2017 Hydrogeology Report

Palmer Exploration Project

Prepared For

Constantine North, Inc.
124 3rd Avenue South
Haines, AK 99827

February 23, 2018

Prepared by
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Executive Summary

The Palmer Exploration Project is a polymetallic, volcanogenic massive sulfide (VMS) deposit located 60 km (37 miles) northeast of Haines, Alaska. After many years of exploration drilling from the surface, Constantine North, Inc. (CNI), the operator, is considering the possibility of underground exploration drilling focused on the South Wall (SW) deposit. Hydrogeological investigations have been ongoing since 2014 with two objectives: develop the understanding of the property to support pre-feasibility and feasibility level characterization, and to estimate the potential water flow rate from an adit, if one were to be driven. The objective of the work performed in 2017 was to estimate the potential water flow rate from the Option 7 adit.

The Option 7 adit conceptual design calls for a portal at the head of the Glacier Creek valley, adjacent to the terminus of the Saksaia Glacier. The adit includes an inclined, 1612-meter (m) access ramp and 400 m drilling drift. The first 1250 m of the ramp is projected to be in Jasper Mountain Basalt, a competent unit with few faults. The ramp then progresses through the “transition unit,” a mix of basalt and metasediment; the Kudo Fault Zone, a major sub-vertical fault zone; and terminates in the Hanging Wall Basalt, which consists of variably faulted basalt and lesser metasediment. The drilling drift is in the Hanging Wall Basalt.

Hydraulic testing in 2017 included 19 packer isolated interval tests (“packer tests”) and one 52-day flow/shut-in test. The packer tests were conducted in three drillholes located near the alignment of the first half of the adit and provide high-quality data for the Jasper Mountain Basalt. Three additional packer tests were performed in a fourth drillhole with one test each in the Hanging Wall Basalt, the SW ore zone, and in the footwall schist. Hydraulic conductivity (K) values from the packer tests ranged from 5.51 x 10-6 meters per day (m/d) to 7.10 x 10-1 m/d for the Jasper Mountain Basalt and a single value of 6.35 m/d for the Hanging Wall Basalt. Data analysis indicates that the Jasper Mountain Basalt can be subdivided into two units; a shallow unit (less than 110 m below the ground surface) that has an average K of 0.102 m/d, and the remainder of the Jasper Mountain Basalt which has a K of 4.34 x 10-4 m/d.

The hydrogeological conceptual model summarizes the current understanding of the hydrogeology at the site. Hydraulic conductivity is dominantly controlled by faults and fracture zones where the K is high while the competent rock is characterized by low K. The adit would intersect three hydrogeological domains: the low K Jasper Mountain domain, the high K Kudo Fault Zone, and the intermediate K South Wall domain which includes the Hanging Wall Basalt.

A transient analytical flow model developed by Perrochet and Dematteis (2007) was applied to estimate flow from the Option 7 adit. The method incrementally estimates flow as the adit is advanced. The analysis is most sensitive to K and pressure head above the adit (i.e., saturated thickness above the adit) and is less sensitive to the storage capacity of the rocks and the adit radius. Reasonably robust data is available for the first 1250 m of the adit (Jasper Mountain Basalt) which would take almost a year to mine. The estimated flow for this portion of the adit would peak at approximately 13 L/s (200 gpm) and settle at a sustained rate of approximately 10 L/s (160 gpm) during the first year of adit development. It should be noted that short-term higher flow rates will likely occur from faults and fracture zones. Insufficient data is available to perform a flow estimation for the remainder of the adit. However, based on the hydrogeological model and the available data for the Hanging Wall Basalt, a high flow rate is expected.

Tundra recommends that hydraulic testing be performed in a pilot hole drilled parallel to the alignment of the adit as the early portion of the adit is advanced. The test results should be used in the analytical analysis to estimate the flow rates that may be encountered in the remainder of the adit.

There is limited space available for construction of facilities to manage the water that may be discharged from the Option 7 adit. The conceptual plan includes settling ponds and a land application disposal (LAD) system. Tundra recommends that the design maximize the flow rate capacity of these facilities. Tundra also recommends that the predicted flow rates and water disposal design capacity be used as inputs to the adit grouting plan.

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Glossary of Acronyms and Technical Terms

BOP – blow-out preventer, a device that prevents uncontrolled release of fluids from a wheel due to excess pressure

btoc – below top of casing

cm – centimeters

CNI – Constantine North, Inc.

d - day

^{o} - degrees

El - elevation

ft – feet or foot

flow/shut-in test – Similar to a pumping test, but performed on a flowing artesian well, the test is performed by allowing the well to flow and measuring the change in flow rate over time and then stopping the flow (shut-in) and measuring the change in pressure over time

flowing artesian well – A well from which water naturally flows from the well head. A well where the piezometric surface is higher than the ground surface.

gpm – gallons per minute

g – gallons

HWT – drillhole casing with nominal diameter of 11 cm

HQ – drill tool with hole size of 9.6 cm and rod inside diameter of 7.78 cm

in – inches

IPI – Inflatable Packers International

K – hydraulic conductivity – The rate at which water flows through a unit cross-sectional area of an aquifer, typically expressed as distance per time (e.g., m/d).

km – kilometers

kPa – kilopascals

L - liters

m – meters

mi – miles

mamsl – meters above mean sea level

mbgs – meters below ground surface

NQ – drill tool with hole size of 7.5 cm and rod inside diameter of 6.0 cm

psi – pounds per square inch

PVC – polyvinyl chloride, a type of plastic used to make pipe

s – second

SPI test – stepped pressure injection test

St Dev = standard deviation

SW – South Wall; one of the prospects at the Palmer Project

SWiPS – Standard Wireline Packer System

T – transmissivity – The rate at which water flows through a unit cross-sectional area of an aquifer multiplied by the thickness of the aquifer. The units are typically in volume per time per distance in imperial (i.e. g/d/ft) and reduced to area per time in metric (i.e, m^2/d). Transmissivity is often used to describe flow into a well screen (or a drift).

TDX – transducer

Tundra – Tundra Consulting, LLC

VMS – volcanogenic massive sulfides; a type of mineral deposit

yr - year

1 Introduction

Hydrogeological investigations have been ongoing at Constantine North, Inc.'s (CNI) Palmer Exploration Project since 2014. CNI requested that Tundra Consulting, LLC (Tundra) continue the evaluation in 2017. This report presents the results of the 2017 work and updates the conceptual hydrogeological model. The focus of the 2017 effort was to estimate the water flow rate from the Option 7 adit.

2 Background and Scope of Work

CNI is advancing exploration to the preliminary economic assessment stage with an emphasis on exploration drilling. Drilling is very challenging at the Palmer Project due to the steep, rugged terrain and the near vertical dip of the South Wall (SW) mineralized zone, which is the current resource area. CNI is considering the possibility of driving an exploration adit to allow more efficient drilling from underground. Hydrogeological studies were begun in 2014 to gain a preliminary understanding of the amount of water that might be encountered. The primary activity in 2014 was the drilling of a sub-horizontal well, GT14-01 (also unknown as U6[1]). In addition, transducers were installed in six monitoring wells in October 2014 to begin baseline groundwater-level monitoring. Hydrogeological work continued in 2016 with a long-term flow/shut-in test of the CMR14-01 well and modeling of water flow.

In 2017, CNI requested that Tundra model flow from a potential adit location at the head of Glacier Creek (Option 7 adit). Tundra's scope of work included the following:

- Perform packer isolated-interval hydraulic tests ("packer tests") to characterize the flow properties of hydrogeological units that would be intercepted in the potential adit
- Perform additional flow/shut-in tests if reasonable
- Continue the groundwater-level monitoring program (reported in Tundra 2017b)
- Update the hydrogeological conceptual model
- Use the results of the hydrogeological work and the conceptual model to estimate the flow rate of water from the potential Option 7 adit

3 Work Program

The project team members and their roles include:

- Steve Teller, Principal, Tundra – Project Manager, planning and design, field installation, test execution, quality control, reporting
- Larry Cope, Principal Consultant, SRK Consulting, Inc. – senior hydrogeology expertise, test analysis, flow prediction, reporting
- Geoffrey Baldwin, Consultant, SRK – packer test execution, mathematical analysis and modeling of inflow

Mr. Teller and Mr. Cope have worked together on the Palmer hydrogeology program since the beginning in 2014. Mr. Baldwin joined the project in 2016.

[1] It is customary at the Palmer project to refer to the monitoring wells by their pad name.

The 2017 program was planned by Mr. Teller and Mr. Cope in coordination with Darwin Green of CNI. Mr. Teller and Mr. Baldwin performed the majority of the field work from approximately June 20 to July 17 in conjunction with other project activities. Mr. Baldwin returned to the site from July 31 to August 3 for testing of CMR17-97. The long-term flow/shut-in test at GT17-05 was started on July 17, and Mr. Teller returned to the site from September 6 to 8 to finish the test, to install a new plug system in that well, and to plug CMR15-76. Monitoring well transducers were downloaded on July 10 by Mr. Teller and Allegra Cairns (CNI) and by Mr. Teller on September 8. CNI staff aided in the flow/shut-in test execution.

4 Project Setting

The Palmer project is located approximately 60 km (37 mi) northeast of Haines, Alaska (Figure 4-1). The project area is in steep, mountainous terrain with 1,200 m (4,000 ft) of relief and numerous glaciers. The climate is temperate rain forest with average precipitation of 119 cm (47 in; ACRC 2014), approximately two-thirds of which occurs as snow.

The prospects are volcanogenic massive sulfides (VMS) that occur in basalt, calcareous siltstone, tuff, and rare rhyolite flows and dikes that have been metamorphosed to lower- to mid-greenschist facies (Greig and Giroux 2010). Three deformational episodes have been recognized. Pillow and amygdaloidal basalts were deposited above the mineralization. The current resource area, the South Wall (SW) deposit, is in the steeply dipping, overturned limb of an overturned anticline. There have been numerous episodes of faulting. A low-angle thrust fault has been identified near the axis of the anticline. Due to folding, the hanging wall basalts are located topographically below the ore zone. High-angle faults cut the deposit, but generally do not have large offsets in the SW area. The exception is the Kudo Fault Zone, which is a major fault with an unknown amount of offset.

The Option 7 adit would be located at the head of the Glacier Creek valley, adjacent to the terminus of the Saksaia Glacier (Figure 4-2). The adit would approach the SW deposit from the south. It is collared in basalt and crosses the Kudo Fault Zone into the overturned basalt on the hanging wall side of the deposit.

