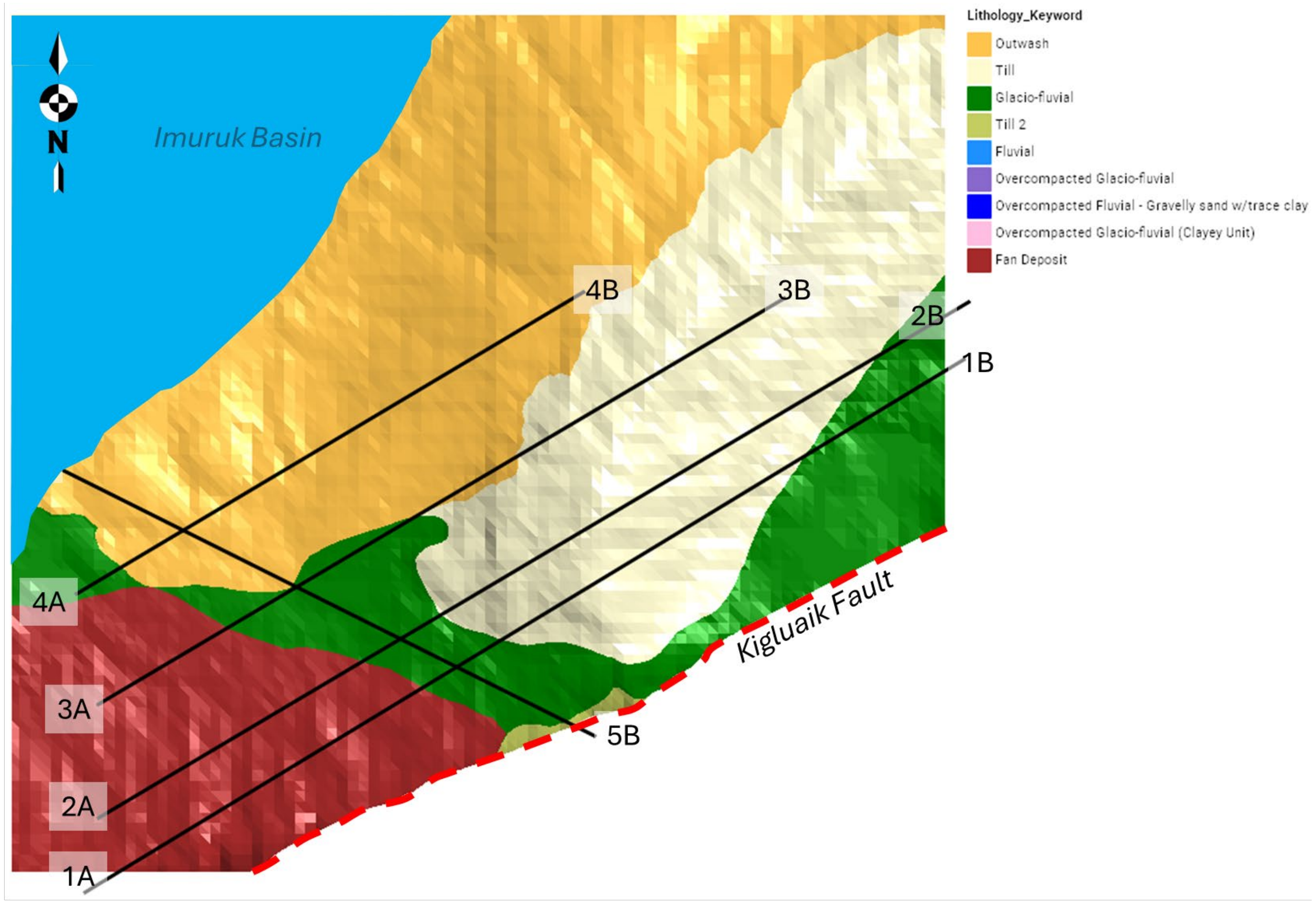


Figure 4-2. Leapfrog model of surficial sediments - plan view

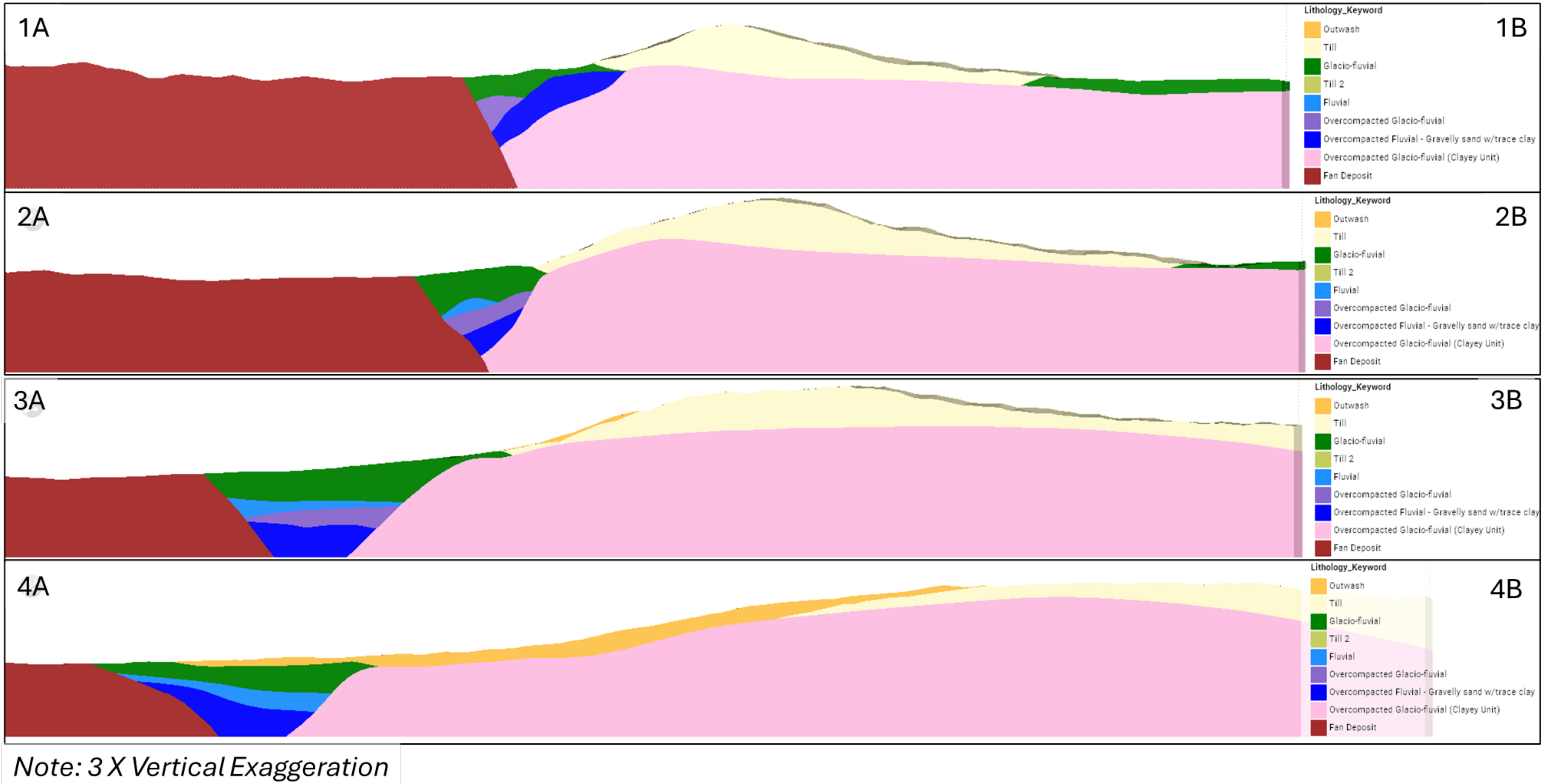


Figure 4-3. Leapfrog model of surficial sediments - cross-sections

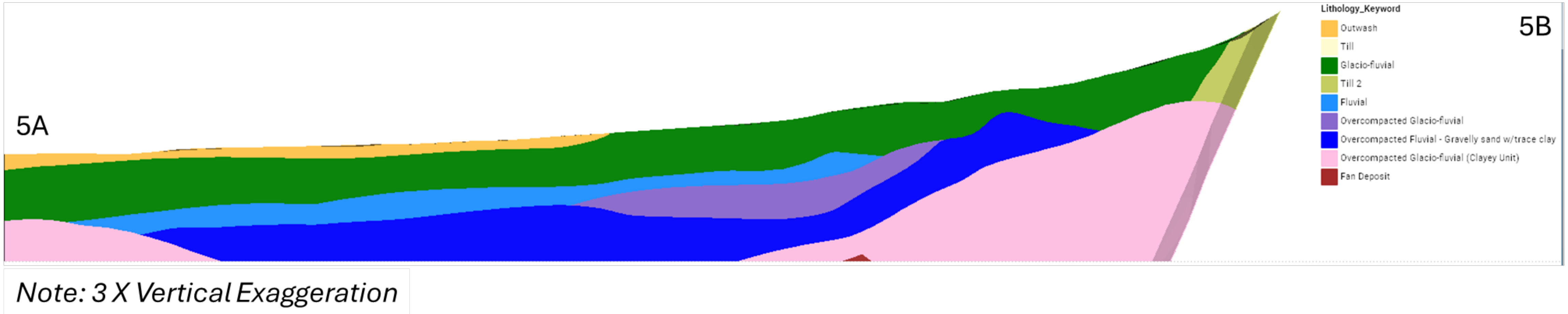


Figure 4-4. Leapfrog model of surficial sediments - long sections

Table 4-1. Surficial geology units

Relative Age	Unit	Description
al	alluvium (al)	Low areas around streams with riparian vegetation and flat topography, thought to have moderately to well sorted and moderately to well rounded sediment with a wide range of grainsizes
sc	silt cover (sc)	Smooth topography, patterned ground and other periglacial features, locally occurring southeast of the Imuruk Basin
ls	landslide (ls)	Areas that show a scarp and a mass that has moved by translation or flow. Two are recognized, other smaller slide areas are likely to exist along the southern edge of the Cobblestone Moraine.
ow	outwash (ow)	Area northwest of the Cobblestone Moraine with relatively smooth sloping terrane thought to be formed by rapid sedimentation in area with abundant meltwater and high sediment load
gf, till	till	Poorly sorted, heterogeneous, clasts size from boulders to silt and clay, subangular to subrounded clasts, often has surface features thought to be the result of thawing ground ice. May include glaciofluvial sub-units.
	glacial fluvial (gf)	Deposits formed in a sub- to pro-glacial environment with high sediment load. Moderately poorly to well sorted, subrounded to subangular, bedding may be seen in drill core. Surface deposits may be difficult to distinguish from till, but are weakly sorted and are generally missing the silt and clay fraction.
fl	Fluvial (fl)	Deposits formed in a moderately to high energy fluvial environment. Moderately to well sorted, subrounded to rounded, sand and gravel with occasional cobbles and boulders. Notably missing the fine sand, silt, and clay fraction. Bedding may be seen in drill core. The unit underlays gf. There are no known surface exposures.
of, sd, gfo	Overcompacted Glaciofluvial (gfo)	Deposits formed in a sub- to pro-glacial environment with high sediment load. Moderately poorly to well sorted, subrounded to subangular, bedding may be seen in drill core. Weakly sorted and generally missing the silt and clay fraction. Very well consolidated but not cemented. Underlays fl. There are no known surface exposures.
flo	Overcompacted Fluvial (flo)	Deposits formed in a moderately to high energy fluvial environment. Moderately to well sorted, subrounded to rounded, sand and gravel with occasional cobbles and boulders and trace clay. Bedding may be seen in drill core. Bedding exhibits evidence of soft-sediment deformation in places. Very well consolidated but not cemented. The unit underlays gfo. There are no known surface exposures.
gfos	Overcompacted Glaciofluvial - Gravelly Sand with Trace Clay (gfos)	Deposits formed in a sub- to pro-glacial environment with high sediment load. Moderately poorly to well sorted, subrounded to subangular, bedding may be seen in drill core. Weakly sorted and with abundant gravelly sand and trace clay. Very well consolidated but not cemented. Underlays flo. There are no known surface exposures.
gfoc	Overcompacted Glaciofluvial - Clayey (gfoc)	Deposits formed in a sub- to pro-glacial environment with high sediment load. Moderately poorly sorted, subrounded to subangular. Bedding is evident. May be difficult to distinguish from till, but weakly sorted and generally missing the silt fraction. Moderately to slightly clayey. Clay content is relatively elevated compared to other glaciofluvial units in the area. Underlays gfos and till. There are no known surface exposures.
	solifluction deposits (sd)	Unit of Kaufman et al. (1989). Colluvium that seasonally moves downslope in the active layer above permafrost and has continued to move and be deposited beyond the mountain front. Found near the mountain front in interfluvial areas.
	old fan (of)	Unit of Kaufman et al. (1989). Thought to be a heterogenous mix of debris flows and fluvial deposits formed where high-gradient mountain streams flow into the low relief area beyond the mountain front.

5 Permafrost

5.1 Overview

Groundwater flow in permafrost regions is influenced by the spatial and temporal distribution of frozen ground, with most flow occurring in suprapermafrost and subpermafrost zones. Permafrost can be expected to have low to very low permeability due to ice-filled pores and fractures. These conditions impede flow, limit storage (seasonal or perennial), and control groundwater recharge and discharge. Groundwater is often confined under permafrost where it is present.

In support of groundwater investigation and modeling at the project site, digital ground temperature cables and vibrating wire piezometers have been installed to characterize the local thermal regime (Tundra 2023a). The ground temperature measurements are further supported by site observations, air photo interpretations, and drillhole data which inform an understanding of local permafrost. Northern Permafrost Consulting (2024) provides a summary of the ground temperature measurements collected to date and permafrost attributes for each instrumented site, which is summarized here.

5.2 Methods

Ground temperature data is primarily collected using digital temperature cables (DTCs). These cables have temperature sensors installed along their length. The sensors are connected to each other and a datalogger at the surface by a pair of wires in a cold tolerant sheath. Tundra uses a cable build with sensors closely spaced at the surface, with gradually increasing spacing to 60 m, and then spaced at 20 m intervals until the end. The cables can be any length, but are typically 140 m to accommodate typical conditions at the site. In 2024, 25 m cables were installed in shorter geotechnical holes. A typical build specification is shown in Appendix A-1.

The cables are installed by hanging them in monitoring wells or standpipes which are described in Section 6.4. Each cable is attached to a datalogger installed in the top of the well. The data loggers are programmed to collect temperature readings from each sensor, typically at 6-hour intervals. Vibrating wire piezometers (VWPs) are installed at the site to collect groundwater level and pore pressure data. Though not nearly as accurate, the VWPs also record ground temperature which is useful when other data is not available in the area. DTC and VWP locations and are shown in Figure 5-1, Table 6-1, and Table 6-2.

Twenty-one holes have had DTCs and there are currently 18 installed DTC. There is a total of 21 VWP installations with 5 used for temperatures.

5.3 Results

Currently there are data from 20 DTCs. The ground temperature at each of these sites is shown in Appendix A2 and is summarized in Table 5-1. It should be noted that 9 of these cables were installed in 2024. Many of these new cables are providing preliminary temperature data because they have not thermally equilibrated from the heat of drilling, which can take two to three months to fully dissipate.

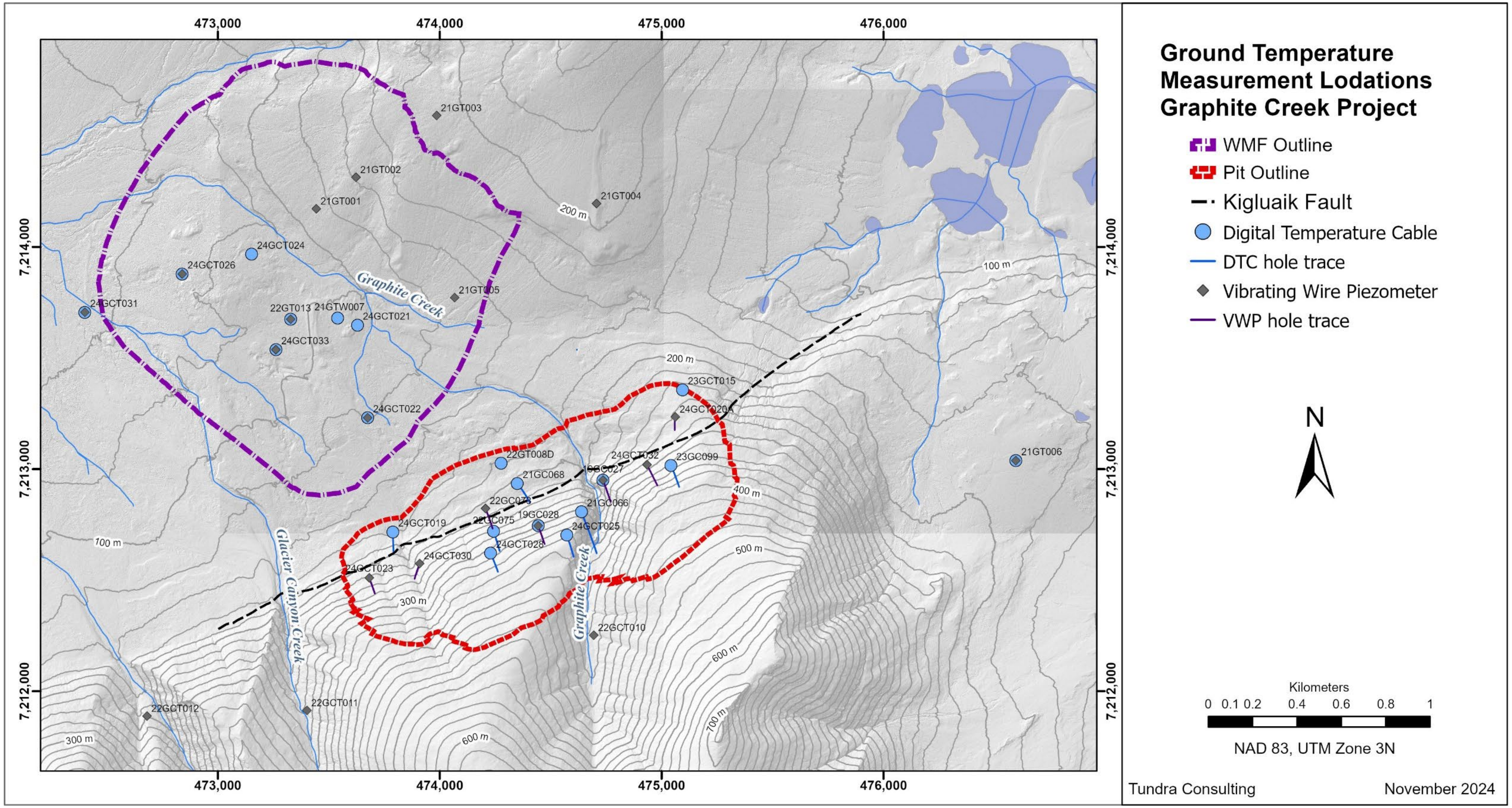


Figure 5-1. Temperature measuring locations

At the Graphite Creek Project site, permafrost is relatively warm (commonly >-1.5°C) and discontinuous. Where permafrost is present, the shallow ground thermal regime can be categorized into two types: locations with a seasonally thawed active layer above permafrost and those with a perennially thawed suprapermafrost talik (NPC 2024). At other locations, permafrost is absent and below freezing conditions are limited to the development of seasonal frost in the ground.

Permafrost is locally discontinuous across the Uplands near the planned pit and the Lowland areas. In the Lowlands, permafrost is commonly a few tenths of a degree Celsius below zero and overlain by a perennially unfrozen suprapermafrost talik, where present. In contrast the Cobblestone Moraine and Imuruk Basin Plain are characterized by relatively colder permafrost (approximately -1.0 to -1.5°C) based on the available data and inferred conditions. The depth to the base of permafrost is generally less in the Lowlands when compared to the expected conditions within the Cobblestone Moraine and Imuruk Basin Plain (NPC 2024).

5.4 Predictive Permafrost Distribution Map

A predictive permafrost distribution map has been developed for the project-wide groundwater model (Figure 5-2). The map units are based on ground temperature measurements, drillhole data, field observations, and analysis of aerial photos and LiDAR data.

The map units include:

- Absent
  - Map unit indicates areas where permafrost is expected to be locally absent
- Warm Discontinuous, Hydrogeology Recharge Zone
  - Map unit indicates areas where permafrost is expected to be locally discontinuous to the extent that surface water can effectively recharge the groundwater system.
- Warm Discontinuous, Suprapermafrost Talik
  - Map unit indicates areas where permafrost is expected to be locally discontinuous and relatively warm. A suprapermafrost talik is commonly present above the top of permafrost.
- Cold, Continuous
  - Map unit indicates areas where permafrost is expected to be locally continuous and relatively cold. The ground thermal regime in this area includes an active layer that seasonally develops above the top of permafrost.

Permafrost conditions included in the map are described as (Figure 5-2):

- Uplands (Open Pit Area and South of Pit)
  - Kigluaik Fault – permafrost is locally absent
  - Pit (south of fault) – permafrost is discontinuous with a thick unfrozen suprapermafrost talik (approx. 35-40 m thick). Where present, the base of permafrost is approximately 100 m bgs
  - South of Pit – permafrost is locally discontinuous with a suprapermafrost talik, where present. This area is expected to be a groundwater recharge zone.
- Lowlands
  - Pit (north of fault) – permafrost is locally absent

  - Southern portion of lowlands – Permafrost is locally discontinuous (>-0.24°C) and may be absent in areas with alder and willow. Base of permafrost approx. 60 m bgs or less. Suprapermafrost taliks are present above the top of permafrost (approximately 5 to 25 m thick).
  - Northern portion of lowlands – Permafrost is locally discontinuous (>-0.24°C). Base of permafrost approx. 100 to 150 m bgs. Suprapermafrost taliks are present above the top of permafrost (approximately 5 to 25 m thick).
- Graphite Creek and Canyon Creek
  - Permafrost is inferred to be absent along mid and upper stretches of the creeks. The absence of permafrost is due to the advected heat from flowing water and the thermal influence of relatively deeper snow that is expected to accumulate within the alders and willows located adjacent to the creeks.
- Cobblestone Moraine
  - Permafrost is locally continuous, ice-rich, and relatively cold for the site (inferred from limited measurements to be -1.0 to -1.5°C). Active layer depth is inferred to be 1 to 2 m. Base of permafrost is inferred to be approximately 150 to 180 m bgs. Massive ground ice is expected to be present.
- Imuruk Basin Plain
  - Permafrost is locally continuous, ice-rich, and relatively cold for the site (inferred to be -1.0 to -1.5°C) and ice-rich with indications of massive ground ice. Active layer depth is inferred to be approximately 1 m. Base of permafrost is inferred to be approximately 150 to 180 m bgs. Massive ground ice is expected to be present.

Table 5-1. Permafrost attributes for sites instrumented with DTC

Site ID	Location	Instrument (DTC, VWP)	Permafrost Present (Y/N)	Minimum Permafrost Temperature (°C)	Condition, Top of Permafrost	Top of Permafrost (m bgs)	Bottom of Permafrost (m bgs)	Permafrost Thickness (m)
19GC027	OP	DTC/VWP		-	-	-	-	-
19GC028	OP	DTC/VWP	Y	-0.23	SPT	35	112	77
21GC066	OP	DTC	Y	-0.30	SPT	28	73	45
21GC068	OP	DTC	Y	-0.18	SPT	91	99	8
21GT006	UPL	DTC/VWP	Y	-1.00	AL	1.5	100	99
21GTW007	WMF	DTC	Y	-0.02	SPT	23	28	5
22GC075	OP	DTC	Y	-0.05	SPT	65	71	6
22GT008D	OP	DTC	N	-	-	-	-	-
22GT013	WMF	DTC/VWP	Y	-0.73	AL	1.7	84	>82
23GC099	OP	DTC	N	-	-	-	-	-
23GCT015	OP	DTC	Y	-0.57	SPT	12	>35	>23
24GCT021	WMF	DTC	Y	-0.07	SPT	11	>25	>14
24GCT022	WMF	DTC/VWP	N	-	-	-	-	-
24GCT024	WMF	DTC	Y	-0.10	SPT	5	>25	>20
24GCT025	OP	DTC	Y	-0.64	SPT	6	118	112
24GCT026	WMF	DTC/VWP	Y	-0.24	SPT	15	>140	>125
24GCT028	OP	DTC	N	-	-	-	-	-
24GCT031	WMF	DTC/VWP	N	-	-	-	-	-
24GCT033	WMF	DTC/VWP	Y	-0.08	SPT	3.4	21	18
24GCT034	SD	DTC/VWP	N	-	-	-	-	-

Notes

Permafrost attributes based on data available at the time of reporting. See Appendix A2 for period of record.

Sites installed in 2024 (24GCT) remain thermally disturbed from drilling and interpretations are preliminary.

Condition at the top of permafrost defined as being an active layer (AL) with seasonal freeze-back to permafrost or a suprapermafrost talik defined by a perennially unfrozen (SPT) above the top of permafrost

Condition at the top of permafrost has not been confirmed for DTCs installed in 2024

Locations include Waste Management Facility (WMF), Open Pit Area (OP), Uplands (UPL), Saddle Area (SD)

Hyphen indicates insufficient information is available to derive value or the attribute is not applicable

Hole locations are shown in Figure 5-1

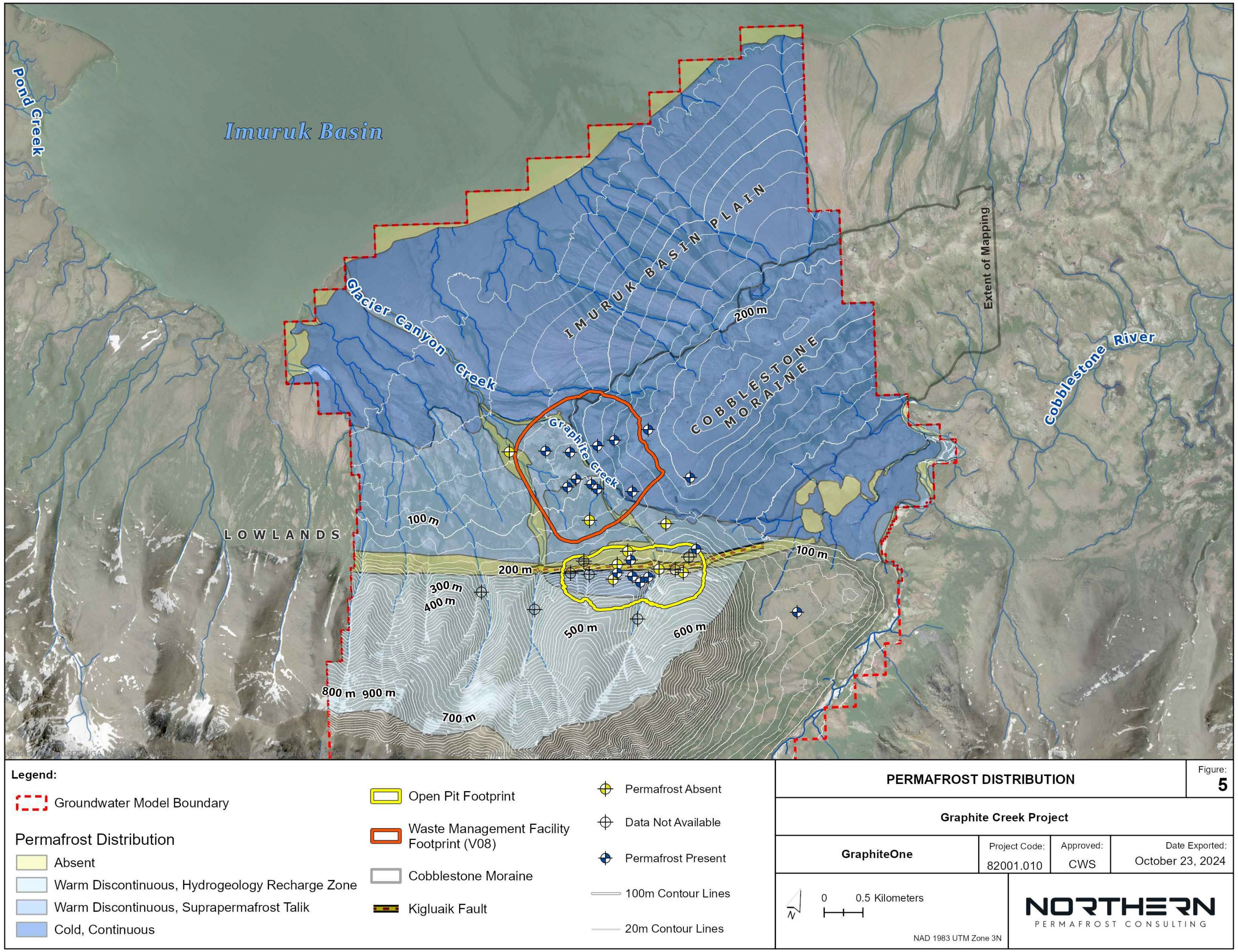


Figure 5-2. Permafrost distribution map

6 Groundwater level

6.1 Introduction

Groundwater level monitoring has been ongoing at the Graphite Creek Project since the first monitoring well installation in 2021 (Tundra 2020, 2022, 2023b).

6.2 Definitions and Concepts

Commonly, the groundwater level is referred to as the water table, which is the surface defined by the transition from saturated to unsaturated ground conditions. The piezometric surface is an imaginary surface defined by the static head. The water table is a subset of piezometric surfaces that occurs when there are unconfined conditions. In many locations in the project area, the groundwater is confined causing artesian conditions and, in many cases, flowing artesian conditions where the piezometric surface is above the ground surface. In other, less dramatic situations, a water bearing layer may be confined by an overlying low permeability layer and the piezometric surface for the confined water bearing layer may be at a different level then the water table at the same location.

Groundwater flow has horizontal and vertical components. If water level measurements are taken at two different depths at the same location, the vertical component is downward if the water level of the deeper measurement is lower than the shallower measurement and the vertical component is upward if the water level of the deeper measurement is higher than the shallower measurement.

6.3 Goal and Objectives

The goal of this work is to document and understand the groundwater level and how it changes over time (seasonally and annually), across the project area, and with depth. This understanding helps inform the hydrogeologic conceptual model. The groundwater level understanding is part of the baseline environmental characterization used in permitting. The hydrogeologic conceptual model, and the groundwater level data and analysis are important inputs to the groundwater numerical model, the results of which are important to many aspects of project permitting, feasibility study, and mine design.

The strategy is to measure the groundwater level at wells located strategically throughout the project area. The groundwater level will be measured continuously for many years.

The objectives are to define how the groundwater level changes across the site, and through time (principally seasonally).

6.4 Methods

6.4.1 Tactics

The tactics include the following

- Install monitoring wells at strategically identified locations in the project area (Figure 6-1, Figure 6-2, Table 6-1)
- Install the screened interval in each well to achieve the objective for that location. The screen is installed just below the anticipated water table if the objective is to define the water table. The

screen may be installed much deeper to achieve other objectives such as vertical gradient, artesian conditions, or water quality.

- Install nested wells (two wells installed in the same boring) or paired well (wells installed in two separate, adjacent borings) to achieve the previous objectives and define the vertical component of the groundwater gradient and chemistry. Often the previous objectives cannot be achieved in a single well, necessitating the multiple well instillation.
- Install a pressure transducer (TDX) in each monitoring well. The TDX measures the pressure of the water (and air) above it, which is directly proportional to the depth of water. Each pressure transducer has a built-in programable datalogger.
- Install a TDX that is designed to record barometric pressure at a central location. This allows the effects of the overlying air to be removed from the water level record.
- Program the TDX's to record the water level at regular intervals daily (four times a day is used on this project).

6.4.2 Well installation

Monitoring wells are installed for multiple purposes including water level monitoring. Monitoring wells are usually two inches in diameter and are made of PVC (Table 6-3). The wells are most commonly installed in diamond drill holes that are 96 mm (3-3/8 in) in diameter. This "slim hole" condition precludes the use of standard monitoring well installation methods, and specialized methods are used. The well construction method varies considerably based on specific drilling methods, ground material, and ground conditions. Methods include:

- Sonic drilling – Of the methods used, this is most conducive to standard monitoring well installation techniques. If the hole is 6 inches in diameter (or larger), a normal 2-inch screen is used with a field installed sand filter pack around it. The subsurface seal and backfill are installed above the filter pack. If the hole diameter at screen elevation is between 3.5 and 6 inches, a prepacked screen is used. Sand is then slowly added with the expectation that it will bridge above the screen and the subsurface seal and backfill are installed above that.
- Diamond drill holes in bedrock – The diameter of these hole is too small for a field installed sand pack without bridging (more specifically the annular space between the hole wall and the PVC well is too small). Therefore, the screen is installed in an open hole. Not having a sand pack is generally acceptable because there is little or no sand and silt in a bedrock hole. Cement baskets are used to support the subsurface seal and backfill.
- Diamond drillholes in unconsolidated sediment
    - PQ diameter holes are of sufficient diameter to use a prepacked screen. In 2024, a cement basket and bentonite sleeves were installed above the prepacked screen as the subsurface seal and to support the backfill above.
    - HQ – A hole reduced to HQ results in sub-optimum conditions. The diameter is too small for a prepacked screen and too small for a field installed sand pack. Therefore, the screen was installed in an open hole with a cement basket and bentonite sleeves for the subsurface seal and to support the backfill above. In some ground conditions careful and prolonged well development can remove sufficient fines to develop a natural sand pack and good quality well.
- A shallow and deep well are often installed at the same location. The deep well accomplishes multiple objectives (hydraulic conductivity tests, ground temperature, water level, water quality) and the shallow well is generally specifically installed to monitor water table depth.

  - When a sonic drill is used, the hole diameter may be sufficient for the two wells to be installed in the same hole (nested wells). These wells have the same hole number with an S (shallow) or D (deep) suffix.
  - Most drilling circumstances preclude installing nested wells. In this case paired wells are installed. Typically, the deep hole is drilled first and then the rig is moved slightly and the shallow hole is drilled. The deep well may be angled or vertical depending on hole objectives and the shallow well is at or near vertical. As separate holes, the practice is to give each hole a separate ID.
- Specialized wellheads are installed on the flowing artesian wells to control the artesian flow, allow instruments to be installed in the well, and accommodate winter freezing conditions.

6.4.3 Instrumentation

TDXs are the preferred method of monitoring water level (Table 6-2). The instrument is suspended in the well on a direct read cable. The TDX has a built-in datalogger and the cable allows the TDX to be read without removing it from the hole. These wells meet multiple needs; therefore, the well may also have a digital temperature cable (DTC) and a dedicated water sampling pump. Most wells have heat trace installed.

An alternate method of measuring water level is a vibrating wire piezometer (VWP). These are best for measuring pore pressure and relative water levels but give less reliable absolute water levels. They are often preferred for geotechnical investigations. Multiple VWPs may be installed in one hole at a variety of depths. VWPs are installed by taping them to the outside of a standpipe or well and they are then grouted in place. The grout is a Mikkelson mix (Mikkelsen and Green 2023) that includes up to approximately 25% powdered bentonite added to the cement mix. The mix may vary from the standard Mikkelson mix due to factors such as the need for a heavier grout to manage artesian conditions. If a one-inch PVC standpipe is used, it may remain filled with grout or kept open for subsequent installation of a DTC.

6.4.4 Data Management

The TDXs are downloaded each year; ideally at least at the beginning and end of the field season. The data files are securely stored and uploaded into an Excel spreadsheet-based database. The data management process is as follows:

- Determine the elevation of the TDX installation by correlating TDX reading and manual water depth reading; taking into account collar elevation, casing stickup, and hole inclination.
- The loggers are set to record every six hours starting at midnight. Correct any minor time variations so that all measurements are at six-hour intervals starting at exactly midnight.
- Screen the pressure data for unreasonable data values (too high or low). These “bad” data points typically represent times when the TDX was removed from the well for water sampling or maintenance reasons. Drop the “bad” data value(s) from further use.
- The TDX measures the pressure of water and air above the TDX. For confined water levels, correct the water level reading for atmospheric pressure, using values from the barometric TDX.
- Convert corrected water level to water elevation using the known elevation of the TDX.
- Convert manual water measurements (“spot measurements”) to water elevation taking into account collar elevation, casing stickup, and hole dip.

- Plot continuous measurements (elevation versus time) and spot measurements and perform a quality control check. Investigate and correct unexplained breaks in trends or discrepancies between continuous and spot measurements.
- Save water elevation data from each hole for further analysis.

The VWPs are also downloaded each year. Data is managed and converted to pressures, depths, and elevations by the engineering contractor.

6.5 Data Summary

Groundwater level studies at Graphite Creek were begun in September of 2021 with four wells. Additional wells are added to the monitoring network each year as the hydrogeologic studies progress. The well locations are shown in Figure 6-1, Figure 6-2, and Table 6-1 and well construction is summarized in Table 6-3.

There are 20 monitoring wells with pressure transducers (Figure 6-3; two have been removed). This includes four single wells and two nested wells in the lowlands, and five single wells and four paired wells in bedrock (angle holes located north of the Kigluaik Fault and complete to the south of the fault are counted as bedrock wells). The pressure transducer monitoring results are summarized in Table 6-4 and Figure 6-4, and hydrographs for each well can be found in Appendix B. VWP results are shown in Table 6-5. Water levels observed during packer testing are shown in the plots in Appendix F (see Section 9.3 The water elevation data is available upon request.

General comments:

- Groundwater depths are traditionally recorded as positive numbers. If the water depth is higher than the well collar (flowing artesian conditions), the water depth is negative.
- Groundwater temperature may be informative at some project sites. There is very little variation in groundwater temperature at this site; therefore, it is not shown in the hydrographs in Appendix B and will not be considered further.

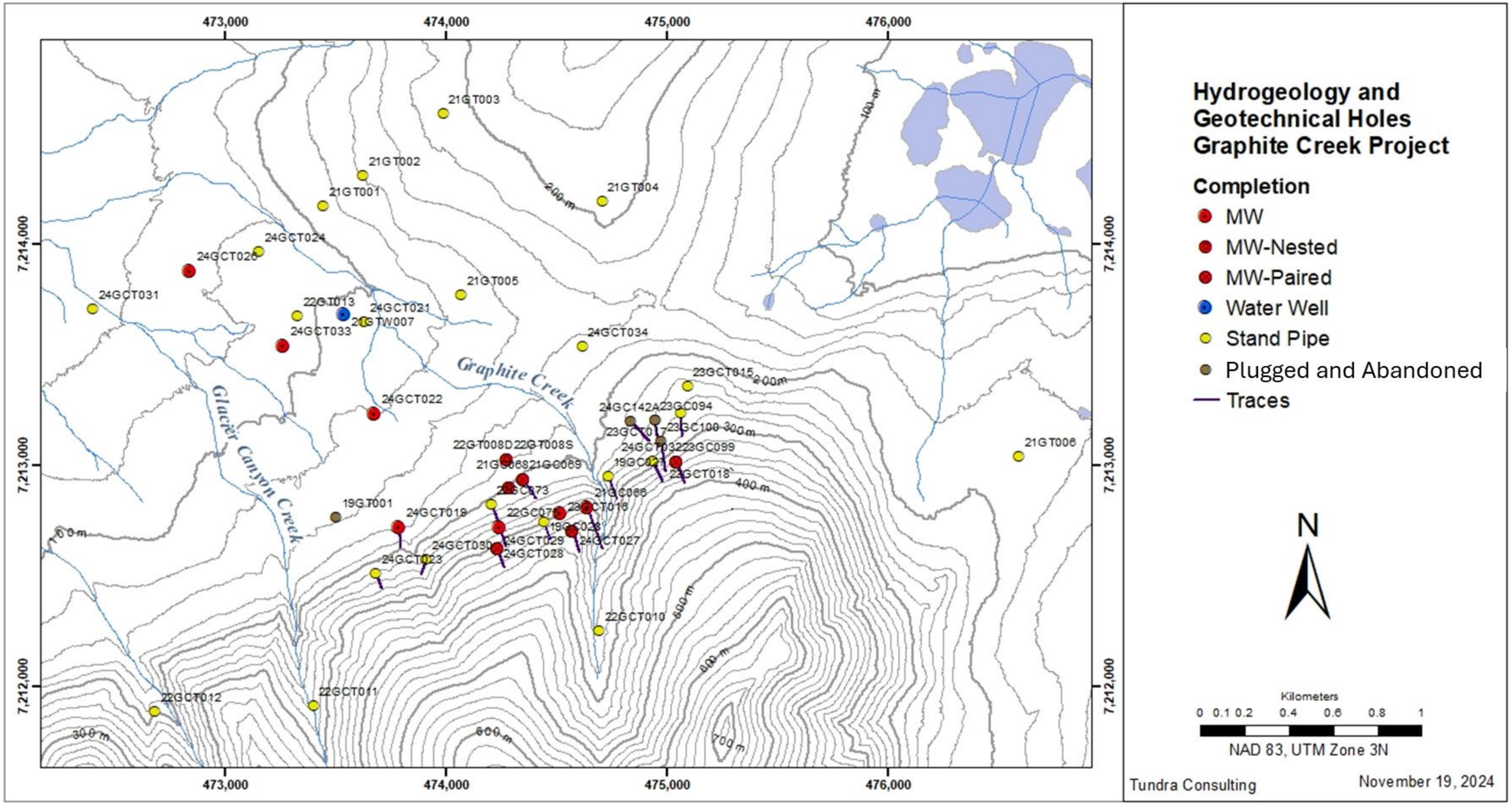


Figure 6-1. Hydrogeologic and geotechnical hole locations – project area

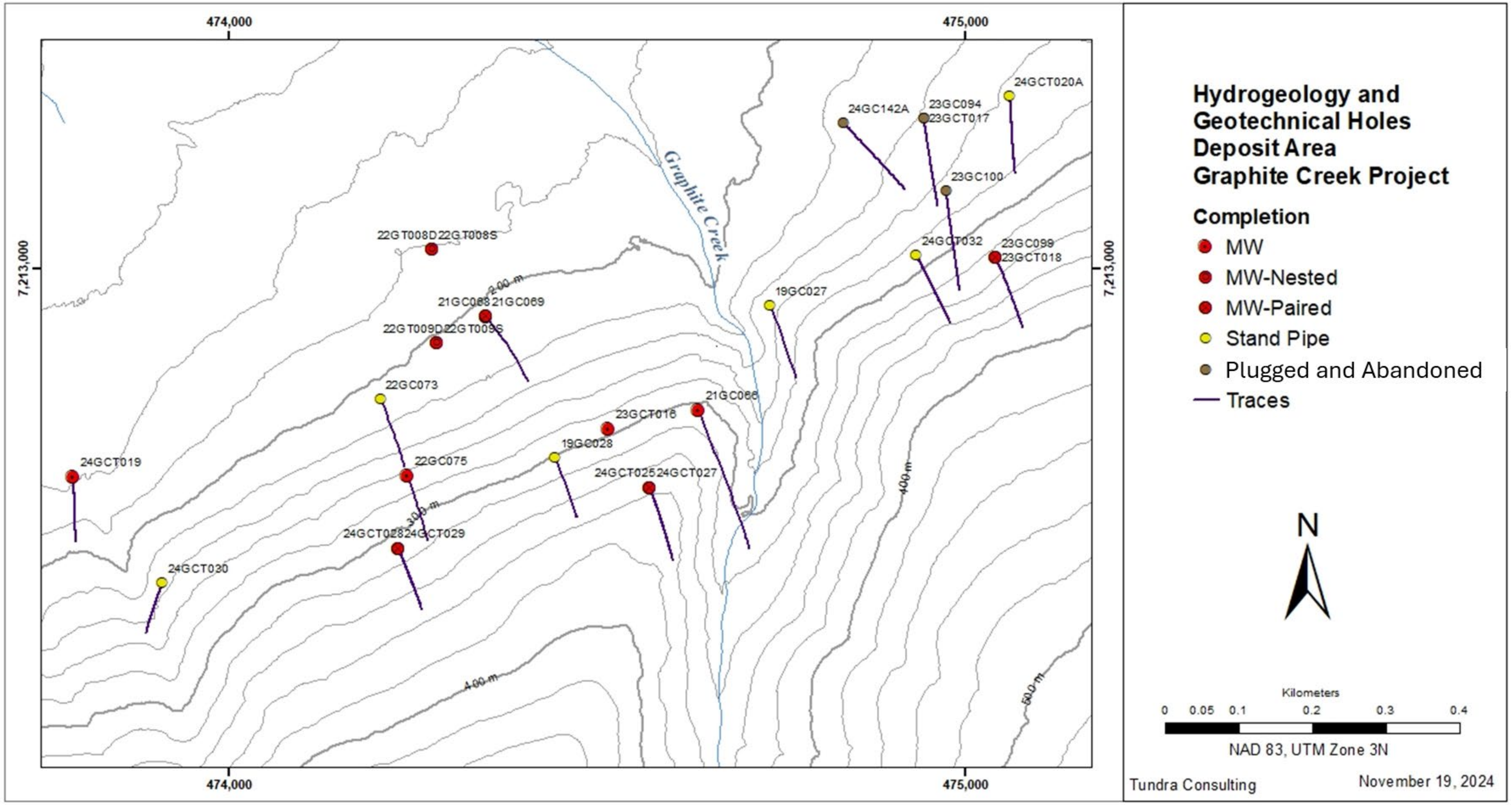


Figure 6-2. Hydrogeologic and geotechnical holes - deposit area

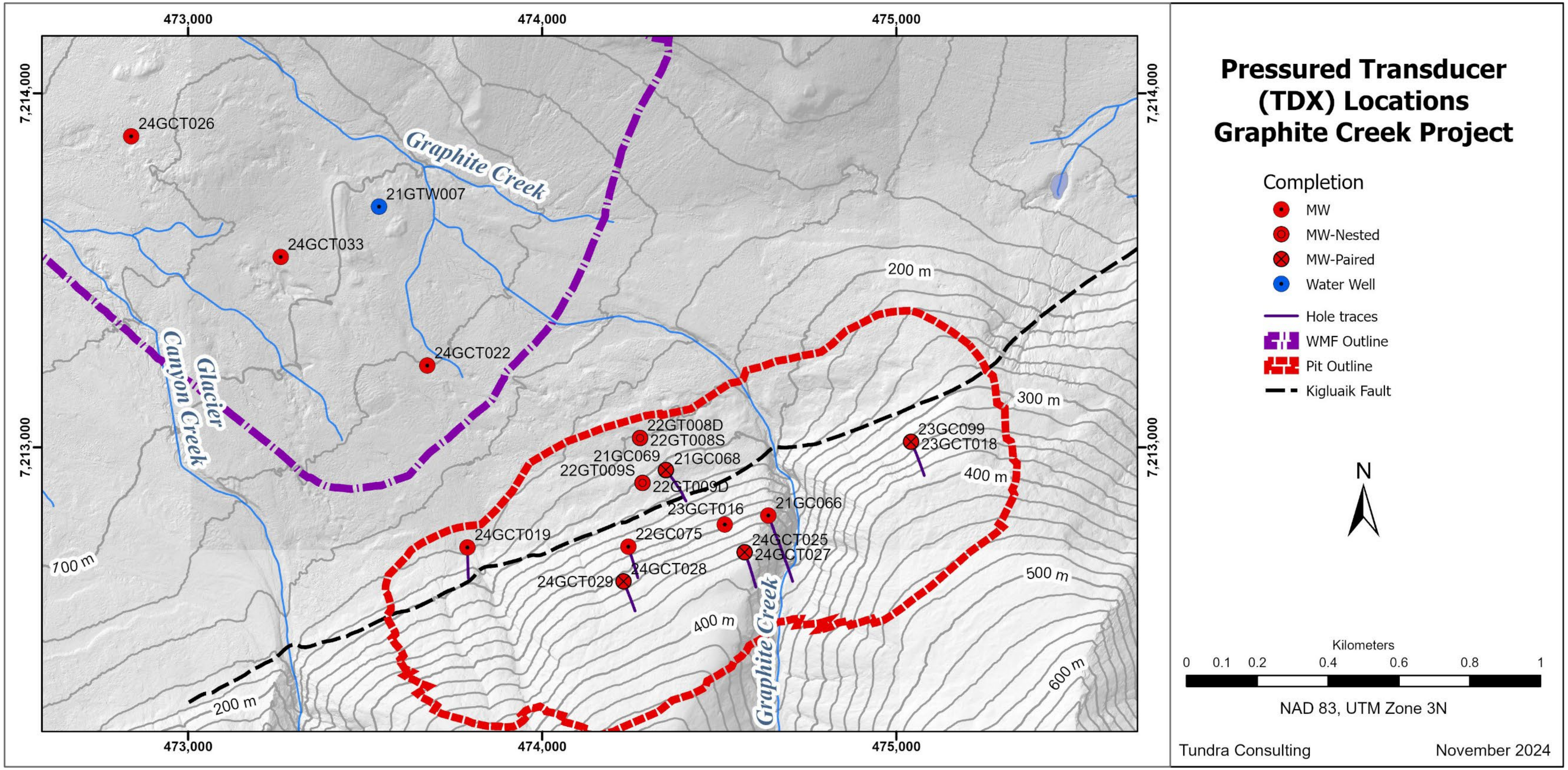


Figure 6-3. Pressure transducer locations

Table 6-1. Hydrogeologic and geotechnical holes

Hole ID	Contractor	East	North	Elev (mamsl)	Azimuth	Dip	Hole Depth (m)	Hole Depth (ft)	Hole Type	Completion Type
19GC027	KP/Tundra	474735.6	7212950.8	253.7	160	-50	151.2	496	Core	Stand Pipe
19GC028	KP/Tundra	474443.3	7212744.9	300.5	160	-50	135.9	446	Core	Stand Pipe
19GT001	KP/Tundra	473503.0	7212766.1	137.6	0	-90	70.7	232	Core	P&A
21GC066	Tundra	474638.2	7212807.4	307.6	158	-51	325.5	1068	Core	MW
21GC068	Tundra	474349.5	7212935.5	207.0	143	-59	195.7	642	Core	MW-Paired
21GC069	Tundra	474348.9	7212936.1	206.6	0	-90	20.1	66	Core	MW-Paired
21GT001	KP	473443.7	7214172.3	111.2	0	-90	66.1	217	Sonic	Stand Pipe
21GT002	KP	473622.5	7214314.2	140.3	0	-90	76.8	252	Sonic	Stand Pipe
21GT003	KP	473986.1	7214592.3	189.7	0	-90	84.4	277	Sonic	Stand Pipe
21GT004	KP	474706.5	7214196.1	207.5	0	-90	60.8	200	Sonic	Stand Pipe
21GT005	KP	474067.2	7213772.2	130.1	0	-90	68.4	225	Sonic	Stand Pipe
21GT006	KP/Tundra	476596.0	7213038.6	193.1	0	-90	145.2	476	Core	Stand Pipe
21GTW007	KP/Tundra	473539.0	7213679.9	104.8	0	-90	76.2	250	Sonic	Water Well
22GC073	Tundra	474206.0	7212823.1	206.8	159	-50	151.9	498	Core	Stand Pipe
22GC075	Tundra	474243.1	7212719.5	265.1	163	-50	150.0	492	Core	MW
22GCT010	KP	474694.0	7212252.0	367.0	0	-90	35.3	116	Core	Stand Pipe
22GCT011	KP	473401.7	7211913.3	264.5	0	-90	31.7	104	Core	Stand Pipe
22GCT012	KP	472680.9	7211888.0	197.7	0	-90	32.6	107	Core	Stand Pipe
22GT008D	Tundra	474276.0	7213026.6	180.6	0	-90	82.6	271	Sonic	MW-nested
22GT008S	Tundra	474276.0	7213026.6	180.6	0	-90	82.6	271	Sonic	MW-nested
22GT009D	Tundra	474283.3	7212899.6	202.7	290	-85	50.4	165	Sonic	MW-nested
22GT009S	Tundra	474283.3	7212899.6	202.7	290	-85	50.4	165	Sonic	MW-nested
22GT013	Tundra	473328.3	7213675.1	89.2	0	-90	88.0	180	Sonic	Stand Pipe
23GC094	Tundra	474944.4	7213204.5	240.8	172	-49	186.2	611	Core	P&A
23GC099	Tundra	475041.6	7213015.9	327.2	157	-51	162.8	534	Core	MW-Paired
23GC100	Tundra	474974.7	7213107.3	264.1	175	-49	208.8	685	Core	P&A
23GCT015	KP	475093.5	7213357.3	250.9	0	-90	36.0	118	Core	Stand Pipe
23GCT016	Tundra	474515.5	7212782.0	294.4	0	-90	40.5	133	Core	MW
23GCT017	Tundra	474944.3	7213205.5	240.7	0	-90	26.8	88	Core	P&A
23GCT018	Tundra	475041.7	7213015.9	327.2	0	-90	40.8	134	Core	MW-Paired
24GCT019	Tundra	473788.7	7212717.4	158.3	179	-50	145.1	148	Core	MW
24GCT020A	Tundra	475061.6	7213235.4	262.8	179	-49	164.6	168	Core	Stand Pipe
24GCT021	Barr/Tundra	473628.7	7213648.6	107.5	0	-90	30.8	34	Core/SPT	Stand Pipe
24GCT022	Barr/Tundra	473675.1	7213231.2	120.4	0	-90	144.8	148	Core/SPT	MW
24GCT023	Barr/Tundra	473682.7	7212510.5	220.4	161	-50	120.1	123	Core	Stand Pipe
24GCT024	Barr/Tundra	473152.4	7213967.3	86.6	0	-90	30.5	34	Core/SPT	Stand Pipe
24GCT025	Barr/Tundra	474571.8	7212703.5	354.5	160	-51	157.9	161	Core	MW-Paired
24GCT026	Barr/Tundra	472839.2	7213878.9	73.2	0	-90	162.0	165	Core/SPT	MW
24GCT027	Tundra	474571.8	7212703.5	354.5	154	-89	39.9	43	Core	MW-Paired
24GCT028	Barr/Tundra	474229.6	7212621.1	308.6	157	-50	143.9	147	Core	MW-Paired
24GCT029	Tundra	474229.5	7212621.2	308.6	326	-90	39.9	43	Core	MW-Paired
24GCT030	Barr/Tundra	473909.3	7212574.9	232.5	200	-51	120.4	124	Core	Stand Pipe
24GCT031	Barr/Tundra	472400.7	7213706.3	55.4	0	-90	30.8	34	Core/SPT	Stand Pipe
24GCT032	G1/Barr/Tundra	474934.2	7213020.0	286.1	155	-50	164.9	168	Core	Stand Pipe
24GCT033	Barr/Tundra	473261.3	7213537.9	88.3	0	-90	146.6	150	Core/SPT	MW
24GCT034	Barr/Tundra	474618.0	7213537.6	164.1	0	-90	45.7	49	Core/SPT	Stand Pipe
24GC142A	Tundra	474834.8	7213198.9	224.9	140	-50	194.8	198	Core	P&A

Notes
Datum – NAD83 UTM Zone 3N
m – meters
mamsl – meters above mean sea level
MW – monitoring well
P&A – plugged and abandoned
SPT – standard penetration test

Table 6-2. Instrumentation

Hole ID	Elev (mamsl)	Dip	Hole Depth (m)	Completion Type	Depth	Flowing Artesian	Artesian wellhead	MW	Packer	Other K Test	WQ sample	TDX	DTC (m)	VWP (count)	Heat trace	Pump
19GC027	253.7	-50	151.2	Stand Pipe	D								R	x		
19GC028	300.5	-50	135.9	Stand Pipe	D								120	x		
19GT001	137.6	-90	70.7	P&A	D											
21GC066	307.6	-51	325.5	MW	D			x		x	x	x	R		x	x
21GC068	207.0	-59	195.7	MW-Paired	D	x	x	x		x	x	x	140		x	
21GC069	206.6	-90	20.1	MW-Paired	S			x				x				
21GT001	111.2	-90	66.1	Stand Pipe	D									2		
21GT002	140.3	-90	76.8	Stand Pipe	D									2		
21GT003	189.7	-90	84.4	Stand Pipe	D									2		
21GT004	207.5	-90	60.8	Stand Pipe	D									2		
21GT005	130.1	-90	68.4	Stand Pipe	D									2		
21GT006	193.1	-90	145.2	Stand Pipe	D								140	2	x	
21GTW007	104.8	-90	76.2	Water Well	D			x		x	x	o	R			x
22GC073	206.8	-50	151.9	Stand Pipe	D	x			x					5		
22GC075	265.1	-50	150.0	MW	D	x	x	x	x		x	x	120		x	
22GCT010	367.0	-90	35.3	Stand Pipe	0	x								2		
22GCT011	264.5	-90	31.7	Stand Pipe	0	x								2		
22GCT012	197.7	-90	32.6	Stand Pipe	0									2		
22GT008D	180.6	-90	82.6	MW-Nested	S			x		x	x	x	60		x	
22GT008S	180.6	-90	82.6	MW-Nested	D			x		x	x	x				x
22GT009D	202.7	-85	50.4	MW-Nested	D			x		x		x			x	
22GT009S	202.7	-85	50.4	MW-Nested	S			x		x		x				
22GT013	89.2	-90	88.0	Stand Pipe	D								84	2		
23GC094	240.8	-49	186.2	P&A	D				x							
23GC099	327.2	-51	162.8	MW-Paired	D			x	x		x	x	140		x	x
23GC100	264.1	-49	208.8	P&A	D	x			x							
23GCT015	250.9	-90	36.0	Stand Pipe	S								40			
23GCT016	294.4	-90	40.5	MW	S			x			x	x				
23GCT017	240.7	-90	26.8	P&A	S											
23GCT018	327.2	-90	40.8	MW-Paired	S			x			x	x				
24GCT019	158.3	-50	145.1	MW	D	x	x	x	x		x	x	140		x	A
24GCT020A	262.8	-49	164.6	Stand Pipe	D									4		
24GCT021	107.5	-90	30.8	Stand Pipe	S								25		G	
24GCT022	120.4	-90	144.8	MW	D			x		x	x	x	140	3	x	x
24GCT023	220.4	-50	120.1	Stand Pipe	D				x					5		
24GCT024	86.6	-90	30.5	Stand Pipe	S								25		G	
24GCT025	354.5	-51	157.9	MW-Paired	D			x	x		x	x	140		x	x
24GCT026	73.2	-90	162.0	MW	D			x		x	x	x	140	2	x	x
24GCT027	354.5	-89	39.9	MW-Paired	S			x				x				
24GCT028	308.6	-50	143.9	MW-Paired	D	x	x	x	x		x	x	140		x	A
24GCT029	308.6	-90	39.9	MW-Paired	S			x		x	x	x				
24GCT030	232.5	-51	120.4	Stand Pipe	D				x					5		
24GCT031	55.4	-90	30.8	Stand Pipe	S								25	1	G	
24GCT032	286.1	-50	164.9	Stand Pipe	D				x					5		
24GCT033	88.3	-90	146.6	MW	D			x		x		x	140	2	x	
24GCT034	164.1	-90	45.7	Stand Pipe	S								50		G	
24GC142A	224.9	-50	194.8	P&A	D				x							

Notes:
m – meters, mamsl – meters above mean sea level
MW – monitoring well
S – shallow (water table), D – deep
G – propylene glycol used instead of heat trace
A – flowing artesian

Table 6-3. Well construction

Hole ID	Well Depth (m)	Stickup (m)	Well Diameter (in)	Material	Slot Size (in)	Screen From (mbtoc)	Screen To (mbtoc)	Screen Length (m)	Screen Location	Screen Installation	Filter pack
21GC066	306.3	0.55	2	PVC, Sch 80	0.010	303.26	306.31	3.0	deep	open hole	none
21GC068	151.6	0.50	2	PVC, Sch 80	0.010	145.53	151.63	6.1	deep	open hole	none
21GC069	20.4	0.46	2	PVC, Sch 80	0.010	15.85	20.42	4.6	water table	open hole	none
21GTW007	76.4	0.43	4	PVC, Sch 40	0.020	48.77	76.20	27.4	water table	open hole	none
22GC075	148.7	0.50	2	PVC, Sch 80	0.010	133.30	148.74	15	deep	open hole	none
22GT008S	46	0.88	2	PVC, Sch 80	0.010	36.88	46.02	9.1	water table	conventional	10-20
22GT008D	78	0.92	2	PVC, Sch 80	0.010	68.88	78.02	9.1	deep	conventional	10-20
22GT009S	34	0.90	2	PVC, Sch 80	0.010	30.48	33.53	3.0	water table	conventional	10-20
22GT009D	44	0.87	2	PVC, Sch 80	0.010	41.15	44.19	3.0	deep	conventional	10-20
23GC099	144.6	0.76	2	PVC, Sch 80	0.010	123.29	144.62	21.3	deep	open hole	none
23GCT016	40.9	1.30	2	PVC, Sch 80	0.010	19.51	40.84	21.3	water table	open hole	none
23GCT018	40.9	1.68	2	PVC, Sch 80	0.010	19.51	40.84	21.3	water table	open hole	none
24GCT019	145.1	0.94	2	PVC, Sch 80	0.020	104.67	140.82	36.2	deep	open hole	none
24GCT022	145.1	0.66	2	PVC, Sch 80	0.020	135.59	144.74	9.2	deep	open hole	none
24GCT025	158.0	0.70	2	PVC, Sch 80	0.020	148.76	157.91	9.2	deep	open hole	none
24GCT026	162.0	0.50	2	PVC, Sch 80	0.020	152.75	162.00	9.3	deep	open hole	none
24GCT027	39.9	0.80	2	PVC, Sch 80	0.010	20.06	39.93	19.9	water table	open hole	none
24GCT028	143.9	1.20	2	PVC, Sch 80	0.020	122.48	143.87	21.4	deep	open hole	none
24GCT029	39.9	0.71	2	PVC, Sch 80	0.010	20.03	39.93	19.9	water table	open hole	none
24GCT033	146.6	0.42	2	PVC, Sch 80	0.010	137.50	146.50	9.0	deep	Prepack	Prepack

Notes
m – meters, in – inches
mbtoc – meters below top of casing – measured downhole
stickup – the distance from the ground surface to the top of the well

Table 6-4. Summary of monitoring results

Well	Collar El (mamsl)	Period of Record		Depth to Water (mbgs)			Water Elevation (mamsl)			Flowing Artesian
		Start	End	Min	Max	Range	Min	Mean	Max	
21GC066	307.59	10/15/2021	7/1/2024	18.76	39.74	20.98	267.85	276.45	288.83	No
21GC068	206.99	10/14/2021	7/20/2024	-54.51	-14.63	39.88	221.63	240.81	261.51	Yes
21GTW007	104.00	10/14/2021	6/29/2022	43.23	58.76	15.53	45.24	52.25	60.77	No
22GC075	266.00	8/30/2022	8/3/2024	-15.31	32.54	47.85	233.46	254.69	281.31	Partial
22GT008S	181.00	8/25/2022	8/3/2024	23.05	40.03	16.99	140.97	146.08	157.95	No
22GT008D	181.00	8/25/2022	8/3/2024	50.42	74.23	23.81	106.77	114.23	130.58	No
22GT009S	203.00	8/29/2022	7/20/2024	27.37	32.61	5.24	170.39	171.74	175.63	No
22GT009D	203.00	8/29/2022	7/20/2024	34.97	43.53	8.56	159.47	162.60	168.03	No
23GC099	327.21	10/1/2023	8/6/2024	33.86	57.72	23.86	269.49	277.61	293.35	No
23GCT016	294.43	10/1/2023	7/20/2024	17.65	30.00	12.35	264.43	265.42	276.78	No
23GCT018	327.21	10/1/2023	8/6/2024	-5.09	24.54	29.63	302.67	304.65	332.30	No
24GCT019	158.67	8/30/2024	8/30/2024	-3.12	-3.12	0.00	161.80	161.80	161.80	Yes
24GCT022	146.00	8/6/2024	8/28/2024	68.63	72.28	3.65	73.72	75.51	77.37	No
24GCT025	351.40	7/15/2024	8/11/2024	54.47	75.79	21.32	275.60	282.72	296.92	No
24GCT026	77.00	8/24/2024	8/29/2024	44.85	45.17	0.32	31.83	31.93	32.15	No
24GCT027	351.40	7/15/2024	8/8/2024	29.35	38.36	9.01	313.03	317.54	322.05	No
24GCT028	306.47	8/4/2024	8/4/2024	5.69	5.69	0.00	300.78	300.78	300.78	Partial
24GCT029	306.47	8/26/2024	8/30/2024	10.32	12.09	1.77	294.38	295.22	296.15	No
24GCT033	98.00	8/23/2024	8/30/2024	49.56	50.19	0.63	47.81	48.17	48.44	No

Notes
** Highlighted cells - water dropped below transducer during part of the winter*
** Depths are meters below ground surface (mbgs) at collar, not directly above the screen interval. There may be a substantial difference between these depths.*
** All 24GCT holes have very short records and should be used with caution. The short monitoring period is during the summer and therefore is likely biased high.*
** Flowing artesian, partial - only flows during periods of high groundwater levels*

Table 6-5. Summary of VWP water elevations

			VWP location			Water Elevation (mamsl)		
Hole	**VWP ID**	**Type**	**Easting**	**Northing**	**Elevation (mamsl)**	**Max**	**Mean**	**Min**
19GC027	VW1	VWP	474765.9769	7212859.397	139.1	259.1	253.2	248.2
19GC028	VW1	VWP	474471.2396	7212665.665	197.1	333.2	322.5	311.4
21GT001	VW1	VWP	473443.659	7214172.343	42.2	PF	PF	PF
21GT001	VW2	VWP	473443.659	7214172.343	76.2	PF	PF	PF
21GT002	VW1	VWP	473622.46	7214314.194	65.3	PF	PF	PF
21GT002	VW2	VWP	473622.46	7214314.194	100.3	PF	PF	PF
21GT003	VW1	VWP	473986.064	7214592.345	108.7	PF	PF	PF
21GT003	VW2	VWP	473986.064	7214592.345	143.7	PF	PF	PF
21GT004	VW1	VWP	474706.455	7214196.05	157.5	PF	PF	PF
21GT004	VW2	VWP	474706.455	7214196.05	190.5	PF	PF	PF
21GT005	VW1	VWP	474067.157	7213772.243	80.1	PF	PF	PF
21GT005	VW2	VWP	474067.157	7213772.243	113.1	PF	PF	PF
21GT006	VW1	VWP	476595.989	7213038.586	95.1	140.3	133.1	125.6
21GT006	VW2	VWP	476595.989	7213038.586	118.1	PF	PF	PF
22GC073	22GC073-471	VWP	474238.7692	7212736.686	96.9	253.6	246.7	239.6
22GC073	22GC073-330	VWP	474228.9653	7212762.54	129.8	250.5	246.0	227.3
22GC073	22GC073-235	VWP	474222.3598	7212779.96	152.0	223.5	219.1	212.9
22GC073	22GC073-160	VWP	474217.145	7212793.712	169.5	217.1	211.3	207.7
22GC073	22GC073-70	VWP	474210.8872	7212810.215	190.5	212.4	208.5	205.6
22GCT010	22GCT010 VW1	VWP at install	474693.98	7212252.03	337.0	na	na	366.5
22GCT010	22GCT010 VW2	VWP at install	474693.98	7212252.03	357.0	na	na	366.7
22GCT011	22GCT011 VW1	VWP at install	473401.71	7211913.26	234.6	na	na	264.9
22GCT011	22GCT011 VW2	VWP at install	473401.71	7211913.26	258.6	na	na	264.9
22GCT012	22GCT012 VW1	VWP at install	472680.89	7211887.96	167.7	na	na	185.3
22GCT012	22GCT012 VW2	VWP at install	472680.89	7211887.96	177.7	na	na	185.3
22GT013	22GT013 VW1	VWP at install	473328.27	7213675.06	4.2	PF	PF	PF
22GT013	22GT013 VW2	VWP at install	473328.27	7213675.06	39.2	PF	PF	PF

Results are through 2023 and do not include 2024 data
Datum – NAD83 UTM Zone 3N
VWP – vibrating wire piezometer
mamsl – meters above mean seal level

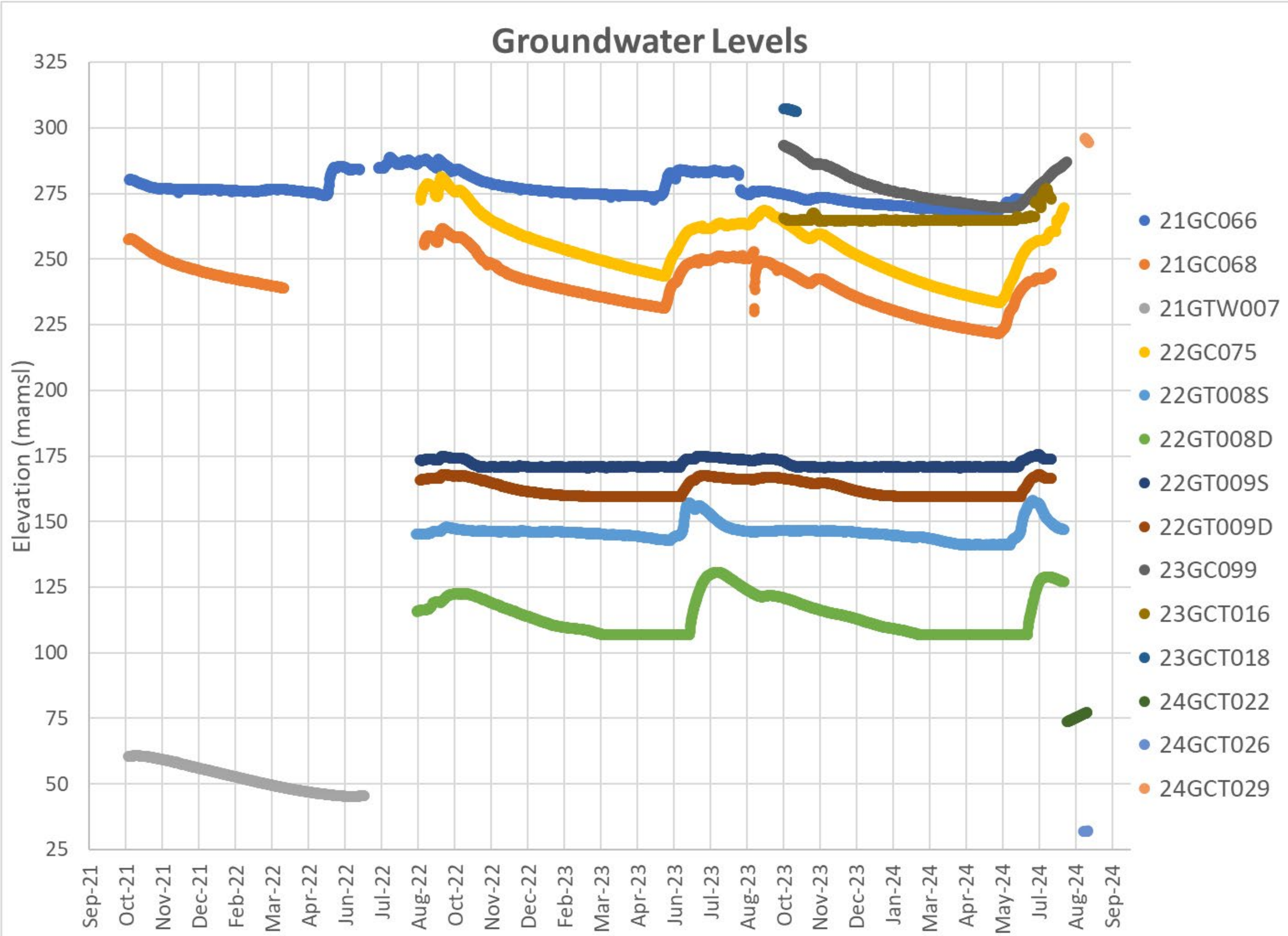


Figure 6-4. Hydrographs, all wells, standard elevation scale

6.6 Results

6.6.1 Mountains

The groundwater level in the deposit area shows considerable seasonal variation, ranging from approximately 15 m to as much as approximately 35 meters (Table 6-4, Figure 6-5). The trends are very similar as seen in a standard normal plot (Figure 6-6). The following seasonal trends are observed:

- There are sustained high water levels in the summer.
- In late September and October, freeze-up occurs and infiltration of precipitation ends.
- From freeze-up to breakup, water levels decline, reaching a minimum just before breakup.
- Upon breakup, in late May and June, infiltration of snowmelt water and precipitation results in a rapid rise in groundwater level.

The sustained high groundwater level in the summer may include a snow melt peak early in the summer or a late summer rains peak. There is insufficient data to determine if one or the other is more common.

Flowing artesian conditions are common. They are typically seen in holes drilled near the break in slope extending to approximately 60 m upslope. Artesian head varies from approximately 60 psi (42 m) at lower elevations to only flowing during high groundwater levels in the upper part of the zone. Flows vary from a trickle to as much as 50 gpm being reported by the drillers. Typical flows are in the 2 gpm range.

Where present, permafrost has been observed to have a suprapermafrost talik (see Section5.4). A perched aquifer is found at the top of permafrost. The thickness of this aquifer varies ranging from over 10 m in the summer to less than a couple meters in winter when the water level drops below the TDX (Figure 6-7).

In the damage zone adjacent to the Kigluaik Fault, groundwater flow is thought to have an upward component to flow based on VWP data from holes 22GC073 (Figure 6-8).

6.6.2 Lowland near the fault:

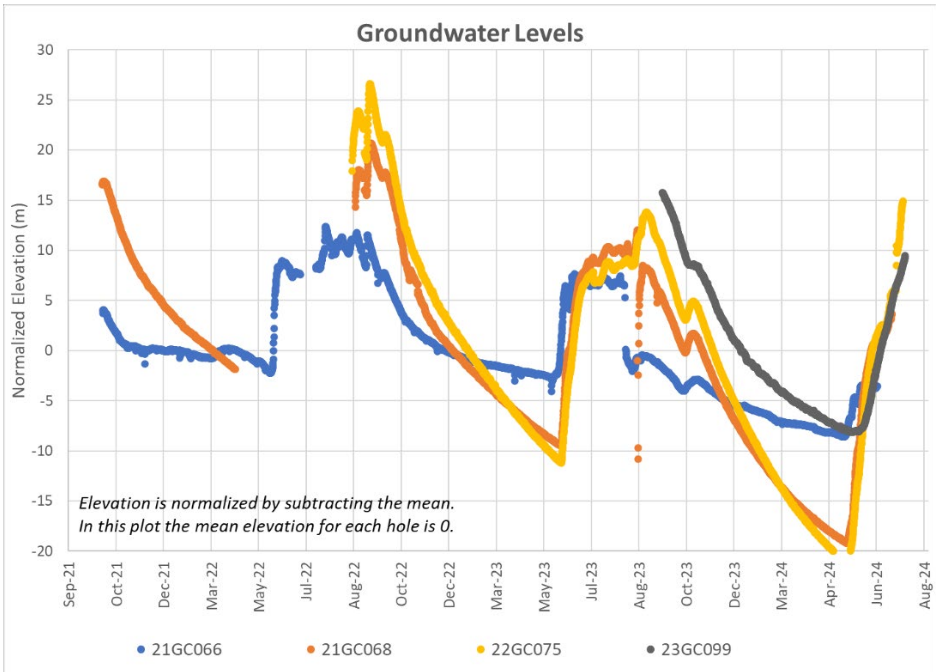
There are only two well located in this zone, each of which are nested. They are all relatively shallow to stay above the fault. The groundwater gradient shows a strong downward gradient as seen by the elevation difference between the water levels in each pair of wells (Table 6-4, Figure 6-9). As in the adjacent upland area, the water drops during the winter, dropping below the transducer in all four wells.

6.6.3 Lowland

Most of the wells in this area were installed in 2024, so little data is currently available (Table 6-4, Figure 6-10). The exception is the camp water well (21GTW007) which had a TDX installed before it went into operation. The data from one winter of observations suggest that seasonal variation in groundwater levels is similar to that of the mountains, but possibly with less magnitude (15.5 m range was observed in 21GTW007).

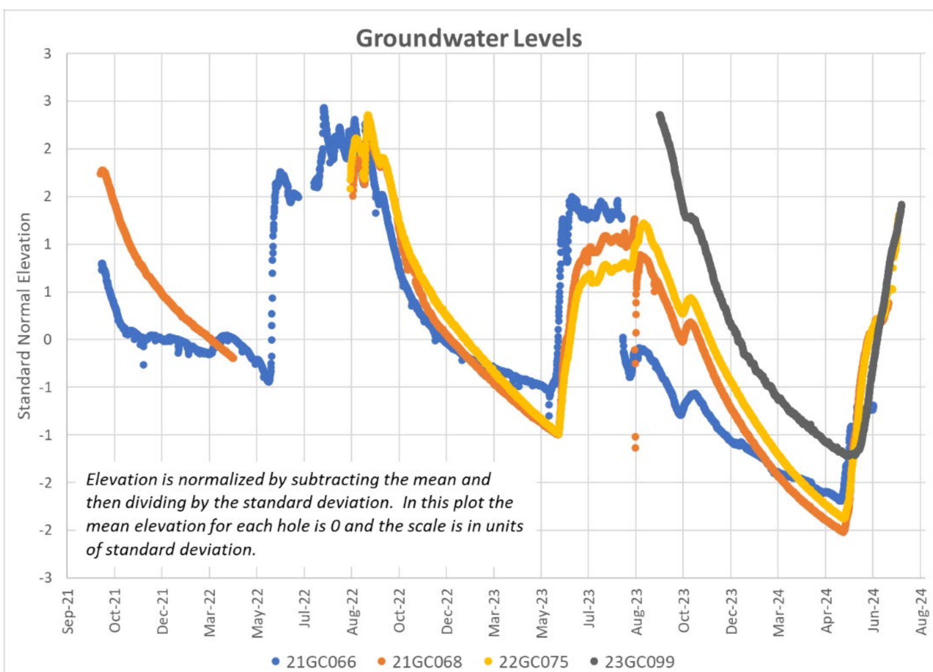
Only wells with relatively deep screened intervals have been installed. Paired wells have not been drilled due to the depth of groundwater and the challenging drilling conditions.

Deep permafrost was observed in hole 24GCT026. The groundwater level in this well is above the bottom of permafrost indicating that it is confined under the permafrost.



Note: 23GCT099 is biased high in this normalized plot due to 2 summers and only one winter of data

Figure 6-5. Hydrograph, bedrock wells, normalized elevation



Note: 23GCT099 is biased high in this standard normal plot due to 2 summers and only one winter of data

Figure 6-6. Hydrographs, bedrock wells, standard normal elevation

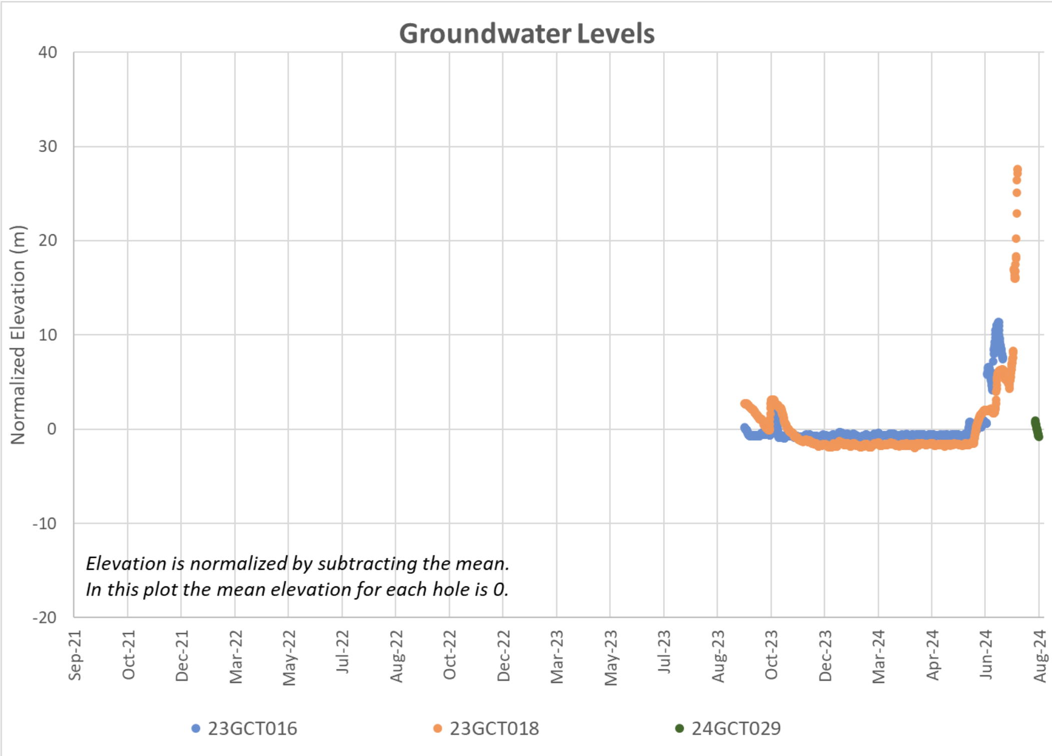


Figure 6-7. Hydrographs, bedrock suprapermafrost aquifer, normalized elevation

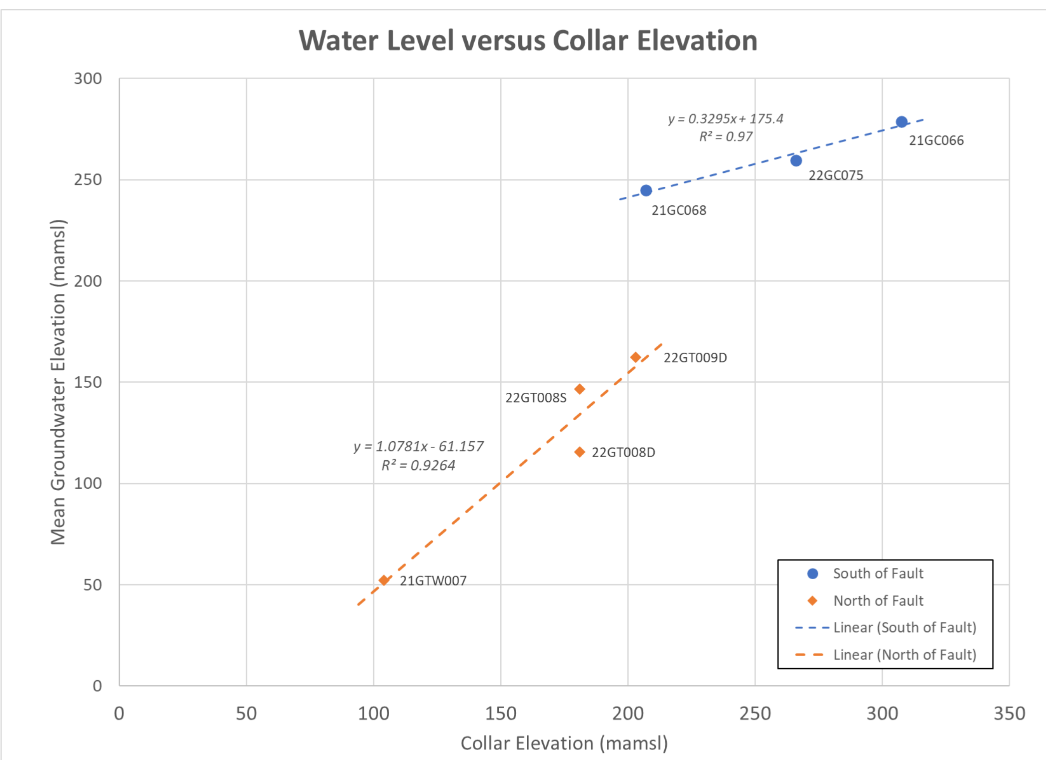


Figure 6-8. Mean groundwater elevation versus collar elevation

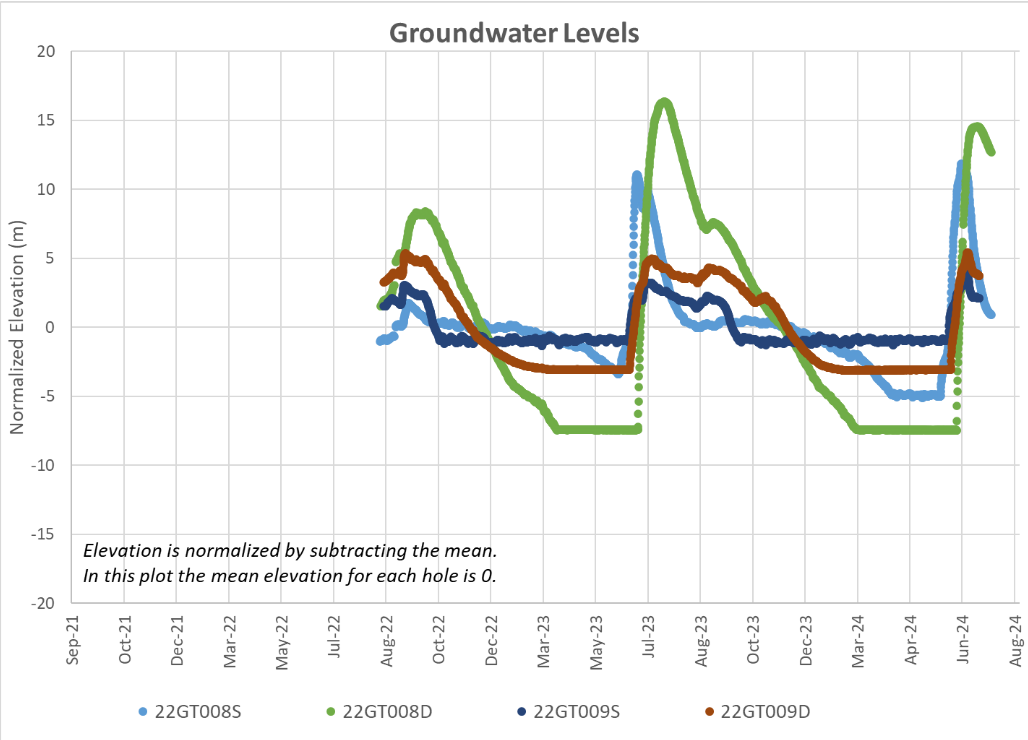


Figure 6-9. Hydrographs, lowlands near fault, normalized elevation

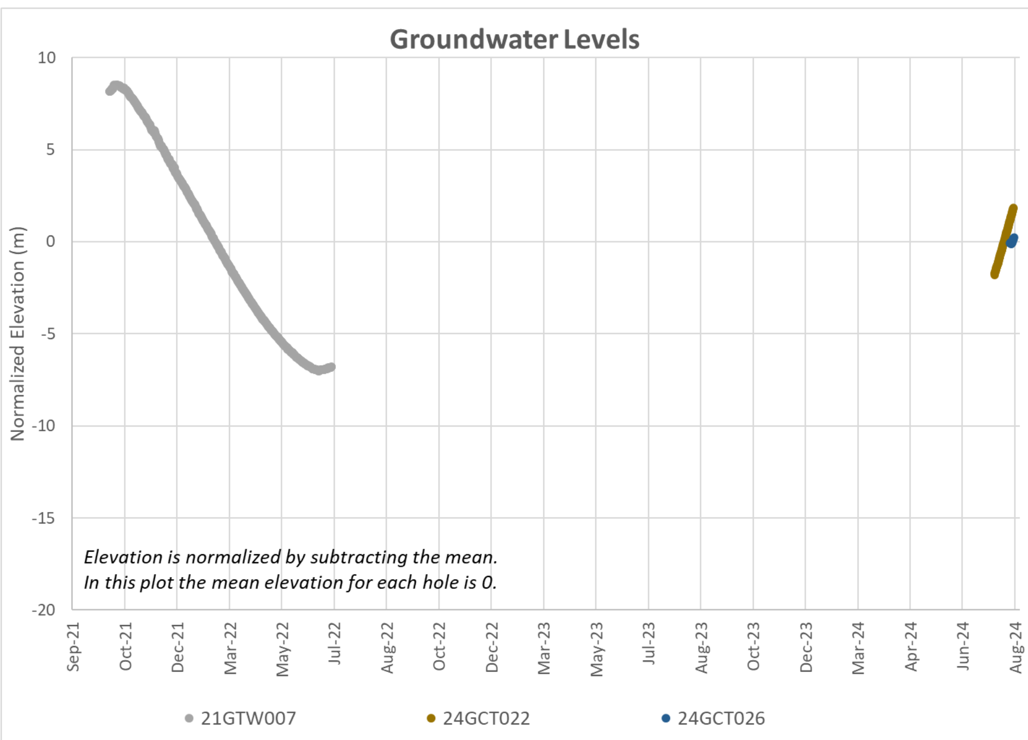


Figure 6-10. Hydrograph, lowlands, normalized elevation

7 Streamflow Monitoring

7.1 Introduction

Streamflow gauging at water quality sampling sites began in 2014 and continued intermittently through 2021 using the incremental velocity- area method. Most of the streams in the project area are small and shallow. In 2022, the gauging program was redesigned in order to achieve more accurate results.

Since 2022, Brailey Hydrologic has conducted streamflow monitoring on rivers and creeks near the Graphite Creek project. This section documents methods and results of the streamflow monitoring program.

7.2 Goals and Objectives

The goal of the streamflow monitoring program is to provide baseline data for NEPA studies, permitting, and preliminary mine design. Streamflow data help define the project's conceptual model (Section 11) and the input parameters for the groundwater model (Section 12). Specifically, streamflow data is needed to calibrate the GR4J model used to quantify recharge and baseflow (Section 8), which are required as inputs to the groundwater model. Streamflow data also help define the model's physical boundaries and influence the selection of streambed conductance values for modeled rivers and creeks. Streamflow data also have a variety of engineering uses including design of bridges, engineered channels, and water treatment works.

7.3 Methodology

7.3.1 Stream Gauge Locations

In 2022, five stream gauges were installed at the locations shown on Figure 7-1. Drainage areas for the stream gauges range from less than 1 square mile for the creek gauges to about 60 square miles for the Cobblestone River (Table 7-1). The creek gauges were located to quantify seasonal flows within the mine footprint, as well as stream losses (or gains) downstream of the mountain front. The Cobblestone River gauge was selected to provide seasonal flows on a larger stream comparable to those with nearby long-term streamflow records (Table 8-2). The following sections describe the stream gauge locations in greater detail.

7.3.1.1 Graphite Creek Stations

In June and July 2022, two stream gauges were installed about 1500 feet (ft, 460 meters, m) apart on Graphite Creek (Figure 7-2). The upper station, GC-A, is located in the mouth of the Graphite Creek canyon upstream of the mountain front. This location was selected to take advantage of a bedrock pool between two waterfalls that forms a natural weir (Figure 7-3). Although the site required installation of an access ladder, the bedrock constriction does not accumulate sediment, provides good sensitivity to flow, and is insulated from winter air temperatures by thick accumulations of avalanche debris.

Avalanche debris appears to have limited ice formation during the winters of 2022 and 2023, resulting in an estimated winter flow record for 2022. Although open-water conditions occurred during the winter of 2023, the measured water levels were compromised by transducer drift.

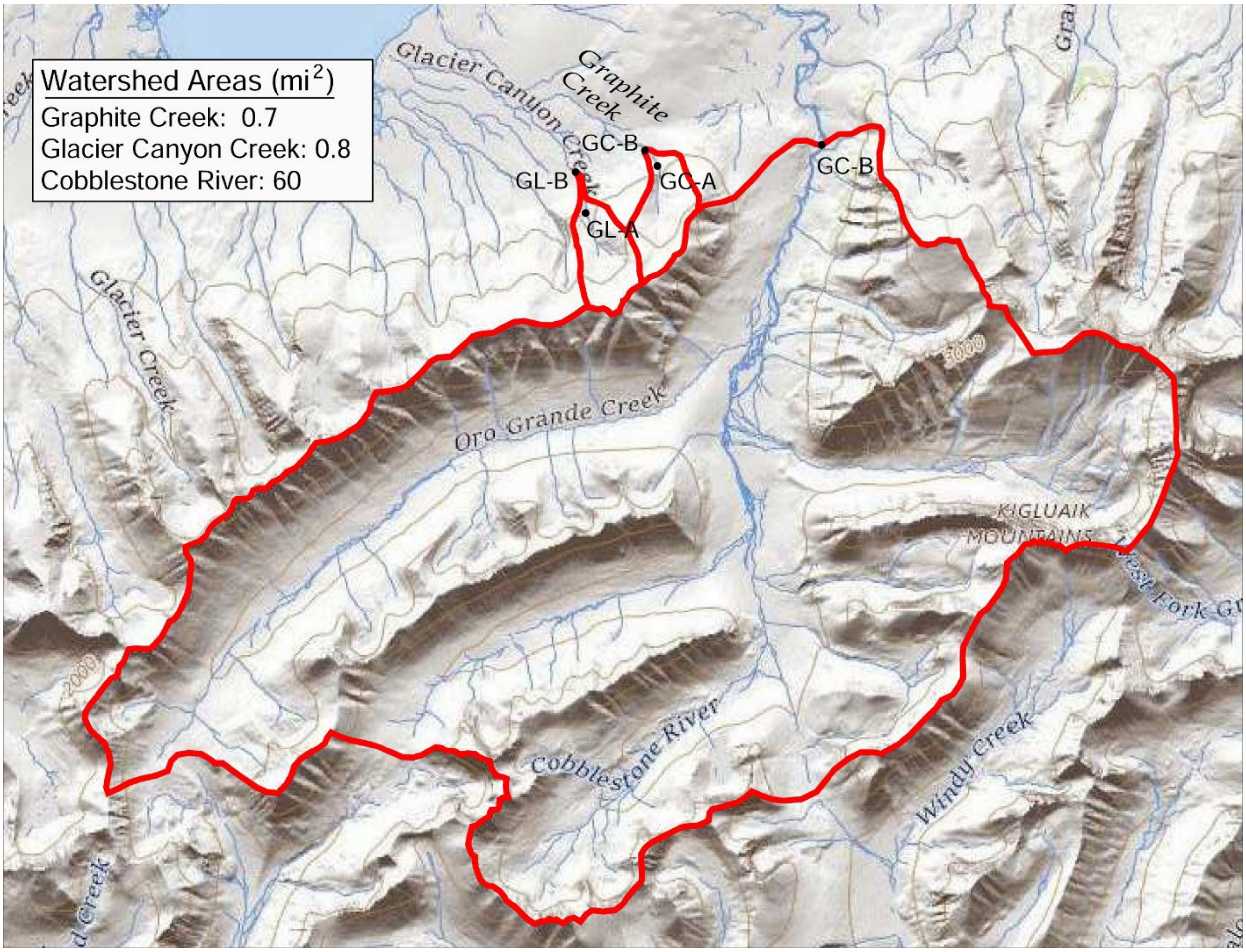


Figure 7-1. Graphite Creek, Glacier Canyon Creek, and Cobblestone River watersheds

Table 7-1. Stream gauge coordinates and watershed areas

Stream	Station	Stream gauge coordinates				Drainage area, mi^2
		WGS 84		NAD83 UTM Zone 3		
		East	North	East	North	
Cobblestone	CR-A	-165.4702	65.04356	477862	7213390	60
Graphite	GC-A	-165.5381	65.03931	474664	7212940	0.6
Graphite	GC-B	-165.5435	65.04269	474411	7213320	0.7
Glacier Canyon	GL-A	-165.5664	65.03196	473324	7212140	0.7
Glacier Canyon	GL-B	-165.5728	65.03899	473027	7212920	0.8

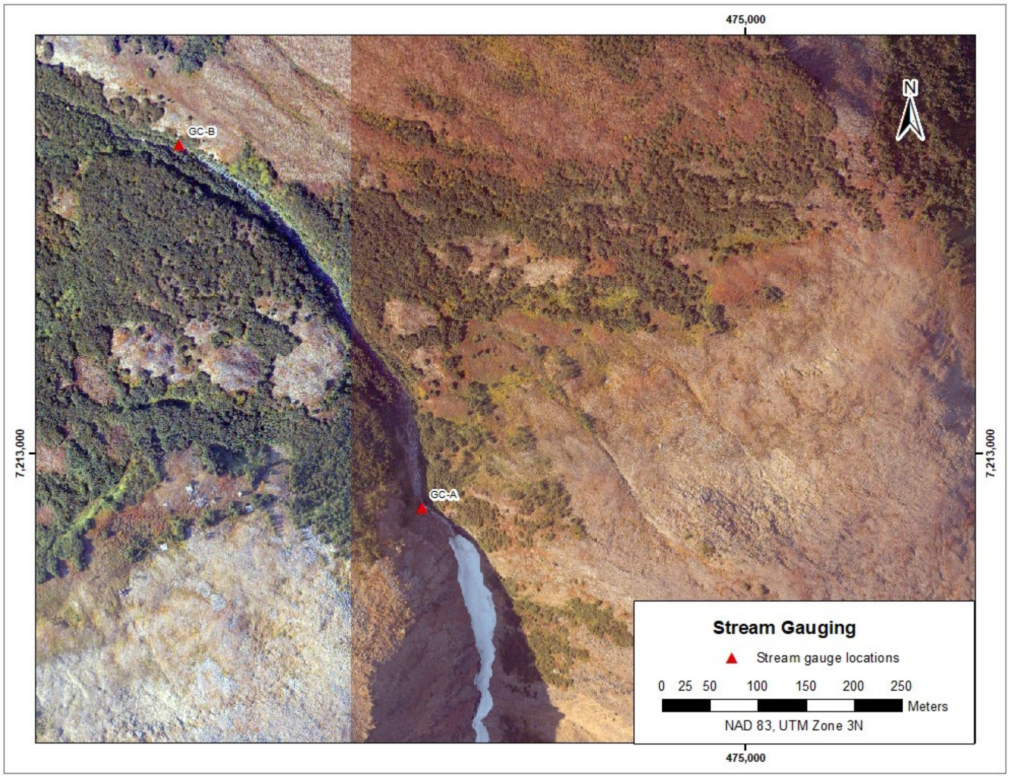


Figure 7-2. Graphite Creek gauge locations.

Figure 7-3. Measuring depth to water at GC-A, 9/14/22.

The lower Graphite Creek station, GC-B, was installed where existing boulders facilitated creation of a gauge pool with a downstream boulder control (Figure 7-4). The gauge pool is deep enough to keep the transducer submerged during low-water conditions, and the boulder control mimics the natural streambed. A reddish precipitate cements the stream substrate such that little bed movement has been observed throughout the period of record (July 2022-September 2024). Like the lower Glacier Canyon Creek gauge, the boulder control is subject to fouling with leaves and woody debris from the surrounding alder forest.

Figure 7-4. GC-B gauge pool, 9/14/22.

7.3.1.2 Glacier Canyon Creek Stations

In June and July 2022, two stream gauges were installed about 2750 ft (840 m) apart on Glacier Canyon Creek. The upper station (GL-A) was installed in the snow-free reach shown on Figure 7-5, which was elsewhere snow-covered on July 2, 2022 (Figure 7-6). The transducer was installed in a relatively quiescent pool bordered by large boulders and a bedrock sill. Using an extension cable, the communication box was moved to the left bank in September 2022.

The lower Glacier Canyon Creek station (GL-B) was installed where a nearby meadow provides a helicopter landing zone. An existing boulder formed the left bank, and boulders were added to make a gauge pool with a downstream boulder control (Figure 7-7). Since installation, the gauge pool has filled with gravel transported during several high-flow events, requiring several rating shifts (see below). The control is also subject to fouling with leaves and woody debris. A natural constriction about 50 m downstream results in a plunge pool that appears to flush gravel mobilized during flood events. This location might provide a better flow record than the current station location.

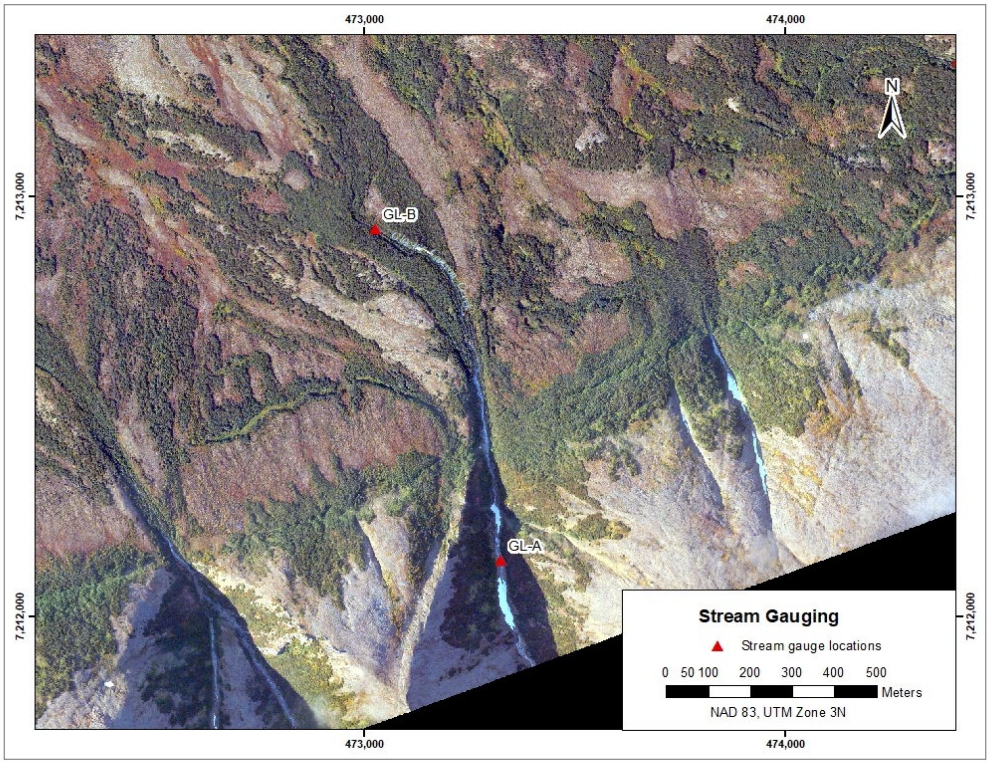


Figure 7-5. Glacier Canyon Creek gauge locations.

Figure 7-6. Upper Glacier Canyon Creek gauge (GL-A) on July 2, 2022. Communication box was later relocated to the west bank.

Figure 7-7. Lower Glacier Canyon Creek gauge (GL-B) on June 30, 2022.

7.3.1.3 Cobblestone River Station

The Cobblestone River station (CR-A) is located about ½ mile (0.8 kilometers) upstream of the Kigluaik Mountain front on the Cobblestone River, where a scour hole formed against a ridge of alluvium (Figure 7-8 and Figure 7-9). The scour hole provides a quiescent gauge pool that minimizes water level fluctuations from waves and turbulence. Although this location has produced an excellent gauge record, the embayment freezes to the streambed during winter, which damaged transducers during the winters of 2023 and 2024. As a result, stream stage is presently measured using non-vented transducers anchored in mid-channel. Data from the non-vented transducers is corrected using local barometric pressure data.

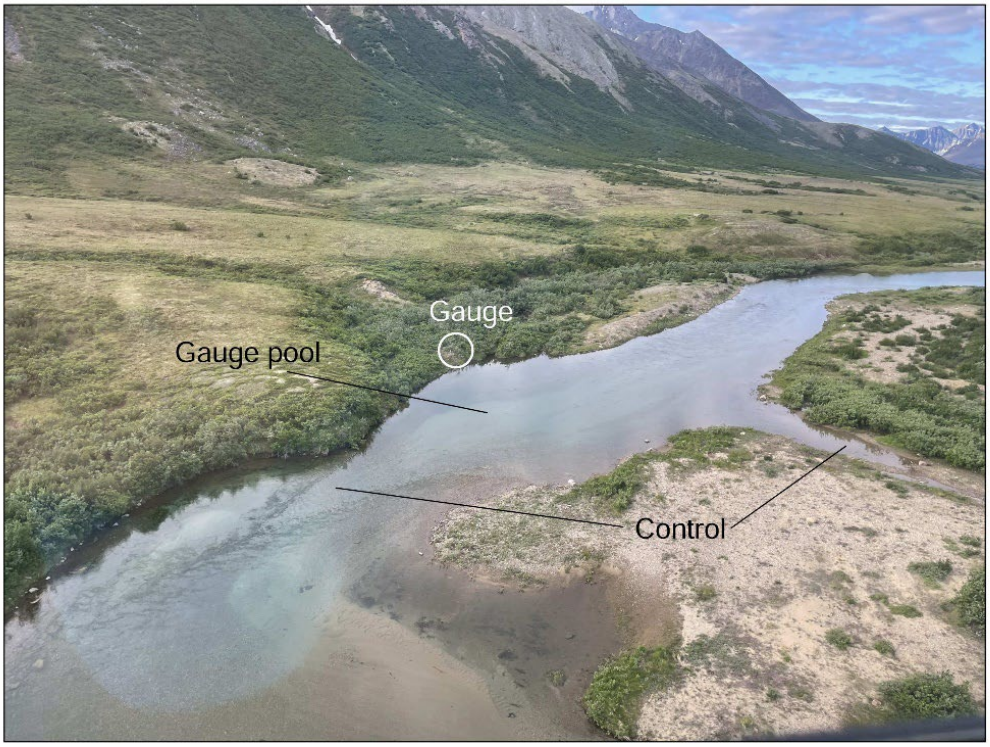


Figure 7-8. Cobblestone River (CR-A) gauge pool on June 30, 2022 (looking upstream)

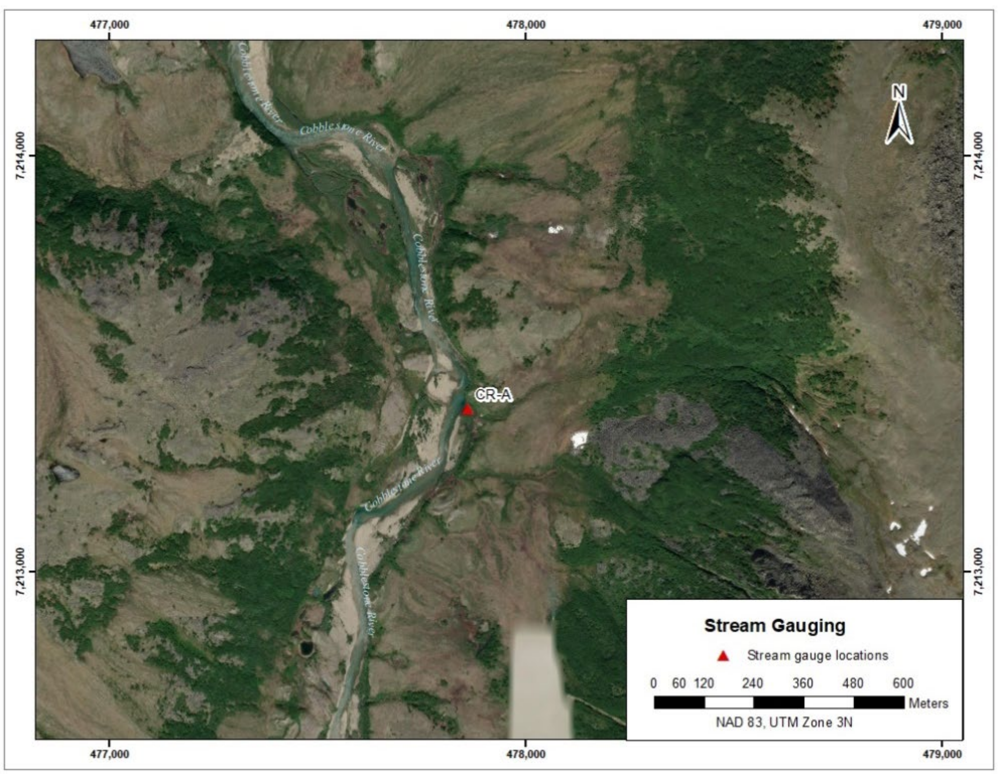


Figure 7-9. Cobblestone River gauge location.

7.3.2 Stream Gauging Activities

Stream gauging work included stream stage recording, elevation surveys, rating measurements, and winterization. These tasks are described below.

7.3.2.1 Stream Stage Recording

Stream stage was recorded using In-Situ Level Troll 500 pressure transducers programmed to log pressure readings at 15-minute intervals. The pressure transducers include surface vent tubes to eliminate atmospheric pressure fluctuations. The vent tubes and communication cables are wrapped with wire rope or conduit secured to boulders and rebar. The transducers are enclosed in 2 inch-diameter well points that allow for installation and removal of winter antifreeze balloons (Figure 7-10).

At the Cobblestone gauge, two non-vented transducers have been anchored in mid-channel since September 2022. These loggers prevented data loss when the Cobblestone's vented pressure transducers were damaged by anchor ice during the winters of 2023 and 2024. The mid-channel loggers are not affected by freezing, and are corrected for atmospheric pressure fluctuations using either an on-site barometric pressure logger or barometric pressure data from Graphite One's Mosquito Pass weather station.

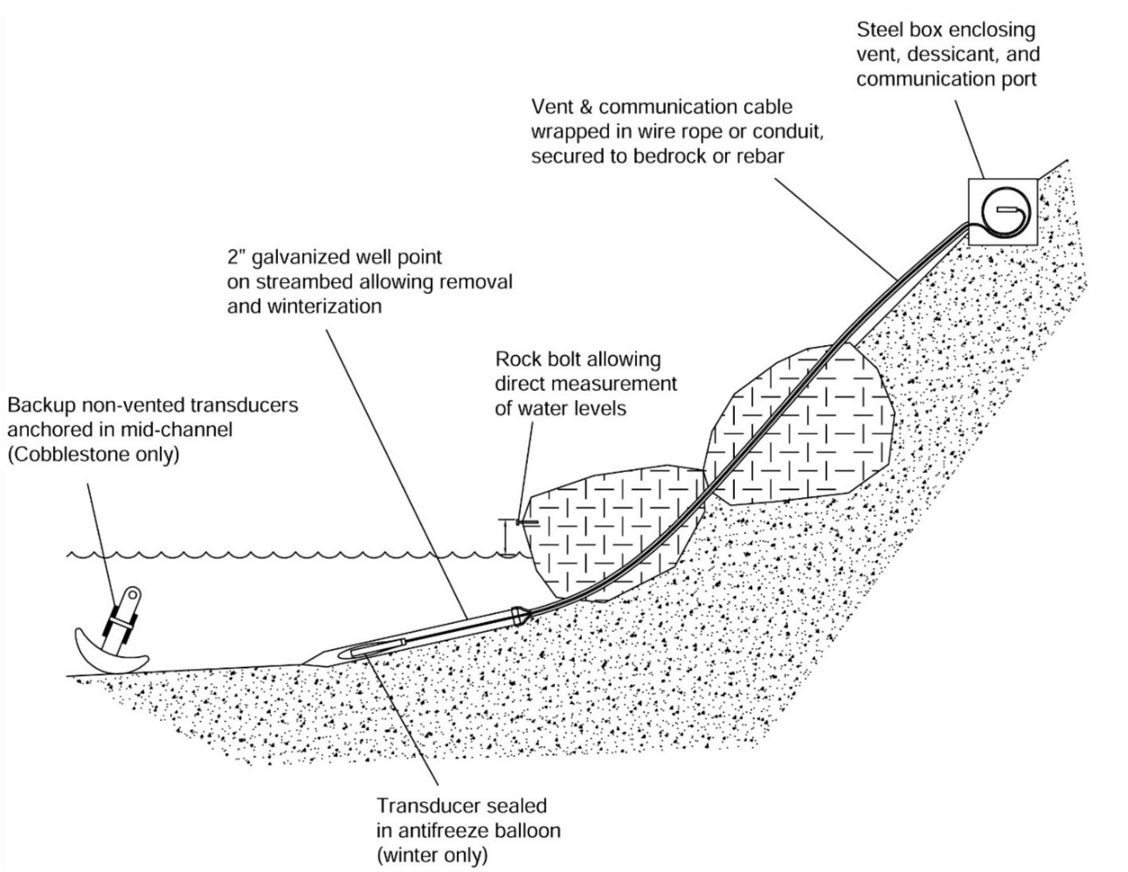


Figure 7-10. Typical stream gauge installation

7.3.2.2 Elevation Surveys

Streamflow monitoring requires local elevation control points to provide reference elevations for water levels measured in the stream. Rock bolts in bedrock at the upper stations on Graphite and Glacier Canyon Creeks provide good control that is not subject to frost heave. At stations where bedrock is not exposed, elevation control originally consisted of steel bars driven into the streambed. Annual elevation surveys show that this method is adequate for the lower stations on Graphite and Glacier Canyon Creeks, where only two of 10 control points have frost-jacked (Table 7-2). However, the silty bank substrate at the Cobblestone River station has caused almost all of the control points to be either frost-jacked or lost to erosion (Table 7-2). As a result, an existing 7-foot fence post was deepened (RP6) and two additional fence posts (RP8 and RP9) were added in August 2024. Site maps showing control points (CP's) and elevation reference points (RP's) are provided on Figures 7-11 through 7-15.

7.3.2.3 Rating Measurements

Rating measurements are used to develop the mathematical relationship used to calculate discharge from water level elevations. Water surface elevations were measured with a metal tape relative to surveyed elevation control points (Table 7-2). River discharge was measured using an acoustic Doppler current profiler, and stream discharge was measured by dye dilution. These techniques are described in the following sections.

Table 7-2. Surveyed control point elevations

Cobblestone River CR-A												
Date	CP1	CP2	CP3	RP1	RP2	RP3	RP4	RP5	RP6	RP7	RP8	RP9
6/29/22	100.00	98.62	98.21	92.23	93.51	96.25						
9/12/22	removed	98.61	98.22	92.23	93.51	removed	93.35	96.51				
6/10/23		98.67	98.22	under ice			94.04	96.77				
7/8/23		98.67	98.22	93.06	94.10		94.06	96.78				
9/24/23		98.62	98.22	93.05	93.95		93.95	96.65				
9/25/23		98.62	98.22	93.03	eroded		93.95	96.64	93.85	96.77		
6/28/24		98.63	98.22	eroded			94.92	96.89	94.92	96.82		
8/25/24		98.61	98.22				gone	96.87	94.93	96.83	100.47	100.85
8/25/24							Deepened RP6		94.06		100.47	
Upper Graphite Creek GC-A												
Date	RP1	RP2	RP3									
7/1/22	100.00	98.83	98.02									
Lower Graphite Creek GC-B												
Date	CP1	CP2	CP3	RP1	RP2							
6/30/22	102.86	100.59	100.00	98.61	98.92							
9/14/22	102.86	100.59	100.00	98.61	98.92							
7/8/23	102.86	100.59	100.00	98.62	98.92							
6/28/24	102.86	100.59	100.00	98.62	98.92							
Upper Glacier Canyon Creek GL-A												
Date	RP1	RP2	RP3									
7/2/22	100.14	100.14	101.23									
Lower Glacier Canyon Creek GL-B												
Date	CP1	CP2	CP3	RP1	RP2							
6/30/22	100.00	98.28	100.33	98.28	97.94							
7/8/23	100.00	missed	100.33	98.28	97.94							
6/28/24	100.00	98.41	102.56	98.29	97.94							

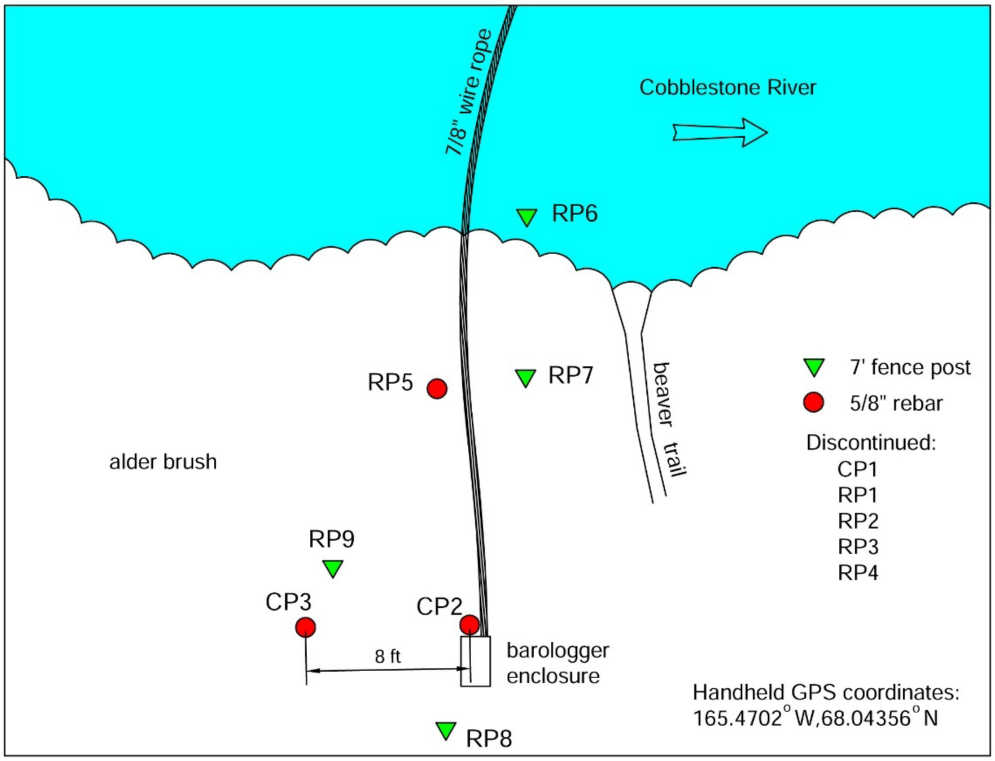


Figure 7-11. Cobblestone River (CR-A) elevation control points

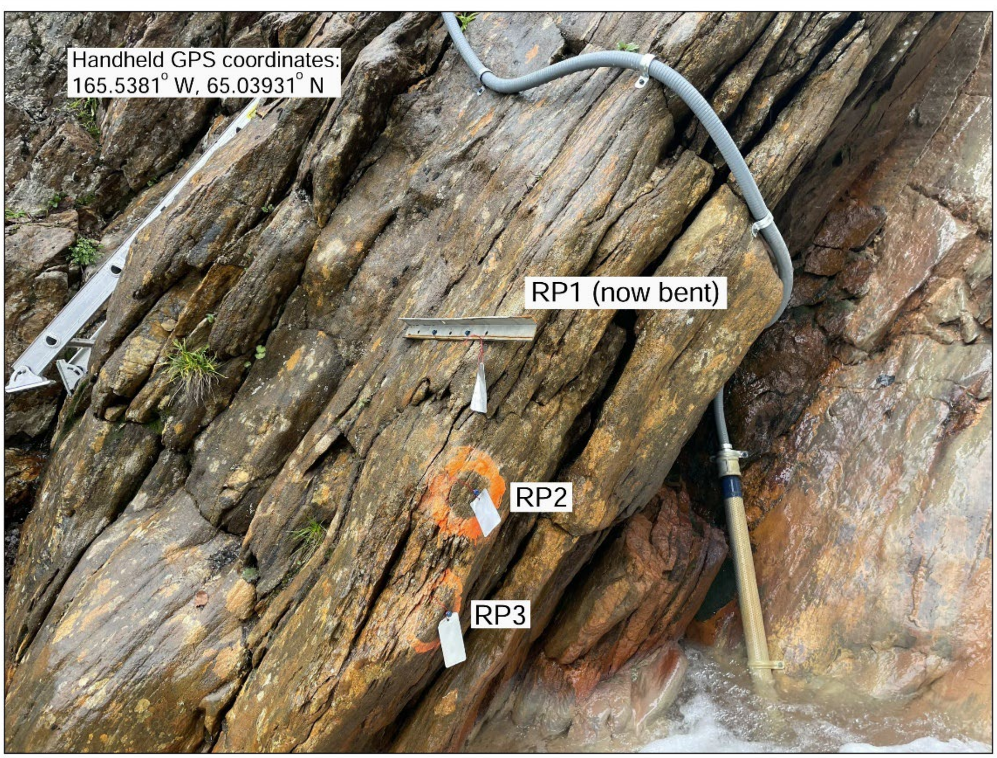


Figure 7-12. Upper Graphite Creek (GC-A) elevation control points

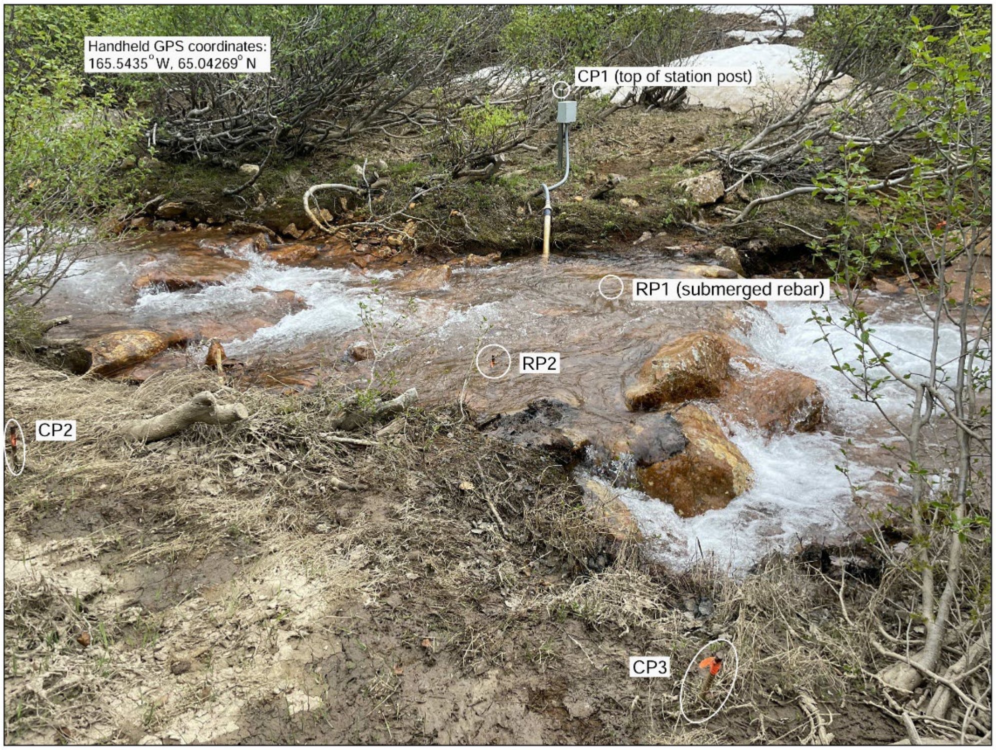


Figure 7-13. Lower Graphite Creek (GC-B) elevation control points

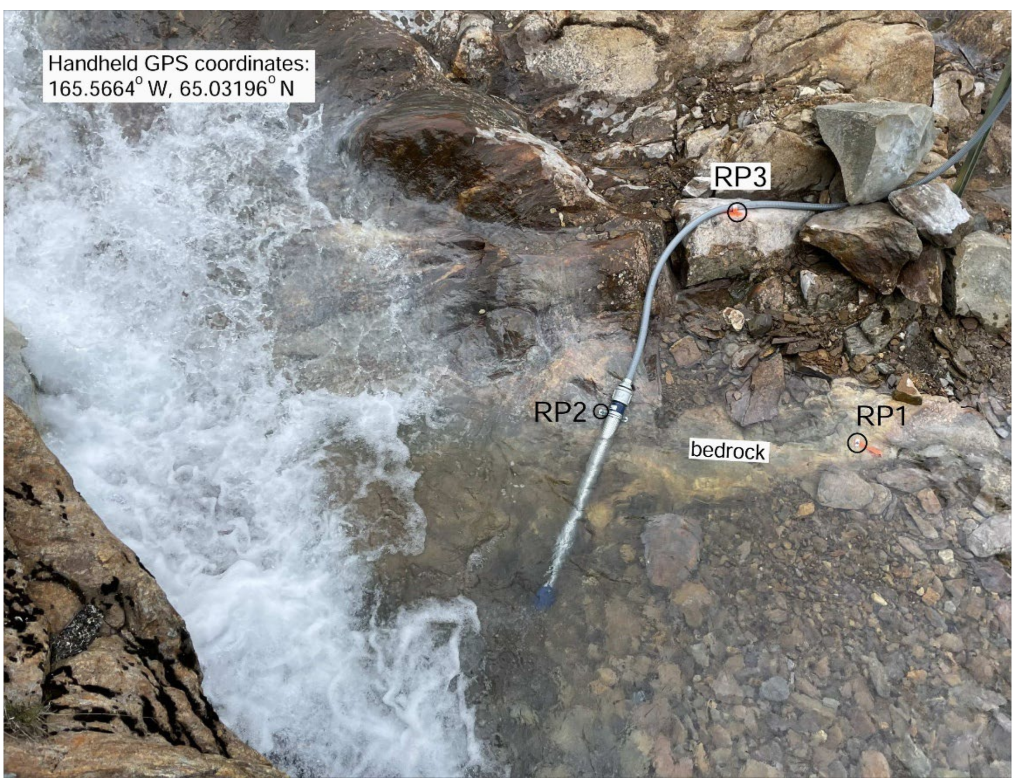


Figure 7-14. Upper Glacier Canyon Creek (GL-B) elevation control points

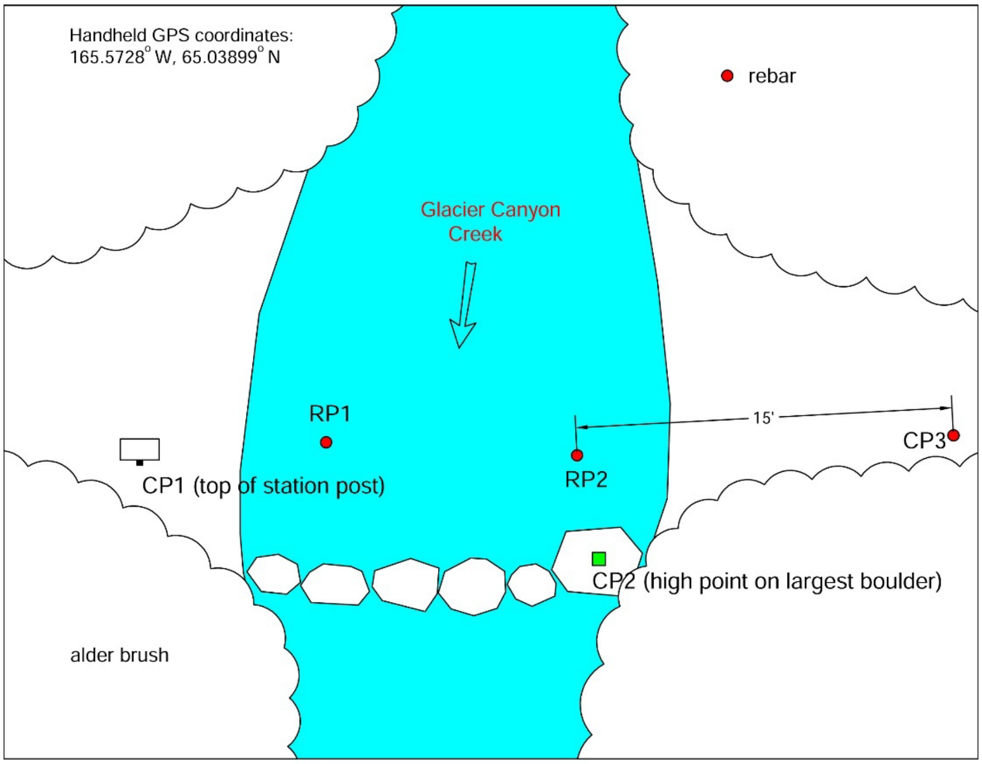


Figure 7-15. Lower Glacier Canyon (GL-B) elevation control points

Acoustic Doppler discharge measurements

A Teledyne RiverPro acoustic Doppler current profiler (ADCP) was used to measure flow at the Cobblestone River gauge (CR-A). The ADCP was deployed on either a cable loop or from a motorized cataraft, depending on water level. ADCPs use the Doppler principle to measure water velocity using acoustic reflections from suspended particles. ADCPs have several applications including measuring discharge using the moving-boat method (Mueller et al. 2013). This technique involves moving a downward-looking ADCP across the channel from bank to bank and integrating the velocity profile with distance to obtain discharge.

Each ADCP measurement consisted of four pairs of reciprocal transects; a summary of 2022 through 2024 ADCP measurements is provided on Table 7-3.

In accordance with current USGS protocol (USGS, 2024a), the measurements were post-processed using the USGS QRev software. QRev provides automated quality control checks, data filtering, and consistent application of USGS algorithms for velocity profile extrapolation and moving bed tests. QRev estimates the measurement's 95 percent uncertainty including several error sources in addition to random error indicated by the variation between transects. A summary of the Cobblestone River QRev results is provided on Table 7-3.

Table 7-3. ADCP discharge measurement summary, Cobblestone River (CR-A)

Date	Start time	Exposure duration, s	No. of transects	Moving bed?	Percent measured	WinRiver[1]		QRev[2]		
						Q, ft^3/s	COV[3]	Q, ft^3/s	COV[3]	95%U[4]
6/30/22	9:08	930	8	No	63.5%	389	2.11%	395	2.04%	4.9%
8/17/22	10:33	1070	8	No	62.5%	352	1.64%	355	1.76%	4.6%
9/12/22	11:15	1029	8	No	68.0%	532	1.76%	516	1.56%	4.3%
6/10/23	11:36	760	8	No	71.9%	1231	1.06%	1228	1.07%	3.4%
7/7/23	16:36	886	8	No	67.0%	561	1.72%	561	1.69%	4.0%
8/9/23	16:11	760	6	No	56.2%	638	0.95%	638	1.40%	3.6%
9/24/23	14:06	820	8	No	62.0%	356	1.60%	358	1.48%	4.7%
6/26/24	16:18	949	8	No	71.4%	1510	1.86%	1511	1.76%	3.6%
7/23/24	15:42	917	8	No	59.7%	368	2.06%	358	2.03%	4.5%
8/24/24	17:41	971	8	No	64.9%	1011	1.36%	1015	1.25%	3.7%
9/13/24	17:00	875	8	No	47.6%	271	2.84%	273	2.58%	5.6%

WinRiver II version 2.23 software developed by Teledyne RDI
QRev version 4.32 software developed by USGS
Coefficient of variation, or standard deviation divided by the mean
Estimated 95% uncertainty of the measurement calculated by QRev

Dye dilution discharge measurements

Dye dilution discharge measurements were performed on Graphite and Glacier Canyon Creeks. This technique involves injecting a small amount of fluorescent dye into the stream and recording dye concentrations at a downstream measurement point using a fluorometer. Streamflow is calculated using an equation of the form (Hudson and Fraser 2005):

$$Q = \frac{M}{\int (C) dt}$$

where:
Q = discharge,
M = mass of dye injected,
C = dye concentration, and
t = time

Dye concentration was measured using an Albilia GGUN FL-24 fluorometer, calibrated by measuring the signal response to a 29 μg/L standard mixed with creek water. The standard was prepared using the method of serial dilutions, using a 5-mL pipette to measure 2-mL aliquots of dye and solution.

ADF&G Fish Habitat Permit No. FH22-03-0123 authorizes Fluorescein dye concentrations up to 500 ug/L for 30 minutes Table 7-4 indicates maximum dye concentrations below 134 ug/L; measurement durations were on the order of 20 minutes. Triplicate measurements were performed at each location, yielding measurement precision ranging from 0.1 to 6.7 percent with an average of 1.3 percent (Table 7-4). Dye concentrations for a typical measurement are shown on Figure 7-16.

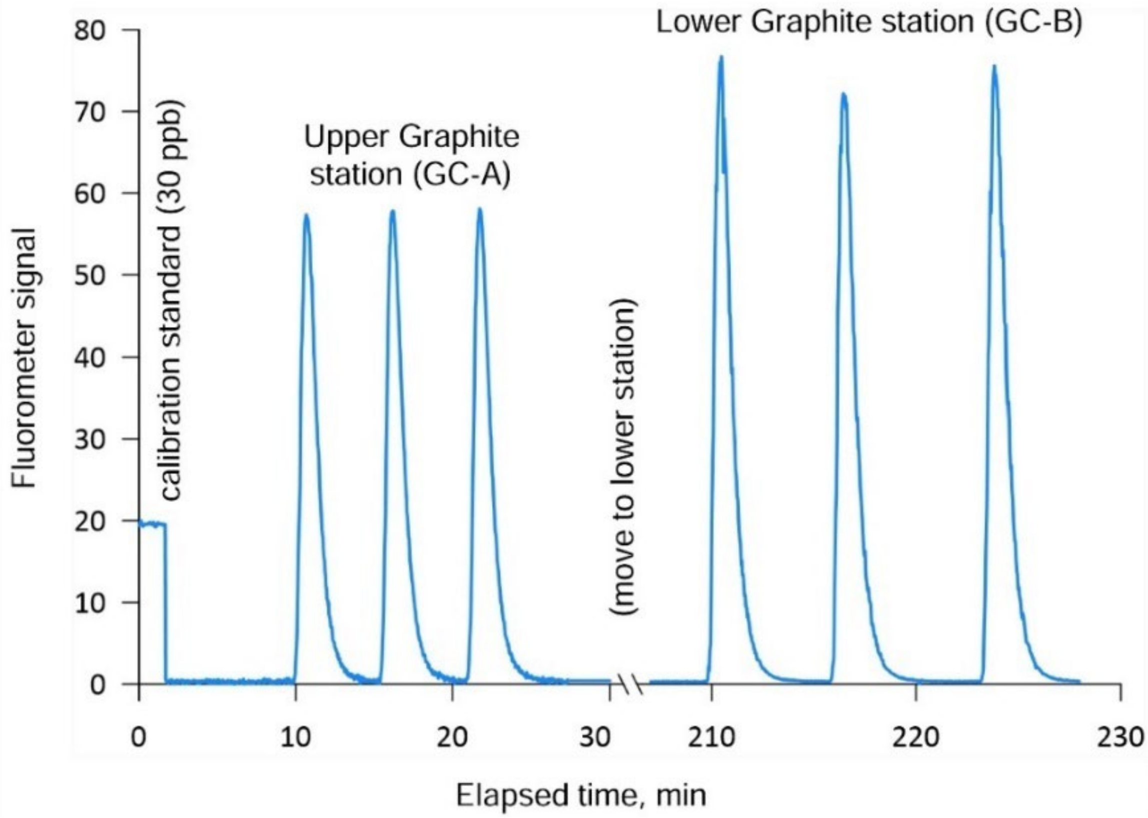


Figure 7-16. Example dye dilution discharge measurement, August 18, 2022

Transducer winterization

During the final site visit of each year, the transducers were winterized by enclosing them in rubber balloons filled with propylene glycol, a nontoxic antifreeze. This required removal and replacement of the well points in the stream. During the first site visit of each year, the well points and antifreeze balloons were again removed and the well points were replaced. This technique has proved effective except at the Cobblestone River station (CR-A), where it appears that anchor ice freezes to the streambed. Crushed closed-cell foam inside the well point attests to repeated cycles of freezing and thawing, which damaged the transducers during the winters of 2022 and 2023. As indicated on Figure 7-9, non-vented transducers anchored in mid-channel were not affected by freezing, but require barometric pressure logging to correct for atmospheric pressure fluctuations.

Table 7-4. Dye dilution discharge measurement summary

Date	Time	Dye volume, mL	Standard signal	Back-ground signal	Max. Conc., ug/L	Avg Q, ft^3/s	Standard deviation, ft^3/s	COV[1], percent
Upper Graphite Creek (GC-A)								
7/1/2022	15:20	5	23.0	0.15	49.6	5.42	0.0146	0.27%
8/18/2022	9:55	10	19.6	0.30	83.8	6.50	0.0283	0.44%
9/14/2022	9:40	10	13.5	0.44	86.1	2.85	0.0078	0.27%
9/19/2022	18:40	20	22.8	0.40	111.9	17.1	0.1909	1.12%
9/20/2022	10:00	20	21.2	0.39	124.9	13.3	0.0180	0.14%
8/11/2023	8:15	5	21.6	0.43	38.5	4.29	0.0080	0.19%
9/25/2023	13:40	5	38.0	0.27	38.1	3.10	0.0284	0.92%
7/24/2024	14:50	5	39.8	0.25	42.7	4.80	0.045	0.93%
8/25/2024	15:30	5	37.2	0.32	35.5	8.91	0.049	0.55%
9/16/2024	18:00	10	39.0	0.35	71.5	6.69	0.126	1.89%
Lower Graphite Creek (GC-B)								
7/1/2022	16:20	5	23.0	0.21	59.2	5.36	0.0517	0.96%
8/18/2022	13:00	10	23.0	0.30	95.0	7.41	0.0769	1.04%
9/14/2022	13:10	5	13.5	0.49	77.7	2.78	0.0083	0.30%
9/20/2022	10:40	20	21.2	0.46	73.7	13.6	0.2797	2.06%
7/8/2023	15:30	5	26.8	0.37	72.3	5.18	0.1220	2.35%
8/11/2023	9:50	5	21.6	0.45	75.0	4.31	0.0764	1.77%
9/25/2023	15:00	5	38.0	0.29	81.5	2.93	0.0250	0.85%
6/28/2024	11:30	5	49.17	0.195	53.5	9.10	0.125	1.37%
7/24/2024	16:10	5	39.79	0.371	75.1	4.55	0.045	0.99%
8/25/2024	16:40	5	37.21	0.329	54.9	8.81	0.055	0.62%
9/16/2024	19:10	5	38.96	0.415	59.7	6.77	0.138	2.04%
Upper Glacier Canyon Creek (GL-A)								
7/2/2022	12:40	5	24.2	0.20	65.9	5.82	0.2043	3.51%
8/17/2022	13:50	10	20.7	0.31	88.2	8.31	0.1027	1.24%
9/12/2022	16:30	10	20.0	0.32	130.0	3.45	0.0139	0.40%
9/19/2022	15:15	20	22.5	0.49	66.6	21.9	0.4841	2.21%
8/10/2023	13:30	5	20.8	0.41	60.5	4.18	0.0395	0.94%
9/25/2023	10:10	5	38.5	0.21	62.3	3.09	0.0242	0.78%
7/24/2024	9:20	10	43.11	0.253	89.4	5.72	0.299	5.23%
8/25/2024	11:15	5	37.21	0.329	54.9	8.81	0.055	0.62%
9/17/2024	12:30	5	49.62	0.331	34.5	12.5	0.272	2.17%
Lower Glacier Canyon Creek (GL-B)								
7/2/2022	14:15	5	24.2	0.23	67.0	5.65	0.0878	1.55%
8/17/2022	15:10	10	20.7	0.23	99.4	8.42	0.0821	0.97%
9/13/2022	16:10	5	20.0	0.38	84.2	3.27	0.0296	0.91%
9/19/2022	16:55	20	22.5	0.46	133.2	19.4	0.0582	0.30%
7/8/2023	13:10	5	22.9	0.50	63.7	5.70	0.0920	1.61%
8/10/2023	14:30	5	20.8	0.46	58.0	4.62	0.3099	6.71%
9/25/2023	11:55	5	38.5	0.37	73.9	3.09	0.0016	0.05%
6/28/2024	08:25	10	42.63	0.204	63.2	9.60	0.250	2.60%
7/24/2024	11:10	5	43.11	0.283	58.1	5.71	0.272	4.76%
8/25/2024	12:55	5	40.41	0.394	41.3	12.3	0.352	2.85%
9/17/2024	10:20	5	49.62	0.347	37.8	12.0	NA – only 1 slug	

COV = coefficient of variation, or standard deviation divided by the mean

7.4 Streamflow data processing

7.4.1 Stage Corrections

Stream gauging uses measurements of stream stage (water surface elevation) to calculate discharge. Pressure transducers measure the pressure of water above the transducer, which can be converted into an equivalent depth of water. Because the depth of water measured by a transducer depends on its placement, transducer depth measurements must be converted to stream stage using field measurements of the depth to water from surveyed reference points (termed "tapedowns"). Tapedowns can also be used to correct transducer data for movements (termed "offsets") and electronic drift, which is normal. The need for data correction was evaluated using Aquarius Workstation, by first converting the transducer data into stage relative to the site's gauge datum (Table 7-2). The resulting stage data were then compared against stage measurements from surveyed reference points. Where the converted transducer readings differed from the measurements shown on Table 7-5, corrections were performed in Aquarius. Figure 7-17 provides a comparison of measured tapedowns against corrected stage data for 2024.

Table 7-5. Stage measurements from surveyed reference points ("tapedowns")

Station CR-A		Station GC-A		Station GC-B		Station GL-A		Station GL-B	
Date & time	Stage[1]	Date & time	Stage[1]	Date & time	Stage[1]	Date	Stage[1]	Date	Stage[1]
6/30/22 9:15	93.20	7/1/22 15:10	96.19	7/1/22 16:30	98.38	7/2/22 12:50	100.165	7/2/22 14:22	97.80
8/17/22 9:16	93.09	8/18/22 9:40	96.25	8/18/22 13:10	98.51	8/17/22 14:00	100.22	8/17/22 15:25	97.93
8/17/22 11:27	93.07	9/14/22 10:30	96.02	9/14/22 13:54	98.38	9/12/22 17:23	100.09	9/13/22 17:21	97.78
9/12/22 9:50	93.55	9/19/22 19:00	96.60	9/20/22 11:08	98.81	9/13/22 13:38	100.08	9/19/22 17:28	98.10
9/12/22 12:28	93.45	9/20/22 10:16	96.50	7/8/23 15:30	98.58	9/19/22 15:45	100.42	7/8/23 13:10	97.84
9/12/22 14:30	93.39	8/11/23 8:15	96.13	8/11/23 9:50	98.53	8/10/23 13:30	100.16	8/10/23 14:30	97.80
9/20/22 9:18	94.85	9/24/23 13:40	96.03	9/25/23 15:00	98.46	9/25/23 10:10	100.11	9/25/23 11:55	97.79
6/10/23 11:43	94.72	7/24/24 14:50	96.16	6/28/24 11:30	98.75	7/24/24 9:20	100.16	6/28/24 8:25	98.06
7/7/23 16:44	93.63	8/25/24 15:30	96.31	7/24/24 16:10	98.61	8/25/24 11:15	100.32	7/24/24 11:10	97.93
8/9/23 16:20	93.80	9/16/24 18:00	96.23	8/25/24 16:40	98.75	9/17/24 12:30	100.33	8/25/24 12:55	98.07
9/24/23 14:14	93.11			9/16/24 19:10	98.70			9/16/24 10:20	98.06
6/30/22 9:15	93.20								
6/26/24 16:26	95.06								
7/23/24 15:52	93.09								
8/24/24 17:50	94.34								
9/13/24 17:10	92.81								

Stage in feet relative to individual station datums listed on Table 7-2

Although ice formation usually renders winter stage records unusable for streamflow monitoring, deep burial by avalanche debris appears to insulate the upper Graphite Creek (GC-A) gauge from winter air temperatures. This conclusion is supported by water temperatures that do not fall below 0^{o}C and a smooth winterlong recession during early 2023. Unfortunately, pressure readings from the GC-A transducer began to drift in late summer 2023, so that by July 2024 the pressure readings were 5 feet higher than the data shown on Table 7-2. Slight transducer drifts can be corrected if they change linearly through time, but the GC-A drift did not change linearly. As a result, winter GC-A transducer data is not usable for streamflow calculations. Similarly, winter transducer data from the other stations is not usable due to ice effects. Avalanche debris precluded access to the upper Graphite and Glacier Canyon Creek stations until late July, when ice was still present at the upper Glacier Canyon Creek gauge (Figure 7-18).

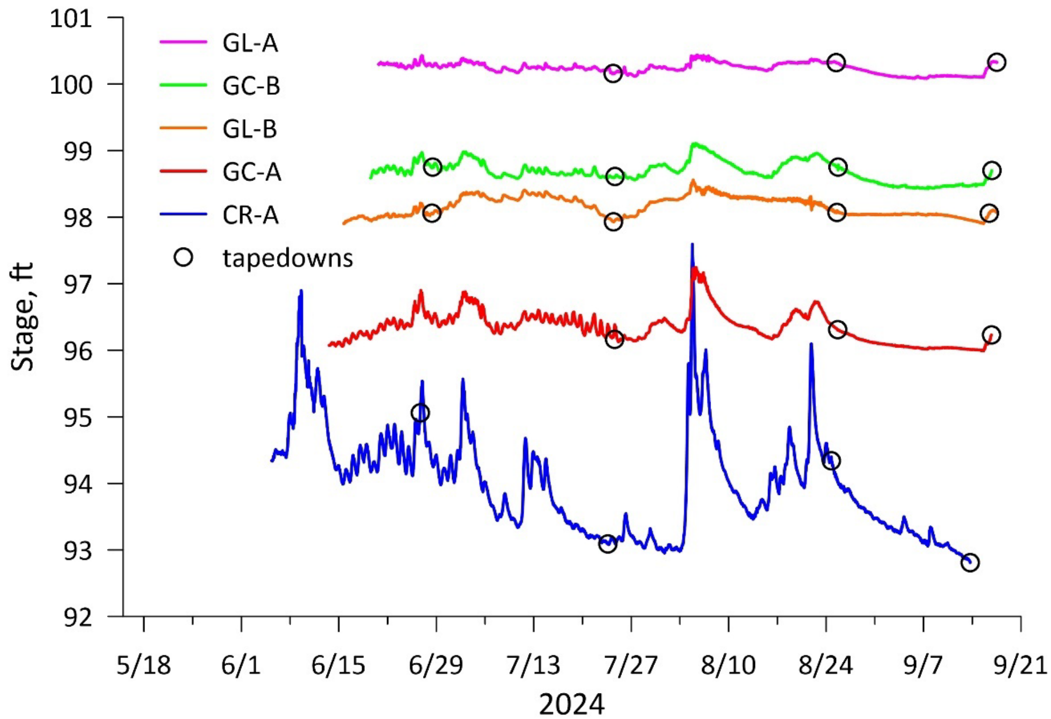


Figure 7-17. Corrected stage hydrographs for 2024

Figure 7-18. Upper Glacier Canyon Creek gauge, July 24, 2024

7.4.2 Rating Curves

Streamflow ratings are based on the premise that flow in natural channels can be described by an equation of the form:

$$Q = C(G - e)^{\alpha}$$

where:

> Q = discharge,
> C = a coefficient mainly controlled by channel width and bed roughness,
> G = stream stage,
> e = an offset that relates gauge height to hydraulic head ("gauge offset"), and
> α = an exponent mainly controlled by channel geometry

With field measurements of Q and G, the rating equation contains three unknowns, which requires solution by numerical optimization. Without constraints on the realistic ranges of C, e, and a, an equally good fit of Q and G can be obtained for a wide variety of parameter values. Within the range of measurement, inaccurate parameter values may have only a minor effect on the overall goodness-of-fit. However, when the rating equation is extrapolated to high and low flows, unrealistic parameter values can result in significant computation errors.

With choice of the correct gauge offset (e), measurements of flow vs. (G - e) should plot as a straight line in log-log space. The gauge offset is further constrained by the elevation of zero flow, which should approach the lowest gauge offset. If there is a breakpoint in the rating (a change in slope), the gauge offset should be larger at higher flows.

The 2022 Cobblestone River rating curve was updated with additional rating measurements in 2023. As shown on Figure 7-19, the 2024 rating measurements plot within 6 percent of the 2023 rating curve. Considering that the largest outlier has a measurement uncertainty of almost 4 percent (Table 7-2), no changes were made to the 2023 rating curve.

Although most recent rating measurements at upper Graphite Creek plot below the rating curve (Figure 7-20), the rating was not shifted because the gauge pool is founded on competent bedrock (Figure 7-21). If the trend continues in 2025, the rating curve will be updated.

2024 rating measurements at lower Graphite Creek indicate continuing upward shifts on the order of 0.13 feet per year (Figure 7-22). This could represent continued scale accumulation on boulders that form the gauge pool's downstream control. The largest shift occurred after gauge installation, as gaps between the boulders filled with cemented bed material.

The upper Glacier Canyon Creek rating measurements plot above and below the 2023 shift that followed Typhoon Merbok (Figure 7-23). No change to the shift curve appears warranted.

The 2024 rating measurements at lower Glacier Canyon Creek indicate a 0.1-foot shift attributed to new gravel aggradation in June 2024 (Figure 7-24). The gauge pool currently has little depth remaining to submerge the well point, which must be removed and replaced for winterization. A plunge pool about 50 m downstream would accommodate a bank-mounted well point like the lower Graphite Creek station (Figure 7-4). Because the plunge pool appears to flush gravel transported during flood events, it might provide a more stable rating than the existing gauge location.

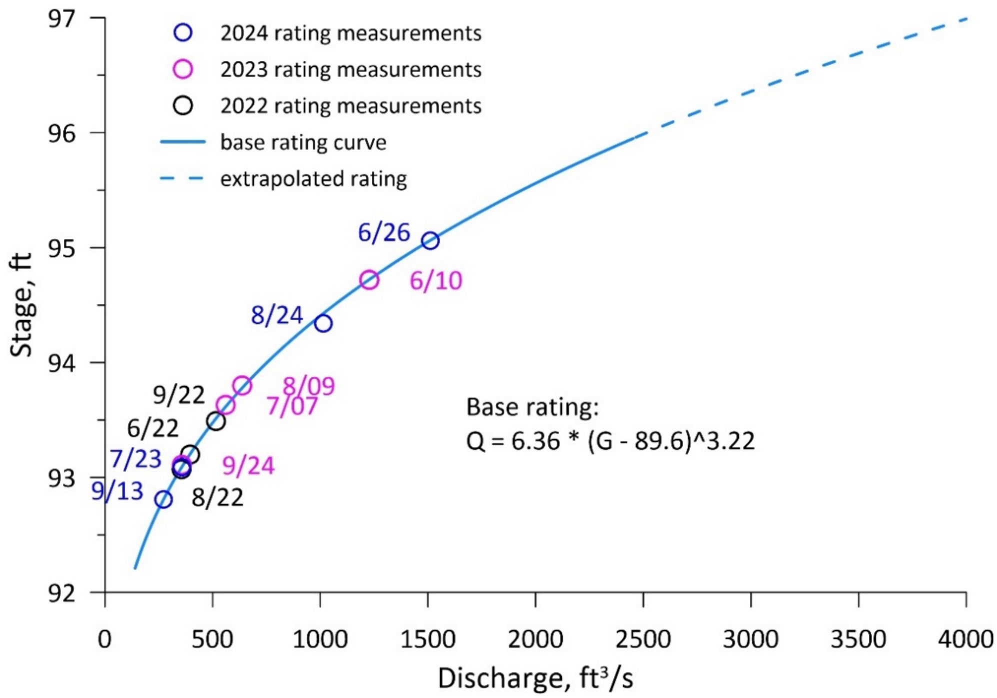


Figure 7-19. Cobblestone River (CR-A) rating curve

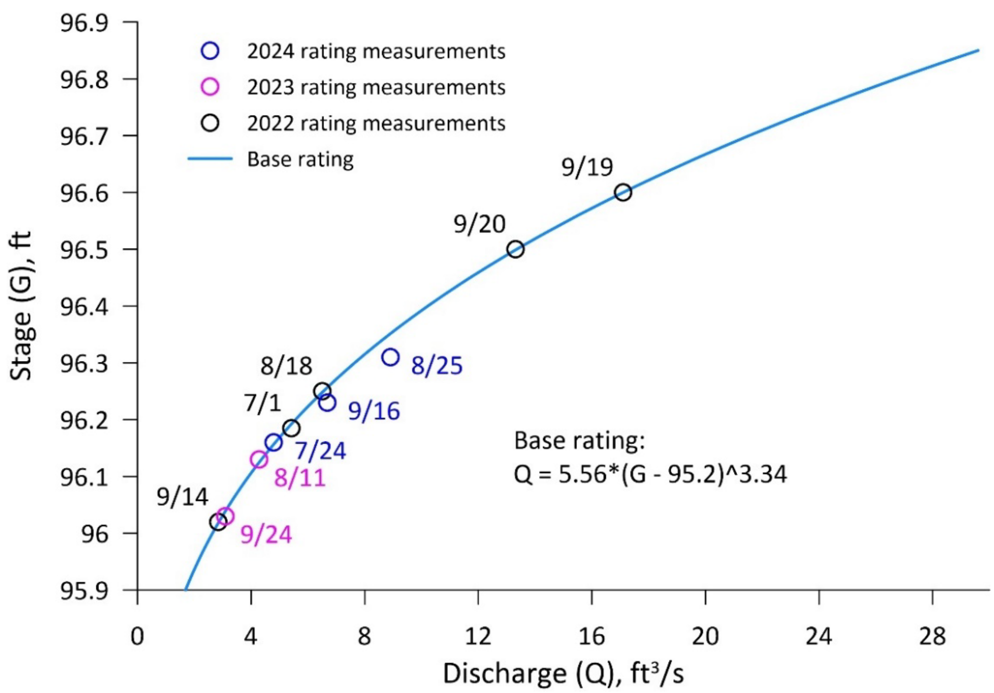


Figure 7-20. Upper Graphite Creek (GC-A) rating curve

Figure 7-21. Upper Graphite Creek gauge pool showing natural bedrock weir on July 1, 2022.

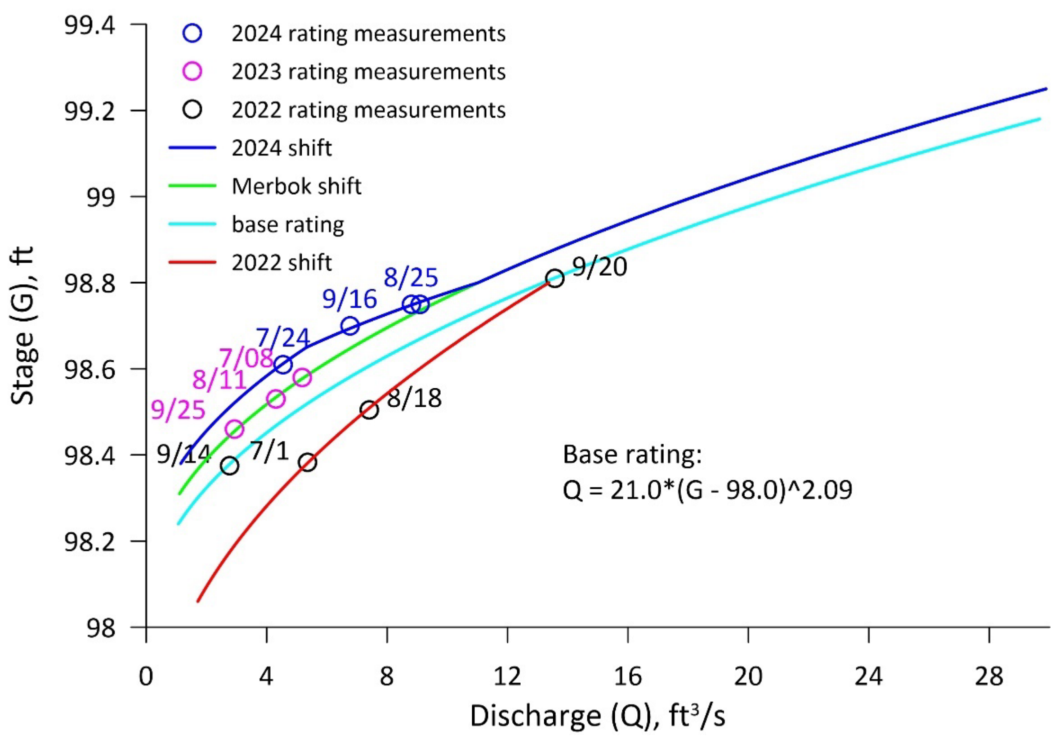


Figure 7-22. Lower Graphite Creek (GC-B) rating curve

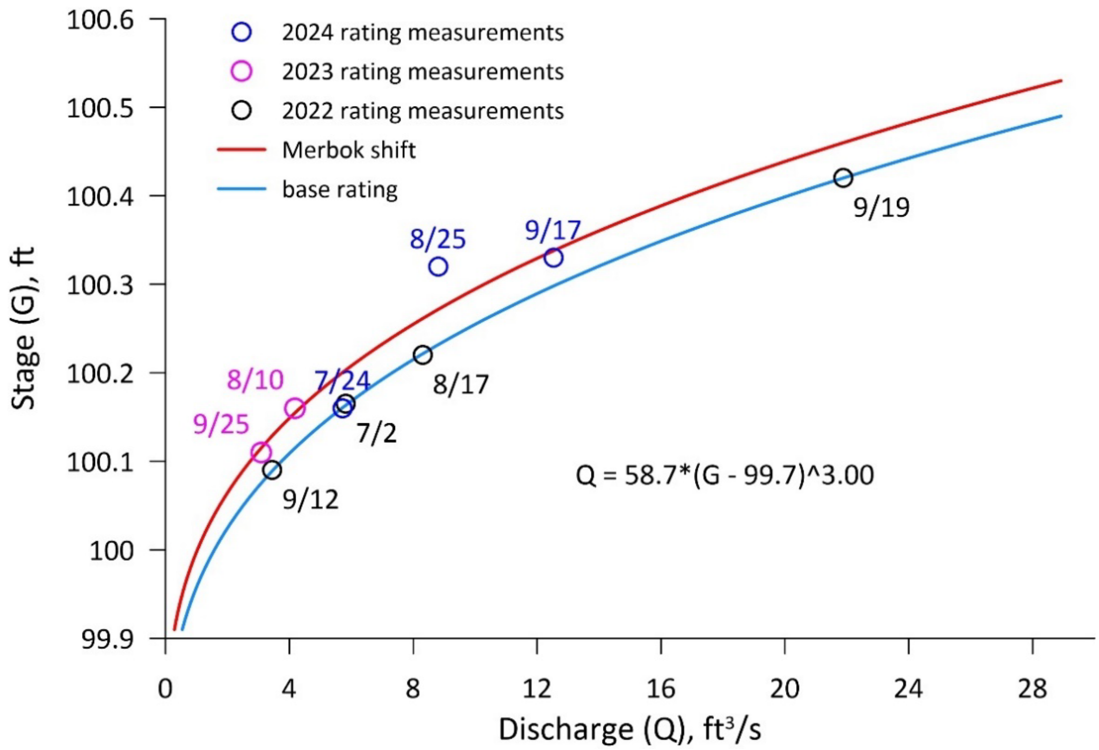


Figure 7-23. Upper Glacier Canyon Creek (GL-A) rating curve

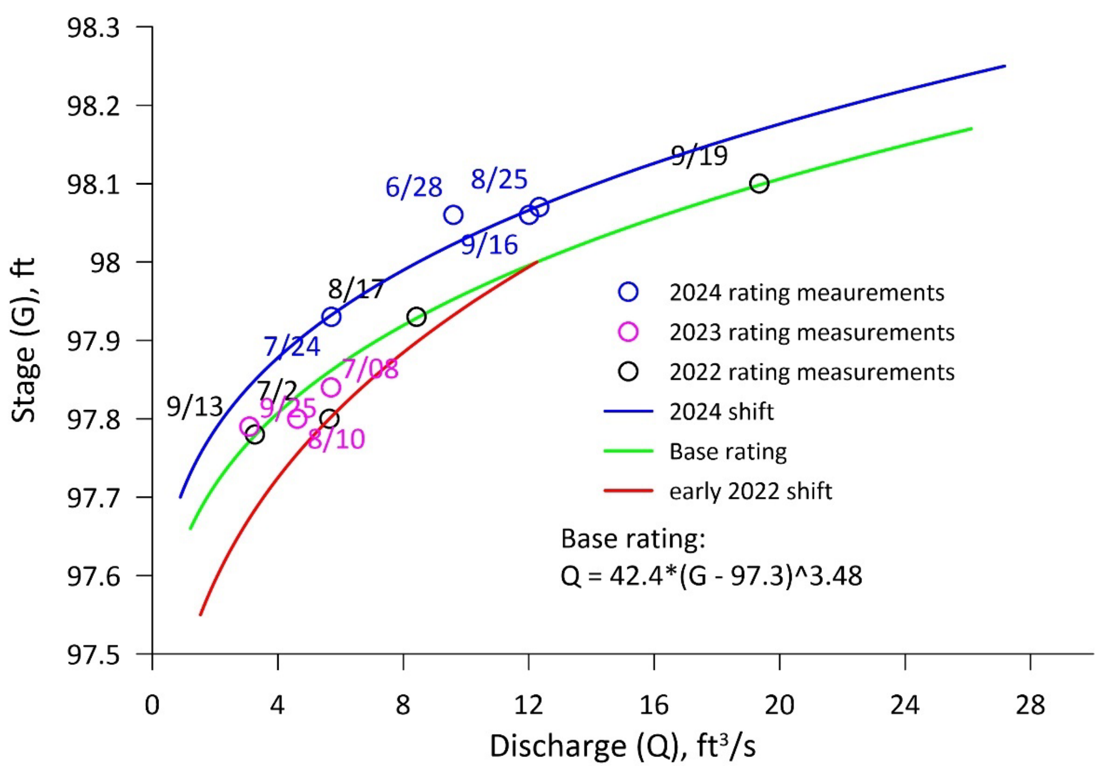


Figure 7-24. Lower Glacier Canyon Creek (GL-B) rating curve

7.5 Streamflow Results

7.5.1 Relative Data Quality

Because of its stable rating curve, quiescent water levels and good sensitivity to flow, the Cobblestone gauge provides the best data quality. The upper Graphite Creek gauge is equally sensitive, but the rating curve probably overestimates high flows. The lower Graphite Creek and Glacier Canyon Creek gauges are less sensitive to flow and have more noise in their stage records, but provide acceptable data quality. Beginning in August 2023, data from the lower Glacier Canyon Creek gauge became compromised by debris fouling, possibly caused by infilling of the gauge pool with gravel mobilized by floods. This gauge should probably be relocated to a downstream plunge pool that has remained fairly stable since 2022. Because it is insulated from winter air temperatures by avalanche debris, the upper Graphite gauge provides a rare winter flow record.

7.5.2 Annual Streamflow Hydrographs

Annual hydrographs for the five stream gauges are provided on Figure 7-25 through Figure 7-29, and a 2022 winter hydrograph for the upper Graphite Creek station is provided on Figure 7-30. Because of its large drainage area (60 mi^2), the Cobblestone gauge is the most representative of regional conditions. The Cobblestone hydrographs show a gradual summer recession punctuated by large rainfall peaks in 2022 and 2024. Although ice precludes discharge computations before early June, the summerlong recession implies that breakup comprises the majority of annual runoff. The winter hydrograph for Graphite Creek shows that snowmelt begins around May 1, and possibly earlier on south-facing aspects in the Cobblestone watershed. The peak flow of record occurred during Typhoon Merbok (September 2022), followed by a comparable rainfall peak in August 2024.

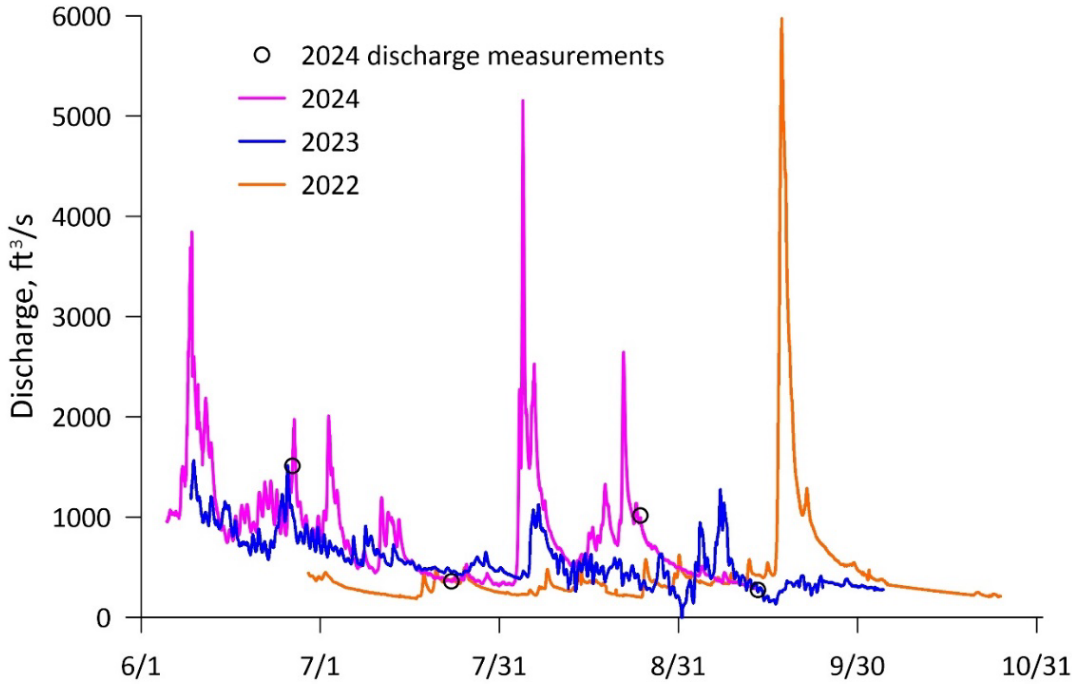


Figure 7-25. 2022-2024 annual hydrographs, Cobblestone River (CR-A)

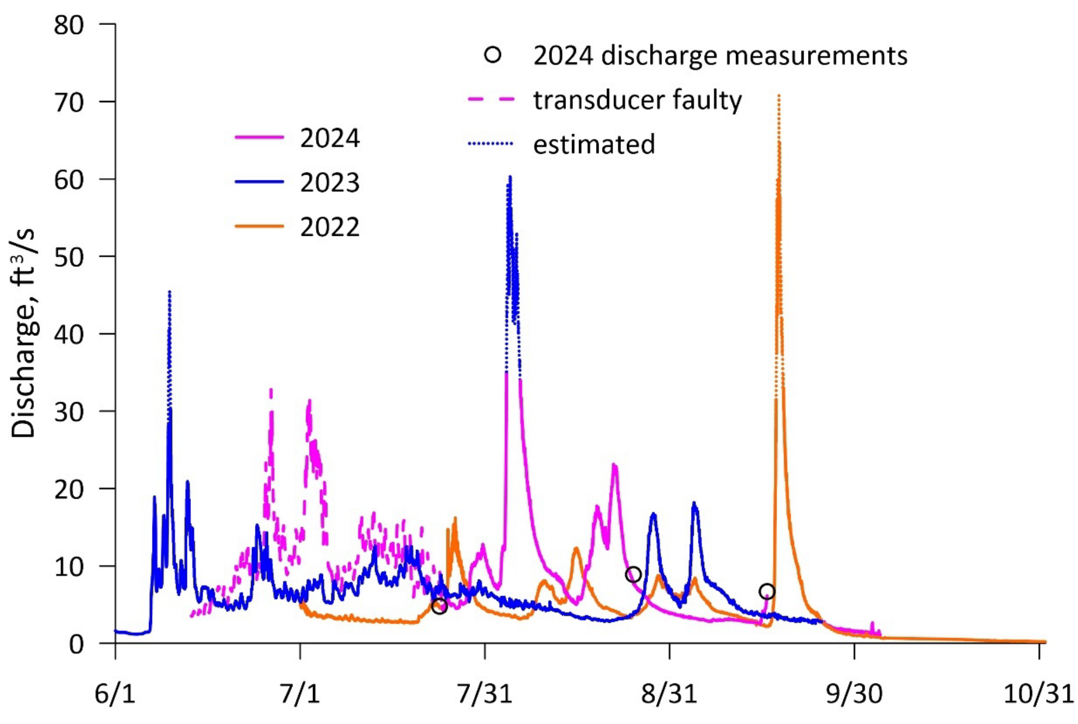


Figure 7-26. 2022-2024 annual hydrographs, upper Graphite Creek (GC-A)

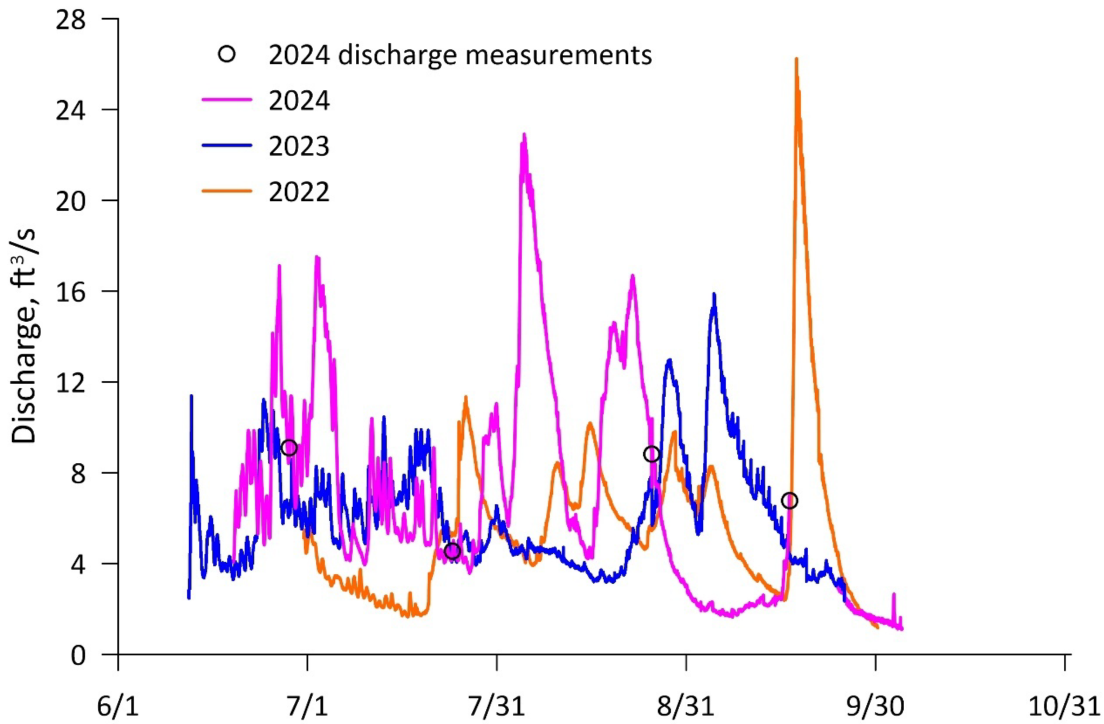


Figure 7-27. 2022-2024 annual hydrographs, lower Graphite Creek (GC-B)

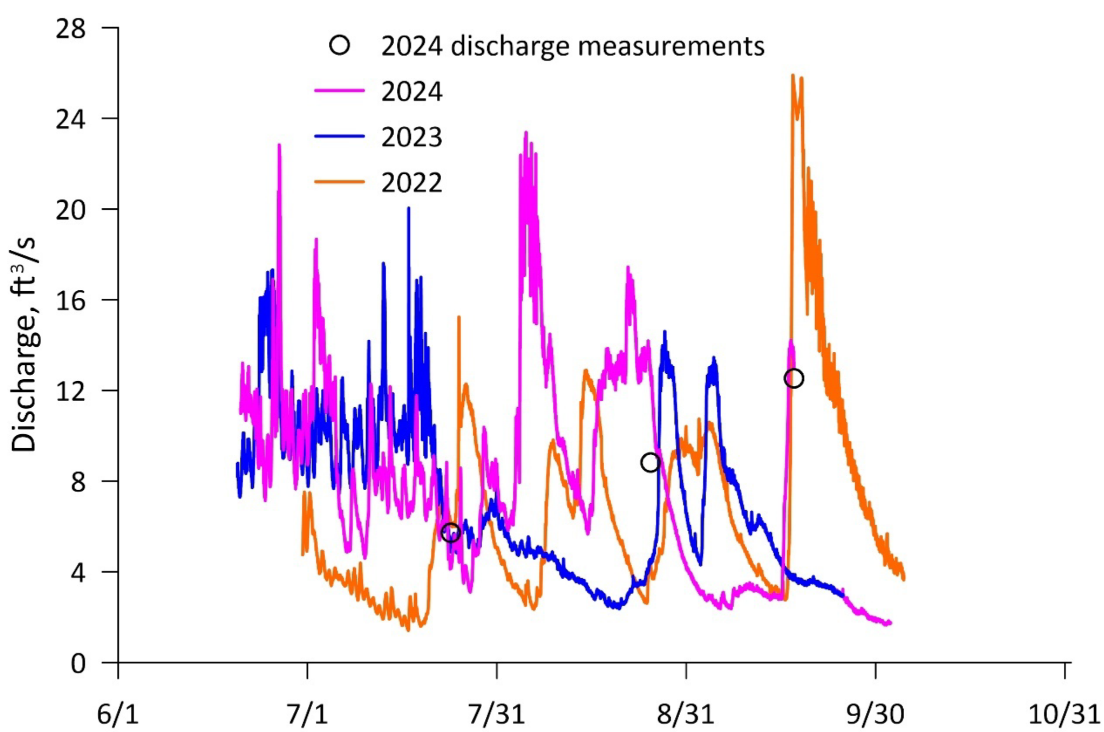


Figure 7-28. 2022-2024 annual hydrographs, upper Glacier Canyon Creek (GL-A)

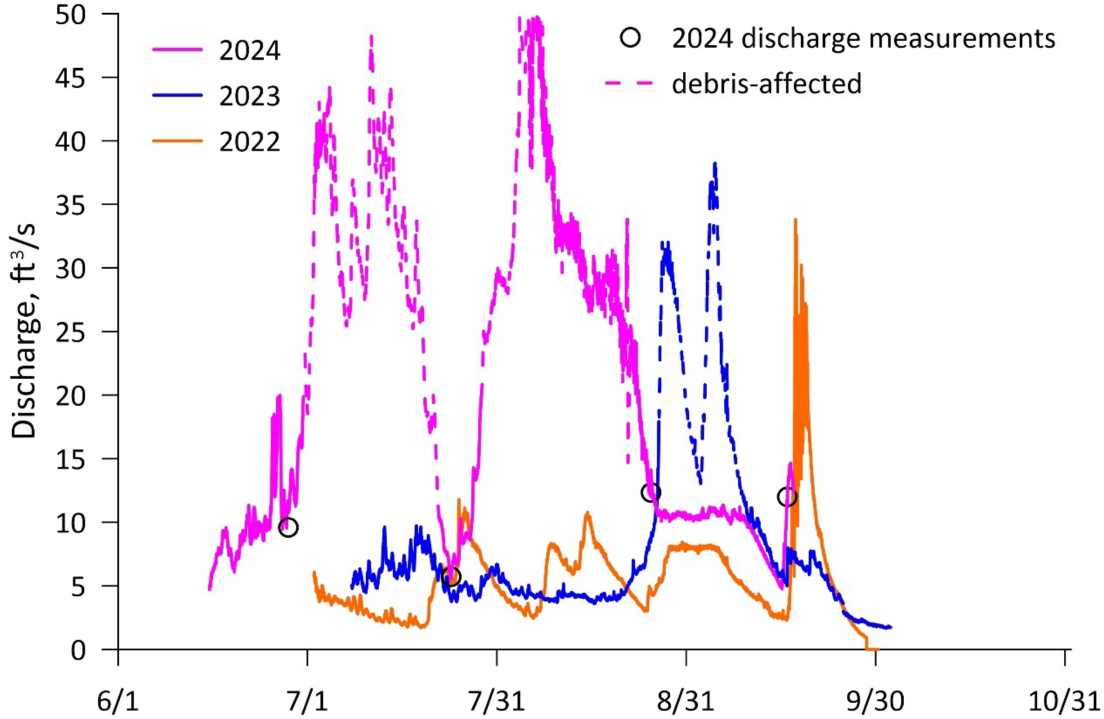


Figure 7-29. 2022-2024 annual hydrographs, lower Glacier Canyon Creek (GL-B)

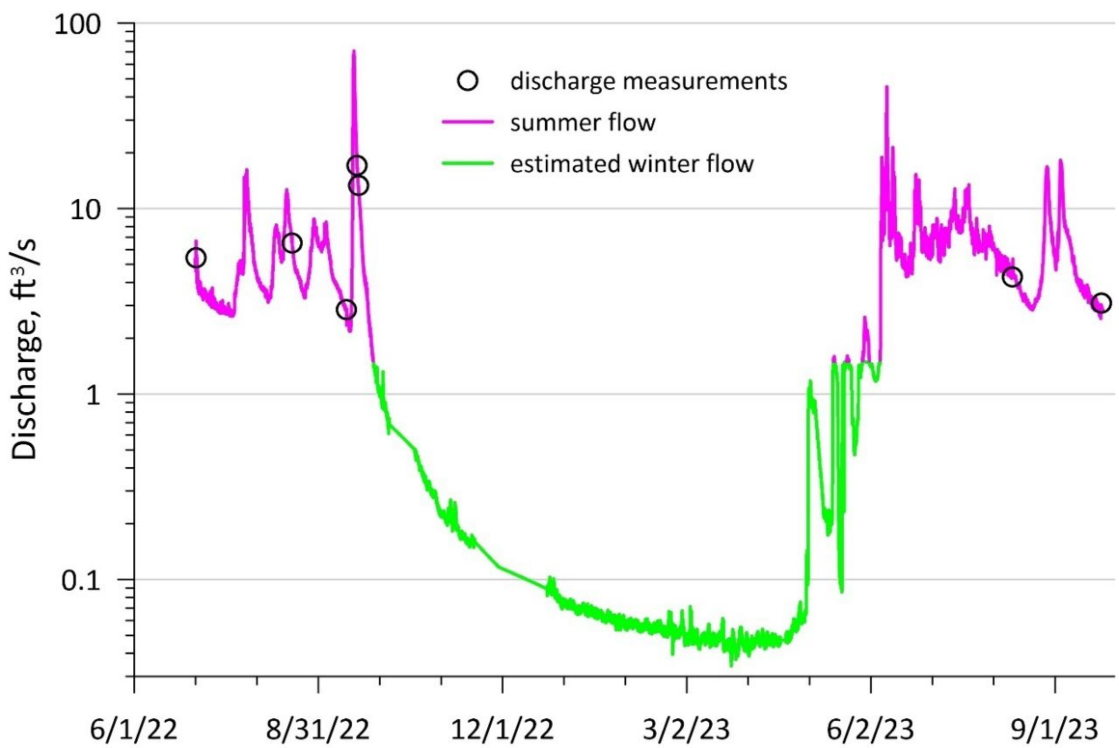


Figure 7-30. 2022-2023 estimated winter hydrograph, upper Graphite Creek (GC-A)

Comparison of hydrographs for upper and lower Graphite Creek indicate higher peak flows at the upper station. Although some of the disparity is due to attenuation of the flood peak as it moves downstream (which is expected), integration of peak runoff volumes suggests that the upper Graphite rating curve overestimates high flows. For this reason, flows more than twice the highest rating measurement (17 ft3/s) are flagged as estimated.

Although computed flows at upper Glacier Canyon Creek are similar to those measured at lower Glacier Canyon Creek, apparent high flows on lower Glacier Canyon Creek are probably caused by debris accumulation on boulders that form the gauge pool's downstream control. This problem could be mitigated by moving the gauge about 50m downstream, where a plunge pool appears to flush transported gravel and debris.

7.5.3 Stream Loss Downstream of the Mountain Front

As described above, problems with debris accumulation and rating curve extrapolation preclude direct comparison of streamflow hydrographs between the upstream and downstream stations on Graphite and Glacier Canyon Creeks. As a result, paired discharge measurements were used to assess stream loss between the upstream and downstream stations. Discharge measurements at the upstream and downstream stations were generally conducted on the same day, but diurnal fluctuations caused by melting snowpack cause flow rates to fluctuate between measurements. To account for changing flow conditions, measured flow rates at the upstream stations were compared against computed flow rates at the downstream stations accounting for the travel time between the two stations. Travel times were estimated based on velocities computed using discharge measurements and stage-area rating curves developed from cross section surveys.

Estimated travel times between the upstream and downstream stations ranged from 15 to 45 minutes for Graphite Creek and from 34 to 120 minutes for Glacier Canyon Creek. Using these travel times, measured flows at the upstream stations are compared against computed flows at the downstream stations on Figure 7-31. Regression yields relatively strong linear relationships that indicate stream losses ranging from 3.3 percent for Graphite Creek to 6.1 percent for Glacier Canyon Creek. For the 1-year period ending August 31, 2023 (the only year with a complete measured flow record), this corresponds to an average stream loss of 33 gallons per minute for the reach between GC-A and GC-B. Although a measured annual flow rate is not available for Glacier Canyon Creek, the average annual stream loss between GL-A and GL-B would be about twice that measured on Graphite Creek.

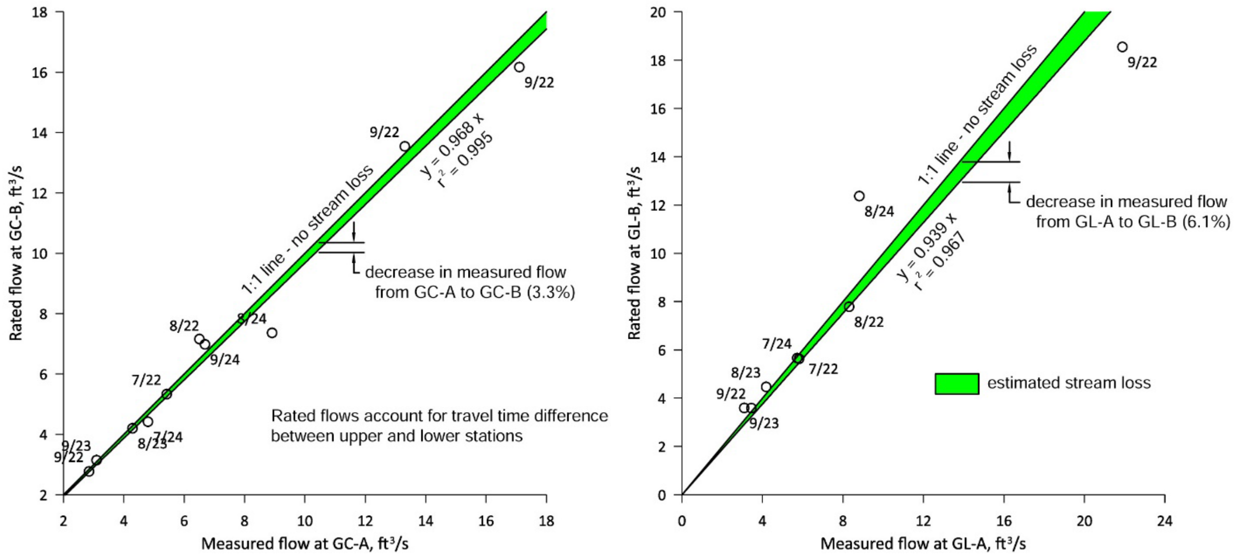


Figure 7-31. Estimated stream losses on Graphite and Glacier Canyon Creeks

8 Hydrologic Analysis

8.1 Introduction

SRK Consulting (Canada) Inc. (SRK) performed a preliminary analysis of the hydrology of the project area in 2022 which can be found in Tundra, 2022. The analysis was updated in 2024 and issued as a stand-alone memorandum (SRK 2024). This memo is reproduced in its entirety in this section and documents the surface water hydrology for the region and provides estimates for groundwater recharge in the local area based on a meteorological and hydrological review. The objectives are to provide climate related inputs (e.g., rain and snow melt), infiltration rates, and base flow estimates to the groundwater model and other project disciplines.

8.2 Methodology

To address the issue of groundwater inflows, a comprehensive understanding of the local meteorology was established. This understanding considered factors such as air temperature, total precipitation, and wind speed. By combining this information, SRK was able to gain insights into the local snowpack and snowmelt patterns. In the initial phase of the review, SRK noted a significant degree of uncertainty as seen in the variability between modeled results and local weather records. This uncertainty was particularly pronounced in relation to the snow capture efficiency, which was heavily influenced by the wind speed prevalent in the local area.

Once SRK compiled local meteorological conditions, SRK combined these data sources to develop a precipitation runoff model. This model was implemented at both regional and local scales. However, due to the absence of long-term records, the models were used solely for calibration purposes, and no validation component was included.

Considering the observed variability, SRK was able to identify the ranges of groundwater recharge, as presented in the next sections. The followings sections present the data sources and general consideration for the meteorological and hydrological review.

8.2.1 Data Sources

Long-term records are required for an accurate estimate of the site hydrology. Available climate and hydrometric data for this study comprise site-specific data from local meteorological stations published by National Oceanic and Atmospheric Administration (NOAA) and climatic gridded models (also known as climate reanalysis datasets). Hydrometric data were obtained from regional water courses published by United States Geological Survey (USGS), and local water courses collected by Tundra. These data sources are described in the following subsections.

8.2.1.1 Climate Records

Climate records were available for the area surrounding the site. A meteorological site was installed in the spring of 2024 resulting in a record too short for use in this analysis. However, the project collects some meteorological data at Mosquito Pass for aviation purposes (Tundra, 2024). Data were also obtained from NOAA stations located on the Seward Peninsula (NOAA, 2024). Table 8-1 provides station details used in this review. Figure 8-1 presents the locations of these meteorological stations with respect to the site.

Table 8-1. Climate stations used in the study

Station ID	Station Name	Location (degrees (°))		Distance		Available Period	Information Available			
		Latitude	Longitude	Kilometers (km)	Miles (mi)		Total Precipitation	Air Temperature	Wind Speed	Snowpack Depth
-	MOSQUITO PASS	64.93	-165.5	14	9	2022 to 2023	-	X	X	-
USR0000AQTZ	QUARTZ CREEK ALASKA	65.4	-164.7	57	36	2022 to 2023	-	X	-	-
USW00026617	NOME MUNI AP	64.51	-165.4	60	37	1900 to 2023	X	X	-	X
702000_26617	NOME AIRPORT	64.51	-165.4	60	37	1940 to 2023	X	X	X	-
997383_99999	NOME NORTON SOUND	64.5	-165.4	62	38	2008 to 2023	-	X	X	-
USC00507669	PORT CLARENCE	65.25	-166.9	66	41	1895 to 1995	-	-	-	X
USS0064P01S	JOHNSON'S CAMP	64.56	-164.3	81	50	2002 to 2023	-	X	-	X
702004_99999	WHITE MOUNTAIN	64.69	-163.4	109	68	2011 to 2023	-	X	X	-
USS0063P02S	PARGON CREEK	64.99	-163.1	115	72	2000 to 2023	X	X	-	X
USR0000AHOO	HOODOO HILL ALASKA	65.59	-163.4	116	72	1992 to 2018	-	X	-	-
USS0063P01S	ROCKY POINT	64.53	-163.4	116	72	1999 to 2023	X	X	-	X
701170_26634	TIN CITY LRRS AIRPORT	65.56	-167.9	124	77	2006 to 2023	-	X	X	-
USW00026634	TIN CITY	65.57	-167.9	124	77	1953 to 1985	-	-	-	X
701170_99999	TIN CITY AFS	65.57	-167.9	124	77	1953 to 2005	-	X	X	-
701995_26628	CAPE DARBY REMOT COM OUTLT	64.55	-163	133	83	2005 to 2023	-	X	X	-
USW00026618	WALES	65.62	-168.1	135	84	1925 to 1995	-	-	-	X
701195_99999	SHISHMAREF	66.25	-166.1	136	84	1983 to 2005	-	X	X	-
701195_26625	SHISHMAREF/ NEW AIRPORT	66.25	-166.1	136	84	2006 to 2023	-	X	X	-

Source: NAUSPR001810 Tundra Consulting - 2023 2024 Graphite Creek Groundwater Model Update - 0300_Hydrology\Hydrology\reports\meteo_review.html

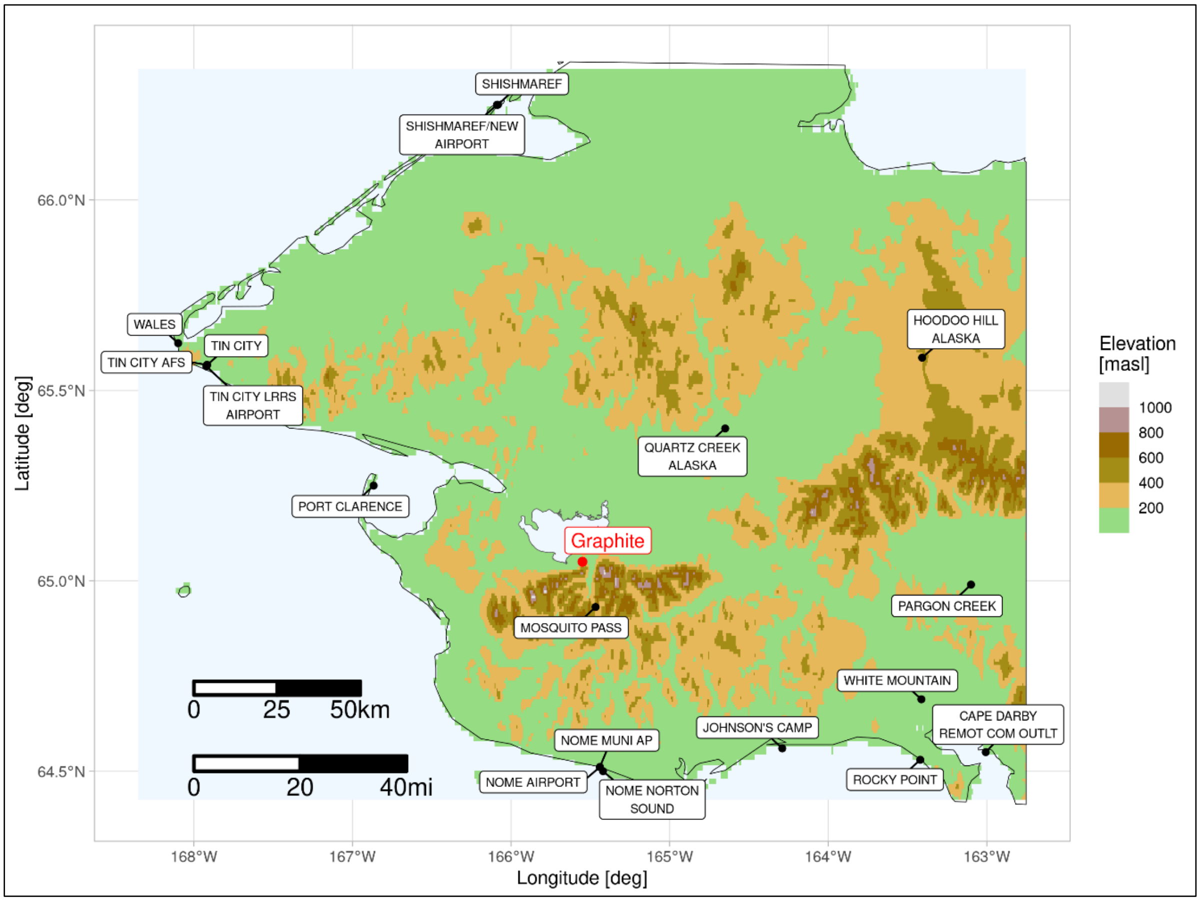


Figure 8-1. Location of climate stations used in the study

8.2.1.2 Climate Reanalysis Data

Datasets from climatic gridded models are generated by an analytical method that develops a comprehensive record of historical weather and climate. This modeling is also known as climate reanalysis. This method uses a collection of algorithms to interpolate from actual observations to generate gridded estimates of meteorological parameters. This combination of observations and numerical or statistical modeling based on earth system characteristics is used to generate a synthetic data series over instrumented and un-instrumented regions. Climate reanalysis typically extends historically over several decades or longer and covers the entire globe from the Earth's surface to well above the stratosphere.

Several climatic gridded models were compared to available site and regional data to find a model suitable to fill site data gaps and extrapolate where necessary. The following models were evaluated:

- Daymet is a gridded estimate of daily weather based on ground observations developed at the Oak Ridge National Laboratory and supported through National Aeronautics and Space Administration (NASA) (Thornton et al., 2021). Data are available on a 1-km gridded surface over continental North America from 1980 to present.

- ERA-5 is the fifth-generation atmospheric reanalysis of the global climate published by the European Centre for Medium-Range Weather Forecasts (ECMWF) (2022). ERA-5 includes sub-daily data from 1979 to present (2022) for the world, based on a 0.25° resolution.
- ERA-5 Land is a replay of the land component of the ERA5 climate reanalysis, forced by meteorological fields from ERA5 (Muñoz Sabater, 2019). This dataset has been carried out by the ECMWF and includes hourly daily data from 1950 to present (2023) for the world at a 0.1° resolution (9 km).
- MERRA-2 is the second generation of NASA's atmospheric reanalysis dataset. MERRA-2 provides daily hindcast estimations from 1980 to 2022 for the world at a 0.5° resolution (Global Modeling and Assimilation Office (GMAO), 2015). Hourly data are available from 2001 to 2022.

8.2.1.3 Hydrometric Records

Publicly available hydrometric records were obtained from USGS, and those collected near the site were used to develop the hydrological model. Table 8-2 provides hydrometric station details used in this review. Figure 8-2 and Figure 8-3 present further locations and respective watersheds in regional and local context, respectively. Initially, the regional gauge station Dahl C NR Kobuk AK – 15743850 was considered. However, since the station is located approximately 450 km from the site, it was later removed from the analysis, as it was not deemed relevant to improving the flow results at the site.

Table 8-2. Hydrometric stations used in study

Station Name	Station ID	Latitude	Longitude	Catchment Area (square miles (mi.^{2}))	Period of Record
Niukluk River above Melsing Creek	15580095	64.89	-163.67	707	2013 to 2023
Snake River near Nome	15621000	64.56	-165.51	86	1965 to 1991 2020 to 2023
Crater Creek near Nome	15668200	64.93	-164.87	22	1975 to 1985
Cobblestone River	CR-A	65.04	-165.47	60	2022 to 2023
Graphite Creek A	GC-A	65.04	-165.54	0.6	2022 to 2023
Graphite Creek B	GC-B	65.04	-165.54	0.7	2022 to 2023
Glacier Creek A	GL-A	65.03	-165.57	0.7	2022 to 2023
Glacier Creek B	GL-B	65.04	-165.57	0.8	2022 to 2023

Source: NAUSPR001810 Tundra Consulting - 2023 2024 Graphite Creek Groundwater Model Update - 0300_Hydrology\Hydrology\reports\meteo_review.html Hypsometric Curves

8.2.1.4 Topography

To understand the site orography, local elevation models were obtained from the USGS 5-meter (m) Alaska Digital Elevation Models (AK5M) (USGS, 2024b). Using this data, hypsometric curves were established, which are important for the precipitation-runoff model. Hypsometric curves illustrate the proportion of catchment area at different elevations and provide insights into the landscape characteristics.

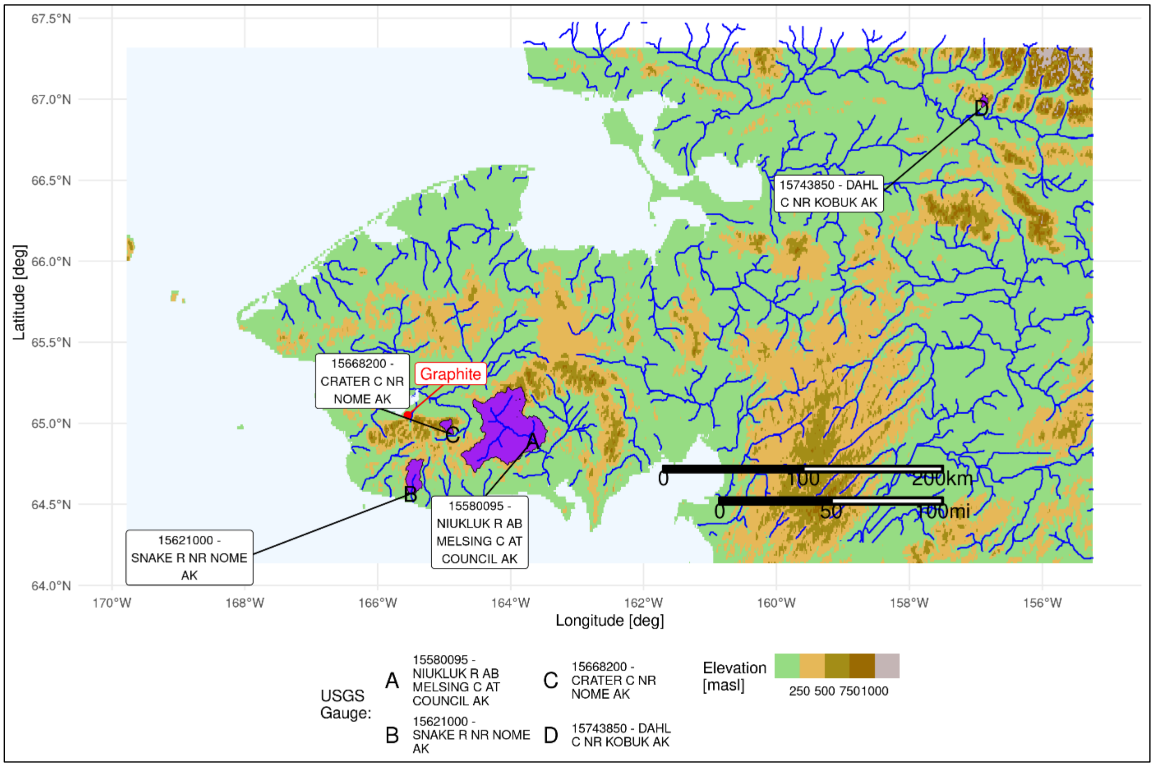


Figure 8-2. Regional flow gauges used in this review

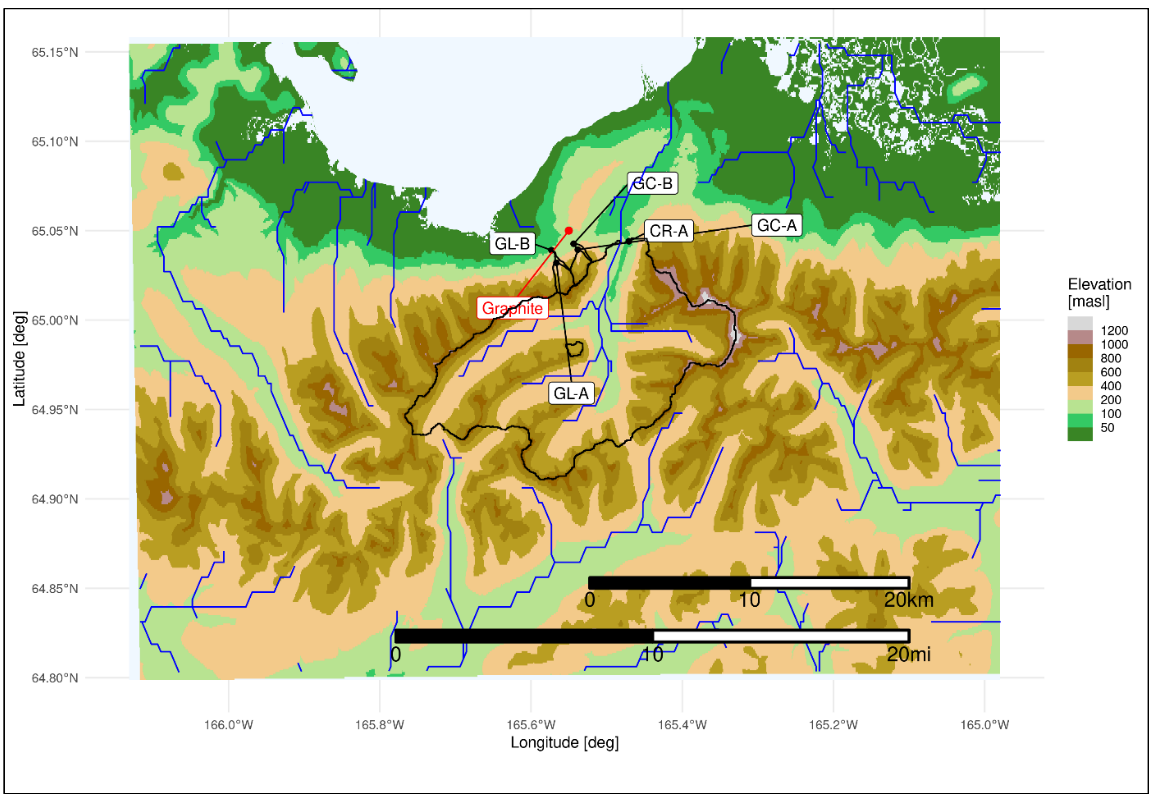


Figure 8-3. Local flow gauges used in this review

8.2.2 Goodness of Fit

The main goal of developing mathematical-physical models is to represent nature. Two mathematical metrics were implemented to predict the goodness of fit of the hydrological models. These metrics of model efficiency provide one number to quantify representativeness of the model results. These metrics are:

- Nash Sutcliffe efficiency (NSE) (Nash and Sutcliffe, 1970): NSE is one of the most commonly used general hydrological model performance statistics. A perfect match between observations and simulations results in an NSE of 1. An NSE below 0 indicates that the mean of all observations provides more predictive power than the modeled data.
- Kling-Gupta efficiency (KGE) (Gupta et al., 2009): This efficiency coefficient is a diagnostical decomposition of the NSE, which facilitates analysis of the relative importance of difference components (correlation, bias, and variability). Similar to NSE, a perfect model has a maximum value of 1.0.