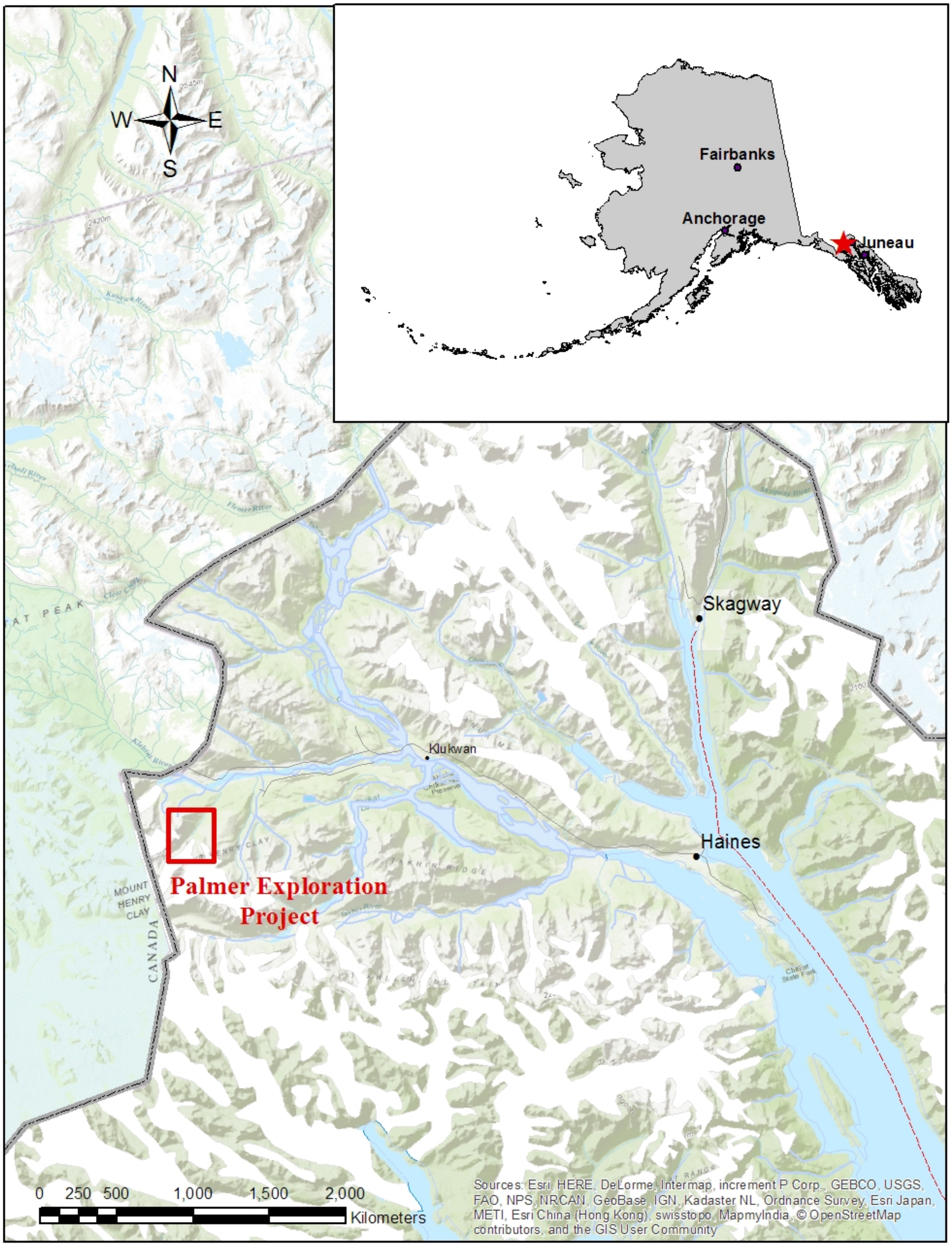


Figure 4-1. Project location map

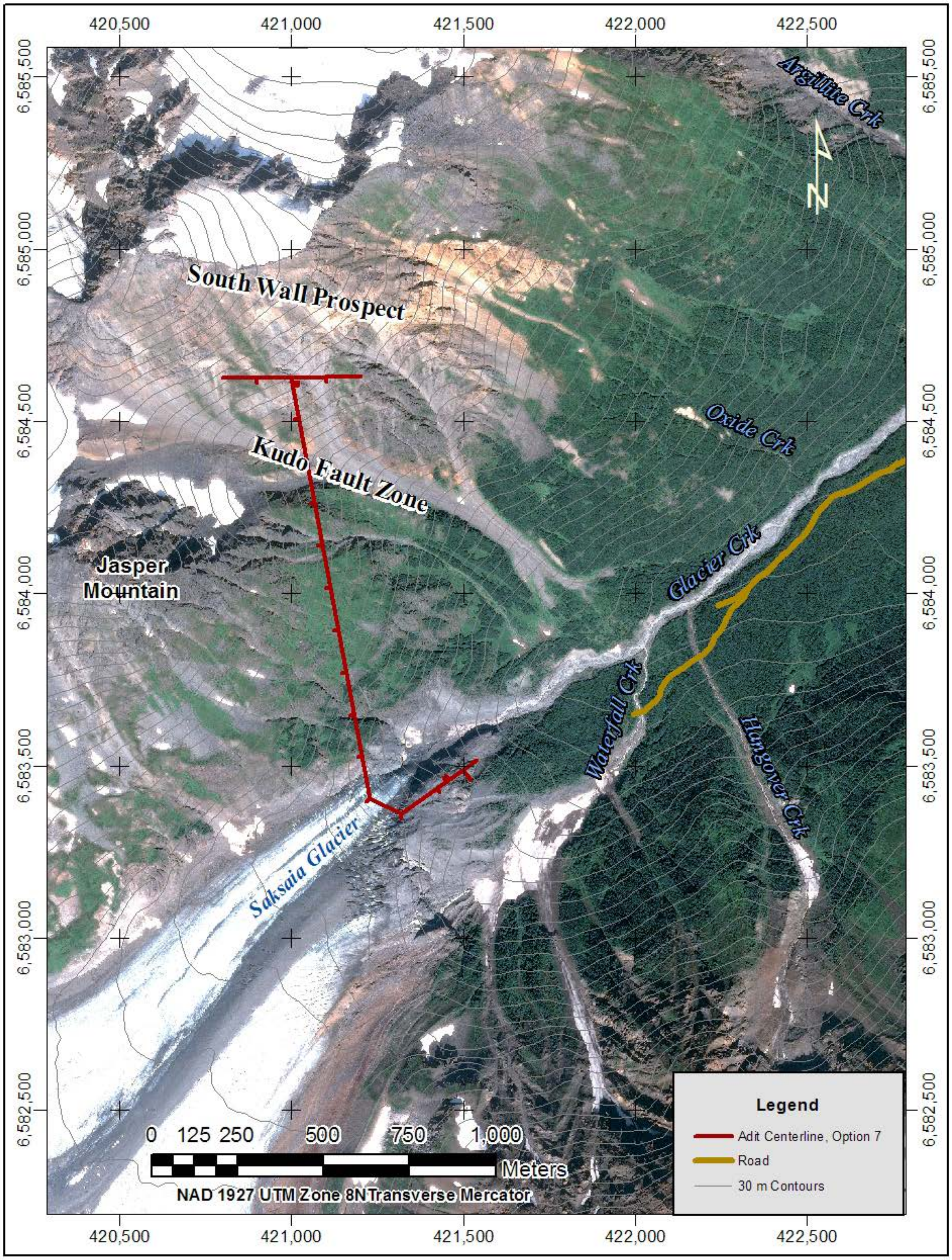


Figure 4-2. Site Map

5 Previous Findings

5.1 Groundwater-Level Monitoring

Pressure transducers were installed in six wells in the fall of 2014 to measure groundwater levels. Five wells have been added since that time, including Hari (GT17-01) in 2017(Figure 5-1, Table 5-1). Three of these wells have artesian flow: U6, Pocket, and Hari. Most holes used for monitoring are open holes with the transducer installed in PVC pipe located in the upper part of the hole. The two sub-horizontal wells, U6 and Hari, are exceptions. They are cased to a depth of 280.5 m and 229 m respectively and are open below the casing. The original wells have a three-year water level record.

The monitoring well data are evaluated on a two-year cycle with an interim memo in the intervening year. The last full evaluation was in the fall of 2016 (Tundra, 2016) with a memo in the fall of 2017 (Tundra 2017b). Findings from water level monitoring include:

- The piezometric surface is irregular, but generally parallels the ground surface. It is deepest at high elevations and relatively near the surface at lower elevations and on steep hillsides.
- The groundwater levels show a pronounced seasonality with high and variable water levels in the summer, a steady drop in water levels starting in early winter, very low levels in late winter, and rapidly rising levels in the spring. These water levels correspond to recharge patterns – unrestricted summer recharge, freeze-up and the beginning of snow accumulation in the early winter resulting in no recharge through the winter, and rapid snow melt and recharge in the spring.
- During the summer, the water levels in the wells have broadly correlative highs and lows that only generally correspond to recharge. Summer water-level patterns correspond poorly between wells in detail, however, suggesting that multiple factors control observed water levels in the summer including recharge, structure, location (dominantly elevation), proximity to glaciers and permanent snowfields, and well construction.
- The seasonal pattern seen in the monitoring well hydrographs group by elevation.
    - Wells located at higher elevations show an extreme seasonal range with over 37 m of drawdown in the winter, and high and variable summer water levels. This pattern suggests filling and draining of fracture systems as might be expected when looking at the upper part of the system.
    - Mid-elevation wells show moderate seasonal variation and small variation in the summer water levels.
    - The moderately low-elevation wells also appear to group and have a different pattern than the other wells, but the period of record is too short to draw inferences at this time.

Figure 5-1. Monitoring well locations

Table 5-1. Monitoring well period of record

Hole ID	Pad	Elevation (mamsl)	Azimuth	Dip	Monitoring Start	Monitoring End	Period (yr)	Status
CMR09-27	Long	1194	337	-48	7-Oct-14	na	3.3	Active
CMR09-29	JP	1358	340	-53	7-Oct-14	na	3.3	Active
CMR13-52	Stryker	1323	153	-72	13-Jul-15	na	2.6	Active
CMR14-58	Green	1258	342	-60	6-Oct-14	1-Jun-15	0.7	Dropped
CMR14-60	Marmot	1096	317	-68	7-Oct-14	na	3.3	Active
CMR14-61B	Brazil	820	0	-50	6-Oct-14	na	3.3	Active
CMR15-76	Pocket	585	0	-46	30-Jun-16	12-Sep-16	0.2	Dropped
CMR16-78	Taz	701	359	-51	23-Aug-16	na	1.4	Active
GT14-01	U6	793	280	-5	na	na	0.0	Inactive
GT17-05	Hari	898	334	-15	7-Sep-17	na	0.4	Active

na – not applicable (monitoring is ongoing) *Palmer_Monitoring Wells_Rev13.xlsx*

5.2 U6 Flow/Shut-in Test

The earliest hydrogeological investigation at the Palmer Project was a flow/shut-in test performed at U6 (GT14-01) in 2014. U6 was drilled at a -5^0 inclination with the end of hole at 302.1 m. Water was first intercepted at approximately 142 m down hole. As the hole was advanced, the water flow and pressure increased each time a fault zone was intercepted. When completed, the hole was artesian with a flow of 12 L/s (191 .1 gpm) and a pressure of greater than 320 kPa (47 psi; SRK, 2014).The U6 flow/shut in test resulted a transmissivity of at least 15.14 m^2/d and a hydraulic conductivity of at least 4.88 m/d; values that are very high and indicative of highly transmissive fractures and faults in the otherwise low-permeability volcanic rocks in the 94 m interval tested (SRK, 2014)

An adit driven into this hydrological regime is likely to encounter high water flow at irregular intervals as faults and fracture zones are encountered. The flow rate will diminish over time as the storage in the faults and fractures is depleted. Baseline flow will be a function of catchment area and annual precipitation.

6 Hydraulic Testing

6.1 Isolated Interval Packer Testing

Isolated-interval packer testing was performed for the first time at the Palmer project during the summer of 2017. The technique uses inflatable packers to isolate and test discrete drillhole intervals. The objectives of this testing were to provide hydraulic input data for the adit inflow analysis and to build the general understanding of the site hydrogeology, ultimately contributing to the prefeasibility and feasibility level hydrogeological characterization.

6.1.1 Methods

6.1.1.1 Field Program

Four HQ drillholes were drilled by Hy-Tech Drilling USA Inc. supported out of Smithers B.C. The drilling and testing sequence included:

- Surface casing – Surface casing was installed if the hole was thought to be potentially flowing-artesian. The surface casing provided an attachment point for a blow-out preventer (BOP), valves, and a solid basis for further drilling and well control. To accomplish this, the hole was advanced using HQ tools until the rock was judged to be suitably competent. Then a reamer was used to increase the hole diameter to accept HWT casing. The casing was grouted in place using a mixture with the ratio of 10 bags cement, 0.5 bags bentonite, and 3% CaCl. The same grout mixture was used for the monitoring well casing. If the hole was not expected to be flowing artesian, a short surface casing was installed without cement.
- Drilling – The cement was drilled out of the HWT casing (if installed) and the HQ hole was advanced. The core was retrieved and examined by the hydrogeologist, and test intervals were identified. If warranted by hole completion objectives or drilling conditions, the hole was reduced to NQ.
- Testing – Hole advancement and testing occurred in sequence. When a test interval was identified, drilling stopped, the drill rods were retracted to place the drill bit at the top of the test interval, the packer was inserted, and the test was performed. After removal of the packer, drilling would resume and the sequence would be repeated. The testing method will be discussed in detail in Section 6.1.1.3.
- Completion – The holes were either plugged and abandoned, a well was installed, or PVC casing was installed. Wells in this program were plugged and abandoned by filling the entire hole with cement. The PVC used for casing the holes was 1.5-inch diameter, unslotted, and open ended.

6.1.1.2 Core Logging

Core recovered from the holes was logged by Constantine staff for geological and geotechnical parameters. The in-depth summary and analysis of the geology and geotechnical logging is beyond the scope of this report.

6.1.1.3 Hydrogeological Testing Methods

A single-packer injection test system was used to collect hydraulic parameters from 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 recently drilled interval of rock to be tested with a single packer inserted through the drill rods. and uses water pressure to inflate the packer.

Upon penetrating a zone targeted for testing, drilling is temporarily discontinued and the hole is flushed with clean water or drilling fluids to remove cuttings. The drilling rods are then retracted to expose the test interval and the drill bit positioned at the top of the interval. The bottom of the core hole constrains the bottom of the test interval. The SWiPS is deployed by lowering the assembly down the drill rods from the surface and allowing it to lock within a standard Boart Longyear-style core barrel. The SWiPS system contains a rubber element that extends through the drill bit into the open borehole. 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 hole wall, isolating the test interval. The flow skid consists of a flow meter to measure discharge into the test interval, a manual diversion valve to control the injection pressure, and monitoring pressure gages. Packer inflation is maintained by means of a one-way valve. A mandrel extends through the center of the packer element to create a connection between the drill rods and the formation test interval. When the pressure to the packer is increased beyond a predetermined threshold, an engineered shear pin is intentionally broken, allowing water to flow from the drill rods into the formation below. A pressure transducer installed inside the packer records downhole pressures before, during, and after the test.

Ideally, water pressures would be allowed to fully equilibrate to static conditions before and after every test. However, in advancing core holes where drill-rig time is at a premium, full equilibration to static conditions is rarely feasible. During the Palmer hydrogeological program, packer tests generally included about 15 to 60 minutes of pre-test equilibration time to approach stabilization, depending on the judgement of the on-site hydrogeologist. Stepped pressure injection tests (SPI-tests) generally required an additional hour to complete. Packer installation and retrieval required more time than testing, especially in the sub-horizontal holes.

Figure 6-1 illustrates a typical hydrograph recorded from the down-hole transducer during packer insertion, inflation and pre-test equilibration, shear pin break, SPI test, and packer recovery.

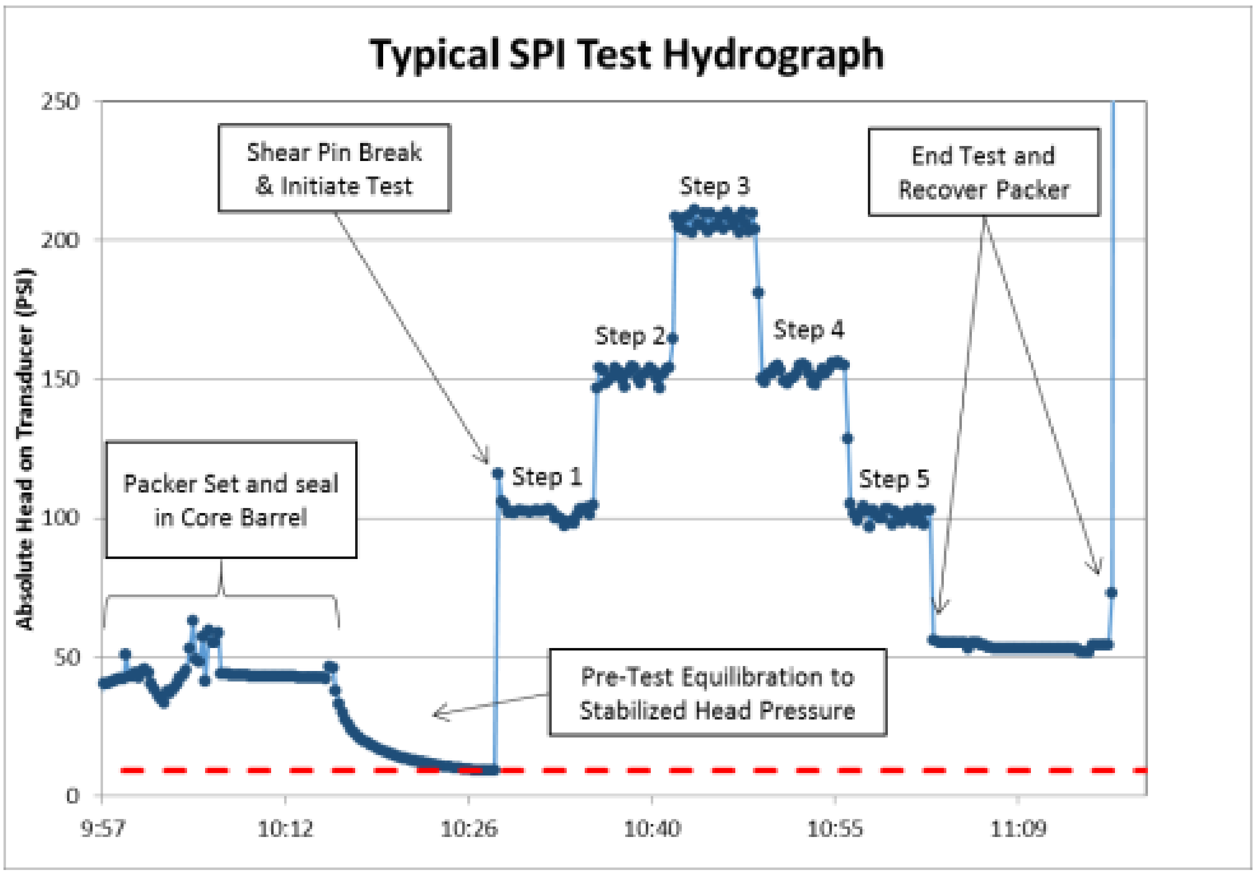


Figure 6-1. Typical stepped pressure interval (SPI) test hydrograph

The isolated-interval water level (head pressure) can be determined during each packer test. The test interval is isolated from up-hole influence prior to breaking the pin, and piezometric pressure value can be measured with a water level indicator or extrapolated from transducer data. Because time is at a premium during drilling, these water levels do not typically represent fully stabilized conditions. They can, however, be useful in identifying general vertical groundwater pressure gradients and interpreting subsequent characterization well measurements. They are also useful when stabilized water levels are not available,

6.1.1.4 Analytical Methods

Packer tests conducted with the SWiPS system can provide data sets that can be analyzed using several different methods. For example, the setup and operation of the SWiPS can generate data for falling-head slug tests and shut-in tests (in the case of flowing artesian conditions), in addition to stepped pressure-injection tests. A discussion of the principal test conditions and analytical methods follows.

Upon inflation and breaking of the shear pin, the water in the drill rods has sudden communication with the test interval and can flow into the formation under gravity. If the test interval rapidly drains the water in the drill rods, a falling head slug injection test results and is analyzed as an "effectively instantaneous" stress to the test interval. The falling water level can then be analyzed as a falling head slug recovery using the Hvorslev (1951), Bouwer and Rice (1976), and Hyder et al. (1994) KGS Model.

After inflating the packer, breaking the shear pin, and recording the subsequent falling head test, a stepped pressure injection test (SPI test) is often conducted. SPI-tests work best in lower-transmissivity intervals since they require that the drill rig water pump be able to discharge into the test interval at a greater rate than the water can flow out into the formation, resulting in a build-up in water pressure. An SPI-test involves recording flow rates into the test interval at three increasing pressure steps, and then stepping back down to the starting pressure in two additional steps. Water injection pressure is maintained at each step by adjusting the flow rate until it stabilizes—typically five to fifteen minutes. The injection pressure is monitored on the flow skid pressure gage, and downhole injection pressures are collected by the data recording pressure transducer set in the packer. The stabilized flow rate and induced injection pressure from each step are used to derive the hydraulic conductivity (K) using a derivation of the Thiem method (Kruseman and de Ridder, 1991).

A constant pressure test can be performed if the transmissivity of the interval is too high for the rig's pump to build sufficient pressure to perform an SPI test. If pressure will not increase after inflating the packer and breaking the shear pin, the hydrogeologist will quickly determine that the formation is too conductive to perform an SPI test. In such a case, a constant pressure test is conducted by injecting water into the test interval at a relatively high rate (approximately 1.5 L/s to 2 L/s; 25 gpm to 30 gpm) for about 30 minutes to 45 minutes to allow the downhole water levels to reach a new equilibrium. At this point, the water is shut off and downhole pressures are allowed to stabilize for another 15 minutes to 30 minutes. The stabilized induced-head pressure can be analyzed using the Thiem method (1906). Additionally, mounding may be analyzed using Cooper-Jacob (1946). The Theis (1935) residual drawdown straight line method may be utilized to analyze the recovery.

In the case of flowing artesian conditions such as those encountered in GT17-05, shut-in testing can be conducted to determine the hydraulic conductivity. The packer is set using the normal procedure to isolate the top of the test interval. After breaking the shear pin, the flow skid valve is closed and pressure buildup is monitored until it stabilizes at which time a static head value can be recorded. Following stabilization, the valves are opened and the discharge rate is measured periodically until it becomes constant. The valve is then closed again until the pressure has returned to pre-test levels. The drawdown part of the test can be analyzed using the Cooper-Jacob (1946) method, while the Theis

(1935) residual drawdown straight line method is used to analyze the recovery curve. Additionally, the rate of discharge decay can be used to determine the hydraulic conductivity by applying methods developed by Jacob and Lohman (1952) or Aron and Scott (1965).

6.1.2 Test holes

Four holes were packer tested in 2017 (Figure 6-2, Table 6-1). Three of these holes (GT17-05, 06, and 07) were planned as hydrogeology test holes and were drilled near the potential alignment of the first half of the adit. Testing was also performed in CMR17-97, an exploration drill hole. The objective for each hole was as follows:

- GT17-05 – Test the Jasper Mountain Basalt near the potential alignment of the adit. The hole was drilled at a shallow angle and was expected to have artesian flow.
- GT17-06 – Test the hydrogeological conditions near where the potential adit passes under the Saksaia Glacier. Determine if there is a fault under the glacier.
- GT17-07 – Because GT17-06 intersected a paleochannel underneath the glacier, GT 17-07 was drilled at a steeper dip to pass below the paleochannel and complete the original objectives of GT17-06.
- CMR17-97 – Obtain hydraulic tests from the footwall, ore zone, and hanging wall near the location of the potential drilling drift.

A monitoring well was installed in GT17-05 with an open-hole completion from 229 m to 292.5 m (Figure 6-3). The well is flowing artesian. Upon completion of the drilling and testing, the HQ drill rods were tripped and then set at 229 m depth. Two Van Ruth plugs were set below the end of the rods, followed by a rubber seal plug and bentonite-polymer mix to reduce the water inflow from the bottom of the hole and provide a down-hole base for the grout.. A mixture of bentonite chips and polymer was then pumped into the hole to blind off fractures in the hole annulus that were allowing water inflow or outflow. These measures were not successful in stopping the water flow completely, but inflow and outflow in the annulus was judged to be sufficiently controlled to proceed with grouting. A cement-bentonite grout was pumped into the drill rods, followed by a rubber plug and water, until the grout flowed out of the annulus at the ground surface. Unfortunately, while the grout formed a structural base around the HQ well casing, it did not provide an adequate seal. A second lift of bentonite slurry and bentonite chips was pumped into the annulus to complete the seal. The plugs were then drilled out using NQ diameter drilling equipment to connect the open hole with the well casing.

A temporary well head (Figure 6-4) was installed on the GT17-05. Prior to drilling, a tee, 4-inch ball valve, and blowout preventer (BOP) were installed. This equipment allowed control of the well if excessive pressure or flow were encountered during drilling. After drilling, a 2-inch testing lateral was mounted on the tee (Figure 6-5) and the temporary well head was used for flow control, well purging, water quality sampling, and flow/shut-in testing. On September 8, 2017, the temporary well head was removed and a long-term well head was installed that consisted of an instrumented artesian well plug (Figure 6-6 and Figure 6-7) designed by Tundra. The plug has a valve that controls artesian-flow and allows water quality monitoring. The valve was installed below the frost line to minimize the possibility of freeze damage to the well head in the winter.

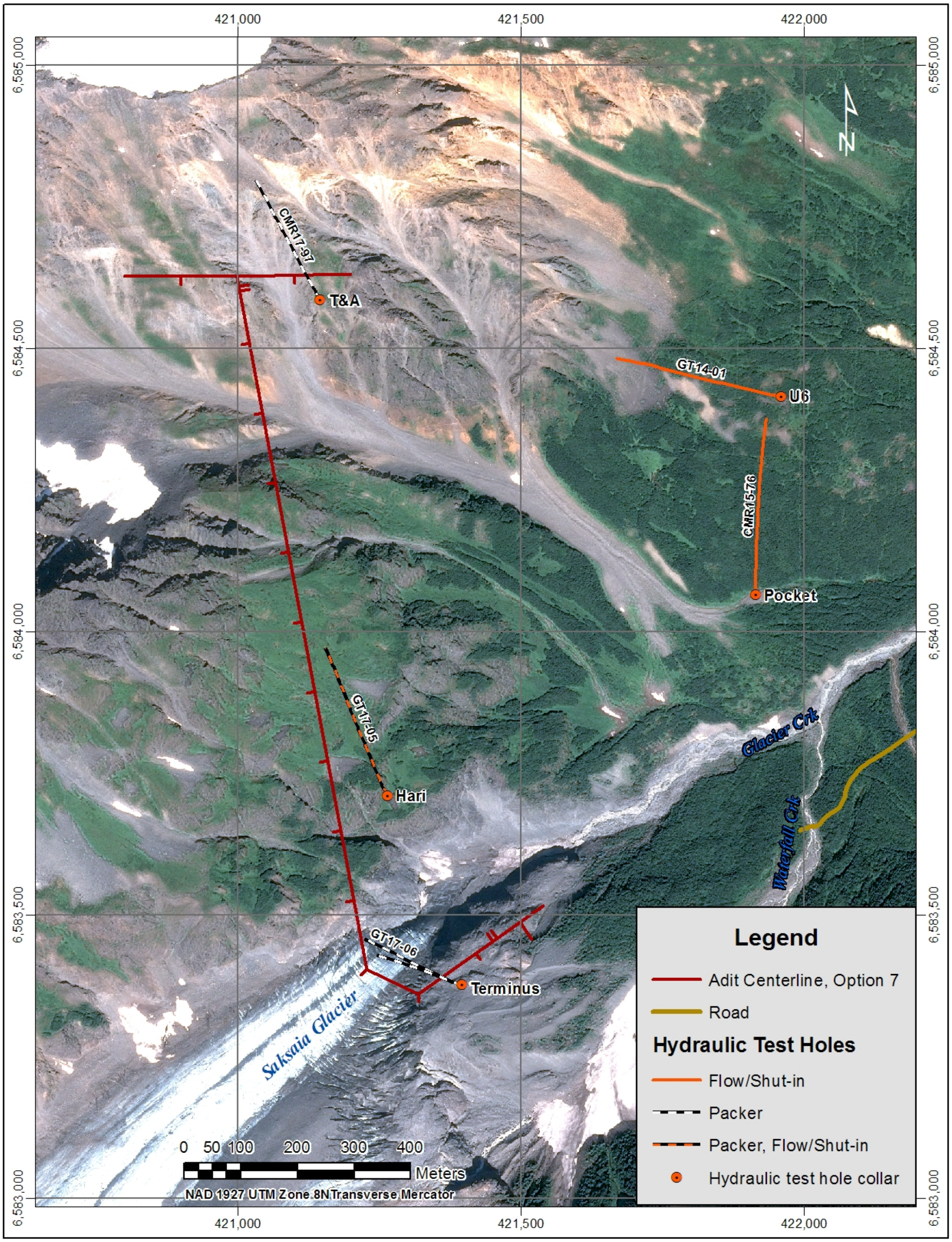


Figure 6-2. Hydraulic test holes

Table 6-1. Drillhole collars

Hole ID	Easting	Northing	Elevation (m)	Drill Pad	Dip	Azimuth	EOH (m)
CMR17-97	421141	6584593	1227	T&A	-47	332	358.8
GT17-05	421259	6583718	899	Hari	-15	334	292.5
GT17-06	421391	6583383	819	Terminus	-39	292	241.8
GT17-07	421391	6583383	819	Terminus	-50	294	251.0