8.3 Climate Analysis

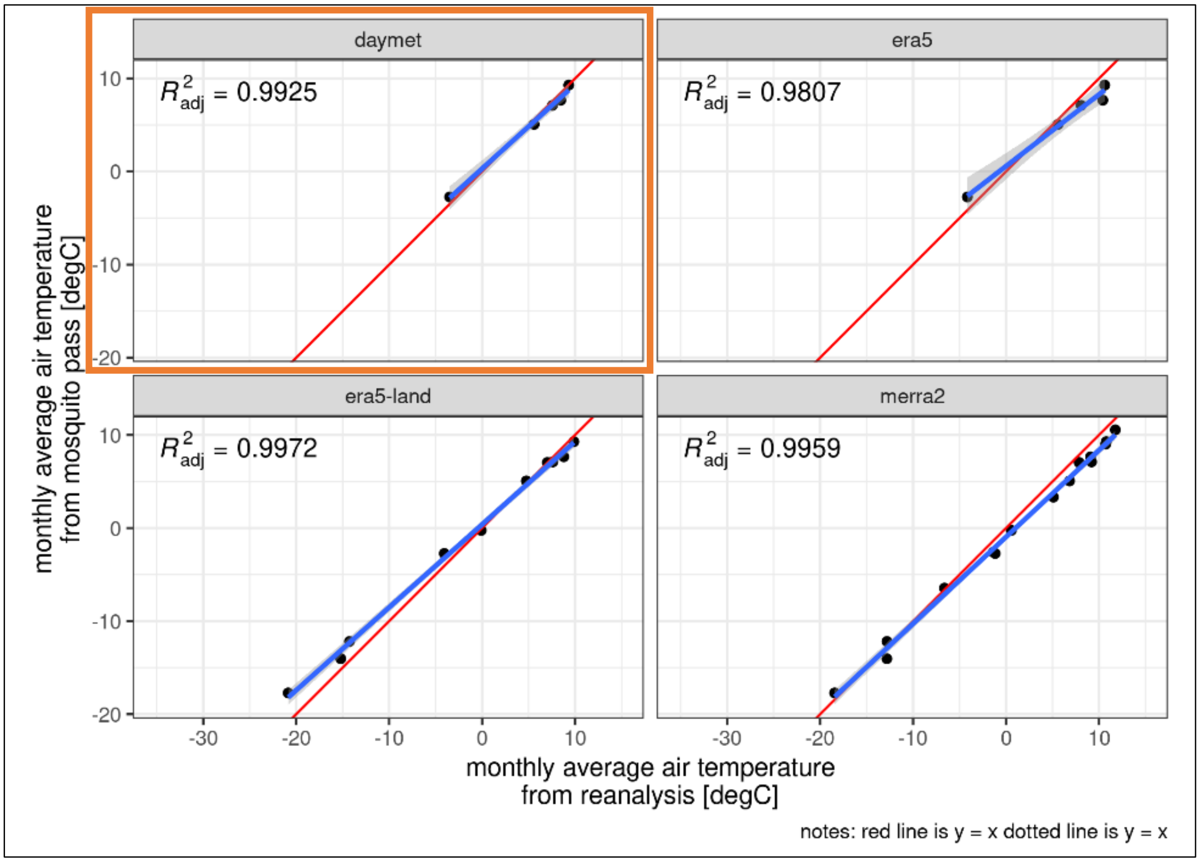
Due to the lack of site-specific records, SRK cross-referenced regional stations with climate reanalysis sources to identify models that could best represent each climatic parameter at the site. The goal was to discern which climate reanalysis most appropriately mirrors site records.

However, it is crucial to note that this process is not a replacement for the use of site meteorological stations. Meteorological stations at the site remain indispensable due to their ability to precisely capture site-specific conditions, whereas climate reanalysis is a broader, more generalized system. For example, ERA5-Land system operates on a 12- x 12-km grid, averaging numerous orographic features within each cell. Such local considerations could potentially understate or overstate a given meteorological parameter.

In the following subsection, SRK conducted a meteorological review within a regional context.

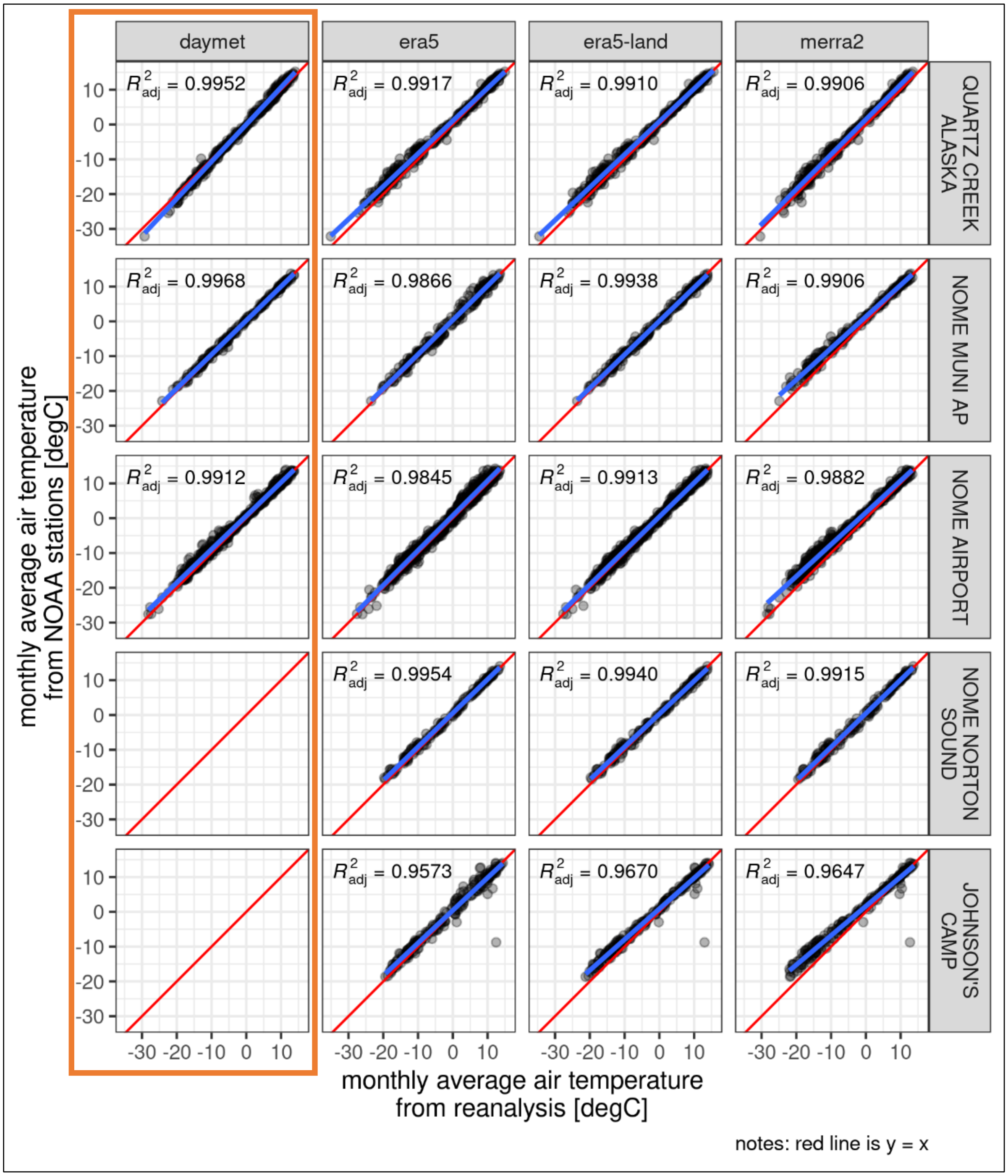
8.3.1 Air Temperature

Air temperatures at regional stations were compared against each climate reanalysis source on a monthly basis. Figure 8-4 and Figure 8-5 show the air temperature evaluation against Mosquito Pass and NOAA stations, respectively. Since some climatic gridded models are only available over land and certain meteorological stations are located quite near the coastline, not all stations align precisely with some climate reanalyzes; on Figure 8-5, this is the case with Daymet, which is not available for Nome Norton South and Johnson's Camp. All reanalysis sources tend to correlate well with the regional stations, with Daymet performing the best for all stations. Based on this review and for having a small grid size, Daymet was chosen as the representative air temperature source for the region.



Source: NAUSPR001810 Tundra Consulting - 2023 2024 Graphite Creek Groundwater Model Update - 0300_Hydrology\Hydrology\reports\meteo_review.html

Figure 8-4. Monthly reanalysis air temperature compared to Mosquito Pass

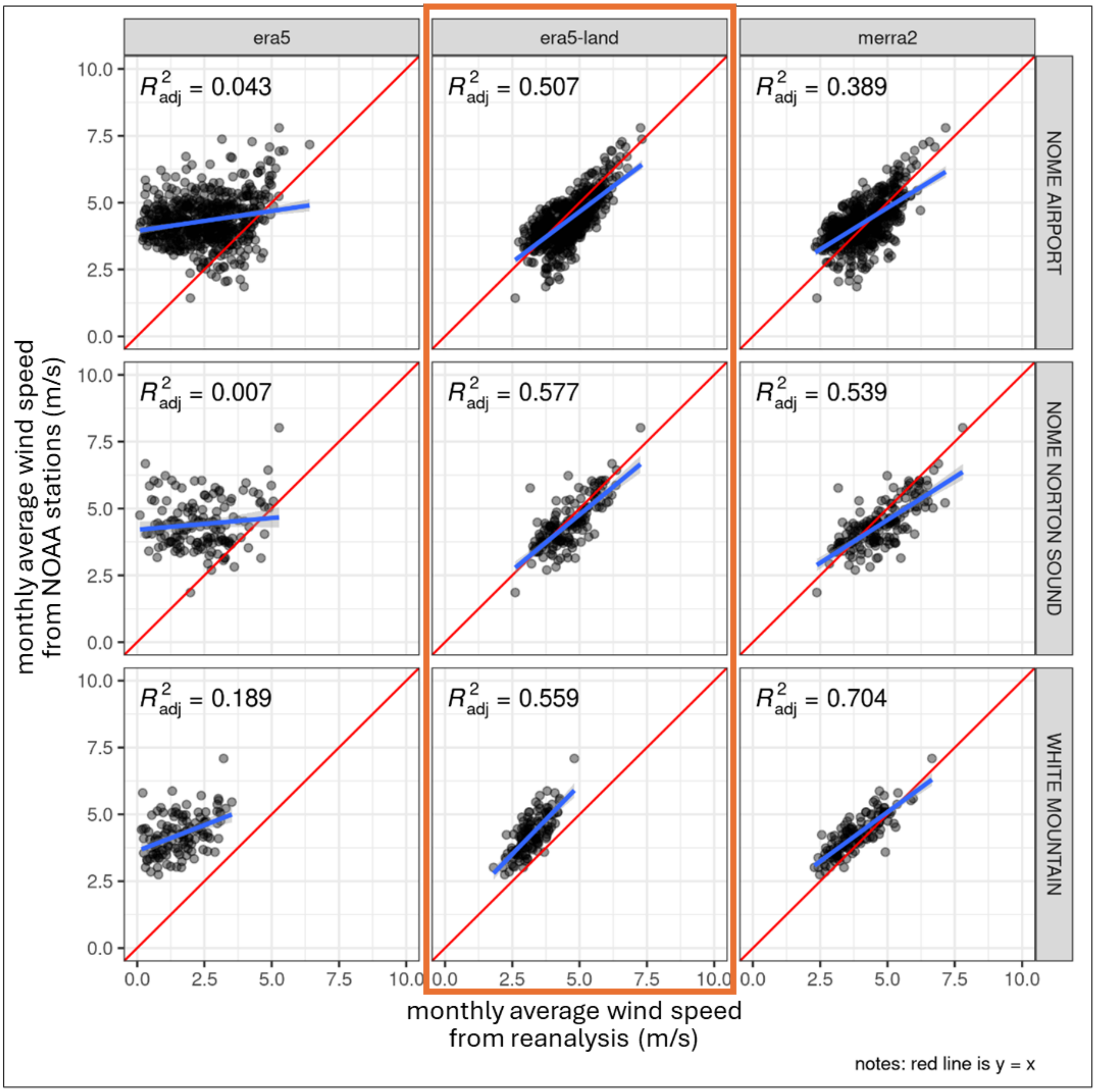


Source: NAUSPR001810 Tundra Consulting - 2023 2024 Graphite Creek Groundwater Model Update - 0300_Hydrology\Hydrology\reports\meteo_review.html

Figure 8-5. Monthly reanalysis air temperature compared to NOAA stations

8.3.2 Wind Speed

Wind speed at regional stations was compared against each climate reanalysis source on a monthly basis. Figure 8-6 shows a comparison of the wind speed between stations and reanalysis sources. Between all reanalysis sources, ERA5-Land tends to correlate best with the regional stations. Therefore, ERA5-Land was used as the representative gridded model for the region.

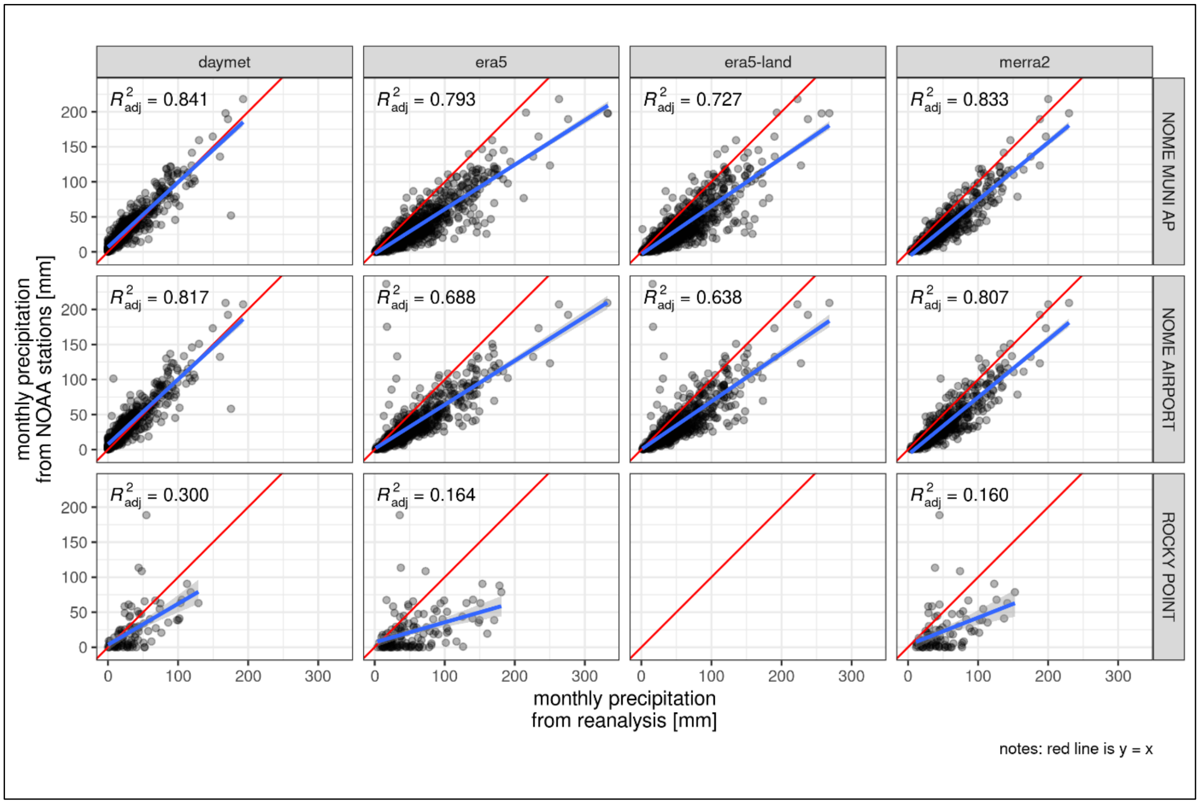


Sources: NAUSPR001810 Tundra Consulting - 2023 2024 Graphite Creek Groundwater Model Update - 0300_Hydrology\Hydrology\reports\meteo_review.html

Figure 8-6. Monthly reanalysis wind speed compared to NOAA stations

8.3.3 Total Precipitation

Total precipitation at regional stations was compared against each climate reanalysis source on a monthly basis. Figure 8-7 shows a comparison of the total precipitation between stations and reanalysis sources. Between all reanalysis sources, Daymet tends to correlate best with the regional stations and was therefore used as the representative gridded model for the region.



Sources: NAUSPR001810 Tundra Consulting - 2023 2024 Graphite Creek Groundwater Model Update - 0300_Hydrology\Hydrology\reports\meteo_review.html

Figure 8-7. Monthly reanalysis total precipitation compared to NOAA stations

8.3.3.1 Snow Capture Efficiency

Meteorological stations within Alaska may exhibit a significant amount of wind-induced undercatch (snow capture efficiency) due to the high amount of snowfall and high wind speeds (Yang et al., 1998). Undercatch is the systemic error in measuring precipitation, particularly snow, due to wind blowing across a gauge's opening. The gauge at Nome has been estimated to under-measure precipitation by as much as 50 percent (%) (Yang et al., 1998). To account for undercatch on a regional scale, the gridded snowfall was adjusted using relationships to gridded wind speed:

$$CE = \exp(4.606 - 0.157U^{1.28})$$

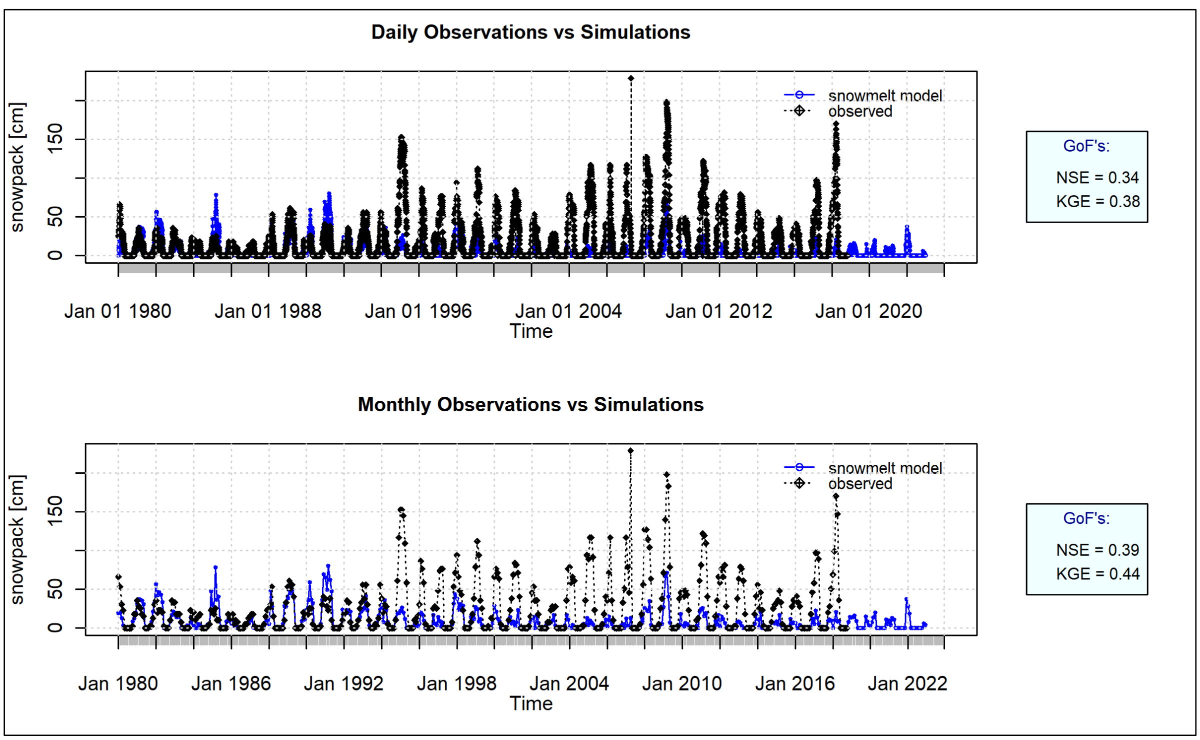
Where CE is the catch efficiency and U is the wind speed for each grid point. This methodology allows for a completely gridded undercatch corrected precipitation dataset for the region.

SRK notes that this correction assumes total precipitation and air temperature are locally defined by the Daymet climatic gridded model, while wind speed is defined by the results from the ERA5-Land climatic gridded model.

8.3.3.2 Snowpack

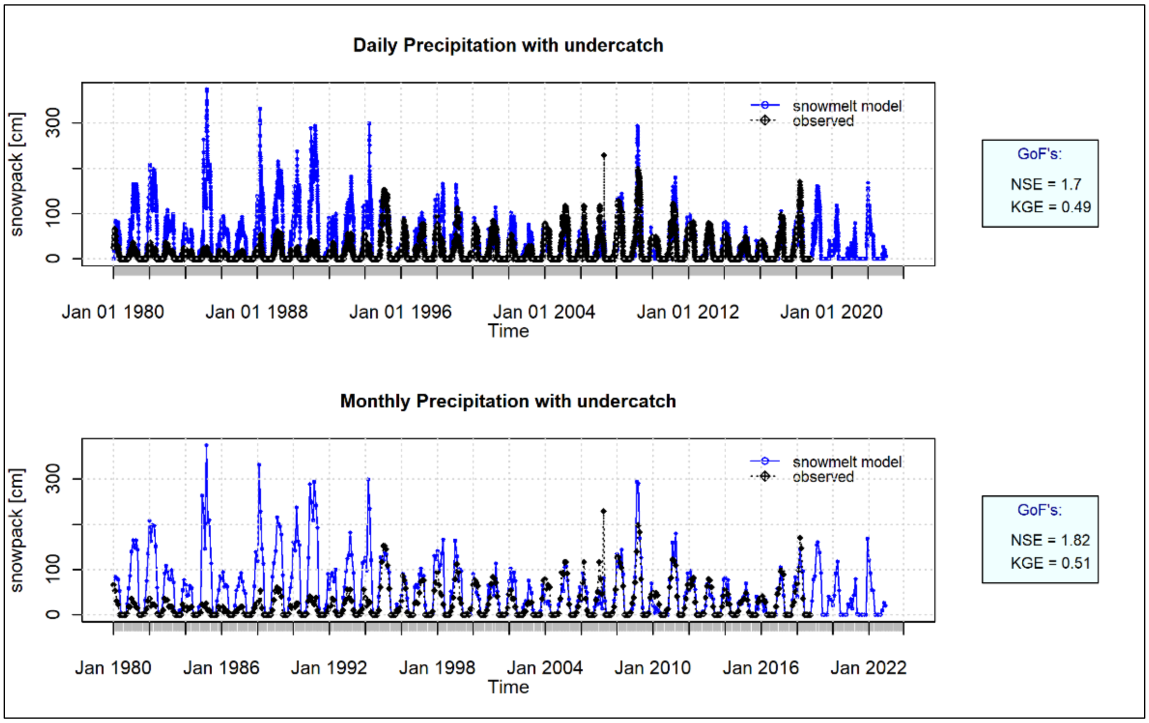
The snow back was first measured in late winter of 2023-2024. For a longer record, the snowpack was estimated using the daily energy snowmelt model established in Walter et al. (2005). This daily energy snowmelt model required climate inputs of daily maximum and minimum air temperatures and total precipitation. Topographical parameters (such as aspect and slope) were required for the snowmelt model and were obtained from USGS 3DEP AK5M (USGS, 2024).

The daily energy snowmelt model was applied to USGS snow course stations to verify the validity of the precipitation and undercatch calculations using the KGE. The snowpack was evaluated at Nome, and Figure 8-8 and Figure 8-9 show the results of the model without and with correction for undercatch, respectively. The snowpack was also evaluated at Pargon Creek, and Figure 8-10 and Figure 8-11 show the results of the model without and with correction for undercatch, respectively. For both stations, there is an improvement in the daily KGE from 0.38 to 0.49 and 0.82 to 0.86 at Nome and Pargon Creek, respectively. Based on the results of the snowpack model in these regional stations, the undercatch correction is considered to have improved the accuracy of the snowpack estimations by increasing the snowfall estimations.



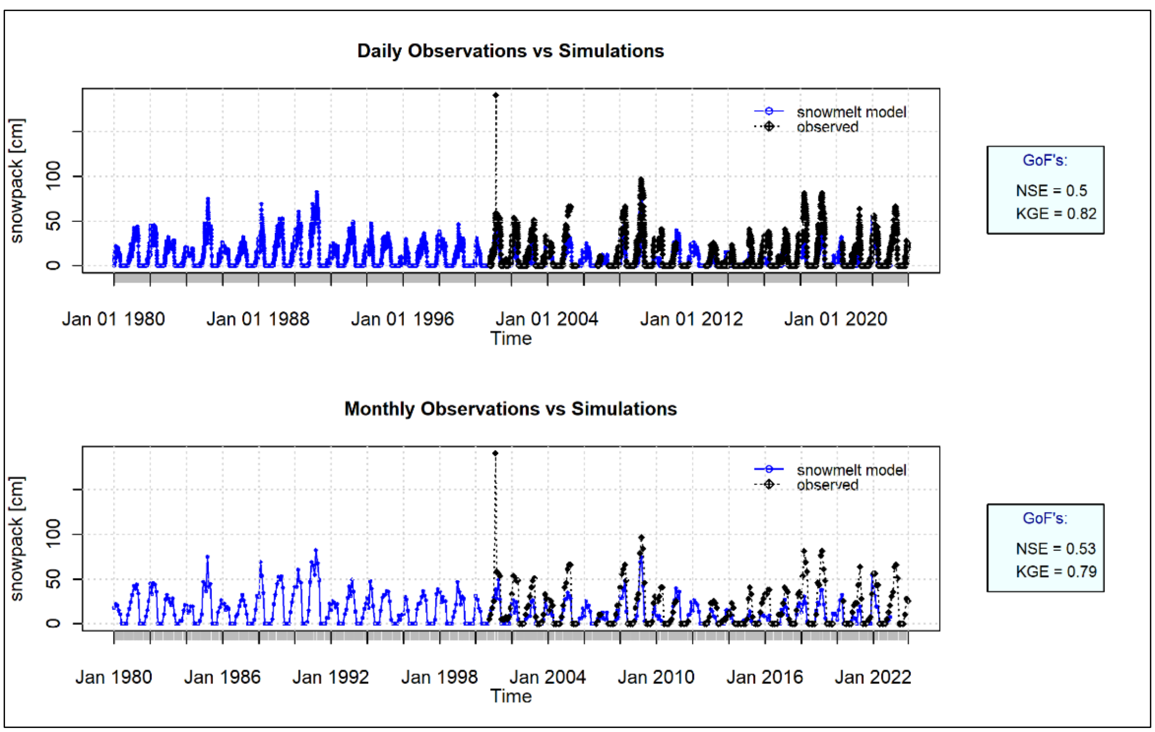
Source: NAUSPR001810 Tundra Consulting - 2023 2024 Graphite Creek Groundwater Model Update - 0300_Hydrology\Hydrology\reports\meteo_review.html

Figure 8-8. Modeled and observed snowpack at Nome without correction for undercatch



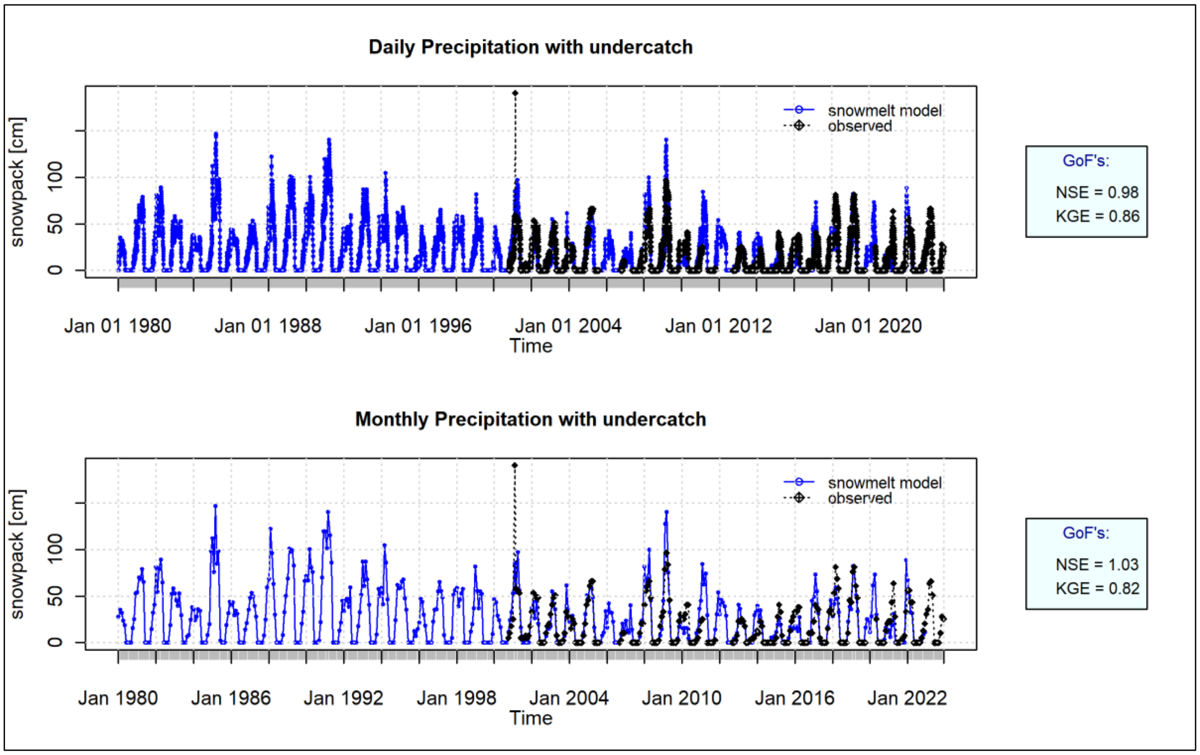
Source: NAUSPR001810 Tundra Consulting - 2023 2024 Graphite Creek Groundwater Model Update - 0300_Hydrology\Hydrology\reports\meteo_review.html

Figure 8-9. Modeled and observed snowpack at Nome with correction for undercatch



Source: NAUSPR001810 Tundra Consulting - 2023 2024 Graphite Creek Groundwater Model Update - 0300_Hydrology\Hydrology\reports\meteo_review.html

Figure 8-10. Modeled and observed snowpack at Pargon Creek without correction for undercatch



Source: NAUSPR001810 Tundra Consulting - 2023 2024 Graphite Creek Groundwater Model Update - 0300_Hydrology\Hydrology\reports\meteo_review.html

Figure 8-11. Modeled and observed snowpack at Pargon Creek with correction for undercatch

8.3.4 Climate Summary

A summary of the local meteorology is presented using data from Daymet on total precipitation and air temperature, as well as wind speed data from ERA5-Land. Undercatch corrections are also considered, factoring in wind speed, corrected total precipitation, and estimated capture efficiency. Potential evaporation was estimated using Oudin's method, which requires only latitude and average air temperature. While this method is not perfect, it is considered fit-for-purpose, particularly for use in a precipitation-runoff model (Oudin et al., 2005). All of these values are available on a daily scale but are provided as monthly averages for the period from 1980 to 2022; Table 8-3 **Error! Reference source not found.**provides these values.

Table 8-3. Mean monthly meteorology at the site from 1980 to 2022

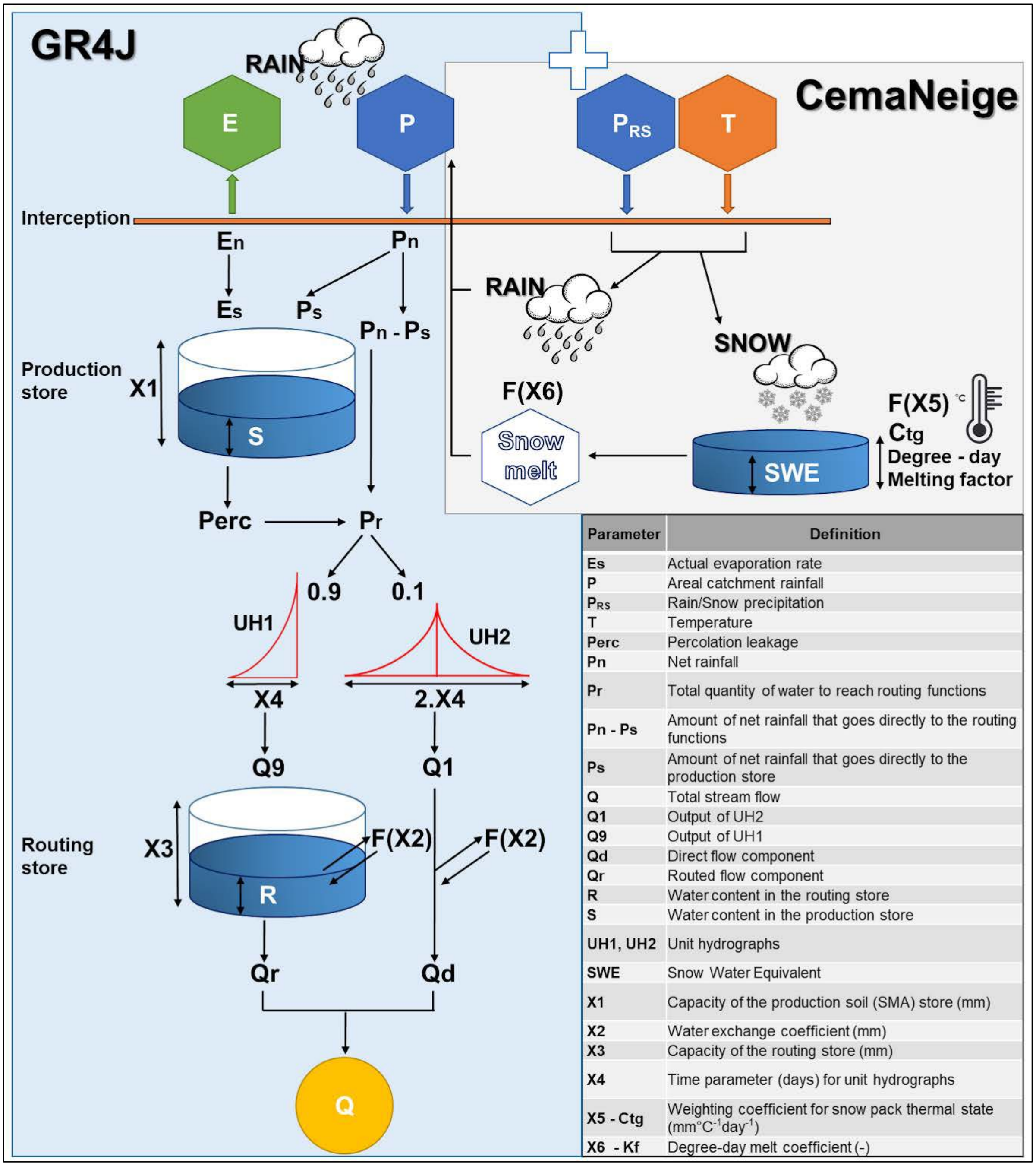
Parameter	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Total precipitation (millimeters (mm))	26	27	22	21	23	30	75	95	72	48	33	35	507
Total precipitation corrected by undercatch (mm)	46	48	38	36	28	30	75	95	72	58	54	59	639
Maximum air temperature (degrees Celsius (°C))	-13.1	-12.1	-10.7	-4.2	4.9	12.1	14.3	12.6	7.9	0.2	-6.7	-10.8	-0.5
Average air temperature (°C)	-16.8	-16	-14.7	-8.1	1.1	7.8	10.4	9	4.7	-2.5	-9.8	-14.4	-4.1
Minimum air temperature (°C)	-20.5	-19.8	-18.8	-12	-2.6	3.4	6.6	5.5	1.6	-5.3	-12.9	-17.9	-7.7
Potential evaporation (mm)	0	0	0	4	30	65	77	53	23	4	0	0	257
Wind speed (meters per second (m/s))	2.1	2.2	2	2.1	2.1	2.2	2.3	2.3	2.3	2.1	2.1	2.2	2.2
Estimated capture efficiency (%)	69	67	69	70	88	100	100	100	96	79	71	68	81

8.4 Hydrological Model

Under ideal conditions, daily local flow records measured over several seasons allow for an understanding of local flow performance, including range, seasonality, variability, and the capacity to identify statistics from flow observations. However, these conditions are not always feasible, as local records tend to be limited in scope, and regional records may not be influenced under the same meteorological conditions expected at the site. To address these gaps, precipitation-runoff models are used to enhance understanding based on meteorology and flow observations.

Local flows were characterized and understood using the GR4J daily precipitation runoff model. The Génie Rural (GR) suite of models, as referenced by Perrin et al. (2003), was utilized for modeling runoff across the region. The four-parameter GR4J model (which stands for journalier or daily) was employed in conjunction with the two-parameter CemaNeige snowpack model. The GR4J model establishes a relationship between runoff and rainfall, as well as evapotranspiration, using either daily or hourly input data.

Figure 8-12 shows the model schematic for GR4J, and Table 8-4 describes the parameters. GR4J includes an exchange factor (X2, noted as F (x2) in the table) to characterize groundwater components. This parameter represents the rate at which groundwater exchanges occur between the catchment and its surroundings. It helps to better simulate the baseflow component of the streamflow, particularly in catchments where groundwater interactions are significant. On Figure 8-12, the production store (X1) models the component associated with soil moisture dynamics, while the routing store (X2) simulates the transfer and delay of runoff through the catchment.



Parameter	Definition
Es	Actual evaporation rate
P	Areal catchment rainfall
P_{RS}	Rain/Snow precipitation
T	Temperature
Perc	Percolation leakage
Pn	Net rainfall
Pr	Total quantity of water to reach routing functions
Pn - Ps	Amount of net rainfall that goes directly to the routing functions
Ps	Amount of net rainfall that goes directly to the production store
Q	Total stream flow
Q1	Output of UH2
Q9	Output of UH1
Qd	Direct flow component
Qr	Routed flow component
R	Water content in the routing store
S	Water content in the production store
UH1, UH2	Unit hydrographs
SWE	Snow Water Equivalent
X1	Capacity of the production soil (SMA) store (mm)
X2	Water exchange coefficient (mm)
X3	Capacity of the routing store (mm)
X4	Time parameter (days) for unit hydrographs
X5 - Ctg	Weighting coefficient for snow pack thermal state ($mm°C^{-1}day^{-1}$)
X6 - Kf	Degree-day melt coefficient (-)

Source: Perrin et al., 2003

Figure 8-12. GR4J Model schematic

Table 8-4. Parameters used in the GR4J model

Parameter	Definition	Parameter Type
E	Potential areal evapotranspiration	Input
E_n	Net evapotranspiration capacity	Calculated
E_s	Actual evaporation rate	Calculated
$F(x_2)$	Groundwater exchange term	Calculated
P	Areal catchment rainfall	Input
Perc	Percolation leakage	Calculated
P_n	Net rainfall	Calculated
P_r	Total quantity of water to reach routing functions	Calculated
P_n-P_s	Amount of net rainfall that goes directly to the routing functions	Calculated
P_s	Amount of net rainfall that goes directly to the production store	Calculated
Q	Total stream flow	Calculated
Q_1	Output of UH2	Calculated
Q_9	Output of UH1	Calculated
Q_d	Direct flow component	Calculated
Q_r	Routed flow component	Calculated
R	Water content in the routing store	Calculated
S	Water content in the production store	Calculated
UH1, UH2	Unit hydrographs	Calculated
x_1	Capacity of the production soil (SMA) store (mm)	Calibrated Parameter
x_2	Water exchange coefficient (mm)	Calibrated Parameter
x_3	Capacity of the routing store (mm)	Calibrated Parameter
x_4	Time parameter (days) for unit hydrographs	Calibrated Parameter
CemaNeige x_1	Weighting coefficient for snowpack thermal state	Calibrated Parameter
CemaNeige x_2	Degree-day melt coefficient (mm/°C)	Calibrated Parameter

Source: Perrin et al., 2003

In the GR4J snowmelt model CemaNeige, the watershed is divided into elevation bands. For each band, precipitation and temperature are adjusted and corrected. By default, the GR4J model considers an elevation gradient for total precipitation of 0.0004 1/m and a temperature gradient of 0.434°C/ 100 m, both established based on studies in French watersheds (Valéry, 2010).

To account for elevation gradients in total precipitation and air temperature, as well as to include climatological differences within each catchment, the model and climate data were divided into four elevation bands using catchment hypsometric curves. These elevation gradients were specifically corrected according to meteorological considerations for each watershed using climatic reanalysis models. This approach allows for variation in snowpack levels within individual catchments.

8.4.1 Model Evaluation

The model was calibrated for each catchment by optimizing the NSE and KGE with equal weighting. GC-A and GC-B and GL-A and GL-B were respectively calibrated in tandem because the stations are adjacent to each other and are expected to have similar catchment characteristics. Table 8-4 provides the resulting calibrated values and goodness-of-fit indicators for each catchment.

Table 8-5. GR4J model results

Station Name	Station ID	NSE	KGE	X1 (mm)	X2 (mm)	X3 (mm)	X4 (days)	CemaNeige X1 (mm)	CemaNeige X2 (mm)
Niukluk River above Melsing Creek	15580095	0.71	0.74	110	3.37	44.3	1.4	0.7	2.1
Snake River near Nome	15621000	-0.06	0.5	0	3.45	234.3	1.1	0.1	8.8
Crater Creek near Nome	15668200	0.55	0.6	0	0.9	41.7	2.2	0.3	3.9
Cobblestone River	CR-A	0.32	0.44	94.6	6.3	61.6	1.1	0.8	2
Graphite Creek A	GC-A	0.35	0.6	32	3.4	73.4	4.1	0.9	1
Graphite Creek B	GC-B	-0.3	0.31	32	3.4	73.4	4.1	0.9	1
Glacier Canyon Creek A	GL-A	0	0.4	1.7	2.5	11.8	3.5	0.5	1.5
Glacier Canyon Creek B	GL-B	-0.03	0.15	1.7	2.5	11.8	3.5	0.5	1.5

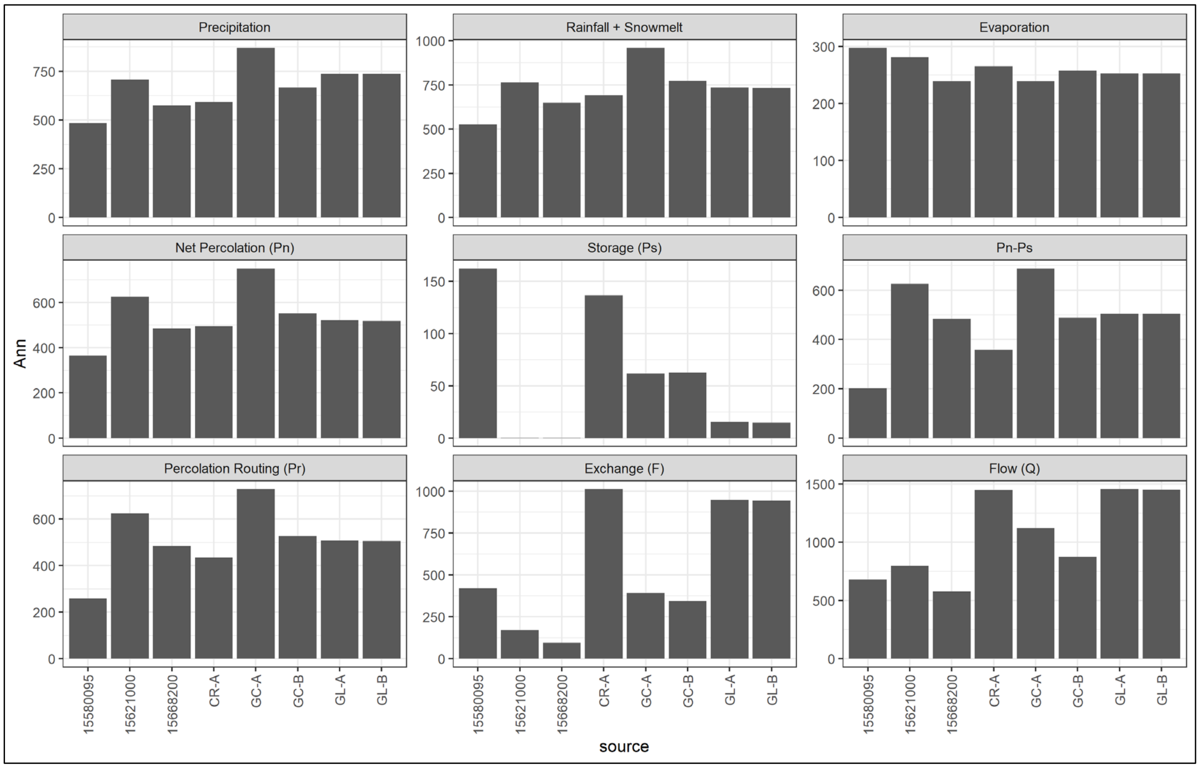
Source: NAUSPR001810 Tundra Consulting - 2023 2024 Graphite Creek Groundwater Model Update - 0300_Hydrology\Hydrology\reports\runoff_review_r3.html

Figure 8-13 compares the annual average flow and runoff results for each catchment. Of importance is the groundwater exchange component (X2). All catchments exhibit positive groundwater exchange (i.e., a net gain of runoff from groundwater). In the region of the project, the groundwater exchange ranges from 350 mm/year (GC-B) to 1,000 mm/year (CR-A).

On Figure 8-13, the flows and overall values are presented in mm/year. To obtain the actual flows, these values need to be multiplied by their respective watershed areas. Since all values are presented as unit depths (mm/year), this figure shows the records in a non-dimensional form. It can be observed that local flows (Q) tend to have a higher yield (flow divided by area) than regional flows in the area.

The model also identified differences in exchange between Graphite Creek and Glacier Canyon Creek. Due to limited information, these differences could be real or could result from artifacts associated with the limited meteorological and flow records used in the runoff model.

Table 8-6 presents an example of runoff performance in the local area, focusing on the watersheds for GC-B. The data used for this performance are derived from the GR4J model at GC-B. The GR4J model uses the raw precipitation value of 510 mm from Daymet. However, upon correction for undercatch, this value increases to 666 mm. Further adjustments are made for elevation gradients,



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Note: Results are shown in mm/year

Figure 8-13. Summary of annual results

To match the observed flows, the GR4J model necessitates an increase above these values, resulting in a total runoff of 873 mm. This adjustment requires accounting for surplus of groundwater exchange of 346 mm (as water surplus from the local aquifer).

Based on SRK's experience, it is anticipated that the surface runoff models should align within an expected range. However, it is suspected that the wind speed may be underestimated, implying that the undercatch correction could be higher, which would result in a higher local total precipitation.

This adjustment would likely lead to a reduction in the groundwater exchange (understood as a mathematical artifact), as expected, while maintaining a similar range for the surface runoff, estimated to be between 850 to 950 mm/year. For now, these values are higher that the up-to-day expected total precipitation; however, as observed in Table 8-6, the modeled monthly runoff tends to match the actual observed runoff.

These results illustrate the uncertainty inherent in local total precipitation, snowpack, wind speed, and undercatch influence. The accuracy of these results can be significantly enhanced with actual local observations, particularly where snowpack records and wind speed are concerned. Furthermore, the model calibration can be improved with longer flow records.

Table 8-6. Mean monthly watershed summary for GC-B from 1980 to 2020

Parameter	January	February	March	April	May	June	July	August	September	October	November	December	Annual
prcp -daymet	26	27	23	20	24	31	75	96	72	48	33	34	510
prcp + undercatch correction	47	55	42	39	30	31	75	96	72	58	58	64	666
rainfall +snowmelt	0	1	0	1	33	162	245	202	103	25	2	1	774
Evap	0	0	0	4	30	65	77	54	23	4	0	0	258
P net(Pn)	0	1	0	0	20	100	169	152	85	23	2	1	551
P storage(Ps)	0	0	0	0	10	21	9	9	8	4	1	0	63
Pn-Ps	0	0	0	0	10	78	160	143	77	18	1	1	488
aft Perc rout.(Pr)	1	1	1	1	10	83	168	150	83	23	4	2	527
Exchange (F)	10	9	8	7	8	33	75	75	56	33	18	13	346
Runoff modeled	13	11	10	9	12	87	238	233	150	65	27	18	873
Runoff observed	-	-	-	-	-	-	211	239	226	-	-	-	-
Wind speed (m/s)	1.9	2.1	1.9	2	2	2.1	2.2	2.2	2.2	2	2	2	2.1
Average temperature (°C)	-17	-16	-15	-8	1.1	7.8	11	9.1	4.7	-3	-9.7	-14	-4.1

Note: Values are in mm/month unless otherwise noted.

8.5 Baseflow

Groundwater modeling necessitates the estimation of baseflow. Originally, the idea was to use the groundwater exchange derived from the GR4J model as a proxy for local baseflows. However, the values yielded by this method deviated from the expected ranges. To address this, SRK applied a mathematical filter to the surface runoff estimated from the GR4J model to estimate the baseflow.

This digital filter, proposed by Nathan and McMahon (1990), operates on two parameters: a filter parameter, which is typically recommended to be between 0.9 and 0.95, and the number of passes, usually recommended to be between 1 to 3. In this instance, we evaluated the values with a filter parameter of 0.925 and conducted two passes.

Figure 8-14 and Table 8-7 present the results from this process, applied to the regional gauge 15580095 and local flow gauges. In Table 8-7, values were patched using linear regression when gaps were smaller than 15 days, as was the case with records from GC-A.

8.6 Summary

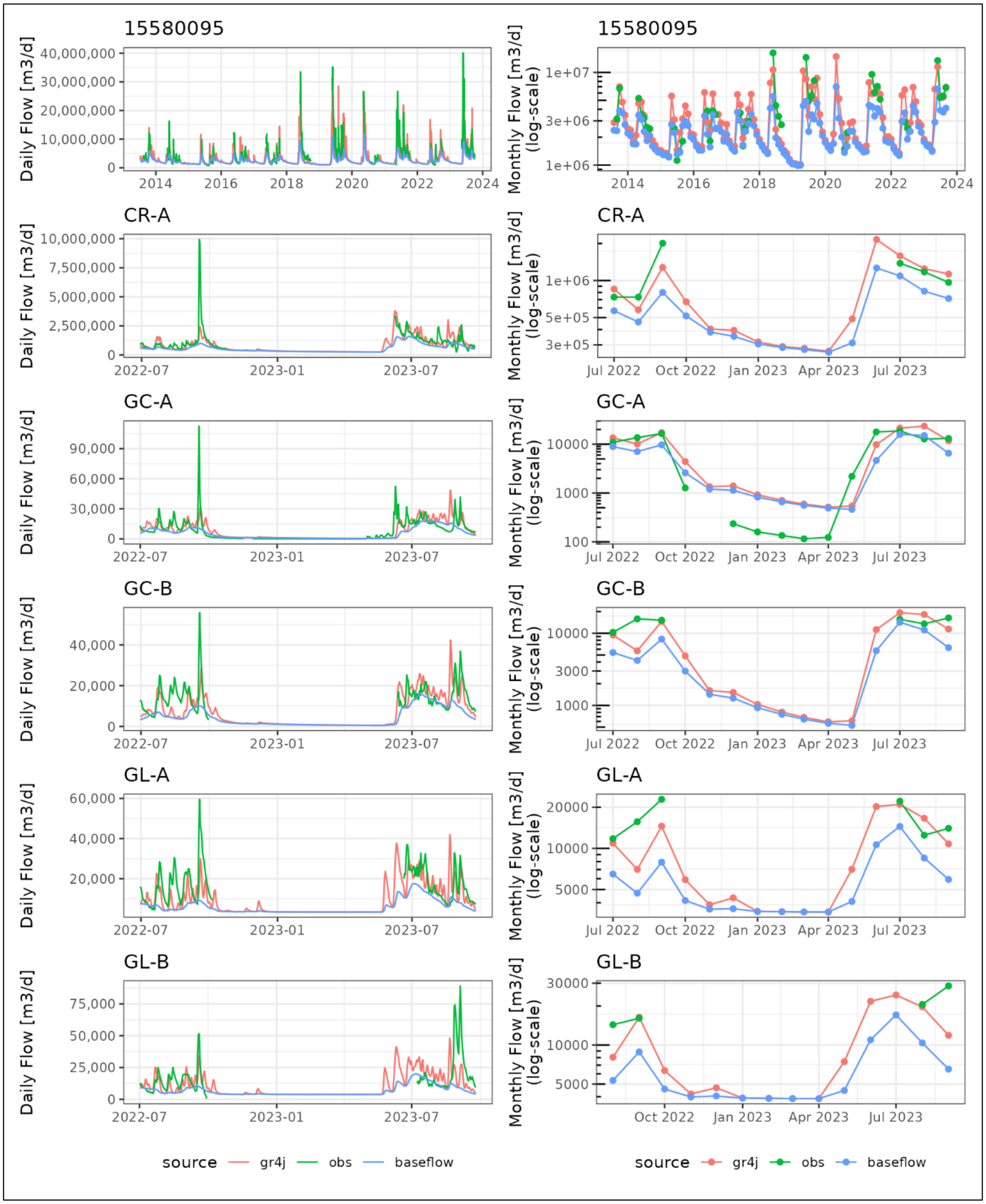
This memorandum presents a meteorological review and a hydrological model for catchments in the Graphite Creek project area; it relies primarily on regional stations, climatic gridded models, and extensions of discrete local flow records, as only a short period of local observations for meteorology and snowpack were available.

In other climate environments, such inputs might barely be enough for a conceptual understanding of meteorology, runoff, and baseflow conditions. However, the cold climate here introduces another significant uncertainty, primarily due to snow capture efficiency (also known as undercatch), especially in windy conditions exceeding 1 m/s, which are typical in the local area.

Undercatch could significantly alter local precipitation estimates, potentially by 200% to 480%, according to studies by Benning and Yank (2005) for Nome, located 65 km south of the project area.

The memorandum provides mean monthly values for total precipitation, air temperature, and wind speed. Due to the significant uncertainty, these values should be treated as proxy values and not precise measurements. Local observations, particularly for wind speed (for estimating snow capture efficiency), snowpack depth, and local runoff, are crucial.

The values presented in this memorandum represent SRK's best effort to provide relevant data for the area in the absence of local measurements. However, obtaining local data is key for future phases of the project.



Note: Obs as measured/observed; GR4J as modeled and baseflow estimations from GR4J model

Figure 8-14. Monthly values

Table 8-7. Mean monthly runoff

Station	Source	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Niukluk River above Melsing Creek 15580095	gr4j	1,629,283	1,508,548	1,369,009	1,346,044	6,040,623	9,651,420	3,964,475	4,055,660	4,399,521	3,802,185	2,495,055	1,879,321	3,516,317
	obs	-	-	-	-	5,250,667	7,791,067	3,444,358	3,714,560	3,898,859	6,734,476	-	-	-
	baseflow	1,535,756	1,431,494	1,324,256	1,271,849	3,110,037	5,429,956	2,689,431	2,735,253	2,928,107	2,658,783	2,103,698	1,731,339	2,414,178
CR-A	gr4j	291,030	279,071	265,788	256,727	420,982	1,363,187	1,370,284	1,016,046	818,249	572,015	385,576	322,107	614,926
	obs	-	-	-	-	-	-	1,057,978	953,653	1,488,013	-	-	-	-
	baseflow	283,554	272,238	261,582	252,791	303,854	849,565	879,734	660,722	555,308	439,426	349,591	307,609	452,127
GC-A	gr4j	689.4	614.9	532.1	473.5	689.6	5,672	16,319	17,562	11,241	3,433	1,386	904.9	4,995
	obs	159.7	134.8	115.5	123.4	2,196	17,860	14,790	13,210	14,830	1,271	405.2	234.9	5,453
	baseflow	640.2	569	505.4	452.7	493.7	2,864	10,221	10,749	5,867	2,095	1,116	804.5	3,055
GC-B	gr4j	817.6	714.1	620.5	550.8	710.4	5,542	14,659	14,320	9,585	4,025	1,715	1,080	4,559
	obs	-	-	-	-	-	-	12,946	14,670	15,743	-	-	-	-
	baseflow	758.8	665.5	589.8	526.9	543.6	2,871	9,147	8,677	5,302	2,479	1,362	960	2,843
GL-A	gr4j	3,466	3,532	3,432	3,438	5,915	13,835	16,055	12,969	9,398	5,553	3,810	3,544	7,100
	obs	-	-	-	-	-	-	16,955	14,075	18,425	-	-	-	-
	baseflow	3,443	3,454	3,429	3,426	4,164	8,416	10,116	7,135	5,123	3,915	3,518	3,459	4,976
GL-B	gr4j	3,898	3,963	3,872	3,869	6,212	15,002	18,657	15,249	10,710	5,963	4,201	3,964	7,988
	obs	-	-	-	-	-	-	10,896	17,444	22,048	-	-	-	-
	baseflow	3,881	3,893	3,869	3,865	4,546	9,003	11,834	8,461	5,838	4,348	3,947	3,895	5,627

Note: obs as measured/observed; GR4J as modeled and baseflow estimations from GR4J model in cubic meters per day (m^3/d)

9 Hydrogeologic Testing – Bedrock

Tundra conducted hydraulic testing of bedrock in diamond core holes (DDH) and wells, and of sediments (Section 10) near the anticipated waste management facility (WMF) using wells. The objective of testing was to support a feasibility study by expanding the understanding of the project hydrogeology and aiding development of the hydrogeologic numerical model. Hydrologic testing and analysis were last reported after the 2021 season (Tundra, 2022) which contains further details on those programs. All testing, analysis, and results are included in the current report.

Tundra hydraulically tested 49 intervals of bedrock from 17 drill holes. During drilling, Tundra utilized a single packer system to test intervals of bedrock as the hole was advanced. In specific locations, Tundra installed 2-inch diameter monitoring wells. After the well installations, Tundra developed the drilling fluids from the wells by means of airlifting and hand bailers. Following well development, Tundra conducted pumping, airlift, artesian flow and shut-in, or slug testing in specific wells. The test analyses are presented in Appendices C and D.

9.1 Drilling Program

Bedrock core drilling programs through 2022 were conducted by T & J Enterprises, Inc. of Arlee, Montana, Discovery Drilling Inc. of Anchorage, Alaska, and Boart Longyear of Salt Lake City, Utah. Major Drilling out of Salt Lake City, Utah, cored bedrock in the 2023 and 2024 programs. The drilling and testing sequence was generally as follows:

- Conductor casing—The conductor casing was installed to stabilize the top of the core hole and control flowing artesian water during well and vibrating wire piezometer (VWP) installations. The hole was advanced using HQ tools until the rock was judged to be suitably competent. Then, the conductor casing with a casing shoe was reamed to the bottom of the hole. The casing was generally cemented in place to manage flowing artesian water.
- Drilling—The HQ core hole was advanced through the conductor casing. Drilling fluid typically consisted of water and a polymer additive. The core was retrieved and examined daily by the hydrogeologist, who identified optimal test intervals.
- Packer Testing—Core hole advancement and packer testing occurred in sequence. When a test interval target was identified, drilling was stopped, and the drill rods were retracted above the test interval. A packer system was lowered into the drill rods and the hydraulic test performed. After testing was complete and the packer was removed, drilling resumed. The sequence would be repeated when each test interval was identified.
- Completion—The completed core holes were either plugged and abandoned or a 2-inch (nominal) well or VWP was installed (Section 6.4). Further hydraulic testing was conducted in certain wells following drill rig demobilization.

9.2 Test Methods

Tundra tested the bedrock using a combination of packer isolated tests from diamond drill holes and pumping, airlifting, and slug tests from wells.

9.2.1 Packer Testing

Packer testing was conducted periodically as the hole was advanced. A Tundra hydrogeologist periodically assessed the rock conditions at the drill rig to identify major structural and lithologic features to target for testing. Drill core was logged by Graphite One staff for geological and geotechnical parameters. The in-depth summary and analysis of the geologic and geotechnical logging is beyond the scope of this report. Key geotechnical parameters that were assessed to supplement and contextualize the hydrogeologic data include fracture frequency per meter (FF/m), rock quality designation (RQD), intact rock strength (IRS), weathering and alteration, and staining and oxidation. The data are presented in visual format on the well logs in Appendix E.

Hydraulic testing utilized a single-packer test system to measure the hydraulic parameters of isolated intervals of the core holes. Specifically, a Standard Wireline Packer System (SWiPS) manufactured by Inflatable Packers International (IPI) was used to test the hole during advancement. This technology allows the most recently drilled interval of rock to be tested with a single packer inserted through the drill rods. A pressure transducer installed inside the packer records downhole pressures before, during, and after the test.

The SWiPS system allows for several testing methods. Most tests were performed as single-step, or multi-step pressure injection tests. This type of test is typical for characterizing rock with moderate to moderately low permeability. However, in certain cases where substantial flowing artesian conditions were encountered, artesian shut-in and discharge testing was performed.

Upon penetrating a zone targeted for testing, drilling was temporarily discontinued, and the hole was flushed with clean water to remove cuttings and drill fluids. The drilling rods were then retracted to expose the test interval and to position the drill bit above the top of the interval. The bottom of the core hole was the bottom of the test interval. The SWiPS was deployed by lowering the instrument down the drill rods where it locked into the core barrel. The SWiPS system contains a rubber element that extends through the drill bit into the open core hole. This rubber packer is inflated with water using the drill rig's water pump routed through a flow skid. When fully inflated, the packer seals against the wall of the core hole, isolating the test interval.

The flow skid consists of a totalizing flow meter to measure discharge into the test interval, a manual diversion valve to control the injection pressure, and monitoring pressure gauges. Packer inflation is maintained by means of a one-way valve. A mandrel extending through the center of the packer element provides a connection between the drill rods and the formation test interval. The mandrel is initially closed during the inflation and shut-in stages.

After installing and inflating the packer, the shut-in test interval water pressure is allowed to equilibrate. Ideally, water pressures would be allowed to fully equilibrate to static conditions before and after every test. However, full equilibration to static conditions is rarely feasible in advancing core holes where drill-rig time is at a premium. During the Graphite Creek programs, packer tests generally included about 15 to 30 minutes of pre-test equilibration time to approach stabilization, depending on the judgement of the on-site hydrogeologist. This provided a baseline potentiometric pressure to determine the "water level" and the later test injection pressure. When the equilibration time is complete, the drill rod water pressure is increased until it exceeds the engineered strength of the packer shear pin. The pin intentionally is sheared to open a valve that allows water to be injected through the packer into the test interval.

Stepped Pressure Injection Testing

Many packer tests conducted prior to the 2023 program consisted of Stepped Pressure Injection (SPI) Tests. The SPI test was initiated after inflating the packer and breaking the shear pin. SPI tests work best in moderate to moderately low permeability intervals since they require that the drill rig water pump be able to discharge into the test interval at a greater rate than water can flow out into the formation, which results in a buildup in water pressure. An SPI test requires recording flow rates into the test interval at two or three increasing pressure steps, and then stepping back down to the starting pressure in one or two additional steps.

Water injection pressure was maintained at each step by adjusting the flow rate until it stabilized—typically ten to fifteen minutes. The injection pressure on the flow skid pressure gage was monitored and adjusted, and downhole injection pressures were measured by the data recording pressure transducer housed in the packer.

Figure 9-1 illustrates a typical hydrograph recorded from the down-hole pressure transducer during packer insertion, inflation and pre-test equilibration, shear pin break, SPI test, and packer recovery.

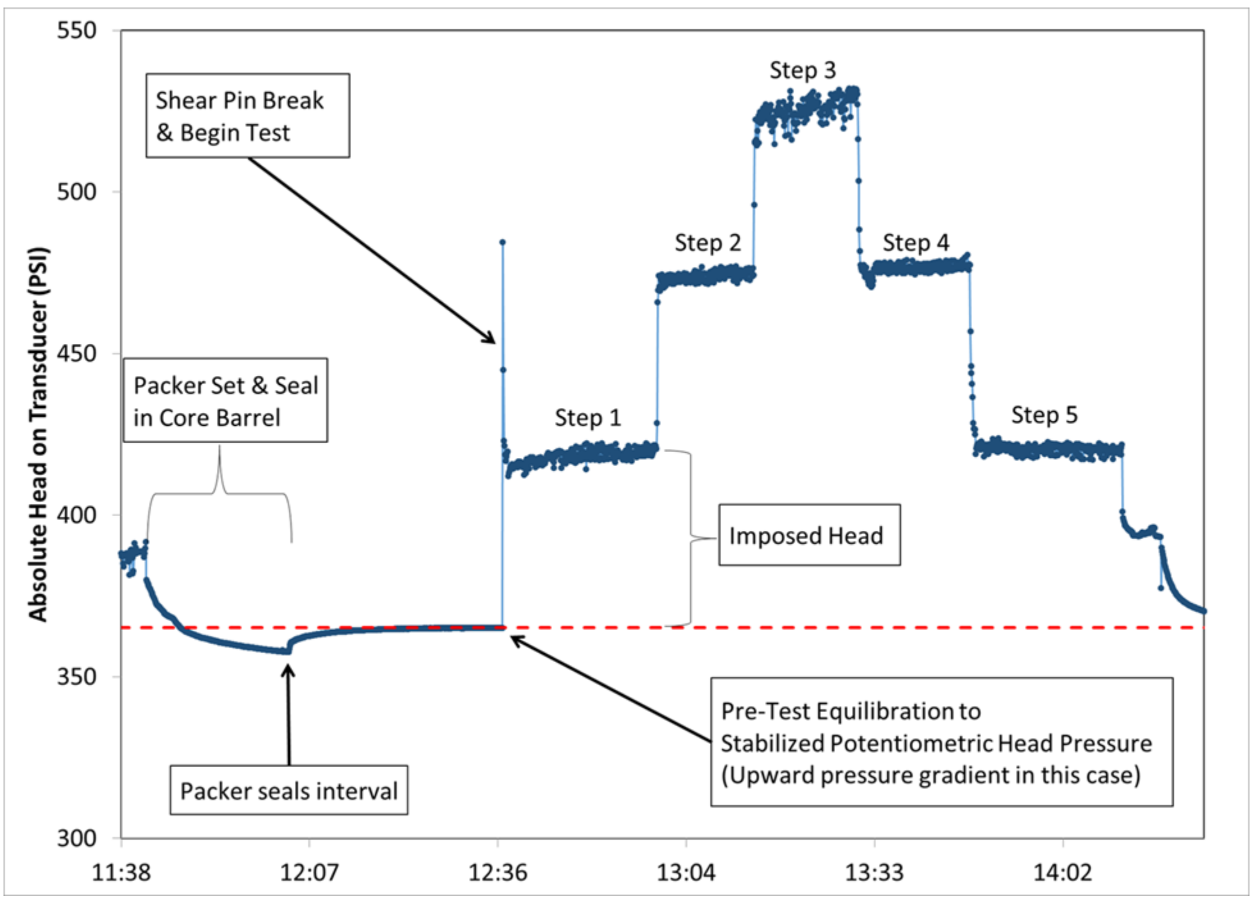


Figure 9-1. Typical packer isolated Stepped Pressure Injection Test Hydrograph

Constant Head Injection Testing

Most packer testing on the Graphite Creek project consisted of Constant Head Pressure Injection (CHI) tests. The CHI test was initiated after inflating the packer and breaking the shear pin. CHI tests are functionally identical to SPI tests except that the injected water pressure is maintained at a single level for the duration of injection. A CHI test requires recording flow rates into the test interval at a constant pressure until the flow rate stabilizes.

Water injection pressure was maintained by adjusting the flow rate until it stabilized—typically ten to thirty minutes. The injection pressure on the flow skid pressure gauge was monitored and adjusted, and downhole injection pressures were measured by the data recording pressure transducer housed in the packer.

Artesian Flow and Shut-in Testing

In instances where Tundra performed artesian shut-in and discharge testing, the packer was inflated, and the shear pin was broken as previously described. Following breaking of the shear pin, the test interval was allowed to discharge flowing artesian water without restriction. The flow rate was periodically measured with the flow skid until the flow rate had stabilized; typically, 30 to 60 minutes. Then, the test interval was shut-in using the flow skid valves to initiate the water pressure recovery. Pressure recovery data was recorded with the transducer housed in the packer. Recovery was allowed to continue for a time equivalent to or longer than the discharge time, depending on the judgement of the onsite hydrogeologist.

Figure 9-2 illustrates a typical hydrograph recorded from the down-hole pressure transducer during packer insertion, inflation and pre-test equilibration, shear pin break, artesian test, CHI test, and packer recovery.

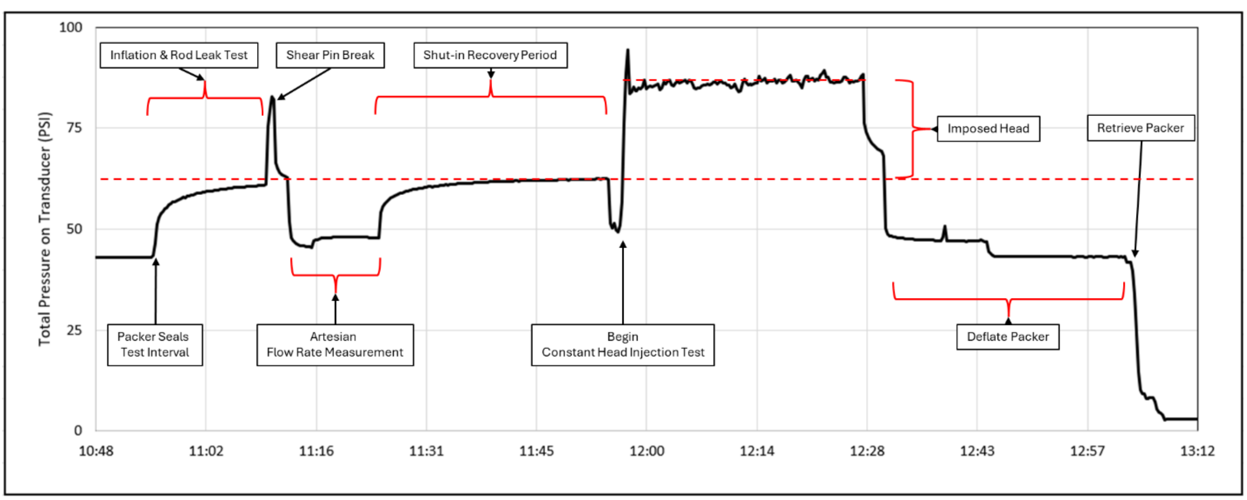


Figure 9-2. Typical packer-isolated Artesian Flow and Shut-in and CHI Hydraulic Test Hydrograph

9.2.2 Well Testing

In certain locations, bedrock wells were tested in lieu of packer testing during drilling. This was conducted by a variety of methods, depending on the situation. These methods included artesian flow shut-in, pumping, airlifting, and slug testing.

Artesian Flow and Shut-in Test

21GC068 is a flowing artesian well where no packer testing was conducted. Rather, the well was tested post-installation using a similar approach to packer isolated artesian flow and shut-in testing previously described. The artesian flow rate was measured and recorded. Then, a valve installed on the well head was closed to stop the flow and allow the water pressure to recover. A data recording pressure transducer was installed in the well to record the water pressure recovery curve.

Pumping Test

A Grundfos submersible pump was used for testing the well installed in 24GCT029, as no packer tests were conducted during drilling. The pump was installed below the water table and discharge water was directed away from the collar. The pumping rate was determined periodically by timing the filling of a 5-gallon bucket. A temporary data recording pressure transducer was installed below the water table to measure the drawdown and recovery of the groundwater.

Groundwater was pumped for two hours until drawdown and discharge rates stabilized. When the pump was stopped, the water level was allowed to recover to the pre-test level prior to removing the pump and transducer. The water level was allowed to recover over 4.5 hours after the cessation of pumping.

Airlift Test

The 21GC066 well was tested using airlifting methods because a submersible pump was not available. Airlifting provides a means to effectively pump water from a well when a submersible pump is not available or practical (i.e. the water level is too deep).

Airlift testing was accomplished by first fitting the monitoring well PVC with a diverter head, and then inserting an airline (3/4-inch PEX pipe) through the diverter head and into the well. A data recording pressure transducer was affixed to the end of the air line. The airline was connected to a high-pressure air hose from the compressor. A discharge pipe was attached to the diverter head.

After setup, the airlift could then proceed by injecting air at about 100 cubic feet per minute (cfm) down the airline. Upon exiting the airline, air bubbles rise in the water column and entrain water as they move up the well casing and out of the discharge pipe. In this way, water is “pumped” out of the test interval. The volume of water being pumped was measured by directing the air/water discharge into a 55-gallon drum while recording the elapsed time.

Airlifting continued for an hour until the discharge reached a constant rate. The air pressure was turned off to end pumping and a recovery period initiated. The recovery data was collected after the well was left to recover for about three hours.

Slug Testing

Mechanical slug tests were conducted in 23GCT016 and 23GCT018 by inserting an object of known volume below the water table and monitoring the water level response. The mechanical slugs were improvised by filling hand bailers with a known volume of water. A transducer was placed several meters below the water table and programmed to take readings every second beginning at a predetermined time. Before starting the test, a manual water level confirmed that the water level had recovered after installing the transducer. When the transducer had started, the bailer was quickly lowered into the water and held stationary by securing the support cable to the well collar. This produced a falling head test as the water levels fell to their pretest level. After about 15 minutes, the slug was removed from the well.

9.3 Results and Analysis

Tundra conducted 45 packer isolated tests, one artesian flow and shut-in test, one pumping test, one airlift, and two slug tests from 49 intervals of bedrock. Figure 9-3 presents the test locations. The well test data were analyzed using industry-standard mathematical solutions. The comprehensive test summary is presented in Appendix C and individual analyses are in Appendix D. Where multiple analytical methods were used, the resulting hydraulic parameters were evaluated to determine the most valid estimate for each test interval. The evaluation included a determination of:

- The appropriate analytical solution for test analysis
- Factors that may have impacted the test results
- A confidence ranking system to compare analytical results.

9.3.1 Analytical Solutions

For constant head injection tests, the stabilized flow rate and induced injection pressure from each step were used to calculate the hydraulic conductivity (K) and transmissivity (T) using a derivation of the Thiem method (Kruseman and de Ridder, 1990). Hydraulic conductivity and transmissivity terms are used to describe how readily water can move through the rock. Experience has demonstrated that the injection tests are most effectively analyzed using spreadsheet methods, rather than with purpose-built software packages (such as AQTESOLV).

The pumping and airlift tests and artesian flow shut-in tests were analyzed with the Theis (Theis, 1935), Cooper-Jacob (Cooper and Jacob, 1946), Theis Residual Drawdown Method (Theis, 1935). Slug tests were analyzed using the Bouwer and Rice method (Bouwer and Rice, 1976). These test data were analyzed using AQTESOLV software.

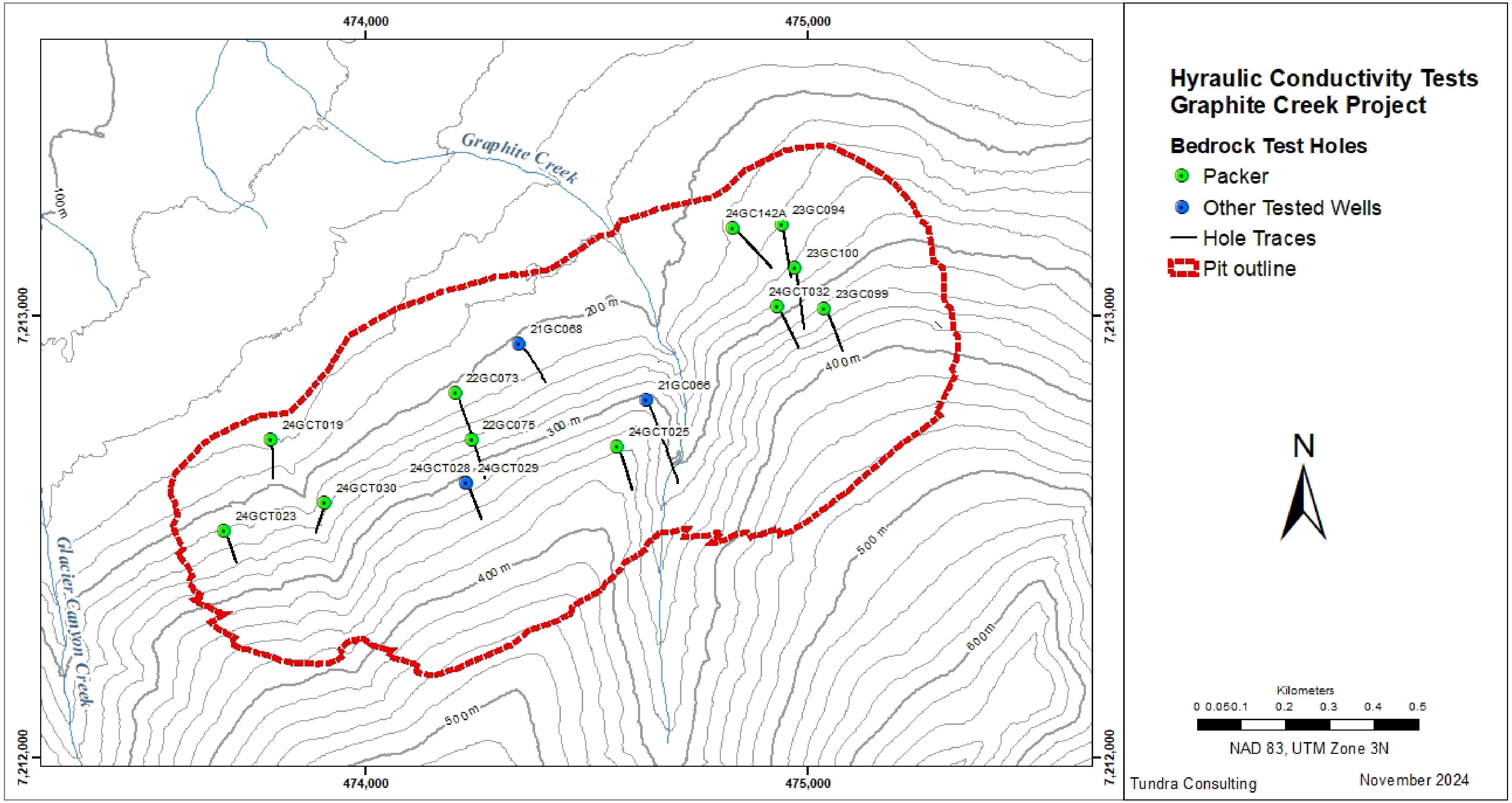


Figure 9-3. Bedrock hydraulic test holes

9.3.2 Test Hole Analyses

The hydraulic test results for each of the bedrock holes are summarized in Table 9-1 and Table 9-2. Where multiple tests were conducted in a single borehole, the hydraulic conductivity was plotted along with the water level to determine changes with depth (Appendix F). The plots show the water level for each test interval (left axis) and hydraulic conductivity (K; right axis) versus depth. The water level is relative to the collar (0 m). Water levels above the collar elevation are reported with a negative value and would be flowing artesian if a well were installed. The horizontal bars at each data point show the width of the test interval. Key findings are:

- There are two distinct bedrock hydrogeologic units: Shallow Bedrock and Deep Bedrock;
- Both units have high variability in K values; and,
- Groundwater flow in the bedrock is controlled by faults, fractures, and joints.

Table 9-1. Shallow bedrock hydraulic test summary

Hole ID	Test No.	Test Interval (mbgs-ah)*		DTW* (m-ah)	K* (m/day)	Hydro-geologic Unit
		From	To			
22GC073	1	19.58	27.43	-13.1	2.92E-01	Shallow Rock
22GC073	2	28.73	47.24	-13.9	9.60E-02	Shallow Rock
22GC075	1	15.93	32.31	-16.6	5.80E-03	Shallow Rock
22GC075	2	31.16	60.29	-16.3	1.49E-01	Shallow Rock
23GC099	1	29.95	56.08	-10.6	1.60E-01	Shallow Rock
23GC100	1	28.42	56.39	-0.4	7.17E-02	Shallow Rock
23GCT016	1	19.51	40.84	26.5	4.62E-02	Shallow Rock
23GCT018	1	19.51	40.84	24.2	1.50E-03	Shallow Rock
24GCT019	1	35.74	58.21	-20.4	1.04E-01	Shallow Rock
24GCT023	1	39.39	62.48	-10.8	1.41E-01	Shallow Rock
24GCT028	1	23.24	55.02	-3.1	2.49E-01	Shallow Rock
24GCT029	1	21.18	41.00	9.6	2.50E+00	Shallow Rock
24GCT030	1	30.25	47.24	-7.6	3.66E-02	Shallow Rock
24GCT030	2	48.54	77.72	-7.8	4.23E-02	Shallow Rock
24GCT032	1	21.41	35.36	-11.2	3.41E+00	Shallow Rock

**mbgs-ah: meters below ground surface along hole (accounts for inclination)*
**DTW: Depth to Water. Negative values are above ground surface (flowing artesian)*
**K: Hydraulic Conductivity*

Table 9-2. Deep bedrock hydraulic test summary

Hole ID	Test No.	Test Interval (mbgs-ah)*		DTW* (m-ah)	K* (m/day)	Hydro-geologic Unit
		From	To			
21GC066	1	303.26	306.31	37.9	2.22E-01	Deep Rock
21GC068	1	145.53	151.63	38.4	4.19E-02	Deep Rock
22GC073	3	50.06	91.34	-15.8	8.75E-03	Deep Rock
22GC073	4	92.73	113.68	-16.9	1.32E-02	Deep Rock
22GC073	5	114.07	151.78	-41.7	5.80E-03	Deep Rock
22GC075	3	61.64	90.83	-28.8	7.32E-03	Deep Rock
22GC075	4	92.12	116.73	-18.1	1.90E-03	Deep Rock
22GC075	5	134.79	148.74	-23.0	3.85E-01	Deep Rock
23GC094	1	83.89	96.01	9.7	2.70E-03	Deep Rock
23GC094	2	97.30	129.53	3.4	1.10E-04	Deep Rock
23GC094	3	127.78	173.73	-0.4	5.11E-03	Deep Rock
23GC094	4	173.50	186.22	-3.7	1.45E-03	Deep Rock
23GC099	2	112.24	162.76	4.0	2.41E-02	Deep Rock
23GC100	2	57.68	96.01	-4.9	2.17E-02	Deep Rock
23GC100	3	97.30	147.82	-13.4	1.71E-03	Deep Rock
23GC100	4	149.12	205.73	-13.9	2.00E-03	Deep Rock
24GC142A	1	97.31	117.35	34.3	9.22E-04	Deep Rock
24GC142A	2	118.64	153.92	-8.6	8.61E-04	Deep Rock
24GC142A	3	155.22	194.77	-9.2	5.87E-05	Deep Rock
24GCT019	2	64.39	81.38	-13.9	3.03E-03	Deep Rock
24GCT019	3	85.72	111.70	-4.0	5.20E-03	Deep Rock
24GCT019	4	119.25	145.08	-6.5	1.00E-05	Deep Rock
24GCT023	2	63.78	120.09	-12.6	1.04E-02	Deep Rock
24GCT025	2	115.28	157.88	92.7	3.74E-02	Deep Rock
24GCT028	3	90.30	119.48	54.1	8.75E-03	Deep Rock
24GCT028	4	117.73	143.87	-1.6	5.02E-03	Deep Rock
24GCT030	3	79.02	120.40	13.5	1.65E-01	Deep Rock
24GCT032	2	36.65	65.84	-19.0	1.77E-02	Deep Rock
24GCT032	3	67.13	117.65	-18.8	1.06E-02	Deep Rock
24GCT032	4	118.95	164.90	-6.5	6.69E-03	Deep Rock

**mbgs-ah: meters below ground surface along hole (accounts for inclination)*
**DTW: Depth to Water. Negative values are above ground surface (flowing artesian)*
**K: Hydraulic Conductivity*

9.4 Hydraulic Parameter Analysis and Unit Definition

2024 is the fourth year that hydraulic testing has been performed. Previous results are presented in Tundra (2020) and Tundra (2022). We now have tested 49 bedrock intervals (Appendix C). This population of K values has been examined along with the geologic observations to define the bedrock hydrogeologic units and the hydraulic conductivity of each unit.

9.4.1 Methods

Commonly, the test from one interval was analyzed using multiple methods (e.g., Theis, Thiem, Cooper-Jacob). The results were rated by the analyst as poor, fair, or good based on the type-curve fit and the mathematical assumptions for the analysis type. The analyst then determined which test for a given interval should be used for further analysis. If more than one test was kept, the median[2] value of the tests was used.

Occasionally, one interval was tested by multiple methods (e.g., slug test, airlift test). The appropriate analytical results were combined first and then these results for each test method were combined to arrive at the final K for that interval.

9.4.2 Data Considerations

Two intervals in 2024 had no detectable K and were treated as below detection results. A value of 1×10^{-5} m/day was assigned to these intervals. The below detection value was chosen based on extending the data population trend shown in Figure 9-4.

Two intervals in 2024 were judged to be in permafrost based on location, subsequent temperature data, and very low K values. These intervals were excluded from further analysis. Two other test intervals were not used because they substantially overlapped other test intervals.

9.4.3 Hydrogeologic Units

Table 9-1 and Table 9-2 show the final K values for all intervals tested to date. These values are shown in a probability plot in Figure 9-4[3] (note the Y-axis is in log units). The data approximates a straight line and therefore is likely lognormally distributed. There are no obvious subpopulations.

Analysis of geotechnical parameters (fracture density, RQD, recovery) was performed after the 2023 season (Appendix G). It was found that the bedrock could be divided into three units – deep bedrock (less fractured, higher RQD and recovery), bedrock shallower than 60 m (more fractured, lower RQD and recovery), and a fault damage zone adjacent to the Kigluaik Fault (more fractured, lower RQD and recovery). Plots of the deep and shallow bedrock are shown Figure 9-5 and Figure 9-6.

The statistical analysis of hydrogeologic parameters found the damage zone to be indistinguishable from the shallow bedrock (shown in Figure 9-7) This is primarily due to a lack of data in the potential damage

[2] The median is used throughout the analysis because it is not known if the population is normally distributed, the basic assumption for using the mean. However, for just two values, the median and mean are the same. For similar reasons, percentiles are used to express the population distribution. This approach avoids the computational challenges of using the standard deviation to describe the population distribution of lognormal distributed populations when the distribution is known or suspected to be a log distribution.

[3] The X-axis in the probability plots is a probability scale, therefore a normal distribution plots as a straight line from lower left to upper right.

zone at depth (Figure 9-7). It is unknown if additional tests in the damage zone below the shallow bedrock zone would have similar or different K values from that of the deep bedrock.

Review of the data suggests that the hydraulic conductivity of the rock east of Graphite Creek may be different than that west of the creek (Figure 9-8). An analysis of variance (ANOVA) showed that the two potential subpopulations are not significantly different at the 90% confidence level and the potential subdivision was no longer considered.

Based on this analysis we have defined two hydrogeologic units: shallow bedrock and deep bedrock. The hydraulic conductivity of the units is shown in Table 9-3.

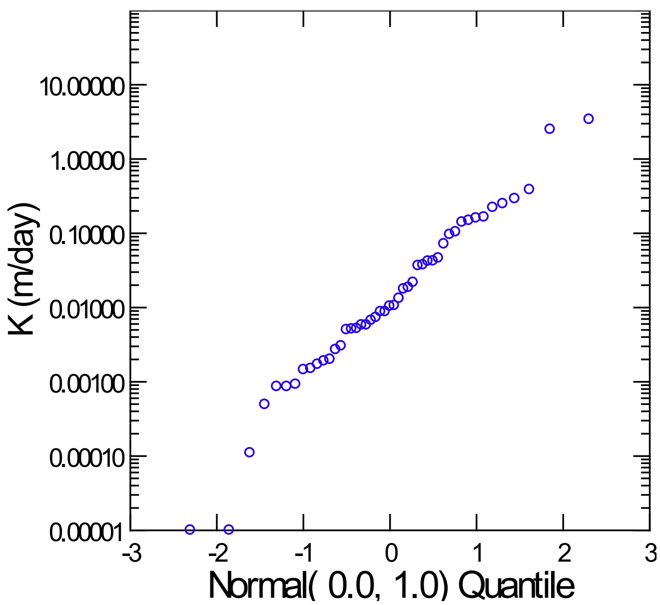


Figure 9-4. Probability showing distribution of bedrock hydraulic conductivity test results

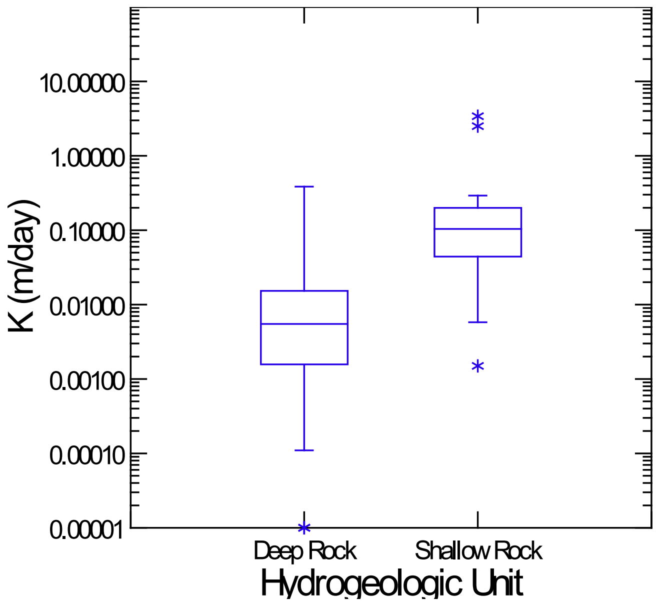


Figure 9-5. Box plots showing hydraulic conductivity of bedrock units

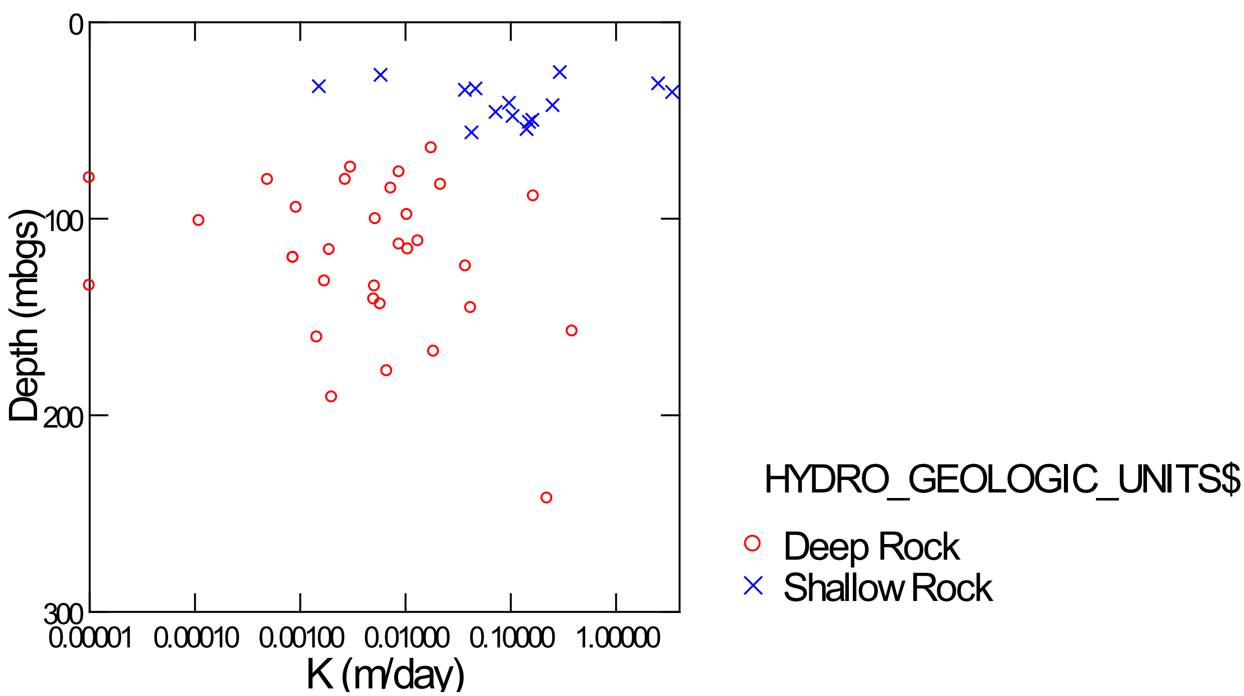


Figure 9-6. Hydraulic conductivity versus depth showing deep and shallow unit test results

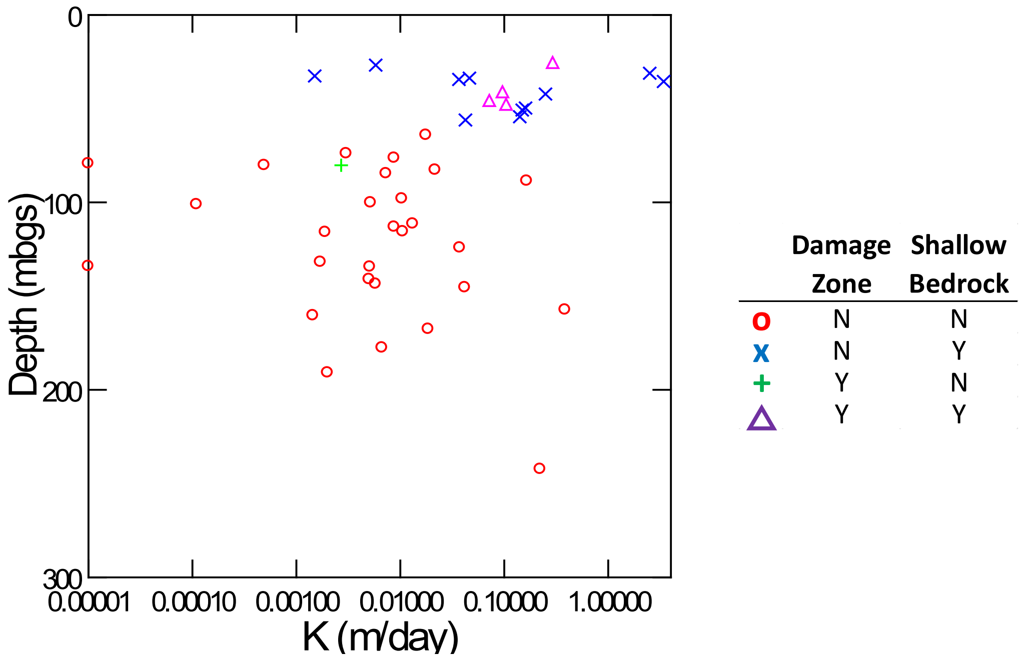


Figure 9-7. Hydraulic conductivity versus depth showing deep, shallow, and damage zone tests. Damage zone was determined to not be significantly different.

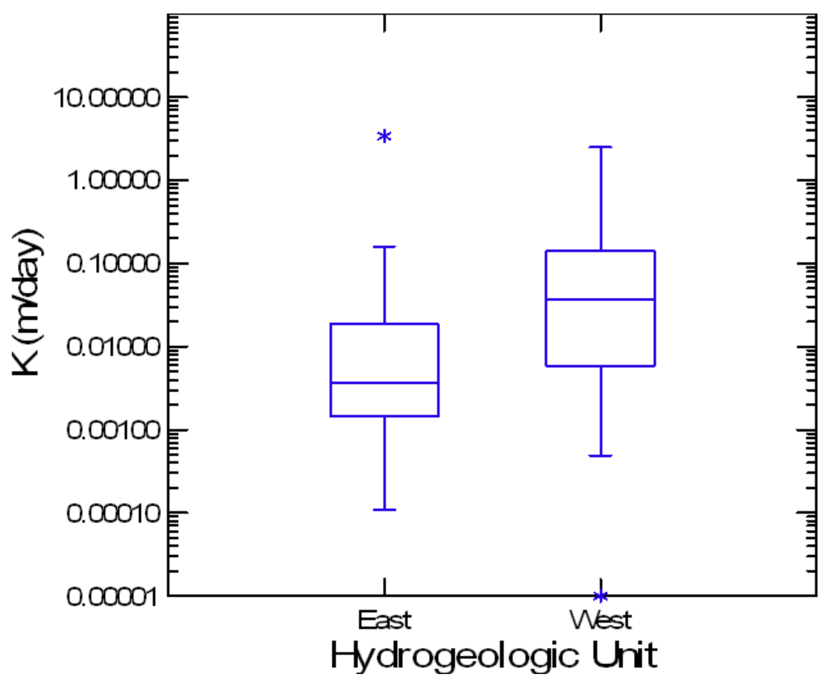


Figure 9-8. Box plots showing hydraulic conductivity of potential east-west units that were determined to not be significantly different

Table 9-3. Hydraulic conductivity of bedrock units

	K (m/day)	
	Deep Rock	Shallow Rock
Count	30	15
Min	1.00E-05	1.50E-03
Percentile 5	6.50E-05	4.51E-03
Percentile 25	1.65E-03	4.43E-02
Median	**5.50E-03**	**1.04E-01**
Percentile 75	1.43E-02	2.05E-01
Percentile 95	1.91E-01	2.77E+00
Max	3.85E-01	3.41E+00

9.4.4 Discussion

Both units have a large range of K values (high variability). We think groundwater flow in the bedrock at this site is controlled by secondary porosity (faults, fractures, joints, etc.) and there is virtually no primary porosity and permeability. Therefore, the K of a given interval is likely controlled by the fracture density and characteristics of those fractures. Future detailed mapping and structural analysis may define cross-faults which could be significant water bearing structures.

9.5 Summary

Hydraulic testing was conducted in 17 bedrock core holes and wells to advance the conceptual model, guide development of the numerical groundwater model, and support a feasibility study. The objective of testing was to measure differences in hydraulic parameters with depth and across structural and lithologic features.

Statistical analyses indicate the presence of two distinct bedrock hydrogeologic units; Shallow Bedrock and Deep Bedrock. A discontinuous permafrost zone may occur across the contact between these units. The shallow bedrock extends to approximately 60 m and exhibits elevated hydraulic conductivity compared to the Deep Bedrock. This is likely due to elevated fracture frequency and depressed RQD. The hydraulic conductivity of the Shallow Bedrock ranges from a low of 1.50×10^{-3} m/day to a high of 3.41×10^{0} m/day. Deep Bedrock begins at approximately 60 m and extends to great depth. Hydraulic conductivity of the Deep Bedrock ranges from effectively impermeable in unfractured bedrock to a high of 3.85×10^{-1} m/day. These values are consistent with values of unfractured to moderately fractured igneous and metamorphic rock from literature (Figure 9-9).

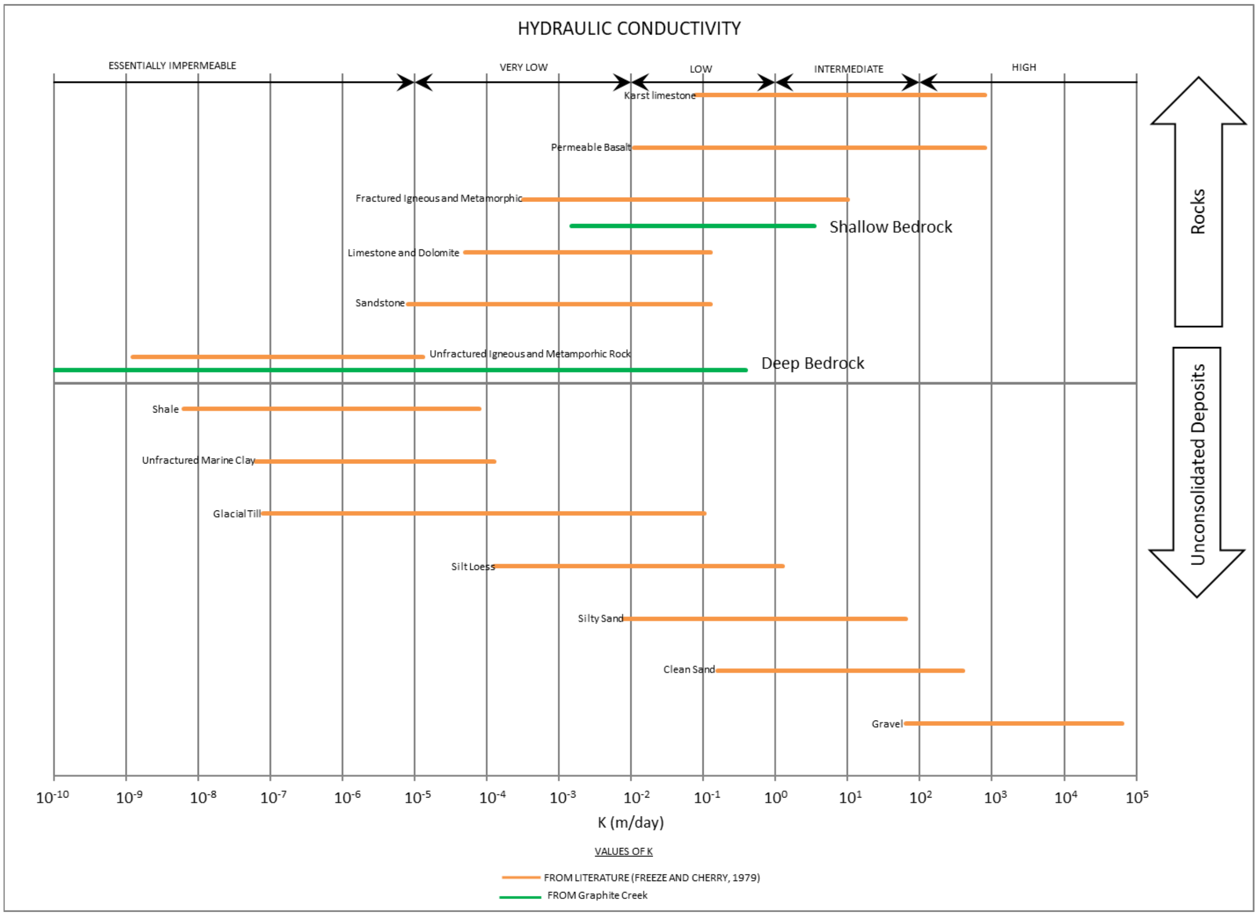


Figure 9-9. Bedrock hydraulic conductivity compared with typical values from literature (Freeze and Cherry, 1979)

10 Hydrogeologic Testing – Sediments

Tundra conducted hydraulic testing of sediments near the anticipated waste management facility (WMF) using wells. In the 2021 program, Tundra installed and tested the camp water supply well. Tundra installed and tested two sets of nested wells in 2022 and three wells in sediments north of the pit area in 2024 to collect baseline water level and water quality data, and to conduct tests for hydraulic parameters (holes planned for wells in 2023 were plugged and abandoned due to technical considerations). In 2024, open hole tests were attempted and Tundra found that tests could only be conducted in completed wells as the ground conditions were too unstable for open hole testing approaches. The test analyses are presented in Appendices C and D.

10.1 Drilling Programs

Sediments were drilled using diamond core and sonic drilling methods through the 2022 program. Drilling in the 2023 and 2024 programs were accomplished using diamond core drilling rigs.

Sonic Drilling

In the 2021 and 2022 sediment drilling programs, Mud Bay Drilling out of Surrey, British Columbia, drilled the camp water supply well and two holes for nested well installations (Table 6-1, Figure 10-1). In addition, Mud Bay Drilling drilled numerous geotechnical holes for Knight Piésold Consulting which were not hydraulically tested. The drilling and testing sequence was generally as follows:

- Conductor casing—Conductor casing was generally not used for sonic drilling.
- Drilling—The hole was drilled through sediments to the target depth using sonic drilling methods whereby the entire drill rod string is tripped out after every run to retrieve the core.
- Completion—The drill rods were removed from the hole and wells were installed in the open hole as described in Section 6.4.2.
- Testing—Tundra completed hydraulic testing of the sediments in the completed wells using a combination of pumping and slug tests.

Diamond Core Drilling

Boart Longyear of Salt Lake City, Utah, drilled one HQ diameter core hole in the 2019 sediment drilling program. Major Drilling out of Salt Lake City, Utah, drilled the two HQ-diameter and five PQ-diameter core holes in the 2023 and 2024 sediment drilling programs. Tundra installed and tested 2-inch (nominal) diameter PVC wells in three of the holes (Figure 10-1). Other installations included 1-inch (nominal) diameter standpipes for downhole temperature cables (Figure 6-1, Table 6-2), which were not hydraulically tested. The drilling and testing sequence was as follows:

- Conductor casing—The conductor casing was installed to stabilize the top of the core hole. The hole was advanced using PQ tools until the sediments were judged to be suitably stable. Then PWT or HWT casing with a casing shoe was reamed to the bottom of the hole. The casing was generally cemented in place.
- Drilling—Either a PQ or HQ core hole was advanced through the conductor casing. Some locations utilized an under-reaming bit to advance through particularly unstable ground conditions. Drilling fluid typically consisted of water, bentonite gel, and polymer additives. Barr conducted Standard

Penetration Testing (SPT) periodically on many of the holes. The core or chips were retrieved by Barr staff and logged for geologic and geotechnical parameters.

- Completion—The completed core holes had either a 2-inch (nominal) well or 1-inch (nominal) standpipe installed (Table 6-1).
- Testing—Tundra found that it was not feasible to hydraulically test the holes as they were advanced. The unconsolidated nature of the sediments resulted in hole collapse upon the introduction of fresh water. Pumping tests were conducted in completed wells by means of a submersible pump or airlifting.

10.2 Test Methods

Tundra tested the sediments using a combination of pumping, airlifting, and slug tests from wells.

Pumping and Airlift Testing

Tundra tested several of the wells using Grundfos submersible pumps and airlifting in the manner described in Section 9.2.2

Mechanical and Pneumatic Slug Testing

Mechanical and pneumatic slug tests were conducted in many of the monitoring wells. Both test types produced effectively equivalent data by displacing a volume of well water and monitoring the water-level recovery.

Mechanical slug tests were conducted by inserting and/or removing an object of known volume below the water table. The mechanical slugs were Solid H(0) Slugs ® by Midwest GeoSciences Group manufactured for use in two-inch diameter wells. The transducer was placed several meters below the water table and programmed to take readings every second beginning at a predetermined time. Before starting the test, a manual water level confirmed that the water level had recovered after installing the transducer. When the transducer had started, the solid slug was quickly lowered into the water and held stationary by securing the support cable to the well collar. This produced a falling head test (“FHT”) as the water levels fell to their pretest level. After about 15 minutes, the slug was abruptly removed from the well to initiate the rising-head test (“RHT”).

Pneumatic slug tests were conducted by sealing the well collar, depressing the water table with compressed air, then rapidly releasing the air pressure to allow the water to recover. The tests were conducted using the Pneumatic Hi-K Slug ® equipment by Midwest GeoSciences Group. A pressure transducer was suspended in the screen interval of the well and set to record measurements at one-second intervals. A manual water level measured several minutes after installing the transducer ensured that the water level had recovered. A manifold sealed the well collar and directed air into the well until it reached a predetermined pressure. The pressure forced the water as deep as possible without pushing it into the screened interval, where air would escape into the formation. Ideally, the air pressure would be held constant for about 20 minutes to allow the water level to fully equilibrate. In practice, it was often not feasible to hold the pressure for that long. After the well had equilibrated, a valve on the manifold was opened to quickly release pressure. The transducer recorded the water-level equilibration.

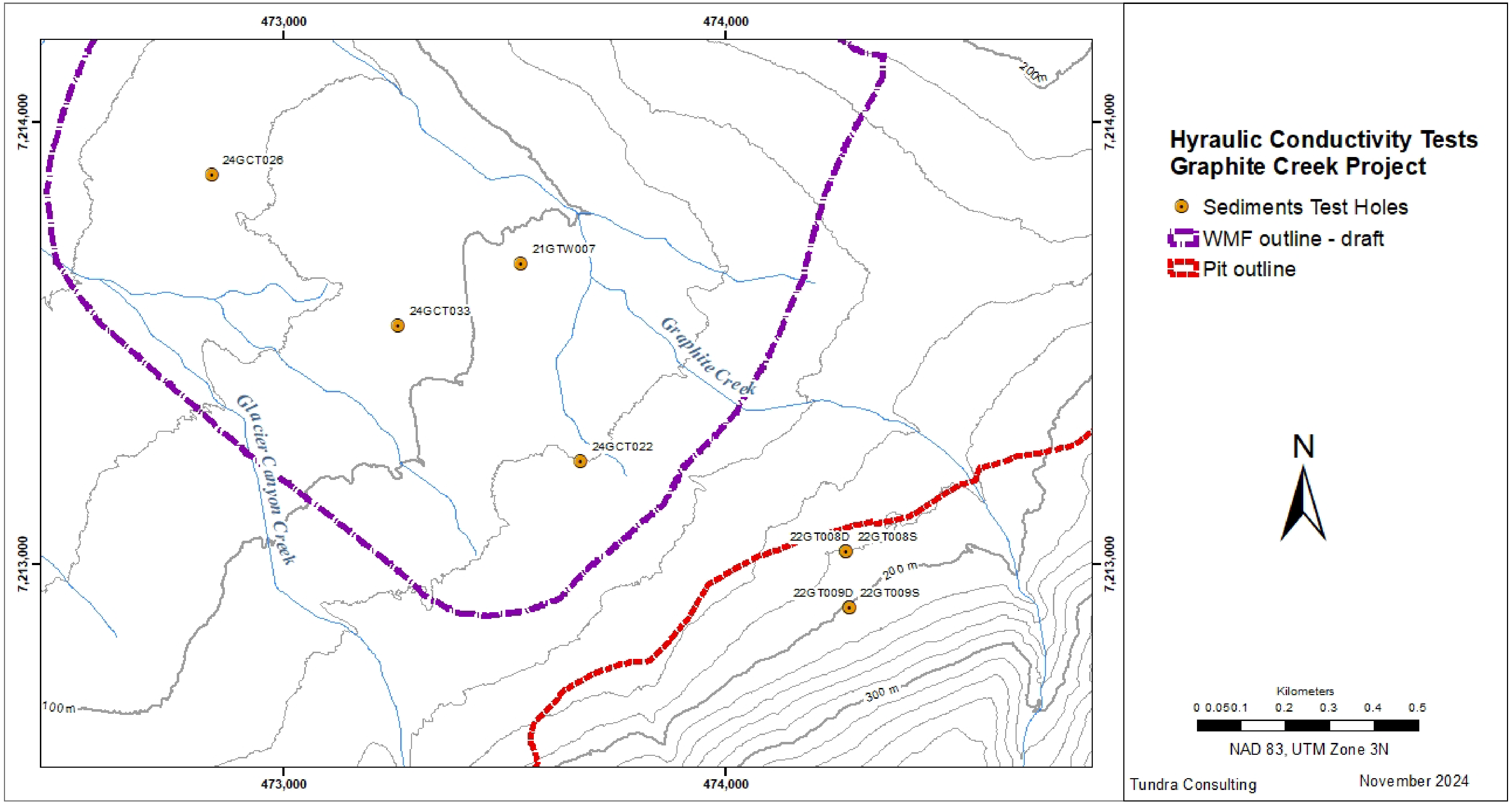


Figure 10-1. Sediment hydraulic tests holes

10.3 Results and Analyses

Tundra conducted 32 hydraulic tests across eight sedimentary intervals. Two additional tests were attempted in an open borehole (24GCT022) but were not analyzed because the borehole collapsed during testing. Figure 10-1 presents the test locations. The comprehensive test summary is presented in Appendix C and individual analyses are in Appendix D.

The well test data were analyzed using industry-standard mathematical solutions. The resulting hydraulic parameters were evaluated to determine the most valid estimate for each test interval. The evaluation included a determination of:

- The appropriate analytical solution for test analysis
- Factors that may have impacted the test results
- A confidence ranking system to compare analytical results.

10.3.1 Analytical Solutions

When there were multiple valid analytical solutions for a test, several were used to develop a suite of hydraulic conductivity estimates. The replicate estimates allow for greater confidence in the test results by facilitating a comparison for trends and outliers. Slug tests were analyzed using the Bouwer and Rice method (Bouwer and Rice, 1976) and Hvorslev method (Hvorslev, 1951). The pumping and airlift tests were analyzed with the Theis (Theis, 1935), Cooper-Jacob (Cooper and Jacob, 1946), or Theis Residual Drawdown Method (Theis, 1935). Test data were analyzed using AQTESOLV software. Individual test analyses can be found in Appendix D.

The derivative of the pumping test drawdown curve was plotted to identify appropriate intervals to analyze. The derivative analysis is useful for curve matching because it reveals intervals of the drawdown curve where infinite-acting radial flow (IARF) conditions are present.

10.3.2 Test Hole Analyses

The hydraulic test analyses of sediments for each of the wells are summarized in Table 10-1. The detailed test summary is presented in Appendix C and individual analyses are in Appendix D. Key findings are:

- Two distinct populations of hydraulic conductivity corresponding to Fluvial Sediments and Till have been identified.
- Half of the sedimentary units identified on the project site have not been tested for hydraulic parameters and their values have been assumed. Two other units only have a single test each.

Table 10-1. Hydraulic test of sediments summary

Hole ID	Test No.	Test Interval (mbgs-ah)*		DTW* (m-ah)	K* (m/day)	Hydro-geologic Unit
		From	To			
21GTW007	1	48.77	76.20	44.3	3.28E+01	Overcompacted Fluvial
22GT008D	1	68.88	78.02	66.7	4.20E-03	Overcompacted Glacio-fluvial - Clayey Unit
22GT008S	1	36.88	46.02	34.9	3.40E-03	Till
22GT009D	1	41.15	44.19	40.4	4.08E-03	Till
22GT009S	1	30.48	33.53	31.3	5.98E-03	Till
24GCT022	3	135.58	144.73	74.9	3.80E+00	Overcompacted Glacio-fluvial
24GCT026	1	153.43	162.67	45.4	4.10E-01	Overcompacted Fluvial
24GCT033	1	137.50	146.50	15.4	1.29E+00	Overcompacted Fluvial

*mbgs-ah: meters below ground surface along hole (accounts for inclination)

*DTW: Depth to Water. Negative values are above ground surface (flowing artesian)

*K: Hydraulic Conductivity

10.4 Hydraulic Parameter Analysis and Unit Definition

The hydraulic test results were analyzed as a population in conjunction with observed geologic properties to define hydrogeologic units. This is the first year where there was sufficient data for this type of analysis.

10.4.1 Methods

The methods are the same as used in the bedrock analysis (Section 9.4.1).

10.4.2 Data Considerations

The K results for all intervals were used.

10.4.3 Hydrogeologic Units

Figure 10-2 shows that the distribution of K values for the sediments is roughly lognormal, but with two distinct populations. These populations correspond to units initially logged as fluvial sediment and till (Figure 10-3). Subsequent review of the logs and three-dimensional modeling of the geology subdivided these units (Section 4.3, Table 4-1). K testing has not been performed in about half of the units and others only have a single test. Literature values (Freeze and Cherry 1979) and professional judgement were used to estimate the K for the units that were not tested. (Figure 10-4, Table 10-2)

10.4.4 Discussion

The single test of the OCGFC unit was conducted near the contact with till. The resulting K appear unreasonably low for a fluvial unit. The test results may be influenced by the nearby till which may have restricted water flow to the test zone.

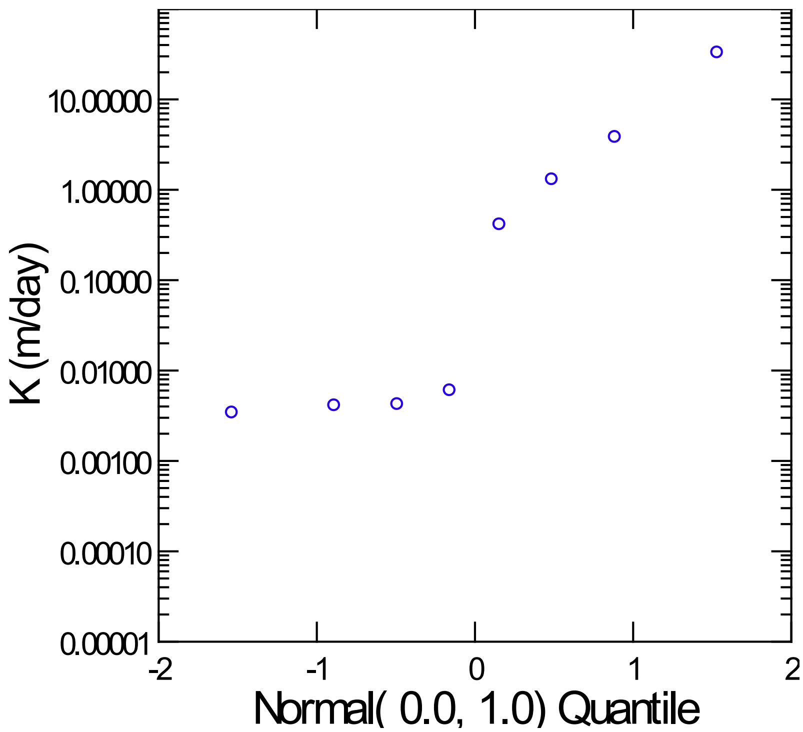


Figure 10-2. Probability plot showing hydraulic conductivity from tests in sediments

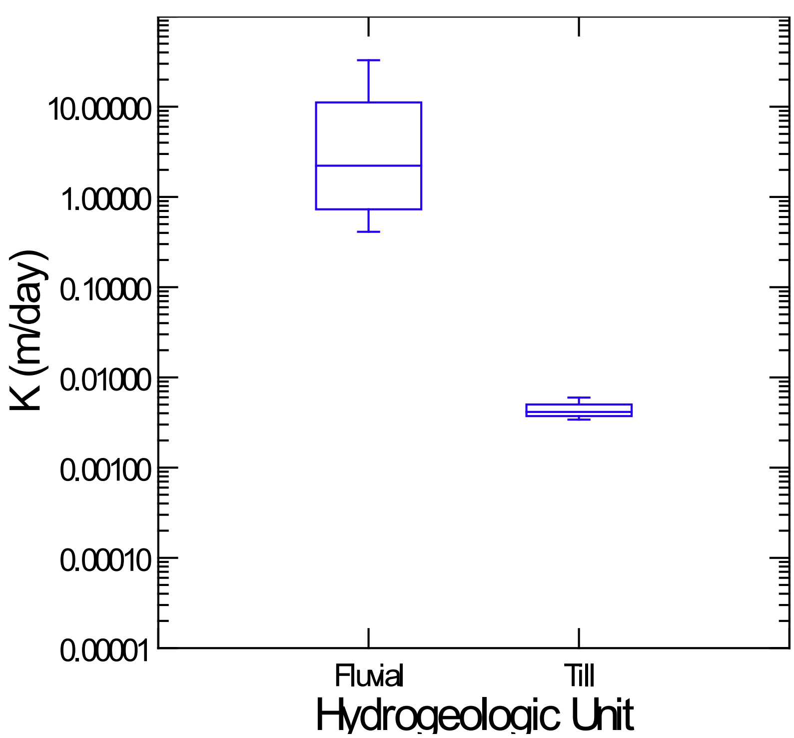


Figure 10-3. Box plots of hydraulic conductivity of preliminary sedimentary units

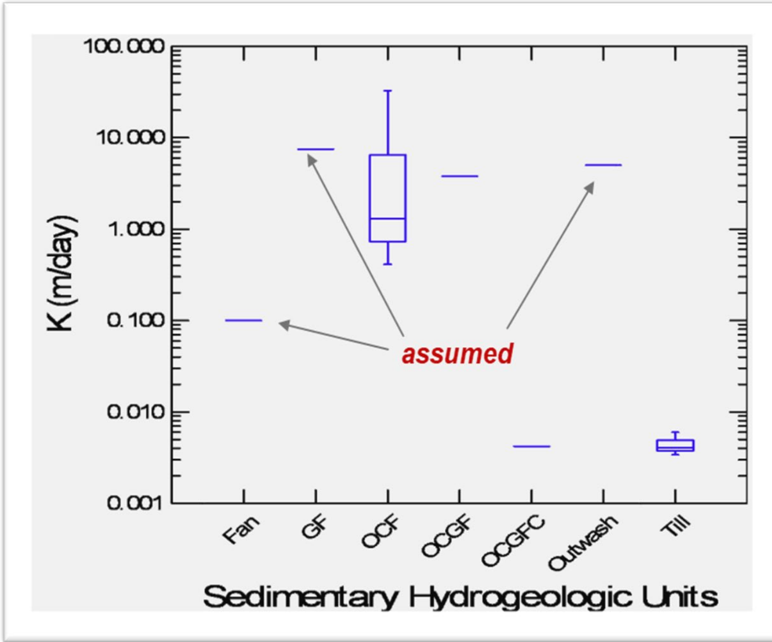


Figure 10-4. Box plots showing hydraulic conductivity of sedimentary units including inferred hydraulic conductivity of untested units

Table 10-2. Hydraulic conductivity of sedimentary units

	K (m/day)							
	Fluvial	**OCF**	**GF**	**OCGF**	**OCGFC****	**Fan***	**Outwash**	**Till**
Count	0	3	0	1	1	0	0	3
Min	1.00E-02	4.10E-01	3.80E+00	3.80E+00	4.20E-03	2.44E-02	1.26E-04	3.40E-03
Percentile 5		4.99E-01		3.80E+00	4.20E-03			3.47E-03
Percentile 25		8.52E-01		3.80E+00	4.20E-03			3.74E-03
Median	**1.00E+01**	**1.29E+00**	**7.50E+00**	**3.80E+00**	**4.20E-03**	**1.00E-01**	**1.00E-03**	**4.08E-03**
Percentile 75		1.70E+01		3.80E+00	4.20E-03			5.03E-03
Percentile 95		2.96E+01		3.80E+00	4.20E-03			5.79E-03
Max	1.00E+02	3.28E+01	1.50E+01	3.80E+00	1e-1**	2.43E+01	1.25E+00	5.98E-03

1E-5 was used for below detection results (2 instances)
** Loosely based on Palmer Fan tests*
*** Max K manually increased to account for visual core inspection; NOT ACTUAL TESTS*

10.5 Summary

Hydraulic testing was conducted in eight sediment wells to advance the conceptual model, guide development of the numerical groundwater model, and support a feasibility study. Groundwater is understood to flow from the bedrock into the sediments on its way to the Imuruk Basin. The hydraulic parameters of the sediments control discharge from the potential pit lake and are important to the waste management facility design. The objective of testing was to measure differences in hydraulic parameters with depth and across stratigraphic features.

Eight sedimentary units were identified from geologic logging and mapping. Hydraulic testing has been conducted in only four of these units, with only one test completed in each of two of the units. The hydraulic parameters of the remaining units have been assumed based upon literature and professional judgement. The measured and assumed hydraulic conductivity values are presented along with published values from literature in Figure 10-5.

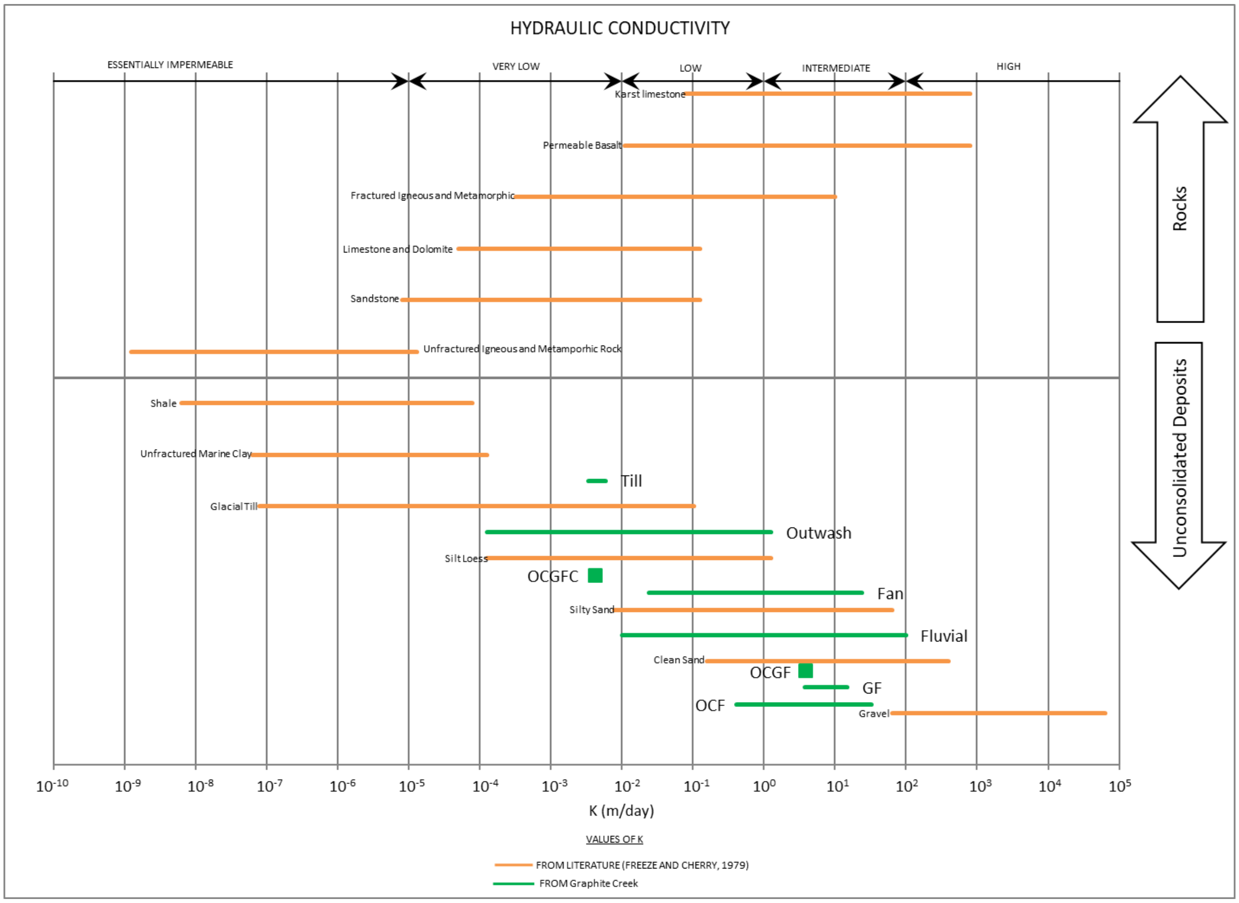


Figure 10-5. Sediment hydraulic conductivity compared with typical values literature (Freeze and Cherry, 1979)

11 Preliminary Hydrogeologic Conceptual Model

In hydrogeology, a conceptual model is developed to capture the understanding of the hydrogeologic system. In the early stages of the project, it is largely conceptual and as work progresses it is refined and becomes more data driven. The current conceptual model includes the following elements (Figure 11-1, Figure 11-2):

- The Kigluaik Fault is a key component of the system. It divides the bedrock system in the mountains to the south from the sedimentary system in the lowlands to the north. It typically has a well-developed clay gouge which restricts water flow across the fault. The Kigluaik Fault acts as a leaky dam to groundwater flow.
- Bedrock Hydrogeologic Units and hydraulic conductivity
  - General – Very highly metamorphosed schist with minor diorite and pegmatite intrusions. The unfractured bedrock has very low permeability. Virtually all permeability is secondary in fractures, joints, and faults. Two bedrock units are recognized.
  - Deep Rock - This has a low K with a median value of 0.00550 m/day and moderate high variability (see percentile ranges (Table 9-3 and boxplots (Figure 9-5)). These values are in the typical range for moderately fractured igneous and metamorphic rock (Duffield, 2019). K1 (parallel to the Kigluaik Fault plane, and dominant foliation and bedding direction) is thought to be greater than K2 (perpendicular to K1). A K1 to K2 range of 3:1 is assumed.
  - Shallow Rock – An approximately 60 m thick zone from the ground surface down with increased fracturing and higher permeability. The median K is 0.104 m/day which is in the middle of the typical range for fractured igneous and metamorphic rocks. The variability of K is somewhat less than that of the deep rock.
- Sedimentary Hydrogeologic Units and hydraulic conductivity
  - General
    - The eastern part of the project area is dominated by glacial derived sediment
    - The western part does not appear to have a significant glacial influence
    - Glacial sediment is derived from the Cobblestone Glacier which emerged from the mountains onto the lowlands each glacial maximum except the youngest late Wisconsin equivalent advance.
    - It appears that, at least during the last advance into the lowlands, a substantial glacial drainage developed on the west side of the glacier
  - Till – Glacial till has a low K of 0.00408 m/day with a limited number of tests showing very low variability. Test results are only available from the north pit wall area. The K is typical for till.
  - Fluvial and Glaciofluvial – Mapped as glaciofluvial at the surface, this unit is subdivided in the subsurface. Some units have been subject to limited hydraulic testing. K for other units is based on published values from literature and Tundra’s experience testing similar units in other locations. The over-compacted character of some of the units suggests that they were overridden by glacial ice:
    - Over-compacted, clayey glaciofluvial unit – K of 0.0045 m/day based on one test and may prove to be low with further testing.
    - Over-compacted fluvial unit – K of 1.29 m/day based on values from literature and observations
    - Over-compacted glacio-fluvial – K of 3.80 m/day based on a single test
    - Fluvial - K of 10.0 m/day based on literature and observations

    - Glaciofluvial – The unit seen at the surface. Due to the depth of groundwater, this unit has not yet been tested for K. Inferred K of 7.5 m/day based on literature values and observations
  - Inferred Units – Units that have not been drill tested:
    - Solifluction deposits – Colluvial deposits located between drainages, at the base of the mountain slope. The unit is thought to have a K similar to the fan deposit and is currently not broken out as a subsurface unit
    - Old fan deposits – Found in the basin west of the glacial sediments. It is thought to occur beneath the other sedimentary units near the mapped eastern boundary of the unit. Conceptually, the unit consists of discontinuous lenses of alluvial and debris flow deposits. The permeability may increase to the north as the ratio of alluvium to debris flow deposits increases. The permeability is likely intermediate, but similar to or less than the glaciofluvial unit, possibly in the range 0.01 to 1 m/day
    - Alluvium – This has been mapped for consistency with permafrost mapping. The streams are small in the project area, and this is not considered a mappable unit for groundwater modeling purposes. It is, however, a mappable unit at the eastern model boundary (Cobblestone River) where it may have a K in the 1 to 100 m/day range.
    - Outwash – This unit has been interpreted to occur northwest of the prominent Cobblestone moraine (ridge between the Cobblestone River and lower Graphite Creek). It has not been visited. The area is thought to be dominated by cold deep permafrost and therefore the permeability is very low.
    - Silt Cover – Similar to the Outwash, this unit has not been evaluated, but is thought to have cold deep permafrost, likely through the entire thickness. Due to the permafrost, it is thought to have very low permeability. Lower Glacier Canyon Creek crosses this unit. The talik under the creek may be closed due to the combination of small creek flow volume and deep, cold permafrost.
- Groundwater gradient and flow direction (Figure 11-2):
  - Bedrock (shallow and deep) – downward, sub-parallel to the ground surface.
  - Kigluaik Fault damage zone – A 25 to 50 m thick zone, parallel and adjacent to the Kigluaik Fault. Current drilling and testing does not allow us define this as a hydrogeologic unit. However, groundwater is thought to flow laterally in this zone, parallel to the fault with an upward component.
  - Immediately north of the Kigluaik Fault – strong downward flow gradient.
  - Lowlands – generally subparallel to the ground surface sloping towards the Imuruk Basin.
  - Northern lowland – The cold deep permafrost restricts groundwater flow towards the basin. Depth and K of units below the permafrost are very poorly understood. Currently assumed K values result in groundwater flow trending to the west to get under the permafrost and reach the basin.
  - Imuruk Basin – This large water body forms the local baseline. It is not known how groundwater discharges to the Imuruk Basin. For groundwater modeling purposes, it is considered to evenly discharge into the basin (constant head boundary).
- Groundwater level:
  - Strong seasonal influence
    - Rapid rise in water level due to snow melt starting in early June
    - Sustained, irregular high-water level through the summer
    - Infiltration stops upon freeze-up in late September or early October
    - Long steady decrease in groundwater level through the winter

  - Seasonal range in groundwater level:
    - Bedrock – 15 to 35 m
    - Lowlands – very limited data suggest roughly 15 m
- Deep bedrock groundwater flow is thought to be controlled by fractures and faults that are thought to be dominantly subparallel to the Kigluaik Fault. Flow of groundwater in these structural features is thought to be restricted due to decreasing permeability with depth and the damming effect of the Kigluaik Fault. Flowing artesian drill holes are common at the site and are thought to result from penetrating these water-filled structures with an angled drillhole.
- A perched aquifer is found in bedrock west of Graphite Creek – The bottom of the aquifer is at a depth of 35 to 40 m. It appears to reach a thickness of 15 to 30 m during the summer and rapidly drain off in the fall.
- The Kigluaik Fault is thought to restrict groundwater flow from south to north. There is likely some leakage through the fault. Some groundwater likely flows over the top of the clay gouge in the fault. Groundwater likely also crosses the fault under the principal streams.
- North of the Kigluaik Fault the groundwater table is thought to drop very rapidly with distance from the fault, reaching depths greater than 70 m before becoming gradually shallower as the ground surface slopes to the north towards the Imuruk Basin

• Permafrost
  - Generally, the permafrost distribution is a function of surficial geology, vegetation, and variations in winter snow depth influenced by drifting.
  - Mountains – Warm and discontinuous, may be absent in areas of drifting snow such as stream valleys and on the lee side of positive terrain features. Where present, there generally is a suprapermafrost talik that is approximately 35 to 40 m thick above the top of permafrost. A perched aquifer is observed in the talik. Depth to the base of permafrost is at about 100 mbgs.
  - **Kigluaik Fault** – There appears to be a zone along the fault that is permafrost absent
  - **Lowlands immediately downgradient of proposed pit** – Permafrost is warm (commonly less than -0.5°C) with a suprapermafrost talik commonly 15 m thick above the top of permafrost. Permafrost is inferred to be locally discontinuous in this area and may be absent within larger areas vegetated with alder and willow that have increased winter snow depth and decreased heat loss from the ground. Where present, the base of permafrost is generally less within proximity to alder and willow. Depth to the base of permafrost is less in the southern extent of this area (approximately 60 mbgs or less) when compared to the north in areas of open tundra (approximately 100 to 150 mbgs).
  - **Lowlands adjacent to Imuruk Basin** – Permafrost is relatively colder (inferred to range from approximately -1.0 to -1.5°C) and locally continuous. The active layer is expected to range from 1.0 to 2.0 m. Silt deposits are ice-rich in the area with indication of massive ground ice. Depth to the base of permafrost is inferred to be in the range of 150 to 180 mbgs.
  - **Cobblestone Moraine** – Permafrost is relatively colder (inferred to range from approximately -1.0 to -1.5°C) and locally continuous. The active layer is expected to range from 1.0 to 2.0 m. Silt deposits are ice-rich in the area with indication of massive ground ice. Depth to the base of permafrost is inferred to be in the range of 150 to 180 mbgs.
  - **Graphite Creek and Glacier Canyon Creek Riparian Zone** – Permafrost is expected to be absent along the mid-stretch of both creeks extending across the lowlands immediately downgradient of the mountain front. The absence of permafrost is based on advection of heat from flowing water and dense alder and willow that act to trap snow and limit heat loss in the winter. Further to the north, permafrost is expected to be present along the creek with a closed talik due to

  colder permafrost immediately surrounding the drainage and less influence from vegetation within the riparian zone.
  - **Cobblestone River** – The Cobblestone River and the active floodplain is expected to be absent of permafrost.
- Streams
  - Baseflow has a strong seasonal pattern similar to that of the groundwater level.
  - The streams are thought to be dominantly gaining from groundwater in the mountain valleys.
  - The rate of gain is thought to increase near the Kigluaik Fault.
  - A small loss to groundwater is observed in the first half kilometer after the water passes from the mountains (bedrock) to the basin (sediments). This is thought to be influenced by decreased permeability of the streambed due to iron precipitate. This has been observed in Graphite and Glacier Canyon Creeks and is thought to be similar in other similar sized creeks to the west.
  - It is assumed that stream loss to groundwater gradually increases downstream due to assumed gradual decrease in the amount of precipitate in the stream bed.

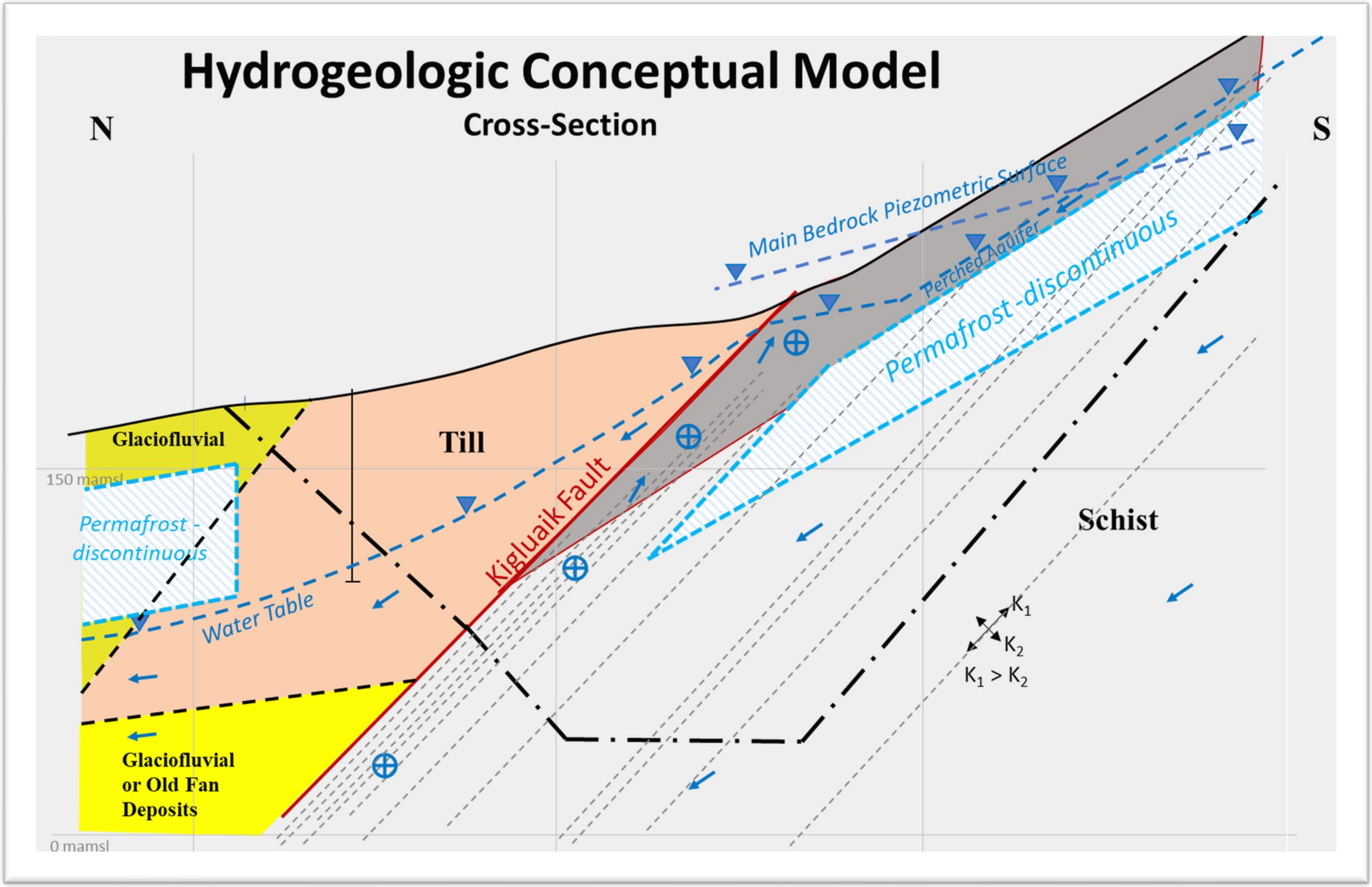


Figure 11-1. Hydrogeologic conceptual model.

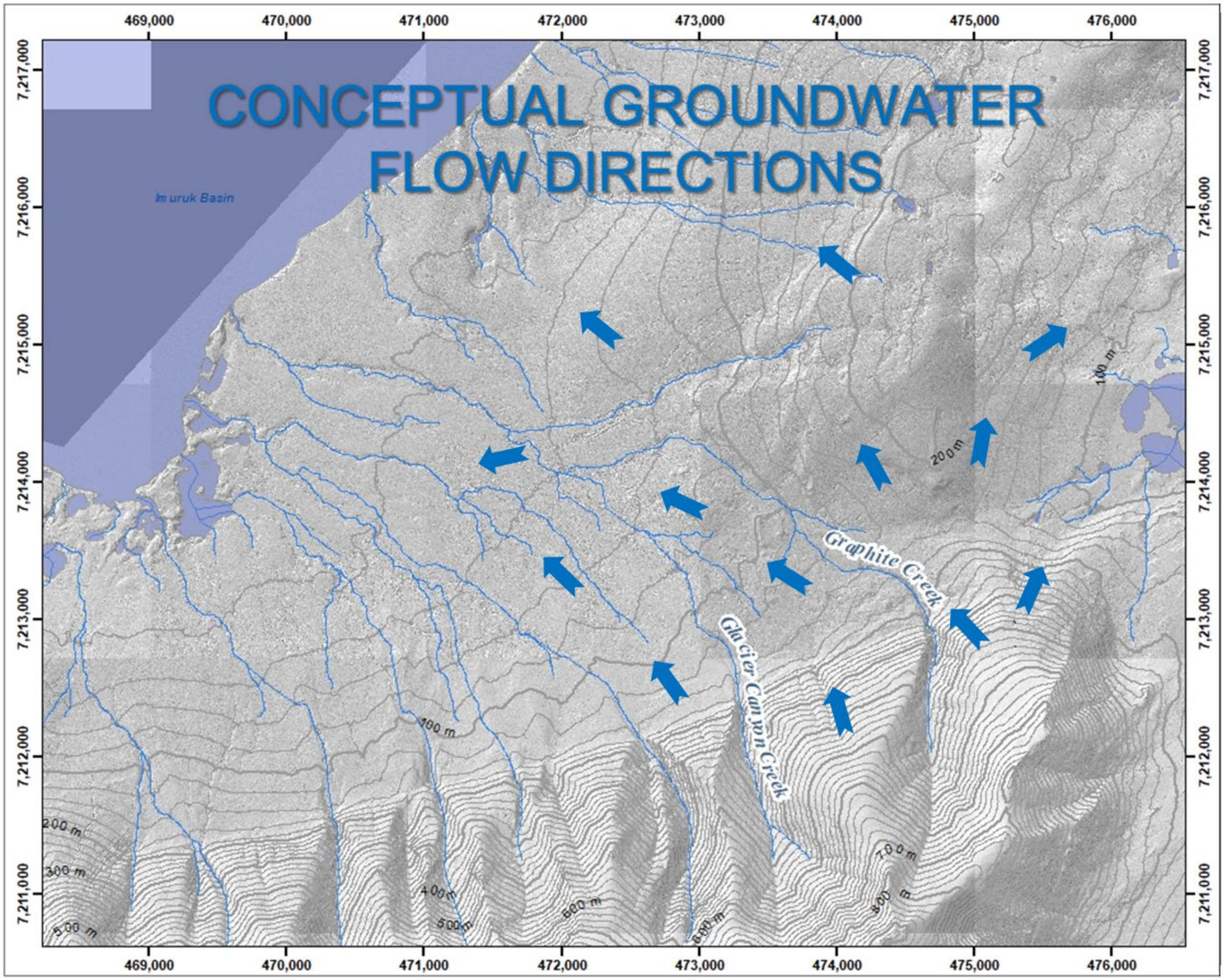


Figure 11-2. Conceptual groundwater flow directions

12 Groundwater Modeling

SRK updated the numerical groundwater model for the Graphite Creek project. The first preliminary version of the model was developed in 2022 (Tundra 2022) and updated in early 2024 (SRK and Tundra 2024). The model is based on the MODFLOW-USG finite-difference code (Panday 2013) using Groundwater Vista's interface version 8 (ESI 2020). A new version of MODFLOW, called MODFLOW-USG (for UnStructured Grid), was developed by the U.S. Geological Survey to support a wide variety of structured and unstructured grid types including quadtree refinement, the grid system implemented for the Graphite Creek model.

MODFLOW-USG is based on an underlying control volume finite-difference (CVFD) formulation in which a cell can be connected to an arbitrary number of adjacent cells. MODFLOW-USG also includes a new Connected Linear Network (CLN) process to simulate the effects of multi-node wells and linear underground developments (e.g., drifts). The CLN process is tightly coupled with the groundwater flow (GWF) process; the equations from both processes are formulated into one matrix equation and are solved simultaneously.

12.1 Description of Numerical Model

The original version of the Graphite Creek model was designed to estimate groundwater inflow to the proposed open pit and define major hydrogeological uncertainties that need to be addressed during the upcoming field investigation. Additionally, the model was used to preliminarily evaluate changes in water levels resulting from pit dewatering and pit lake infilling, and changes in hydrogeological conditions. The most recent model update is targeted to provide hydrogeological input for the project Feasibility Study.

12.1.1 Model Extent and Grid Discretization

A plan view of the model extent and its finite-difference grid is shown in Figure 12-1. The model grid is rotated by 21.9 degrees to better simulate the Kigluaik Fault, which deepens at an angle of about 45 degrees to the north.

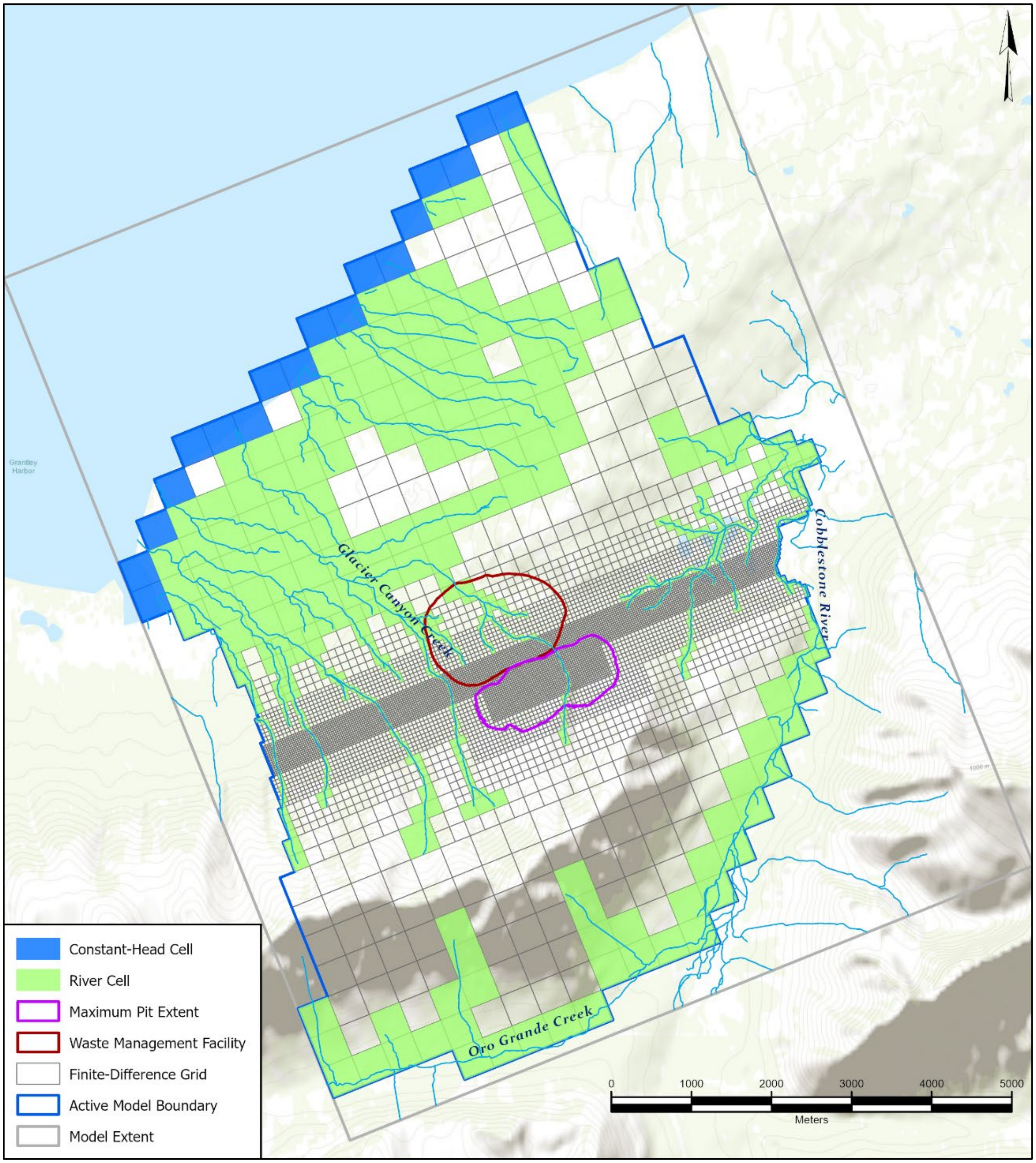


Figure 12-1. Plan-View of Model Extent, Finite-Difference Grid, and Simulated Surface Water Features

The model has 29 rows, 22 columns, 19 vertical layers, and 168,416 active cells covering an area of about 102 km^2. The grid utilizes a nested approach—in the proposed open pit, the number of cells within the model layer is 4 times larger than in the parent grid. The grid size varies laterally from 400 to

25 meters (m) and vertically from 20 to 80 m. The bottom layer varies in thickness with a flat bottom elevation of -600 mamsl.

The external model boundary conditions are set as follows:

- Northern – constant heads representing the Imuruk Basin in the top twelve layers (including 4 layers below the permafrost, to a depth of 240 m), set to the elevation of the Imuruk Basin (0 mamsl) (H=const).
- Western, eastern, and southern – no-flow in all layers, except the first where surface water bodies are modeled as described below (Q=0).
- Top of the model – recharge from precipitation (Q=const) – described below.
- Bottom of the model – no-flow (Q=0)

12.1.2 Simulation of Hydrogeology

Thirteen hydrogeological units were incorporated into the model with the hydraulic parameters shown in Table 12-1, and lateral and vertical distributions are shown in Figure 12-2 and Figure 12-3.

The bedrock units include:

- Kigluaik Fault Zone (main body and upper part).
- Schist (main body, upper part, and less fractured zone in the divide area)
- Low-permeability bedrock at the depth

Unconsolidated sediment units north of the Kigluaik fault:

- Fan deposit
- Fluvial (main part and over-compacted zone)
- Glaciofluvial (main part and over compacted/clayey zone)
- Till
- Outwash
- Tertiary sediments
- Frozen sediments (within cold permafrost distribution)

Table 12-1. Simulated hydrogeological units and associated hydraulic parameters

Hydrogeologic Unit		Color	Hydraulic Conductivity (m/d)			Specific Yield ()	Specific Storage (1/m)
			Kx	Ky	Kz		
Bedrock	Kigluaik Fault Zone		0.001	0.001	0.001	0.01	1.00E-06
	Kigluaik Fault Zone (Upper Part)		0.03	0.03	0.03	0.01	1.00E-06
	Schist		0.0055	0.0018	0.0055	0.01	1.00E-06
	Schist (Upper Part)		0.1	0.1	0.1	0.02	1.00E-06
	Schist (Less Fractured in Divide Area)		0.0015	0.0005	0.0015	0.01	1.00E-06
	Low-Permeability Bedrock at Depth		0.001	0.00033	0.001	0.01	1.00E-06
Sediments	Fan Deposit		15	15	1.5	0.2	1.00E-06
	Fluvial		10	10	1	0.2	1.00E-06
	Overcompacted Fluvial		1.29	1.29	0.129	0.1	1.00E-06
	Glaciofluvial		10	10	0.1	0.2	1.00E-06
	Overcompacted Glaciofluvial		3.8	3.8	0.38	0.1	1.00E-06
	Overcompacted Glaciofluvial (Clayey Unit)		0.004	0.0042	0.0004	0.1	1.00E-05
	Till (Moraine)		0.004	0.004	0.0004	0.1	1.00E-05
	Till North of Kigluaik Fault Zone		0.004	0.004	0.0004	0.1	1.00E-05
	Outwash		0.001	0.001	0.0001	0.1	1.00E-05
	Tertiary sediments		0.001	0.001	0.0001	0.1	1.00E-05
	Cold, Continuous Permafrost		0.001	0.001	0.001	0.1	1.00E-06

Notes:
1 –Schists (including the Less Fractured in Divide Area) were modeled with lateral anisotropy Kx=Kz>Ky.
2 – All sedimentary units were modeled with vertical anisotropy Kx=Ky>Kz

Hydraulic parameters in Table 12-1 were obtained by:

- Matching median values of measured hydraulic conductivity of hydrogeologic units measured in the field (Table 9-3, Table 10-2)
- Adjusting hydraulic conductivity values of Glaciofluvial and Fan deposits during model calibration to the measured water levels (simulated values were increased compared to median values by a factor of 1.5)
- Assuming lateral anisotropy of bedrock units in the south-north direction (reduction of hydraulic conductivity) at a ratio of 3 to 1.
- Assigning groundwater storage parameters based on literature data and the modeler’s experience.

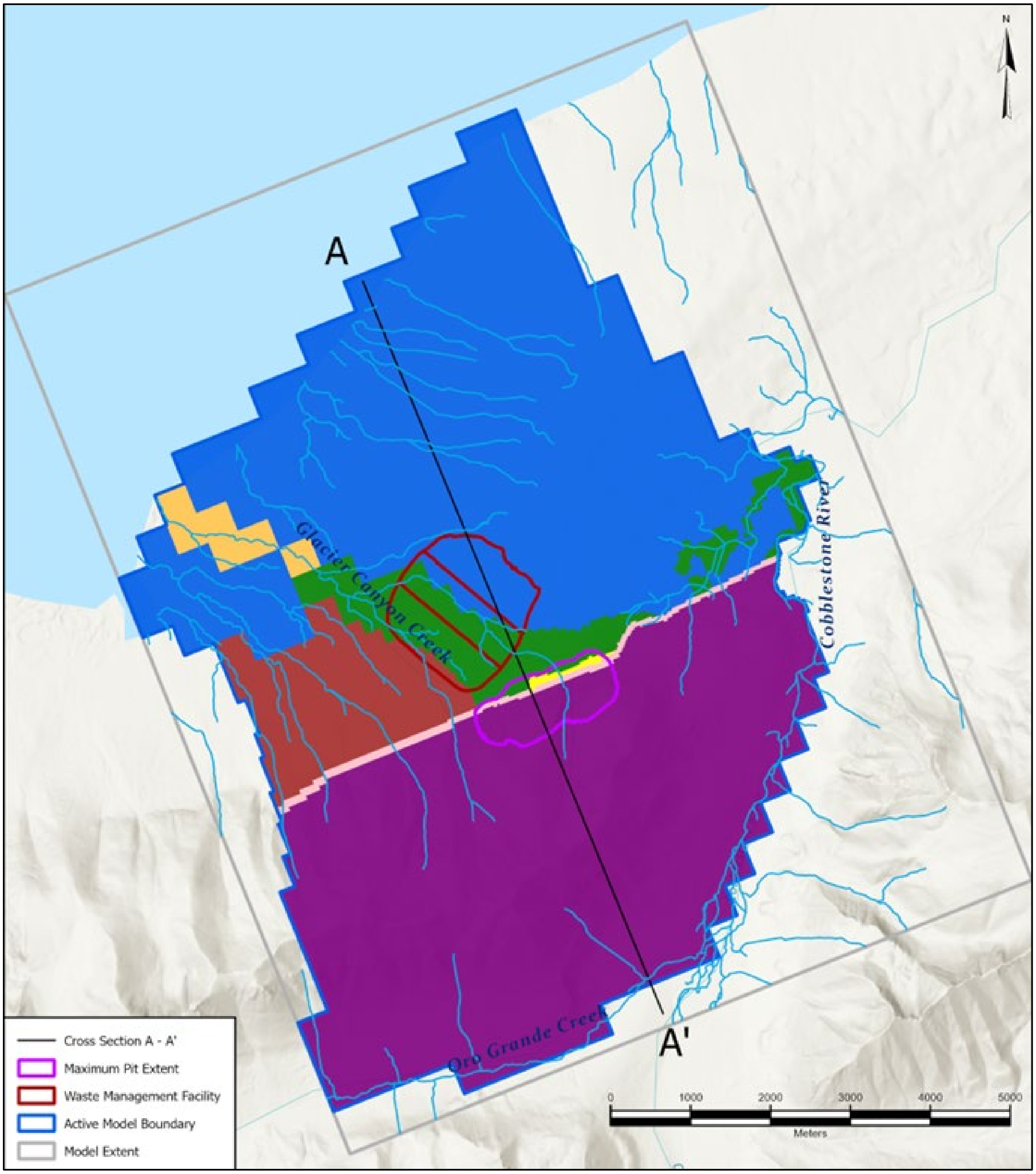


Figure 12-2. Simulated Hydrogeological Units in Plan-View (Uppermost Layer)

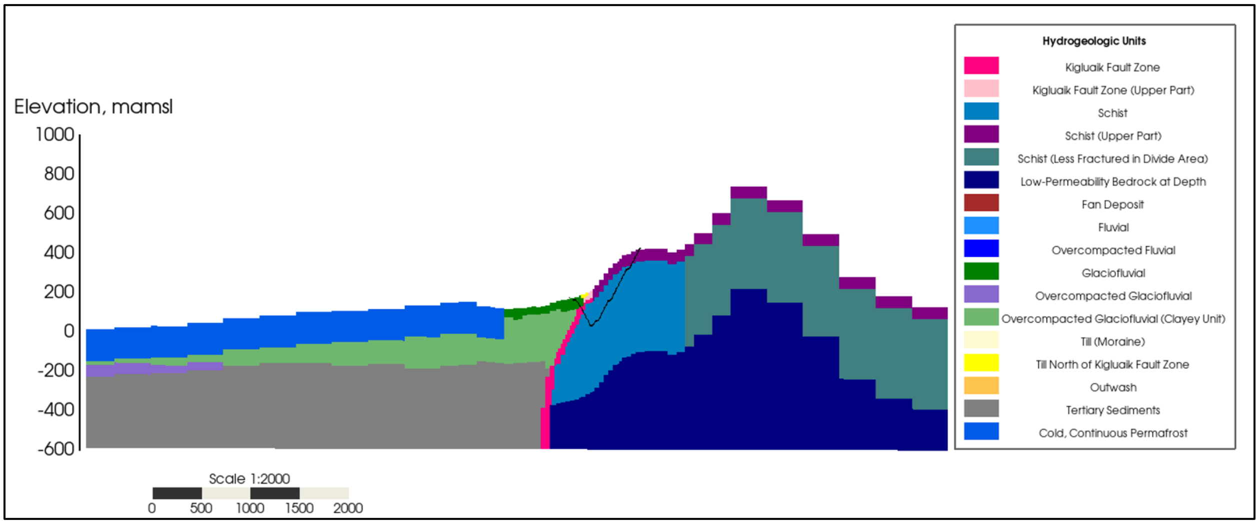


Figure 12-3. Cross Section of Simulated Hydrogeological Units through the Pit Area (South-North – A-A')

12.1.3 Simulation of Recharge from Precipitation

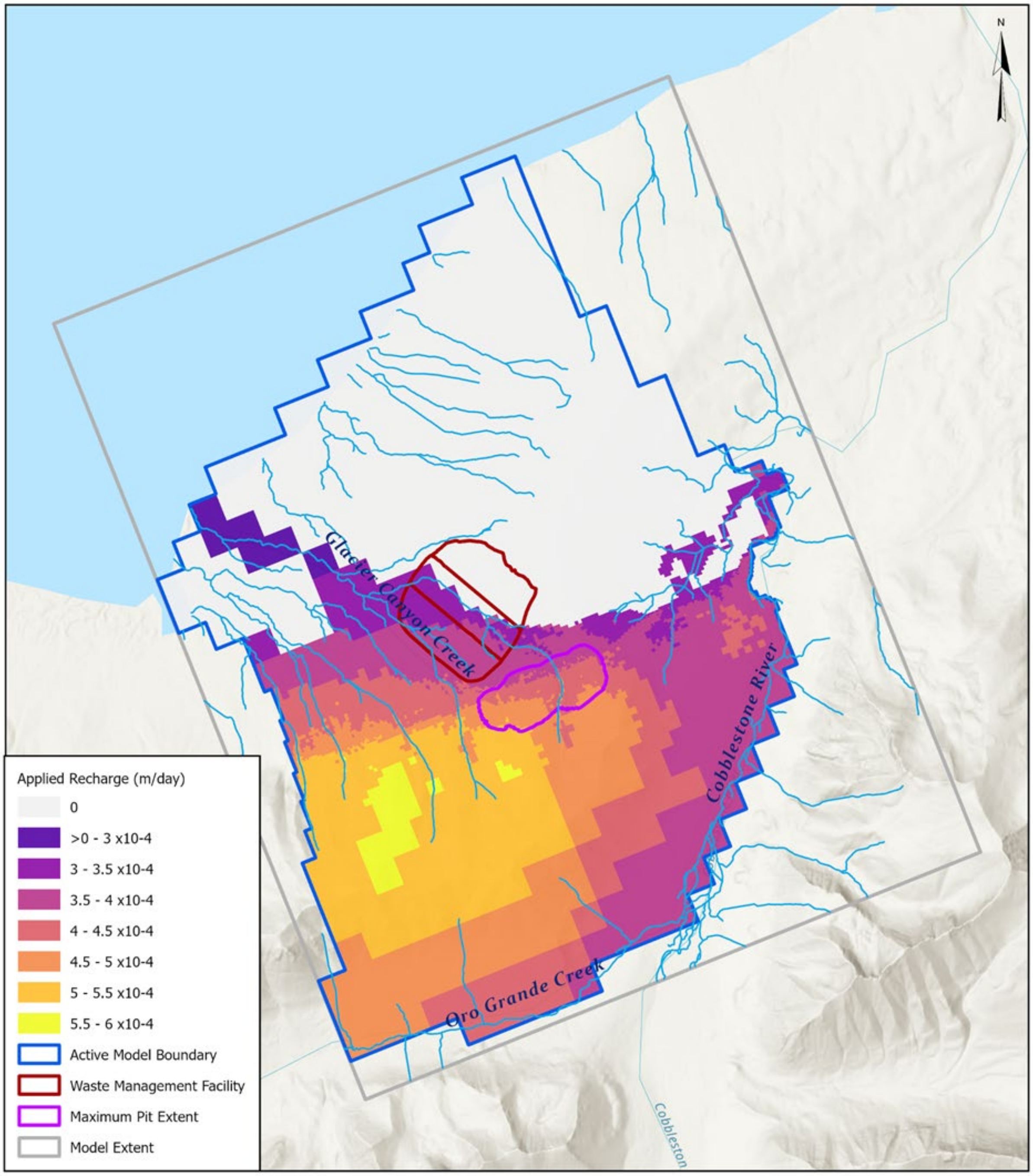
The mechanism of groundwater recharge from precipitation is not clearly understood, and a detailed investigation of groundwater recharge rates has not been performed. SRK used DAYMET and MERRA2 precipitation data for the period from 1980 through 2023 to calculate recharge rates. Precipitation data were corrected for undercatch (as described in Section 7 of the report).

The recharge coefficient was initially assumed to be 0.20 (or 20%) and applied uniformly within the model domain to the groundwater table (in the first saturated layer of the model). This coefficient was determined by the model calibration under assumed average values of hydraulic parameters measured in the field.

The recharge coefficient was initially applied uniformly within the model domain except for the zone of cold permafrost (the recharge coefficient was assumed equal to zero there).

The recharge rate is calculated by multiplying the recharge coefficient by the annual precipitation from the DAYMET/MERRA2 model. The distribution of recharge rates within the model domain based on the DAYMET/MERRA2 precipitation model is shown Figure 12-4.

It should be noted that this approach is an approximate method to simulate transient recharge from precipitation. The use of average monthly precipitation plus snowmelt data, combined with a recharge coefficient, is the more accurate way to model the transient groundwater regime and will be used for future model updates when data are available.



Note: Applied recharge is 20% of estimated precipitation, except in the area where cold permafrost was identified/interpreted.

Figure 12-4. Distribution of Recharge Rates from Precipitation

Observed water level changes in monitoring wells indicate that recharge from precipitation has significant seasonal fluctuations. To simulate the seasonal fluctuations in recharge for the transient model calibration, recharge coefficients were varied monthly. A yearly average of 20% of precipitation to recharge was maintained in the time-varying precipitation coefficients. Simulated monthly recharge coefficients are shown in Table 12-2.

Table 12-2. Simulated monthly recharge coefficients

Month	Recharge Coefficient
January	0.00
February	0.00
March	0.00
April	0.00
May	0.00
June	1.00
July	0.70
August	0.50
September	0.20
October	0.00
November	0.00
December	0.00
Average	0.20

12.1.4 Simulation of River and Creeks

The model simulates surface-water features as follows:

- Cobblestone River
- Oro Grande Creek
- Graphite Creek (the part of the creek within the proposed pit was excluded for simulation of the mining and post-mining conditions)
- Glacier Canyon Creek
- Creek tributaries

Their locations are shown in Figure 12-1. These rivers and creeks are incorporated into the model as RIVER cells (Anderson and Woessner, 1992), allowing the model to simulate these surface-water features as gaining or losing depending on the simulated water table relative to their stage. The river cell conductance values were calculated under the following preliminary assumptions:

- Oro Grande Creek and Cobblestone River: The width of the river is 10 m, the thickness of the riverbed sediments is 1 m, and the hydraulic conductivity of the riverbed sediments is 1 m/day.
- Graphite Creek, Glacier Canyon Creek, and Creek tributaries: The width of the river is 1 m, the thickness of the riverbed sediments is 1 m, and the hydraulic conductivity of the riverbed sediments is 1 m/day. The latter parameter is the most sensitive and especially will require refining tor the next model update.

It should be noted that the simulation of the rivers and creeks was done approximately to simulate generalized elements of the conceptual hydrogeological model – gaining water in the bedrock units (groundwater discharge into the streams) and losing water in the sediments to the north of the Kigluaik Fault.

12.1.5 Simulation of Permafrost

The presence of the permafrost within the model domain was:

- Simulated by a low permeability hydrogeological unit (from the ground surface to the depth of 160 m) distributed in the areas where cold permafrost was found/ interpreted (shown in Figure 12-2)
- Ignored in the areas where warm permafrost was found/interpreted. Significant variation in water level measurements was recorded there indicating the presence of recharge to the groundwater system and groundwater flow.

12.2 Model Calibration

The calibration process for the numerical model included the following steps:

- Run a steady-state model to simulate hydraulic heads as input for the transient model run.
- Run a transient model (10 years with the same distribution of recharge in time) and analyze the last year of simulation.
- Average simulated water levels and compare them with measured values in the form of a quality line.
- Compare hydrographs in 8 wells of measured water level changes through time (average generalized curves for 2021 through 2023 where data are available) with simulated values.
- Compare the simulated groundwater discharge in Graphite Creek to the targeted baseflow estimate (make simulated groundwater discharge as high as possible while maintaining model calibration to observed water levels under measured/estimated hydraulic parameters).

The locations of water-level monitoring points used as calibration targets during the model calibration are shown in Figure 12-11.

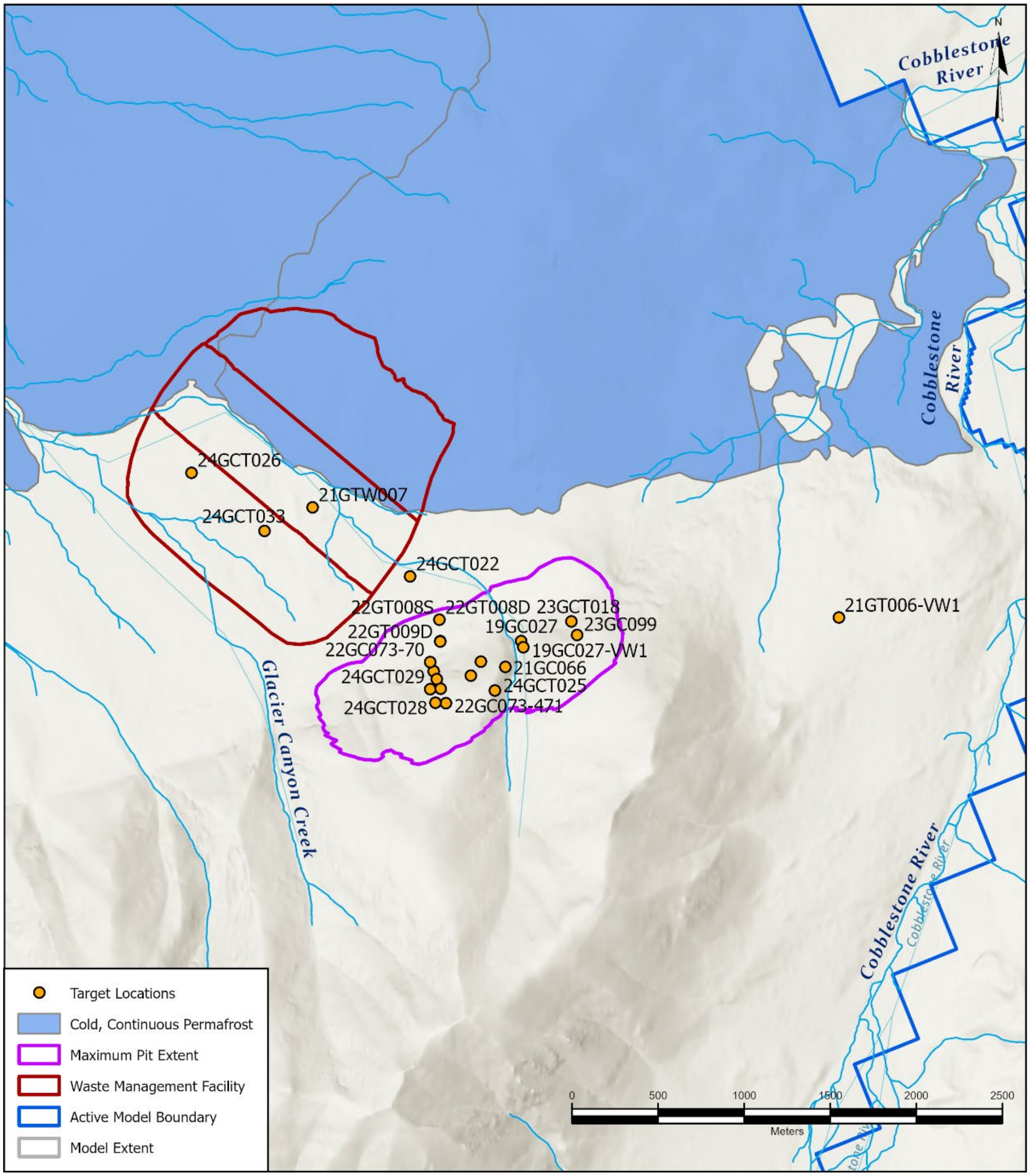


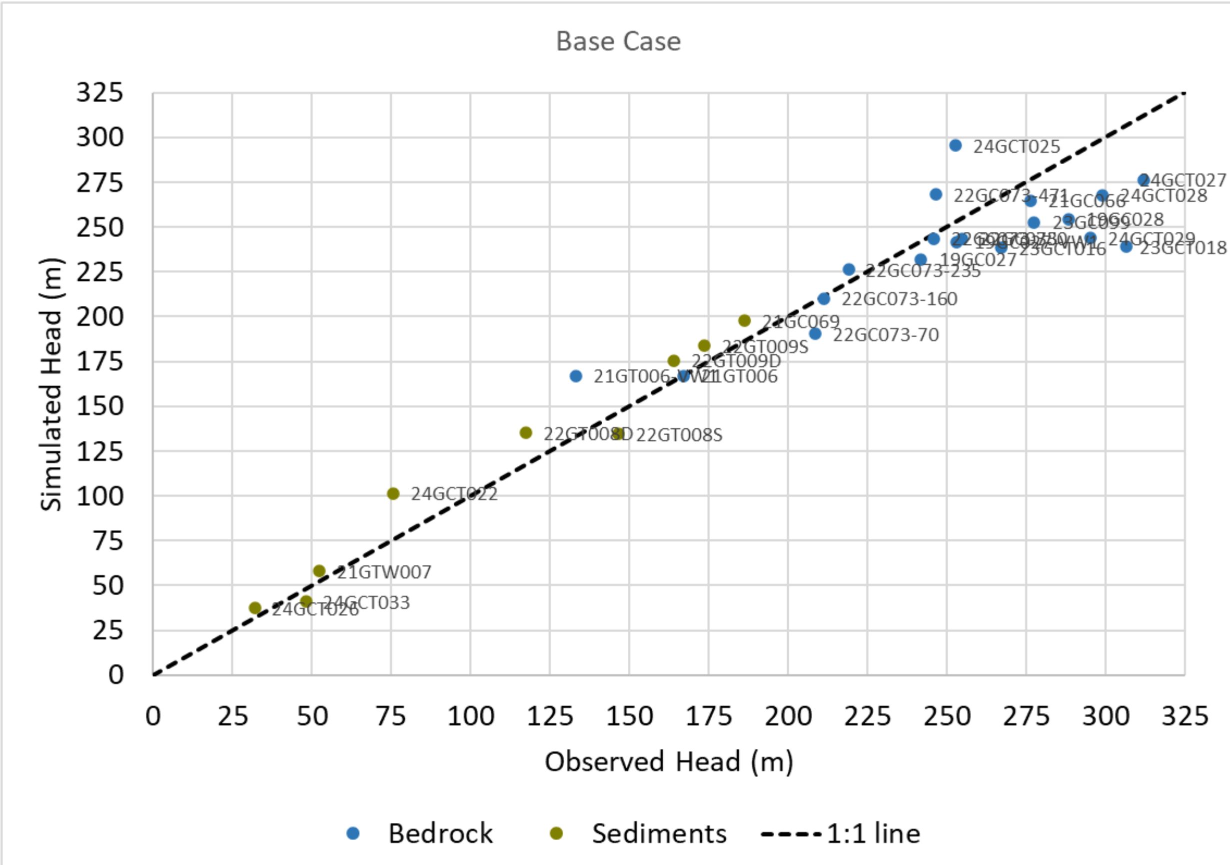
Figure 12-5. Location of water-level monitoring points used as calibration targets

Figure 12-12 shows the comparison of measured and simulated water levels in the form of a Quality Line. A perfect model fit is when the simulated water levels equal the measured or observed water levels. This would result in a 1-to-1 (straight line) relationship, shown as the dashed line. An approximate 1-to-1 relationship exists over the entire range of water levels, which indicates that there is not a systematic bias related to the water-level elevation. Several statistical measures can be used to assess how well the model represents the groundwater system, and they are presented in Table 12-3.

Table 12-3. Model calibration statistics to measured water levels

Residual Mean (m)	5
Absolute Residual Mean (m)	19
Residual Std Deviation (m)	25
Sum of squares (m^2)	16,544
Number of observations	26
Range of observations (m)	275
RMS Error (m)	25
Min Residual (m)	-43
Max Residual (m)	68
Scaled Residual Standard Deviation	9.0%
Scaled Absolute Residual Mean	7.1%
Scaled RMS Error	9.2%
Scaled Residual Mean	2.0%

The model generally simulates water levels slightly higher than measured (by about 5m). The root mean square (RMS) error is a measure of how much the simulated water levels vary from the observed values. The scaled RMS error accounts for the magnitude of water-level changes within the model area. In practice, a well-calibrated model should have a scaled RMS error of less than 10 percent (Anderson & Woessner, 1992). With a scaled RMS error of just below 10% and a limited range of observations, this model is considered preliminarily calibrated to the measured water levels.



Note: A major contributor to the Scaled RMS Error is the short record for the new wells. These measurements are all biased quite high compared to annual average due to being measured in the summer only.

Figure 12-6. Comparison of measured and simulated water levels

In the future, model calibration can may be improved by the incorporation of additional hydrogeological zones within the bedrock and especially the sedimentary units based on additional field investigations, and by adjusting recharge coefficients.

Figure 12-7 shows examples of comparison of the simulated and measured seasonal changes in water levels in the transient calibrated model.

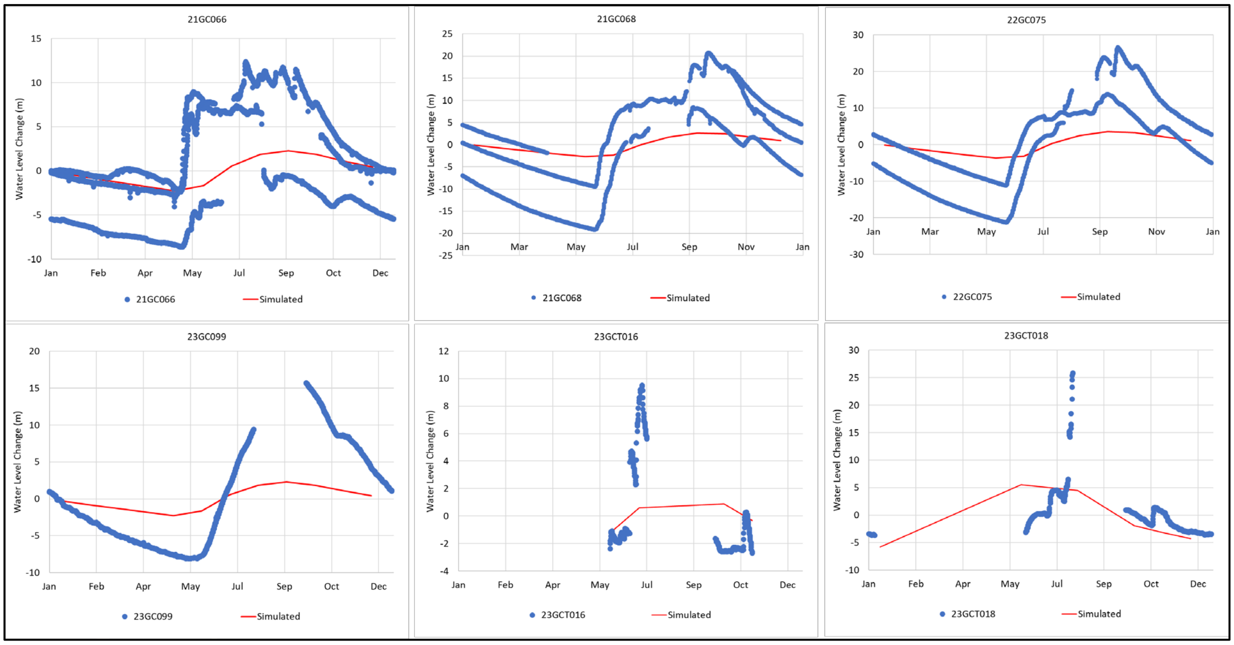


Figure 12-7. Comparison between simulated and measured water level changes

The model simulates groundwater level fluctuations up to 11 m in bedrock monitoring wells but does not reproduce significant changes in water levels in the sedimentary monitoring wells. The mechanism of large (up to 25m) variations in water levels in the sedimentary monitoring wells is currently poorly understood and the model fails to reproduce them. Most likely this is because the model does not simulate the warm permafrost which acts as a temporally variable confining layer. Use of average monthly precipitation plus snowmelt data with the application of a recharge coefficient should better help to reproduce the measured water levels and will be used for the next model update. It is also possible that overall hydraulic conductivity values of the bedrock units are conservatively overestimated.

The model reasonably simulates groundwater discharge into Graphite Creek above the Kigluaik Fault at location GC-A. The observed baseflow (low flow during winter months) at GC-A ranges between 123 m^3/d to 160 m^3/d and the estimated baseflow by the CR4J model varies from 452 m^3/d to 640 m^3/d (as shown in Table 8-7). These flows reasonably compare with the simulated value of groundwater discharge at GC-A, which is 187 m^3/day.

A summary of conclusions from the completed model calibration is below:

- The model reasonably simulates identified hydrogeological units, their hydraulic parameters, measured water levels in general, and the direction of groundwater flows.
- The partially unresolved issues with model calibration include the inability to properly simulate:
  - **High water levels in the bedrock boreholes and monitoring wells drilled at higher elevations (short record is biased high)**
  - **Large vertical hydraulic gradient observed north of the proposed pit**
  - **Large seasonal variations in both sedimentary and bedrock water level elevations**

- Remaining hydrogeological uncertainties relate to:
  - **Schist anisotropy**
  - **Recharge rates**
  - **Restrictive role of the warm permafrost**
- The calibrated groundwater model is suitable for predictive simulations. The effect of the remaining uncertainties can be further evaluated by additional sensitivity analyses.

Figure 12-8 and Figure 12-9 present the simulated water table and direction of groundwater flow shown in the plan view and north-south cross-section through the pit area.

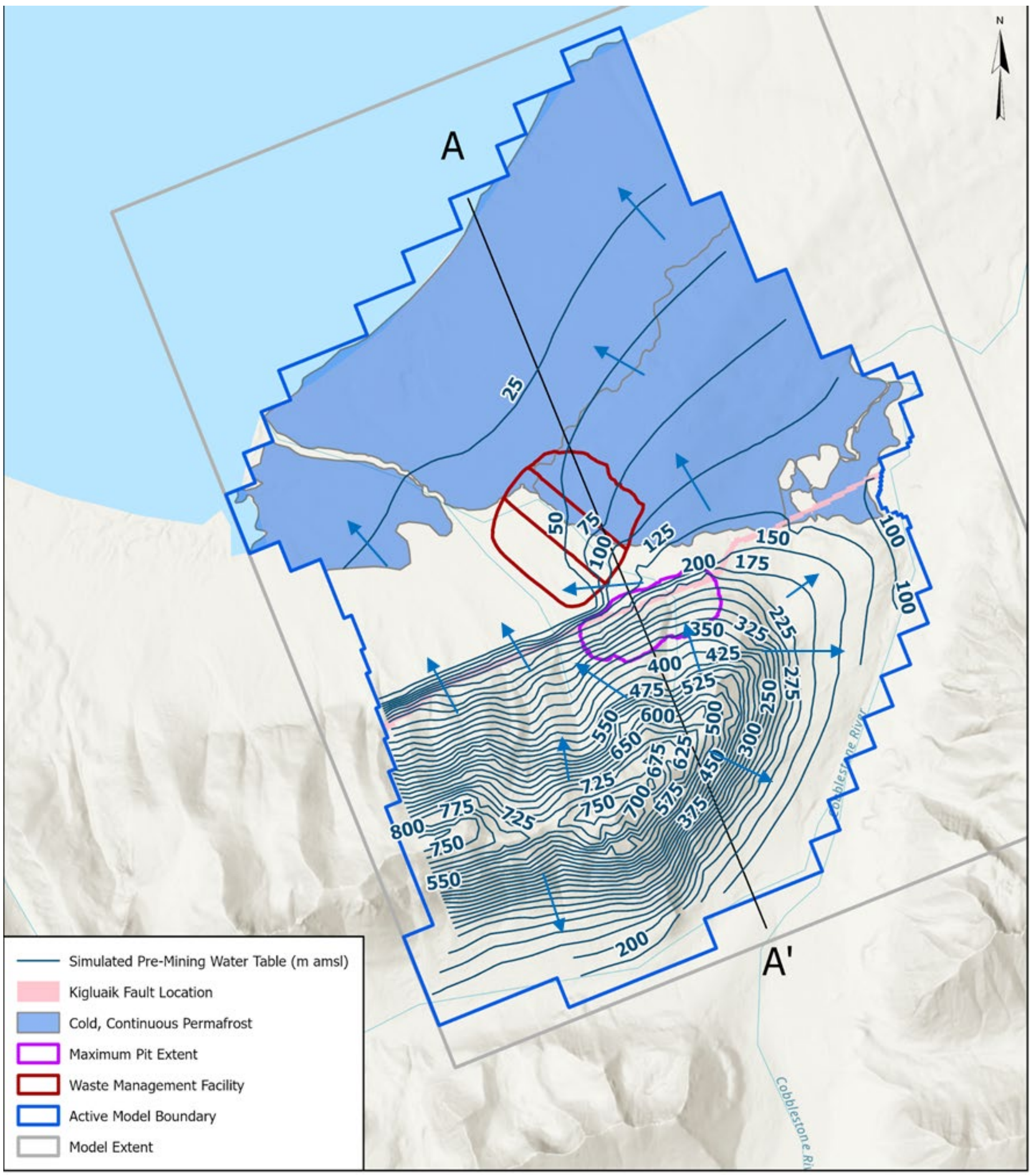


Figure 12-8. Simulated pre-mixing water table and direction of groundwater flow in plan-view

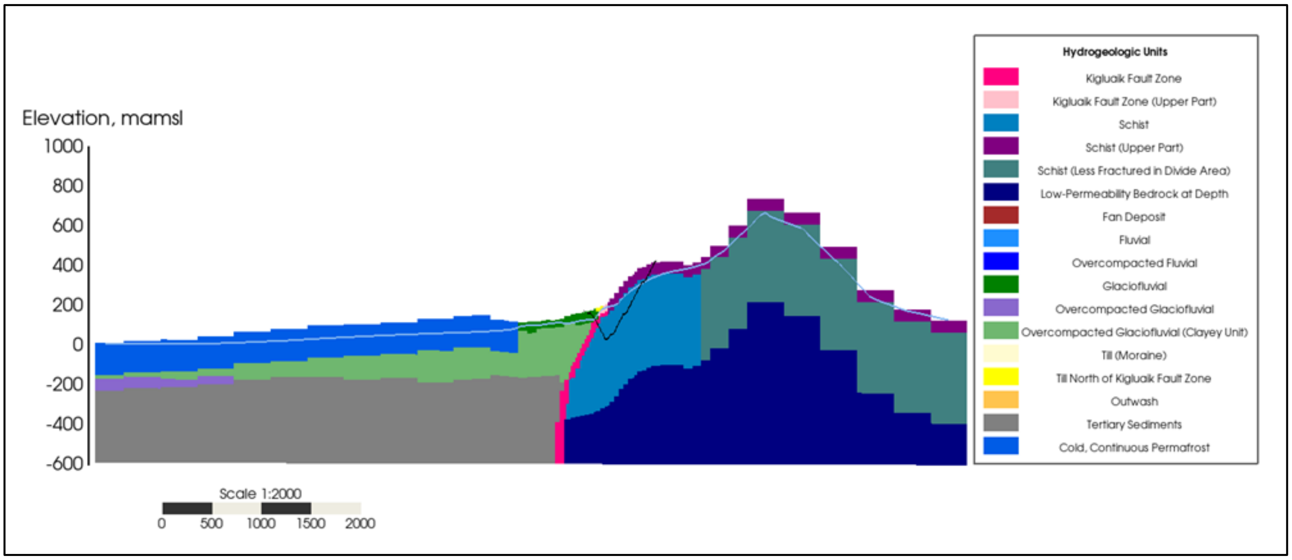


Figure 12-9. Simulated water table shown on Cross-section A-A'

Figure 12-10 shows the simulated location of gaining and losing parts of the streams.

The model simulates that:

- Groundwater generally discharges into the streams within bedrock above the Kigluaik Fault except at higher elevation at the top of the mountains
- The streams recharge groundwater within the sediments to the north of the Kigluaik Fault, where the water table is very deep and significantly below the streambed elevations
- The streams start to gain groundwater part within the northern part of the sediments near the cold permafrost boundary. The permafrost is simulated as a low-permeability unit to a depth of 160m, blocking groundwater flow within the shallow part of the sediments and forcing groundwater to discharge into the streams through the open taliks (it is currently unknown if this talik is open or closed).

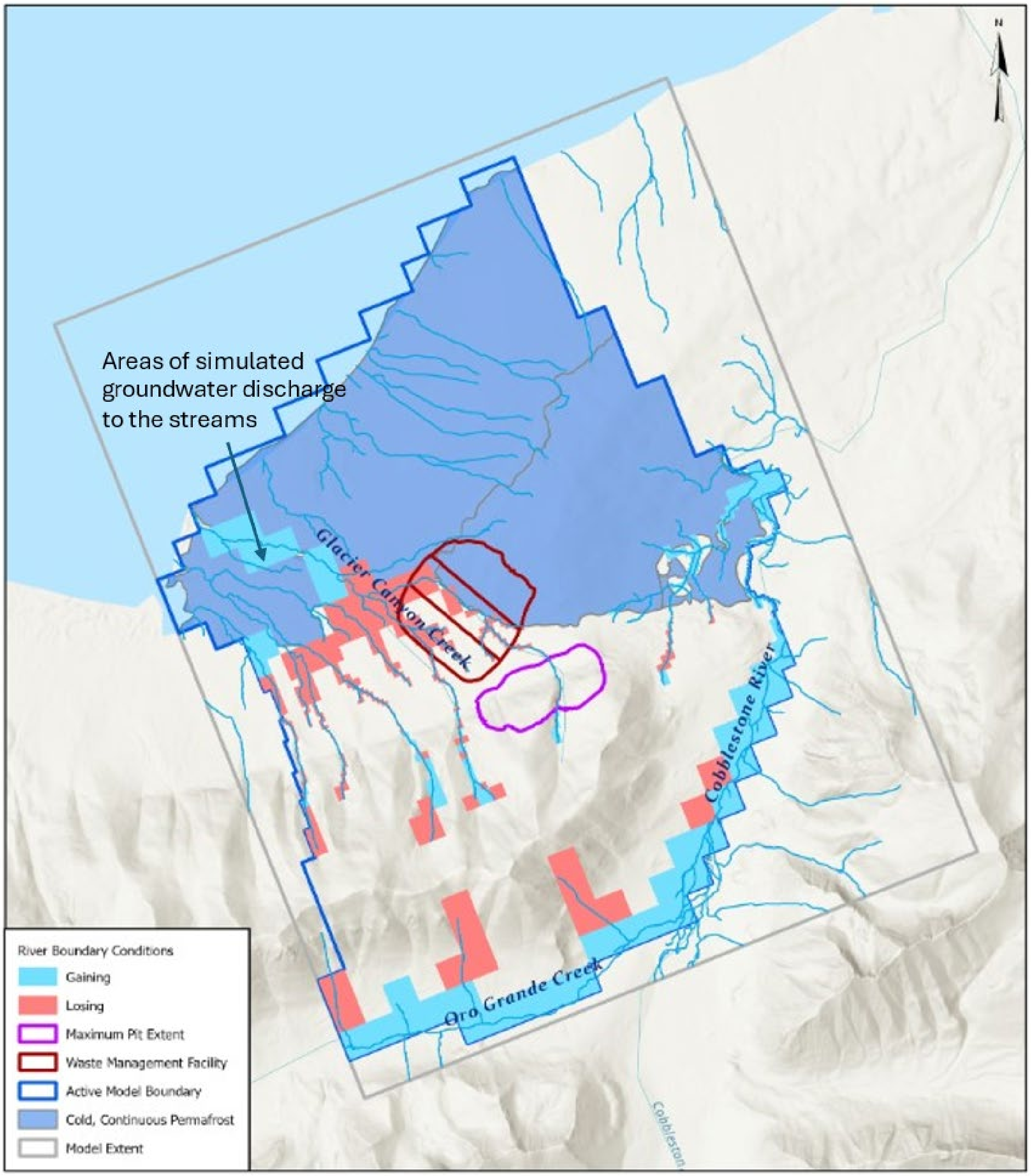


Figure 12-10. Areas of simulated groundwater discharge into the streams and recharge from the streams (simulated gaining and losing portions of the streams)

The simulated groundwater budget for the pre-mining conditions is shown in Table 12-4.

Table 12-4. Simulated groundwater budget for pre-mining conditions

Component	Flows (gpm)
Recharge from Precipitation	2,883
Groundwater Gain from Rivers/Creeks	5,745
Groundwater Gain from Storage	0
Total Inflow	**8,628**
Groundwater Discharge to Imuruk Basin	5,134
Groundwater Discharge to Rivers/Creeks/Wetlands	3,494
Total Outflow	**8,628**

12.3 Predictions of Mining Conditions

12.3.1 Simulation of Mining Facilities

Future mining conditions were simulated considering changes in hydrogeological conditions as follows:

- Open pit excavation below the water table
- Re-routing of Graphite Creek to the south of the proposed pit into the Glacier Canyon Creek by a pipe and/or a lined channel
- Construction of a lined Waste Management Facility (WMF)

Excavation of the open pit through time was simulated by drain cells using the yearly plans developed by Graphite One. Groundwater inflow to the pit was calculated using the following relationship:

$$Q_d = \begin{cases} C_L \text{ x } (H - Z_d) \text{ if } H>Z_d \\ 0, \text{ if } H< Z_d \end{cases} \qquad \text{Equation 1}$$

Where:

Q_d = Inflow to drain cell (m^3/day)
H = Hydraulic head (m)
Z_d = Pit bottom elevation (m) (variable in time)
C_L = Drain cell conductance (m^2/day)

The conductance value was assumed equal to 1,000 m^2/day, allowing the model to simulate the water table in the pit area as equal to the pit bottom elevation.

The location of 8,659 drain cells used for the simulation of the open pit excavation is shown in Figure 12-11 and Figure 12-12.

The currently proposed mine plan considers 24 years of excavation of the open pit. SRK used yearly pit shells for mining below the water table according to the 2024 mine plan developed by Graphite One and provided to SRK by Tundra. The simulated yearly pit bottom elevation in time is shown in Figure 12-13 and is based on the provided 2024 mining plan.

Re-routing of Graphite Creek to the south of the proposed pit into Glacier Canyon Creek by a pipe or/and lined channel was simulated by deactivation of the river cells simulating surface water/groundwater interaction.

The construction of a lined WMF was simulated by the elimination of recharge from precipitation. It was simulated in time based on the proposed extent of the WMF.