NAD 27 UTM Zone 8N

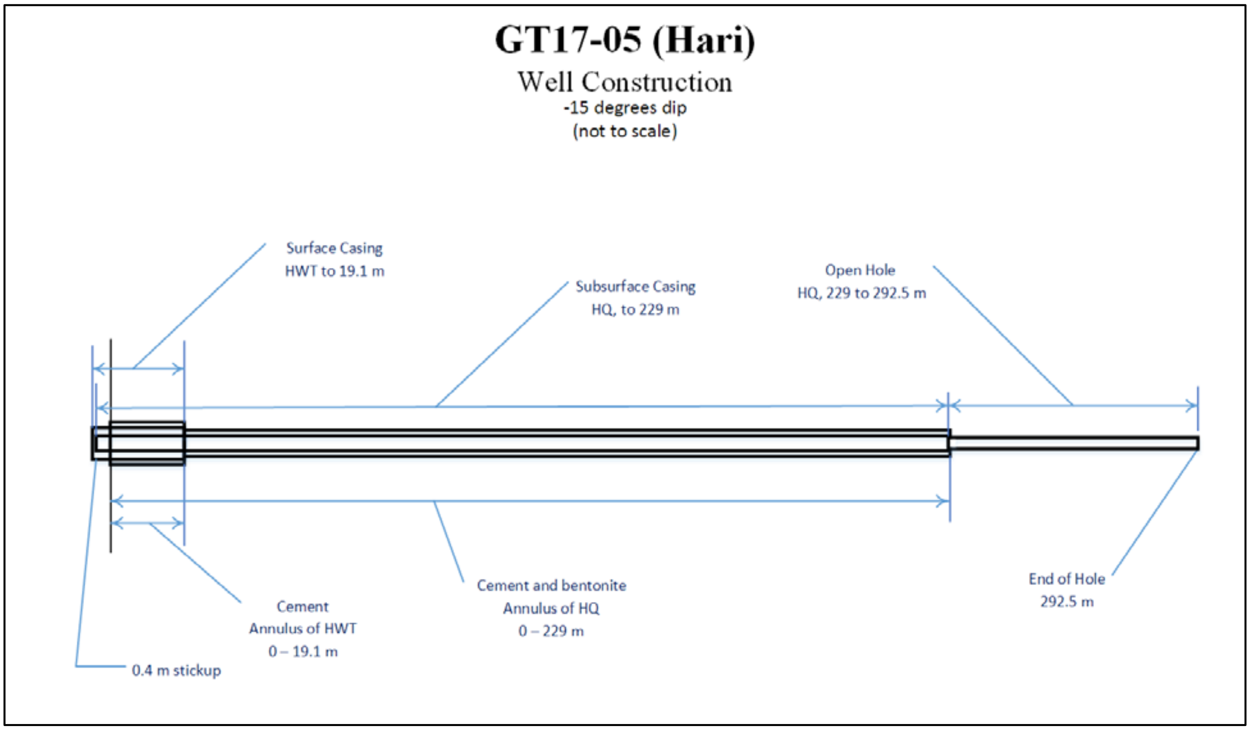


Figure 6-3. GT17-05 (Hari) - Well completion diagram

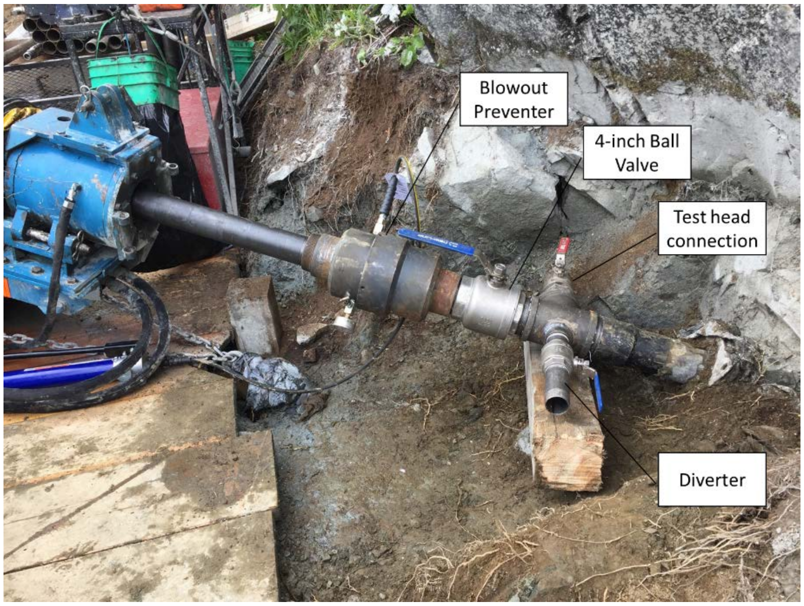


Figure 6-4. GT17-05 - Well head during drilling

Figure 6-5. GT17-05 - Temporary testing well head

Figure 6-6. Instrumented artesian well plug

Figure 6-7. GT17-05 - Instrumented artesian well head

6.1.3 Results

The single packer method allows testing of a wide range of rock intervals, and can target specific lithologic and structural features. During this field program, intervals ranging from 16.7 m to 273.5 m in length were successfully packer tested. Packer tests conducted with the SWiPS system can provide data sets that can be analyzed using several different methods. Forty-seven analyses were completed for the 19 data sets. However, only 33 of the analyses are considered valid. Table 6-2 summarizes the packer test results. Comprehensive packer test analyses can be found in Appendix A.

The packer test results for each of the four drill holes are shown in Figure 6-8 through Figure 6-11. These plots show the water level for each test interval (left axis) and hydraulic conductivity (K, right axis) versus depth. Water level is relative to the collar (0 m) which is shown as a reference line. Water levels greater than the collar elevation would be flowing artesian if a well were to be installed. The horizontal bars at each data point show the width of the test interval. The results for each hole will be discussed in the following paragraphs with more in-depth analysis of the results presented in Section 8.3.

CMR17-97 was an exploration hole drilled for infill ore-zone-definition purposes. Packer tests were performed on three intervals, one each in the hanging wall of the ore zone, across the ore zone, and in the footwall of the ore zone (note that the ore zone is sub-vertical and slightly overturned at this location). The first test interval, in the Hanging Wall Basalt, had a very high K of 6.35 m/d, likely due multiple minor faults. The ore zone has a moderately high K of 3.29×10^{-2} m/d, typical of highly fractured rock, and the footwall had a low K of 3.19×10^{-4} m/d, typical of lightly fractured to tight rock. The water level varied over a range of approximately 10 m.

GT17-05 penetrated lightly fractured basalt with mafic dikes and a few minor faults. This unit has been dubbed the Jasper Mountain Basalt. The K of 4.69×10^{-4} m/d to 8.53×10^{-3} m/d is very low to low, and is typical of fractured tight rock to moderately fractured rock. The exception is the first interval, which had a moderate K of 8.28×10^{-2} m/d due to faults. The water level (head pressure) increased down-hole as would be expected in a sub-horizontal hole drilled into a steep mountainside. A final test (Test 8) included the entire length of the drillhole. The K calculated from this test was very similar to that of the first test interval. This result will be discussed in Section 6.3.

GT17-06 targeted the area where the potential adit would pass under the Saksaia Glacier. It was drilled in Jasper Mountain Basalt. Under the glacier, the hole encountered an interval of rounded gravel, cobbles, and boulders at a depth of 160.1 m to 173.4 m. This interval is interpreted as a paleochannel, thought to have formed at a time when the Saksaia Glacier was much smaller or absent. The first two, relatively shallow intervals had moderately high Ks of 0.383 m/d to 0.710 m/d. The deeper intervals, on the far side of the channel, had low to extremely low Ks of 2.53×10^{-3} m/d and 9.04×10^{-6} m/d. The paleochannel apparently controlled the water level, as would be expected, with the water level decreasing toward the channel on both sides.

GT17-07 was drilled from the same pad (Terminus) and at a similar azimuth as the GT1-06, but with a steeper dip, to achieve the test objectives below the paleochannel. There was considerable debate concerning whether a significant fault existed under the Saksaia Glacier based on the linear trend of the Glacier Creek valley and parallel trends of adjacent valleys. The drill hole did not encounter a fault under the glacier. The hole encountered Jasper Mountain Basalt and had low to extremely low Ks of 1.42×10^{-3} m/d to 5.51×10^{-6} m/d, similar to the bottom half of GT17-06. Water levels varied over a range of almost 60 m with high water levels occurring under the paleochannel suggesting that the channel may have an influence on the water level.

Table 6-2. 2017 Packer test results

Hole ID	Test No.	From (m)	To (m)	Interval (m)	Water Level (vert. m btoc)	Test Type	K (m/d)	Lithologic Unit	Significant Structure
CMR17-097	1	231.1	267.0	35.9	42.5	Injection Test and Recovery	6.35	Basalt & sedimentary tuff	Multiple minor faults and gouge
	2	279.1	297.2	18.1	46.8	SPI	3.29E-02	VMS with QSP	Minor clayey fault gouge. Moderate fracture frequency
	3	334.1	359.8	25.7	36.4	SPI	3.19E-04	QSP	Low fracture frequency.
GT17-05	1	47.8	91.3	43.5	3.9	SPI	8.68E-02	Basalt	Minor discrete fault
	2	107.8	133.5	25.7	21.9	SPI	2.00E-03	Basalt	Minor discrete fault
	3	149.8	175.5	25.7	3.4	SPI	2.84E-03	Basalt	No significant structures
	4	176.8	198.1	21.3	-10.6	SPI	3.74E-03	Basalt	No significant structures
	5	200.8	230.1	29.3	-11.7	SPI	2.62E-03	Basalt	Minor discrete fault
	6	233.8	265.5	31.7	-101.6	SPI	4.69E-04	Basalt	No significant structures
	7	263.3	292.5	29.2	-109.4	Shut-In Test	8.53E-03	Basalt	No significant structures
	8	19.0	292.5	273.5	-4.9	Constant Rate Injection	8.28E-02	Basalt	No significant structures
GT17-06	1	39.1	64.8	25.7	17.5	SPI	8.34E-02	Basalt	Calcite seams with voids
	2	78.1	94.8	16.7	33.7	Constant Rate Injection	0.71	Basalt	Broken zone, rapid loss of drill fluids
	3	120.1	148.8	28.7	66.6	Constant Rate Injection	5.39E-02	Basalt	Highly broken/gouge zone
	4	175.1	193.8	18.7	66.1	SPI	2.53E-03	Basalt	No significant structures
	6	210.1	241.8	31.7	43.0	SPI	9.04E-06	Basalt	No significant structures
GT17-07	1	159.3	182.0	22.7	71.0	SPI	1.42E-03	Basalt	Minor discrete fault
	2	192.3	224.0	31.7	10.5	SPI	5.51E-06	Basalt	Low fracture frequency
	3	223.3	251.0	27.7	14.5	SPI	1.35E-05	Basalt	Low fracture frequency

SPI denotes a Stepped Pressure Injection test (occasionally referred to as a Lugeon test) *Test Summary Sheet_180124.xlsx*
K = hydraulic conductivity, VMS = volcanogenic massive sulfide, QSP = quartz, sericite, pyrite schist