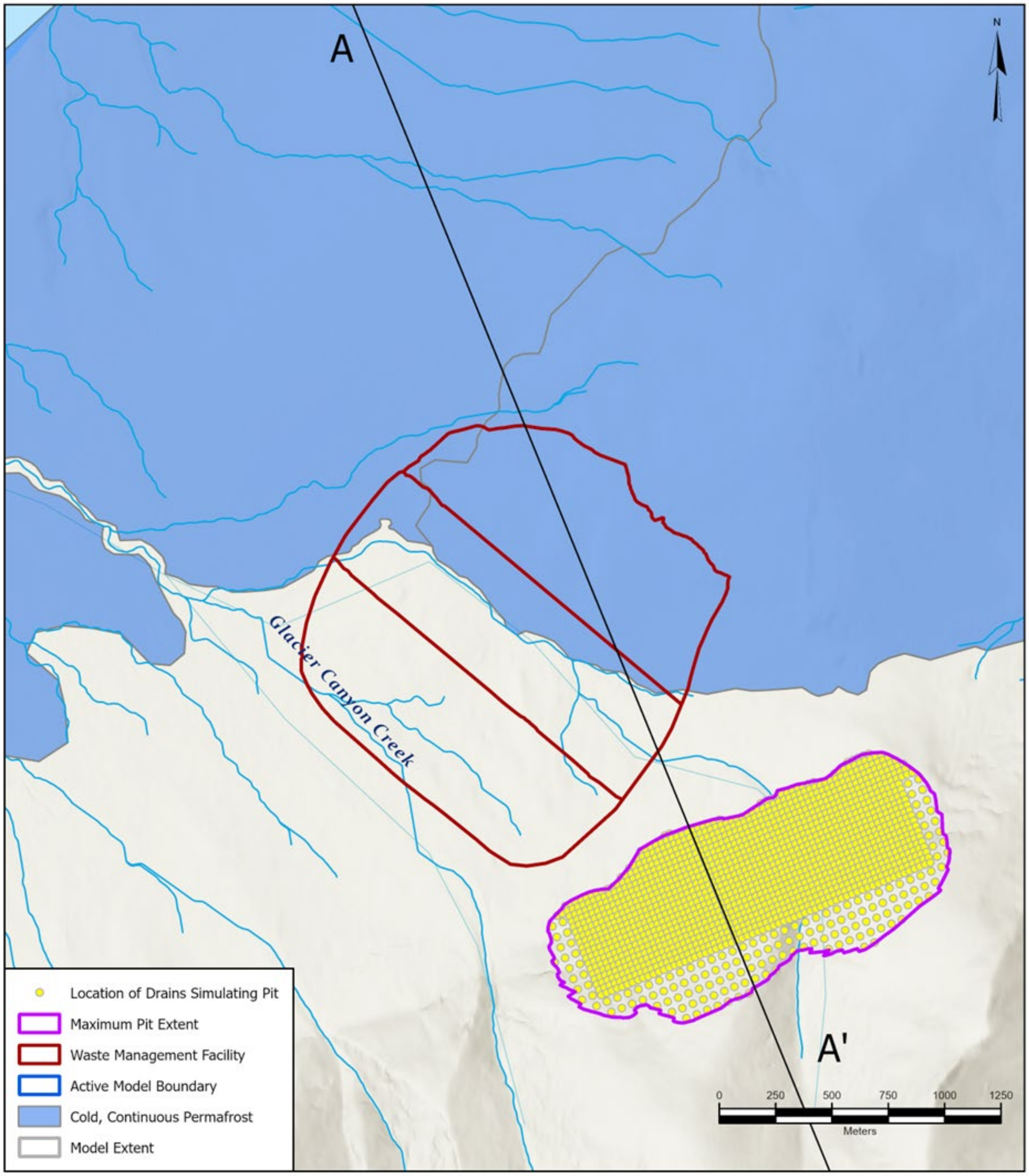
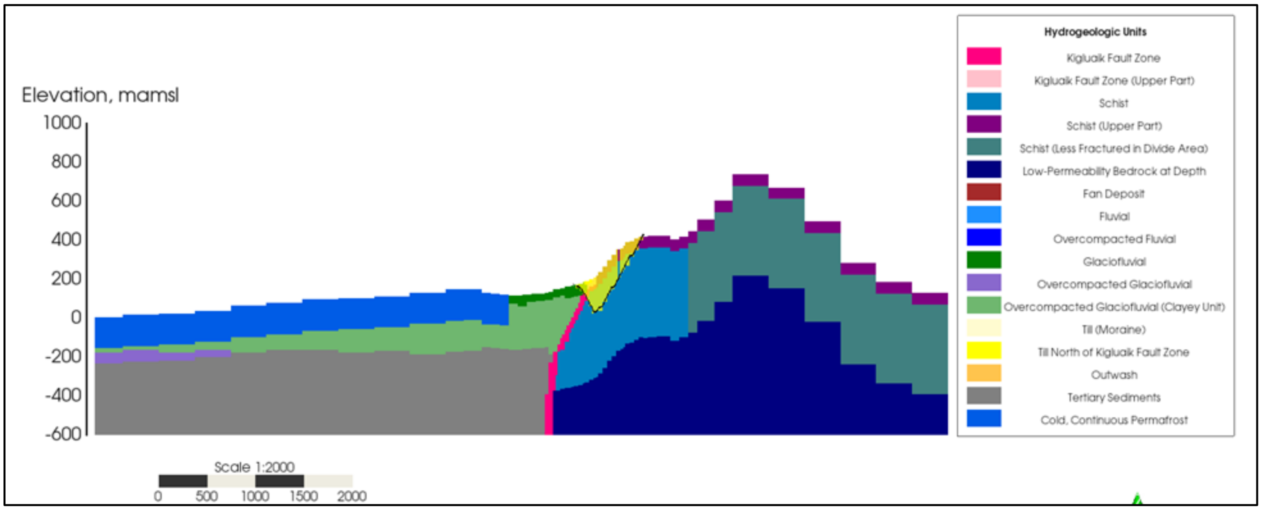


Figure 12-11. Location of drain cells used for simulation of open pit (plan-view)



Note: Drain cells used in the simulation of pit excavation are shown in bright yellow.

Figure 12-12. Location of Drain Cells Used for Simulation of Open Pit (Cross Section)

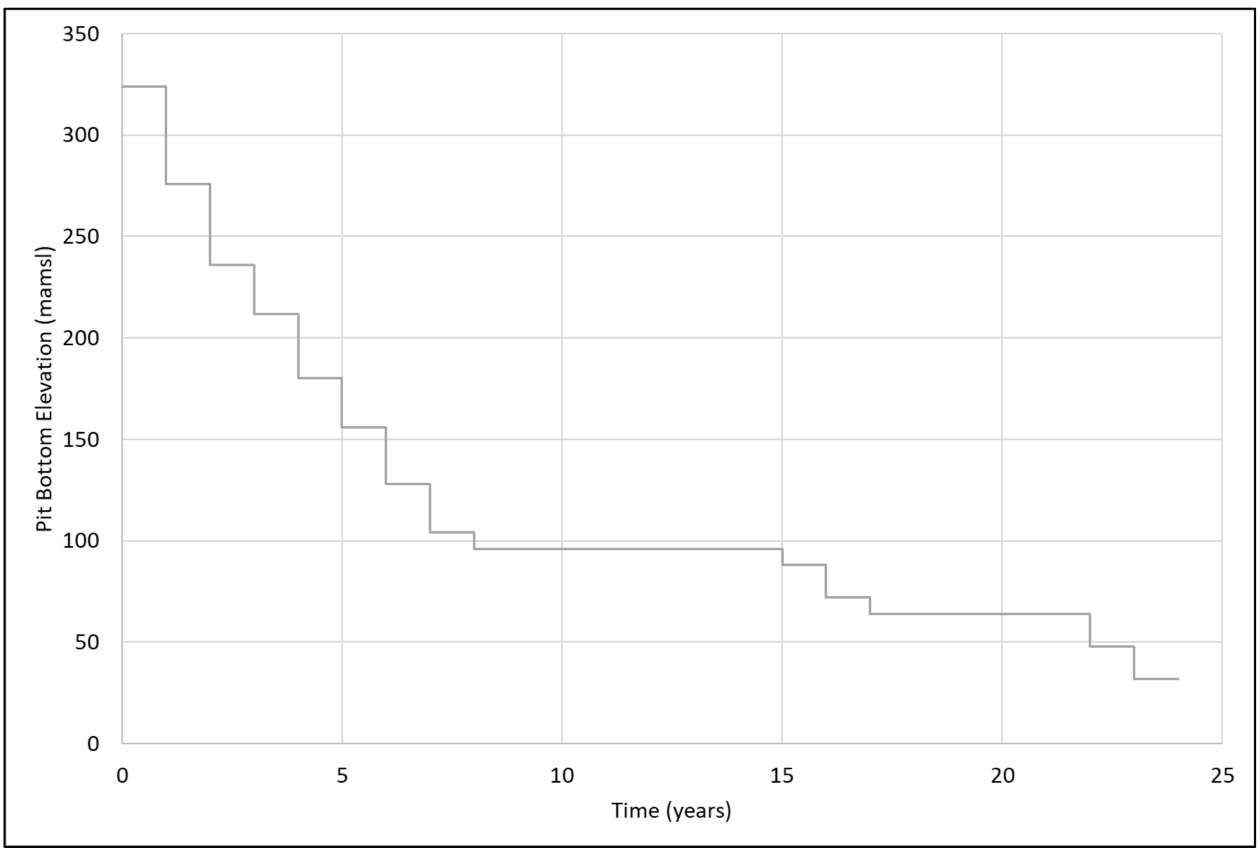


Figure 12-13. Proposed Pit Bottom Elevation in Time

12.3.2 Predicted Groundwater Inflow into Open Pit

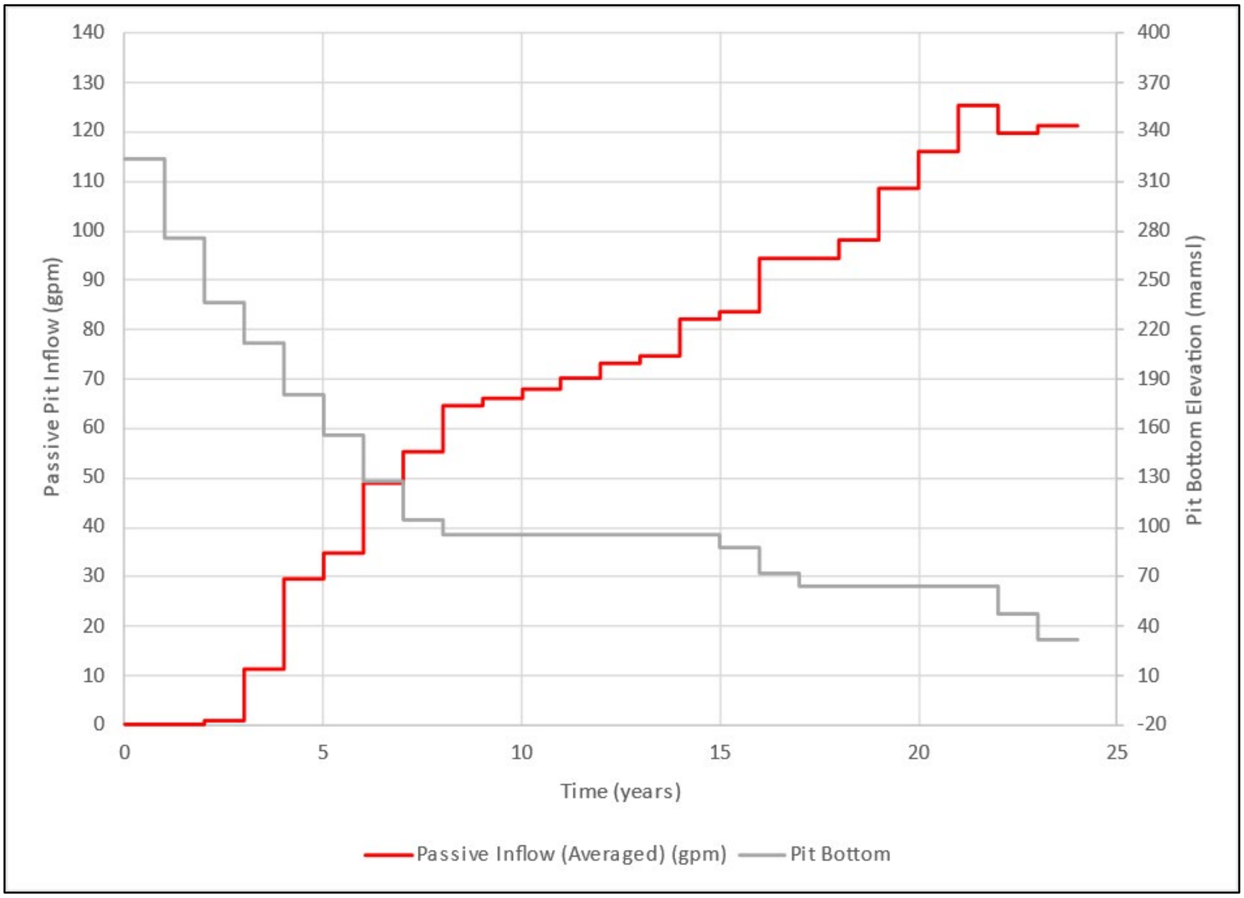
The predicted yearly average passive groundwater inflow to the proposed pit in time and the proposed pit bottom elevation are shown in Figure 12-14.

The distributions of groundwater inflow to the proposed pit from different hydrogeological units are shown Figure 12-15.

The model predicts a gradual increase of groundwater inflow from 0 gpm (in the first two years of mining) to 125 gpm. The major source of the groundwater inflow to the pit is the depletion of storage in the schist.

The low predicted groundwater inflows to the pit can be explained by:

- Completion of the pit within low-permeability schist (with assumed lateral anisotropy, Kx>Ky)
- Low water table in the highly permeable sedimentary units to the north of the fault. The model simulates no inflow from the sediments since the water table is below the elevation at which the pit will excavate the fault.



Note: Yearly averaged inflows are shown.

Figure 12-14. Predicted Passive Groundwater Inflow into Open Pit

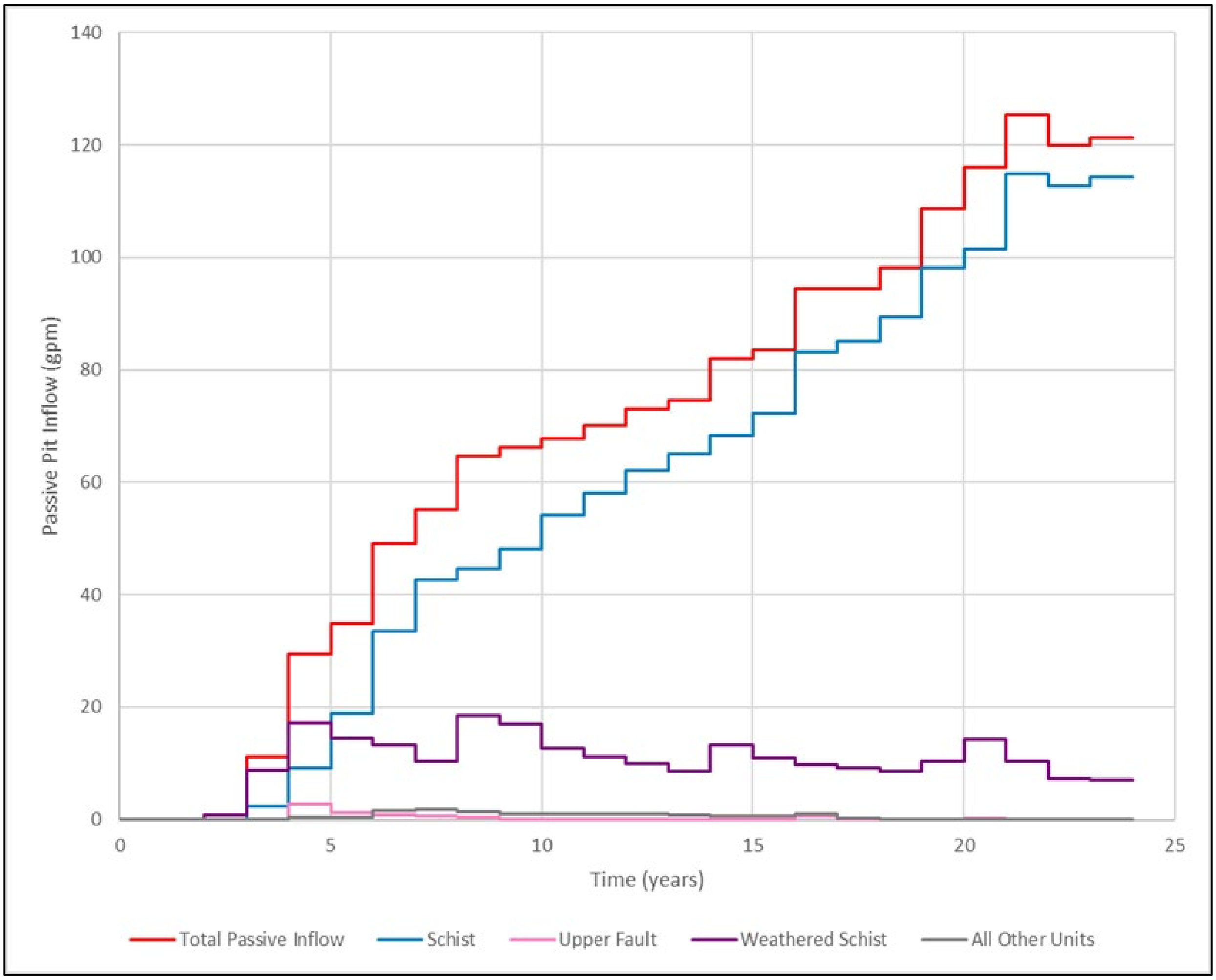
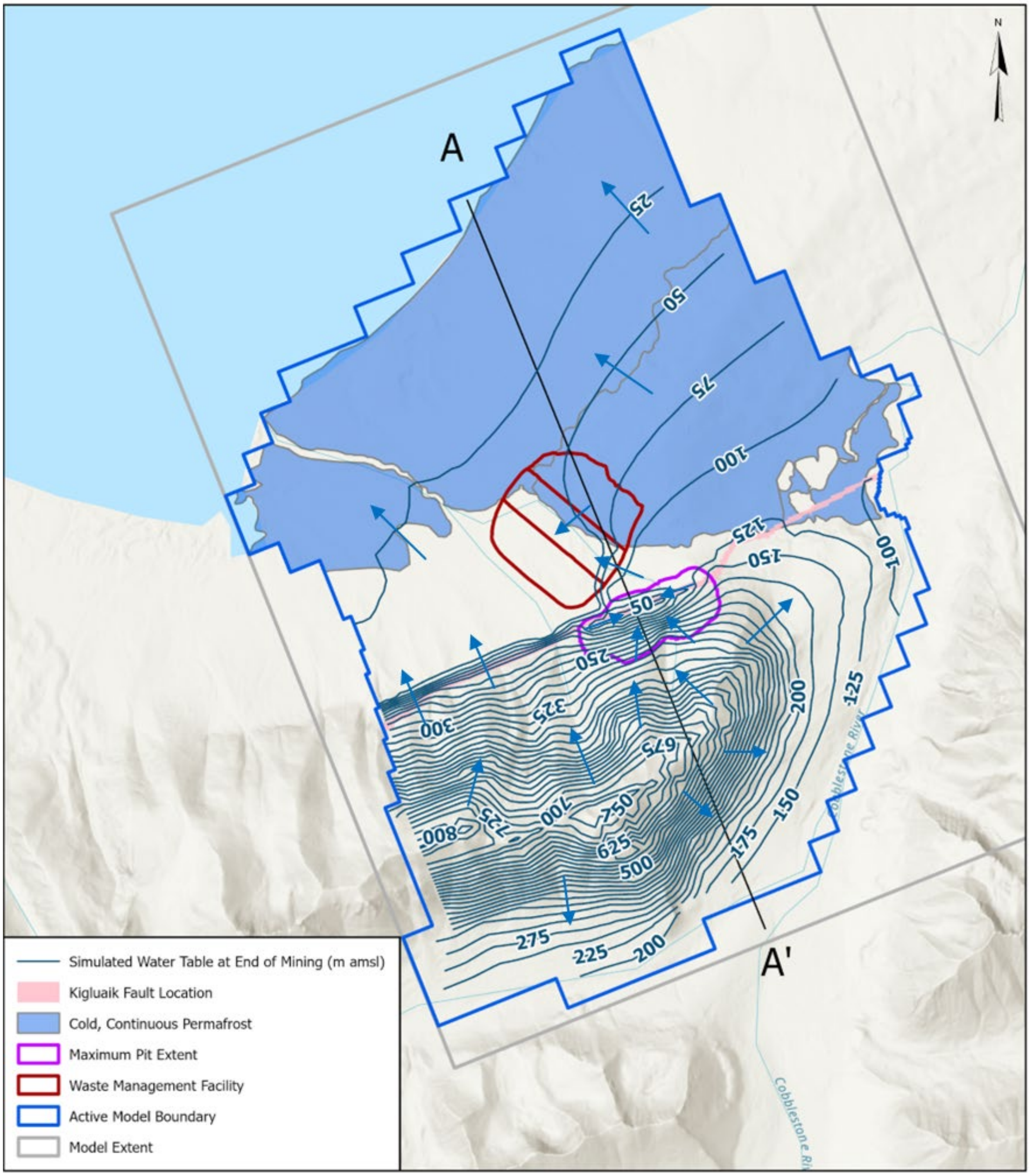


Figure 12-15. Distribution of Groundwater Inflow to Pit from Different Hydrogeological Units

It should be noted that completed predictions of the pit inflow (shown in Figure 12-14 and Figure 12-15) do not count surface-water components (direct inflow from precipitation). A very preliminary analysis completed by SRK indicates that additional yearly average inflow from direct precipitation (rainfall, snowmelt) could be up to 451 gpm (based on the assumption that 90% of precipitation within the extent of the ultimate pit will be discharged to the pit bottom). This indicates that the simulated groundwater inflow component is only about 27% of the total required dewatering rate, at maximum. Direct precipitation makes up the rest of the dewatering rate.

12.3.3 Predicted Changes in Water Levels During Proposed Mining

The predicted water table and direction of groundwater flow at the end of mining in plan-view and cross-section are shown in Figure 12-16 and Figure 12-17, respectively. The predicted change in the water table between pre-mining and the end of the mining conditions (drawdown) is shown in Figure 12-18.



Note: The blue arrows show the direction of groundwater flow

Figure 12-16. Predicted Water Table and Direction of Groundwater Flow in Mine Area in Plan-View at End of Mining

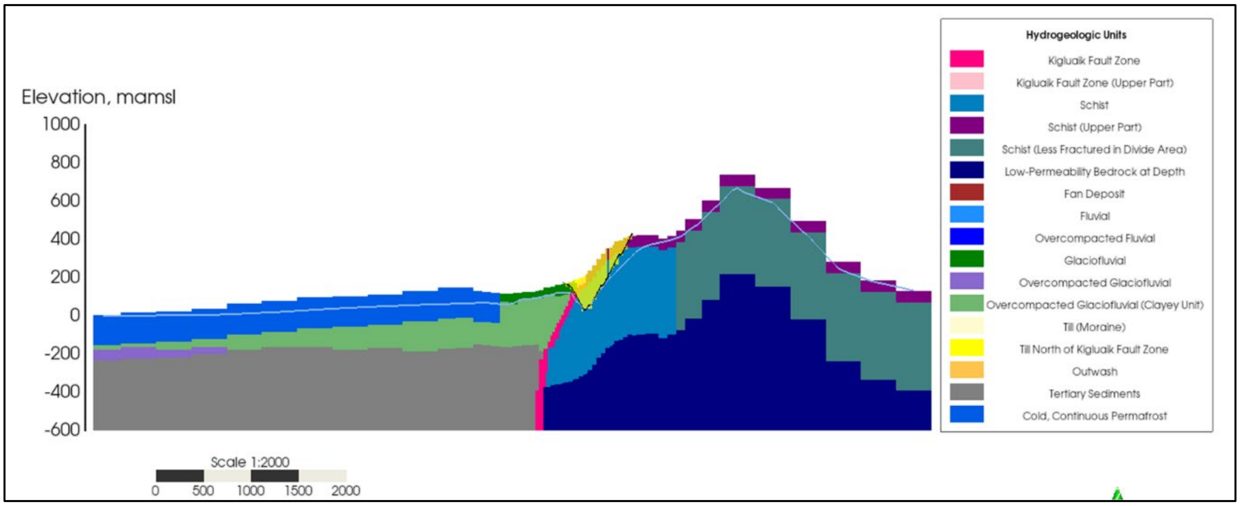
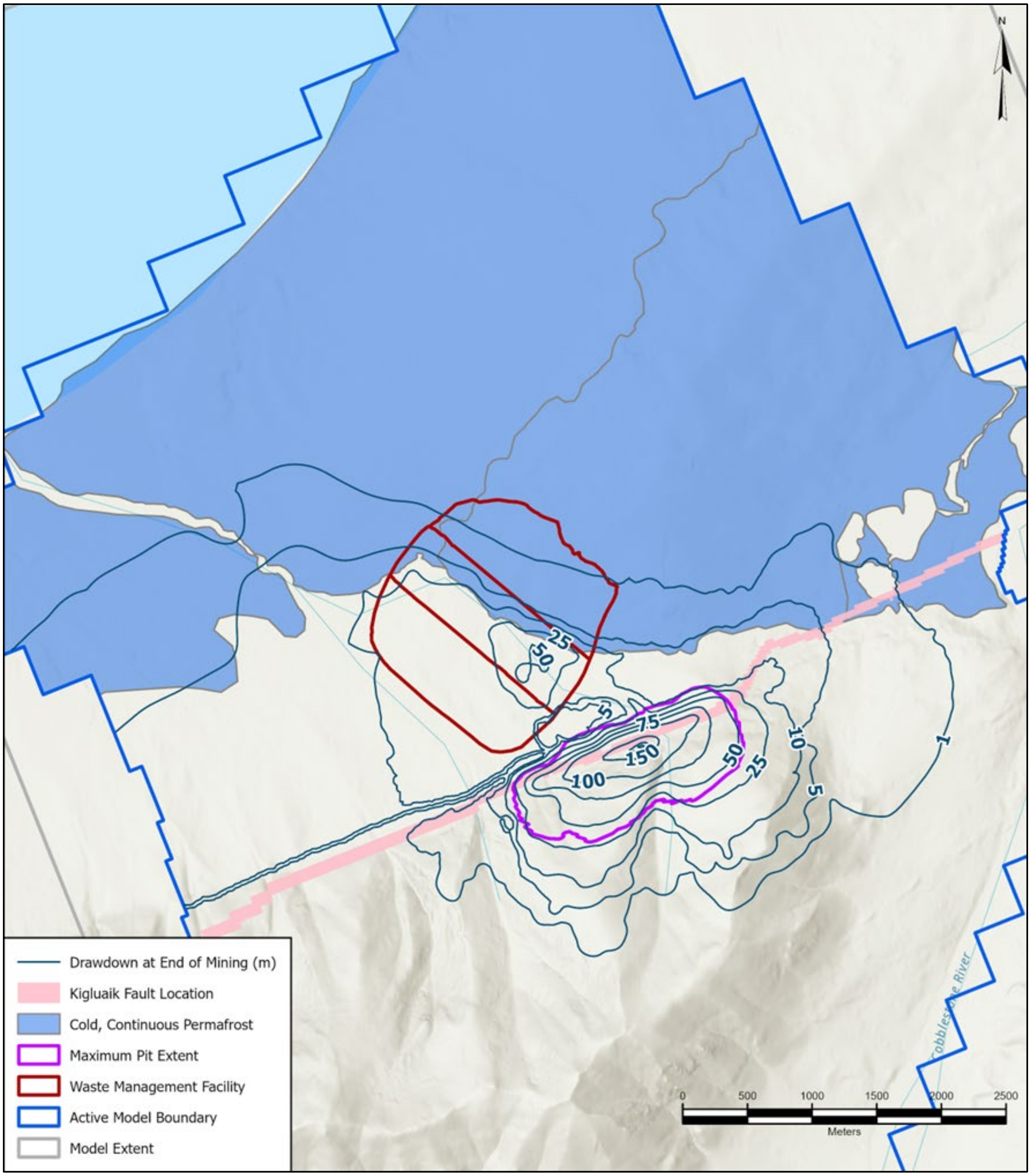


Figure 12-17. Predicted Water Table in Cross-Section at End of Mining



Note: Graphite Creek is assumed to be re-routed into Glacier Canyon Creek during mining.

Figure 12-18. Predicted change in water table between pre-mining and end of mining conditions

The model predicts a combination of two drawdown cones:

- Within the pit due to its dewatering
- Below the WMF due to its lining

The model predicts the propagation of drawdown to the west due to:

- Capturing of bedrock groundwater flow by the pit
- Decreased recharge into the sediments due to the lining of WMF
- The presence of the cold permafrost to a depth of 160 m to the north limiting drawdown propagation within the first 160 m of the depth (cross-sectional transmissivity of the sediments below the permafrost is relatively low; the most permeable units are frozen).
- High hydraulic conductivity of two important hydrogeologic units, Glaciofluvial and Fan deposits, allowing greater propagation of drawdown toward the western model boundary.

The predicted groundwater budget at the end of mining and its changes compared to pre-mining conditions are shown in Table 12-5.

Table 12-5. Predicted groundwater budget at the end of mining

Component	**Pre-Mining Flows (gpm)**	**End of Mining Flows (gpm)**	**Change in Flows (gpm)**
Recharge from Precipitation	2,883	2,694	-189
Groundwater Gain from Rivers/Creeks	5,745	3,761	-1,985
Groundwater Gain from Storage	0	72	72
Total Inflow	**8,628**	**6,526**	**-2,102**
Groundwater Discharge to Imuruk Basin	5,134	3,978	-1,156
Groundwater Discharge to Rivers/Creeks/Wetlands	3,494	2,428	-1,066
Groundwater Discharge to Storage	0	0	0
Groundwater Discharge to Pit	0	119	119
Total Outflow	**8,628**	**6,526**	**-2,102**

Notes:

- *Negative numbers indicate a decrease in flow/*
- *Decrease in recharge is due to the removal of recharge in the areas of the open pit and the WMF.*
- *Decrease in groundwater gain from rivers/creeks is due to the re-routing of Graphite Creek through a lined channel into Glacier Canyon Creek and the removal of Graphite Creek and tributaries to Glacier Canyon Creek under the waste management facility.*

Table 12-5 indicates that:

- Groundwater inflow into the pit has the following sources:
  - Depletion of groundwater storage
  - Capturing of groundwater discharge into the rivers/creeks and Imuruk Basin
- Mining (pit inflow, elimination of recharge below WMF, and surface water re-routing) will cause a reduction of groundwater gain from the surface water bodies with net values of about 1,108 gpm

The latter estimate is approximate due to the inaccuracy of the simulation of surface water flow.

The predicted passive groundwater inflow into the pit is relatively low and can be managed by in-pit sumps.

12.4 Predictions of Post-Mining Conditions

A pit lake will be formed after the mining and dewatering operation has ceased. Pit lake infilling during post-mining conditions was evaluated preliminarily by two methods under the following assumptions:

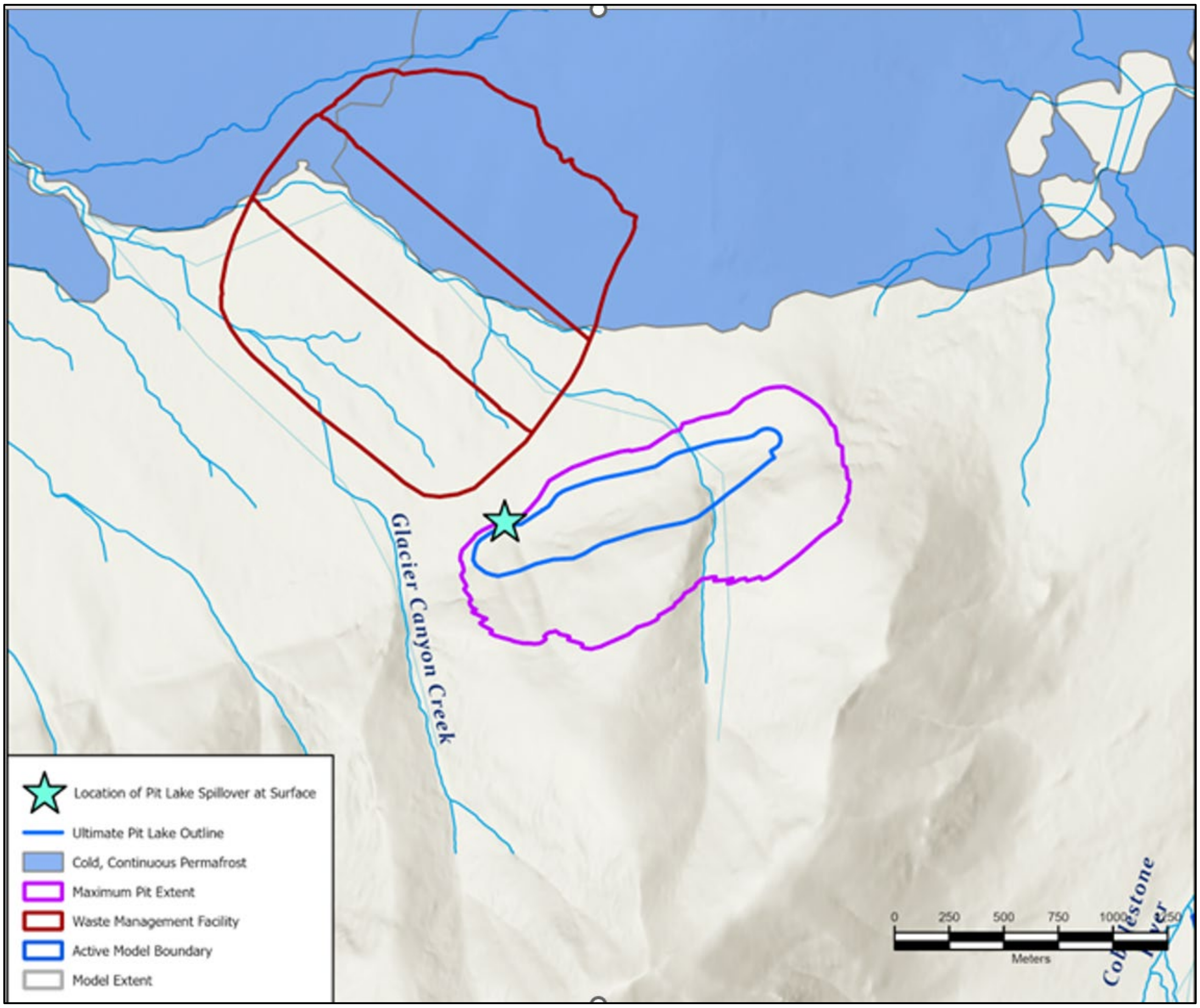
- Up-catchment runoff will continue to be captured at the pit southern wall.
- The pit lake will spill over as surface water if it reaches an elevation of 148 mamsl.
- Net pit lake precipitation minus evaporation rate of 404 gpm.

The last assumption is based on the following estimates:

- Adjusted rain plus snow water equivalent is 824 mm/yr
- Potential evaporation (Pe) is 250 mm/yr
- Pit lake evaporation is 70% of Pe
- Pit Lake surface area at the surface spillover elevation

It should be noted that the assumed pit lake evaporation rate of 175 mm/yr may be overestimated since the pit lake will be ice-covered a proximately 2/3 of the year, and this rate needs to be evaluated later for more precise pit-lake infilling predictions.

The locations of an ultimate pit lake and spillover point are shown in Figure 12-19.



Note: Graphite Creek and its tributaries are shown for pre-mining conditions
Figure 12-19. Location of ultimate pit lake and spillover point

The pit lake infilling was preliminarily simulated by the groundwater model without consideration of the changes in pit lake precipitation and evaporation in time (as the size of the pit lake grows).

The grid cells representing pit voids were replaced by pit lake cells with hydraulic parameters as follows:

- Hydraulic conductivity of 1,000 m/day
- Specific yield of 1

For example, the location of pit lake cells in Layer 1 is shown in Figure 12-20

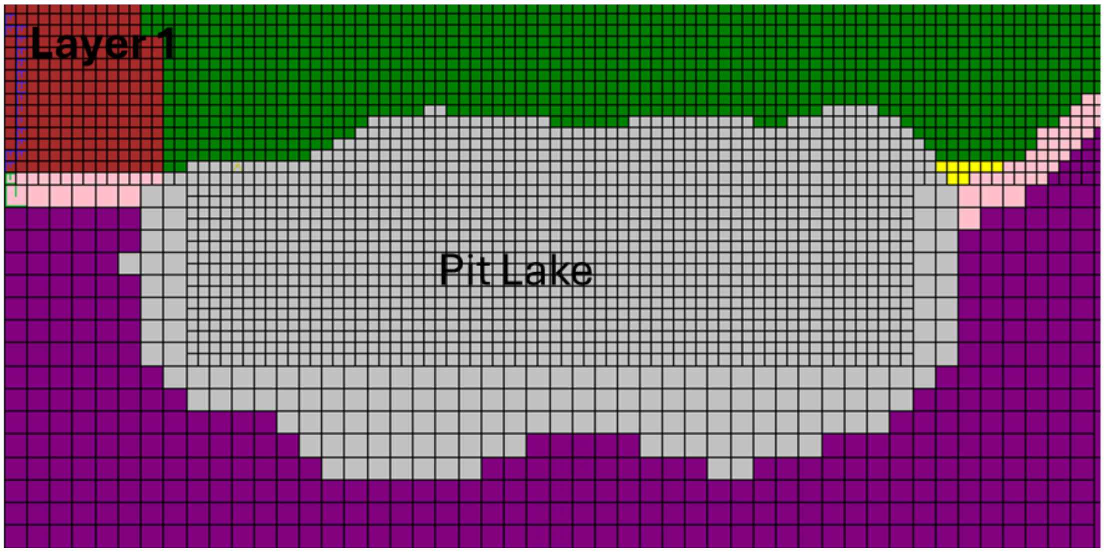


Figure 12-20. Location of pit lake cells in uppermost model layer

Additionally, the simulated pit lake stage-volume relationship was verified by comparison with the mine plan.

The predicted pit lake infilling in time is shown in Figure 12-21. The predicted ultimate pit lake flows are shown in Table 12-6.

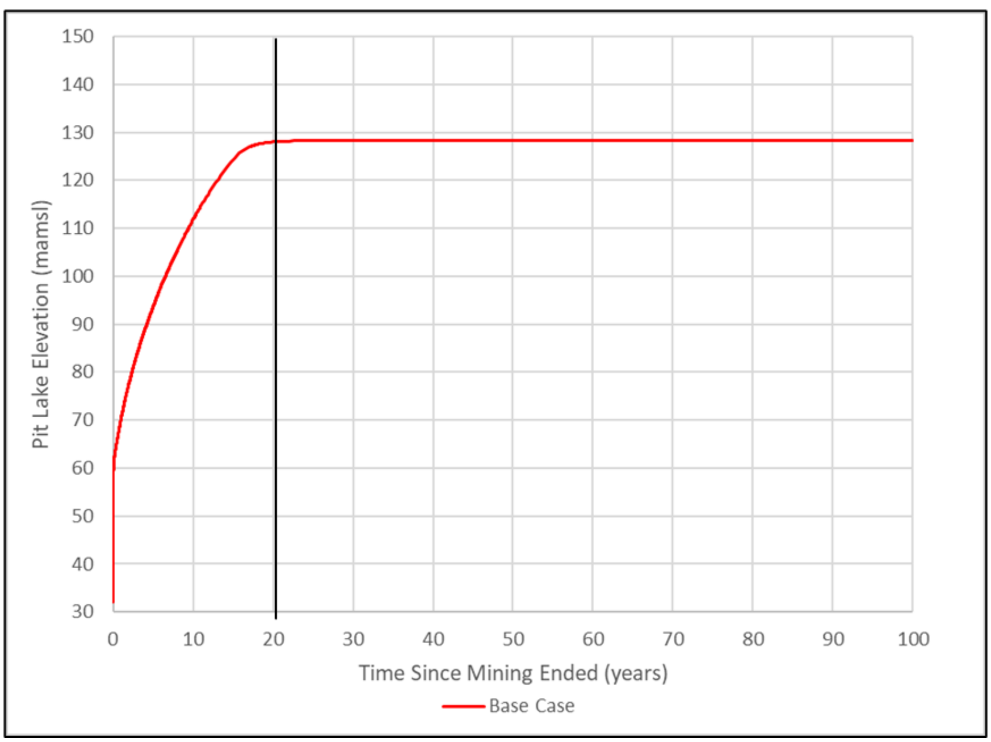


Figure 12-21. Predicted pit lake elevation over time

Table 12-6. Predicted ultimate pit lake flows

Component	Flow (gpm)
Groundwater Inflow to the Pit Lake	62
Pit Lake Outflow to Groundwater	466
Spillover Rate into Surface Water	0
Net Precipitation - Evaporation	404

The predicted long-term water table across the pit lake is shown in Figure 12-22.

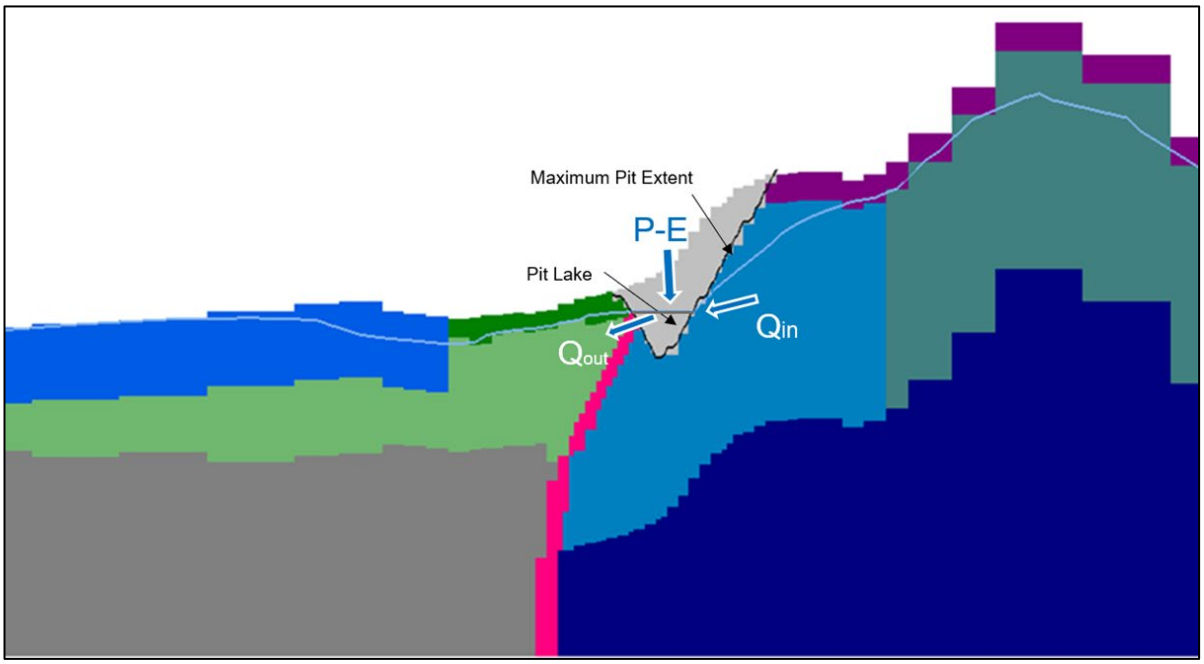


Figure 12-22. Predicted long-term post-mining water table and pit lake elevation

The pit lake begins spilling over into the groundwater north of the Kigluaik Fault above the excavation of the fault due to the presence of highly permeable glaciofluvial sediments, as shown in Figure 12-23. This figure shows the distribution of different sedimentary units to the north of the pit lake for the upper 5 layers of the model and potential locations of spillover.

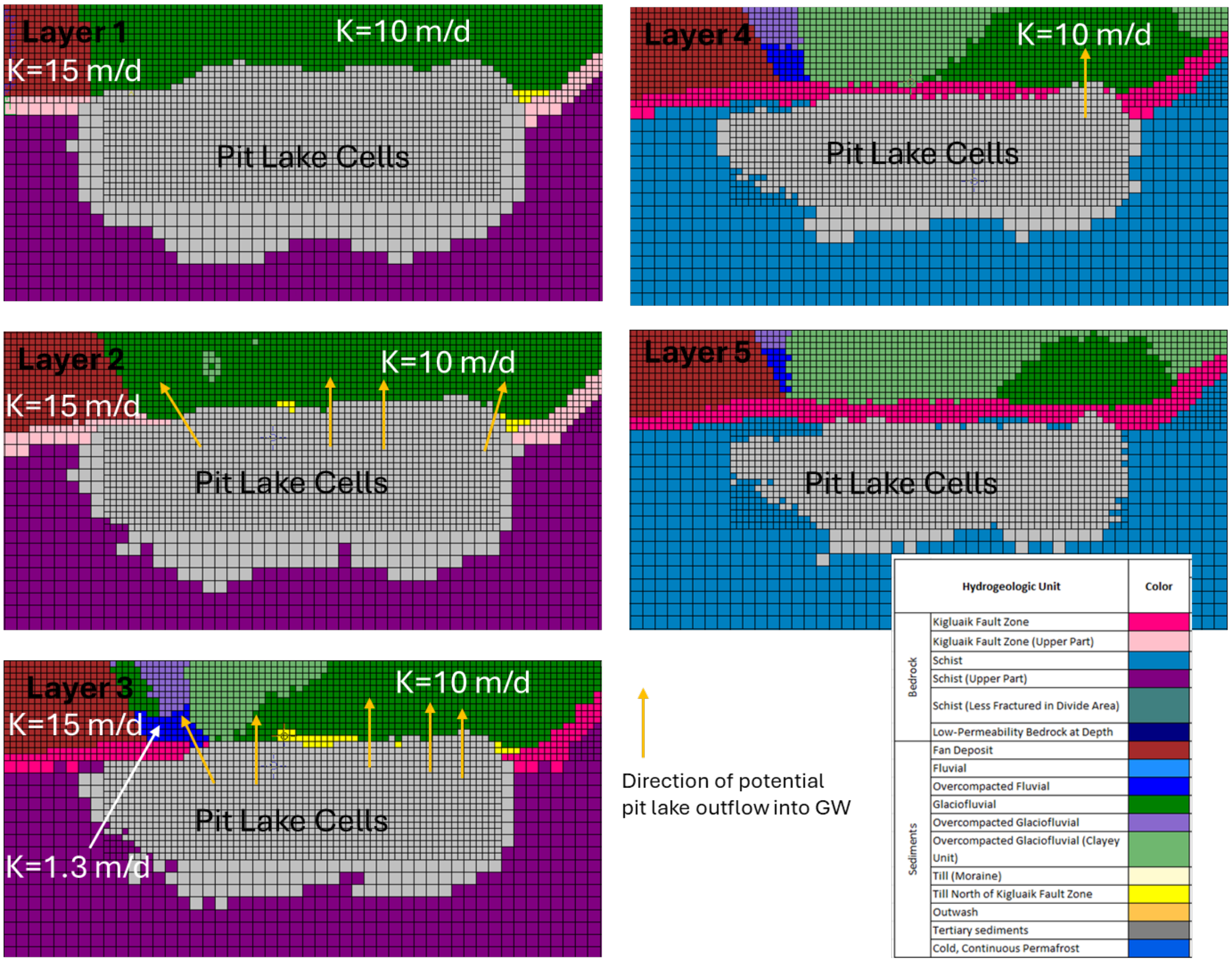


Figure 12-23. Locations of potential pit lake spillover into groundwater shown on the first five upper model layers

Figure 12-21, Figure 12-22, Figure 12-23 and Table 12-6 indicate:

- The hydraulic conductivity of the Glaciofluvial and Fan deposits controls the final pit lake elevation.
- Pit lake elevation will not reach the ground surface at the spillover elevation due to the high hydraulic conductivity of these units. The pit lake starts spilling over into the sedimentary groundwater system as it reaches the lowest elevation at which the pit excavates the Kigluaik Fault.
- The maximum pit lake elevation is predicted to be about 128.5 m in 15 to 20 years (or 19.5 m below ground surface spillover elevation) with pit lake outflow to the groundwater of about 466 gpm.
- This indicates flow-through pit lake behavior. Groundwater inflow into the pit lake will decrease from 125 gpm at the beginning of infilling to about 66 gpm at the ultimate pit lake elevation.

12.5 Results of Sensitivity Analysis of Groundwater Inflow into Proposed Pit

The schist bedrock unit is the primary source of groundwater inflow to the open pit during mining, so the hydrogeological properties of the schist are a major control on the amount of passive inflow to the pit. If the Schist unit is more permeable in the south-north direction (i.e., isotropic), more recharge from precipitation is required to reproduce the measured water levels. Therefore, three additional scenarios were explored that varied the properties of the schist and recharge from precipitation values:

- Scenario 1 - The lateral anisotropy in Schist was removed (Kx=Ky=Kz), allowing additional flow from south to north towards the pit.
- Scenario 2 – The recharge from precipitation was increased from 20% to 25%.
- Scenario 3 – Combination of Scenarios 1 and 2 – the Schist was assumed isotropic, and recharge increased to 25%

The passive groundwater inflow to the pit under these various scenarios is shown in Figure 12-24.

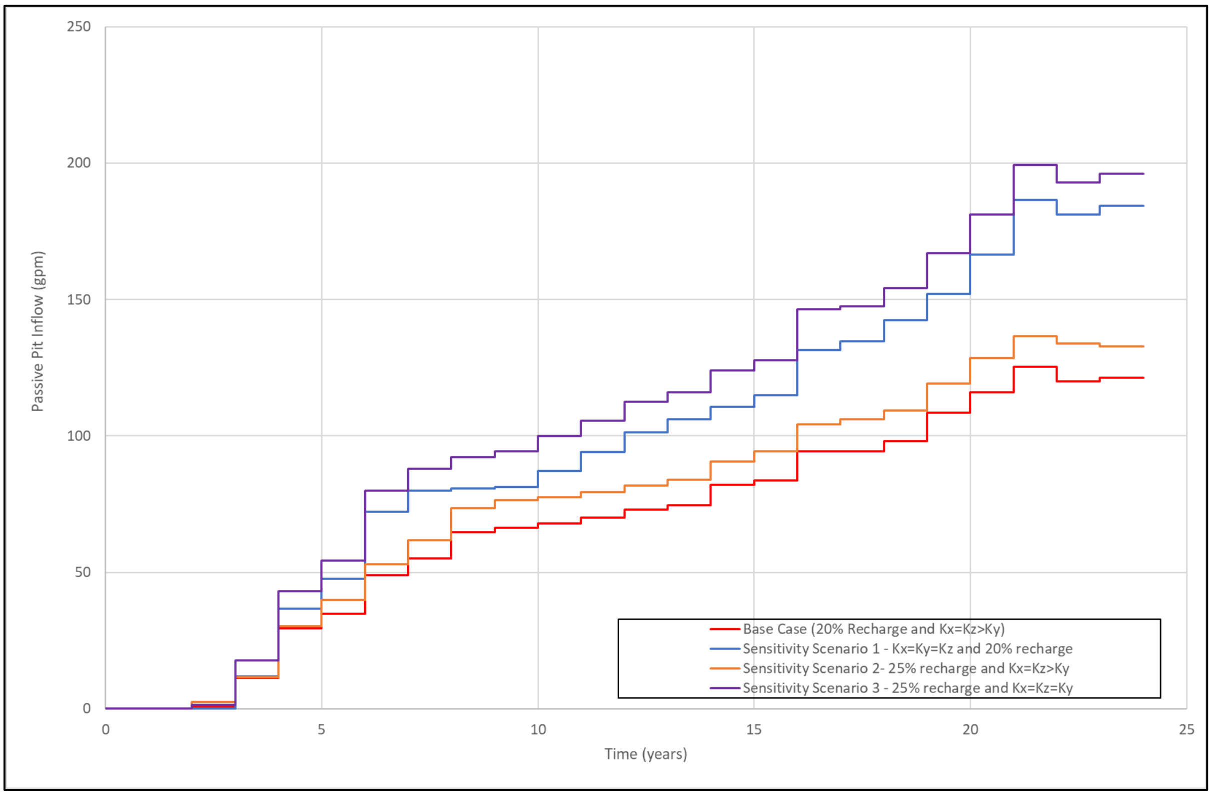


Figure 12-24. Results of sensitivity analysis on groundwater inflow to proposed pit

The results of the sensitivity analysis indicate that:

- The lateral anisotropy ratio of the schist unit is a major control of the amount of passive groundwater inflow to the pit. If no lateral anisotropy exists, the passive pit inflow may reach up to 187 gpm (Scenario 1). There is some evidence for lateral anisotropy in the schist, but the exact ratio and direction are unknown.
- The inflow prediction is less sensitive to changes in the recharge from precipitation from 20% to 25% (Scenario 2). The maximum groundwater inflow is 136 gpm or about 9% larger compared to the inflow rate of 125 gpm for the Base Case.

- The model cannot reasonably reproduce measured water levels under both Scenario 1 and Scenario 2 (simulated water levels are lower than the measured for Scenario 1 and higher – for Scenario 2)
- The maximum groundwater inflow to the pit of 200 gpm was obtained under Scenario 3 – no anisotropy in the schist and recharge is 25 of precipitation. In this case, the model reasonably simulates measured water levels with a Scaled RMS Error of 9.4% slightly higher than for the Base Case (9.2%).

12.6 Results of Sensitivity Analysis of Pit Lake Infilling

The permeable Glaciofluvial and Fan deposits control the ultimate pit lake elevation and its hydrogeological role. If the sediments are less permeable in the northern pit wall, pit lake elevation can be higher than simulated in the Base Case. Additionally, sensitivity runs were completed by:

- Incorporating into the model a new hydrogeological unit: sediments around the northern pit wall. This unit with a width from two to four cells was simulated around the northern pit wall replacing the permeable Glaciofluvial and Fan deposits in the pit walls, as shown in Figure 12-25.
- Varying the hydraulic conductivity of this unit from 10-2 m/d to 1 m/d.

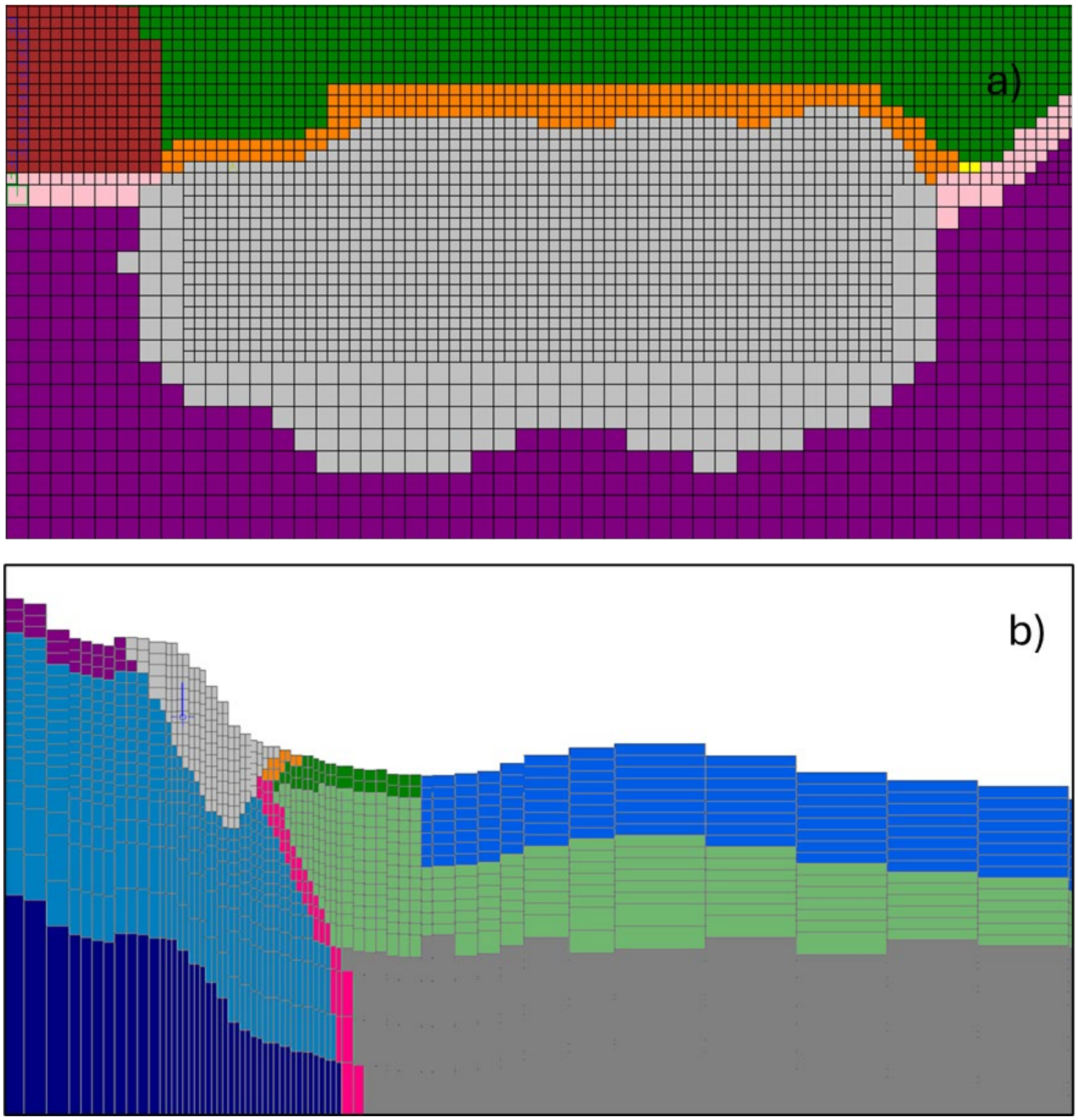


Figure 12-25. Location of new hydrogeological unit - sediments around the northern pit wall used for sensitivity analysis (shown by orange cells in plan-view (a) and cross-section (b))

These sensitivity runs were completed to evaluate the pit lake elevations and water balance components if the hydraulic parameters of the pit wall's permeable sediments are different from those used in the Base Case.

The results of completed sensitivity runs are presented in Figure 12-26 and Table 12-7.

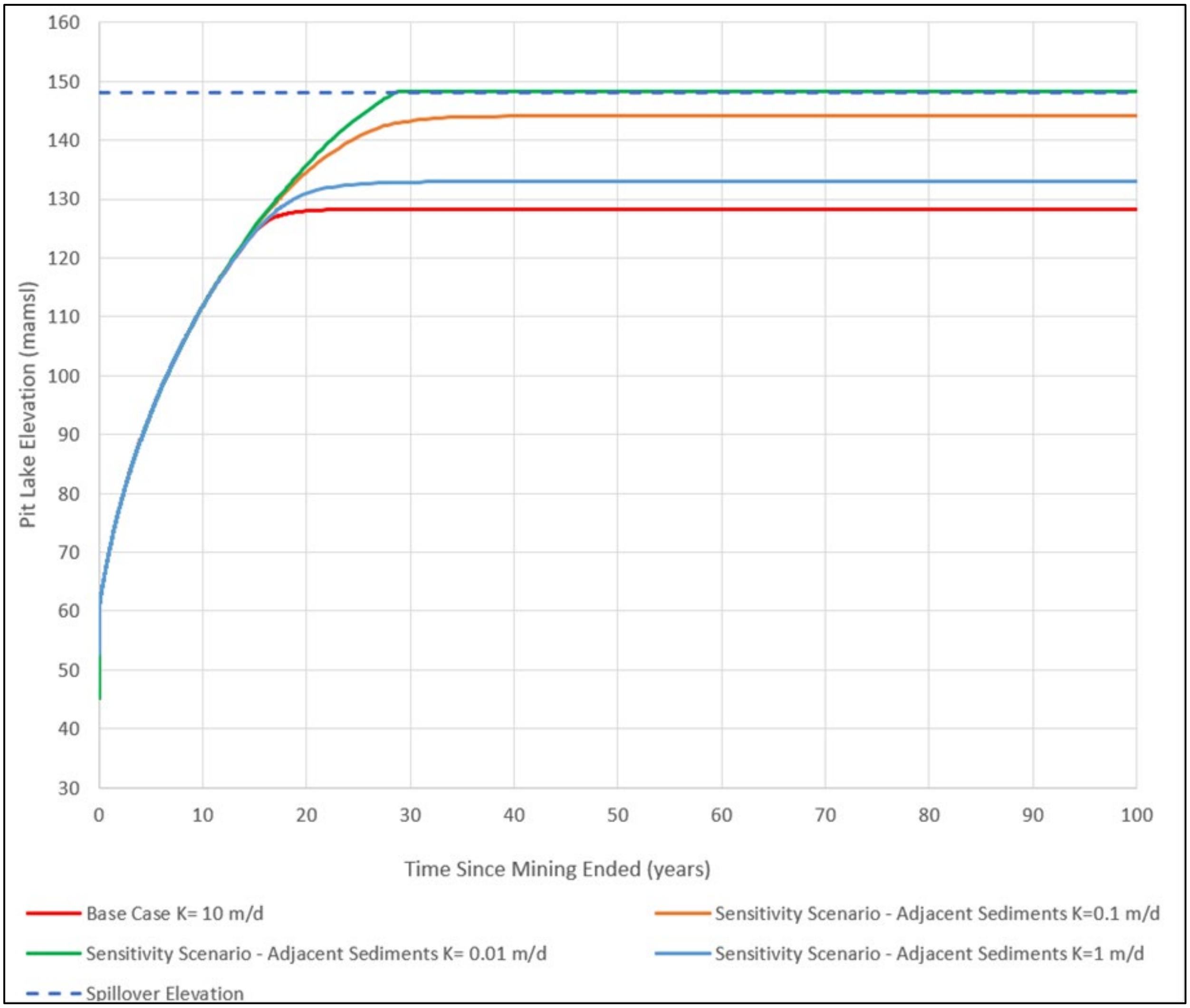


Figure 12-26. Results of sensitivity analysis on the pit lake elevation

Table 12-7. Predicted ultimate pit lake flows

Ultimate Pit Lake Elevation	Hydraulic Conductivity of the Sediments	Pit Lake Outflow into the Groundwater System (gpm)	Pit Lake Outflow into the Surface Water (gpm)	Groundwater Inflow to the pit (gpm)
128.5	10	470	0	66
133	1	468	0	64
144.1	0.1	461	0	57
148.3	0.01	161	296	53

Figure 12-26 and Table 12-7 shows that:

- Pit Lake elevation will not reach the ground surface spillover elevation if the hydraulic conductivity of the sediments in the northern pit wall is 0.1 m/d or more.

- Pit Lake can reach ground-surface spillover elevation if the hydraulic conductivity of the sediments is 0.01 m/d or less.

Recently identified permeable Glaciofluvial and Fan deposits in the northern pit wall (shown in Figure 12-2) suggest that the pit lake will most likely outflow into the groundwater system in the sediments as soon as it reaches an elevation of about 128.5 m (as simulated for the Base Case).

12.7 Hydrogeological Uncertainties

Analysis of available data indicates hydrogeological uncertainties including:

- Hydraulic conductivity and saturated thickness of the most permeable unconsolidated sediments in the northern pitwall area – horizontal K_h, and anisotropy ratio (Kh: Kv).
- Water table elevation in the alluvium and solifluction deposits to the north of the Kigluaik Fault and their saturated thickness.
- Mechanism of recharge from precipitation (snowmelt, rainfall, runoff infiltration) and recharge rates considering the presence of warm permafrost and possible infiltration of surface runoff into the sediments to the north of the Kigluaik Fault.
- Hydraulic connection of surface-water features with the groundwater system, especially within the unconsolidated sediments. Surface water flow in the creeks may be the main source of recharge to the groundwater system.
- Shape of the Kigluaik Fault within the deposit area and the elevation at which the final pit shell will excavate this fault.
- Lateral anisotropy and groundwater storage parameters in the bedrock units (schist and weathered schist)

12.8 Summary

The completed update of the numerical groundwater model for the Graphite Creek Project leads to the following summaries and conclusions:

- The existing numerical groundwater model is updated based on new data collected in the field in 2024 and the revised conceptual hydrogeological model
- The calibrated model reasonably reproduces the current pre-mining hydrogeological conditions.
- The model predicts:
    - Groundwater inflow into the proposed pit of up to 125 gpm under the Base Case and up to 200 gpm under the sensitivity runs. SRK recommends using a groundwater inflow of 200 gpm for the estimation of a total pit inflow after adding surface water inflow estimates.
    - The drawdown at the end of mining will propagate to the west. The maximum extent of the 1 m drawdown contour will reach the western model boundary. This is due to the capturing of bedrock groundwater by the pit and decreased recharge into the sediments due to the lining of WMF. If part of the recharge from precipitation into WMF will be collected and rerouted into the groundwater system after treatment, the predicted drawdown extent within the sediments will be smaller.
    - The pit lake infills in about 15-20 years reaching an elevation of about 128.5 mamsl (or 19.5 m below the ground surface spillover elevation) with pit lake outflow to the groundwater of about 466 gpm. This indicates flow-through pit lake behavior.

- Completed limited sensitivity analysis indicates that the major uncertainties in predictions are related to:
  - Lateral anisotropy of bedrock units in pit walls (controls groundwater inflow to the pit)
  - Hydraulic conductivity of the Glaciofluvial and Fan deposits (controls pit lake outflow into the groundwater system and ultimate pit lake elevation)

These estimates are based on available hydrogeological data and should be considered preliminary due to the hydrogeological uncertainties described above. These uncertainties should be addressed during additional hydrogeological studies and groundwater model updates.

The updated numerical groundwater model is sufficient for the Feasibility Study. Additional work should be considered to support the permitting process as follows:

- Revision of mechanism of groundwater outflow to the north:
  - Below cold permafrost – sufficient cross-sectional transmissivity needs to be simulated if cold permafrost exists there
  - Through the taliks
- Use of average monthly precipitation plus snowmelt data while applying the recharge coefficient for more detailed simulation of the transient groundwater regime.
- Improving transient model calibration to the observed seasonal water level changes.
- More accurate simulation of pit lake infilling considering the pit lake surface area variable in time. .
- Implementing solute-transport modeling for the evaluation of potential groundwater impacts by the pit lake water. This modeling can be done by a combination of:
  - Forward particle tracking to evaluate the direction of contaminant movement and estimate the time when it can reach the areas near the southern extent of the permafrost, where groundwater is expected to discharge into the creeks. These locations are shown in Figure 12-10.
  - 3-D non-reactive solute transport modeling using MODFLOW-USG Transport (USG-T) to evaluate dilution of pit lake water concentration due to the simulated mechanisms of convection and dispersion. The recommended modeling allows estimating the potential extent of a plume of impacted groundwater from the pit lake outflow to the groundwater and creeks over time.
- Updating the extent of hydrogeological units and their hydraulic parameters based on new data collected during the 2025 field season.

13 Discussion

The bedrock hydrogeology is considered to be at the feasibility level. To a substantial degree, this is because our current understanding is that meteoric water is the dominant source of water that will need to be removed from the pit. Our hydraulic testing is adequate in most areas of the pit with the exception of the western quarter. We do not have any reason to believe that additional work in this area will result in a substantial change in pit inflow predictions.

There is substantial uncertainty in the nature, distribution, and hydraulic conductivity of the sediments that will form the upper portion of the north wall of the pit. It is unlikely that this area represents a source of meaningful groundwater inflow to the pit due to lack of saturated thickness and lack of source (the pit will isolate this area from upgradient groundwater). This area is significant, however, in predicting pit lake behavior. Further investigation of this area is needed to gain confidence in pit lake seepage rates, fill timing, fill level, and ultimately whether or not the pit lake will overflow.

Meteoric modeling of long-term rainfall, snow melt, and runoff is currently modeled based on large scale gridded climate models with limited scaling to local conditions. The availability of site meteorologic data and snow surveys will allow a substantial improvement in our ability to replicate local conditions in the groundwater model.

The current groundwater modeling results predicts mining impacts will reach the western boundary of the model. This is caused by a number of factors, most of which are partially or poorly understood:

- Lack of meteoric water input – This is due to the size of the WMF, which will be lined, precluding water input; and deep cold permafrost under the Cobblestone moraine. The nature of the permafrost under the Cobblestone moraine is poorly documented, however additional work is unlikely to substantially change the current understanding.
- Sedimentary hydrogeologic units – The distribution of the units is reasonable given our current understanding, but is conceptual model driven. Further investigation will certainly result in refinements to the geologic model. The estimated hydraulic conductivity of most of these units is currently dependent on one test or literature values. Changing the hydraulic conductivity and distribution of some of these units; particularly the over-compacted, clayey glaciofluvial unit; could have a substantial effect on groundwater flow direction.

The feasibility of a Land Application Disposal (LAD) system for water disposal has been modeled outside the scope of this report (Stevens, 2024). The study shows that a LAD is feasible from a ground temperature perspective. Detailed hydrogeologic investigation will be required to determine the feasibility from a hydraulic perspective. The primary question is whether the receiving surficial hydrogeologic units are sufficiently permeable to receive the planned water discharge quantities.

Further integration of the water management plan with the groundwater model is needed. Water from upper Graphite Creek and mid and upper Glacier Canyon Creek is planned to be routed around the WMF. This water has not been brought back into the model at this time. In addition, further refinement of the water management plan may identify ways to maintain more water as non-contact water, which will then need to be brought into the groundwater model domain.

Permafrost has a substantial influence on meteoric water infiltration to groundwater and groundwater flow. Further understanding of permafrost distribution and properties will influence the understanding of groundwater flow.

The streams are thought to lose water to groundwater north in the lowlands. Additional gauging station(s) should be established downstream of the WMF in an attempt to quantify this loss (or gain).

14 Summary

This report presents the results from hydrogeologic studies performed at the Graphite Creek Project since 2019. This is the first comprehensive report since 2021. The principal goal of these studies is to understand the hydrogeologic system sufficiently well to predict pit inflow and post-mining effects at the feasibility study level. The work also supports environmental baseline and permitting requirements which will be the goal of work in future years.

The project area is divided into two mostly separate hydrogeologic systems by the Kigluaik Fault, a regional normal fault located on the north side of the Kigluaik Mountains. High metamorphic grade schist is found to the south of the fault and unconsolidated glacial and fluvial sediments fill the lowlands to the north. The fault has a well-developed clay-gouge zone which greatly restricts groundwater flow from the mountains to the lowlands.

The proposed pit is located primarily on southside of the fault, in bedrock, with the Kigluaik Fault exposed in the north pit wall. Sediments will only be exposed in the upper part of the north wall of the pit. Other principal mine facilities will be located in the lowlands.

Due to the high-grade metamorphic character of the bedrock, it has extremely low primary permeability. Virtually all of the permeability is in faults, fractures, and joints. The overall permeability of the bedrock is low with low storage as well. Two bedrock units are defined – shallow (less than 60m deep) and deep bedrock with median hydraulic conductivities (K) of 1.04E-01 m/day and 5.50E-03 m/day respectively.

The surficial geology of the lowlands consists of three main units: glacial till, glaciofluvial sediment, and older fan deposits. The glaciofluvial sediment is subdivided at depth based on limited drilling. The Cobblestone moraine, consisting mostly of till, dominates the eastern part of the projects area. The glaciofluvial sediments are found between Graphite Creek and Glacier Canyon Creek, and the fan deposit is found west of Glacier Canyon Creek. The till is thought to have low K of 4.08E-03 m/day. The old fan deposits have not been tested but are inferred to have an intermediate K of 1E0-1 m/day. The various glaciofluvial units have K values from 4.2E-03 m/day to 3.8E+00 based on limited testing or inferred values.

Permafrost is discontinuous in the mountains. Where present, it is warm with the bottom at approximately 100 meters, top of permafrost at 35 to 40 meters, and a perched aquifer often found on the permafrost in a suprapermafrost talik. Permafrost appears to be absent along the Kigluaik Fault. Permafrost in the southern part of the lowlands, where part of the WMF will be located, is warm and discontinuous. Further north near the Imuruk Basin and to the east under the Cobblestone moraine, the permafrost is thought to be cold and deep and nearly continuous.

Groundwater levels have large seasonal range. Water levels are high in the summer. In late September and October when surface temperatures drop below freezing, infiltration of meteoric water drops to a minimum and the groundwater level begins to drop. The groundwater level steadily declines all winter and then rises rapidly in late May and June upon spring breakup. This pattern is pronounced in the bedrock with a 20 to 35 m range of groundwater levels observed. Available data is much more limited in the lowlands, but a similar, though smaller pattern is seen.

Streams also have a large flow variation with peak flow in the summer and very little flow in the winter. Stream flow peaks in the early summer due to snow melt, then gradually declines through the rest of the summer. Peak flow, similar to breakup levels, may occur due to late summer and early fall storms.

The data and understanding were used to build a numerical groundwater model of the project area. The model was calibrated to the observed water level and then used to predict groundwater behavior during mining and post-mining. Pit inflow from groundwater at maximum pit development is predicted to average 125 gpm (base case) and up to 200 gpm (high end scenario). Net precipitation and evaporation input is expected to be approximately 400 gpm at that time. The majority of the groundwater inflow is expected to be from bedrock with only a minor contribution from the unconsolidated sediment on the north side of the pit.

A pit lake is expected to form post-closure. The pit lake is predicted to reach a stable elevation of about 128.5 m elevation in 15 to 20 years. This elevation is 19.5 m below the spill-over point. The behavior of the pit lake is dependent on the distribution and hydraulic conductivity of the sediment in the north wall of the pit which is poorly understood. Modeling of various scenarios by varying the net hydraulic conductivity indicates that the pit will likely not overflow except at the lowest hydraulic conductivity that was modeled.

Further work is needed to better define the distribution and hydraulic properties of the sedimentary units north of the fault. With this data we will be better able to predict the groundwater flow in the lowlands north of the pit, pit lake behavior, and the fate of constituents from the pit lake.

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Appendices

Appendix A. Ground Temperature

A1 – Typical Digital Temperature Cable Design

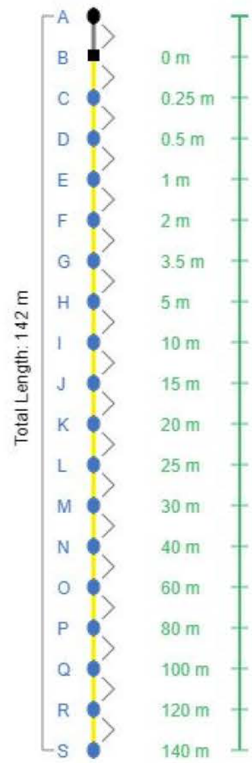
beadedstream

DTC Order Sheet

DTC Name: 140m Profiler, custom spacing v.3	Date Generated: 06-24-2021
Quantity: 4	Serial Number(s): Draft

Client Notes:
None

Component	Mold	Position	Section	Cable
XLR	XLR Mold	-	2 m	gray armored
Zero Marker	None	0 m	0.25 m	yellow
Protection/Sensor 1	Straight	0.25 m	0.25 m	yellow
Sensor 2	Straight	0.5 m	0.5 m	yellow
Sensor 3	Straight	1 m	1 m	yellow
Sensor 4	Straight	2 m	1.5 m	yellow
Sensor 5	Straight	3.5 m	1.5 m	yellow
Sensor 6	Straight	5 m	5 m	yellow
Sensor 7	Straight	10 m	5 m	yellow
Sensor 8	Straight	15 m	5 m	yellow
Sensor 9	Straight	20 m	5 m	yellow
Sensor 10	Straight	25 m	5 m	yellow
Sensor 11	Straight	30 m	10 m	yellow
Sensor 12	Straight	40 m	20 m	yellow
Sensor 13	Straight	60 m	20 m	yellow
Sensor 14	Straight	80 m	20 m	yellow
Sensor 15	Straight	100 m	20 m	yellow
Sensor 16	Straight	120 m	20 m	yellow
Sensor 17	End Mold	140 m	- m	-

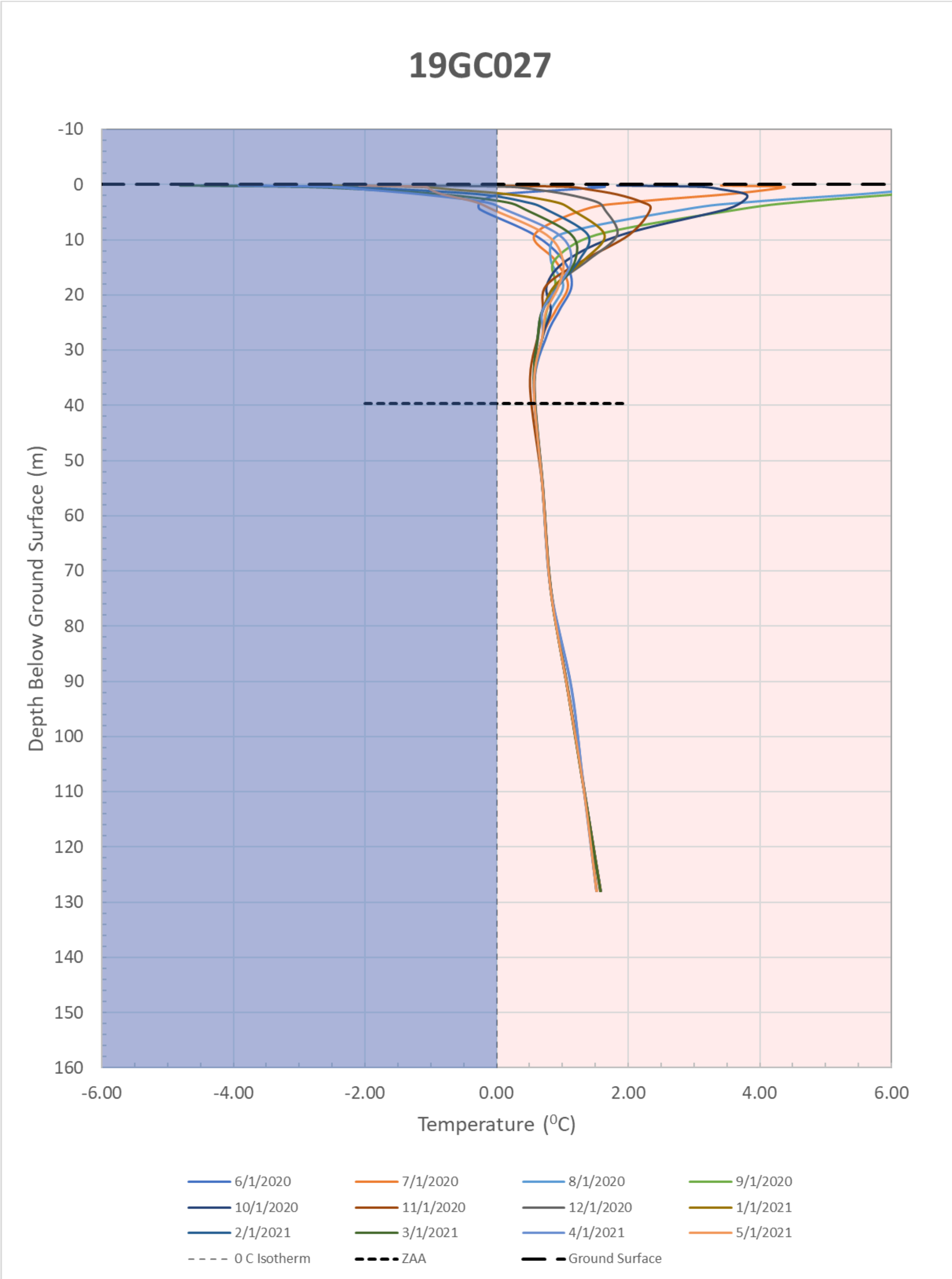


Return signed order sheet to BeadedStream at:
email: order@beadedstream.com
phone: 844-488-4880

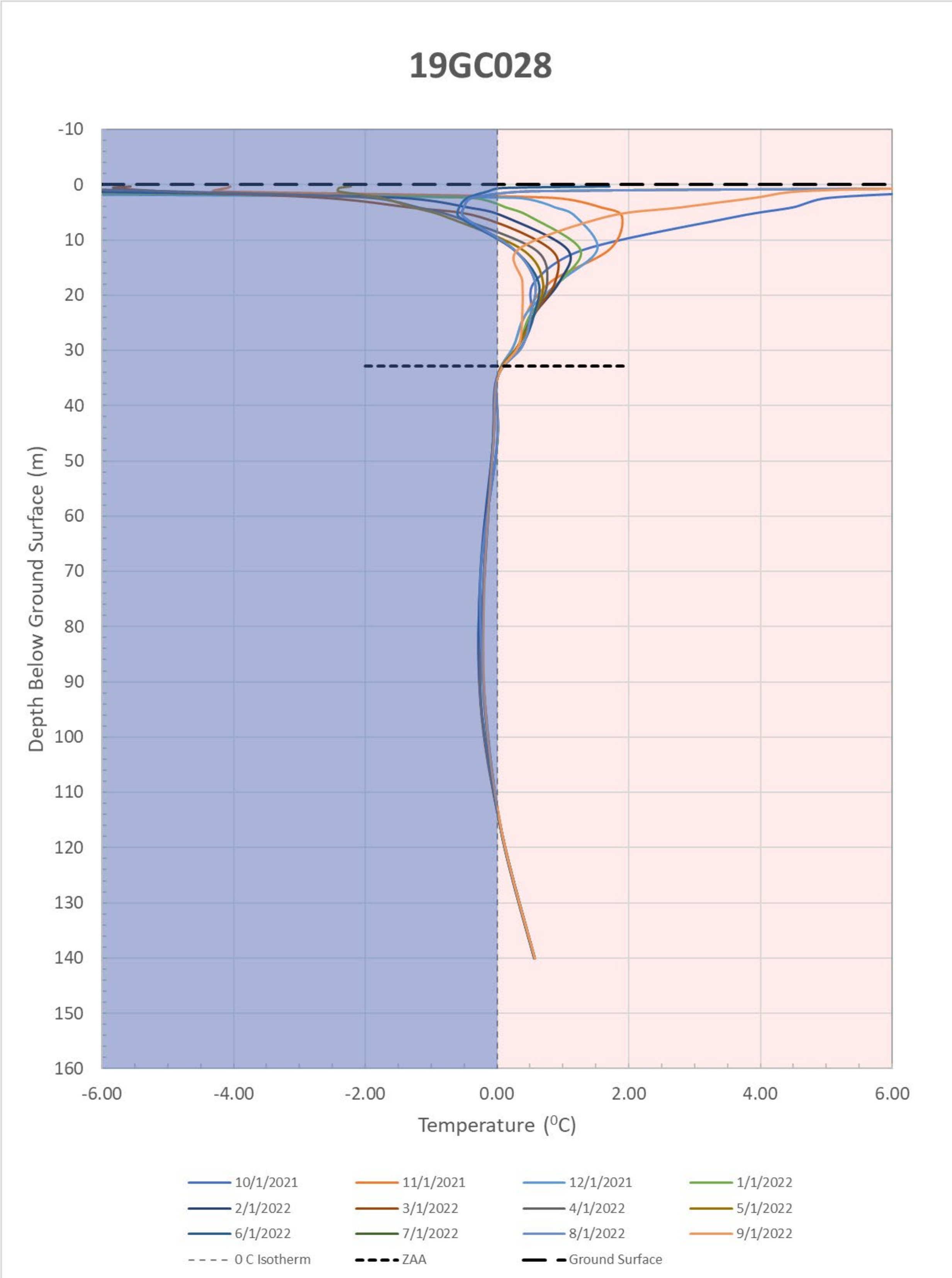
____
Approved by

____
Date

A2 – Ground Temperature Profiles



19GC027
Depth Below Ground Surface (m)
Temperature (⁰C)
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
6/1/2020
7/1/2020
8/1/2020
9/1/2020
10/1/2020
11/1/2020
12/1/2020
1/1/2021
2/1/2021
3/1/2021
4/1/2021
5/1/2021
0 C Isotherm
ZAA
Ground Surface



19GC028
Depth Below Ground Surface (m)
Temperature (⁰C)
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
10/1/2021
11/1/2021
12/1/2021
1/1/2022
2/1/2022
3/1/2022
4/1/2022
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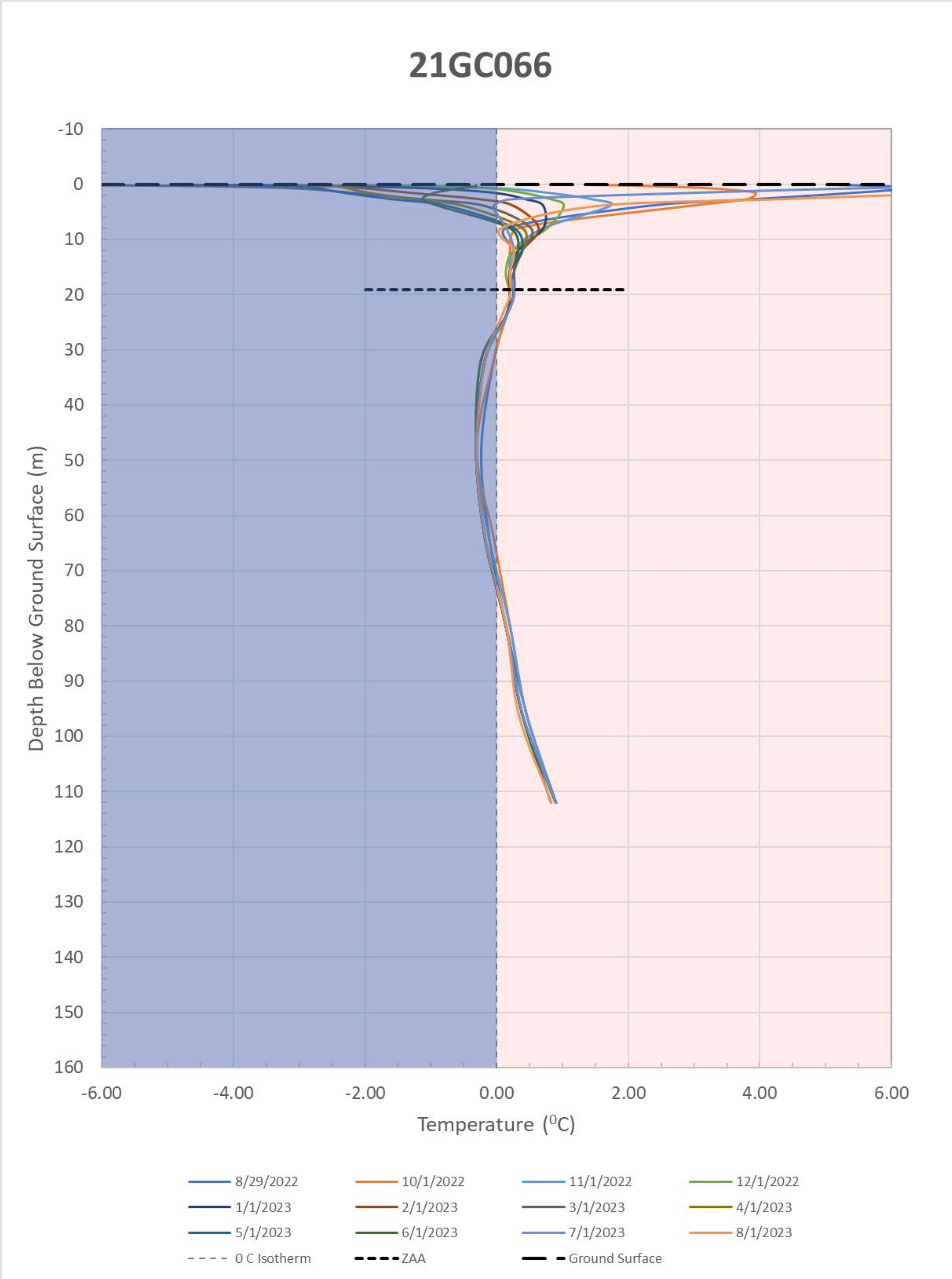
0 C Isotherm
ZAA
Ground Surface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Depth Below Ground Surface (m)
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20
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80
90
100
110
120
130
140
150
160
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
Temperature (0C)
8/29/2022
10/1/2022
11/1/2022
12/1/2022
1/1/2023
2/1/2023
3/1/2023
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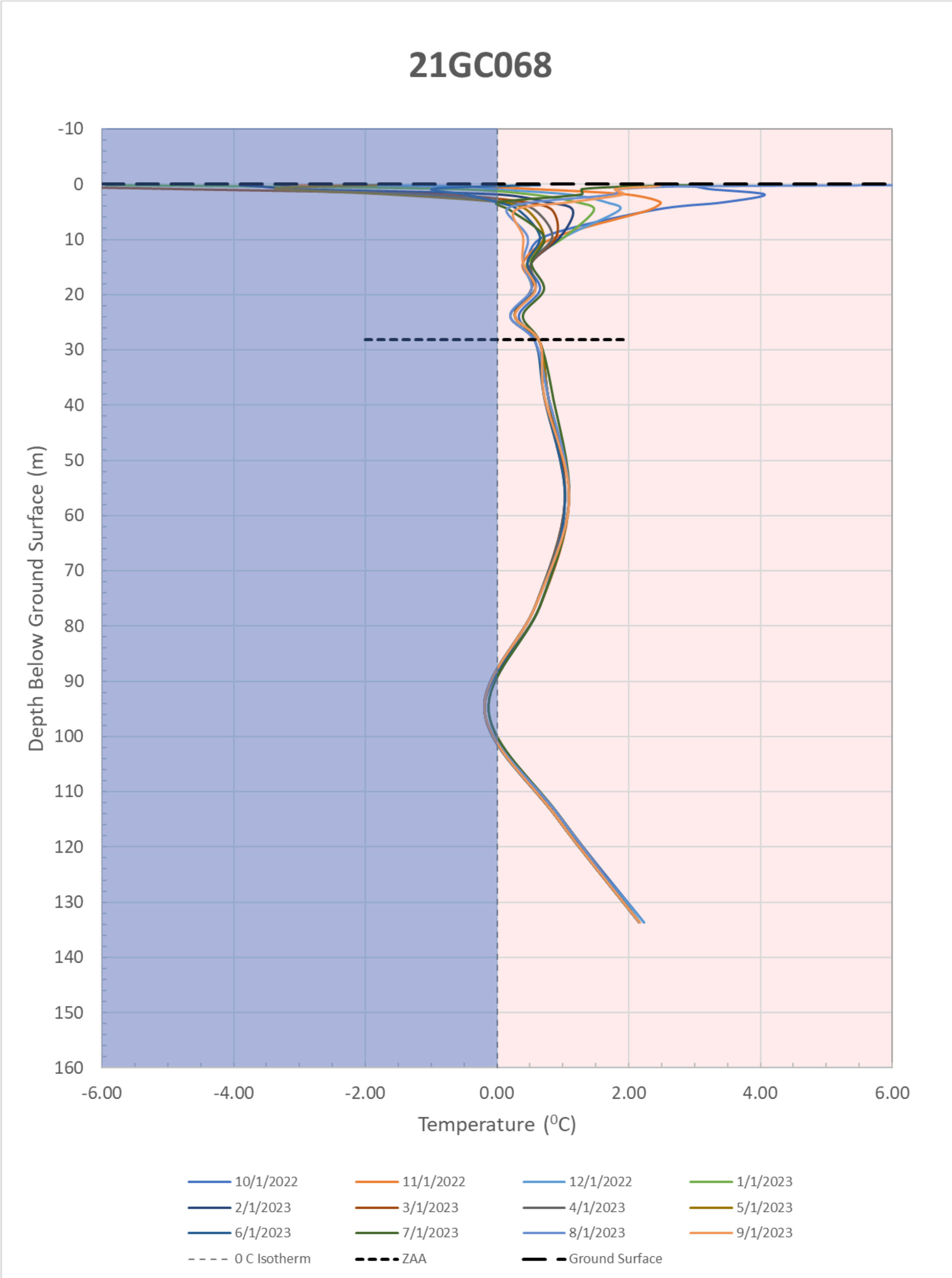
7/1/2023
8/1/2023
0 C Isotherm
ZAA
Ground Surface



21GC068
Depth Below Ground Surface (m)
Temperature (⁰C)
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0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
10/1/2022
11/1/2022
12/1/2022
1/1/2023
2/1/2023
3/1/2023
4/1/2023
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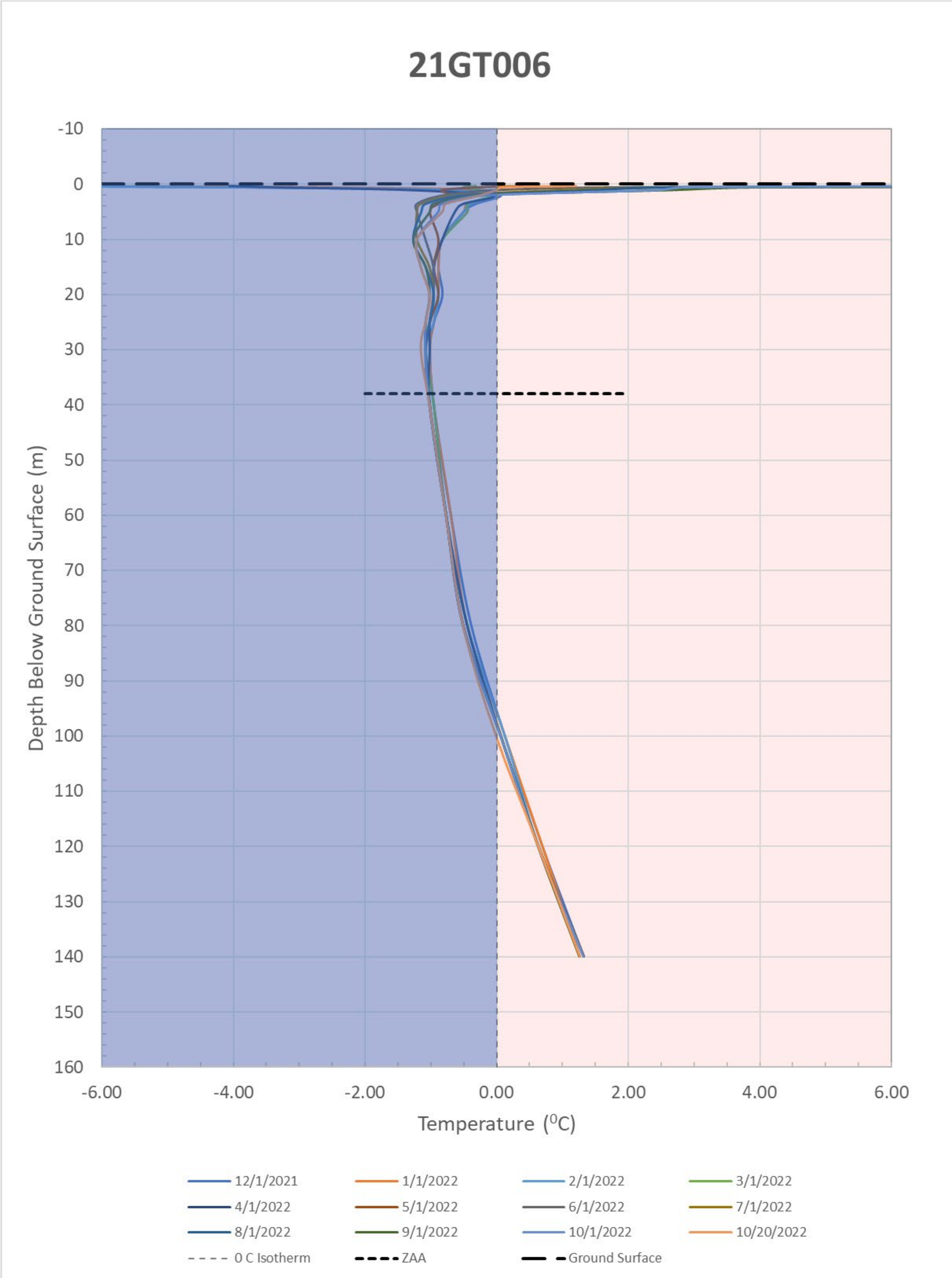
0 C Isotherm
ZAA
Ground Surface



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Temperature (⁰C)
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110
120
130
140
150
160
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
12/1/2021
1/1/2022
2/1/2022
3/1/2022
4/1/2022
5/1/2022
6/1/2022
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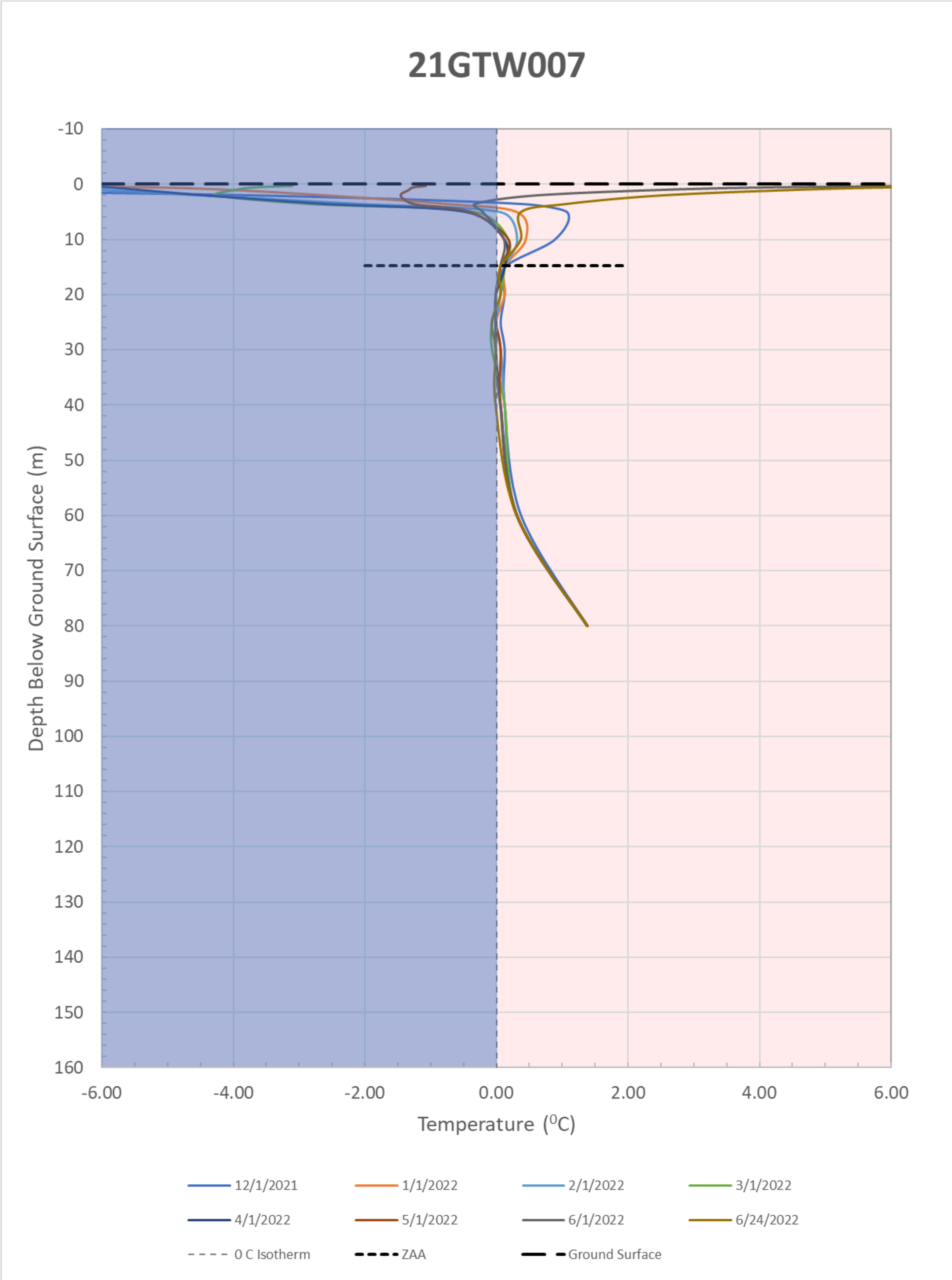
0 C Isotherm
ZAA
Ground Surface



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Temperature (⁰C)
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110
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140
150
160
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
12/1/2021
1/1/2022
2/1/2022
3/1/2022
4/1/2022
5/1/2022
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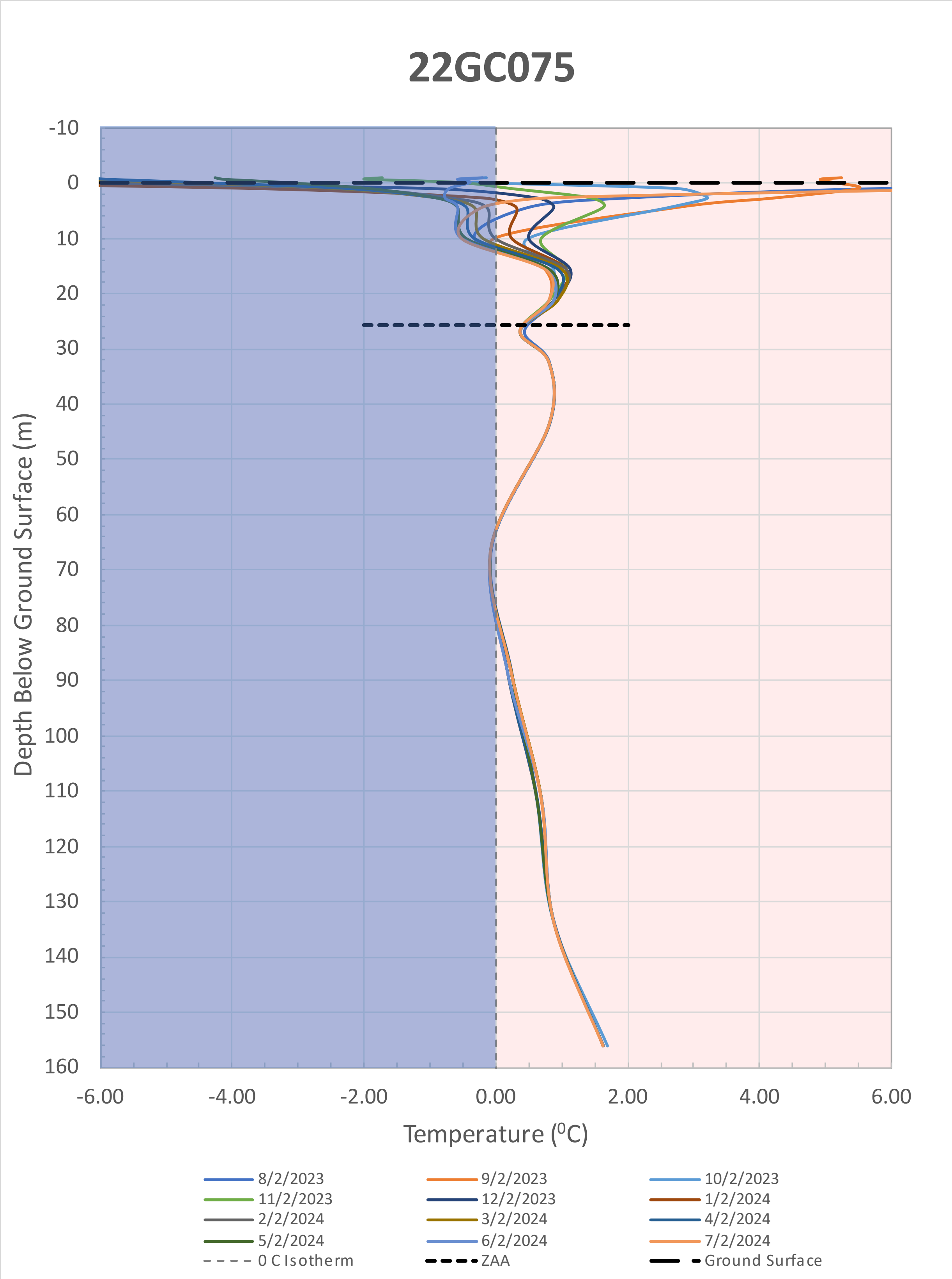
6/24/2022
0 C Isotherm
ZAA
Ground Surface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-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
Temperature (^{0}C)
8/2/2023
9/2/2023
10/2/2023
11/2/2023
12/2/2023
1/2/2024
2/2/2024
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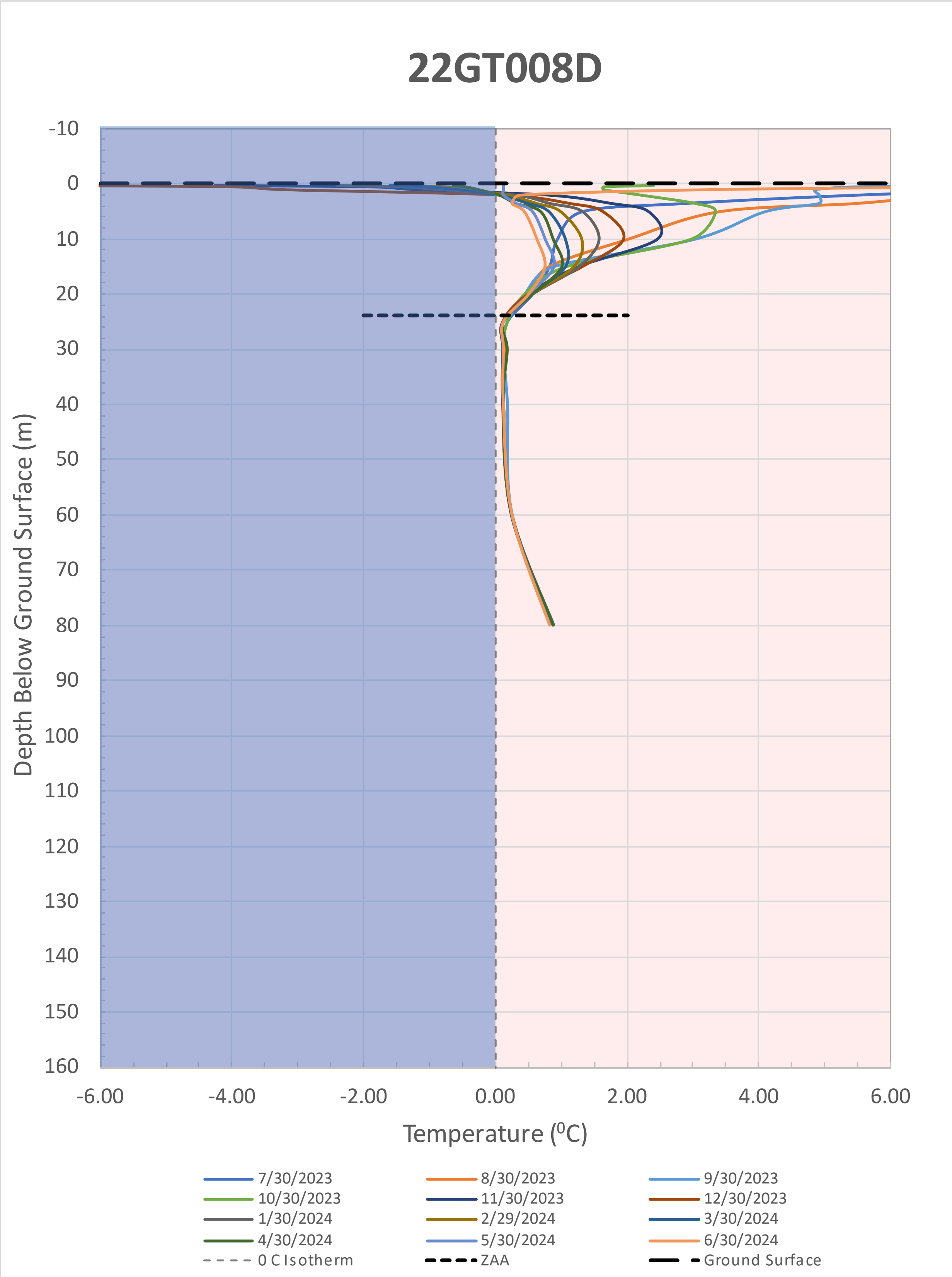
7/2/2024
0 C Isotherm
ZAA
Ground Surface



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0.00
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4.00
6.00
Depth Below Ground Surface (m)
Temperature (⁰C)
7/30/2023
8/30/2023
9/30/2023
10/30/2023
11/30/2023
12/30/2023
1/30/2024
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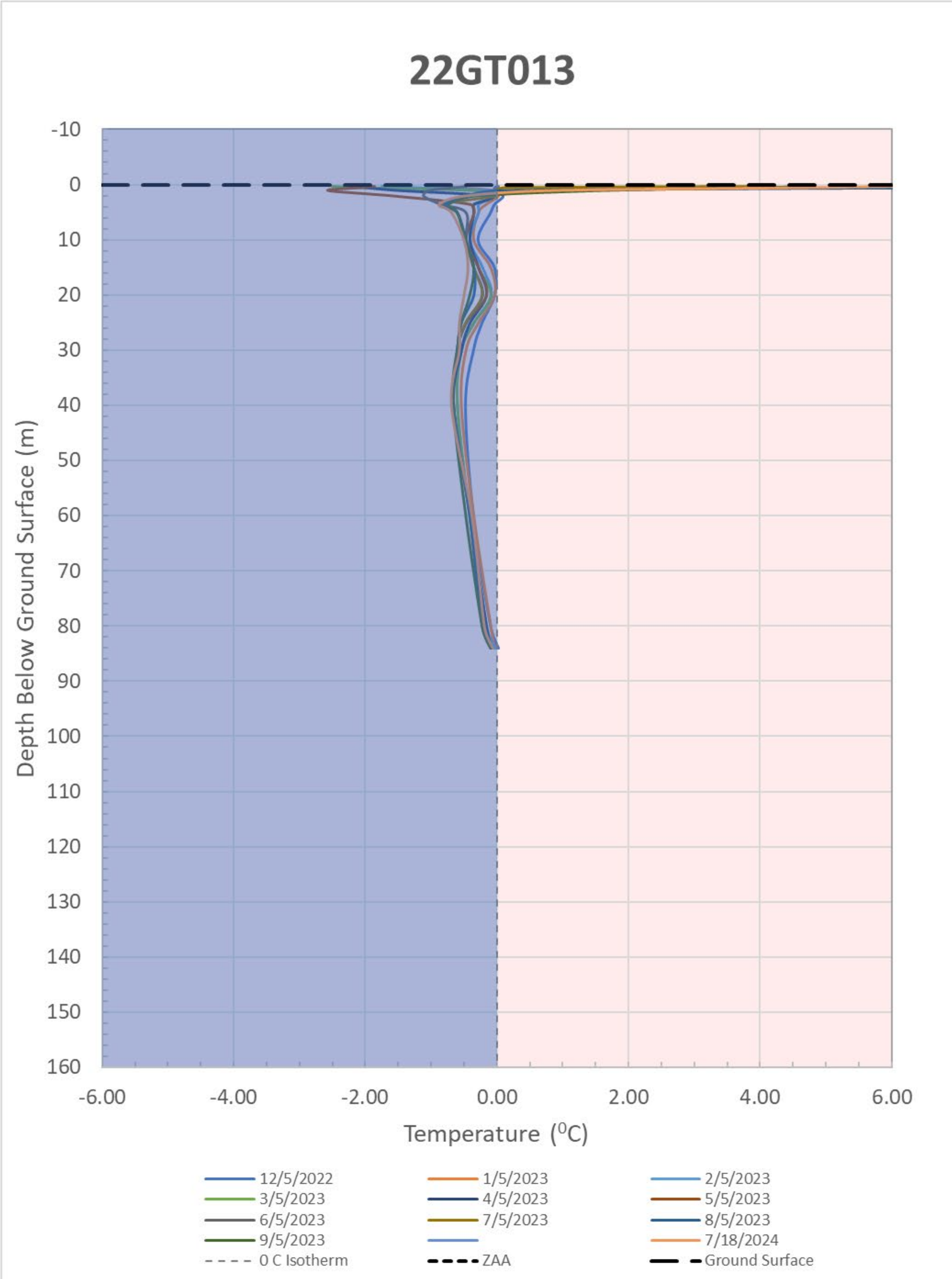
0 C Isotherm
ZAA
Ground Surface



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-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
Temperature (⁰C)
Depth Below Ground Surface (m)
12/5/2022
1/5/2023
2/5/2023
3/5/2023
4/5/2023
5/5/2023
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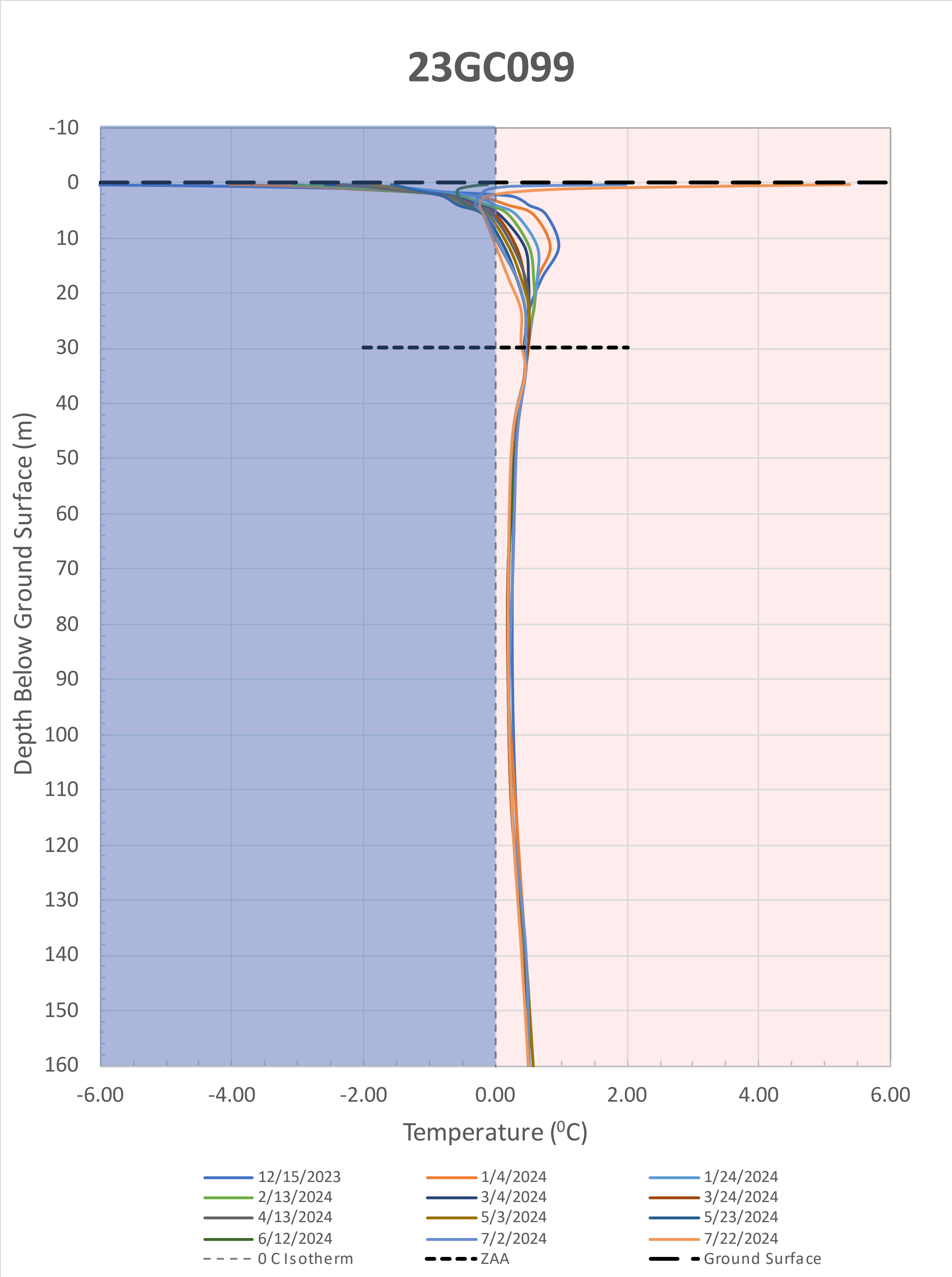
7/18/2024
0 C Isotherm
ZAA
Ground Surface


23GC099
Depth Below Ground Surface (m)
Temperature (⁰C)
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100
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120
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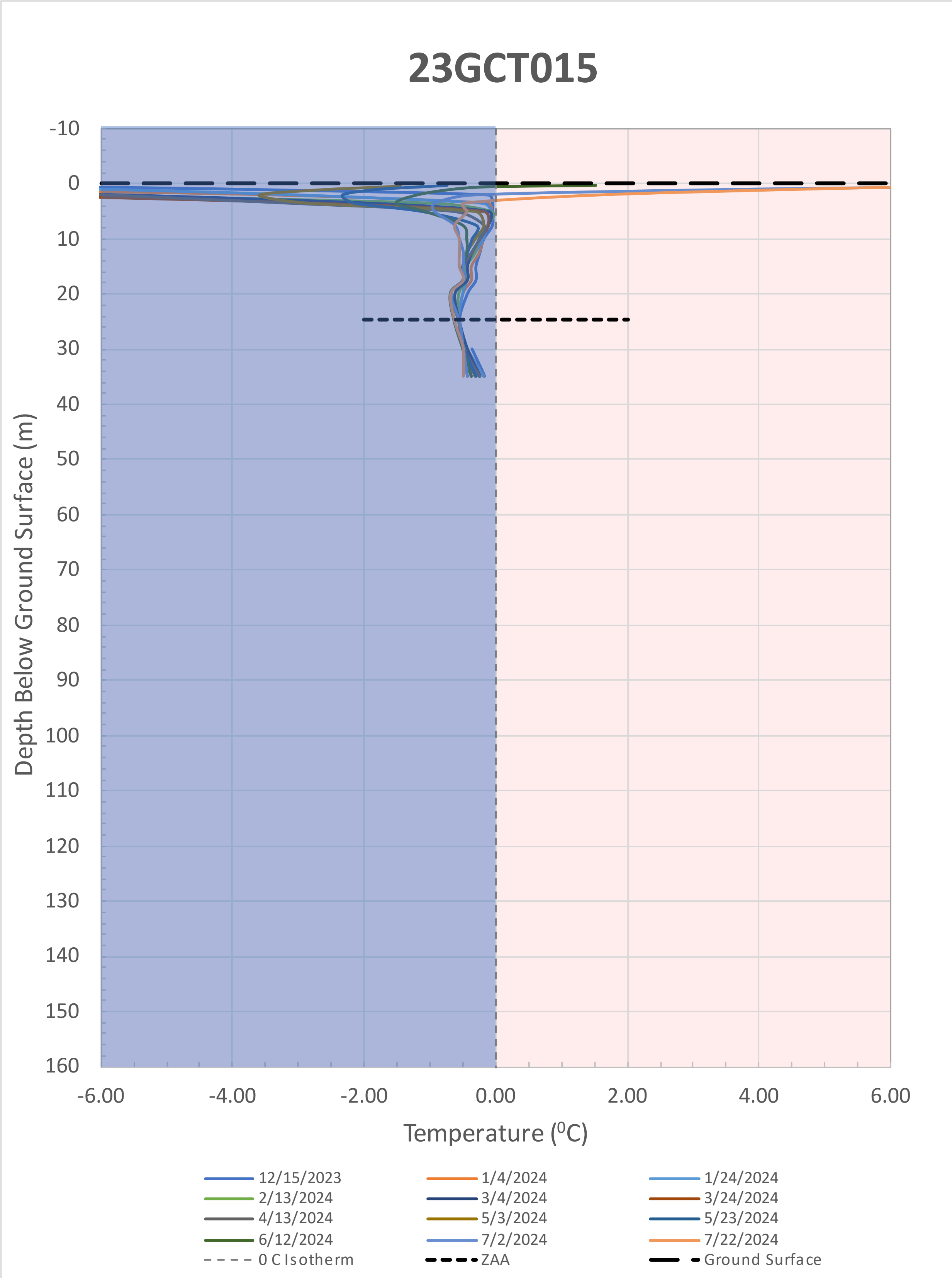
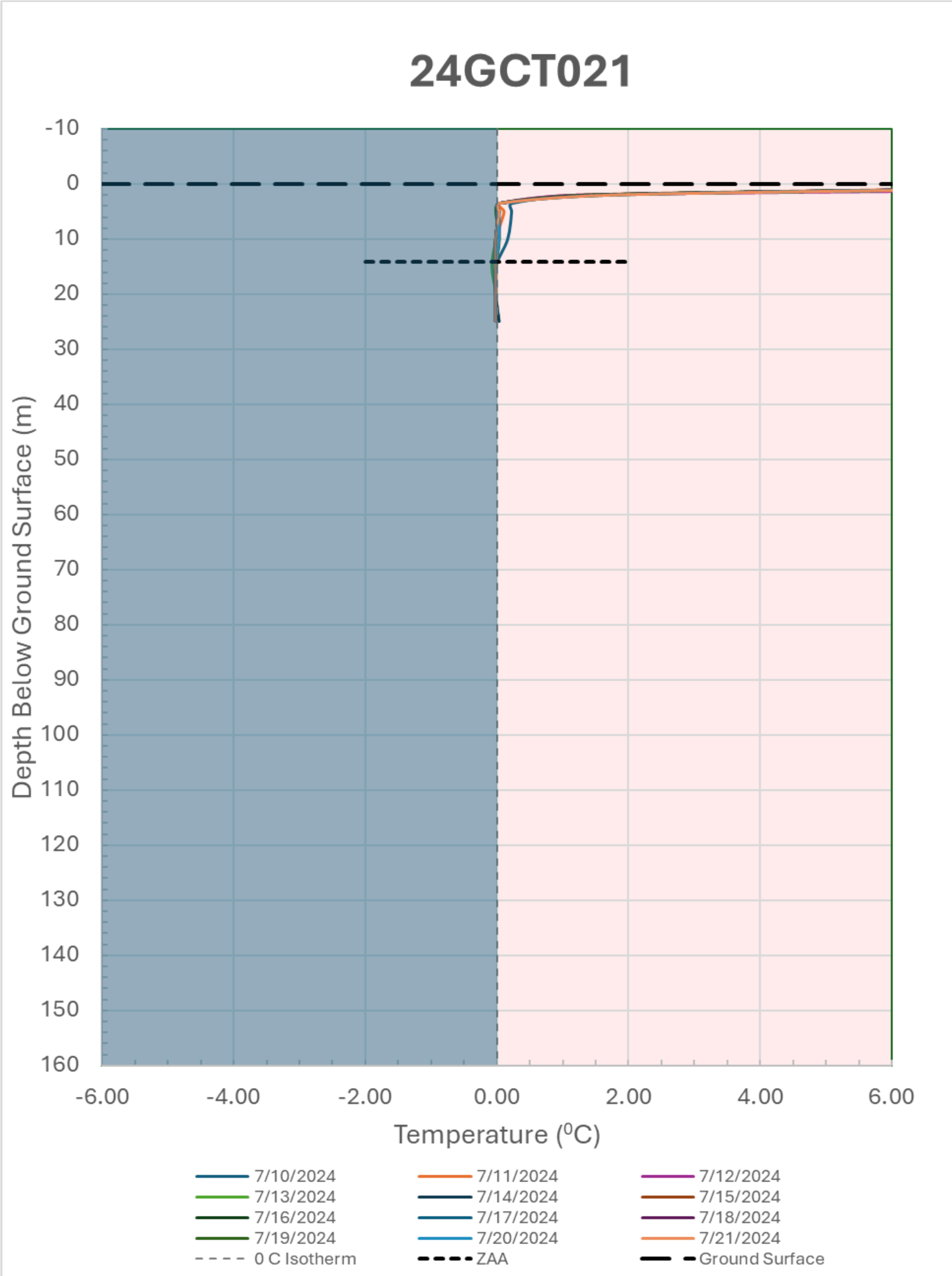
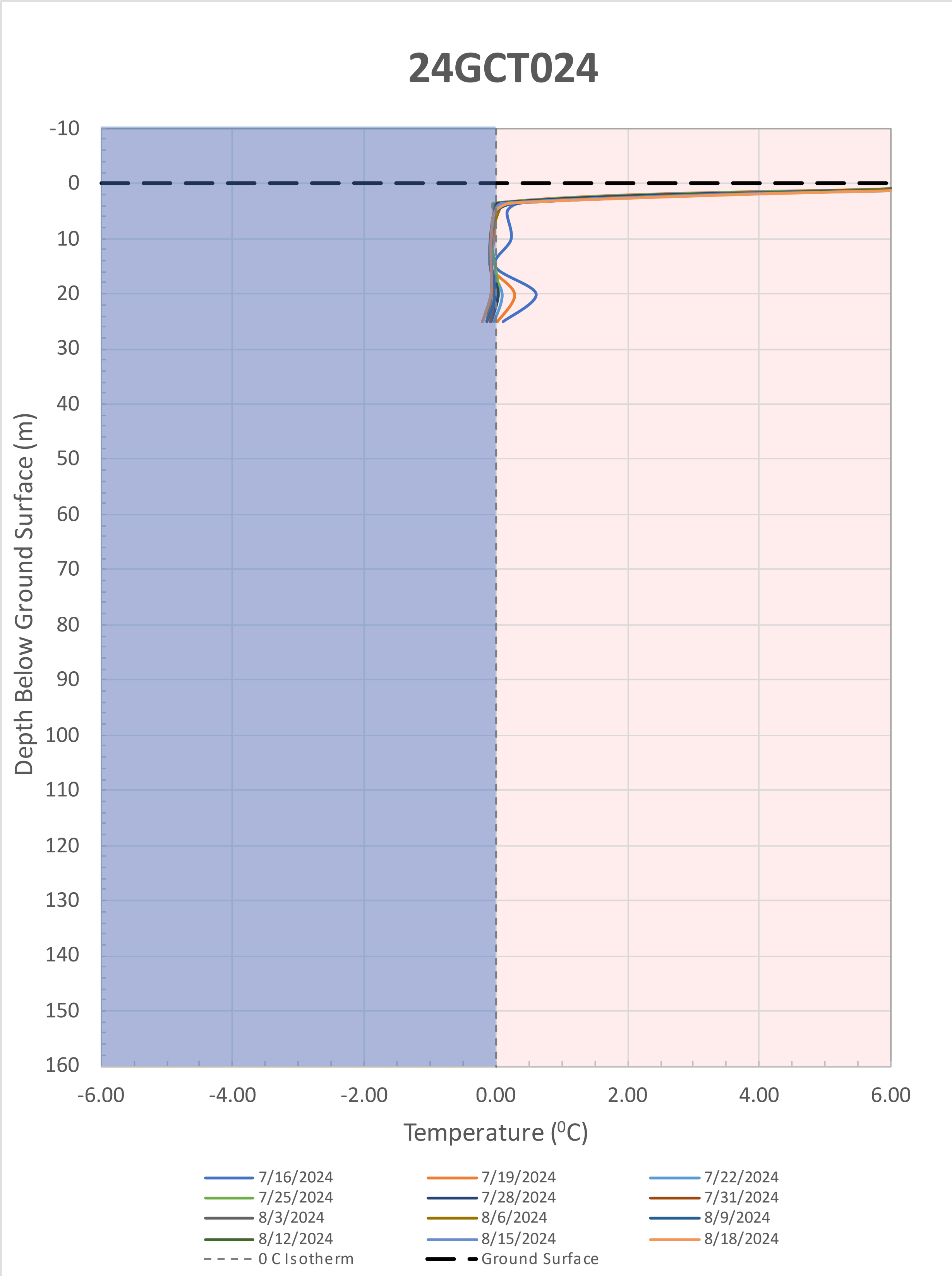
140
150
160
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
12/15/2023
1/4/2024
1/24/2024
2/13/2024
3/4/2024
3/24/2024
4/13/2024
5/3/2024
5/23/2024
6/12/2024
7/2/2024
7/22/2024
0 C Isotherm
ZAA
Ground Surface

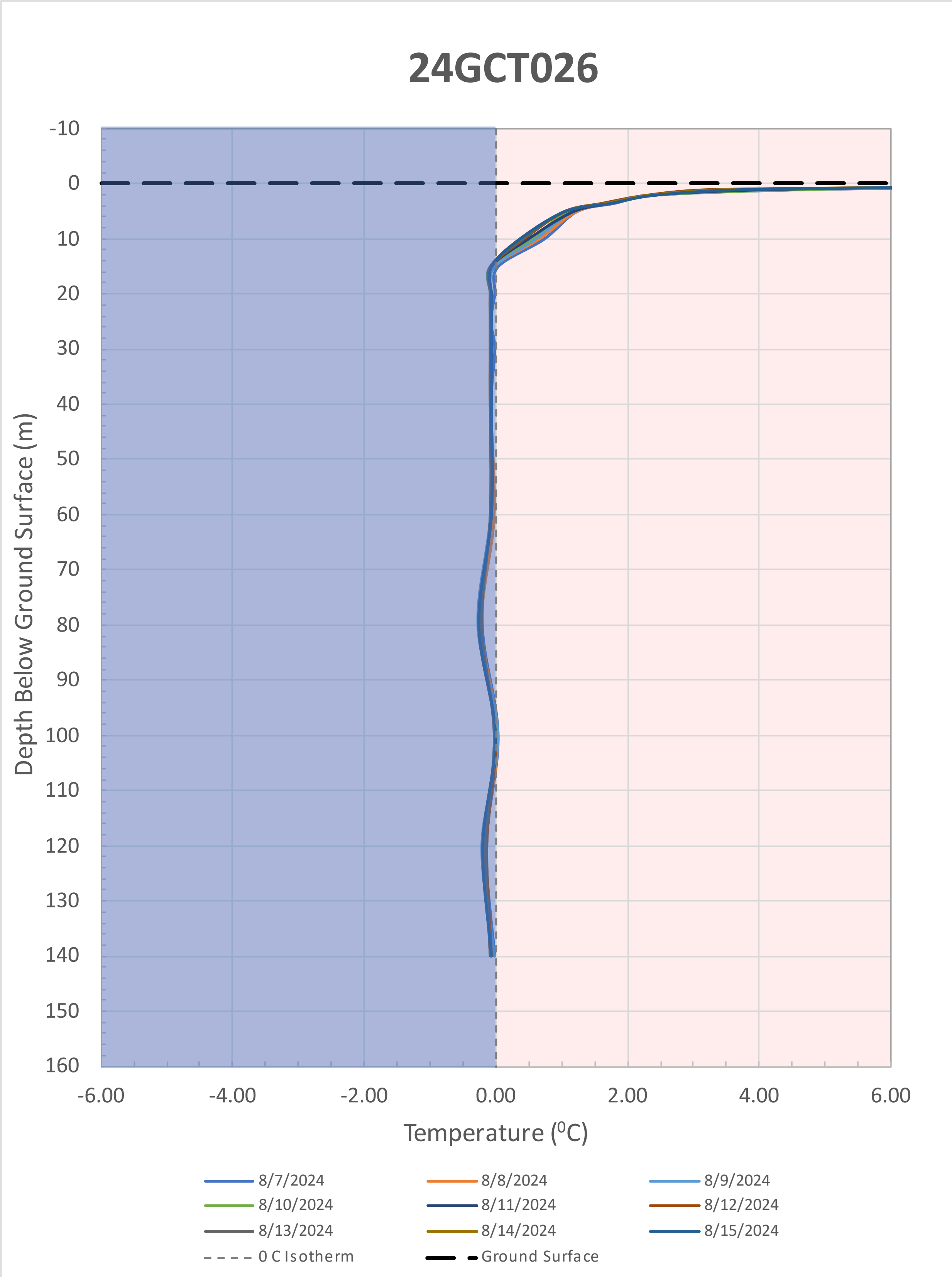


23GCT015
Depth Below Ground Surface (m)
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
Temperature (⁰C)
12/15/2023
1/4/2024
1/24/2024
2/13/2024
3/4/2024
3/24/2024
4/13/2024
5/3/2024
5/23/2024
6/12/2024
7/2/2024
7/22/2024
0 C Isotherm
ZAA
Ground Surface

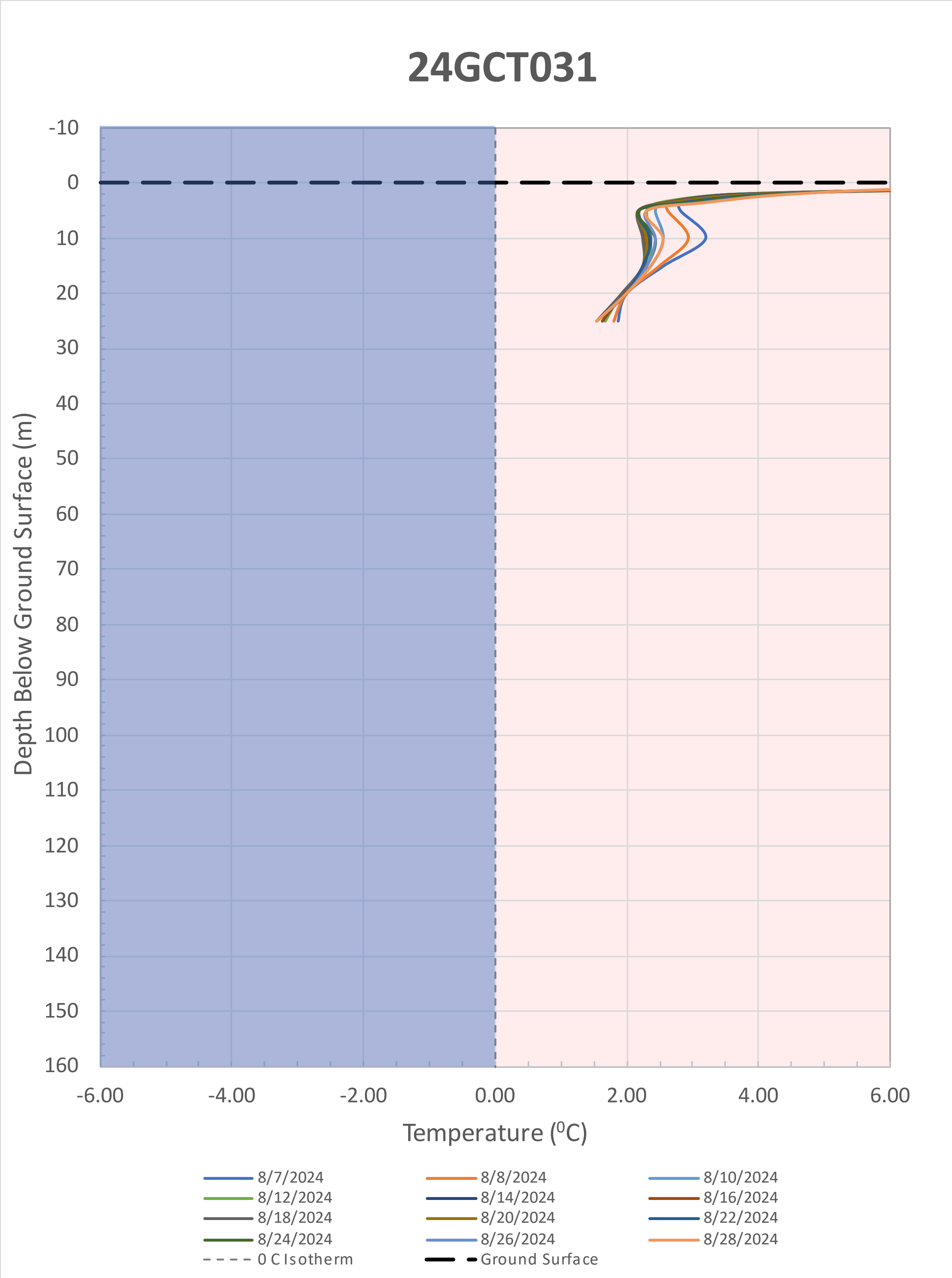

24GCT021
Depth Below Ground Surface (m)
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
Temperature (⁰C)
7/10/2024
7/11/2024
7/12/2024
7/13/2024
7/14/2024
7/15/2024
7/16/2024
7/17/2024
7/18/2024
7/19/2024
7/20/2024
7/21/2024
0 C Isotherm
ZAA
Ground Surface



24GCT024
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
Depth Below Ground Surface (m)
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
Temperature (⁰C)
7/16/2024
7/19/2024
7/22/2024
7/25/2024
7/28/2024
7/31/2024
8/3/2024
8/6/2024
8/9/2024
8/12/2024
8/15/2024
8/18/2024
0 C Isotherm
Ground Surface

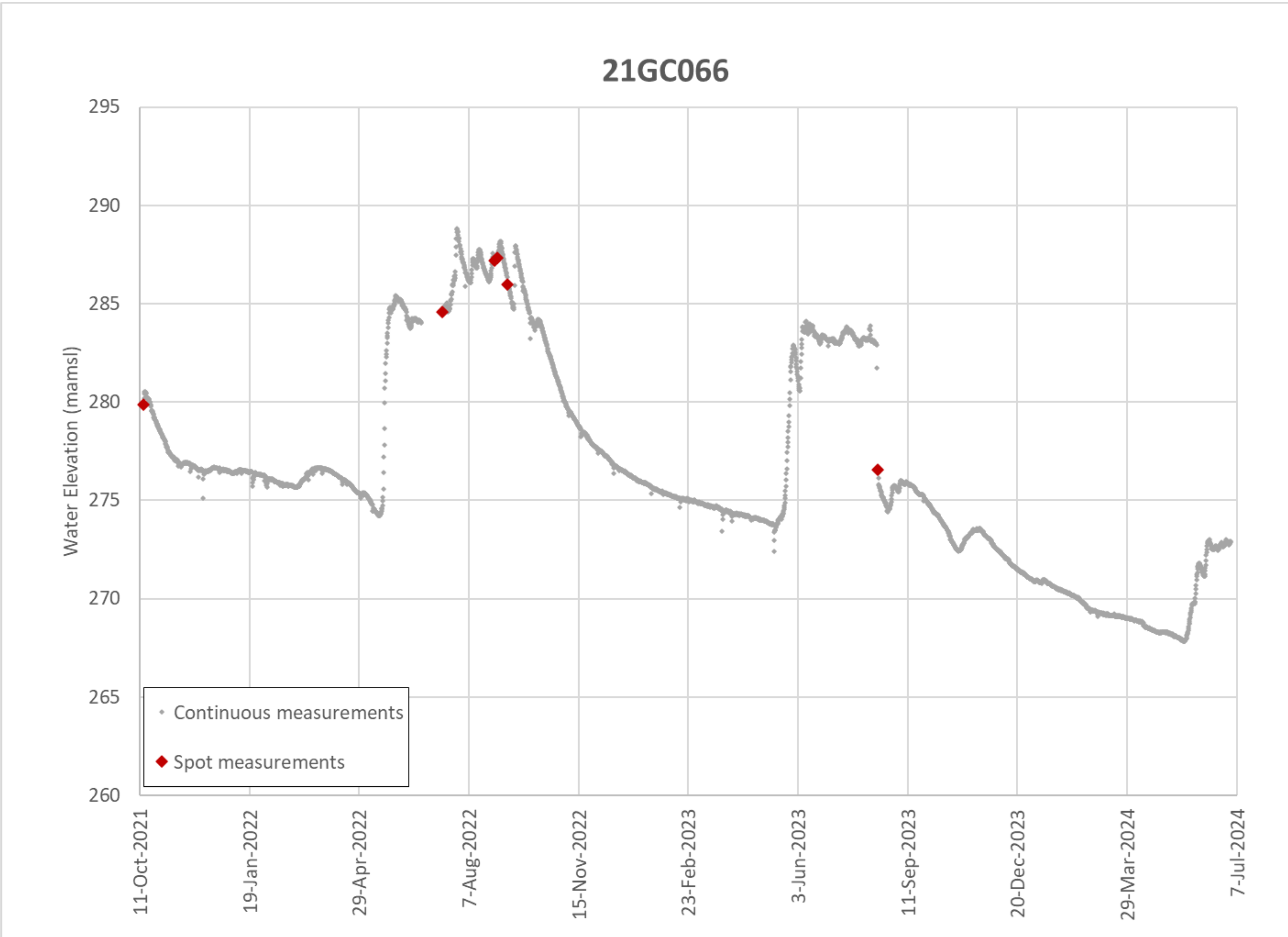


24GCT026
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
Depth Below Ground Surface (m)
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
Temperature (⁰C)
8/7/2024
8/8/2024
8/9/2024
8/10/2024
8/11/2024
8/12/2024
8/13/2024
8/14/2024
8/15/2024
0 C Isotherm
Ground Surface

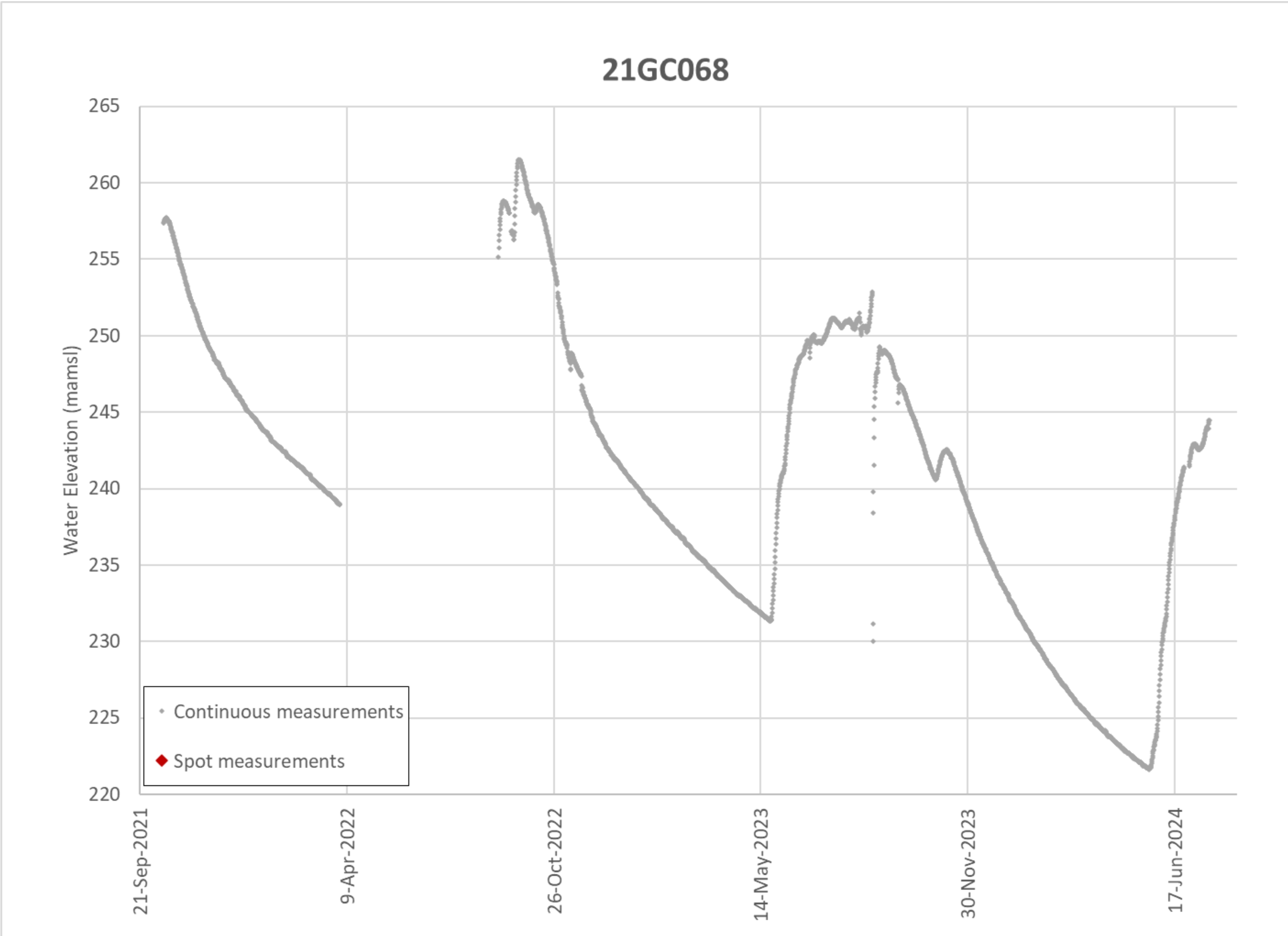


24GCT031
Depth Below Ground Surface (m)
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
-6.00
-4.00
-2.00
0.00
2.00
4.00
6.00
Temperature (⁰C)
8/7/2024
8/8/2024
8/10/2024
8/12/2024
8/14/2024
8/16/2024
8/18/2024
8/20/2024
8/22/2024
8/24/2024
8/26/2024
8/28/2024
0 C Isotherm
Ground Surface

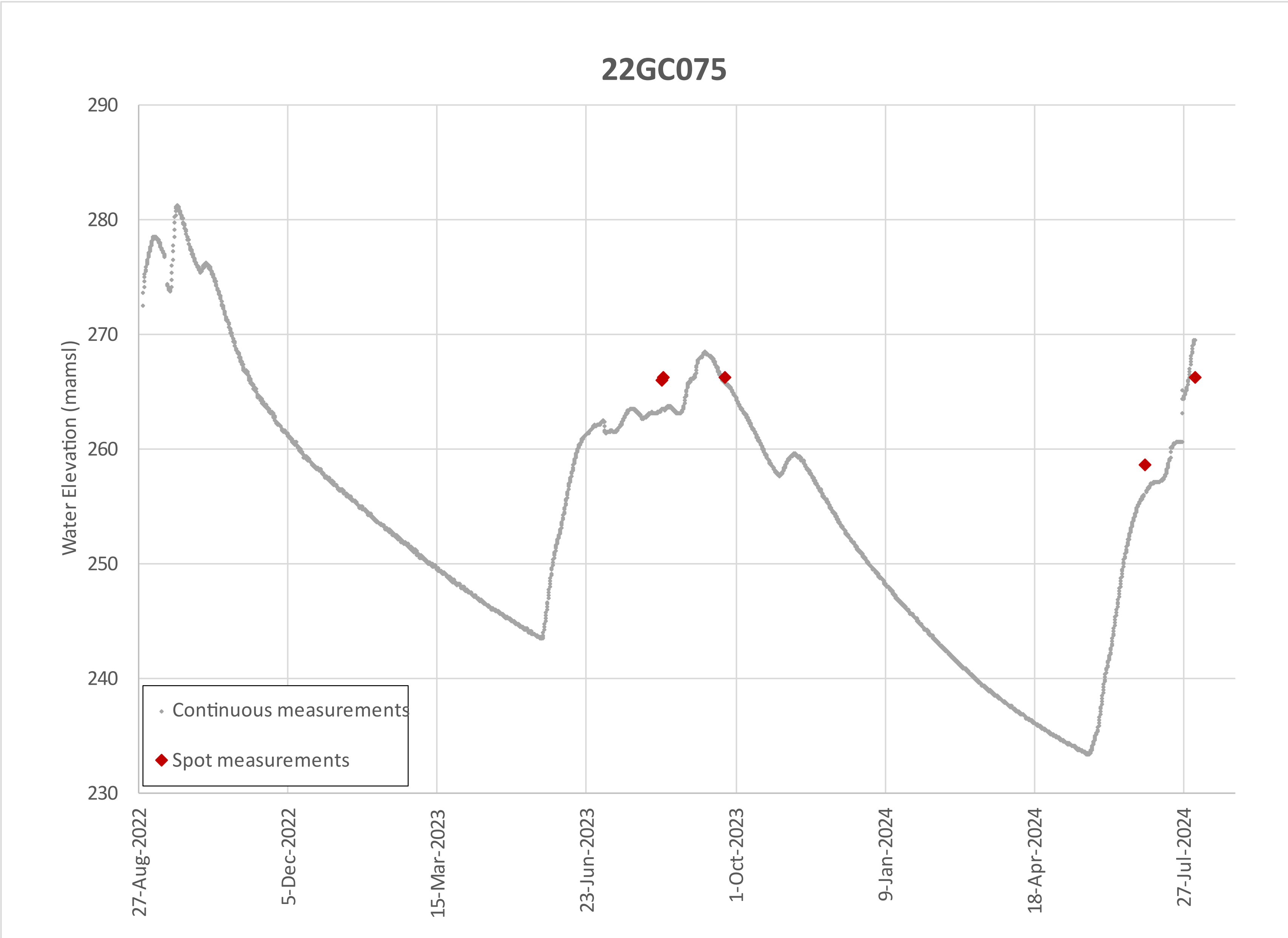
Appendix B. Monitoring Well Hydrographs

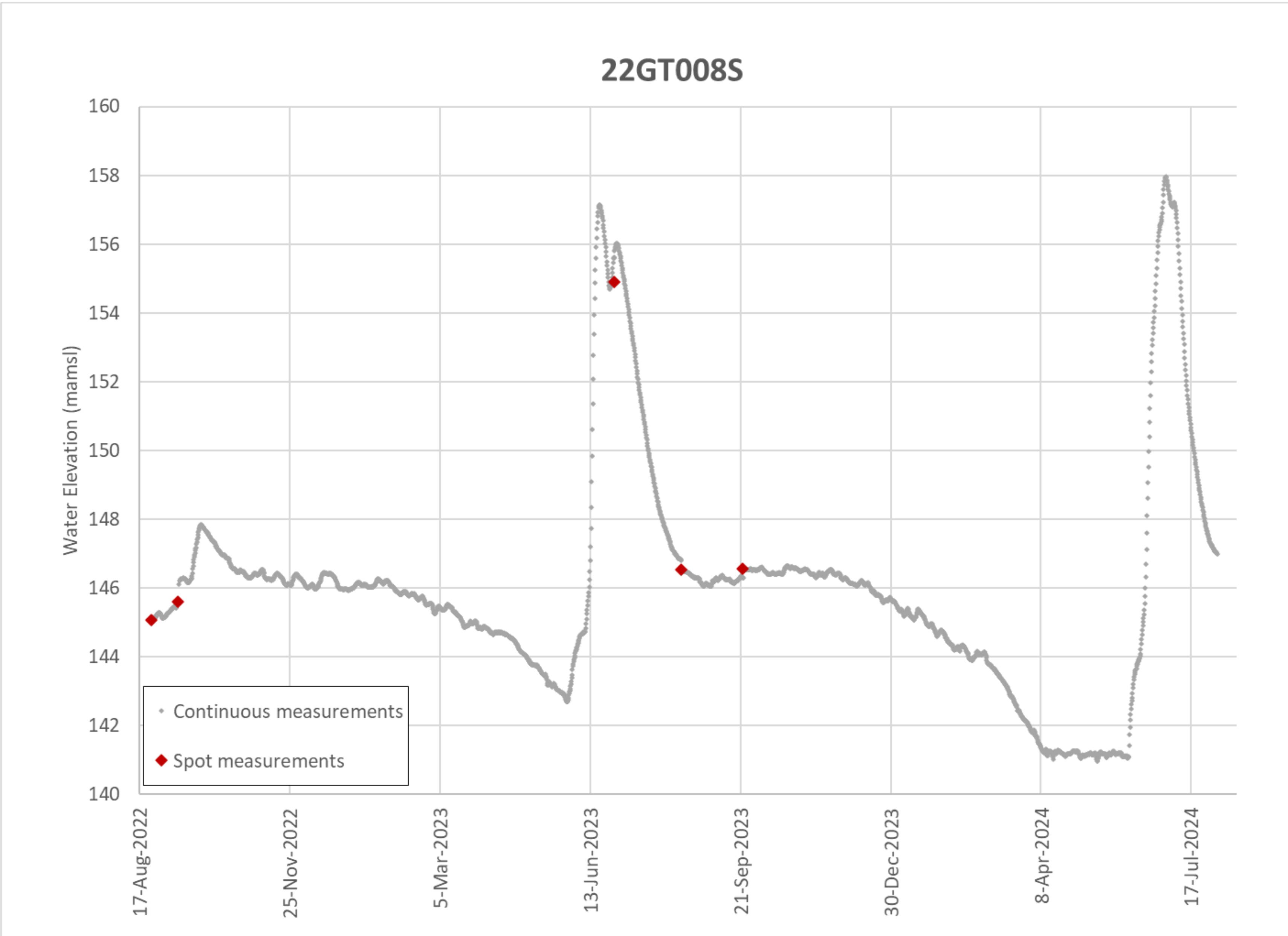


21GC066
Water Elevation (mamsl)
295
290
285
280
275
270
265
260
11-Oct-2021
19-Jan-2022
29-Apr-2022
7-Aug-2022
15-Nov-2022
23-Feb-2023
3-Jun-2023
11-Sep-2023
20-Dec-2023
29-Mar-2024
7-Jul-2024
Continuous measurements
Spot measurements

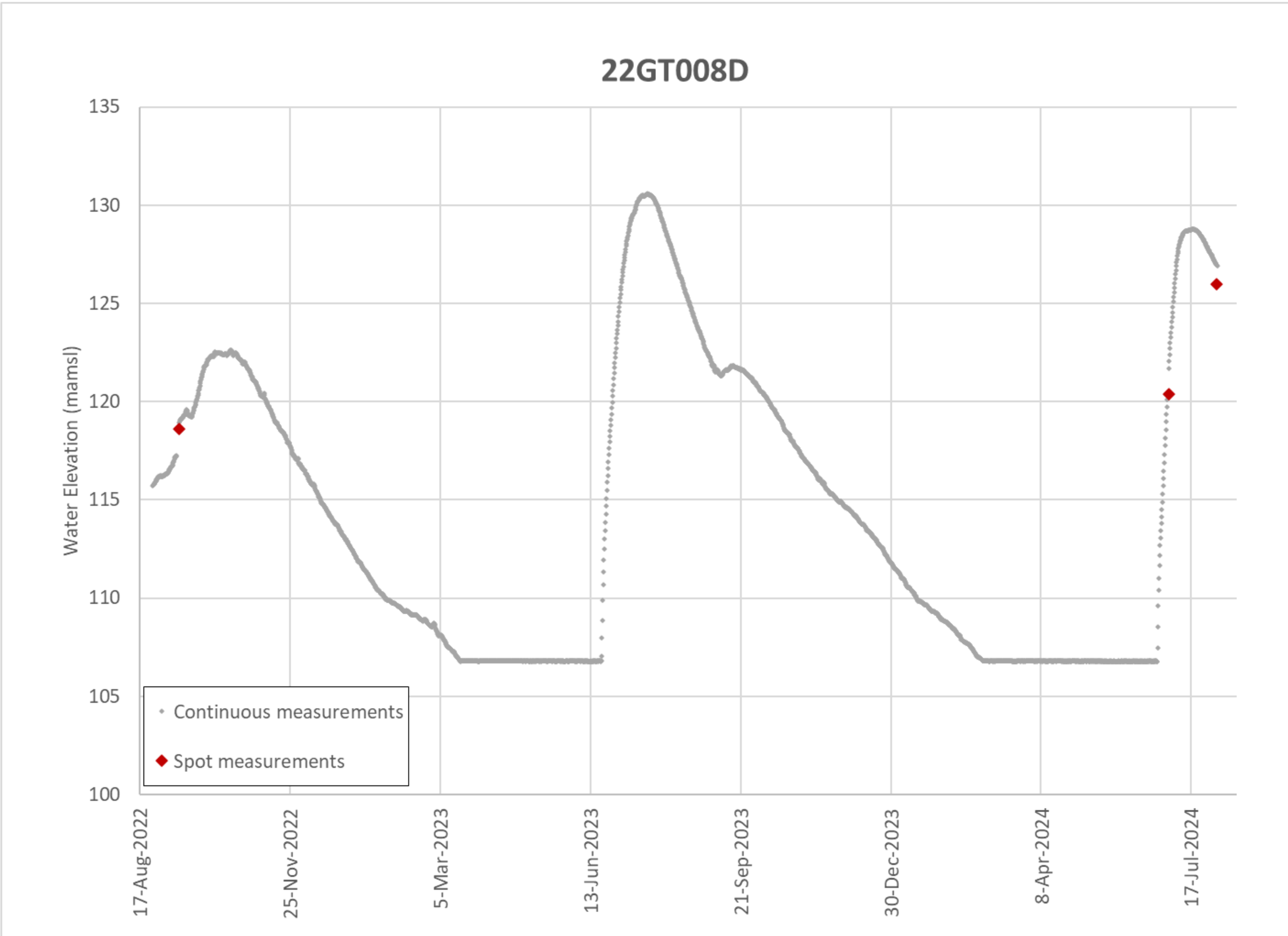


21GC068
Water Elevation (mamsl)
265
260
255
250
245
240
235
230
225
220
21-Sep-2021
9-Apr-2022
26-Oct-2022
14-May-2023
30-Nov-2023
17-Jun-2024
Continuous measurements
Spot measurements

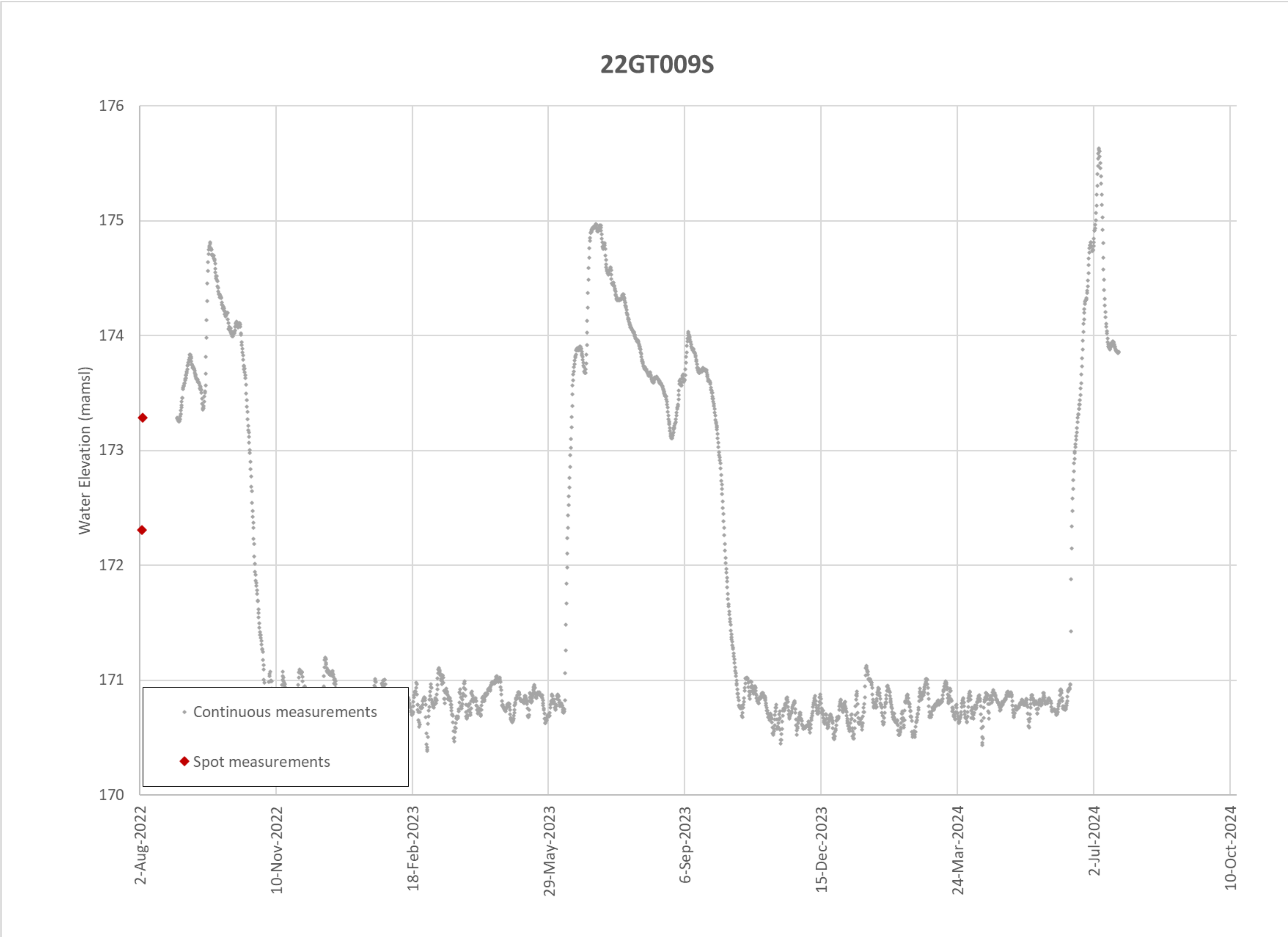

22GC075
Water Elevation (mamsl)
290
280
270
260
250
240
230
27-Aug-2022
5-Dec-2022
15-Mar-2023
23-Jun-2023
1-Oct-2023
9-Jan-2024
18-Apr-2024
27-Jul-2024
Continuous measurements
Spot measurements



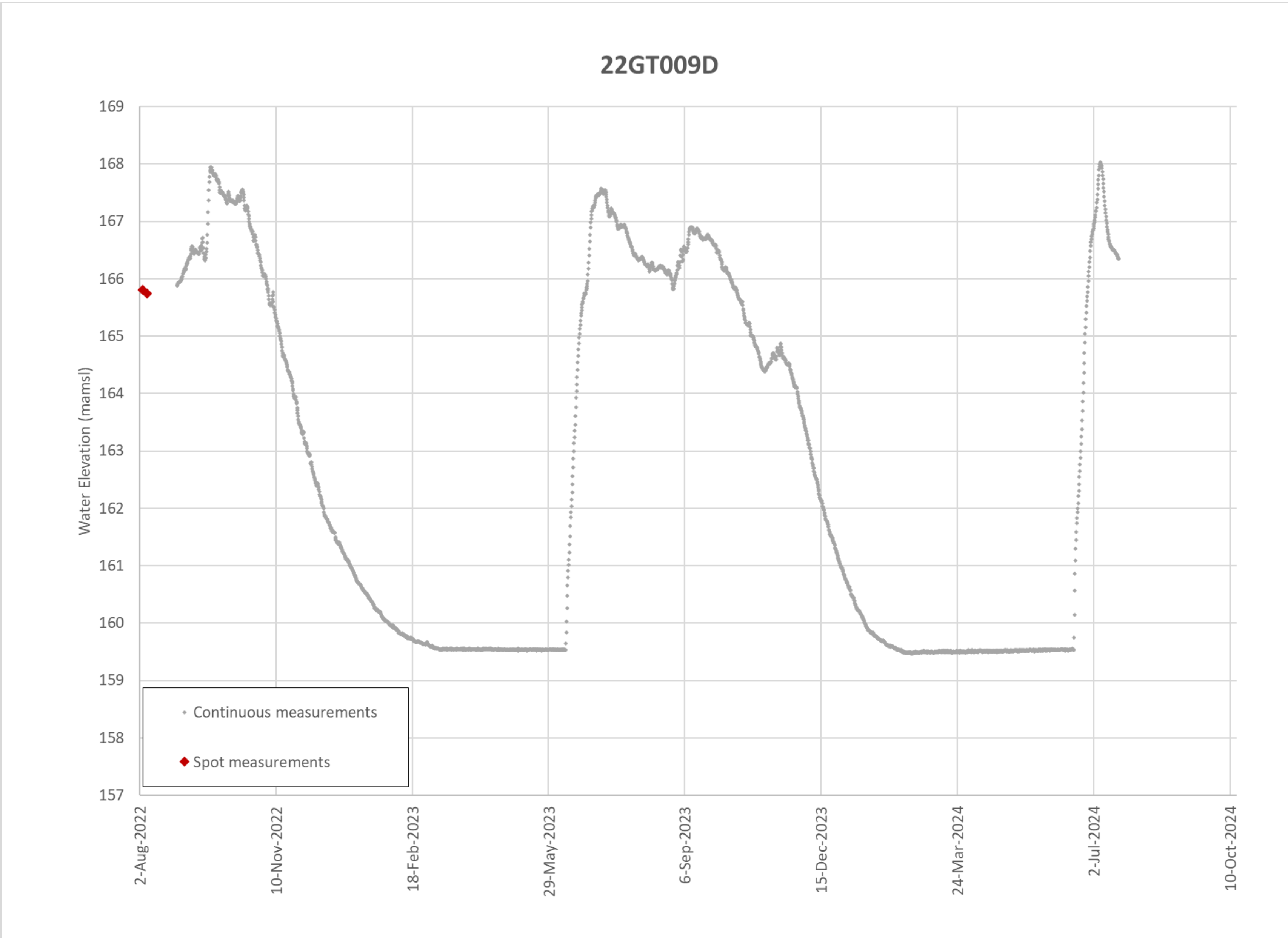
22GT008S
Water Elevation (mamsl)
160
158
156
154
152
150
148
146
144
142
140
17-Aug-2022
25-Nov-2022
5-Mar-2023
13-Jun-2023
21-Sep-2023
30-Dec-2023
8-Apr-2024
17-Jul-2024
Continuous measurements
Spot measurements



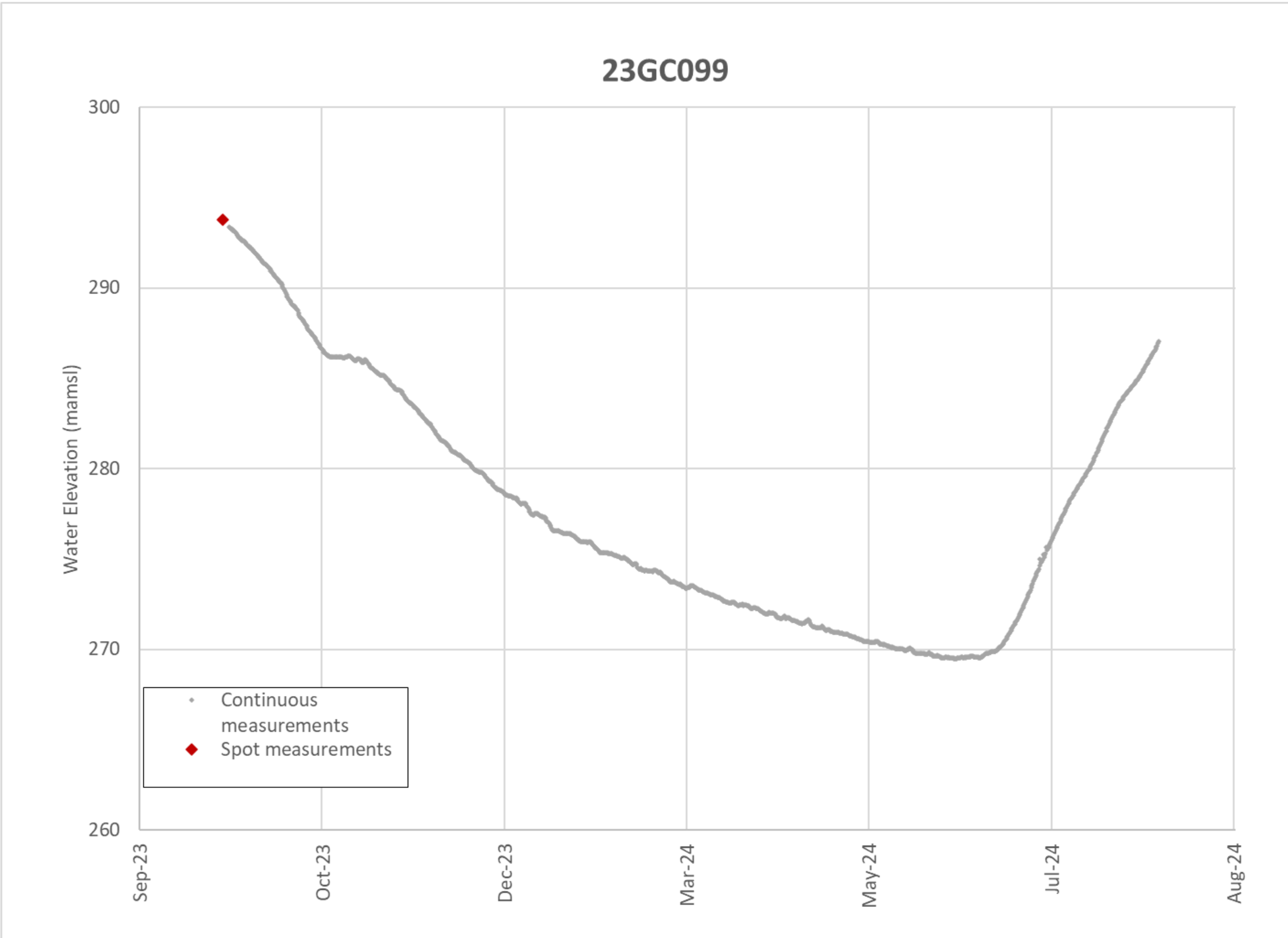
22GT008D
Water Elevation (mamsl)
135
130
125
120
115
110
105
100
17-Aug-2022
25-Nov-2022
5-Mar-2023
13-Jun-2023
21-Sep-2023
30-Dec-2023
8-Apr-2024
17-Jul-2024
Continuous measurements
Spot measurements

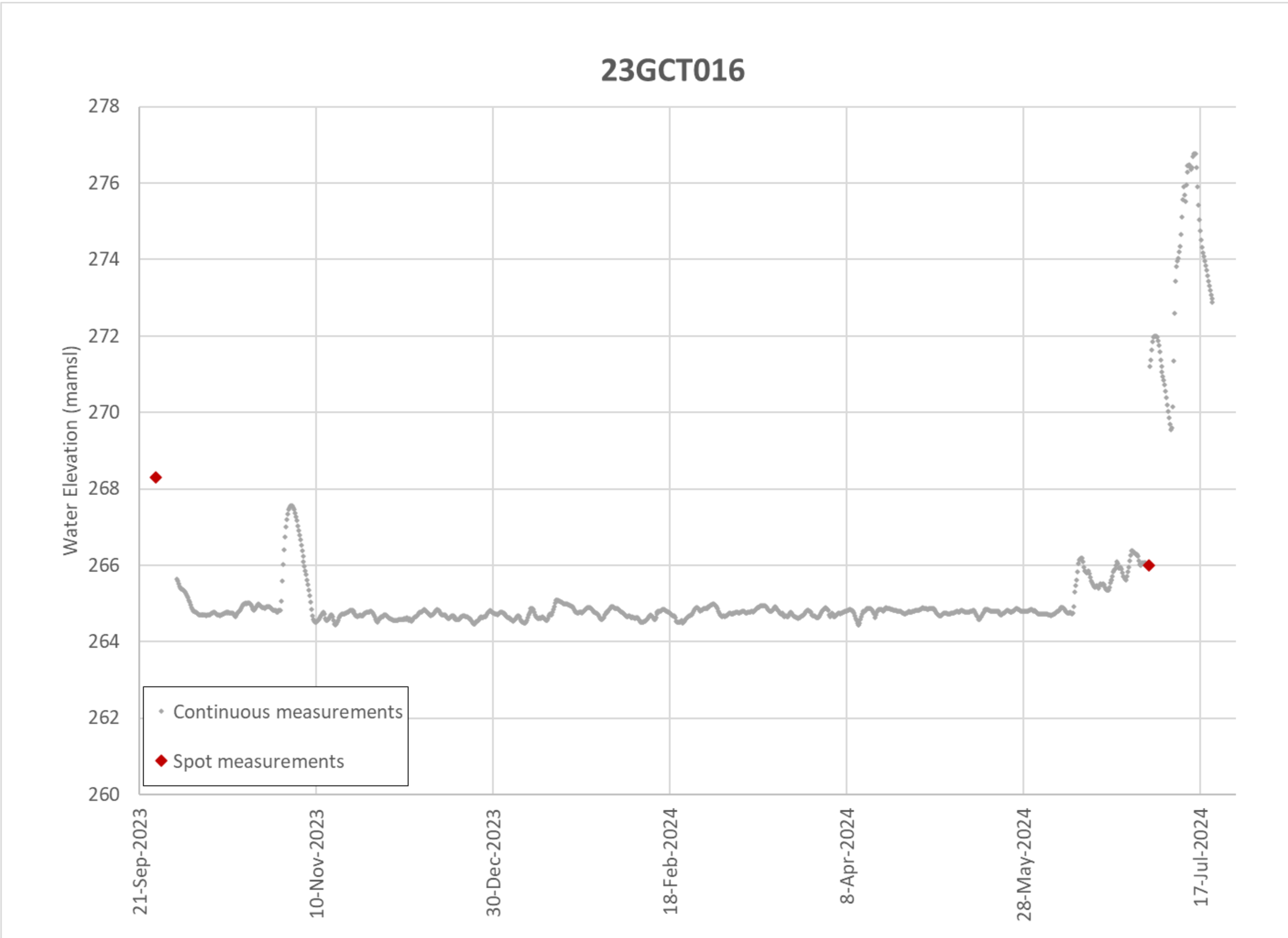


22GT009S
Water Elevation (mamsl)
176
175
174
173
172
171
170
2-Aug-2022
10-Nov-2022
18-Feb-2023
29-May-2023
6-Sep-2023
15-Dec-2023
24-Mar-2024
2-Jul-2024
10-Oct-2024
Continuous measurements
Spot measurements

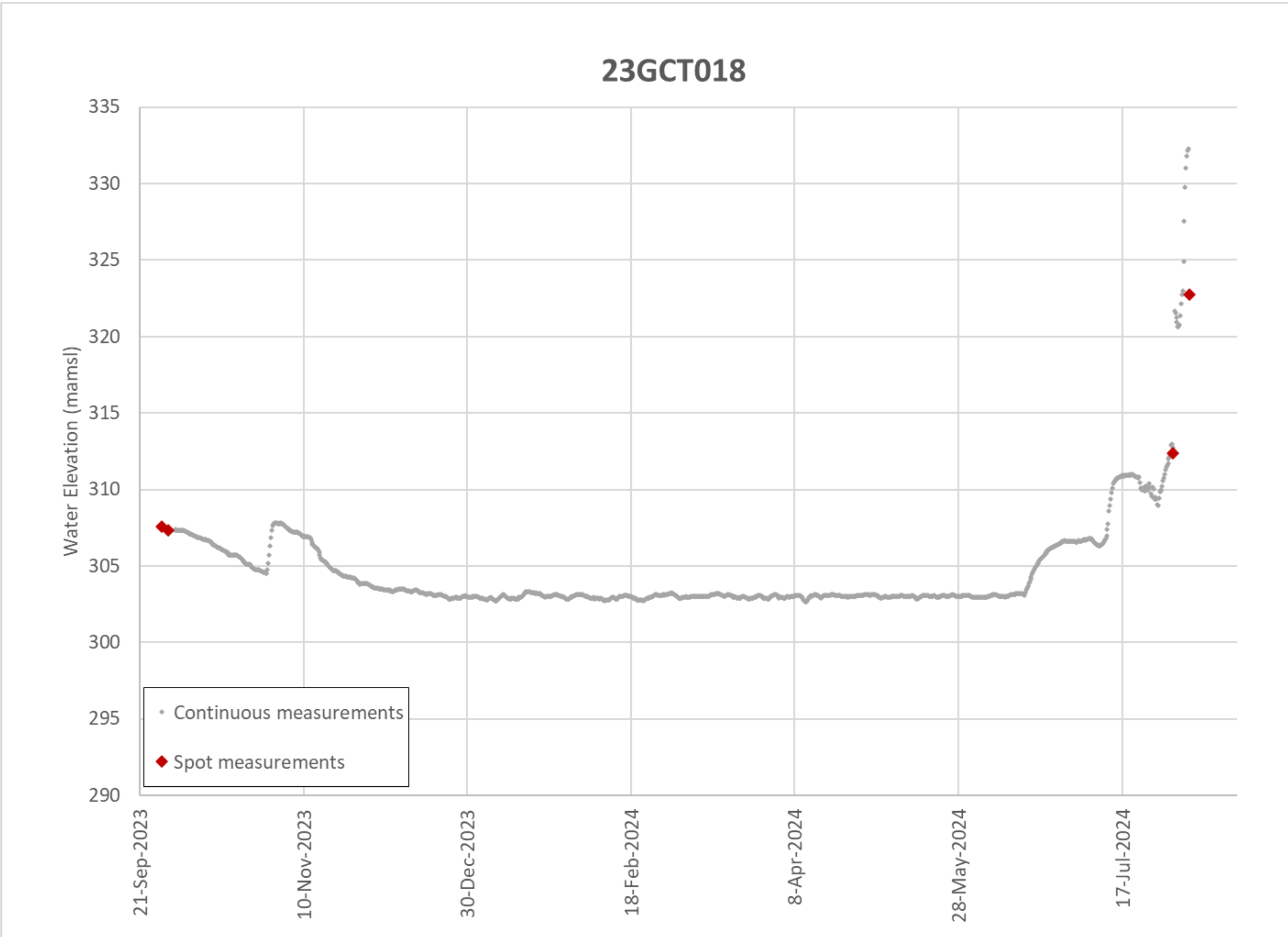


22GT009D
169
168
167
166
165
164
163
162
161
160
159
158
157
Water Elevation (mamsl)
2-Aug-2022
10-Nov-2022
18-Feb-2023
29-May-2023
6-Sep-2023
15-Dec-2023
24-Mar-2024
2-Jul-2024
10-Oct-2024
Continuous measurements
Spot measurements

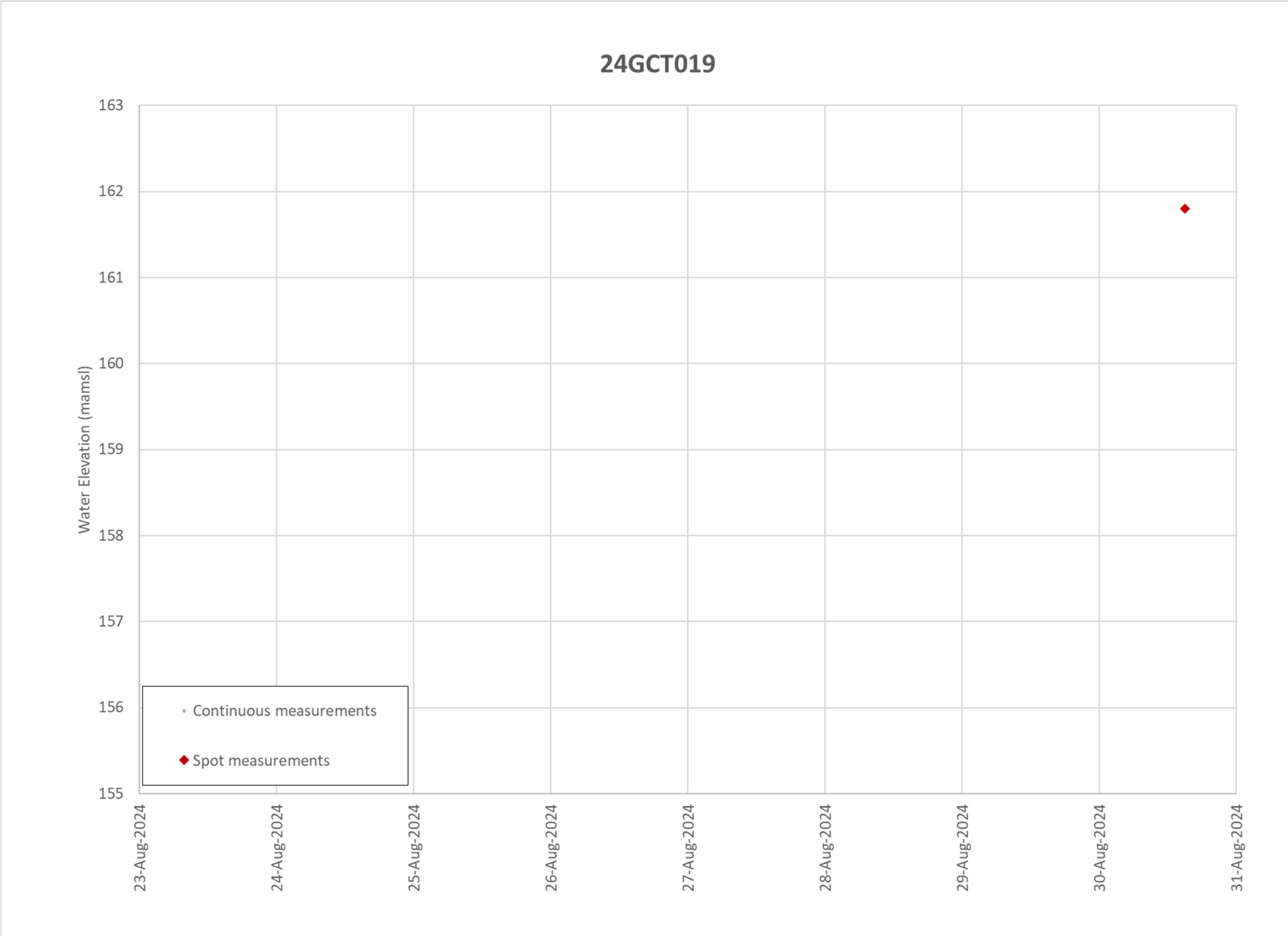

23GC099
300
290
280
270
260
Water Elevation (mamsl)
Sep-23
Oct-23
Dec-23
Mar-24
May-24
Jul-24
Aug-24
Continuous measurements
Spot measurements



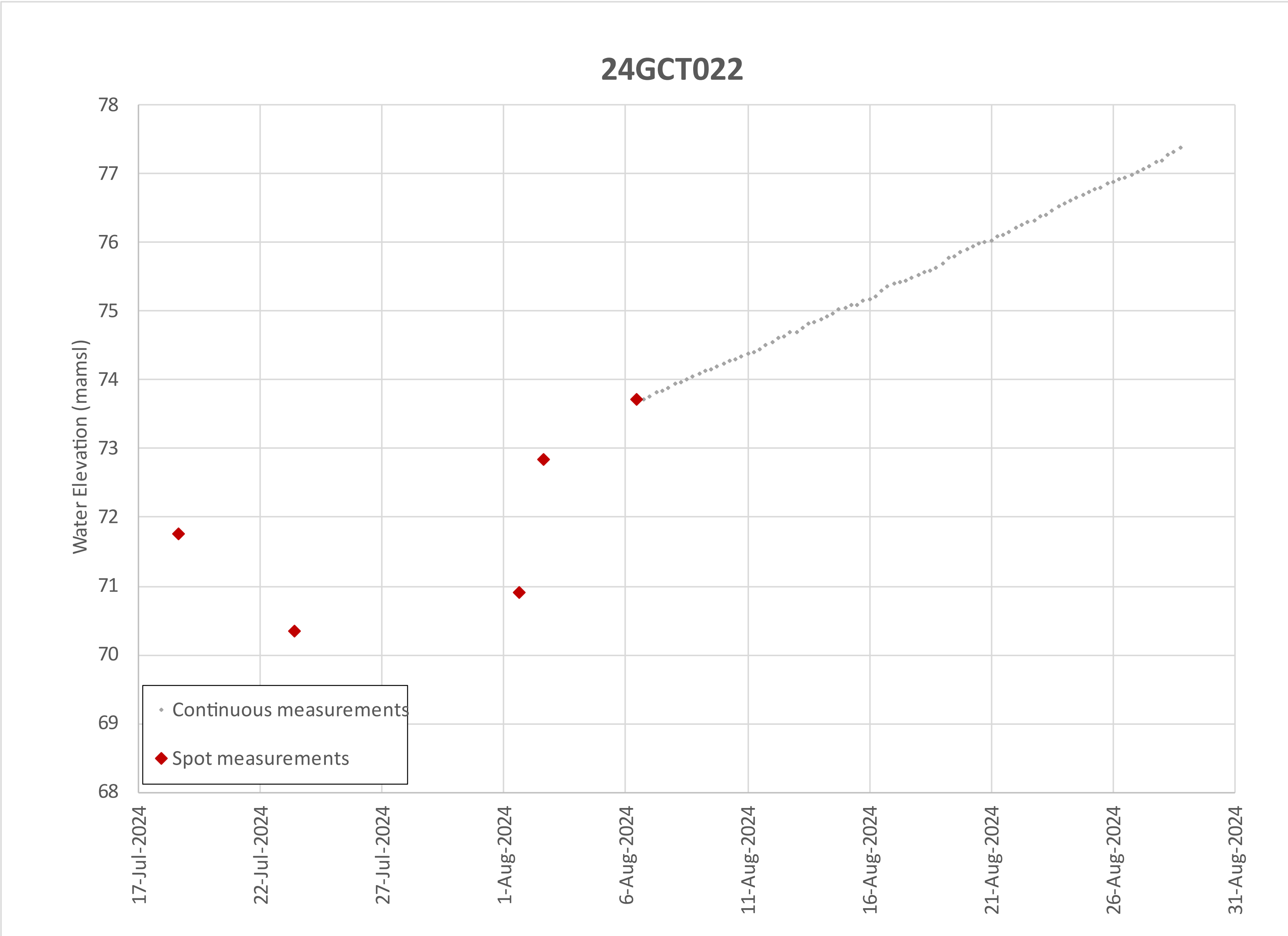
23GCT016
Water Elevation (mamsl)
278
276
274
272
270
268
266
264
262
260
21-Sep-2023
10-Nov-2023
30-Dec-2023
18-Feb-2024
8-Apr-2024
28-May-2024
17-Jul-2024
Continuous measurements
Spot measurements



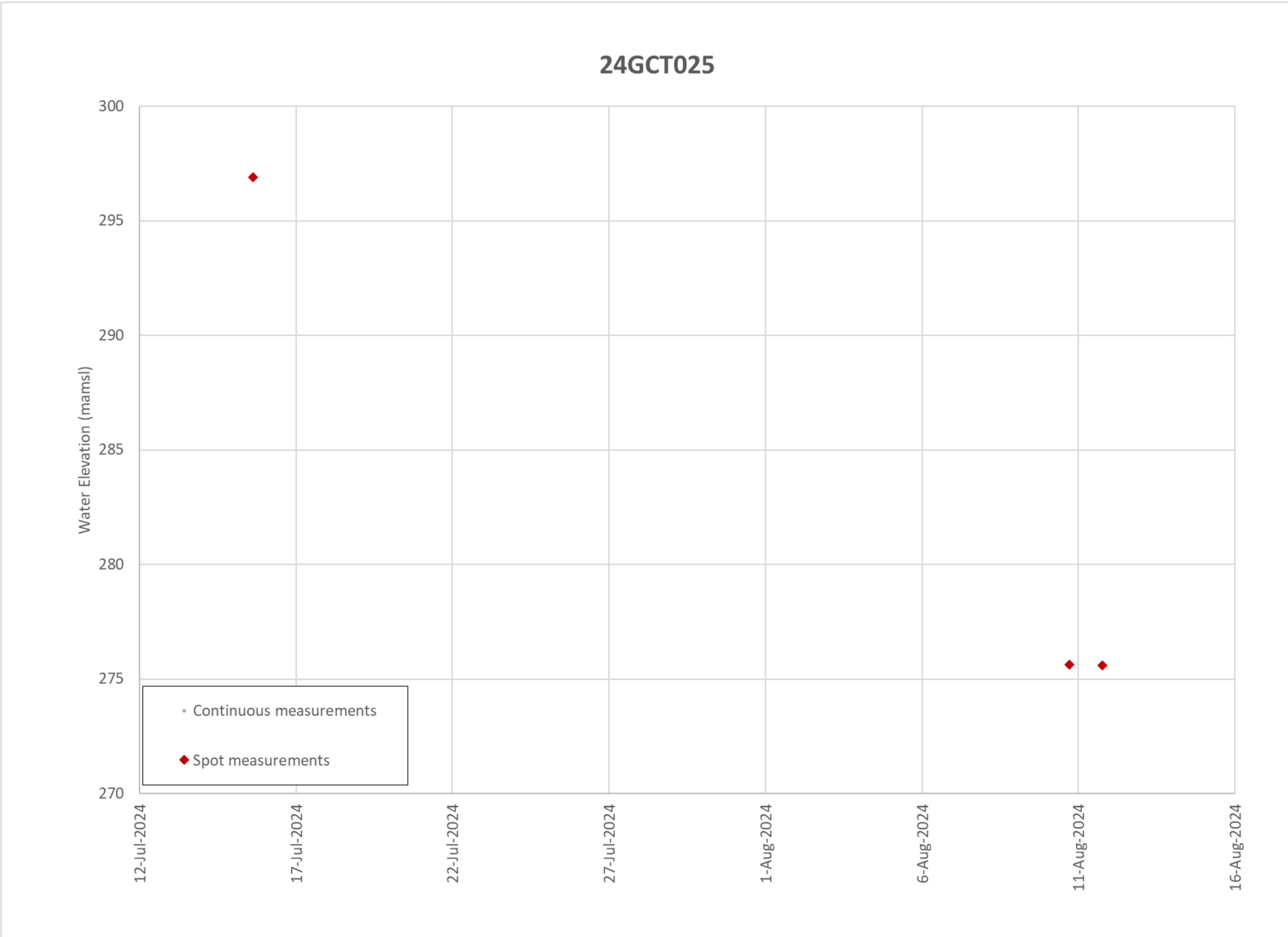
23GCT018
335
330
325
320
315
310
305
300
295
290
Water Elevation (mamsl)
21-Sep-2023
10-Nov-2023
30-Dec-2023
18-Feb-2024
8-Apr-2024
28-May-2024
17-Jul-2024
Continuous measurements
Spot measurements



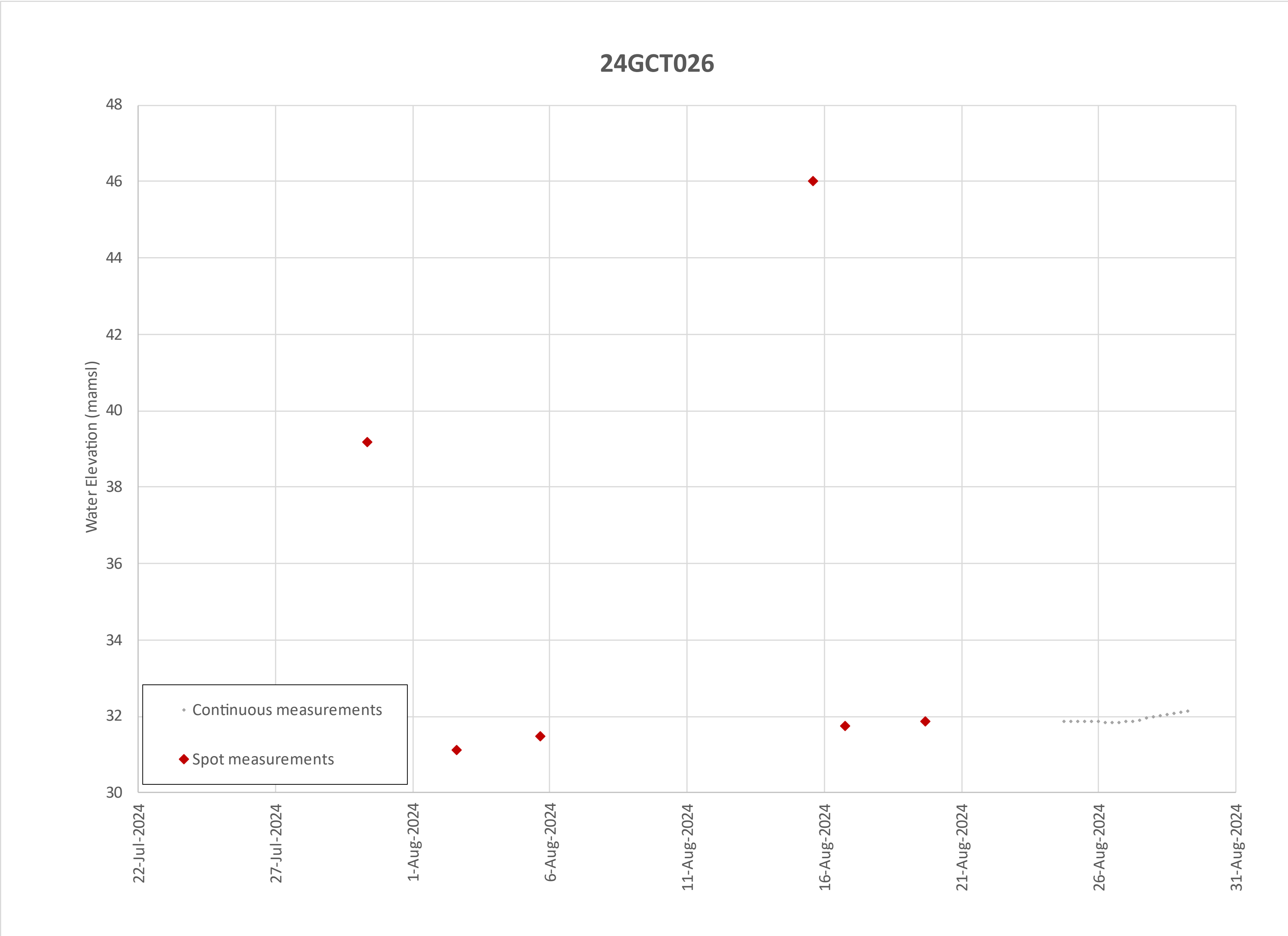
24GCT019
163
162
161
160
159
158
157
156
155
Water Elevation (mamsl)
Continuous measurements
Spot measurements
23-Aug-2024
24-Aug-2024
25-Aug-2024
26-Aug-2024
27-Aug-2024
28-Aug-2024
29-Aug-2024
30-Aug-2024
31-Aug-2024



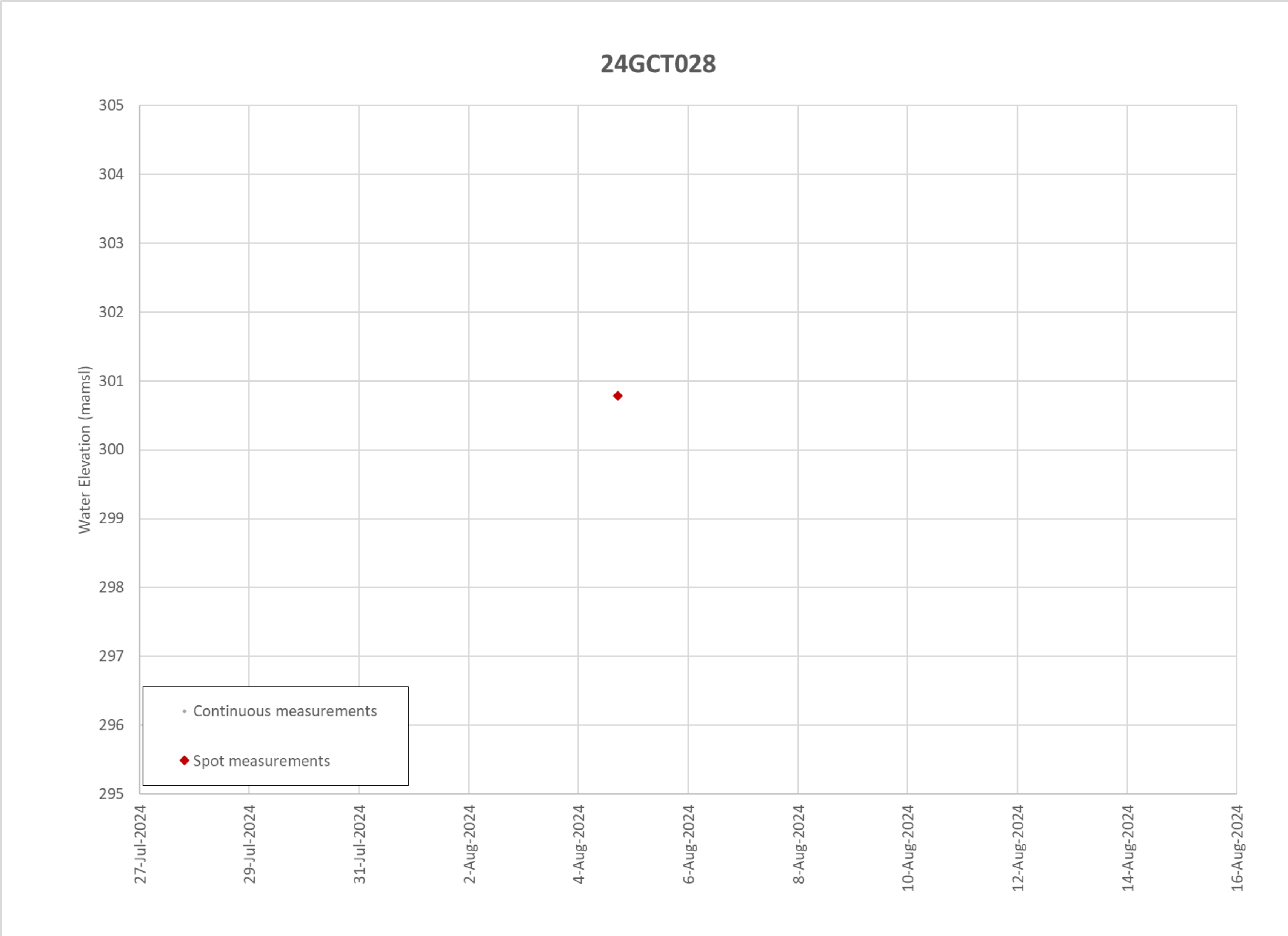
24GCT022
Water Elevation (mamsl)
78
77
76
75
74
73
72
71
70
69
68
17-Jul-2024
22-Jul-2024
27-Jul-2024
1-Aug-2024
6-Aug-2024
11-Aug-2024
16-Aug-2024
21-Aug-2024
26-Aug-2024
31-Aug-2024
Continuous measurements
Spot measurements

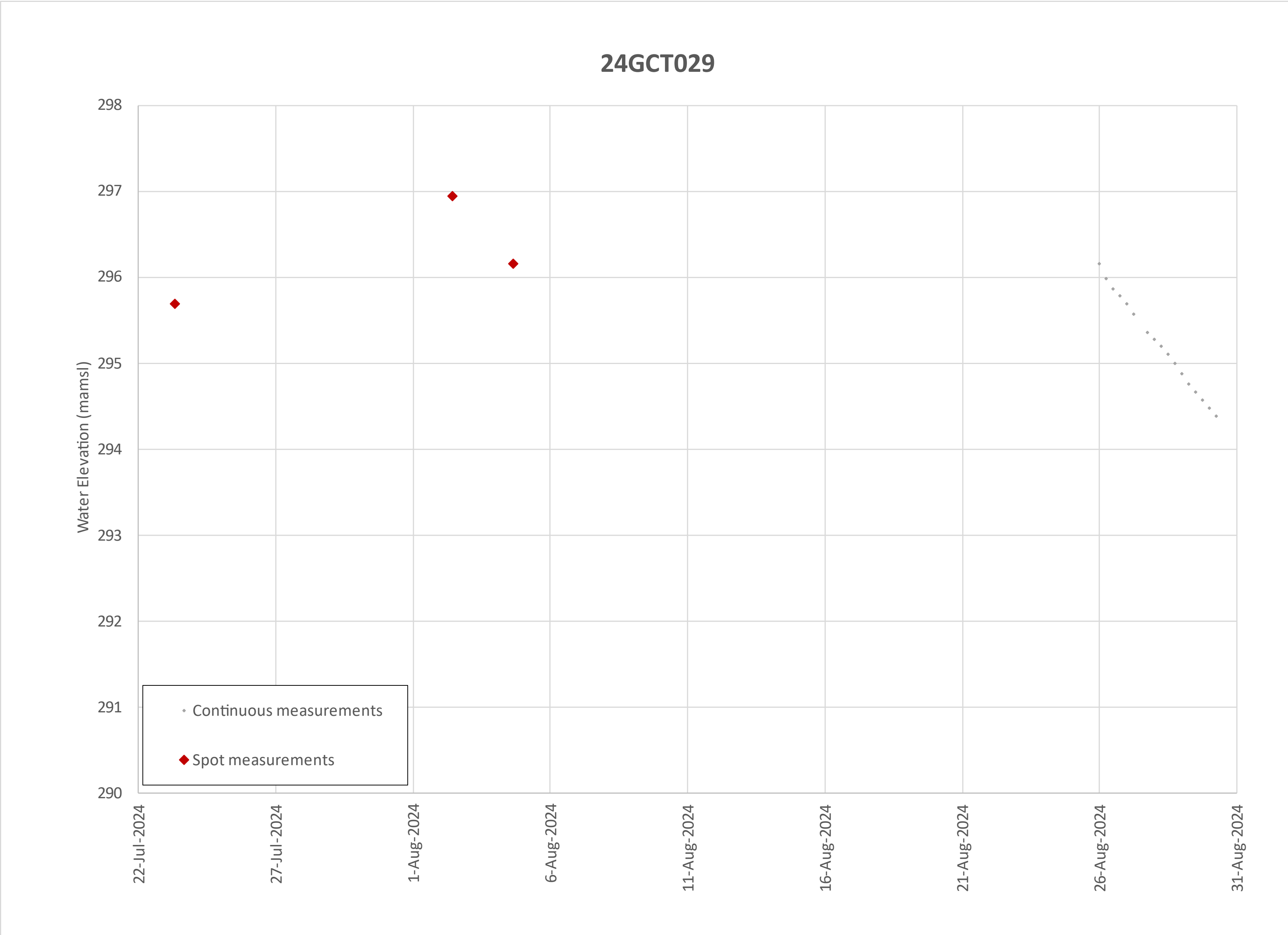


24GCT025
Water Elevation (mamsl)
300
295
290
285
280
275
270
12-Jul-2024
17-Jul-2024
22-Jul-2024
27-Jul-2024
1-Aug-2024
6-Aug-2024
11-Aug-2024
16-Aug-2024
Continuous measurements
Spot measurements

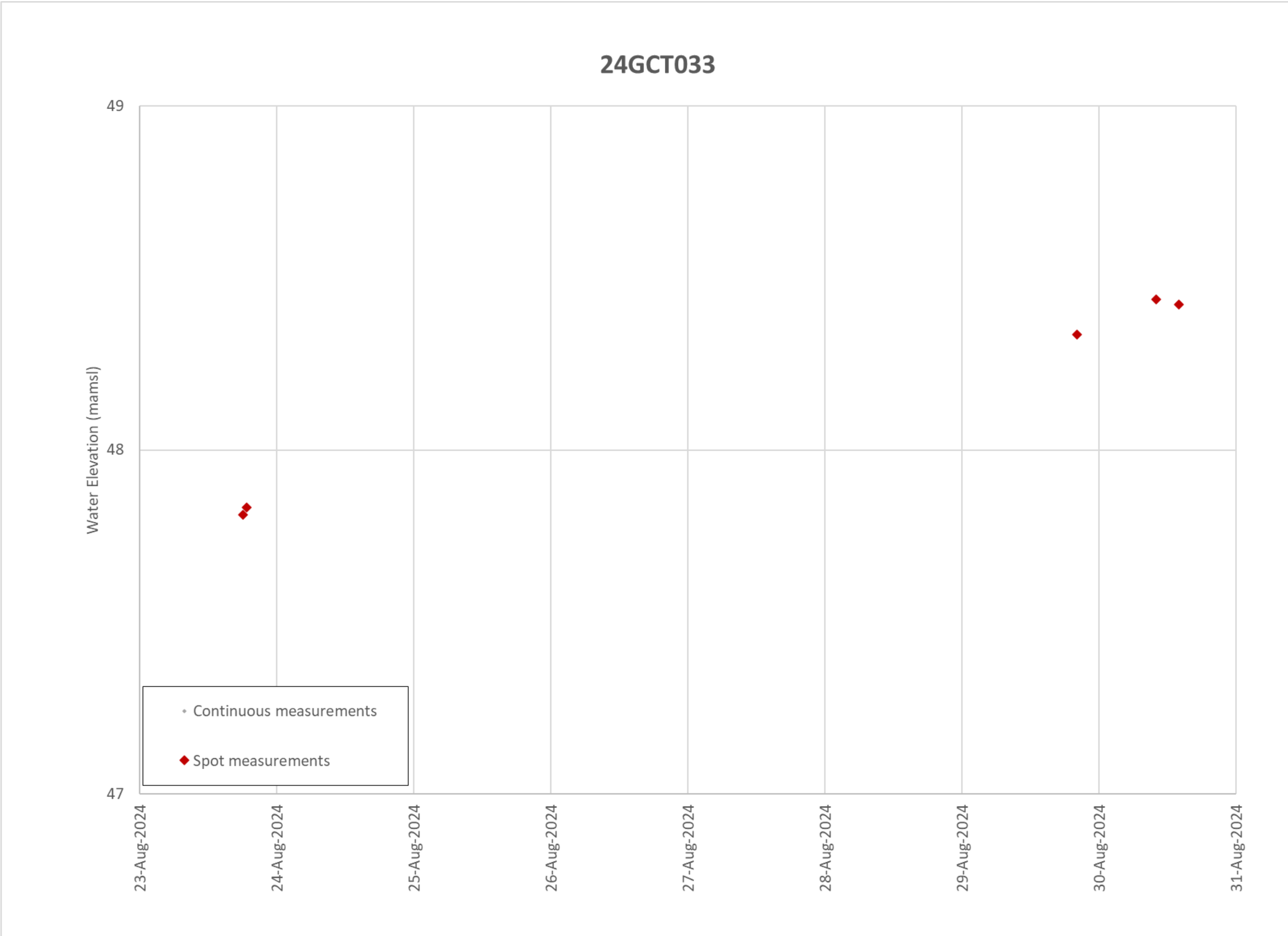


24GCT026
Water Elevation (mamsl)
48
46
44
42
40
38
36
34
32
30
22-Jul-2024
27-Jul-2024
1-Aug-2024
6-Aug-2024
11-Aug-2024
16-Aug-2024
21-Aug-2024
26-Aug-2024
31-Aug-2024
Continuous measurements
Spot measurements


24GCT028
Water Elevation (mamsl)
305
304
303
302
301
300
299
298
297
296
295
27-Jul-2024
29-Jul-2024
31-Jul-2024
2-Aug-2024
4-Aug-2024
6-Aug-2024
8-Aug-2024
10-Aug-2024
12-Aug-2024
14-Aug-2024
16-Aug-2024
Continuous measurements
Spot measurements



24GCT029
298
297
296
295
294
293
292
291
290
Water Elevation (mamsl)
Continuous measurements
Spot measurements
22-Jul-2024
27-Jul-2024
1-Aug-2024
6-Aug-2024
11-Aug-2024
16-Aug-2024
21-Aug-2024
26-Aug-2024
31-Aug-2024


24GCT033
49
48
47
Water Elevation (mamsl)
23-Aug-2024
24-Aug-2024
25-Aug-2024
26-Aug-2024
27-Aug-2024
28-Aug-2024
29-Aug-2024
30-Aug-2024
31-Aug-2024
Continuous measurements
Spot measurements

Appendix C. Hydraulic Test – Detailed Summary

Hole/Well	Interval-Test		Test Interval (mbgs-ah*)			DTW* (m-ah)	Test Type	Analysis Method	Confined Assumption	T*-Test (m^2/day)	K *-Test (m/day)	K-Interval (m/day)	Test Quality (qualitative)	Test Used?	Hydro-geologic Unit	Comments
			From	To	Length (m)											
21GC066	1	A	303.3	306.3	3.0	37.9	Well - Airlift	Theis RDD*	Confined	6.77E-01	2.22E-01	2.22E-01	Fair	Yes	Deep Rock	Good straight-line portion of recovery to match in early time. However, need to refine pumping time interval.
21GC068	1	A	145.5	151.6	6.1	38.4	Well - Artesian Flow/Shut-in	Theis RDD	Confined	2.56E-01	4.19E-02	4.19E-02	Fair	Yes	Deep Rock	Estimated discharge rate. Poor record of "Pumping" time (TDX recovery only). Despite poor constraints on several key parameter, the recovery curve provides a good late time straight-line to match for Theis Residual Drawdown analysis. Uncertainty in pumping time could significantly impact T. Uncertainty in stable water level could significantly impact S/S'.
21GTW007	1	A					Pumping	Cooper Jacob	Confined	1.08E+03	3.95E+01		Good	Yes		There is a very pronounced background water level rise making the recovery data essentially unusable. It is not clear where this originates. Pumping produced minimal drawdown, so the recovery is relatively highly affected by the background water level flux. Drawdown data is fairly clean. Drawdown was analyzed using multiple pumping rates, and a single pumping rate. The single pumping rate analyses tend to be less noisy but I cross-checked it with the multiple rate to rule out boundary effects. The derivitate suggests a possible recharge boundary in late time, but the confidence is low. A longer term, higher rate test would be useful to confirm.
21GTW007	1	B					Pumping	Theis	Confined	6.35E+02	2.31E+01		Good	Yes		
21GTW007	1	C	48.8	76.2	27.4	44.3	Pumping	Theis RDD	Confined	7.32E+01	2.67E+00	3.28E+01	Poor	No	Overcompacted Fluvial	
21GTW007	1	D					Pumping	Cooper Jacob	Confined	1.00E+03	3.66E+01		Good	Yes		
21GTW007	1	E					Pumping	Theis	Confined	7.94E+02	2.90E+01		Good	Yes		
22GC073	1	A	19.6	27.4	7.8	-13.1	Packer	Thiem - 5 Step	Confined	2.29E+00	2.92E-01	2.92E-01	Good	Yes	Shallow Rock	Severe rock leakage. Injected at low pressure due to the shallow depth and relatively low rock competence. Hydro fraccing doesn't appear to have been an issue but was a concern. Ran out of water at 3:35 Hrs and temporary stopped the test while cleaning out the supply water filter.
22GC073	2	A	28.7	47.2	18.5	-13.9	Packer	Thiem - 5 Step	Confined	1.78E+00	9.60E-02	9.60E-02	Good	Yes	Shallow Rock	Low permeability, but washingout of gouge material from the fractures, increasing permeability. Increasing permeability with time, indicating cleaning out of fractures during testing
22GC073	3	A	50.1	91.3	41.3	-15.8	Packer	Thiem - 5 Step	Confined	3.61E-01	8.75E-03	8.75E-03	Good	Yes	Deep Rock	Some leakage from casing during testing: strongly suspect rod leakage. Slight increase of permeability with time, indicating cleaning out of fractures and flow paths during testing. Highest pressure step indicates enhanced system leakage or, less probably, minor hydrofraccing.
22GC073	4	A	92.7	113.7	21.0	-16.9	Packer	Thiem - 2 Step	Confined	2.77E-01	1.32E-02	1.32E-02	Fair	Yes	Deep Rock	Low flow artesian. Experienced difficulty seating the packer in the artesian flow, but second attempt was successful. Bad rod leakage. At 23:43 Hrs the Bean pump started surging very severely. At 23:58:30 Hrs, the surging stopped. A few seconds later the packer lost seal. The 3rd, 4th, and 5th injection steps were not completed. The rig's hydraulic system had to be replaced in the following days. It is suspected that a hydraulic issue was to blame and the surging caused the packer to unseat. However, it is possible that the packer wasn't seated properly to begin with, which could have resulted in excess system leakage
22GC073	5	A	114.1	151.8	37.7	-41.7	Packer	Thiem - 5 Step	Confined	2.19E-01	5.80E-03	5.80E-03	Good	Yes	Deep Rock	The decreasing permeability with time is a result of artificially raising the effective water table during testing. Calculated K from Steps 1, 2, and 3 are likely most representative of in situ conditions and were used. Flowing Artesian (5 GPM @ 14 PSI). Strong upward pressure gradient. Set bit at 380 ft, set packer, then pull 10 ft (to 370 ft). 22:14 Hrs - Bean pump surging too badly so rebuild but still badly oscillating. Last pressure step water was flowing out of the hole at 50 PSI due to effective water table being elevated from testing. Shut-in test interval post-test to determine effective water table.