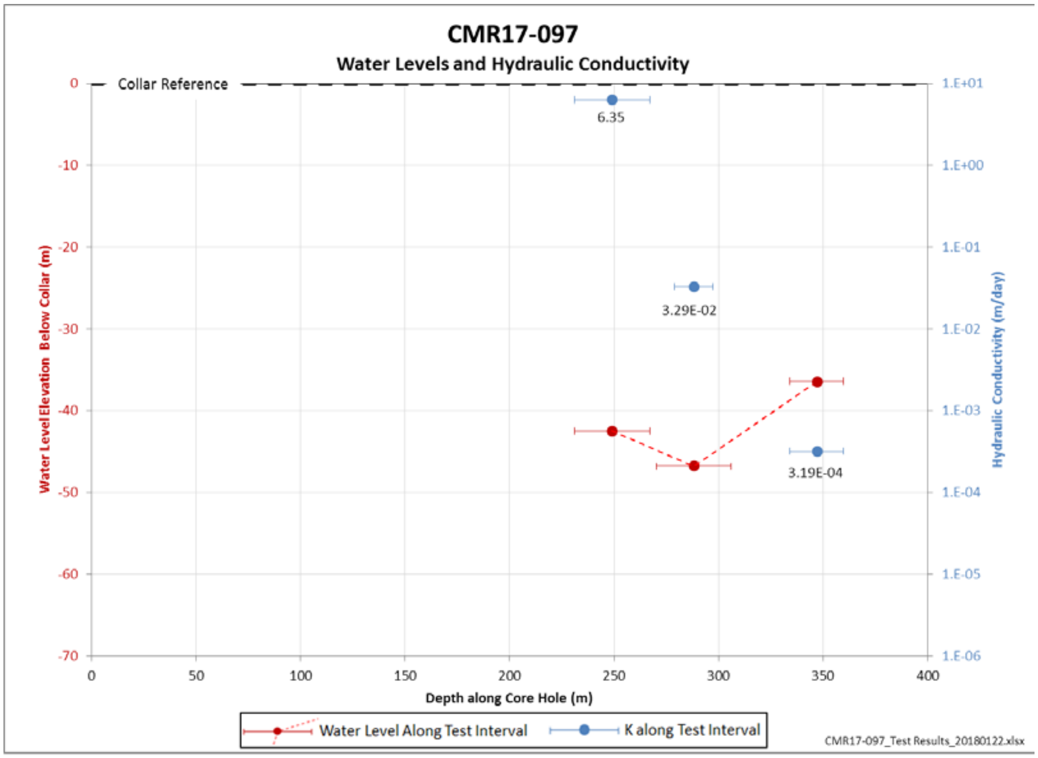


Figure 6-8. CMR17-97 - Water levels and hydraulic conductivity

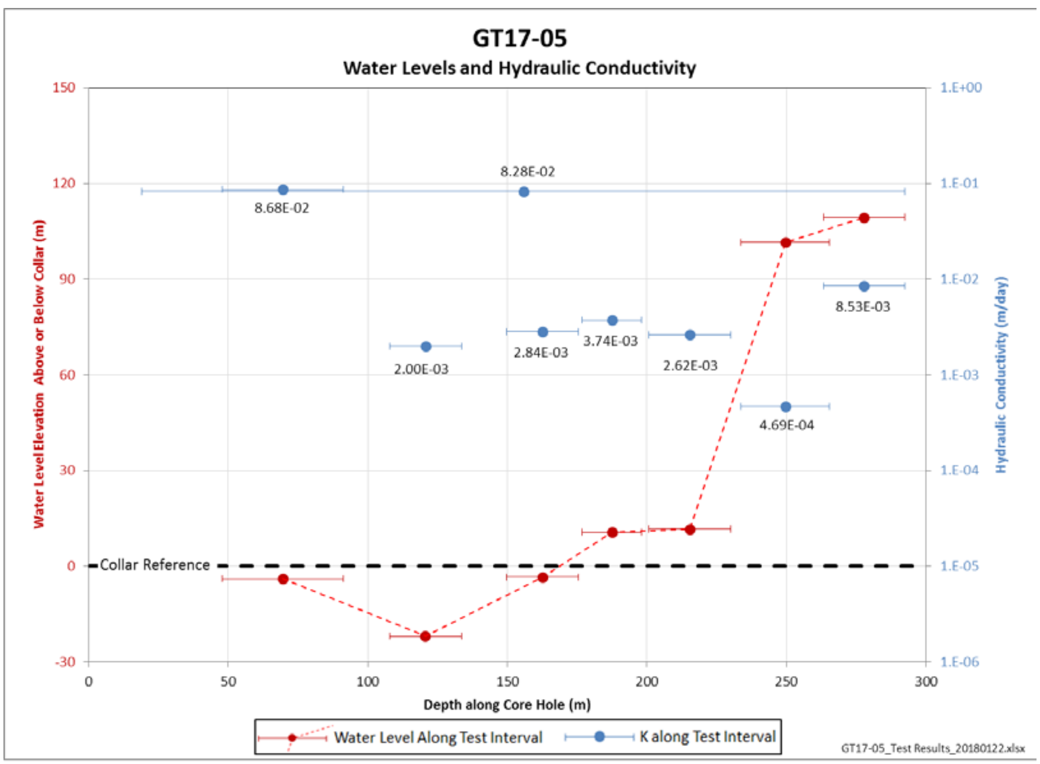


Figure 6-9. GT17-05 - Water levels and hydraulic conductivity

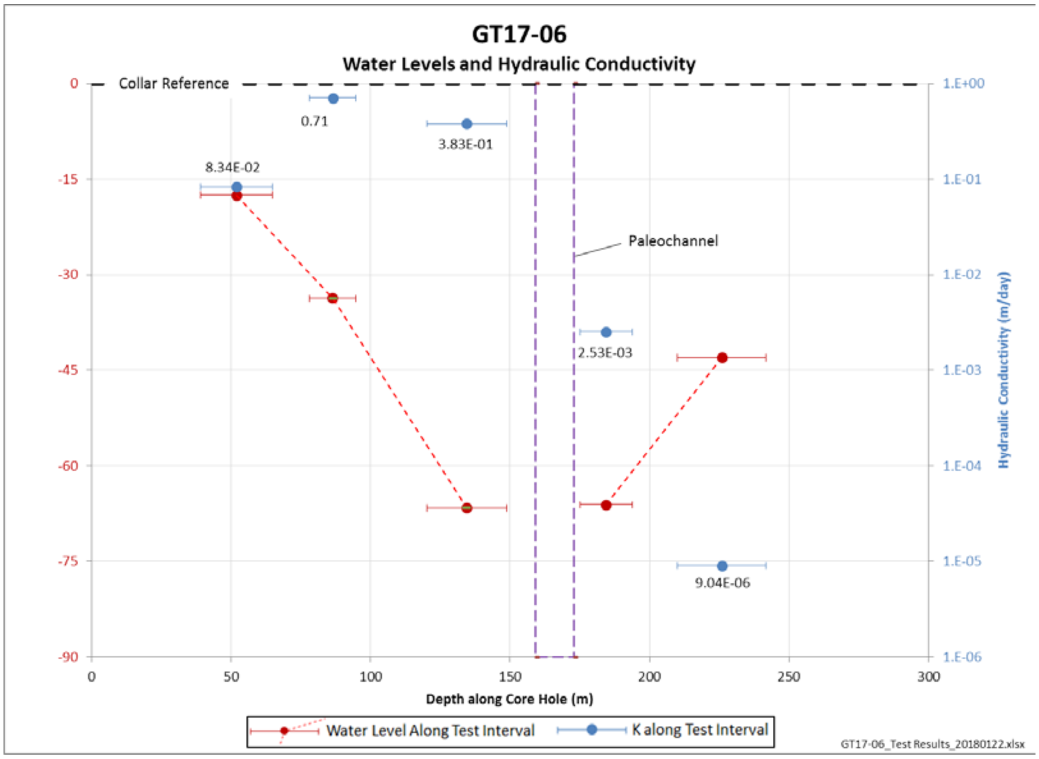


Figure 6-10. GT17-06 - Water levels and hydraulic conductivity

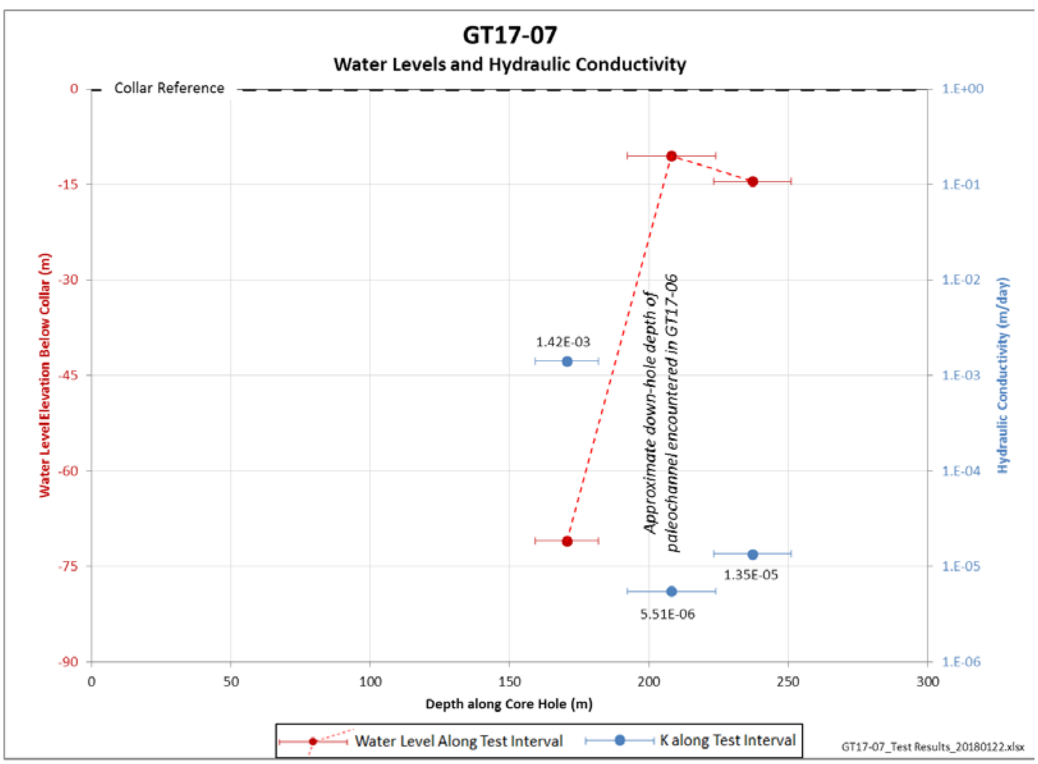


Figure 6-11. GT17-07 - Water levels and hydraulic conductivity

6.2 GT17-05 Flow/Shut-in Test

A 52-day flow/shut-in test was performed on GT17-05 (Hari) from July 17 to September 7, 2017.

6.2.1 Methods

Hari was completed as a monitoring well with an open hole below the casing from 229 m to 292.5 m (Figure 6-3). A 2-inch testing lateral was installed on the temporary well head (Figure 6-5) consisting of ball valves to selectively control flow and an externally mounted pressure transducer to measure pressure-head.

The well was allowed to flow freely from July 17 to August 16. Flow rates were measured prior to and at the end of this period. The flow rate was not monitored continuously because it was too low to measure accurately with available flow meter/data logging equipment. The flow was measured four times by repeatedly recording the time it took to fill a calibrated bucket. A short interim flow period of 26.7 hours was allowed starting on August 30 to purge for water quality sampling.

On August 8 the valve was closed, shutting in the well. Due to communication issues the datalogger was started 2 days later. The test ended on the last available helicopter day, September 7. That day, the data logger was downloaded, the temporary well head was removed and a new well head was installed (Figure 6-7). A pressure transducer in the new well head continues to record the well pressure.

6.2.2 Results

The well was allowed to flow for 30 days with flow rates ranging from 0.0908 L/s (1.44 gpm) to 0.156 L/s (2.48 gpm; Appendix B). The head pressure reached a maximum of 1078 kPa (156.3 psi) after being shut in for 22 days.

To allow analysis by the Cooper Jacob method, the recovery was treated as drawdown with an initial flow rate of 0.156 L/s (2.48 gpm). The method is not particularly sensitive to saturated thickness, but it is a required input; a value of 21 m was used, which is the maximum increase in head. This is close to the length of the “screened” interval (19.4 m; open interval in this well), which is a common method of specifying the saturated thickness. The analysis yields a transmissivity (T) of 1.53 x 20^{-1} m^2/d and a K of 7.40 x 10^{-3} m/d (Appendix B).