*mbgs-ah: meters below ground surface along hole (accounts for inclination)

*DTW: Depth to Water. Negative values are above ground surface (flowing artesian)

*T: Transmissivity

*K: Hydraulic Conductivity

*Thies RDD: Theis residual drawdown

Hole/Well	Interval-Test		Test Interval (mbgs-ah) From	To	Length (m)	DTW (m-ah)	Test Type	Analysis Method	Confined Assumption	T-Test (m^2/day)	K-Test (m/day)	K-Interval (m/day)	Test Quality (qualitative)	Test Used?	Hydro-geologic Unit	Comments
22GC075	1	A	15.9	32.3	16.4	-16.6	Packer	Thiem - 5 Step	Confined	9.50E-02	5.80E-03	5.80E-03	Good	Yes	Shallow Rock	Fracture faces oxidized, stained, and weathered. Hit water at about 25-30 ft. Bean pump severely surging. Paused inflate to clean pump (0810 - 0825 hrs). Distinct upward pressure gradient.
22GC075	2	A	31.2	60.3	29.1	-16.3	Packer	Thiem - 5 Step	Confined	4.33E+00	1.49E-01	1.49E-01	Good	Yes	Shallow Rock	Water bypass through formation on first test tedst attempt (108 ft), so reset packer higher in the hole. Injected clean water with no polymer. Flush until clean return. Very permeable rock so couldn't build planned pressure steps. No measureable rod leak (most bad rods were finally sorted out). Distinct upward pressure gradient. Slightly increasing permeability with time indicates cleaning of fractures with injected water.
22GC075	3	A	61.6	90.8	29.2	-28.8	Packer	Thiem - 5 Step	Confined	2.14E-01	7.32E-03	7.32E-03	Good	Yes	Deep Rock	
22GC075	4	A	92.1	116.7	24.6	-18.1	Packer	Thiem - 5 Step	Confined	4.68E-02	1.90E-03	1.90E-03	Good	Yes	Deep Rock	Shut-in pressure recovered slowly and wasn't stabilized before initiating test. Distinct upward pressure gradient. Bean pump surging severely. Shut in interval after test (13:00 Hrs) as effective water table had been artificially elevated from injecting water, as evidenced by generally decreasing permeability with time and pressure. The slightly elevated permeability of Step 3 could be the result of minor hydrojacking but is more likely the result of leakage or a larger radius of influence. Injection steps 1, 2, and 3 are most representative of in situ conditions and were used for the estimated hydraulic conductivity.
22GC075	5	A1	134.8	148.7	13.9	-23.0	Packer Injection & Artesian Shut-in	Thiem - Constant Head	Confined	1.51E+00	1.08E-01	3.85E-01	Good	Yes	Deep Rock	Artesian zone(s) 422.4 - 488 ft. Bean pump severely surging. Bad rod leakage. After shearing pin, can only build 80 PSI pressure all out, so shut-in. Shut-in PSI decline from 13 to 11. Then injection test.
22GC075	5	A2						Shut-in - Theis Residual Drawdown	Confined	9.36E+00	6.72E-01		Good	Yes		Analyzed residual drawdown from shut-in test. The bad rod leakage may have impacted the results.
22GC075	5	B1					Packer Shut-in	Shut-in - Theis Residual Drawdown	Confined	4.67E+00	3.35E-01		Good	Yes		The quality of the previous test along the same interval wasn't entirely clear due to rod leakage and packer deflation issues, so repeated a short duplicate test to check. Both tests behaved similarly, so test 5 was probably good.
22GC075	5	B2						Cooper-Jacob	Confined	5.97E+00	4.28E-01		Good	Yes		
22GC075	5	B3						Theis	Confined	3.64E+00	2.61E-01		Fair	No		
22GC075	6	A1	119.6	148.7	29.2	-57.0	Packer Shut-in	Shut-in - Theis Residual Drawdown	Confined	3.84E+00	1.32E-01	1.32E-01	Good	No		Drillers had advanced the hole beyond an artesian zone. Test 5/5A spanned a fracture set. Test 6 pulled back to where the new artesian zone was first suspected (correctly, as it turned out) and also included the Test 5/5A zone. Did not use because test substantially overlapped previous test interval.
22GC075	6	A2						Cooper-Jacob	Confined	1.18E+01	4.03E-01		Fair	No		
22GT008D	1	A	68.9	78.0	9.1	66.7	Large Mechanical Slug - FHT	Bouwer-Rice	Confined	4.42E-02	4.84E-03	4.20E-03	Good	Yes	Overcompacted Glacio-fluvial - Clayey Unit	Initial displacement H(0) is slightly higher than what it should be for the large mechanical slug
22GT008D	1	B					Large Mechanical Slug - RHT	Bouwer-Rice	Confined	1.02E-01	1.12E-02		Fair	No		Initial displacement H(0) is significantly greater than what it should be for the large mechanical slug. The concave habit of the recovery curve is characteristic of a relatively large formation storage parameter
22GT008D	1	C					Medium Mechanical Slug - FHT	Bouwer-Rice	Confined	3.26E-02	3.57E-03		Good	Yes		Minor formation water level increase over the course of testing. Slightly higher H(0) than expected for size of slug.
22GT008D	1	D					Medium Mechanical Slug - RHT	Bouwer-Rice	Confined	6.63E-02	7.25E-03		Fair	No		Not as clean of a test as FHT, but still appears good. Concave recovery curve indicative of large formation storage.
22GT008D	1	E					Pneumatic Slug	Bouwer-Rice	Confined	7.73E-02	8.45E-03		Fair	No		Poorly defined H(0) value. An estimated value was used.

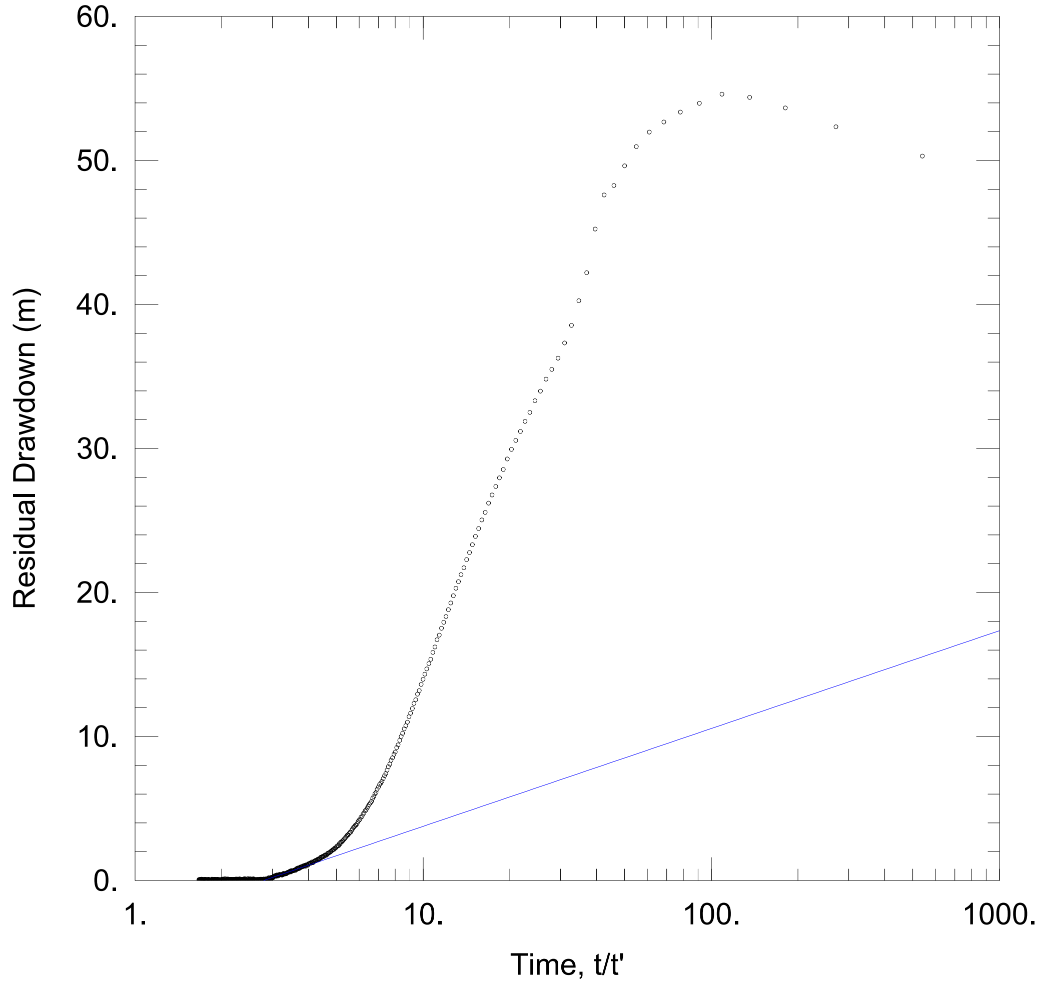
Hole/Well	Interval	Test	Test Interval (mbgs-ah) From	To	Length (m)	DTW (m-ah)	Test Type	Analysis Method	Confined Assumption	T-Test (m^2/day)	K-Test (m/day)	K-Interval (m/day)	Test Quality (qualitative)	Test Used?	Hydrogeologic Unit	Comments
22GT008S	1	A1					Large Mechanical Slug - FHT	Bouwer-Rice	Confined	2.58E-01	2.82E-02		Fair	No		Incomplete recovery. Projected recovery through match interval, but good straight line trend. The confined assumption may not be very appropriate. Substantially larger H(0) than expected for the size of the slug.
22GT008S	1	A2						Hvorslev	Unconfined	3.05E-02	3.33E-03		Fair	No		Incomplete recovery. Projected recovery through match interval, but good straight line trend. Substantially larger H(0) than expected for the size of the slug.
22GT008S	1	B1					Large Mechanical Slug - RHT	Bouwer-Rice	Confined	5.02E-02	5.49E-03		Good	Yes		Moderately larger H(0) than expected for the size of the mechanical slug. The confined assumption may not be very appropriate.
22GT008S	1	B2						Hvorslev	Unconfined	5.87E-02	6.42E-03		Good	Yes		Moderately larger H(0) than expected for the size of the mechanical slug.
22GT008S	1	C1					Medium Mechanical Slug - FHT	Bouwer-Rice	Confined	2.78E-02	3.04E-03		Fair	No		Slightly larger H(0) than expected. The confined assumption may not be very appropriate.
22GT008S	1	C2						Hvorslev	Unconfined	3.11E-02	3.40E-03		Good	Yes		Slightly larger H(0) than expected.
22GT008S	1	D1	36.9	46.0	9.1	34.9	Medium Mechanical Slug - RHT	Bouwer-Rice	Confined	4.33E-02	4.73E-03	3.40E-03	Fair	No	Till	Slightly larger H(0) than expected. The confined assumption may not be very appropriate. The concave-down recovery trend is unusual and the reasons are not clear.
22GT008S	1	D2						Hvorslev	Unconfined	5.34E-02	5.84E-03		Good	Yes		Slightly larger H(0) than expected. The concave-down recovery trend is unusual and the reasons are not clear.
22GT008S	1	E1					Small Mechanical Slug - FHT	Bouwer-Rice	Confined	3.38E-02	3.69E-03		Good	Yes		The confined assumption may not be entirely appropriate.
22GT008S	1	E2						Hvorslev	Unconfined	4.05E-02	4.43E-03		Good	Yes		
22GT008S	1	F1					Small Mechanical Slug - RHT	Bouwer-Rice	Confined	3.19E-02	3.49E-03		Good	Yes		The confined assumption may not be entirely appropriate. Noise in data is from helicopter slinging around well.
22GT008S	1	F2						Hvorslev	Unconfined	3.85E-02	4.21E-03		Good	Yes		Noise in data is from helicopter slinging around well.
22GT008S	1	G					Pneumatic Slug	Hvorslev	Unconfined	3.53E-02	3.86E-03		Poor	No		Incomplete recovery. Minimal data to match.
22GT008S	1	H					Pneumatic Slug	Hvorslev	Unconfined	6.03E-02	6.60E-03		Poor	No		Incomplete recovery. Minimal data to match.
22GT008S	1	I					Pneumatic Slug	Hvorslev	Unconfined	5.42E-02	5.92E-03		Poor	No		Incomplete recovery. Minimal data to match.
22GT009D	1	A					Large Mechanical Slug - FHT	Bouwer-Rice	Confined	1.03E-02	3.40E-03		Good	No		Slightly larger H(0) than expected for the size of the mechanical slug, but likely insignificant impact on interpretation. The subsequent Rising Head Test (after allowing to recovery overnight) did not recover to the same level, suggesting the transducer was moved while pulling the slug. As such, there is some question as to the stable water level. Water levels were measured prior and post test and are in very close agreement. The cause of the anomalous late time noise mirroring the recovery curve is unclear. The cause of the concave-down recovery curve is also unclear.
22GT009D	1	B	41.1	44.2	3.0	40.4	Large Mechanical Slug - RHT	Bouwer-Rice	Confined	1.02E-02	3.35E-03	4.08E-03	Fair	No	Till	Moderately larger H(0) than expected for the size of the mechanical slug. The water level did not recover to the same level of the preceding Falling Head Test from the previous day (Recovery was allowed to continue all night), suggesting the transducer was moved while pulling the slug. As such, there is some question as to the stable water level. Water levels were measured prior and post test and are in very close agreement.
22GT009D	1	C					Small Mechanical Slug - FHT	Bouwer-Rice	Confined	1.54E-02	5.04E-03		Good	Yes		Slightly larger H(0) than expected for the size of the mechanical slug but it does not appear to significantly impact the analysis.
22GT009D	1	D					Small Mechanical Slug - RHT	Bouwer-Rice	Confined	9.52E-03	3.12E-03		Good	Yes		Slightly larger H(0) than expected for the size of the mechanical slug but it does not appear to significantly impact the analysis.
22GT009D	1	E					Bail recovery	Bouwer-Rice	Confined	1.27E-02	4.18E-03		Fair	No		Recovery from bailing develoment. Non-instantaneous slug and poor control on H(0) value, but relatively large displacement translates to a low percentage uncertainty on H(0). Distinctive "elbow" in recovery curve may be from wellbore storage as the filter pack recharged with water.

Hole/Well	Interval-Test		Test Interval (mbgs-ah)			DTW (m-ah)	Test Type	Analysis Method	Confined Assumption	T-Test (m^2/day)	K-Test (m/day)	K-Interval (m/day)	Test Quality (qualitative)	Test Used?	Hydro-geologic Unit	Comments
			From	To	Length (m)											
22GT009S	1	A					Large Mechanical Slug - FHT	Hvorslev	Unconfined	1.82E-02	5.98E-03		Good	Yes		Initial displacement is much larger than expected H(0), but was almost certainly a shock wave from lowering the slug. Recovery curve is very good.
22GT009S	1	B	30.5	33.5	3.0	31.3	Small Mechanical Slug - FHT	Hvorslev	Unconfined	1.92E-02	6.30E-03	5.98E-03	Good	No	Till	Gradually declining backround water level (likely due to atmospheric pressure) but likely did not significantly impact the analysis. Slightly larger H(0) than expected for the size of the mechanical slug used.
22GT009S	1	C					Small Mechanical Slug - RHT	Hvorslev	Unconfined	2.12E-02	6.94E-03		Fair	No		Anomalous offset of recovery curve at critical matching interval. Gradually declining backround water level (likely due to atmospheric pressure) but likely did not significantly impact the analysis. Slightly larger H(0) than expected for the size of the mechanical slug used.
23GC094	1	A	83.9	96.0	12.1	9.7	Packer	Thiem - 1-step	Confined	3.30E-02	2.70E-03	2.70E-03	Good	Yes	Deep Rock	Good test with stable injection pressure.
23GC094	2	A	97.3	129.5	32.2	3.4	Packer	Thiem - 1-step	Confined	3.50E-03	1.10E-04	1.10E-04	Good	Yes	Deep Rock	Good test with stable injection pressure.
23GC094	3	A	127.8	173.7	45.9	-0.4	Packer	Thiem - 1-step	Confined	2.35E-01	5.11E-03	5.11E-03	Good	Yes	Deep Rock	Good test with stable injection pressure.
23GC094	4	A	173.5	186.2	12.7	-3.7	Packer	Thiem - 1-step	Confined	1.84E-02	1.45E-03	1.45E-03	Good	Yes	Deep Rock	Good test, but consistant injection rate had high fluctuation range. Most likely do to high injection rate than many other tests.
23GC099	1	A	29.9	56.1	26.1	-10.6	Packer	Thiem - 1-step	Confined	4.18E+00	1.60E-01	1.60E-01	Fair	Yes	Shallow Rock	Questionable K Value. Likely partial bypass around packer. This might make true k lower than shown in this test.
23GC099	2	A	112.2	162.8	50.5	4.0	Packer	Thiem - 1-step	Confined	1.22E+00	2.41E-02	2.41E-02	Fair	Yes	Deep Rock	Questionable K Value. Likely partial bypass around packer. This might make true k lower than shown in this test.
23GC099	3	A	57.4	162.8	105.4	5.2	Packer	Thiem - 1-step	Confined	1.44E+00	1.36E-02	1.36E-02	Good	No	Deep Rock	Good test, stable injection rate. Did not use because test substantially overlapped previous test
23GC100	1	A	28.4	56.4	28.0	-0.4	Packer	Thiem - 1-step	Confined	2.00E+00	7.17E-02	7.17E-02	Good	Yes	Shallow Rock	20 minute test pressure not fully stabilized during test.
23GC100	2	A	57.7	96.0	38.3	-4.9	Packer	Thiem - 1-step	Confined	8.30E-01	2.17E-02	2.17E-02	Good	Yes	Deep Rock	Test was good once good seal with packer was obtained.injection pressure was a little unstable.
23GC100	3	A	97.3	147.8	50.5	-13.4	Packer	Thiem - 1-step	Confined	8.60E-01	1.71E-03	1.71E-03	Good	Yes	Deep Rock	Shut-in, pretest water level does not match post test water level.
23GC100	4	A	149.1	205.7	56.6	-13.9	Packer	Thiem - 1-step	Confined	1.13E-01	2.00E-03	2.00E-03	Good	Yes	Deep Rock	Good test.
23GCT016	1	A	19.5	40.8	14.3	26.5	Well - Slug	Bouwer-Rice	Confined	5.60E-01	4.62E-02	4.62E-02	Good	Yes	Shallow Rock	Only single falling head test; rated as fair due to only one slug test. Having FHT, RHT, and also different size slugs can add to quality assessmnent.
23GCT018	1	A	19.5	40.8	16.6	24.2	Well - Slug	Bouwer-Rice	Confined	2.33E-02	1.50E-03	1.50E-03	Good	Yes	Shallow Rock	Only single falling head test; rated as fair due to only one slug test. Having FHT, RHT, and also different size slugs can add to quality assessmnent.
		A						Thiem - 1-step	Confined	2.33	1.04E-01		Good	Yes		Good Test. Performed artesian flow and shut-in test prior to injection test. Artesian flow rate is about 22.5 L/min. Leak rate estimated: couldn't inject at planned pressure due to artesian Pressure
24GCT019	1	B	35.74	58.21	22.5	-20.4	Packer Artesian Shut-in Test	Cooper-Jacob	Confined	7.776	3.46E-01	1.04E-01	Fair	No	Shallow Rock	Some noise in data and possible impact to drawdown as hole was left discharging at shift change, shut-in during packer inflation, then opened again.
		C						Theis RDD	Confined	1.264	5.62E-02		Good	Yes		Very nice recovery curve. As noted in previous comment, discharge time (pumping time) was perhaps poorly constrained.
		D						Theis	Confined	2.661	1.18E-01		Fair	Yes		Good late pumping/early recovery match, but possibly impacted by long unconstrained flow at shift change.
24GCT019	2	A	64.39	81.38	17.0	-13.9	Packer	Thiem - 1-step	Confined	0.052	3.03E-03	3.03E-03	Good	Yes	Deep Rock	Pin sheared prematurely, so no leak test but packer was inflated. Performed multiple checks to ensure packer was set correctly. Used leak rates from Test 1 and 3 for estimated leak. Those leaks were nearly identical.
24GCT019	3	A	85.72	111.70	26.0	-4.0	Packer	Thiem - 1-step	Confined	0.14	5.20E-03	5.20E-03	Good	Yes	Deep Rock	Good Test, although Bean pump cycled a bit, causing noise in data. Run leak at 100 PSI but test at 50 PSI, so calculate leak rate.
24GCT019	4	A	119.25	145.08	25.8	-6.5	Packer	Thiem - 1-step	Confined	0	0E+00	0.00E+00	Good	Yes	Deep Rock	Good test but no measureable injection. Very tight rock.

Hole/Well	Interval-Test		Test Interval (mbgs-ah) From	To	Length (m)	DTW (m-ah)	Test Type	Analysis Method	Confined Assumption	T-Test (m^2/day)	K-Test (m/day)	K-Interval (m/day)	Test Quality (qualitative)	Test Used?	Hydro-geologic Unit	Comments
24GCT022	1	A	30.48	60.96	30.5	69.0	Open Hole	Thiem - 1-step	Confined	14.79	5E-01			No		Open hole test with substantial caving causing poor constraints on effective interval
24GCT022	2	A	60.96	91.44	30.5		Open Hole							No		Not analyzable. Appears to be low permeability.
24GCT022	3	A	135.58	144.73	9.1	74.9	Well Airlift	Theis RDD	Confined	34.79	3.80E+00	3.80E+00	Good	Yes	Overcompacted Glacio-fluvial	Good airlift recovery. Drawdown is not analyzable.
24GCT023	1	A	39.39	62.48	23.1	-10.8	Packer	Thiem - 1-step	Confined	3.26	1.41E-01	1.41E-01	Good	Yes	Shallow Rock	Low fracture-frequency foliated garnet schist
24GCT023	2	A	63.78	120.09	56.31	-12.6	Packer	Thiem - 1-step	Confined	0.59	1.04E-02	1.04E-02	Good	Yes	Deep Rock	Low fracture-frequency foliated garnet schist
24GCT025	1	A	60.42	113.99	53.57	13.0	Packer	Thiem - 1-step	Confined	0	0E+00	0.00E+00	Good	No	Deep Rock	Low fracture-frequency foliated garnet schist. Below detectiong limits. Test interval in permafrost so did not use.
24GCT025	2	A	115.28	157.88	42.59	92.7	Packer	Thiem - 1-step	Confined	1.59	3.74E-02	3.74E-02	Good	Yes	Deep Rock	Garnet schist. Moderate fracture frequency.
24GCT026	1	A				31.5	Well Airlift	Cooper-Jacob	Confined	0.1724	1.86E-02		Fair	No		Noisy airlift drawdown data, but mid- to late-drawdown produced an interval of possible IARF, as indicated by the derivative.
	1	B						Theis-Hantush	Confined	0.1928	2.09E-02		Poor	No		Poor match of the recovery. Good match of late-time drawdown; matching same interval as the Cooper-Jacob analysis.
	1	C						Theis RDD	Confined	8.55	9.25E-01		Poor	No		The recovery data is overprinted with some other trends, resulting in a poor curve match. Straight line portion of residual drawdown curve is very subtle, being masked by the collapse of the suspended air/water column and a long term (12+ hour) slow trend of increasing water levels. TheisRDD matches a different part of the curve compared to Cooper-jacob or Theis-Hantush.
24GCT026	1	D	153.43	162.67	9.25	31.5	Well Airlift	Cooper-Jacob	Confined	0.2703	2.92E-02	4.10E-01	Fair	No		Fair drawdown and derivative match.
	1	E						Theis-Hantush	Confined	0.2703	2.92E-02		Fair	No		Fair late-time drawdown and early-time recovery curve match.
	1	F						Theis RDD	Confined	27.39	2.96E+00		Poor	No		The recovery data is overprinted with some other trends, resulting in a poor curve match.
	1	G						Theis RDD	Confined	0.05354	5.79E-03		Fair	No		Matched a different part of the residual drawdown curve. The straight-line portion of the RDD/T/t' curve doesn't occur in the typical interval, probably due to a compination of the airlift approach (collapsing air/water column) and exhaustion of the aquifer storage.
24GCT026		H				45.4	Pumping Test w/Grundfos	Cooper-Jacob	Confined	1.768	1.91E-01		Fair	Yes	Overcompacted Fluvial	Noisy drawdown curve, but a substantial straight-line interval provided a fair match, as evidenced in the derivative. It seems the pump may have shifted during the test. The drawdown intervals are offset but generally follow the same slope.
	1	I						Theis-Hantush	Confined	1.574	1.70E-01		Poor	No		Difficult to match both drawdown and recovery. Very rapid recovery, despite use of a check valve in the pump drop tubing.
		J						Theis RDD	Confined	5.821	6.30E-01		Good	Yes		Still a somewhat strange recovery T/t' curve with an anomalous inflection point in the straight-line portion. Matched early T/t' curve. Later portion of curve seemed to high T and deviates from Cooper-Jacob.
24GCT028	1	A	23.24	55.02	31.78	-3.1	Packer	Thiem - 1-step	Confined	7.9	2.49E-01	2.49E-01	Good	Yes	Shallow Rock	Surficial/fault damage zone in top of test interval.
24GCT028	2	A	56.77	92.05	35.28	-1.1	Packer	Thiem - 1-step	Confined	0.017	4.93E-04	4.93E-04	Good	No		Test in permafrost zone so not used.
24GCT028	3	A	90.30	119.48	29.18	54.1	Packer	Thiem - 1-step	Confined	0.255	8.75E-03	8.75E-03	Good	Yes	Deep Rock	Low fracture-frequency foliated garnet schist with graphitic zones
24GCT028	4	A	117.73	143.87	26.14	-1.6	Packer	Thiem - 1-step	Confined	0.131	5.02E-03	5.02E-03	Good	Yes	Deep Rock	Largely unfractured bedrock with one fracture set 410 - 417 feet.

Hole/Well	Interval-	Test	Test Interval (mbgs-ah) From	To	Length (m)	DTW (m-ah)	Test Type	Analysis Method	Confined Assumption	T-Test (m^2/day)	K-Test (m/day)	K-Interval (m/day)	Test Quality (qualitative)	Test Used?	Hydro-geologic Unit	Comments
		A						Cooper-Jacob	Confined	24.22	1.22E+00		Fair	Yes		Hydrograph required detrending to remove long term declining water levels. Fair match of late time drawdown.
24GCT029	1	B	21.18	41.00	19.82	9.6	Well - Pumping Test w/Grundfos	Theis-Hantush	Confined	36.63	1.85E+00	2.50E+00	Poor	No	Shallow Rock	Hydrograph required detrending to remove long term declining water levels. Cannot closely match both drawdown and recovery curve. This is likely due to a late-time collapse of the drawdown trend.
		C						Theis RDD	Confined	75	3.78E+00		Fair	Yes		Hydrograph required detrending to remove long term declining water levels. Matched early t/t' data, but another later t/t' straight-line curve provides T values more inline with the Cooper-Jacob and Theis-Hantush results.
24GCT030	1	A	30.25	47.24	16.99	-7.6	Packer	Thiem - 1-step	Confined	0.62	3.66E-02	3.66E-02	Good	Yes	Shallow Rock	Upward gradient. Flowing artesian pressure. Good test.
24GCT030	2	A	48.54	77.72	29.18	-7.8	Packer	Thiem - 1-step	Confined	1.23	4.23E-02	4.23E-02	Good	Yes	Shallow Rock	Difficulty seating packer, but seated just prior to injection. Determined artesian head post-test by adding rods until flow stopped. Rate stabilized halfway though test, then psi started to gradually climb w/o fully stabilizing. However, good test.
24GCT030	3	A	79.02	120.40	41.38	13.5	Packer	Thiem - 1-step	Confined	6.82	1.65E-01	1.65E-01	Fair	Yes	Deep Rock	Flow rate much higher than expected; rate higher than measured leak. So test leak rate calculated instead of measured. Analysis dropped the low end estimated imposed head to account for some question on the shut-in pressure. Some concern that packer was properly sealed.
		A						Theis		51.96	3.73E+00		Good	Yes		
24GCT032	1	B	21.41	35.36	13.94	-11.2	Packer Artesian Shut-in Test	Cooper-Jacob	Confined	85.06	6.10E+00	3.41E+00	Fair	No	Shallow Rock	Primary artesian flow from 50 - 67 feet down-hole. Artesian flow 42 LPM
		C						Theis RDD		43.11	3.09E+00		Good	Yes		
24GCT032	2	A	36.65	65.84	29.18	-19.0	Packer	Thiem - 1-step	Confined	0.52	1.77E-02	1.77E-02	Good	Yes	Deep Rock	Artesian. Shut-in not fully equilibrated prior to start test, but near equilibration. Generally good test.
24GCT032	3	A	67.13	117.65	50.52	-18.8	Packer	Thiem - 1-step	Confined	0.54	1.06E-02	1.06E-02	Good	Yes	Deep Rock	Artesian. Flush w/artesian flow. Good test. Artesian flow not fully equilibrated, but looks to be approaching stability.
24GCT032	4	A	118.95	164.90	45.95	-6.5	Packer	Thiem - 1-step	Confined	0.31	6.69E-03	6.69E-03	Fair	Yes	Deep Rock	
		A						Theis		11.64	1.29E+00		Fair	Yes		Noisy data but fair match to both drawdown and recovery curve.
24GCT033	1	B	137.50	146.50	9.00	15.4	Pumping Test w/Grundfos	Cooper-Jacob	Confined	3.45	3.84E-01	1.29E+00	Fair	No	Overcompacted Fluvial	Noisy drawdown data but one good interval to match.
		C						Theis RDD		19.75	2.19E+00		Good	No		Fairly good flat time recovery to match.
24GC142A	1	A	97.31	117.35	20.04	34.3	Packer	Thiem - 1-step	Confined	0.18	9.22E-04	9.22E-04	Good	Yes	Deep Rock	Downward pressure gradient. Minimal necessary washing to preserve integrity of alluvial interval. Rel. low permeability and shut-in not fully equilibrated prior to start of test. However, generally good constraints. Moderate fracture frequency. Some zones of elevated fractures and pervasive FeOx staining and weathering. Garnet gneiss w/graphitic zones. Some hydrothermal alteration of rock mass.
24GC142A	2	A	118.64	153.92	35.28	-8.6	Packer	Thiem - 1-step	Confined	0.03	8.61E-04	8.61E-04	Good	Yes	Deep Rock	Artesian and upward pressure gradient. Min. req'd flush to preserve integrity of alluvial interval. Upward pressure gradient. Rel. low perm. & shut-in not fully equilibrated prior to start. However, generally good constraints. Mod. to low fracture frequency. Some healed low-alpha joints. Some intervals of mild FeOx staining. Garent geniss w/minor intrusive(?) veins and minor graphitic zones. Some hydrothermal alteration of rock mass.
24GC142A	3	A	155.22	194.77	39.55	-9.2	Packer	Thiem - 1-step	Confined	0.0023	5.87E-05	5.87E-05	Good	Yes	Deep Rock	Artesian and upward pressure gradient. Minimal necessary washing to preserve integrity of alluvial interval. Low permeability so shut-in not fully equilibrated prior to start of test. However, generally good constraints. Low fracture frequency. Some zones of elevated FF (minor faults). Garnet gneiss w/graphitic zones w/veins. Some hydrothermal alteration of rock mass. Pervasive alteration beginning about 620 feet.

Appendix D. Hydraulic Test by Interval



20GC066 AIRLIFT

Data Set: C:\...\TheisRDD.aqt
Date: 11/23/24 Time: 14:47:44

PROJECT INFORMATION

Company: Tundra
Location: Graphite Creek
Test Well: 20GC066
Test Date: 10/14/21

AQUIFER DATA

Saturated Thickness: 270.5 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
21GC066	0	0

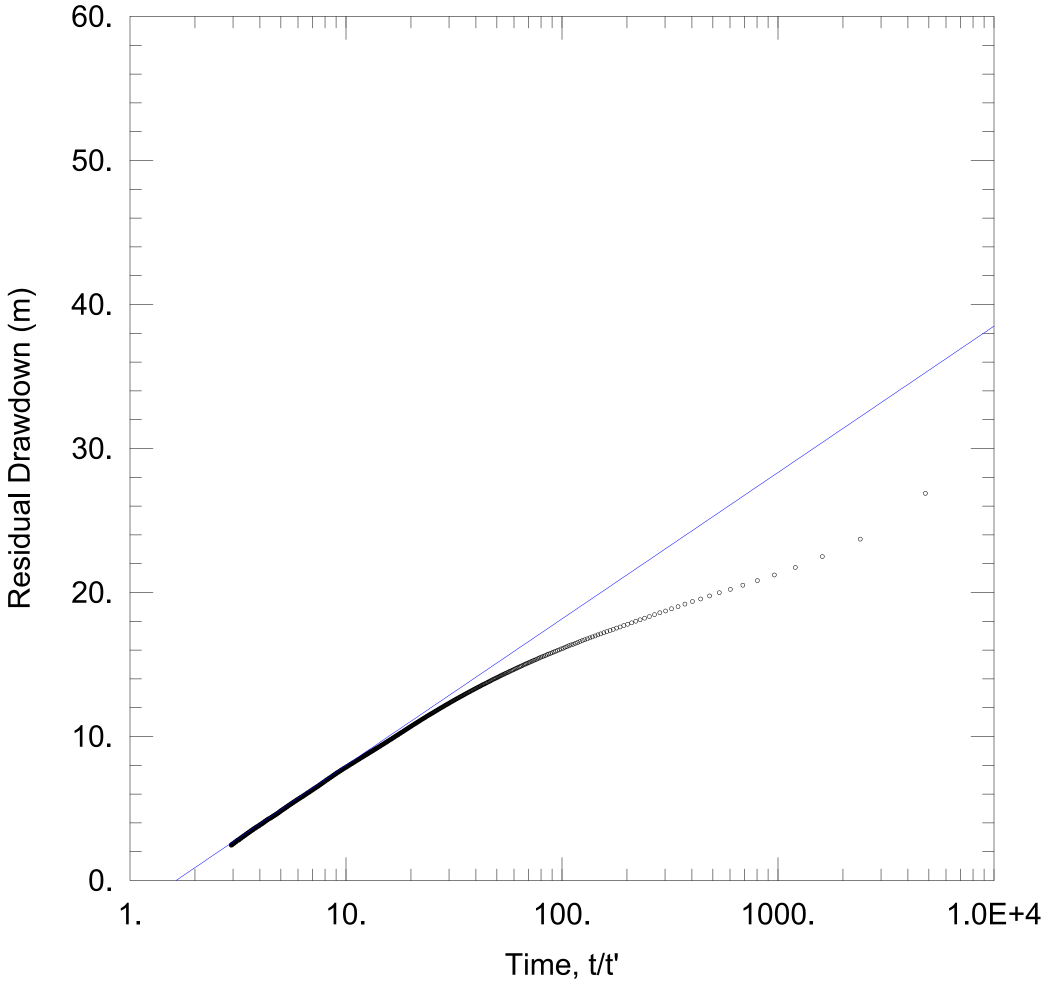
Observation Wells

Well Name	X (m)	Y (m)
◦ 21GC066	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 0.6766 m^2/day S/S' = 2.798



SHUT-IN TEST

Data Set: C:\...\21GC068_TheisRDD_Rev3.aqt
Date: 11/23/24 Time: 14:48:58

PROJECT INFORMATION

Company: Tundra
Location: Graphite Creek
Test Well: 21GC068
Test Date: 10/7/21

AQUIFER DATA

Saturated Thickness: 120. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
21GC068	0	0

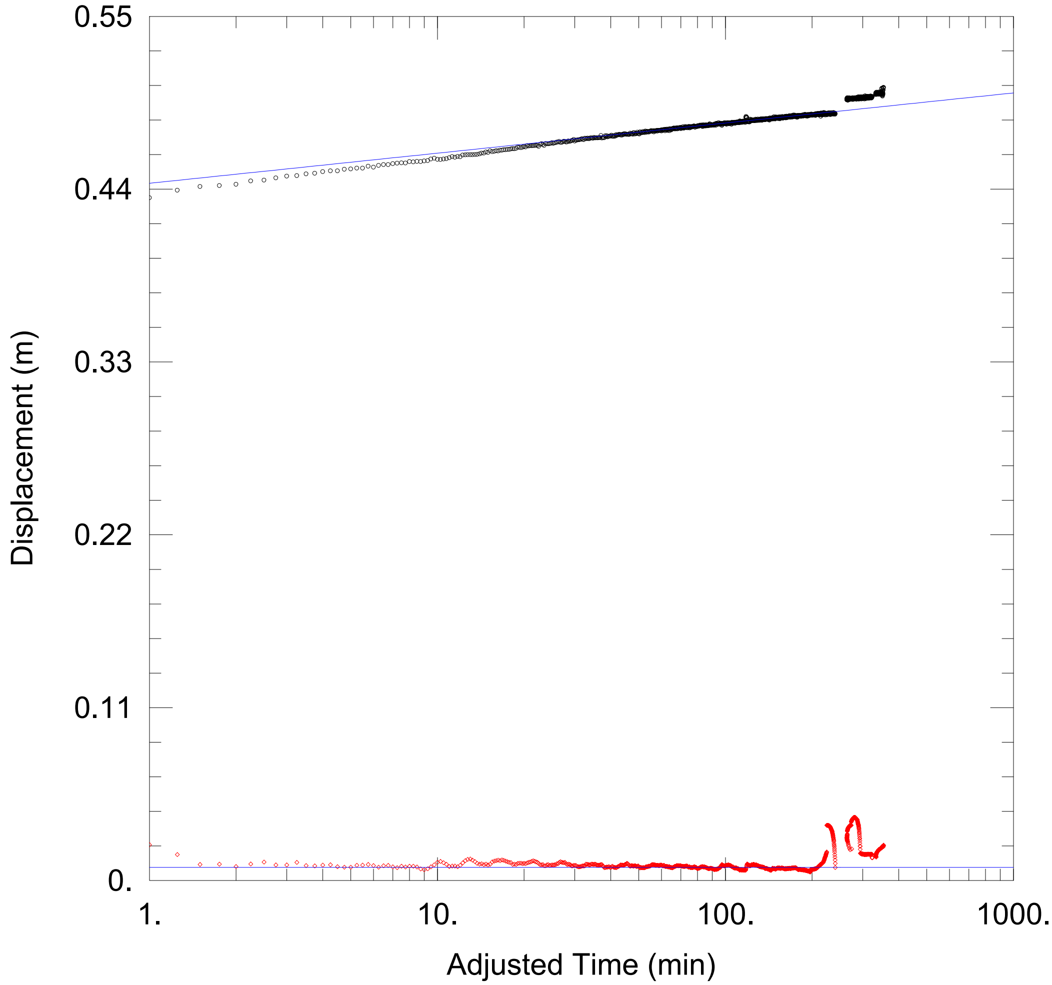
Observation Wells

Well Name	X (m)	Y (m)
◦ 21GC068	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 0.2555 m^2/day S/S' = 1.636



PUMPING TEST

Data Set: C:\...\21GTW007_MultipleGPM_NoRec_CJ.aqt
Date: 11/23/24 Time: 14:49:59

PROJECT INFORMATION

Company: Tundra
Location: Graphite Creek
Test Well: 21GTW007
Test Date: 10/13/21

AQUIFER DATA

Saturated Thickness: 32. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
21GTW007	0	0

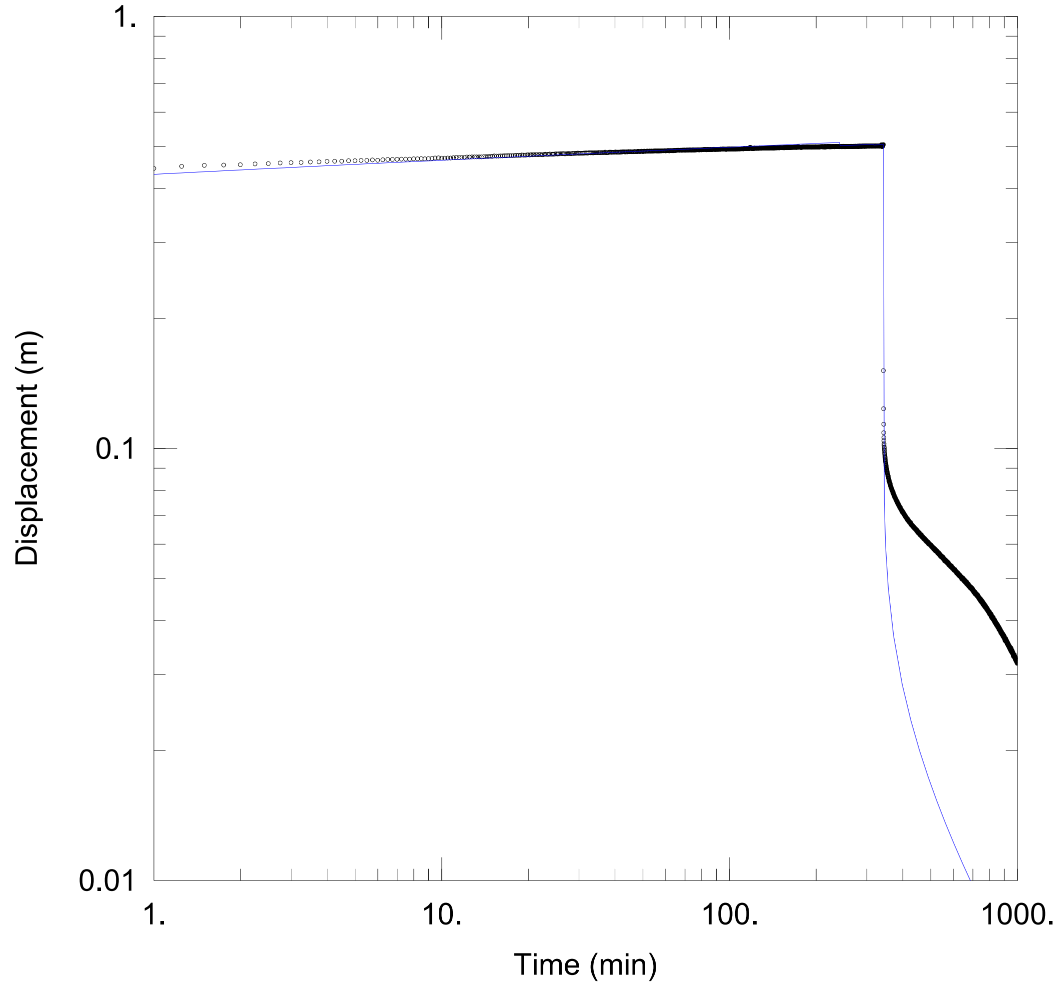
Observation Wells

Well Name	X (m)	Y (m)
◦ 21GTW007	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 1083.2 m^2/day S = 1.992E-21



PUMPING TEST

Data Set: C:\...\21GTW007_MultipleGPM_Theis.aqt
Date: 11/23/24 Time: 14:50:21

PROJECT INFORMATION

Company: Tundra
Location: Graphite Creek
Test Well: 21GTW007
Test Date: 10/13/21

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
21GTW007	0	0

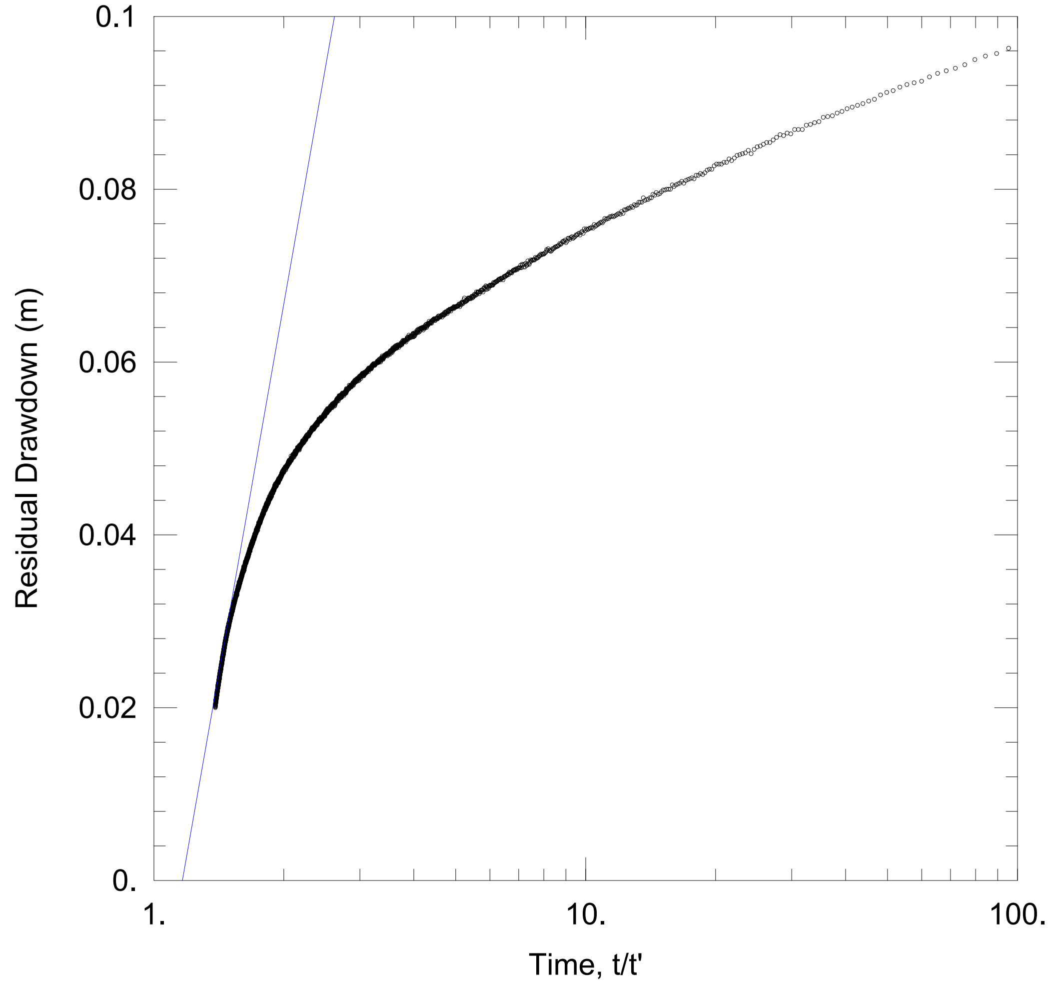
Observation Wells

Well Name	X (m)	Y (m)
◦ 21GTW007	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis

T = 634.8 m^2/day
S = 2.149E-11
Kz/Kr = 1.
b = 32. m



PUMPING TEST

Data Set: C:\...\21GTW007_MultipleGPM_TheisRDD.aqt
Date: 11/23/24 Time: 14:50:46

PROJECT INFORMATION

Company: Tundra
Location: Graphite Creek
Test Well: 21GTW007
Test Date: 10/13/21

AQUIFER DATA

Saturated Thickness: 32. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
21GTW007	0	0

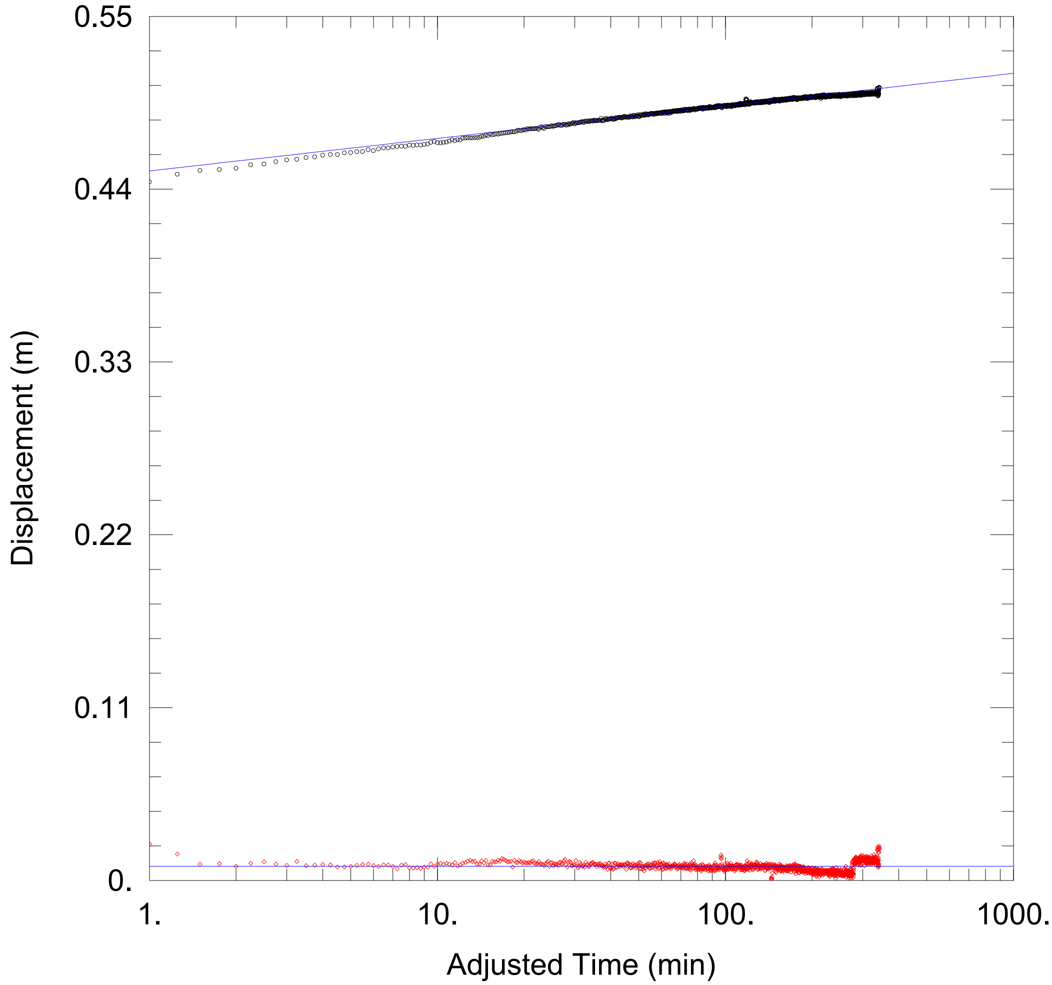
Observation Wells

Well Name	X (m)	Y (m)
◦ 21GTW007	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 73.16 m^2/day S/S' = 1.164



PUMPING TEST

Data Set: C:\...\21GTW007_SingleGPM_NoRec_CJ.aqt
Date: 11/23/24 Time: 14:51:04

PROJECT INFORMATION

Company: Tundra
Location: Graphite Creek
Test Well: 21GTW007
Test Date: 10/13/21

AQUIFER DATA

Saturated Thickness: 32. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
21GTW007	0	0

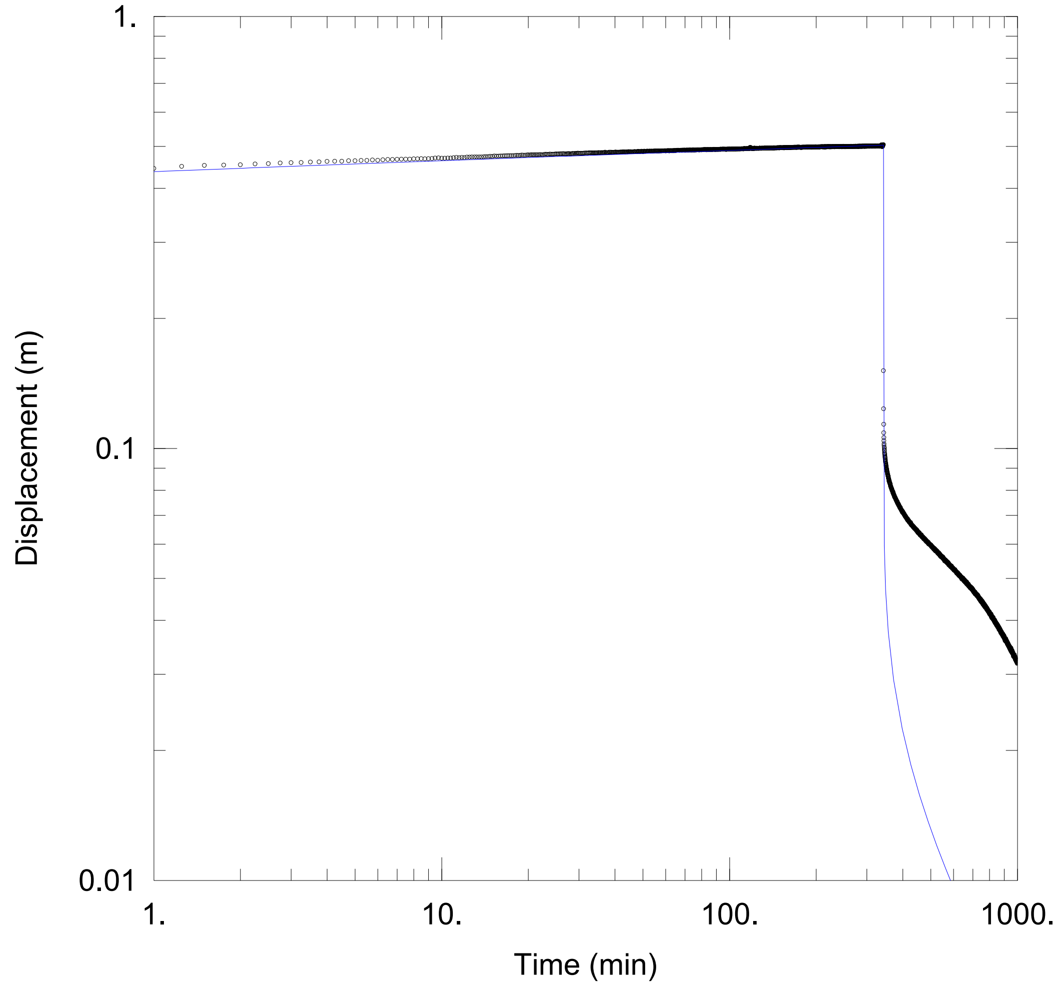
Observation Wells

Well Name	X (m)	Y (m)
◦ 21GTW007	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 1003.3 m^2/day S = 3.93E-20



PUMPING TEST

Data Set: C:\...\21GTW007_SingleGPM_Theis.aqt
Date: 11/23/24 Time: 14:51:20

PROJECT INFORMATION

Company: Tundra
Location: Graphite Creek
Test Well: 21GTW007
Test Date: 10/13/21

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
21GTW007	0	0

Observation Wells

Well Name	X (m)	Y (m)
◦ 21GTW007	0	0

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 794.3 m^2/day
S = 3.877E-15
Kz/Kr = 1.
b = 32. m

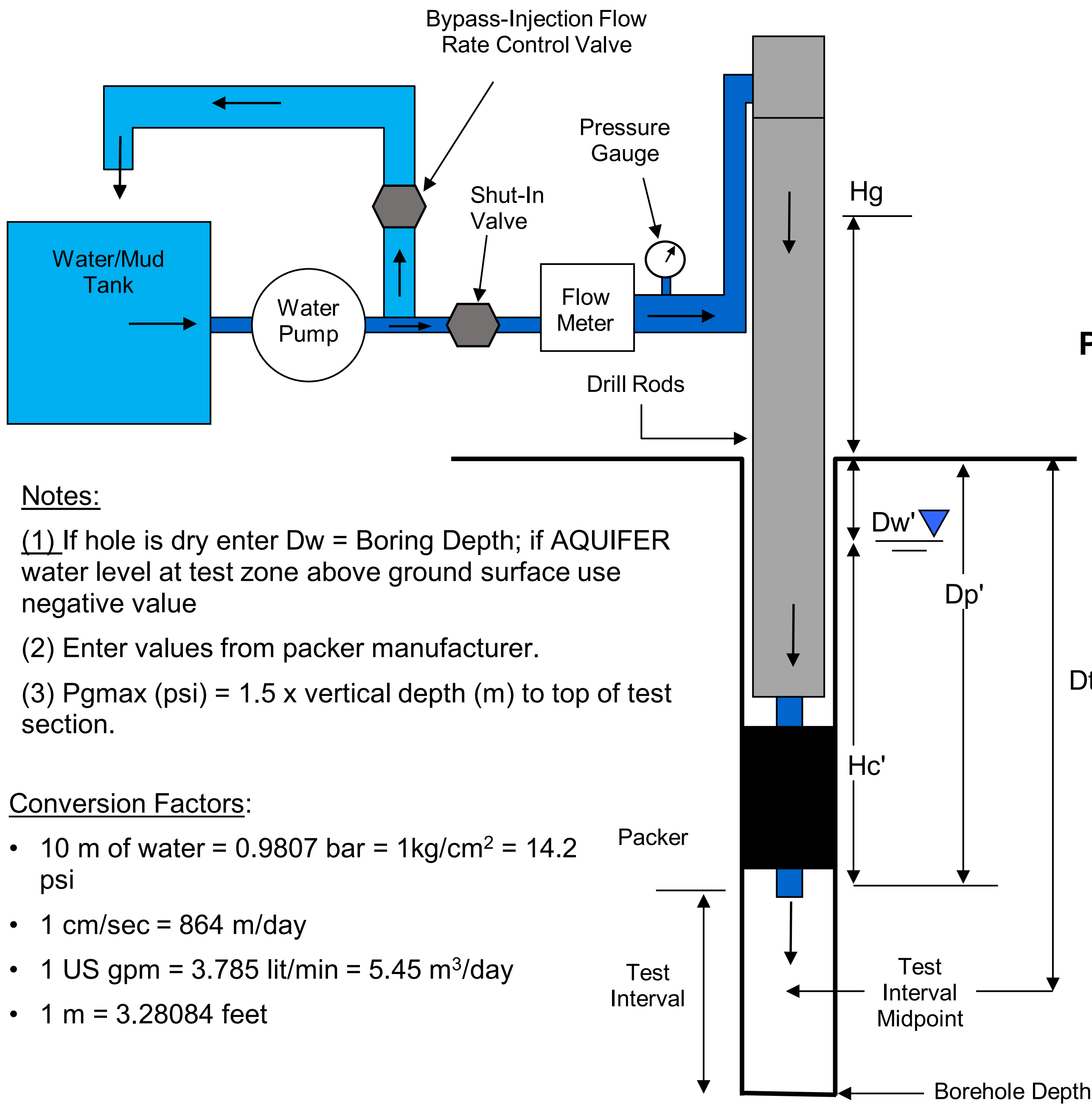
APPLIED HYDROLOGIC

STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	**Graphite Creek**	**Test Interval (ft):**	**64.25**	**To:**	**90.00**	**Test Nº**	**1**
Drillhole Nº:	**22GC073**	**Start Date:**	**22-Jul-22**	**Time:**	**1:41**	**Drill Bit Depth (ft)**	**60**
		End Date:	**22-Jul-22**	**Time:**	**5:00**	**DH Depth (ft)**	**90**
		Supervisor:	**G. Baldwin**	**Rig:**	**T&J**		

Max Injection P (psi)

23



Notes:

(1) If hole is dry enter Dw = Boring Depth; if AQUIFER water level at test zone above ground surface use negative value

(2) Enter values from packer manufacturer.

(3) Pgmax (psi) = 1.5 x vertical depth (m) to top of test section.

Conversion Factors:

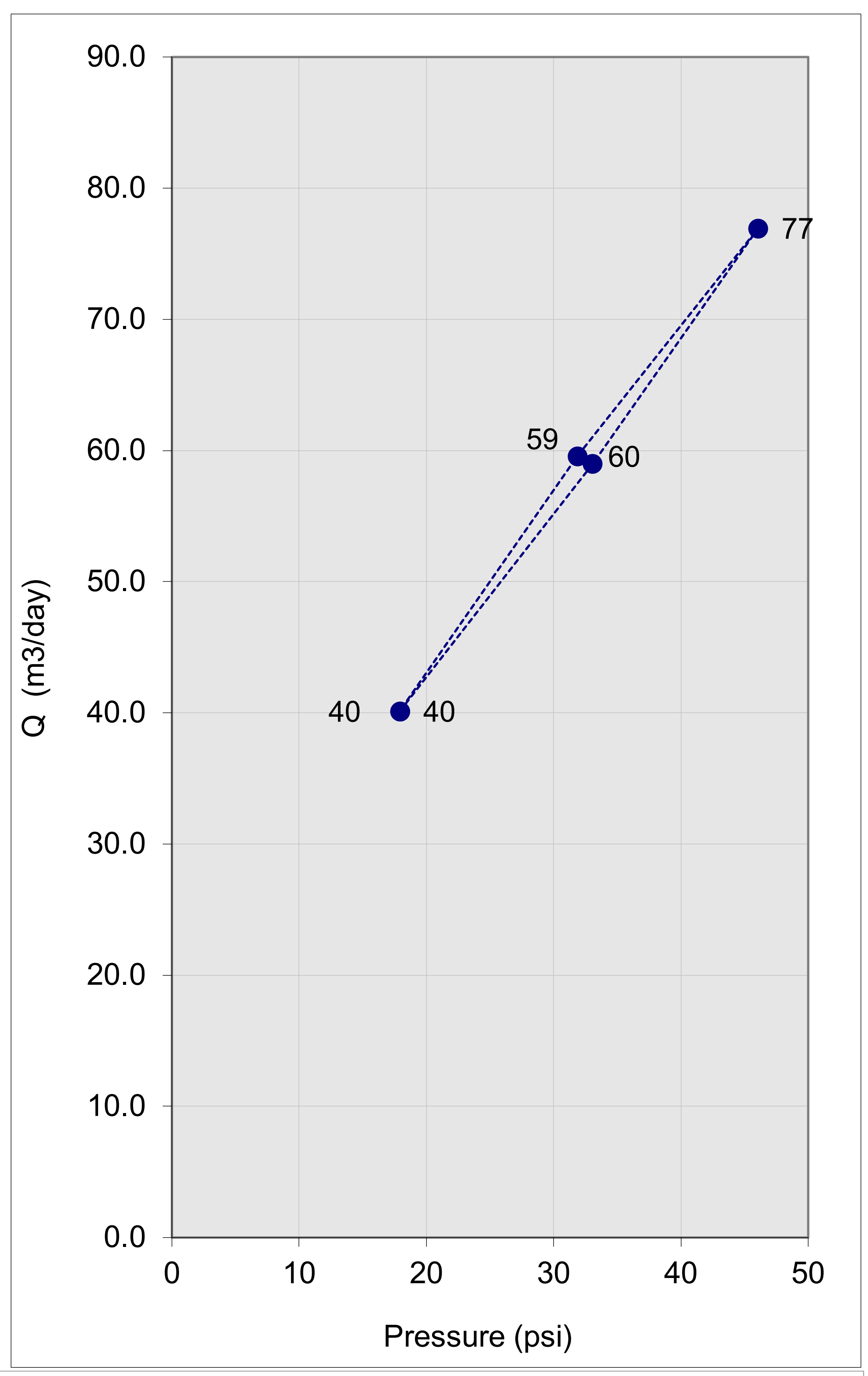
- 10 m of water = 0.9807 bar = 1kg/cm^2 = 14.2 psi
- 1 cm/sec = 864 m/day
- 1 US gpm = 3.785 lit/min = 5.45 m^3/day
- 1 m = 3.28084 feet

Dw	Measured depth of static water level (1)	-13.1	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**19.6**	m
Dt	Measured depth to midpoint of test	**23.5**	m
ß	Inclination from horizontal (degrees)	50.5	°
Dw'	Vertical depth to static water level	**0.0**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**15.1**	m
Dt'	Vertical depth to midpoint of test	**18.1**	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	**21**	psi
Pshear	Estimated differential shear pressure required	**519**	psi
Pgmax	Maximum injection gauge pressure (3)	**27**	psi
Hg	Gauge height	-0.9	m
Lp	Length of discharge pipe	6.10	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0127	m
R	Radius of influence (10 m is standard value)	10	m
rb	Borehole radius (HQ=0.048m, NQ=0.038m)	0.048	m
L	Length of test section	**7.85**	m
Hf	Friction Loss		
Htot	Induced head recorded by transducer		
K	Hydraulic conductivity		

Equations:

- Hf = 8.65x10^{-15} (Q^2*Lp/rp^5)
- K = (Q*Ln(R/r$_b$)) / (2*π*H$_{tot}$*L)

Measurement (last 3 to 5 stable readings)	**Q (Liters / 30sec)**				
	P_g (psi) Step 1	**P_g (psi) Step 2**	**P_g (psi) Step 3**	**P_g (psi) Step 4**	**P_g (psi) Step 5**
Induced Pressure at TDX	**17.92**	**33.05**	**46.07**	**31.86**	**17.92**
Induced Pressure at Surface Gage	**20**	**40**	**60**	**40**	**20**
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**14.50**	**22.00**	**28.00**	**21.50**	**14.50**
2	**14.58**	**21.50**	**28.50**	**21.00**	**14.00**
3	**14.40**	**20.50**	**28.00**	**21.00**	**14.50**
4	**14.35**	**21.00**	**28.50**	**21.00**	**13.50**
5	**14.25**	**21.00**	**28.00**	**21.50**	**14.50**
Stable Q (L/30sec)	**14.25**	**21.00**	**28.25**	**21.20**	**14.25**
Leak Q (L/30sec)	**0.313**	**0.515**	**1.530**	**0.515**	**0.313**
Q (m^3/day)	40	59	77	60	40
Hf (m)	0.26	0.56	0.95	0.57	0.26
Htot (m)	12.6	23.3	32.4	22.4	12.6
K (m/day)	3.4E-01	2.7E-01	2.6E-01	2.9E-01	3.4E-01
K (m/s)	**4.0E-06**	**3.2E-06**	**3.0E-06**	**3.3E-06**	**4.0E-06**
+/- (m/s)	5.0E-07	6.8E-07	3.4E-07	5.3E-07	5.1E-07
+/- order of mag.	0.05	0.08	0.05	0.06	0.05



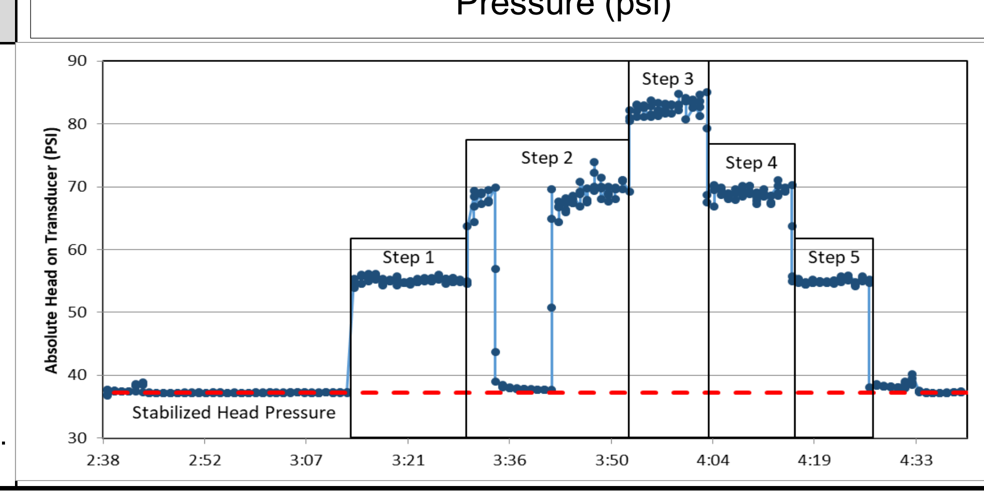
Geology: Gneiss

RQ-JC-Structures: Moderate fracture frequency. Fault damage zone.

Flow Monitoring-System-Test Comments: Bad rock leakage. Injected at low pressure due to the shallow depth and relatively low rock competence. Hydro fraccing doesn't appear to have been an issue but was a concern.
Ran out of water at 3:35 HRS and temporary stopped the test while cleaning out the supply water filter.

Injected clean water with no polymer.

Nearly ideal diagnostic plot where flow is laminar, probably on clean fractures, and discharge is proportional to pressure head.



APPLIED HYDROLOGIC

STEPPED PRESSURE INJECTION TEST

(page 2)

Drillhole Nº	22GC073
Test Nº	1

Pressure oscillation during test

Pressure step	P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Min P during step	16.4	31.6	42.3	28.1	16.2
Max P during step	19.4	34.5	49.9	35.6	19.6
average pressure +/- psi	**1.491**	**1.434**	**3.82**	**3.777**	**1.694**

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	**0.29**	**0.42**	**0.57**	**0.43**	**0.28**

High estimate of K

Q_{avg} (m^3/day)	40.97	60.21	78.58	60.81	40.96
Hf (m)	0.27	0.58	0.99	0.59	0.27
Htot (m)	11.6	22.3	29.8	19.8	11.4
K (m/sec)	4.4E-06	3.4E-06	3.3E-06	3.9E-06	4.5E-06

Low estimate of K

Q_{avg} (m^3/day)	39.31	57.79	75.33	58.34	39.32
Hf (m)	0.25	0.53	0.91	0.54	0.25
Htot (m)	13.7	24.3	35.1	25.1	13.8
K (m/sec)	3.6E-06	3.0E-06	2.7E-06	2.9E-06	3.6E-06

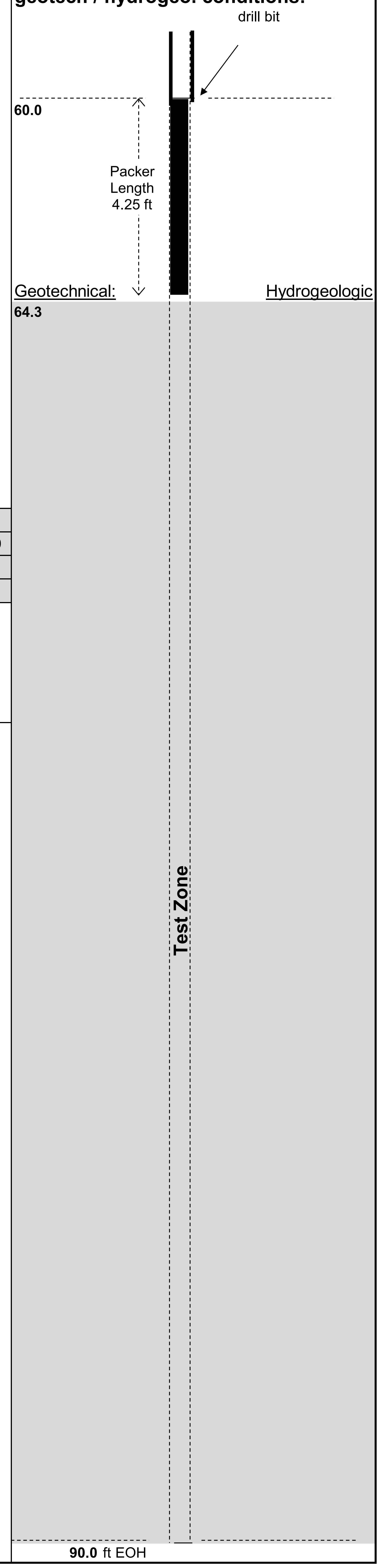
K calculated for P step — m/second

PSI	17.9	32.5	46.1
High est of K	4.5.E-06	3.9.E-06	3.3.E-06
Average K	4.0.E-06	3.3.E-06	3.0.E-06
Low est of K	3.6.E-06	2.9.E-06	2.7.E-06

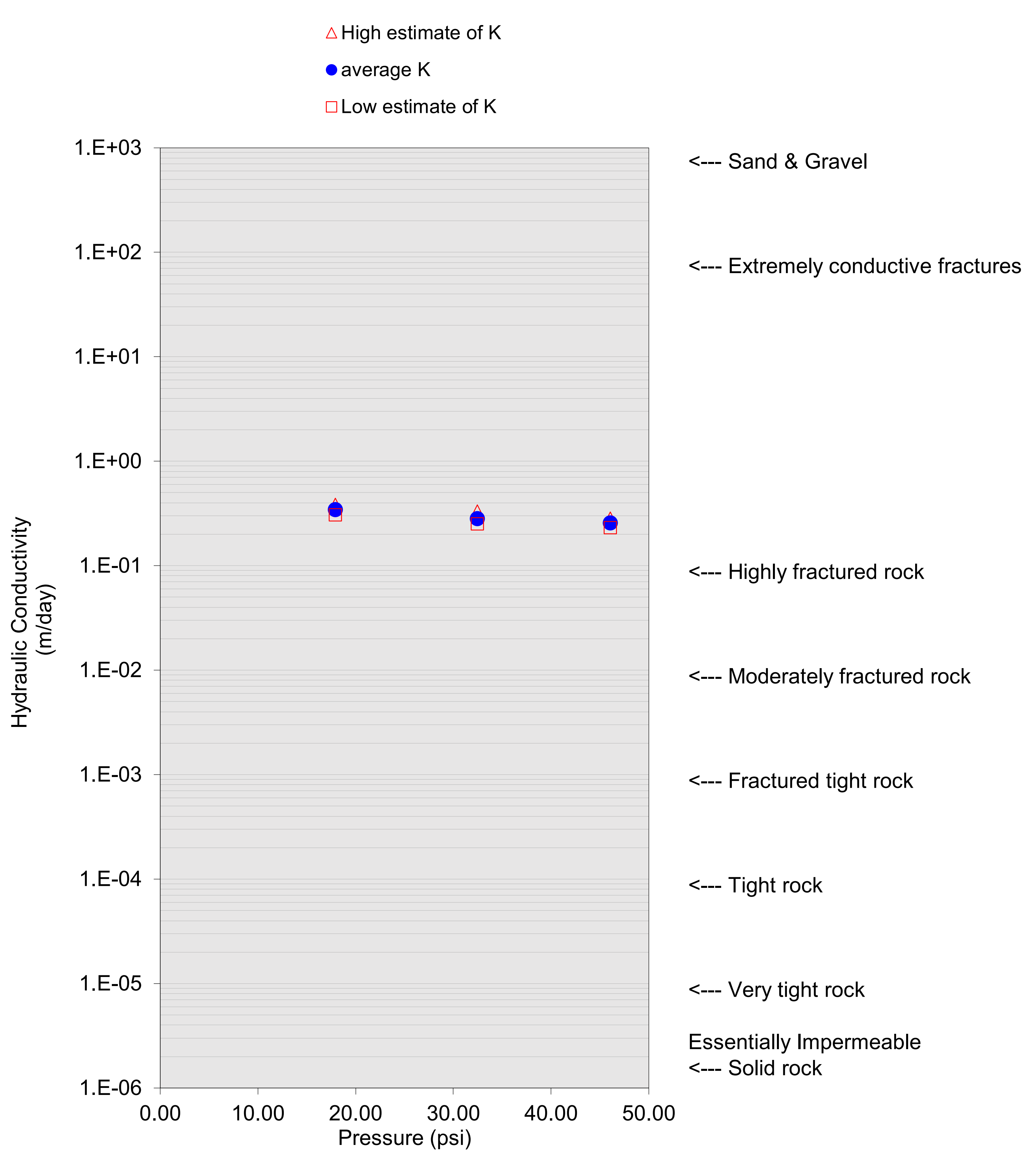
K all P steps

	m/day	Ft/Day
MAX	3.88E-01	1.27E+00
Geomean	2.92E-01	9.57E-01
MIN	2.32E-01	7.61E-01

Drawing of zone tested, including geotech / hydrogeo. conditions:



Graph of estimated hydraulic conductivity and error bounds.



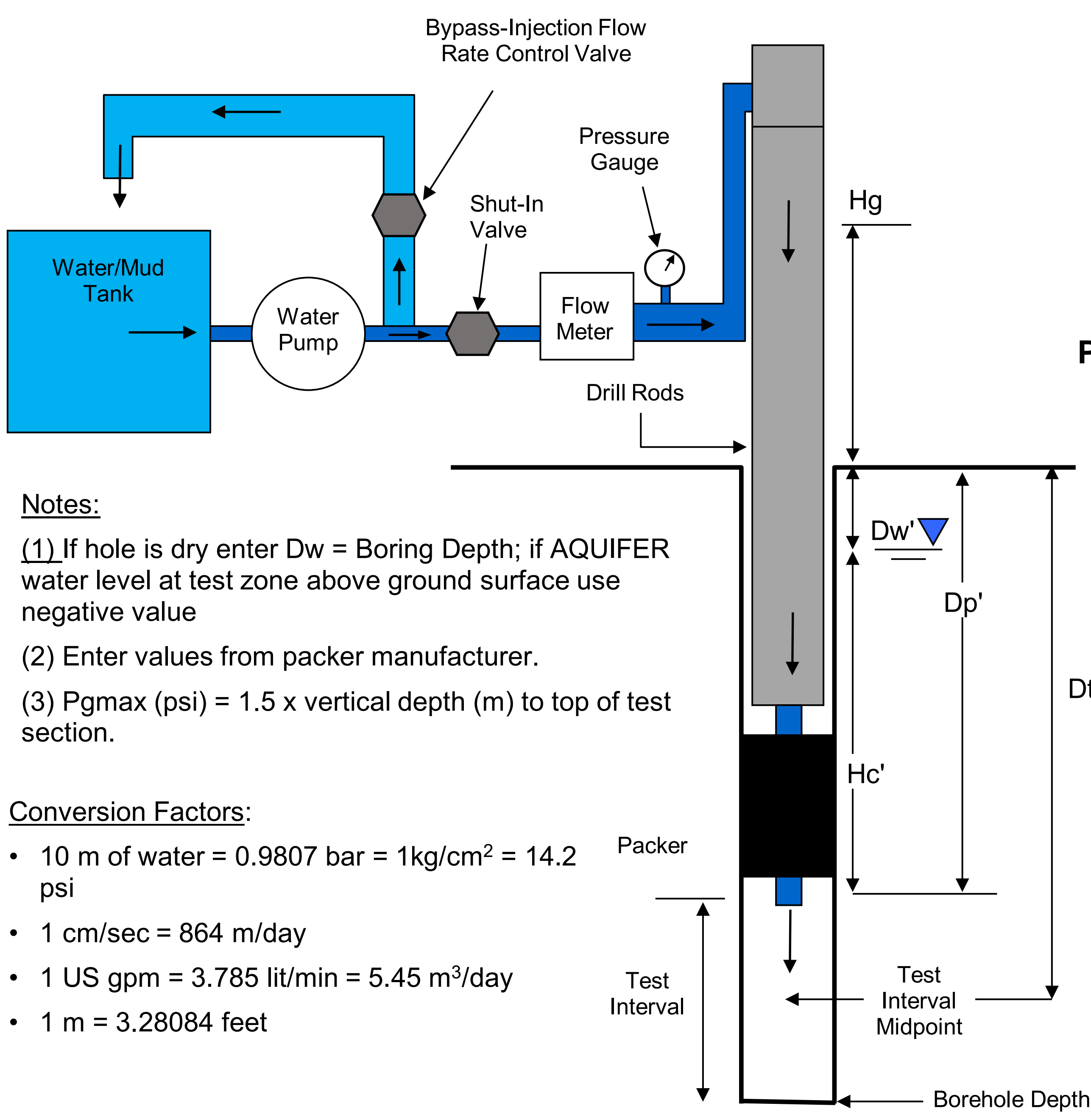
APPLIED HYDROLOGIC

STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	**Graphite Creek**	**Test Interval (ft):**	**94.25**	**To:**	**155.00**	**Test Nº**	**2**
Drillhole Nº:	**22GC073**	**Start Date:**	**22-Jul-22**	**Time:**	**14:05**	**Drill Bit Depth (ft)**	**90**
		End Date:	**22-Jul-22**	**Time:**	**18:10**	**DH Depth (ft)**	**155**
		Supervisor:	**G. Baldwin**	**Rig:**	**T&J**		

Max Injection P (psi)

33



Notes:

(1) If hole is dry enter Dw = Boring Depth; if AQUIFER water level at test zone above ground surface use negative value

(2) Enter values from packer manufacturer.

(3) Pgmax (psi) = 1.5 x vertical depth (m) to top of test section.

Conversion Factors:

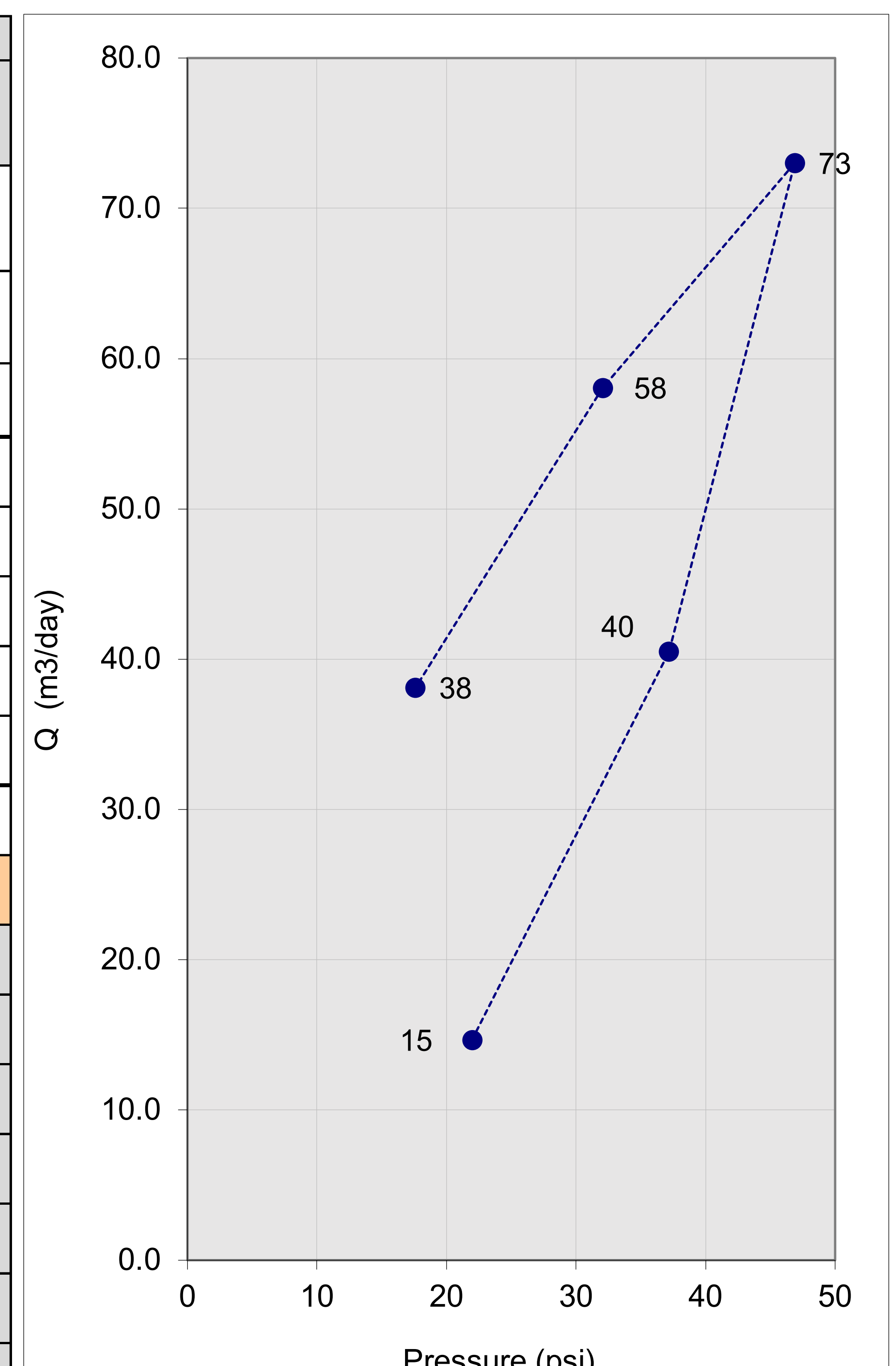
- 10 m of water = 0.9807 bar = 1kg/cm^2 = 14.2 psi
- 1 cm/sec = 864 m/day
- 1 US gpm = 3.785 lit/min = 5.45 m^3/day
- 1 m = 3.28084 feet

Dw	Measured depth of static water level (1)	-13.9	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**28.7**	m
Dt	Measured depth to midpoint of test	**38.0**	m
ß	Inclination from horizontal (degrees)	51	°
Dw'	Vertical depth to static water level	**0.0**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**22.2**	m
Dt'	Vertical depth to midpoint of test	**29.3**	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	**31**	psi
Pshear	Estimated differential shear pressure required	**520**	psi
Pgmax	Maximum injection gauge pressure (3)	**44**	psi
Hg	Gauge height	-0.9	m
Lp	Length of discharge pipe	7.62	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0095	m
R	Radius of influence (10 m is standard value)	10	m
rb	Borehole radius (HQ=0.048m, NQ=0.038m)	0.048	m
L	Length of test section	**18.52**	m
Hf	Friction Loss		
Htot	Induced head recorded by transducer		
K	Hydraulic conductivity		

Equations:

- Hf = 8.65x10^{-15} (Q^2*Lp/rp^5)
- K = (Q*Ln(R/r$_b$)) / (2*π*H$_{tot}$*L)

Measurement (last 3 to 5 stable readings)	**Q (Liters / 30sec)**				
	P$_g$ (psi) Step 1	**P$_g$ (psi) Step 2**	**P$_g$ (psi) Step 3**	**P$_g$ (psi) Step 4**	**P$_g$ (psi) Step 5**
Induced Pressure at TDX	**22.0**	**37.2**	**46.9**	**32.1**	**17.6**
Induced Pressure at Surface Gage	**20**	**40**	**60**	**40**	**20**
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**6.22**	**14.05**	**25.50**	**20.50**	**13.50**
2	**5.53**	**14.75**	**26.00**	**20.50**	**13.35**
3	**5.22**	**14.55**	**25.50**	**20.50**	**14.00**
4	**5.40**	**14.45**	**25.50**	**20.50**	**12.80**
5	**5.30**	**14.35**	**26.50**	**20.50**	**13.45**
Stable Q (L/30sec)	**5.31**	**14.40**	**25.80**	**20.50**	**13.45**
Leak Q (L/30sec)	**0.220**	**0.340**	**0.450**	**0.340**	**0.220**
Q (m^3/day)	15	40	73	58	38
Hf (m)	0.18	1.38	4.48	2.83	1.22
Htot (m)	15.5	26.2	33.0	22.6	12.4
K (m/day)	4.3E-02	7.1E-02	1.0E-01	1.2E-01	1.4E-01
K (m/s)	**5.0E-07**	**8.2E-07**	**1.2E-06**	**1.4E-06**	**1.6E-06**
+/- (m/s)	1.4E-06	6.5E-07	1.7E-07	1.1E-07	2.3E-07
+/- order of mag.	0.57	0.25	0.06	0.03	0.06

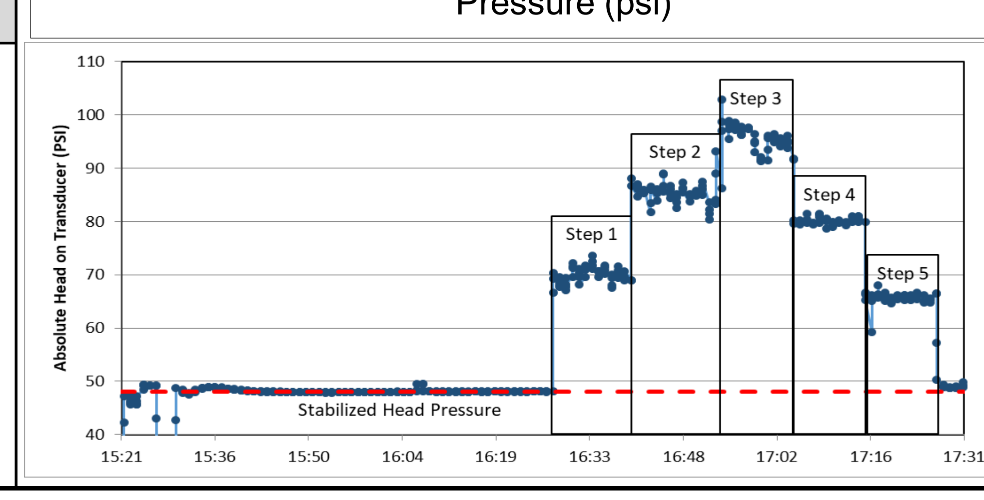


Geology:

RQ-JC-Structures:

Flow Monitoring-System-Test Comments:
Injected clean water with no polymer.

Low permeability, but washingout of gouge material from the fractures, increasing permeability. Increasing permeability with time, indicating cleaning out of fractures during testing.



APPLIED HYDROLOGIC	STEPPED PRESSURE INJECTION TEST (page 2)	Drillhole Nº	22GC073
		Test Nº	2

Pressure oscillation during test

Pressure step	P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Min P during step	19.5	33.3	41.9	30.3	15.8
Max P during step	24.5	41.0	51.9	33.8	19.4
average pressure +/- psi	**2.504**	**3.818**	**4.985**	**1.72**	**1.845**

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	**0.106**	**0.291**	**0.516**	**0.410**	**0.268**

High estimate of K

Q_{avg} (m^3/day)	14.97	41.33	74.49	59.24	38.87
Hf (m)	0.19	1.44	4.67	2.95	1.27
Htot (m)	13.7	23.5	29.5	21.4	11.1
K (m/sec)	5.8E-07	9.3E-07	1.3E-06	1.5E-06	1.9E-06

Low estimate of K

Q_{avg} (m^3/day)	14.35	39.66	71.52	56.88	37.33
Hf (m)	0.17	1.32	4.30	2.72	1.17
Htot (m)	17.2	28.9	36.5	23.8	13.7
K (m/sec)	4.4E-07	7.3E-07	1.0E-06	1.3E-06	1.4E-06

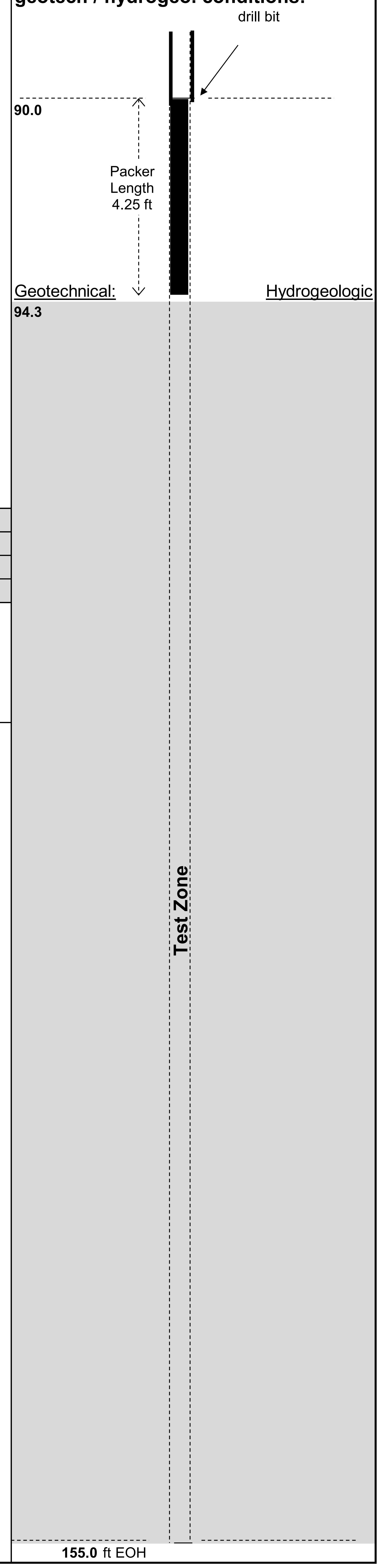
K calculated for P step — m/second

PSI	19.8	34.6	46.9
High est of K	1.9.E-06	1.5.E-06	1.3.E-06
Average K	1.1.E-06	1.1.E-06	1.2.E-06
Low est of K	4.4.E-07	7.3.E-07	1.0.E-06

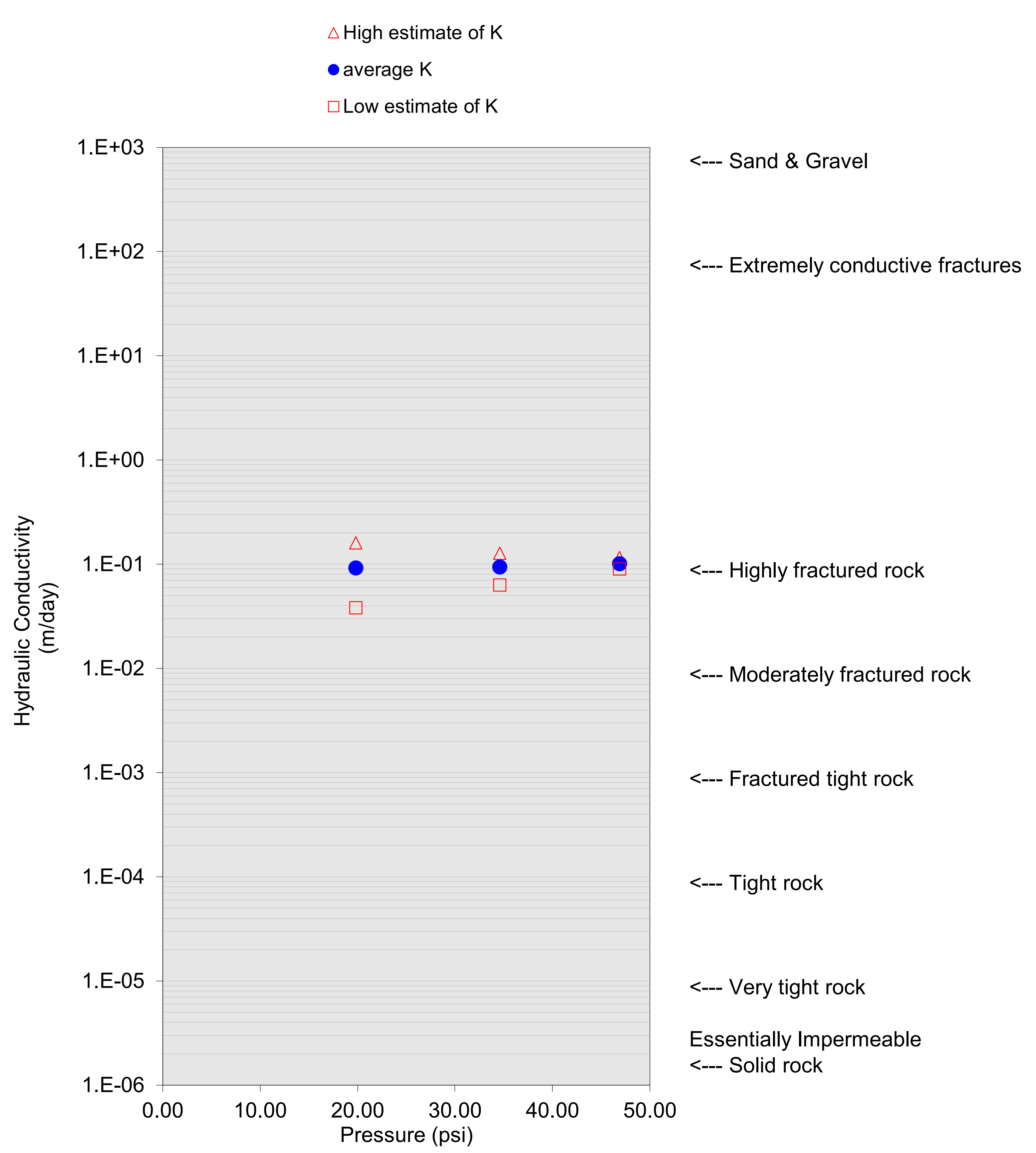
K all P steps

	m/day	Ft/Day
MAX	1.61E-01	5.27E-01
Geomean	9.60E-02	3.15E-01
MIN	3.82E-02	1.25E-01

Drawing of zone tested, including geotech / hydrogeo. conditions:



Graph of estimated hydraulic conductivity and error bounds.



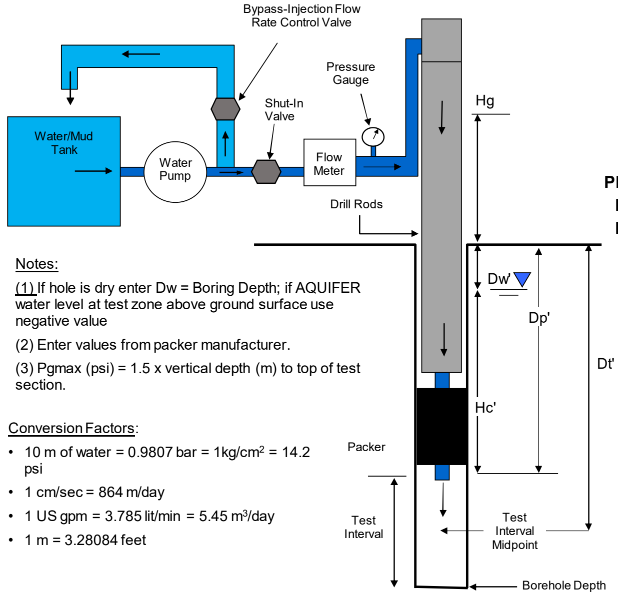
APPLIED HYDROLOGIC

STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	**Graphite Creek**	**Test Interval (ft):**	**164.25**	**To:**	**299.70**	**Test Nº**	**3**
Drillhole Nº:	**22GC073**	**Start Date:**	**23-Jul-22**	**Time:**	**8:35**	**Drill Bit Depth (ft)**	**160**
		End Date:	**23-Jul-22**	**Time:**	**12:00**	**DH Depth (ft)**	**299.7**
		Supervisor:	**G. Baldwin**	**Rig:**	**T&J**		

Max Injection P (psi)

58



Notes:

(1) If hole is dry enter Dw = Boring Depth; if AQUIFER water level at test zone above ground surface use negative value

(2) Enter values from packer manufacturer.

(3) Pgmax (psi) = 1.5 x vertical depth (m) to top of test section.

Conversion Factors:

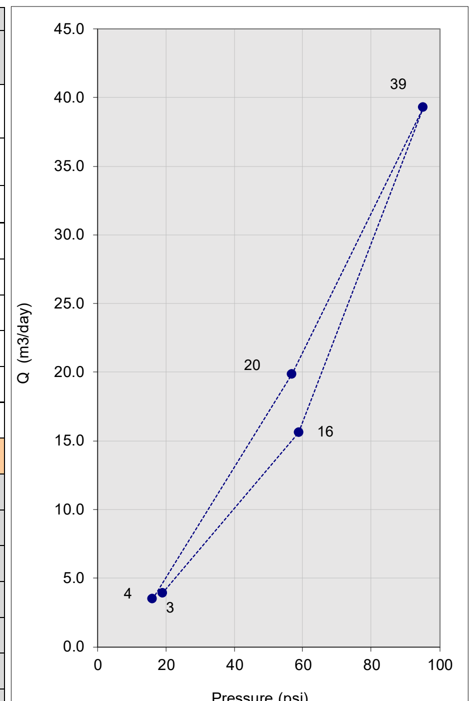
- 10 m of water = 0.9807 bar = 1kg/cm² = 14.2 psi
- 1 cm/sec = 864 m/day
- 1 US gpm = 3.785 lit/min = 5.45 m³/day
- 1 m = 3.28084 feet

Dw	Measured depth of static water level (1)	-15.8	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**50.1**	m
Dt	Measured depth to midpoint of test	**70.7**	m
ß	Inclination from horizontal (degrees)	50.5	º
Dw'	Vertical depth to static water level	**0.0**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**38.6**	m
Dt'	Vertical depth to midpoint of test	**54.6**	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	**55**	psi
Pshear	Estimated differential shear pressure required	**522**	psi
Pgmax	Maximum injection gauge pressure (3)	**82**	psi
Hg	Gauge height	-0.9	m
Lp	Length of discharge pipe	7.62	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0095	m
R	Radius of influence (10 m is standard value)	10	m
rb	Borehole radius (HQ=0.048m, NQ=0.038m)	0.048	m
L	Length of test section	**41.29**	m
Hf	Friction Loss		
Htot	Induced head recorded by transducer		
K	Hydraulic conductivity		

Equations:

- $Hf = 8.65 \times 10^{-15} (Q^2 \cdot Lp/rp^5)$
- $K = (Q \cdot Ln(R/r_b)) / (2 \cdot \pi \cdot H_{tot} \cdot L)$

Measurement (last 3 to 5 stable readings)	**Q (Liters / 30sec)** P_g **(psi) Step 1**	P_g **(psi) Step 2**	P_g **(psi) Step 3**	P_g **(psi) Step 4**	P_g **(psi) Step 5**
Induced Pressure at TDX	**18.99**	**58.81**	**95.19**	**56.89**	**16.10**
Induced Pressure at Surface Gage	**20**	**60**	**100**	**60**	**20**
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**1.73**	**6.25**	**13.85**	**7.35**	**1.69**
2	**1.67**	**5.63**	**14.60**	**7.00**	**1.43**
3	**1.65**	**5.90**	**14.15**	**7.35**	**1.43**
4	**1.57**	**5.85**	**13.85**	**7.30**	**1.44**
5	**1.56**	**5.85**	**14.60**	**7.35**	**1.41**
Stable Q (L/30sec)	**1.56**	**5.85**	**14.21**	**7.33**	**1.41**
Leak Q (L/30sec)	**0.200**	**0.430**	**0.570**	**0.430**	**0.200**
Q (m³/day)	4	16	39	20	3
Hf (m)	0.01	0.20	1.30	0.33	0.01
Htot (m)	13.4	41.4	67.0	40.1	11.3
K (m/day)	6.0E-03	7.8E-03	1.2E-02	1.0E-02	6.3E-03
K (m/s)	**7.0E-08**	**9.0E-08**	**1.4E-07**	**1.2E-07**	**7.3E-08**
+/- (m/s)	1.0E-08	5.0E-08	1.8E-08	2.1E-08	6.9E-09
+/- order of mag.	0.06	0.19	0.05	0.07	0.04



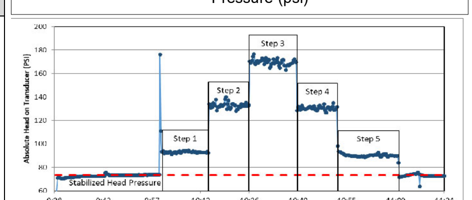
Geology:

RQ-JC-Structures: Fault damage zone extends to about 240 feet.

Flow Monitoring-System-Test Comments: Flushed hole with clean water until clean return at surface. Some leakage from casing during testing: strongly suspect rod leakage.

Injected clean water with no polymer.

Slight increase of permeability with time, indicating cleaning out of fractures and flow paths during testing. Highest pressure step indicates enhanced system leakage or, less probably, minor hydrofraccing.



APPLIED HYDROLOGIC	STEPPED PRESSURE INJECTION TEST (page 2)	Drillhole Nº	22GC073
		Test Nº	3

Pressure oscillation during test

Pressure step	P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Min P during step	18.8	53.1	86.0	48.2	15.1
Max P during step	19.2	64.5	104.4	65.5	17.1
average pressure +/- psi	**0.167**	**5.733**	**9.22**	**8.654**	**1.038**

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	**0.031**	**0.116**	**0.284**	**0.015**	**0.029**

High estimate of K

Q_{avg} (m^3/day)	4.01	15.94	40.10	19.91	3.57
Hf (m)	0.01	0.21	1.35	0.33	0.01
Htot (m)	13.3	37.4	60.5	34.0	10.6
K (m/sec)	7.2E-08	1.0E-07	1.6E-07	1.4E-07	8.0E-08

Low estimate of K

Q_{avg} (m^3/day)	3.83	15.28	38.46	19.83	3.40
Hf (m)	0.01	0.20	1.24	0.33	0.01
Htot (m)	13.5	45.5	73.5	46.2	12.1
K (m/sec)	6.8E-08	8.0E-08	1.2E-07	1.0E-07	6.7E-08

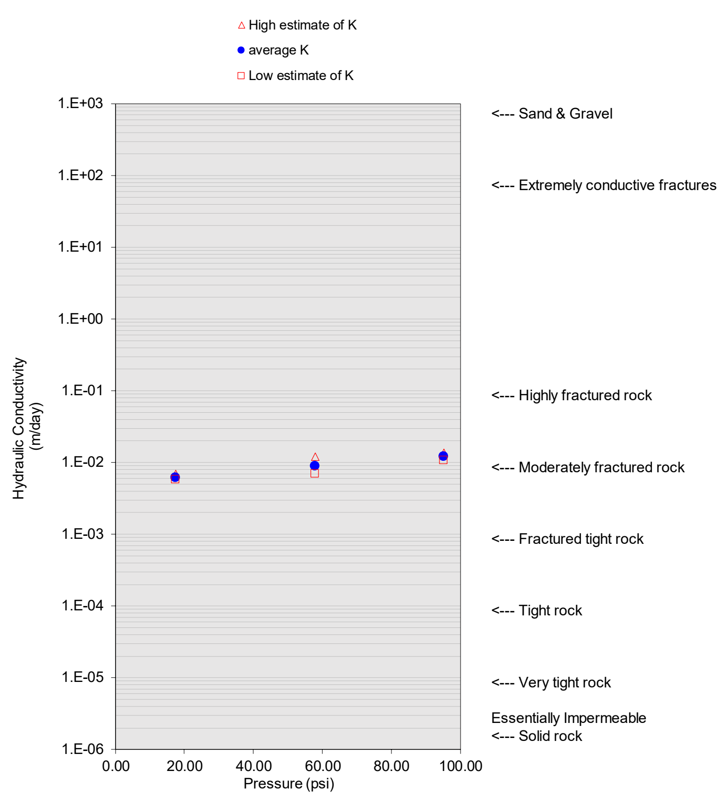
K calculated for P step m/second

PSI	17.5	57.8	95.2
High est of K	8.0.E-08	1.4.E-07	1.6.E-07
Average K	7.1.E-08	1.0.E-07	1.4.E-07
Low est of K	6.7.E-08	8.0.E-08	1.2.E-07

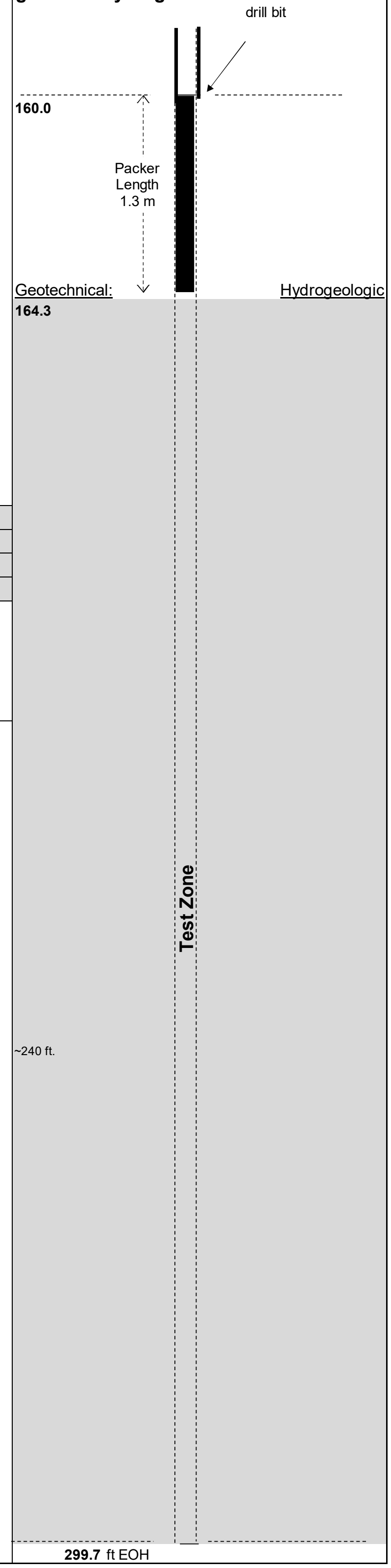
K all P steps

	m/day	Ft/Day
MAX	1.36E-02	4.47E-02
Geomean	8.75E-03	2.87E-02
MIN	5.80E-03	1.90E-02

Graph of estimated hydraulic conductivity and error bounds.



Drawing of zone tested, including geotech / hydrogeo. conditions:



STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

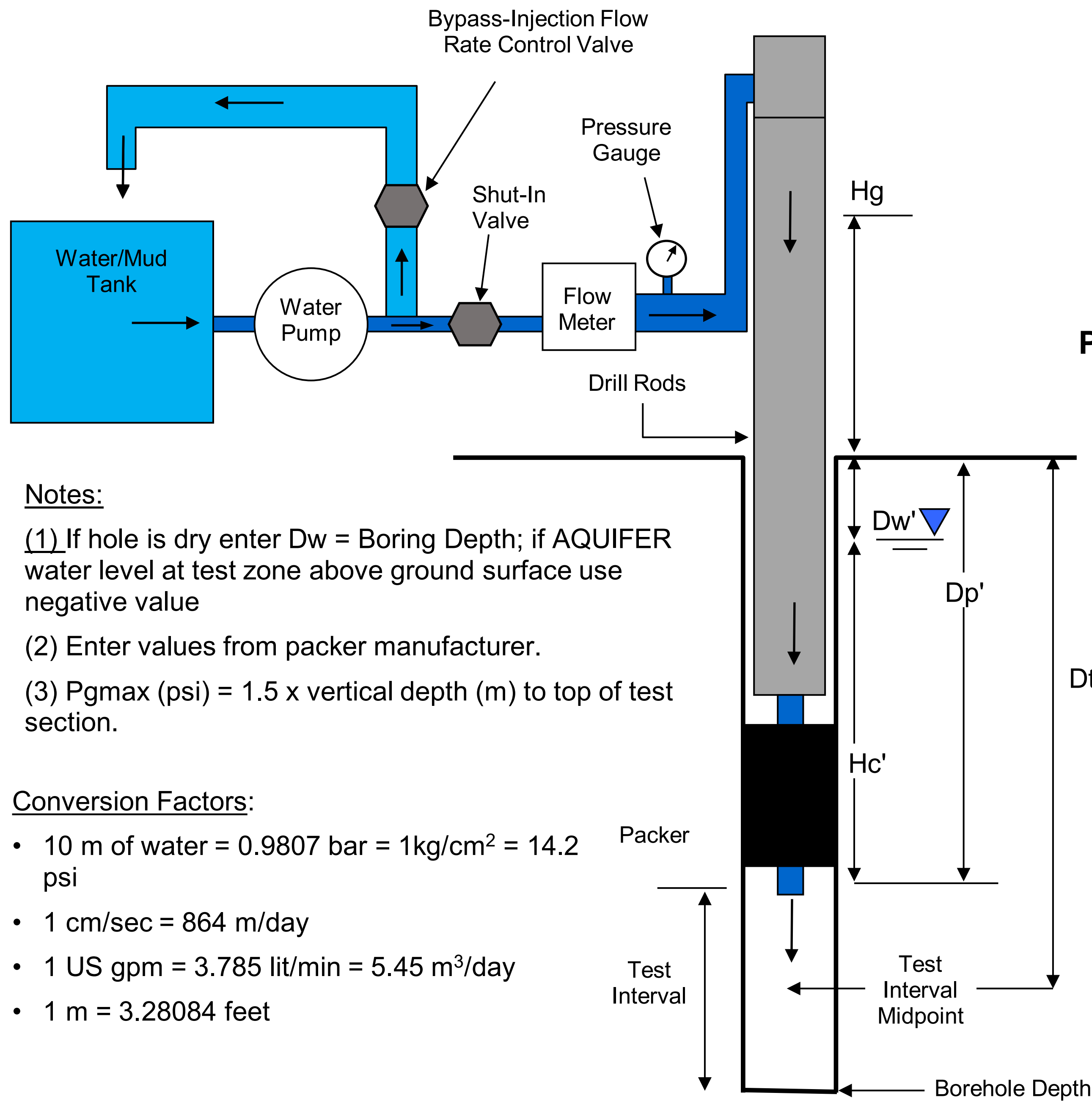
APPLIED HYDROLOGIC

Project:	**Graphite Creek**	**Test Interval (ft):**	**304.25**	**To:**	**373.00**	**Test Nº**	**4**
Drillhole Nº:	**22GC073**	**Start Date:**	**23-Jul-22**	**Time:**	**22:05**	**Drill Bit Depth (ft)**	**300**
		End Date:	**24-Jul-22**	**Time:**	**1:00**	**DH Depth (ft)**	**373**
		Supervisor:	**G. Baldwin**	**Rig:**	**T&J**		

Max Injection P (psi)

108

Dw	Measured depth of static water level (1)	-16.9	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**92.7**	m
Dt	Measured depth to midpoint of test	**103.2**	m
ß	Inclination from horizontal (degrees)	51	°
Dw'	Vertical depth to static water level	**0.0**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**71.6**	m
Dt'	Vertical depth to midpoint of test	**79.6**	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	**102**	psi
Pshear	Estimated differential shear pressure required	**524**	psi
Pgmax	Maximum injection gauge pressure (3)	**119**	psi
Hg	Gauge height	-0.9	m
Lp	Length of discharge pipe	7.62	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0095	m
R	Radius of influence (10 m is standard value)	10	m
rb	Borehole radius (HQ=0.048m, NQ=0.038m)	0.048	m
L	Length of test section	**20.95**	m
Hf	Friction Loss		
Htot	Induced head recorded by transducer		
K	Hydraulic conductivity		



Notes:

(1) If hole is dry enter Dw = Boring Depth; if AQUIFER water level at test zone above ground surface use negative value

(2) Enter values from packer manufacturer.

(3) Pgmax (psi) = 1.5 x vertical depth (m) to top of test section.

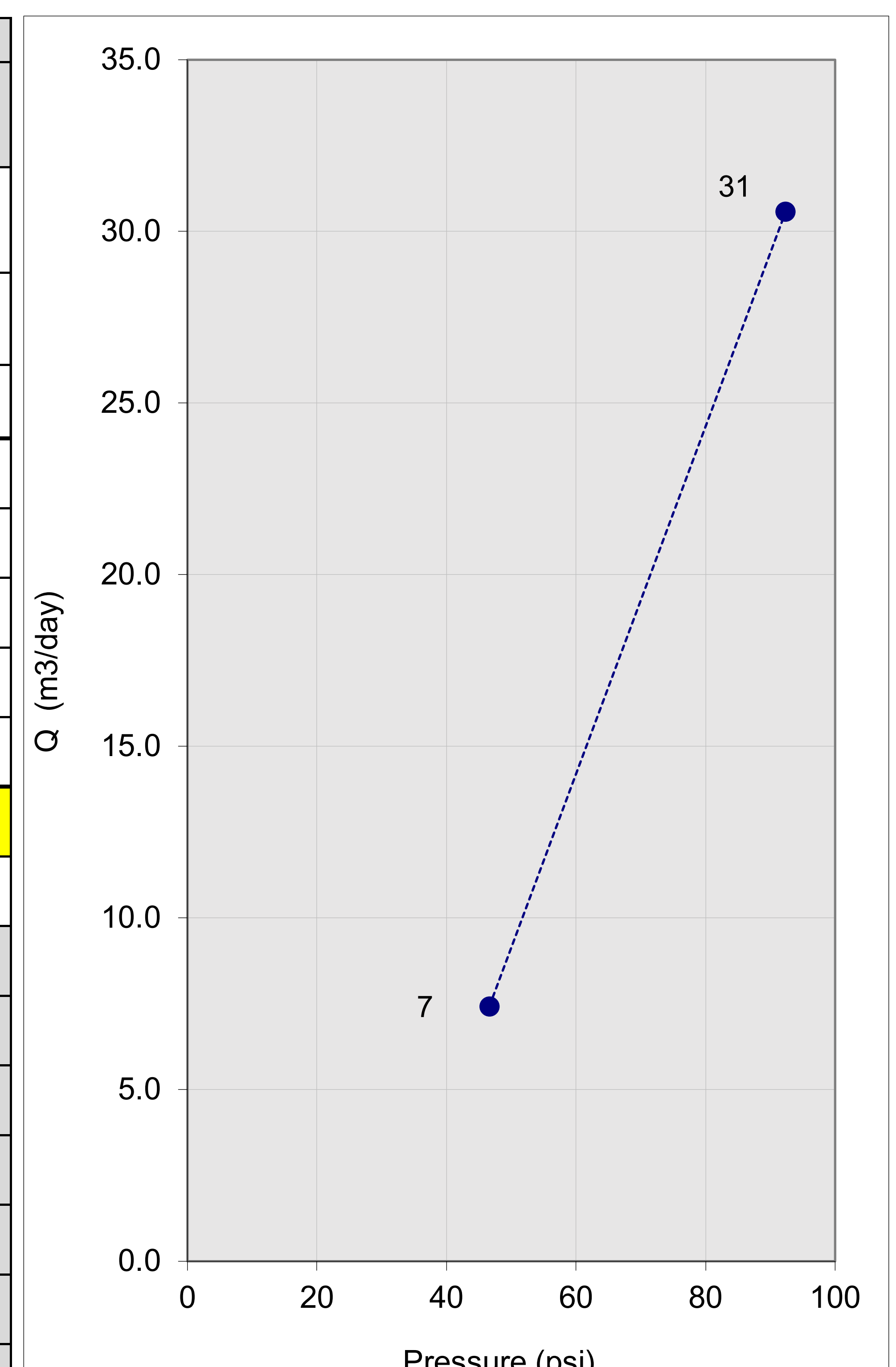
Conversion Factors:

- 10 m of water = 0.9807 bar = 1kg/cm^2 = 14.2 psi
- 1 cm/sec = 864 m/day
- 1 US gpm = 3.785 lit/min = 5.45 m^3/day
- 1 m = 3.28084 feet

Equations:

- Hf = 8.65x10^{-15} (Q^2*Lp/rp^5)
- K = (Q*Ln(R/r$_b$)) / (2*π*H$_{tot}$*L)

Measurement (last 3 to 5 stable readings)	Q (Liters / 30sec)				
	P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Induced Pressure at TDX	**46.63**	**92.38**			
Induced Pressure at Surface Gage	**50**	**100**			
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**			
1	**3.35**	**12.03**			
2	**2.63**	**11.80**			
3	**2.93**	**11.70**			
4	**3.07**	**10.60**			
5	**3.02**	**11.30**			
Stable Q (L/30sec)	**3.00**	**11.35**			
Leak Q (L/30sec)	**0.420**	**0.730**			
Q (m^3/day)	7	31	#N/A	#N/A	#N/A
Hf (m)	0.05	0.79	#N/A	#N/A	#N/A
Htot (m)	32.8	65.1	0.0	0.0	0.0
K (m/day)	9.2E-03	1.9E-02	#N/A	#N/A	#N/A
K (m/s)	**1.1E-07**	**2.2E-07**	**#N/A**	**#N/A**	**#N/A**
+/- (m/s)	4.9E-08	1.5E-07	#N/A	#N/A	#N/A
+/- order of mag.	0.16	0.23	#NUM!	#N/A	#N/A

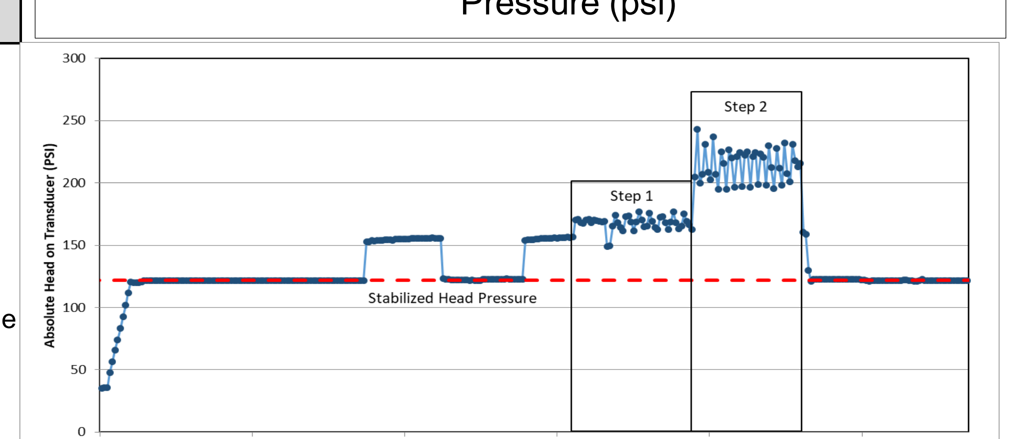


Geology:

RQ-JC-Structures:

Flow Monitoring-System-Test Comments: Low flow artesian. Experienced difficulty seating the packer in the artesian flow, but second attempt was successful. Bad rod leakage. At 23:43 Hrs the Bean pump started surging very severely. At 23:58:30 Hrs, the surging stopped. A few seconds later the packer lost seal. The 3rd, 4th, and 5th injection steps were not completed. The rig's hydraulic system had to be replaced in the following days. It is suspected that a hydraulic issue was to blame and the surging caused the packer to unseat. However, it is possible that the packer wasn't seated properly to begin with, which could have resulted in excess system leakage.

Injected clean water with no polymer.



APPLIED HYDROLOGIC

STEPPED PRESSURE INJECTION TEST

(page 2)

Drillhole Nº	22GC073
Test Nº	4

Pressure oscillation during test

Pressure step	P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Min P during step	32.7	55.9	0.0	0.0	0.0
Max P during step	60.6	128.9	0.0	0.0	0.0
average pressure +/- psi	**13.934**	**36.532**			

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	**0.0602**	**0.2270**			

High estimate of K

Q_{avg} (m^3/day)	7.60	31.24			
Hf (m)	0.05	0.82			
Htot (m)	23.0	39.3			
K (m/sec)	1.6E-07	3.7E-07			

Low estimate of K

Q_{avg} (m^3/day)	7.26	29.93			
Hf (m)	0.04	0.75			
Htot (m)	42.6	90.8			
K (m/sec)	8.0E-08	1.5E-07			

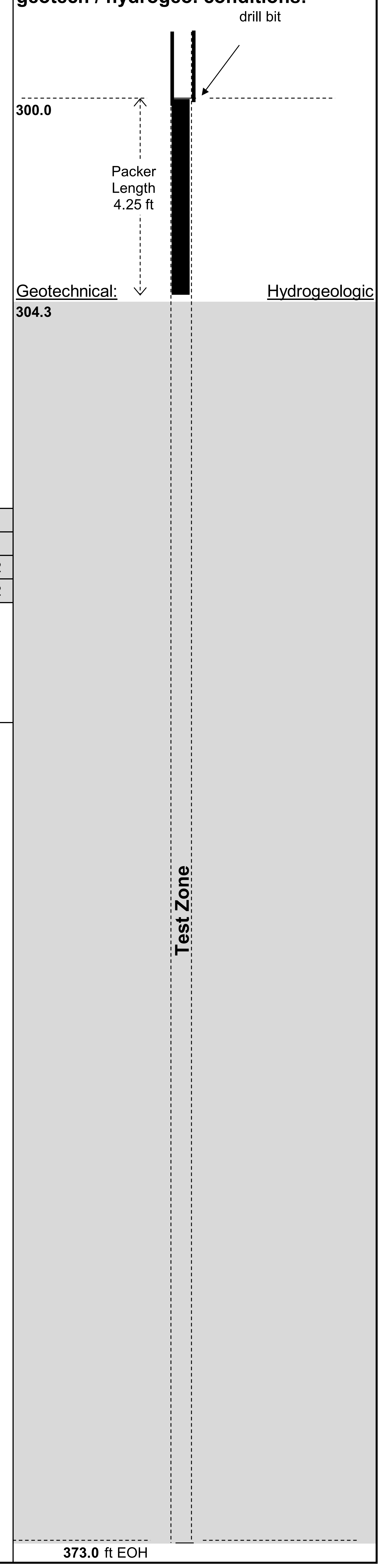
K calculated for P step (m/second)

PSI	46.6	92.4	
High est of K	1.6.E-07	3.7.E-07	
Average K	1.1.E-07	2.2.E-07	
Low est of K	8.0.E-08	1.5.E-07	

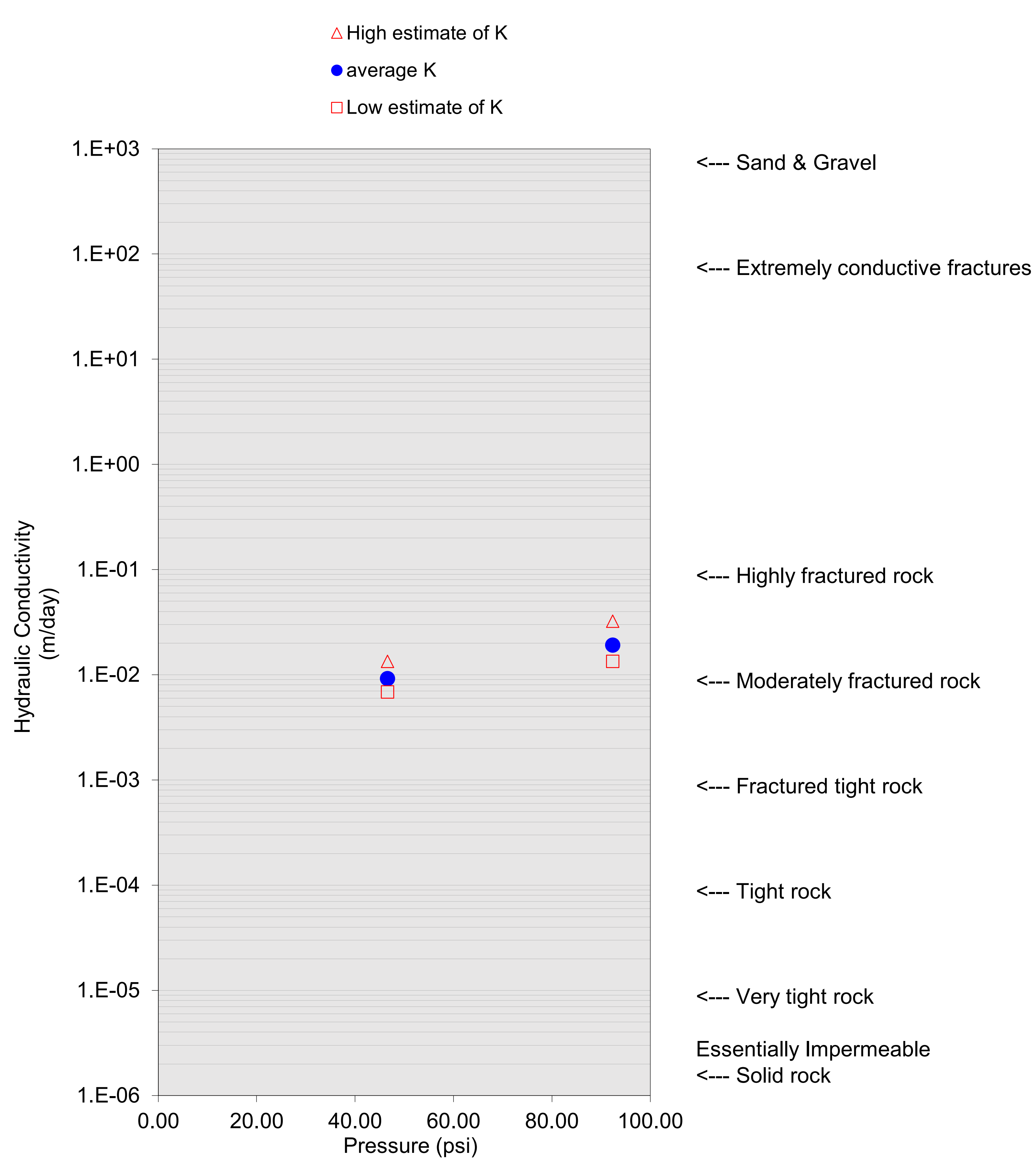
K all P steps

	m/day	Ft/Day
MAX	3.22E-02	1.06E-01
Geomean	1.32E-02	4.34E-02
MIN	6.90E-03	2.26E-02

Drawing of zone tested, including geotech / hydrogeo. conditions:



Graph of estimated hydraulic conductivity and error bounds.



STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

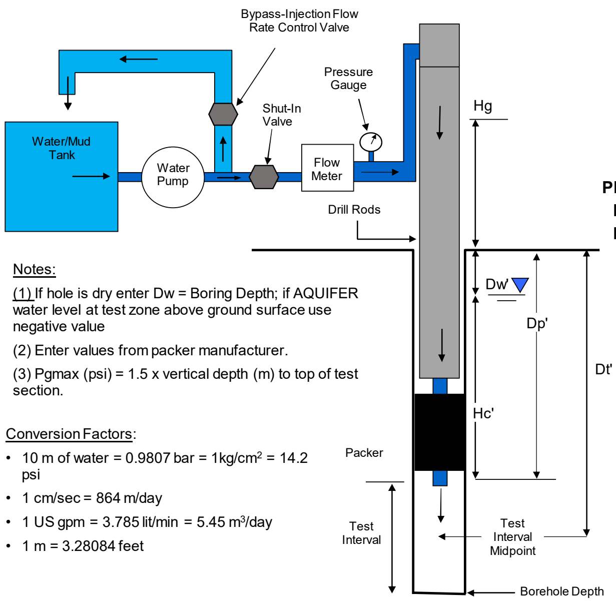
APPLIED HYDROLOGIC

Project:	Graphite Creek	**Test Interval (ft):**	374.25	**To:**	498.00	**Test Nº**	5
Drillhole Nº:	22GC073	**Start Date:**	24-Jul-22	**Time:**	21:18	**Drill Bit Depth (ft)**	370
		End Date:	25-Jul-22	**Time:**	0:20	**DH Depth (ft)**	498
		Supervisor:	G. Baldwin	**Rig:**	T&J		

Max Injection P (psi)

133

Dw	Measured depth of static water level (1)	-41.7	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**114.1**	m
Dt	Measured depth to midpoint of test	**132.9**	m
ß	Inclination from horizontal (degrees)	50.5	°
Dw'	Vertical depth to static water level	**0.0**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**88.0**	m
Dt'	Vertical depth to midpoint of test	**102.6**	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	**125**	psi
Pshear	Estimated differential shear pressure required	**559**	psi
Pgmax	Maximum injection gauge pressure (3)	**154**	psi
Hg	Gauge height	-0.9	m
Lp	Length of discharge pipe	7.62	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0095	m
R	Radius of influence (10 m is standard value)	10	m
rb	Borehole radius (HQ=0.048m, NQ=0.038m)	0.048	m
L	Length of test section	**37.72**	m
Hf	Friction Loss		
Htot	Induced head recorded by transducer		
K	Hydraulic conductivity		



Notes:

(1) If hole is dry enter Dw = Boring Depth; if AQUIFER water level at test zone above ground surface use negative value

(2) Enter values from packer manufacturer.

(3) Pgmax (psi) = 1.5 x vertical depth (m) to top of test section.

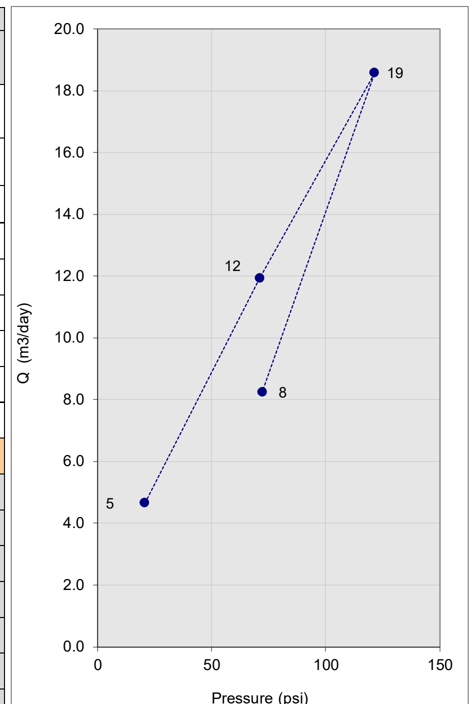
Conversion Factors:

- 10 m of water = 0.9807 bar = 1kg/cm^2 = 14.2 psi
- 1 cm/sec = 864 m/day
- 1 US gpm = 3.785 lit/min = 5.45 m^3/day
- 1 m = 3.28084 feet

Equations:

- Hf = 8.65x10^{-15} (Q^2*Lp/rp^5)
- K = (Q*Ln(R/r$_b$)) / (2*π*H$_{tot}$*L)

Measurement (last 3 to 5 stable readings)	Q (Liters / 30sec)				
	P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Induced Pressure at TDX	20.71	71.12	121.33	72.25	22.48
Induced Pressure at Surface Gage	50	100	150	100	50
Marsh Funnel Secs. (Clean Water = 26)	26	26	26	26	26
1	2.12	4.88	7.70	3.55	-0.68
2	1.79	4.97	6.80	3.57	-0.18
3	1.91	4.28	7.35	3.15	0.19
4	2.08	4.45	7.65	3.23	0.06
5	1.97	4.95	6.95	3.63	0.13
Stable Q (L/30sec)	1.98	4.71	7.19	3.43	0.13
Leak Q (L/30sec)	0.360	0.570	0.740	0.570	0.360
Q (m^3/day)	5	12	19	8	#N/A
Hf (m)	0.02	0.12	0.29	0.06	#N/A
Htot (m)	14.6	50.1	85.4	50.9	15.8
K (m/day)	7.2E-03	5.4E-03	4.9E-03	3.6E-03	#N/A
K (m/s)	8.3E-08	6.2E-08	5.7E-08	4.2E-08	#N/A
+/- (m/s)	3.4E-08	1.4E-08	8.5E-09	3.4E-08	#N/A
+/- order of mag.	0.15	0.09	0.06	0.26	#N/A

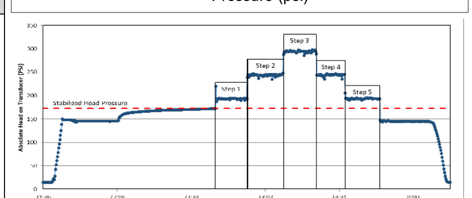


Geology:

RQ-JC-Structures:

Flow Monitoring-System-Test Comments: Injected clean water with no polymer. Flowing Artesian (5 GPM @ 14 PSI). Strong upward pressure gradient. Set bit at 380 ft, set packer, then pull 10 ft (to 370 ft). 22:14 Hrs - Bean pump surging too badly so rebuild but still badly oscillating. Last pressure step water was flowing out of the hole at 50 PSI due to effective water table being elevated from testing. Shut-in test interval post-test to determine effective water table.

The decreasing permeability with time is a result of artificially raising the effective water table during testing. Calculated K from Steps 1, 2, and 3 are likely most representative of in situ conditions.



APPLIED HYDROLOGIC	STEPPED PRESSURE INJECTION TEST (page 2)	Drillhole Nº	22GC073
		Test Nº	5

Pressure oscillation during test

Pressure step	P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Min P during step	15.1	59.0	107.9	59.9	20.7
Max P during step	26.4	83.2	134.8	84.6	24.2
average pressure +/- psi	**5.646**	**12.102**	**13.437**	**12.326**	**1.741**

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	**0.0397**	**0.0951**	**0.1467**	**0.0683**	**0.0025**

High estimate of K

Q_{avg} (m^3/day)	4.78	12.20	19.00	8.43	#N/A
Hf (m)	0.02	0.13	0.30	0.06	#N/A
Htot (m)	10.6	41.6	76.0	42.2	14.6
K (m/sec)	1.2E-07	7.7E-08	6.5E-08	5.2E-08	#N/A

Low estimate of K

Q_{avg} (m^3/day)	4.55	11.65	18.15	8.04	#N/A
Hf (m)	0.02	0.11	0.28	0.05	#N/A
Htot (m)	18.6	58.6	94.9	59.6	17.1
K (m/sec)	6.4E-08	5.2E-08	5.0E-08	3.5E-08	#N/A

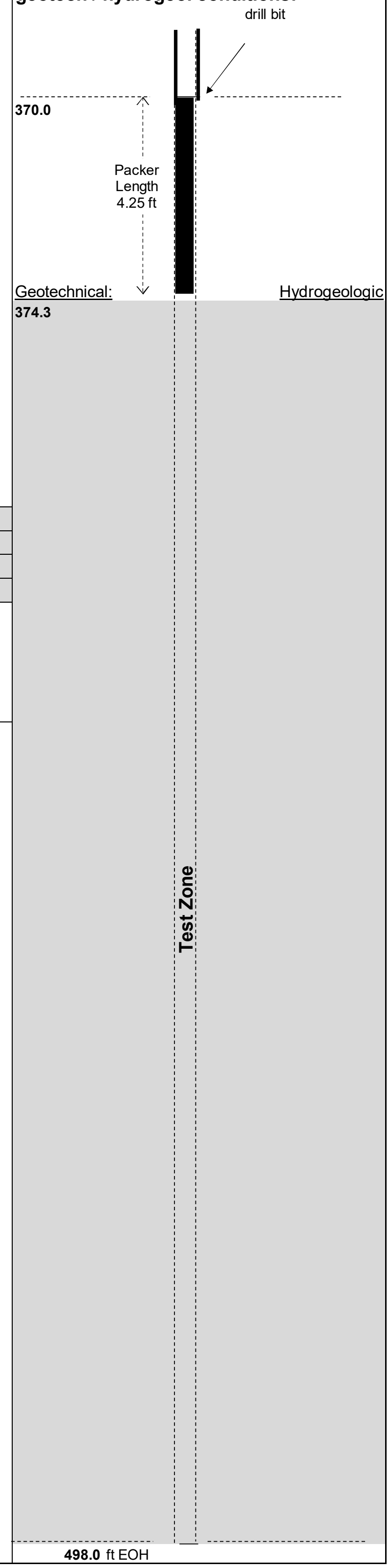
K calculated for P step m/second

PSI	21.6	71.7	121.3
High est of K	1.2.E-07	7.7.E-08	6.5.E-08
Average K	8.3.E-08	5.2.E-08	5.7.E-08
Low est of K	6.4.E-08	3.5.E-08	5.0.E-08

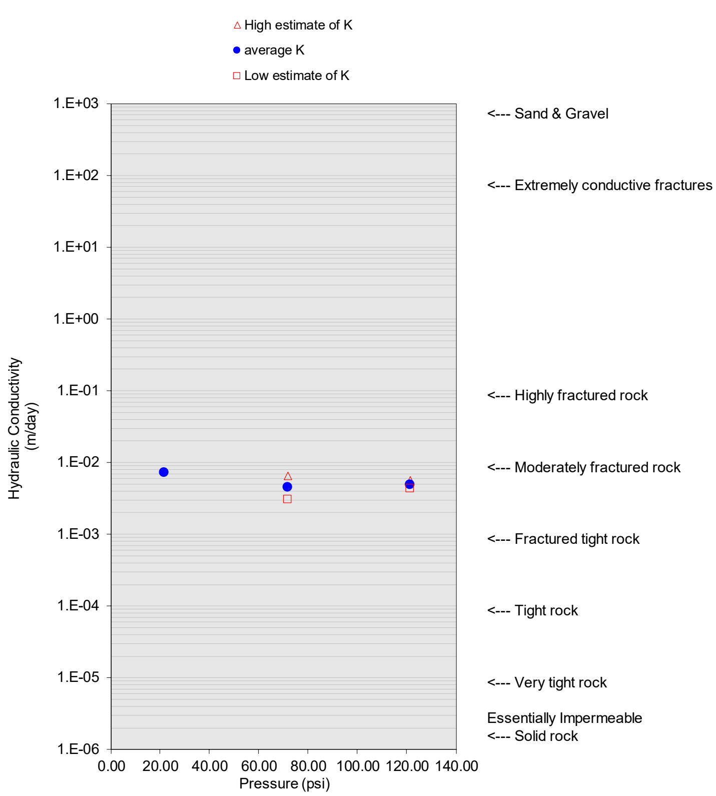
K all P steps

	m/day	Ft/Day
MAX	1.01E-02	3.33E-02
Geomean	5.42E-03	1.78E-02
MIN	3.04E-03	9.98E-03

Drawing of zone tested, including geotech / hydrogeo. conditions:



Graph of estimated hydraulic conductivity and error bounds.

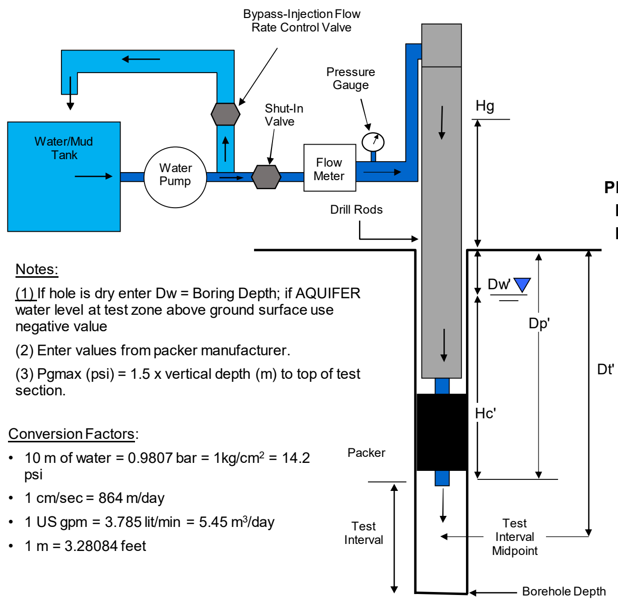


APPLIED HYDROLOGIC	STEPPED PRESSURE INJECTION TEST *(modified from HCI)*					
Project:	**Graphite Creek**	**Test Interval (ft):** 52.25	**To:** 106.00	**Test Nº** 1		
Drillhole Nº:	**22GC075**	**Start Date:** 1-Aug-22	**Time:** 6:45	**Drill Bit Depth (ft)** 48		
		End Date: 1-Aug-22	**Time:** 10:15	**DH Depth (ft)** 106		
		Supervisor: G. Baldwin	**Rig:** T&J			

Max Injection P (psi)

19

Dw	Measured depth of static water level (1)	-16.6	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**15.9**	m
Dt	Measured depth to midpoint of test	**24.1**	m
ß	Inclination from horizontal (degrees)	50.4	°
Dw'	Vertical depth to static water level	**0.0**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**12.3**	m
Dt'	Vertical depth to midpoint of test	**18.6**	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	**17**	psi
Pshear	Estimated differential shear pressure required	**524**	psi
Pgmax	Maximum injection gauge pressure (3)	**28**	psi
Hg	Gauge height	-1.2	m
Lp	Length of discharge pipe	7.62	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0127	m
R	Radius of influence (10 m is standard value)	10	m
rb	Borehole radius (HQ=0.048m, NQ=0.038m)	0.048	m
L	Length of test section	**16.38**	m
Hf	Friction Loss		
Htot	Induced head recorded by transducer		
K	Hydraulic conductivity		



Notes:

(1) If hole is dry enter Dw = Boring Depth; if AQUIFER water level at test zone above ground surface use negative value

(2) Enter values from packer manufacturer.

(3) Pgmax (psi) = 1.5 x vertical depth (m) to top of test section.

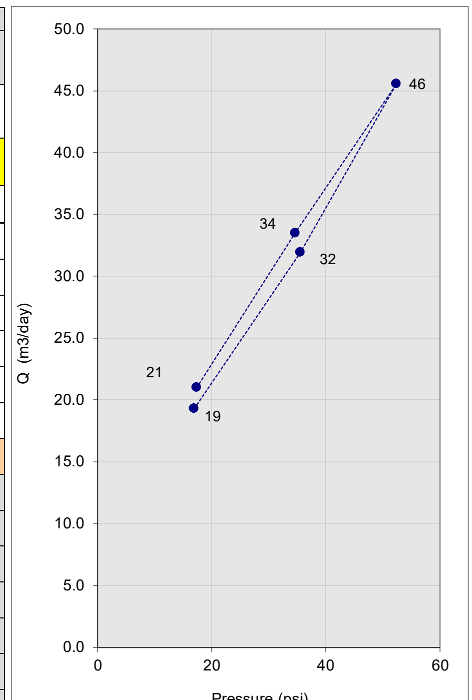
Conversion Factors:

- 10 m of water = 0.9807 bar = 1kg/cm^2 = 14.2 psi
- 1 cm/sec = 864 m/day
- 1 US gpm = 3.785 lit/min = 5.45 m^3/day
- 1 m = 3.28084 feet

Equations:

- Hf = 8.65x10^{-15} (Q^2*Lp/rp^5)
- K = (Q*Ln(R/r$_b$)) / (2*π*H$_{tot}$*L)

Measurement (last 3 to 5 stable readings)	Q (Liters / 30sec) P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Induced Pressure at TDX	**16.95**	**35.60**	**52.41**	**34.70**	**17.42**
Induced Pressure at Surface Gage	**20**	**40**	**60**	**40**	**20**
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**6.85**	**11.30**	**15.70**	**11.95**	**7.20**
2	**6.75**	**10.85**	**16.25**	**11.10**	**7.55**
3	**6.67**	**11.18**	**15.60**	**12.05**	**7.13**
4	**6.95**	**11.20**	**16.00**	**11.75**	**7.38**
5	**6.75**	**11.08**	**15.90**	**11.70**	**7.35**
Stable Q (L/30sec)	**6.75**	**11.15**	**15.90**	**11.70**	**7.35**
Leak Q (L/30sec)	**0.050**	**0.060**	**0.070**	**0.060**	**0.050**
Q (m^3/day)	19	32	46	34	21
Hf (m)	0.07	0.20	0.41	0.22	0.09
Htot (m)	11.9	25.1	36.9	24.4	12.3
K (m/day)	8.4E-02	6.6E-02	6.4E-02	7.1E-02	8.9E-02
K (m/s)	**9.7E-07**	**7.6E-07**	**7.4E-07**	**8.2E-07**	**1.0E-06**
+/- (m/s)	4.9E-07	2.5E-07	1.3E-07	1.9E-07	4.3E-07
+/- order of mag.	0.18	0.12	0.07	0.09	0.15

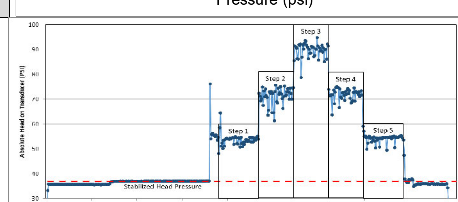


Geology: Fracture faces oxidized, stained, and weathered. Hit water at about 25-30 ft.

RQ-JC-Structures: Highly fractured to about 60 ft, then slightly lower fracture frequency.

Flow Monitoring-System-Test Comments: Injected clean water with no polymer. Flush until clean return. Bean pump severely surging. Paused inflate to clean pump (0810 - 0825 hrs).

Distinct upward pressure gradient.



APPLIED HYDROLOGIC	STEPPED PRESSURE INJECTION TEST (page 2)	Drillhole Nº	22GC075
		Test Nº	1

Pressure oscillation during test

Pressure step	P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Min P during step	14.6	31.0	45.3	28.6	12.6
Max P during step	19.3	40.2	59.5	40.8	22.3
average pressure +/- psi	**2.377**	**4.556**	**7.102**	**6.054**	**4.87**

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	**0.1360**	**0.2230**	**0.3188**	**0.2342**	**0.1470**

High estimate of K

Q_{avg} (m^3/day)	19.69	32.58	46.51	34.20	21.45
Hf (m)	0.08	0.21	0.43	0.23	0.09
Htot (m)	10.3	21.9	31.9	20.2	8.8
K (m/sec)	1.2E-06	8.9E-07	8.8E-07	1.0E-06	1.5E-06

Low estimate of K

Q_{avg} (m^3/day)	18.90	31.30	44.67	32.85	20.60
Hf (m)	0.07	0.20	0.40	0.22	0.08
Htot (m)	13.6	28.3	41.9	28.7	15.7
K (m/sec)	8.3E-07	6.6E-07	6.4E-07	6.9E-07	7.9E-07

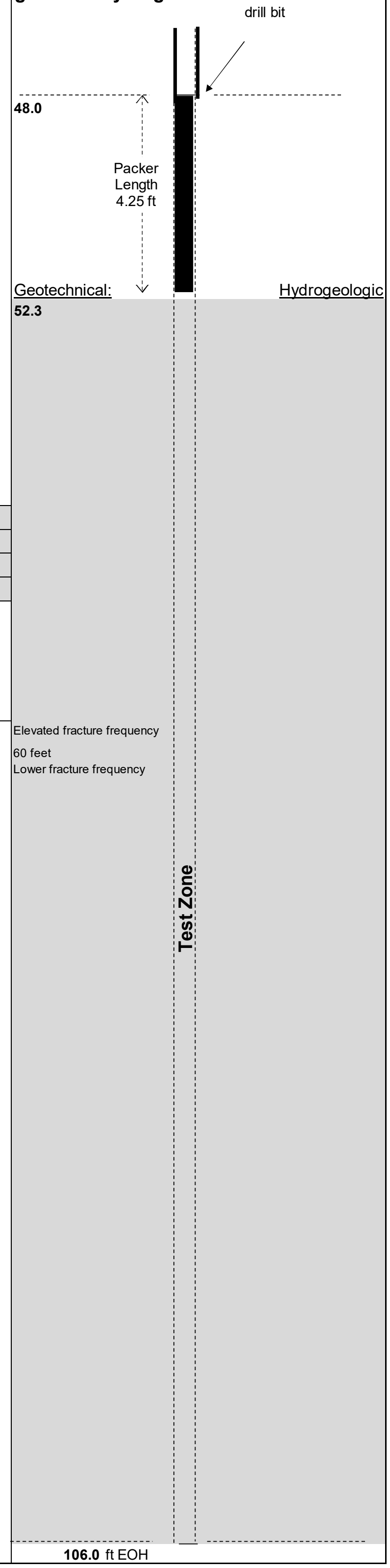
K calculated for P step m/second

PSI	17.2	35.1	52.4
High est of K	1.5.E-06	1.0.E-06	8.8.E-07
Average K	1.0.E-06	7.9.E-07	7.4.E-07
Low est of K	7.9.E-07	6.6.E-07	6.4.E-07

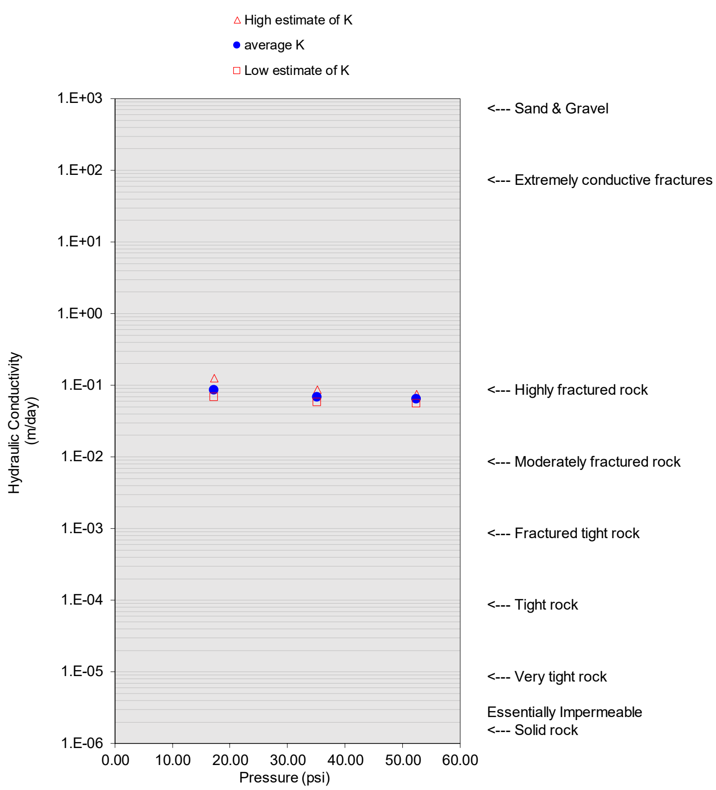
K all P steps

	m/day	Ft/Day
MAX	1.26E-01	4.13E-01
Geomean	7.24E-02	2.38E-01
MIN	5.53E-02	1.81E-01

Drawing of zone tested, including geotech / hydrogeo. conditions:



Graph of estimated hydraulic conductivity and error bounds.



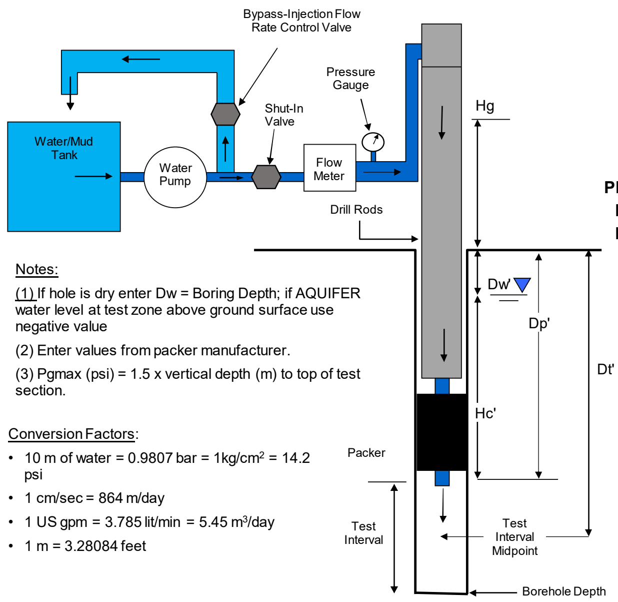
APPLIED HYDROLOGIC

STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	**Graphite Creek**	**Test Interval (ft):**	**102.25**	**To:**	**197.80**	**Test Nº**	**2**
Drillhole Nº:	**22GC075**	**Start Date:**	**2-Aug-22**	**Time:**	**8:45**	**Drill Bit Depth (ft)**	**98**
		End Date:	**2-Aug-22**	**Time:**	**13:20**	**DH Depth (ft)**	**197.8**
		Supervisor:	**G. Baldwin**	**Rig:**	**T&J**		

Max Injection P (psi)

36



Notes:

(1) If hole is dry enter Dw = Boring Depth; if AQUIFER water level at test zone above ground surface use negative value

(2) Enter values from packer manufacturer.

(3) Pgmax (psi) = 1.5 x vertical depth (m) to top of test section.

Conversion Factors:

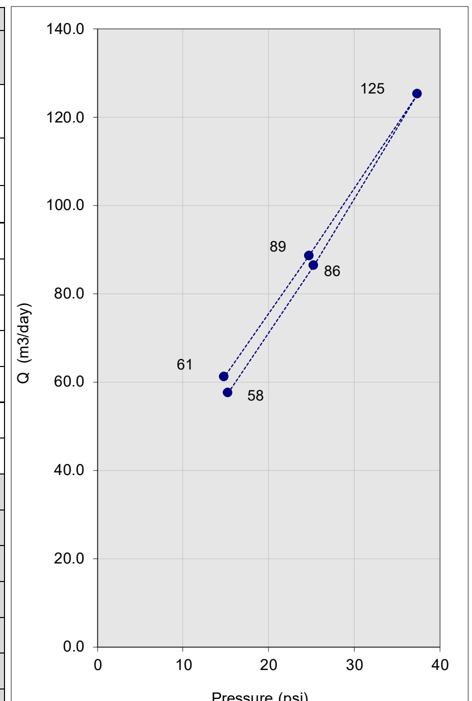
- 10 m of water = 0.9807 bar = 1kg/cm^2 = 14.2 psi
- 1 cm/sec = 864 m/day
- 1 US gpm = 3.785 lit/min = 5.45 m^3/day
- 1 m = 3.28084 feet

Dw	Measured depth of static water level (1)	-16.3	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**31.2**	m
Dt	Measured depth to midpoint of test	**45.7**	m
ß	Inclination from horizontal (degrees)	50.7	º
Dw'	Vertical depth to static water level	**0.0**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**24.1**	m
Dt'	Vertical depth to midpoint of test	**35.4**	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	**34**	psi
Pshear	Estimated differential shear pressure required	**523**	psi
Pgmax	Maximum injection gauge pressure (3)	**53**	psi
Hg	Gauge height	-1.2	m
Lp	Length of discharge pipe	7.62	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0127	m
R	Radius of influence (10 m is standard value)	10	m
rb	Borehole radius (HQ=0.048m, NQ=0.038m)	0.048	m
L	Length of test section	**29.12**	m
Hf	Friction Loss		
Htot	Induced head recorded by transducer		
K	Hydraulic conductivity		

Equations:

- Hf = 8.65x10^{-15} (Q^2*Lp/rp^5)
- K = (Q*Ln(R/r$_b$)) / (2*π*H$_{tot}$*L)

Measurement (last 3 to 5 stable readings)	Q (Liters / 30sec)				
	P$_g$ (psi) Step 1	P$_g$ (psi) Step 2	P$_g$ (psi) Step 3	P$_g$ (psi) Step 4	P$_g$ (psi) Step 5
Induced Pressure at TDX	**15.28**	**25.31**	**37.39**	**24.74**	**14.83**
Induced Pressure at Surface Gage	**20**	**35**	**55**	**35**	**20**
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**20.50**	**30.50**	**43.50**	**31.00**	**20.65**
2	**20.50**	**30.00**	**44.00**	**31.00**	**21.40**
3	**20.00**	**30.50**	**43.00**	**31.00**	**21.05**
4	**20.00**	**29.50**	**44.00**	**31.00**	**21.45**
5	**20.00**	**30.00**	**43.50**	**30.50**	**21.00**
Stable Q (L/30sec)	**20.00**	**30.00**	**43.50**	**30.75**	**21.23**
Leak Q (L/30sec)	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Q (m^3/day)	58	86	125	89	61
Hf (m)	0.66	1.49	3.13	1.56	0.75
Htot (m)	10.8	17.8	26.3	17.4	10.4
K (m/day)	1.6E-01	1.4E-01	1.4E-01	1.5E-01	1.7E-01
K (m/s)	**1.8E-06**	**1.6E-06**	**1.6E-06**	**1.7E-06**	**2.0E-06**
+/- (m/s)	5.2E-07	2.0E-07	1.2E-07	1.2E-07	3.5E-07
+/- order of mag.	0.11	0.05	0.03	0.03	0.07



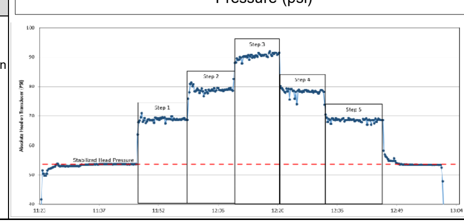
Geology:

RQ-JC-Structures: Artesian (0.6 GPM) zone 119 - 121 ft along fault(?) and dike contact. Highly broken with oxidzed faces in artesian zone. Rest of interval has mildly to highly oxidized/stained and weathered joints. Abundant graphite in lower 1/2 of interval.

Flow Monitoring-System-Test Comments: Water bypass through formation on first test tedst attempt (108 ft), so reset packer higher in the hole. Injected clean water with no polymer. Flush until clean return.

Very permeable rock so couldn't build planned pressure steps. No measureable rod leak (most bad rods were finally sorted out). Distinct upward pressure gradient.

Slightly increasing permeability with time indicates cleaning of fractures with injected water.



APPLIED HYDROLOGIC	STEPPED PRESSURE INJECTION TEST (page 2)	Drillhole Nº	22GC075
		Test Nº	2

Pressure oscillation during test

Pressure step	P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Min P during step	14.7	24.3	35.5	23.6	12.8
Max P during step	15.9	26.3	39.3	25.9	16.8
average pressure +/- psi	**0.624**	**1.013**	**1.917**	**1.142**	**2.001**

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	**0.4000**	**0.6000**	**0.8725**	**0.6180**	**0.4245**

High estimate of K

Q_{avg} (m^3/day)	58.75	88.13	127.79	90.34	62.36
Hf (m)	0.69	1.55	3.26	1.63	0.78
Htot (m)	10.3	17.1	25.0	16.6	9.0
K (m/sec)	1.9E-06	1.7E-06	1.7E-06	1.8E-06	2.3E-06

Low estimate of K

Q_{avg} (m^3/day)	56.45	84.67	122.77	86.78	59.92
Hf (m)	0.64	1.43	3.01	1.50	0.72
Htot (m)	11.2	18.5	27.7	18.2	11.9
K (m/sec)	1.7E-06	1.5E-06	1.5E-06	1.6E-06	1.7E-06

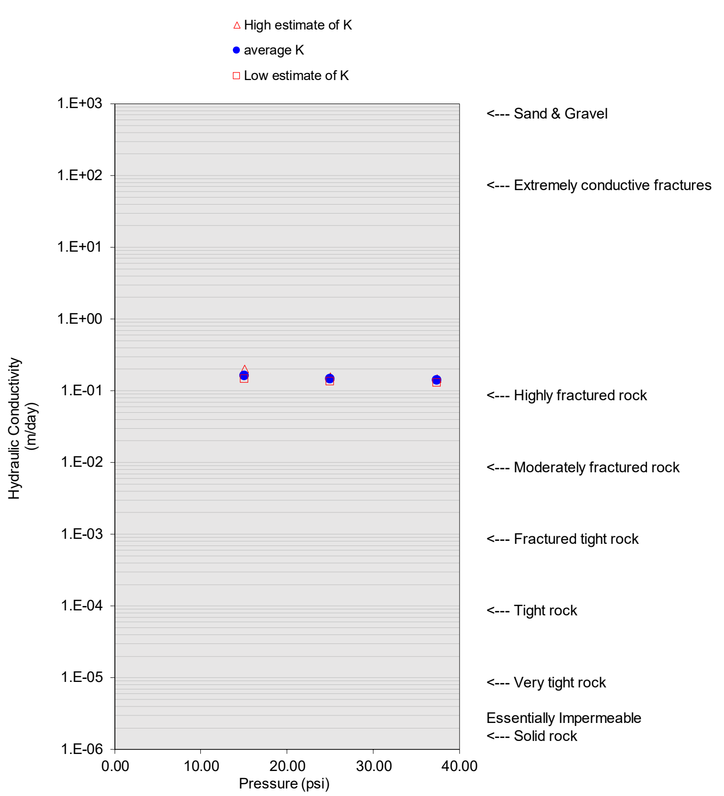
K calculated for P step m/second

PSI	15.1	25.0	37.4
High est of K	2.3.E-06	1.8.E-06	1.7.E-06
Average K	1.9.E-06	1.7.E-06	1.6.E-06
Low est of K	1.7.E-06	1.5.E-06	1.5.E-06

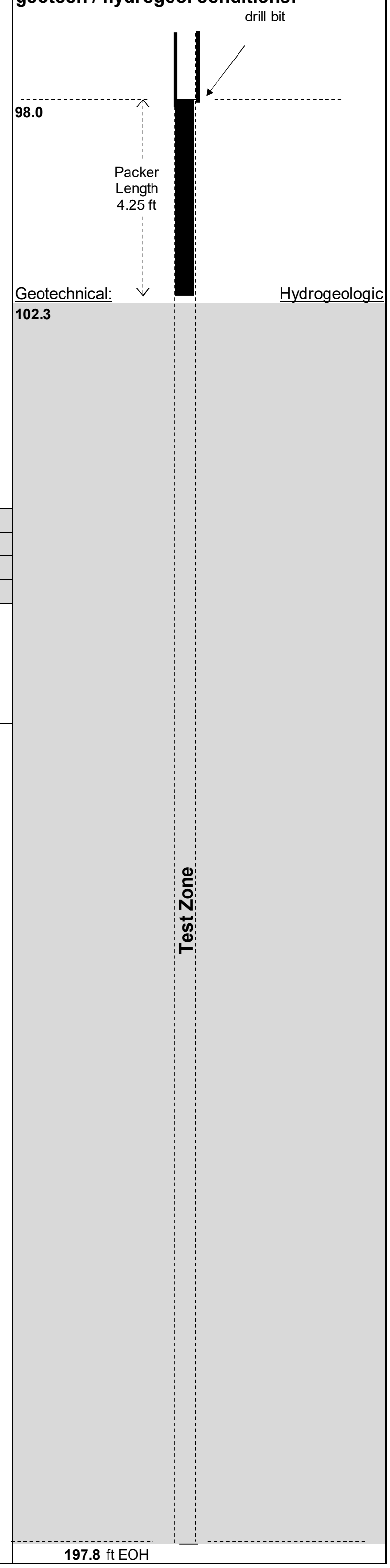
K all P steps

	m/day	Ft/Day
MAX	2.01E-01	6.60E-01
Geomean	1.49E-01	4.88E-01
MIN	1.29E-01	4.24E-01

Graph of estimated hydraulic conductivity and error bounds.



Drawing of zone tested, including geotech / hydrogeo. conditions:



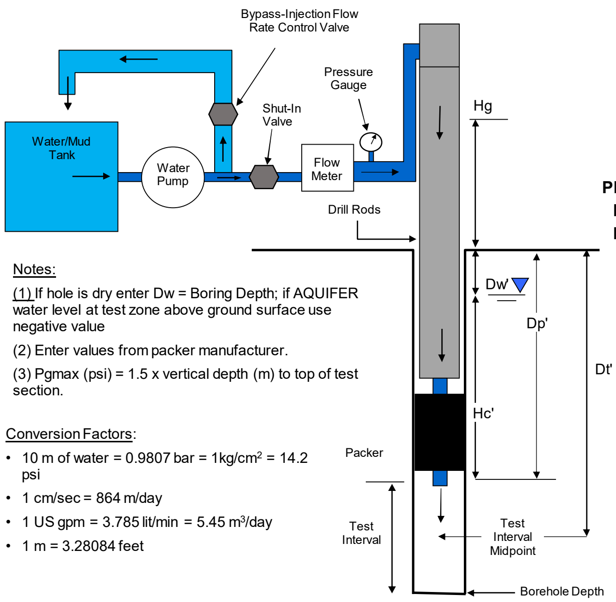
STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

APPLIED HYDROLOGIC

Project:	**Graphite Creek**	**Test Interval (ft):**	**202.25**	**To:**	**298.00**	**Test Nº**	**3**
Drillhole Nº:	**22GC075**	**Start Date:**	**3-Aug-22**	**Time:**	**13:25**	**Drill Bit Depth (ft)**	**198**
		End Date:	**3-Aug-22**	**Time:**	**17:00**	**DH Depth (ft)**	**298**
		Supervisor:	**G. Baldwin**	**Rig:**	**T&J**		

Max Injection P (psi)

73



Notes:

(1) If hole is dry enter Dw = Boring Depth; if AQUIFER water level at test zone above ground surface use negative value

(2) Enter values from packer manufacturer.

(3) Pgmax (psi) = 1.5 x vertical depth (m) to top of test section.

Conversion Factors:

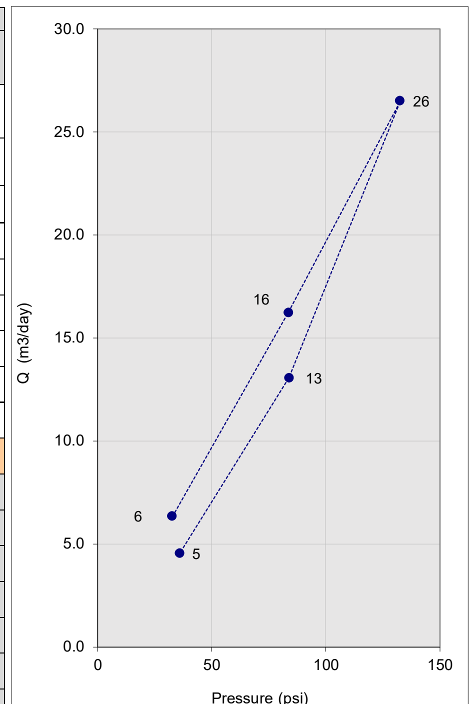
- 10 m of water = 0.9807 bar = 1kg/cm^2 = 14.2 psi
- 1 cm/sec = 864 m/day
- 1 US gpm = 3.785 lit/min = 5.45 m^3/day
- 1 m = 3.28084 feet

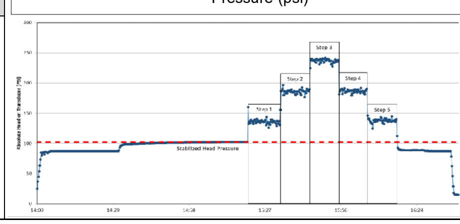
Dw	Measured depth of static water level (1)	-28.8	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**61.6**	m
Dt	Measured depth to midpoint of test	**76.2**	m
ß	Inclination from horizontal (degrees)	51.4	º
Dw'	Vertical depth to static water level	**0.0**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**48.2**	m
Dt'	Vertical depth to midpoint of test	**59.6**	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	**68**	psi
Pshear	Estimated differential shear pressure required	**541**	psi
Pgmax	Maximum injection gauge pressure (3)	**89**	psi
Hg	Gauge height	-1.2	m
Lp	Length of discharge pipe	7.62	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0127	m
R	Radius of influence (10 m is standard value)	10	m
rb	Borehole radius (HQ=0.048m, NQ=0.038m)	0.048	m
L	Length of test section	**29.18**	m
Hf	Friction Loss		
Htot	Induced head recorded by transducer		
K	Hydraulic conductivity		

Equations:

- $H_f = 8.65 \times 10^{-15} (Q^2 * L_p / r_p^5)$
- $K = (Q * \ln(R/r_b)) / (2 * \pi * H_{tot} * L)$

Measurement (last 3 to 5 stable readings)	Q (Liters / 30sec) P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Induced Pressure at TDX	**32.88**	**83.78**	**132.77**	**84.03**	**36.05**
Induced Pressure at Surface Gage	**50**	**100**	**150**	**100**	**50**
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**2.25**	**5.97**	**10.30**	**5.13**	**1.65**
2	**2.60**	**5.88**	**9.85**	**5.10**	**1.70**
3	**2.37**	**6.30**	**9.35**	**4.95**	**1.77**
4	**2.31**	**5.70**	**9.95**	**4.90**	**1.88**
5	**2.53**	**6.00**	**9.65**	**4.90**	**1.83**
Stable Q (L/30sec)	**2.45**	**6.00**	**9.70**	**4.90**	**1.83**
Leak Q (L/30sec)	**0.250**	**0.365**	**0.500**	**0.365**	**0.250**
Q (m^3/day)	6	16	26	13	5
Hf (m)	0.01	0.05	0.14	0.03	0.00
Htot (m)	23.2	59.0	93.5	59.2	25.4
K (m/day)	8.0E-03	8.0E-03	8.3E-03	6.4E-03	5.2E-03
K (m/s)	**9.2E-08**	**9.3E-08**	**9.5E-08**	**7.4E-08**	**6.0E-08**
+/- (m/s)	5.3E-08	2.1E-08	1.1E-08	4.0E-08	8.5E-08
+/- order of mag.	0.20	0.09	0.05	0.19	0.38





Geology:

RQ-JC-Structures: Flowing artesian zone at 248 ft, corresponding to a fracture zone along a dike.

Flow Monitoring-System-Test Comments:

Injected clean water with no polymer. Flushed until clean return. Minor but progressive decrease in permeability with pressure and time indicating incomplete blocking of the fractures and flow paths by transported material.

APPLIED HYDROLOGIC	STEPPED PRESSURE INJECTION TEST (page 2)	Drillhole Nº	22GC075
		Test Nº	3

Pressure oscillation during test

Pressure step	P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Min P during step	21.4	69.6	121.3	74.6	27.9
Max P during step	44.4	98.0	144.2	93.5	44.2
average pressure +/- psi	**11.504**	**14.173**	**11.419**	**9.473**	**8.176**

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	**0.0490**	**0.1200**	**0.1940**	**0.0980**	**0.0365**

High estimate of K

Q_{avg} (m^3/day)	6.48	16.57	27.05	13.34	4.66
Hf (m)	0.01	0.05	0.15	0.04	0.00
Htot (m)	15.1	49.0	85.5	52.5	19.6
K (m/sec)	1.4E-07	1.1E-07	1.1E-07	8.6E-08	8.0E-08

Low estimate of K

Q_{avg} (m^3/day)	6.19	15.88	25.94	12.78	4.45
Hf (m)	0.01	0.05	0.13	0.03	0.00
Htot (m)	31.3	69.0	101.5	65.8	31.1
K (m/sec)	6.7E-08	7.8E-08	8.6E-08	6.5E-08	4.8E-08

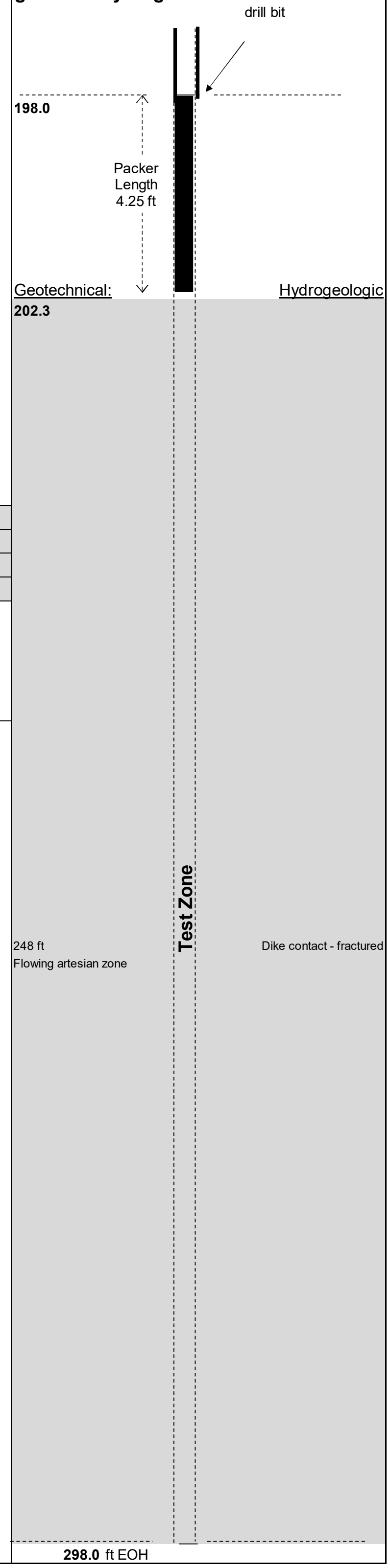
K calculated for P step m/second

PSI	34.5	83.9	132.8
High est of K	1.4.E-07	1.1.E-07	1.1.E-07
Average K	7.6.E-08	8.4.E-08	9.5.E-08
Low est of K	4.8.E-08	6.5.E-08	8.6.E-08

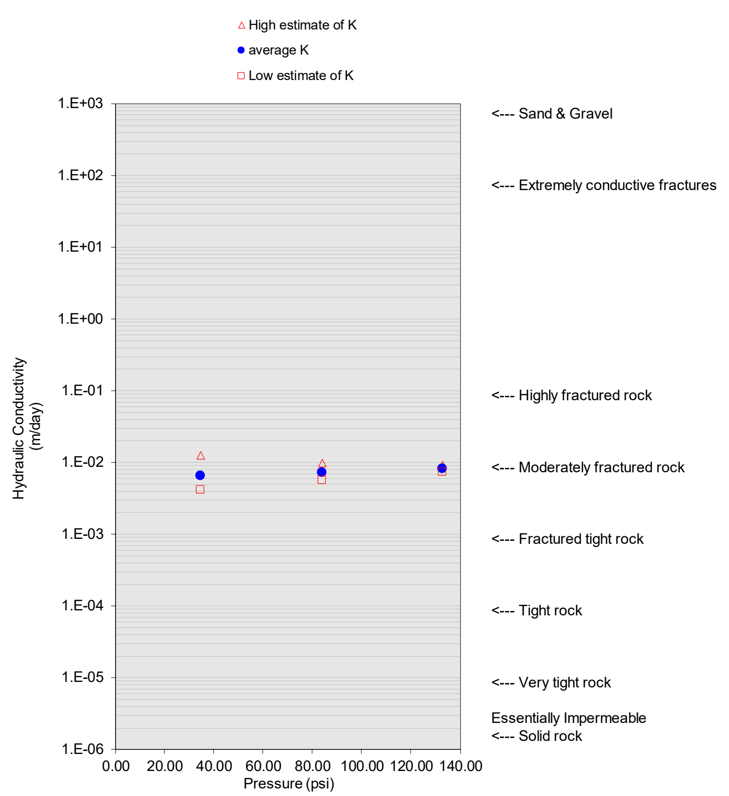
K all P steps

	m/day	Ft/Day
MAX	1.25E-02	4.11E-02
Geomean	7.32E-03	2.40E-02
MIN	4.16E-03	1.36E-02

Drawing of zone tested, including geotech / hydrogeo. conditions:



Graph of estimated hydraulic conductivity and error bounds.



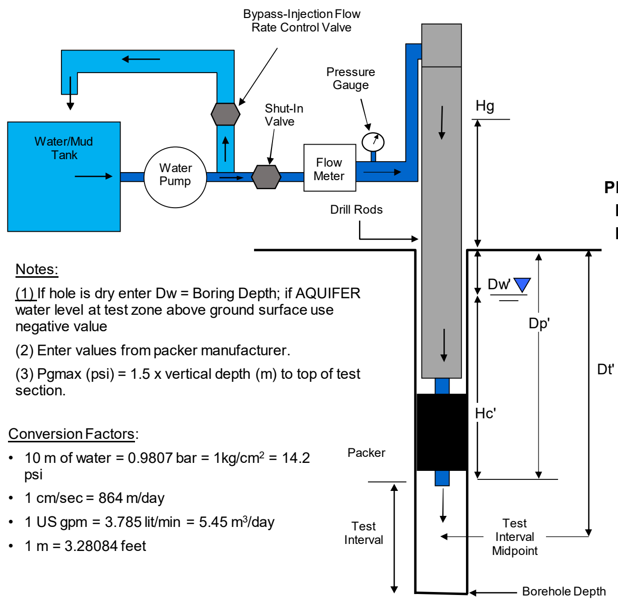
STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

APPLIED HYDROLOGIC

Project:	Graphite Creek	Test Interval (ft):	302.25	To:	383.00	Test Nº	4
Drillhole Nº:	22GC075	Start Date:	4-Aug-22	Time:	10:00	Drill Bit Depth (ft)	298
		End Date:	4-Aug-22	Time:	13:45	DH Depth (ft)	383
		Supervisor:	G. Baldwin	Rig:	T&J		

Max Injection P (psi)

110



Notes:

(1) If hole is dry enter Dw = Boring Depth; if AQUIFER water level at test zone above ground surface use negative value

(2) Enter values from packer manufacturer.

(3) Pgmax (psi) = 1.5 x vertical depth (m) to top of test section.

Conversion Factors:

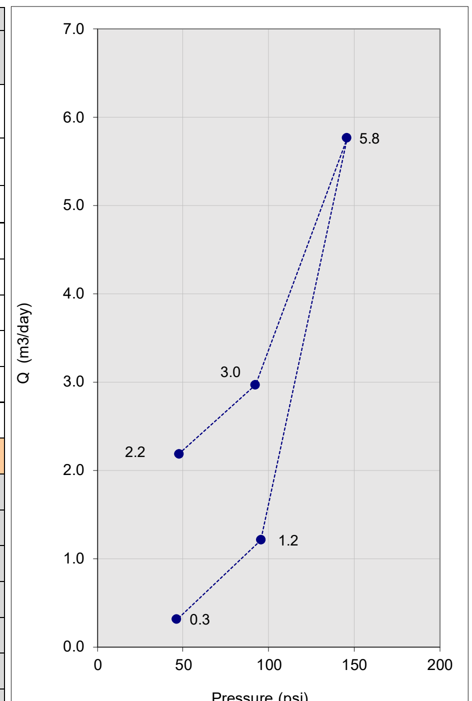
- 10 m of water = 0.9807 bar = 1kg/cm² = 14.2 psi
- 1 cm/sec = 864 m/day
- 1 US gpm = 3.785 lit/min = 5.45 m³/day
- 1 m = 3.28084 feet

Dw	Measured depth of static water level (1)	-18.1	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**92.1**	m
Dt	Measured depth to midpoint of test	**104.4**	m
ß	Inclination from horizontal (degrees)	52.0	°
Dw'	Vertical depth to static water level	**0.0**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**72.6**	m
Dt'	Vertical depth to midpoint of test	**82.3**	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	**103**	psi
Pshear	Estimated differential shear pressure required	**526**	psi
Pgmax	Maximum injection gauge pressure (3)	**123**	psi
Hg	Gauge height	-1.2	m
Lp	Length of discharge pipe	7.62	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0127	m
R	Radius of influence (10 m is standard value)	10	m
rb	Borehole radius (HQ=0.048m, NQ=0.038m)	0.048	m
L	Length of test section	**24.61**	m
Hf	Friction Loss		
Htot	Induced head recorded by transducer		
K	Hydraulic conductivity		

Equations:

- $H_f = 8.65 \times 10^{-15} (Q^2 * Lp/rp^5)$
- $K = (Q * Ln(R/r_b)) / (2 * \pi * H_{tot} * L)$

Measurement (last 3 to 5 stable readings)	Q (Liters / 30sec)				
	P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Induced Pressure at TDX	**47.72**	**92.38**	**145.73**	**95.63**	**46.41**
Induced Pressure at Surface Gage	**50**	**100**	**150**	**100**	**50**
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**0.94**	**1.58**	**2.91**	**1.07**	**0.25**
2	**0.94**	**1.52**	**3.01**	**1.24**	**0.20**
3	**0.88**	**1.68**	**2.76**	**1.06**	**0.26**
4	**0.84**	**1.79**	**2.83**	**1.12**	**0.27**
5	**0.93**	**1.71**	**2.80**	**1.09**	**0.24**
Stable Q (L/30sec)	**0.91**	**1.70**	**2.80**	**1.09**	**0.26**
Leak Q (L/30sec)	**0.152**	**0.670**	**0.800**	**0.670**	**0.152**
Q (m³/day)	2.2	3.0	5.8	1.2	0.3
Hf (m)	0.00	0.00	0.01	0.00	0.00
Htot (m)	33.6	65.1	102.6	67.3	32.7
K (m/day)	2.2E-03	1.6E-03	1.9E-03	6.2E-04	3.3E-04
K (m/s)	**2.6E-08**	**1.8E-08**	**2.2E-08**	**7.2E-09**	**3.8E-09**
+/- (m/s)	3.2E-08	1.2E-08	1.7E-09	2.3E-08	5.5E-08
+/- order of mag.	0.35	0.22	0.03	0.63	1.19

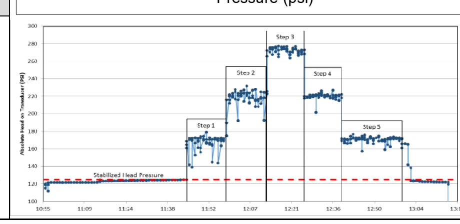


Geology:

RQ-JC-Structures: Low flow artesian. Large dike in interval. Multiple open joints at lower edge of dike (~381 - 382 ft).

Flow Monitoring-System-Test Comments: Injected clean water with no polymer. Flushed until clean return. Shut-in pressure recovered slowly and wasn't stabilized before initiating test. Distinct upward pressure gradient. Bean pump surging severely.

Shut in interval after test (13:00 Hrs) as effective water table had been artificially elevated from injecting water, as evidenced by generally decreasing permeability with time and pressure. The slightly elevated permeability of Step 3 could be the result of minor hydrojacking but is more likely the result of leakage or a larger radius of influence. Injection steps 1, 2, and 3 are most representative of in situ conditions.



APPLIED HYDROLOGIC	STEPPED PRESSURE INJECTION TEST (page 2)	Drillhole Nº: 22GC075 Test Nº: 4

Pressure oscillation during test

Pressure step	P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Min P during step	21.7	57.2	139.4	83.7	35.1
Max P during step	73.7	127.6	152.0	107.5	57.7
average pressure +/- psi	**26.01**	**35.169**	**6.291**	**11.881**	**11.275**

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	**0.0181**	**0.0338**	**0.0559**	**0.0219**	**0.0048**

High estimate of K

Q_{avg} (m^3/day)	2.24	3.06	5.92	1.27	0.33
Hf (m)	0.00	0.00	0.01	0.00	0.00
Htot (m)	15.3	40.3	98.2	59.0	24.7
K (m/sec)	5.8E-08	3.0E-08	2.4E-08	8.6E-09	5.3E-09

Low estimate of K

Q_{avg} (m^3/day)	2.13	2.87	5.60	1.15	0.30
Hf (m)	0.00	0.00	0.01	0.00	0.00
Htot (m)	51.9	89.8	107.1	75.7	40.6
K (m/sec)	1.6E-08	1.3E-08	2.1E-08	6.1E-09	2.9E-09

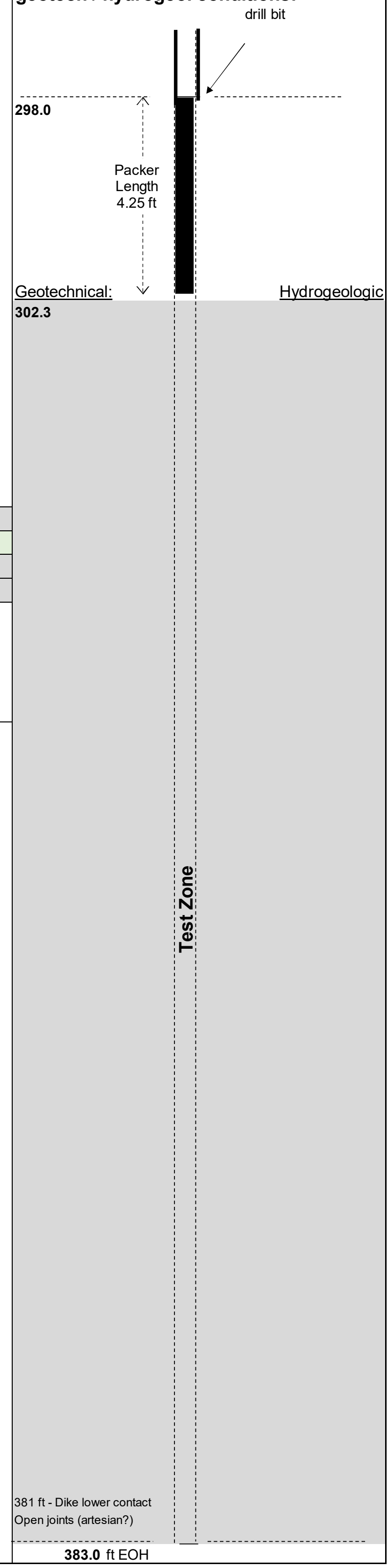
K calculated for P step m/second

PSI	47.1	94.0	145.7
High est of K	5.8.E-08	3.0.E-08	2.4.E-08
Average K	1.5.E-08	1.3.E-08	2.2.E-08
Low est of K	2.9.E-09	6.1.E-09	2.1.E-08

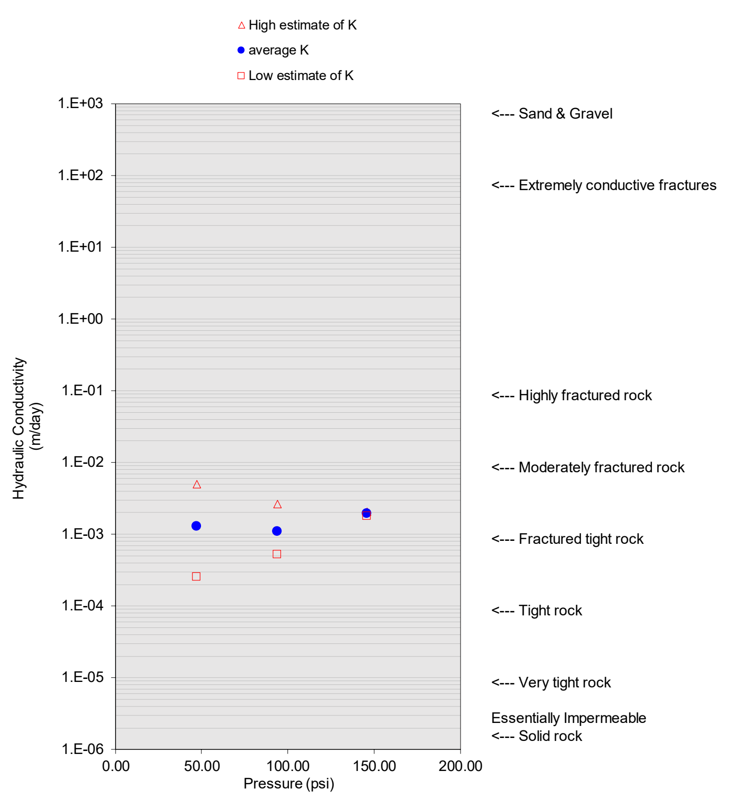
K all P steps

	m/day	Ft/Day
MAX	5.05E-03	1.66E-02
Geomean	1.40E-03	4.59E-03
MIN	2.53E-04	8.31E-04

Drawing of zone tested, including geotech / hydrogeo. conditions:



Graph of estimated hydraulic conductivity and error bounds.



Drill Hole ID:	22GC075	CONSTANT HEAD INJECTION TEST
Test Number:	5	*Packer Isolated:* 442.25 - 488 feet
Project:	Graphite Creek	

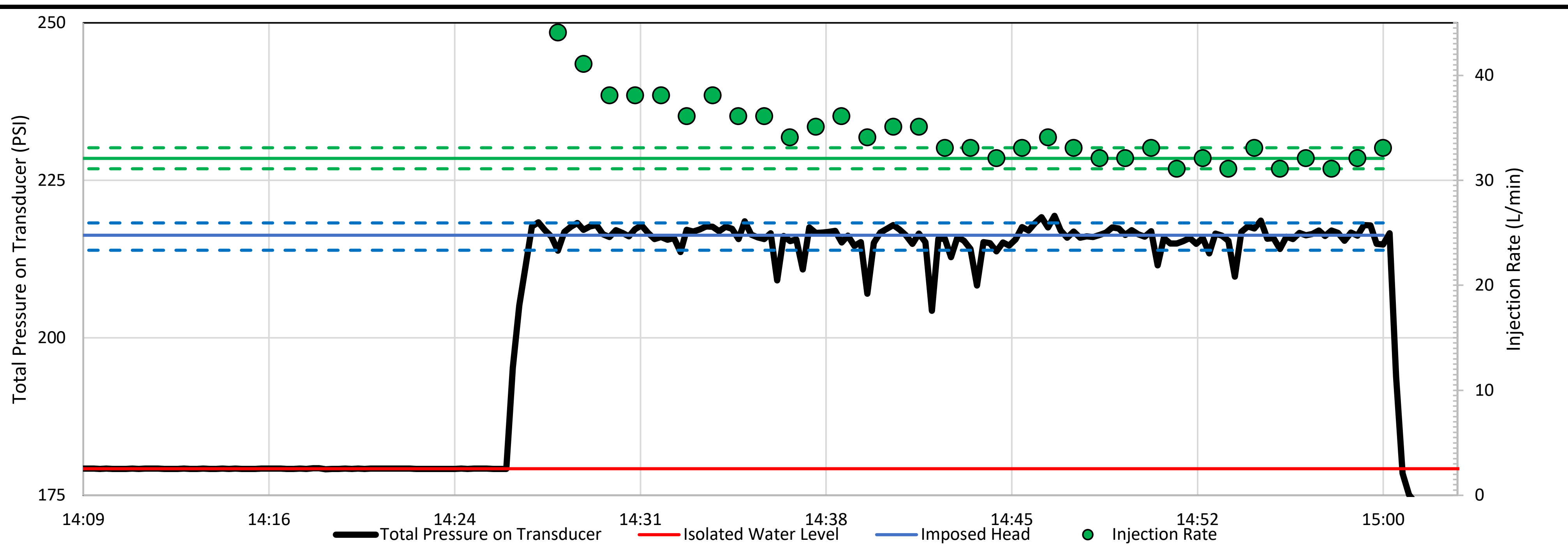
Location Description			Test Interval			General	
Current Depth:	488		Bit Position:	438	(ft-ah)	Test Start Date/Time:	8/5/2022 10:15
Hole Size[A]:	HQ3		Top of Test Interval:	442.25	(ft-ah)	Test End Date/Time:	8/5/2022 15:45
Inclination:	52.4		Stable Water Level[B]:	179.22	(PSI)	Supervisor:	G. Baldwin
Azimuth:	154.6		*Stable Water Level[C]:*	*-75.54*	*(ft-bgs)*	Drill Contractor:	T&J
Elevation:	-	(ft-amsl)	*Transducer Position[D]:*	*446.25*	(ft-ah)	Rig No. & Type:	

Test Notes

Start Flush:	10:23		Test Fluid (water/poly):	Fresh Water	Shear Pin Break Time:	10:13
End Flush:	11:01		Seal Quality:	Fair	Injection End Time:	15:00
Flushed Volume[E]:	1140	(gal)	Start Inflate Time:	11:45	Deflation Method:	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection after a shut-in test.
Drilling Comments:	Good rock quality.
Geology, Hydrogeology, & Rock Mass:	Artesian zone(s) 422.4 - 488 ft.
Test Quality and Assesment:	Clean water. Bean pump severely surging. Bad rod leakage. After shearing pin, can only build 80 PSI pressure all out, so shut-in. Shut-in PSI decline from 13 to 11. Then injection test.



	Estimate	Low End	High End	
Imposed Head (H):	85.5	80	90	(ft-H_2O)
Injection Rate (Q):	1632	1582	1683	(ft^3/day)
Hydraulic Conductivity:	**3.54E-01**	3.26E-01	3.91E-01	(ft/day)
Transmissivity:	**16.217**	14.93	17.877	(ft^2/day)

Test Parameters

Radius of Influence[F]:	(R)	32.8	(ft)
Radius of the Well:	(r_w)	0.158	(ft)
Test Interval Length:	(b)	45.75	(ft)
System Leak Rate:		46	(ft^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	22GC075
Test Number:	5
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
12:04	58.23	-	50
12:05	59.46	1.23	50
12:06	60.63	1.17	50
12:07	61.77	1.14	50
12:08	62.8	1.03	50
12:09	63.78	0.98	50
12:10	64.71	0.93	50
12:11	65.59	0.88	50
12:12	66.49	0.90	50

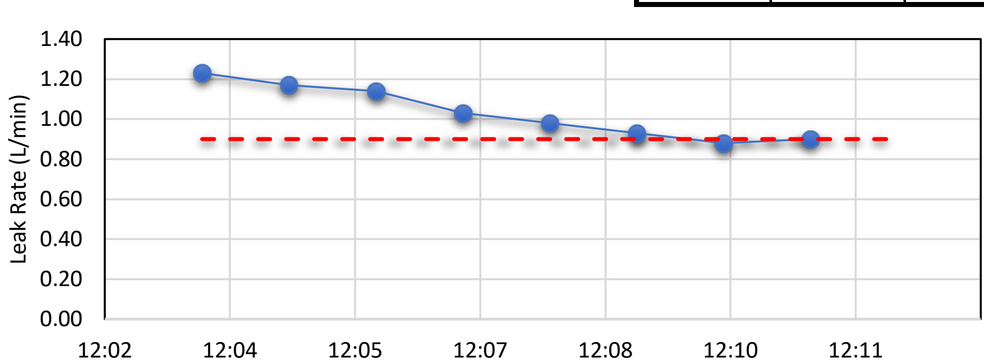
Leak Rate	0.9 L/min
Injection Rate	32.09 L/min
Min Injection Rate	31.1 L/min
Max Injection Rate	33.1 L/min

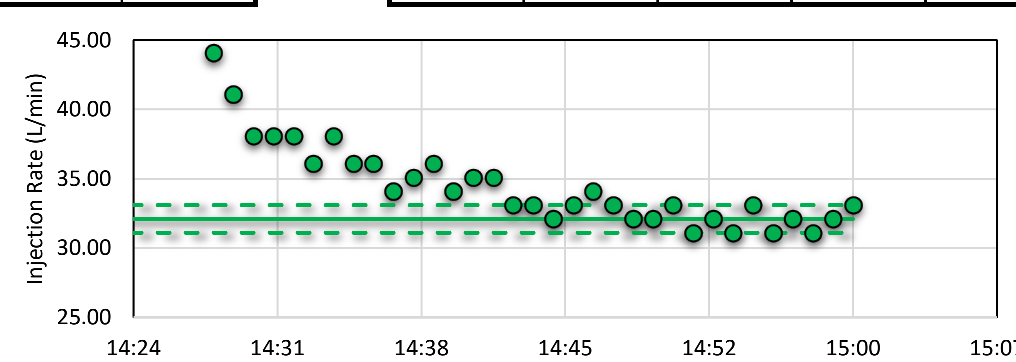
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
14:26		-	-	50
14:27	417	-	-	50
14:28	462	45.00	44.10	50
14:29	504	42.00	41.10	50
14:30	543	39.00	38.10	50
14:31	582	39.00	38.10	50
14:32	621	39.00	38.10	50
14:33	658	37.00	36.10	50
14:34	697	39.00	38.10	50
14:35	734	37.00	36.10	50
14:36	771	37.00	36.10	50
14:37	806	35.00	34.10	50
14:38	842	36.00	35.10	50
14:39	879	37.00	36.10	50
14:40	914	35.00	34.10	50
14:41	950	36.00	35.10	50
14:42	986	36.00	35.10	50
14:43	1020	34.00	33.10	50
14:44	1054	34.00	33.10	50
14:45	1087	33.00	32.10	50
14:46	1121	34.00	33.10	50
14:47	1156	35.00	34.10	50
14:48	1190	34.00	33.10	50
14:49	1223	33.00	32.10	50
14:50	1256	33.00	32.10	50
14:51	1290	34.00	33.10	50
14:52	1322	32.00	31.10	50
14:53	1355	33.00	32.10	50
14:54	1387	32.00	31.10	50

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
14:55	1421	34.00	33.10	50
14:56	1453	32.00	31.10	50
14:57	1486	33.00	32.10	50
14:58	1518	32.00	31.10	50
14:59	1551	33.00	32.10	50
15:00	1585	34.00	33.10	50

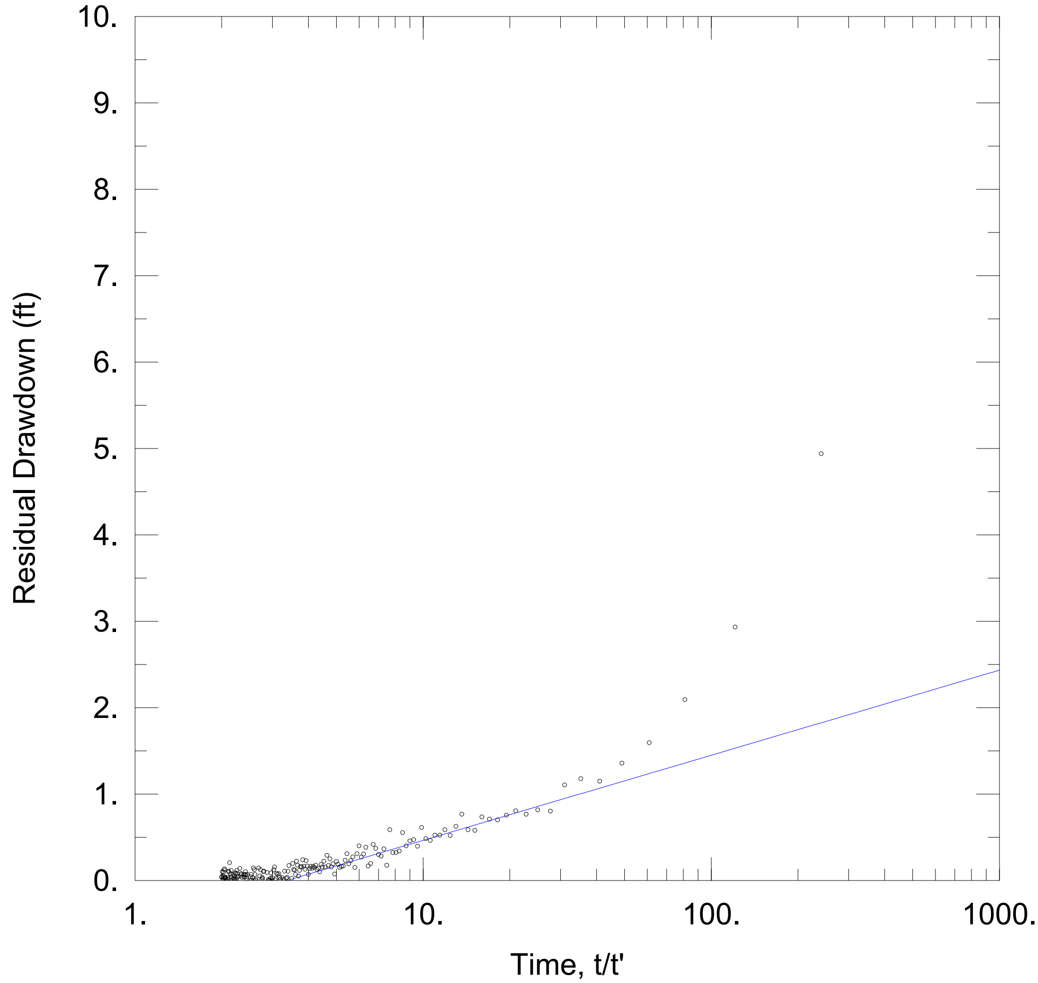




Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (inch):	2.984	2.984	2.984	3.781	3.781	4.828	4.828

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.



TEST 5 SHUT-IN

Data Set: C:\...\22GC075_Test5_ShutIn_TheisRDD.aqt
Date: 11/23/24 Time: 15:03:42

PROJECT INFORMATION

Company: Tundra
Location: Graphite Creek
Test Well: 22GC075
Test Date: 8/5/22

AQUIFER DATA

Saturated Thickness: 45.75 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
22GC075	0	0

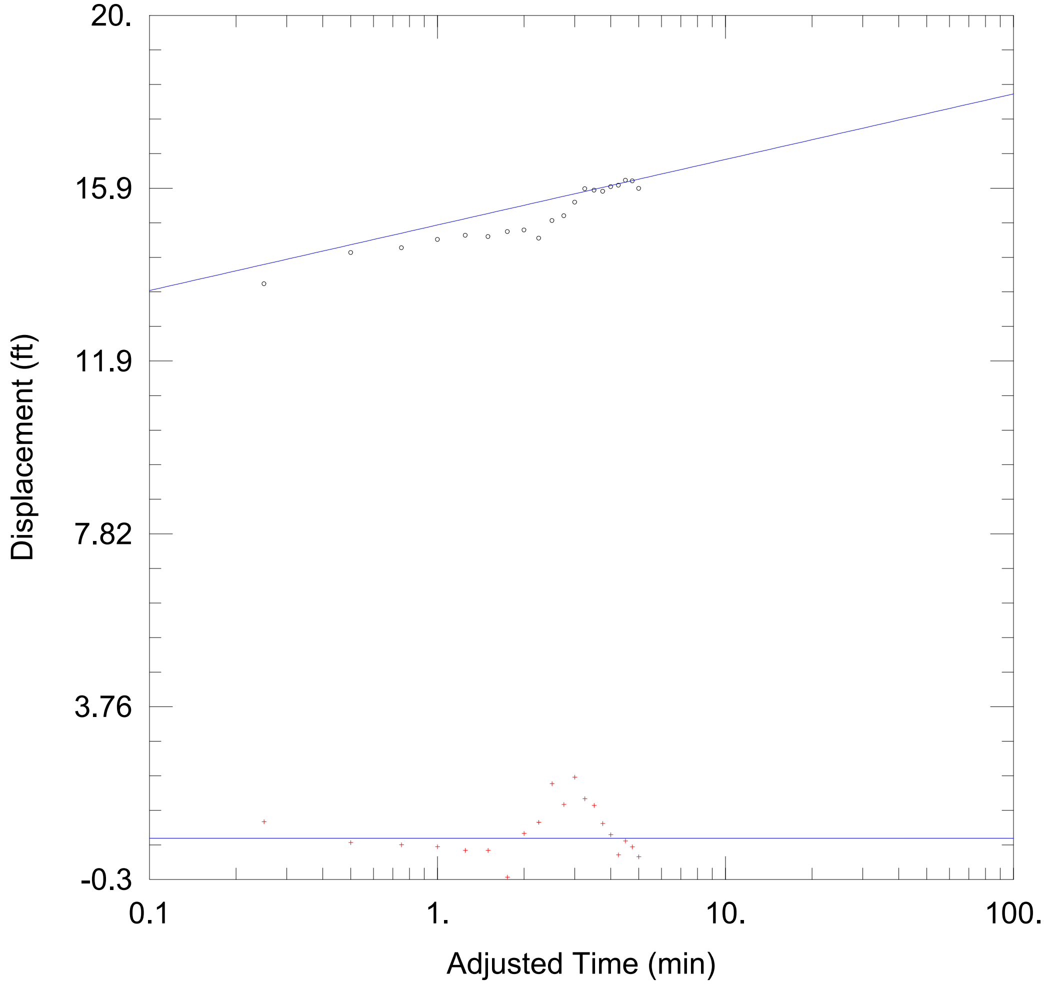
Observation Wells

Well Name	X (ft)	Y (ft)
◦ 22GC075	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 100.8 ft^2/day S/S' = 3.376



TEST 5 SHUT-IN

Data Set: C:\...\22GC075_Test5A_ShutIn_CooperJacob.aqt
Date: 11/23/24 Time: 15:05:32

PROJECT INFORMATION

Company: Tundra
Location: Graphite Creek
Test Well: 22GC075
Test Date: 8/5/22

AQUIFER DATA

Saturated Thickness: 45.75 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
22GC075	0	0

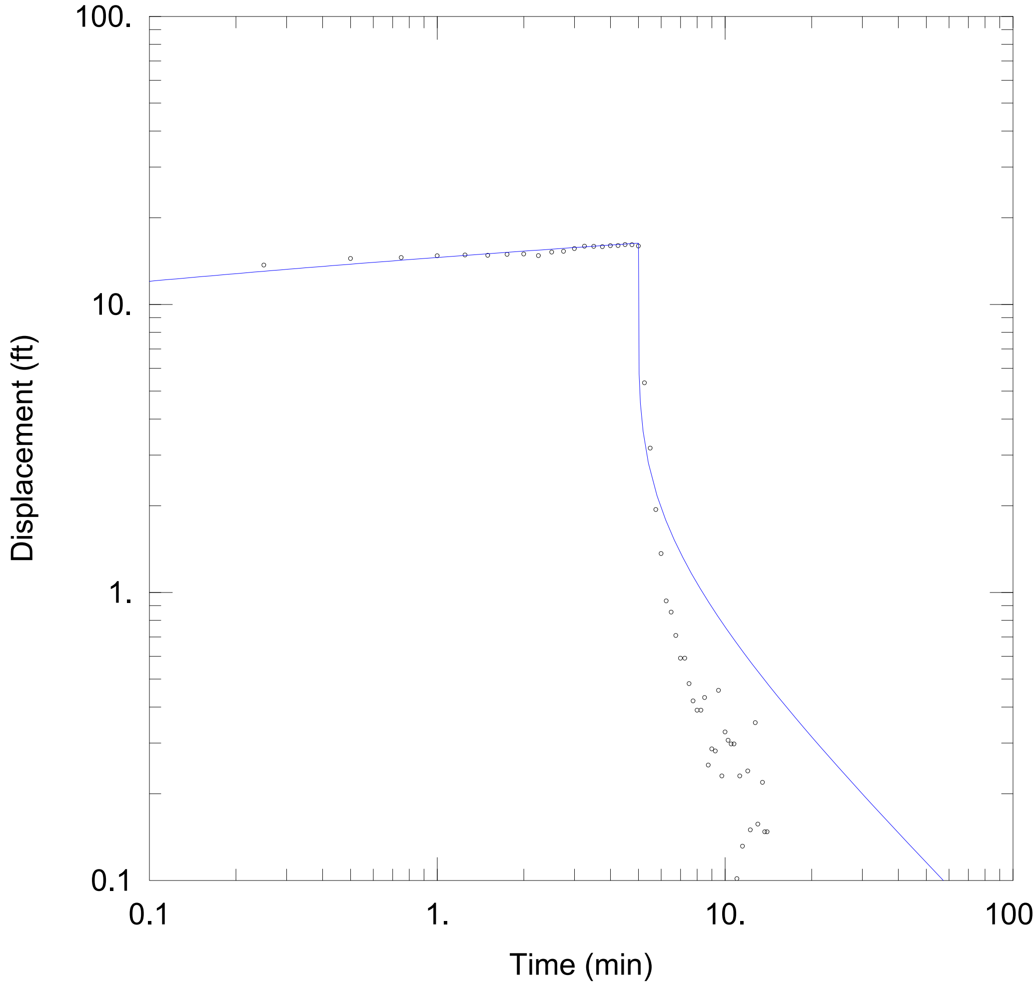
Observation Wells

Well Name	X (ft)	Y (ft)
◦ 22GC075	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 64.21 ft^2/day S = 6.502E-10



TEST 5 SHUT-IN

Data Set: C:\...\22GC075_Test5A_ShutIn_TheisHantush.aqt
Date: 11/23/24 Time: 15:06:02

PROJECT INFORMATION

Company: Tundra
Location: Graphite Creek
Test Well: 22GC075
Test Date: 8/5/22

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
22GC075	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
◦ 22GC075	0	0

SOLUTION

Aquifer Model: Confined

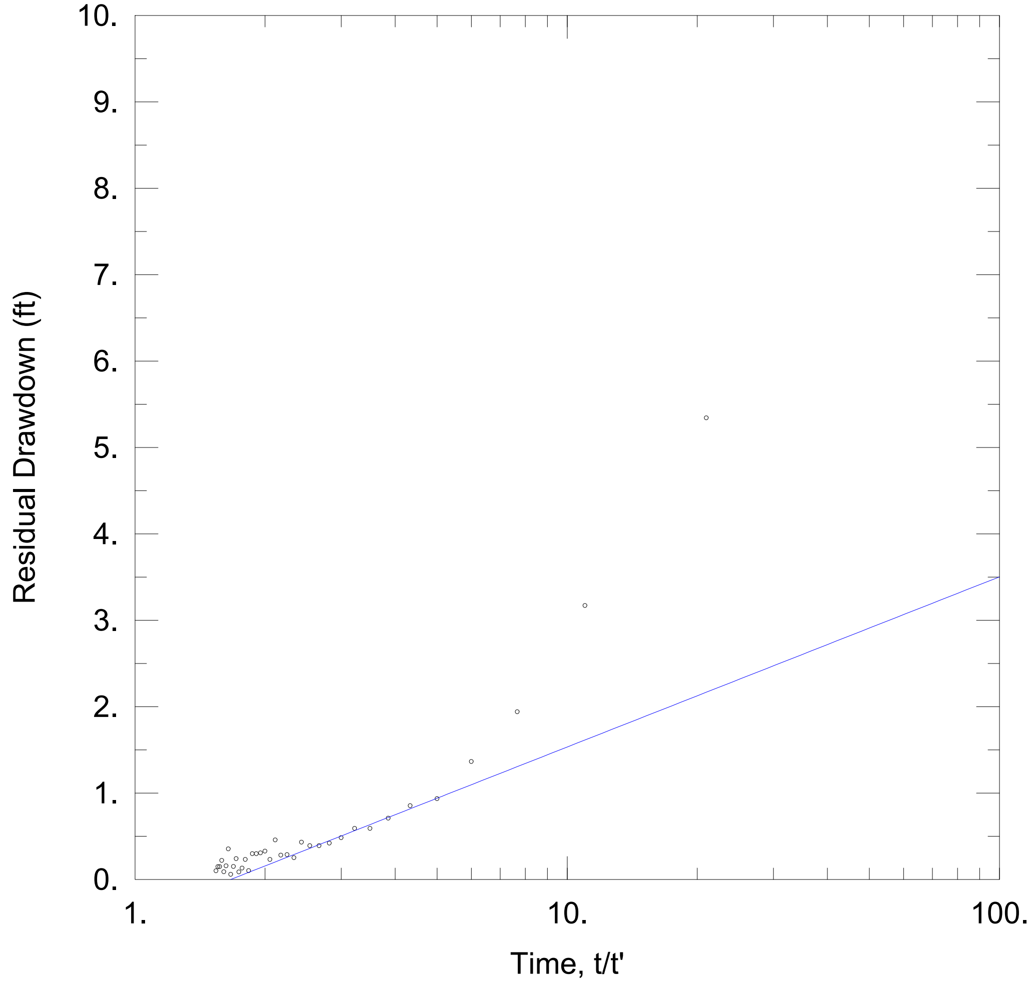
Solution Method: Theis

T = 39.19 ft^2/day

S = 4.192E-6

Kz/Kr = 1.

b = 45.75 ft



TEST 5 SHUT-IN

Data Set: C:\...\22GC075_Test5A_ShutIn_TheisRDD.aqt
Date: 11/23/24 Time: 15:05:02

PROJECT INFORMATION

Company: Tundra
Location: Graphite Creek
Test Well: 22GC075
Test Date: 8/5/22

AQUIFER DATA

Saturated Thickness: 45.75 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
22GC075	0	0

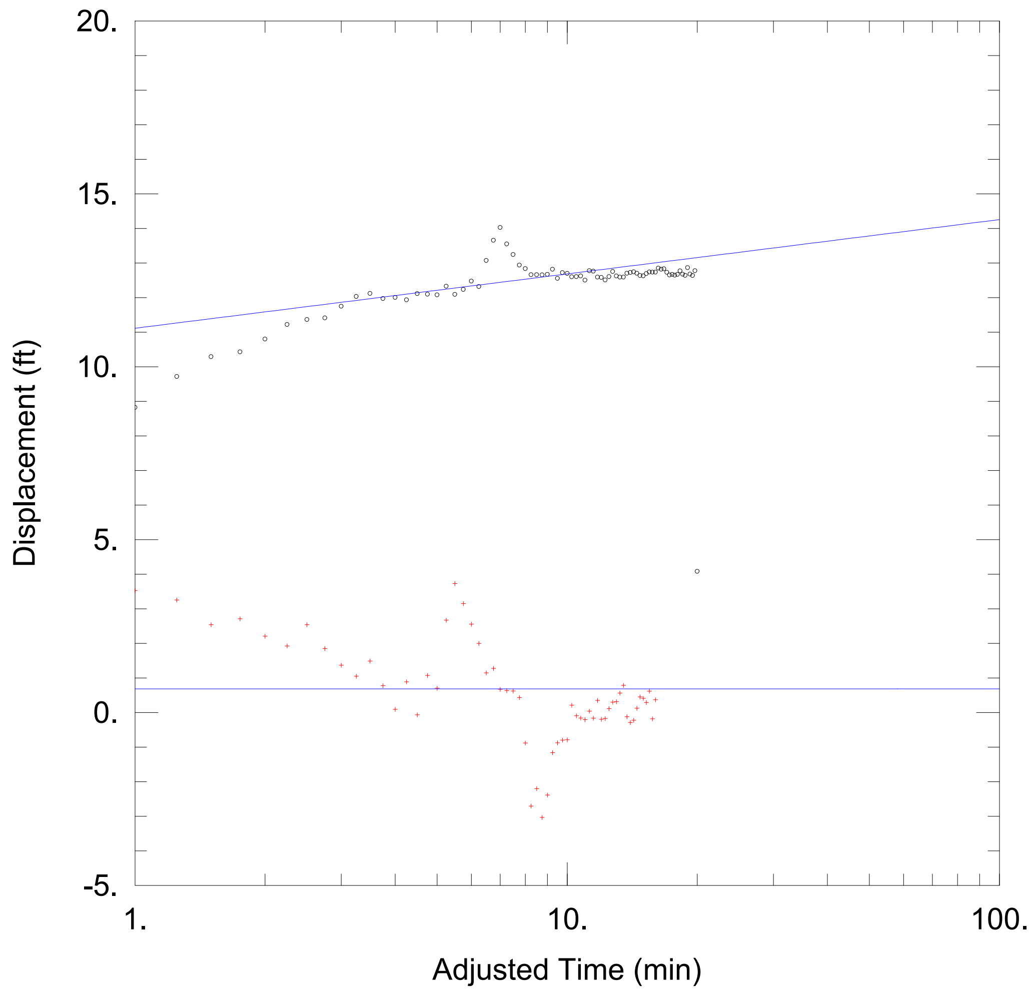
Observation Wells

Well Name	X (ft)	Y (ft)
◦ 22GC075	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 50.22 ft^2/day S/S' = 1.666



TEST 6 SHUT-IN

Data Set: C:\...\22GC075_Test6_CooperJacob.aqt
Date: 11/23/24 Time: 15:07:19

PROJECT INFORMATION

Company: Tundra
Location: Graphite Creek
Test Well: 22GC075
Test Date: 8/5/22

AQUIFER DATA

Saturated Thickness: 95.75 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
22GC075	0	0

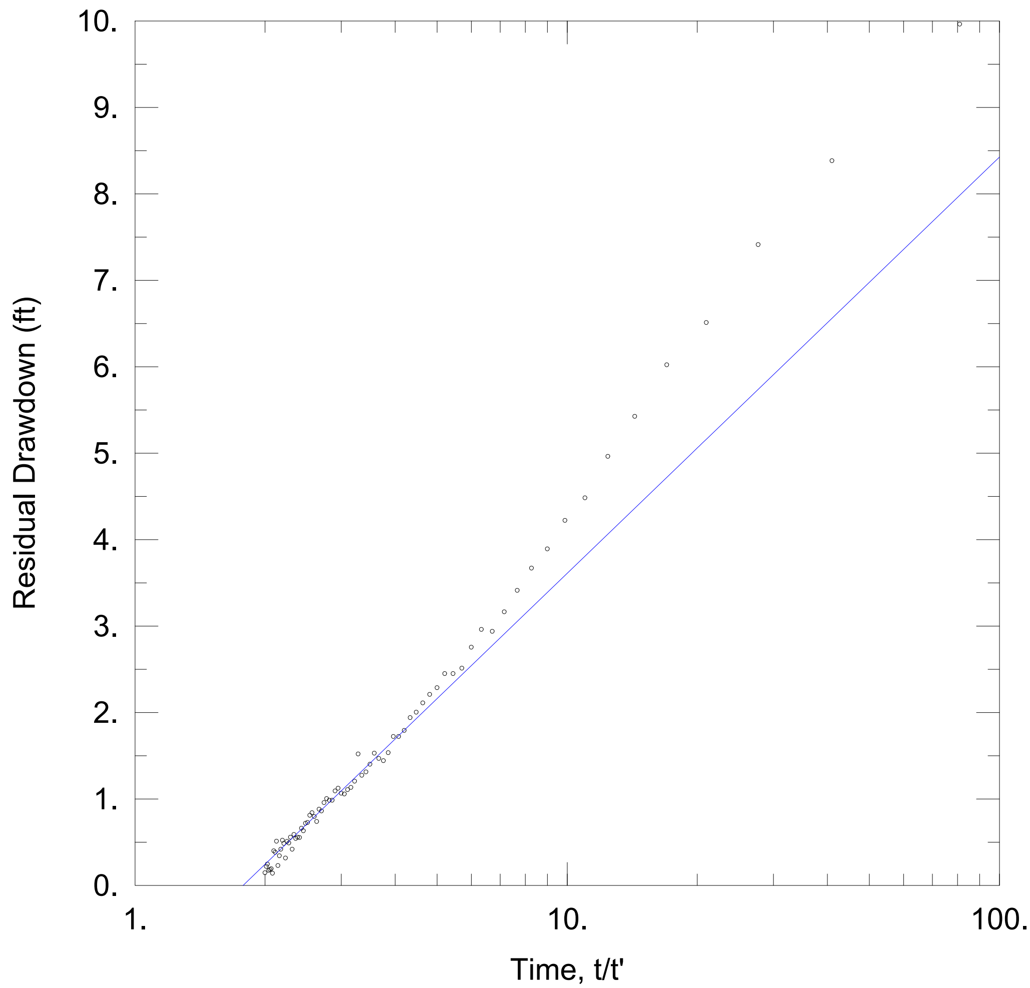
Observation Wells

Well Name	X (ft)	Y (ft)
◦ 22GC075	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 126.6 ft^2/day S = 6.727E-7



TEST 6 SHUT-IN

Data Set: C:\...\22GC075_Test6_TheisRDD.aqt
Date: 11/23/24 Time: 15:07:01

PROJECT INFORMATION

Company: Tundra
Location: Graphite Creek
Test Well: 22GC075
Test Date: 8/5/22

AQUIFER DATA

Saturated Thickness: 95.75 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
22GC075	0	0

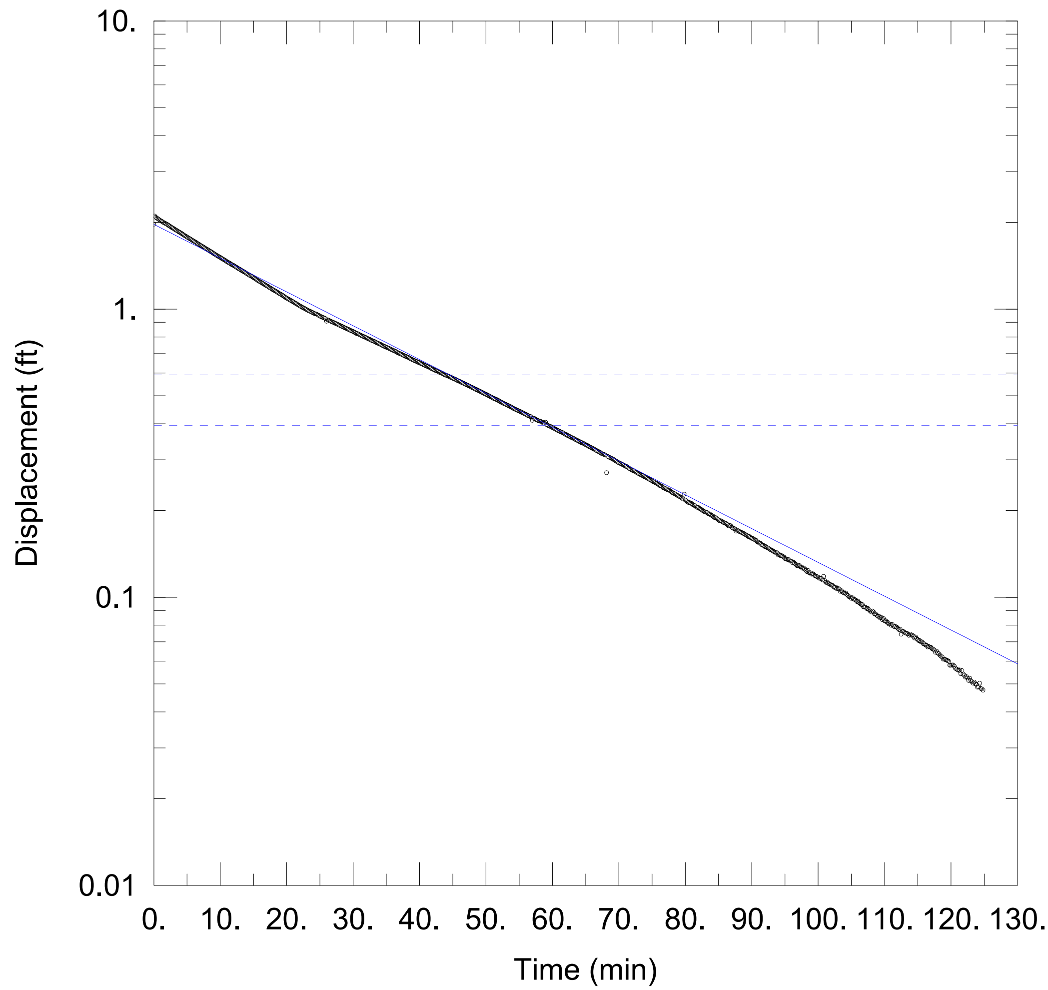
Observation Wells

Well Name	X (ft)	Y (ft)
◦ 22GC075	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 41.32 ft^2/day S/S' = 1.78



FALLING HEAD TEST - LARGE MECHANICAL SLUG

Data Set: C:\...\22GT008D_Large_FHT_Conf_BR.aqt
Date: 11/23/24 Time: 15:08:43

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008D
Test Date: 7/30/22

AQUIFER DATA

Saturated Thickness: 38.5 ft Anisotropy Ratio (Kz/Kr): 1.

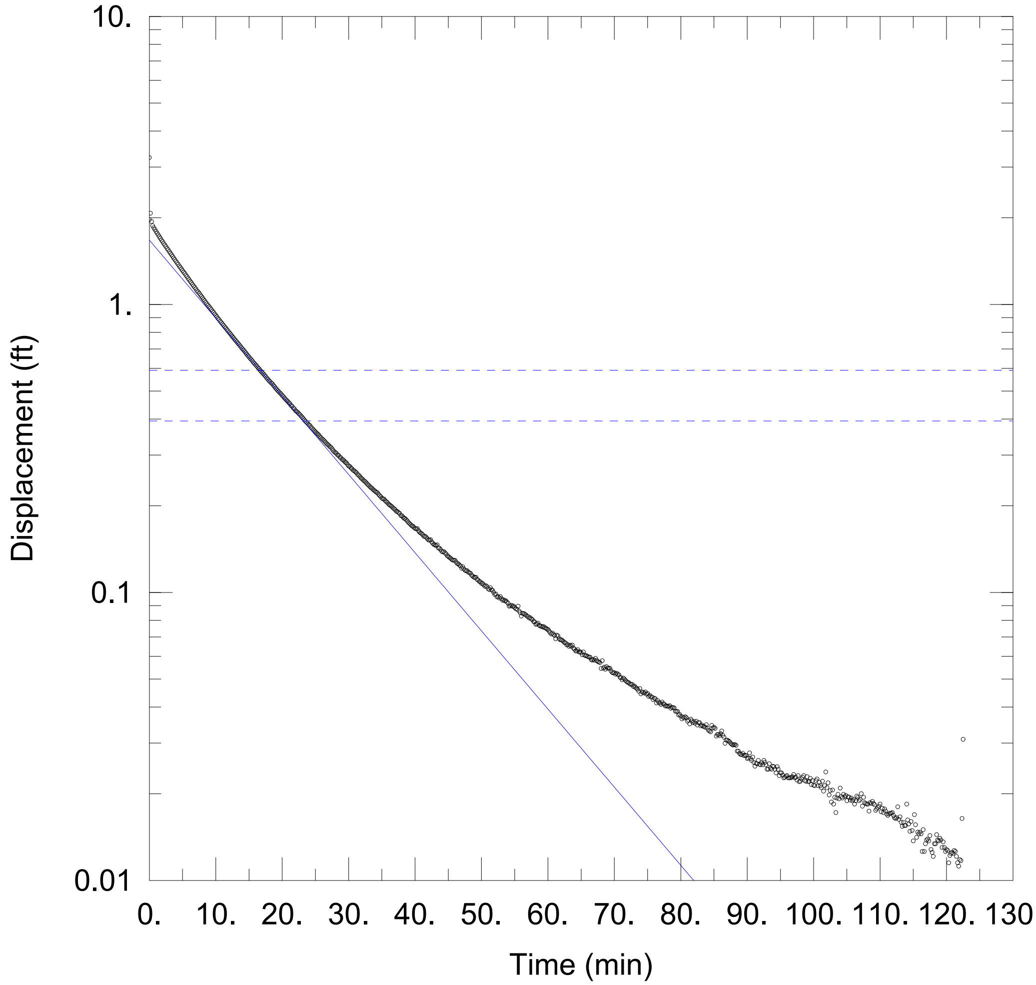
WELL DATA (22GT008-D)

Initial Displacement: 1.969 ft
Total Well Penetration Depth: 38.5 ft
Casing Radius: 0.07971 ft
Static Water Column Height: 38.5 ft
Screen Length: 30. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.01587 ft/day y0 = 1.968 ft



RISING HEAD TEST - LARGE MECHANICAL SLUG

Data Set: C:\...\22GT008D_Large_RHT_Conf_BR.aqt
Date: 11/23/24   Time: 15:08:29

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008D
Test Date: 7/30/22

AQUIFER DATA

Saturated Thickness: 38.5 ft   Anisotropy Ratio (Kz/Kr): 1.

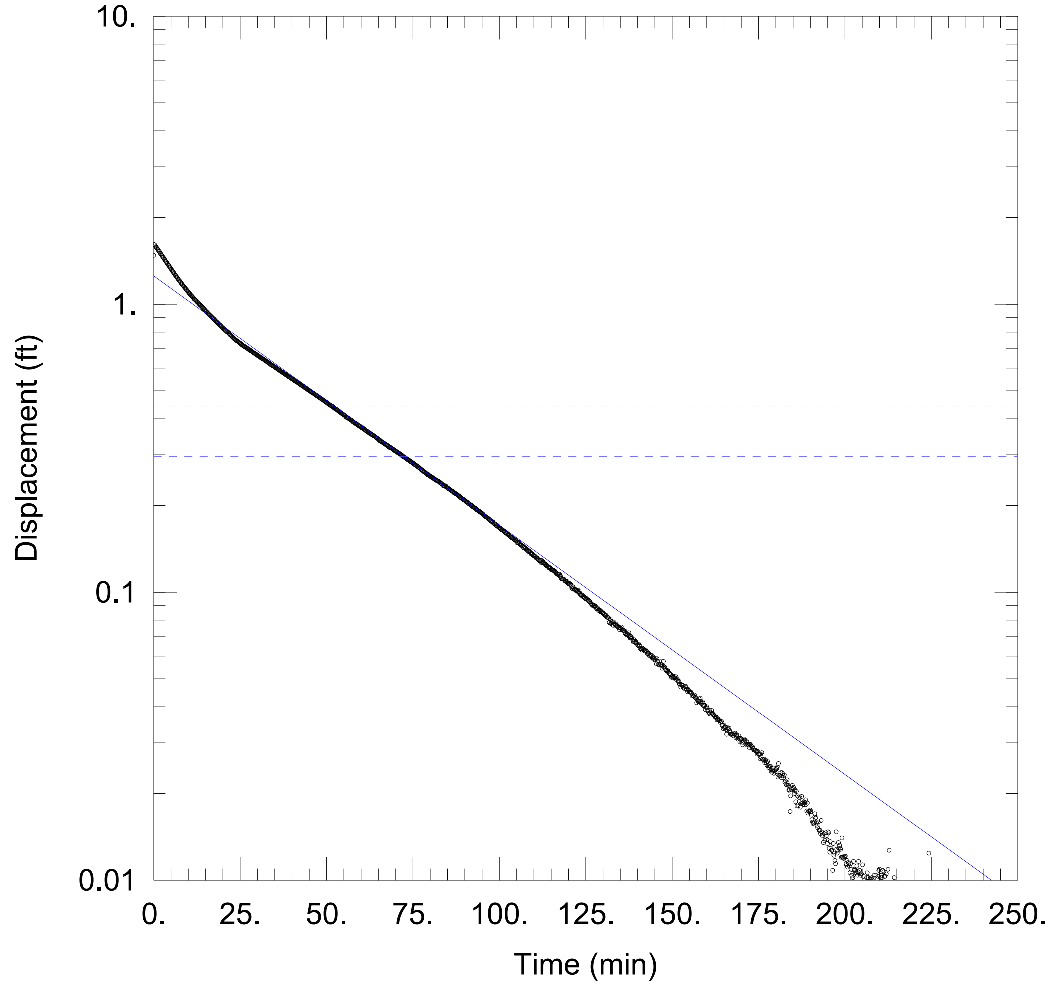
WELL DATA (22GT008-D)

Initial Displacement: 1.969 ft   Static Water Column Height: 38.5 ft
Total Well Penetration Depth: 38.5 ft   Screen Length: 30. ft
Casing Radius: 0.07971 ft   Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined   Solution Method: Bouwer-Rice

K = 0.0367 ft/day   y0 = 1.671 ft



FALLING HEAD TEST - MEDIUM MECHANICAL SLUG

Data Set: C:\...\22GT008D_Medium_FHT_Conf_BR.aqt
Date: 11/23/24 Time: 15:09:35

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008D
Test Date: 8/1/22

AQUIFER DATA

Saturated Thickness: 38.5 ft Anisotropy Ratio (Kz/Kr): 1.

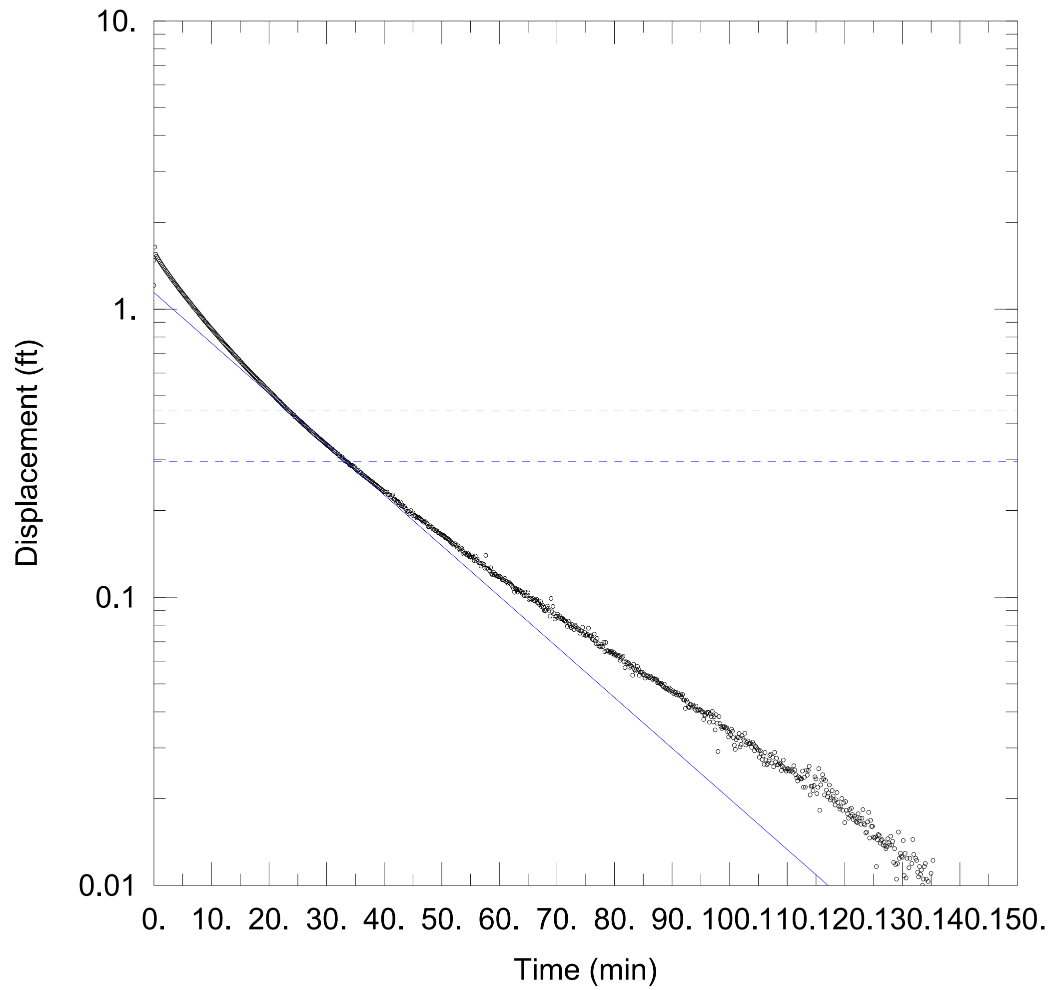
WELL DATA (22GT008-D)

Initial Displacement: 1.476 ft Static Water Column Height: 38.31 ft
Total Well Penetration Depth: 38.5 ft Screen Length: 30. ft
Casing Radius: 0.07971 ft Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.01171 ft/day y0 = 1.253 ft



RISING HEAD TEST - MEDIUM MECHANICAL SLUG

Data Set: C:\...\22GT008D_Medium_RHT_Conf_BR.aqt
Date: 11/23/24 Time: 15:09:20

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008D
Test Date: 8/1/22

AQUIFER DATA

Saturated Thickness: 38.5 ft Anisotropy Ratio (Kz/Kr): 1.

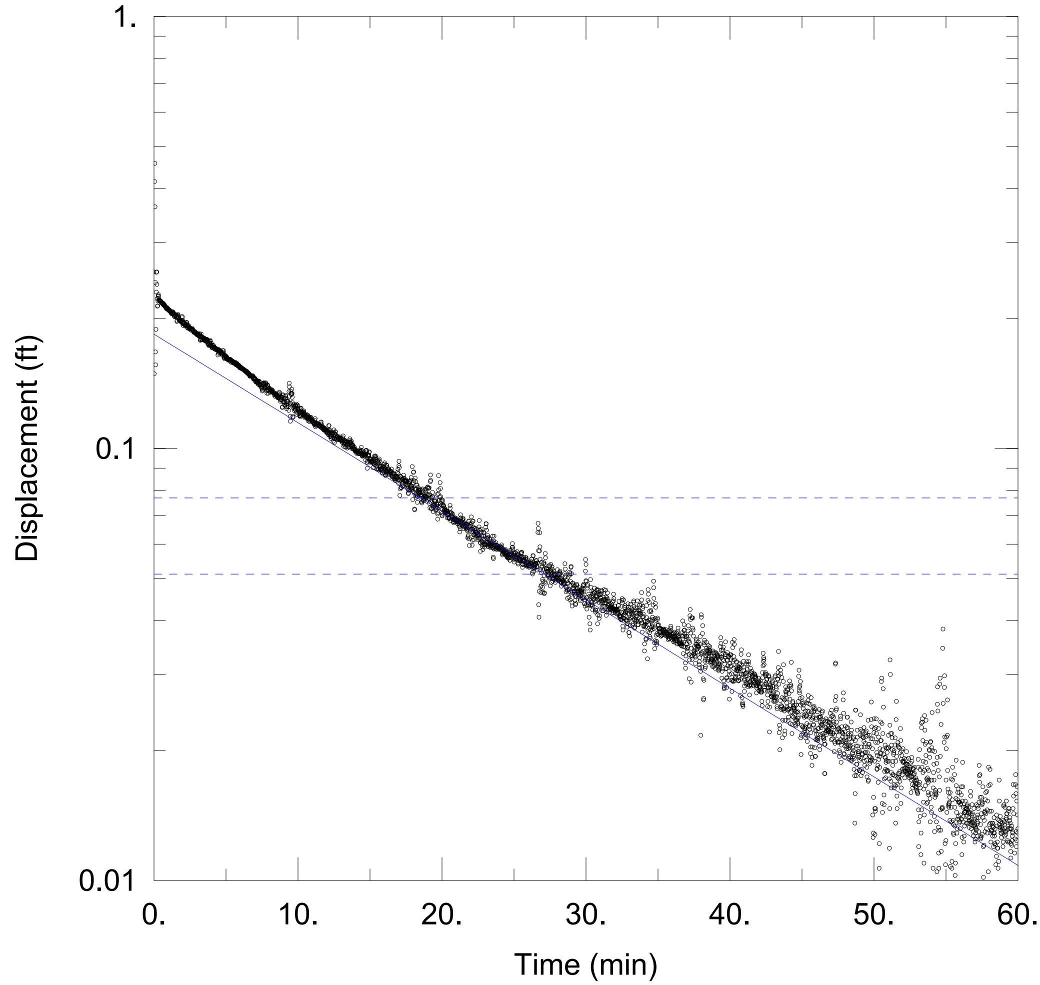
WELL DATA (22GT008-D)

Initial Displacement: 1.476 ft Static Water Column Height: 38.31 ft
Total Well Penetration Depth: 38.5 ft Screen Length: 30. ft
Casing Radius: 0.07971 ft Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.02378 ft/day y0 = 1.142 ft



RISING HEAD TEST - PNEUMATIC SLUG

Data Set: C:\...\22GT008D_Pneumatic_RHT_Conf_BR.aqt
Date: 11/23/24 Time: 15:10:02

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008D
Test Date: 7/29/22

AQUIFER DATA

Saturated Thickness: 38.5 ft Anisotropy Ratio (Kz/Kr): 1.

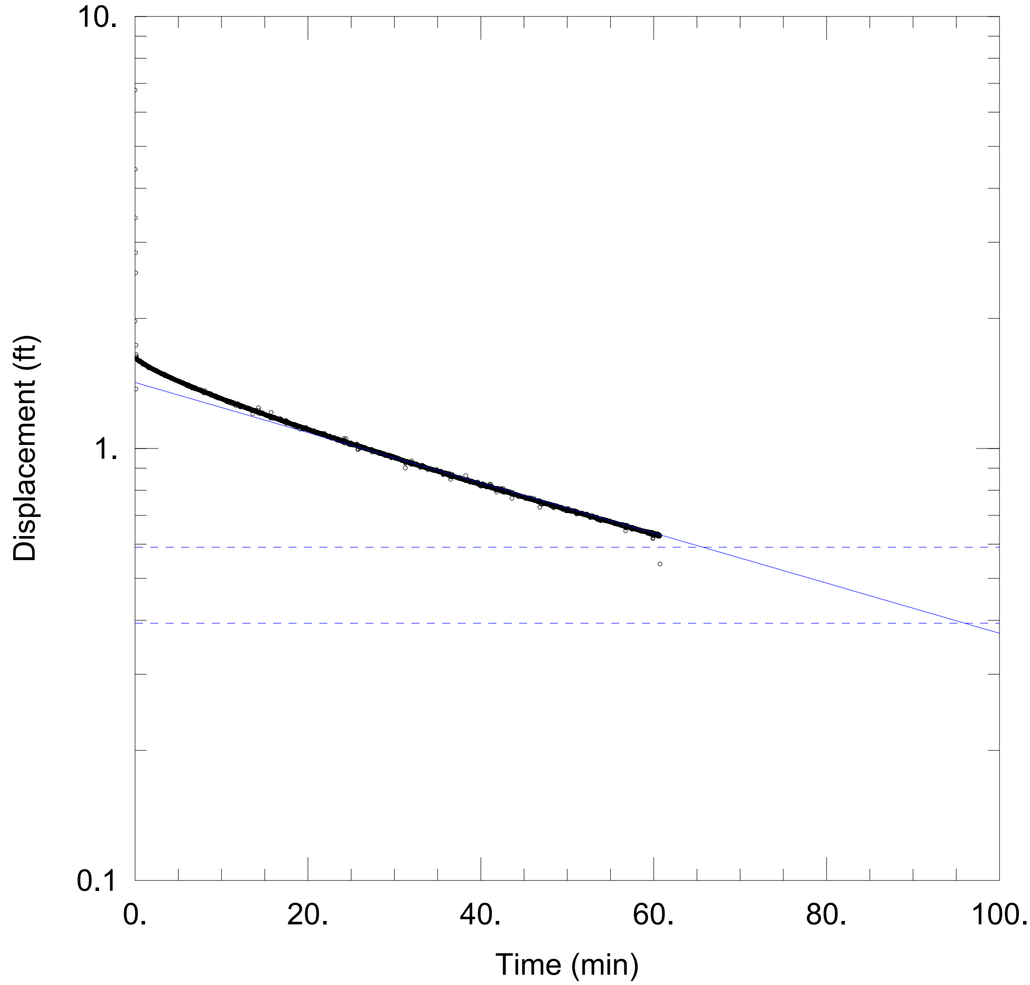
WELL DATA (22GT008-D)

Initial Displacement: 0.256 ft Static Water Column Height: 38.31 ft
Total Well Penetration Depth: 38.5 ft Screen Length: 30. ft
Casing Radius: 0.07971 ft Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.02773 ft/day y0 = 0.1838 ft



LARGE MECHANICAL SLUG_FALLING HEAD TEST

Data Set: C:\...\22GT008S_Large_FHT_BR.aqt
Date: 11/23/24 Time: 15:12:18

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008S
Test Date: 7/29/22

AQUIFER DATA

Saturated Thickness: 114.8 ft Anisotropy Ratio (Kz/Kr): 1.

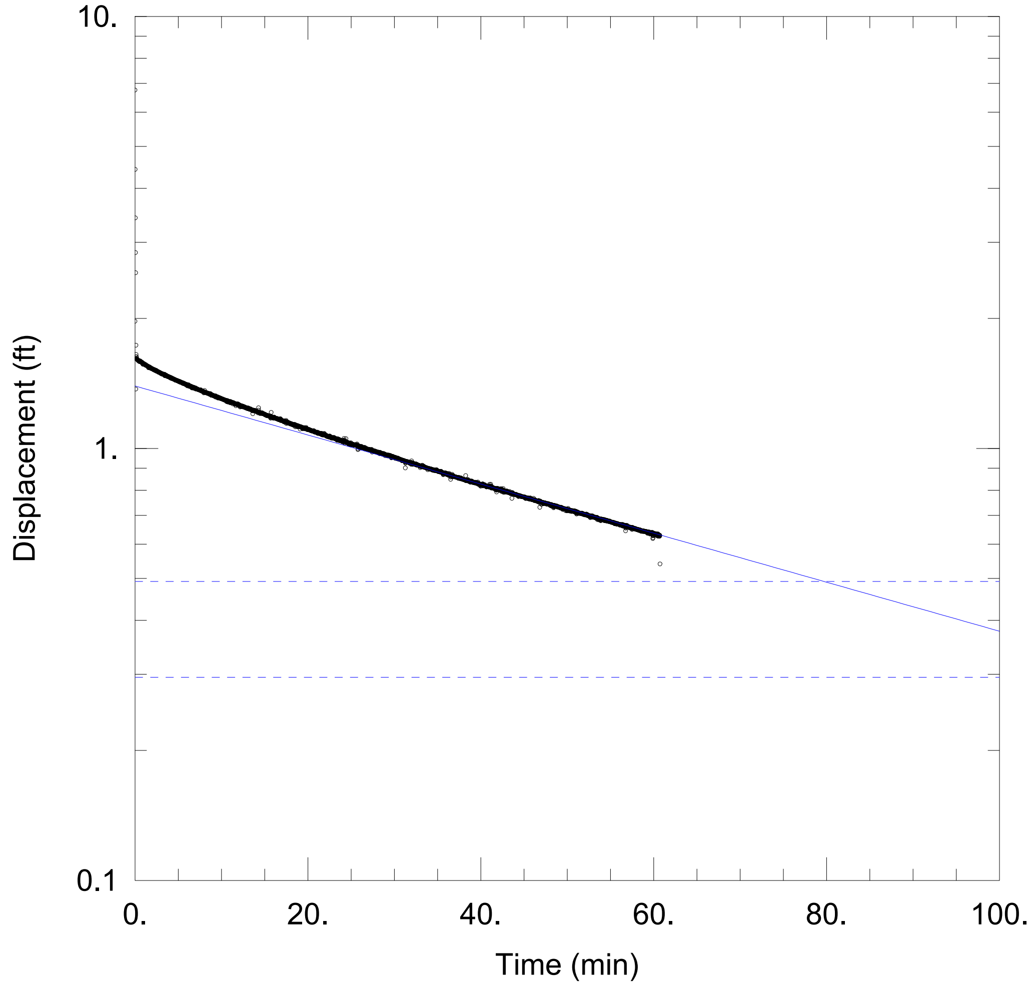
WELL DATA (22GT008-S)

Initial Displacement: 1.969 ft
Total Well Penetration Depth: 114.8 ft
Casing Radius: 0.07971 ft
Static Water Column Height: 32.25 ft
Screen Length: 30. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.009242 ft/day y0 = 1.421 ft



LARGE MECHANICAL SLUG FALLING HEAD TEST

Data Set: C:\...\22GT008S_Large_FHT_UnC_HVorslev.aqt
Date: 11/23/24 Time: 15:12:04

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008S
Test Date: 7/29/22

AQUIFER DATA

Saturated Thickness: 114.8 ft Anisotropy Ratio (Kz/Kr): 1.

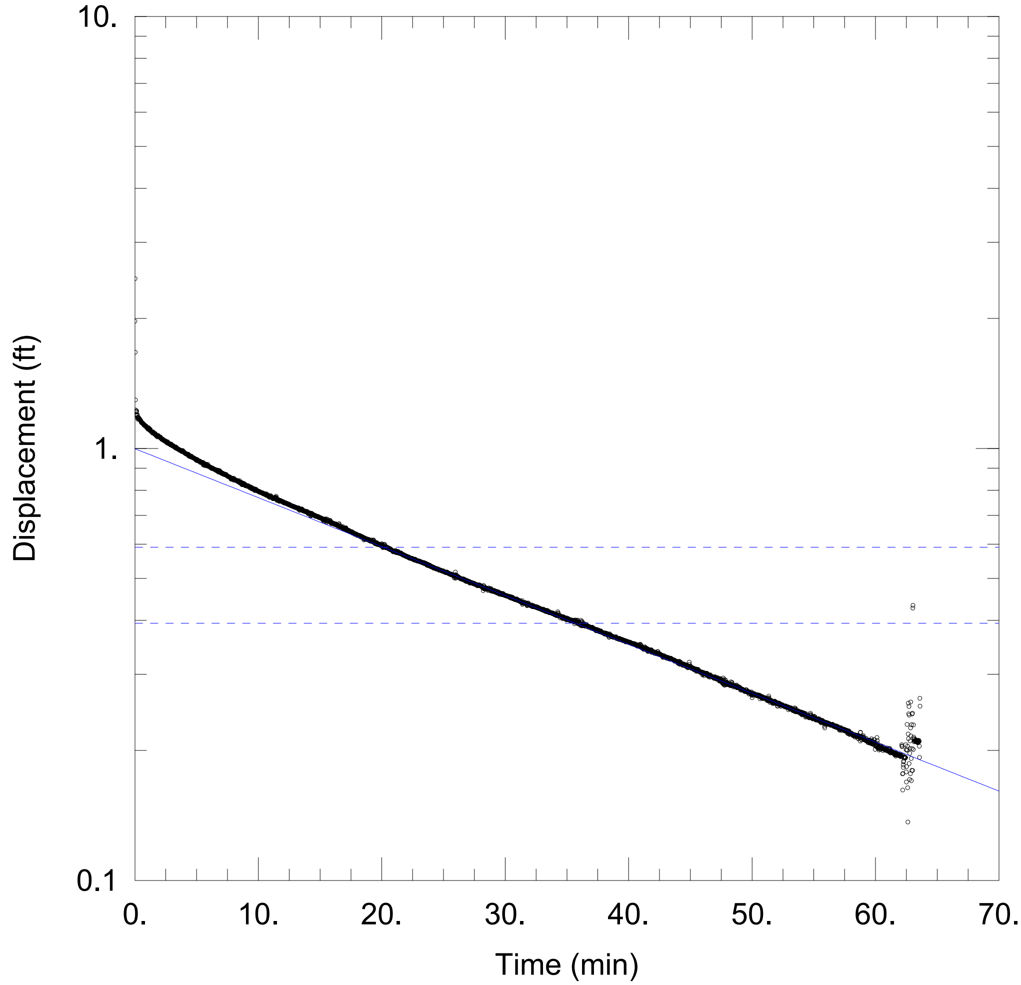
WELL DATA (22GT008-S)

Initial Displacement: 1.969 ft
Total Well Penetration Depth: 114.8 ft
Casing Radius: 0.07971 ft
Static Water Column Height: 32.25 ft
Screen Length: 30. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.01093 ft/day y0 = 1.395 ft



LARGE MECHANICAL SLUG RISING HEAD TEST

Data Set: C:\...\22GT008S_Large_RHT_BR.aqt
Date: 11/23/24 Time: 15:11:44

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008S
Test Date: 7/29/22

AQUIFER DATA

Saturated Thickness: 114.8 ft Anisotropy Ratio (Kz/Kr): 1.

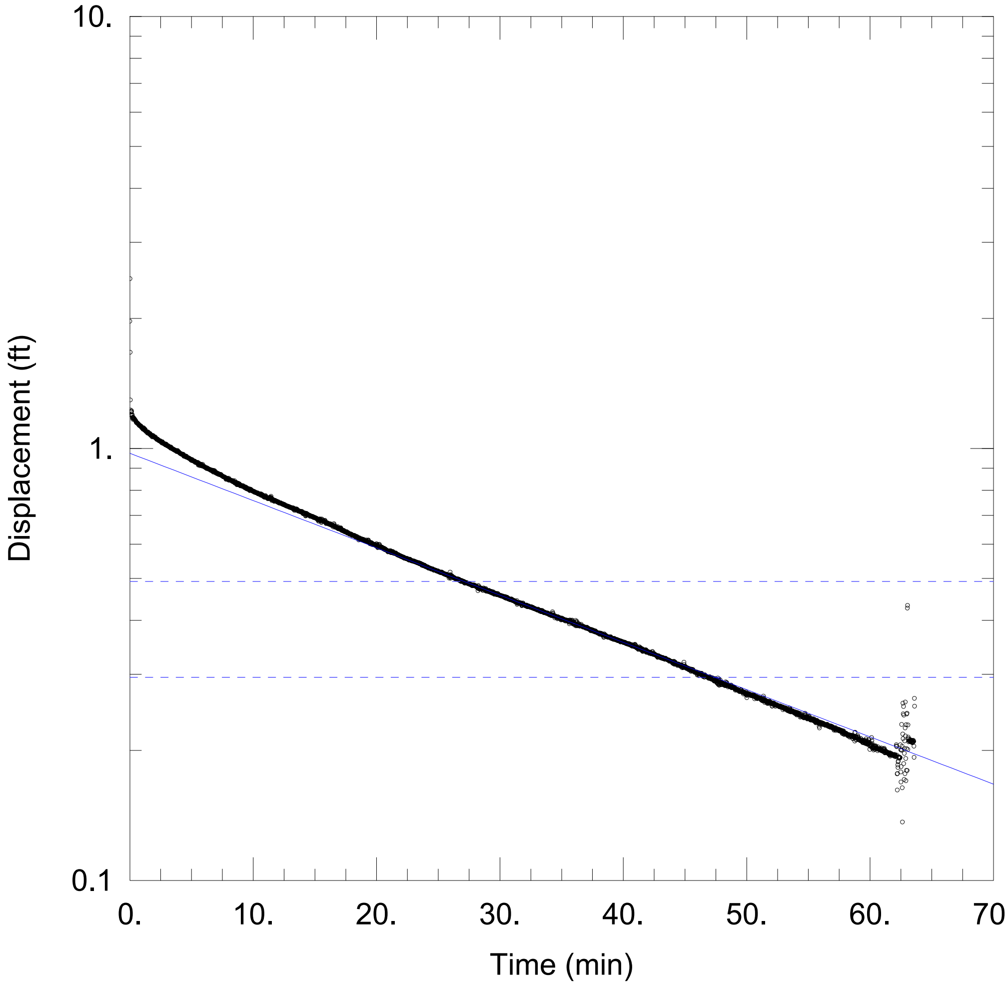
WELL DATA (22GT008-S)

Initial Displacement: 1.969 ft
Total Well Penetration Depth: 114.8 ft
Casing Radius: 0.07971 ft
Static Water Column Height: 32.25 ft
Screen Length: 30. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.01802 ft/day y0 = 0.9982 ft



LARGE MECHANICAL SLUG RISING HEAD TEST

Data Set: C:\...\22GT008S_Large_RHT_UnC_Hvorslev.aqt
Date: 11/23/24 Time: 15:11:31

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008S
Test Date: 7/29/22

AQUIFER DATA

Saturated Thickness: 114.8 ft Anisotropy Ratio (Kz/Kr): 1.

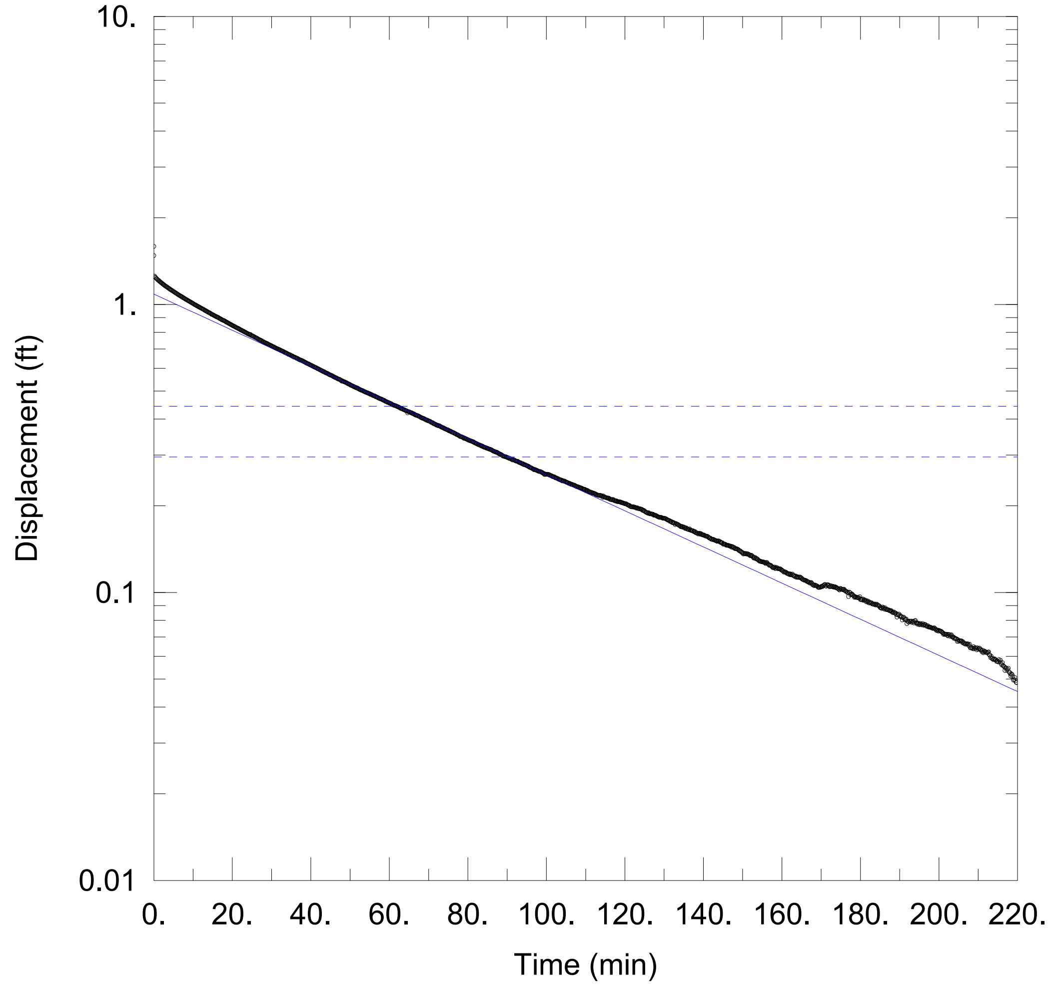
WELL DATA (22GT008-S)

Initial Displacement: 1.969 ft
Total Well Penetration Depth: 114.8 ft
Casing Radius: 0.07971 ft
Static Water Column Height: 32.25 ft
Screen Length: 30. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.02105 ft/day y0 = 0.9742 ft



MEDIUM MECHANICAL SLUG - FALLING HEAD TEST

Data Set: C:\...\22GT008S_Medium_FHT_BR.aqt
Date: 11/23/24 Time: 15:13:56

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008S
Test Date: 7/31/22

AQUIFER DATA

Saturated Thickness: 114.8 ft Anisotropy Ratio (Kz/Kr): 1.

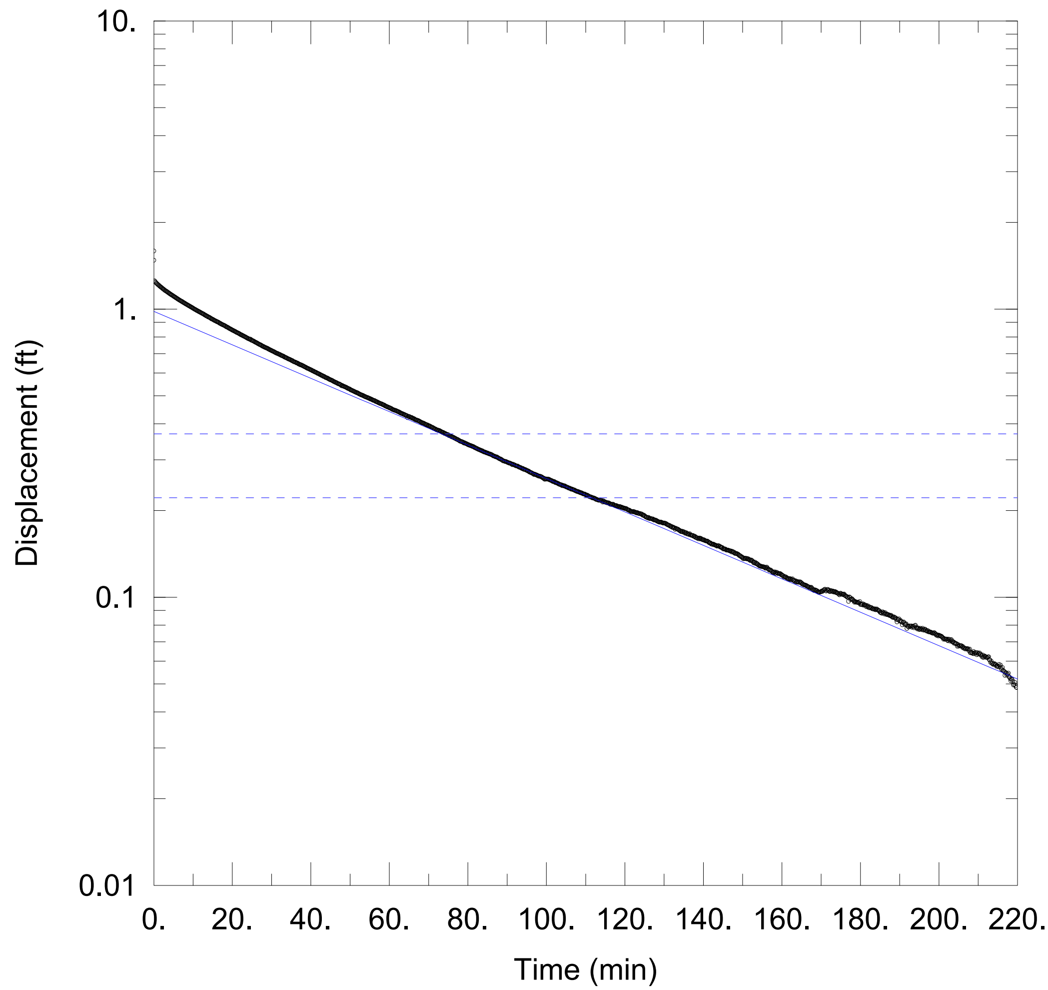
WELL DATA (22GT008-S)

Initial Displacement: 1.476 ft Static Water Column Height: 114.8 ft
Total Well Penetration Depth: 114.8 ft Screen Length: 30. ft
Casing Radius: 0.07971 ft Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.00998 ft/day y0 = 1.086 ft



MEDIUM MECHANICAL SLUG - FALLING HEAD TEST

Data Set: C:\...\22GT008S_Medium_FHT_UnC_Hvorslev.aqt
Date: 11/23/24 Time: 15:13:44

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008S
Test Date: 7/31/22

AQUIFER DATA

Saturated Thickness: 114.8 ft Anisotropy Ratio (Kz/Kr): 1.

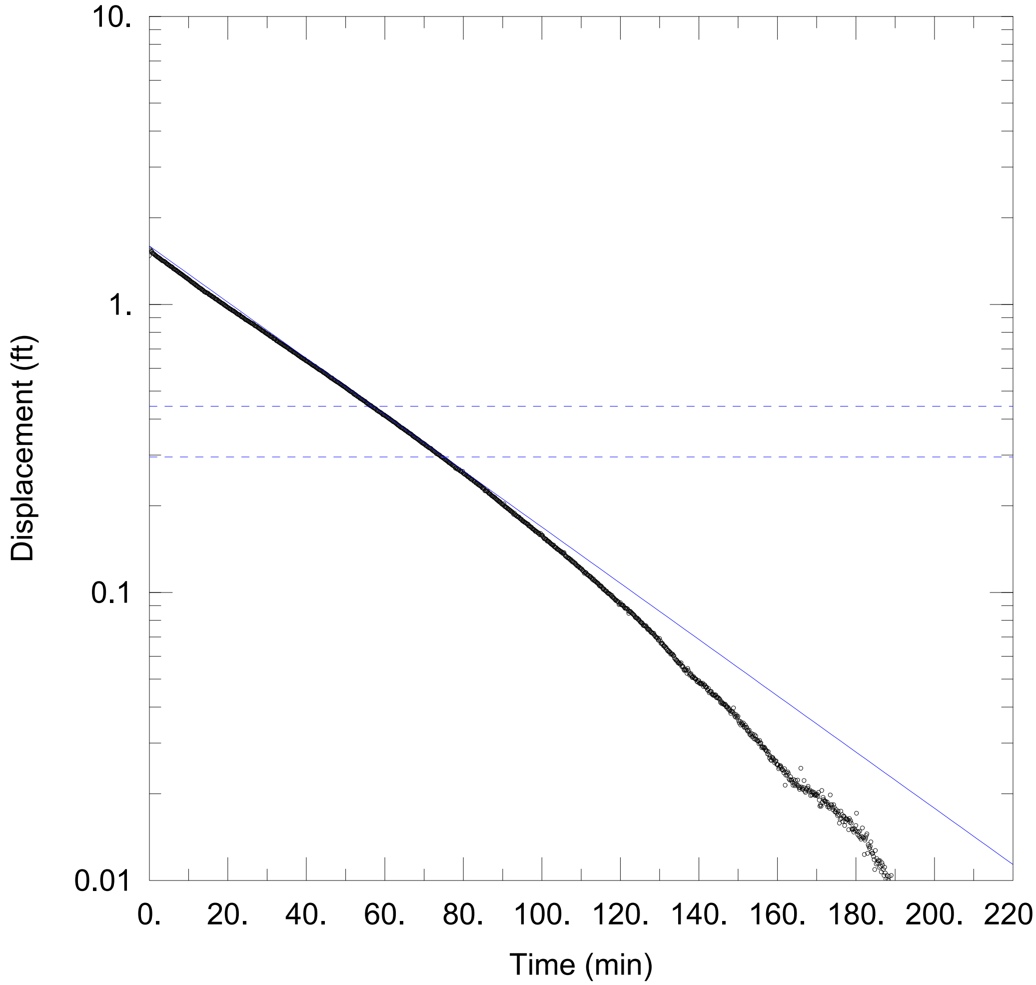
WELL DATA (22GT008-S)

Initial Displacement: 1.476 ft
Total Well Penetration Depth: 114.8 ft
Casing Radius: 0.07971 ft
Static Water Column Height: 114.8 ft
Screen Length: 30. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.01116 ft/day y0 = 0.981 ft



MEDIUM MECHANICAL SLUG - RISING HEAD TEST

Data Set: C:\...\22GT008S_Medium_RHT_BR.aqt
Date: 11/23/24 Time: 15:13:30

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008S
Test Date: 7/31/22

AQUIFER DATA

Saturated Thickness: 114.8 ft Anisotropy Ratio (Kz/Kr): 1.

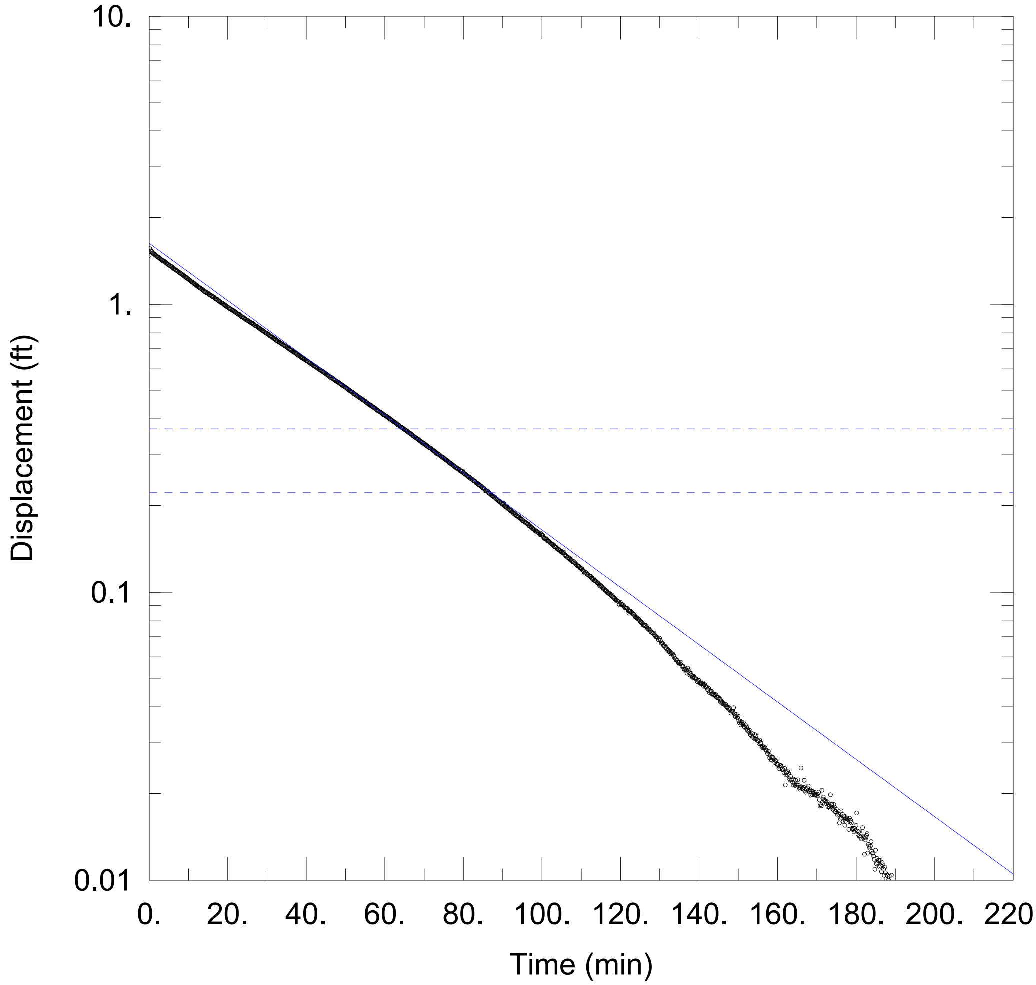
WELL DATA (22GT008-S)

Initial Displacement: 1.476 ft
Total Well Penetration Depth: 114.8 ft
Casing Radius: 0.07971 ft
Static Water Column Height: 114.8 ft
Screen Length: 30. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.01553 ft/day y0 = 1.595 ft



MEDIUM MECHANICAL SLUG - RISING HEAD TEST

Data Set: C:\...\22GT008S_Medium_RHT_Unc_Hvorslev.aqt
Date: 11/23/24 Time: 15:13:18

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008S
Test Date: 7/31/22

AQUIFER DATA

Saturated Thickness: 114.8 ft Anisotropy Ratio (Kz/Kr): 1.

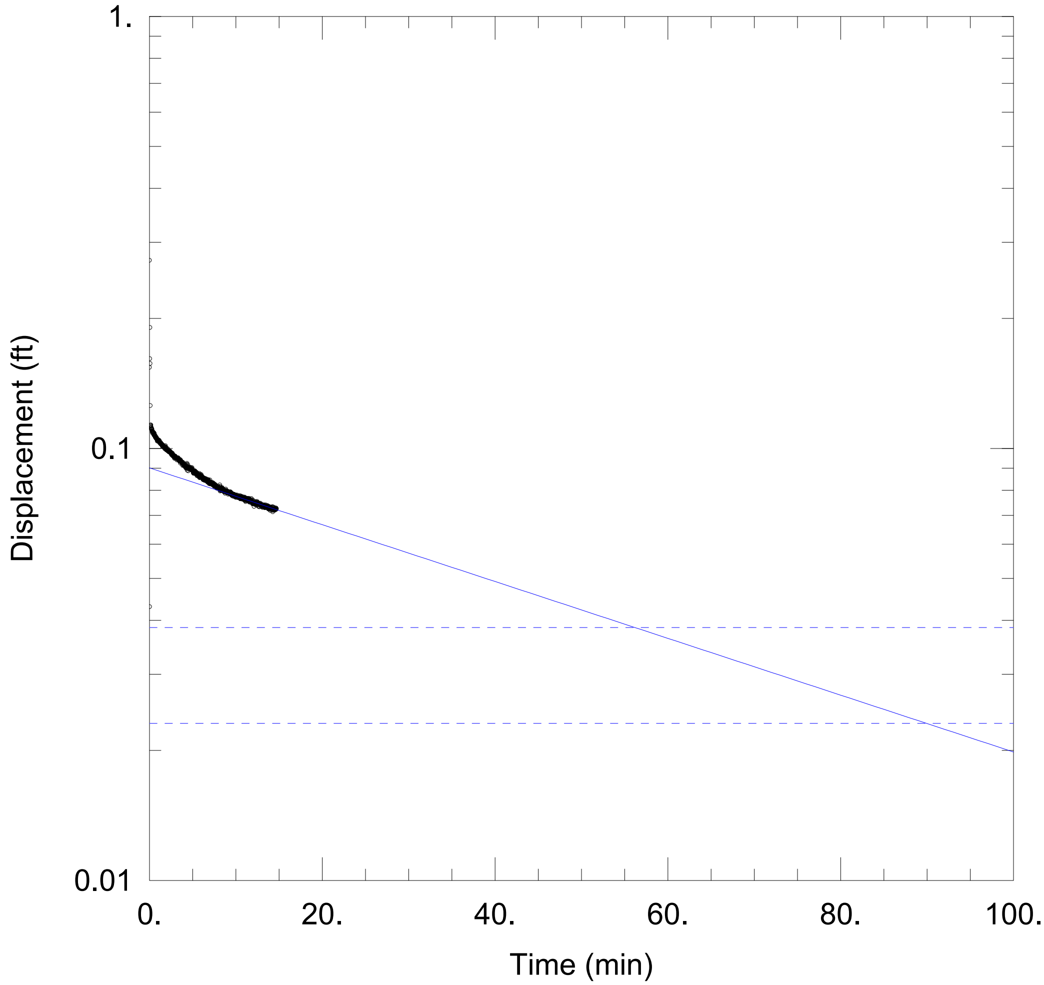
WELL DATA (22GT008-S)

Initial Displacement: 1.476 ft
Total Well Penetration Depth: 114.8 ft
Casing Radius: 0.07971 ft
Static Water Column Height: 114.8 ft
Screen Length: 30. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.01915 ft/day y0 = 1.626 ft



PNEUMATIC SLUG TEST #1

Data Set: C:\...\22GT008S_Pneumatic_RHT_1_UnC_Hvorslev.aqt
Date: 11/23/24 Time: 15:17:30

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008S
Test Date: 7/28/22

AQUIFER DATA

Saturated Thickness: 114.8 ft Anisotropy Ratio (Kz/Kr): 1.

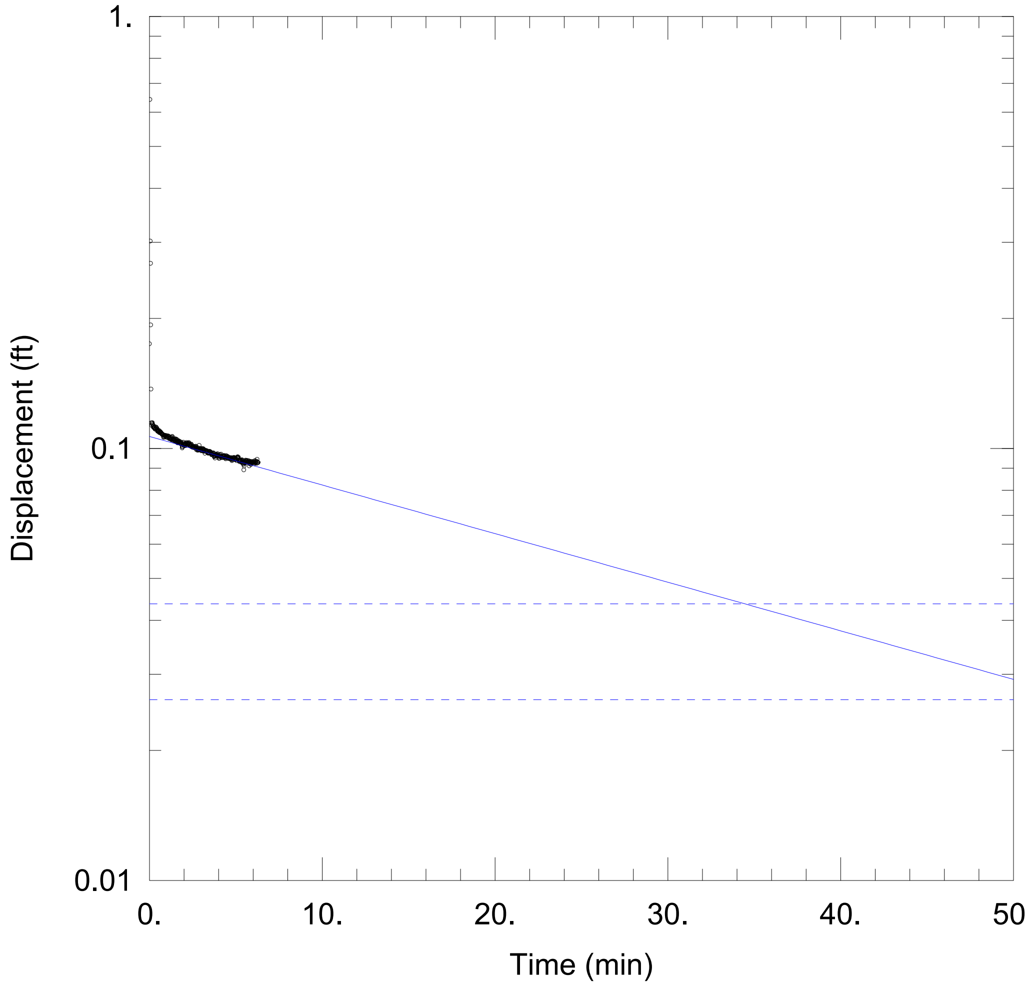
WELL DATA (22GT008-S)

Initial Displacement: 0.154 ft
Total Well Penetration Depth: 114.8 ft
Casing Radius: 0.07971 ft
Static Water Column Height: 114.8 ft
Screen Length: 30. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.01265 ft/day y0 = 0.09013 ft



PNEUMATIC SLUG TEST #2

Data Set: C:\...\22GT008S_Pneumatic_RHT_2_UnC_Hvorslev.aqt
Date: 11/23/24 Time: 15:17:18

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008S
Test Date: 7/28/22

AQUIFER DATA

Saturated Thickness: 114.8 ft Anisotropy Ratio (Kz/Kr): 1.

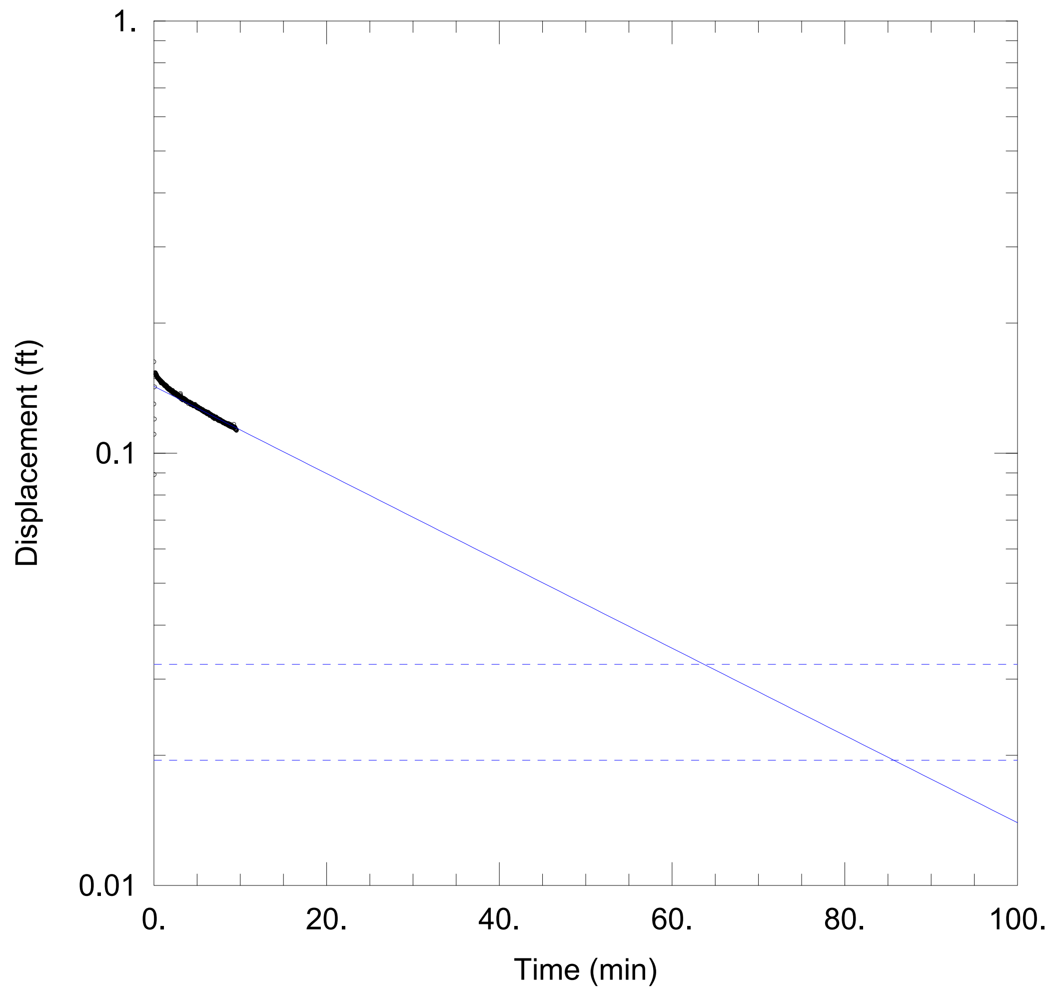
WELL DATA (22GT008-S)

Initial Displacement: 0.1746 ft Static Water Column Height: 114.8 ft
Total Well Penetration Depth: 114.8 ft Screen Length: 30. ft
Casing Radius: 0.07971 ft Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.02164 ft/day y0 = 0.1066 ft



PNEUMATIC SLUG TEST #3

Data Set: C:\...\22GT008S_Pneumatic_RHT_3_UnC_Hvorslev.aqt
Date: 11/23/24 Time: 15:16:46

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008S
Test Date: 7/28/22

AQUIFER DATA

Saturated Thickness: 114.8 ft
Anisotropy Ratio (Kz/Kr): 1.

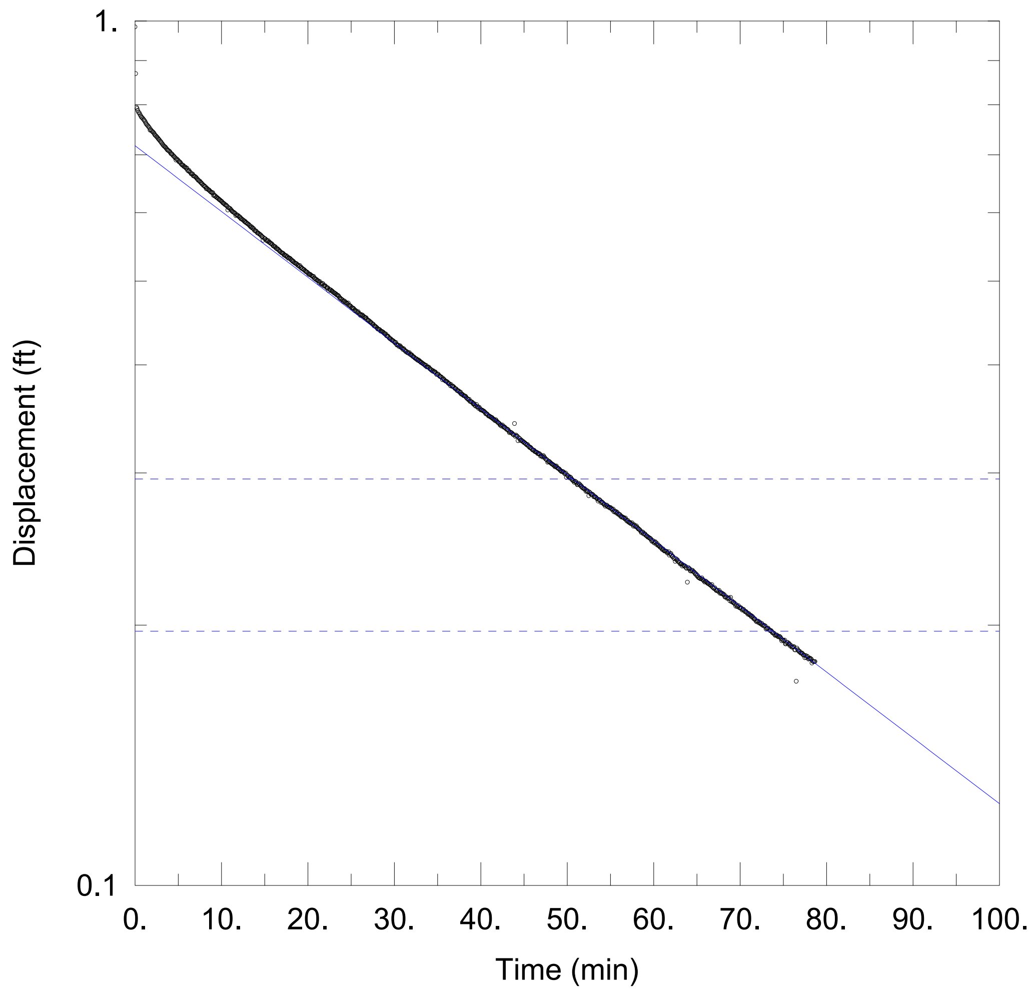
WELL DATA (22GT008-S)

Initial Displacement: 0.1298 ft
Total Well Penetration Depth: 114.8 ft
Casing Radius: 0.07971 ft
Static Water Column Height: 114.8 ft
Screen Length: 30. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.01943 ft/day
y0 = 0.1428 ft



MEDIUM MECHANICAL SLUG

Data Set: C:\...\22GT008S_SmallSlug_FHT_Con_BR.aqt
Date: 11/23/24 Time: 15:15:19

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008S
Test Date: 7/30/22

AQUIFER DATA

Saturated Thickness: 114.8 ft Anisotropy Ratio (Kz/Kr): 1.

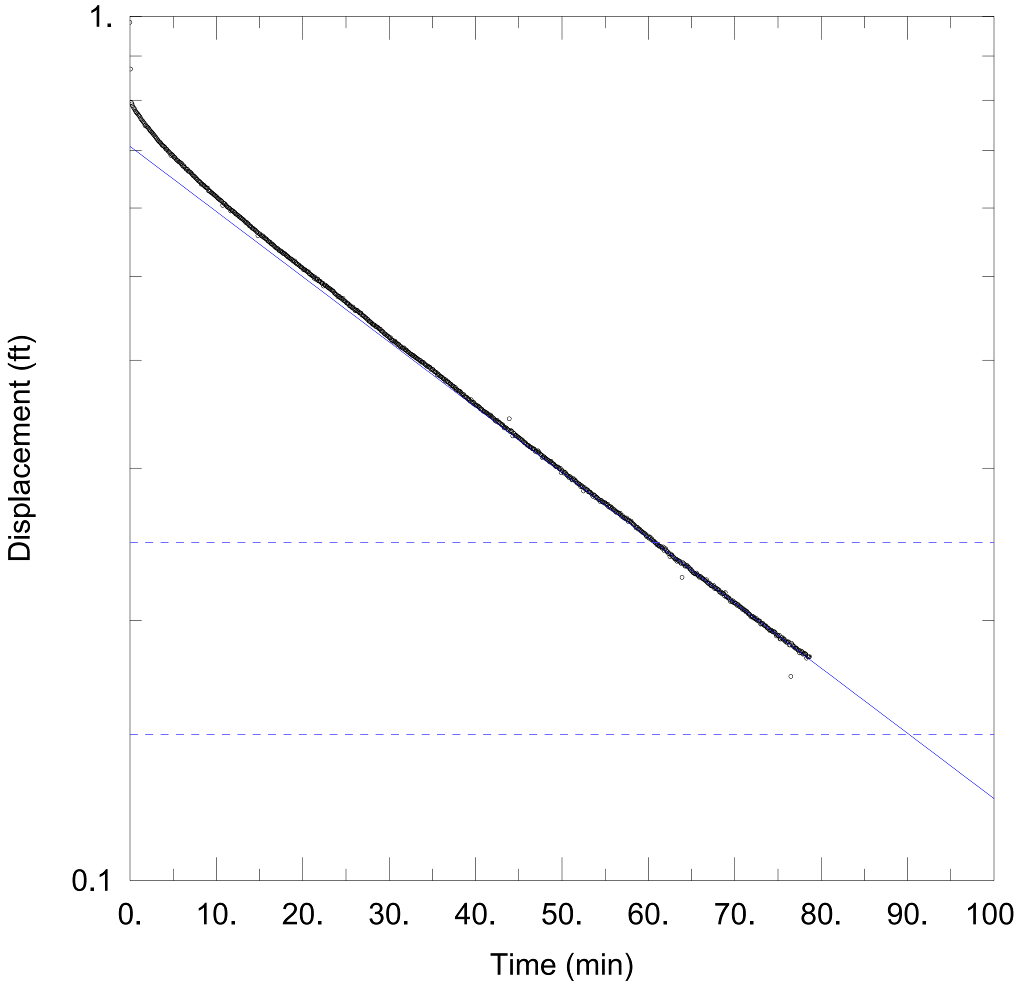
WELL DATA (22GT008-S)

Initial Displacement: 0.984 ft Static Water Column Height: 114.8 ft
Total Well Penetration Depth: 114.8 ft Screen Length: 30. ft
Casing Radius: 0.07971 ft Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.01212 ft/day y0 = 0.7172 ft



MEDIUM MECHANICAL SLUG

Data Set: C:\...\22GT008S_SmallSlug_FHT_UnC_Hvorslev.aqt
Date: 11/23/24 Time: 15:15:09

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008S
Test Date: 7/30/22

AQUIFER DATA

Saturated Thickness: 114.8 ft Anisotropy Ratio (Kz/Kr): 1.

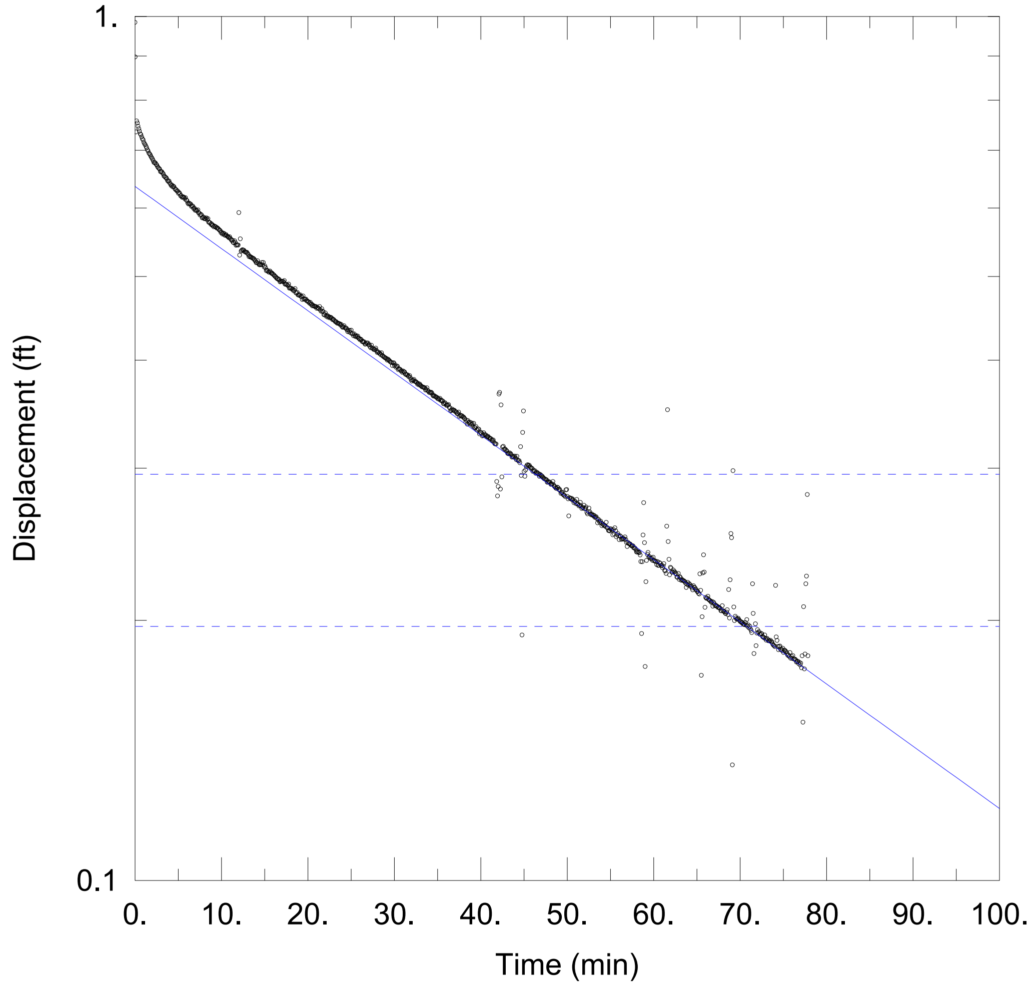
WELL DATA (22GT008-S)

Initial Displacement: 0.984 ft
Total Well Penetration Depth: 114.8 ft
Casing Radius: 0.07971 ft
Static Water Column Height: 114.8 ft
Screen Length: 30. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.01453 ft/day y0 = 0.7073 ft



MEDIUM MECHANICAL SLUG_RISING HEAD TEST

Data Set: C:\...\22GT008S_SmallSlug_RHT_Con_BR.aqt
Date: 11/23/24 Time: 15:14:58

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008S
Test Date: 7/30/22

AQUIFER DATA

Saturated Thickness: 114.8 ft Anisotropy Ratio (Kz/Kr): 1.

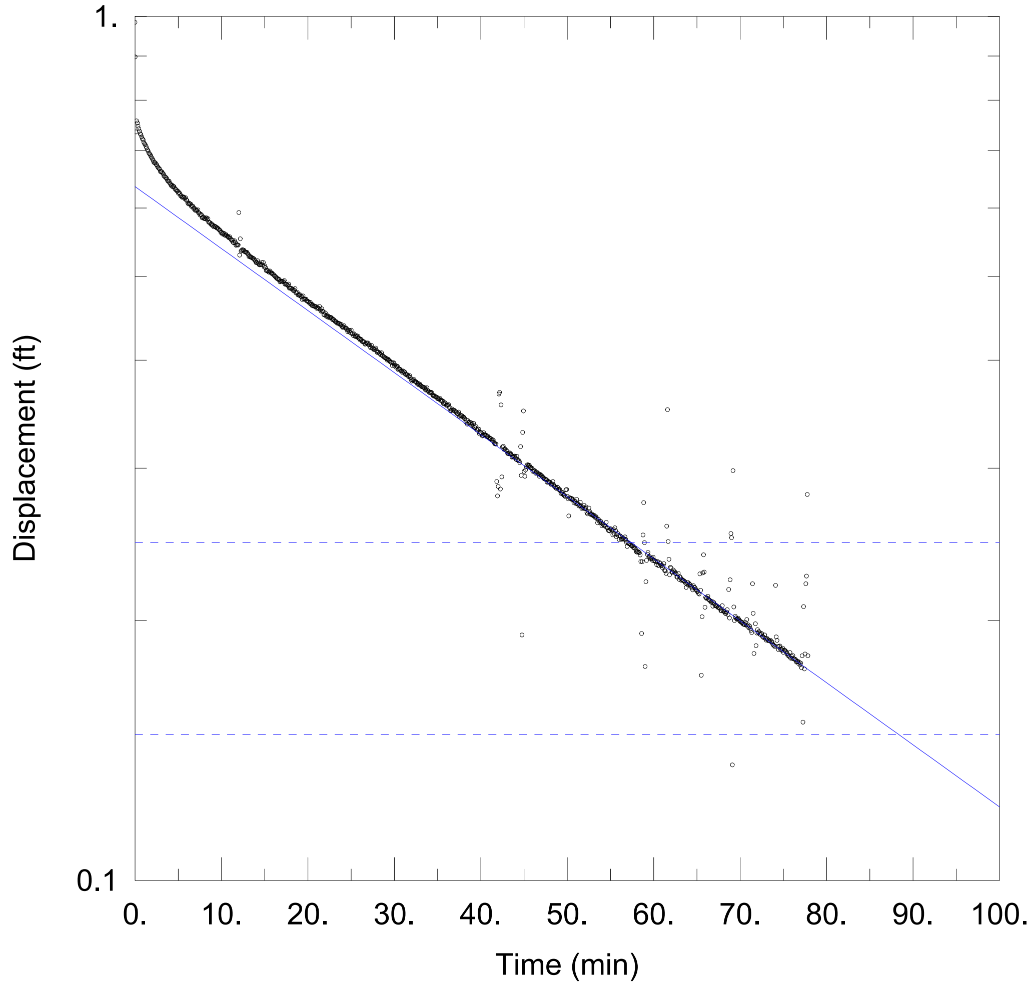
WELL DATA (22GT008-S)

Initial Displacement: 0.984 ft
Total Well Penetration Depth: 114.8 ft
Casing Radius: 0.07971 ft
Static Water Column Height: 114.8 ft
Screen Length: 30. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.01146 ft/day y0 = 0.6358 ft



MEDIUM MECHANICAL SLUG_RISING HEAD TEST

Data Set: C:\...\22GT008S_SmallSlug_RHT_UnC_Hvorslev.aqt
Date: 11/23/24 Time: 15:14:48

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT008S
Test Date: 7/30/22

AQUIFER DATA

Saturated Thickness: 114.8 ft Anisotropy Ratio (Kz/Kr): 1.

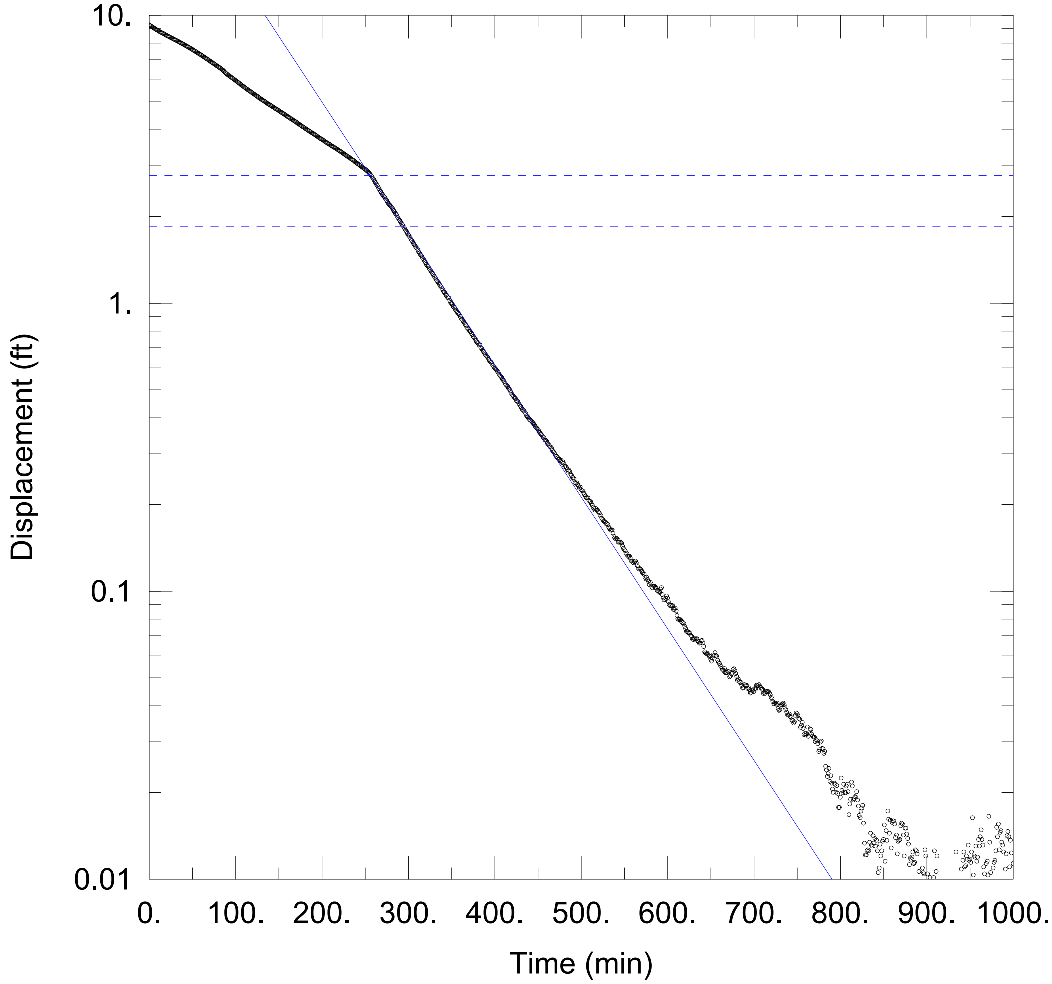
WELL DATA (22GT008-S)

Initial Displacement: 0.984 ft
Total Well Penetration Depth: 114.8 ft
Casing Radius: 0.07971 ft
Static Water Column Height: 114.8 ft
Screen Length: 30. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.01381 ft/day y0 = 0.6355 ft



DEVELOPMENT RECOVERY RISING HEAD TEST

Data Set: C:\...\22GT009D_DevelopmentRecovery_RHT_Con_BR.aqt
Date: 11/23/24 Time: 15:20:02

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT009D
Test Date: 8/3/22

AQUIFER DATA

Saturated Thickness: 30. ft
Anisotropy Ratio (Kz/Kr): 1.

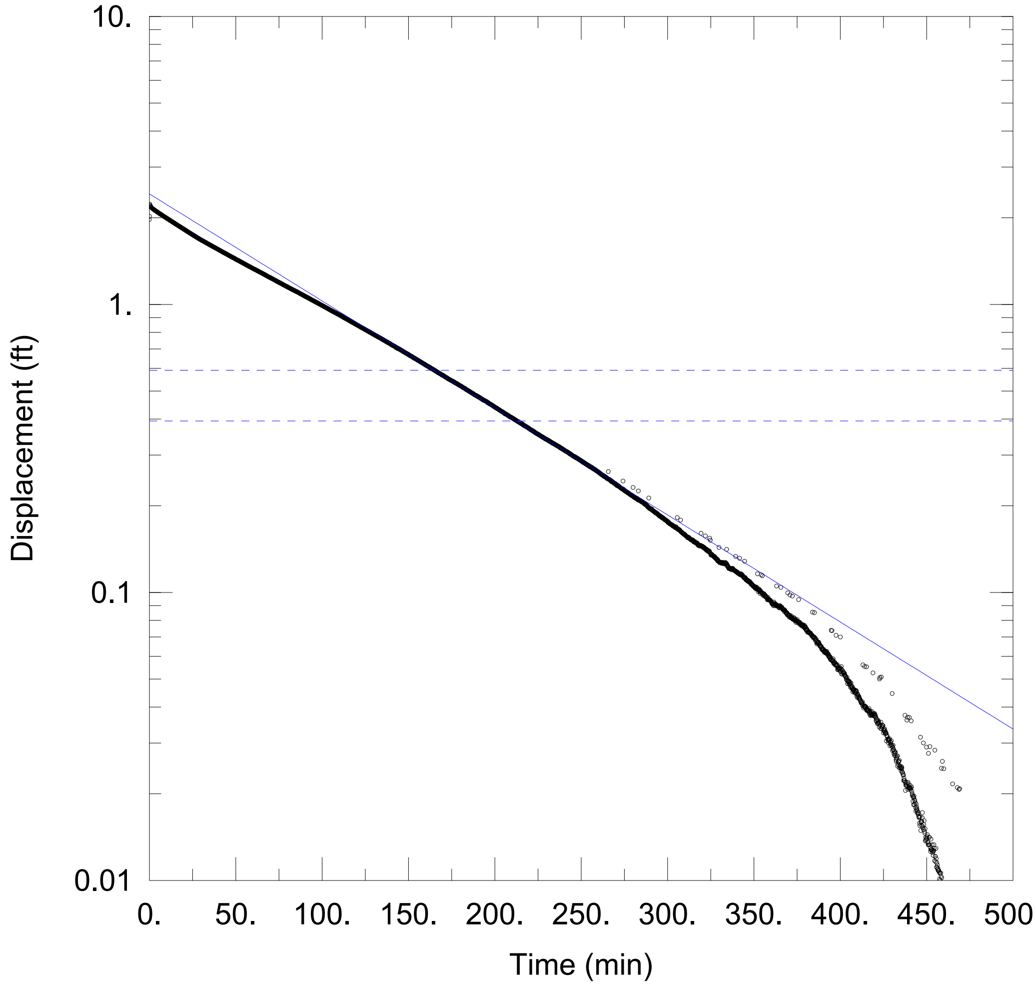
WELL DATA (22GT009D)

Initial Displacement: 9.25 ft
Total Well Penetration Depth: 22.51 ft
Casing Radius: 0.07971 ft
Static Water Column Height: 22.51 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.0137 ft/day
y0 = 40.96 ft



LARGE MECHANICAL SLUG - FALLING HEAD TEST

Data Set: C:\...\22GT009D_Large_FHT_Con_BR_.aqt
Date: 11/23/24 Time: 15:18:56

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT009D
Test Date: 8/5/22

AQUIFER DATA

Saturated Thickness: 30. ft Anisotropy Ratio (Kz/Kr): 1.

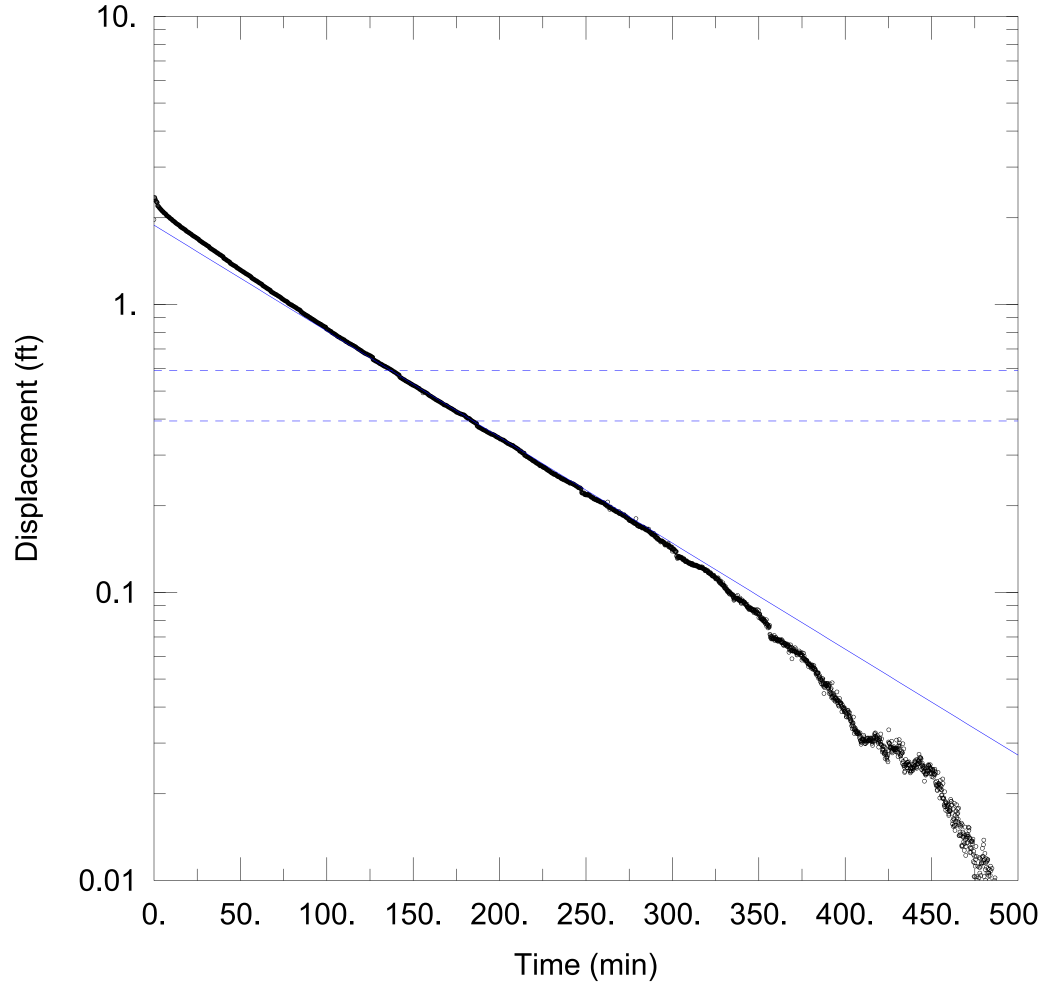
WELL DATA (22GT009D)

Initial Displacement: 1.969 ft Static Water Column Height: 22.51 ft
Total Well Penetration Depth: 22.51 ft Screen Length: 10. ft
Casing Radius: 0.07971 ft Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.01114 ft/day y0 = 2.42 ft



LARGE MECHANICAL SLUG - RISING HEAD TEST

Data Set: C:\...\22GT009D_Large_RHT_Con_BR.aqt
Date: 11/23/24 Time: 15:18:46

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT009D
Test Date: 8/6/22

AQUIFER DATA

Saturated Thickness: 30. ft Anisotropy Ratio (Kz/Kr): 1.

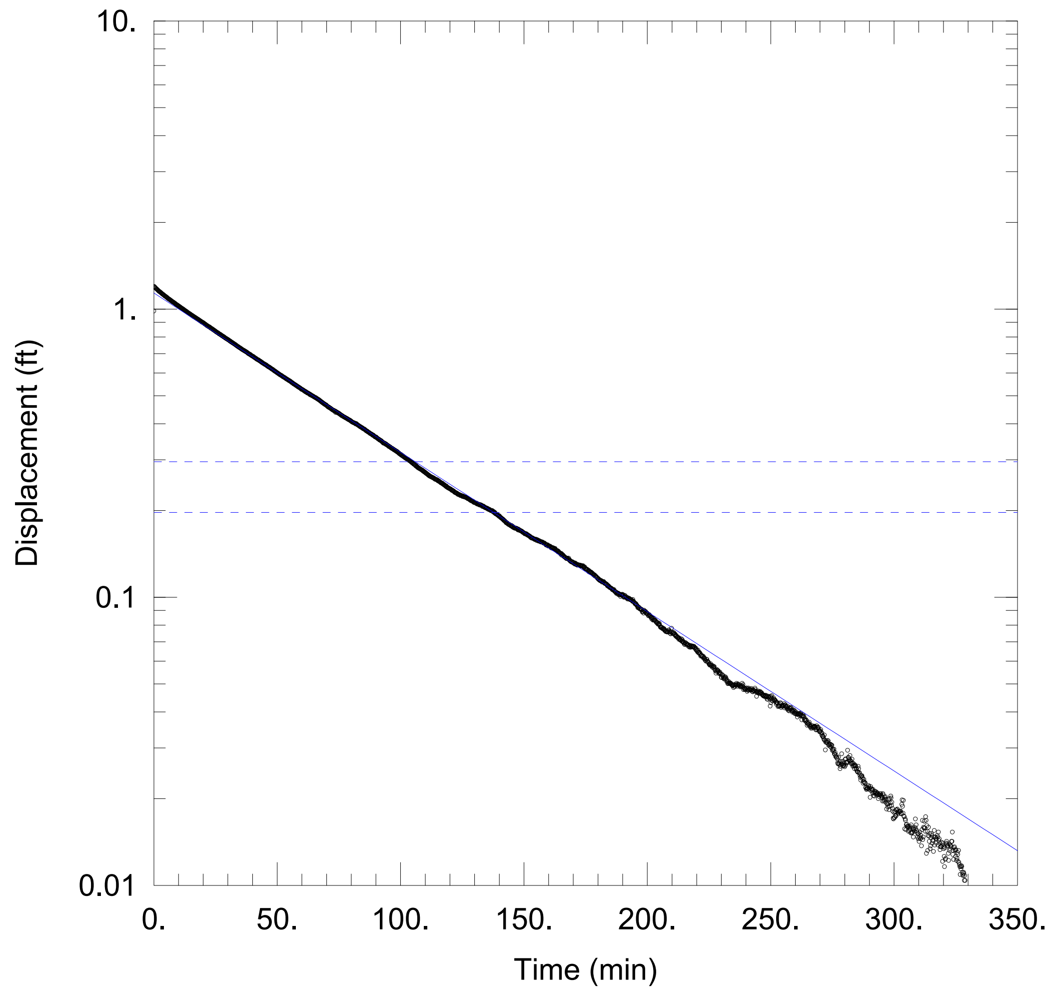
WELL DATA (22GT009D)

Initial Displacement: 1.969 ft Static Water Column Height: 22.3 ft
Total Well Penetration Depth: 22.3 ft Screen Length: 10. ft
Casing Radius: 0.07971 ft Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.011 ft/day y0 = 1.885 ft



SMALL MECHANICAL SLUG - FALLING HEAD TEST

Data Set: C:\...\22GT009D_Small_FHT_Con_BR.aqt
Date: 11/23/24 Time: 15:19:38

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT009D
Test Date: 8/7/22

AQUIFER DATA

Saturated Thickness: 30. ft Anisotropy Ratio (Kz/Kr): 1.

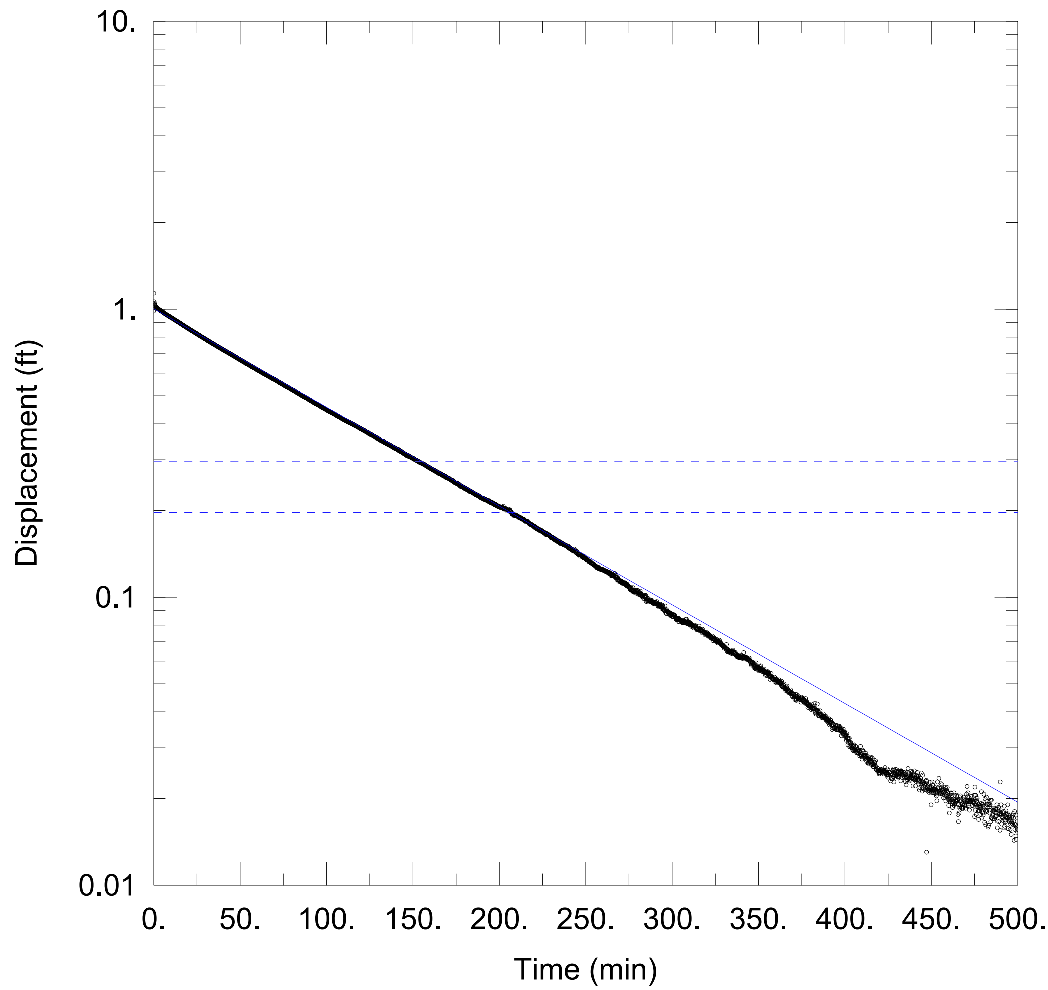
WELL DATA (22GT009D)

Initial Displacement: 0.984 ft
Total Well Penetration Depth: 22.3 ft
Casing Radius: 0.07971 ft
Static Water Column Height: 22.3 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.01653 ft/day y0 = 1.137 ft



SMALL MECHANICAL SLUG - RISING HEAD TEST

Data Set: C:\...\22GT009D_Small_RHT_Con_BR.aqt
Date: 11/23/24 Time: 15:19:27

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT009D
Test Date: 8/7/22

AQUIFER DATA

Saturated Thickness: 30. ft Anisotropy Ratio (Kz/Kr): 1.

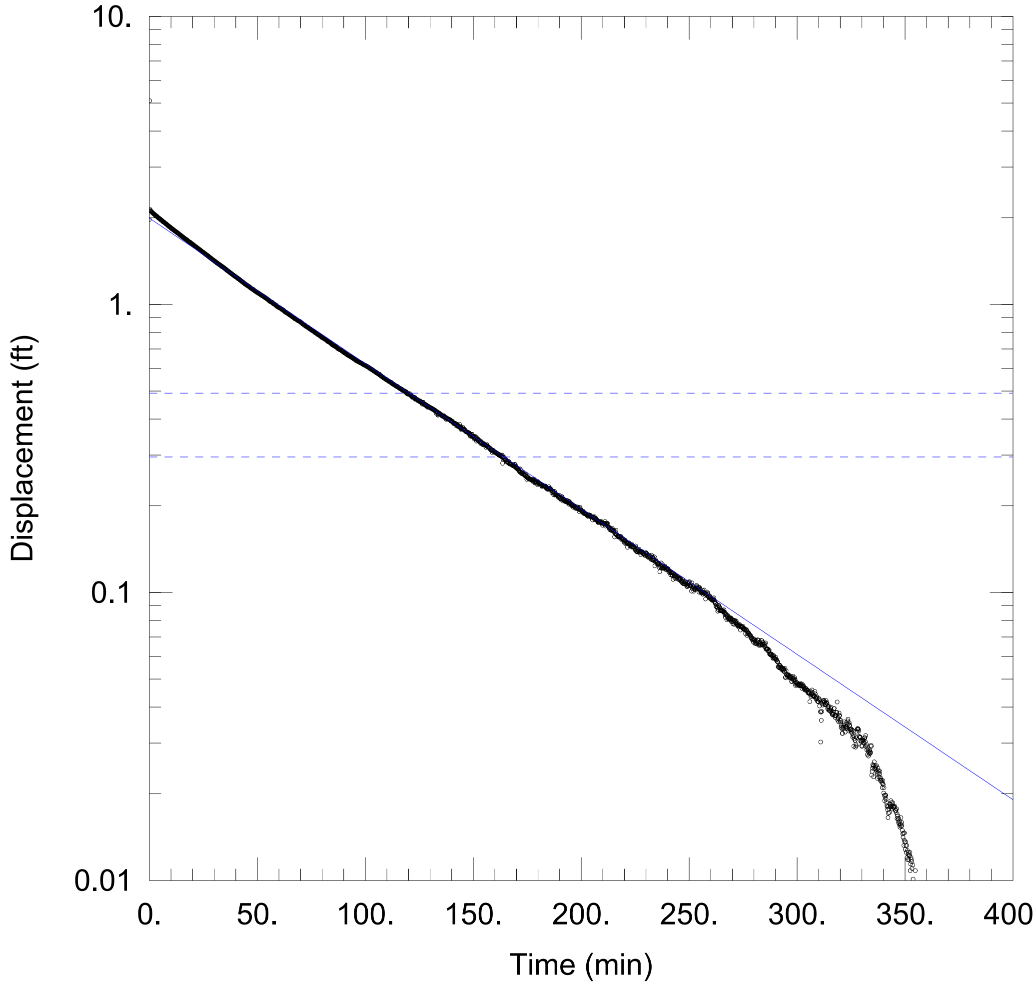
WELL DATA (22GT009D)

Initial Displacement: 0.984 ft Static Water Column Height: 22.3 ft
Total Well Penetration Depth: 22.3 ft Screen Length: 10. ft
Casing Radius: 0.07971 ft Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.01025 ft/day y0 = 1.004 ft



LARGE MECHANICAL SLUG FALLING HEAD TEST

Data Set: C:\...\22GT009S_Large_FHT_UnCon_Hvorslev.aqt
Date: 11/23/24 Time: 15:20:55

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT009S
Test Date: 8/4/22

AQUIFER DATA

Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

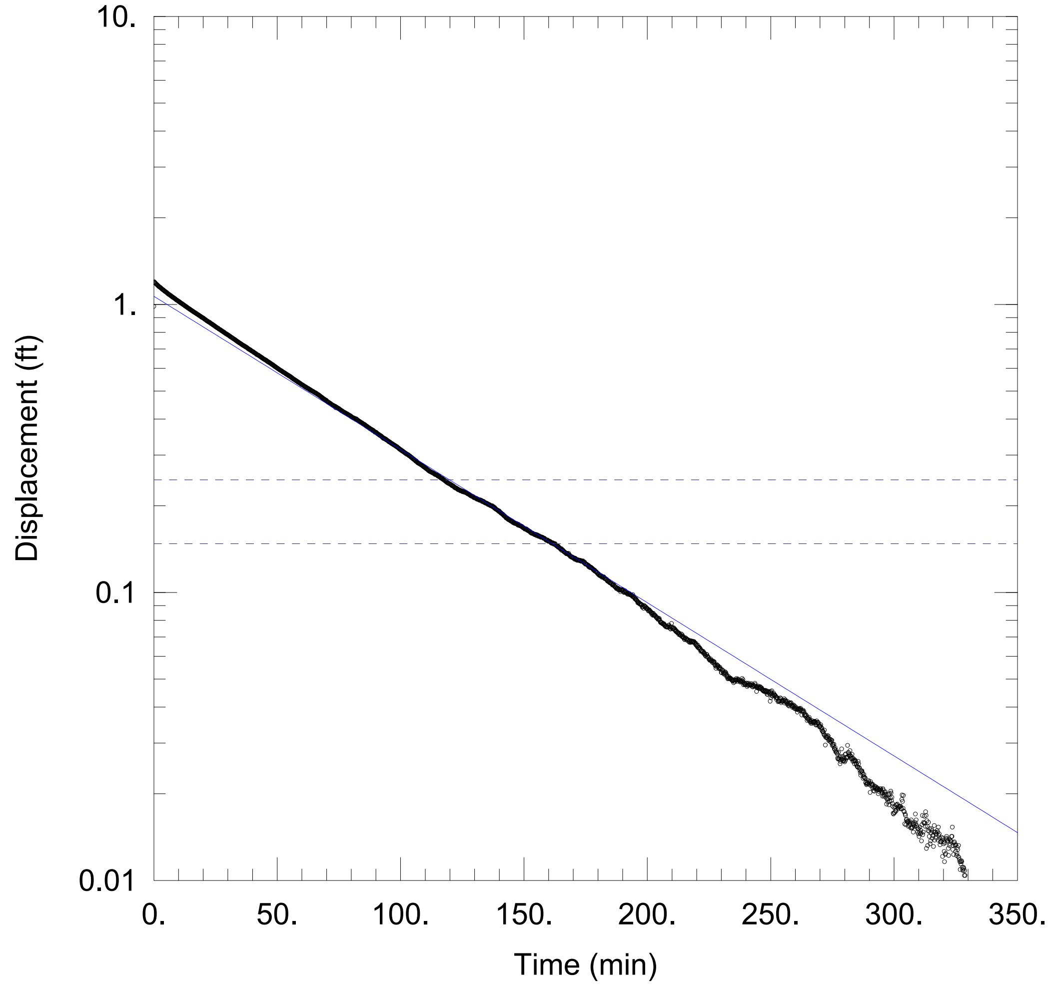
WELL DATA (22GT009S)

Initial Displacement: 1.969 ft Static Water Column Height: 12.15 ft
Total Well Penetration Depth: 12.15 ft Screen Length: 10. ft
Casing Radius: 0.07971 ft Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.01962 ft/day y0 = 1.993 ft



SMALL MECHANICAL SLUG - FALLING HEAD TEST

Data Set: C:\...\22GT009S_Small_FHT_UnCon_Hvorslev.aqt
Date: 11/23/24 Time: 15:21:24

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT009S
Test Date: 8/6/22

AQUIFER DATA

Saturated Thickness: 15. ft
Anisotropy Ratio (Kz/Kr): 1.

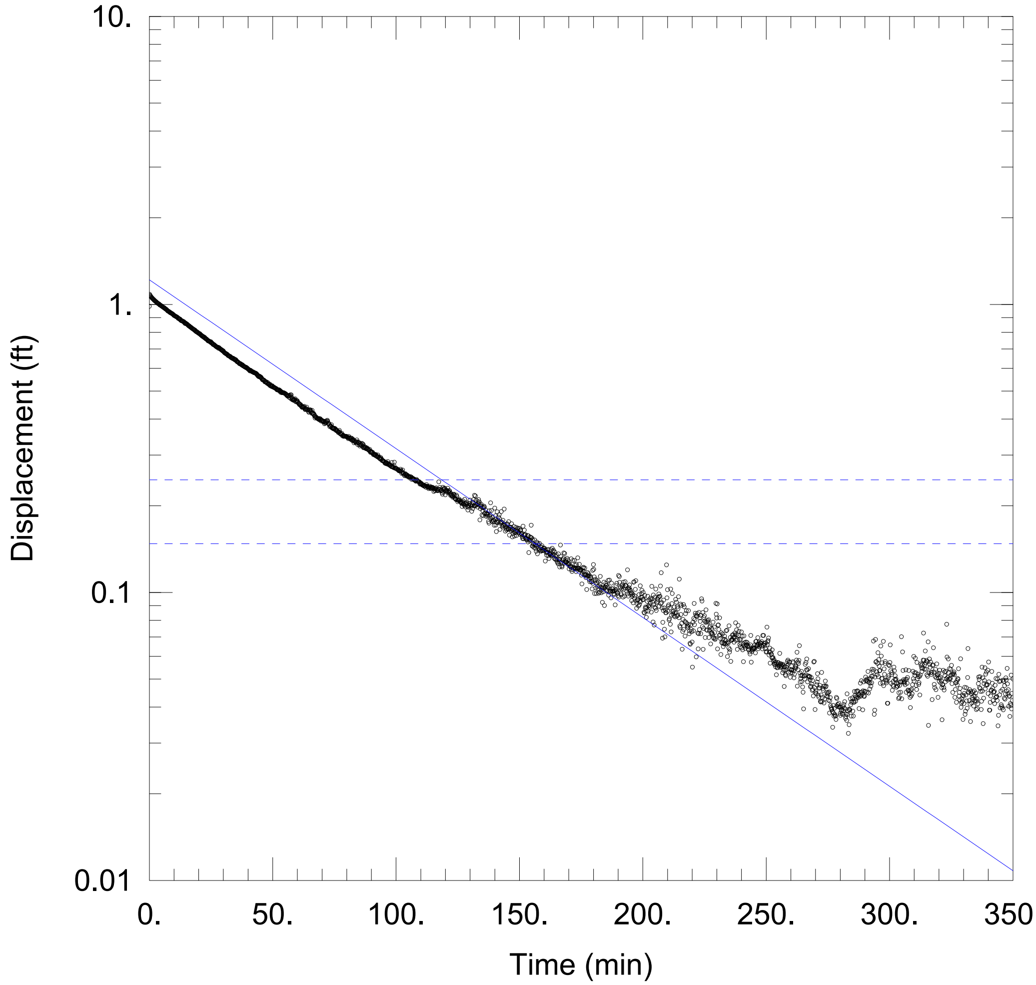
WELL DATA (22GT009S)

Initial Displacement: 0.984 ft
Total Well Penetration Depth: 12.15 ft
Casing Radius: 0.07971 ft
Static Water Column Height: 12.15 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.02068 ft/day
y0 = 1.067 ft



SMALL MECHANICAL SLUG - RISING HEAD TEST

Data Set: C:\...\22GT009S_Small_RHT_UnCon_Hvorslev.aqt
Date: 11/23/24 Time: 15:21:14

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 22GT009S
Test Date: 8/6/22

AQUIFER DATA

Saturated Thickness: 15. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (22GT009S)

Initial Displacement: 0.984 ft
Total Well Penetration Depth: 12.15 ft
Casing Radius: 0.07971 ft
Static Water Column Height: 12.15 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.02278 ft/day y0 = 1.217 ft

Drill Hole ID:	23GC094	CONSTANT HEAD INJECTION TEST *Packer Isolated*	Tundra Consulting, LLC
Test Number:	1		
Project No.:	Graphite Creek		

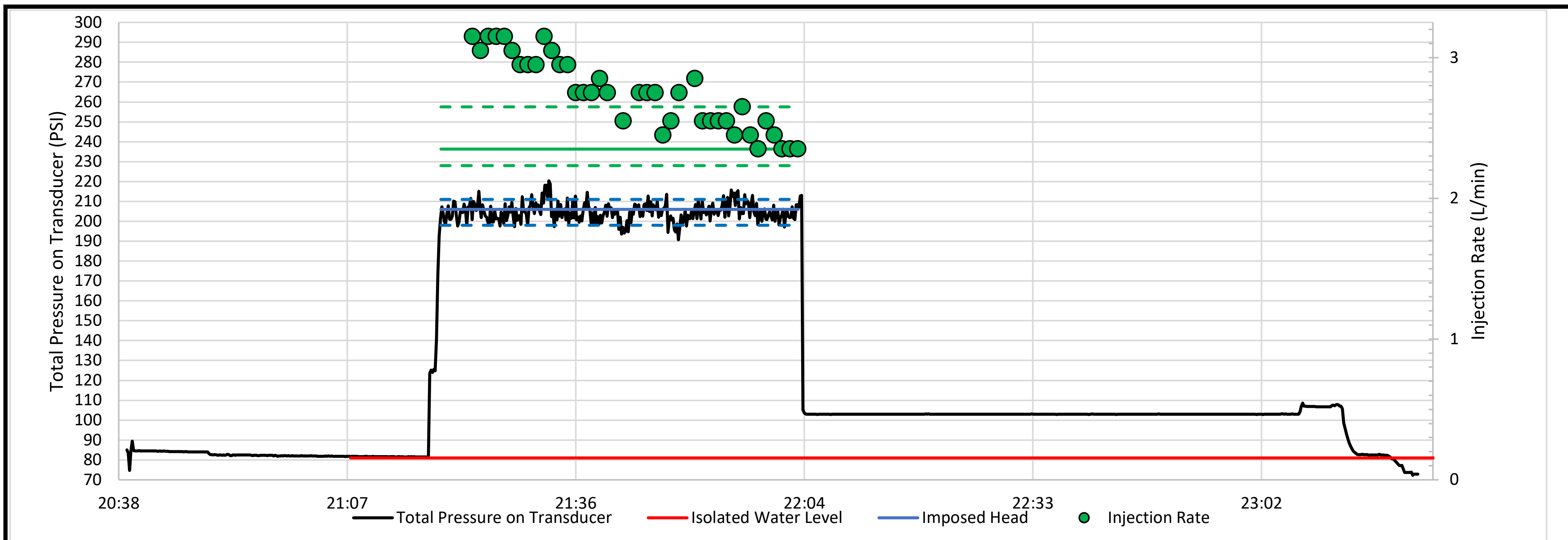
Location Description			Test Interval			General	
Current Depth:	315		Bit Depth:	271	(ft-ah)	Test Start Date/Time:	8/14/2023 16:00
Hole Size[A]:	HQ3		Top of Test Interval:	275.25	(ft-ah)	Test End Date/Time:	8/14/2023 23:45
Inclination:	49		Stable Water Level[B]:	81	(PSI)	Supervisor:	L. Marshall
Azimuth:	172		*Stable Water Level[C]:*	*31.68*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	791	(ft-amsl)	*Transducer Position[D]:*	*279.25*	(ft-ah)	Rig No. & Type:	Rig 37

Test Notes

Start Flush:	16:00		Test Fluid (water/poly):	Fresh Water	Shear Pin Break Time:	21:19
End Flush:	17:00		Seal Quality:	Good	Injection End Time:	22:04
Flushed Volume[E]:	475	(gal)	Start Inflate Time:	19:19	Deflation Method:	E-Pin

Zone Description & Comments

Test Type:	Constant Head Injection
Drilling Comments:	Good return
Geology, Hydrogeology, & Rock Mass:	More weathered joints 271-280 ft, but overall fairly competent
Test Quality and Assessment:	Good test after a premature pin shear, although pressures crept up and down a few times, thus requiring slight adjustments.



	Estimate	Low End	High End	
Imposed Head (H):	87.89	82.26	91.40	($m\text{-}H_2O$)
Injection Rate (Q):	3.38	*3.21*	*3.82*	(m^3/day)
Hydraulic Conductivity:	**2.70E-03**	*2.47E-03*	*3.25E-03*	(m/day)
Transmissivity:	**0.033**	*0.030*	*0.039*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	12.12	(m)
System Leak Rate:		0	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	23GC094	CONSTANT HEAD INJECTION TEST	Tundra Consulting, LLC
Test Number:	1	*Packer Isolated*	
Project No.:	Graphite Creek		

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
20:54	563.20	0.000	90
20:55	563.30	0.100	90
20:56	563.45	0.150	90
20:57	563.60	0.150	90

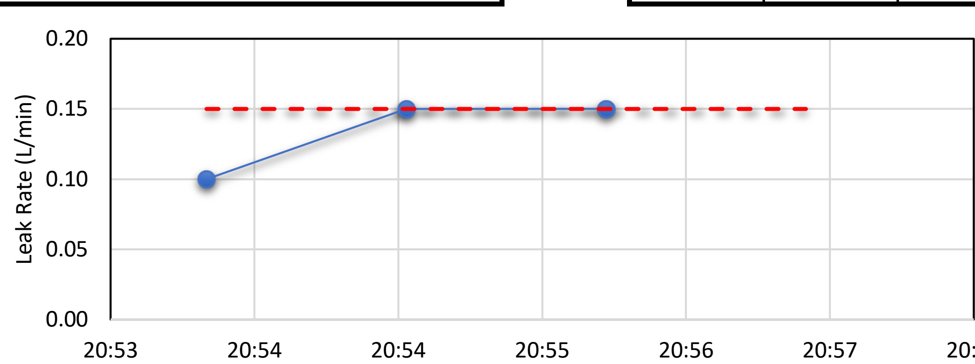
Leak Rate	0.15 L/min
Injection Rate	2.4 L/min
Min Injection Rate	2.23 L/min
Max Injection Rate	2.65 L/min

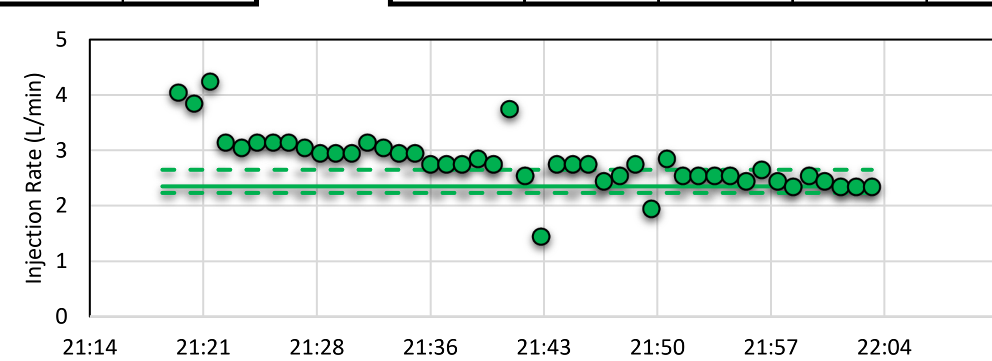
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
21:19	584.20	-	-	90
21:20	588.40	4.2	4.05	90
21:21	592.40	4.0	3.85	90
21:22	596.80	4.4	4.25	90
21:23	600.10	3.3	3.15	90
21:24	603.30	3.2	3.05	90
21:25	606.60	3.3	3.15	90
21:26	609.90	3.3	3.15	90
21:27	613.20	3.3	3.15	90
21:28	616.40	3.2	3.05	90
21:29	619.50	3.1	2.95	90
21:30	622.60	3.1	2.95	90
21:31	625.70	3.1	2.95	90
21:32	629.00	3.3	3.15	90
21:33	632.20	3.2	3.05	90
21:34	635.30	3.1	2.95	90
21:35	638.40	3.1	2.95	90
21:36	641.30	2.9	2.75	90
21:37	644.20	2.9	2.75	90
21:38	647.10	2.9	2.75	90
21:39	650.10	3.0	2.85	90
21:40	653.00	2.9	2.75	90
21:41	656.90	3.9	3.75	90
21:42	659.60	2.7	2.55	90
21:43	661.20	1.6	1.45	90
21:44	664.10	2.9	2.75	90
21:45	667.00	2.9	2.75	90
21:46	669.90	2.9	2.75	90
21:47	672.50	2.6	2.45	90

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
21:48	675.20	2.70	2.55	90
21:49	678.10	2.90	2.75	90
21:50	680.20	2.10	1.95	85
21:51	683.20	3.00	2.85	90
21:52	685.90	2.70	2.55	90
21:53	688.60	2.70	2.55	90
21:54	691.30	2.70	2.55	90
21:55	694.00	2.70	2.55	90
21:56	696.60	2.60	2.45	90
21:57	699.40	2.80	2.65	90
21:58	702.00	2.60	2.45	90
21:59	704.50	2.50	2.35	85
22:00	707.20	2.70	2.55	90
22:01	709.80	2.60	2.45	90
22:02	712.30	2.50	2.35	90
22:03	714.80	2.50	2.35	90
22:04	717.30	2.50	2.35	90





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	**23GC094**	**CONSTANT HEAD INJECTION TEST** *Packer Isolated*
Test Number:	2	Tundra Consulting, LLC
Project No.:	Graphite Creek	

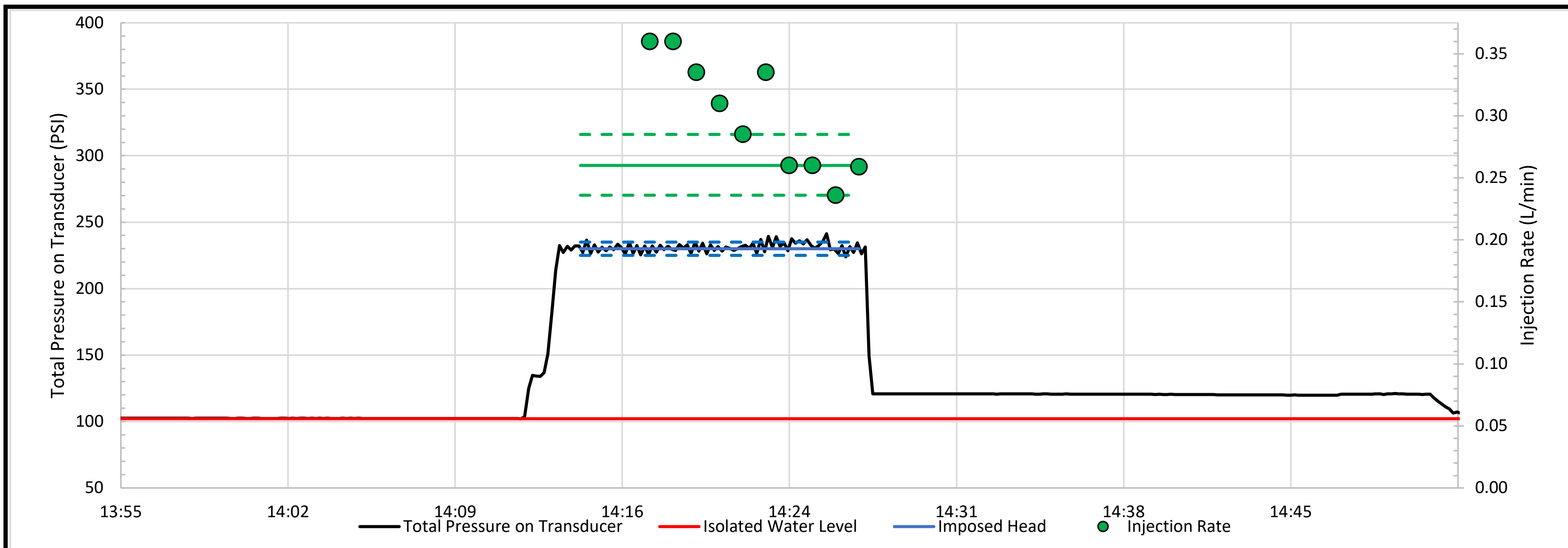
Location Description			Test Interval			General	
Current Depth:	425		**Bit Depth:**	315	(ft-ah)	**Test Start Date/Time:**	8/15/2023 11:30
Hole Size[A]:	HQ3		**Top of Test Interval:**	319.25	(ft-ah)	**Test End Date/Time:**	8/15/2023 15:00
Inclination:	49		**Stable Water Level[B]:**	102.1	(PSI)	**Supervisor:**	L. Marshall
Azimuth:	172		*Stable Water Level[C]:*	*11.19*	*(ft-bgs)*	**Drill Contractor:**	Major
Elevation:	791	(ft-amsl)	*Transducer Position[D]:*	*323.25*	(ft-ah)	**Rig No. & Type:**	Rig 37

Test Notes

Start Flush:	11:45		**Test Fluid** (water/poly):	Fresh Water	**Shear Pin Break Time:**	14:15
End Flush:	12:50		**Seal Quality:**	Good	**Injection End Time:**	14:27
Flushed Volume[E]:	515	(gal)	**Start Inflate Time:**	13:42	**Deflation Method:**	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection
Drilling Comments:	Good return
Geology, Hydrogeology, & Rock Mass:	Competent rock
Test Quality and Assessment:	Good test. Shorter test due to very low injection rate. Interval is below possibly confining fault.



	Estimate	Low End	High End	
Imposed Head (H):	89.93	86.41	93.44	(m-H_2O)
Injection Rate (Q):	0.37	*0.34*	*0.41*	(m^3/day)
Hydraulic Conductivity:	**1.10E-04**	*9.59E-05*	*1.25E-04*	(m/day)
Transmissivity:	**0.0035**	*0.0031*	*0.0040*	(m/day/m)

Test Parameters

Radius of Influence[F]:	**(R)**	10	(m)
Radius of the Well:	**(r_w)**	48.0	(mm)
Test Interval Length:	**(b)**	32.23	(m)
System Leak Rate:		0.06	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H} \ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	**23GC094**
Test Number:	**2**
Project No.:	**Graphite Creek**

CONSTANT HEAD INJECTION TEST

Packer Isolated

Tundra Consulting, LLC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
13:47	907.200		100
13:48	907.250	0.050	100
13:49	907.280	0.030	100
13:50	907.325	0.045	100
13:51	907.350	0.025	100
13:52	907.375	0.025	100
13:53	907.415	0.040	100
13:54	907.455	0.040	100

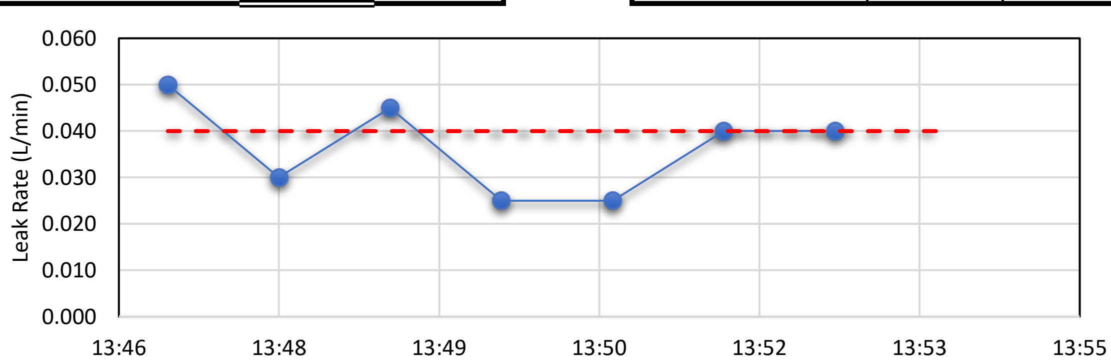
Injection Test

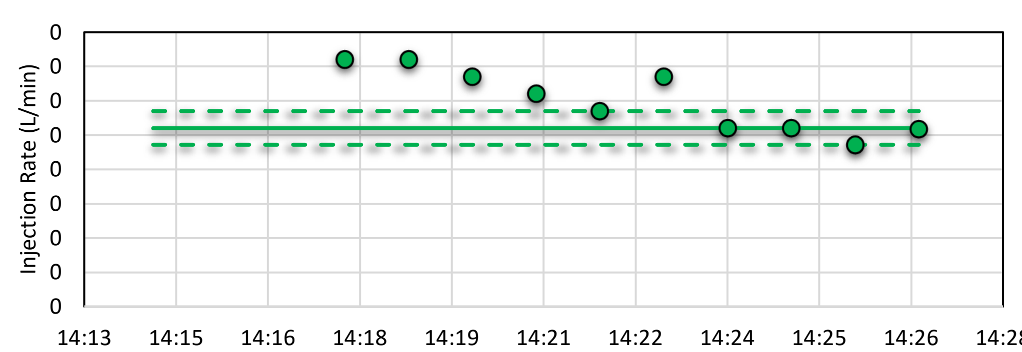
Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
14:15	912.850	-	-	100
14:16	913.750	0.90	0.86	100
14:17	913.825	0.08	0.04	100
14:18	914.225	0.40	0.36	100
14:19	914.625	0.40	0.36	100
14:20	915.000	0.38	0.33	100
14:21	915.350	0.35	0.31	100
14:22	915.675	0.32	0.28	100
14:23	916.050	0.38	0.33	100
14:24	916.350	0.30	0.26	105
14:25	916.650	0.30	0.26	100
14:26	916.926	0.28	0.24	105
14:27	917.225	0.30	0.26	100

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)

Leak Rate	0.04	L/min
Injection Rate	0.3	L/min
Min Injection Rate	0.24	L/min
Max Injection Rate	0.28	L/min





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	23GC094
Test Number:	3
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

Tundra Consulting, LLC

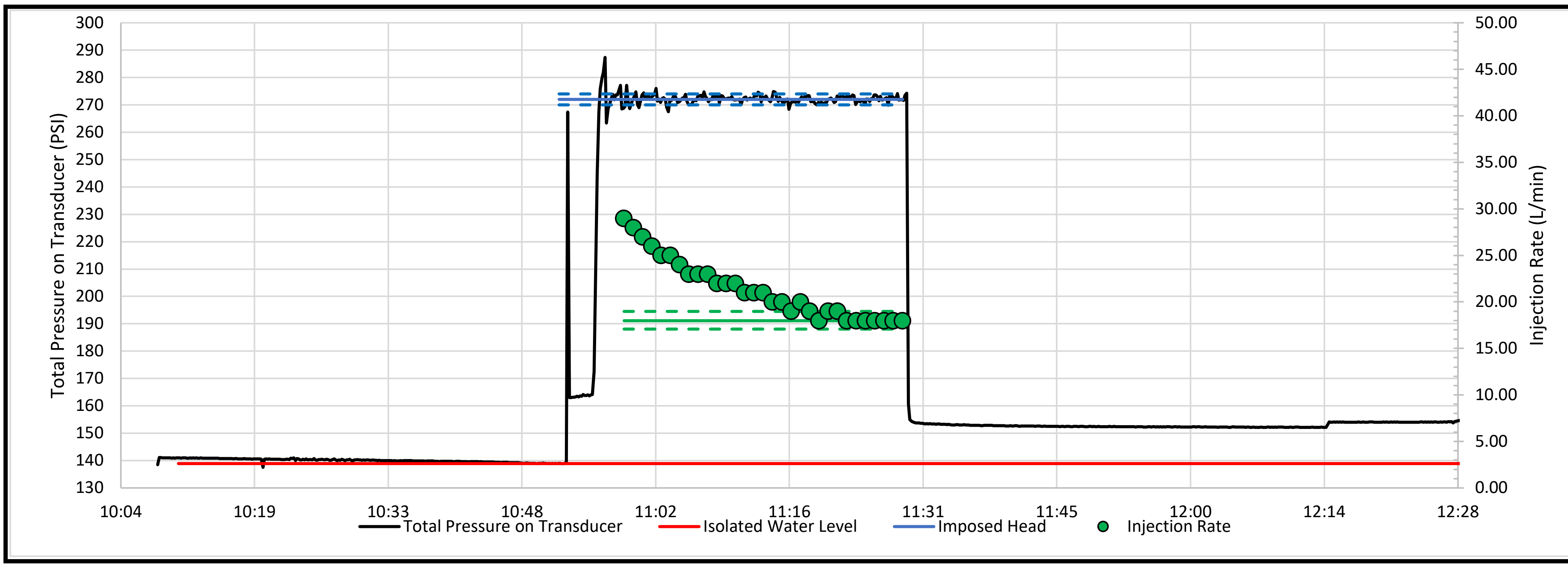
Location Description			Test Interval			General	
Current Depth:	570		Bit Depth:	415	(ft-ah)	Test Start Date/Time:	8/16/2023 7:00
Hole Size[A]:	HQ3		Top of Test Interval:	419.25	(ft-ah)	Test End Date/Time:	8/16/2023 13:00
Inclination:	49		Stable Water Level[B]:	138.9	(PSI)	Supervisor:	L. Marshall
Azimuth:	172		*Stable Water Level[C]:*	*-1.28*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	791	(ft-amsl)	*Transducer Position[D]:*	*423.25*	(ft-ah)	Rig No. & Type:	Rig 37

Test Notes

Start Flush:	7:30		Test Fluid (water/poly):	Fresh Water	Shear Pin Break Time:	10:52
End Flush:	9:30		Seal Quality:	Good	Injection End Time:	11:29
Flushed Volume[E]:	950	(gal)	Start Inflate Time:	12:28	Deflation Method:	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection
Drilling Comments:	Drill fluid has return.
Geology, Hydrogeology, & Rock Mass:	Weathered joint @ 425 ft, appeared to be 0.6 ft of core loss. Fairly competent rock otherwise
Test Quality and Assessment:	Good test with fully stabilized parameters. Sounder indicated water was rising after test.



	Estimate	Low End	High End	
Imposed Head (H):	93.58	92.17	94.99	(m-H_2O)
Injection Rate (Q):	25.88	*24.59*	*27.32*	(m^3/day)
Hydraulic Conductivity:	**5.11E-03**	*4.79E-03*	*5.48E-03*	(m/day)
Transmissivity:	**0.235**	*0.220*	*0.252*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	45.95	(m)
System Leak Rate:		0.04	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H} \ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	23GC094	**CONSTANT HEAD INJECTION TEST**	Tundra Consulting, LLC
Test Number:	3	***Packer Isolated***	
Project No.:	Graphite Creek		

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
10:25	928.125		110
10:26	928.175	0.05	110
10:27	928.225	0.05	110
10:28	928.250	0.025	110
10:29	928.275	0.025	110
10:30	928.300	0.025	110

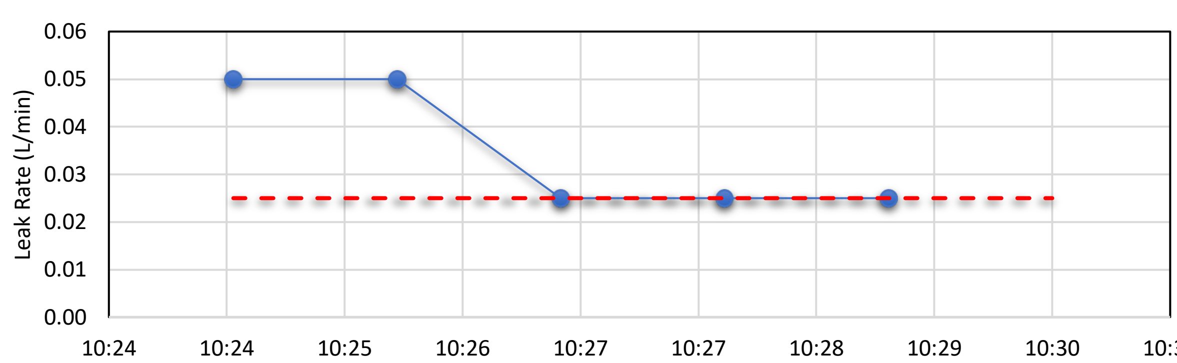
Leak Rate	0.025 L/min
Injection Rate	18.0 L/min
Min Injection Rate	17.08 L/min
Max Injection Rate	18.97 L/min

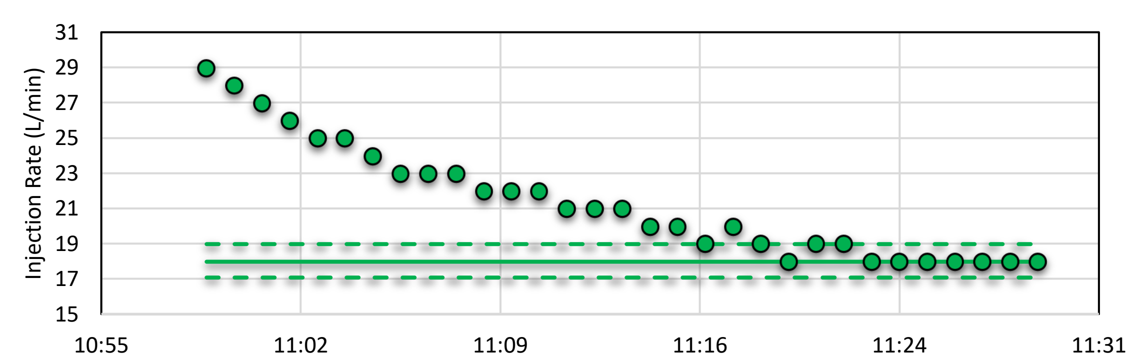
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
10:57	1000.0	-	-	110
10:58	1032.0	32.00	31.98	110
10:59	1061.0	29.00	28.97	110
11:00	1089.0	28.00	27.98	110
11:01	1116.0	27.00	26.97	110
11:02	1142.0	26.00	25.98	110
11:03	1167.0	25.00	24.98	110
11:04	1192.0	25.00	24.97	110
11:05	1216.0	24.00	23.98	110
11:06	1239.0	23.00	22.97	110
11:07	1262.0	23.00	22.98	110
11:08	1285.0	23.00	22.98	110
11:09	1307.0	22.00	21.97	110
11:10	1329.0	22.00	21.98	110
11:11	1351.0	22.00	21.97	110
11:12	1372.0	21.00	20.98	110
11:13	1393.0	21.00	20.98	110
11:14	1414.0	21.00	20.97	110
11:15	1434.0	20.00	19.98	110
11:16	1454.0	20.00	19.97	110
11:17	1473.0	19.00	18.98	110
11:18	1493.0	20.00	19.98	110
11:19	1512	19.00	18.97	110
11:20	1530	18.00	17.98	110
11:21	1549	19.00	18.98	110
11:22	1568	19.00	18.97	110
11:23	1586	18.00	17.98	110
11:24	1604	18.00	17.97	110
11:25	1622	18.00	17.98	110

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
11:26	1640	18.00	17.97	110
11:27	1658	18.00	17.98	110
11:28	1676	18.00	17.97	110
11:29	1694	18.00	17.98	110





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	23GC094	CONSTANT HEAD INJECTION TEST *Packer Isolated*	Tundra Consulting, LLC
Test Number:	4		
Project No.:	Graphite Creek		

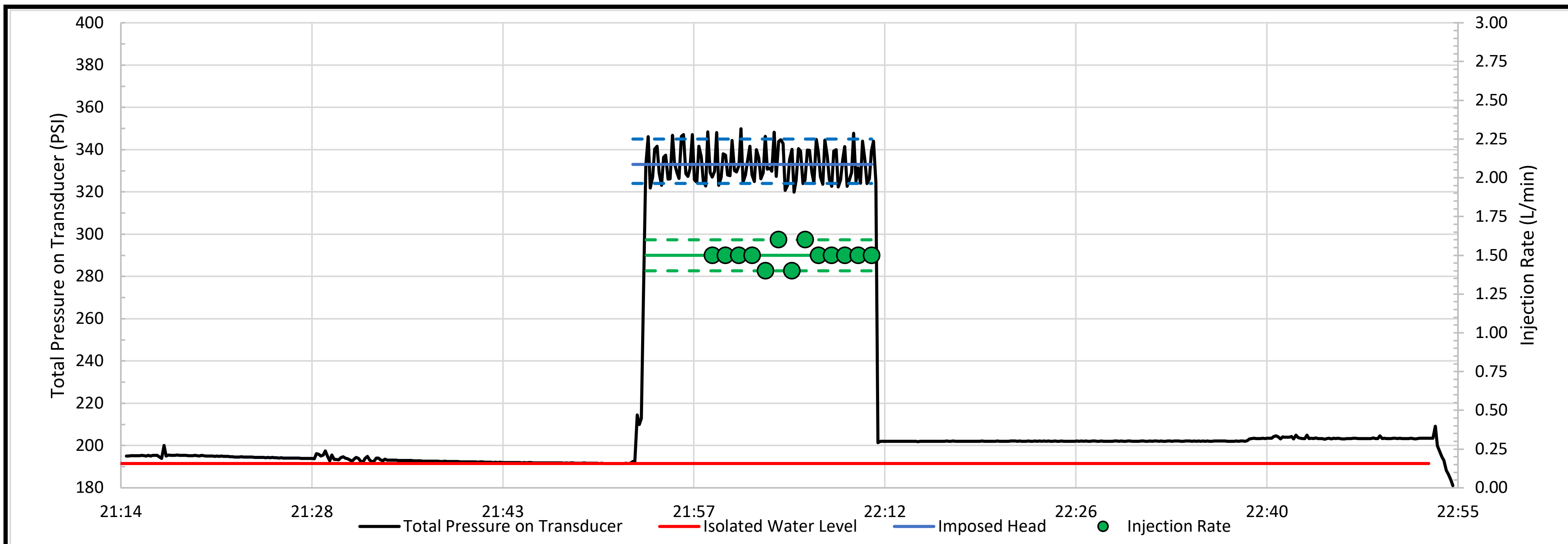
Location Description			Test Interval			General	
Current Depth:	611		Bit Depth:	565	(ft-ah)	Test Start Date/Time:	8/16/2023 19:30
Hole Size[A]:	HQ3		Top of Test Interval:	569.25	(ft-ah)	Test End Date/Time:	8/16/2023 23:30
Inclination:	49		Stable Water Level[B]:	191.5	(PSI)	Supervisor:	L. Marshall
Azimuth:	172		*Stable Water Level[C]:*	*-12.05*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	791	(ft-amsl)	*Transducer Position[D]:*	*573.25*	(ft-ah)	Rig No. & Type:	Rig 37

Test Notes

Start Flush:	19:30		Test Fluid (water/poly):	Fresh Water	Shear Pin Break Time:	21:53
End Flush:	22:30		Seal Quality:	Perfect	Injection End Time:	22:11
Flushed Volume[E]:	475	(gal)	Start Inflate Time:	21:28	Deflation Method:	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection
Drilling Comments:	Had return
Geology, Hydrogeology, & Rock Mass:	Appeared to have 2 ft of core loss between 583.5 and 593.5, and 1 ft overage between 593.5 and 603.5 ft. Fairly disked/broken zone between 593.5 and 603.5 ft.
Test Quality and Assessment:	Good test with fully stabilized parameters. No measureable rod leakage. Rig water pump is oscillating, causing noise in data.



	Estimate	Low End	High End	
Imposed Head (H):	99.49	93.16	107.92	(m-H_2O)
Injection Rate (Q):	2.16	*2.02*	*2.30*	(m^3/day)
Hydraulic Conductivity:	**1.45E-03**	*1.25E-03*	*1.65E-03*	(m/day)
Transmissivity:	**0.0184**	*0.0159*	*0.0210*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	12.73	(m)
System Leak Rate:		0.00	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H} \ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	23GC094
Test Number:	4
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

Tundra Consulting, LLC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
21:32	1414.30		120
21:33	1414.30	0.00	120
21:34	1414.30	0.00	120

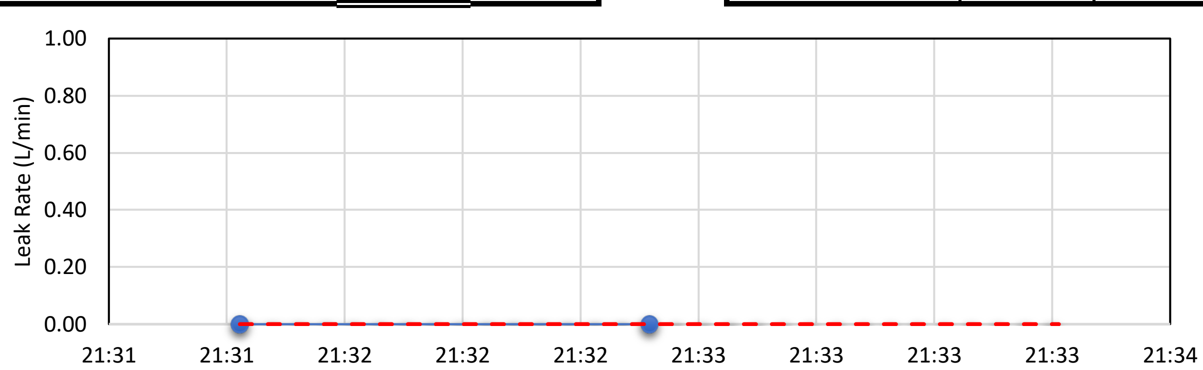
Leak Rate	0.00 L/min
Injection Rate	1.5 L/min
Min Injection Rate	1.40 L/min
Max Injection Rate	1.60 L/min

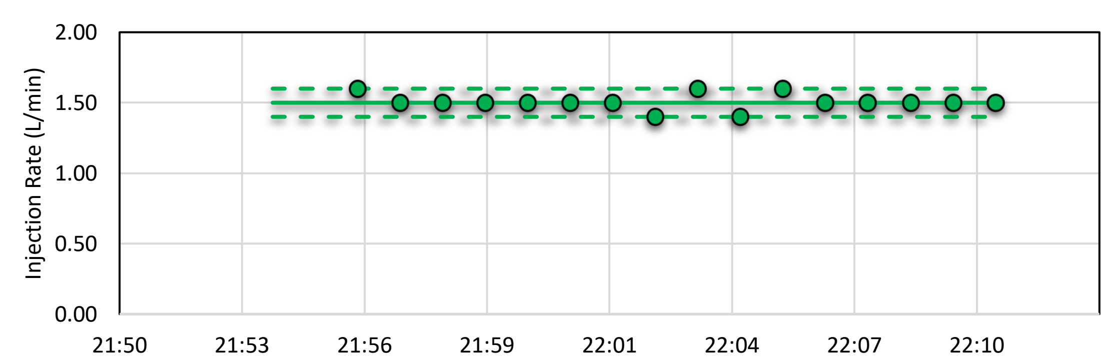
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
21:55	1417.6	-	-	120
21:56	1419.2	1.60	1.60	120
21:57	1420.7	1.50	1.50	120
21:58	1422.2	1.50	1.50	120
21:59	1423.7	1.50	1.50	120
22:00	1425.2	1.50	1.50	120
22:01	1426.7	1.50	1.50	120
22:02	1428.2	1.50	1.50	120
22:03	1429.6	1.40	1.40	120
22:04	1431.2	1.60	1.60	120
22:05	1432.6	1.40	1.40	120
22:06	1434.2	1.60	1.60	120
22:07	1435.7	1.50	1.50	120
22:08	1437.2	1.50	1.50	120
22:09	1438.7	1.50	1.50	120
22:10	1440.2	1.50	1.50	120
22:11	1441.7	1.50	1.50	120

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	23GC099	**CONSTANT HEAD INJECTION TEST** *Packer Isolated*	Tundra Consulting, LLC
Test Number:	1		
Project No.:	Graphite Creek		

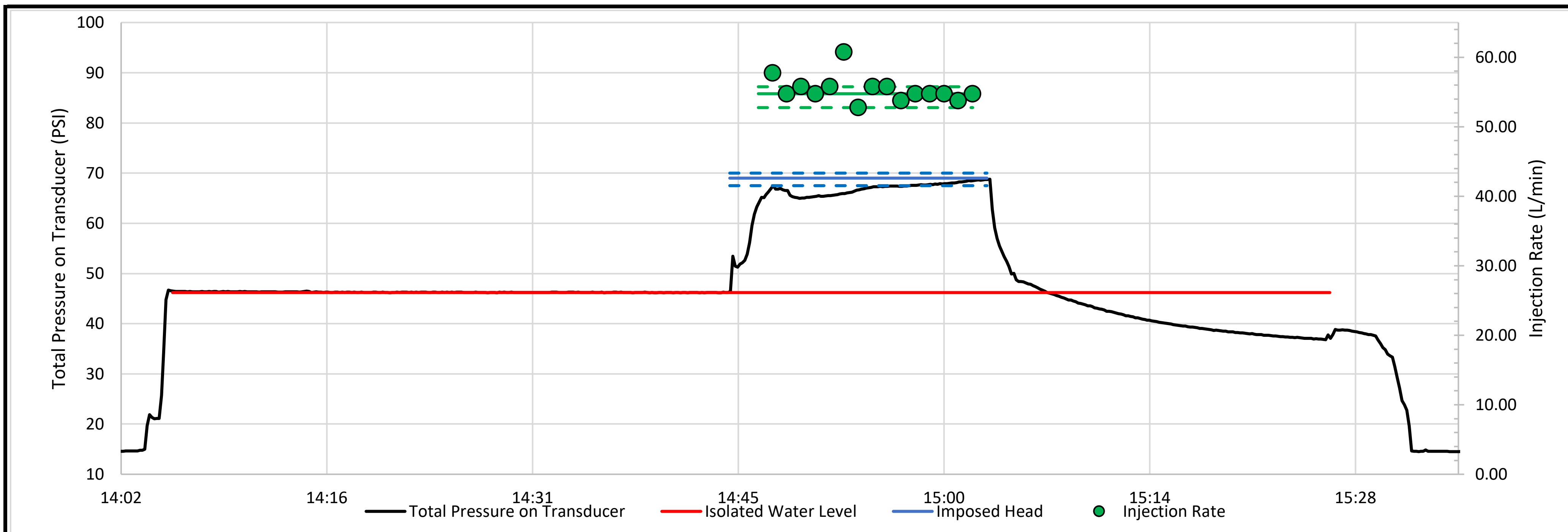
Location Description			Test Interval			General	
Current Depth:	184		Bit Depth:	94	(ft-ah)	Test Start Date/Time:	8/21/2023 9:05
Hole Size[A]:	HQ3		Top of Test Interval:	98.25	(ft-ah)	Test End Date/Time:	8/21/2023 16:30
Inclination:	51		Stable Water Level[B]:	46.2	(PSI)	Supervisor:	L. Marshall
Azimuth:	157		*Stable Water Level[C]:*	*-34.88*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	1078	(ft-amsl)	*Transducer Position[D]:*	*102.25*	(ft-ah)	Rig No. & Type:	Rig 37

Test Notes

Start Flush:	9:09		Test Fluid (water/poly):	Fresh Water	Shear Pin Break Time:	14:45
End Flush:	10:45		Seal Quality:	Perfect	Injection End Time:	15:03
Flushed Volume[E]:	1078	(gal)	Start Inflate Time:	14:09	Deflation Method:	E Pin

Zone Description & Comments

Test Type:	Constant Head Injection
Drilling Comments:	Good drilling
Geology, Hydrogeology, & Rock Mass:	Few weathered joints, graphitic, possibly artesian
Test Quality and Assessment:	Initial attempted failed to seat packer. The post-test water level dropped below the shut-in pressure. Possible partial bypass around packer through fractures.



	Estimate	Low End	High End	
Imposed Head (H):	16.03	14.98	16.73	(m-H_2O)
Injection Rate (Q):	78.85	*75.97*	*80.29*	(m^3/day)
Hydraulic Conductivity:	**1.60E-01**	*1.48E-01*	*1.74E-01*	(m/day)
Transmissivity:	**4.18**	*3.86*	*4.56*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	26.14	(m)
System Leak Rate:		0.34	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	23GC099	CONSTANT HEAD INJECTION TEST	Tundra Consulting, LLC
Test Number:	1	*Packer Isolated*	
Project No.:	Graphite Creek		

Leak Rate

Time	Totalizer	Rate	Pressure
(Hours)	*(L)*	*(L/min)*	*(PSI)*
14:18	1831.700		30
14:19	1831.900	0.20	30
14:20	1832.125	0.22	30
14:21	1832.375	0.25	30
14:22	1832.625	0.25	30
14:23	1832.825	0.20	30
14:24	1833.125	0.30	30
14:25	1833.325	0.20	30

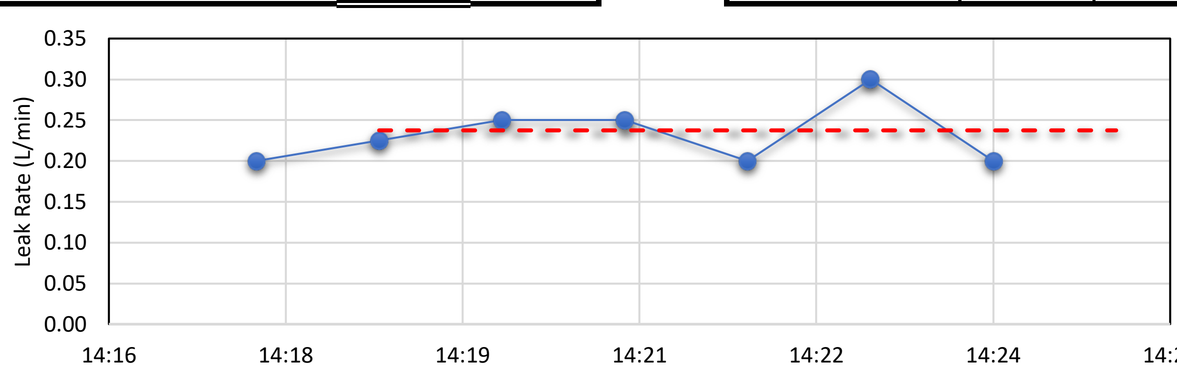
Leak Rate	0.24 L/min
Injection Rate	54.8 L/min
Min Injection Rate	52.76 L/min
Max Injection Rate	55.76 L/min

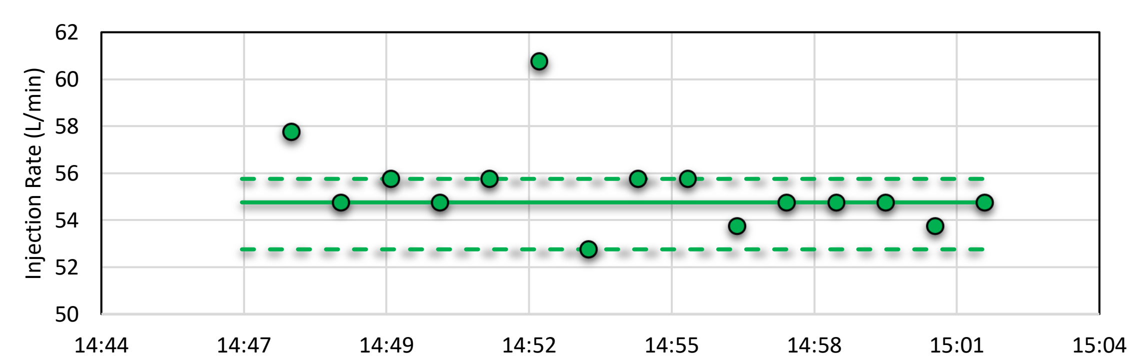
Injection Test

Time	Totalizer	Total Rate	Test Rate	Pressure
(Hours)	*(L)*	*(L/min)*	*(L/min)*	*(PSI)*
14:47	1978.0	-	-	30
14:48	2036.0	58.00	57.76	30
14:49	2091.0	55.00	54.76	30
14:50	2147.0	56.00	55.76	30
14:51	2202.0	55.00	54.76	30
14:52	2258.0	56.00	55.76	30
14:53	2319.0	60.99	60.76	30
14:54	2372.0	53.00	52.76	30
14:55	2428.0	56.00	55.76	30
14:56	2484.0	56.00	55.76	30
14:57	2538.0	54.00	53.76	30
14:58	2593.0	55.00	54.76	30
14:59	2648.0	55.00	54.76	30
15:00	2703.0	55.00	54.76	30
15:01	2757.0	54.00	53.76	30
15:02	2812.0	55.00	54.76	30

Injection Test *(Continued)*

Time	Totalizer	Total Rate	Test Rate	Pressure
(Hours)	*(L)*	*(L/min)*	*(L/min)*	*(PSI)*





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	**23GC099**	**CONSTANT HEAD INJECTION TEST**	**Tundra Consulting, LLC**
Test Number:	**2**	***Packer Isolated***	
Project No.:	**Graphite Creek**		

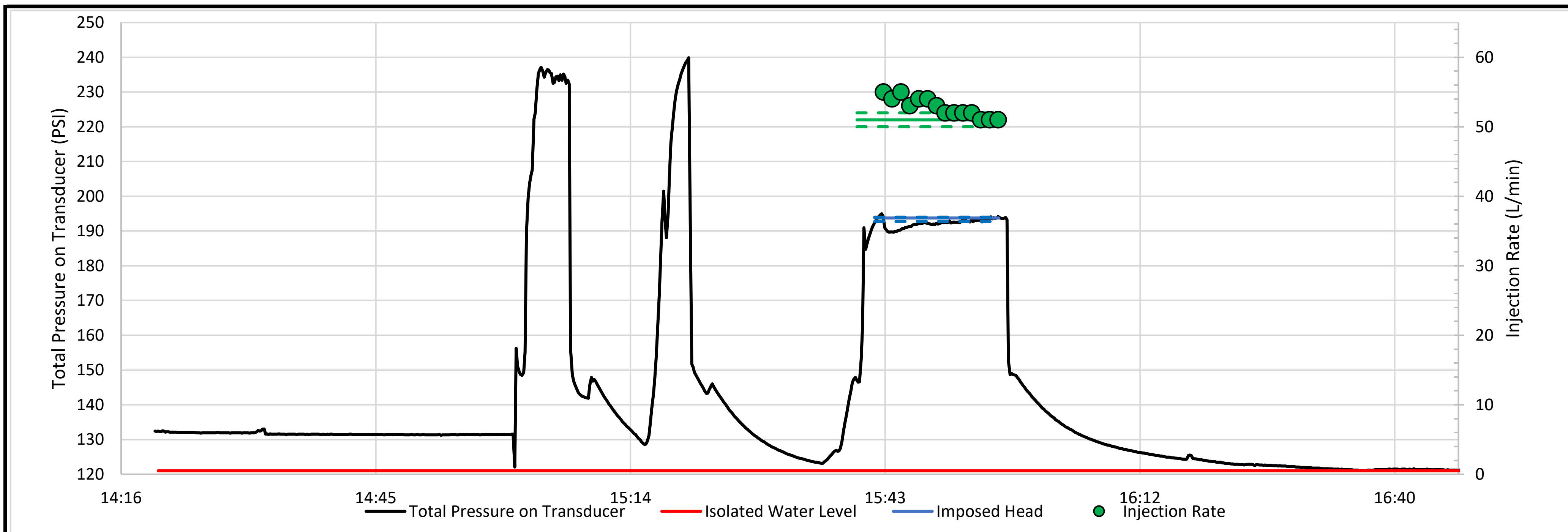
Location Description			**Test Interval**			**General**	
Current Depth:	534		**Bit Depth:**	364	(ft-ah)	**Test Start Date/Time:**	8/22/2023 10:50
Hole Size[A]:	HQ3		**Top of Test Interval:**	368.25	(ft-ah)	**Test End Date/Time:**	8/22/2023 17:30
Inclination:	51		**Stable Water Level[B]:**	121	(PSI)	**Supervisor:**	L. Marshall
Azimuth:	157		*Stable Water Level[C]:*	*13.10*	*(ft-bgs)*	**Drill Contractor:**	Major
Elevation:	1073	(ft-amsl)	*Transducer Position[D]:*	*372.25*	(ft-ah)	**Rig No. & Type:**	Rig 37

Test Notes

Start Flush:	9:09		**Test Fluid** (water/poly):	Fresh Water	**Shear Pin Break Time:**	15:00
End Flush:	10:45		**Seal Quality:**	Perfect	**Injection End Time:**	15:56
Flushed Volume[E]:	1078	(gal)	**Start Inflate Time:**	14:09	**Deflation Method:**	E Pin+overshot

Zone Description & Comments

Test Type:	Constant Head Injection NOTE: (1 of 2 tests on same Total Depth. Different Top of Test)
Drilling Comments:	Good drilling
Geology, Hydrogeology, & Rock Mass:	Few weathered joints, graphitic
Test Quality and Assessment:	Pump couldn't keep up with ~90 L/min injection rate at 110 psi, swivel off, let tank fill again, swivel on, then started injection again at 50 psi. The post-test water level dropped below the shut-in pressure. Possible partial bypass around packer through fractures.



	Estimate	**Low End**	**High End**	
Imposed Head (H):	51.15	50.45	51.33	(m-H_2O)
Injection Rate (Q):	73.44	*72.00*	*74.88*	(m^3/day)
Hydraulic Conductivity:	**2.41E-02**	*2.36E-02*	*2.50E-02*	(m/day)
Transmissivity:	**1.2200**	*1.1919*	*1.2612*	(m/day/m)

Test Parameters

Radius of Influence[F]:	**(R)**	10	(m)
Radius of the Well:	**(r_w)**	48.0	(mm)
Test Interval Length:	**(b)**	50.52	(m)
System Leak Rate:		0.00	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	23GC099	CONSTANT HEAD INJECTION TEST
Test Number:	2	*Packer Isolated*
Project No.:	Graphite Creek	

Tundra Consulting, LLC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
14:36	2842.850		110
14:37	2842.850	0.00	110
14:38	2842.850	0.00	110

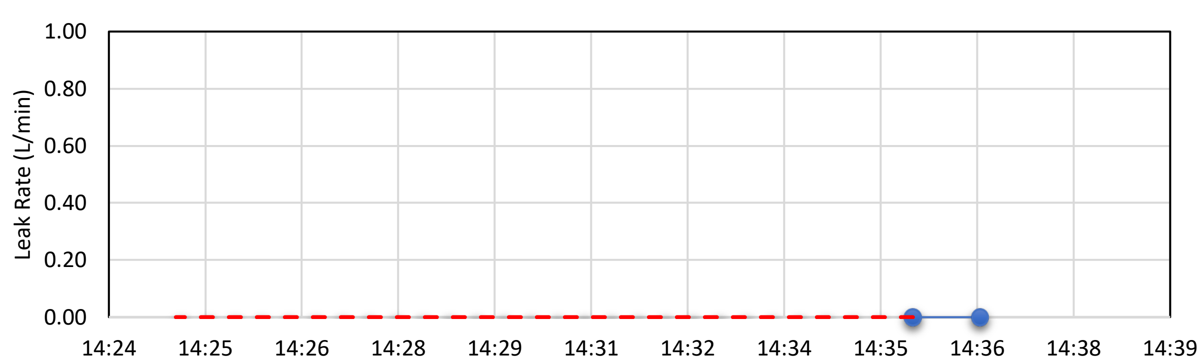
Leak Rate	0.00 L/min
Injection Rate	51.0 L/min
Min Injection Rate	50.00 L/min
Max Injection Rate	52.00 L/min

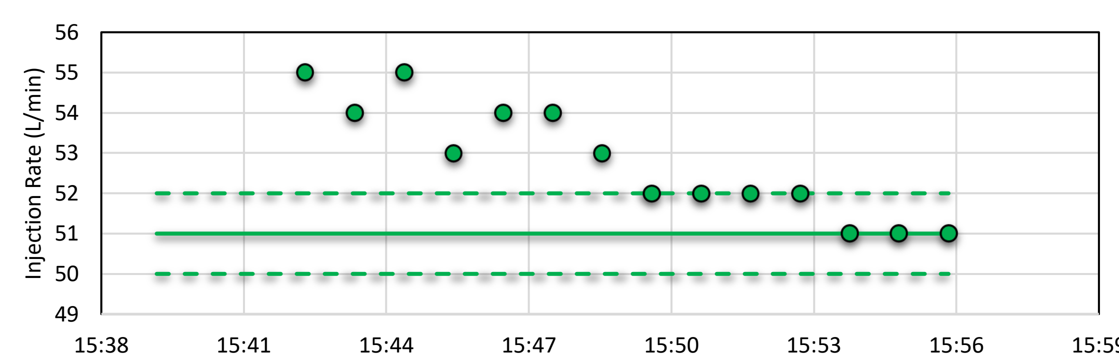
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
15:42	568.0	-	-	30
15:43	623.0	55.00	55.00	30
15:44	677.0	54.00	54.00	30
15:45	732.0	55.00	55.00	30
15:46	785.0	53.00	53.00	30
15:47	839.0	54.00	54.00	30
15:48	893.0	54.00	54.00	30
15:49	946.0	53.00	53.00	30
15:50	998.0	52.00	52.00	30
15:51	1050.0	52.00	52.00	30
15:52	1102.0	52.00	52.00	30
15:53	1154.0	52.00	52.00	30
15:54	1205.0	51.00	51.00	30
15:55	1256.0	51.00	51.00	30
15:56	1307.0	51.00	51.00	30

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	23GC099	CONSTANT HEAD INJECTION TEST	Tundra Consulting, LLC
Test Number:	3	*Packer Isolated*	
Project No.:	Graphite Creek		

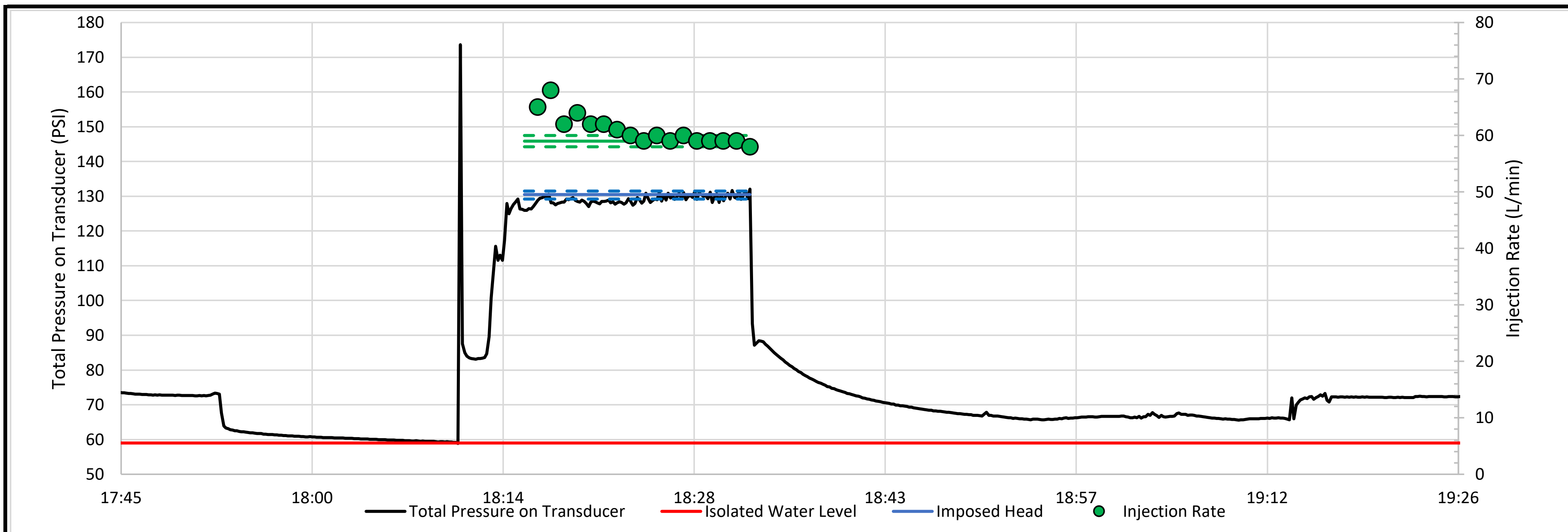
Location Description			Test Interval			General	
Current Depth:	534		Bit Depth:	184	(ft-ah)	Test Start Date/Time:	8/22/2023 17:35
Hole Size[A]:	HQ3		Top of Test Interval:	188.25	(ft-ah)	Test End Date/Time:	8/22/2023 20:30
Inclination:	51		Stable Water Level[B]:	59	(PSI)	Supervisor:	L. Marshall
Azimuth:	157		*Stable Water Level[C]:*	*17.13*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	1073	(ft-amsl)	*Transducer Position[D]:*	*192.25*	(ft-ah)	Rig No. & Type:	Rig 37

Test Notes

Start Flush:	10:50	Test Fluid (water/poly):	Fresh Water	Shear Pin Break Time:	18:11
End Flush:	12:30	Seal Quality:	Perfect	Injection End Time:	18:33
Flushed Volume[E]:	793 (gal)	Start Inflate Time:	17:50:00	Deflation Method:	E Pin+overshot

Zone Description & Comments

Test Type:	Constant Head Injection NOTE: (2 of 2 tests on same current depth. Adjusted Top of Test)
Drilling Comments:	Good drilling
Geology, Hydrogeology, & Rock Mass:	Few weathered joints, graphitic
Test Quality and Assessment:	Good test. Leak test at 200 psi (no leakage) but tested at 50 psi as pump could not handle higher injection rate. Graphite borehole walls act as a lubricant, occasionally making it difficult to deflate elements with E-pin. Post-test water level compares well with shut-in pressure (some residual mounding), indicating good seal.