6.3 Hydraulic Testing Discussion

Two long interval tests were performed in GT17-05 in addition to the discrete interval packer tests as follows:

- A packer test of the full length of the hole prior to well installation (Test 8, Section 6.1.3)
- A 52-day flow/shut-in test after well installation, which tested the open portion of the hole from 229 m to 292.5 m (Section 6.2.2)

Results of the discrete interval tests versus the longer interval tests indicated that the K derived from a test is controlled by the highest K interval within the test range. This can be seen in Figure 6-12 where the full-hole test value of 8.28 x 10^{-2} m/d is very similar to the Test 1 result of 8.68 x 10^{-2} m/d and substantially higher than any of the other values from discrete test intervals. This can also be seen in Figure 6-13 where the flow/shut-in test result of 7.40 x 10^{-3} m/d is quite close to the highest K of the two intervals: Test 7, with 8.53 x 10^{-3} m/d.

The water level relationship between long and corresponding short intervals is less clear. For the flow/shut-in test (Figure 6-13), the water level from that test is very close to that of Test 7, the highest water level of the two discrete interval tests, although all three water levels are fairly similar. However, there is no apparent relationship between the water level from the long-interval packer test and water levels of the discrete-interval packer tests (Figure 6-12).

We should be cautious about drawing conclusions from just two comparisons, but these results suggest the following:

- The water level in the rocks intersected in a hole is not uniform over the length of the hole. The water level may vary considerably with depth, the hydrogeological characteristics of the various faults and fracture sets that are intersected, the characteristics of each rock type, etc.
- Hydraulic conductivity tests yield the maximum value of the test interval, not the average value.
- Hydraulic test results from long interval test should be used judiciously because they provide the maximum K for the interval. It is likely that multiple short tests of the same zone would result in an average K that is lower - substantially lower where less fractured.
- Hydraulic conductivity test results are inherently conservative, yielding the value of the most conductive zone within the interval.
- It appears that shorter screened (or open) intervals in a well yield more meaningful water level readings than longer intervals. The water level in a long-interval well appears to be influenced by multiple factors, including water levels from multiple fractures in which each may have different heads.

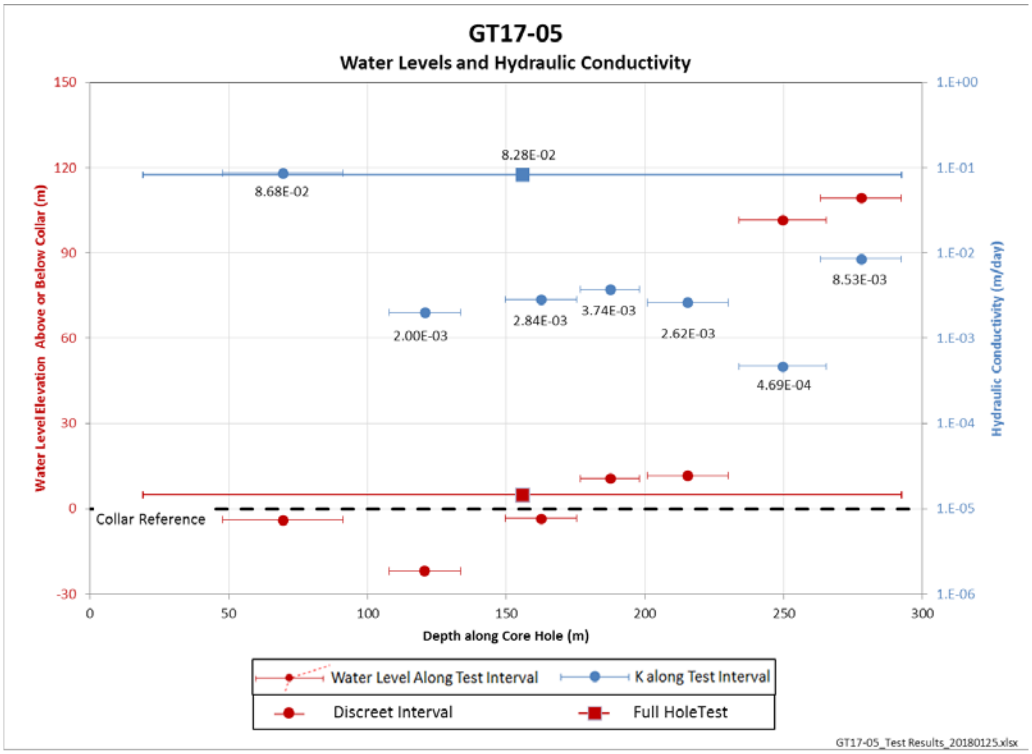


Figure 6-12. Hydraulic test – discrete- versus long-interval tests

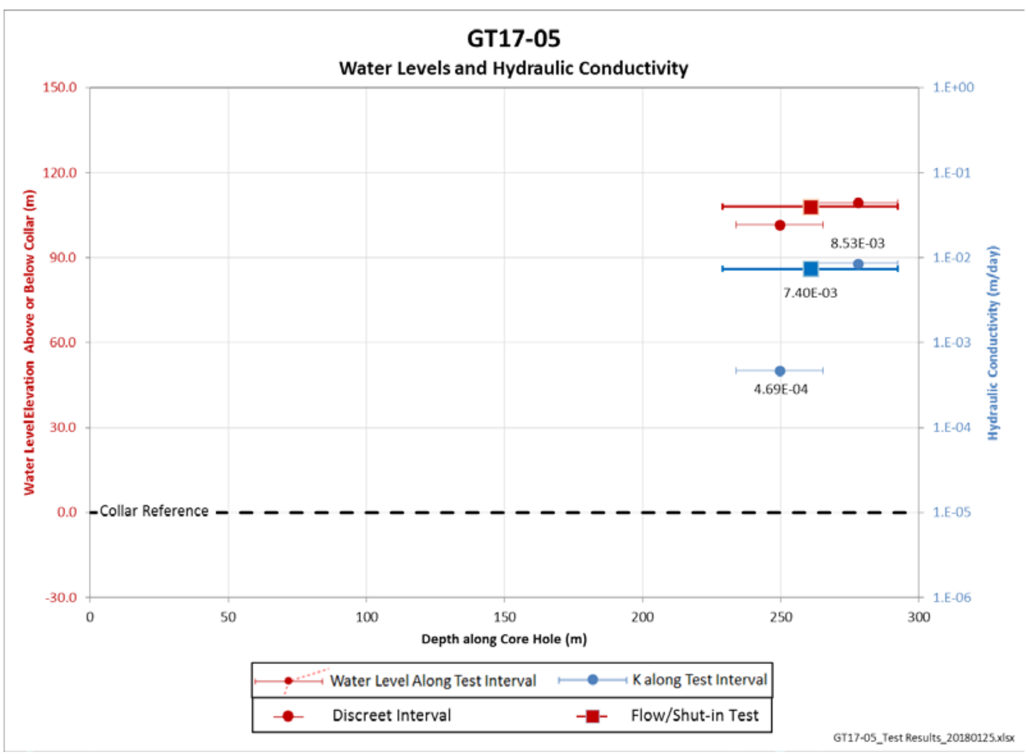


Figure 6-13. Hydraulic tests - discrete versus long flow/shut-in tests

7 Hydrogeological Conceptual Model

The hydrogeological conceptual model was last presented in Tundra (2017a). It has been revised based on work in 2017 and is presented below and in Figure 7-1.

- Fault and fracture control
  - Groundwater flow is compartmentalized.
  - Groundwater flow and storage is principally in faults. There is very little flow and storage in the rock mass between faults, and most of that is in subsidiary faults and fractures.
  - Groundwater flow is dominantly parallel to the plane of the faults.
  - Flow perpendicular to the fault plane is restricted, likely due to clayey gouge zones.
  - Groundwater flow is dominantly vertical (downward) which is a function of the number of sub-vertical faults in the area of interest.
- Groundwater flow
  - Annual groundwater flux in a given area is mostly a function of the immediate catchment area and annual precipitation because vertical flow is dominant over lateral flow (i.e., there is only a small contribution from lateral flow).
  - The faults can be highly transmissive, but store a relatively small amount of water. When faults are encountered during mining, a large amount of water will be released initially, but the faults will drain down to base-level flow relatively quickly.
  - The base-level flow is controlled by the overall (system-wide scale) resistance to flow along fractures and faults and the long-term recharge to the system.
- Recharge and discharge
  - Groundwater levels have a substantial seasonal variation. In the winter, levels are a function of minimal recharge, and drain-down of water storage in the faults. Rapid refilling of the fault storage occurs during the spring/early summer snow melt period. The fault storage is maintained at a high level during the summer with a dynamic equilibrium between precipitation input and discharge at the bottom of the system.
  - Draining of the system and water levels are influenced by the rate at which water exits from the bottom of the system into Glacier Creek.
  - In upland areas, precipitation dominantly infiltrates with minimal runoff. Runoff may be a large component in the valley bottom where the near-surface sediment is dominated by clay rich till.
  - Stream flow is a combination of groundwater discharge, and glacial and snow-field meltwater. Winter base flow is dominantly groundwater discharge while summer flow levels are strongly influenced by glacier/snow melt.
- The current project area can be divided into the following domains:
  - **Southwall** – Generally intermediate, but locally high K. The dominant factor that controls K is a relatively high fault and fracture density. The variety of rock types respond variably to stress, from brittle fracture (e.g., basalt) to ductile fracture (e.g., high sericite or other micaceous units). Due to high-angle faults that cross the drainage divide, the glacial basins to the northwest contribute some recharge to the system. The piezometric surface is likely highly variable due to compartmentalization caused by the numerous internal faults.
  - **Kudo and bounding fault zones** – high K. Two west-northwest trending faults appear to bound the Southwall area, the Kudo Fault on the southwest and a poorly known fault on the northeast. These high-angle fault zones likely have high K parallel to the fault with strong downward and then outward movement of water. They likely have low K perpendicular to the fault plane due to multiple clayey fault gouge zones. The Kudo Fault continues into the glacial basin to the west,

which may contribute a moderate amount of recharge to this domain. The piezometric surface is likely low relative to that of the adjacent domains.

- **Jasper Mountain** – low K. This domain generally consists of competent rocks with few faults and a low fracture density, and therefore a low K. The piezometric surface is likely high relative to the other domains.
- **Lower Southwall** – High K. This existence of this feature on the lower part of the Southwall is speculative. If it exists, it may be due to local, slope parallel, stress relief faults. The resulting high fault and fracture density would result in a high K. The piezometric surface may be high in most of this domain due to its position low on the slope.

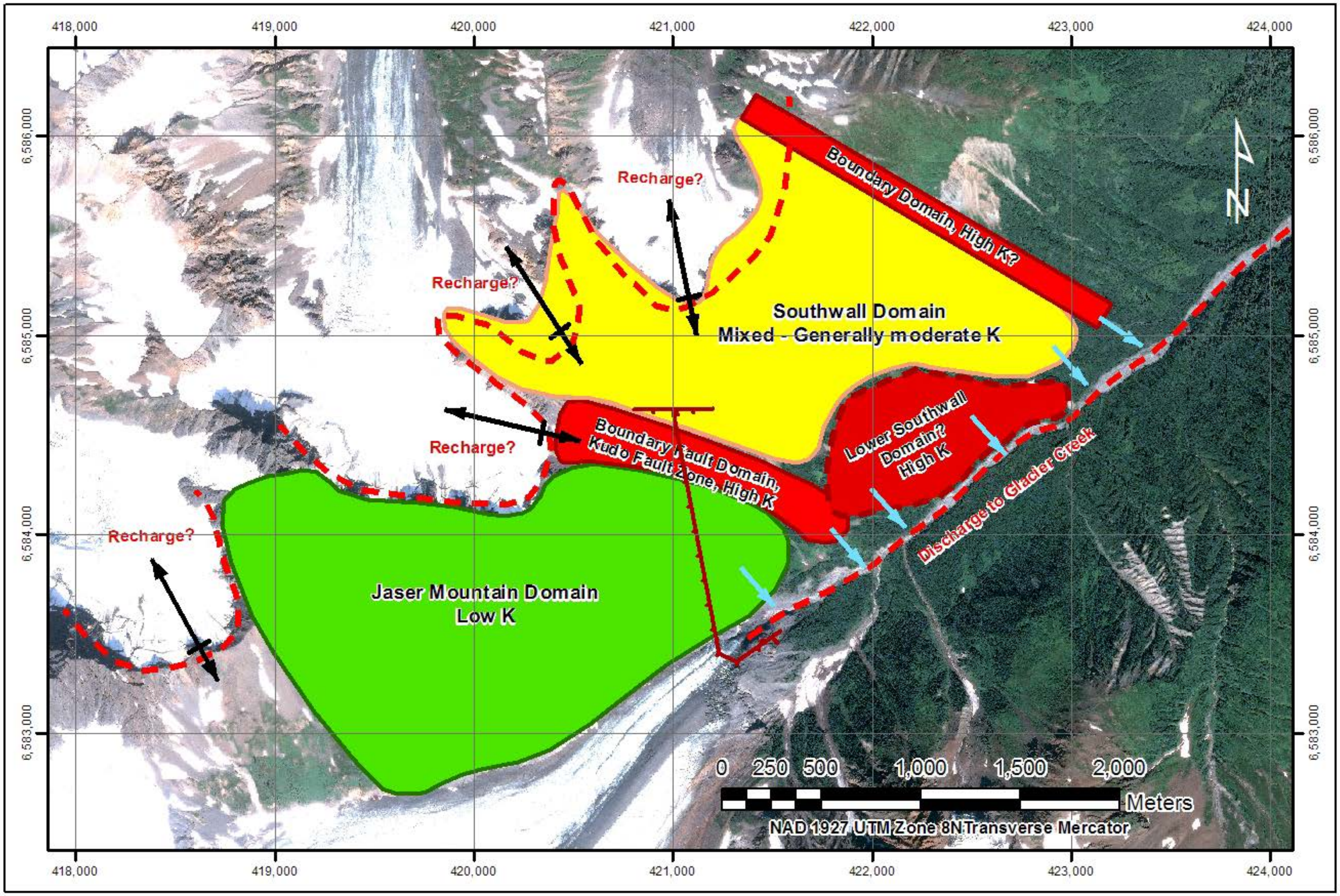


Figure 7-1. Hydrogeological conceptual model - plan view

8 Option 7 Adit Flow Analysis

The primary objective of the 2017 hydrogeology program was to estimate the potential flow rate of water from the Option 7 adit. This section describes the adit and analytical methods, and presents the data used in the analysis and the results. There is reasonably good data for the first 1250 m of the ramp, and very little data for the remainder of the adit (remaining 362 m of ramp and 400 m of drilling drift). All available data were analyzed for potential use, but due to the sparse data available for the distal part of the potential adit the flow analysis was only performed on the first 1250 m.