	Estimate	Low End	High End	
Imposed Head (H):	50.27	49.36	50.97	(m-H_2O)
Injection Rate (Q):	84.95	*83.51*	*86.39*	(m^3/day)
Hydraulic Conductivity:	**1.36E-02**	*1.32E-02*	*1.41E-02*	(m/day)
Transmissivity:	**1.44**	*1.39*	*1.49*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	105.38	(m)
System Leak Rate:		0.00	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	23GC099	CONSTANT HEAD INJECTION TEST	Tundra Consulting, LLC
Test Number:	3	*Packer Isolated*	
Project No.:	Graphite Creek		

Leak Rate

Time *(Hours)*	Totalizer *(L)*	Rate *(L/min)*	Pressure *(PSI)*
17:54	1438.200		200
17:55	1438.200	0.00	200

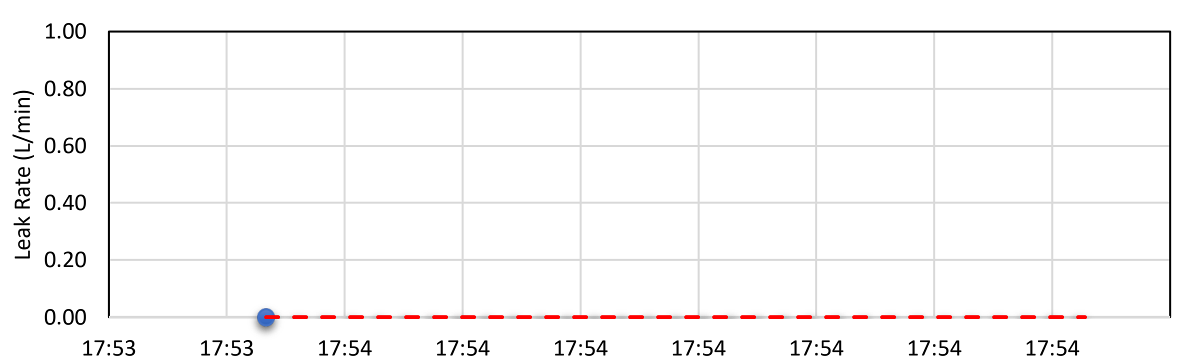
Leak Rate	0.00	L/min
Injection Rate	59.0	L/min
Min Injection Rate	58.00	L/min
Max Injection Rate	60.00	L/min

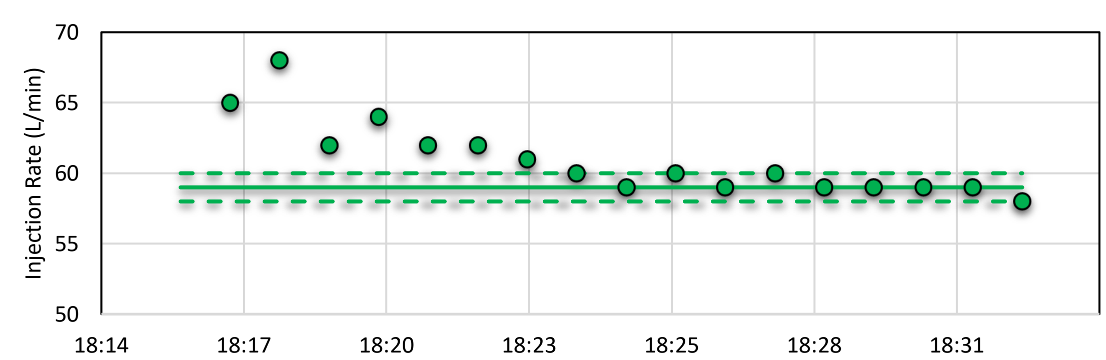
Injection Test

Time *(Hours)*	Totalizer *(L)*	Total Rate *(L/min)*	Test Rate *(L/min)*	Pressure *(PSI)*
18:16	1681.0	-	-	50
18:17	1746.0	65.00	65.00	50
18:18	1814.0	67.99	67.99	50
18:19	1876.0	61.99	61.99	50
18:20	1940.0	63.99	63.99	50
18:21	2002.0	61.99	61.99	50
18:22	2064.0	61.99	61.99	50
18:23	2125.0	60.99	60.99	50
18:24	2185.0	60.00	60.00	50
18:25	2244.0	59.00	59.00	50
18:26	2304.0	59.99	59.99	50
18:27	2363.0	59.00	59.00	50
18:28	2423.0	60.00	60.00	50
18:29	2482.0	59.00	59.00	50
18:30	2541.0	59.00	59.00	50
18:31	2600.0	59.00	59.00	50
18:32	2659.0	59.00	59.00	50
18:33	2717.0	58.00	58.00	50

Injection Test *(Continued)*

Time *(Hours)*	Totalizer *(L)*	Total Rate *(L/min)*	Test Rate *(L/min)*	Pressure *(PSI)*





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	23GC100	CONSTANT HEAD INJECTION TEST
Test Number:	1	*Packer Isolated*
Project No.:	Graphite Creek	Tundra Consulting, LLC

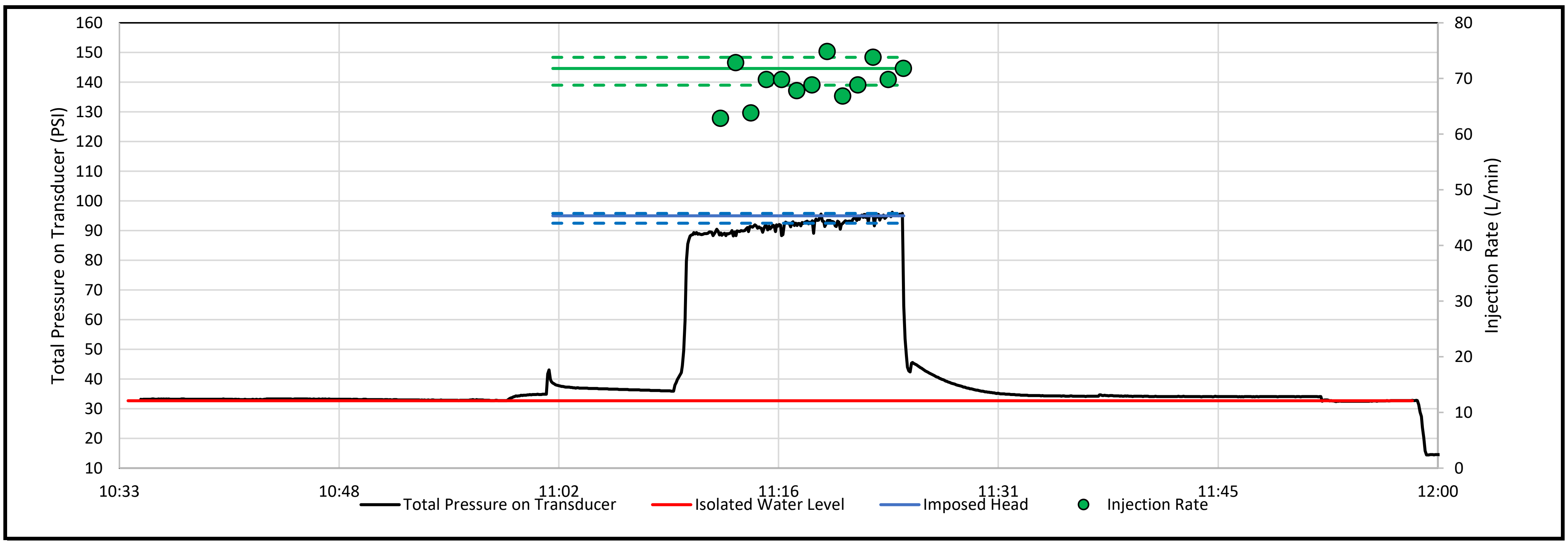
Location Description			Test Interval			General	
Current Depth:	185		**Bit Depth:**	89	(ft-ah)	**Test Start Date/Time:**	8/27/2023 8:15
Hole Size[A]:	HQ3		**Top of Test Interval:**	93.25	(ft-ah)	**Test End Date/Time:**	8/27/2023 12:05
Inclination:	50		**Stable Water Level[B]:**	32.7	(PSI)	**Supervisor:**	E. Wilson
Azimuth:	175		*Stable Water Level[C]:*	*-1.22*	*(ft-bgs)*	**Drill Contractor:**	Major
Elevation:	866	(ft-amsl)	*Transducer Position[D]:*	*97.25*	(ft-ah)	**Rig No. & Type:**	Rig 37

Test Notes

Start Flush:	8:15		**Test Fluid** (water/poly):	Fresh Water	**Shear Pin Break Time:**	11:02
End Flush:	9:00		**Seal Quality:**	Good	**Injection End Time:**	11:25
Flushed Volume[E]:	450	(gal)	**Start Inflate Time:**	10:57	**Deflation Method:**	E-Pin

Zone Description & Comments

Test Type:	Constant Head Injection
Drilling Comments:	No return. Below fault; stable hole. Good unfractured zone to set packer.
Geology, Hydrogeology, & Rock Mass:	Good solid Graphite.
Test Quality and Assessment:	Good Test although not fully stabilized. Match very latest time imposed head and injection rates. Pressure during test was not very stable.



	Estimate	Low End	High End	
Imposed Head (H):	43.80	42.04	44.36	(m-H_2O)
Injection Rate (Q):	103	*99*	*106*	(m^3/day)
Hydraulic Conductivity:	**7.17E-02**	*6.78E-02*	*7.68E-02*	(m/day)
Transmissivity:	**2.0**	*1.9*	*2.1*	(m/day/m)

Test Parameters			
Radius of Influence[F]:	**(R)**	10	(m)
Radius of the Well:	**(r_w)**	48.0	(mm)
Test Interval Length:	**(b)**	27.97	(m)
System Leak Rate:		0	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	23GC100
Test Number:	1
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

Tundra Consulting, LLC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
10:51	244.0	-	50
10:52	244.3	0.30	50
10:53	244.5	0.20	50
10:54	244.7	0.20	50
10:55	244.8	0.10	50
10:56	245.0	0.20	50

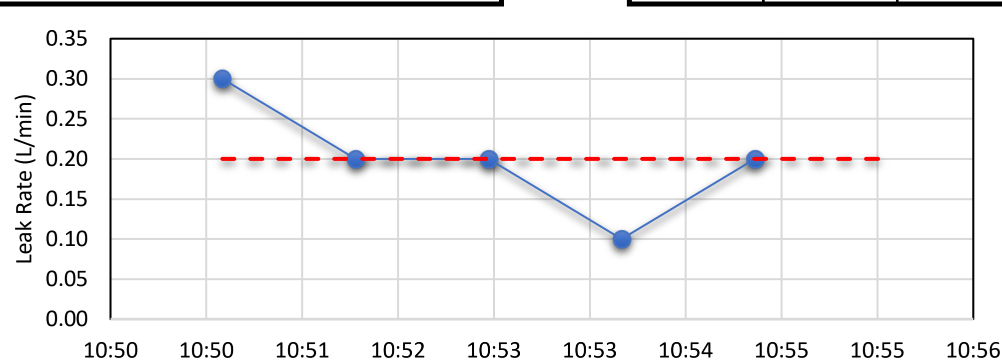
Injection Test

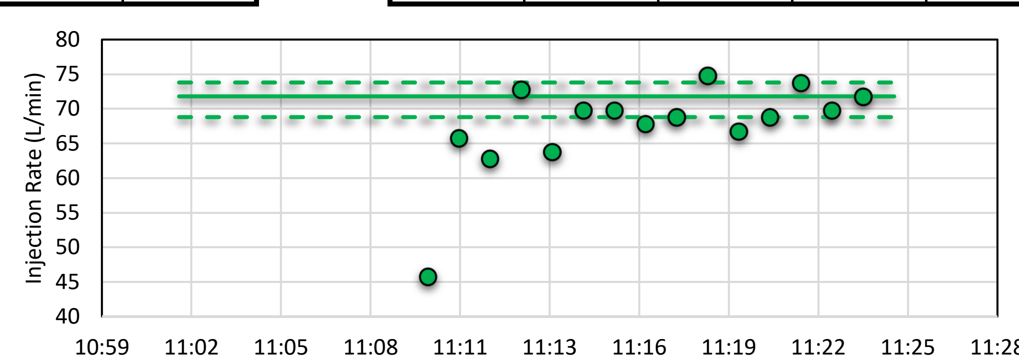
Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
11:10	3254	-	-	50
11:11	3300	46.0	45.8	50
11:12	3366	66.0	65.8	50
11:13	3429	63.0	62.8	50
11:14	3502	73.0	72.8	50
11:15	3566	64.0	63.8	50
11:16	3636	70.0	69.8	50
11:17	3706	70.0	69.8	50
11:18	3774	68.0	67.8	50
11:19	3843	69.0	68.8	50
11:20	3918	75.0	74.8	50
11:21	3985	67.0	66.8	50
11:22	4054	69.0	68.8	50
11:23	4128	74.0	73.8	50
11:24	4198	70.0	69.8	50
11:25	4270	72.0	71.8	50

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)

Leak Rate	0.2 L/min
Injection Rate	71.8 L/min
Min Injection Rate	68.8 L/min
Max Injection Rate	73.8 L/min





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	23GC100
Test Number:	2
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

Tundra Consulting, LLC

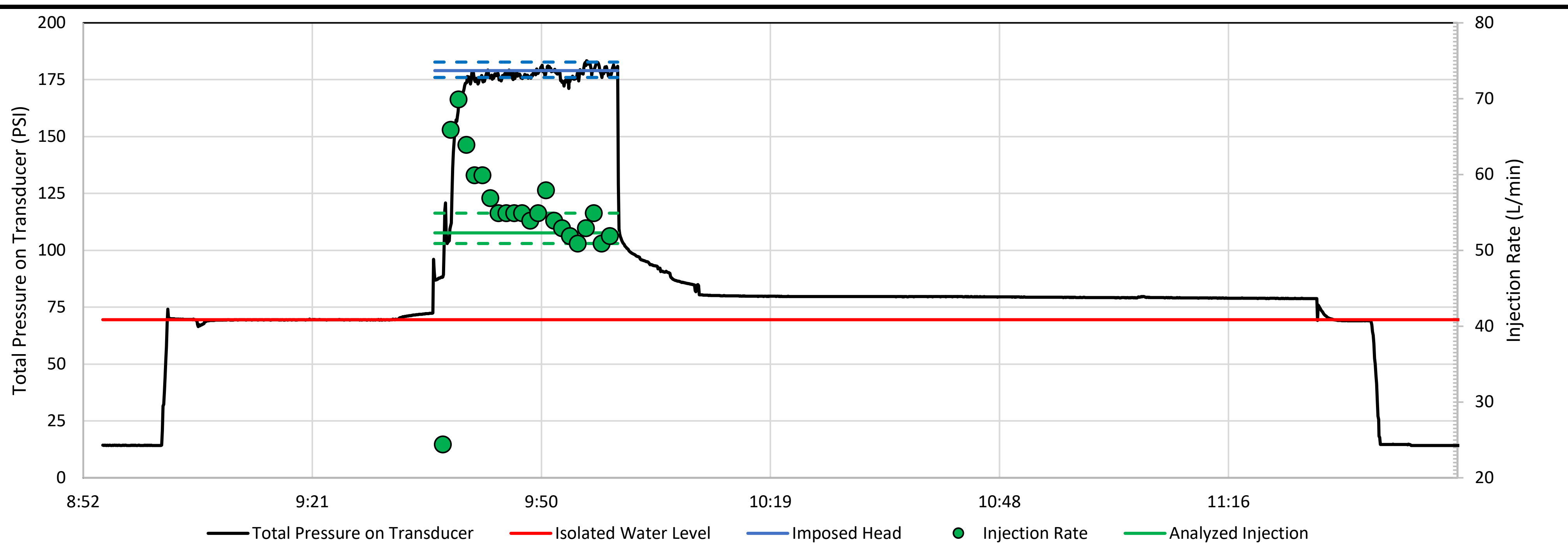
Location Description			Test Interval			General	
Current Depth:	315		Bit Depth:	185	(ft-ah)	Test Start Date/Time:	8/28/2023 7:45
Hole Size[A]:	HQ3		Top of Test Interval:	189.25	(ft-ah)	Test End Date/Time:	8/28/2023 12:05
Inclination:	50		Stable Water Level[B]:	69.5	(PSI)	Supervisor:	E. Wilson
Azimuth:	175		*Stable Water Level[C]:*	*-16.03*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	866	(ft-amsl)	*Transducer Position[D]:*	*193.25*	(ft-ah)	Rig No. & Type:	Rig 37

Test Notes

Start Flush:	7:45		Test Fluid (water/poly):	Fresh Water	Shear Pin Break Time:	9:37
End Flush:	8:30		Seal Quality:	Good	Injection End Time:	10:00
Flushed Volume[E]:	450	(gal)	Start Inflate Time:	9:30	Deflation Method:	E-Pin

Zone Description & Comments

Test Type:	Constant Head Injection
Drilling Comments:	No return. Below fault; stable hole. Good unfractured zone to set packer.
Geology, Hydrogeology, & Rock Mass:	Good solid Graphite.
Test Quality and Assessment:	Good Test, although injection rate was very noisy.



	Estimate	Low End	High End	
Imposed Head (H):	76.99	*74.88*	*79.62*	($m\text{-}H_2O$)
Injection Rate (Q):	75	*73*	*79*	(m^3/day)
Hydraulic Conductivity:	**2.17E-02**	*2.04E-02*	*2.34E-02*	(m/day)
Transmissivity:	**0.83**	*0.78*	*0.90*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	38.33	(m)
System Leak Rate:		0	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

$$T = \frac{Q}{2\pi H} \ln\left(\frac{R}{r_w}\right)$$

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	**23GC100**	**CONSTANT HEAD INJECTION TEST**
Test Number:	**2**	***Packer Isolated***
Project No.:	**Graphite Creek**	Tundra Consulting, LLC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
9:21	355.8	-	30
9:22	356.8	1.00	100
9:23	357.2	0.40	100
9:24	357.5	0.30	100
9:25	357.6	0.10	100
9:26	357.7	0.10	100
9:27	357.8	0.10	100
9:28	357.9	0.10	100
9:29	358.0	0.10	100
9:30	358.1	0.10	100

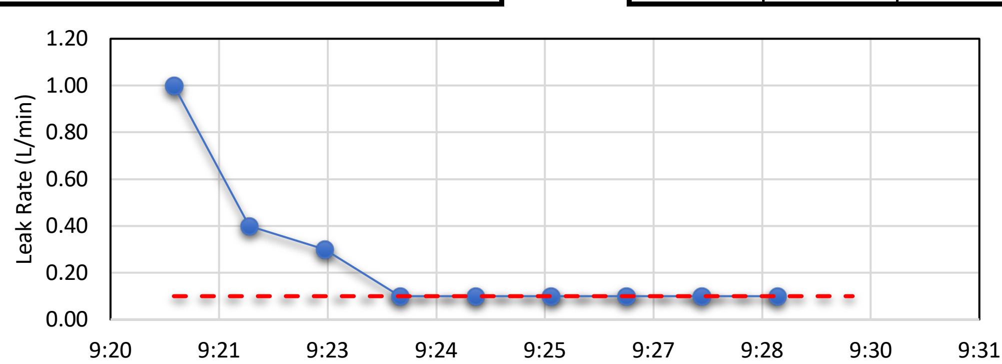
Leak Rate	0.10 L/min
Injection Rate	52.30 L/min
Min Injection Rate	50.90 L/min
Max Injection Rate	54.90 L/min

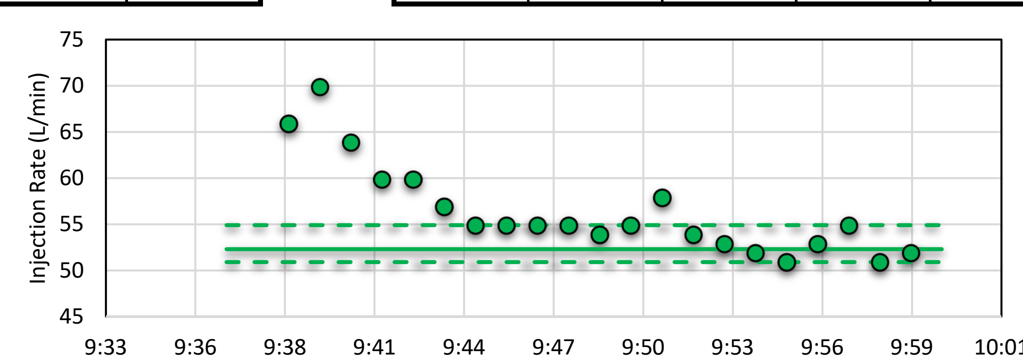
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
9:38	4385.5	-	-	25
9:39	4410	24.50	24.40	60
9:40	4476	66.00	65.90	95
9:41	4546	70.00	69.90	100
9:42	4610	64.00	63.90	100
9:43	4670	60.00	59.90	100
9:44	4730	60.00	59.90	100
9:45	4787	57.00	56.90	100
9:46	4842	55.00	54.90	100
9:47	4897	55.00	54.90	100
9:48	4952	55.00	54.90	100
9:49	5007	55.00	54.90	100
9:50	5061	54.00	53.90	100
9:51	5116	55.00	54.90	100
9:52	5174	58.00	57.90	100
9:53	5228	54.00	53.90	100
9:54	5281	53.00	52.90	100
9:55	5333	52.00	51.90	100
9:56	5384	51.00	50.90	100
9:57	5437	53.00	52.90	100
9:58	5492	55.00	54.90	100
9:59	5543	51.00	50.90	100
10:00	5595	52.00	51.90	100

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	23GC100	CONSTANT HEAD INJECTION TEST	Tundra Consulting, LLC
Test Number:	3	*Packer Isolated*	
Project No.:	Graphite Creek		

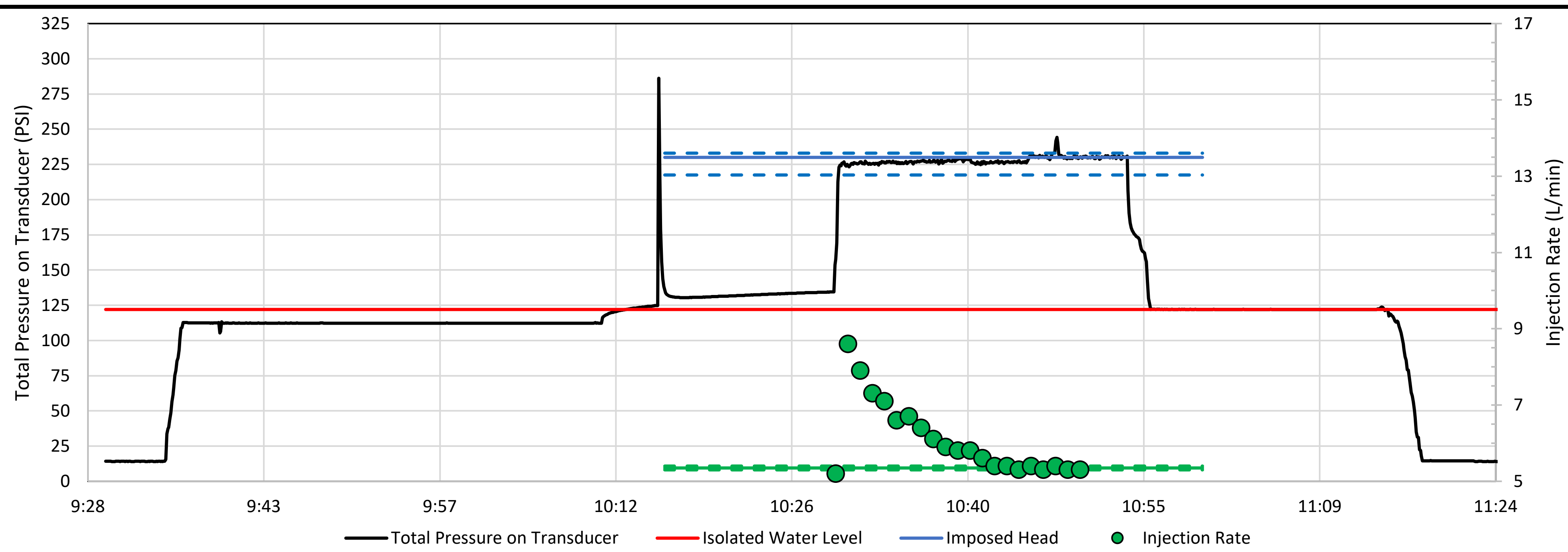
Location Description			Test Interval			General	
Current Depth:	485		Bit Depth:	315	(ft-ah)	Test Start Date/Time:	8/29/2023 8:00
Hole Size[A]:	HQ3		Top of Test Interval:	319.25	(ft-ah)	Test End Date/Time:	8/29/2023 12:05
Inclination:	50		Stable Water Level[B]:	122	(PSI)	Supervisor:	E. Wilson
Azimuth:	175		*Stable Water Level[C]:*	*-44.11*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	866	(ft-amsl)	*Transducer Position[D]:*	*323.25*	(ft-ah)	Rig No. & Type:	Rig 37

Test Notes

Start Flush:	8:00		Test Fluid (water/poly):	Fresh Water	Shear Pin Break Time:	10:16
End Flush:	8:45		Seal Quality:	Good	Injection End Time:	11:00
Flushed Volume[E]:	450	(gal)	Start Inflate Time:	10:10	Deflation Method:	E-Pin

Zone Description & Comments

Test Type:	Constant Head Injection
Drilling Comments:	No return. Test below fault. Stable hole. Good unfractured zone to set packer.
Geology, Hydrogeology, & Rock Mass:	Good solid Graphite.
Test Quality and Assessment:	Good Test. Post-test water level was lower than shut-in and was used for the Stable Water Level parameter. Fractures may have cleaned during testing and established connection with a different piezometric pressure zone. The low estimate H accounts for the uncertainty.



	Estimate	Low End	High End	
Imposed Head (H):	75.93	*67.14*	*78.04*	($m\text{-}H_2O$)
Injection Rate (Q):	8	*8*	*8*	(m^3/day)
Hydraulic Conductivity:	**1.71E-03**	*1.64E-03*	*1.95E-03*	(m/day)
Transmissivity:	**0.086**	*0.083*	*0.098*	(m/day/m)

Test Parameters			
Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	50.52	(m)
System Leak Rate:		0	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	23GC100
Test Number:	3
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

Tundra Consulting, LLC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
9:59	606.0	-	80
10:00	606.4	0.4	100
10:01	606.6	0.2	100
10:02	606.8	0.2	100
10:03	606.9	0.1	100
10:04	607.0	0.1	100
10:05	607.1	0.1	100
10:06	607.2	0.1	100
10:07	607.3	0.1	100
10:08	607.4	0.1	100
10:09	607.5	0.1	100
10:10	607.6	0.1	100

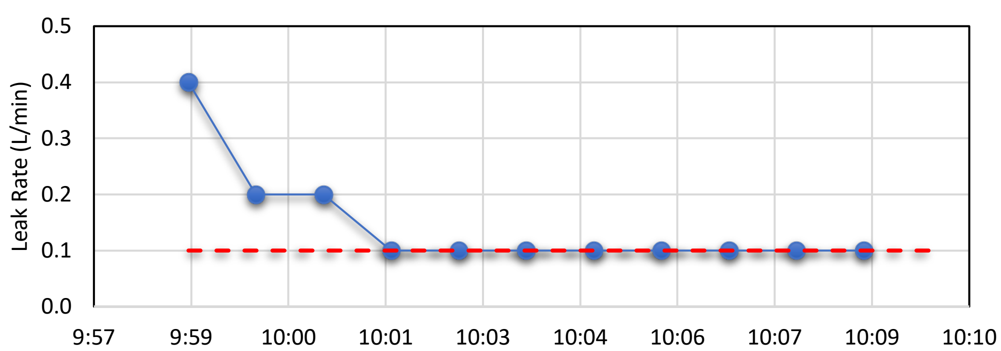
Injection Test

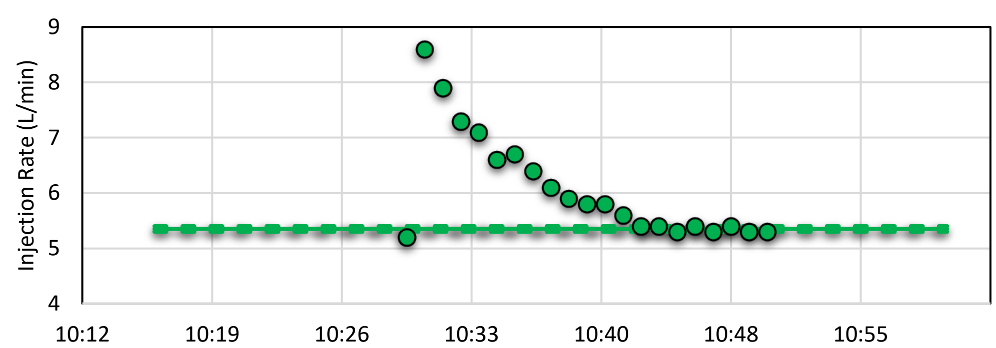
Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
10:30	618.5	-	-	100
10:31	623.8	5.30	5.20	100
10:32	632.5	8.70	8.60	100
10:33	640.5	8.00	7.90	100
10:34	647.9	7.40	7.30	100
10:35	655.1	7.20	7.10	100
10:36	661.8	6.70	6.60	100
10:37	668.6	6.80	6.70	100
10:38	675.1	6.50	6.40	100
10:39	681.3	6.20	6.10	100
10:40	687.3	6.00	5.90	100
10:41	693.2	5.90	5.80	100
10:42	699.1	5.90	5.80	100
10:43	704.8	5.70	5.60	100
10:44	710.3	5.50	5.40	100
10:45	715.8	5.50	5.40	100
10:46	721.2	5.40	5.30	100
10:47	726.7	5.50	5.40	100
10:48	732.1	5.40	5.30	100
10:49	737.6	5.50	5.40	100
10:50	743	5.40	5.30	100
10:51	748.4	5.40	5.30	100

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)

Leak Rate	0.1 L/min
Injection Rate	5.35 L/min
Min Injection Rate	5.3 L/min
Max Injection Rate	5.40 L/min





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	**23GC100**	**CONSTANT HEAD INJECTION TEST** *Packer Isolated*	Tundra Consulting, LLC
Test Number:	**4**		
Project No.:	**Graphite Creek**		

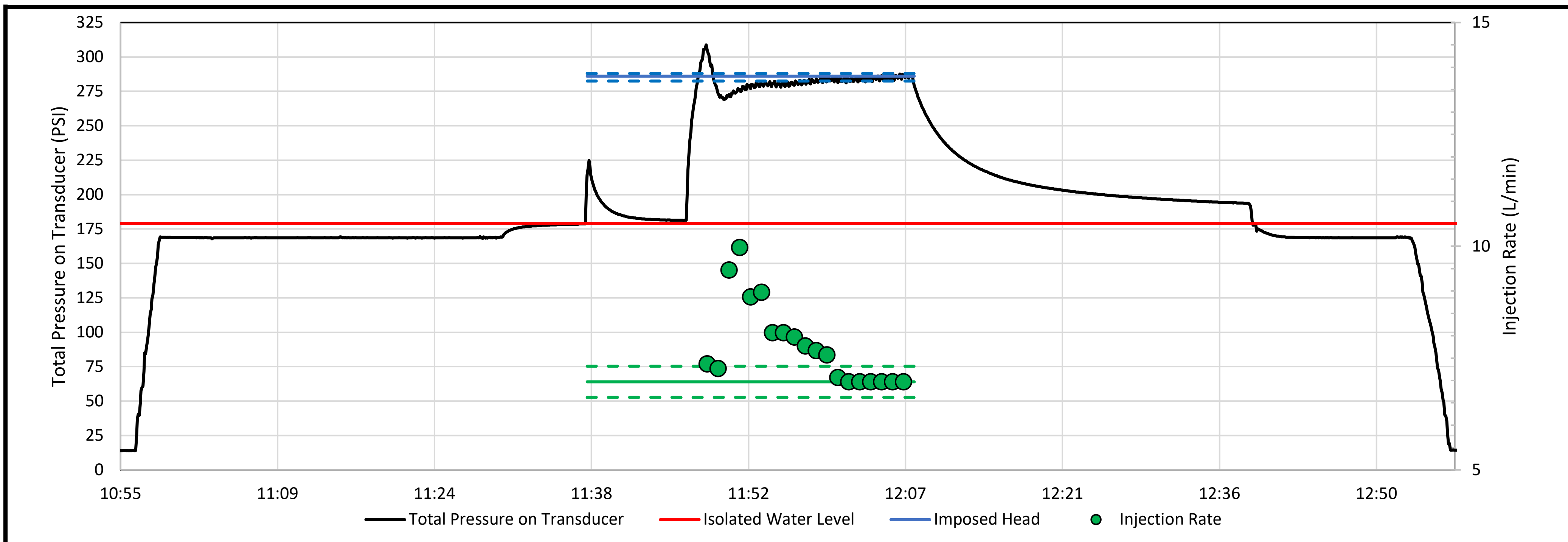
Location Description			**Test Interval**			**General**	
Current Depth:	675		**Bit Depth:**	485	(ft-ah)	**Test Start Date/Time:**	8/30/2023 9:30
Hole Size[A]:	HQ3		**Top of Test Interval:**	489.25	(ft-ah)	**Test End Date/Time:**	8/30/2023 13:05
Inclination:	50		**Stable Water Level[B]:**	179	(PSI)	**Supervisor:**	E. Wilson
Azimuth:	175		*Stable Water Level [C] :*	*-45.75*	*(ft-bgs)*	**Drill Contractor:**	Major
Elevation:	866	(ft-amsl)	*Transducer Position [D] :*	*493.25*	(ft-ah)	**Rig No. & Type:**	Rig 37

Test Notes

Start Flush:	9:30		**Test Fluid** (water/poly):	Fresh Water		**Shear Pin Break Time:**	11:38
End Flush:	10:30		**Seal Quality:**	Good		**Injection End Time:**	12:08
Flushed Volume[E]:	475	(gal)	**Start Inflate Time:**	12:28		**Deflation Method:**	E-Pin

Zone Description & Comments

Test Type:	Constant Head Injection
Drilling Comments:	No return. Test below fault. Stable hole. Good unfractured zone to set packer.
Geology, Hydrogeology, & Rock Mass:	Good solid Graphite.
Test Quality and Assessment:	Good Test. Imposed head not fully stabilized.



	Estimate	**Low End**	**High End**	
Imposed Head (H):	75.23	72.77	76.64	(m-H_2O)
Injection Rate (Q):	10	*10*	*11*	(m^3/day)
Hydraulic Conductivity:	**2.00E-03**	*1.87E-03*	*2.17E-03*	(m/day)
Transmissivity:	**0.113**	*0.106*	*0.123*	(m/day/m)

Test Parameters

Radius of Influence[F]: **(R)**	10	(m)
Radius of the Well: **(r_w)**	48.0	(mm)
Test Interval Length: **(b)**	56.62	(m)
System Leak Rate:	0.043	(m^3/day)
Marsh Funnel Time[G]:	26	(sec)
Viscosity Correction Factor:	1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H} \ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	23GC100
Test Number:	4
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

Tundra Consulting, LLC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
11:21	862.10	-	50
11:22	862.40	0.30	100
11:23	862.70	0.30	100
11:24	862.74	0.04	100
11:25	862.78	0.04	100
11:26	862.86	0.08	100
11:27	862.89	0.03	100
11:28	862.92	0.03	100

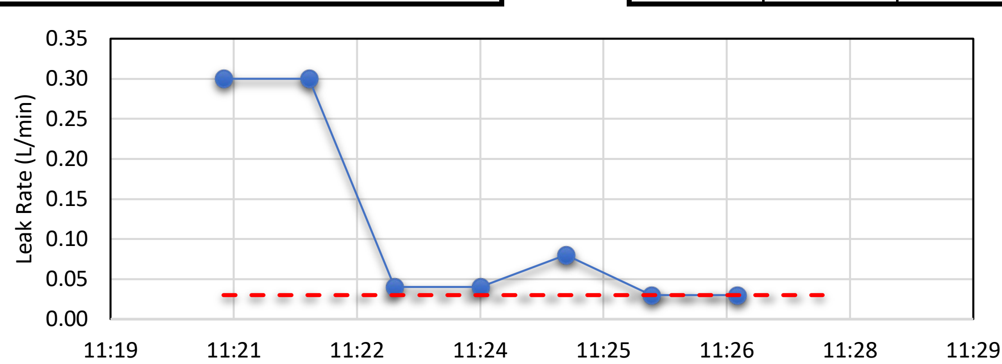
Leak Rate	0.03 L/min
Injection Rate	6.97 L/min
Min Injection Rate	6.62 L/min
Max Injection Rate	7.32 L/min

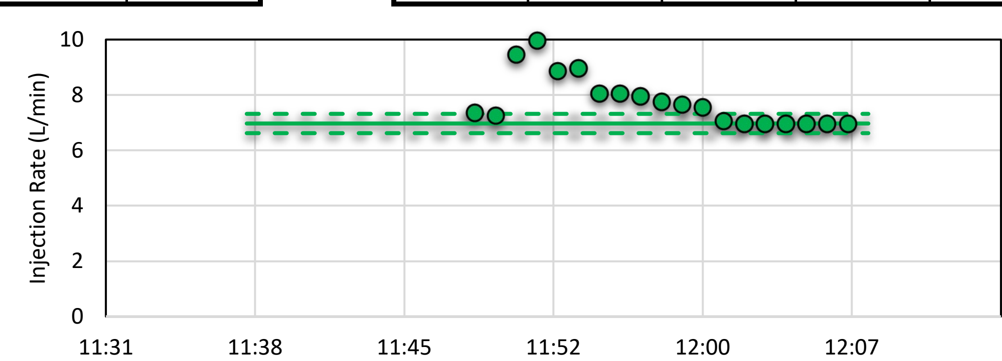
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
11:47	5873.4	-	-	50
11:48	5895.0	21.60	21.57	95
11:49	5924.0	29.00	28.97	150
11:50	5931.4	7.40	7.37	105
11:51	5938.7	7.30	7.27	100
11:52	5948.2	9.50	9.47	100
11:53	5958.2	10.00	9.97	100
11:54	5967.1	8.90	8.87	100
11:55	5976.1	9.00	8.97	100
11:56	5984.2	8.10	8.07	100
11:57	5992.3	8.10	8.07	100
11:58	6000.3	8.00	7.97	100
11:59	6008.1	7.80	7.77	100
12:00	6015.8	7.70	7.67	100
12:01	6023.4	7.60	7.57	100
12:02	6030.5	7.10	7.07	100
12:03	6037.5	7.00	6.97	100
12:04	6044.5	7.00	6.97	100
12:05	6051.5	7.00	6.97	100
12:06	6058.5	7.00	6.97	100
12:07	6065.5	7.00	6.97	100
12:08	6072.5	7.00	6.97	100

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)

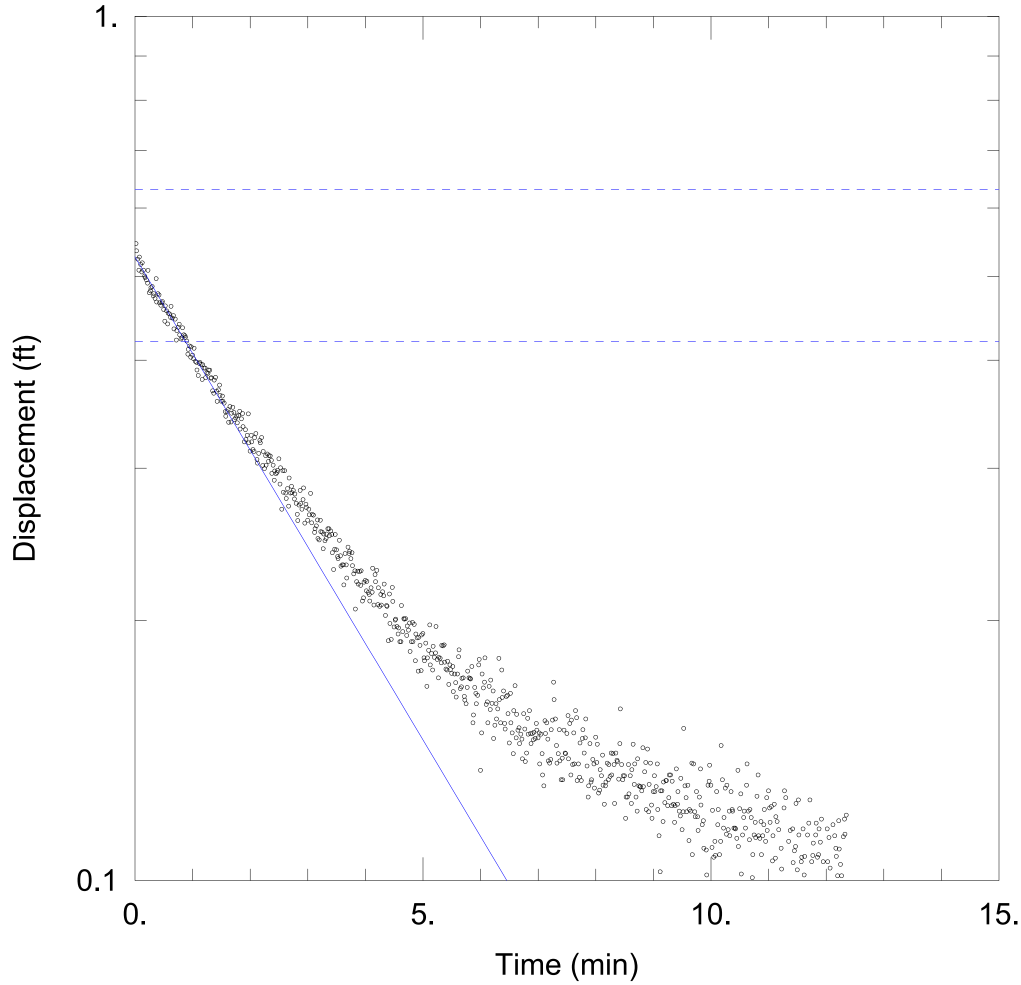




Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.



TEST 1 FHT

Data Set: C:\...\23gct016_Test1_BouwerRice_FHT_GB.aqt
Date: 11/23/24 Time: 15:33:42

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 23GCT016
Test Date: 10/01/2023

AQUIFER DATA

Saturated Thickness: 39.75 ft
Anisotropy Ratio (Kz/Kr): 1.

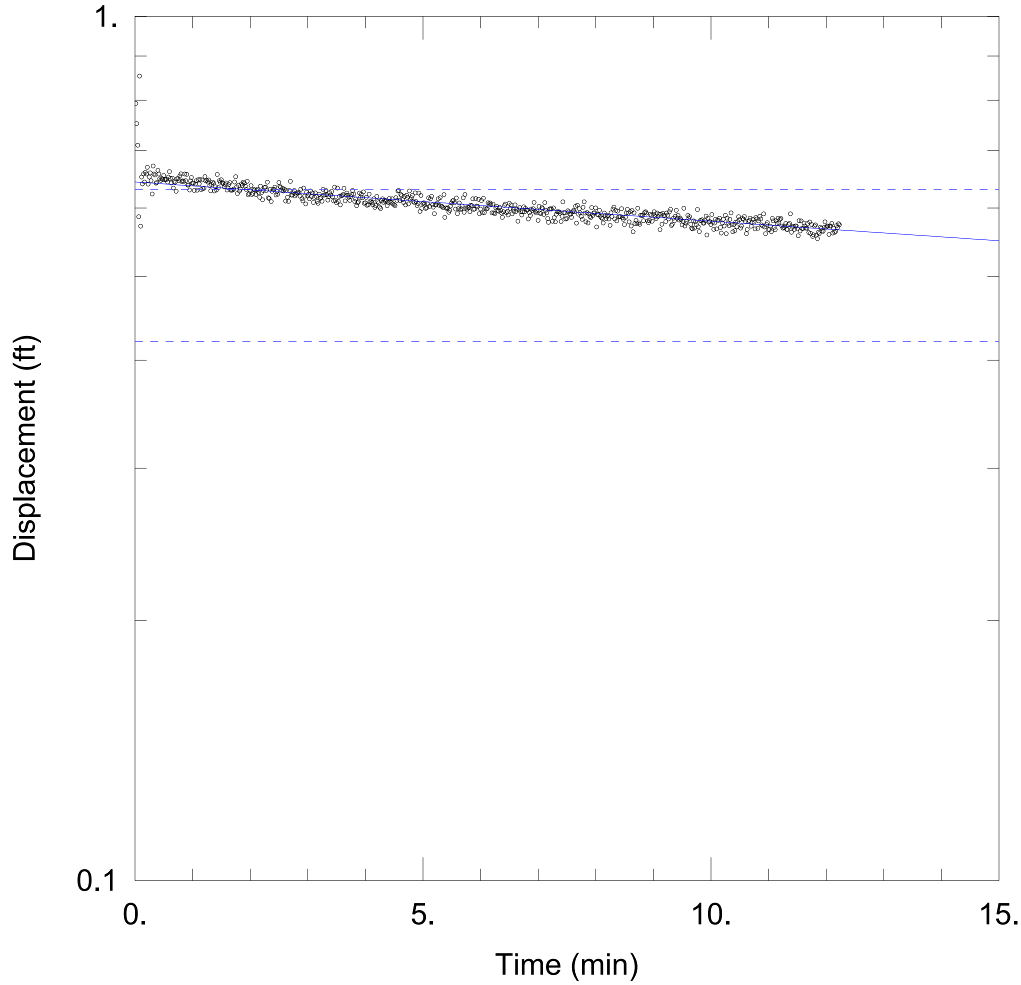
WELL DATA (23GCT016)

Initial Displacement: 2.102 ft
Total Well Penetration Depth: 125.5 ft
Casing Radius: 0.08538 ft
Static Water Column Height: 39.75 ft
Screen Length: 39.75 ft
Well Radius: 0.315 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.04621 m/day
y0 = 0.5269 ft



TEST 1 FHT

Data Set: C:\...\23gct018_Test1_FHT_BRconfined_GB.aqt
Date: 11/23/24 Time: 15:34:43

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 23GCT018
Test Date: 10/01/2023

AQUIFER DATA

Saturated Thickness: 50.82 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (23GCT018)

Initial Displacement: 2.102 ft
Static Water Column Height: 50.82 ft
Total Well Penetration Depth: 134. ft
Screen Length: 50.82 ft
Casing Radius: 0.08538 ft
Well Radius: 0.315 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.001501 m/day
y0 = 0.6433 ft

Drill Hole ID:	24GC142A	CONSTANT HEAD INJECTION TEST *Packer Isolated*	Tundra Consulting, LLC
Test Number:	1		
Project No.:	Graphite Creek		

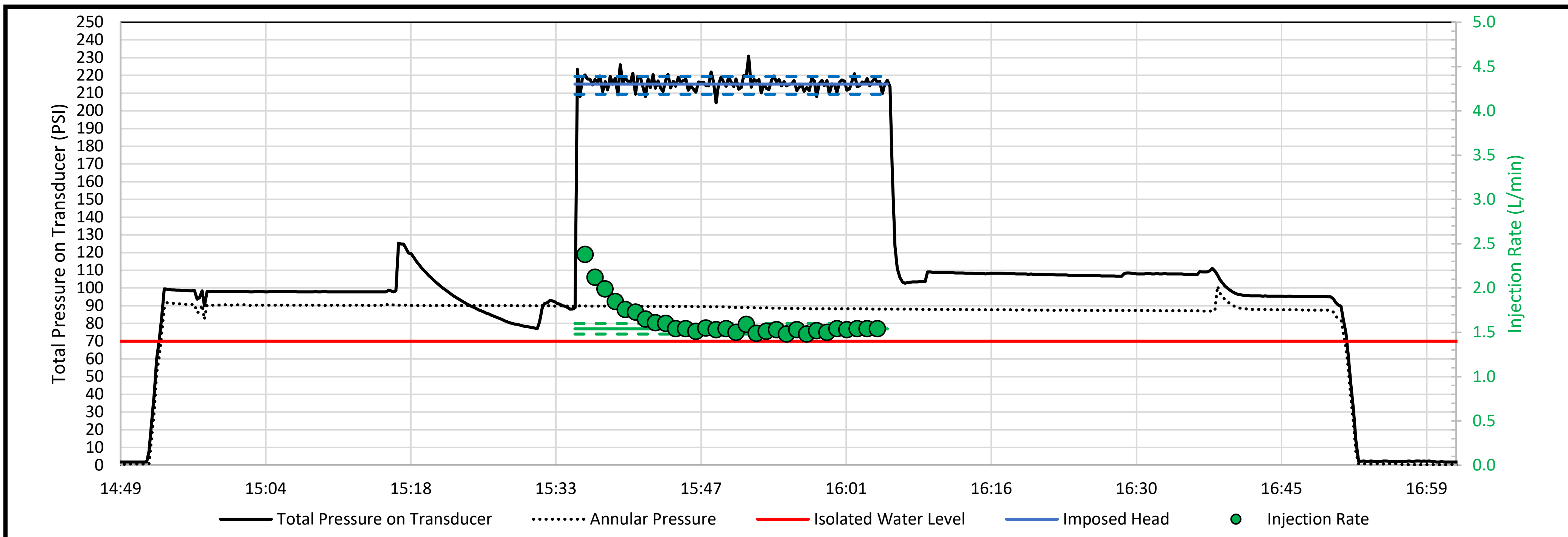
Location Description			Test Interval			General	
Current Depth (ft):	385		Bit Position:	315	(ft-ah)	Test Start Date/Time:	8/19/2024 14:00
Hole Size[A]:	HQ		Top of Test Interval:	319.25	(ft-ah)	Test End Date/Time:	8/19/2024 17:30
Inclination:	50		Stable Water Level[B]:	70	(PSI)	Supervisor:	G. Baldwin
Azimuth:	140		*Stable Water Level [C]:*	*112.5*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	69	(ft-amsl)	*Transducer Position [D]:*	*323.25*	(ft-ah)	Rig No. & Type:	#38 LF90

Test Notes

Start Flush:	14:15		Test Fluid (water/poly):	Fresh Water	Shear Pin Break Time:	15:35
End Flush:	14:27		Seal Quality:	Fair	Injection End Time:	16:06
Flushed Volume[E]:	180	(gal)	Start Inflate Time:	15:17	Deflation Method:	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection - Single Step
Drilling Comments:	No return circulation. Previous shift had drilled with gel. Recent interval drilled w/poly.
Geology, Hydrogeology, & Rock Mass:	Moderate fracture frequency. Some zones of elevated fractures and pervasive FeOx staining and weathering. Garnet gneiss w/graphitic zones. Some hydrothermal alteration of rock mass.
Test Quality and Assessment:	Minimal necessary washing to preserve integrity of alluvial interval. Rel. low permeability and shut-in not fully equilibrated prior to start of test. However, generally good constraints.



	Estimate	Low End	High End	
Imposed Head (H):	102.00	*98.00*	*105.00*	($m\text{-}H_2O$)
Injection Rate (Q):	2.22	*2.13*	*2.30*	(m^3/day)
Hydraulic Conductivity:	**9.22E-04**	*8.61E-04*	*9.97E-04*	(m/day)
Transmissivity:	**0.018**	*0.017*	*0.020*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	20.04	(m)
System Leak Rate:		0.00	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H} \ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GC142A
Test Number:	1
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
15:20	3.94	-	100
15:21	4.04	0.10	100
15:22	4.08	0.04	100
15:23	4.14	0.06	100
15:24	4.16	0.02	100
15:25	4.25	0.09	100
15:26	4.35	0.10	100
15:27	4.4	0.05	100
15:28	4.35		50
15:29	4.36	0.01	50
15:30	4.36	0.00	50
15:31	4.36	0.00	50

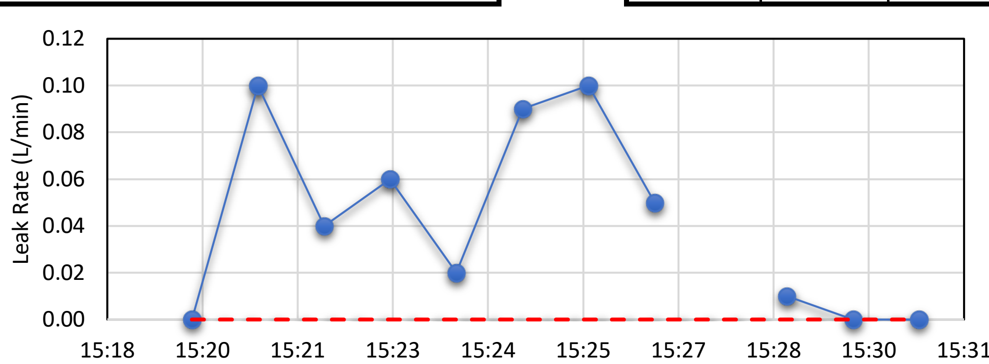
Leak Rate	0.00 L/min
Injection Rate	1.54 L/min
Min Injection Rate	1.48 L/min
Max Injection Rate	1.60 L/min

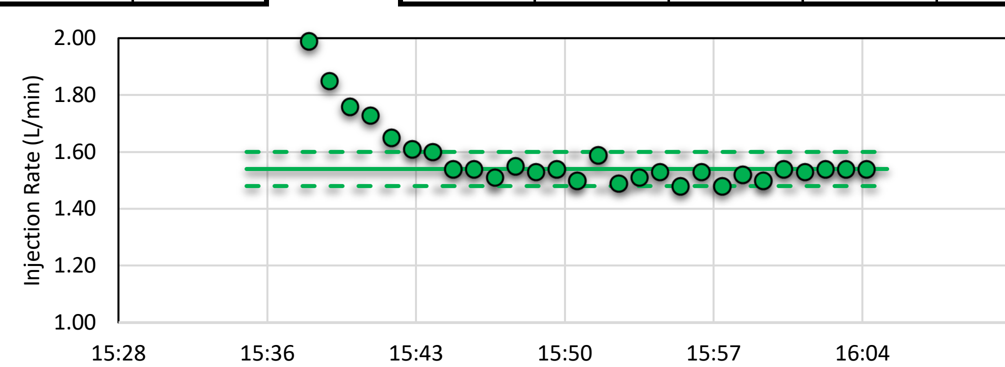
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
15:36	9.20			100
15:37	11.58	2.38	2.38	100
15:38	13.70	2.12	2.12	100
15:39	15.69	1.99	1.99	100
15:40	17.54	1.85	1.85	100
15:41	19.30	1.76	1.76	100
15:42	21.03	1.73	1.73	100
15:43	22.68	1.65	1.65	100
15:44	24.29	1.61	1.61	100
15:45	25.89	1.60	1.60	100
15:46	27.43	1.54	1.54	100
15:47	28.97	1.54	1.54	100
15:48	30.48	1.51	1.51	100
15:49	32.03	1.55	1.55	100
15:50	33.56	1.53	1.53	100
15:51	35.10	1.54	1.54	100
15:52	36.60	1.50	1.50	100
15:53	38.19	1.59	1.59	100
15:54	39.68	1.49	1.49	100
15:55	41.19	1.51	1.51	100
15:56	42.72	1.53	1.53	100
15:57	44.2	1.48	1.48	100
15:58	45.7	1.53	1.53	100
15:59	47.2	1.48	1.48	100
16:00	48.7	1.52	1.52	100
16:01	50.2	1.50	1.50	100
16:02	51.8	1.54	1.54	100
16:03	53.3	1.53	1.53	100
16:04	54.8	1.54	1.54	100

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
16:05	56.38	1.54	1.54	100
16:06	57.92	1.54	1.54	100





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	24GC142A	CONSTANT HEAD INJECTION TEST *Packer Isolated*	Tundra Consulting, LLC
Test Number:	2		
Project No.:	Graphite Creek		

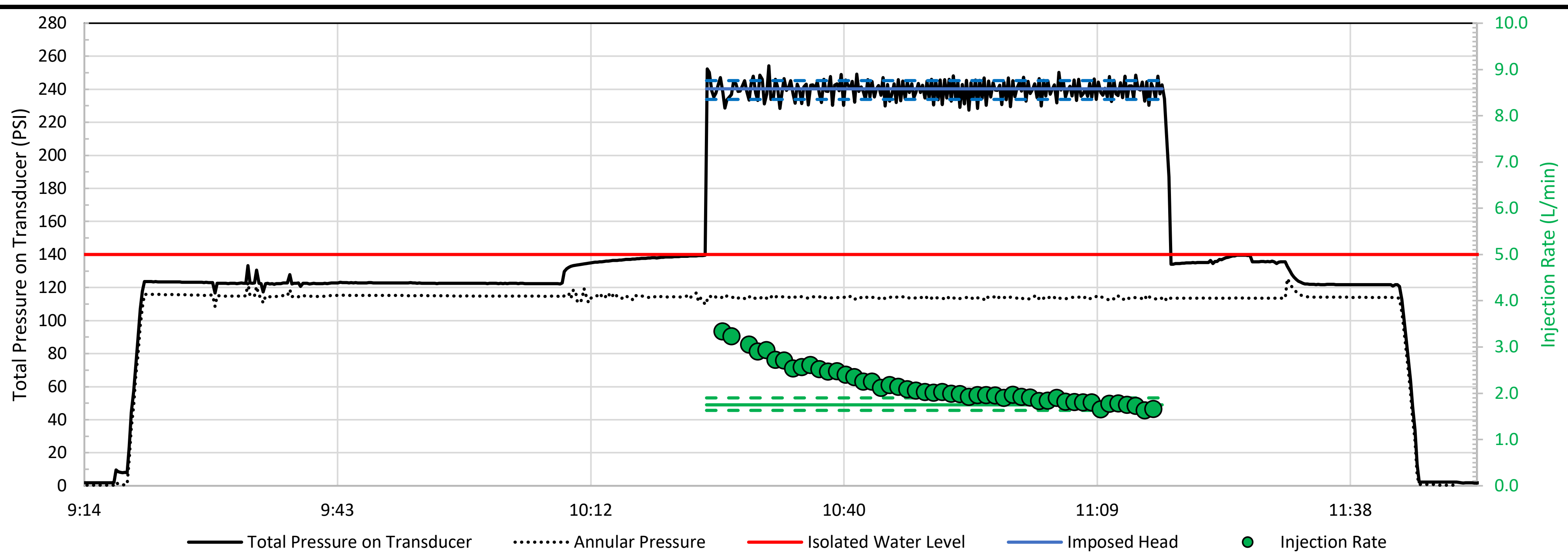
Location Description			Test Interval			General	
Current Depth (ft):	505		**Bit Position:**	385	(ft-ah)	**Test Start Date/Time:**	8/20/2024 8:15
Hole Size[A]:	HQ		**Top of Test Interval:**	389.25	(ft-ah)	**Test End Date/Time:**	8/20/2024 12:00
Inclination:	50		**Stable Water Level[B]:**	140	(PSI)	**Supervisor:**	G. Baldwin
Azimuth:	140		*Stable Water Level[C]:*	*-28.3*	*(ft-bgs)*	**Drill Contractor:**	Major
Elevation:	69	(ft-amsl)	*Transducer Position[D]:*	*393.25*	(ft-ah)	**Rig No. & Type:**	#38 LF90

Test Notes

Start Flush:	8:30		**Test Fluid** (water/poly):	Fresh Water	**Shear Pin Break Time:**	10:25
End Flush:	8:47		**Seal Quality:**	Fair	**Injection End Time:**	11:17
Flushed Volume[E]:	255	(gal)	**Start Inflate Time:**	10:09	**Deflation Method:**	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection - Single Step
Drilling Comments:	No return circulation. Drilling with poly-water.
Geology, Hydrogeology, & Rock Mass:	Mod. to low fracture frequency. Some healed low-alpha joints. Some intervals of mild FeOx staining. Garent geniss w/minor intrusive(?) veins and minor graphitic zones. Hydrotherm. Alt.
Test Quality and Assessment:	Min. req'd flush to preserve integrity of alluvial interval. Upward pressure gradient. Rel. low perm. & shut-in not fully equilibrated prior to start. However, generally good constraints.



	Estimate	Low End	High End	
Imposed Head (H):	70.50	*66.00*	*74.00*	(m-H_2O)
Injection Rate (Q):	2.52	*2.35*	*2.74*	(m^3/day)
Hydraulic Conductivity:	**8.61E-04**	*7.64E-04*	*9.98E-04*	(m/day)
Transmissivity:	**0.030**	*0.027*	*0.035*	(m/day/m)

Test Parameters

Radius of Influence[F]:	**(R)**	10	(m)
Radius of the Well:	**(r_w)**	48.0	(mm)
Test Interval Length:	**(b)**	35.28	(m)
System Leak Rate:		1.89	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GC142A
Test Number:	2
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
10:13	82.39	-	100
10:14	83.7	1.31	100
10:15	85.01	1.31	100
10:16	86.32	1.31	100
10:17	87.62	1.30	100
10:18	88.49		50
10:19	89.39	0.90	50
10:20	90.28	0.89	50
10:21	91.18	0.90	50
10:22	92.09	0.91	50
10:23	92.99	0.90	50

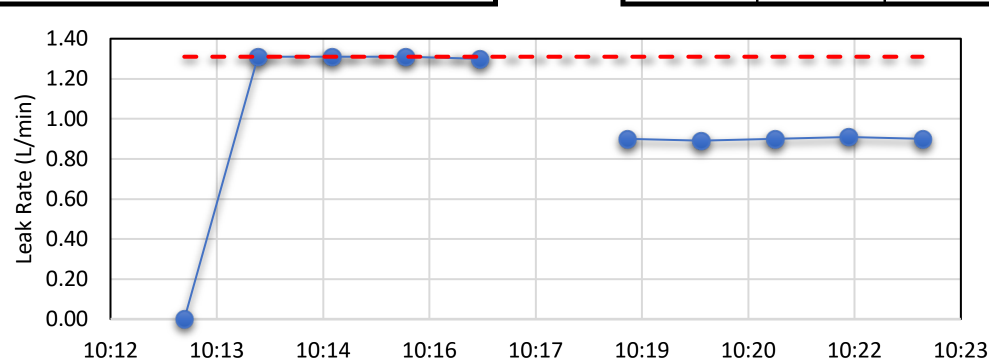
Leak Rate	1.31 L/min
Injection Rate	1.75 L/min
Min Injection Rate	1.63 L/min
Max Injection Rate	1.90 L/min

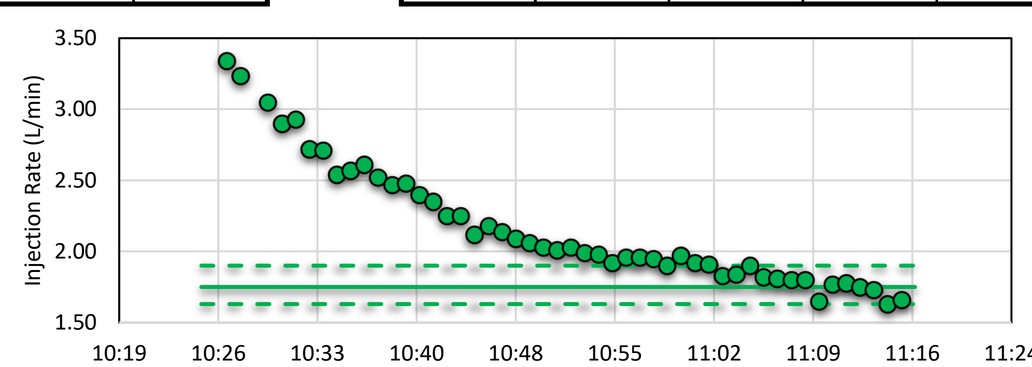
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
10:27	309.90			100
10:28	314.55	4.65	3.34	100
10:30	323.64	4.55	3.24	100
10:31	328.00	4.36	3.05	100
10:32	332.21	4.21	2.90	100
10:33	336.45	4.24	2.93	100
10:34	340.48	4.03	2.72	100
10:35	344.50	4.02	2.71	100
10:36	348.35	3.85	2.54	100
10:37	352.23	3.88	2.57	100
10:38	356.15	3.92	2.61	100
10:39	359.98	3.83	2.52	100
10:40	363.76	3.78	2.47	100
10:41	367.55	3.79	2.48	100
10:42	371.26	3.71	2.40	100
10:43	374.92	3.66	2.35	100
10:44	378.48	3.56	2.25	100
10:45	382.04	3.56	2.25	100
10:46	385.47	3.43	2.12	100
10:47	388.96	3.49	2.18	100
10:48	392.41	3.45	2.14	100
10:49	395.81	3.40	2.09	100
10:50	399.18	3.37	2.06	100
10:51	402.52	3.34	2.03	100
10:52	405.84	3.32	2.01	100
10:53	409.18	3.34	2.03	100
10:54	412.48	3.30	1.99	100
10:55	415.77	3.29	1.98	100
10:56	419.00	3.23	1.92	100

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
10:57	422.27	3.27	1.96	100
10:58	425.54	3.27	1.96	100
10:59	428.8	3.26	1.95	100
11:00	432.01	3.21	1.90	100
11:01	435.29	3.28	1.97	100
11:02	438.52	3.23	1.92	100
11:03	441.74	3.22	1.91	100
11:04	444.88	3.14	1.83	100
11:05	448.03	3.15	1.84	100
11:06	451.24	3.21	1.90	100
11:07	454.37	3.13	1.82	100
11:08	457.49	3.12	1.81	100
11:09	460.6	3.11	1.80	100
11:10	463.71	3.11	1.80	100
11:11	466.67	2.96	1.65	100
11:12	469.75	3.08	1.77	100
11:13	472.84	3.09	1.78	100
11:14	475.9	3.06	1.75	100
11:15	478.94	3.04	1.73	100
11:16	481.88	2.94	1.63	100
11:17	484.85	2.97	1.66	100





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	24GC142A	CONSTANT HEAD INJECTION TEST
Test Number:	3	*Packer Isolated*
Project No.:	Graphite Creek	Tundra Consulting, LLC

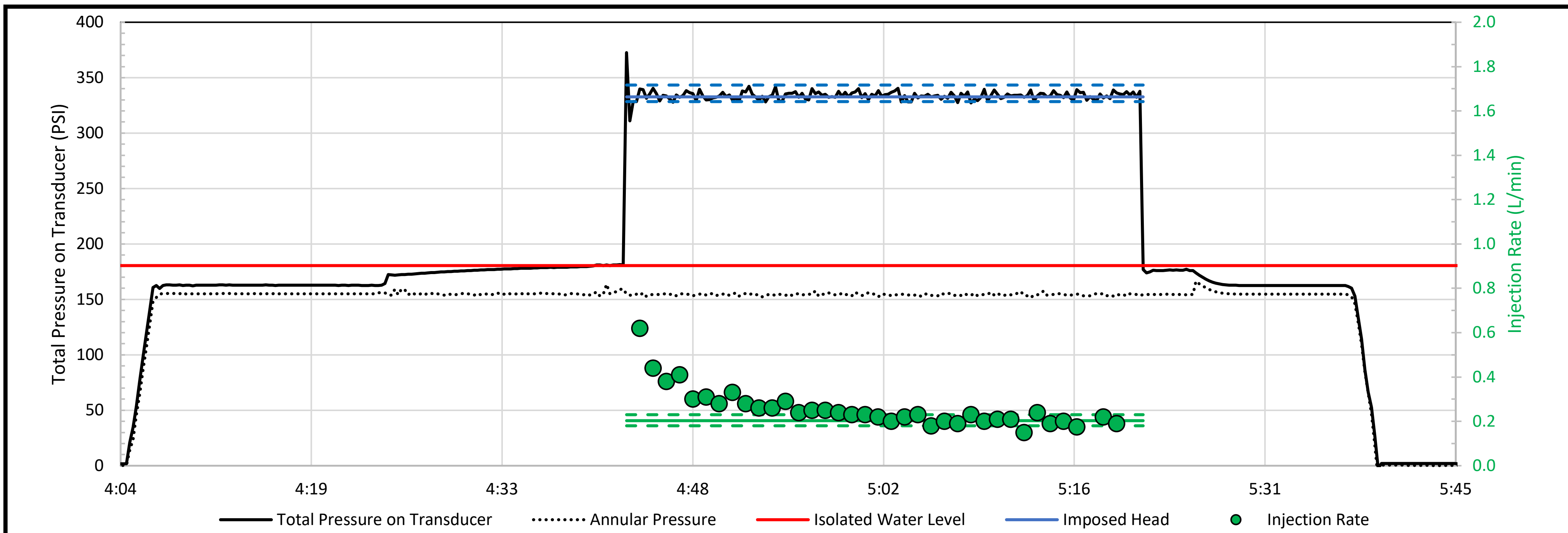
Location Description			Test Interval			General	
Current Depth (ft):	639		Bit Position:	505	(ft-ah)	Test Start Date/Time:	8/21/2024 3:30
Hole Size[A]:	HQ		Top of Test Interval:	509.25	(ft-ah)	Test End Date/Time:	8/21/2024 6:00
Inclination:	50		Stable Water Level[B]:	180.5	(PSI)	Supervisor:	G. Baldwin
Azimuth:	140		*Stable Water Level[C]:*	*-30.3*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	69	(ft-amsl)	*Transducer Position[D]:*	*513.25*	(ft-ah)	Rig No. & Type:	#38 LF90

Test Notes

Start Flush:	3:00		Test Fluid (water/poly):	Fresh Water	Shear Pin Break Time:	4:43
End Flush:	3:30		Seal Quality:	Fair	Injection End Time:	5:22
Flushed Volume[E]:	450	(gal)	Start Inflate Time:	4:25	Deflation Method:	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection - Single Step
Drilling Comments:	No return circulation. Drilling with poly water.
Geology, Hydrogeology, & Rock Mass:	Low fracture frequency. Some zones of elevated FF. Garnet gneiss w/graphitic zones w/veins. Some hydrothermal alteration of rock mass. Pervasive alteration beginning about 620 feet.
Test Quality and Assessment:	Minimal necessary washing to preserve integrity of alluvial interval. Low permeability so shut-in not fully equilibrated prior to start of test. However, generally good constraints.



	Estimate	Low End	High End	
Imposed Head (H):	107.00	*104.00*	*114.50*	(m-H_2O)
Injection Rate (Q):	0.29	*0.26*	*0.33*	(m^3/day)
Hydraulic Conductivity:	**5.87E-05**	*4.86E-05*	*6.84E-05*	(m/day)
Transmissivity:	**0.0023**	*0.0019*	*0.0027*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	39.55	(m)
System Leak Rate:		0.35	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

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ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GC142A	CONSTANT HEAD INJECTION TEST *Packer Isolated*
Test Number:	3	
Project No.:	Graphite Creek	

APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
4:28	2.46		100
4:29	2.46	0.00	100
4:30	2.46	0.00	100
4:31	2.5	0.04	100
4:32	2.51	0.01	100
4:33	2.86		150
4:34	3.11	0.25	150
4:35	3.35	0.24	150
4:36	3.57	0.22	150
4:37	3.83	0.26	150
4:38	3.6		50
4:39	3.6	0.00	50
4:40	3.6	0.00	50

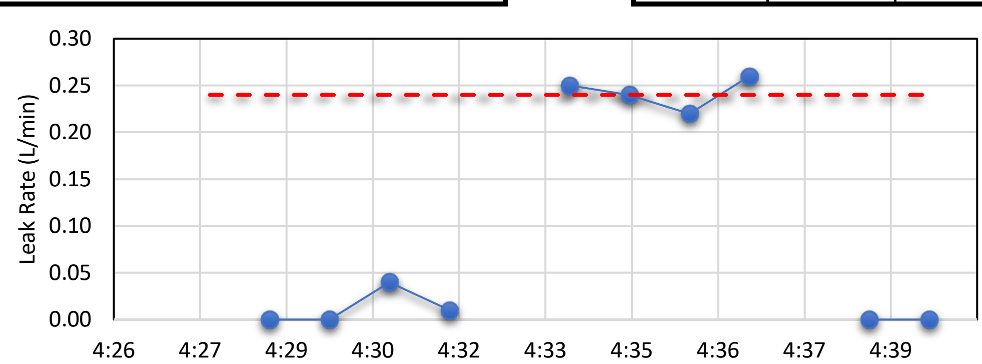
Leak Rate	0.24 L/min
Injection Rate	0.20 L/min
Min Injection Rate	0.18 L/min
Max Injection Rate	0.23 L/min

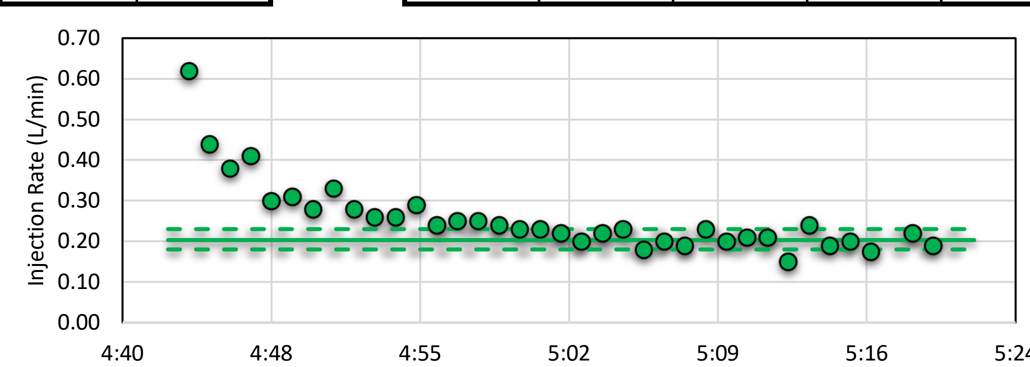
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
4:44	8.99			100
4:45	9.85	0.86	0.62	100
4:46	10.53	0.68	0.44	100
4:47	11.15	0.62	0.38	100
4:48	11.80	0.65	0.41	100
4:49	12.34	0.54	0.30	100
4:50	12.89	0.55	0.31	100
4:51	13.41	0.52	0.28	100
4:52	13.98	0.57	0.33	100
4:53	14.50	0.52	0.28	100
4:54	15.00	0.50	0.26	100
4:55	15.50	0.50	0.26	100
4:56	16.03	0.53	0.29	100
4:57	16.51	0.48	0.24	100
4:58	17.00	0.49	0.25	100
4:59	17.49	0.49	0.25	100
5:00	17.97	0.48	0.24	100
5:01	18.44	0.47	0.23	100
5:02	18.91	0.47	0.23	100
5:03	19.37	0.46	0.22	100
5:04	19.81	0.44	0.20	100
5:05	20.27	0.46	0.22	100
5:06	20.74	0.47	0.23	100
5:07	21.16	0.42	0.18	100
5:08	21.60	0.44	0.20	100
5:09	22.03	0.43	0.19	100
5:10	22.50	0.47	0.23	100
5:11	22.94	0.44	0.20	100
5:12	23.39	0.45	0.21	100

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
5:13	23.84	0.45	0.21	100
5:14	24.23	0.39	0.15	100
5:15	24.71	0.48	0.24	100
5:16	25.14	0.43	0.19	100
5:17	25.58	0.44	0.20	100
5:19	26.41	0.42	0.18	100
5:20	26.87	0.46	0.22	100
5:21	27.3	0.43	0.19	100

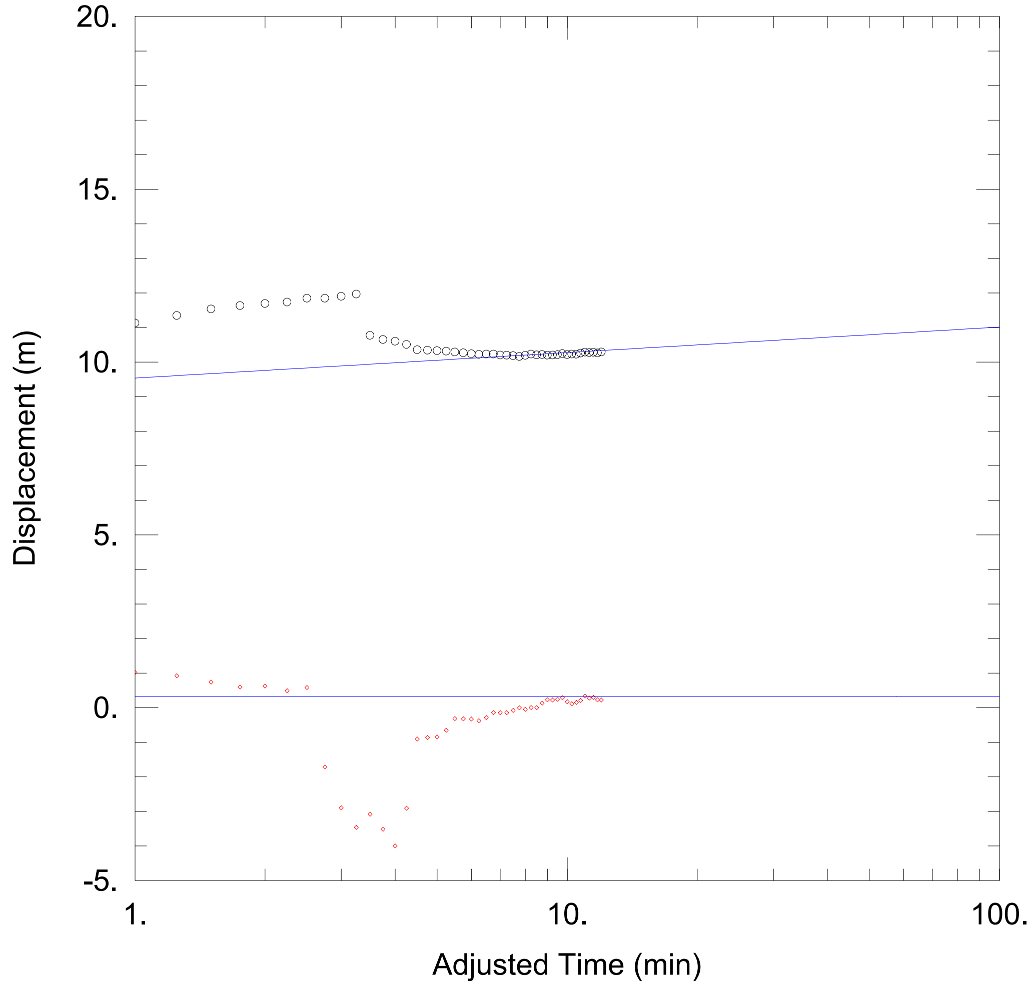




Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level [C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position [D] : Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.



TEST 1 - ARTESIAN

Data Set: C:\...\24GCT019_CJ.aqt
Date: 11/23/24 Time: 15:40:40

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT-019
Test Date: 6/20/2024

AQUIFER DATA

Saturated Thickness: 37. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT-019	0	0

Observation Wells

Well Name	X (m)	Y (m)
○ 24GCT-019	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 7.776 m^2/day S = 6.342E-13

Drill Hole ID:	24GCT-019	CONSTANT HEAD INJECTION TEST
Test Number:	1	*Packer Isolated*
Project No.:	Graphite Creek	APPLIED HYDROLOGIC

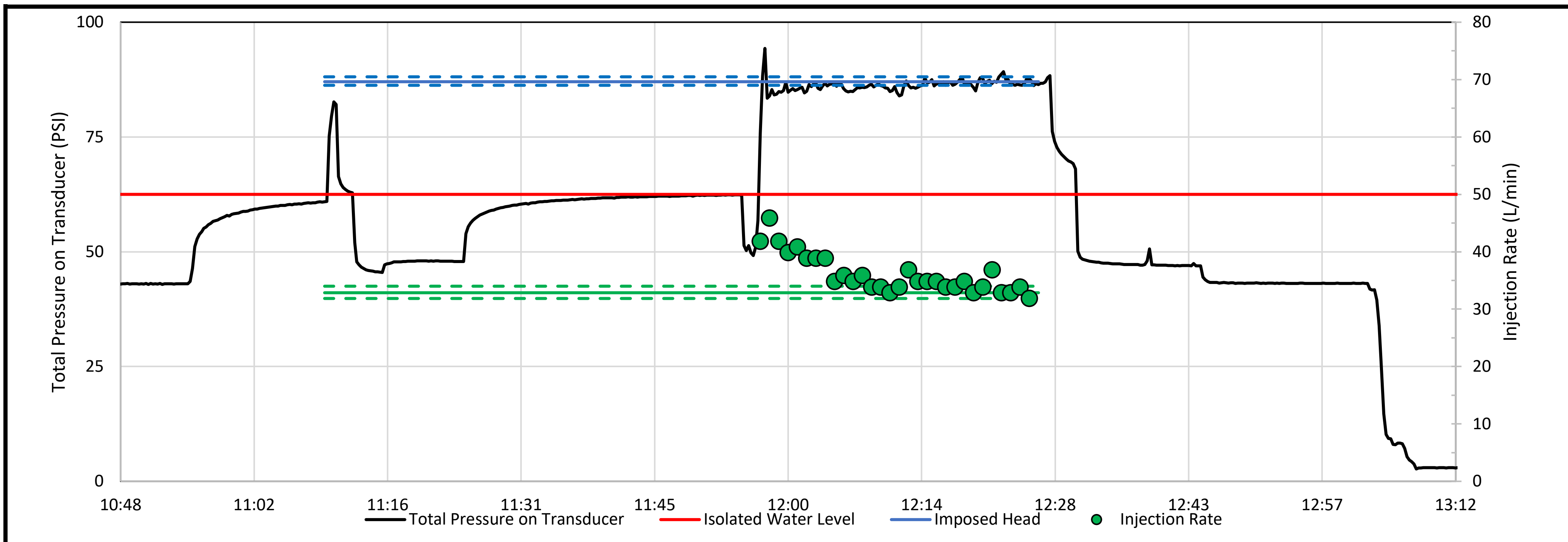
Location Description			Test Interval			General	
Current Depth:	191		Bit Position:	113	(ft-ah)	Test Start Date/Time:	6/20/2024 8:30
Hole Size[A]:	HQ		Top of Test Interval:	117.25	(ft-ah)	Test End Date/Time:	6/20/2024 13:00
Inclination:	50		Stable Water Level[B]:	62.5	(PSI)	Supervisor:	G. Foushee
Azimuth:	180		*Stable Water Level[C]:*	*-66.95*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	522	(ft-amsl)	*Transducer Position[D]:*	*121.25*	*(ft-ah)*	Rig No. & Type:	#37 LF90

Test Notes

Start Flush:	7:00		Test Fluid (water/poly):	Fresh Water		Shear Pin Break Time:	11:10
End Flush:	9:30		Seal Quality:	Fair		Injection End Time:	12:27
Flushed Volume[E]:	1500	(gal)	Start Inflate Time:	10:56		Deflation Method:	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection
Drilling Comments:	Intersected artesian 120 - 130 ft. Drilling with thin poly.
Geology, Hydrogeology, & Rock Mass:	Highly broken & faulted. FeOx and clay alteration along fractures. Strongly foliated rock mass. Some joints crossing foliation; many along foliation.
Test Quality and Assesment:	Good Test. Performed artesian flow and shut-in test prior to injection test. Artesian flow rate is about 22.5 L/min. Leak rate estimated: couldn't inject at planned pressure.



	Estimate	Low End	High End	
Imposed Head (H):	17.25	*16.7*	*18*	(m-H_2O)
Injection Rate (Q):	47	*46*	*49*	(m^3/day)
Hydraulic Conductivity:	**1.04E-01**	*9.63E-02*	*1.11E-01*	(m/day)
Transmissivity:	**2.33**	*2.17*	*2.49*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	22.48	(m)
System Leak Rate:		0	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

$$T = \frac{Q}{2\pi H} \ln\left(\frac{R}{r_w}\right)$$

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GCT-019
Test Number:	1
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
11:02	6530.42	0	100
11:03	6530.81	0.39	100
11:04	6531.2	0.39	100
11:05	6531.58	0.38	100
11:06	6531.95	0.37	100
11:07	6532.3	0.35	100
11:08	6532.68	0.38	100
11:09	6533.03	0.35	100

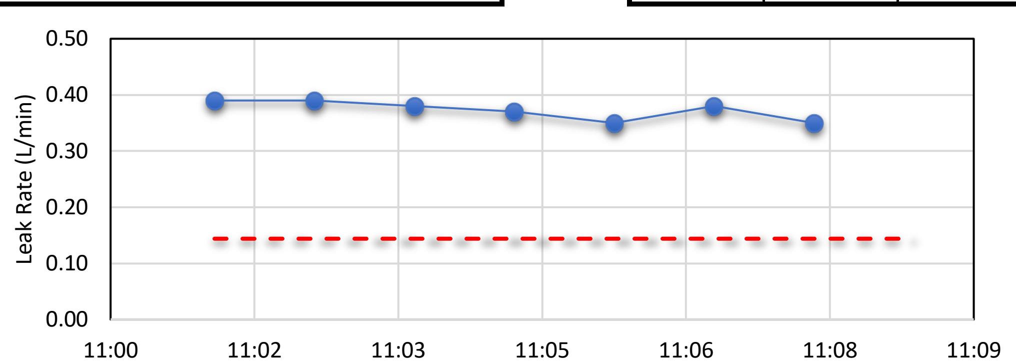
Leak Rate	0.144 L/min
Injection Rate	32.86 L/min
Min Injection Rate	31.86 L/min
Max Injection Rate	34 L/min

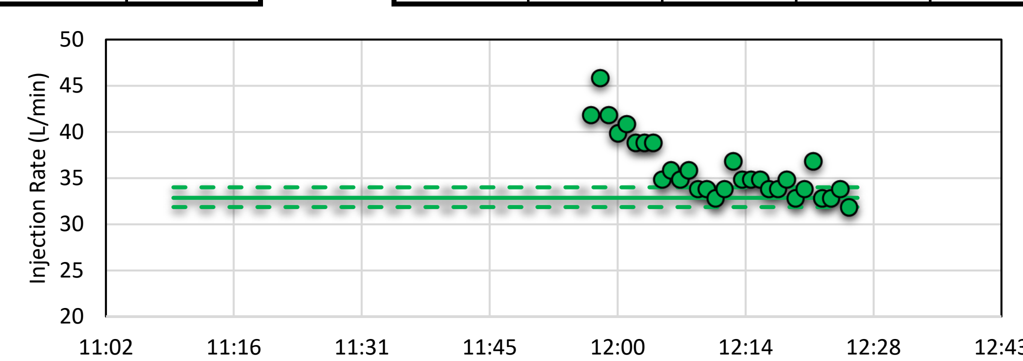
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
11:57	6806	-	-	40
11:58	6848	42.00	41.86	40
11:59	6894	46.00	45.86	40
12:00	6936	42.00	41.86	40
12:01	6976	40.00	39.86	40
12:02	7017	41.00	40.86	40
12:03	7056	39.00	38.86	40
12:04	7095	39.00	38.86	40
12:05	7134	39.00	38.86	40
12:06	7169	35.00	34.86	40
12:07	7205	36.00	35.86	40
12:08	7240	35.00	34.86	40
12:09	7276	36.00	35.86	40
12:10	7310	34.00	33.86	40
12:11	7344	34.00	33.86	40
12:12	7377	33.00	32.86	40
12:13	7411	34.00	33.86	40
12:14	7448	37.00	36.86	40
12:15	7483	35.00	34.86	40
12:16	7518	35.00	34.86	40
12:17	7553	35.00	34.86	40
12:18	7587	34.00	33.86	40
12:19	7621	34.00	33.86	40
12:20	7656	35.00	34.86	40
12:21	7689	33.00	32.86	40
12:22	7723	34.00	33.86	40
12:23	7760	37.00	36.86	40
12:24	7793	33.00	32.86	40
12:25	7826	33.00	32.86	40

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
12:26	7860	34.00	33.86	40
12:27	7892	32.00	31.86	40





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	24GCT-019	CONSTANT HEAD INJECTION TEST *Packer Isolated*	APPLIED HYDROLOGIC
Test Number:	2		
Project No.:	Graphite Creek		

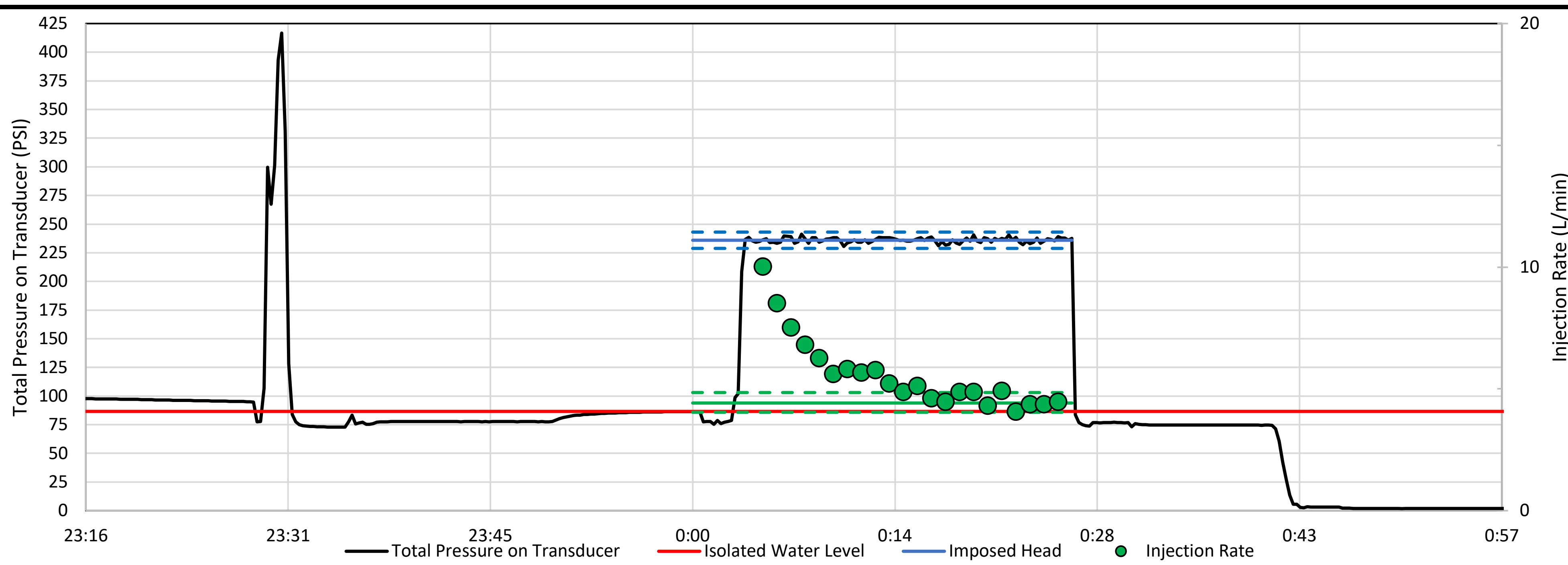
Location Description			Test Interval			General	
Current Depth:	267		Bit Position:	207	(ft-ah)	Test Start Date/Time:	6/20/2024 20:50
Hole Size[A]:	HQ		Top of Test Interval:	211.25	(ft-ah)	Test End Date/Time:	6/21/2024 1:00
Inclination:	50		Stable Water Level[B]:	86.6	(PSI)	Supervisor:	G. Foushee
Azimuth:	180		*Stable Water Level[C]:*	*-45.52*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	522	(ft-amsl)	*Transducer Position[D]:*	*215.25*	(ft-ah)	Rig No. & Type:	#37 LF90

Test Notes

Start Flush:	20:50	**Test Fluid** (water/poly):	Fresh Water	Shear Pin Break Time:	0:00
End Flush:	21:30	Seal Quality:	Poor	Injection End Time:	0:27
Flushed Volume[E]:	400 (gal)	Start Inflate Time:	22:09	Deflation Method:	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection
Drilling Comments:	Drilling with thin poly. Good drilling
Geology, Hydrogeology, & Rock Mass:	Some broken rock from fault damage zone, but minimal. Generally good rock. Low flow artesian; much lower than from 120 - 130 feet.
Test Quality and Assesment:	Pin sheared prematurely, so no leak test but packer was inflated. Performed multiple checks to ensure packer was set correctly. Used leak rates from Test 1 and 3 for estimated leak.



	Estimate	Low End	High End	
Imposed Head (H):	105	*100*	*110*	(m-H_2O)
Injection Rate (Q):	6	*6*	*7*	(m^3/day)
Hydraulic Conductivity:	**3.03E-03**	*2.64E-03*	*3.49E-03*	(m/day)
Transmissivity:	**0.052**	*0.045*	*0.059*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	16.99	(m)
System Leak Rate:		1	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

$$T = \frac{Q}{2\pi H} \ln\left(\frac{R}{r_w}\right)$$

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GCT-019
Test Number:	2
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
No Leak Test			

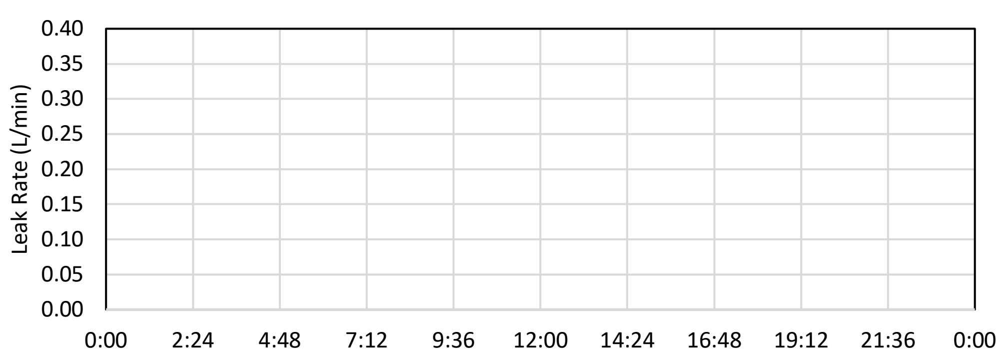
Injection Test

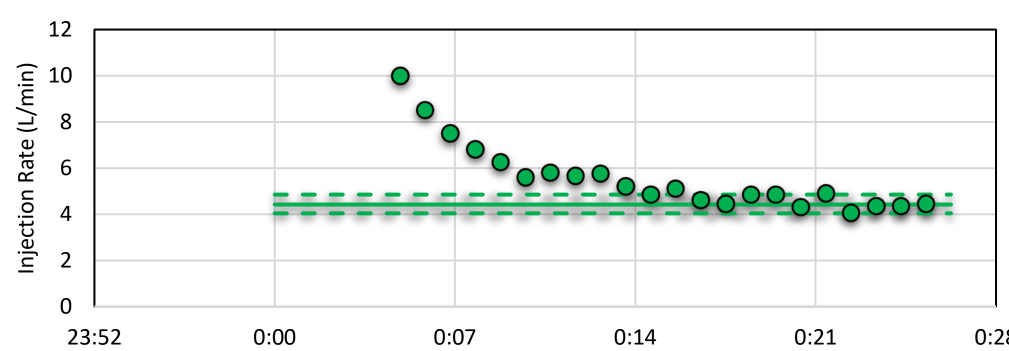
Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
0:05	382.9	-	-	150
0:06	393.3	10.40	10.02	150
0:07	402.2	8.90	8.52	150
0:08	410.1	7.90	7.52	150
0:09	417.3	7.20	6.82	150
0:10	423.95	6.65	6.27	150
0:11	429.95	6.00	5.62	150
0:12	436.15	6.20	5.82	150
0:13	442.2	6.05	5.67	150
0:14	448.35	6.15	5.77	150
0:15	453.95	5.60	5.22	150
0:16	459.2	5.25	4.87	150
0:17	464.7	5.50	5.12	150
0:18	469.7	5.00	4.62	150
0:19	474.55	4.85	4.47	150
0:20	479.8	5.25	4.87	150
0:21	485.05	5.25	4.87	150
0:22	489.75	4.70	4.32	150
0:23	495.05	5.30	4.92	150
0:24	499.5	4.45	4.07	150
0:25	504.25	4.75	4.37	150
0:26	509	4.75	4.37	150
0:27	513.85	4.85	4.47	150

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)

Leak Rate	0.38 L/min
Injection Rate	4.42 L/min
Min Injection Rate	4.04 L/min
Max Injection Rate	4.85 L/min





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	24GCT-019	CONSTANT HEAD INJECTION TEST
Test Number:	3	*Packer Isolated*
Project No.:	Graphite Creek	APPLIED HYDROLOGIC

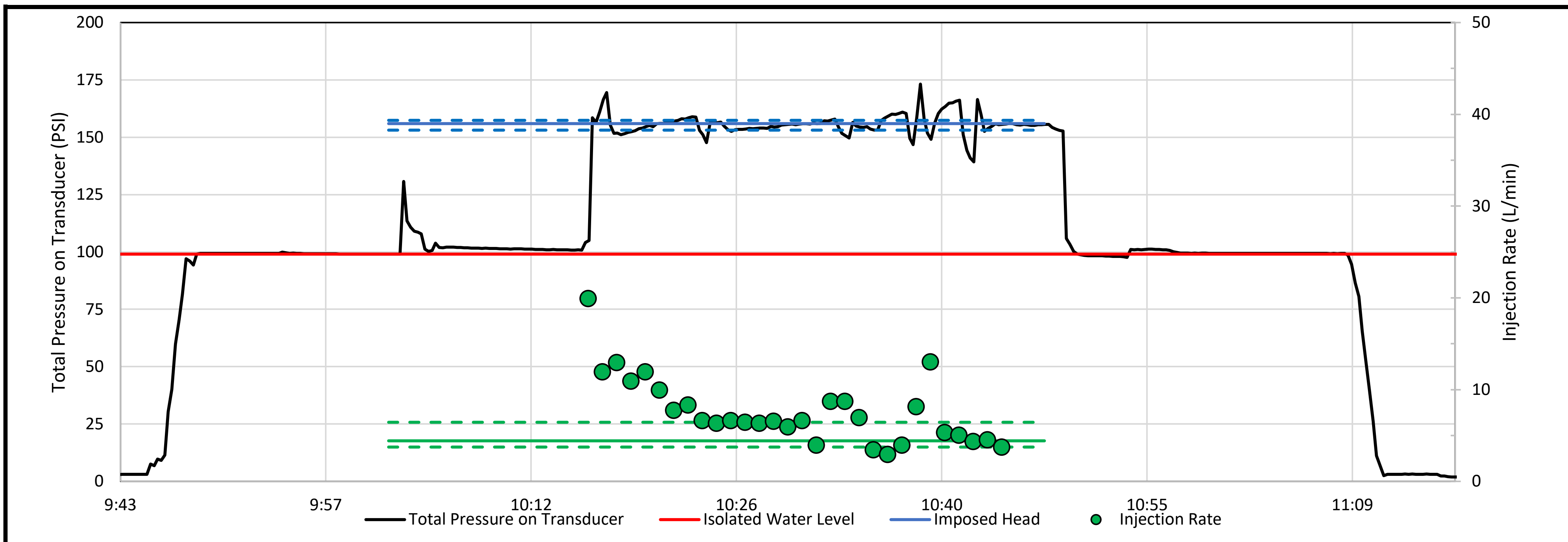
Location Description			Test Interval			General	
Current Depth:	366.5		Bit Position:	277	(ft-ah)	Test Start Date/Time:	6/21/2024 8:00
Hole Size[A]:	HQ		Top of Test Interval:	281.25	(ft-ah)	Test End Date/Time:	6/21/2024 11:45
Inclination:	50		Stable Water Level[B]:	99.062	(PSI)	Supervisor:	G. Foushee
Azimuth:	180		*Stable Water Level[C]:*	*-13.04*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	522	(ft-amsl)	*Transducer Position[D]:*	*285.25*	(ft-ah)	Rig No. & Type:	#37 LF90

Test Notes

Start Flush:	8:00		Test Fluid (water/poly):	Fresh Water	Shear Pin Break Time:	10:02
End Flush:	21:30		Seal Quality:	Good	Injection End Time:	10:48
Flushed Volume[E]:	400	(gal)	Start Inflate Time:	9:54	Deflation Method:	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection
Drilling Comments:	Drilling with thin poly.
Geology, Hydrogeology, & Rock Mass:	Drilling through good, competent rock
Test Quality and Assesment:	Good Test, although Bean pump cycled a bit, causing noise in data. Run leak at 100 PSI but test at 50 PSI, so calculate leak rate.



	Estimate	Low End	High End	
Imposed Head (H):	40	*38*	*41*	(m-H_2O)
Injection Rate (Q):	6	*5*	*9*	(m^3/day)
Hydraulic Conductivity:	**5.20E-03**	*4.30E-03*	*7.98E-03*	(m/day)
Transmissivity:	**0.14**	*0.11*	*0.21*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	25.98	(m)
System Leak Rate:		0	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H} \ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GCT-019	CONSTANT HEAD INJECTION TEST
Test Number:	3	*Packer Isolated*
Project No.:	Graphite Creek	

APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
9:57	505.18	0	100
9:58	505.22	0.04	100
9:59	505.45	0.23	100
10:00	505.55	0.10	100
10:01	505.57	0.02	100
10:02	505.71	0.14	100

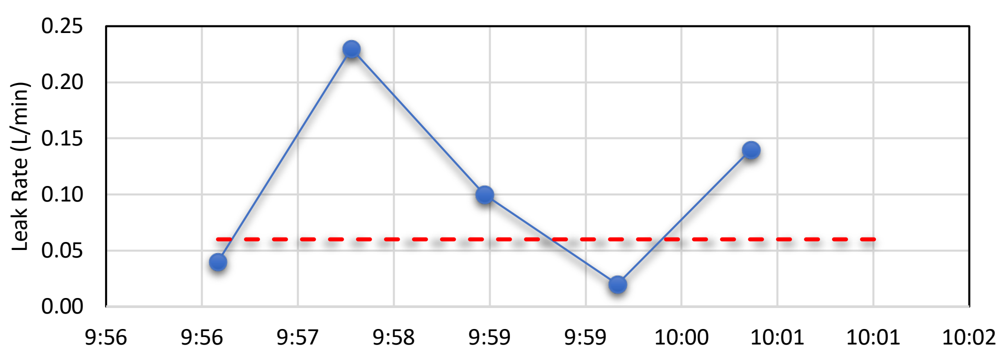
Leak Rate	0.06 L/min
Injection Rate	4.42 L/min
Min Injection Rate	3.74 L/min
Max Injection Rate	6.44 L/min

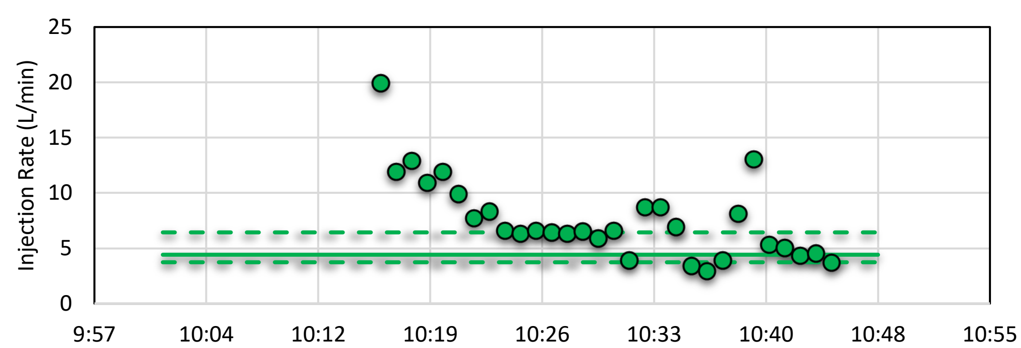
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
10:16	548	-	-	50
10:17	568	20.00	19.94	50
10:18	580	12.00	11.94	50
10:19	593	13.00	12.94	50
10:20	604	11.00	10.94	50
10:21	616	12.00	11.94	50
10:22	626	10.00	9.94	50
10:23	633.8	7.80	7.74	50
10:24	642.2	8.40	8.34	50
10:25	648.9	6.70	6.64	50
10:26	655.3	6.40	6.34	50
10:27	662	6.70	6.64	50
10:28	668.5	6.50	6.44	50
10:29	674.9	6.40	6.34	50
10:30	681.5	6.60	6.54	50
10:31	687.5	6.00	5.94	50
10:32	694.2	6.70	6.64	50
10:33	698.2	4.00	3.94	50
10:34	707	8.80	8.74	50
10:35	715.8	8.80	8.74	50
10:36	722.8	7.00	6.94	50
10:37	726.3	3.50	3.44	50
10:38	729.3	3.00	2.94	50
10:39	733.3	4.00	3.94	50
10:40	741.5	8.20	8.14	50
10:41	754.6	13.10	13.04	50
10:42	760	5.40	5.34	50
10:43	765.1	5.10	5.04	50
10:44	769.5	4.40	4.34	50

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
10:45	774.1	4.60	4.54	40
10:46	777.9	3.80	3.74	40





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	**24GCT-019**	**CONSTANT HEAD INJECTION TEST** *Packer Isolated* — APPLIED HYDROLOGIC
Test Number:	**4**	
Project No.:	**Graphite Creek**	

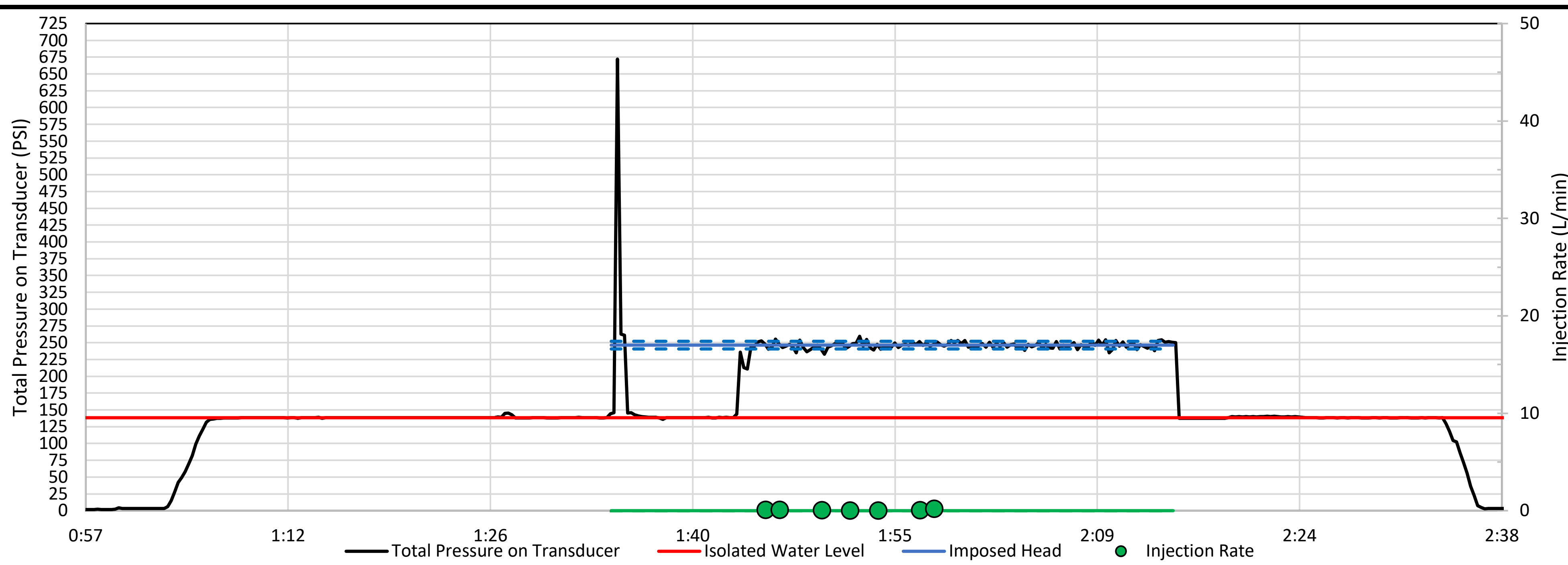
Location Description			Test Interval			General	
Current Depth:	476		**Bit Position:**	391.25	(ft-ah)	**Test Start Date/Time:**	6/22/2024 0:30
Hole Size[A]:	HQ		**Top of Test Interval:**	395.5	(ft-ah)	**Test End Date/Time:**	6/22/2024 3:00
Inclination:	50		**Stable Water Level[B]:**	138.307	(PSI)	**Supervisor:**	G. Foushee
Azimuth:	180		*Stable Water Level [C] :*	*-16.97*	*(ft-bgs)*	**Drill Contractor:**	Major
Elevation:	522	(ft-amsl)	*Transducer Position [D] :*	*399.5*	(ft-ah)	**Rig No. & Type:**	#37 LF90

Test Notes

Start Flush:	0:30		**Test Fluid** (water/poly):	Fresh Water		**Shear Pin Break Time:**	1:35
End Flush:	1:10		**Seal Quality:**	Good		**Injection End Time:**	2:15
Flushed Volume[E]:	800	(gal)	**Start Inflate Time:**	1:20		**Deflation Method:**	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection
Drilling Comments:	Drilling with thin poly.
Geology, Hydrogeology, & Rock Mass:	Drilling into the pegmatite. Good, competent rock. Very few fractures.
Test Quality and Assesment:	Good Test.



	Estimate	Low End	High End	
Imposed Head (H):	76	*72*	*80*	(m-H_2O)
Injection Rate (Q):	#NUM!	*0*	*0*	(m^3/day)
Hydraulic Conductivity:	**#NUM!**	*-6.86E-05*	*-3.46E-05*	(m/day)
Transmissivity:	**#NUM!**	*0.00*	*0.00*	(m/day/m)

Test Parameters

Radius of Influence[F]:	**(R)**	10	(m)
Radius of the Well:	**(r_w)**	48.0	(mm)
Test Interval Length:	**(b)**	24.54	(m)
System Leak Rate:		1	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GCT-019
Test Number:	4
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

APPLIED HYDROLOGIC

Leak Rate

Time	Totalizer	Rate	Pressure
(Hours)	*(L)*	*(L/min)*	*(PSI)*
1:28	3.95	0	100
1:29	4.78	0.83	100
1:30	5.6	0.82	100
1:31	6.42	0.82	100
1:32	7.23	0.81	100
1:33	8.04	0.81	100

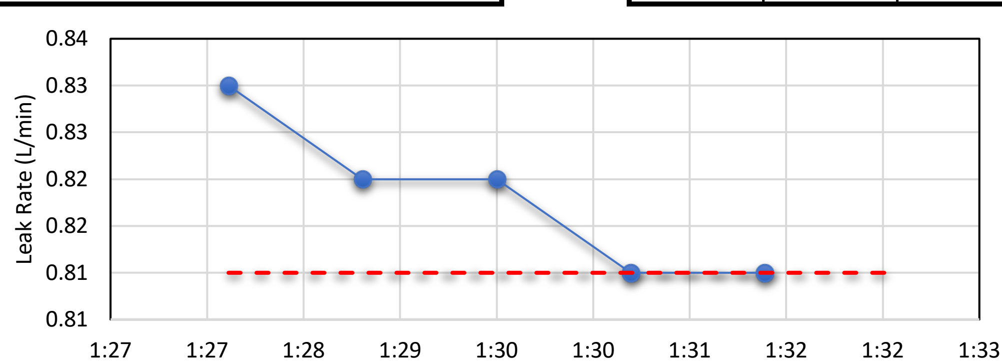
Leak Rate	0.81	L/min
Injection Rate	#NUM!	L/min
Min Injection Rate	-0.11	L/min
Max Injection Rate	-0.05	L/min

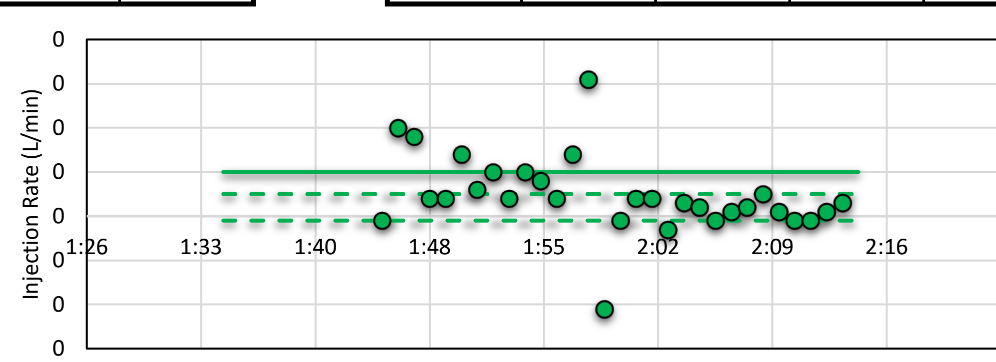
Injection Test

Time	Totalizer	Total Rate	Test Rate	Pressure
(Hours)	*(L)*	*(L/min)*	*(L/min)*	*(PSI)*
1:45	56	-	-	50
1:46	56.7	0.70	-0.11	50
1:47	57.61	0.91	0.10	50
1:48	58.5	0.89	0.08	50
1:49	59.25	0.75	-0.06	50
1:50	60	0.75	-0.06	50
1:51	60.85	0.85	0.04	50
1:52	61.62	0.77	-0.04	50
1:53	62.43	0.81	0.00	50
1:54	63.18	0.75	-0.06	50
1:55	63.99	0.81	0.00	50
1:56	64.78	0.79	-0.02	50
1:57	65.53	0.75	-0.06	50
1:58	66.38	0.85	0.04	50
1:59	67.4	1.02	0.21	50
2:00	67.9	0.50	-0.31	50
2:01	68.6	0.70	-0.11	50
2:02	69.35	0.75	-0.06	50
2:03	70.1	0.75	-0.06	50
2:04	70.78	0.68	-0.13	50
2:05	71.52	0.74	-0.07	50
2:06	72.25	0.73	-0.08	50
2:07	72.95	0.70	-0.11	50
2:08	73.67	0.72	-0.09	50
2:09	74.4	0.73	-0.08	50
2:10	75.16	0.76	-0.05	50
2:11	75.88	0.72	-0.09	50
2:12	76.58	0.70	-0.11	50
2:13	77.28	0.70	-0.11	50

Injection Test *(Continued)*

Time	Totalizer	Total Rate	Test Rate	Pressure
(Hours)	*(L)*	*(L/min)*	*(L/min)*	*(PSI)*
2:14	78	0.72	-0.09	40
2:15	78.74	0.74	-0.07	40

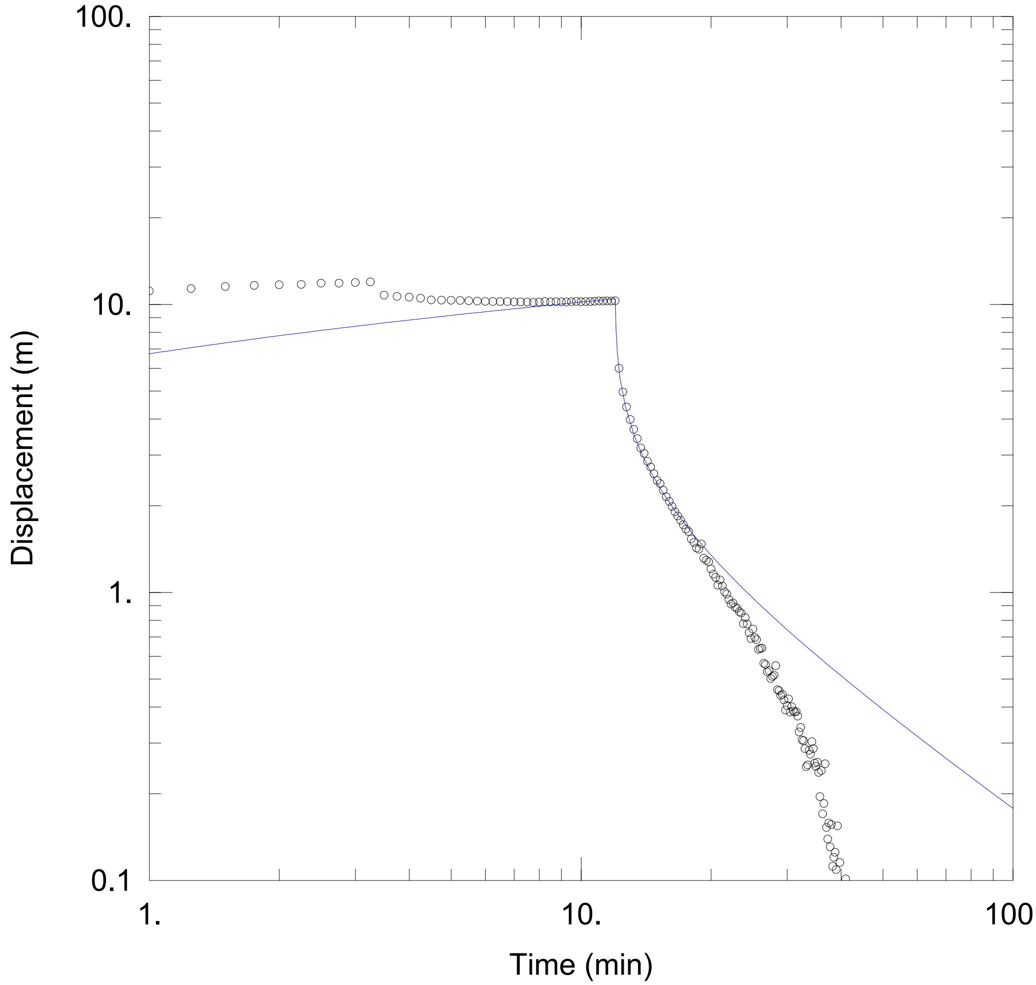




Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.



TEST 1 - ARTESIAN

Data Set: C:\...\24GCT019_Theis.aqt
Date: 11/23/24 Time: 15:40:51

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT-019
Test Date: 6/20/2024

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT-019	0	0

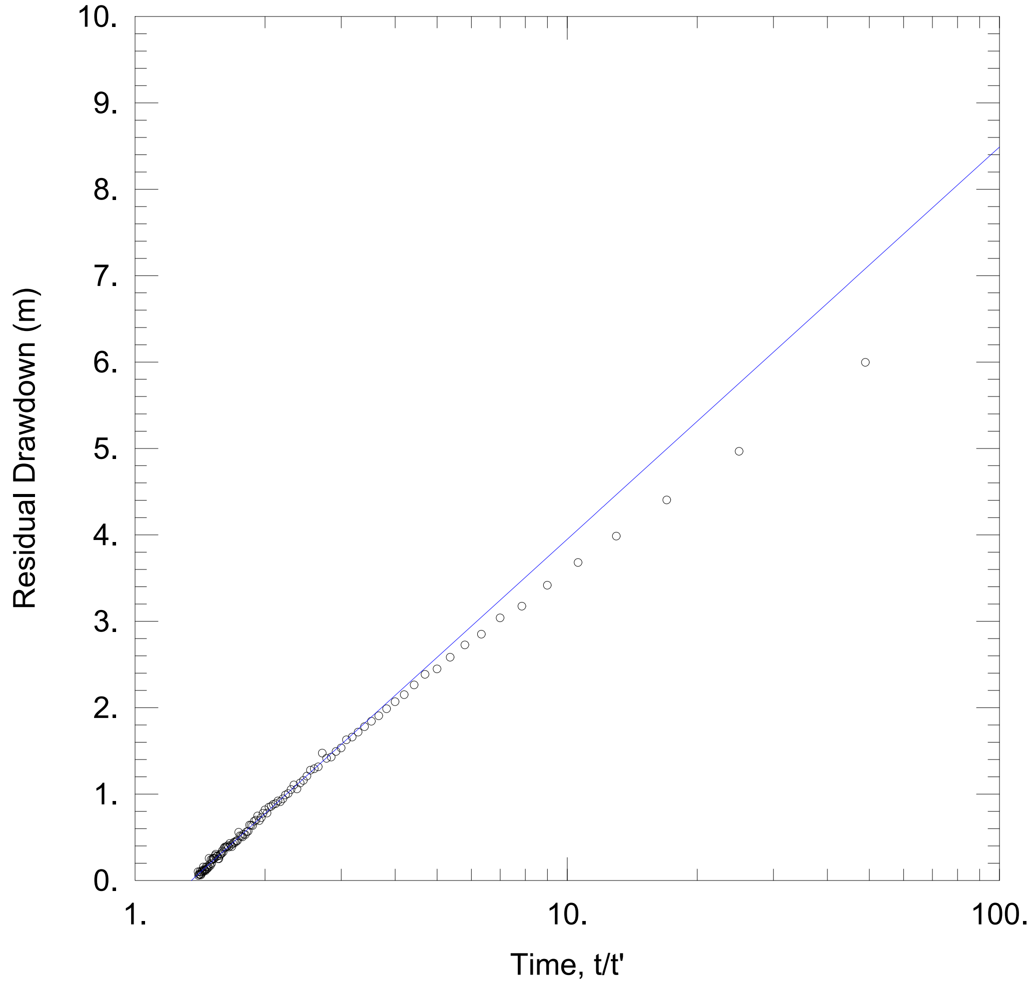
Observation Wells

Well Name	X (m)	Y (m)
○ 24GCT-019	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis

T = 2.661 m^2/day S = 0.02232
Kz/Kr = 1. b = 37. m



TEST 1 - ARTESIAN

Data Set: C:\...\24GCT019_TheisRDD.aqt
Date: 11/23/24 Time: 15:40:28

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT-019
Test Date: 6/20/2024

AQUIFER DATA

Saturated Thickness: 37. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT-019	0	0

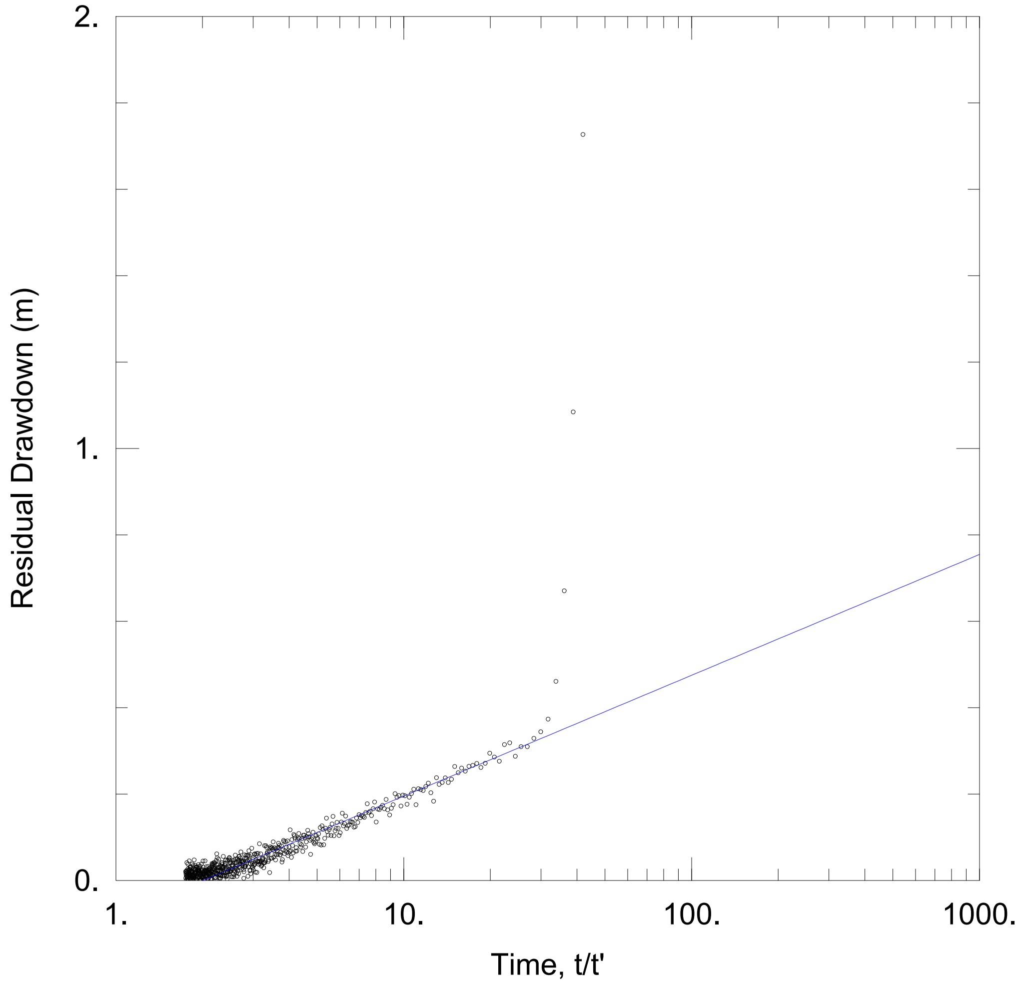
Observation Wells

Well Name	X (m)	Y (m)
○ 24GCT-019	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 1.264 m^2/day S/S' = 1.35



TEST 3

Data Set: C:\...\24GCT022_Test3_TheisRDD.aqt
Date: 11/23/24 Time: 15:46:13

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT022
Test Date: 7/22/2024

AQUIFER DATA

Saturated Thickness: 74.91 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT022	0	0

Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT022	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 34.79 m^2/day S/S' = 2.007

Drill Hole ID:	24GCT-023	CONSTANT HEAD INJECTION TEST
Test Number:	2	*Packer Isolated*
Project No.:	Graphite Creek	Tundra Consulting, LLC

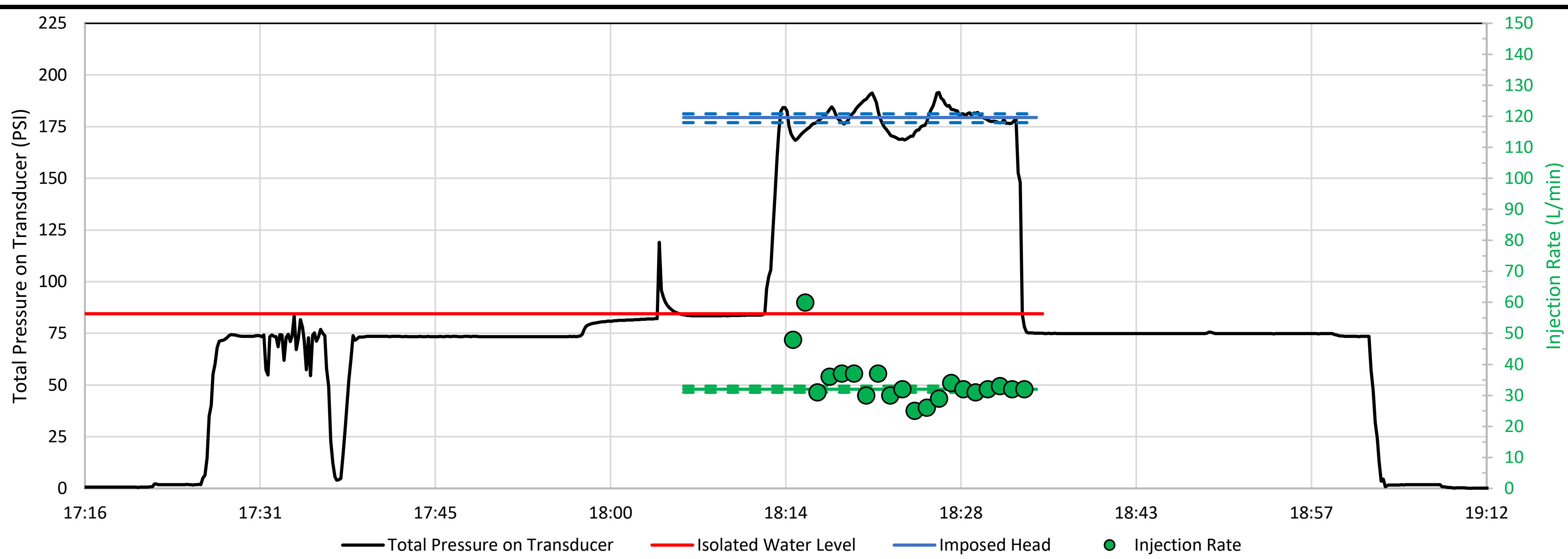
Location Description			Test Interval			General	
Current Depth:	394		Bit Position:	205	(ft-ah)	Test Start Date/Time:	7/4/2024 20:15
Hole Size[A]:	HQ		Top of Test Interval:	209.25	(ft-ah)	Test End Date/Time:	7/4/2024 23:50
Inclination:	50		Stable Water Level[B]:	84.5	(PSI)	Supervisor:	E. Wilson
Azimuth:	160		*Stable Water Level [C]:*	*-41.19*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	725	(ft-amsl)	*Transducer Position [D]:*	*213.25*	(ft-ah)	Rig No. & Type:	#37 LF90

Test Notes

Start Flush:	14:00		Test Fluid (water/poly):	Fresh Water	Shear Pin Break Time:	18:06
End Flush:	14:30		Seal Quality:	Very Good	Injection End Time:	18:35
Flushed Volume[E]:	750	(gal)	Start Inflate Time:	17:59	Deflation Method:	E-Pin

Zone Description & Comments

Test Type:	Constant Head Injection
Drilling Comments:	Below main and obvious artesian zone at 164 ft. Drilling with thin poly.
Geology, Hydrogeology, & Rock Mass:	Mostly intact and solid foliated rock (Garnet schist). Easy to find place to set packer.
Test Quality and Assessment:	Good Test. Artesian flow rate is ~10 gpm in bucket. Rate doesn't noticeably increase w/depth. Pressure didn't fully equilibrate during shut-in. Difficulty holding pressure stable (Bean pump?).



	Estimate	Low End	High End	
Imposed Head (H):	66.75	*65*	*68*	(m-H_2O)
Injection Rate (Q):	46	*45*	*48*	(m^3/day)
Hydraulic Conductivity:	**1.04E-02**	*9.90E-03*	*1.10E-02*	(m/day)
Transmissivity:	**0.59**	*0.56*	*0.62*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	56.31	(m)
System Leak Rate:		0	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H} \ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GCT-023
Test Number:	2
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
17:51	281.4	0.00	80
17:52	282	0.60	100
17:53	282.31	0.31	100
17:54	282.28	-0.03	100
17:55	282.3	0.02	100
17:56	282.32	0.02	100
17:57	282.34	0.02	100
17:58	282.34	0.00	100
17:59	282.35	0.01	100

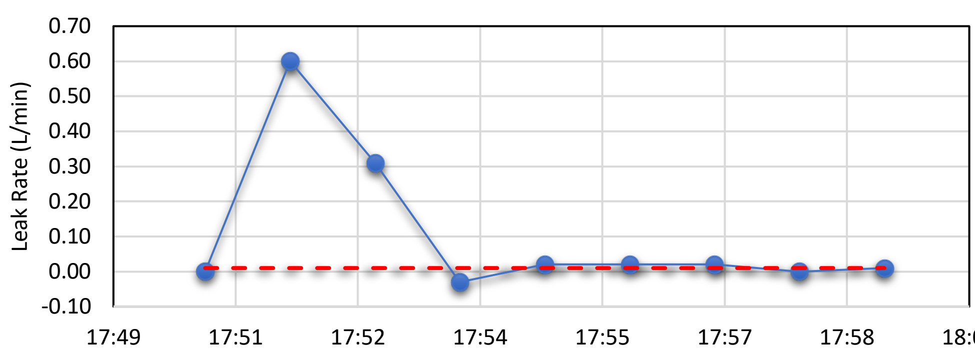
Injection Test

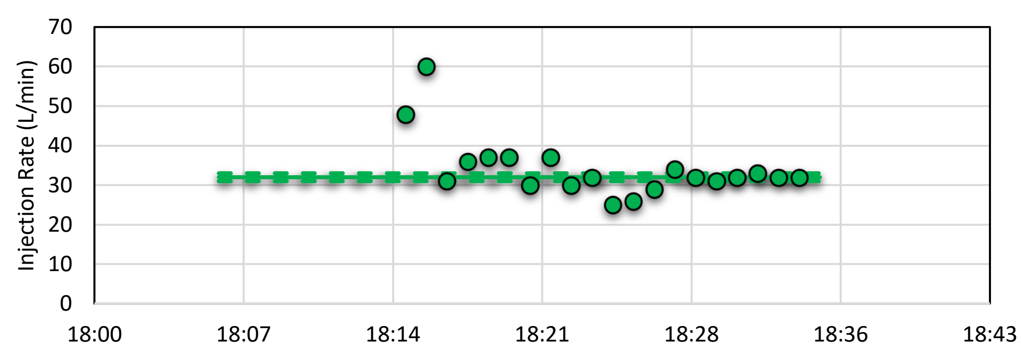
Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
18:15	286.07	-	-	50
18:16	334	47.9	47.9	100
18:17	394	60.0	60.0	100
18:18	425	31.0	31.0	100
18:19	461	36.0	36.0	100
18:20	498	37.0	37.0	100
18:21	535	37.0	37.0	100
18:22	565	30.0	30.0	100
18:23	602	37.0	37.0	100
18:24	632	30.0	30.0	100
18:25	664	32.0	32.0	100
18:26	689	25.0	25.0	100
18:27	715	26.0	26.0	100
18:28	744	29.0	29.0	100
18:29	778	34.0	34.0	100
18:30	810	32.0	32.0	100
18:31	841	31.0	31.0	100
18:32	873	32.0	32.0	100
18:33	906	33.0	33.0	100
18:34	938	32.0	32.0	100
18:35	970	32.0	32.0	100

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)

Leak Rate	0.01 L/min
Injection Rate	31.99 L/min
Min Injection Rate	31.0 L/min
Max Injection Rate	33.0 L/min





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	24GCT-023	**CONSTANT HEAD INJECTION TEST**	APPLIED HYDROLOGIC
Test Number:	1	***Packer Isolated***	
Project No.:	Graphite Creek		

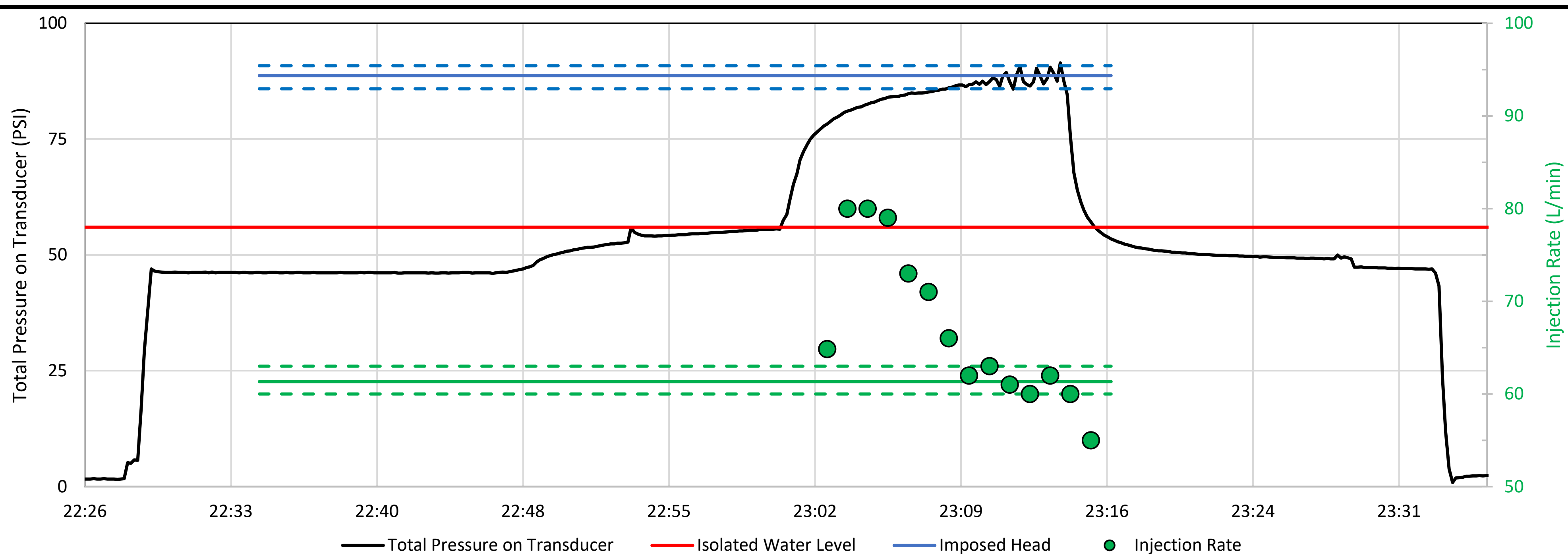
Location Description			Test Interval			General	
Current Depth:	205		**Bit Position:**	125	(ft-ah)	**Test Start Date/Time:**	7/3/2024 20:15
Hole Size[A]:	HQ		**Top of Test Interval:**	129.25	(ft-ah)	**Test End Date/Time:**	7/3/2024 23:50
Inclination:	50		**Stable Water Level[B]:**	56	(PSI)	**Supervisor:**	E. Wilson
Azimuth:	160		*Stable Water Level [C]:*	*-35.38*	*(ft-bgs)*	**Drill Contractor:**	Major
Elevation:	725	(ft-amsl)	*Transducer Position [D]:*	*133.25*	(ft-ah)	**Rig No. & Type:**	#37 LF90

Test Notes

Start Flush:	20:15		**Test Fluid** (water/poly):	Fresh Water	**Shear Pin Break Time:**	22:35
End Flush:	21:20		**Seal Quality:**	Good	**Injection End Time:**	23:17
Flushed Volume[E]:	1625	(gal)	**Start Inflate Time:**	22:47	**Deflation Method:**	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection
Drilling Comments:	Intersected artesian 164 ft. Drilling with thin poly.
Geology, Hydrogeology, & Rock Mass:	Mostly intact and solid foliated rock (Garnet schist). Artesian; approximately 10 GPM.
Test Quality and Assesment:	Good Test. However, pressure didn't fully stabilize during shut-in test and rigs' water supply ran out early, so conducted short injection test.



	Estimate	Low End	High End	
Imposed Head (H):	23	*21*	*24.5*	(m-H_2O)
Injection Rate (Q):	88	*86*	*91*	(m^3/day)
Hydraulic Conductivity:	**1.41E-01**	*1.30E-01*	*1.59E-01*	(m/day)
Transmissivity:	**3.26**	*3.00*	*3.67*	(m/day/m)

Test Parameters

Radius of Influence[F]: (R)		10	(m)
Radius of the Well: (r_w)		48.0	(mm)
Test Interval Length: (b)		23.09	(m)
System Leak Rate:		0	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H} \ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GCT-023
Test Number:	1
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
22:37	304	0.00	50
22:38	307.9	3.90	50
22:39	309.4	1.50	50
22:40	309.4	0.00	50
22:41	309.4	0.00	50
22:42	309.4	0.00	50
22:43	309.5	0.10	75
22:44	309.5	0.00	75
22:45	309.5	0.00	75
22:46	309.5	0.00	75
22:47	309.5	0.00	75

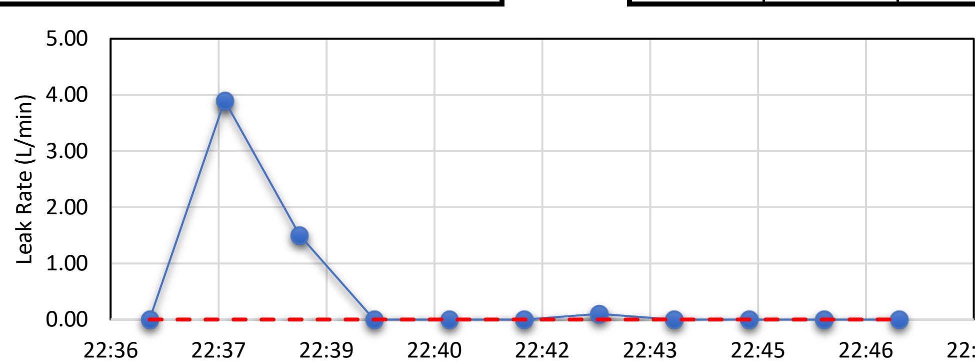
Injection Test

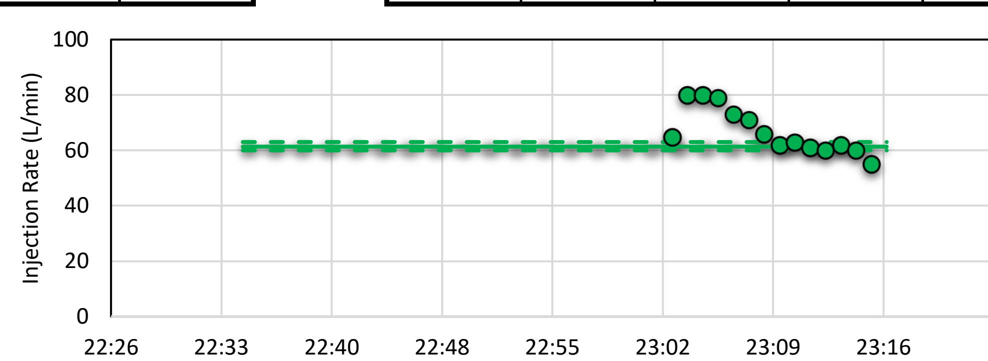
Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
23:03	9315.15	-	-	45
23:04	9380	64.85	64.85	45
23:05	9460	80.00	80.00	45
23:06	9540	80.00	80.00	45
23:07	9619	79.00	79.00	45
23:08	9692	73.00	73.00	45
23:09	9763	71.00	71.00	45
23:10	9829	66.00	66.00	45
23:11	9891	62.00	62.00	45
23:12	9954	63.00	63.00	45
23:13	10015	61.00	61.00	45
23:14	10075	60.00	60.00	45
23:15	10137	62.00	62.00	45
23:16	10197	60.00	60.00	45
23:17	10252	55.00	55.00	45

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)

Leak Rate	0 L/min
Injection Rate	61.33 L/min
Min Injection Rate	60.00 L/min
Max Injection Rate	63.00 L/min





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	24GCT-025	CONSTANT HEAD INJECTION TEST *Packer Isolated*	Tundra Consulting, LLC
Test Number:	1		
Project No.:	Graphite Creek		

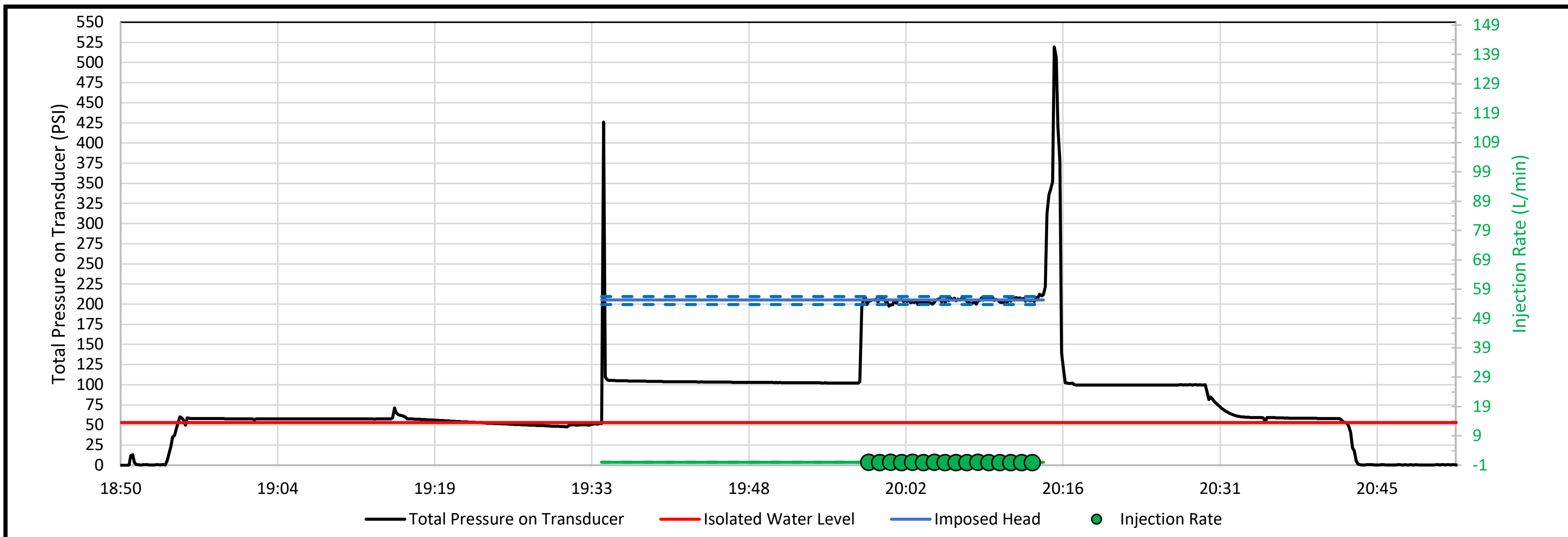
Location Description			Test Interval			General	
Current Depth:	374		Bit Position:	194	(ft-ah)	Test Start Date/Time:	7/11/2024 17:45
Hole Size[A]:	HQ		Top of Test Interval:	198.25	(ft-ah)	Test End Date/Time:	7/11/2024 21:00
Inclination:	50		Stable Water Level[B]:	53	(PSI)	Supervisor:	E. Wilson
Azimuth:	160		*Stable Water Level[C]:*	*42.7*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	1152	(ft-amsl)	*Transducer Position[D]:*	*202.25*	(ft-ah)	Rig No. & Type:	#37 LF90

Test Notes

Start Flush:	17:45		Test Fluid (water/poly):	Fresh Water	Shear Pin Break Time:	19:34
End Flush:	18:05		Seal Quality:	Very Good	Injection End Time:	20:15
Flushed Volume[E]:	500	(gal)	Start Inflate Time:	19:30	Deflation Method:	E-Pin

Zone Description & Comments

Test Type:	Constant Head Injection
Drilling Comments:	Deep water table. Lost circulation. Drillers used LCM (paper)
Geology, Hydrogeology, & Rock Mass:	Solid rock; very good drilling. Garnet schist.
Test Quality and Assessment:	The hydraulic conductivity is low and the pressure did not fully recover during the shut-in. No measureable injection rate.



	Estimate	Low End	High End	
Imposed Head (H):	107	*103*	*110*	(m-H_2O)
Injection Rate (Q):	0	*0*	*0*	(m^3/day)
Hydraulic Conductivity:	**0.00E+00**	*0.00E+00*	*6.65E-06*	(m/day)
Transmissivity:	**0.00**	*0.00*	*0.00*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	53.57	(m)
System Leak Rate:		0	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GCT-025	CONSTANT HEAD INJECTION TEST
Test Number:	1	*Packer Isolated*
Project No.:	Graphite Creek	

APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
19:14	198.5	0.00	100
19:15	206	7.50	100
19:16	206.21	0.21	95
19:17	206.47	0.26	100
19:18	206.52	0.05	100
19:19	206.64	0.12	100
19:20	207.12	0.48	100
19:21	207.41	0.29	100
19:22	207.74	0.33	100
19:23	208.04	0.30	100
19:24	208.31	0.27	100
19:25	208.64	0.33	100
19:26	208.94	0.30	100
19:27	209.25	0.31	100
19:28	209.56	0.31	100
19:29	209.86	0.30	100
19:30	210.17	0.31	100

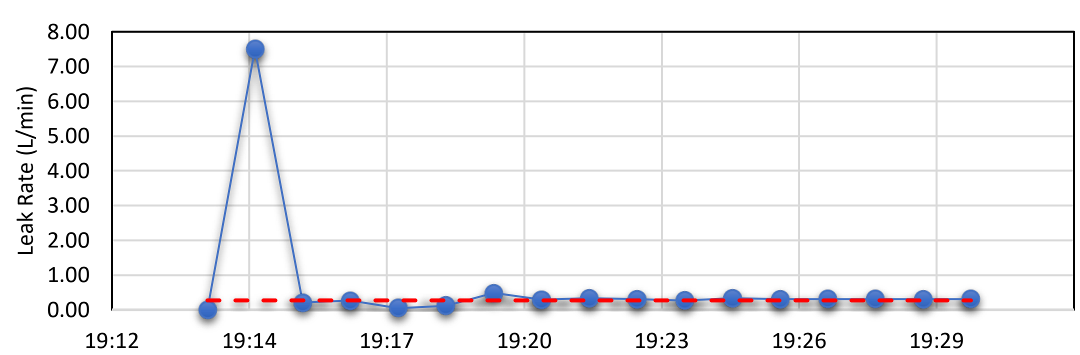
Leak Rate	0.27 L/min
Injection Rate	0.00 L/min
Min Injection Rate	0.00 L/min
Max Injection Rate	0.03 L/min

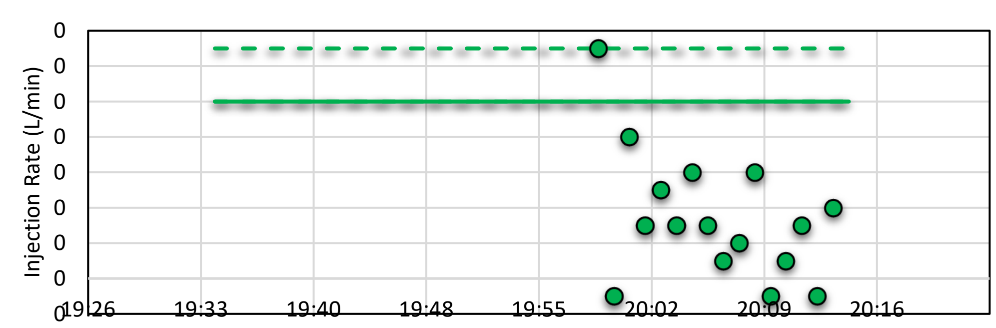
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
19:57		-	-	
19:58				
19:59	14.19			
20:00	14.49	0.30	0.03	100
20:01	14.65	0.16	-0.11	100
20:02	14.9	0.25	-0.02	100
20:03	15.1	0.20	-0.07	100
20:04	15.32	0.22	-0.05	100
20:05	15.52	0.20	-0.07	100
20:06	15.75	0.23	-0.04	100
20:07	15.95	0.20	-0.07	100
20:08	16.13	0.18	-0.09	100
20:09	16.32	0.19	-0.08	100
20:10	16.55	0.23	-0.04	100
20:11	16.71	0.16	-0.11	100
20:12	16.89	0.18	-0.09	100
20:13	17.09	0.20	-0.07	100
20:14	17.25	0.16	-0.11	100
20:15	17.46	0.21	-0.06	100

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	24GCT-025	CONSTANT HEAD INJECTION TEST *Packer Isolated*	Tundra Consulting, LLC
Test Number:	2		
Project No.:	Graphite Creek		

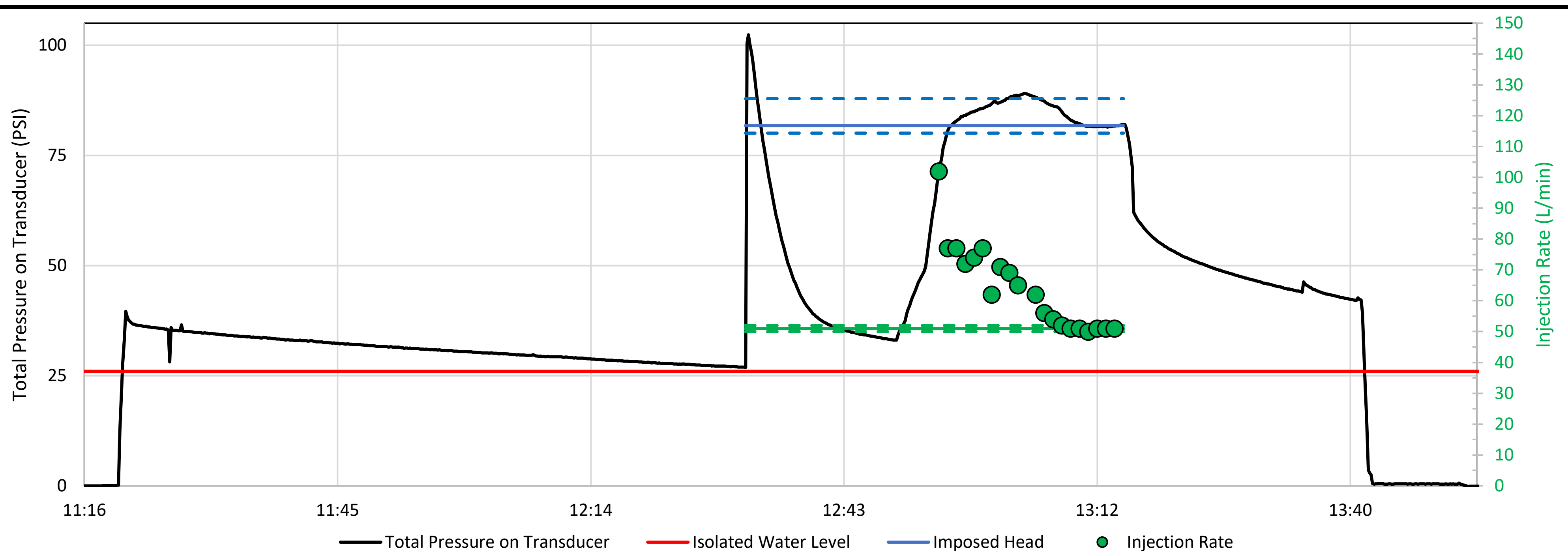
Location Description			Test Interval			General	
Current Depth:	518		Bit Position:	374	(ft-ah)	Test Start Date/Time:	7/12/2024 9:55
Hole Size[A]:	HQ		Top of Test Interval:	378.25	(ft-ah)	Test End Date/Time:	7/12/2024 14:00
Inclination:	50		Stable Water Level[B]:	26	(PSI)	Supervisor:	E. Wilson
Azimuth:	160		*Stable Water Level [C] :*	*304.0*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	1152	(ft-amsl)	*Transducer Position [D] :*	*382.25*	(ft-ah)	Rig No. & Type:	#37 LF90

Test Notes

Start Flush:	9:55		**Test Fluid** (water/poly):	Fresh Water	Shear Pin Break Time:	12:32
End Flush:	10:20		Seal Quality:	Very Good	Injection End Time:	13:15
Flushed Volume[E]:	625	(gal)	Start Inflate Time:	12:26	Deflation Method:	

Zone Description & Comments

Test Type:	Constant Head Injection
Drilling Comments:	Deep water table. Lost circulation. Drillers used LCM (paper)
Geology, Hydrogeology, & Rock Mass:	Garnet schist. 1-2 ft fracture frequency. Generally fresh, unaltered fractures.
Test Quality and Assessment:	Water pressure not fully stabilized during shut-in test. Some pressure irregularities during injection. However, good test.



	Estimate	Low End	High End	
Imposed Head (H):	39.20	*38*	*43.5*	(m-H_2O)
Injection Rate (Q):	73.4	*72.0*	*74.9*	(m^3/day)
Hydraulic Conductivity:	**3.74E-02**	*3.30E-02*	*3.93E-02*	(m/day)
Transmissivity:	**1.59**	*1.41*	*1.67*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	42.60	(m)
System Leak Rate:		0.029	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GCT-025	CONSTANT HEAD INJECTION TEST
Test Number:	2	*Packer Isolated*
Project No.:	Graphite Creek	APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
12:14	3.8	0.00	100
12:15	4.25	0.45	100
12:16	4.7	0.45	100
12:17	4.98	0.28	100
12:18	5.3	0.32	100
12:19	5.6	0.30	100
12:20	5.82	0.22	100
12:21	6	0.18	100
12:22	6.12	0.12	100
12:23	6.28	0.16	100
12:24	6.41	0.13	100
12:25	6.55	0.14	100
12:26	6.69	0.14	100

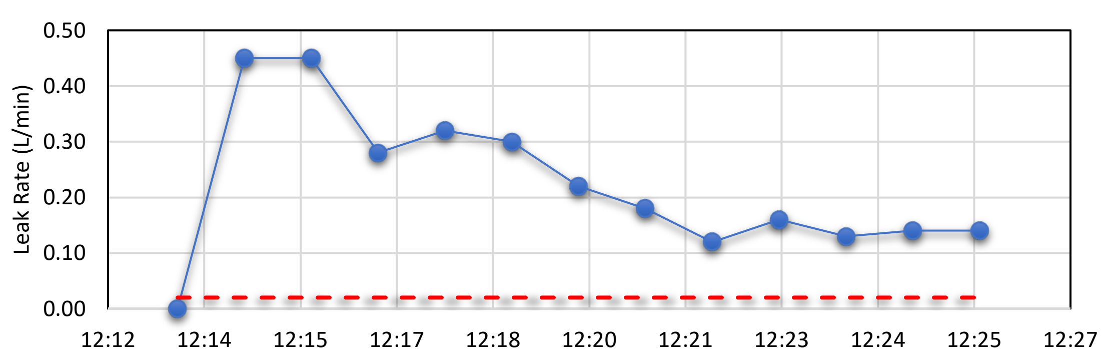
Leak Rate	0.02 L/min
Injection Rate	50.98 L/min
Min Injection Rate	49.98 L/min
Max Injection Rate	51.98 L/min

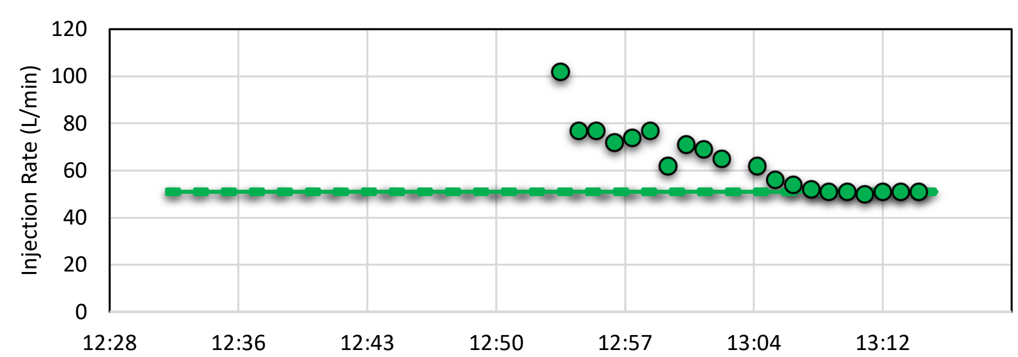
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
12:54	1603	-	-	10
12:55	1705	102.00	101.98	5
12:56	1782	77.00	76.98	5
12:57	1859	77.00	76.98	5
12:58	1931	72.00	71.98	5
12:59	2005	74.00	73.98	10
13:00	2082	77.00	76.98	10
13:01	2144	62.00	61.98	15
13:02	2215	71.00	70.98	15
13:03	2284	69.00	68.98	15
13:05	2414	65.00	64.98	15
13:06	2476	62.00	61.98	15
13:07	2532	56.00	55.98	15
13:08	2586	54.00	53.98	15
13:09	2638	52.00	51.98	15
13:10	2689	51.00	50.98	15
13:11	2740	51.00	50.98	15
13:12	2790	50.00	49.98	15
13:13	2841	51.00	50.98	15
13:14	2892	51.00	50.98	15
13:15	2943	51.00	50.98	15

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)

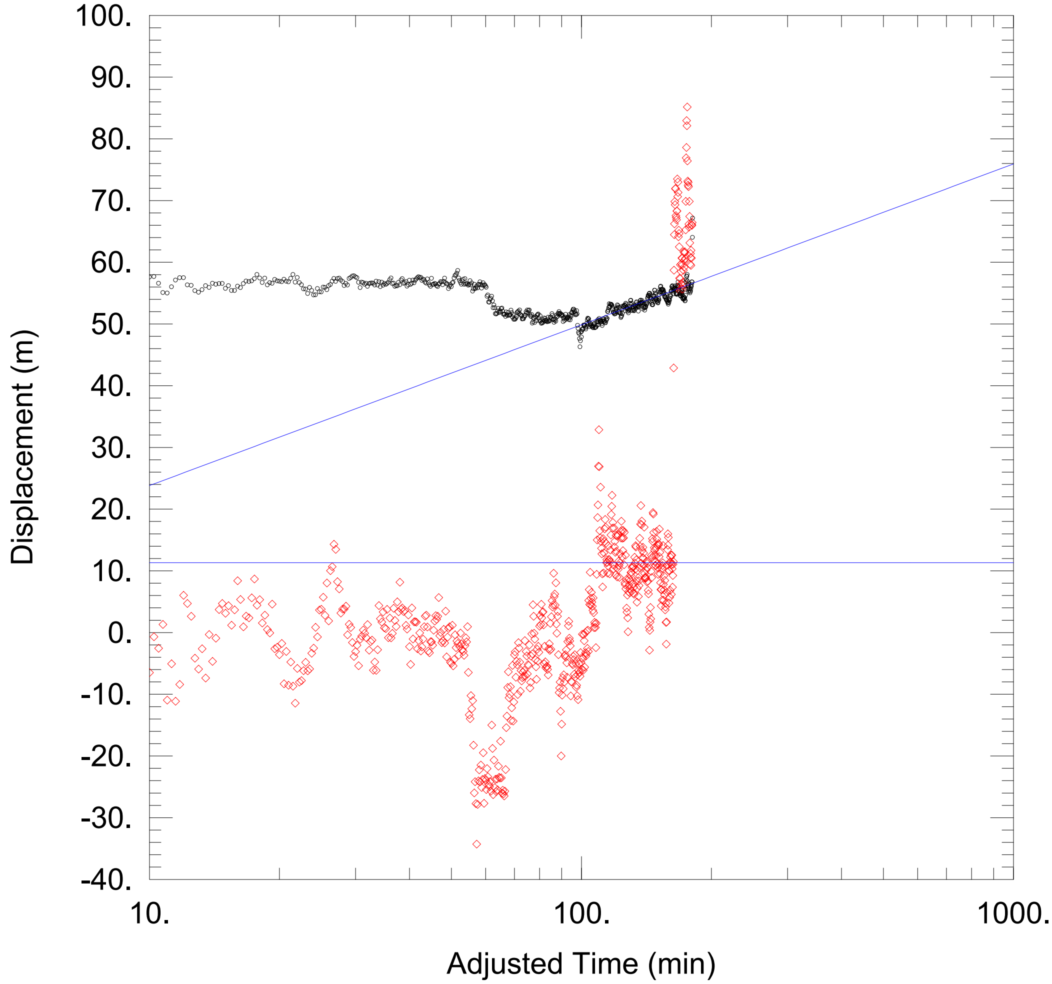




Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.



TEST 1 - AIRLIFT

Data Set: C:\...\24GCT026_Test1_CooperJacob.aqt
Date: 11/23/24 Time: 15:54:16

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT026
Test Date: 8/15/2024

AQUIFER DATA

Saturated Thickness: 80. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT026	0	0

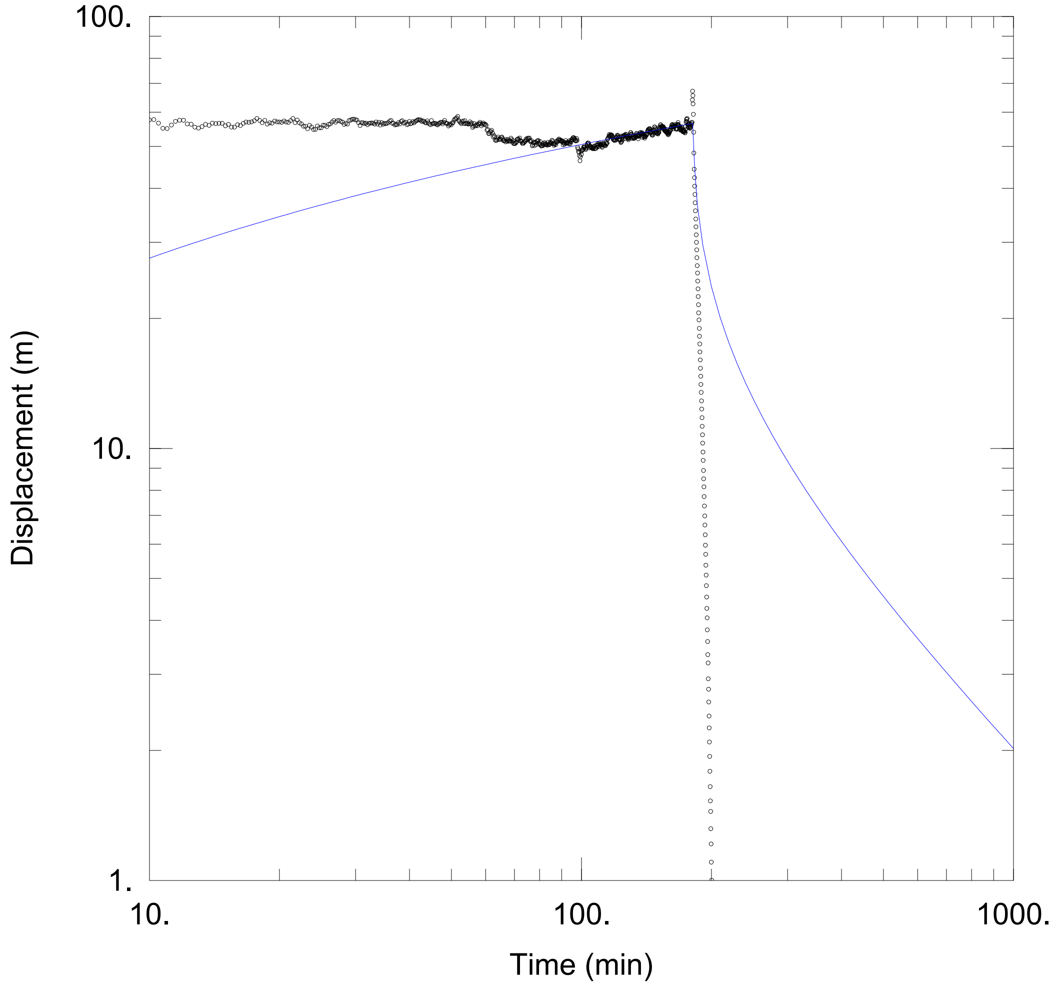
Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT026	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 0.1724 m^2/day S = 0.1423



TEST 1 - AIRLIFT

Data Set: C:\...\24GCT026_Test1_Theis.aqt
Date: 11/23/24 Time: 15:53:57

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT026
Test Date: 8/15/2024

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT026	0	0

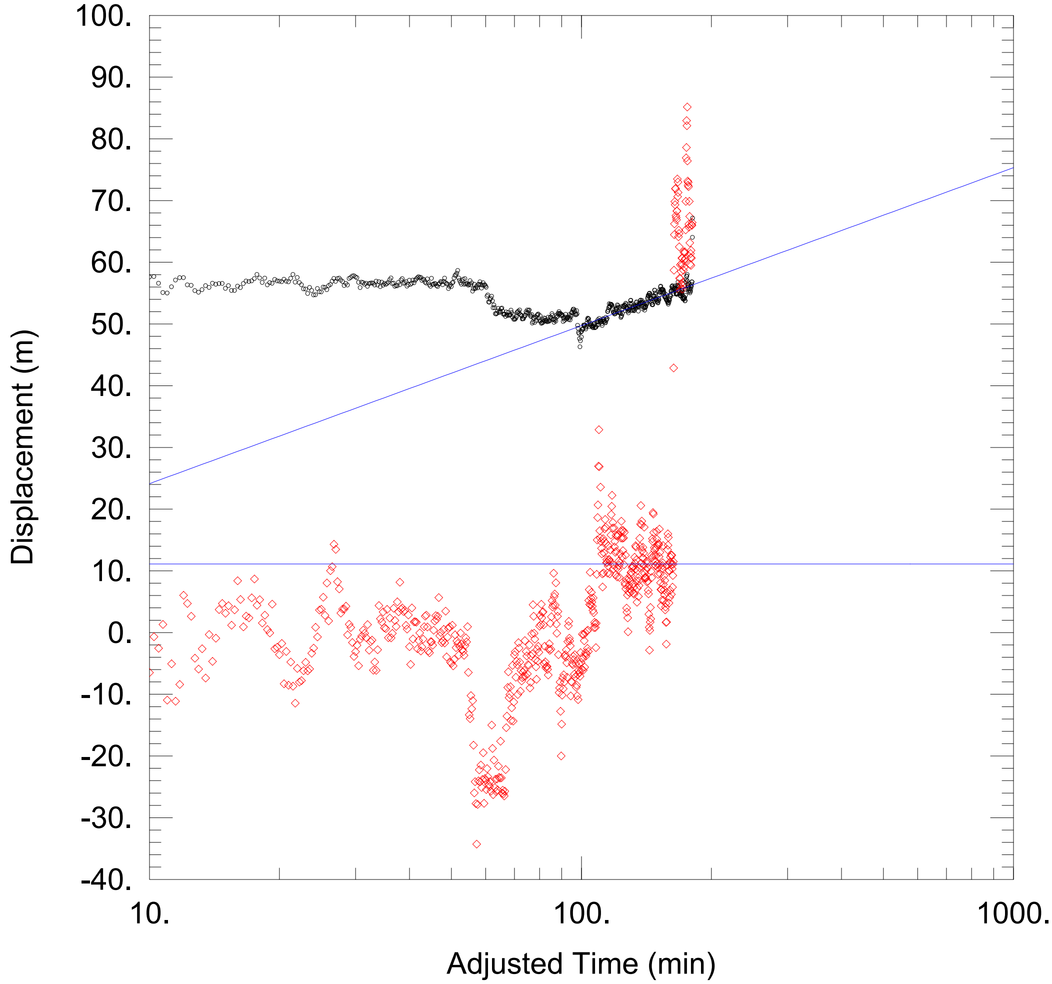
Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT026	0	0

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 0.1928 m^2/day
S = 0.08894
Kz/Kr = 1.
b = 80. m



TEST 1 - AIRLIFT

Data Set: C:\...\24GCT026_Test1_TheisRDD.aqt
Date: 11/23/24 Time: 15:53:48

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT026
Test Date: 8/15/2024

AQUIFER DATA

Saturated Thickness: 80. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT026	0	0

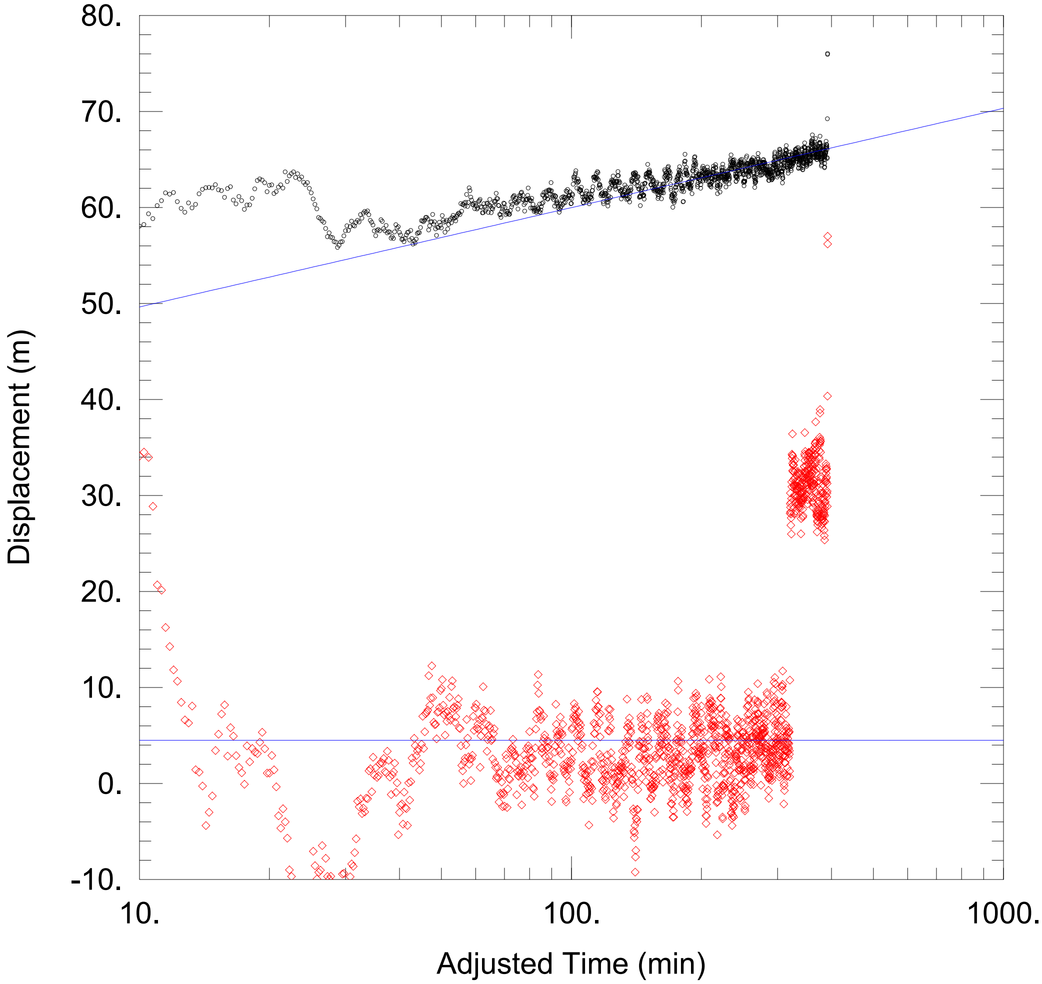
Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT026	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 0.1755 m^2/day S = 0.1357



TEST 1 - AIRLIFT

Data Set: C:\...\24GCT026_Test2_CooperJacob.aqt
Date: 11/23/24 Time: 15:56:13

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT026
Test Date: 8/15/2024

AQUIFER DATA

Saturated Thickness: 80. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT026	0	0

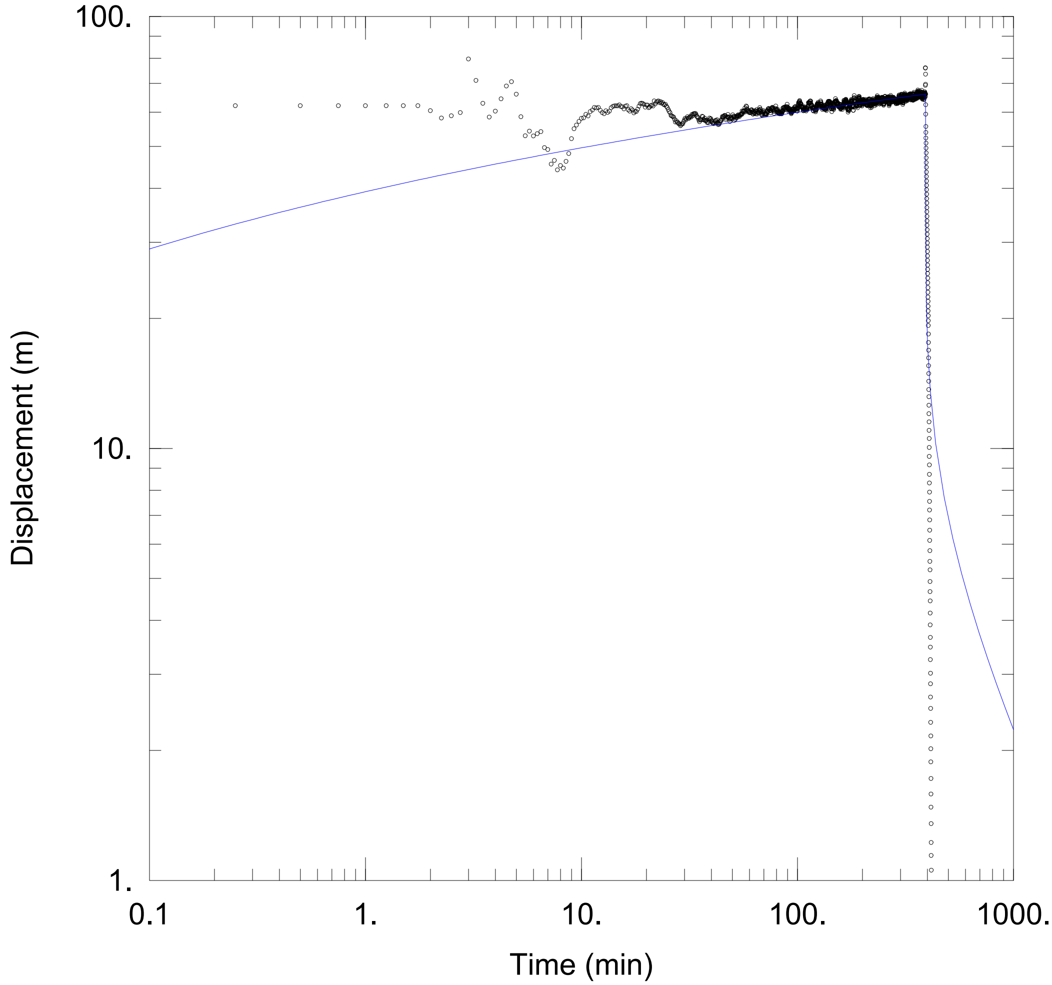
Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT026	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 0.2703 m^2/day S = 2.919E-5



TEST 1 - AIRLIFT

Data Set: C:\...\24GCT026_Test2_Theis.aqt
Date: 11/23/24 Time: 15:56:01

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT026
Test Date: 8/15/2024

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT026	0	0

Observation Wells

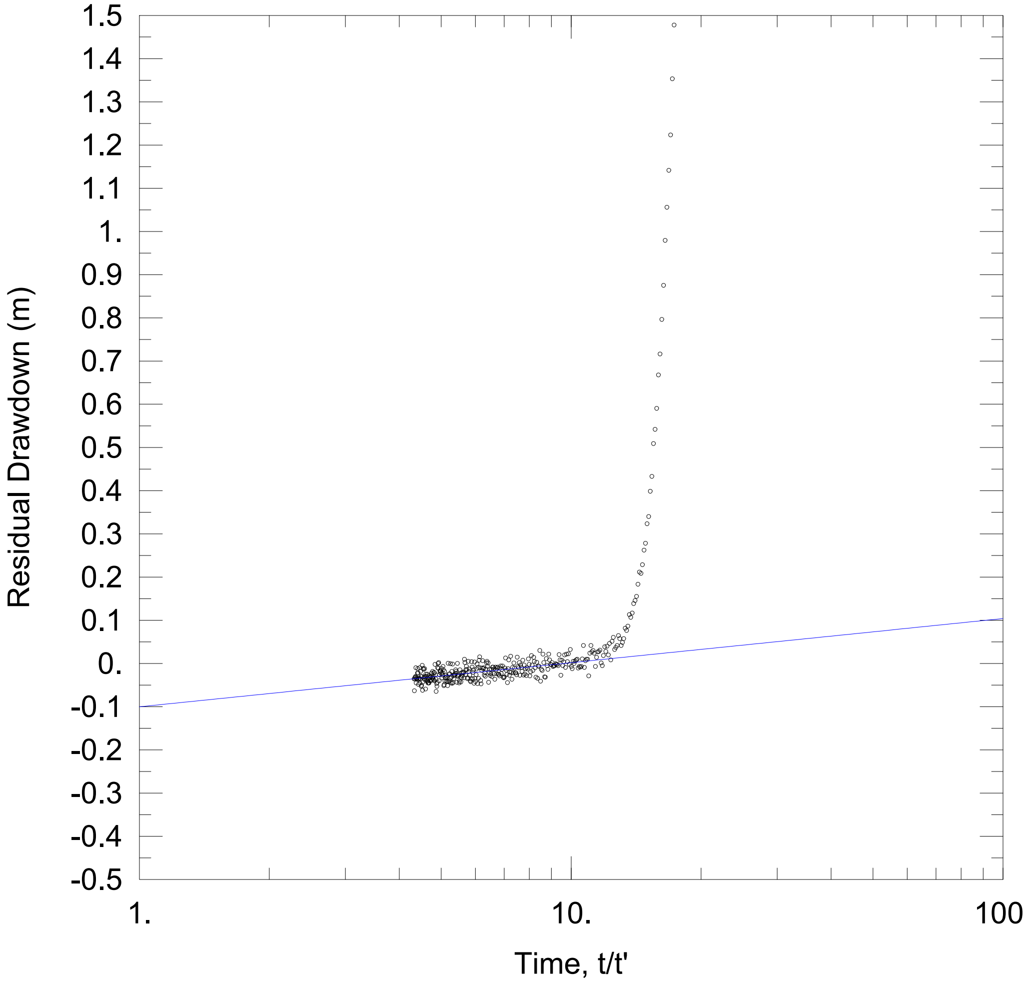
Well Name	X (m)	Y (m)
◦ 24GCT026	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis

T = 0.2703 m^2/day
Kz/Kr = 1.

S = 2.919E-5
b = 80. m



TEST 1 - AIRLIFT

Data Set: C:\...\24GCT026_Test2_TheisRDD.aqt
Date: 11/23/24 Time: 15:55:42

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT026
Test Date: 8/15/2024

AQUIFER DATA

Saturated Thickness: 80. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT026	0	0

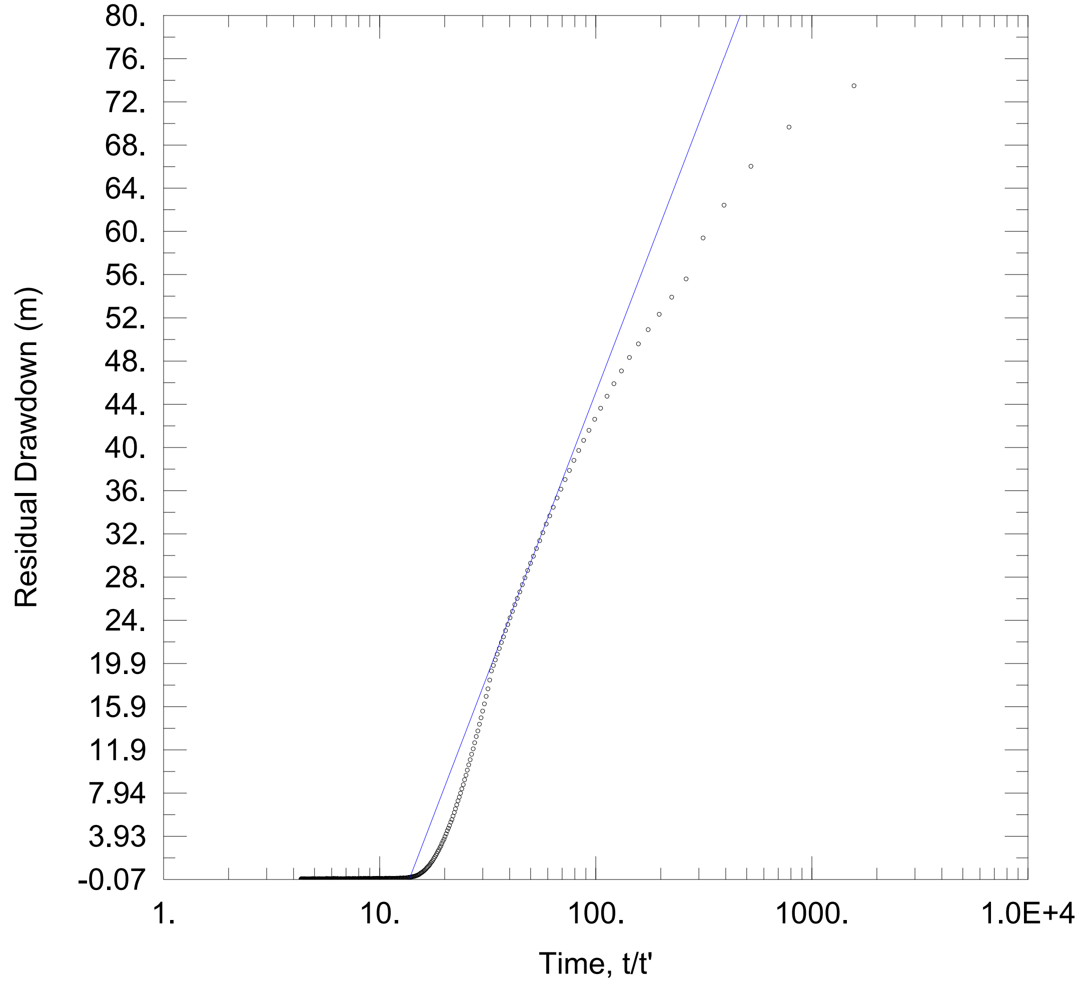
Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT026	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 27.39 m^2/day S/S' = 9.624



TEST 1 - AIRLIFT

Data Set: C:\...\24GCT026_Test2_TheisRDD_2.aqt
Date: 11/23/24 Time: 15:55:33

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT026
Test Date: 8/15/2024

AQUIFER DATA

Saturated Thickness: 80. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT026	0	0

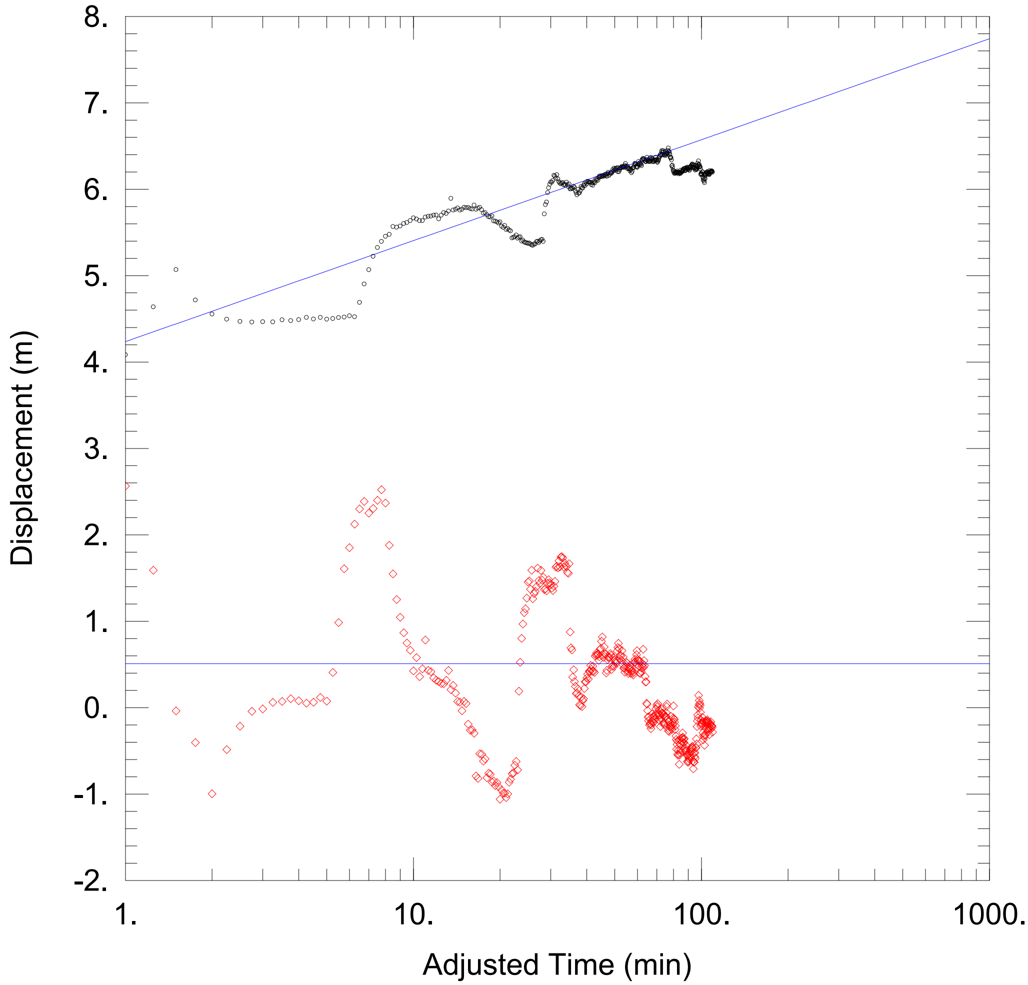
Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT026	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 0.05354 m^2/day S/S' = 13.75



TEST 1 - AIRLIFT

Data Set: C:\...\24GCT026_Test3_CooperJacob.aqt
Date: 11/23/24 Time: 15:59:35

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT026
Test Date: 8/15/2024

AQUIFER DATA

Saturated Thickness: 80. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT026	0	0

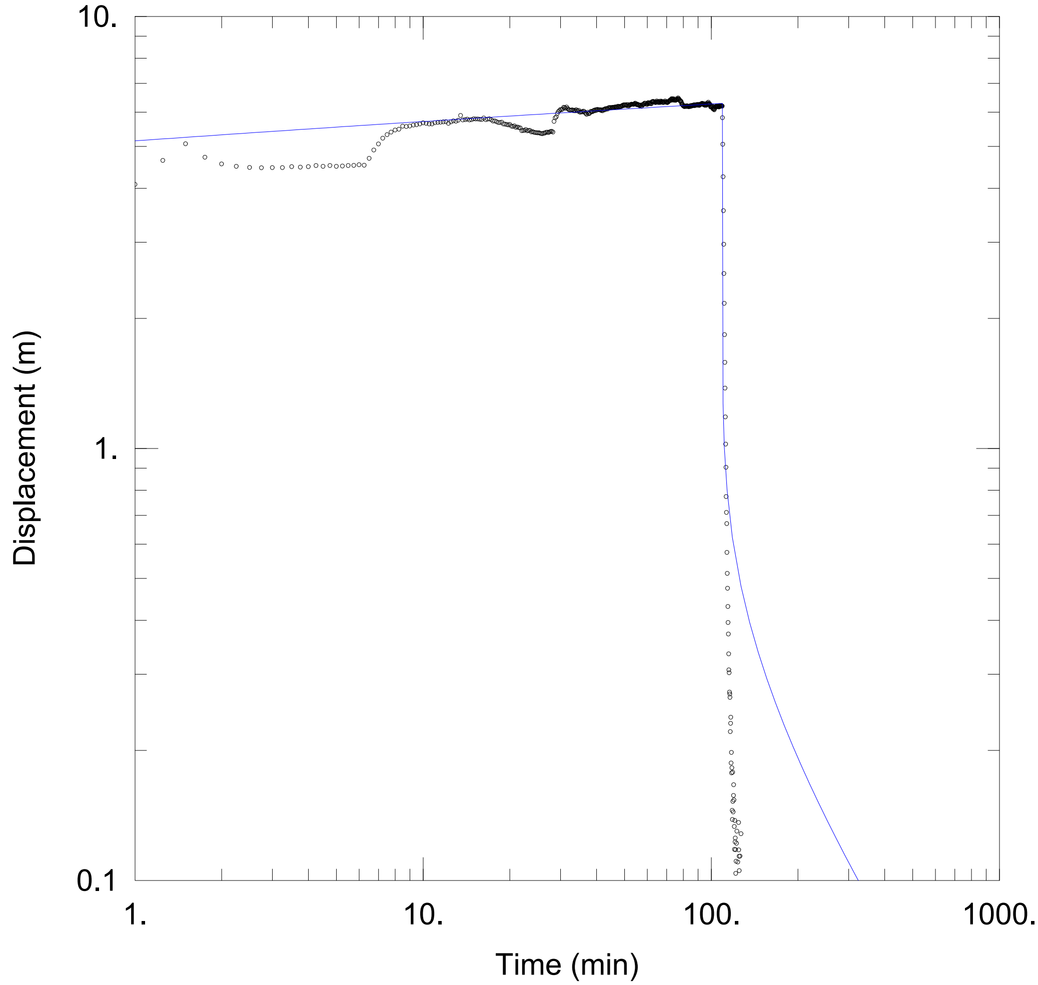
Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT026	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 1.768 m^2/day S = 0.0002838



TEST 1 - AIRLIFT

Data Set: C:\...\24GCT026_Test3_Theis.aqt
Date: 11/23/24 Time: 15:57:16

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT026
Test Date: 8/15/2024

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT026	0	0

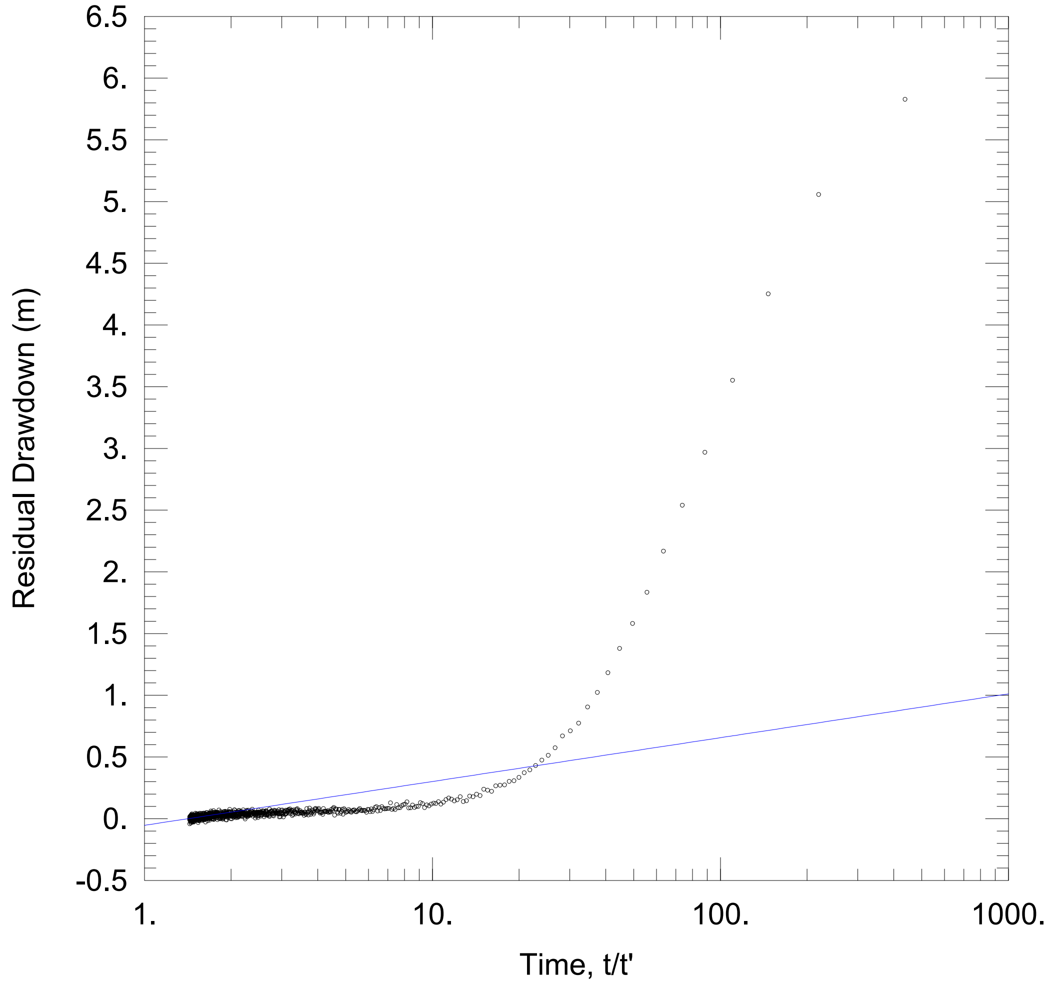
Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT026	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis

T = 3.694 m^2/day
Kz/Kr = 1.
S = 1.542E-9
b = 80. m



TEST 1 - AIRLIFT

Data Set: C:\...\24GCT026_Test3_TheisRDD.aqt
Date: 11/23/24 Time: 15:57:06

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT026
Test Date: 8/15/2024

AQUIFER DATA

Saturated Thickness: 80. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT026	0	0

Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT026	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 5.821 m^2/day S/S' = 1.417

Drill Hole ID:	24GCT-028
Test Number:	1
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

Tundra Consulting, LLC

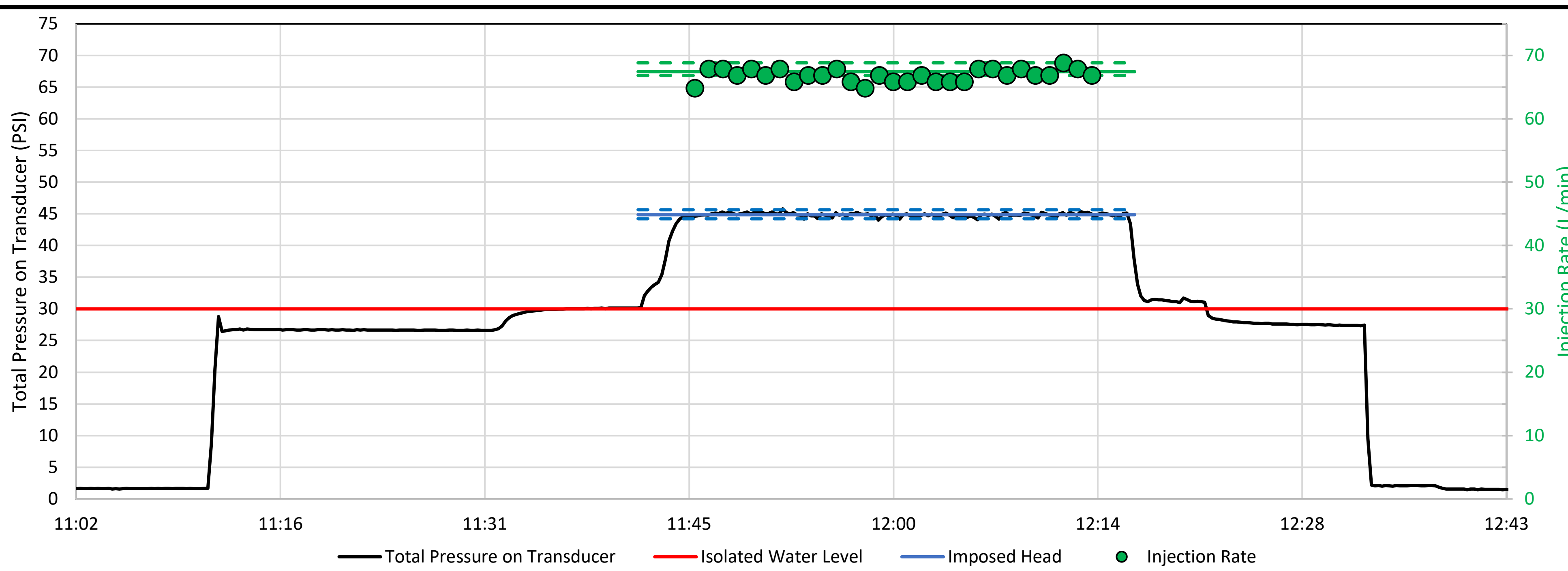
Location Description			Test Interval			General	
Current Depth:	180.5		Bit Position:	72	(ft-ah)	Test Start Date/Time:	7/17/2024 10:20
Hole Size[A]:	HQ		Top of Test Interval:	76.25	(ft-ah)	Test End Date/Time:	7/17/2024 12:39
Inclination:	50		Stable Water Level[B]:	30	(PSI)	Supervisor:	G. Foushee
Azimuth:	160		*Stable Water Level [C]:*	*-10.1*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	1004	(ft-amsl)	*Transducer Position [D]:*	*80.25*	(ft-ah)	Rig No. & Type:	#38 LF90

Test Notes

Start Flush:	10:20		**Test Fluid** (water/poly):	Fresh Water	Shear Pin Break Time:	11:42
End Flush:	10:35		Seal Quality:	Good	Injection End Time:	12:17
Flushed Volume[E]:	300	(gal)	Start Inflate Time:	11:30	Deflation Method:	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection - Single Step
Drilling Comments:	Lost circulation at about 80 feet. Drillers used LCM (paper) to regain.
Geology, Hydrogeology, & Rock Mass:	High fracture frequency with alteration/weathering to 100 feet. Decreasing FF and alteration below that.
Test Quality and Assessment:	Test leak rate calculated. Measured leak rate was at different pressure, but was low and not significant. Upward pressure gradient. Good test with generally tight controls.



	Estimate	Low End	High End	
Imposed Head (H):	10.45	*10.00*	*11.00*	(m-H_2O)
Injection Rate (Q):	97.12	*96.25*	*99.13*	(m^3/day)
Hydraulic Conductivity:	**2.49E-01**	*2.34E-01*	*2.65E-01*	(m/day)
Transmissivity:	**7.90**	*7.43*	*8.42*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	31.78	(m)
System Leak Rate:		0.23	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GCT-028	CONSTANT HEAD INJECTION TEST *Packer Isolated*	APPLIED HYDROLOGIC
Test Number:	1		
Project No.:	Graphite Creek		

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
11:38	79.1	0.00	50
11:39	79.47	0.37	50
11:40	79.85	0.38	50
11:41	80.26	0.41	50
11:42	80.65	0.39	50

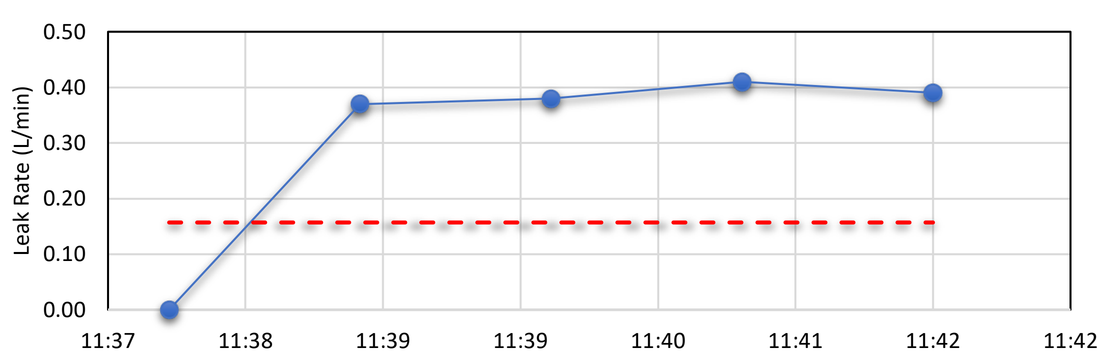
Leak Rate	0.16 L/min
Injection Rate	67.44 L/min
Min Injection Rate	66.84 L/min
Max Injection Rate	68.84 L/min

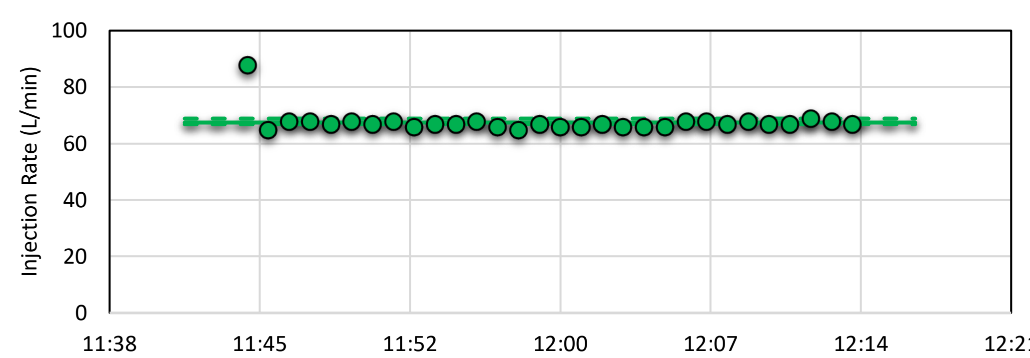
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
11:45	3090	-	-	20
11:46	3178	88.00	87.84	20
11:47	3243	65.00	64.84	20
11:48	3311	68.00	67.84	20
11:49	3379	68.00	67.84	20
11:50	3446	67.00	66.84	20
11:51	3514	68.00	67.84	20
11:52	3581	67.00	66.84	20
11:53	3649	68.00	67.84	20
11:54	3715	66.00	65.84	20
11:55	3782	67.00	66.84	20
11:56	3849	67.00	66.84	20
11:57	3917	68.00	67.84	20
11:58	3983	66.00	65.84	20
11:59	4048	65.00	64.84	20
12:00	4115	67.00	66.84	20
12:01	4181	66.00	65.84	20
12:02	4247	66.00	65.84	20
12:03	4314	67.00	66.84	20
12:04	4380	66.00	65.84	20
12:05	4446	66.00	65.84	20
12:06	4512	66.00	65.84	20
12:07	4580	68.00	67.84	20
12:08	4648	68.00	67.84	20
12:09	4715	67.00	66.84	20
12:10	4783	68.00	67.84	20
12:11	4850	67.00	66.84	20
12:12	4917	67.00	66.84	20
12:13	4986	69.00	68.84	20

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
12:14	5054	68.00	67.84	20
12:15	5121	67.00	66.84	20





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	24GCT-028	CONSTANT HEAD INJECTION TEST *Packer Isolated*	Tundra Consulting, LLC
Test Number:	2		
Project No.:	Graphite Creek		

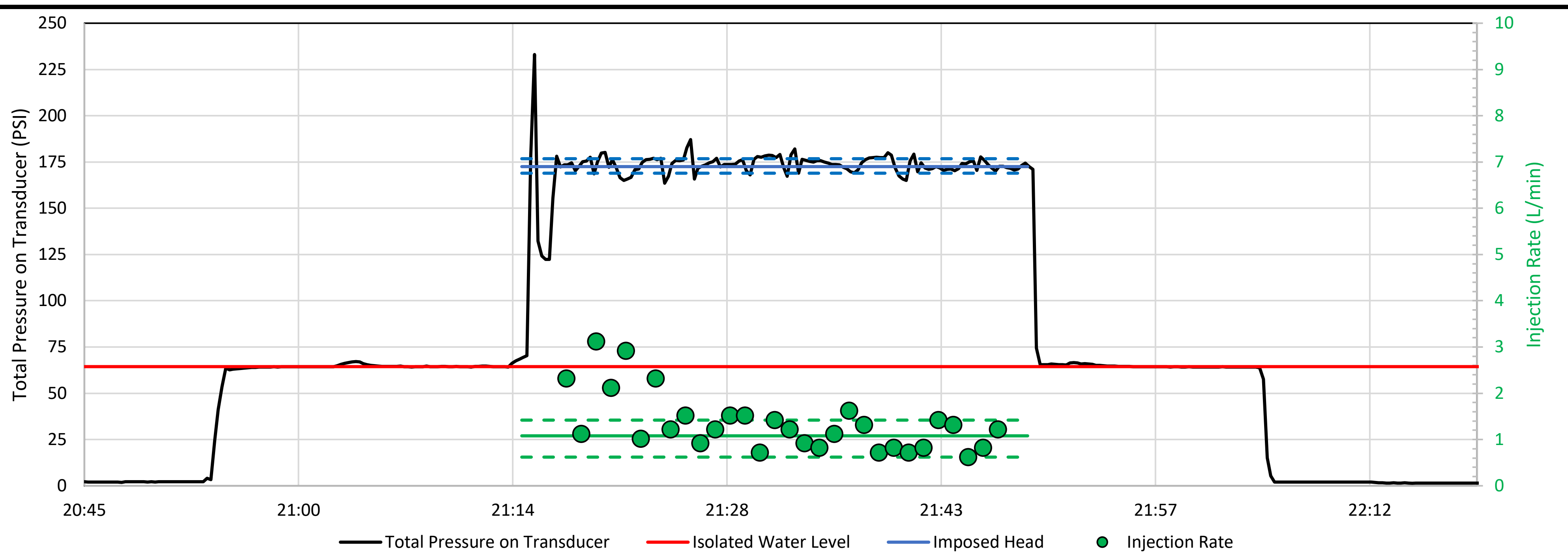
Location Description			Test Interval			General	
Current Depth:	302		**Bit Position:**	182	(ft-ah)	**Test Start Date/Time:**	7/17/2024 19:45
Hole Size[A]:	HQ		**Top of Test Interval:**	186.25	(ft-ah)	**Test End Date/Time:**	7/17/2024 22:15
Inclination:	50		**Stable Water Level[B]:**	64.4	(PSI)	**Supervisor:**	G. Foushee
Azimuth:	160		*Stable Water Level [C] :*	*-3.7*	*(ft-bgs)*	**Drill Contractor:**	Major
Elevation:	1004	(ft-amsl)	*Transducer Position [D] :*	*190.25*	(ft-ah)	**Rig No. & Type:**	#38 LF90

Test Notes

Start Flush:	19:45		**Test Fluid** (water/poly):	Fresh Water	**Shear Pin Break Time:**	21:15
End Flush:	20:05		**Seal Quality:**	Fair	**Injection End Time:**	21:49
Flushed Volume[E]:	400	(gal)	**Start Inflate Time:**	21:06	**Deflation Method:**	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection - Single Step
Drilling Comments:	Good drilling
Geology, Hydrogeology, & Rock Mass:	Competent bedrock.
Test Quality and Assessment:	Good test. No significant issues. Measured leak rate was different than test pressure, so leak was calculated.



	Estimate	Low End	High End	
Imposed Head (H):	76.00	*73.50*	*79.00*	(m-H_2O)
Injection Rate (Q):	1.56	*0.89*	*2.04*	(m^3/day)
Hydraulic Conductivity:	**4.93E-04**	*2.72E-04*	*6.70E-04*	(m/day)
Transmissivity:	**0.017**	*0.010*	*0.024*	(m/day/m)

Test Parameters

Radius of Influence[F]:	**(R)**	10	(m)
Radius of the Well:	**(r_w)**	48.0	(mm)
Test Interval Length:	**(b)**	35.28	(m)
System Leak Rate:		0.69	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

$$T = \frac{Q}{2\pi H} \ln\left(\frac{R}{r_w}\right)$$

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	**24GCT-028**	
Test Number:	**2**	
Project No.:	**Graphite Creek**	

CONSTANT HEAD INJECTION TEST
Packer Isolated

APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
21:10	9.77	0.00	300
21:11	9.96	0.19	250
21:12	10.22	0.26	250
21:13	11.32	1.10	250
21:14	12.88	1.56	250
21:15	13.82	0.94	250

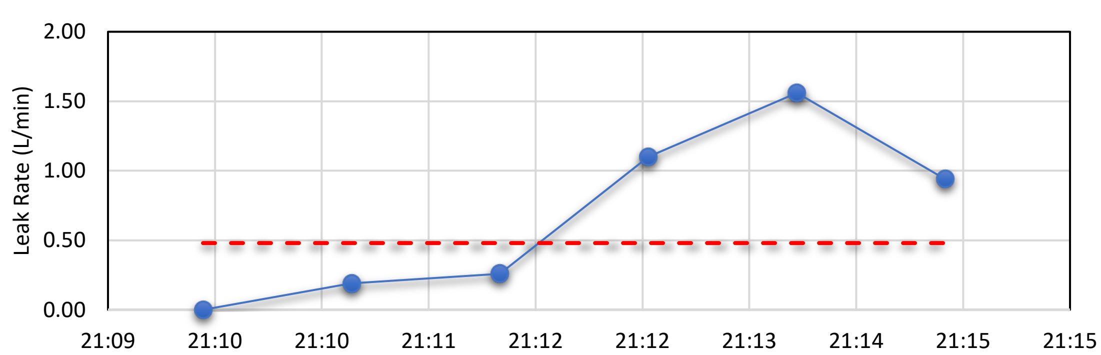
Leak Rate	0.48 L/min
Injection Rate	1.08 L/min
Min Injection Rate	0.62 L/min
Max Injection Rate	1.42 L/min

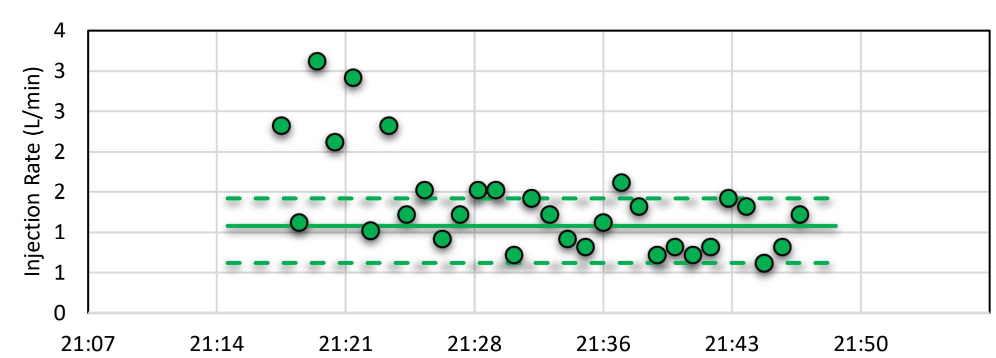
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
21:18	6.5	-	-	100
21:19	9.3	2.80	2.32	100
21:20	10.9	1.60	1.12	100
21:21	14.5	3.60	3.12	100
21:22	17.1	2.60	2.12	100
21:23	20.5	3.40	2.92	100
21:24	22.0	1.50	1.02	100
21:25	24.8	2.80	2.32	100
21:26	26.5	1.70	1.22	100
21:27	28.5	2.00	1.52	100
21:28	29.9	1.40	0.92	100
21:29	31.6	1.70	1.22	100
21:30	33.6	2.00	1.52	100
21:31	35.6	2.00	1.52	100
21:32	36.8	1.20	0.72	100
21:33	38.7	1.90	1.42	100
21:34	40.4	1.70	1.22	100
21:35	41.8	1.40	0.92	100
21:36	43.1	1.30	0.82	100
21:37	44.7	1.60	1.12	100
21:38	46.8	2.10	1.62	100
21:39	48.6	1.80	1.32	100
21:40	49.8	1.20	0.72	100
21:41	51.1	1.30	0.82	100
21:42	52.3	1.20	0.72	100
21:43	53.6	1.30	0.82	100
21:44	55.5	1.90	1.42	100
21:45	57.3	1.80	1.32	100
21:46	58.4	1.10	0.62	100

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
21:47	59.7	1.30	0.82	100
21:48	61.4	1.70	1.22	100





Inputs & Notes

Hole Size[A]:	**NQ**	**NQTK**	**NQ3**	**HQ**	**HQ3**	**PQ**	**PQ3**
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	24GCT-028	CONSTANT HEAD INJECTION TEST *Packer Isolated*	Tundra Consulting, LLC
Test Number:	3		
Project No.:	Graphite Creek		

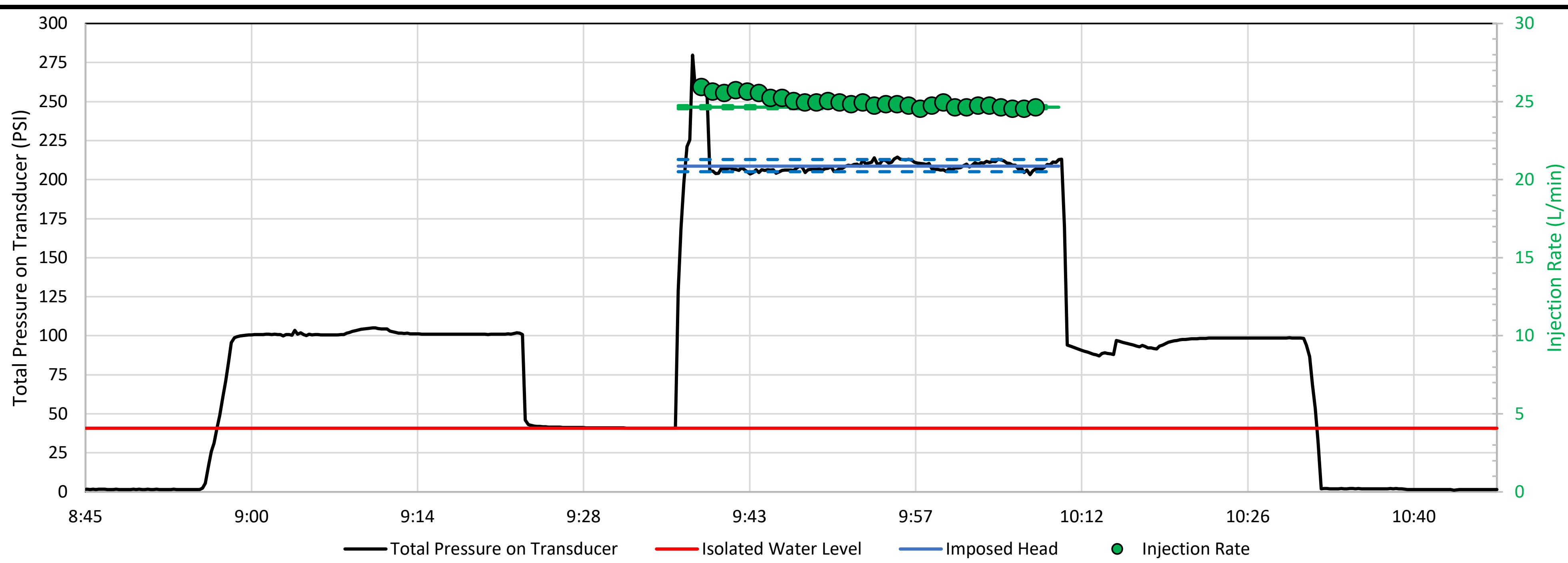
Location Description			Test Interval			General	
Current Depth:	392		Bit Position:	292	(ft-ah)	Test Start Date/Time:	7/18/2024 7:30
Hole Size[A]:	HQ		Top of Test Interval:	296.25	(ft-ah)	Test End Date/Time:	7/18/2024 11:15
Inclination:	50		Stable Water Level[B]:	40.8	(PSI)	Supervisor:	G. Baldwin
Azimuth:	160		*Stable Water Level [C]:*	*177.4*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	1004	(ft-amsl)	*Transducer Position [D]:*	*300.25*	(ft-ah)	Rig No. & Type:	#38 LF90

Test Notes

Start Flush:	7:53		**Test Fluid** (water/poly):	Fresh Water	Shear Pin Break Time:	9:37
End Flush:	8:10		Seal Quality:	Very Good	Injection End Time:	10:10
Flushed Volume[E]:	340	(gal)	Start Inflate Time:	9:22	Deflation Method:	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection - Single Step
Drilling Comments:	Very fast drilling ground. Good return circulation, but LCM used above this interval.
Geology, Hydrogeology, & Rock Mass:	Very competent garnetic schist with graphitic zones. Very low fracture frequency. Mostly clean fractures but some have oxidation, alteration, and FeOx staining.
Test Quality and Assessment:	Downward pressure gradient. Good test with tight controls on parameters, although there were some oscillations in pressure from the Bean Pump.



	Estimate	Low End	High End	
Imposed Head (H):	118.00	*115.50*	*121.00*	(m-H_2O)
Injection Rate (Q):	35.48	*35.34*	*35.63*	(m^3/day)
Hydraulic Conductivity:	**8.75E-03**	*8.50E-03*	*8.98E-03*	(m/day)
Transmissivity:	**0.255**	*0.248*	*0.262*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	29.18	(m)
System Leak Rate:		0.66	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H} \ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GCT-028
Test Number:	3
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
9:26	3.93	-	150
9:27	4.54	0.61	150
9:28	5.14	0.60	150
9:29	5.55	-	100
9:30	6	0.45	100
9:31	6.46	0.46	100
9:32	6.92	0.46	100
9:33	7.17	-	50
9:34	7.48	0.31	50
9:35	7.8	0.32	50
9:36	8.11	0.31	50

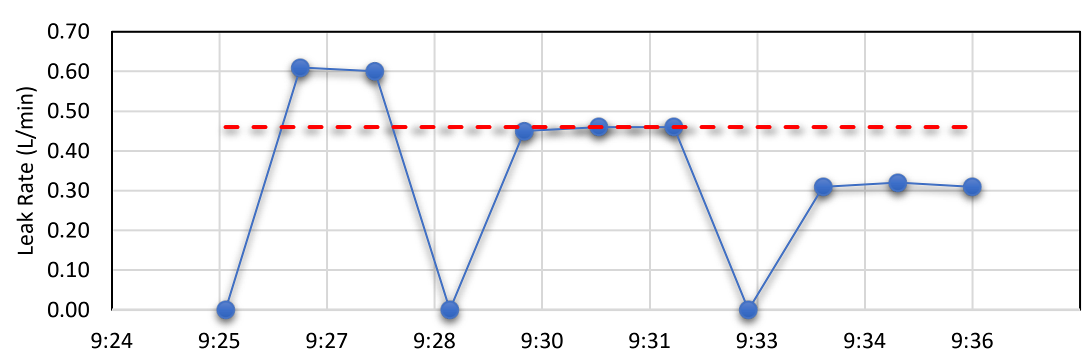
Leak Rate	0.46 L/min
Injection Rate	24.64 L/min
Min Injection Rate	24.54 L/min
Max Injection Rate	24.74 L/min

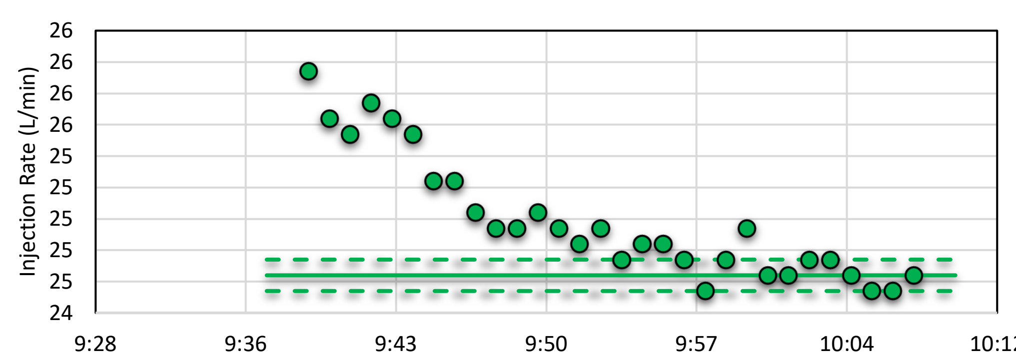
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
9:39	5425.0	-	-	150
9:40	5455.5	-	-	100
9:41	5481.9	26.40	25.94	100
9:42	5508.0	26.10	25.64	100
9:43	5534.0	26.00	25.54	100
9:44	5560.2	26.20	25.74	100
9:45	5586.3	26.10	25.64	100
9:46	5612.3	26.00	25.54	100
9:47	5638.0	25.70	25.24	100
9:48	5663.7	25.70	25.24	100
9:49	5689.2	25.50	25.04	100
9:50	5714.6	25.40	24.94	100
9:51	5740.0	25.40	24.94	100
9:52	5765.5	25.50	25.04	100
9:53	5790.9	25.40	24.94	100
9:54	5816.2	25.30	24.84	100
9:55	5841.6	25.40	24.94	100
9:56	5866.8	25.20	24.74	100
9:57	5892.1	25.30	24.84	100
9:58	5917.4	25.30	24.84	100
9:59	5942.6	25.20	24.74	100
10:00	5967.6	25.00	24.54	100
10:01	5992.8	25.20	24.74	100
10:02	6018.2	25.40	24.94	100
10:03	6043.3	25.10	24.64	100
10:04	6068.4	25.10	24.64	100
10:05	6093.6	25.20	24.74	100
10:06	6118.8	25.20	24.74	100
10:07	6143.9	25.10	24.64	100

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
10:08	6168.9	25.00	24.54	100
10:09	6193.9	25.00	24.54	100
10:10	6219	25.10	24.64	100





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	24GCT-028	CONSTANT HEAD INJECTION TEST *Packer Isolated*	Tundra Consulting, LLC
Test Number:	4		
Project No.:	Graphite Creek		

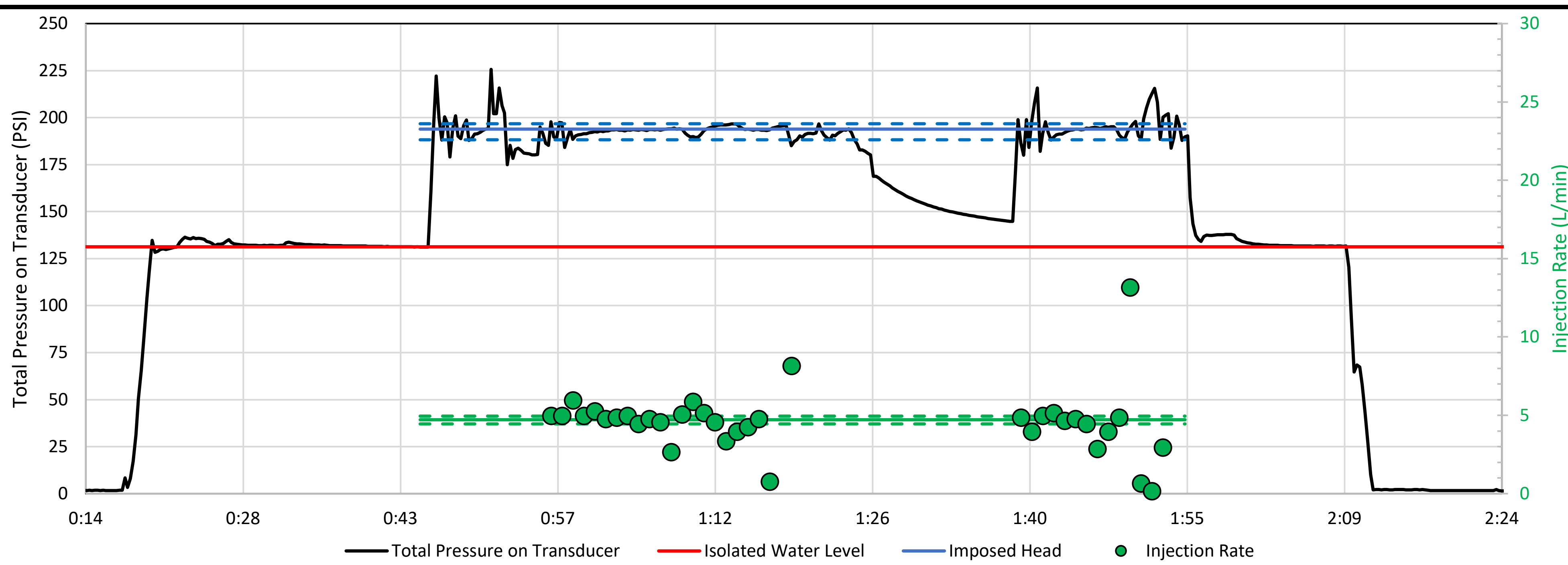
Location Description			Test Interval			General	
Current Depth:	472		Bit Position:	382	(ft-ah)	Test Start Date/Time:	7/18/2024 23:40
Hole Size[A]:	HQ		Top of Test Interval:	386.25	(ft-ah)	Test End Date/Time:	7/19/2024 2:15
Inclination:	50		Stable Water Level[B]:	131.3	(PSI)	Supervisor:	G. Foushee
Azimuth:	160		*Stable Water Level [C]:*	*-5.1*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	1004	(ft-amsl)	*Transducer Position [D]:*	*390.25*	(ft-ah)	Rig No. & Type:	#38 LF90

Test Notes

Start Flush:	23:40		Test Fluid (water/poly):	Fresh Water	Shear Pin Break Time:	0:45
End Flush:	0:10		Seal Quality:	Good	Injection End Time:	1:55
Flushed Volume[E]:	1000	(gal)	Start Inflate Time:	0:32	Deflation Method:	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection - Single Step
Drilling Comments:	Slow drilling. Very hard rock.
Geology, Hydrogeology, & Rock Mass:	Very competent garnitic schist. Low fracture frequency. Fracture cluster centered at about 410 - 417 feet is likely responsible for most/all of the flow (supported by FTC geophysics).
Test Quality and Assessment:	Water supply issues to rig resulted in noise in data and test being cut short. The test was reattempted but cut short again. Head stabilization was achieved both times. Good Test but noisy data.



	Estimate	Low End	High End	
Imposed Head (H):	44.00	*40.00*	*46.00*	($m\text{-}H_2O$)
Injection Rate (Q):	6.79	*6.41*	*7.13*	(m^3/day)
Hydraulic Conductivity:	**5.02E-03**	*4.53E-03*	*5.79E-03*	(m/day)
Transmissivity:	**0.131**	*0.118*	*0.151*	(m/day/m)

Test Parameters			
Radius of Influence[F]: (R)	10	(m)
Radius of the Well: (r_w)	48.0	(mm)
Test Interval Length: (b)	26.14	(m)
System Leak Rate:	1.51	(m^3/day)
Marsh Funnel Time[G]:	26	(sec)
Viscosity Correction Factor:	1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	**24GCT-028**	**CONSTANT HEAD INJECTION TEST**
Test Number:	4	***Packer Isolated***
Project No.:	Graphite Creek	APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
0:34	1.58	-	250
0:35	3.45	1.87	250
0:36	5.4	1.95	250
0:37	7.35	1.95	250
0:38	9.38	2.03	250
0:39	11.58	2.20	250
0:40	12.82	-	50
0:41	13.8	0.98	50
0:42	14.86	1.06	50
0:43	15.9	1.04	50
0:44	16.96	1.06	50
0:45	18	1.04	50

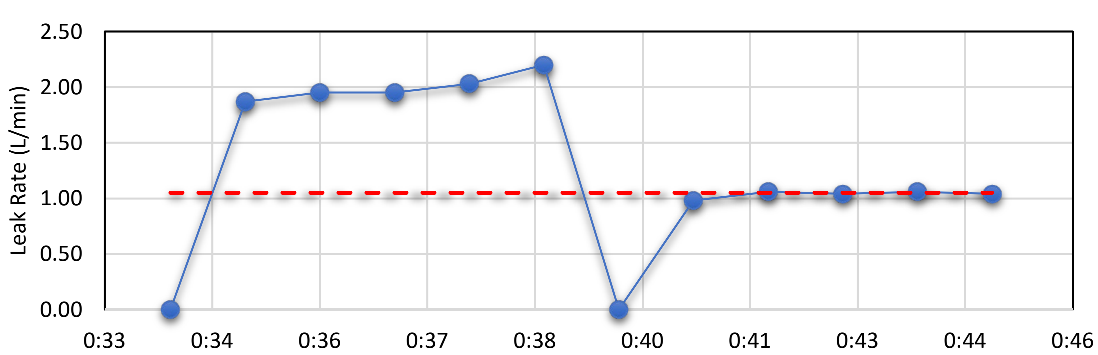
Leak Rate	1.05 L/min
Injection Rate	4.72 L/min
Min Injection Rate	4.45 L/min
Max Injection Rate	4.95 L/min

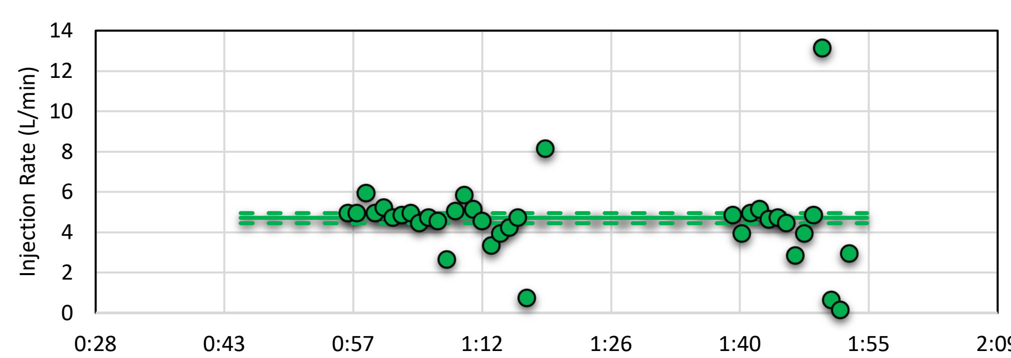
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
0:57	366.0	-	-	50
0:58	371.0	5.00	3.95	50
0:59	377.0	6.00	4.95	50
1:00	383.0	6.00	4.95	50
1:01	390.0	7.00	5.95	50
1:02	396.0	6.00	4.95	50
1:03	402.3	6.30	5.25	50
1:04	408.1	5.80	4.75	50
1:05	414.0	5.90	4.85	50
1:06	420.0	6.00	4.95	50
1:07	425.5	5.50	4.45	50
1:08	431.3	5.80	4.75	50
1:09	436.9	5.60	4.55	50
1:10	440.6	3.70	2.65	50
1:11	446.7	6.10	5.05	50
1:12	453.6	6.90	5.85	50
1:13	459.8	6.20	5.15	50
1:14	465.4	5.60	4.55	50
1:15	469.8	4.40	3.35	50
1:16	474.8	5.00	3.95	50
1:17	480.1	5.30	4.25	50
1:18	485.9	5.80	4.75	50
1:19	487.7	1.80	0.75	50
1:40	537.9	-		50
1:41	547.1	9.20	8.15	50
1:42	553.0	5.90	4.85	50
1:43	558.0	5.00	3.95	50
1:44	564.0	6.00	4.95	50
1:45	570.2	6.20	5.15	50

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
1:46	575.9	5.70	4.65	50
1:47	581.7	5.80	4.75	50
1:48	587.2	5.50	4.45	50
1:49	591.1	3.90	2.85	50
1:50	596.1	5.00	3.95	50
1:51	602	5.90	4.85	50
1:52	616.2	14.20	13.15	50
1:53	617.9	1.70	0.65	50
1:54	619.1	1.20	0.15	50
1:55	623.1	4.00	2.95	50

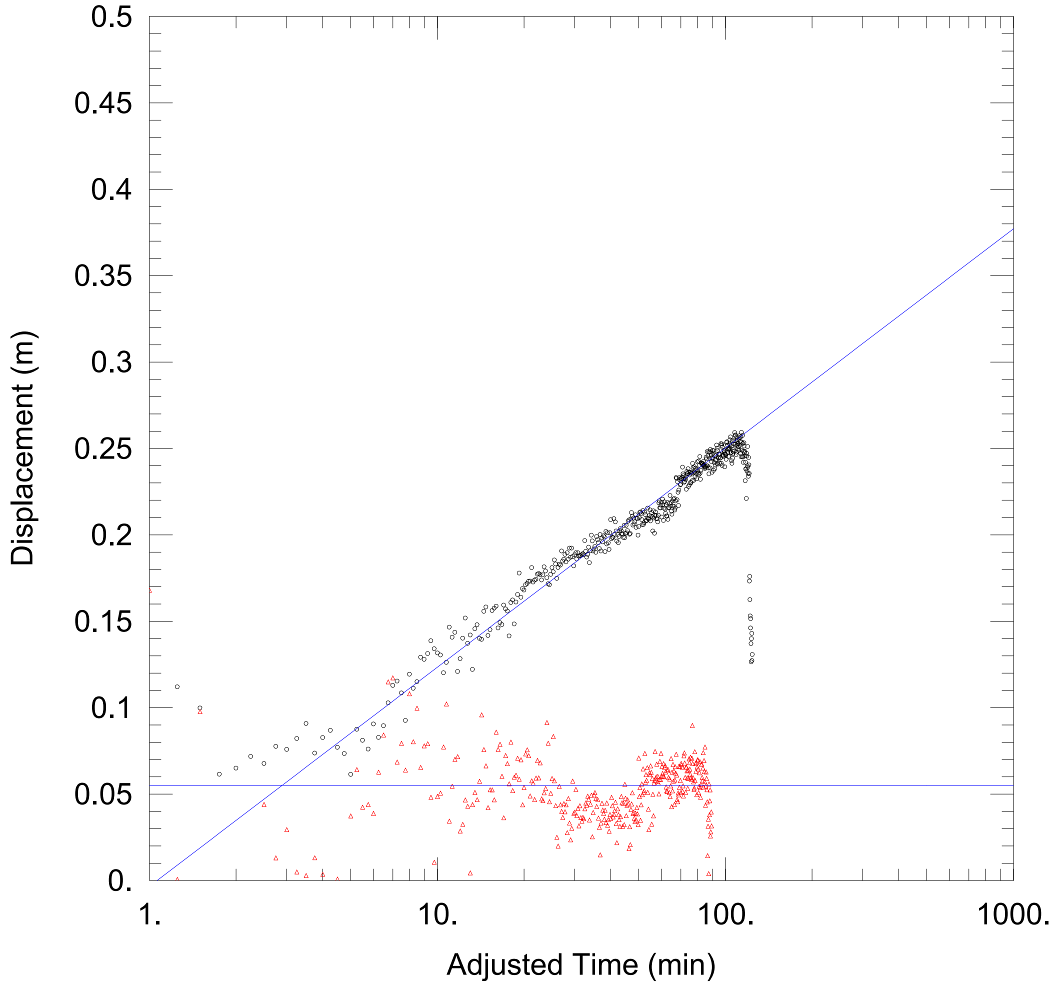




Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.



PUMPING TEST

Data Set: C:\...\24GCT029_Test1_CooperJacob.aqt
Date: 11/23/24 Time: 16:08:55

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT029
Test Date: 8/27/2024

AQUIFER DATA

Saturated Thickness: 10.2 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT029	0	0

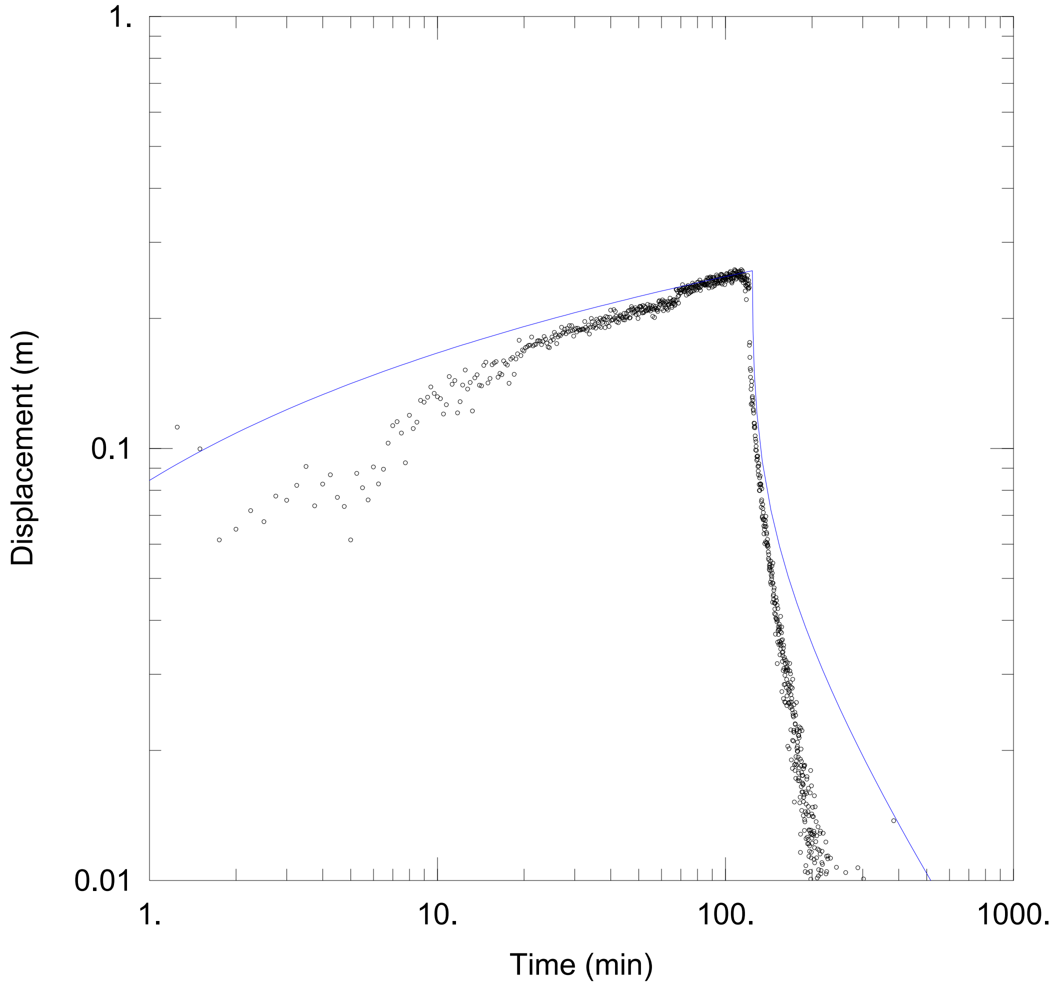
Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT029	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 24.22 m^2/day S = 17.45



PUMPING TEST

Data Set: C:\...\24GCT029_Test1_Theis.aqt
Date: 11/23/24 Time: 16:08:38

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT029
Test Date: 8/27/2024

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT029	0	0

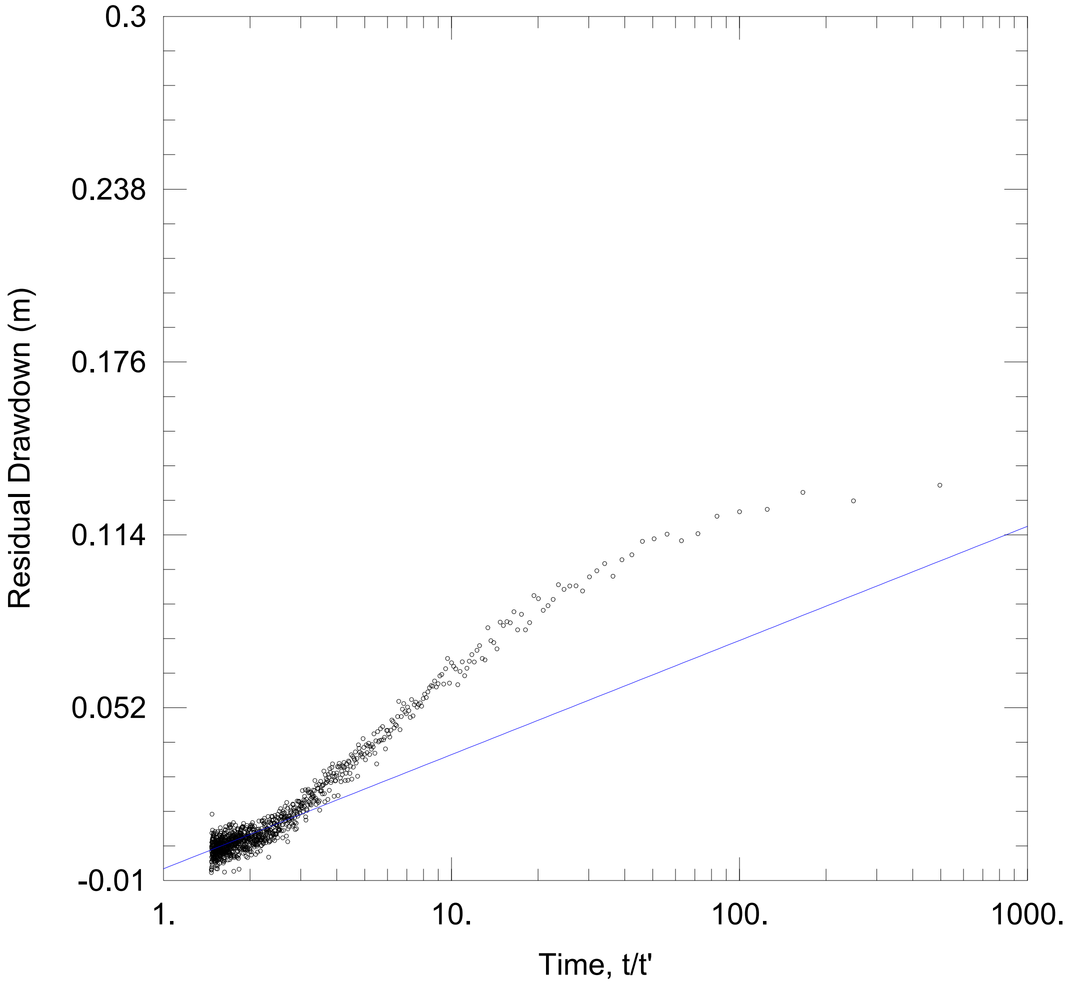
Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT029	0	0

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

$T = 36.63\ m^2/day$
$S = 2.593$
$Kz/Kr = 1.$
$b = 10.2\ m$



PUMPING TEST

Data Set: C:\...\24GCT029_Test1_TheisRDD.aqt
Date: 11/23/24 Time: 16:08:26

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT029
Test Date: 8/27/2024

AQUIFER DATA

Saturated Thickness: 10.2 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT029	0	0

Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT029	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 75. m^2/day S/S' = 1.388

Drill Hole ID:	24GCT-030	CONSTANT HEAD INJECTION TEST *Packer Isolated*	Tundra Consulting, LLC
Test Number:	1		
Project No.:	Graphite Creek		

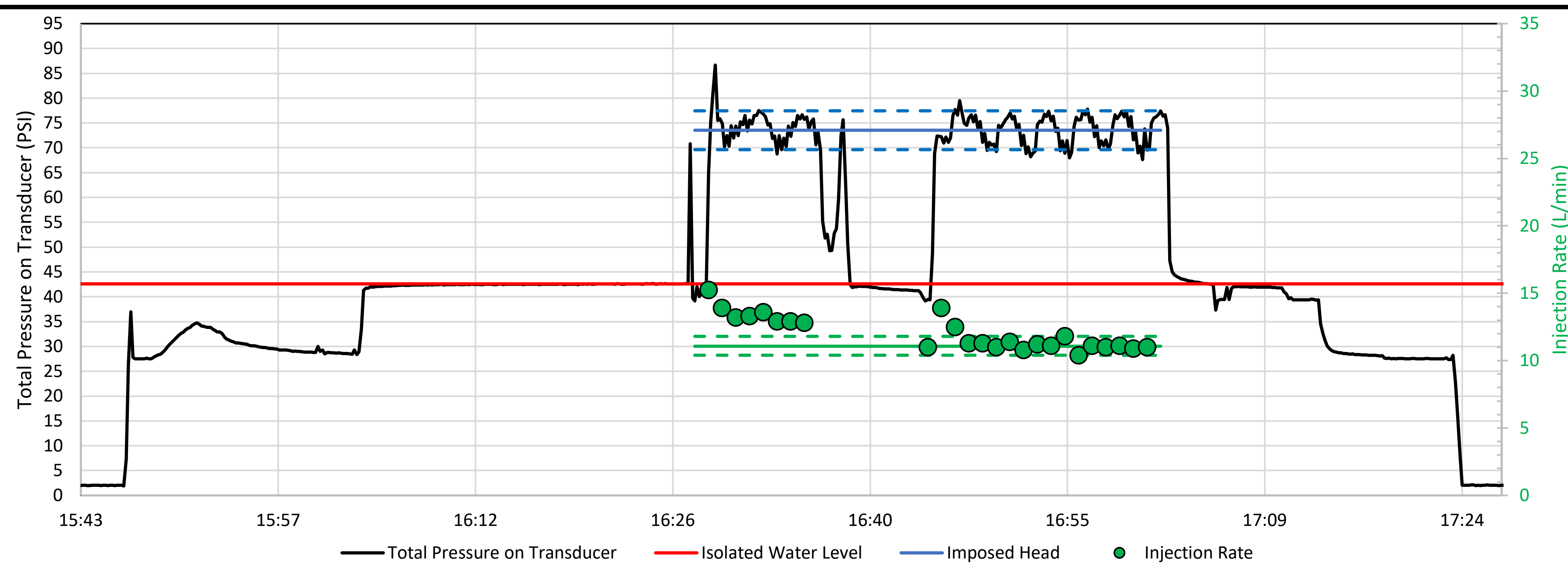
Location Description			Test Interval			General	
Current Depth (ft):	155		Bit Position:	95	(ft-ah)	Test Start Date/Time:	7/28/2024 13:00
Hole Size[A]:	HQ		Top of Test Interval:	99.25	(ft-ah)	Test End Date/Time:	7/28/2024 18:00
Inclination:	50		Stable Water Level[B]:	42.6	(PSI)	Supervisor:	E. Wilson
Azimuth:	200		*Stable Water Level [C]:*	*-25.0*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	801	(ft-amsl)	*Transducer Position [D]:*	*103.25*	(ft-ah)	Rig No. & Type:	#38 LF90

Test Notes

Start Flush:	13:05		Test Fluid (water/poly):	Fresh Water	Shear Pin Break Time:	16:28
End Flush:	13:35		Seal Quality:	Very Good	Injection End Time:	17:02
Flushed Volume[E]:	780	(gal)	Start Inflate Time:	16:00	Deflation Method:	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection - Single Step
Drilling Comments:	None
Geology, Hydrogeology, & Rock Mass:	Garnet Schist. Small gouge zone at 143 feet. Upward pressure gradient.
Test Quality and Assessment:	First test attempt packer wasn't latched. Reset and successful 2nd attempt, but ran out of water half way through and restarted. Bean pump cycled severely, introducing noise in test data. Generally good test.



	Estimate	Low End	High End	
Imposed Head (H):	21.75	*19.00*	*24.50*	(m-H_2O)
Injection Rate (Q):	15.94	*14.98*	*16.99*	(m^3/day)
Hydraulic Conductivity:	**3.66E-02**	*3.06E-02*	*4.47E-02*	(m/day)
Transmissivity:	**0.62**	*0.52*	*0.76*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	16.99	(m)
System Leak Rate:		0.43	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GCT-030	CONSTANT HEAD INJECTION TEST
Test Number:	1	*Packer Isolated*
Project No.:	Graphite Creek	APPLIED HYDROLOGIC

Leak Rate

Time	Totalizer	Rate	Pressure
(Hours)	*(L)*	*(L/min)*	*(PSI)*
16:14	0	-	25
16:15	0	0.00	25
16:16	0.4	0.40	25
16:17	0.6	0.20	25
16:18	0.9	0.30	25
16:19	1.2	0.30	25
16:20	1.5	0.30	25
16:21	1.9	-	50
16:22	2.2	0.30	50
16:23	2.5	0.30	50
16:24	2.8	0.30	50
16:25	3.1	0.30	50

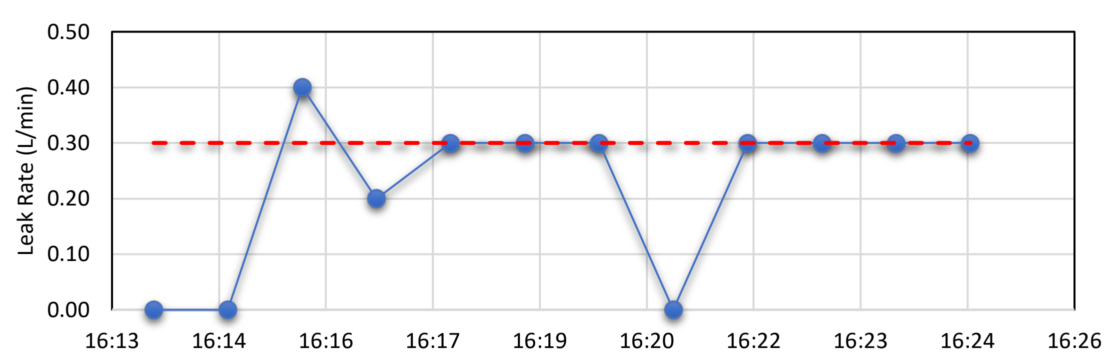
Leak Rate	0.30 L/min
Injection Rate	11.07 L/min
Min Injection Rate	10.40 L/min
Max Injection Rate	11.80 L/min

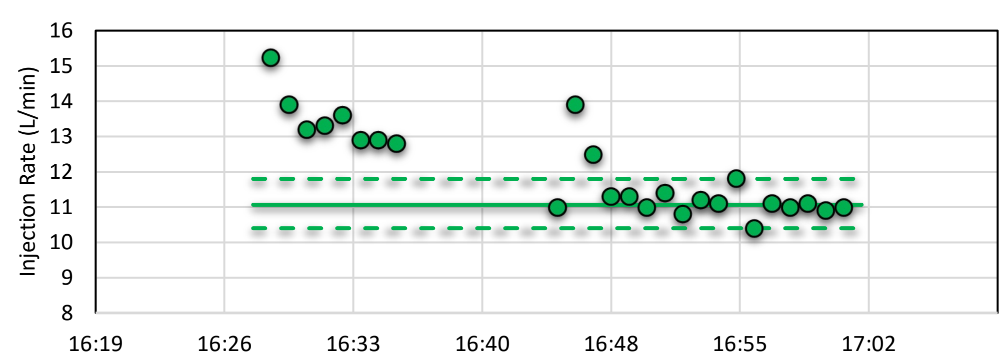
Injection Test

Time	Totalizer	Total Rate	Test Rate	Pressure
(Hours)	*(L)*	*(L/min)*	*(L/min)*	*(PSI)*
16:28	356.7			20
16:29	356.7			20
16:30	372.2	15.54	15.24	20
16:31	386.4	14.20	13.90	20
16:32	399.9	13.50	13.20	20
16:33	413.5	13.60	13.30	20
16:34	427.4	13.90	13.60	20
16:35	440.6	13.20	12.90	20
16:36	453.8	13.20	12.90	20
16:37	466.9	13.10	12.80	20
16:38	Out of H2O			20
16:39	Out of H2O			20
16:40	Out of H2O			20
16:41	Out of H2O			20
16:42	Out of H2O			20
16:43	Out of H2O			20
16:44	Out of H2O			20
16:45	476.0			20
16:46	487.3	11.30	11.00	20
16:47	501.5	14.20	13.90	20
16:48	514.3	12.80	12.50	20
16:49	525.9	11.60	11.30	20
16:50	537.5	11.60	11.30	20
16:51	548.8	11.30	11.00	20
16:52	560.5	11.70	11.40	20
16:53	571.6	11.10	10.80	20
16:54	583.1	11.50	11.20	20
16:55	594.5	11.40	11.10	20
16:56	606.6	12.10	11.80	20

Injection Test *(Continued)*

Time	Totalizer	Total Rate	Test Rate	Pressure
(Hours)	*(L)*	*(L/min)*	*(L/min)*	*(PSI)*
16:57	617.3	10.70	10.40	20
16:58	628.7	11.40	11.10	20
16:59	640	11.30	11.00	20
17:00	651.4	11.40	11.10	20
17:01	662.6	11.20	10.90	20
17:02	673.9	11.30	11.00	20





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	24GCT-030
Test Number:	2
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

Tundra Consulting, LLC

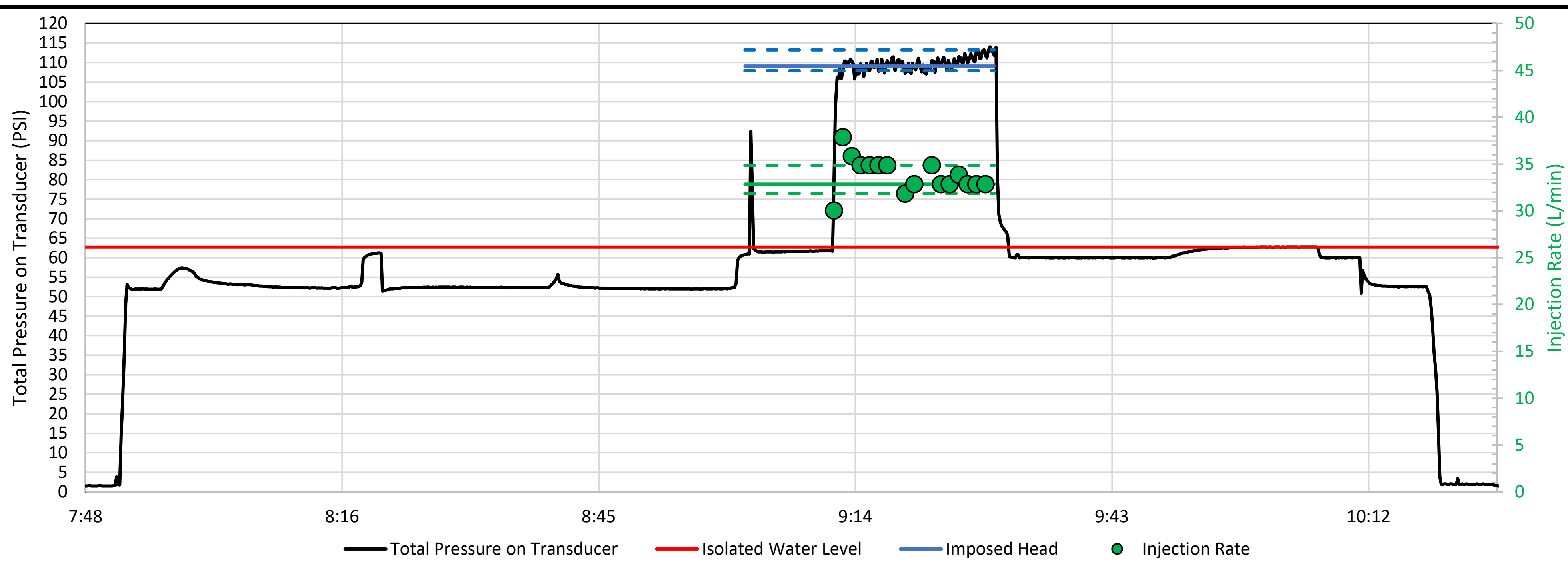
Location Description			Test Interval			General	
Current Depth (ft):	255		Bit Position:	155	(ft-ah)	Test Start Date/Time:	7/29/2024 6:00
Hole Size[A]:	HQ		Top of Test Interval:	159.25	(ft-ah)	Test End Date/Time:	7/29/2024 10:45
Inclination:	50		Stable Water Level[B]:	62.74	(PSI)	Supervisor:	E. Wilson
Azimuth:	200		*Stable Water Level[C]:*	*-25.7*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	801	(ft-amsl)	*Transducer Position[D]:*	*163.25*	(ft-ah)	Rig No. & Type:	#38 LF90

Test Notes

Start Flush:	6:00		**Test Fluid** (water/poly):	Fresh Water	Shear Pin Break Time:	9:02
End Flush:	6:30		Seal Quality:	Good	Injection End Time:	9:30
Flushed Volume[E]:	750	(gal)	Start Inflate Time:	8:15	Deflation Method:	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection - Single Step
Drilling Comments:	None
Geology, Hydrogeology, & Rock Mass:	Garnet Schist with graphite.
Test Quality and Assessment:	Difficulty seating packer, but seated just prior to injection. Determined artesian head post-test by adding rods until flow stopped. Rate stabilized halfway though test, then psi started to gradually climb w/o fully stabilizing. However, good test.



	Estimate	Low End	High End	
Imposed Head (H):	32.60	*31.75*	*35.50*	($m\text{-}H_2O$)
Injection Rate (Q):	47.32	*45.88*	*50.20*	(m^3/day)
Hydraulic Conductivity:	**4.23E-02**	*3.76E-02*	*4.60E-02*	(m/day)
Transmissivity:	**1.23**	*1.10*	*1.34*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	29.18	(m)
System Leak Rate:		0.20	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GCT-030	CONSTANT HEAD INJECTION TEST
Test Number:	2	*Packer Isolated*
Project No.:	Graphite Creek	APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
8:42	27.3	-	75
8:43	28.1	0.80	75
8:44	29.2	1.10	75
8:45	29.75	0.55	75
8:46	30.1	0.35	75
8:47	30.48	0.38	75
8:48	30.77	0.29	75
8:49	31.08	-	75
8:50	31.37	0.29	75
8:51	31.51	0.14	50
8:52	31.61	0.10	50
8:53	31.81	0.20	50
8:54	32.08	0.27	50
8:55	32.25	0.17	50
8:56	32.4	0.15	50
8:57	32.55	0.15	50
8:58	32.69	0.14	50
8:59	32.83	0.14	50

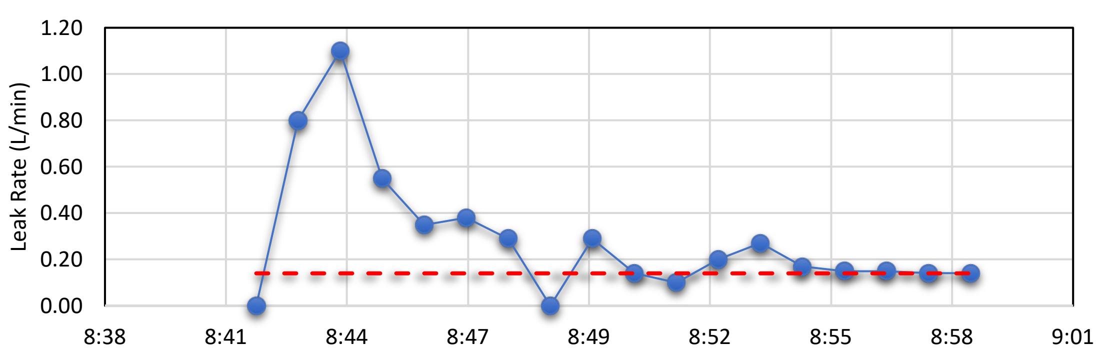
Leak Rate	0.14 L/min
Injection Rate	32.86 L/min
Min Injection Rate	31.86 L/min
Max Injection Rate	34.86 L/min

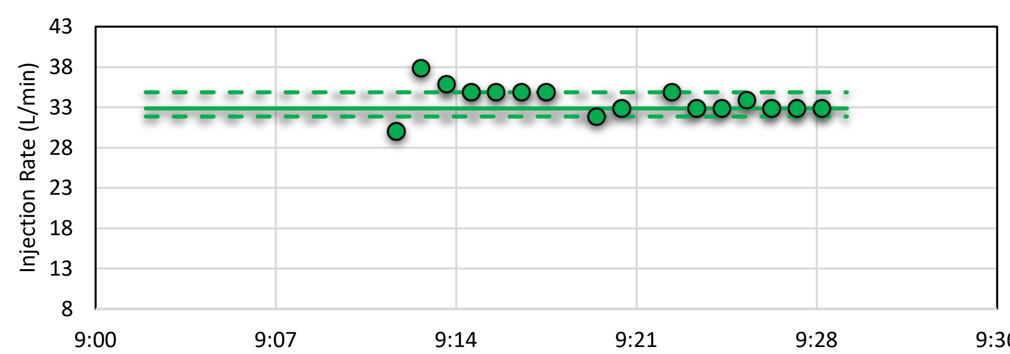
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
9:12	7742.8			50
9:13	7773.0	30.18	30.04	50
9:14	7811.0	38.00	37.86	50
9:15	7847.0	36.00	35.86	50
9:16	7882.0	35.00	34.86	50
9:17	7917.0	35.00	34.86	50
9:18	7952.0	35.00	34.86	50
9:20	8022.0	35.00	34.86	50
9:21	8054.0	32.00	31.86	50
9:23	8120.0	33.00	32.86	50
9:24	8155.0	35.00	34.86	50
9:25	8188.0	33.00	32.86	50
9:26	8221.0	33.00	32.86	50
9:27	8255.0	34.00	33.86	50
9:28	8288.0	33.00	32.86	50
9:29	8321.0	33.00	32.86	50
9:30	8354.0	33.00	32.86	50

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	24GCT-030	CONSTANT HEAD INJECTION TEST *Packer Isolated*	Tundra Consulting, LLC
Test Number:	3		
Project No.:	Graphite Creek		

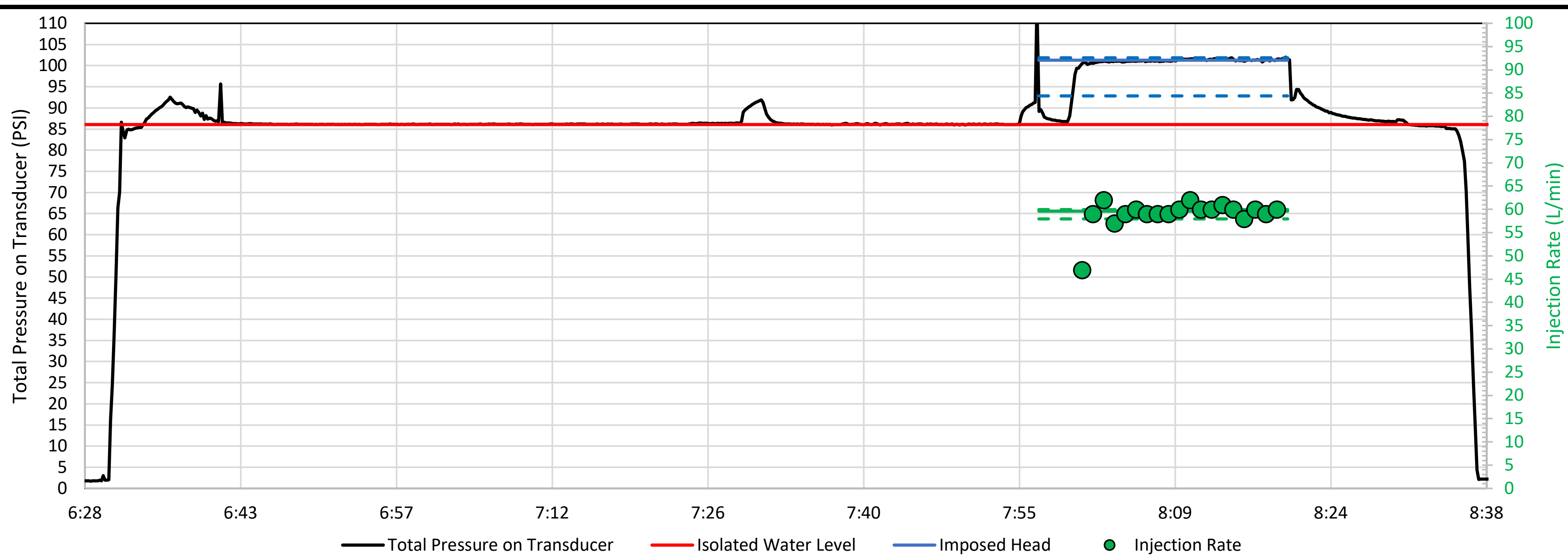
Location Description			Test Interval			General	
Current Depth (ft):	395		Bit Position:	255	(ft-ah)	Test Start Date/Time:	7/30/2024 5:30
Hole Size[A]:	HQ		Top of Test Interval:	259.25	(ft-ah)	Test End Date/Time:	7/30/2024 9:00
Inclination:	50		Stable Water Level[B]:	86.06	(PSI)	Supervisor:	E. Wilson
Azimuth:	200		*Stable Water Level[C]:*	*4.1*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	801	(ft-amsl)	*Transducer Position[D]:*	*263.25*	(ft-ah)	Rig No. & Type:	#38 LF90

Test Notes

Start Flush:	5:30		Test Fluid (water/poly):	Fresh Water	Shear Pin Break Time:	7:57
End Flush:	6:00		Seal Quality:	Good	Injection End Time:	8:20
Flushed Volume[E]:	750	(gal)	Start Inflate Time:	7:25	Deflation Method:	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection - Single Step
Drilling Comments:	None
Geology, Hydrogeology, & Rock Mass:	
Test Quality and Assessment:	Flow rate much higher than expected; rate higher than measured leak. So test leak rate calculated instead of measured. Analysis dropped the low end estimated imposed head to account for some question on the shut-in pressure



	Estimate	Low End	High End	
Imposed Head (H):	10.70	*4.76*	*11.10*	($m\text{-}H_2O$)
Injection Rate (Q):	85.84	*83.44*	*86.32*	(m^3/day)
Hydraulic Conductivity:	**1.65E-01**	*1.54E-01*	*3.72E-01*	(m/day)
Transmissivity:	**6.82**	*6.39*	*15.41*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	41.38	(m)
System Leak Rate:		0.08	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

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ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GCT-030	CONSTANT HEAD INJECTION TEST *Packer Isolated*
Test Number:	3	
Project No.:	Graphite Creek	

APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
7:37	398.11		100
7:38	398.11		100
7:39	399.9	1.79	100
7:40	400.6	0.70	100
7:41	401.08	0.48	100
7:42	401.41	0.33	100
7:43	401.78	0.37	100
7:44	402.11	0.33	100
7:45	402.42	0.31	100
7:46	402.75	0.33	100
7:47	403.09	0.34	100
7:48	403.06		75
7:49	403.3	0.24	75
7:50	403.59	0.29	75
7:51	403.89	0.30	75
7:52	404.17	0.28	75
7:53	404.45	0.28	75
7:54	404.72	0.27	75

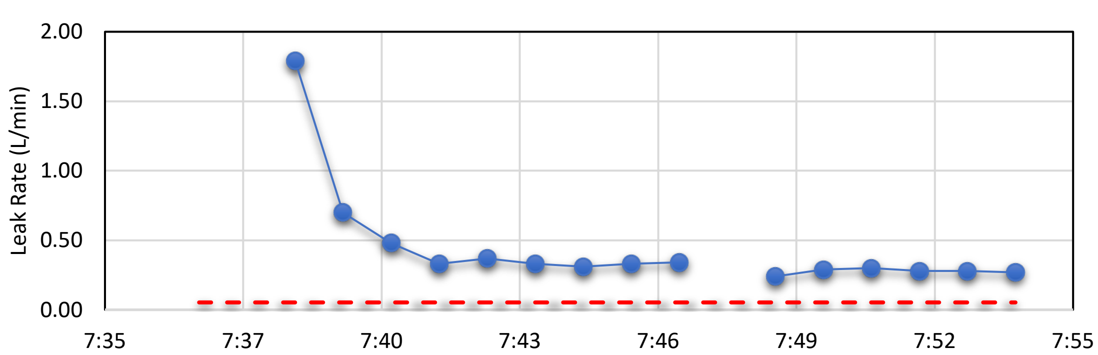
Leak Rate	0.05 L/min
Injection Rate	59.61 L/min
Min Injection Rate	57.95 L/min
Max Injection Rate	59.95 L/min

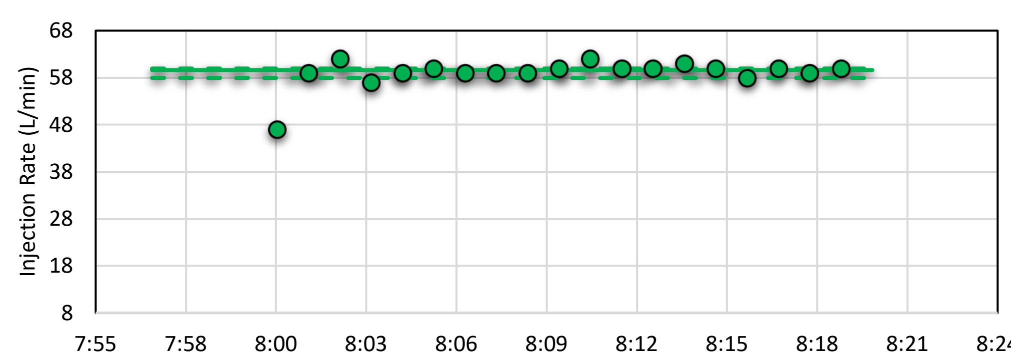
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
8:01	8492.0			15
8:02	8539.0	47.00	46.95	15
8:03	8598.0	59.00	58.95	15
8:04	8660.0	62.00	61.95	15
8:05	8717.0	57.00	56.95	15
8:06	8776.0	59.00	58.95	15
8:07	8836.0	60.00	59.95	15
8:08	8895.0	59.00	58.95	15
8:09	8954.0	59.00	58.95	15
8:10	9013.0	59.00	58.95	15
8:11	9073.0	60.00	59.95	15
8:12	9135.0	62.00	61.95	15
8:13	9195.0	60.00	59.95	15
8:14	9255.0	60.00	59.95	15
8:15	9316.0	61.00	60.95	15
8:16	9376.0	60.00	59.95	15
8:17	9434.0	58.00	57.95	15
8:18	9494.0	60.00	59.95	15
8:19	9553.0	59.00	58.95	15
8:20	9613.0	60.00	59.95	15

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	24GCT-032	CONSTANT HEAD INJECTION TEST
Test Number:	2	*Packer Isolated*
Project No.:	Graphite Creek	Tundra Consulting, LLC

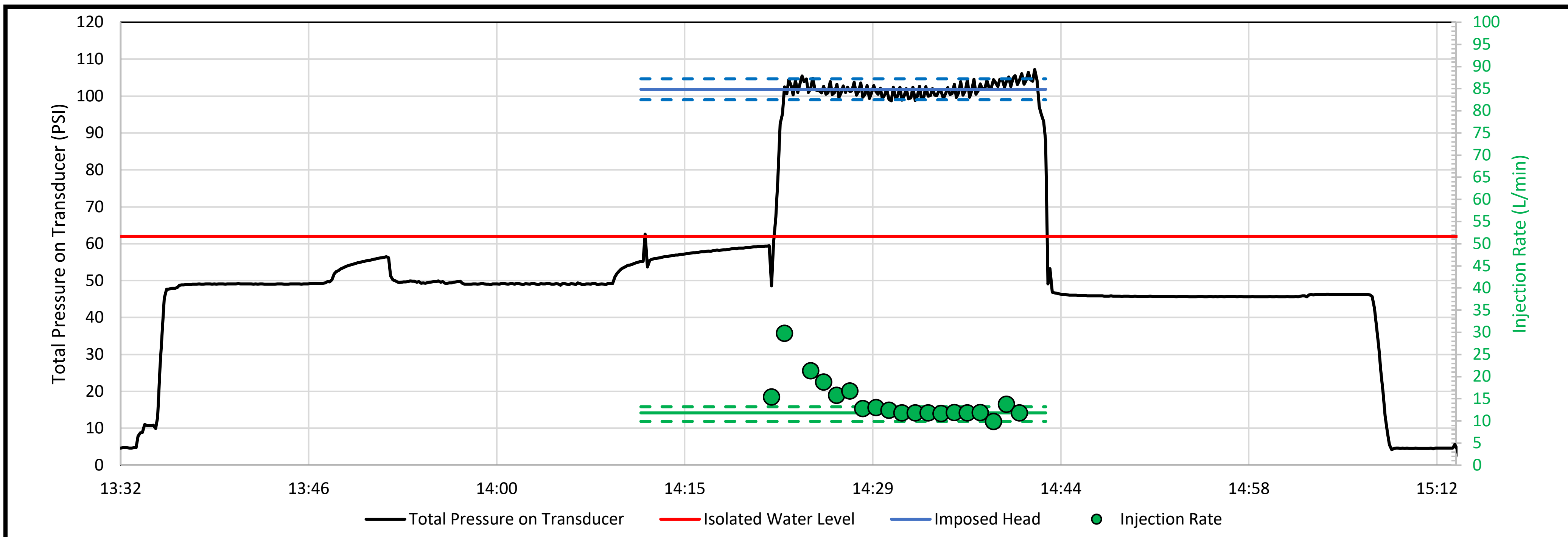
Location Description			Test Interval			General	
Current Depth (ft):	216		Bit Position:	116	(ft-ah)	Test Start Date/Time:	8/6/2024 13:00
Hole Size[A]:	HQ		Top of Test Interval:	120.25	(ft-ah)	Test End Date/Time:	8/6/2024 15:30
Inclination:	50		Stable Water Level[B]:	62	(PSI)	Supervisor:	E. Wilson
Azimuth:	160		*Stable Water Level[C]:*	*-62.4*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	945	(ft-amsl)	*Transducer Position[D]:*	*124.25*	(ft-ah)	Rig No. & Type:	#38 LF90

Test Notes

Start Flush:	13:00		**Test Fluid** (water/poly):	Fresh Water	Shear Pin Break Time:	14:12
End Flush:	13:25		Seal Quality:	Good	Injection End Time:	14:43
Flushed Volume[E]:	625	(gal)	Start Inflate Time:	13:40	Deflation Method:	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection - Single Step
Drilling Comments:	None
Geology, Hydrogeology, & Rock Mass:	
Test Quality and Assessment:	Artesian. Shut-in not fully equilibrated prior to start test, but near equilibration. Generally good test.



	Estimate	Low End	High End	
Imposed Head (H):	28.00	*26.00*	*30.00*	(m-H_2O)
Injection Rate (Q):	17.02	*14.24*	*19.01*	(m^3/day)
Hydraulic Conductivity:	**1.77E-02**	*1.38E-02*	*2.13E-02*	(m/day)
Transmissivity:	**0.52**	*0.40*	*0.62*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	29.18	(m)
System Leak Rate:		0.30	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H} \ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GCT-032
Test Number:	2
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
13:54	0.75	-	100
13:55	1.2	0.45	100
13:56	1.58	0.38	100
13:57	2	0.42	100
13:58	2.38	0.38	100
13:59	1.95		50
14:00	1.94	-0.01	50
14:01	2.05	0.11	50
14:02	2.33	0.28	50
14:03	2.62	0.29	50
14:04	2.88	0.26	50
14:05	3.08	0.20	50
14:06	3.3	0.22	50
14:07	3.5	0.20	50
14:08	3.71	0.21	50
14:09	3.92	0.21	50

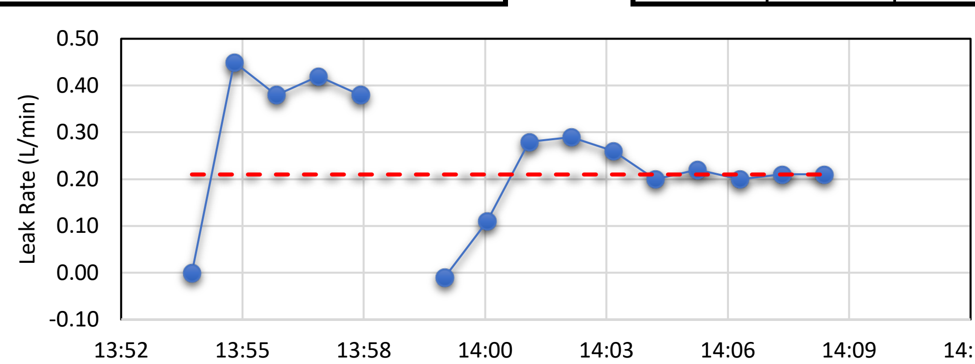
Injection Test

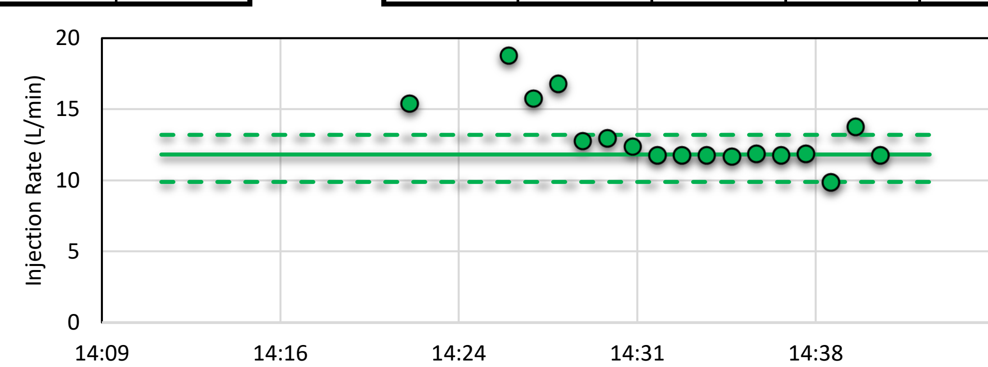
Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
14:22	389.38			50
14:23	405.00	15.62	15.41	50
14:24	435.00	30.00	29.79	50
14:25				50
14:26	478.00	21.50	21.29	50
14:27	497.00	19.00	18.79	50
14:28	513.00	16.00	15.79	50
14:29	530.00	17.00	16.79	50
14:30	543.00	13.00	12.79	50
14:31	556.20	13.20	12.99	50
14:32	568.80	12.60	12.39	50
14:33	580.80	12.00	11.79	50
14:34	592.80	12.00	11.79	50
14:35	604.80	12.00	11.79	50
14:36	616.70	11.90	11.69	50
14:37	628.80	12.10	11.89	50
14:38	640.80	12.00	11.79	50
14:39	652.90	12.10	11.89	50
14:40	663.00	10.10	9.89	50
14:41	677.00	14.00	13.79	50
14:42	689.00	12.00	11.79	50

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)

Leak Rate	0.21 L/min
Injection Rate	11.82 L/min
Min Injection Rate	9.89 L/min
Max Injection Rate	13.20 L/min





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	24GCT-032	CONSTANT HEAD INJECTION TEST *Packer Isolated*	Tundra Consulting, LLC
Test Number:	3		
Project No.:	Graphite Creek		

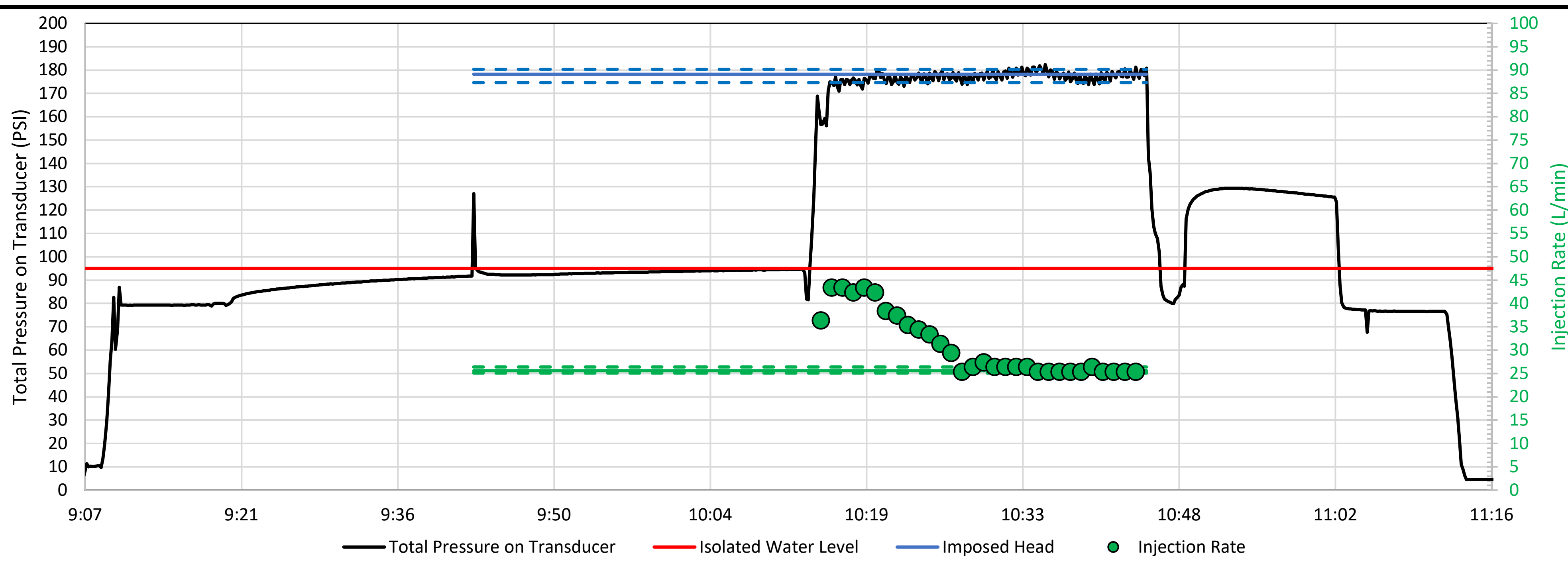
Location Description			Test Interval			General	
Current Depth (ft):	386		Bit Position:	216	(ft-ah)	Test Start Date/Time:	8/7/2024 7:30
Hole Size[A]:	HQ		Top of Test Interval:	220.25	(ft-ah)	Test End Date/Time:	8/7/2024 11:30
Inclination:	50		Stable Water Level[B]:	95	(PSI)	Supervisor:	E. Wilson
Azimuth:	160		*Stable Water Level[C]:*	*-61.8*	*(ft-bgs)*	Drill Contractor:	Major
Elevation:	945	(ft-amsl)	*Transducer Position[D]:*	*224.25*	(ft-ah)	Rig No. & Type:	#38 LF90

Test Notes

Start Flush:	7:30		Test Fluid (water/poly):	Fresh Water	Shear Pin Break Time:	9:43
End Flush:	9:00		Seal Quality:	Good	Injection End Time:	10:45
Flushed Volume[E]:	1350	(gal)	Start Inflate Time:	9:17	Deflation Method:	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection - Single Step
Drilling Comments:	None
Geology, Hydrogeology, & Rock Mass:	
Test Quality and Assessment:	Artesian. Flush w/artesian flow. Good test. Artesian flow not fully equilibrated, but looks to be approaching stability.



	Estimate	Low End	High End	
Imposed Head (H):	58.50	*56.00*	*60.00*	($m\text{-}H_2O$)
Injection Rate (Q):	36.85	*36.11*	*38.00*	(m^3/day)
Hydraulic Conductivity:	**1.06E-02**	*1.01E-02*	*1.14E-02*	(m/day)
Transmissivity:	**0.54**	*0.51*	*0.58*	(m/day/m)

Test Parameters

Radius of Influence[F]:	(R)	10	(m)
Radius of the Well:	(r_w)	48.0	(mm)
Test Interval Length:	(b)	50.52	(m)
System Leak Rate:		0.88	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r_w}\right)$$

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GCT-032	CONSTANT HEAD INJECTION TEST
Test Number:	3	*Packer Isolated*
Project No.:	Graphite Creek	APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
9:23	25.18	-	25
9:24	26.72	1.54	25
9:25	27.08	0.36	25
9:26	27.4	0.32	25
9:27	27.75	0.35	25
9:28	28.1	0.35	25
9:29	28.44	0.34	25
9:30	28.78	0.34	50
9:31	29.12	0.34	50
9:33	30.94		100
9:34	31.55	0.61	100
9:35	32.16	0.61	100
9:36	32.76	0.60	100
9:37	33.4	0.64	100
9:38	33.93	0.53	100
9:39	34.54	0.61	100
9:40	35.15	0.61	100
9:41	35.76	0.61	100

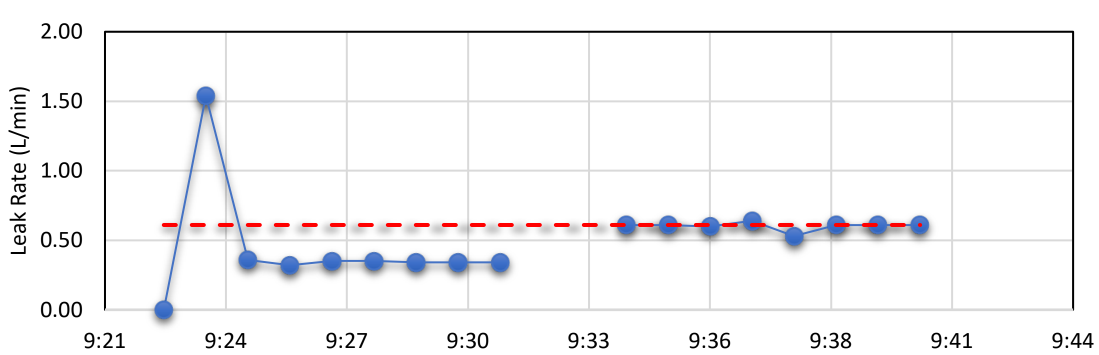
Leak Rate	0.61 L/min
Injection Rate	25.59 L/min
Min Injection Rate	25.08 L/min
Max Injection Rate	26.39 L/min

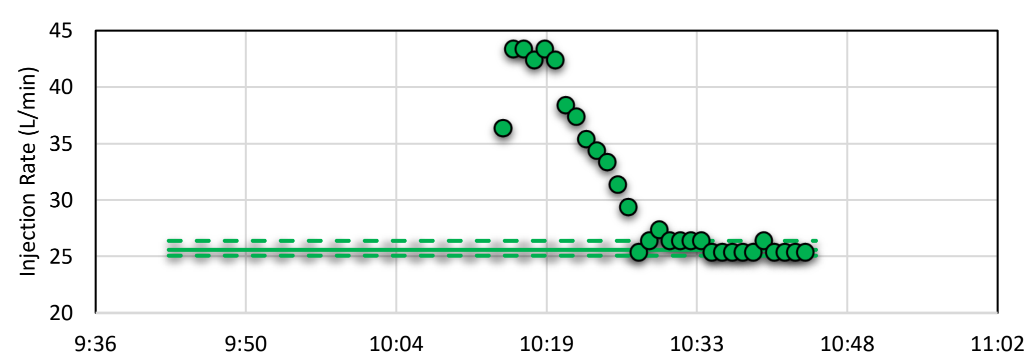
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
10:15	768.0			100
10:16	805.0	37.00	36.39	100
10:17	849.0	44.00	43.39	100
10:18	893.0	44.00	43.39	100
10:19	936.0	43.00	42.39	100
10:20	980.0	44.00	43.39	100
10:21	1023.0	43.00	42.39	100
10:22	1062.0	39.00	38.39	100
10:23	1100.0	38.00	37.39	100
10:24	1136.0	36.00	35.39	100
10:25	1171.0	35.00	34.39	100
10:26	1205.0	34.00	33.39	100
10:27	1237.0	32.00	31.39	100
10:28	1267.0	30.00	29.39	100
10:29	1293.0	26.00	25.39	100
10:30	1320.0	27.00	26.39	100
10:31	1348.0	28.00	27.39	100
10:32	1375.0	27.00	26.39	100
10:33	1402.0	27.00	26.39	100
10:34	1429.0	27.00	26.39	100
10:35	1456.0	27.00	26.39	100
10:36	1482.0	26.00	25.39	100
10:37	1508.0	26.00	25.39	100
10:38	1534.0	26.00	25.39	100
10:39	1560.0	26.00	25.39	100
10:40	1586.0	26.00	25.39	100
10:41	1613.0	27.00	26.39	100
10:42	1639.0	26.00	25.39	100
10:43	1665.0	26.00	25.39	100

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
10:44	1691	26.00	25.39	100
10:45	1717	26.00	25.39	100





Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.

Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.

Transducer Position[D]: Distance from drill bit to transducer in the packer housing.

Flushed Volume[E]: Estimated volume used to flush the hole.

Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.

Marsh Funnel Time[G]: Fresh water is 26 seconds.

Drill Hole ID:	**24GCT-032**	
Test Number:	**4**	
Project No.:	**Graphite Creek**	

CONSTANT HEAD INJECTION TEST
Packer Isolated

Tundra Consulting, LLC

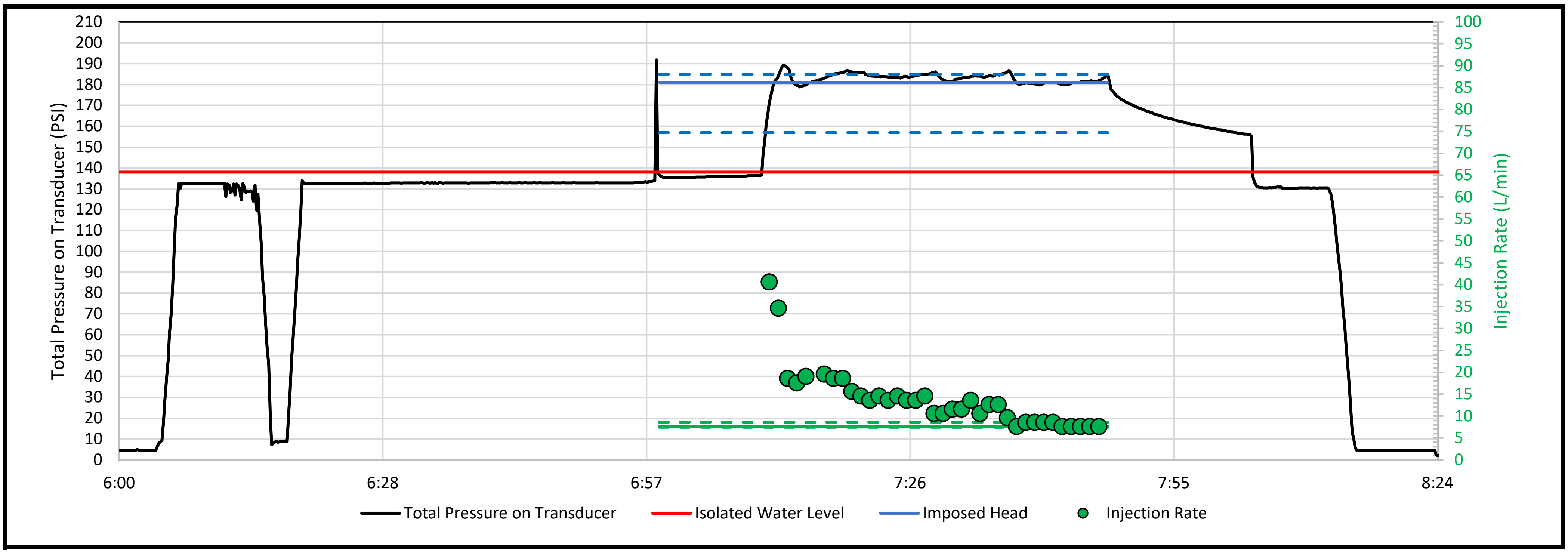
Location Description			Test Interval			General	
Current Depth (ft):	541		**Bit Position:**	386	(ft-ah)	**Test Start Date/Time:**	8/8/2024 4:00
Hole Size[A]:	HQ		**Top of Test Interval:**	390.25	(ft-ah)	**Test End Date/Time:**	8/8/2024 8:45
Inclination:	50		**Stable Water Level[B]:**	138	(PSI)	**Supervisor:**	E. Wilson
Azimuth:	160		*Stable Water Level[C]:*	*-21.3*	*(ft-bgs)*	**Drill Contractor:**	Major
Elevation:	945	(ft-amsl)	*Transducer Position[D]:*	*394.25*	(ft-ah)	**Rig No. & Type:**	#38 LF90

Test Notes

Start Flush:	4:00		**Test Fluid** (water/poly):	Fresh Water	**Shear Pin Break Time:**	6:59
End Flush:	6:00		**Seal Quality:**	Good	**Injection End Time:**	7:48
Flushed Volume[E]:	1080	(gal)	**Start Inflate Time:**	6:30	**Deflation Method:**	Overshot

Zone Description & Comments

Test Type:	Constant Head Injection - Single Step
Drilling Comments:	None
Geology, Hydrogeology, & Rock Mass:	
Test Quality and Assessment:	Artesian. Flush w/artesian flow. Packer didn't fully seat until shear pin broke, so poor constraint on shut-in pressure translating to possible underestimate of K. "High End" estimate accounts for the uncertainty.



	Estimate	Low End	High End	
Imposed Head (H):	30.30	*13.30*	*33.00*	(m-H_2O)
Injection Rate (Q):	10.96	*10.74*	*12.40*	(m^3/day)
Hydraulic Conductivity:	**6.69E-03**	*6.02E-03*	*1.72E-02*	(m/day)
Transmissivity:	**0.31**	*0.28*	*0.79*	(m/day/m)

Test Parameters

Radius of Influence[F]: (R)		10	(m)
Radius of the Well: (r_w)		48.0	(mm)
Test Interval Length: (b)		45.95	(m)
System Leak Rate:		0.56	(m^3/day)
Marsh Funnel Time[G]:		26	(sec)
Viscosity Correction Factor:		1	(unitless)

Analysis of the constant head injection response is based on the Thiem equation:

$$T = \frac{Q}{2\pi H} \ln\left(\frac{R}{r_w}\right)$$

See Kruseman, G.P., and DeRidder, N.A., (1970). Analysis and Evaluation of Pumping Test Data, 2nd edition. International Institute for Land Reclamation and Improvement, Publication 47.

Also see Batu, Vedat, (1998). Aquifer Hydraulics: A Comprehensive Guide to Hydrogeologic Data Analysis. New York, New York: John Wiley & Sons.

ft-amsl: Feet Above Mean Sea Level.

ft-ah: Feet Along Hole. Distance **measured** down along the hole from the collar, regardless of drill hole inclination.

ft-bgs: Feet Below Ground Surface. Depth **calculated** vertically below the collar, regardless of drill hole inclination.

Drill Hole ID:	24GCT-032
Test Number:	4
Project No.:	Graphite Creek

CONSTANT HEAD INJECTION TEST
Packer Isolated

APPLIED HYDROLOGIC

Leak Rate

Time (Hours)	Totalizer (L)	Rate (L/min)	Pressure (PSI)
6:44	2.71	-	100
6:45	3.23	0.52	100
6:46	3.71	0.48	100
6:47	4.21	0.50	100
6:48	4.71	0.50	100
6:49	5.21	0.50	100
6:50	5.72	0.51	100
6:51	5.76		50
6:52	6.11	0.35	50
6:53	6.51	0.40	50
6:54	6.89	0.38	50
6:55	7.28	0.39	50
6:56	7.67	0.39	50

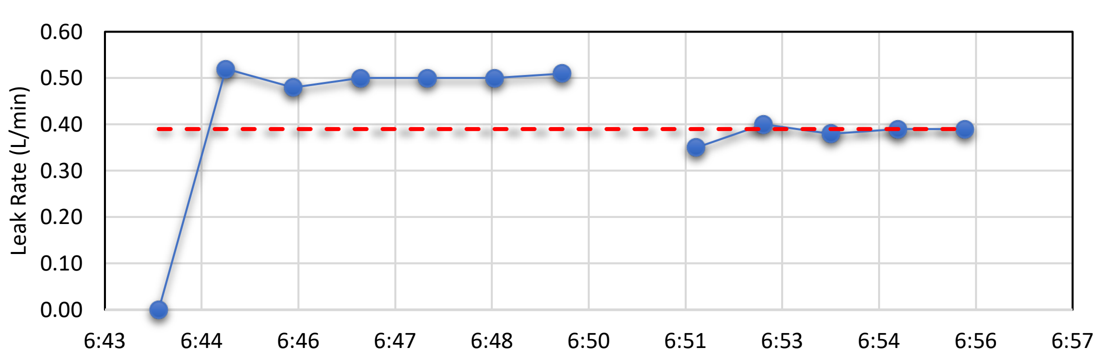
Leak Rate	0.39 L/min
Injection Rate	7.61 L/min
Min Injection Rate	7.46 L/min
Max Injection Rate	8.61 L/min

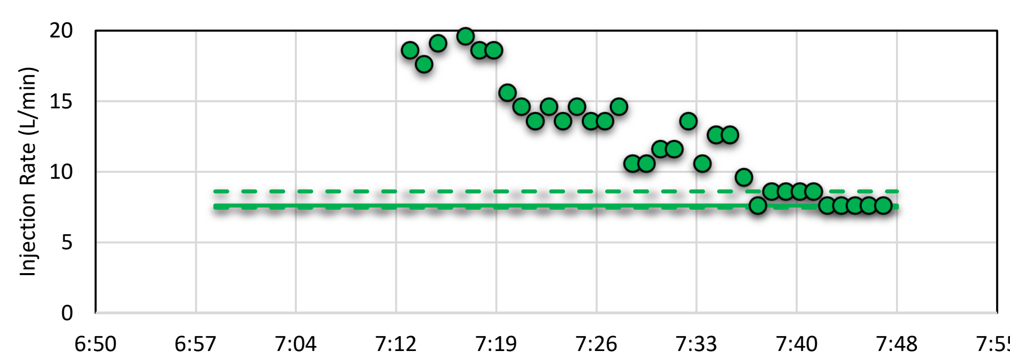
Injection Test

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
7:11	638.0			100
7:12	679.0	41.00	40.61	100
7:13	714.0	35.00	34.61	100
7:14	733.0	19.00	18.61	100
7:15	751.0	18.00	17.61	100
7:17	790.0	19.50	19.11	100
7:18	810.0	20.00	19.61	100
7:19	829.0	19.00	18.61	100
7:20	848.0	19.00	18.61	100
7:21	864.0	16.00	15.61	100
7:22	879.0	15.00	14.61	100
7:23	893.0	14.00	13.61	100
7:24	908.0	15.00	14.61	100
7:25	922.0	14.00	13.61	100
7:26	937.0	15.00	14.61	100
7:27	951.0	14.00	13.61	100
7:28	965.0	14.00	13.61	100
7:29	980.0	15.00	14.61	100
7:30	991.0	11.00	10.61	100
7:31	1002.0	11.00	10.61	100
7:32	1014.0	12.00	11.61	100
7:33	1026.0	12.00	11.61	100
7:34	1040.0	14.00	13.61	100
7:35	1051.0	11.00	10.61	100
7:36	1064.0	13.00	12.61	100
7:37	1077.0	13.00	12.61	100
7:38	1087.0	10.00	9.61	100
7:39	1095.0	8.00	7.61	100
7:40	1104.0	9.00	8.61	100

Injection Test *(Continued)*

Time (Hours)	Totalizer (L)	Total Rate (L/min)	Test Rate (L/min)	Pressure (PSI)
7:41	1113	9.00	8.61	100
7:42	1122	9.00	8.61	100
7:43	1131	9.00	8.61	100
7:44	1139	8.00	7.61	100
7:45	1147	8.00	7.61	100
7:46	1155	8.00	7.61	100
7:47	1163	8.00	7.61	100
7:48	1171	8.00	7.61	100

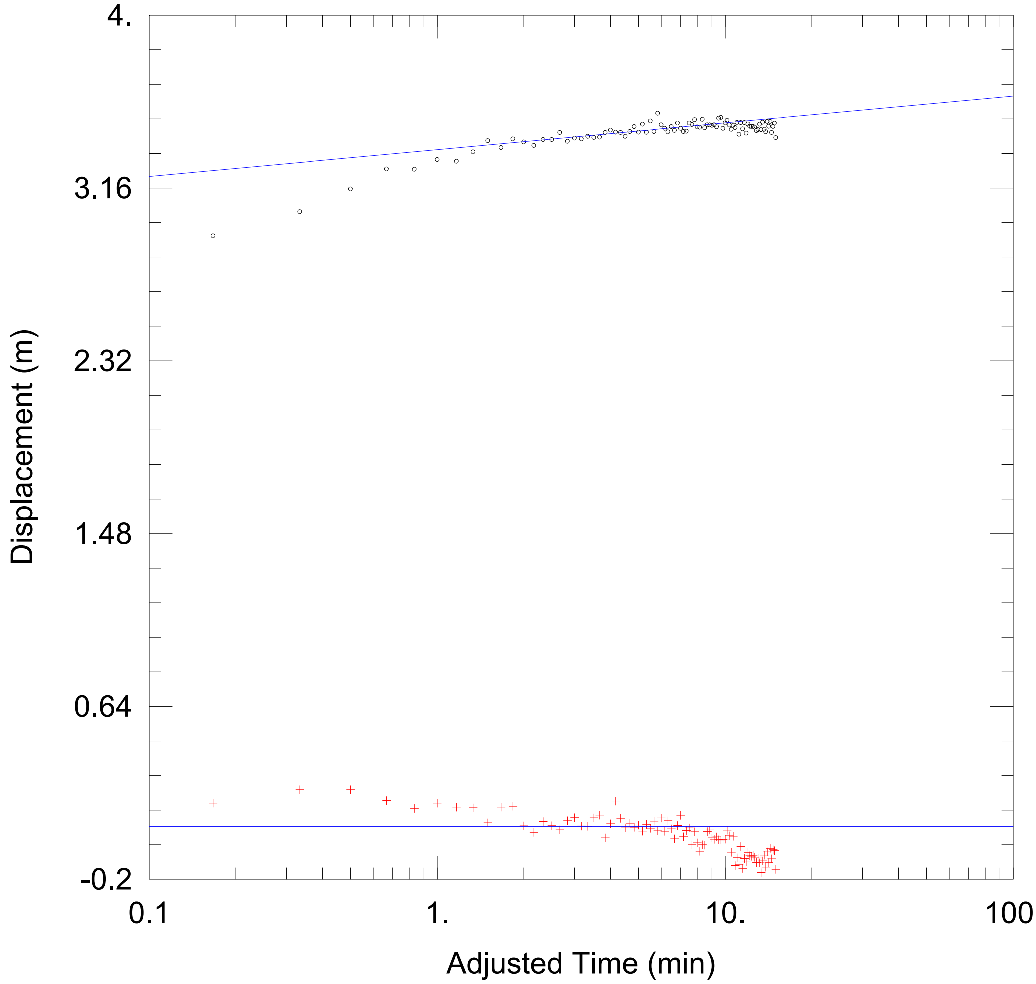




Inputs & Notes

Hole Size[A]:	NQ	NQTK	NQ3	HQ	HQ3	PQ	PQ3
Diameter (mm):	75.8	75.8	75.8	96.0	96.0	122.6	122.6

Stable Water Level[B] (PSI): Pre-Test "static" water level: As measured by transducer in packer in PSI.
Stable Water Level[C] (ft-ah): Pre-Test "static" water level: along the hole, as measured with a water tape.
Transducer Position[D]: Distance from drill bit to transducer in the packer housing.
Flushed Volume[E]: Estimated volume used to flush the hole.
Radius of Influence[F] (R): 10 m (32.8 ft) is a standard value.
Marsh Funnel Time[G]: Fresh water is 26 seconds.



TEST 1

Data Set: C:\...\24GCT032_Test1_50.25-116_Ft_CJ.aqt
Date: 11/23/24 Time: 16:13:56

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT032
Test Date: 8/5/2024

AQUIFER DATA

Saturated Thickness: 20.05 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT032	0	0

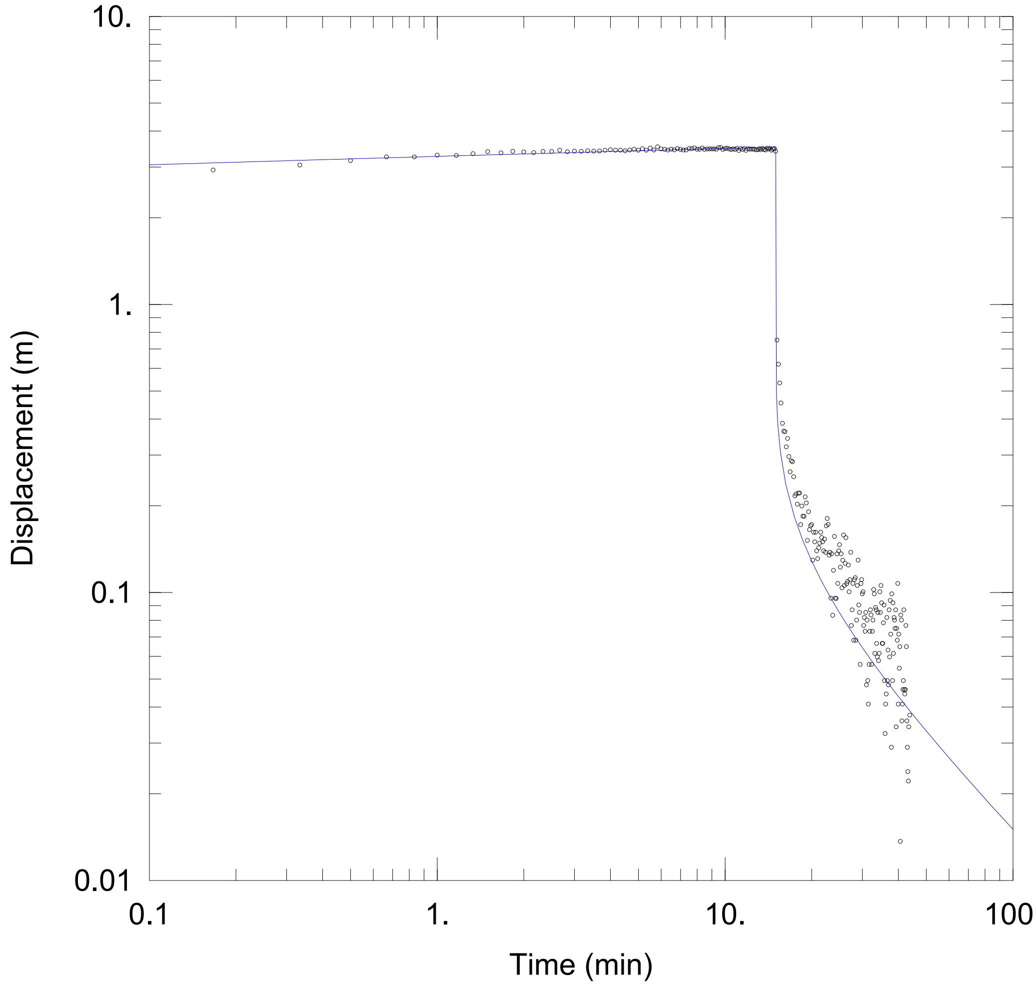
Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT032	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 85.06 m^2/day S = 1.193E-24



TEST 1

Data Set: C:\...\24GCT032_Test1_50.25-116_Ft_Theis.aqt
Date: 11/23/24 Time: 16:14:43

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT032
Test Date: 8/5/2024

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT032	0	0

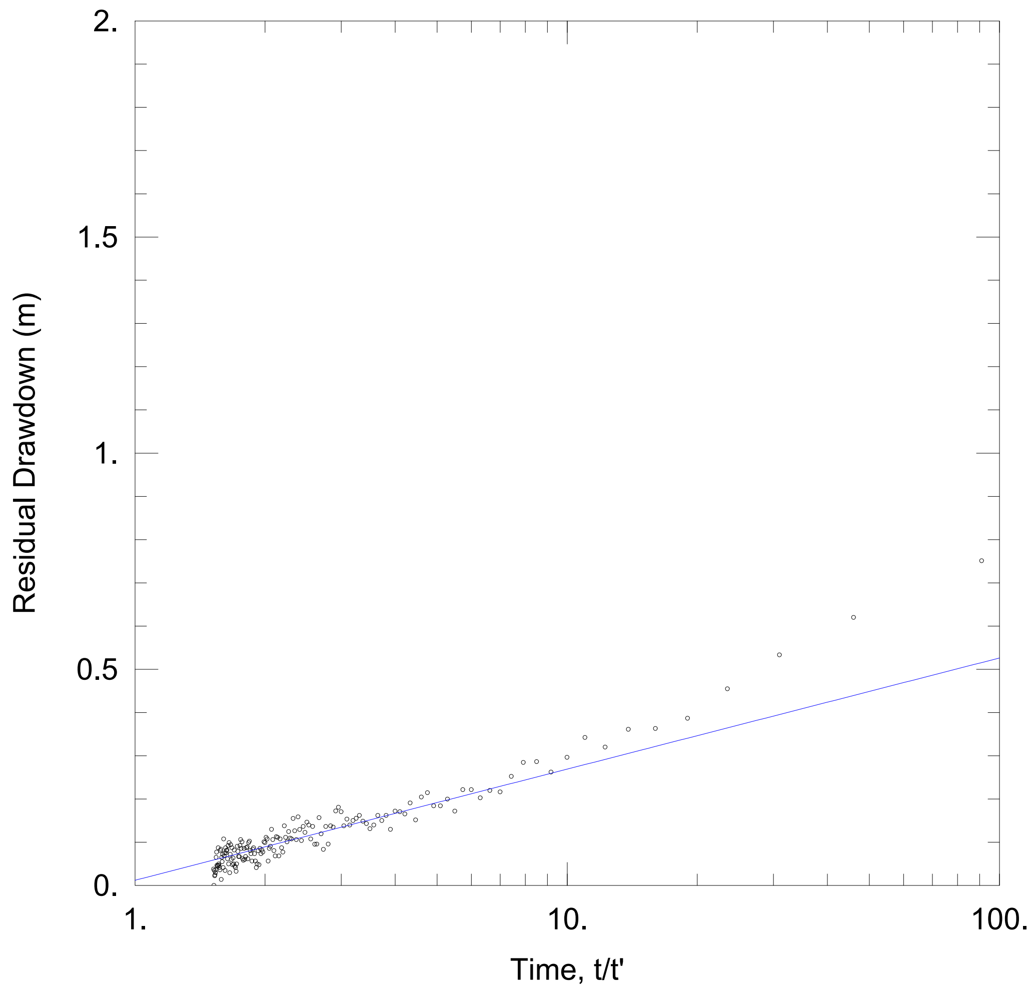
Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT032	0	0

SOLUTION

Aquifer Model: Confined
Solution Method: Theis

T = 51.96 m^2/day
S = 1.704E-14
Kz/Kr = 1.
b = 20.05 m



TEST 1

Data Set: C:\...\24GCT032_Test1_50.25-116_Ft_TheisRDD.aqt
Date: 11/23/24 Time: 16:14:23

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT032
Test Date: 8/5/2024

AQUIFER DATA

Saturated Thickness: 20.05 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT032	0	0

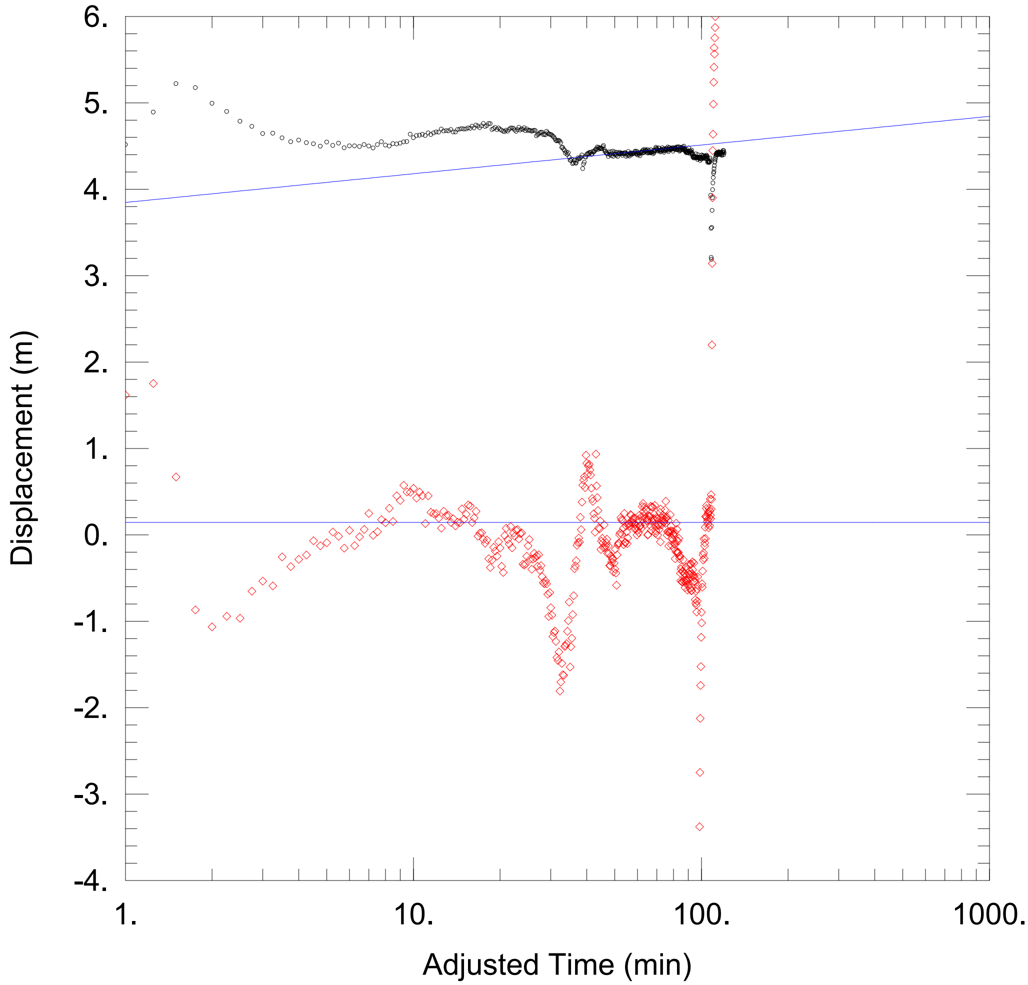
Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT032	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 43.11 m^2/day S/S' = 0.8995



TEST 1 - PUMPING TEST

Data Set: C:\...\24GCT033_Test1_CooperJacob.aqt
Date: 11/23/24 Time: 16:18:39

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT033
Test Date: 8/23/2024

AQUIFER DATA

Saturated Thickness: 78. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT033	0	0

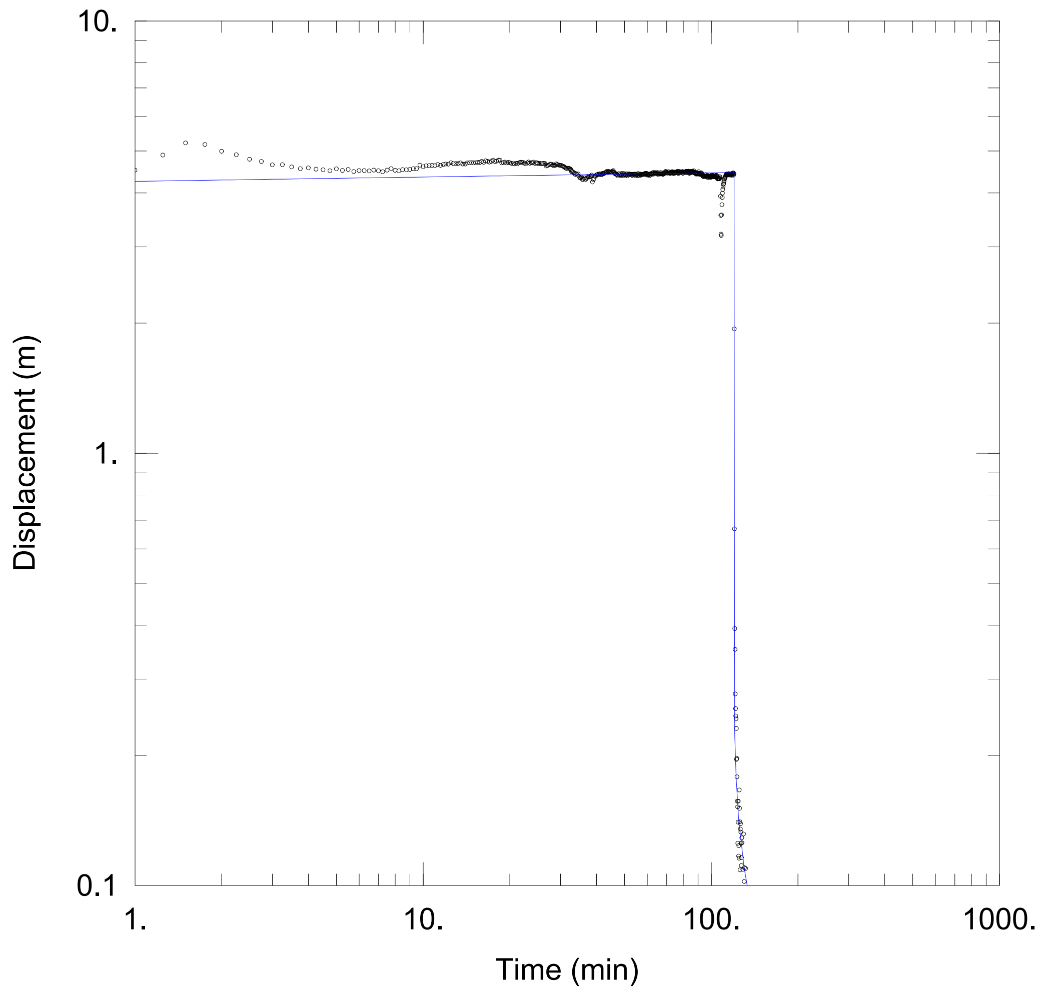
Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT033	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 3.454 m^2/day S = 3.795E-12



TEST 1 - PUMPING TEST

Data Set: C:\...\24GCT033_Test1_Theis.aqt
Date: 11/23/24 Time: 16:18:25

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT033
Test Date: 8/23/2024

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT033	0	0

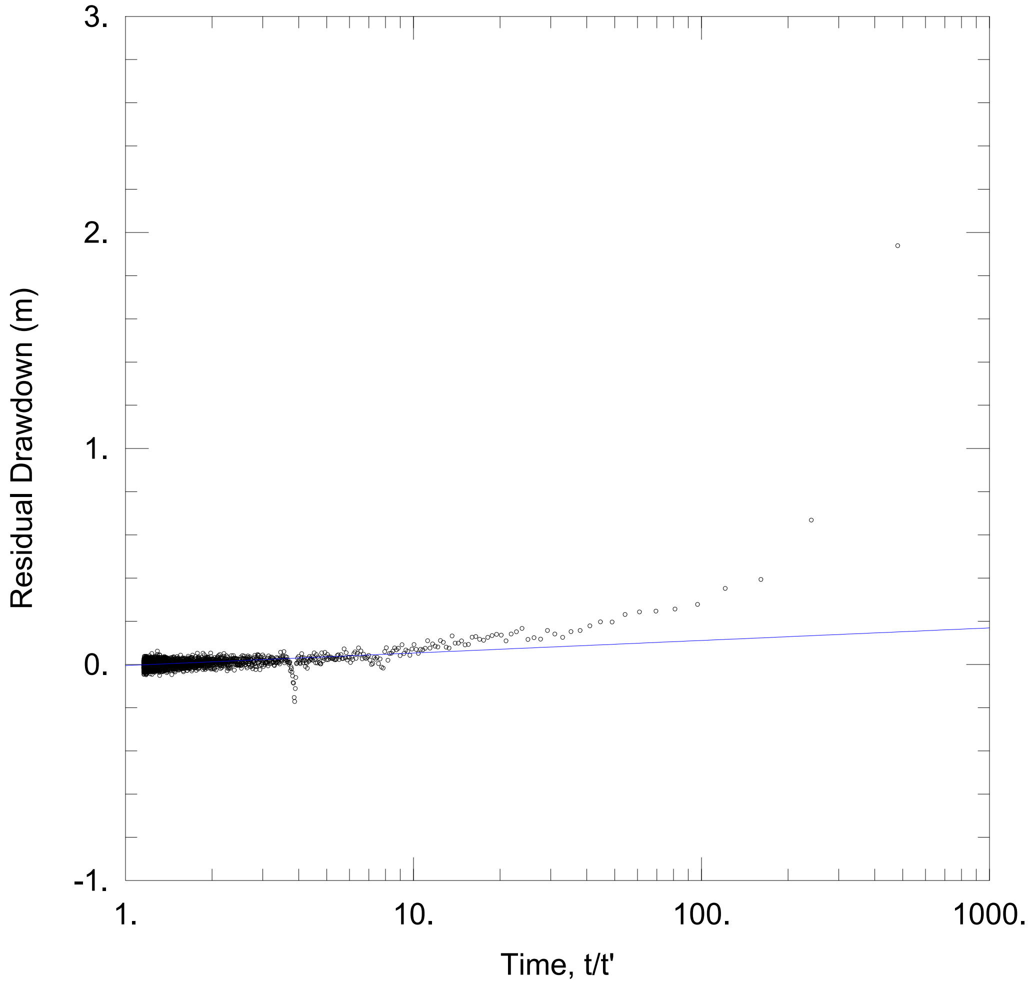
Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT033	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis

T = 11.64 m^2/day S = 3.347E-43
Kz/Kr = 1. b = 78. m



TEST 1 - PUMPING TEST

Data Set: C:\...\24GCT033_Test1_TheisRDD.aqt
Date: 11/23/24 Time: 16:18:14

PROJECT INFORMATION

Company: Tundra
Client: Graphite One
Location: Graphite Creek
Test Well: 24GCT033
Test Date: 8/23/2024

AQUIFER DATA

Saturated Thickness: 78. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
24GCT033	0	0

Observation Wells

Well Name	X (m)	Y (m)
◦ 24GCT033	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 19.75 m^2/day S/S' = 1.238

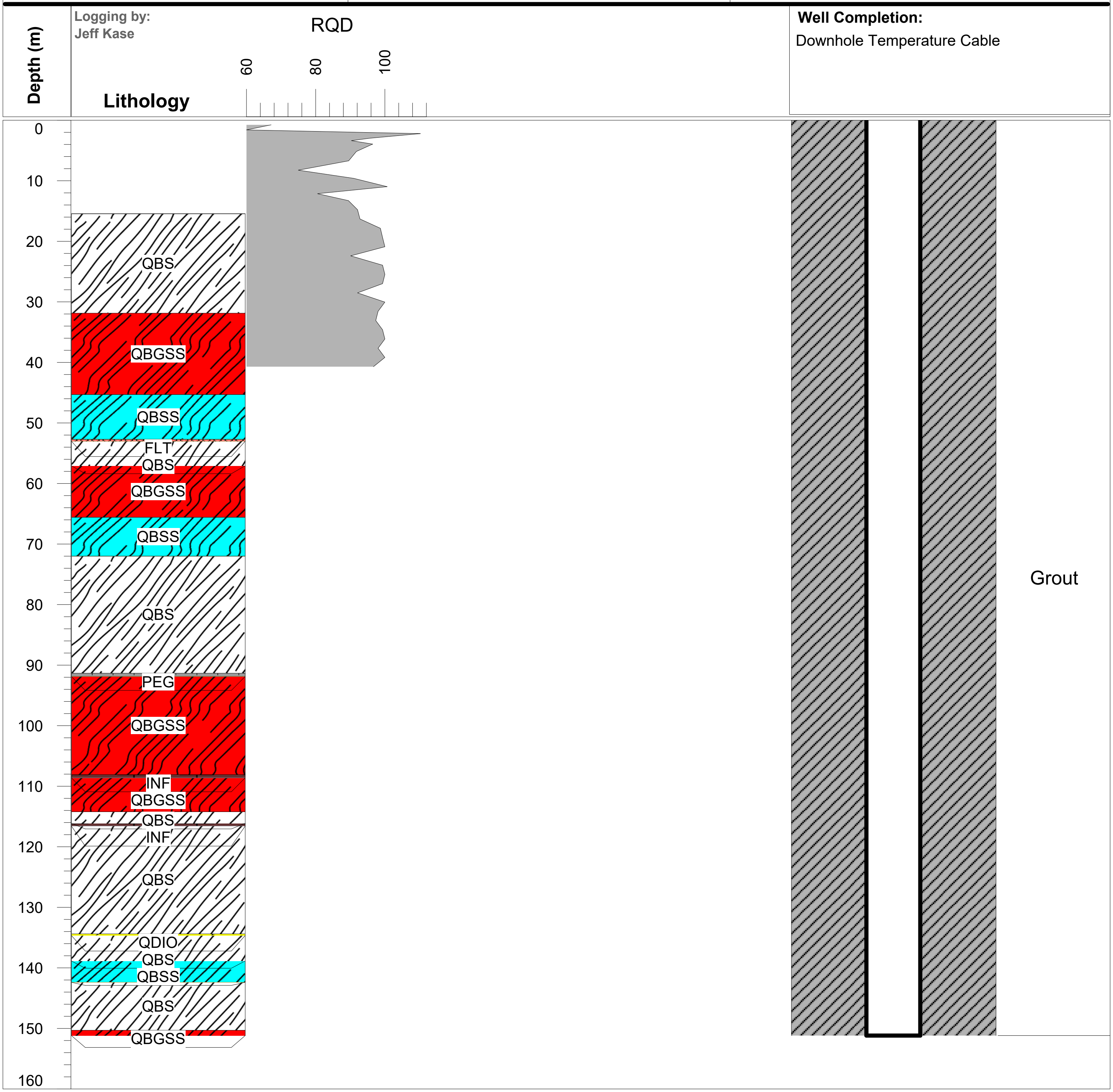
Appendix E. Drill Logs

DDH

19GC027

Tundra Consulting, LLC

Installed by KP/Tundra Consulting	Coordinate System: NAD83 Z3N	Stickup: NA m-ags	Drill Rig:
Project: Graphite Creek	Easting: 474733 m Elevation: 254 mamsl	Azimuth: 160°	Hole Diameter: HQ3
Date Completed: 30-Oct-19	Northing: 7212950 Drill Pad: Resource	Inclination: -50°	Total Depth: 151.17 m



Lithology

- Quartz-Biotite-Garnet-Sillimanite Schist
- Quartz-Biotite Schist
- Fault
- Pegmatite
- Quartz Diorite
- Felsic Intrusive
- Quartz-Biotite-Sillimanite Schist

Project Manager: KP

Drilling Manager: Boart Longyear

Field Manager: Unkown

Hole Drilled: From: 12-Oct-19 To: 30-Oct-19

Notes:

No fracture frequency logged & RQD partially logged.
DTC Removed.

DDH

19GC028

Tundra Consulting, LLC

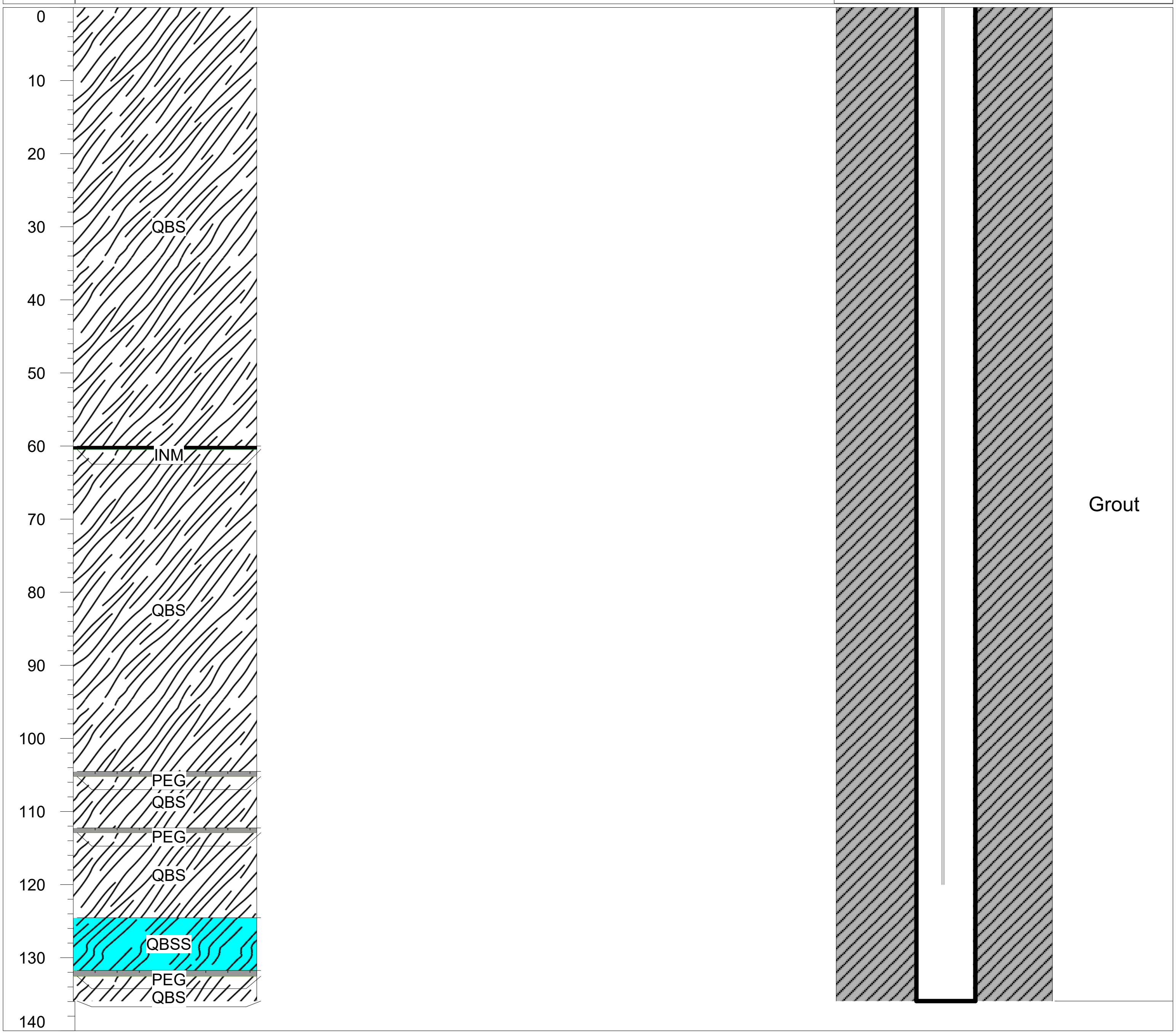
Installed by KP/Tundra Consulting	Coordinate System: NAD83 Z3N		Stickup: NA m-ags	Drill Rig:
Project: Graphite Creek	Easting: 474442 m	Elevation: 299 mamsl	Azimuth: 160°	Hole Diameter: HQ3
Date Completed: 06-Nov-19	Northing: 7212746	Drill Pad: Resource	Inclination: -50°	Total Depth: 135.92 m

Depth (m)

Logging by:
Mike Bethe

Lithology

Well Completion:
Downhole Temperature Cable



Lithology

- Quartz-Biotite Schist
- Pegmatite
- Mafic Intrusive
- Quartz-Biotite-Sillimanite Schist

Project Manager: KP

Drilling Manager: Boart Longyear

Field Manager: Unkown

Hole Drilled: From: 01-Nov-19 To: 06-Nov-19

Notes:
No geotechnical data logged. Geology simplified for display.

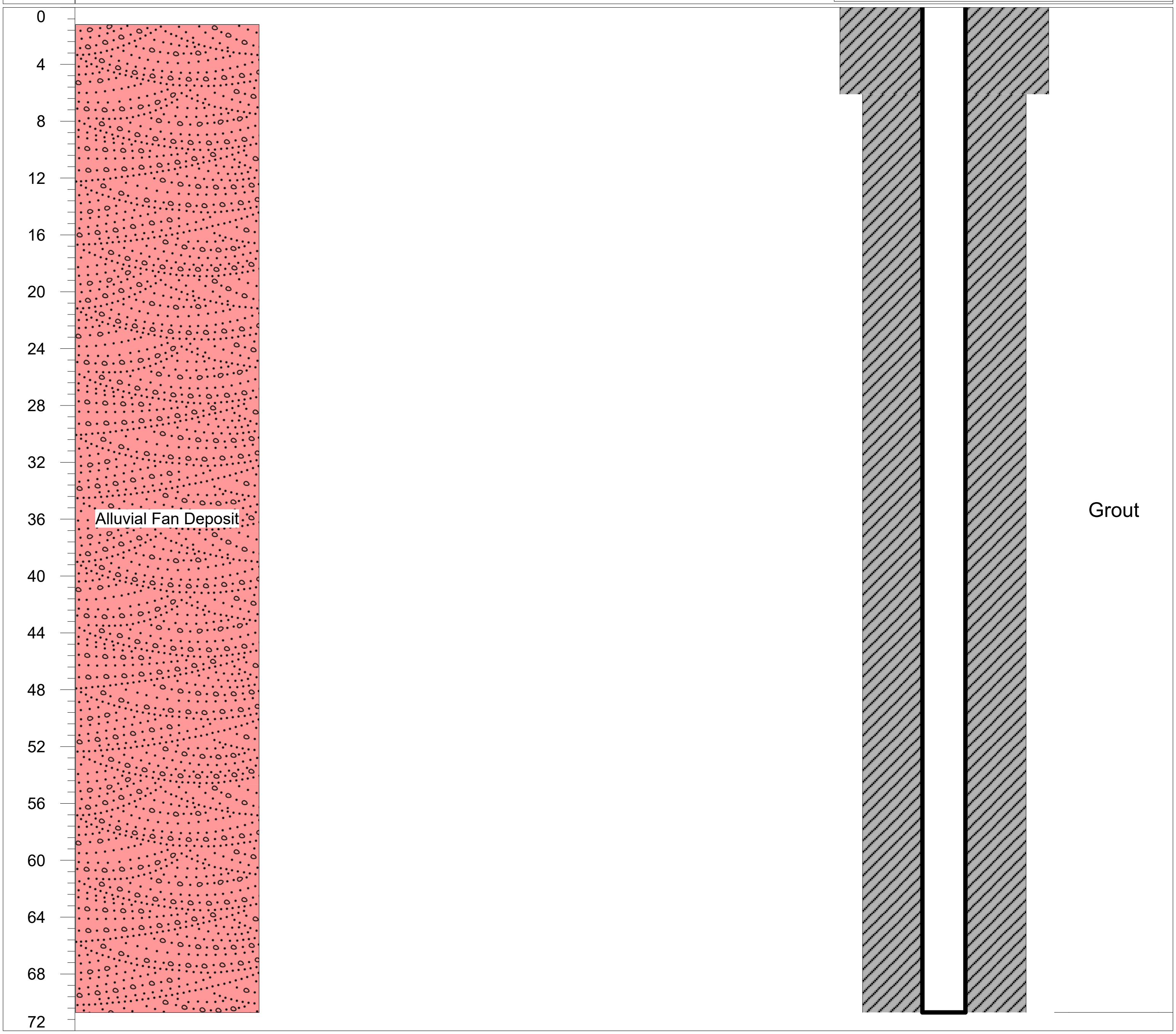
DDH - Sediment

19GT001

Tundra Consulting, LLC

Installed by KP/Tundra Consulting Project: Graphite Creek Date Completed: 10/11/2019	Coordinate System: NAD83 Z3N Easting: 473511 m Elevation: 140 mamsl Northing: 7212767 TSF Embankment Abutment	Stickup: NA m-ags Azimuth: 0° Inclination: -90°	Drill Rig: LF-70 Hole Diameter: HQ3 Total Depth: 70.71 m

Depth (m)	Logging by: LS/NAB Lithology	**Well Completion:** Abandoned - Vibrating Wire Piezometer



Lithology

Alluvial Fan Deposit

Project Manager: KP

Drilling Contractor: Boart Longyear

Field Manager: Unkown

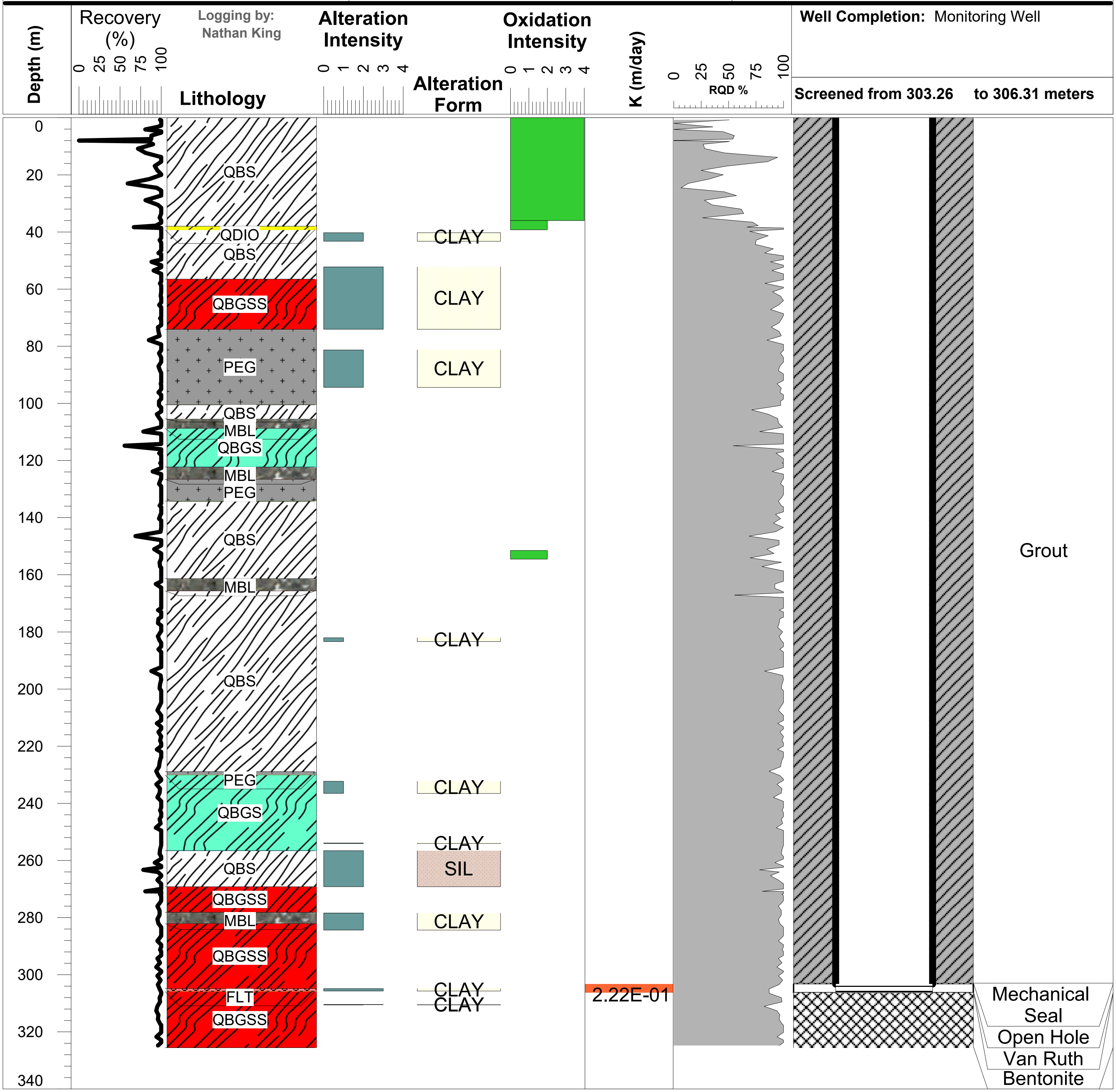
Hole Drilled: From: 9/24/2019 To: 10/11/2019

Notes:

Abandoned - VWP cables severed during installation.
Drilled with core rig using mud rotary tooling.

DDH **21GC066** Tundra Consulting, LLC

Installed by Tundra Consulting	Coordinate System: NAD83 Z3N	Stickup: 0.55 m-ags
Project: Graphite Creek	Easting: 474638 m	Azimuth: 158°
Date Completed: 10-Sep-21	Northing: 7212807	Inclination: -50.6°
	Elevation: 308 mamsl	Drill Rig: American Recon 65
		Hole Diameter: HQ3
		Total Depth: 325.53 m



Lithology

- Quartz-Biotite-Garnet-Sillimanite Schist
- Quartz-Biotite Schist
- Fault
- Marble
- Pegmatite
- Quartz Diorite
- Quartz-Biotite-Garnet Schist

Project Manager: Steve Teller

Drilling Contractor: T&J

Field Manager: Steve Teller

Hole Drilled: From: 30-Aug-21 To: 10-Sep-21

Notes:

Deep monitoring well. Geology Simplified for display

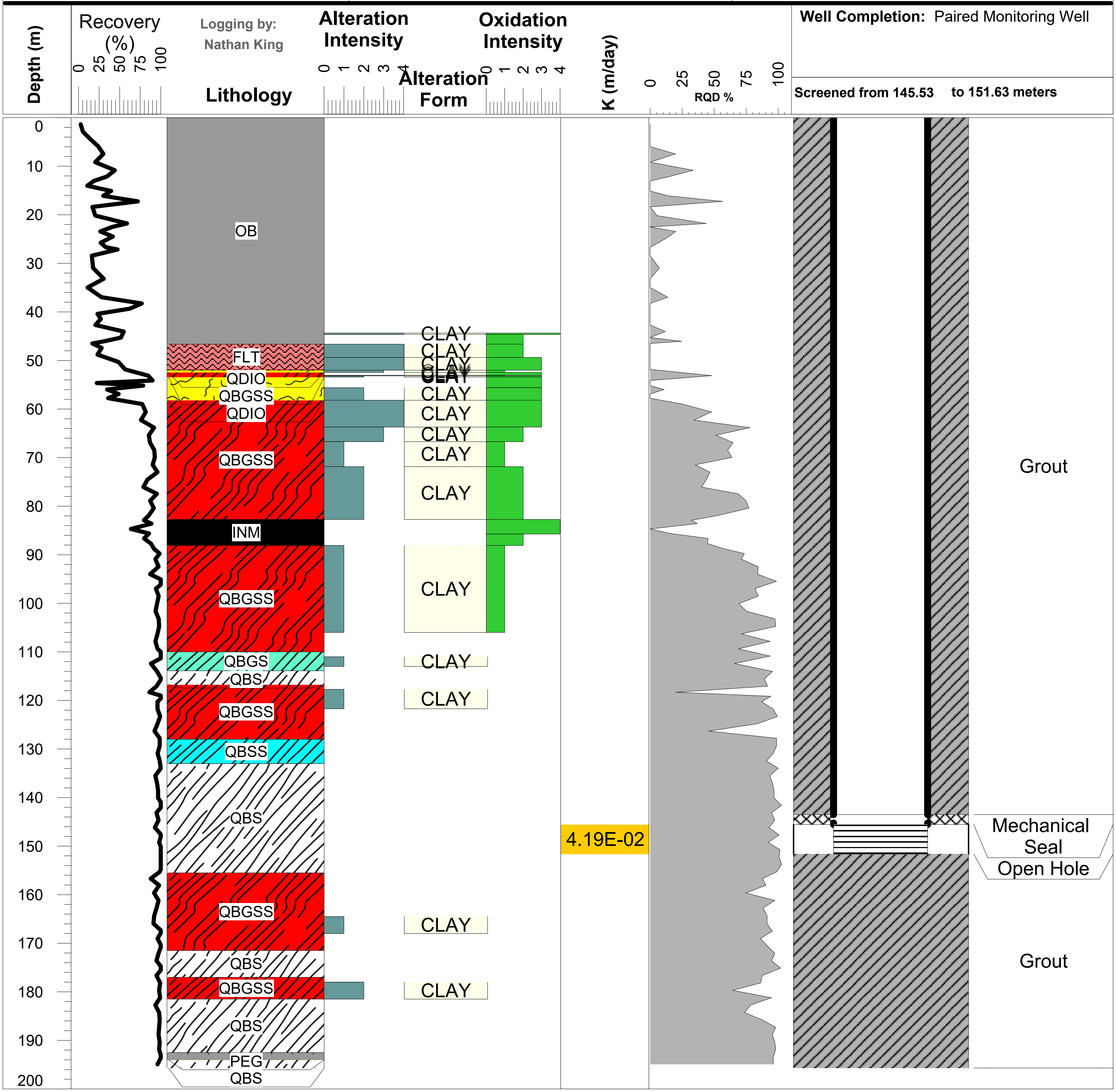
DDH **21GC068**

Tundra Consulting, LLC

Installed by Tundra Consulting	Coordinate System: NAD83 Z3N	Stickup: 0.5 m-ags	Drill Rig: American Recon 65
Project: Graphite Creek	Easting: 474349 m Elevation: 207 mamsl	Azimuth: 142.9°	Hole Diameter: HQ3
Date Completed: 22-Sep-21	Northing: 7212936	Inclination: -59°	Total Depth: 195.68 m

Well Completion: Paired Monitoring Well

Screened from 145.53 to 151.63 meters



Lithology

- Overburden
- Quartz-Biotite-Garnet-Sillimanite Schist
- Quartz-Biotite Schist
- Fault
- Pegmatite
- Quartz Diorite
- Mafic Intrusive
- Quartz-Biotite-Garnet Schist
- Quartz-Biotite-Sillimanite Schist

Project Manager: Steve Teller

Drilling Contractor: T&J

Field Manager: Steve Teller

Hole Drilled: From: 13-Sep-21 To: 22-Sep-21

Notes:

Deep paired monitoring well with 21GC069

DDH

21GC069

Tundra Consulting, LLC

Installed by Tundra Consulting
Project: Graphite Creek
Date Completed: 25-Sep-21

Coordinate System: NAD83 Z3N
Easting: 474349 m
Northing: 7212936
Elevation: 207 mamsl
Drill Pad: Resource

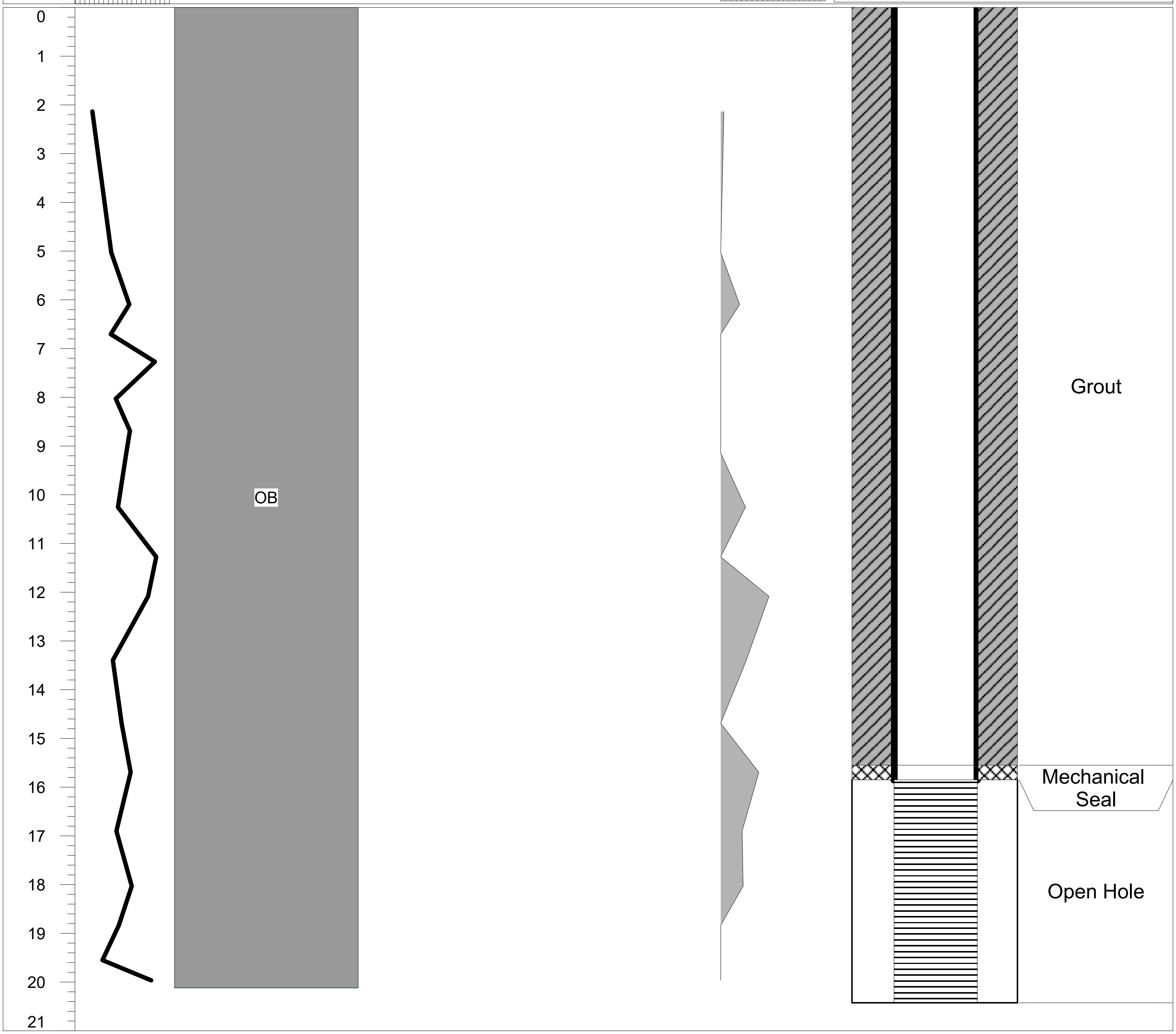
Stickup: 0.46 m-ags
Azimuth: 0°
Inclination: -90°

Drill Rig: American Recon 65
Hole Diameter: HQ3
Total Depth: 20.12 m

Depth (m) | Recovery (%) 0 25 50 75 100 | Logging by: Jeff Kase | Lithology | RQD % 0 25 50 75 100

Well Completion:
Paired Monitoring Well

Screened from 15.85 to 20.42 m



Lithology

Overburden

Project Manager: Steve Teller

Drilling Contractor: T&J

Field Manager: Steve Teller

Hole Drilled: From: 25-Sep-21 To: 25-Sep-21

Notes:

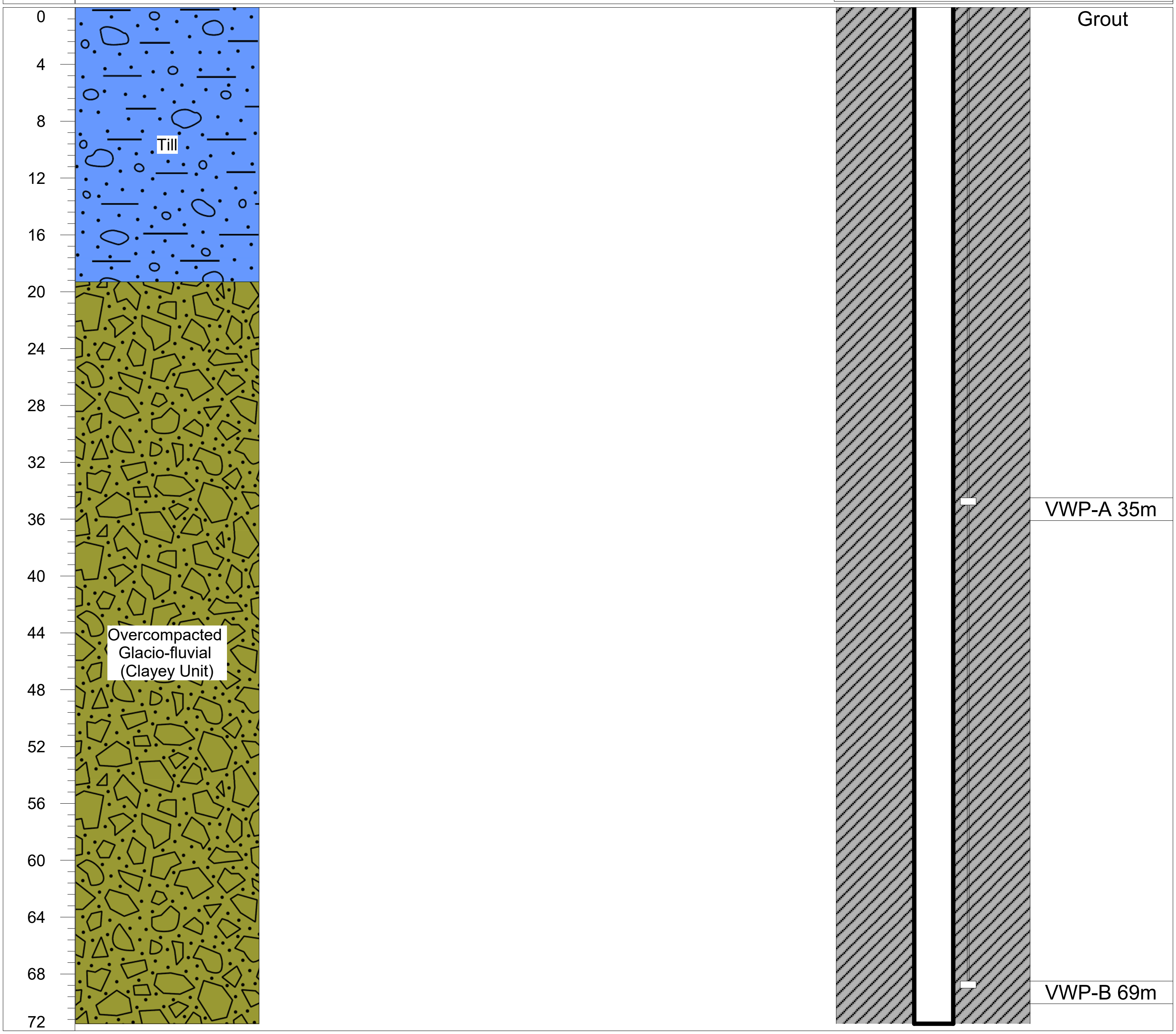
Shallow paired monitoring well with 21GC068. No Fracture Frequency logged

Sonic - Sediment | **21GT001** | Tundra Consulting, LLC

Installed by KP	Coordinate System: NAD83 Z3N	Stickup: NA m-ags	Drill Rig: Hydracore HC5000S
Project: Graphite Creek	Easting: 473444 m / Elevation: 111 mamsl	Azimuth: 0°	Hole Diameter: 4x6
Date Completed: 04-Aug-21	Northing: 7214172 / Drill Pad: Geotech	Inclination: -90°	Total Depth: 71.50 m

Logging by:
KP. Relogged by Tundra.

Well Completion:
Vibrating Wire Piezometer



Lithology

- Till
- Overcompacted Glacio-fluvial (Clayey Unit)

Project Manager: KP
Drilling Contractor: Mud Bay
Field Manager: KP
Hole Drilled: From: 22-Jul-21 To: 04-Aug-21
Notes:
VWP Installed by KP

Sonic - Sediment | **21GT002** | Tundra Consulting, LLC

Installed by KP
Project: Graphite Creek
Date Completed: 14-Aug-21

Coordinate System: NAD83 Z3N
Easting: 473622 m
Northing: 7214314
Elevation: 140 mamsl
Drill Pad: Geotech

Stickup: NA m-ags
Azimuth: 0°
Inclination: -90°

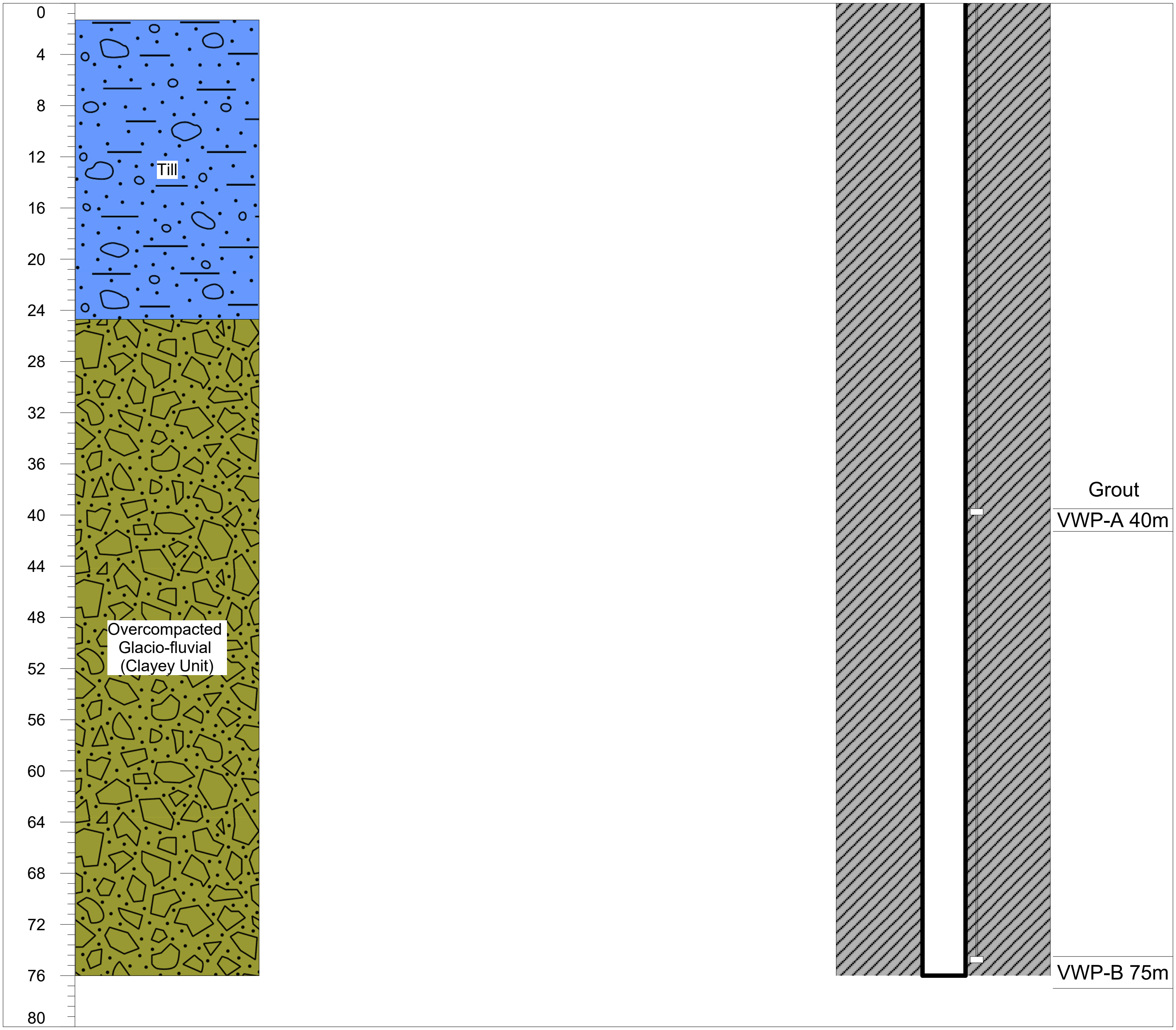
Drill Rig: Hydracore HC5000S
Hole Diameter: 4x6
Total Depth: 76.00 m

Depth (m)

Logging by:
KP. Relogged by Tundra.

Lithology

Well Completion:
Vibrating Wire Piezometer



Lithology

- Till
- Overcompacted Glacio-fluvial (Clayey Unit)

Project Manager: KP
Drilling Contractor: Mud Bay
Field Manager: KP
Hole Drilled: From: 05-Aug-21 To: 14-Aug-21
Notes:
VWP Installed by KP

Sonic - Sediment

21GT003

Tundra Consulting, LLC

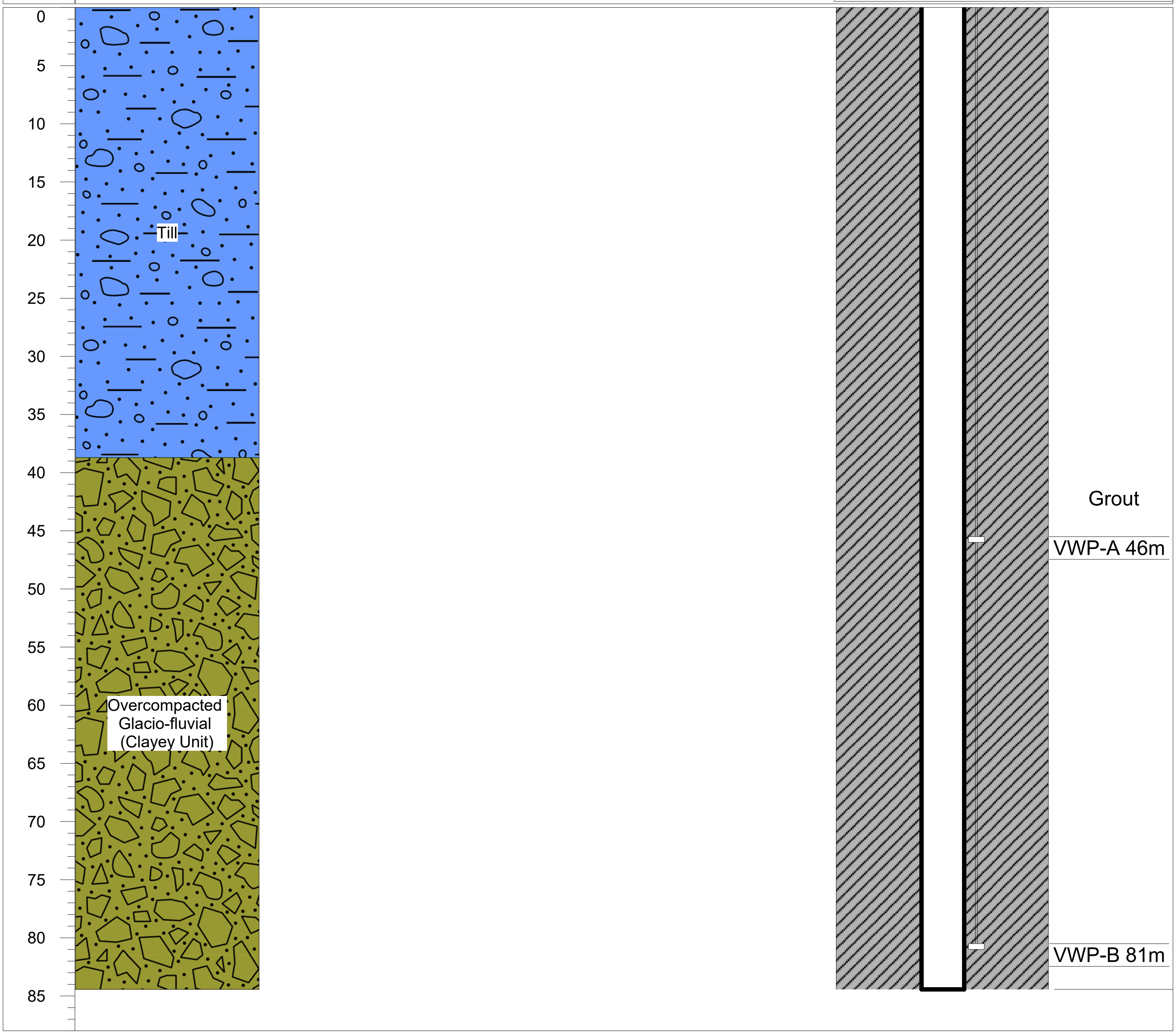
Installed by KP	Coordinate System: NAD83 Z3N	Stickup: NA m-ags	Drill Rig: Hydracore HC5000S
Project: Graphite Creek	Easting: 473986 m / Elevation: 190 mamsl	Azimuth: 0°	Hole Diameter: 4x6
Date Completed: 24-Aug-21	Northing: 7214592 / Drill Pad: Geotech	Inclination: -90°	Total Depth: 84.43 m

Depth (m)

Logging by:
KP. Relogged by Tundra.

Lithology

Well Completion:
Vibrating Wire Piezometer



Lithology

- Till
- Overcompacted Glacio-fluvial (Clayey Unit)

Project Manager: KP

Drilling Contractor: Mud Bay

Field Manager: KP

Hole Drilled: From: 15-Aug-21 To: 24-Aug-21

Notes:

VWP Installed by KP

Sonic - Sediment | **21GT004** | Tundra Consulting, LLC

Installed by KP
Project: Graphite Creek
Date Completed: 31-Aug-21

Coordinate System: NAD83 Z3N
Easting: 474706 m
Northing: 7214196
Elevation: 207 mamsl
Drill Pad: Geotech

Stickup: NA m-ags
Azimuth: 0°
Inclination: -90°

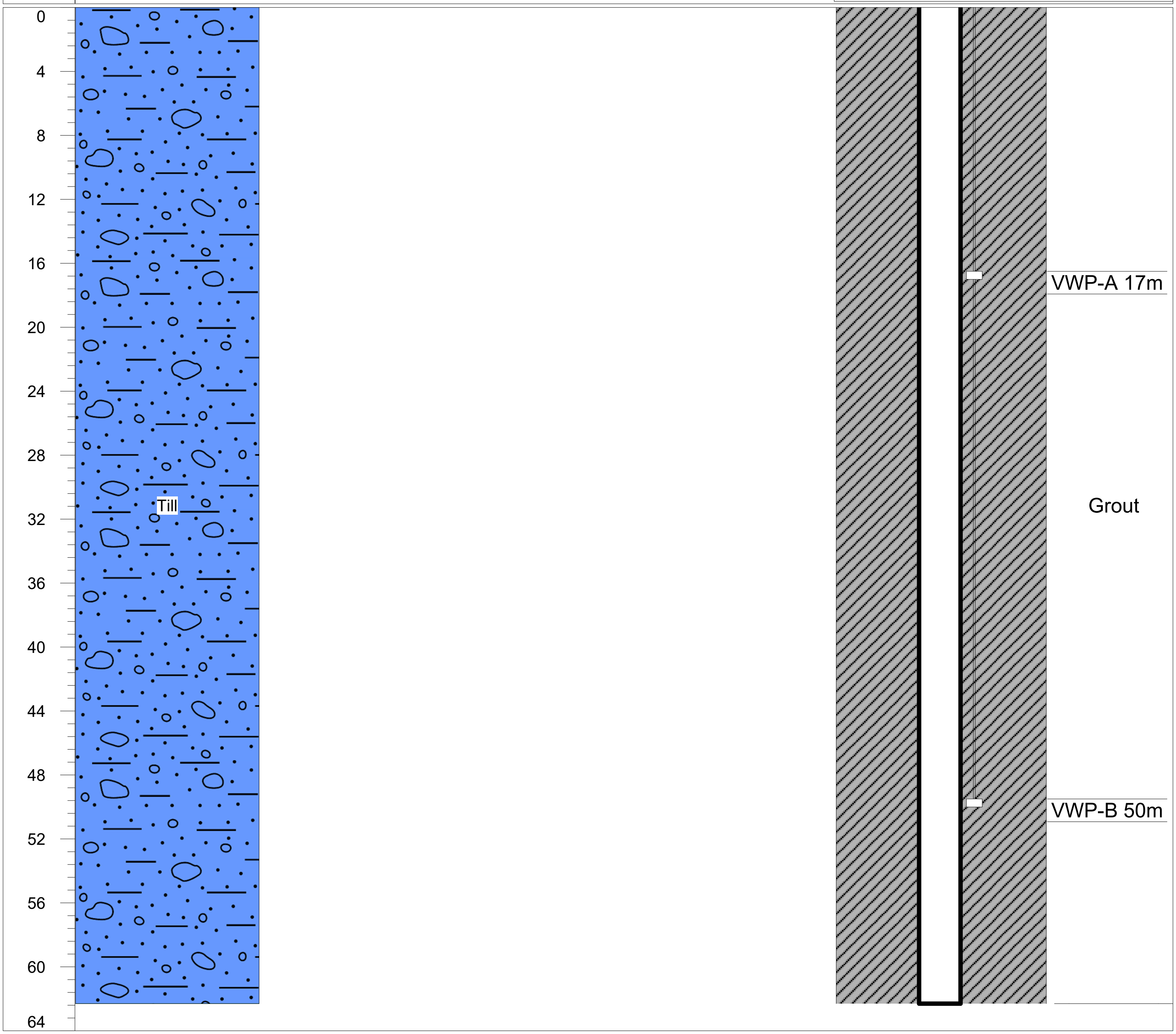
Drill Rig: Hydracore HC5000S
Hole Diameter: 4x6
Total Depth: 62.30 m

Depth (m)

Logging by:
KP. Relogged by Tundra.

Lithology

Well Completion:
Vibrating Wire Piezometer



Lithology

Till

Project Manager: KP

Drilling Contractor: Mud Bay

Field Manager: KP

Hole Drilled: From: 26-Aug-21 To: 31-Aug-21

Notes:

VWP Installed by KP

Sonic - Sediment

21GT005

Tundra Consulting, LLC

Installed by KP
Project: Graphite Creek
Date Completed: 12-Sep-21

Coordinate System: NAD83 Z3N
Easting: 474067 m
Northing: 7213772
Elevation: 130 mamsl
Drill Pad: Geotech

Stickup: NA m-ags
Azimuth: 0°
Inclination: -90°

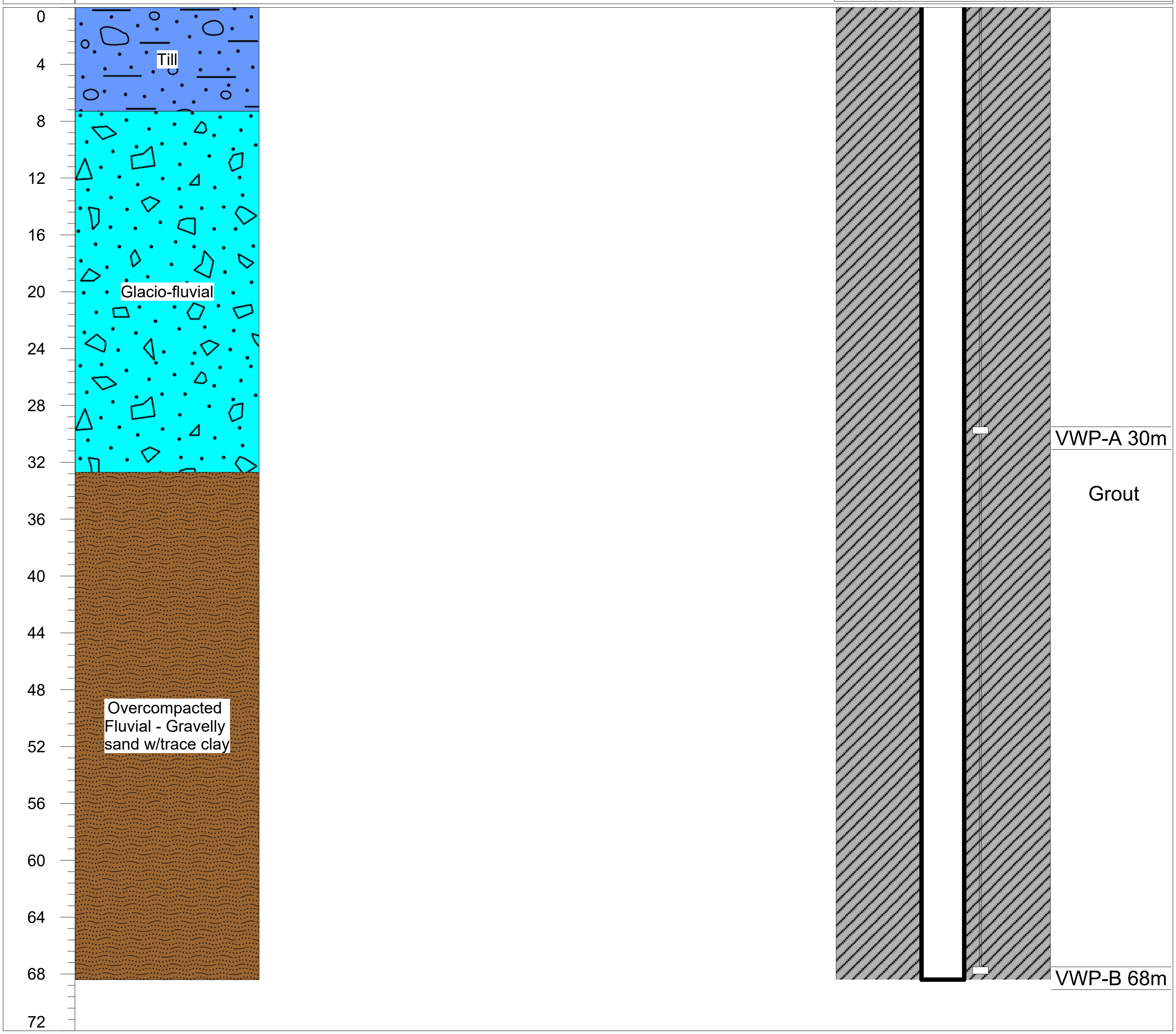
Drill Rig: Hydracore HC5000S
Hole Diameter: 4x6
Total Depth: 68.40 m

Depth (m)

Logging by:
KP. Relogged by Tundra.

Lithology

Well Completion:
Vibrating Wire Piezometer



Lithology

- Till
- Glacio-fluvial
- Overcompacted Fluvial - Gravelly sand w/trace clay

Project Manager: KP
Drilling Contractor: Mud Bay
Field Manager: KP
Hole Drilled: From: 02-Sep-21 To: 12-Sep-21
Notes:
VWP Installed by KP

DDH

21GT006

Tundra Consulting, LLC

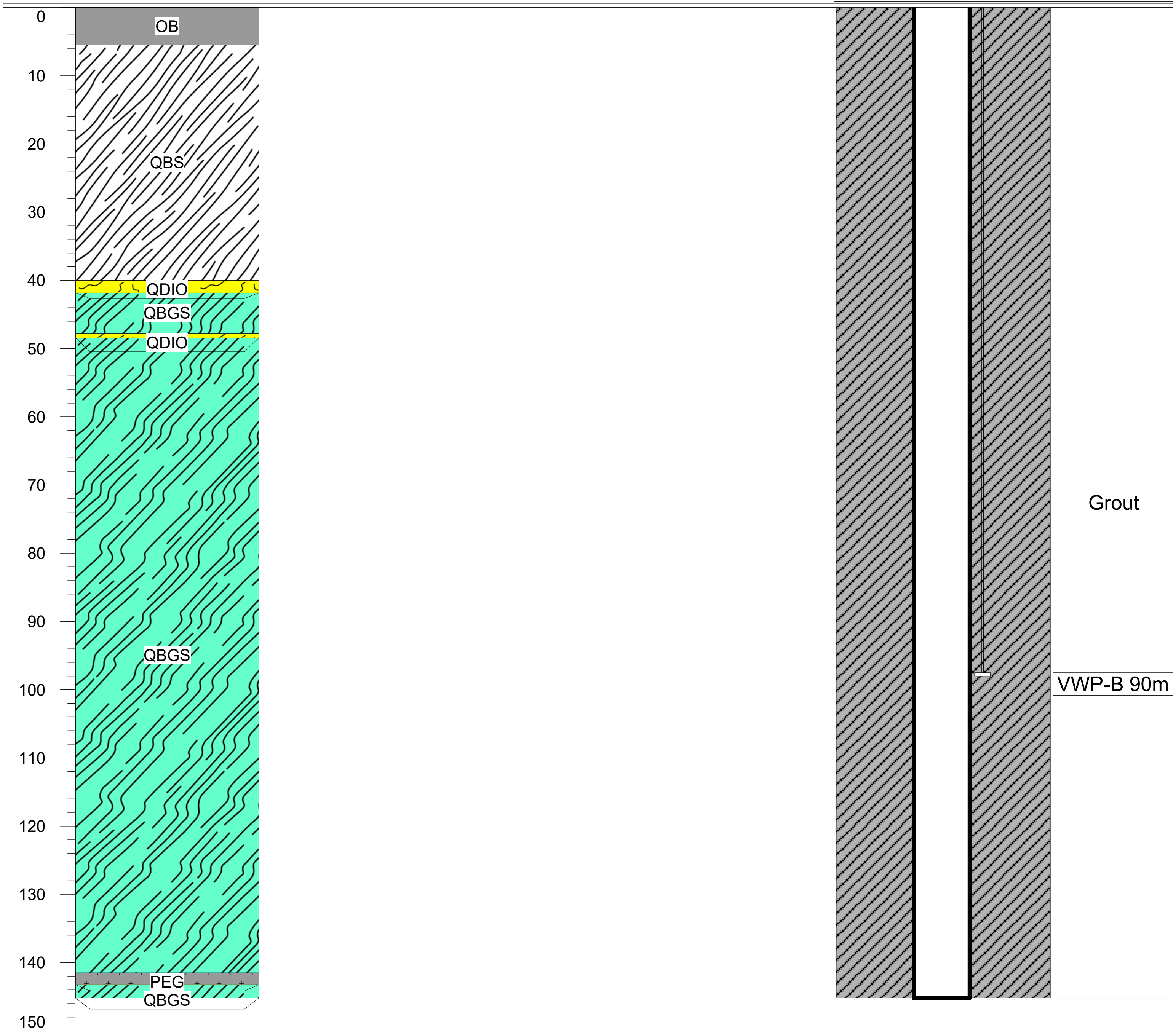
Installed by KP/Tundra Consulting	Coordinate System: NAD83 Z3N		Stickup: NA m-ags	Drill Rig: Hydracore HC5000S
Project: Graphite Creek	Easting: 476596 m	Elevation: 193 mamsl	Azimuth: 0°	Hole Diameter: HQ3
Date Completed: 28-Sep-21	Northing: 7213039	Drill Pad: Geotech	Inclination: -90°	Total Depth: 145.19 m

Depth (m)

Logging by:
Jeff Kase

Lithology

Well Completion:
Downhole Temperature Cable & vibrating wire piezometer



Lithology

- Overburden
- Quartz-Biotite Schist
- Pegmatite
- Quartz Diorite
- Quartz-Biotite-Garnet Schist

Project Manager: KP/Steve Teller

Drilling Contractor: Mud Bay

Field Manager: KP/Steve Teller

Hole Drilled: From: 14-Sep-21 To: 28-Sep-21

Notes:

Downhole Temperature Cable installed to 140 m w/VWP strapped to side of standpipe

Sonic - Sediment

21GTW007

Tundra Consulting, LLC

Installed by KP/Tundra Consulting	Coordinate System: NAD83 Z3N	Stickup: 0.43 m-ags	Drill Rig: Hydracore HC5000S
Project: Graphite Creek	Easting: 473539 m Elevation: 105 mamsl	Azimuth: 0°	Hole Diameter: 4x6
Date Completed: 07-Oct-21	Northing: 7213680	Inclination: -90°	Total Depth: 76.20 m

Depth (m)

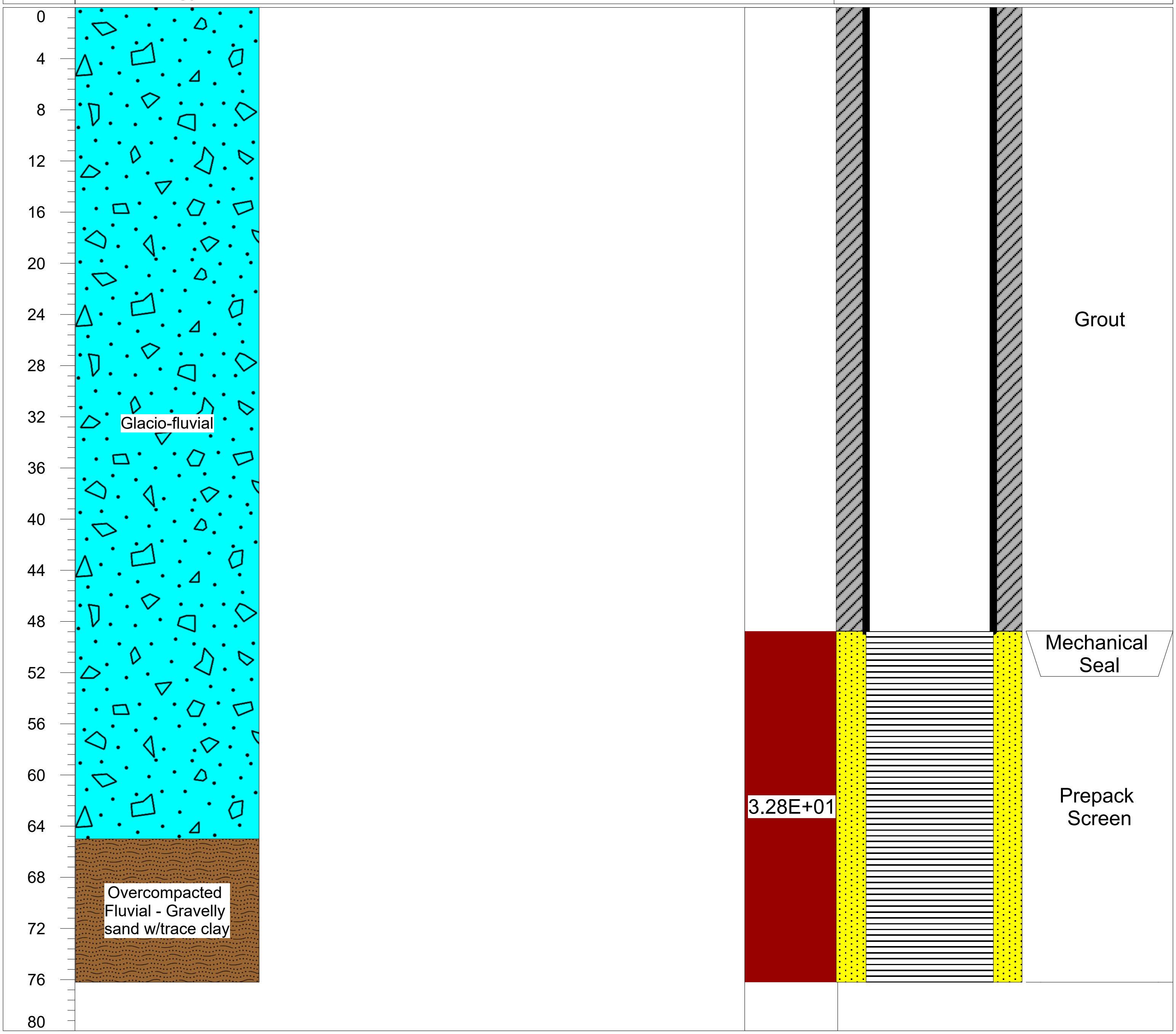
Logging by:
Tundra

Lithology

K (m/day)

Well Completion:
Water Production Well for Camp

Screened from 48.77to 76.2 meters



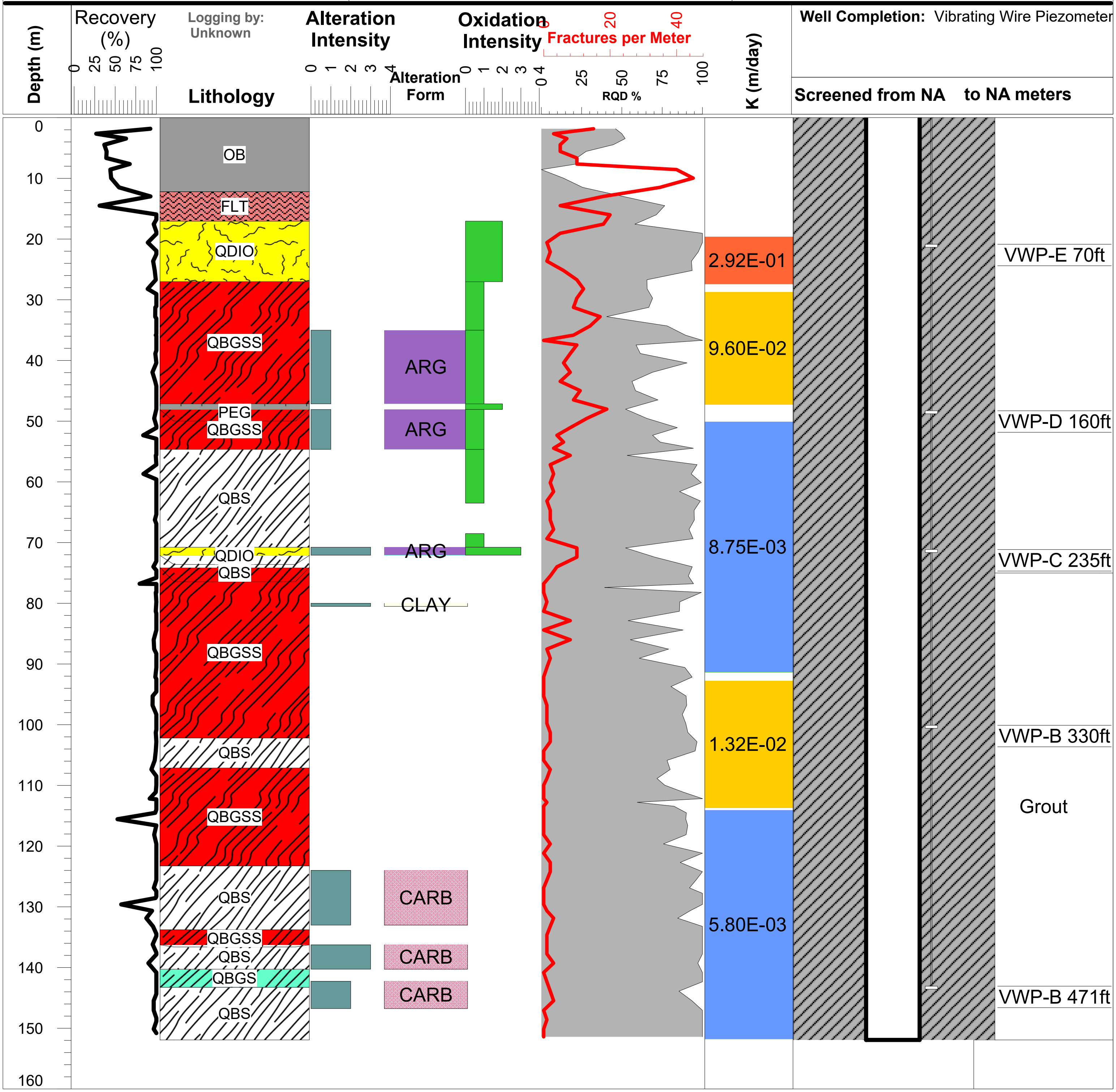
Lithology

- Glacio-fluvial
- Overcompacted Fluvial - Gravelly sand w/trace clay

Project Manager: Steve Teller
Driling Manager: Mud Bay
Field Manager: Steve Teller
Hole Drilled: From: 01-Oct-21 To: 07-Oct-21
Notes:
Water Table Well - Camp Water Supply

DDH **22GC073** Tundra Consulting, LLC

Installed by Tundra Consulting	Coordinate System: NAD83 Z3N	Stickup: NA m-ags / Drill Rig: American Recon 65
Project: Graphite Creek	Easting: 474206 m / Elevation: 207 mamsl	Azimuth: 159.23° / Hole Diameter: HQ
Date Completed: 24-Jul-22	Northing: 7212823	Inclination: -50° / Total Depth: 151.91 m



<u>Lithology</u>

- Overburden
- Quartz-Biotite-Garnet-Sillimanite Schist
- Quartz-Biotite Schist
- Fault
- Pegmatite
- Quartz Diorite
- Quartz-Biotite-Garnet Schist

Project Manager: Steve Teller
Driling Contractor: T&J
Field Manager: G. Baldwin
Hole Drilled: From: 20-Jul-22 To: 24-Jul-22
Notes:
Fully Grouted VWP's

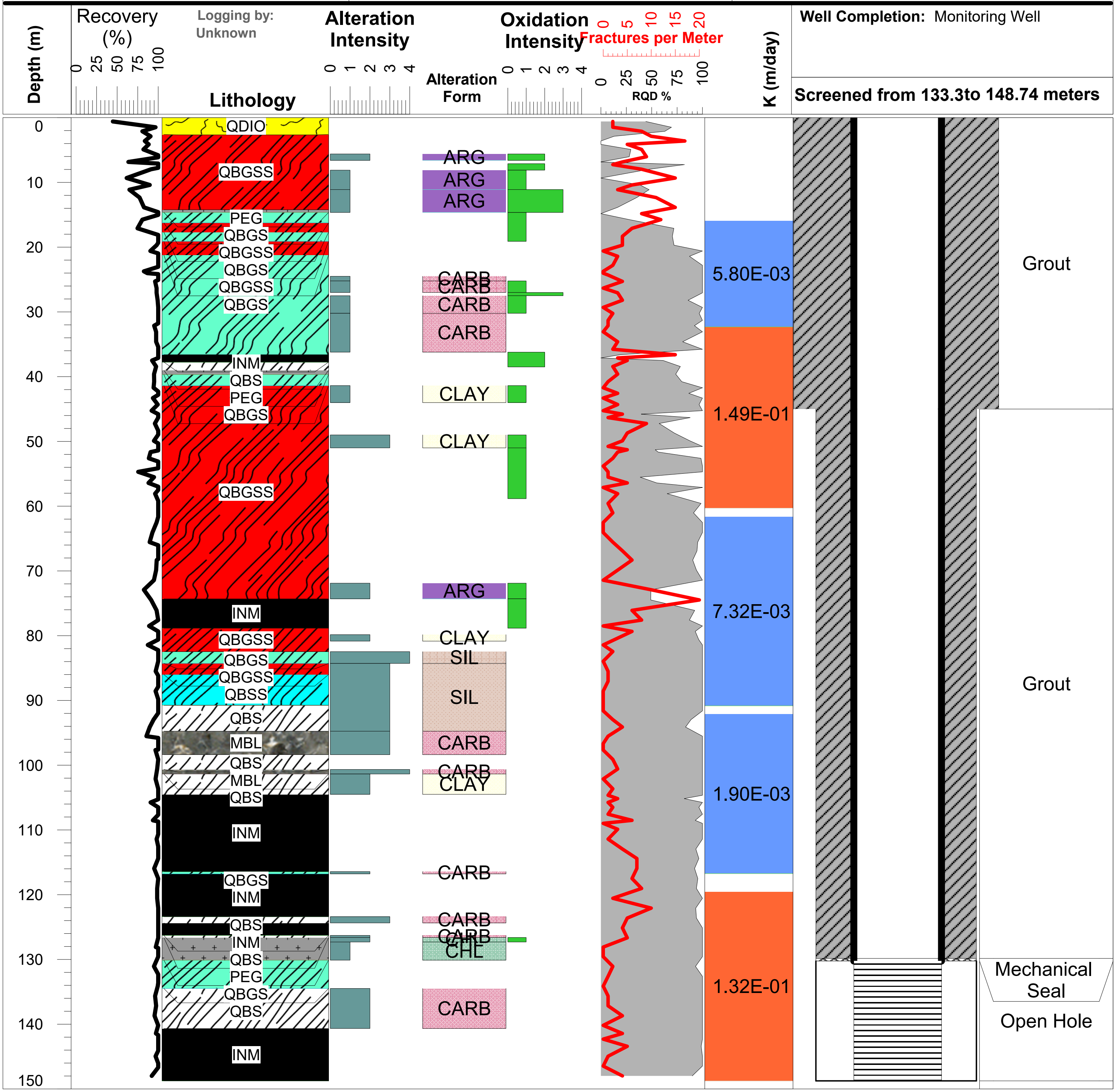
DDH **22GC075** Tundra Consulting, LLC

Installed by Tundra Consulting
Project: Graphite Creek
Date Completed: 06-Aug-22

Coordinate System: NAD83 Z3N
Easting: 474243 m Elevation: 265 mamsl
Northing: 7212720

Stickup: 0.5 m-ags
Azimuth: 163°
Inclination: -50.4°

Drill Rig: American Recon 65
Hole Diameter: HQ
Total Depth: 148.74 m



Lithology

- Quartz-Biotite-Garnet-Sillimanite Schist
- Quartz-Biotite Schist
- Marble
- Pegmatite
- Quartz Diorite
- Mafic Intrusive
- Quartz-Biotite-Garnet Schist
- Quartz-Biotite-Sillimanite Schist

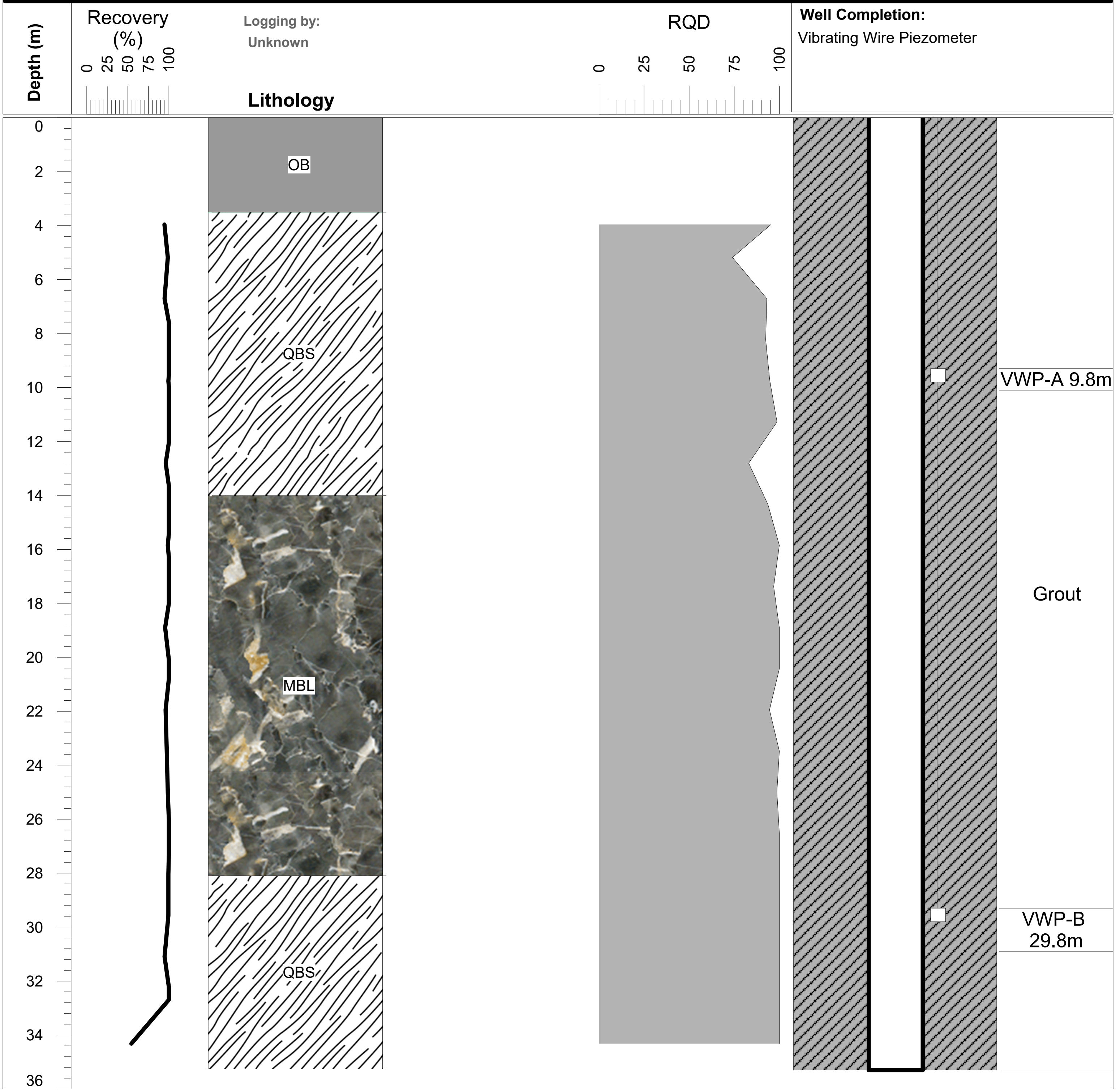
Project Manager: Steve Teller
Driling Contractor: T&J
Field Manager: G. Baldwin
Hole Drilled: From: 27-Jul-22 To: 06-Aug-22
Notes:
Artesian Bedrock Well

DDH

22GCT010

Tundra Consulting, LLC

Installed by KP	Coordinate System: NAD83 Z3N		Stickup: NA m-ags	Drill Rig: Hydracore HC5000S
Project: Graphite Creek	Easting: 474694 m	Elevation: 367 mamsl	Azimuth: 0°	Hole Diameter: HQ3
Date Completed: 03-Aug-22	Northing: 7212252	Drill Pad: Geotech	Inclination: -90°	Total Depth: 35.30 m



Lithology

- Overburden
- Quartz-Biotite Schist
- Marble

Project Manager: KP

Drilling Contractor: Mud Bay

Field Manager: Unkown

Hole Drilled: From: 01-Aug-22 To: 03-Aug-22

Notes:

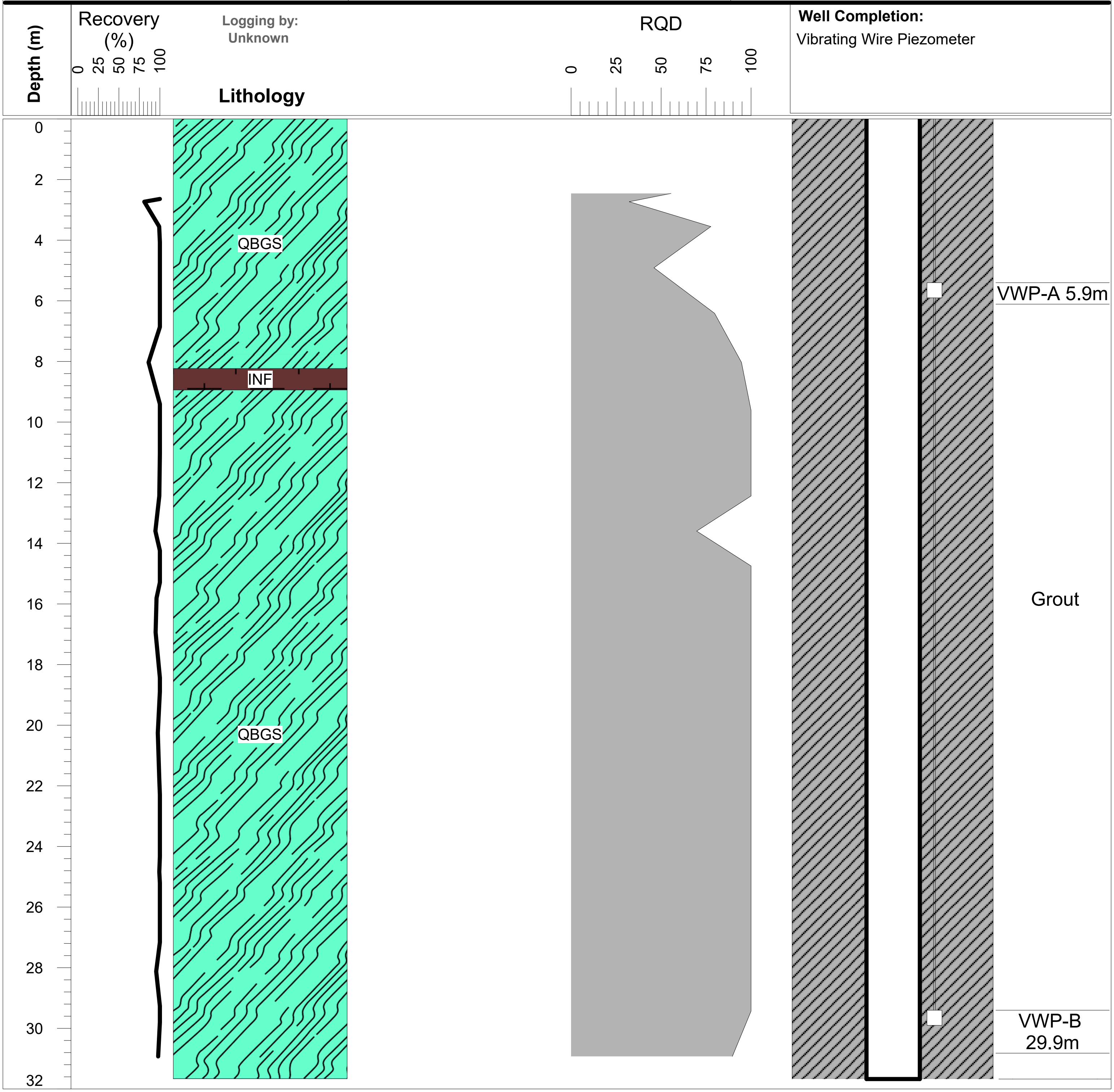
VWP Installed by KP

DDH

22GCT011

Tundra Consulting, LLC

Installed by KP	Coordinate System: NAD83 Z3N		Stickup: NA m-ags	Drill Rig: Geoprobe 6712DT
Project: Graphite Creek	Easting: 473402 m	Elevation: 265 mamsl	Azimuth: 0°	Hole Diameter: HQ3
Date Completed: 18-Aug-22	Northing: 7211913	Drill Pad: Geotech	Inclination: -90°	Total Depth: 31.67 m



Lithology

- Felsic Intrusive
- Quartz-Biotite-Garnet Schist

Project Manager: KP

Drilling Contractor: Discovery

Field Manager: Unkown

Hole Drilled: From: 13-Aug-22 To: 18-Aug-22

Notes:

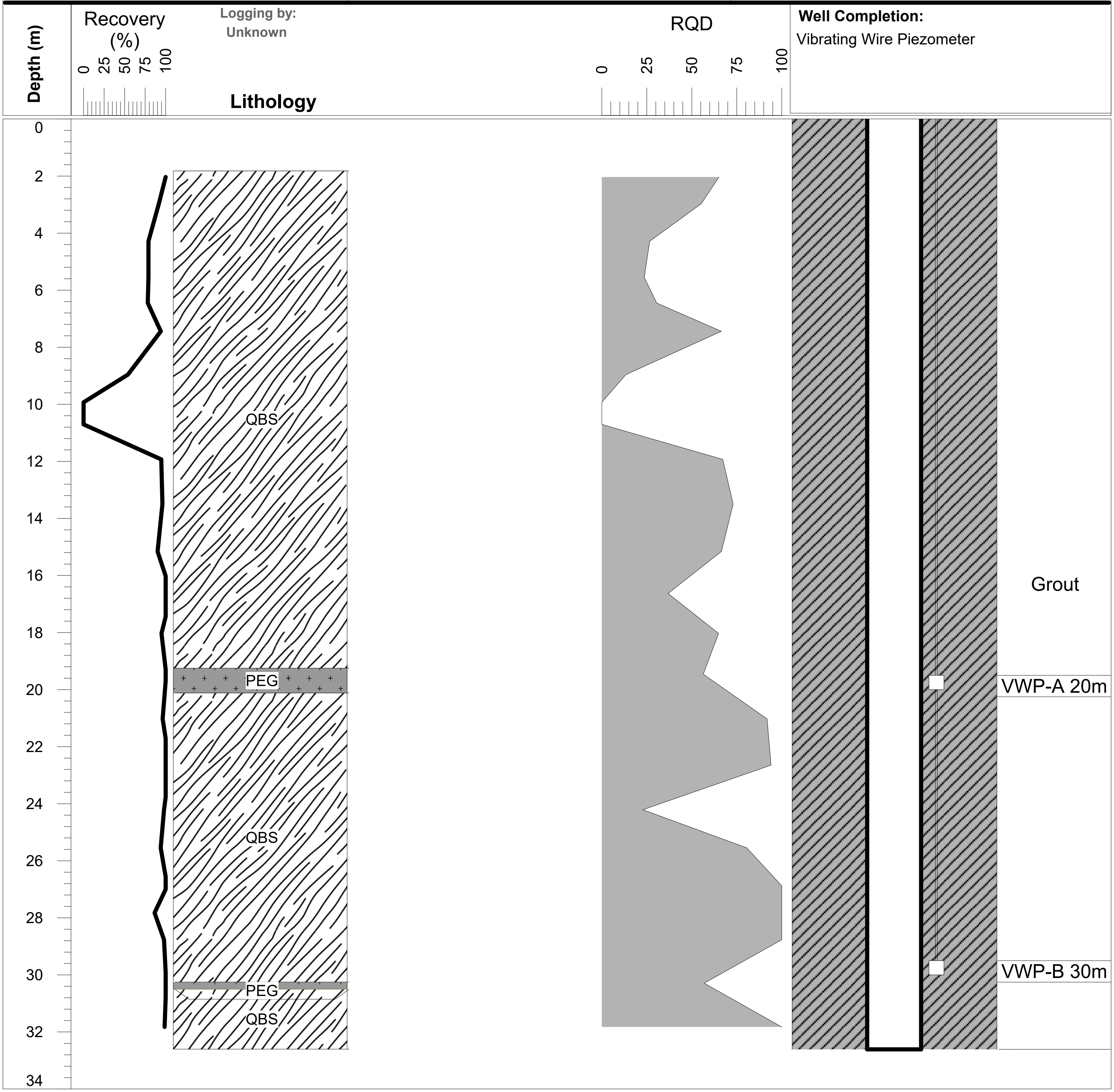
VWP Installed by KP

DDH

22GCT012

Tundra Consulting, LLC

Installed by KP	Coordinate System: NAD83 Z3N	Stickup: NA m-ags	Drill Rig: Geoprobe 6712DT
Project: Graphite Creek	Easting: 472681 m	Elevation: 198 mamsl	Azimuth: 0°	Hole Diameter: HQ3
Date Completed: 24-Aug-22	Northing: 7211888	Drill Pad: Geotech	Inclination: -90°	Total Depth: 32.61 m



Lithology

Quartz-Biotite Schist

Pegmatite

Project Manager: KP

Drilling Contractor: Discovery

Field Manager: Unkown

Hole Drilled: From: 19-Aug-22 To: 24-Aug-22

Notes:

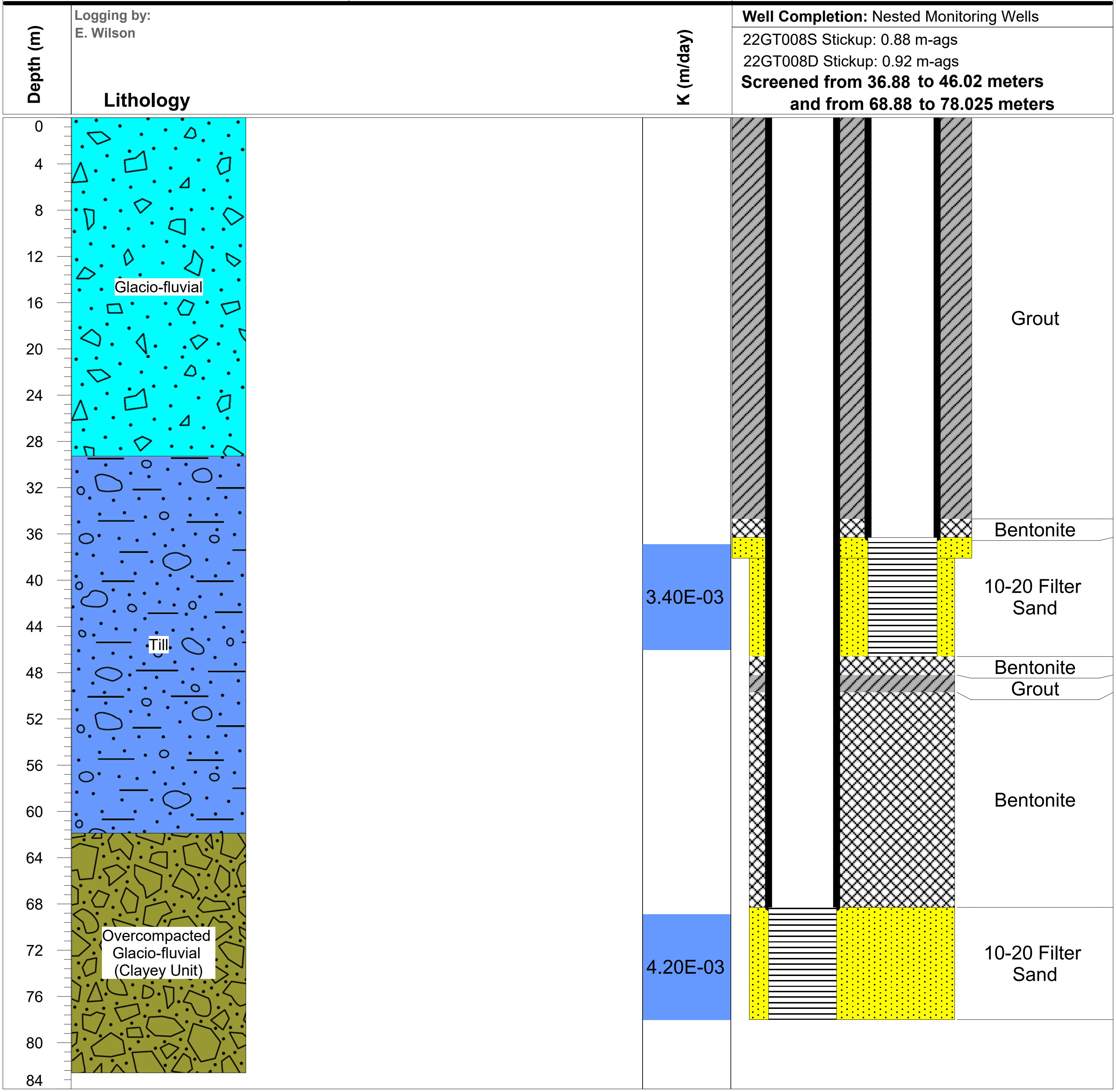
VWP Installed by KP

Sonic - Sediment | **22GT008S/D** | Tundra Consulting, LLC

Installed by Project: Graphite Creek Date Completed: 20-Jul-22	Coordinate System: NAD83 Z3N Easting: 474276 m Elevation: 181 mamsl Northing: 7213027	Drill Rig: Hydracore HC5000S Azimuth: 0° Hole Diameter: 4x6 Inclination: -90° Total Depth: 82.60 m

Logging by: E. Wilson

Well Completion: Nested Monitoring Wells
22GT008S Stickup: 0.88 m-ags
22GT008D Stickup: 0.92 m-ags
Screened from 36.88 to 46.02 meters
and from 68.88 to 78.025 meters



Lithology

- Till
- Glacio-fluvial
- Overcompacted Glacio-fluvial (Clayey Unit)

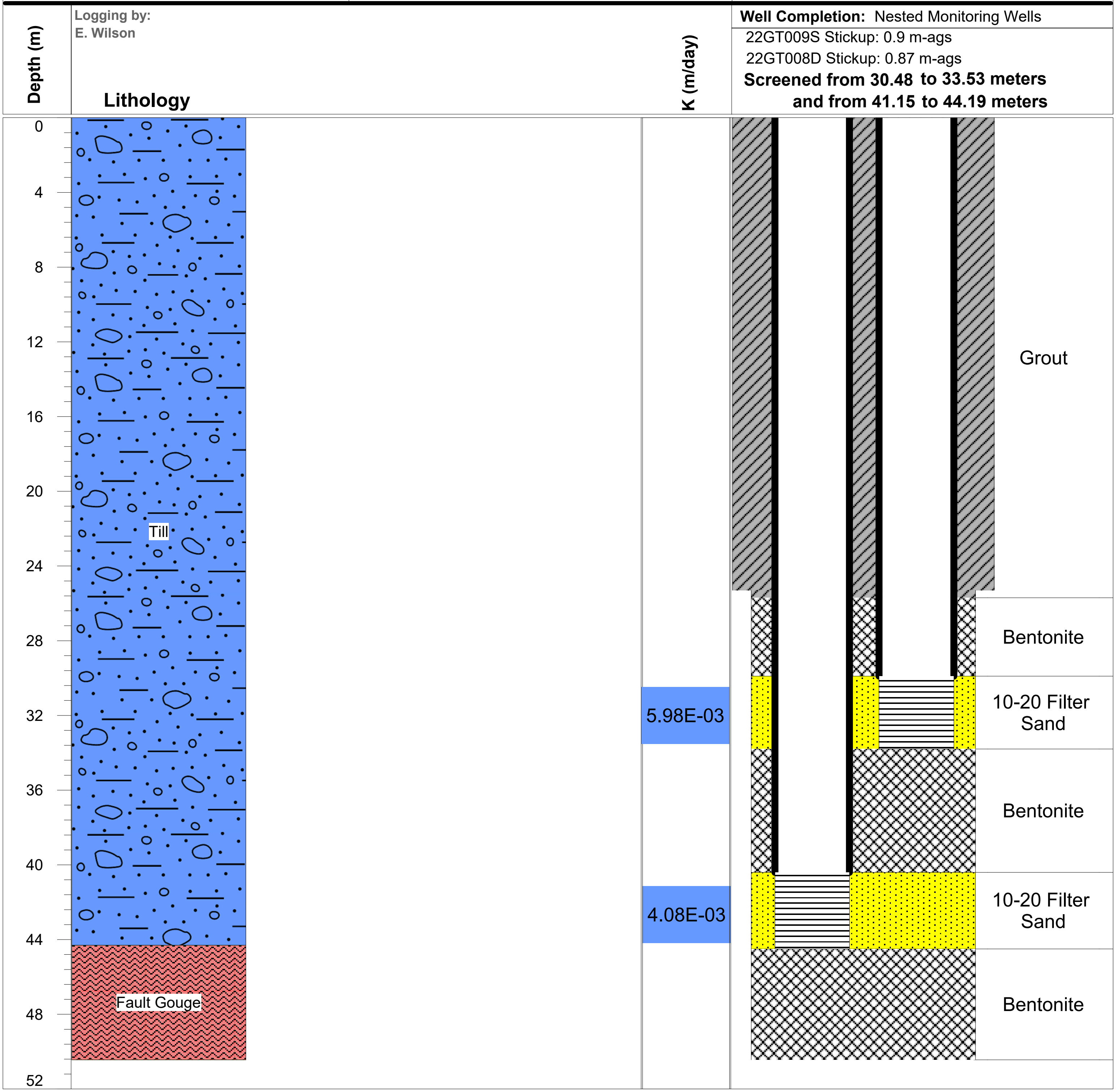
Project Manager: Steve Teller
Driling Contractor: Mud Bay
Field Manager: Eric Wilson
Hole Drilled: From: 14-Jul-22 To: 20-Jul-22
Notes:
Paired monitoring wells

Sonic | **22GT009S/D** | Tundra Consulting, LLC

Installed by Tundra Consulting Project: Graphite Creek Date Completed: 01-Aug-22	Coordinate System: NAD83 Z3N Easting: 474283 m Northing: 7212900 Elevation: 203 mamsl	Azimuth: 290° Inclination: -85° Drill Rig: Hydracore HC5000S Hole Diameter: 4x6 Total Depth: 50.44 m

Logging by:
E. Wilson

Well Completion: Nested Monitoring Wells
22GT009S Stickup: 0.9 m-ags
22GT008D Stickup: 0.87 m-ags
Screened from 30.48 to 33.53 meters
and from 41.15 to 44.19 meters



Lithology
- Fault
- Till

Project Manager: Steve Teller
Driling Contractor: Mud Bay
Field Manager: Eric Wilson
Hole Drilled: From: 29-Jul-22 To: 01-Aug-22
Notes:
Paired monitoring wells

Sonic - Sediment | **22GT013** | Tundra Consulting, LLC

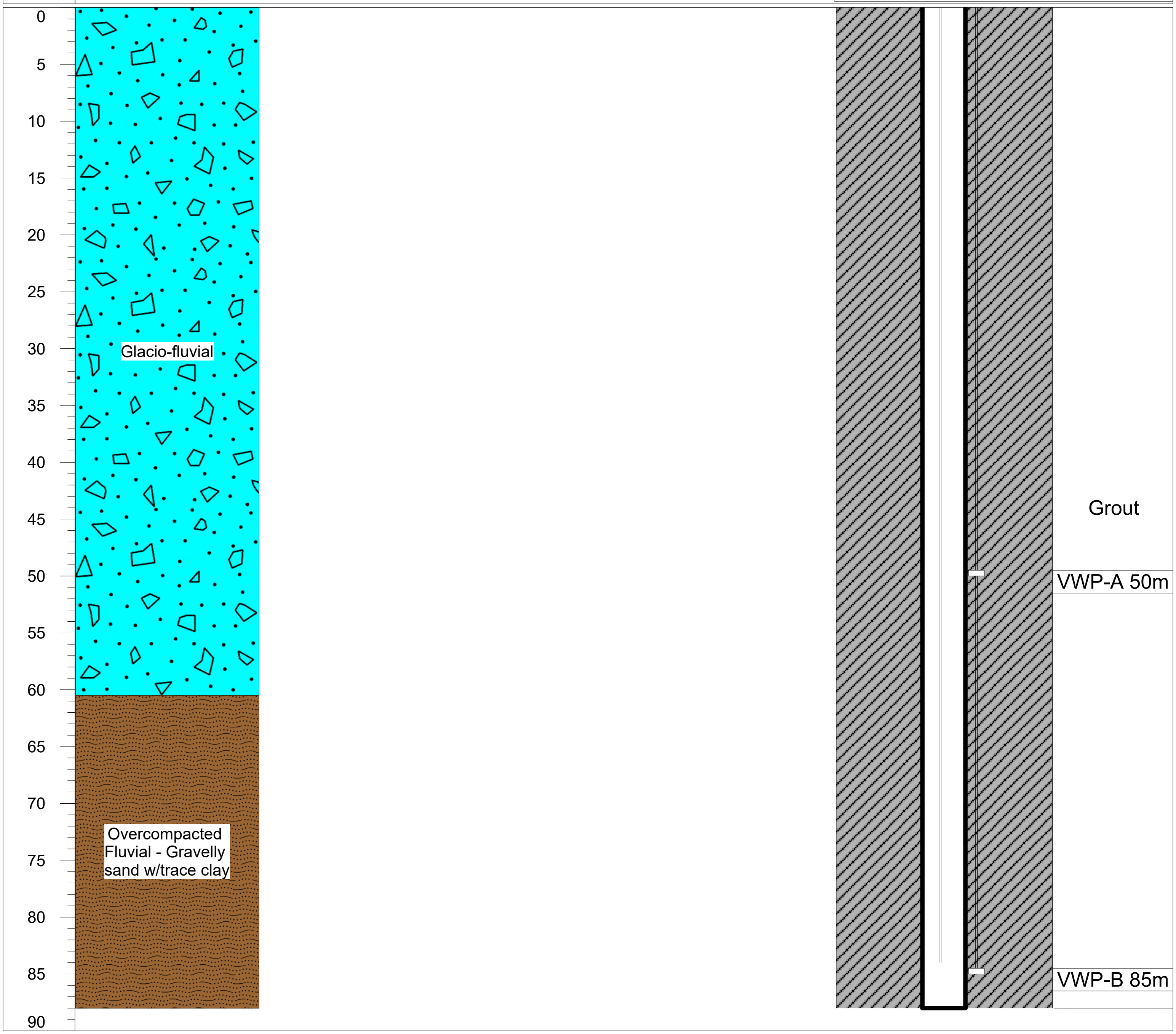
Installed by Tundra Consulting	Coordinate System: NAD83 Z3N		Stickup: NA m-ags	Drill Rig: Hydracore HC5000S
Project: Graphite Creek	Easting: 473328 m	Elevation: 89 mamsl	Azimuth: 0°	Hole Diameter: 3x5
Date Completed: 28-Aug-22	Northing: 7213675	Drill Pad: Geotech	Inclination: -90°	Total Depth: 88.00 m

Depth (m)

Logging by:
KP. Relogged by Tundra.