8.1 Adit Description

The Option 7 adit is a potential exploration adit that would have a portal at a nominal elevation of 680 mamsl located at the head of the Glacier Creek valley, adjacent to the terminus of the Saksaia Glacier (Figure 8-1). The conceptual design consists of a 1612 m ramp that ends in a 400 m drilling drift. The ramp (Figure 8-2) starts on a southwest heading and proceeds 270 m at a 2.5% incline. It then turns to the west- northwest, proceeds for another 100 m at a 2.5% incline and begins to pass under the Saksaia Glacier. It then turns to the north-northwest, steepens to a 12.4% incline and proceeds 1242 m to the end. Muck bays are located every 125 m. The drill drift (Figure 8-2) is oriented east-west and proceeds 200 m in each direction from the end of the ramp. It has an incline of 2.5% in both directions to allow water to drain toward the ramp.

The geologic setting consists of four units (Figure 8-2). The portal is in Jasper Mountain Basalt. At 1250 m from the portal, the adit enters the Transition Unit which is a mix of basalt and argillite. At 1450 m, it enters the Kudo Fault Zone, and then enters the Hanging Wall Basalt at 1575 m from the portal. The drilling drift is in the Hanging Wall Basalt.

Hydrogeological units closely parallel geological units. There are 5 units, one for each of the geologic units with the Jasper Mountain Basalt divided into two units, which will be discussed in Section 8.3.1.

For flow modeling purposes, the adit is divided into 10 sectors. The rationale for the sector divisions will be presented in 8.3.4. The hydrogeological and sector divisions are shown in Figure 8-2.

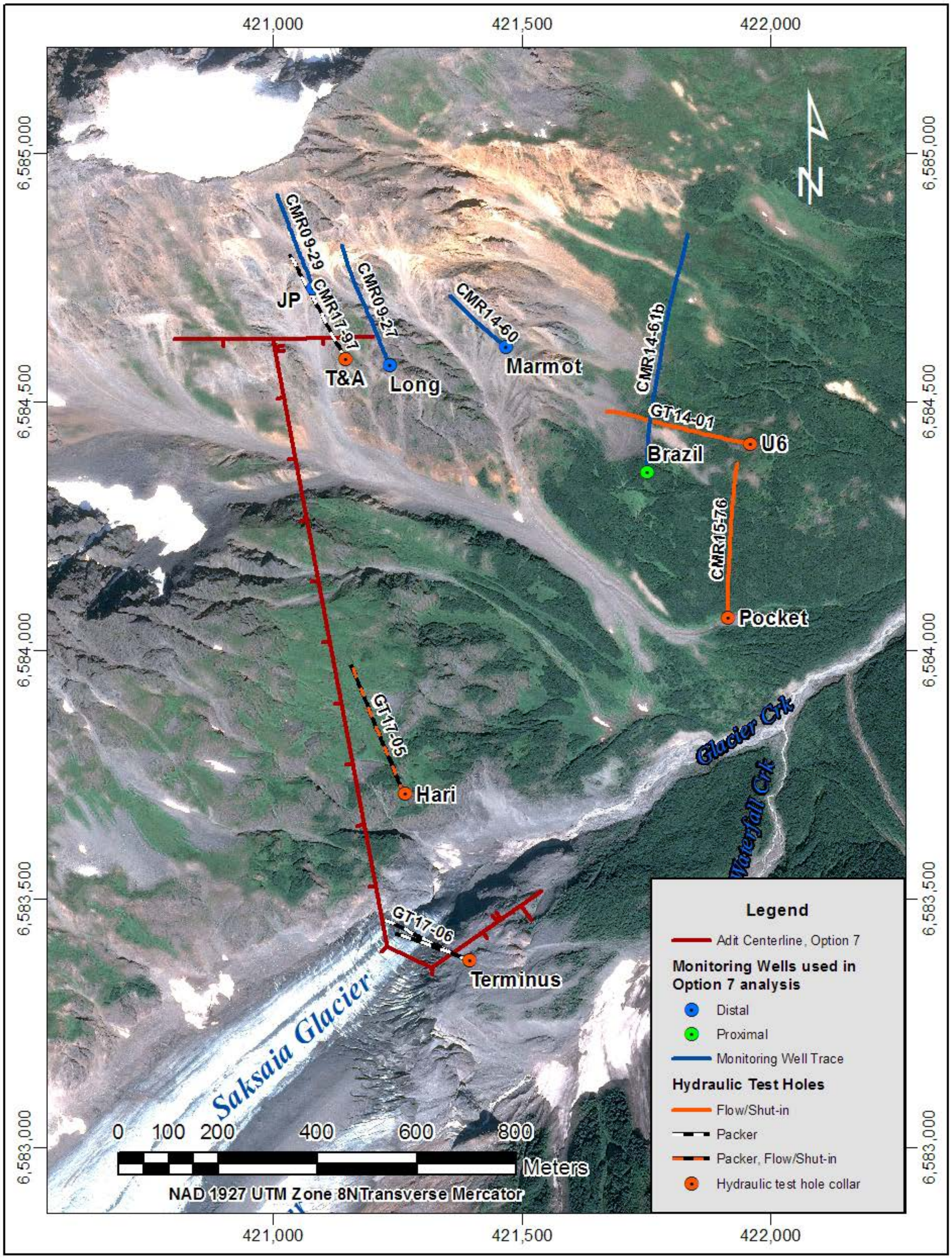


Figure 8-1. Option 7 hydraulic test holes and monitoring wells

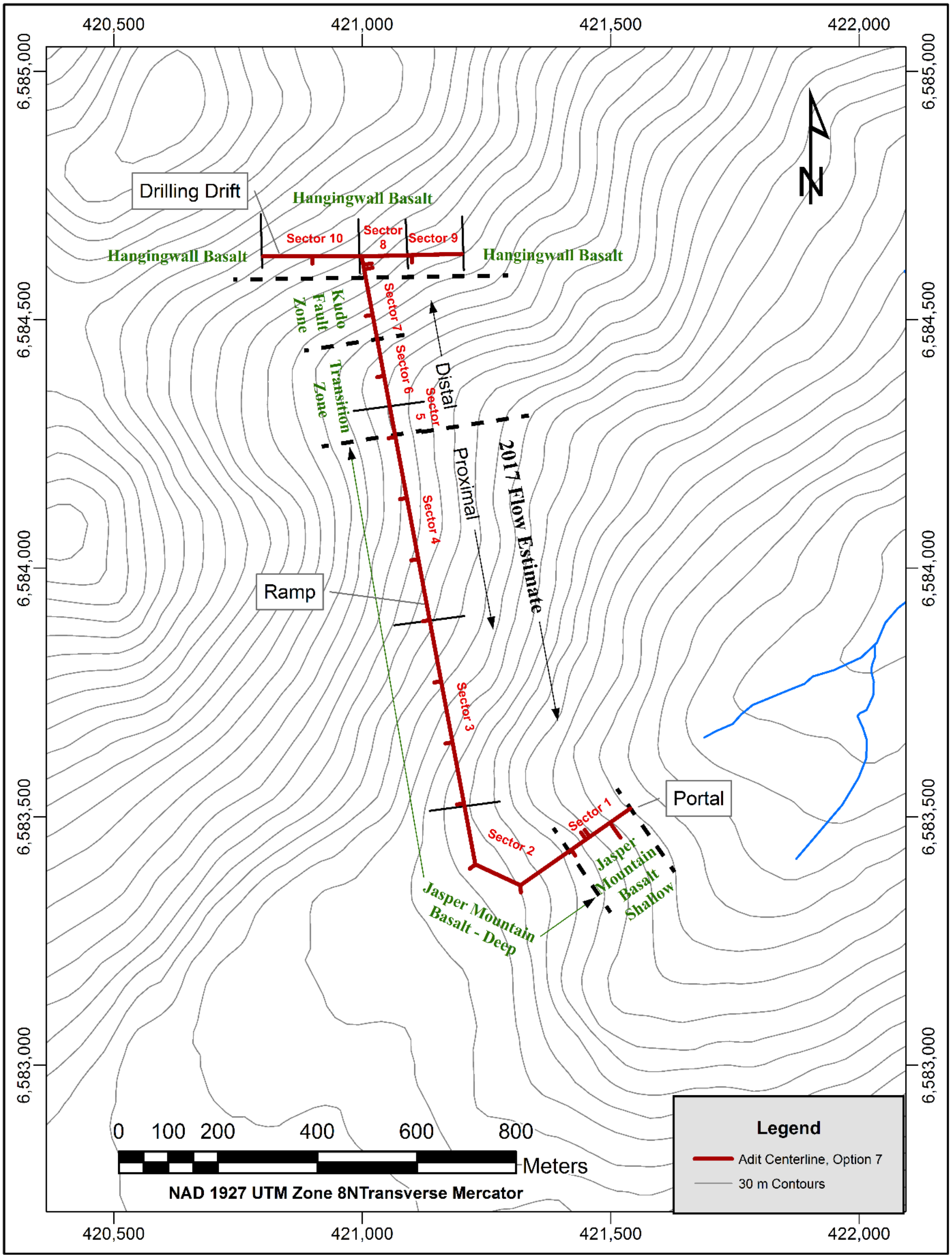


Figure 8-2. Option 7 adit

8.2 Methodology

A preliminary estimate of inflow that may be expected into the exploration adit was calculated using a mathematical solution derived to estimate inflow to individual tunnels/adits. The solution is a transient analysis that considers changes in inflow over time and length as an adit is advanced (Perrochet and Dematteis, 2007).

A transient flow approach is appropriate for the Palmer analysis because of the large seasonal variation in groundwater conditions observed in monitoring well data, and because the analysis considers the decrease in inflow over time due to depletion of storage; a condition that is common to drainage from fractured rock systems.

The analysis relies on hydrogeological characteristics of the various rock types, and transmissive features within the rocks. The hydrogeological data used in this analysis come from packer tests performed in geotechnical holes located near the first two-thirds of the potential adit, and from monitoring wells in the general area. The model input data will be described in detail in the next section.

The mathematical tool used for this analysis has the benefit of providing an estimate of inflow as the adit is advanced through the Jasper Mountain Basalt over a period of about one year. The Perrochet solution is computationally complex, and its full description is not presented here. In brief, inflow at a given time, Q(t), is strongly related to hydraulic conductivity (K), hydrostatic head (s) above the adit, and duration of drainage (t+ti, or Dt); and is less strongly related to groundwater storage (S) and the radius of the adit (r). The computational form of the equation presented below was solved using an Excel spreadsheet.

General form:

$$Q(t) = 2\pi \int_{0}^{vt} \frac{KsH(L-x)}{ln[1+\sqrt{\frac{\pi\,K}{Sr^2}\left(t-\frac{x}{v}\right)}]} dx$$

Computational form: $Q_i(t) = H(t-t_1)Q_i^{\infty}(t-t_i) - H(t-t_{i+1})Q_i^{\infty}(t-t_{i+1}), \quad \text{where } t > 0$

Where: $Q_i^{\infty}(u) = 4S_i r_i^2 s_i v_i [E_i(2X_i) - E_i(X_i) - ln(2)], \quad \text{and } X_i = ln(1+\sqrt{\frac{\pi\,K_i}{S_i r_i^2}}u)$

The variables are:

Q = flow rate	x or L = distance along adit
K = hydraulic conductivity	v = rate of adit advance
s = hydrostatic pressure above adit	E_i = solution to the exponential integral
S = groundwater storage	u = time step (t+t_i or t-t_i)
r = adit radius	H = 1 or 0 as a calculation on-off toggle

8.3 Input Data

Three principal parameters are needed for the flow analysis: hydraulic conductivity (K), water level, and the seasonal variation of the water level. The packer testing performed in 2017 is the source of the majority of the data used to determine the K for each of the hydrogeological units. The data also include additional test results from previous work. Results from the ongoing groundwater level monitoring program were used to estimate seasonal variation of the water level. Both the 2017 packer testing and the groundwater monitoring program were used to estimate the water level.