Lithology

Well Completion:
Stand Pipe for Downhole Temperature Cable with Vibrating Wire Piezometer



Lithology

Glacio-fluvial

Overcompacted Fluvial - Gravelly sand w/trace clay

Project Manager: Steve Teller

Drilling Contractor: Mud Bay

Field Manager: Eric Wilson

Hole Drilled: From: 24-Aug-22 To: 28-Aug-22

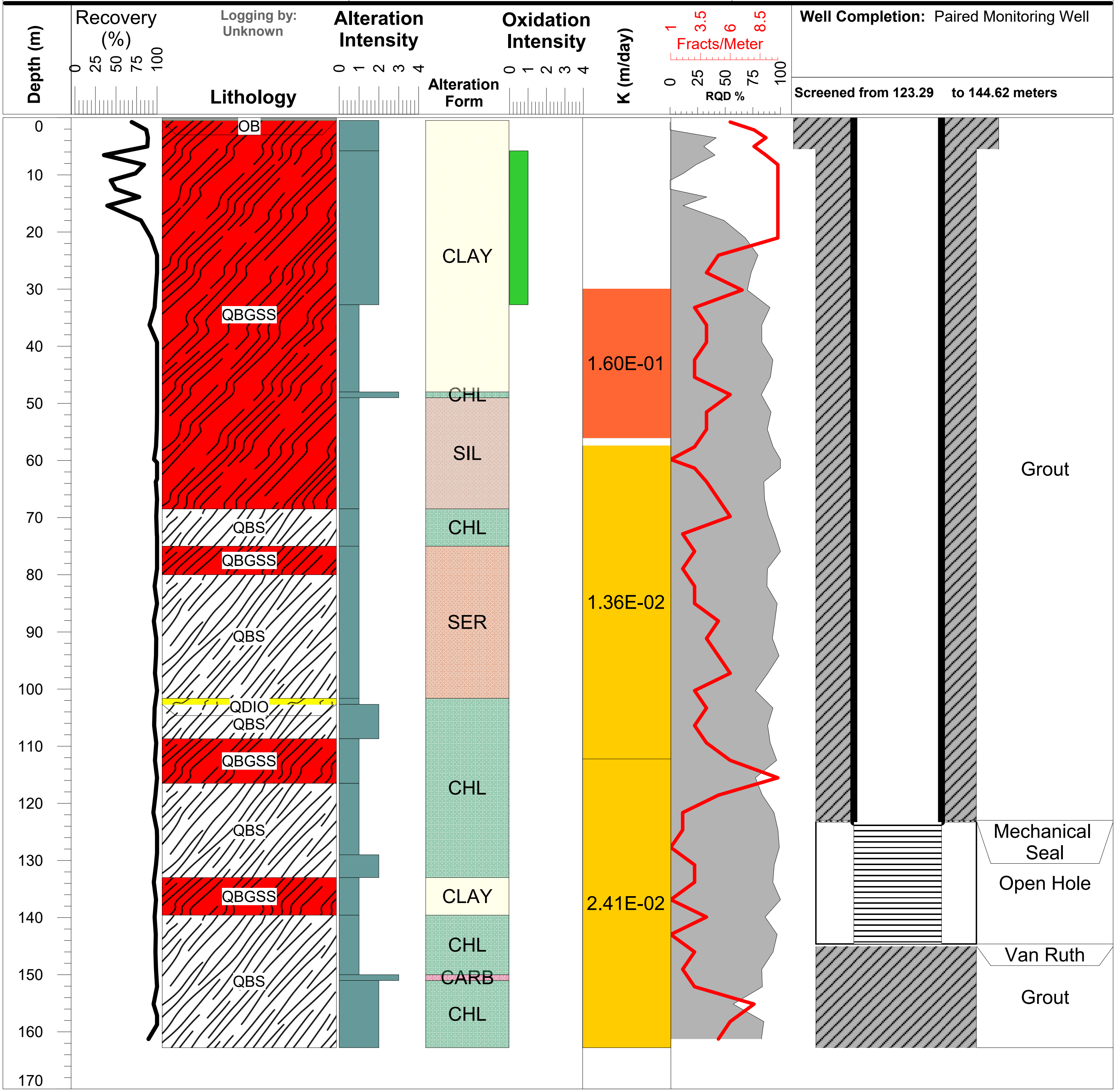
Notes:

100 m Downhole Temperature Cable folded over so bottom node is at 84 m. 2 VWP's strapped to side of standpipe.

DDH # 23GC099

Tundra Consulting, LLC

Installed by Tundra Consulting	Coordinate System: NAD83 Z3N	Stickup: 0.76 m-ags	Drill Rig: LF-90
Project: Graphite Creek	Easting: 475042 m Elevation: 327 mamsl	Azimuth: 156.56°	Hole Diameter: HQ
Date Completed: 22-Aug-23	Northing: 7213016	Inclination: -50.78°	Total Depth: 162.76 m



Lithology

- Overburden
- Quartz-Biotite-Garnet-Sillimanite Schist
- Quartz-Biotite Schist
- Quartz Diorite

Alteration Type

- CARB
- SER
- CLAY
- CHL
- SIL

Project Manager: Steve Teller

Driling Contractor: Major

Field Manager: Eric Wilson

Hole Drilled: From: 19-Aug-23 To: 22-Aug-23

Notes:

Deep monitoring well paired with 23GCT018

DDH - Sediment | **23GCT015** | Tundra Consulting, LLC

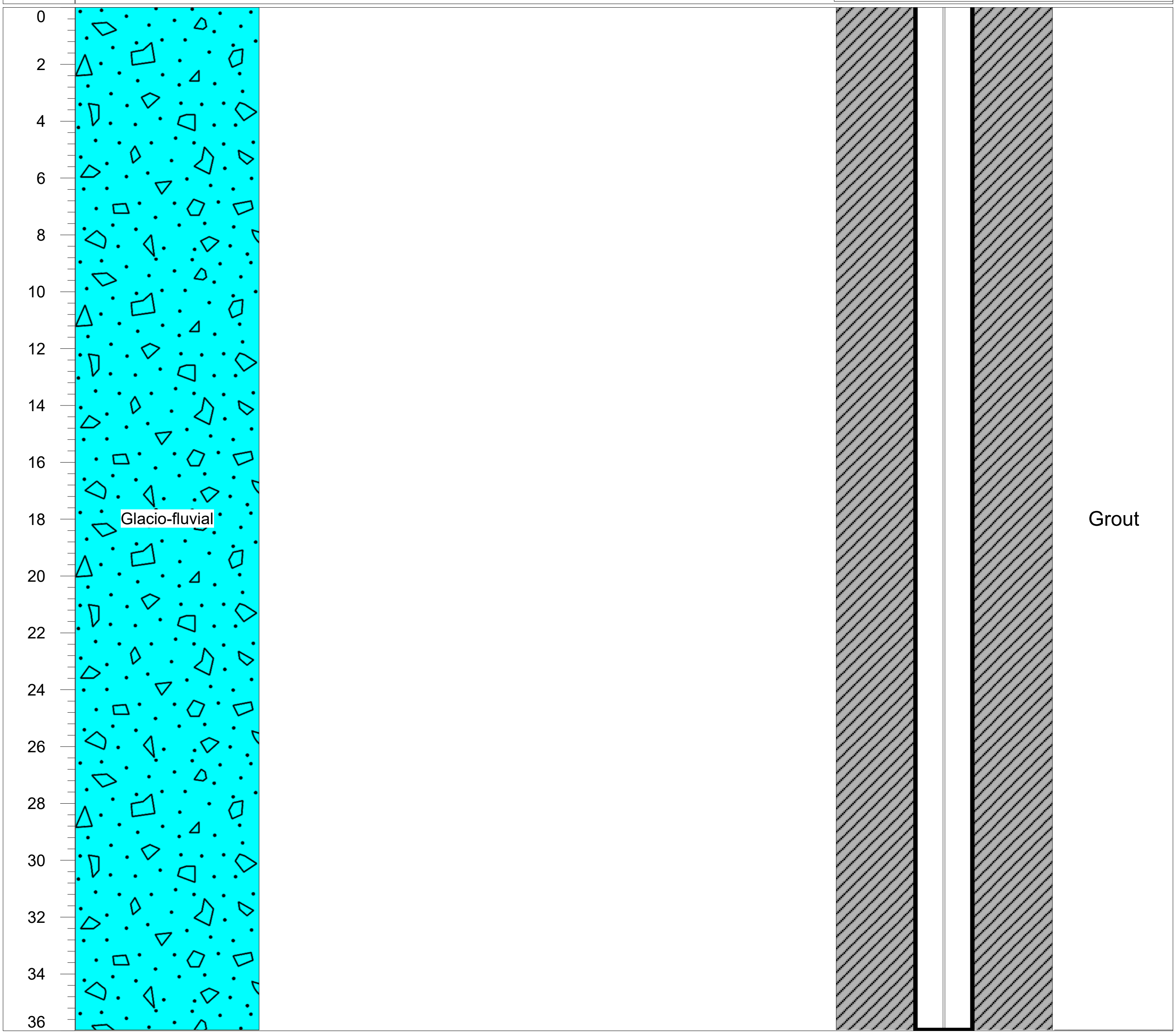
Installed by Tundra Consulting	Coordinate System: NAD83 Z3N	Stickup: NA m-ags	Drill Rig: LF-90
Project: Graphite Creek	Easting: 475093 m / Elevation: 251 mamsl	Azimuth: 0°	Hole Diameter: HQ
Date Completed: 19-Jul-23	Northing: 7213357 / Drill Pad: Geotech	Inclination: -90°	Total Depth: 35.97 m

Depth (m)

Logging by:
Tundra

Lithology

Well Completion:
Downhole Temperature Cable



Lithology

Glacio-fluvial

Project Manager: Steve Teller

Drilling Contractor: Major

Field Manager: Eric Wilson

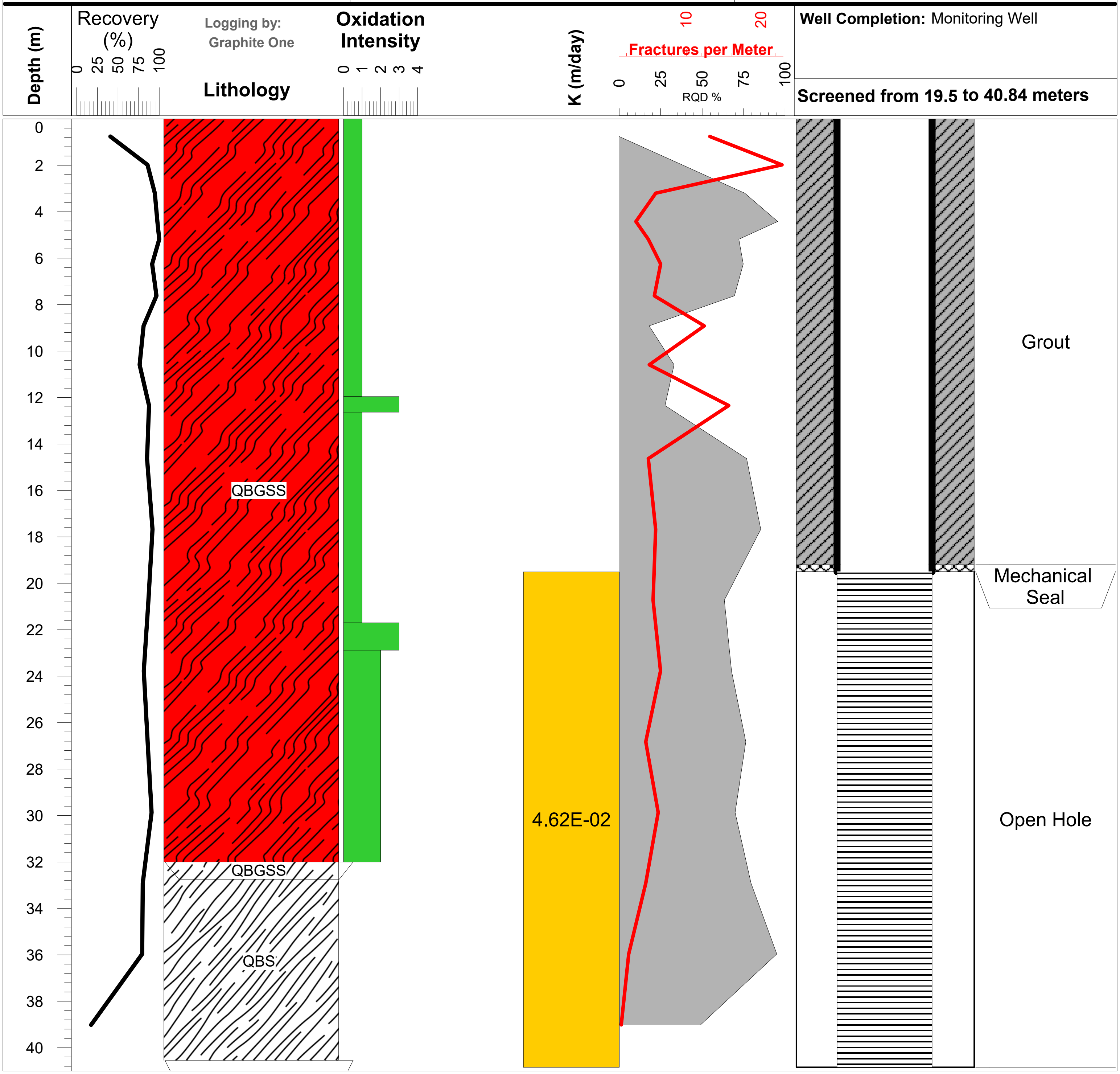
Hole Drilled: From: 15-Jul-23 To: 19-Jul-23

Notes:

Standpipe for DTC. 40 m DTC installed to 35.97 m.

DDH | **23GCT016** | Tundra Consulting, LLC

Installed by Tundra Consulting	Coordinate System: NAD83 Z3N	Stickup: 1.3 m-ags	Drill Rig: LF-90
Project: Graphite Creek	Easting: 474516 Elevation: 294 mamsl	Azimuth: 0°	Hole Diameter: HQ3
Date Completed: 10-Aug-23	Northing: 7212782	Inclination: -90°	Total Depth: 41 m



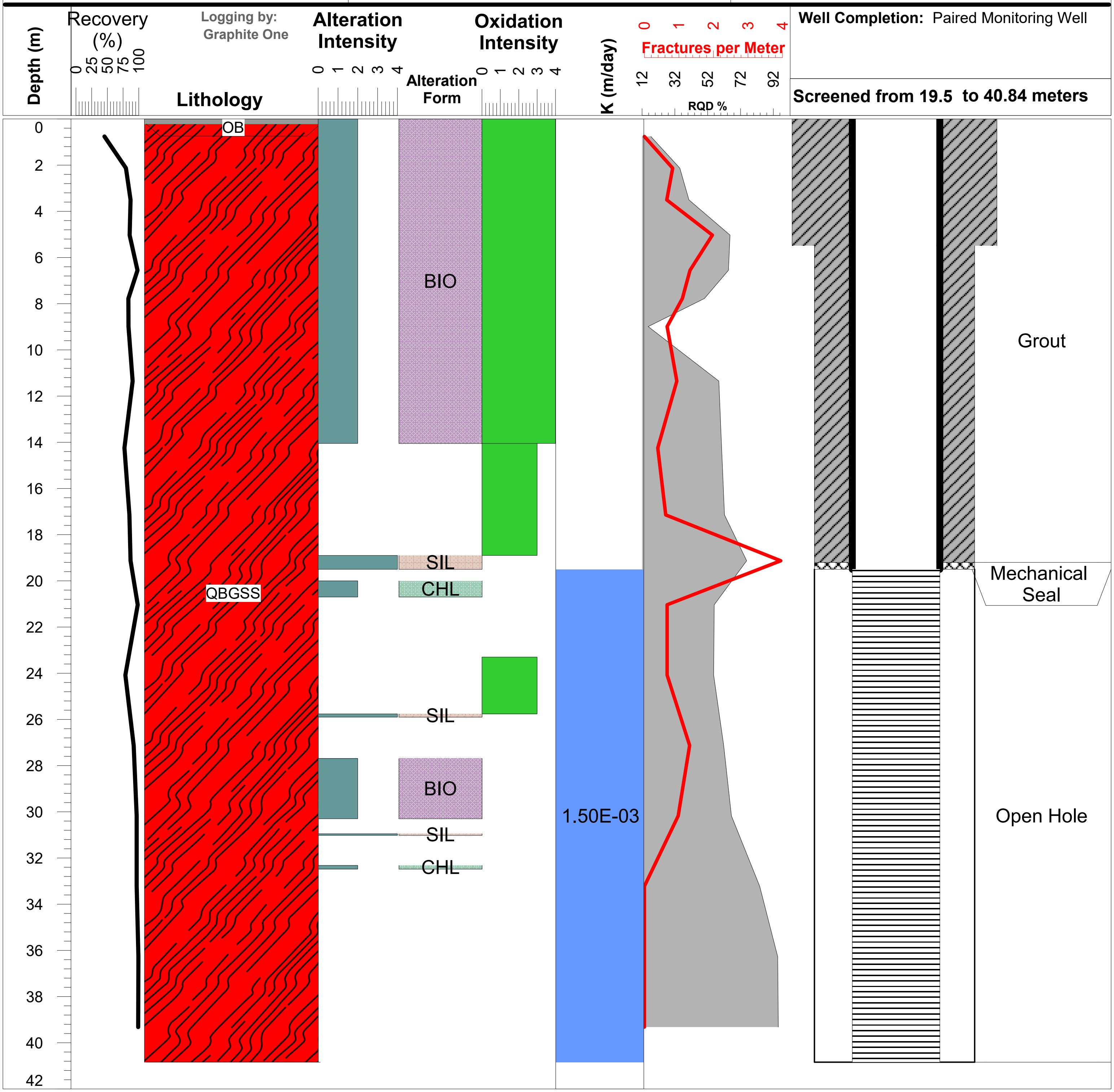
Lithology

- Quartz-Biotite-Garnet-Sillimanite Schist
- Quartz-Biotite Schist

Project Manager: Steve Teller
Drilling Contractor: Major Drilling
Field Manager: Eric Wilson
Hole Drilled: From: 09-Aug-23 To: 10-Aug-23
Notes:
Watertable Well

DDH | **23GCT018** | Tundra Consulting, LLC

Installed by Tundra Consulting	Coordinate System: NAD83 Z3N	Stickup: 1.7 m-ags	Drill Rig: LF-90
Project: Graphite Creek	Easting: 475042 m Elevation: 327 mamsl	Azimuth: 0°	Hole Diameter: HQ3
Date Completed: 24-Aug-23	Northing: 7213016	Inclination: -90°	Total Depth: 41 m



Lithology

- Overburden
- Quartz-Biotite-Garnet-Sillimanite Schist

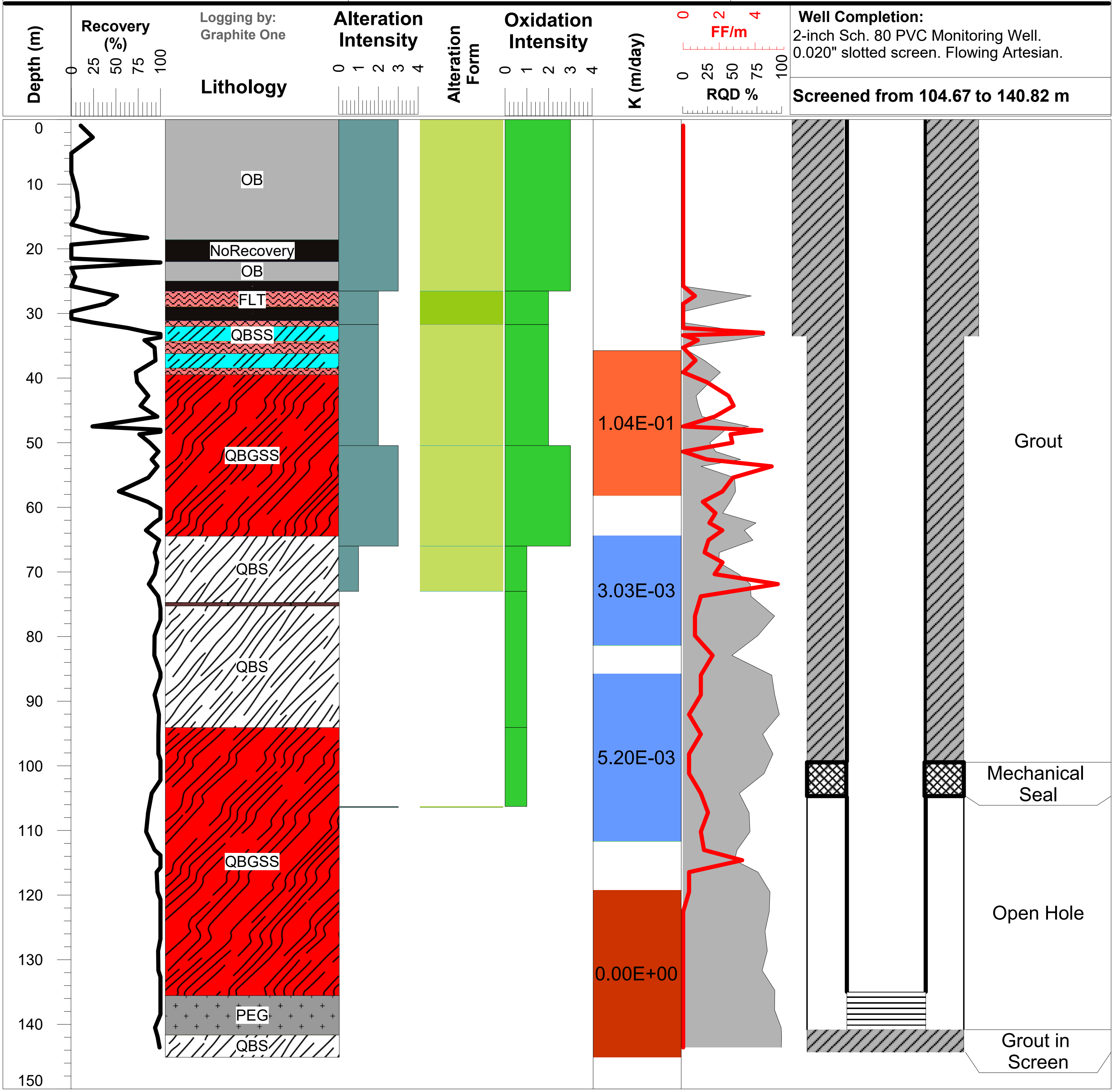
Alteration Type

- BIO
- CHL
- SIL

Project Manager: Steve Teller
Driling Manager: Major Drilling
Field Manager: Eric Wilson
Hole Drilled: From: 23-Aug-23 To: 24-Aug-23
Notes:
Shallow monitoring well paired with 23GC099.

Diamond Core - Bedrock **24GCT019** Tundra Consulting, LLC

Installed by Tundra Project: Graphite Creek Date Completed: 6/21/2024	Coordinate System: NAD83 Z3N Easting: 473789 m Northing: 7212717	Elevation: 158 mamsl Drill Pad: Pit	Stickup: 0.94 m-ags Azimuth: 180° Inclination: -50°	Drill Rig: LF-90 Hole Diameter: PQ/HQ Total Depth: 145.08 m



Lithology

- Overburden
- Fault
- Pegmatite
- No Recovery
- Felsic Intrusive
- Quartz-Biotite Schist
- Quartz-Biotite-Sillimanite Schist
- Quartz-Biotite-Garnet-Sillimanite Schist

Alteration Form

- CLAY
- LIMINITE

Project Manager: Steve Teller

Drilling Manager: Major Drilling

Field Manager: Geno Foushee

Hole Drilled: From: 6/16/2024 To: 6/21/2024

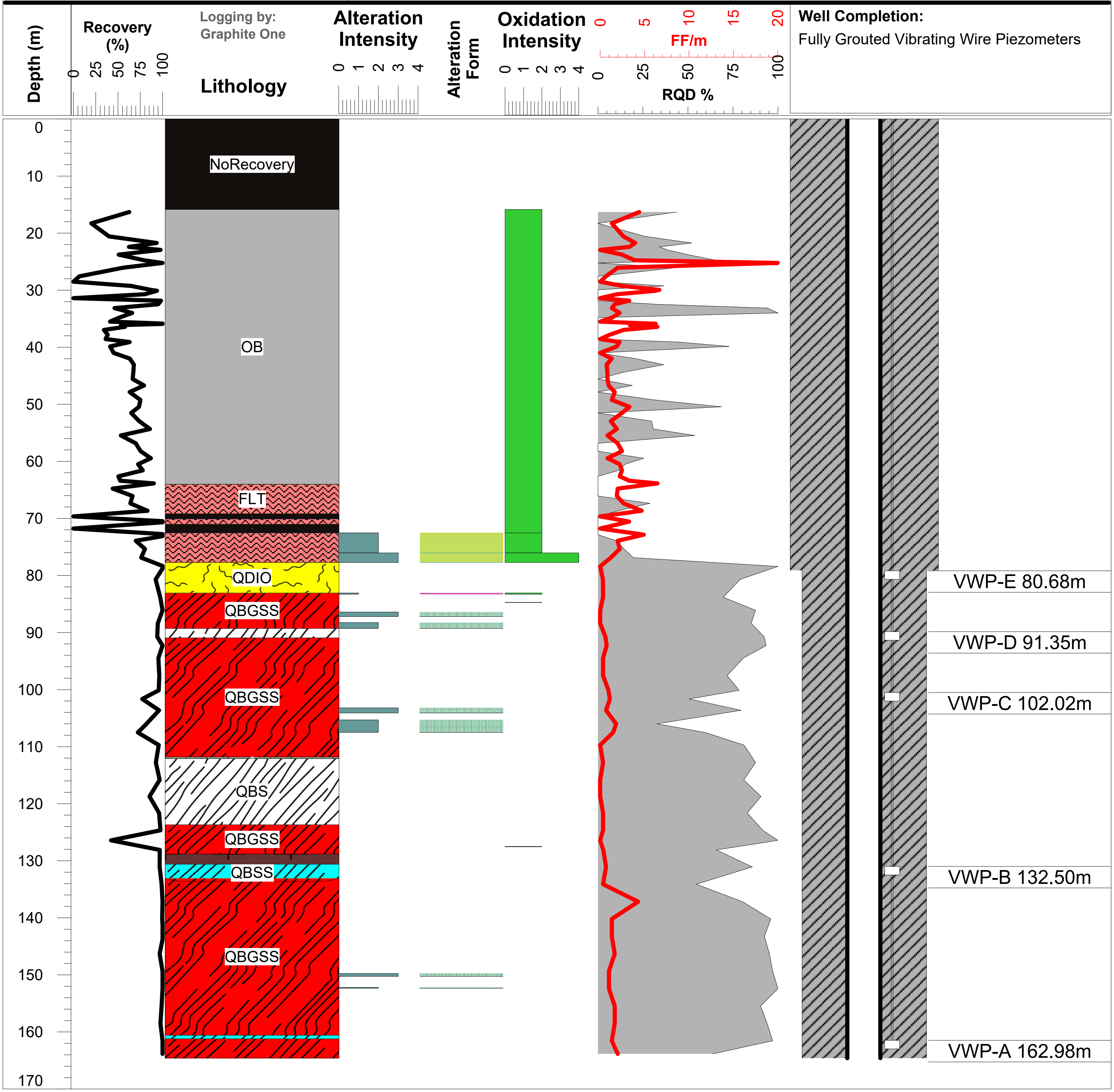
Notes: Drilled PQ to 33.53 m, then HQ to 145.08 m. Some grout bypassed the cement basket and set in the bottom of the screen. Slotted from 134.96 - 140.82 m but effectively screened 104.67 - 140.82 m.

Diamond Core - Bedrock

24GCT020A

Tundra Consulting, LLC

Installed by Tundra	Coordinate System: NAD83 Z3N		Stickup: NA m-ags	Drill Rig: LF-90
Project: Graphite Creek	Easting: 475062 m	Elevation: 263 mamsl	Azimuth: 180°	Hole Diameter: PQ/HQ
Date Completed: 6/30/2024	Northing: 7213235	Drill Pad: Pit	Inclination: -50°	Total Depth: 164.59 m



Lithology

- Overburden
- Fault
- Pegmatite
- No Recovery
- Quartz Diorite
- Felsic Intrusive
- Quartz-Biotite Schist
- Quartz-Biotite-Sillimanite Schist
- Quartz-Biotite-Garnet-Sillimanite Schist

Alteration Form

- CHL
- HEM
- LIMINITE

Project Manager: Steve Teller

Drilling Manager: Major Drilling

Field Manager: Eric Wilson

Hole Drilled: From: 6/22/2024 To: 6/30/2024

Notes:

VWP's attached to 1-inch Schedule 80 PVC

Under-Reamed PQ

24GCT021

Tundra Consulting, LLC

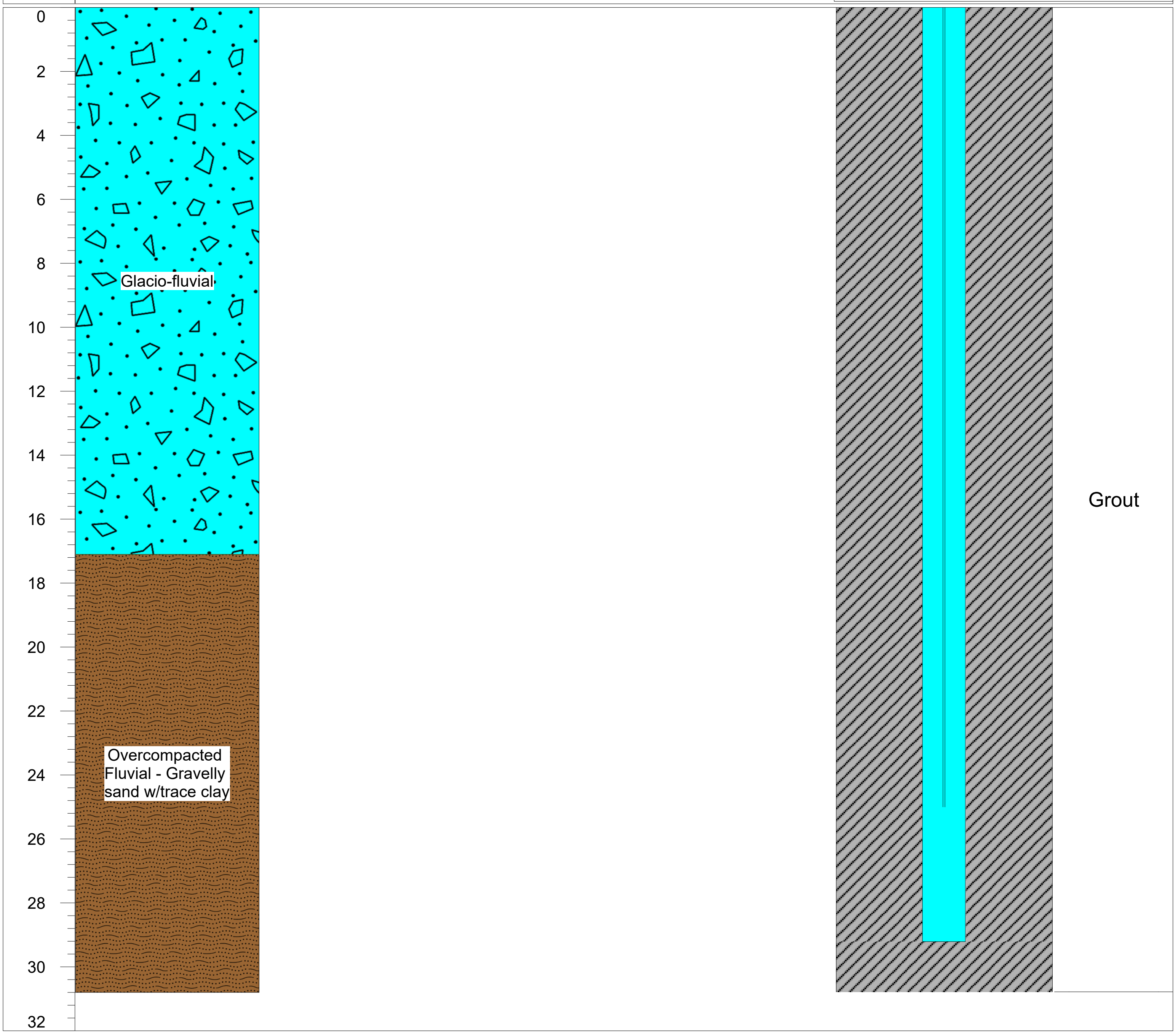
Installed by Tundra	Coordinate System: NAD83 Z3N		Stickup: 0.4 m-ags	Drill Rig: LF-90
Project: Graphite Creek	Easting: 473629 m	Elevation: 108 mamsl	Azimuth: 0°	Hole Diameter: PQ
Date Completed: 6/22/2024	Northing: 7213649	Drill Pad: WMF	Inclination: -90°	Total Depth: 30.78 m

Depth (m)

Logging by:
Barr

Lithology

Well Completion:
1-inch PVC Stand Pipe with Downhole Temperature Cable.



Lithology

- Glacio-fluvial
- Overcompacted Fluvial - Gravelly sand w/trace clay

Project Manager: Steve Teller

Drilling Manager: Major Drilling

Field Manager: G. Baldwin

Hole Drilled: From: 6/19/2024 To: 6/22/2024

Notes:

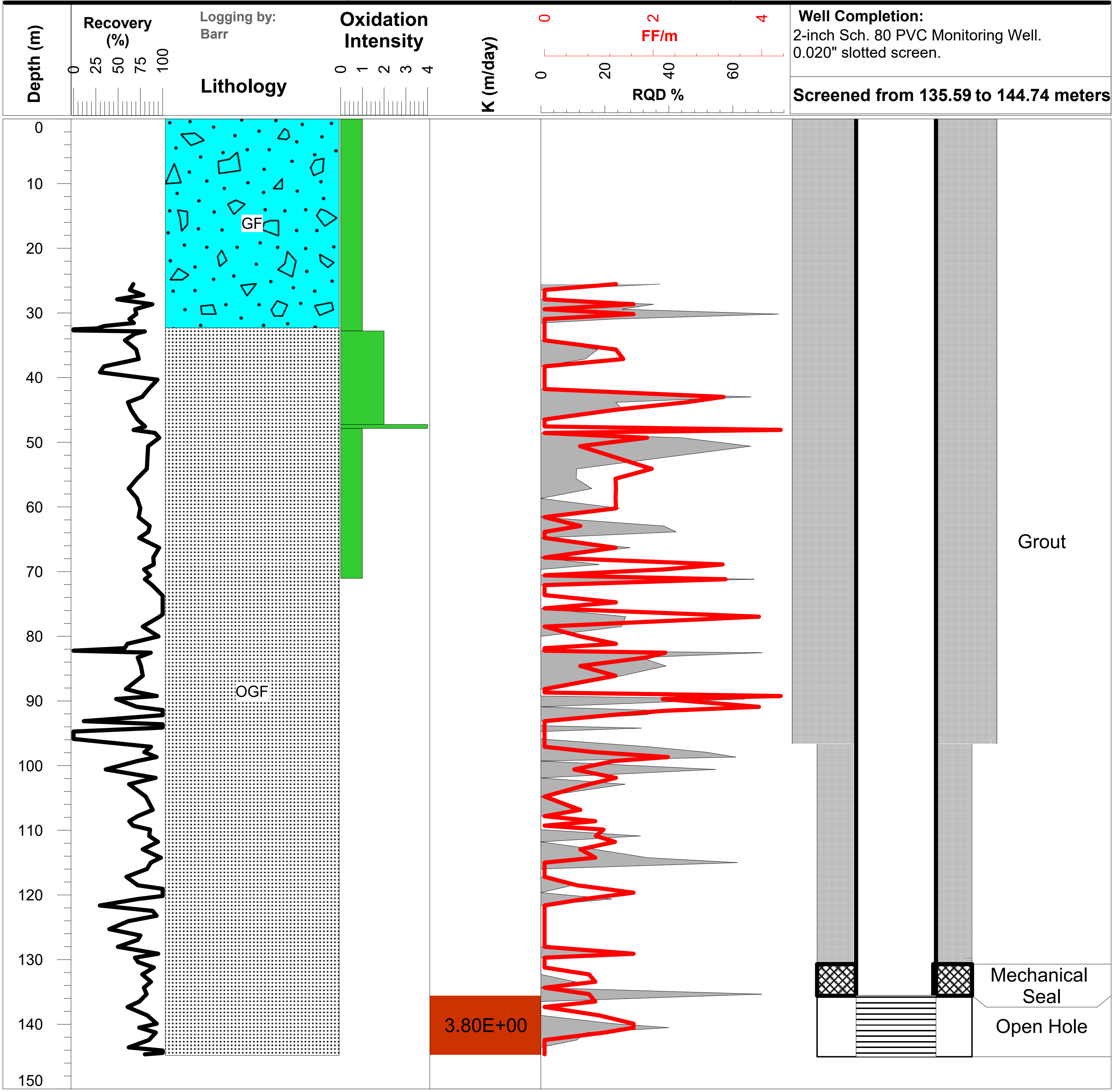
DTC suspended in PVC to 25 m. PVC filled with Glycol.

Diamond Core - Alluvium

24GCT022

Tundra Consulting, LLC

Installed by Tundra	Coordinate System: NAD83 Z3N	Stickup: 0.66 m-ags	Drill Rig: LF-90
Project: Graphite Creek	Easting: 473675 m / Elevation: 120 mamsl	Azimuth: 0°	Hole Diameter: PQ/HQ
Date Completed: 7/5/2024	Northing: 7213231 / Drill Pad: WMF	Inclination: -90°	Total Depth: 145.08 m



Lithology

- Glacio-fluvial
- Overcompacted Glacial-fluvial

Project Manager: Steve Teller

Drilling Manager: Major Drilling

Field Manager: Geno Foushee

Hole Drilled: From: 6/23/2024 To: 7/5/2024

Notes:

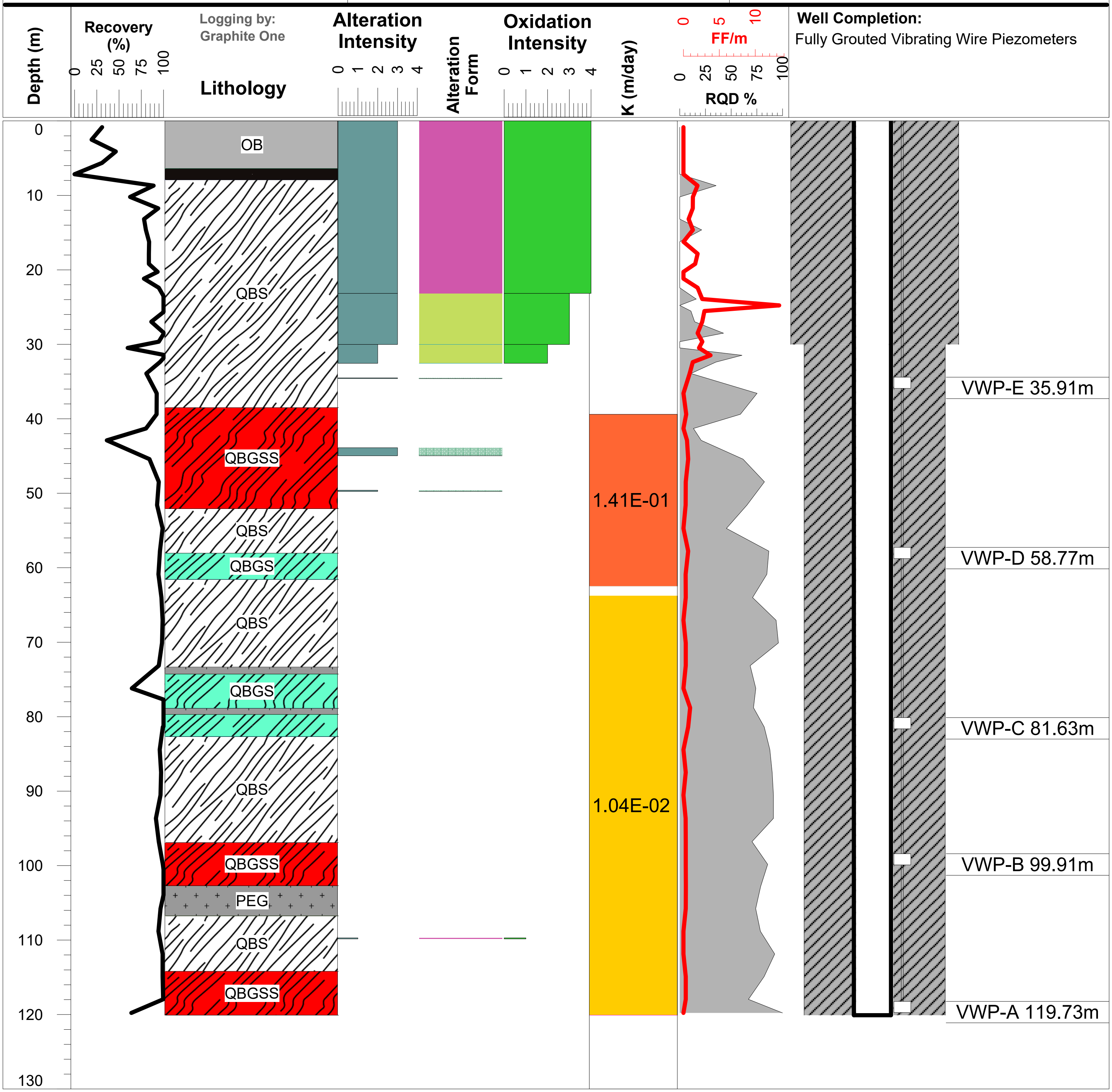
Drilled PQ to 96.6 m and under reamed, then drilled HQ to TD (145.08 m)

Diamond Core - Bedrock

24GCT023

Tundra Consulting, LLC

Installed by Tundra	Coordinate System: NAD83 Z3N	Stickup: NA m-ags
Project: Graphite Creek	Easting: 473683 m	Elevation: 220 mamsl
Date Completed: 7/5/2024	Northing: 7212510	Drill Pad: Pit
Azimuth: 160°	Inclination: -50°	Drill Rig: LF-90
Hole Diameter: HQ	Total Depth: 120.09 m	



Lithology

- Overburden
- Pegmatite
- No Recovery
- Quartz-Biotite Schist
- Quartz-Biotite-Garnet Schist
- Quartz-Biotite-Garnet-Sillimanite Schist

Alteration Form

- CHL
- HEM
- LIMINITE

Project Manager: Steve Teller

Drilling Manager: Major Drilling

Field Manager: Eric Wilson

Hole Drilled: From: 6/30/2024 To: 7/5/2024

Notes:

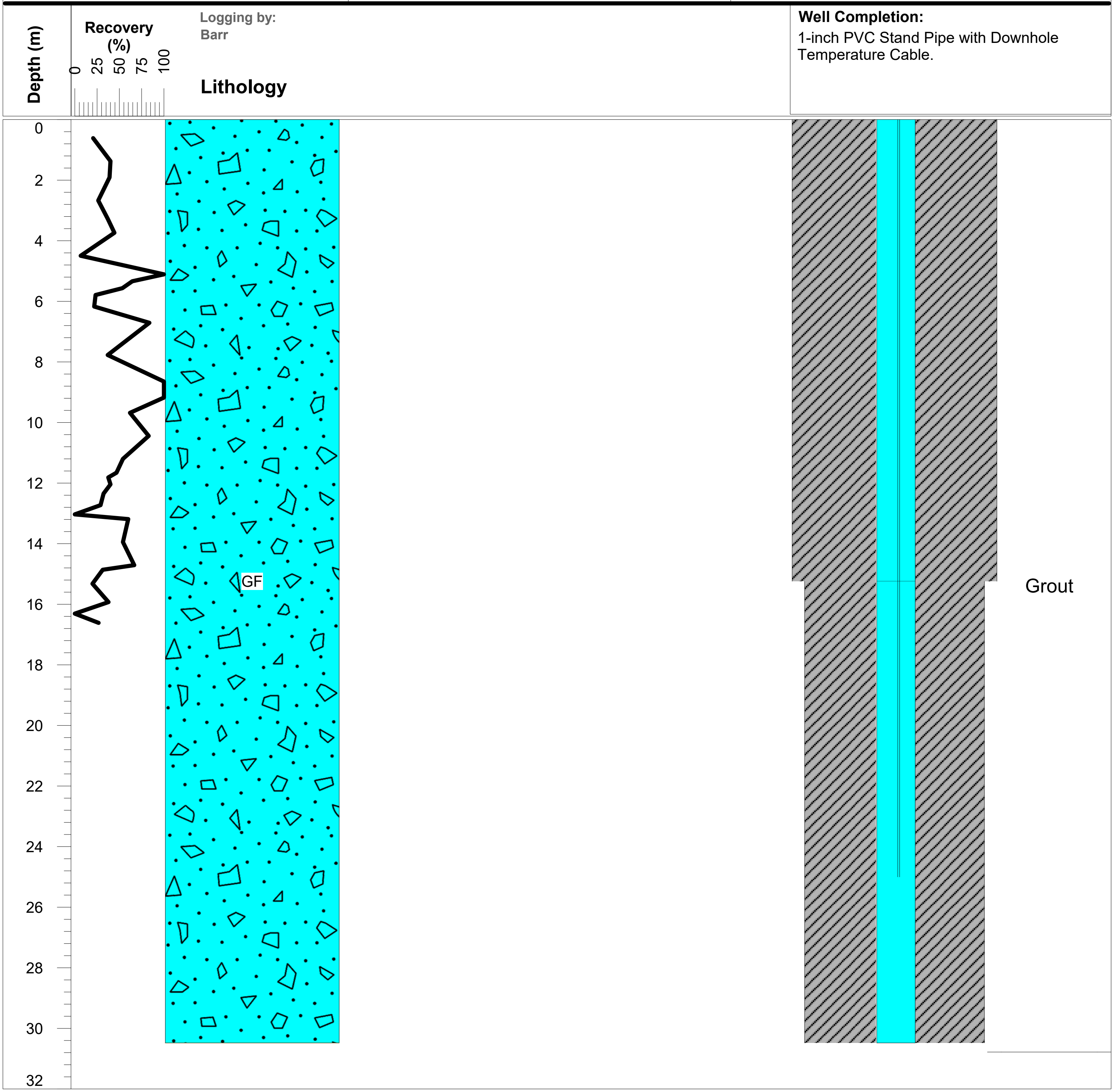
VWP's attached to 1-inch Schedule 80 PVC

Diamond Core - Alluvium

24GCT024

Tundra Consulting, LLC

Installed by Tundra Project: Graphite Creek Date Completed: 7/10/2024	Coordinate System: NAD83 Z3N Easting: 473152 m Northing: 7213967 Elevation: 87 mamsl Drill Pad: WMF	Stickup: 0.061 m-ags Azimuth: 0° Inclination: -90° Drill Rig: LF-90 Hole Diameter: PQ Total Depth: 30.48 m



Lithology

Glacio-fluvial

Project Manager: Steve Teller

Drilling Manager: Major Drilling

Field Manager: Eric Wilson

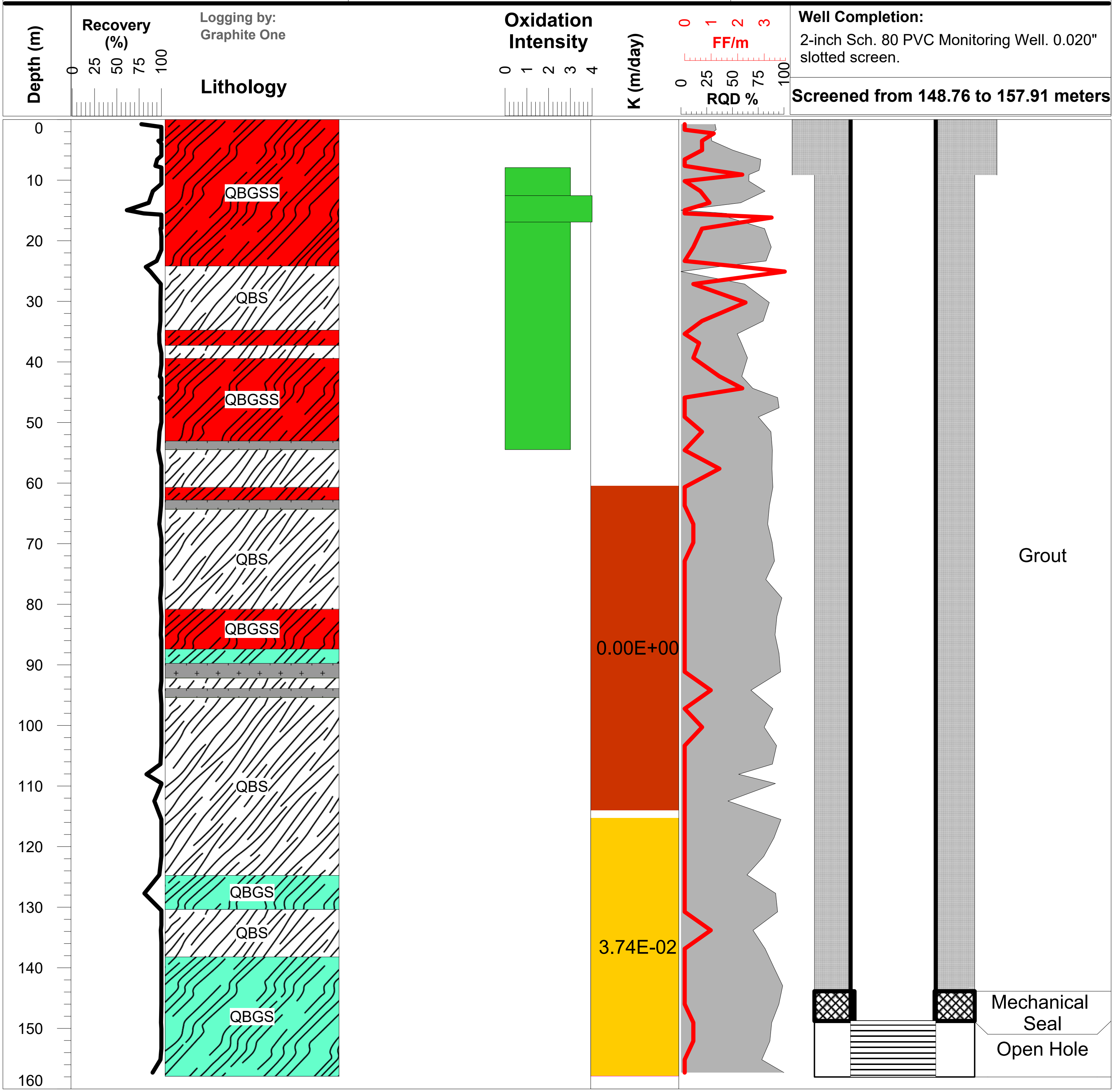
Hole Drilled: From: 7/6/2024 To: 7/10/2024

Notes:

DTC suspended in PVC Filled with Glycol to 25m.
Recovery log only recorded to 16.76 m.

Diamond Core - Bedrock | **24GCT025** | Tundra Consulting, LLC

Installed by Tundra	Coordinate System: NAD83 Z3N	Stickup: 0.7 m-ags	Drill Rig: LF-90
Project: Graphite Creek	Easting: 474572 m / Elevation: 354 mamsl	Azimuth: 160°	Hole Diameter: PQ/HQ
Date Completed: 7/13/2024	Northing: 7212703 / Drill Pad: Pit	Inclination: -50°	Total Depth: 158.01 m



Lithology

- Pegmatite
- Quartz-Biotite Schist
- Quartz-Biotite-Garnet Schist
- Quartz-Biotite-Garnet-Sillimanite Schist

Project Manager: Steve Teller

Drilling Manager: Major Drilling

Field Manager: Geno Foushee

Hole Drilled: From: 7/8/2024 To: 7/13/2024

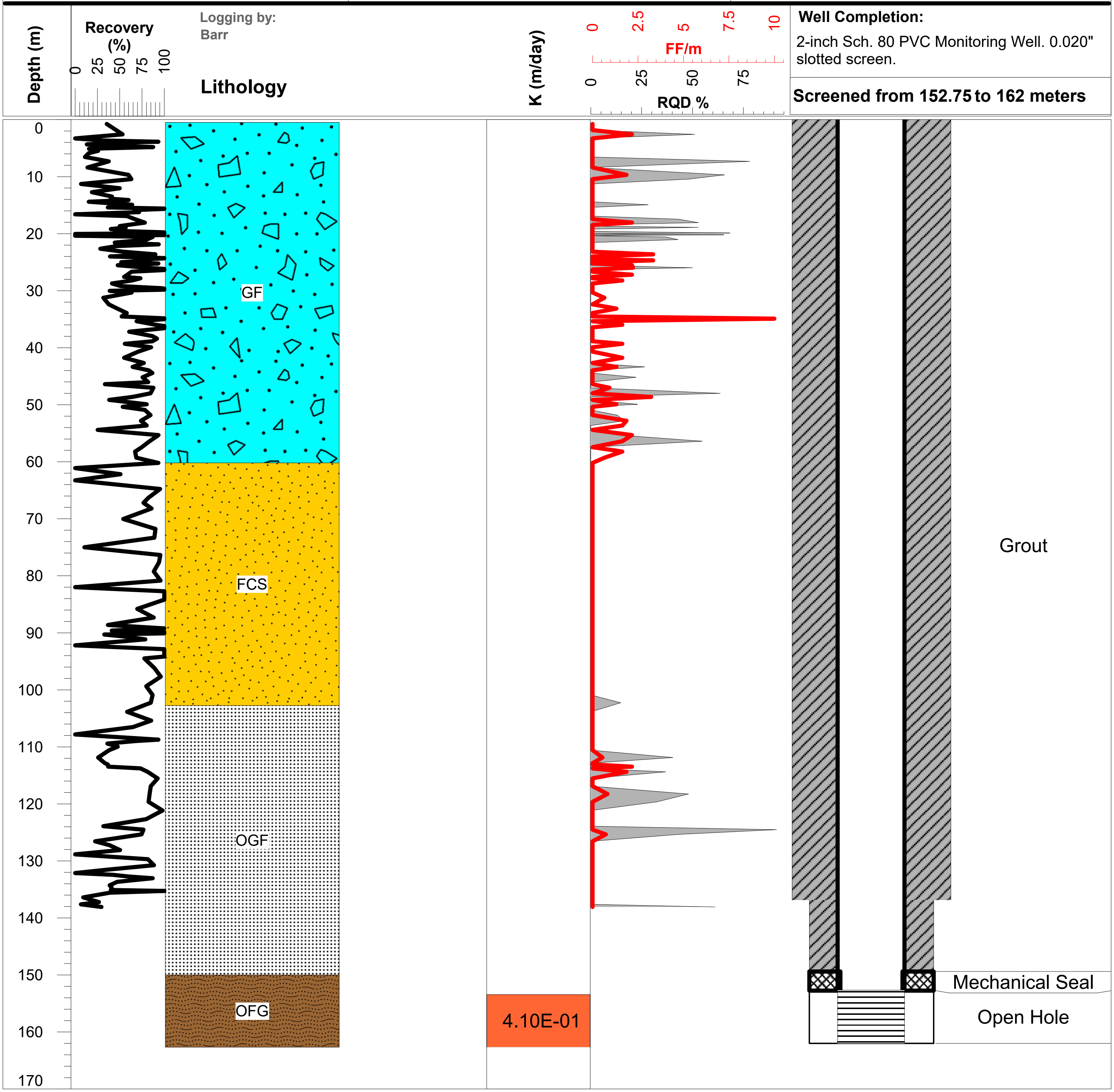
Notes: Deep well paired w/24GCT027.

Diamond Core - Alluvium

24GCT026

Tundra Consulting, LLC

Installed by Tundra Project: Graphite Creek Date Completed: 7/28/2024	Coordinate System: NAD83 Z3N Easting: 472839 m Northing: 7213879 Elevation: 73 mamsl Drill Pad: WMF	Stickup: 0.5 m-ags Azimuth: 0° Inclination: -90° Drill Rig: LF-90 Hole Diameter: PQ/HQ Total Depth: 162.00 m



Lithology

- Glacio-fluvial
- Fluvial - Clean Sand
- Overcompacted Glacial-fluvial
- Overcompacted Fluvial - Gravelly sand w/trace clay

Project Manager: Steve Teller

Drilling Manager: Major Drilling

Field Manager: Eric Wilson

Hole Drilled: From: 7/11/2024 To: 7/28/2024

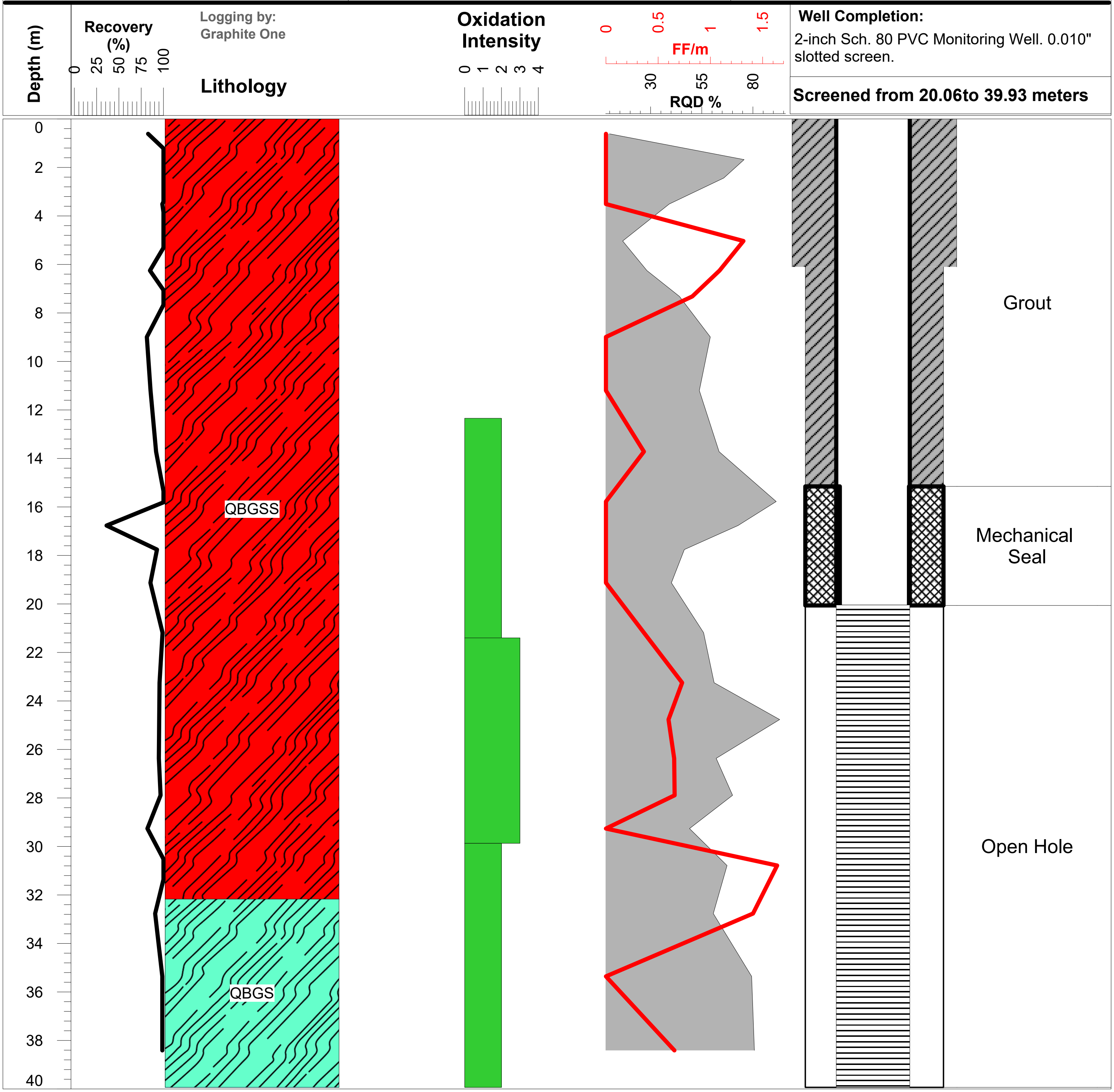
Notes: Although extensively developed, well produces abundant fine sand and must be pumped slowly to prevent pump from seizing.

Diamond Core - Bedrock

24GCT027

Tundra Consulting, LLC

Installed by Tundra	Coordinate System: NAD83 Z3N		Stickup: 0.8 m-ags	Drill Rig: LF-90
Project: Graphite Creek	Easting: 474572 m	Elevation: 354 mamsl	Azimuth: 0°	Hole Diameter: PQ/HQ
Date Completed: 7/15/2024	Northing: 7212703	Drill Pad: Pit	Inclination: -90°	Total Depth: 39.93 m



Lithology

- Quartz-Biotite-Garnet Schist
- Quartz-Biotite-Garnet-Sillimanite Schist

Project Manager: Steve Teller

Drilling Manager: Major Drilling

Field Manager: Geno Foushee

Hole Drilled: From: 7/13/2024 To: 7/15/2024

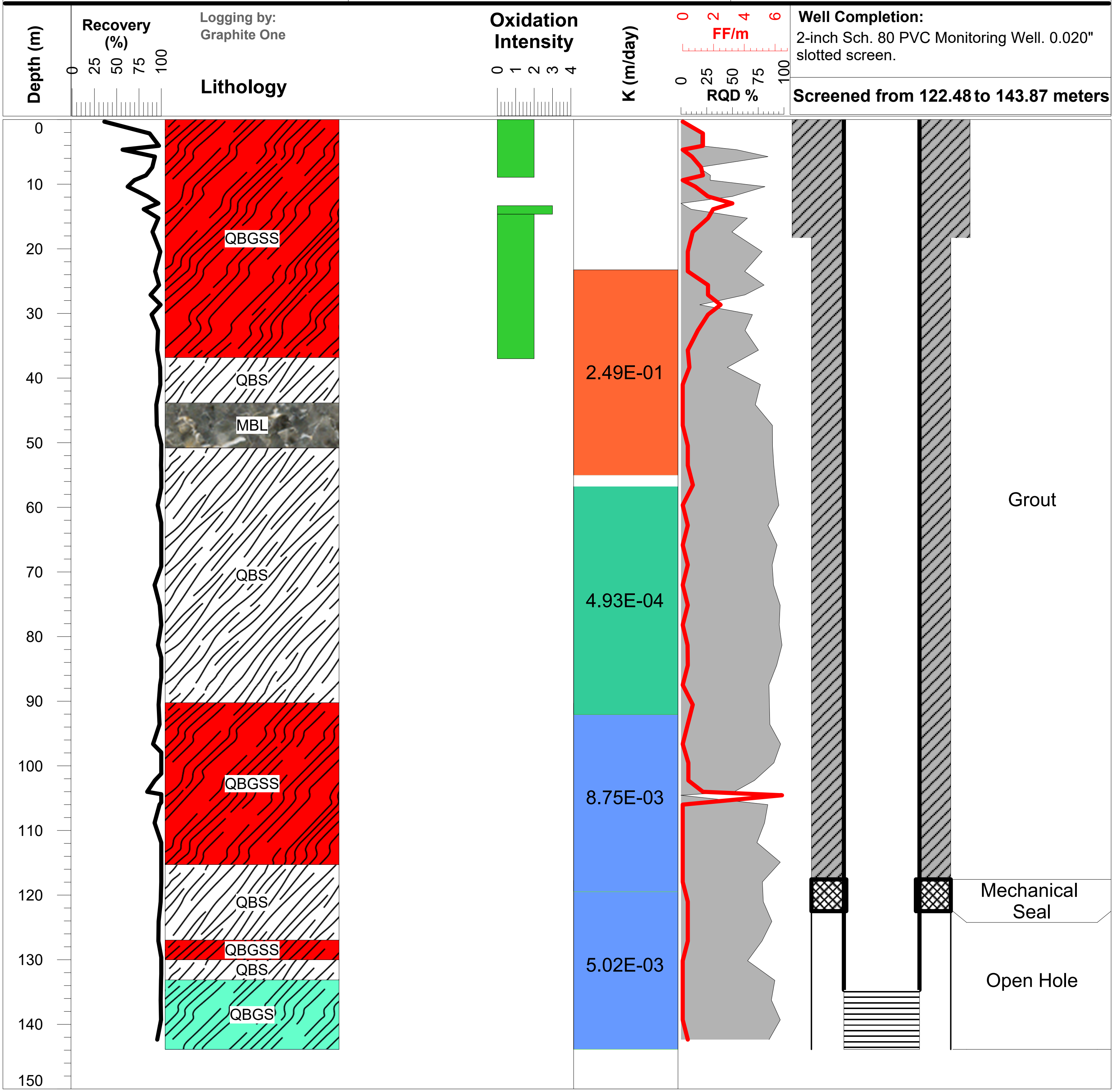
Notes: Shallow well paired w/24GCT025 to check for super-permafrost aquifer. No water table found after initial installation.

Diamond Core - Bedrock

24GCT028

Tundra Consulting, LLC

Installed by Tundra	Coordinate System: NAD83 Z3N	Stickup: 1.2 m-ags	Drill Rig: LF-90
Project: Graphite Creek	Easting: 474230 m — Elevation: 309 mamsl	Azimuth: 160°	Hole Diameter: PQ/HQ
Date Completed: 7/19/2024	Northing: 7212621 — Drill Pad: Pit	Inclination: -50°	Total Depth: 143.87 m



Lithology

- Marble
- Quartz-Biotite Schist
- Quartz-Biotite-Garnet Schist
- Quartz-Biotite-Garnet-Sillimanite Schist

Project Manager: Steve Teller

Drilling Manager: Major Drilling

Field Manager: Geno Foushee

Hole Drilled: From: 7/16/2024 To: 7/19/2024

Notes:

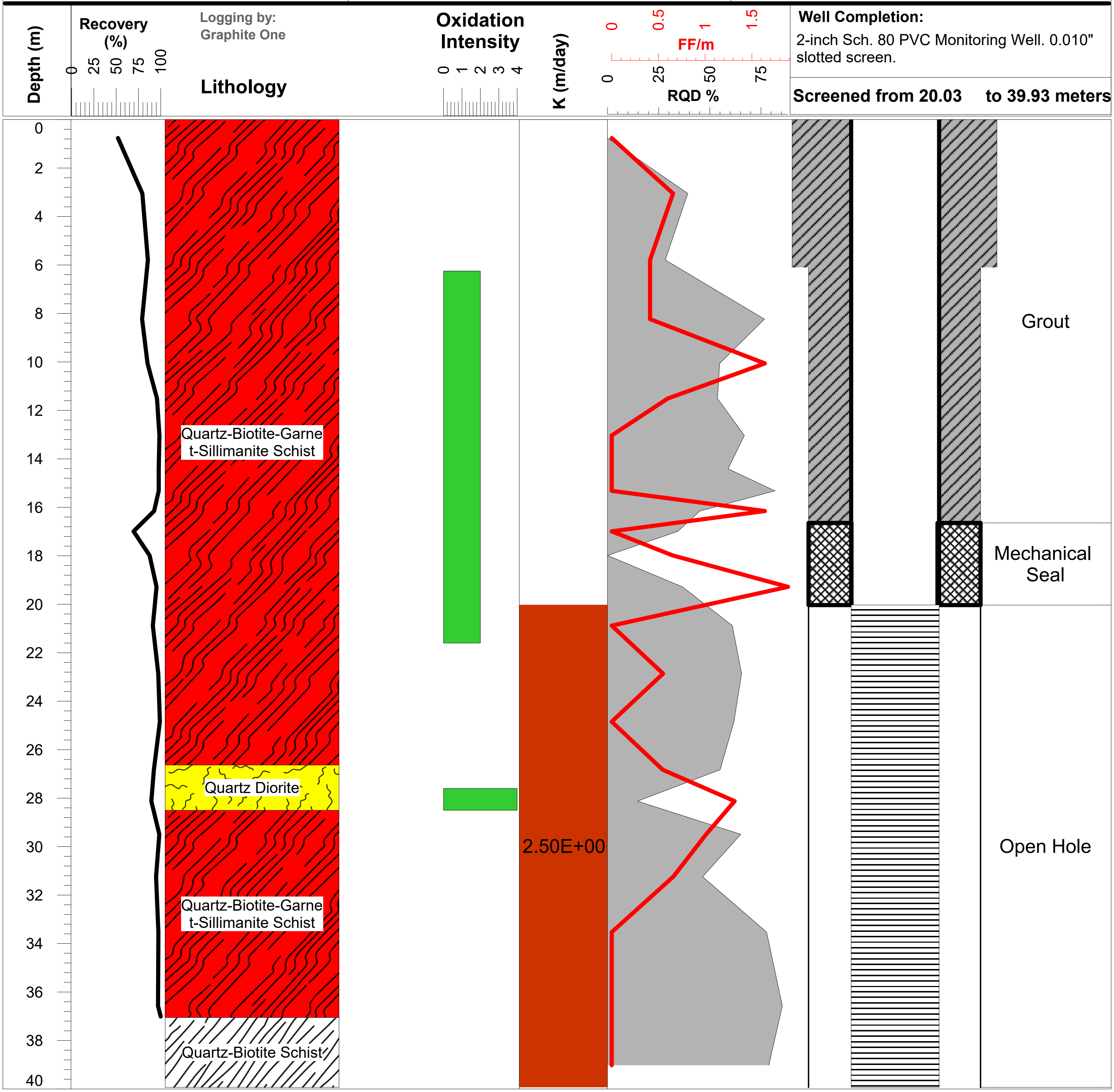
Deep well paired w/24GCT029. Flowing Artesian. Slotted 135.24 - 144.38 m but effectively screened 123.05 - 144.38 m

Diamond Core - Bedrock

24GCT029

Tundra Consulting, LLC

Installed by Tundra	Coordinate System: NAD83 Z3N	Stickup: 0.71 m-ags	Drill Rig: LF-90
Project: Graphite Creek	Easting: 474230 m / Elevation: 309 mamsl	Azimuth: 0°	Hole Diameter: PQ/HQ
Date Completed: 7/21/2024	Northing: 7212621 / Drill Pad: Pit	Inclination: -90°	Total Depth: 39.93 m



Lithology

- Quartz Diorite
- Quartz-Biotite Schist
- Quartz-Biotite-Garnet-Sillimanite Schist

Project Manager: Steve Teller

Drilling Manager: Major Drilling

Field Manager: Geno Foushee

Hole Drilled: From: 7/19/2024 To: 7/21/2024

Notes:

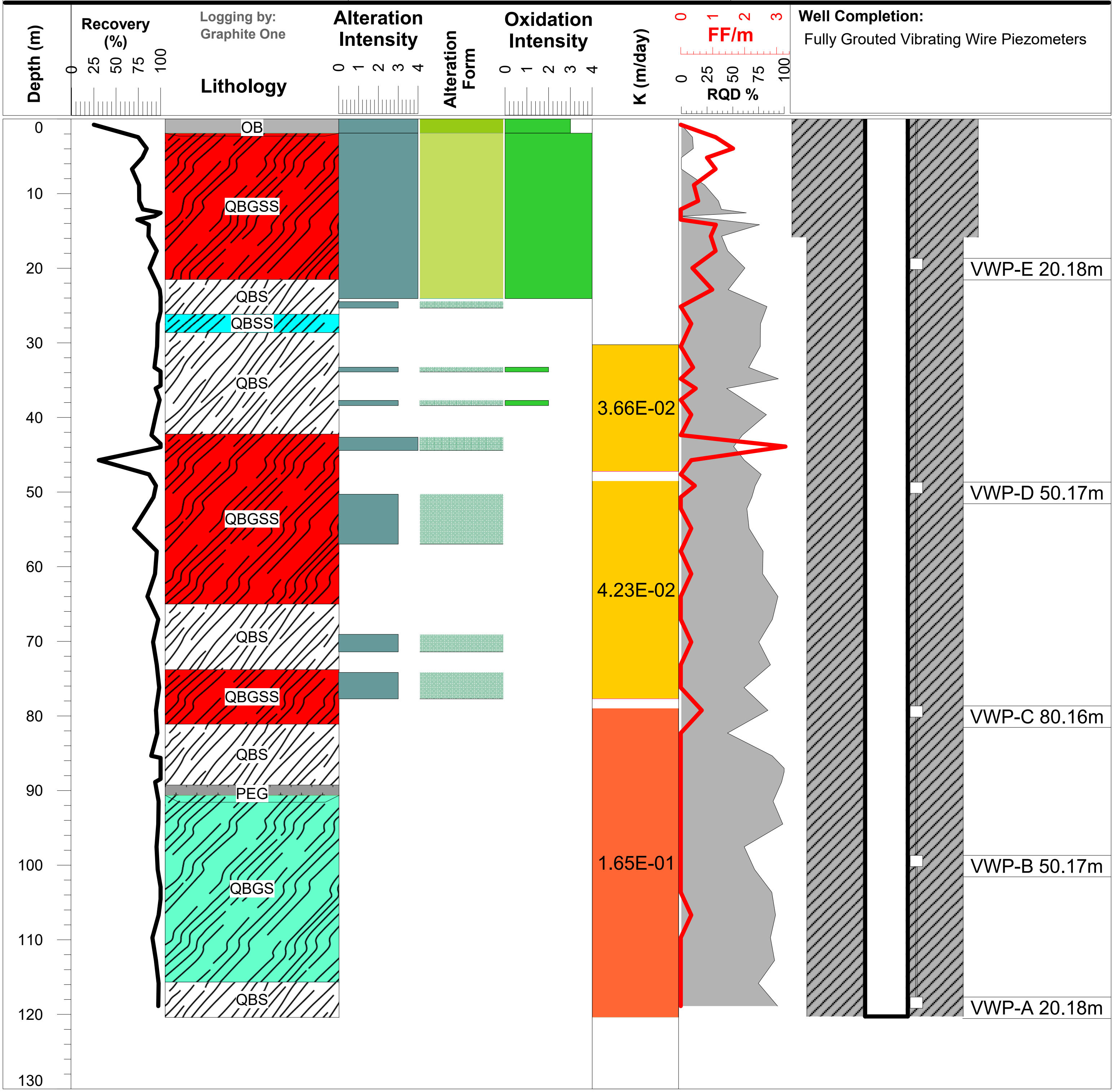
Shallow well paired w/24GCT028

Diamond Core - Bedrock

24GCT030

Tundra Consulting, LLC

Installed by Tundra	Coordinate System: NAD83 Z3N	Stickup: NA m-ags	Drill Rig: LF-90
Project: Graphite Creek	Easting: 473909 m / Elevation: 233 mamsl	Azimuth: 200°	Hole Diameter: HQ
Date Completed: 7/30/2024	Northing: 7212575 / Drill Pad: Pit	Inclination: -50°	Total Depth: 120.27 m



Lithology

- Overburden
- Pegmatite
- Quartz-Biotite Schist
- Quartz-Biotite-Garnet Schist
- Quartz-Biotite-Sillimanite Schist
- Quartz-Biotite-Garnet-Sillimanite Schist

Alteration Type

- CHL
- CLAY
- LIMINITE

Project Manager: Steve Teller

Drilling Manager: Major Drilling

Field Manager: Eric Wilson

Hole Drilled: From: 7/26/2024 To: 7/30/2024

Notes:

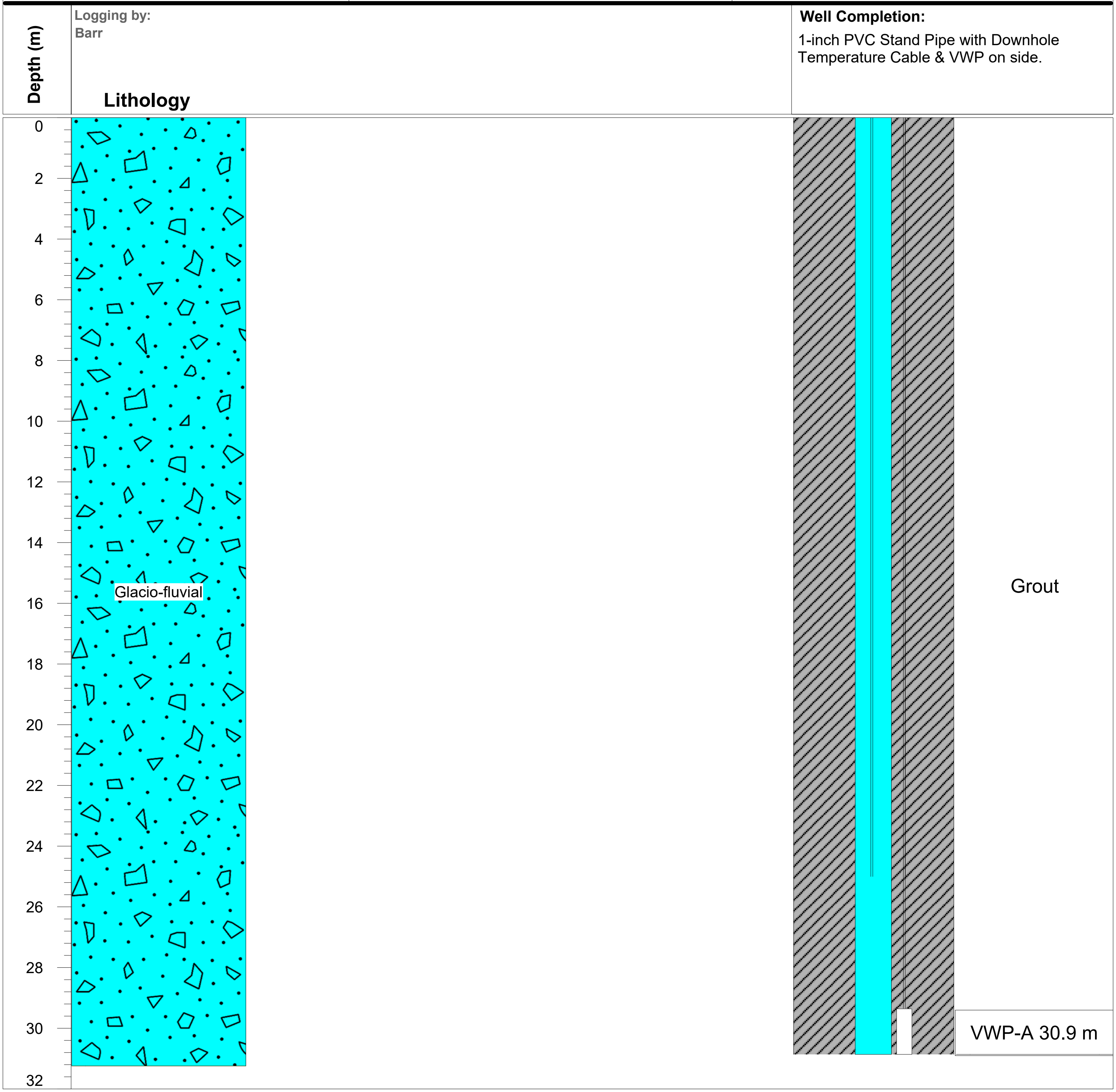
VWP's attached to 1-inch Schedule 80 PVC

Diamond Core - Alluvium | **24GCT031** | Tundra Consulting, LLC

Installed by Barr	Coordinate System: NAD83 Z3N		Stickup: NA m-ags	Drill Rig: LF-90
Project: Graphite Creek	Easting: 472401 m	Elevation: 55 mamsl	Azimuth: 0°	Hole Diameter: PQ
Date Completed: 7/31/2024	Northing: 7213706	Drill Pad: WMF	Inclination: -90°	Total Depth: 30.86 m

Logging by:
Barr

Well Completion:
1-inch PVC Stand Pipe with Downhole Temperature Cable & VWP on side.



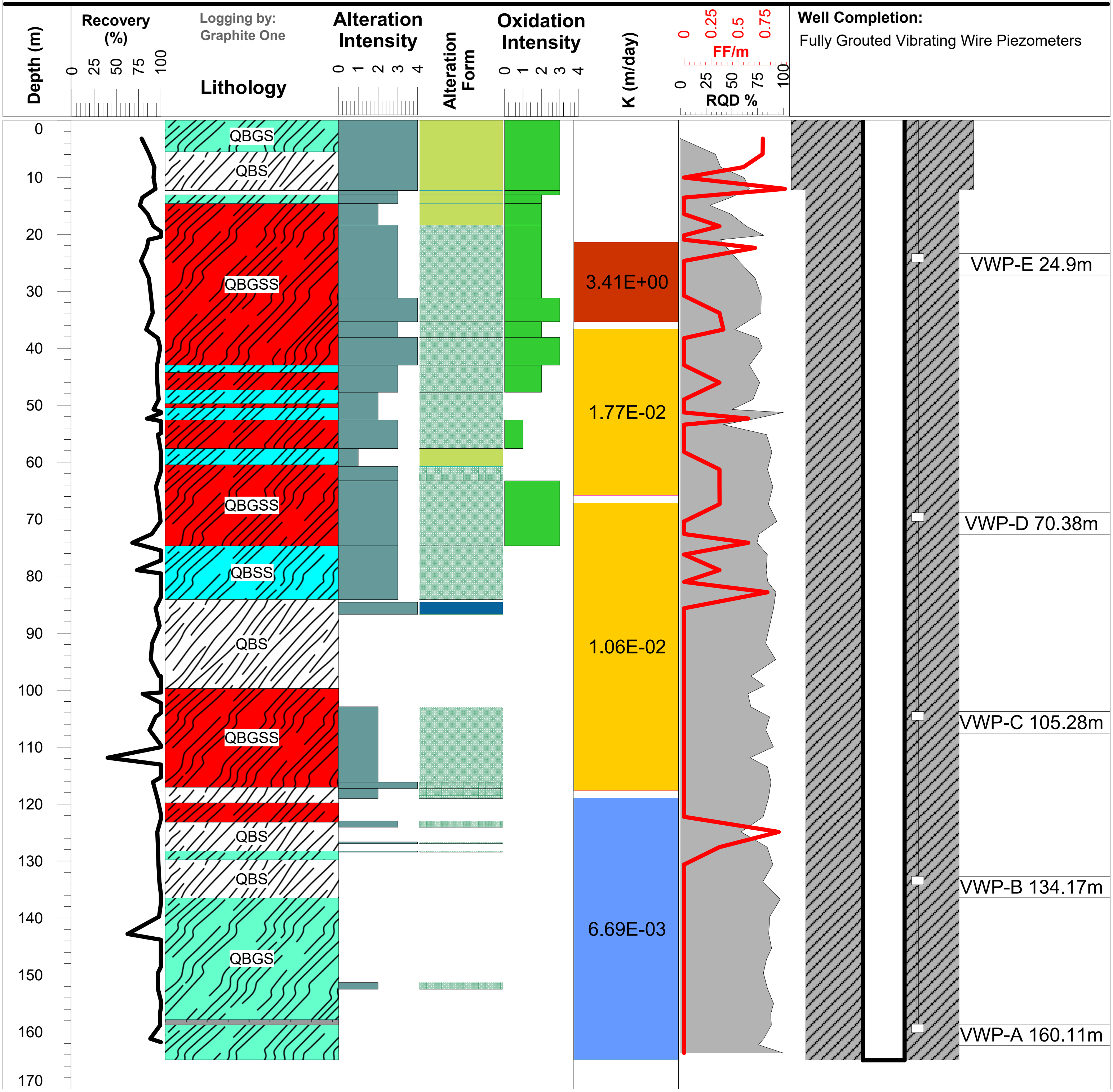
Lithology

Glacio-fluvial

Project Manager: Steve Teller
Driling Manager: Major Drilling
Field Manager: Eric Wilson
Hole Drilled: From: 7/29/2024 To: 7/31/2024
Notes:
DTC suspended in PVC to 25 m. PVC filled with Glycol. Fulled grouted VWP installed attached to side of PVC.

Diamond Core - Bedrock | **24GCT032** | Tundra Consulting, LLC

Installed by Tundra Project: Graphite Creek Date Completed: 8/8/2024	Coordinate System: NAD83 Z3N Easting: 474934 m Elevation: 286 mamsl Northing: 7213020 Drill Pad: Pit	Stickup: NA m-ags Drill Rig: LF-90 Azimuth: 160° Hole Diameter: HQ Inclination: -50° Total Depth: 164.96 m



Lithology

- Pegmatite
- Quartz-Biotite Schist
- Quartz-Biotite-Garnet Schist
- Quartz-Biotite-Sillimanite Schist
- Quartz-Biotite-Garnet-Sillimanite Schist

Alteration Type

- CARB
- CHL
- LIMINITE
- SER

Project Manager: Steve Teller

Drilling Manager: Major Drilling

Field Manager: Eric Wilson

Hole Drilled: From: 8/2/2024 To: 8/8/2024

Notes:

VWP's attached to 1-inch Schedule 80 PVC

Diamond Core - Alluvium

24GCT033

Tundra Consulting, LLC

Installed by Tundra	Coordinate System: NAD83 Z3N	Stickup: 0.42 m-ags	Drill Rig: LF-90
Project: Graphite Creek	Easting: 473261 m / Elevation: 88 mamsl	Azimuth: 0°	Hole Diameter: PQ
Date Completed: 8/15/2024	Northing: 7213538 / Drill Pad: WMF	Inclination: -90°	Total Depth: 146.61 m

Depth (m)

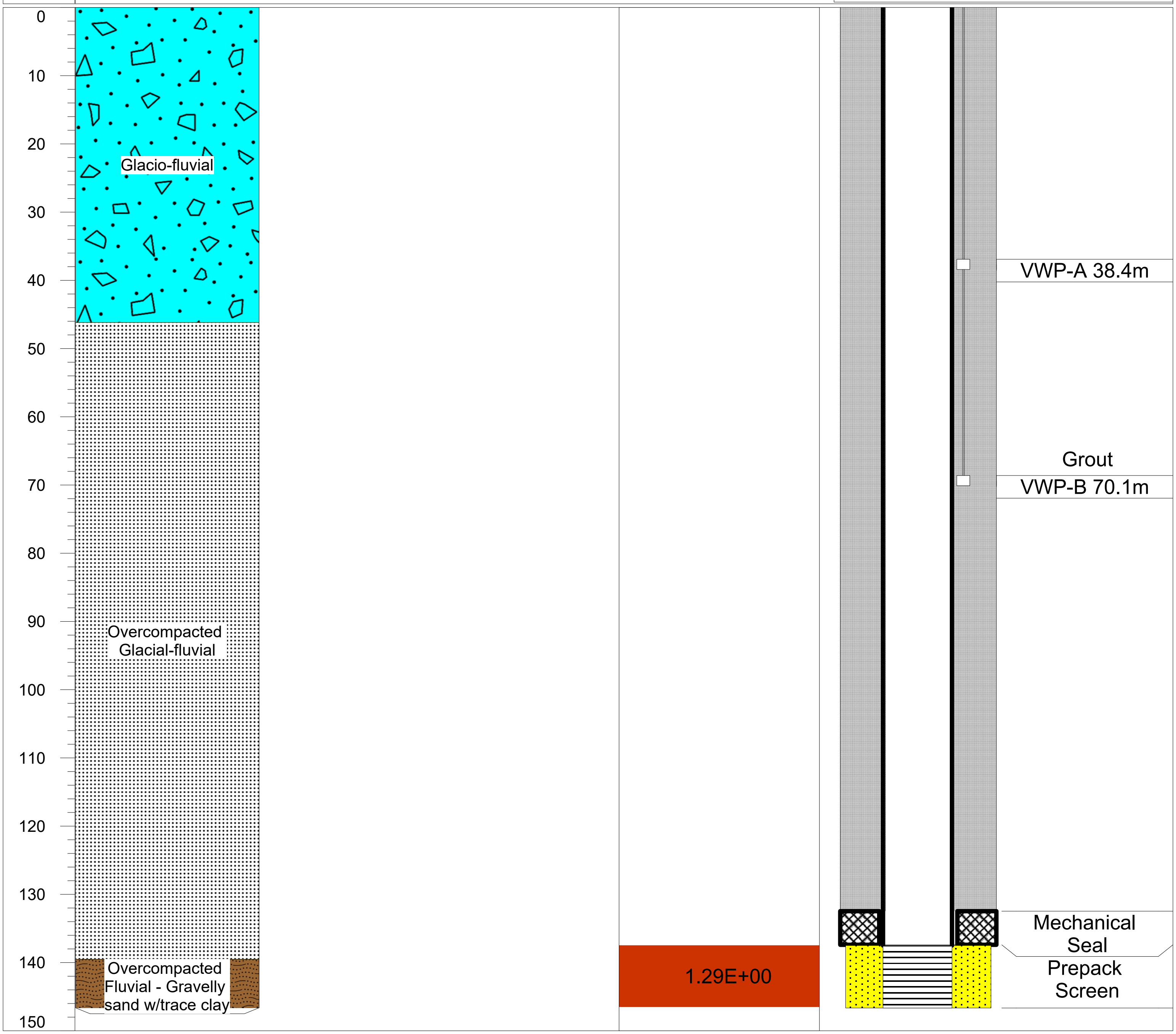
Logging by: Barr

Lithology

K (m/day)

Well Completion:
2-inch Sch. 80 PVC Monitoring Well.
0.010" slot screen w/ Sch. 40 prepack.

Screened from 137.5 to 146.5 meters



Lithology

- Glacio-fluvial
- Overcompacted Glacial-fluvial
- Overcompacted Fluvial - Gravelly sand w/trace clay

Project Manager: Steve Teller

Drilling Manager: Major Drilling

Field Manager: G. Baldwin

Hole Drilled: From: 8/2/2024 To: 8/15/2024

Notes:
Fully Grouted VWP's attached to side of well. Screen is prepack filter pack on Sch. 40 PVC

Diamond Core - Alluvium

24GCT034

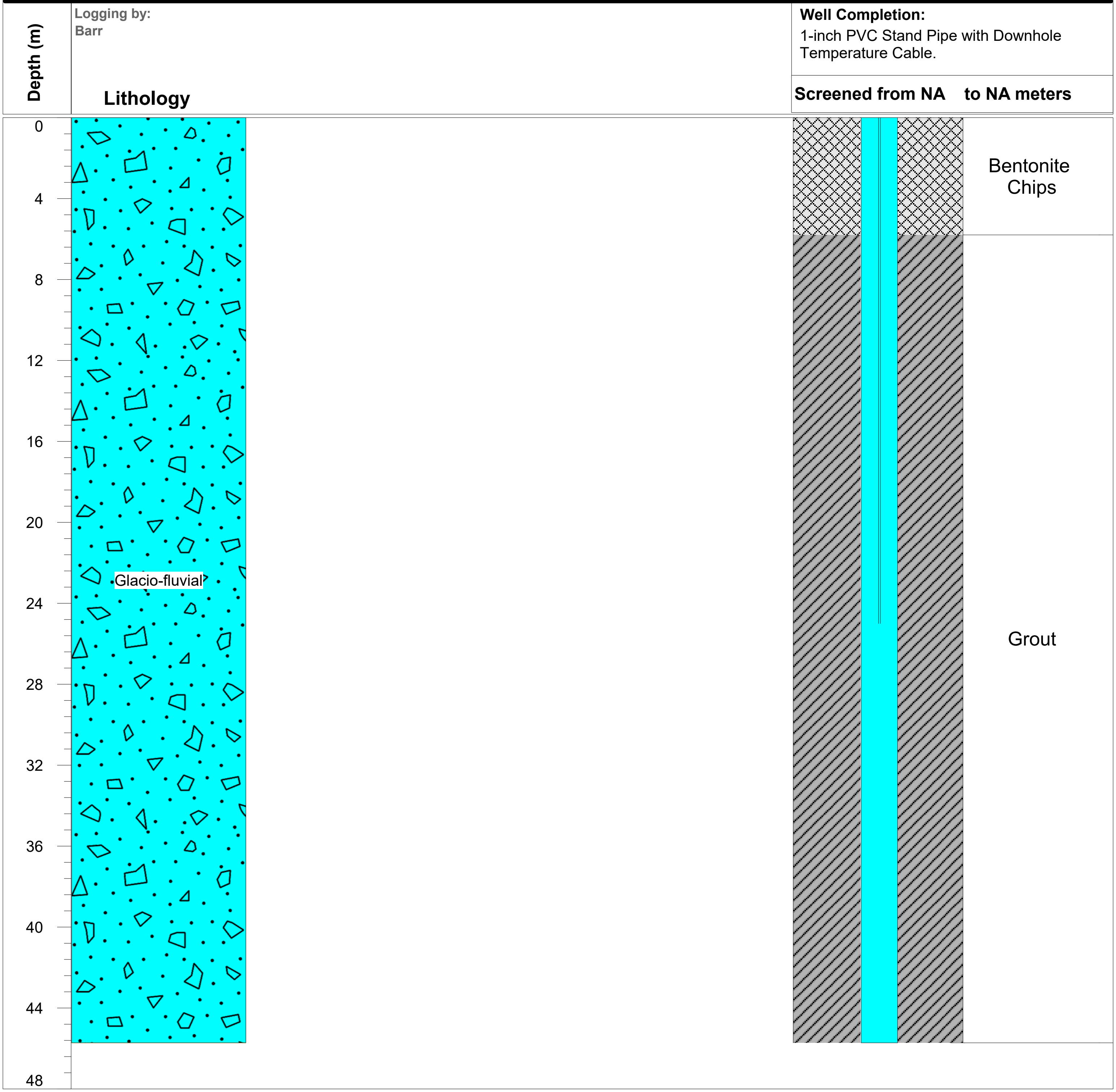
Tundra Consulting, LLC

Installed by Barr	Coordinate System: NAD83 Z3N		Stickup: NA m-ags	Drill Rig: LF-90
Project: Graphite Creek	Easting: 474618 m	Elevation: 164 mamsl	Azimuth: 0°	Hole Diameter: PQ
Date Completed: 8/19/2024	Northing: 7213538	Drill Pad: Mill Facility	Inclination: -90°	Total Depth: 45.70 m

Logging by: Barr

Well Completion:
1-inch PVC Stand Pipe with Downhole Temperature Cable.

Screened from NA to NA meters



Lithology

Glacio-fluvial

Project Manager: Steve Teller

Drilling Manager: Major Drilling

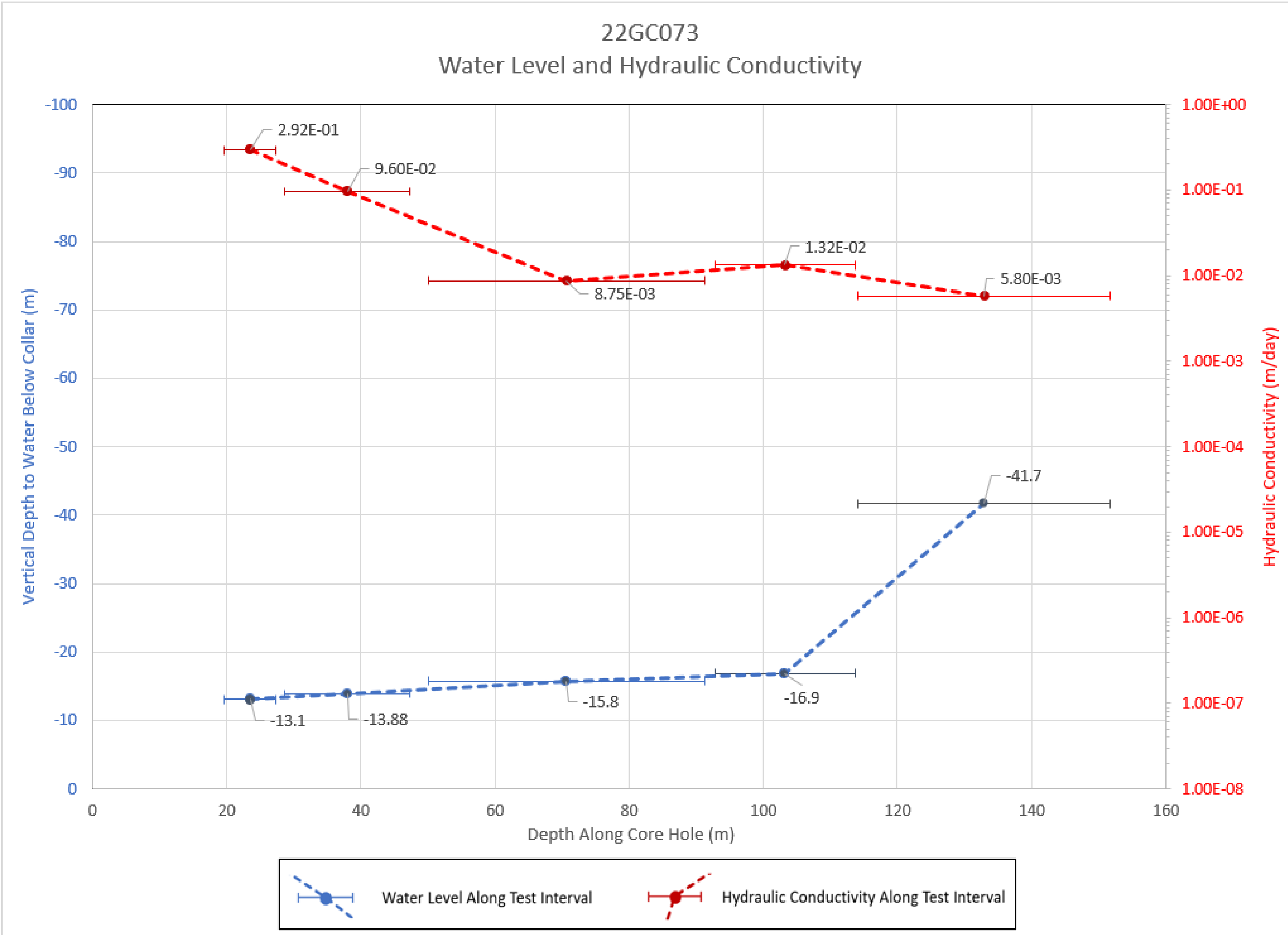
Field Manager: G. Baldwin

Hole Drilled: From: 8/17/2024 To: 8/19/2024

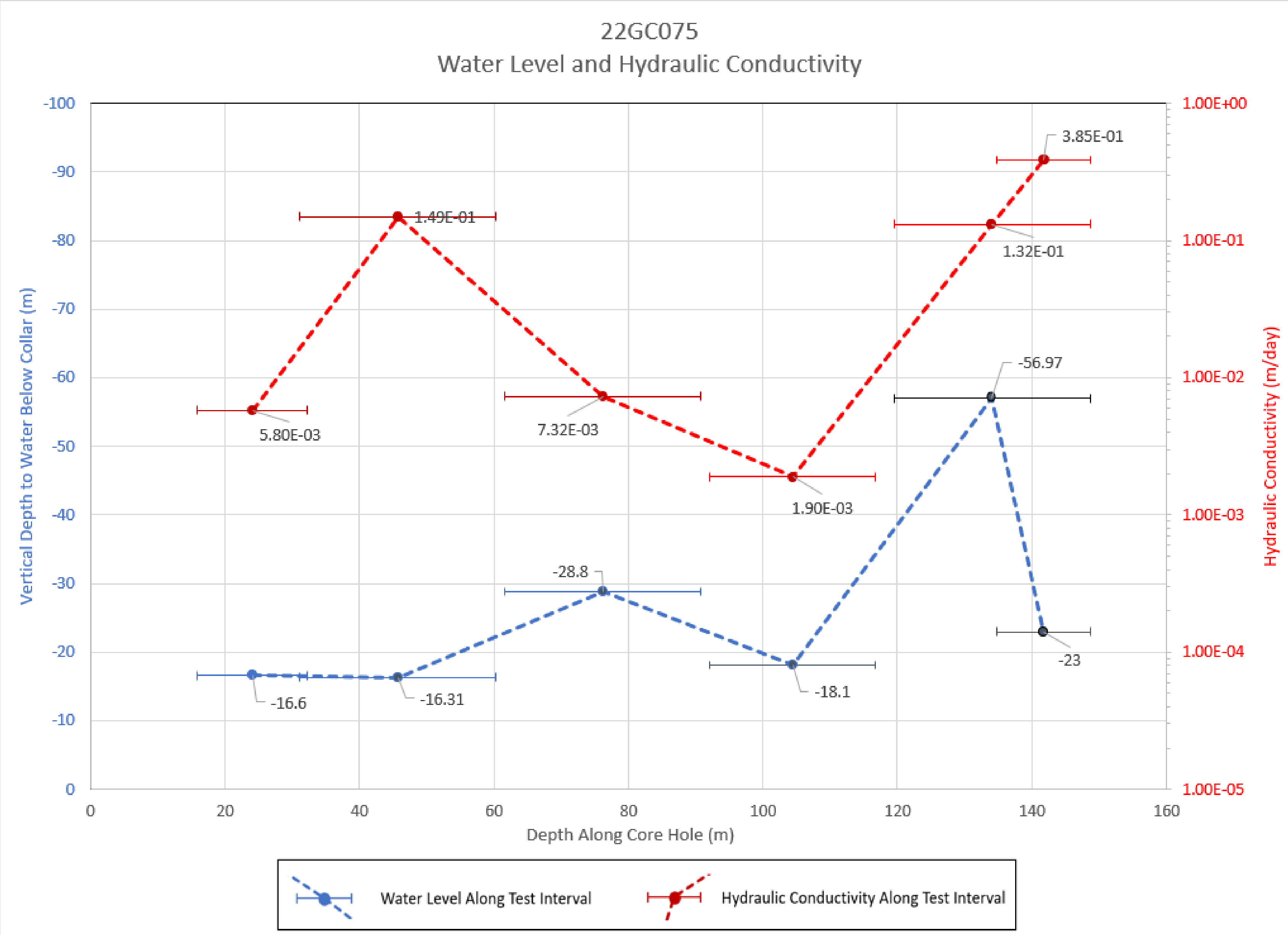
Notes:

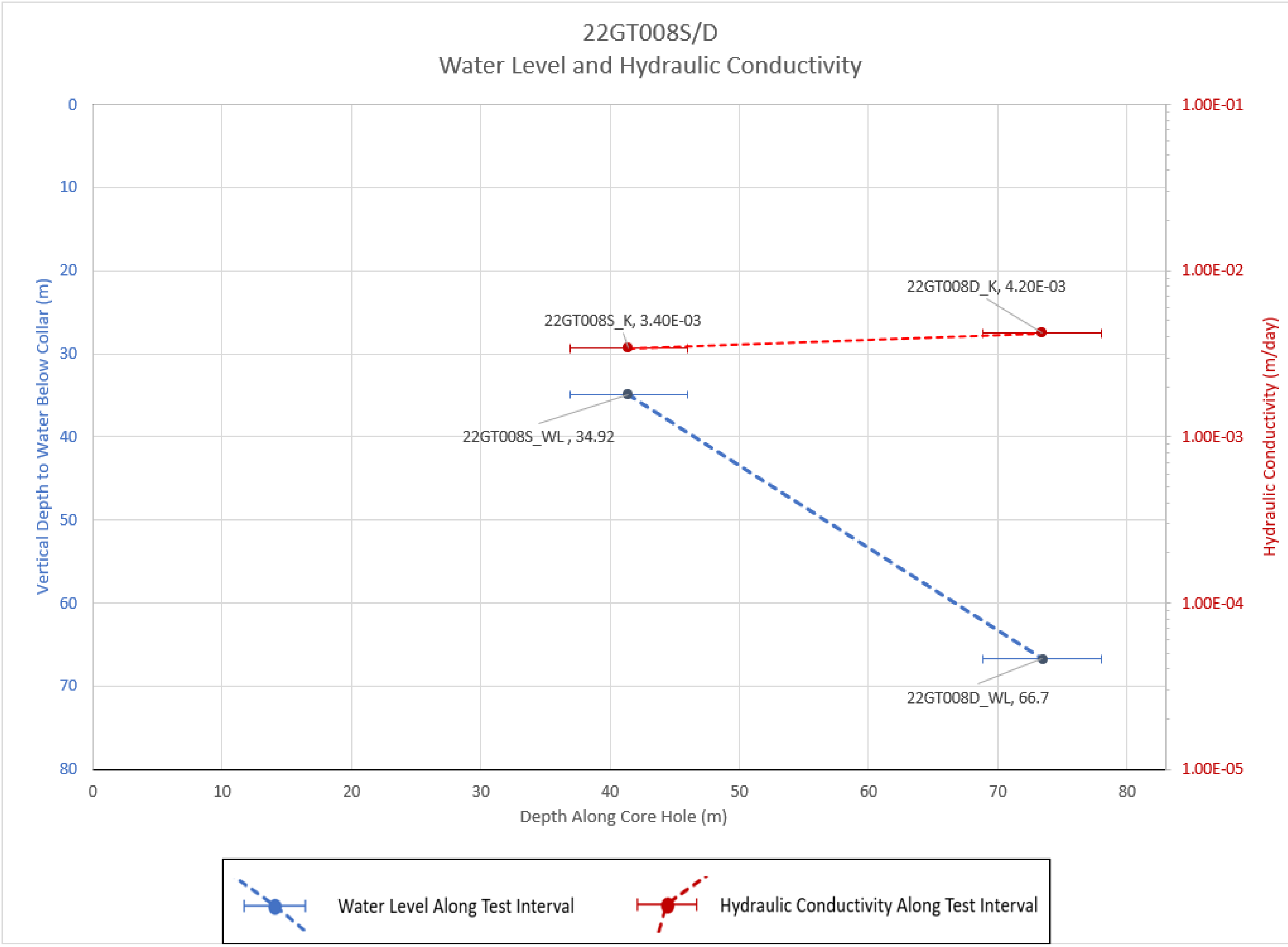
DTC suspended in PVC to 25 m. PVC filled with Glycol.

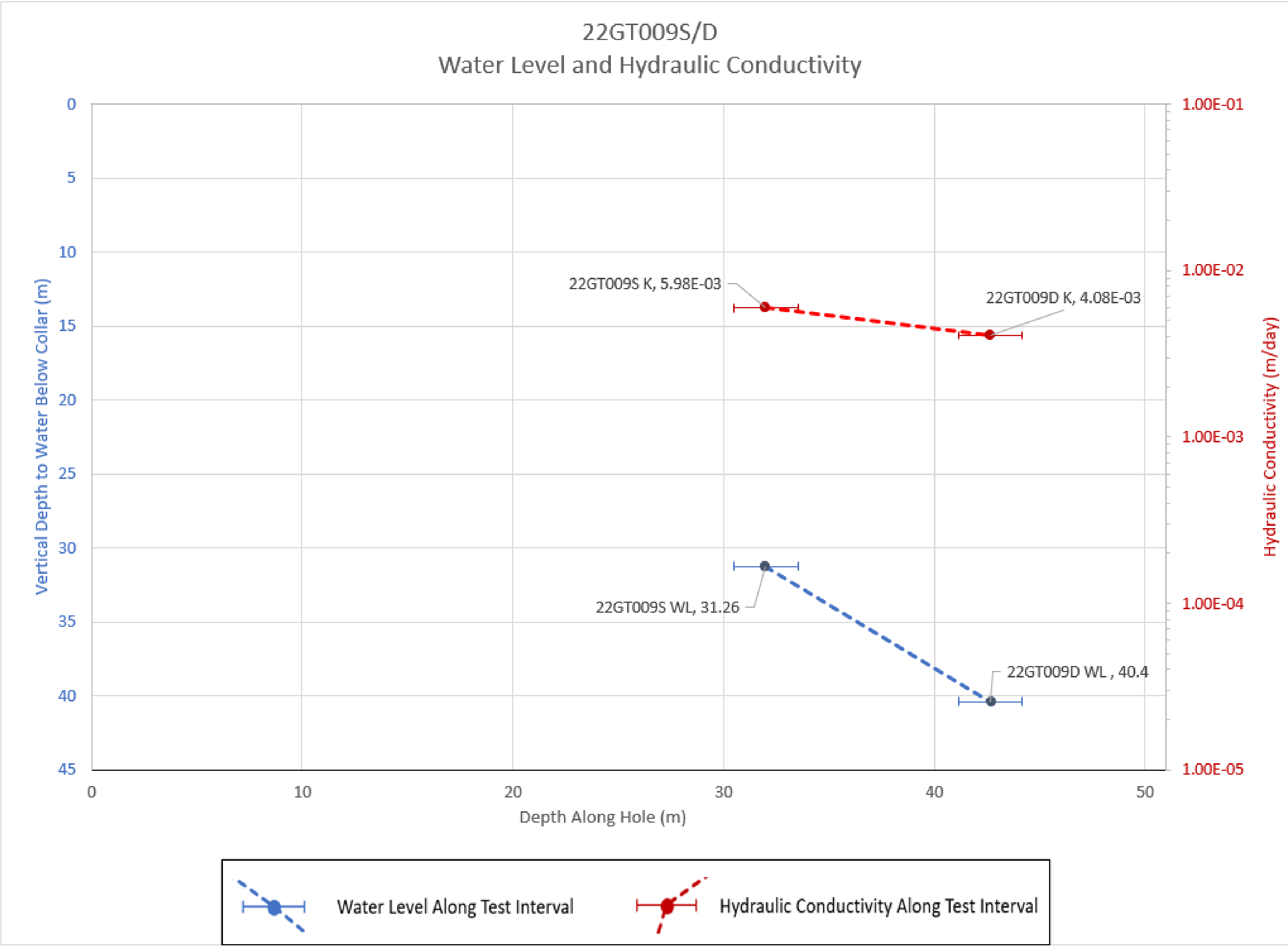
Appendix F. Water Level and Hydraulic Conductivity Plots

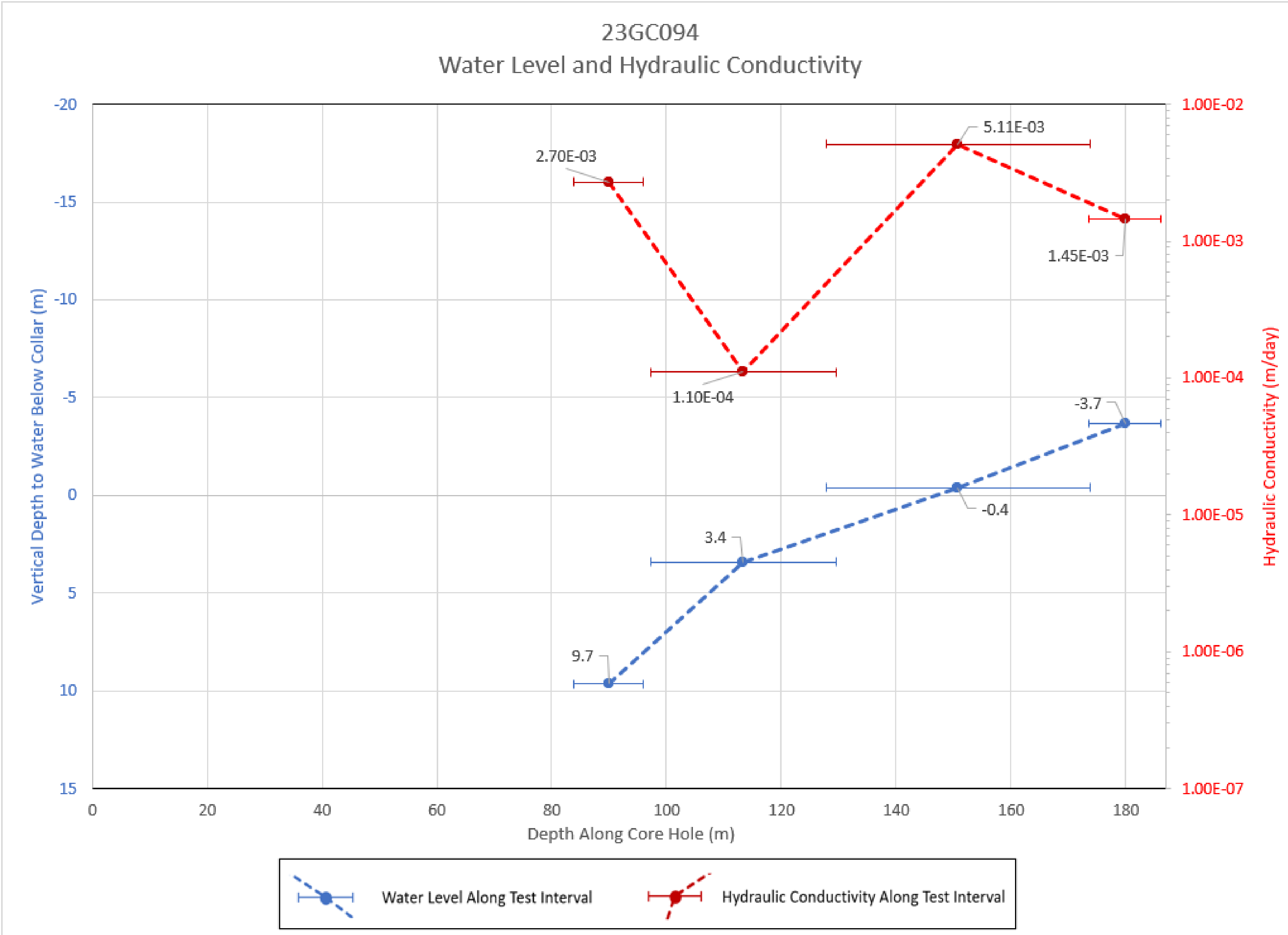


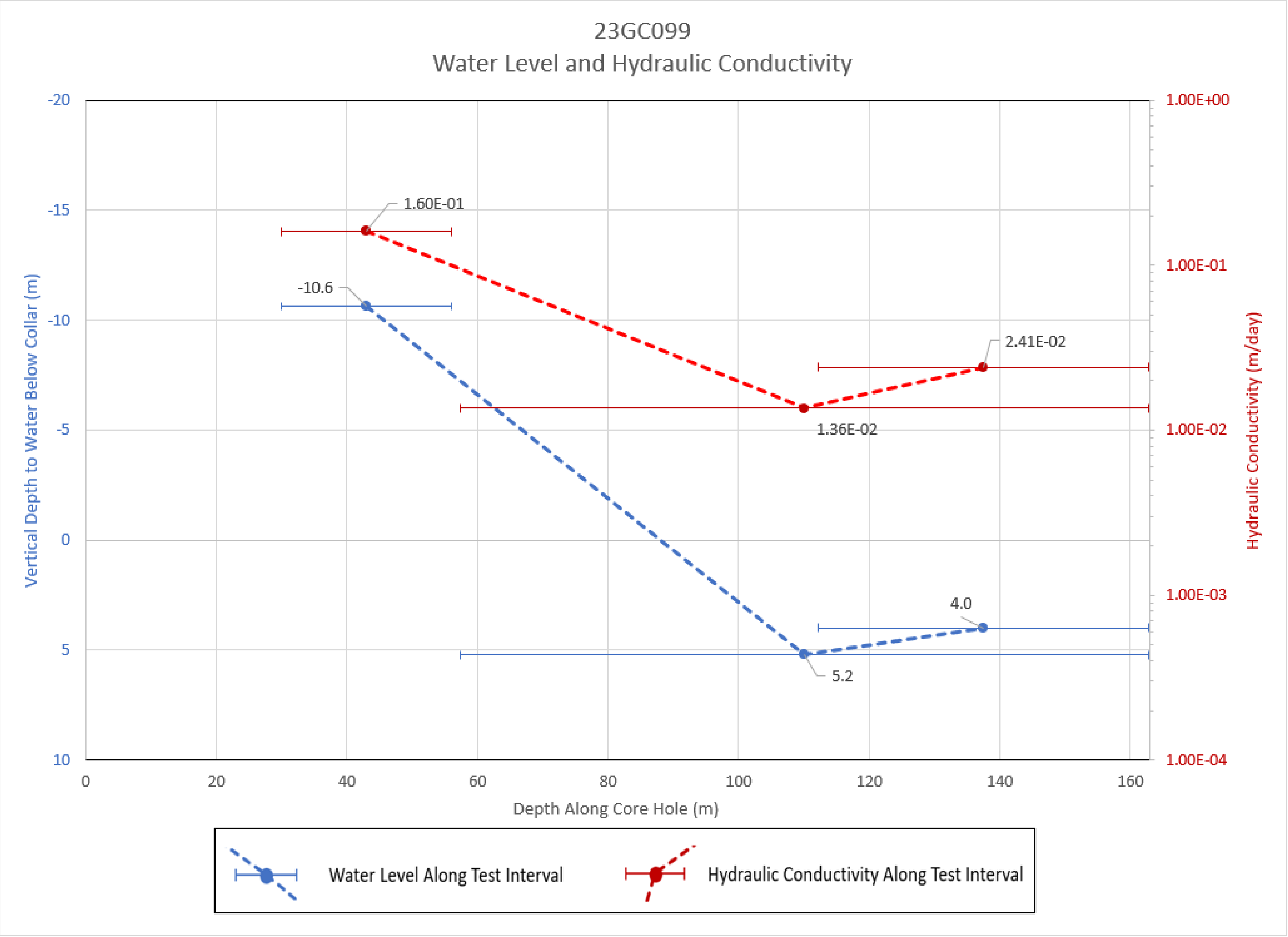
22GC073
Water Level and Hydraulic Conductivity
Vertical Depth to Water Below Collar (m)
Hydraulic Conductivity (m/day)
Depth Along Core Hole (m)
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.00E-06
1.00E-07
1.00E-08
0
20
40
60
80
100
120
140
160
2.92E-01
9.60E-02
8.75E-03
1.32E-02
5.80E-03
-41.7
-13.1
-13.88
-15.8
-16.9
Water Level Along Test Interval
Hydraulic Conductivity Along Test Interval


22GC075
Water Level and Hydraulic Conductivity
Vertical Depth to Water Below Collar (m)
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
Hydraulic Conductivity (m/day)
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
0
20
40
60
80
100
120
140
160
Depth Along Core Hole (m)
5.80E-03
1.49E-01
7.32E-03
1.90E-03
1.32E-01
3.85E-01
-16.6
-16.31
-28.8
-18.1
-56.97
-23
Water Level Along Test Interval
Hydraulic Conductivity Along Test Interval

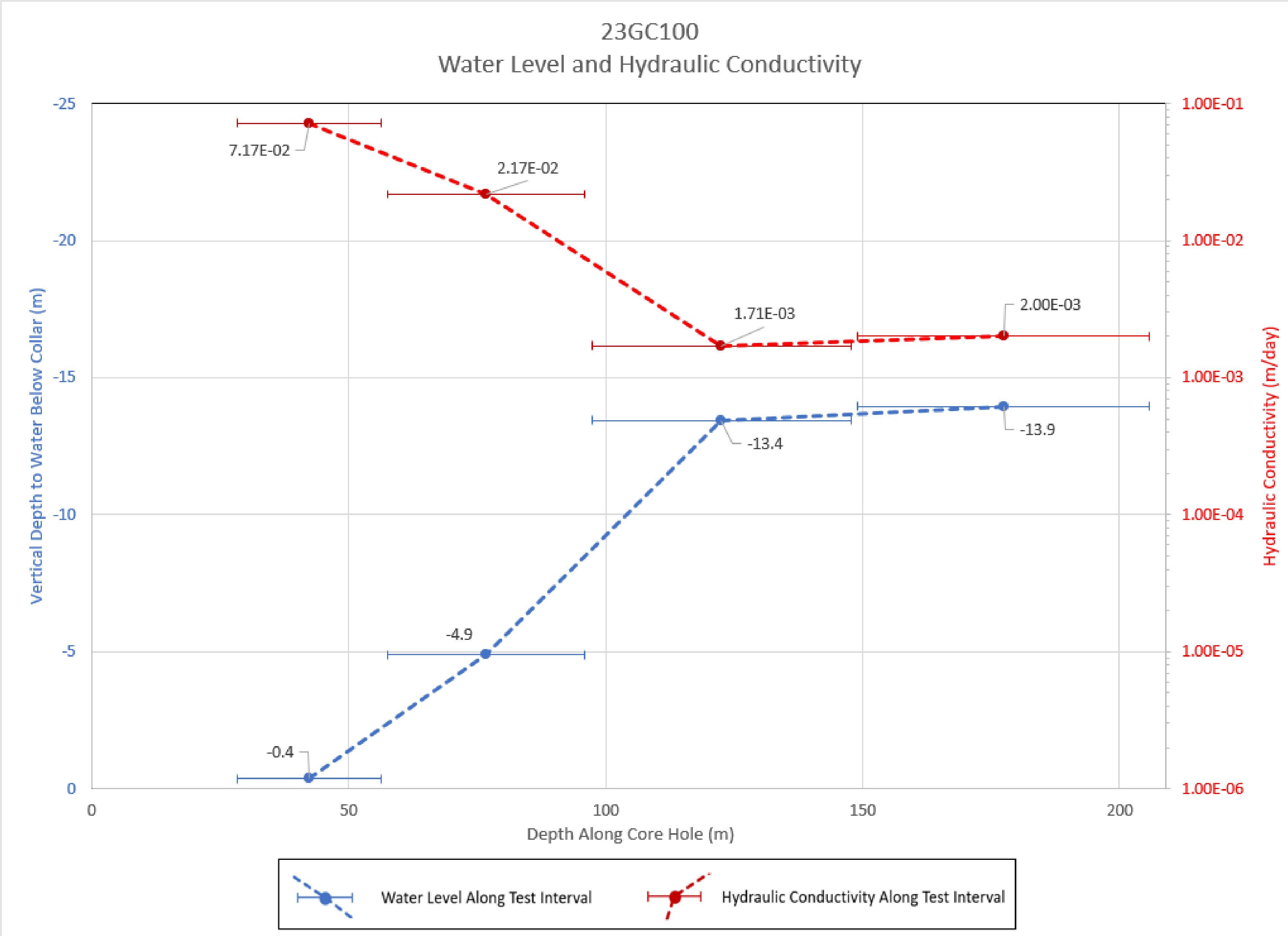

22GT008S/D
Water Level and Hydraulic Conductivity
Vertical Depth to Water Below Collar (m)
Hydraulic Conductivity (m/day)
Depth Along Core Hole (m)
0
10
20
30
40
50
60
70
80
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
22GT008D_K, 4.20E-03
22GT008S_K, 3.40E-03
22GT008S_WL , 34.92
22GT008D_WL, 66.7
Water Level Along Test Interval
Hydraulic Conductivity Along Test Interval


22GT009S/D
Water Level and Hydraulic Conductivity
Vertical Depth to Water Below Collar (m)
0
5
10
15
20
25
30
35
40
45
Hydraulic Conductivity (m/day)
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
Depth Along Hole (m)
0
10
20
30
40
50
22GT009S K, 5.98E-03
22GT009D K, 4.08E-03
22GT009S WL, 31.26
22GT009D WL , 40.4
Water Level Along Test Interval
Hydraulic Conductivity Along Test Interval

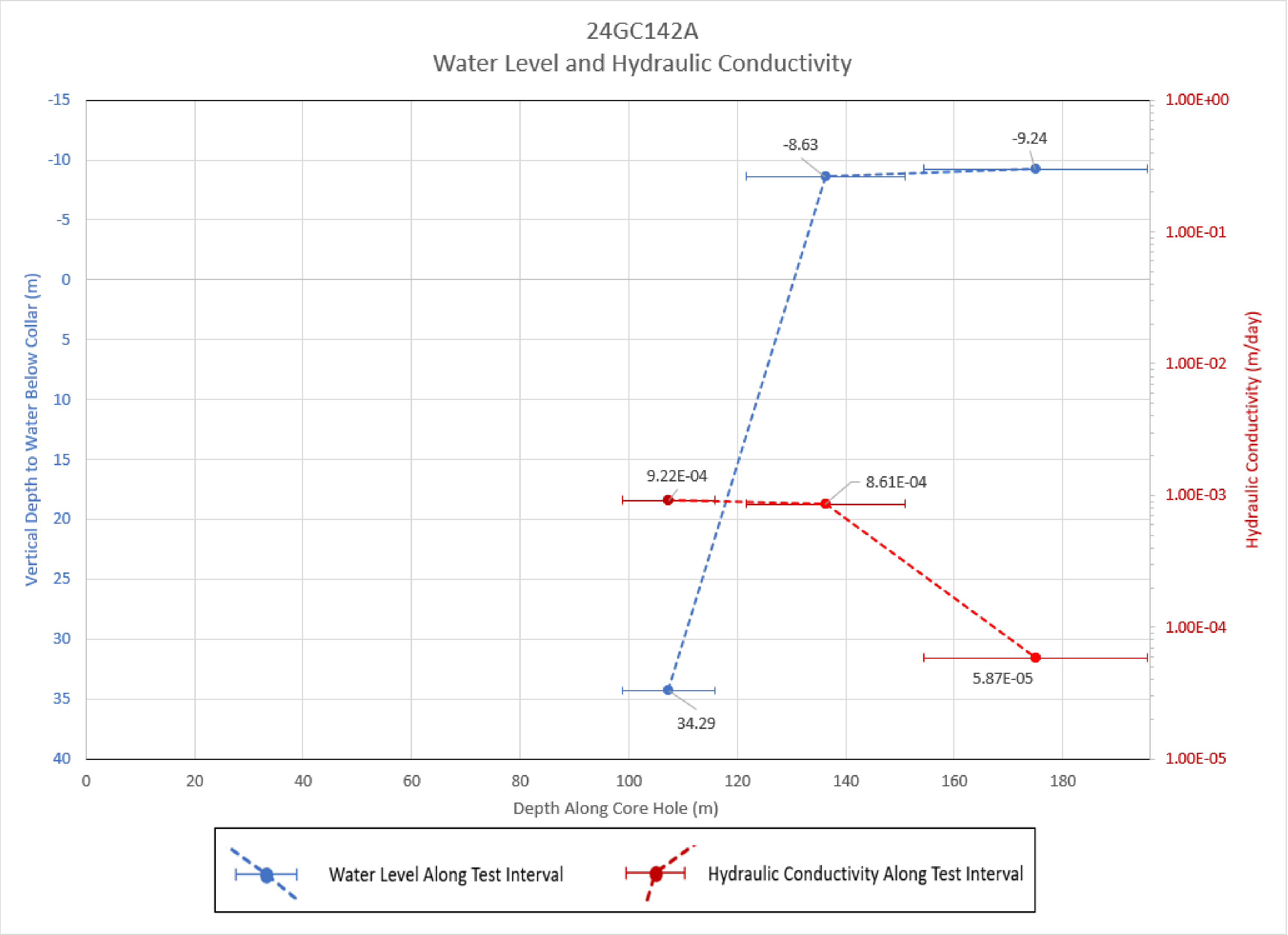

23GC094
Water Level and Hydraulic Conductivity
Vertical Depth to Water Below Collar (m)
-20
-15
-10
-5
0
5
10
15
Hydraulic Conductivity (m/day)
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.00E-06
1.00E-07
0
20
40
60
80
100
120
140
160
180
Depth Along Core Hole (m)
2.70E-03
5.11E-03
1.45E-03
1.10E-04
-3.7
-0.4
3.4
9.7
Water Level Along Test Interval
Hydraulic Conductivity Along Test Interval



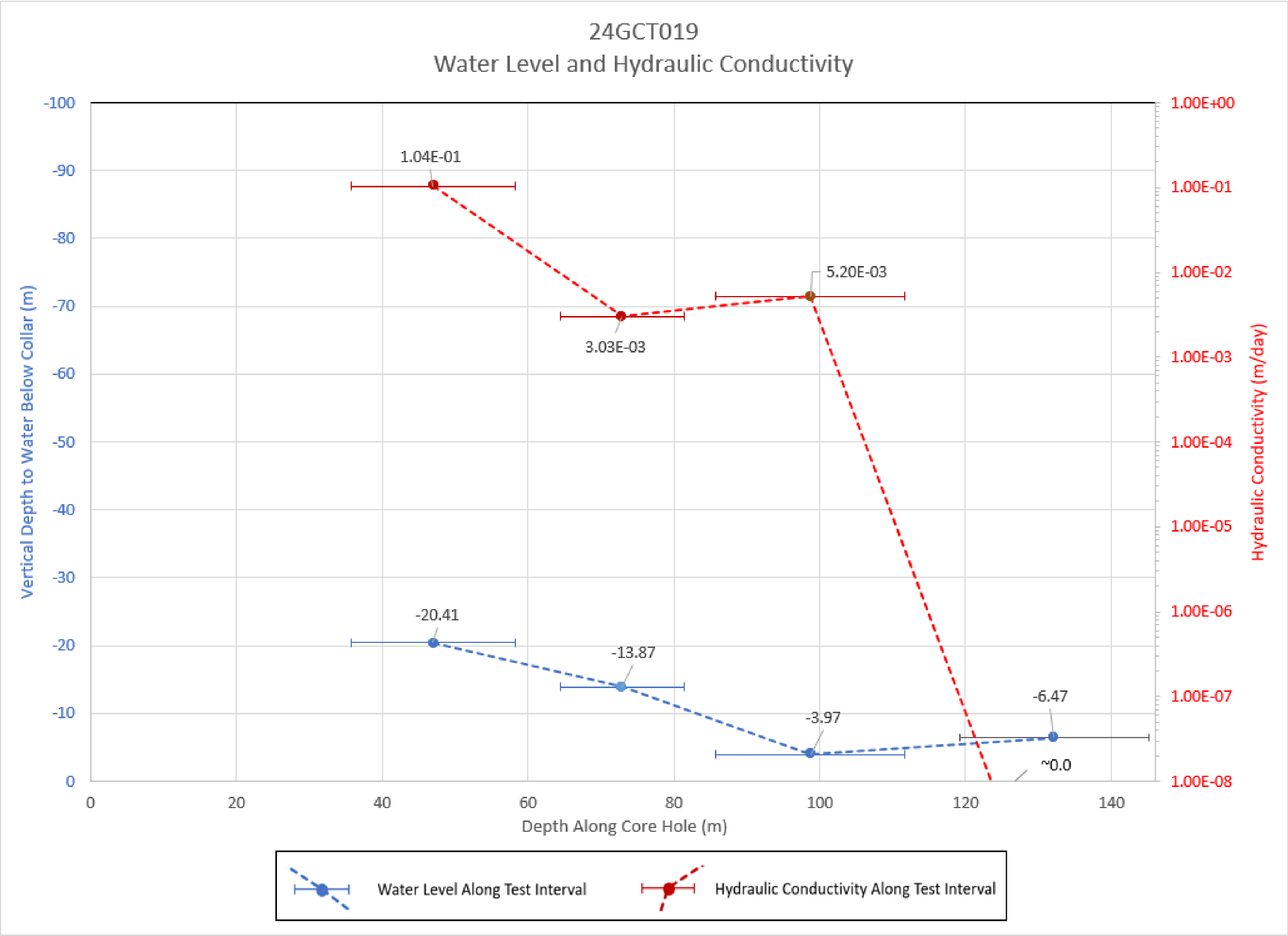
23GC099
Water Level and Hydraulic Conductivity
Vertical Depth to Water Below Collar (m)
-20
-15
-10
-5
0
5
10
Hydraulic Conductivity (m/day)
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
Depth Along Core Hole (m)
0
20
40
60
80
100
120
140
160
1.60E-01
-10.6
2.41E-02
1.36E-02
4.0
5.2
Water Level Along Test Interval
Hydraulic Conductivity Along Test Interval



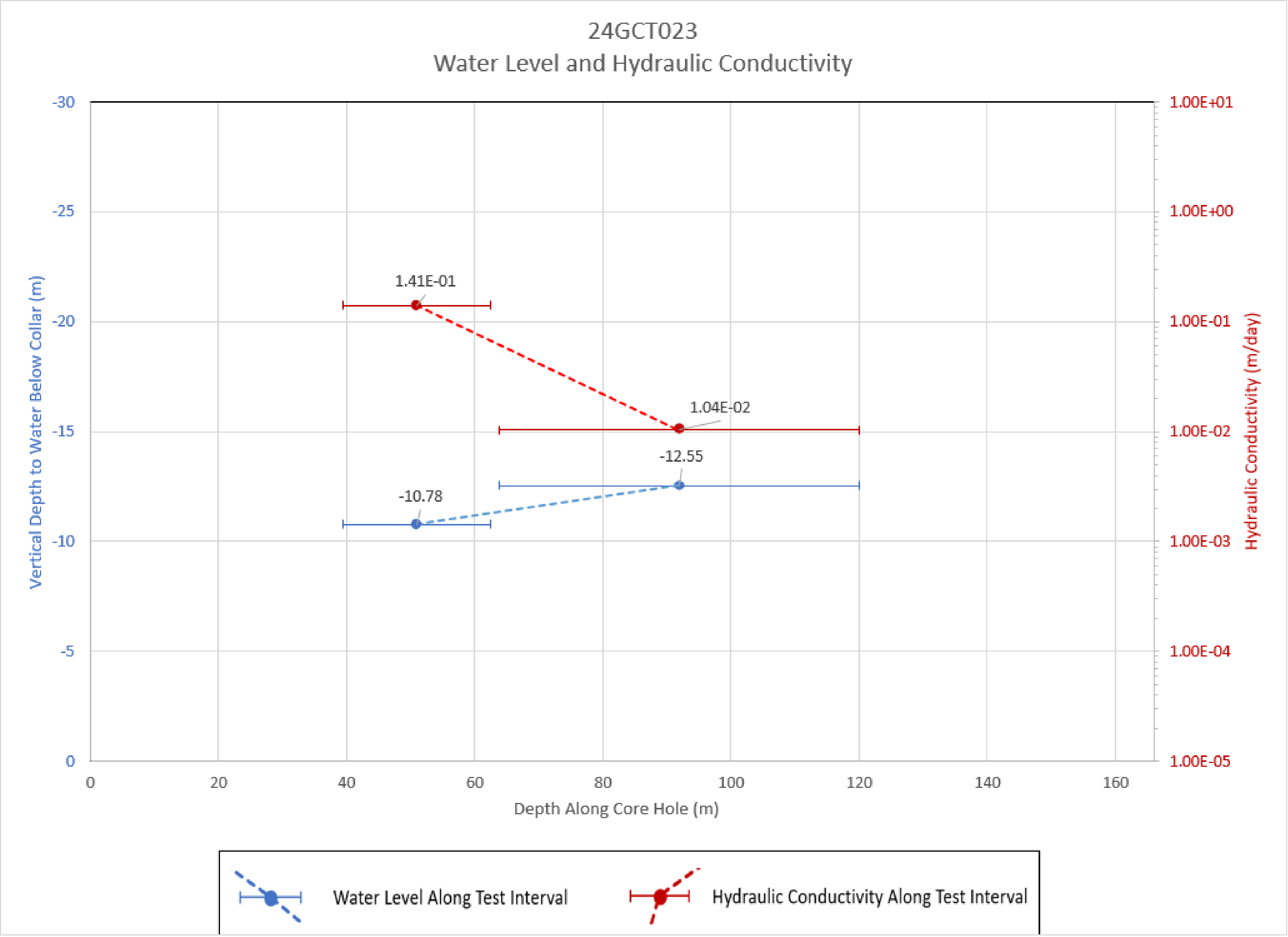
23GC100
Water Level and Hydraulic Conductivity
-25
-20
-15
-10
-5
0
Vertical Depth to Water Below Collar (m)
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.00E-06
Hydraulic Conductivity (m/day)
7.17E-02
2.17E-02
1.71E-03
2.00E-03
-13.4
-13.9
-4.9
-0.4
0
50
100
150
200
Depth Along Core Hole (m)
Water Level Along Test Interval
Hydraulic Conductivity Along Test Interval



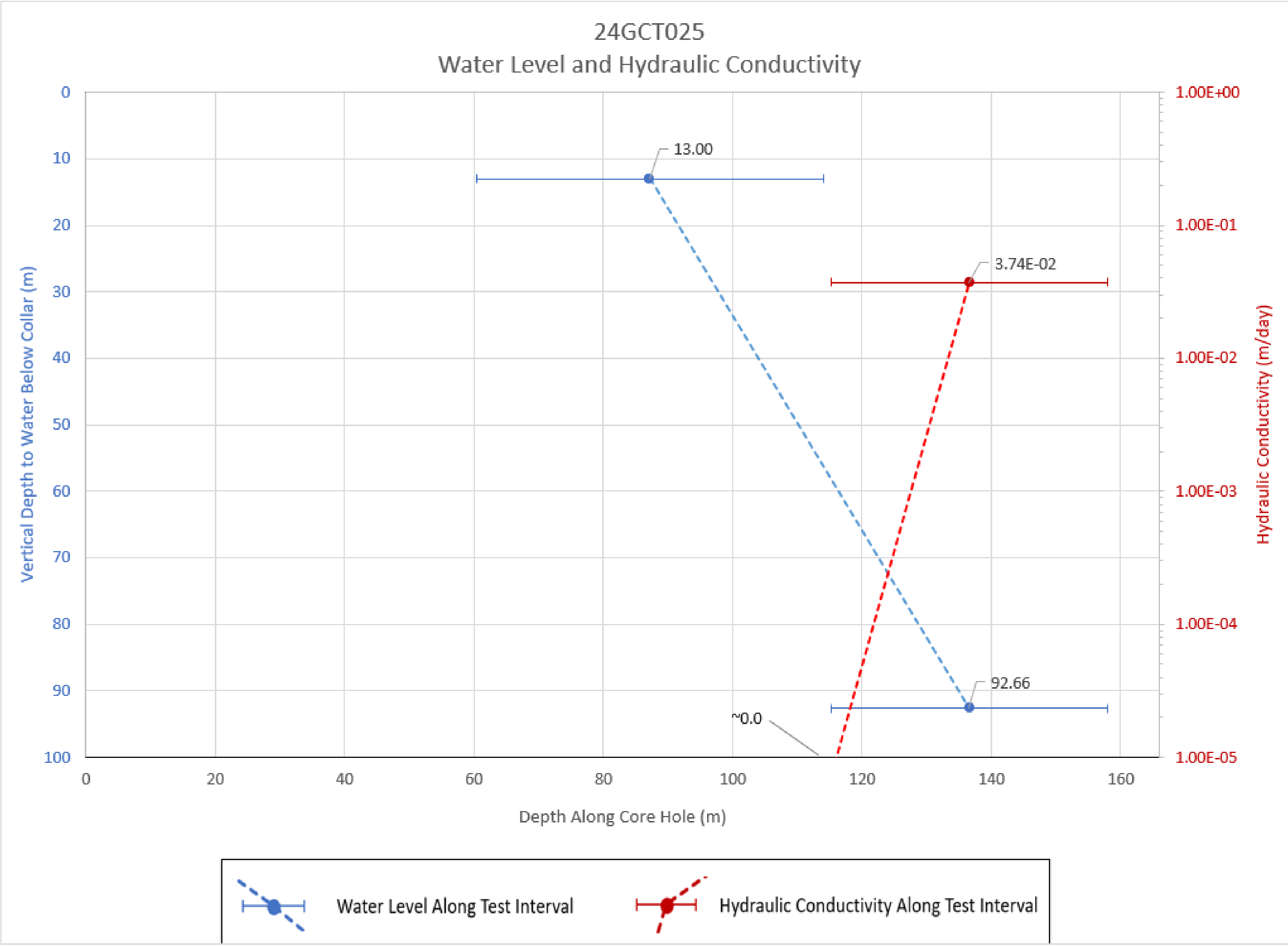
24GC142A
Water Level and Hydraulic Conductivity
Vertical Depth to Water Below Collar (m)
-15
-10
-5
0
5
10
15
20
25
30
35
40
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
Hydraulic Conductivity (m/day)
-8.63
-9.24
9.22E-04
8.61E-04
5.87E-05
34.29
0
20
40
60
80
100
120
140
160
180
Depth Along Core Hole (m)
Water Level Along Test Interval
Hydraulic Conductivity Along Test Interval



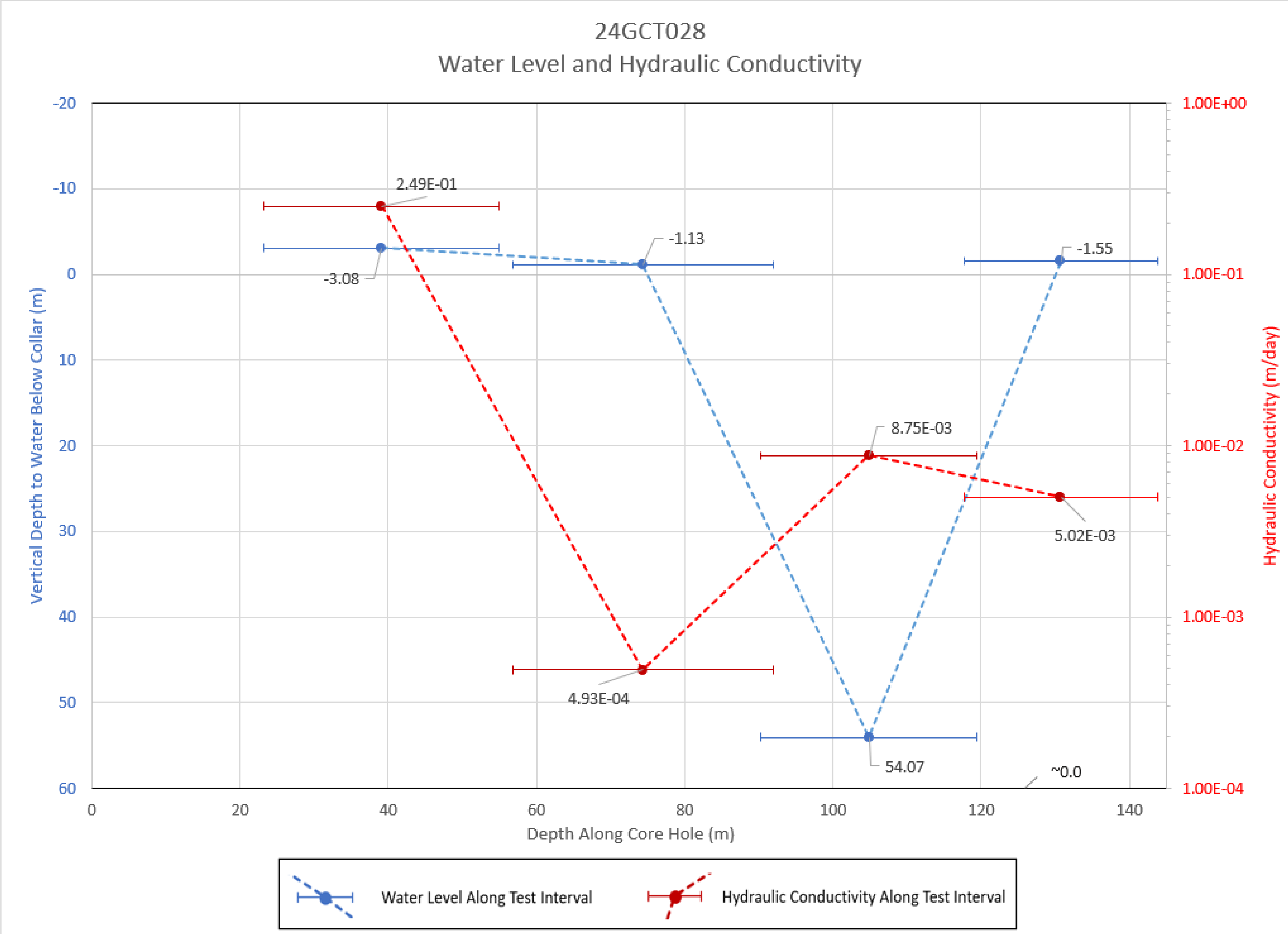
24GCT019
Water Level and Hydraulic Conductivity
Vertical Depth to Water Below Collar (m)
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
Hydraulic Conductivity (m/day)
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.00E-06
1.00E-07
1.00E-08
Depth Along Core Hole (m)
0
20
40
60
80
100
120
140
1.04E-01
3.03E-03
5.20E-03
-20.41
-13.87
-3.97
-6.47
~0.0
Water Level Along Test Interval
Hydraulic Conductivity Along Test Interval

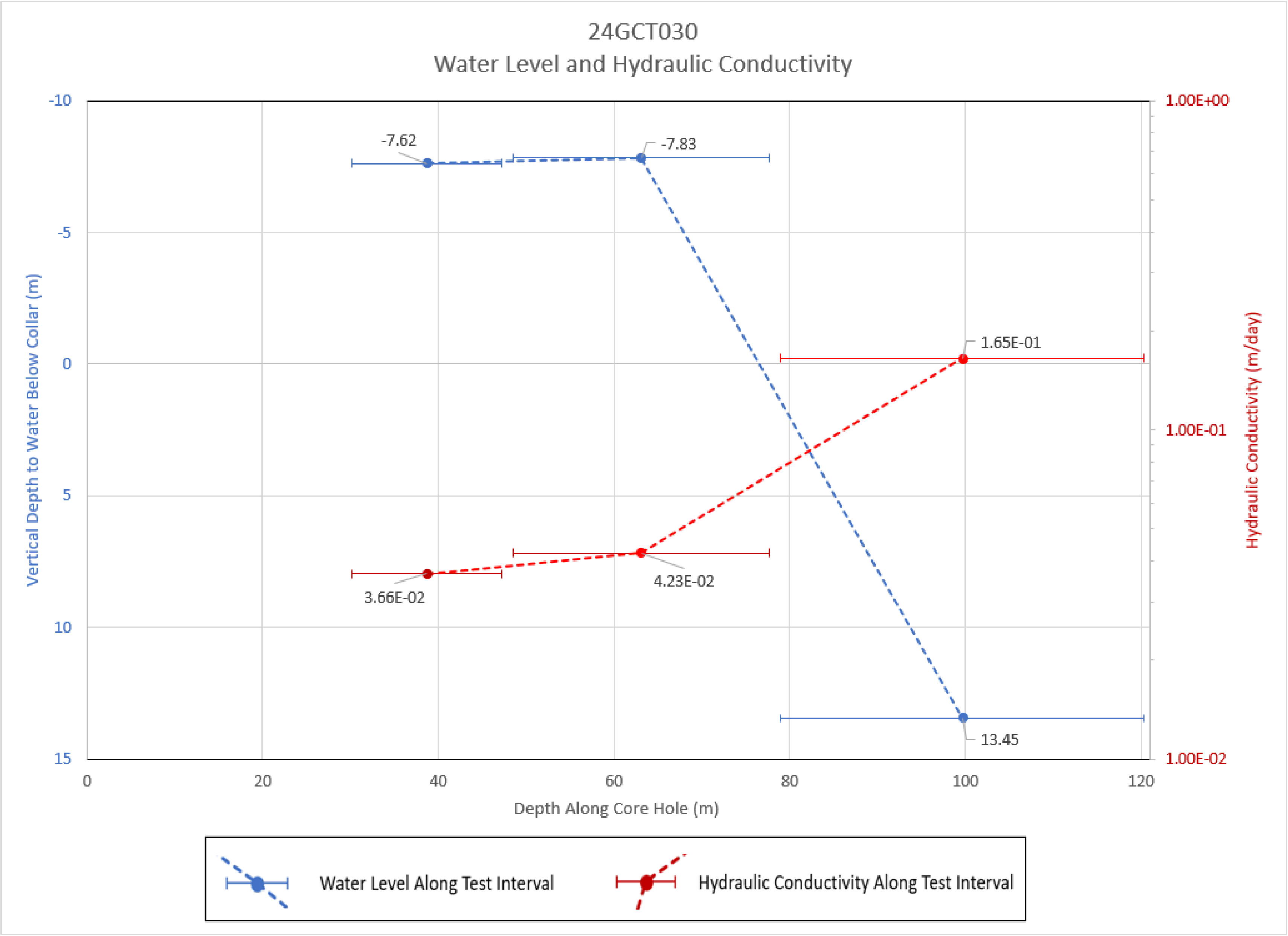


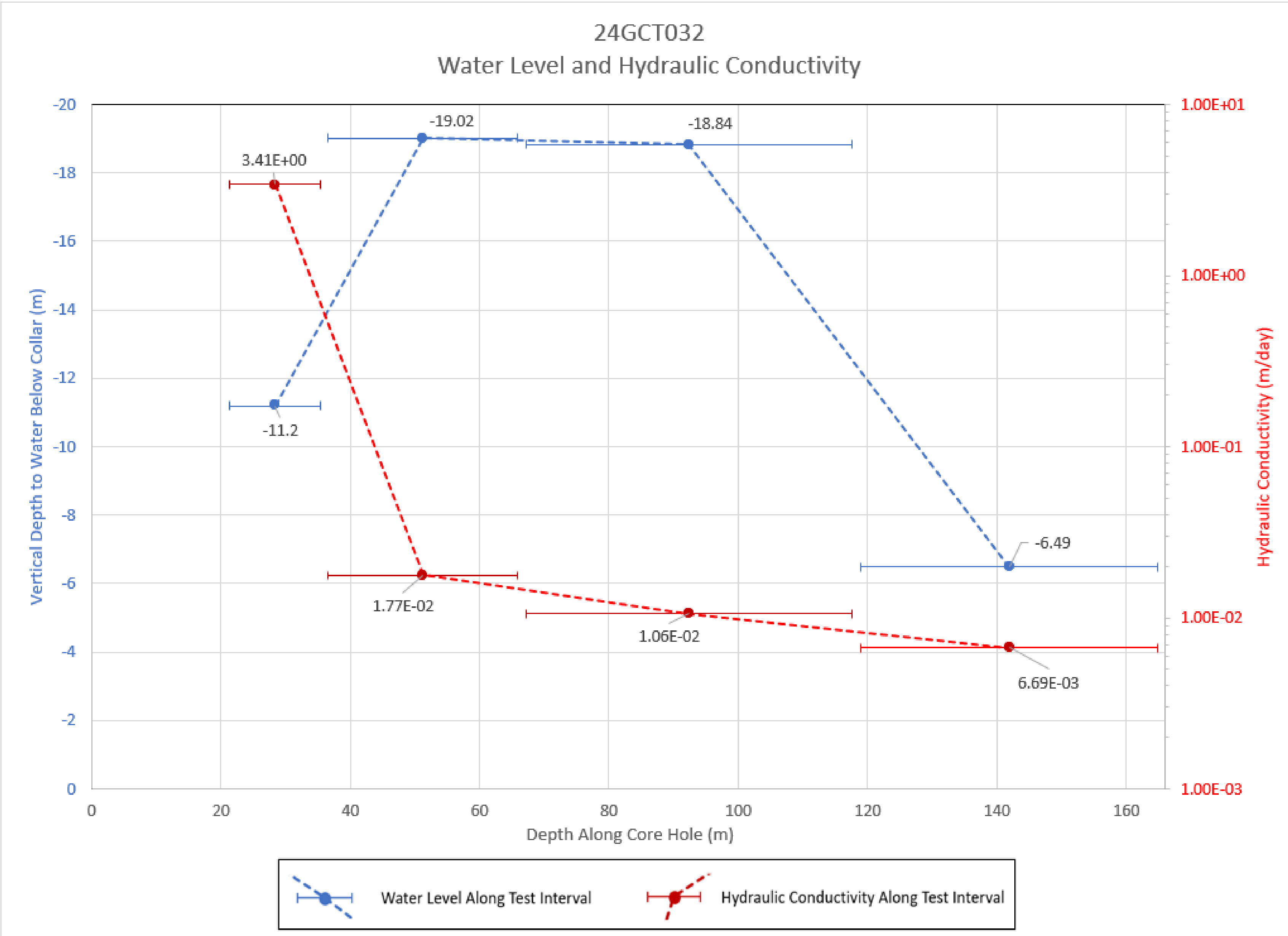
24GCT023
Water Level and Hydraulic Conductivity
Vertical Depth to Water Below Collar (m)
-30
-25
-20
-15
-10
-5
0
Hydraulic Conductivity (m/day)
1.00E+01
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.41E-01
1.04E-02
-12.55
-10.78
0
20
40
60
80
100
120
140
160
Depth Along Core Hole (m)
Water Level Along Test Interval
Hydraulic Conductivity Along Test Interval



24GCT025
Water Level and Hydraulic Conductivity
Vertical Depth to Water Below Collar (m)
Hydraulic Conductivity (m/day)
Depth Along Core Hole (m)
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100
120
140
160
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
13.00
3.74E-02
92.66
~0.0
Water Level Along Test Interval
Hydraulic Conductivity Along Test Interval

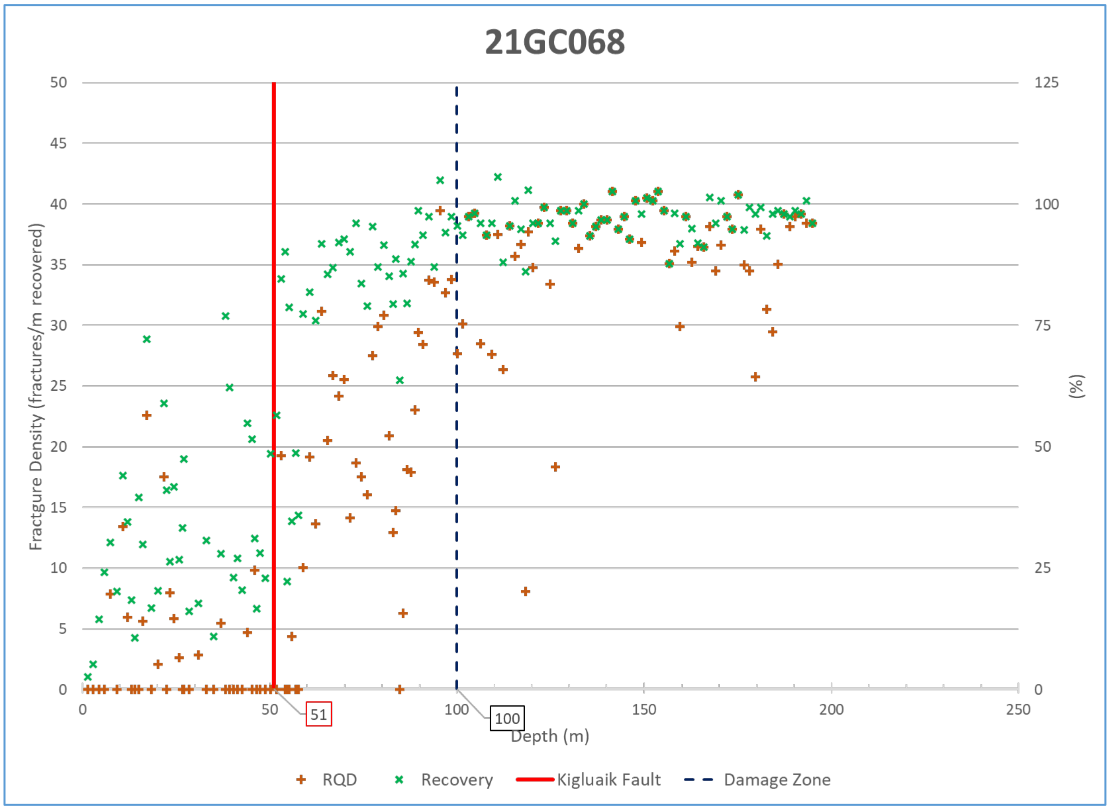

24GCT028
Water Level and Hydraulic Conductivity
-20
-10
0
10
20
30
40
50
60
Vertical Depth to Water Below Collar (m)
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
Hydraulic Conductivity (m/day)
0
20
40
60
80
100
120
140
Depth Along Core Hole (m)
2.49E-01
-3.08
-1.13
-1.55
8.75E-03
5.02E-03
4.93E-04
54.07
~0.0
Water Level Along Test Interval
Hydraulic Conductivity Along Test Interval

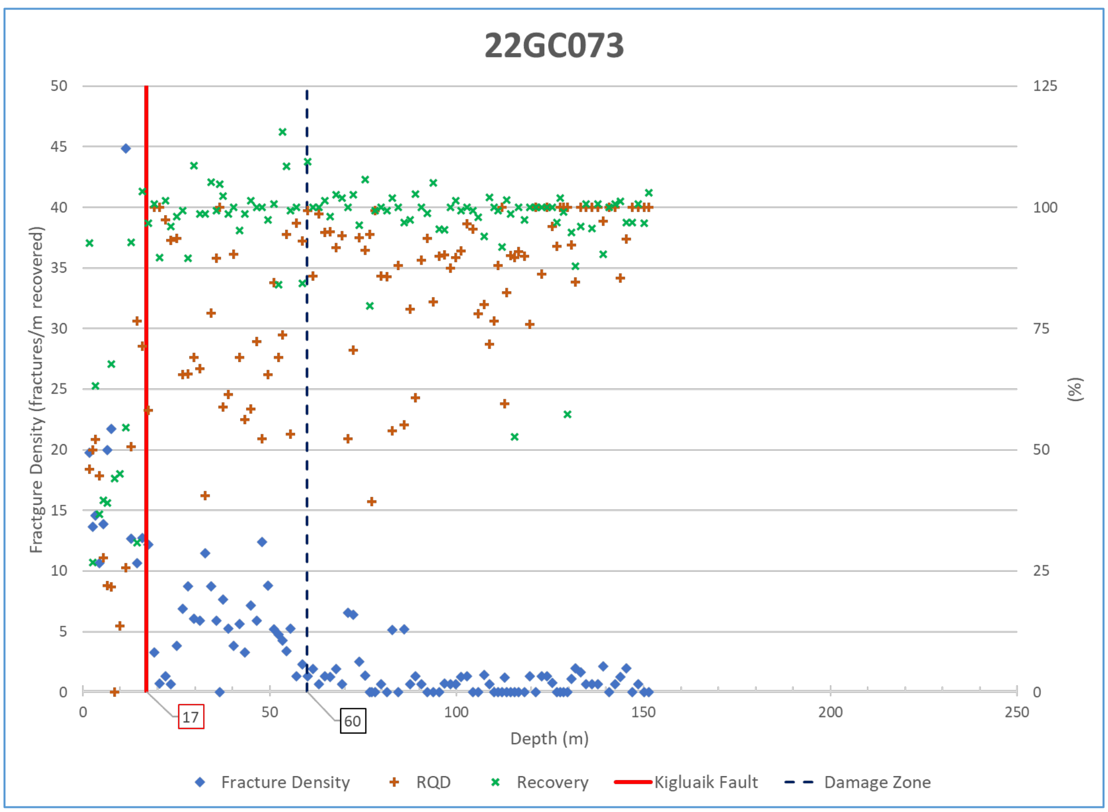

24GCT030
Water Level and Hydraulic Conductivity
Vertical Depth to Water Below Collar (m)
-10
-5
0
5
10
15
Hydraulic Conductivity (m/day)
1.00E+00
1.00E-01
1.00E-02
Depth Along Core Hole (m)
0
20
40
60
80
100
120
-7.62
-7.83
13.45
3.66E-02
4.23E-02
1.65E-01
Water Level Along Test Interval
Hydraulic Conductivity Along Test Interval

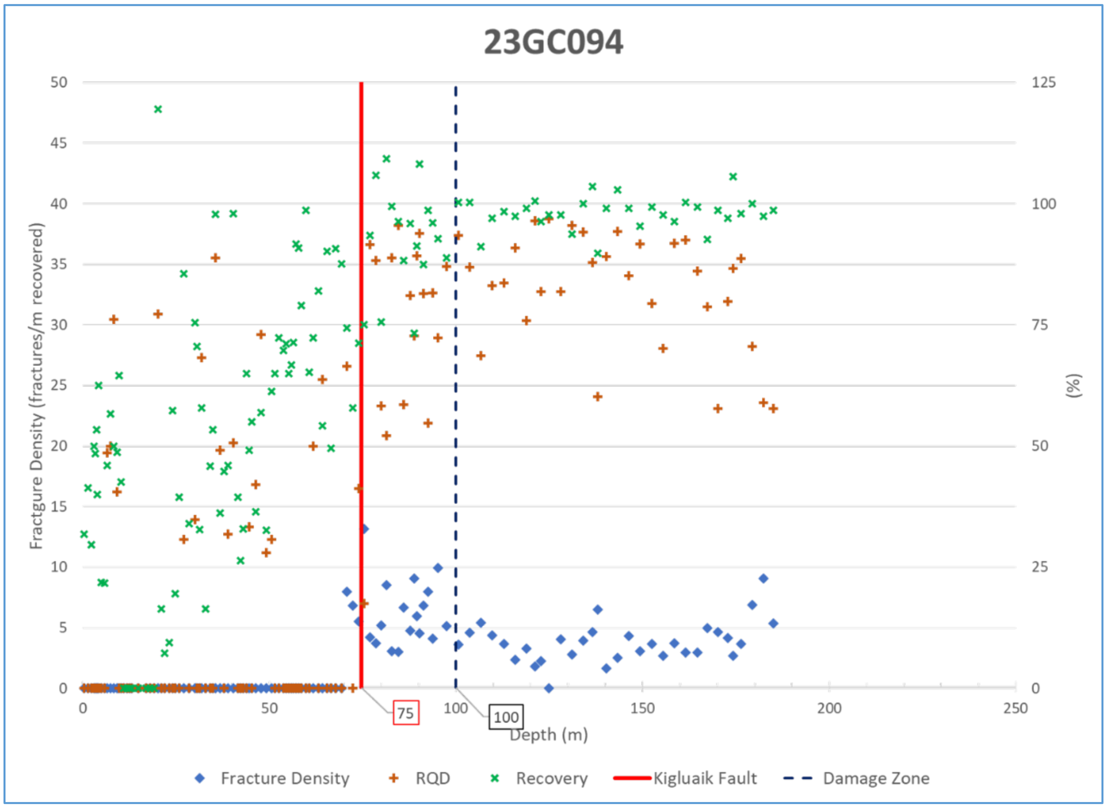

24GCT032
Water Level and Hydraulic Conductivity
Vertical Depth to Water Below Collar (m)
Hydraulic Conductivity (m/day)
Depth Along Core Hole (m)
-20
-18
-16
-14
-12
-10
-8
-6
-4
-2
0
1.00E+01
1.00E+00
1.00E-01
1.00E-02
1.00E-03
0
20
40
60
80
100
120
140
160
-19.02
-18.84
-11.2
-6.49
3.41E+00
1.77E-02
1.06E-02
6.69E-03
Water Level Along Test Interval
Hydraulic Conductivity Along Test Interval

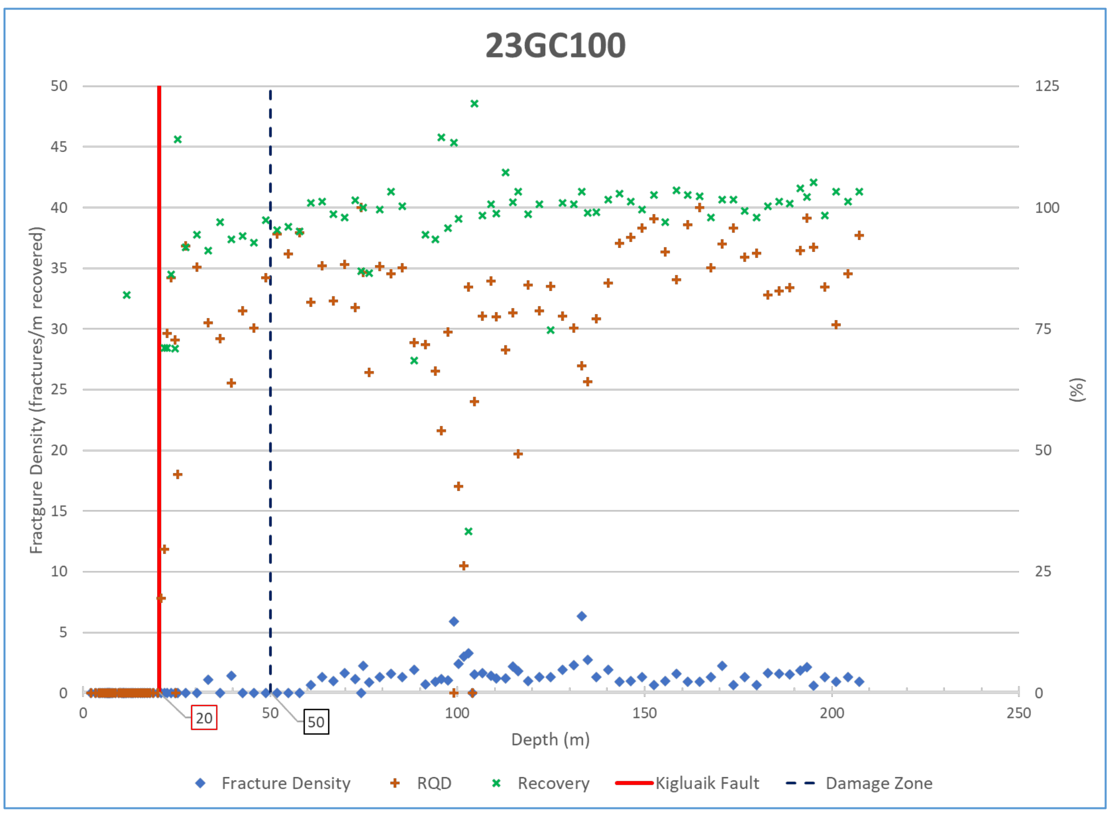
Appendix G. Bedrock Unit, Geotechnical Analysis

G1 – Damage Zone

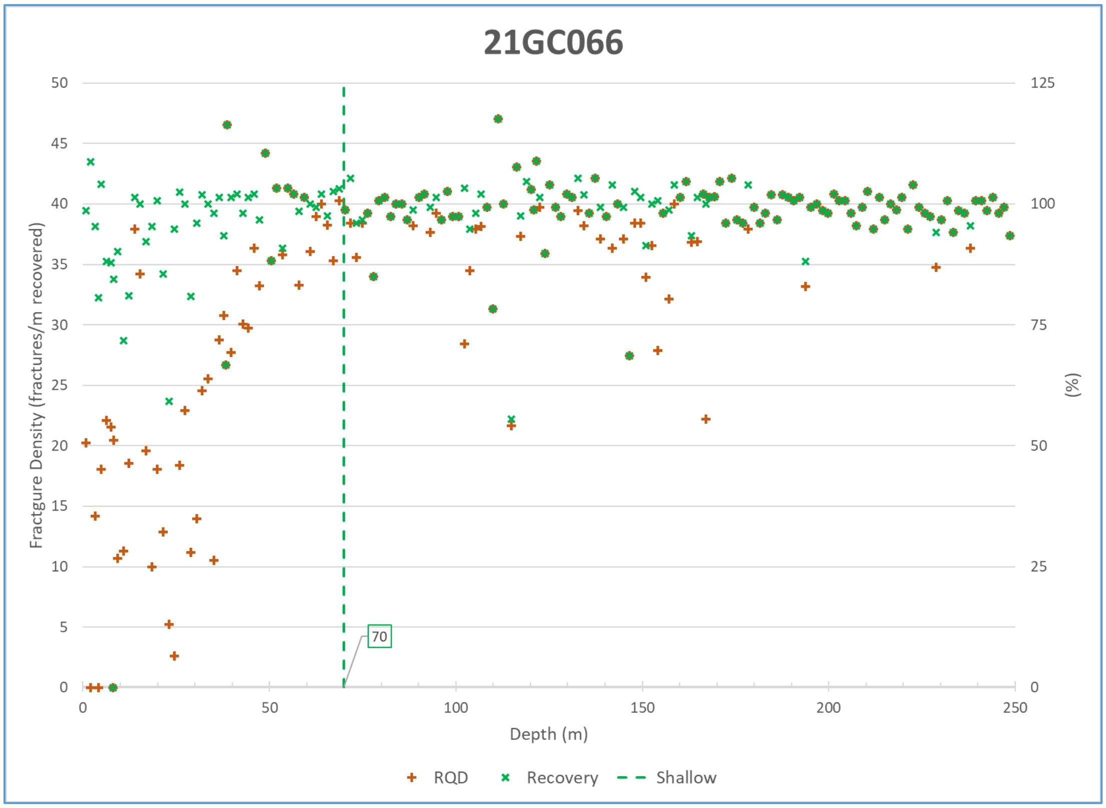

21GC068
Fractgure Density (fractures/m recovered)
(%)
Depth (m)
51
100
RQD
Recovery
Kigluaik Fault
Damage Zone

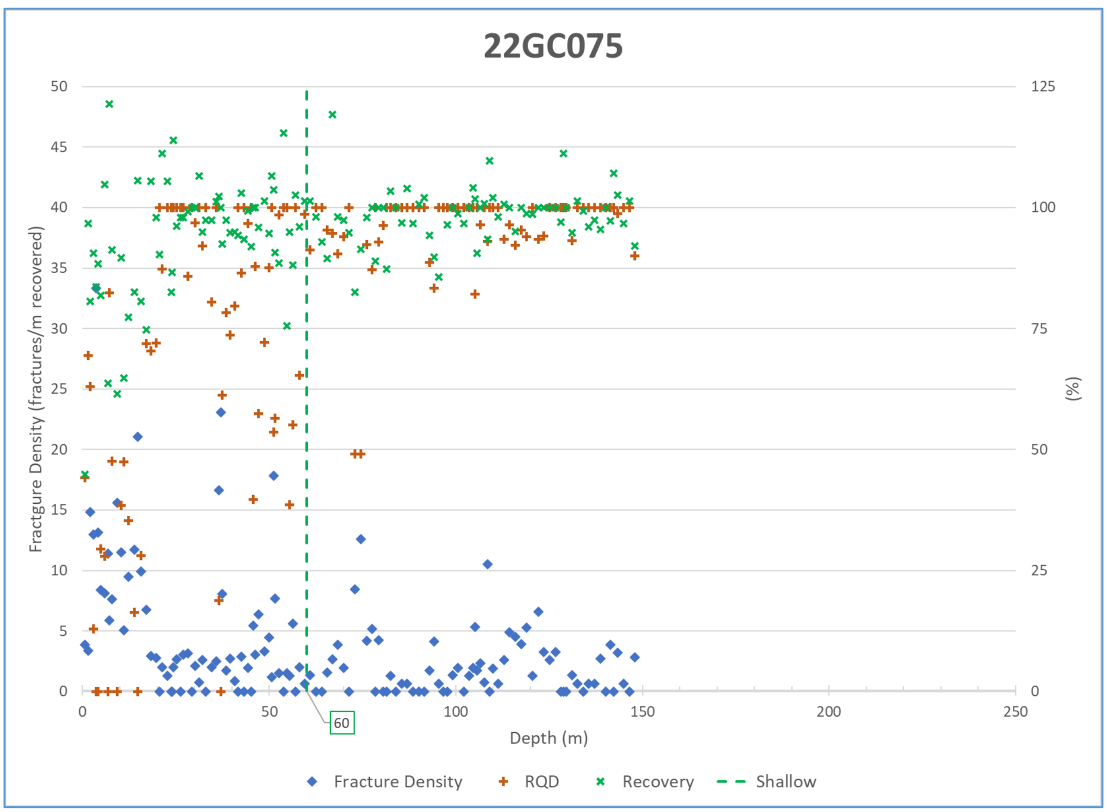

22GC073
Fractgure Density (fractures/m recovered)
(%)
Depth (m)
17
60
Fracture Density
RQD
Recovery
Kigluaik Fault
Damage Zone

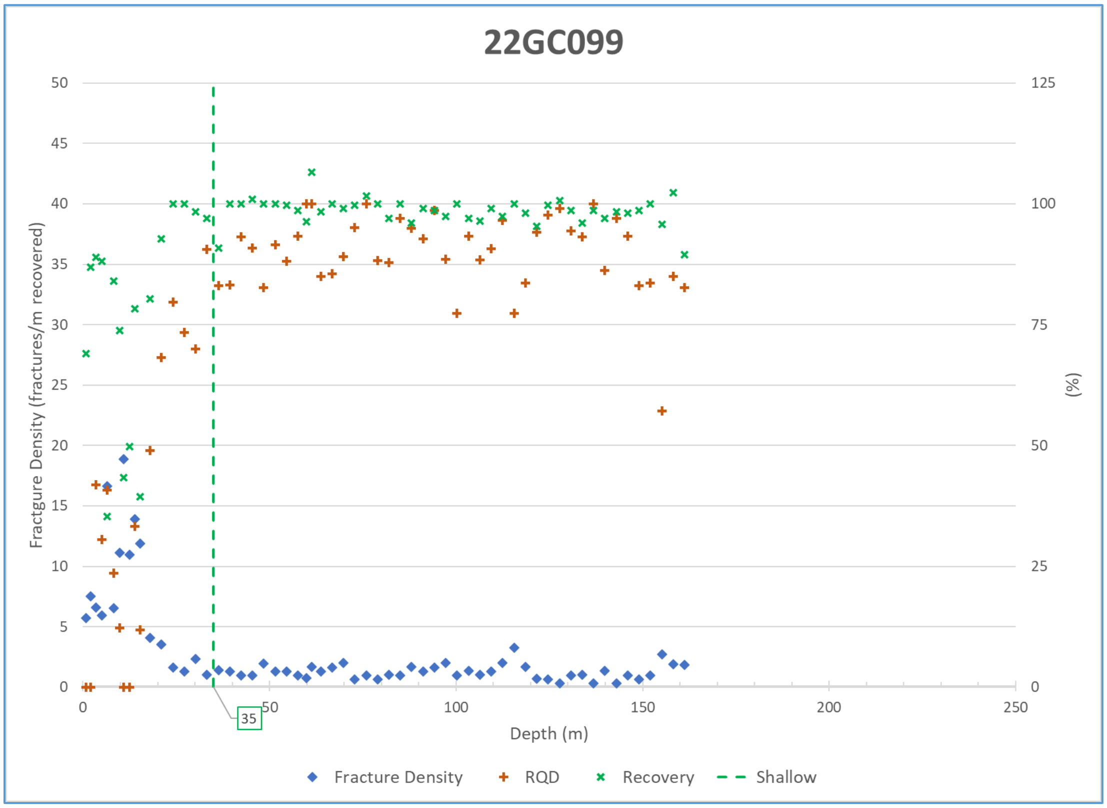

23GC094
Fractgure Density (fractures/m recovered)
(%)
Depth (m)
75
100
Fracture Density
RQD
Recovery
Kigluaik Fault
Damage Zone

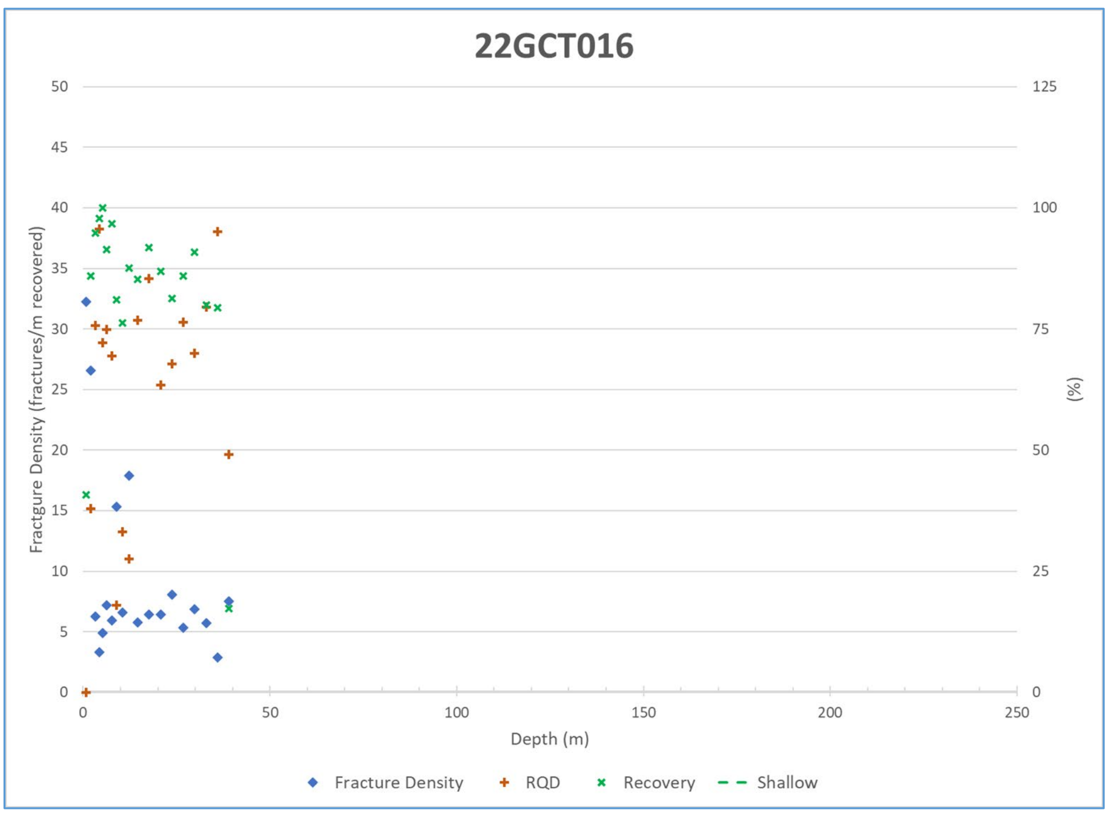

23GC100
Fractgure Density (fractures/m recovered)
(%)
Depth (m)
20
50
Fracture Density
RQD
Recovery
Kigluaik Fault
Damage Zone

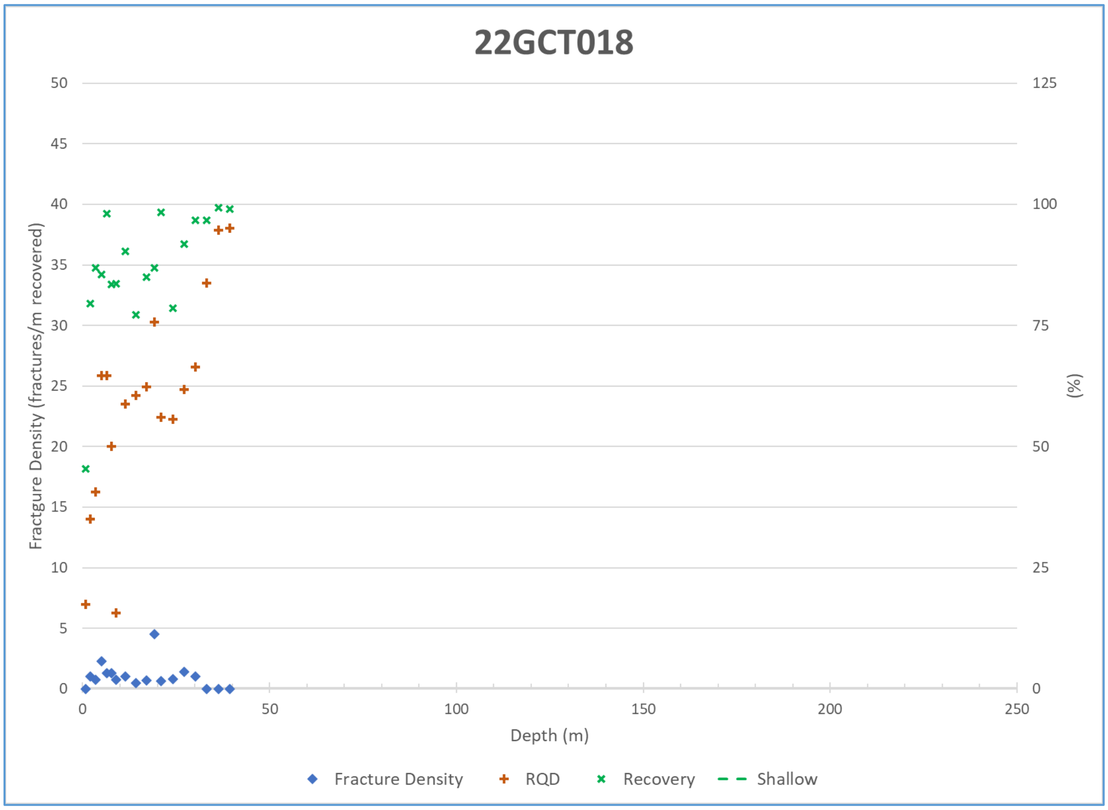
G2 – Shallow Bedrock


21GC066
Fractgure Density (fractures/m recovered)
(%)
Depth (m)
70
RQD
Recovery
Shallow


22GC075
Fractgure Density (fractures/m recovered)
(%)
Depth (m)
60
Fracture Density
RQD
Recovery
Shallow


22GC099
Fractgure Density (fractures/m recovered)
(%)
Depth (m)
35
Fracture Density
RQD
Recovery
Shallow


22GCT016
Fractgure Density (fractures/m recovered)
(%)
Depth (m)
Fracture Density
RQD
Recovery
Shallow


22GCT018
Fractgure Density (fractures/m recovered)
(%)
Depth (m)
50
45
40
35
30
25
20
15
10
5
0
125
100
75
50
25
0
0
50
100
150
200
250
Fracture Density
RQD
Recovery
Shallow