The adit intersects five hydrogeological units. These correspond to the four geologic units; Jasper Mountain Basalt, Transition Zone, Kudo Fault, and Hanging Wall Basalt; with the Jasper Mountain Basalt divided into two units as discussed below.

8.3.1 Hydraulic Conductivity

Isolated interval hydraulic tests (“packer tests”) were performed in four drill holes in 2017. The results of these tests that are used in the flow analysis are shown in Table 8-1. Two long-term whole-hole flow/shut-in tests performed in 2016 (Tundra, 2017a) also were used in the analysis and are shown in Table 8-1.

The amount of hydraulic data available for each unit varies. The 2017 testing provided 15 data points for the Jasper Mountain Basalt unit. There are three points from a mix of sources for the Hanging Wall Basalt unit. No data are available for the transition zone and the Kudo Fault Zone.

High quality hydraulic data based on packer testing are available for approximately the first three-quarters of the Jasper Mountain Basalt unit encountered by the Option 7 adit. The resulting K values are roughly lognormally distributed (Figure 8-3), but the plot suggests there are multiple subpopulations. A plot of K versus depth for the Jasper Mountain Basalt shows that the tests conducted at a depth of less than 110 meters below ground surface (mbgs) have a significantly lower K than that of the underlying Jasper Mountain Basalt (Figure 8-4). Therefore, the Jasper Mountain Basalt is divided into two hydrogeological units. The resulting K’s for the two units are shown in Table 8-2 and the data distribution is shown in box plots in Figure 8-5.

In the Hanging Wall Basalt, only one packer test was performed in 2017 and two other tests were performed in 2016. Given the limited amount of available data all three tests results are used to characterize this unit. The test locations are fairly widely distributed in the unit. The resulting K and data distribution are shown in Table 8-2 and Figure 8-5, respectively. The two 2016 tests are long-interval tests and, as discussed earlier, the resulting K for this unit is likely a high-end value rather than the mid-range value.

There are no data available for the Kudo Fault Zone and Transition Unit. The Kudo Fault Zone is expected to conducted large quantities of water based on the current hydrogeological model. No data are available for the Transition Zone. The unit is thought to have hydrologic properties intermediate between the Jasper Mountain Basalt and the Kudo Fault Zone.

Table 8-1. Hydraulic test results

Hole	Test	Top (m)	Bottom (m)	Type	Length (m)	K (m/d)	Head (m above TDX)	Vertical Depth to Water (m)	Hydro Unit
GT17-05	1	47.8	91.3	Packer	43.5	5.70E-02	9.2	57.6	1
GT17-05	2	107.8	133.5	Packer	25.7	1.74E-03	6.3	108.6	2
GT17-05	3	149.8	175.5	Packer	25.7	3.07E-03	35.6	112.1	2
GT17-05	4	176.8	198.1	Packer	21.3	1.95E-03	56.7	110.1	2
GT17-05	5	200.8	230.1	Packer	29.3	2.60E-03	64.0	120.0	2
GT17-05	6	233.8	262.5	Packer	28.7	4.60E-04	162.4	41.1	2
GT17-05	7	263.3	292.5	Packer	29.2	9.80E-03	177.8	45.3	2
GT17-06	1	39.1	64.8	Packer	25.7	4.94E-02	8.4	20.4	1
GT17-06	2	78.1	94.8	Packer	16.7	7.10E-01	15.3	24.6	1
GT17-06	3	120.1	148.8	Packer	28.7	5.39E-02	11.4	73.5	1
GT17-06	4	175.1	193.8	Packer	18.7	1.21E-03	47.3	77.0	2
GT17-06	5	210	241.8	Packer	31.8	6.67E-06	70.3	77.4	2
GT17-07	1	159.3	182.0	Packer	22.7	1.42E-03	52.0	78.0	2
GT17-07	2	192.3	224.0	Packer	31.7	5.51E-06	94.2	72.0	2
GT17-07	3	223.3	251	Packer	27.7	1.35E-05	157.5	35.5	2
CMR17-97	1	231.1	267	Packer	35.9	6.35E+00	118.9	177.7	5
GT14-1	1			F/S		9.20E-01			5
CMR15-76	1			F/S		5.50E-02			5

Type: F/S – Flow/Shut-in, long term; TDX = transducer
Hydro Units: 10 Jasper Mountain Basalt, Shallow; 2) Jasper Mountain Basalt; 5) Hanging Wall Basalt

Table 8-2. Hydraulic conductivity (m/d) statistics for hydrogeological units

Hole	Jasper Mountain Basalt, Shallow	Jasper Mountain Basalt	Transition Zone	Kudo Fault Zone	Hanging Wall Basalt
count	4	11	0	0	3
min	4.94E-02	5.51E-06			5.50E-02
mean	1.02E-01	4.34E-04			6.85E-01
median	5.54E-02	1.42E-03			9.20E-01
max	7.10E-01	9.80E-03			6.35E+00
-1 st dev	2.79E-02	2.97E-05			6.29E-02
+1 st dev	3.72E-01	6.35E-03			7.46E+00

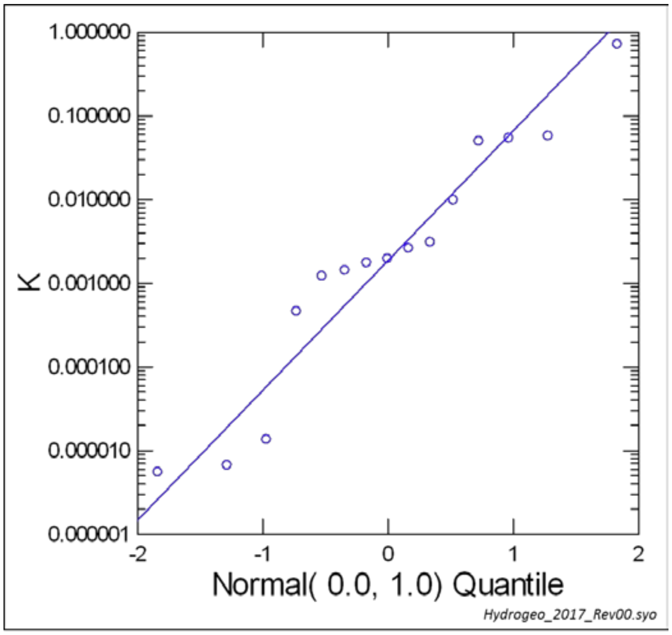


Figure 8-3. Probability distribution of Jasper Mountain Basalt hydraulic conductivity measurements

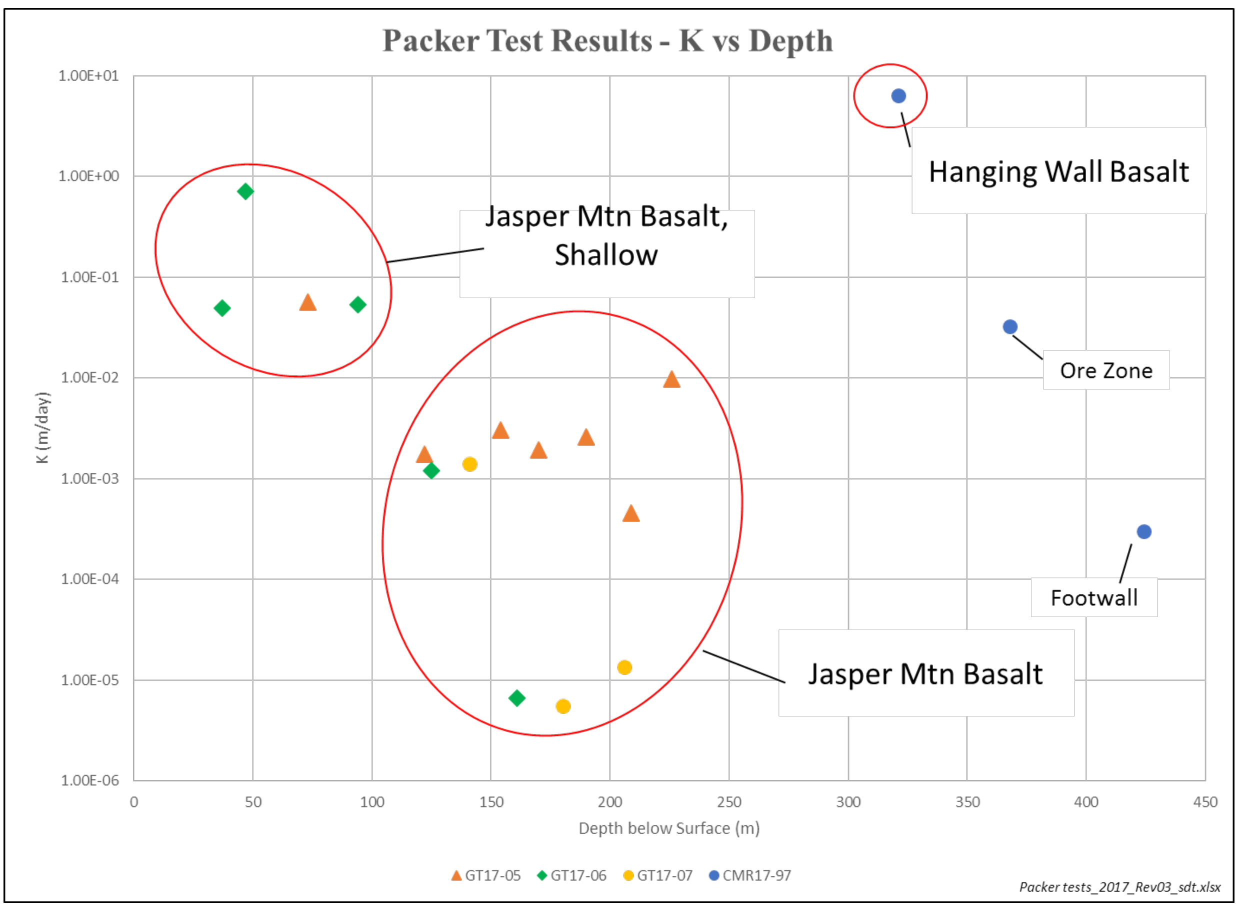


Figure 8-4. Hydraulic conductivity versus depth (packer test results)

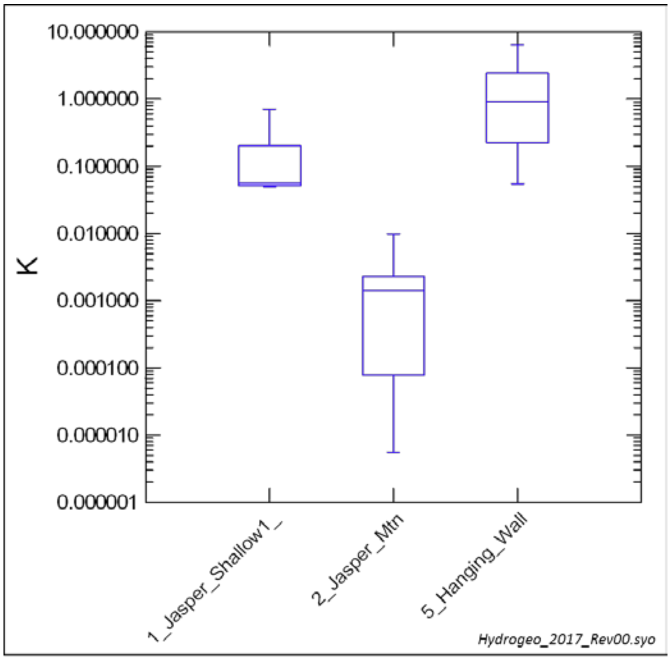


Figure 8-5. Box plots of hydraulic conductivity (m/d) by hydrogeological unit

8.3.2 Water Level Seasonality

Many monitoring wells in the Palmer Project area (Figure 8-1) show a large seasonal variation in groundwater level (greater than 38 m in Stryker; Tundra, 2016; see Figure 8-1 and Table 5-1 for name cross-references). The adit flow model is sensitive to the saturated thickness above the adit, which is a function of the water level. For the purpose of describing water levels, the drift is divided into proximal and distal sections. The proximal section is the first 1250 m and includes the two Hanging Wall Basalt hydrologic units. The distal section extends from 1250 m to the end and includes the transition zone, Kudo Fault Zone, and Hanging Wall Basalt units.

There are no long-term monitoring wells near the proximal end of the potential adit. Three wells are at a similar or lower elevation: Pocket, Taz, and Brazil. Pocket has a short and sporadic record and monitoring has been discontinued. Monitoring of Taz was started a year ago, so there is only a short record, and it is located over a 1000 m away from the adit. Brazil (shown in green in Figure 8-1), deemed the best available surrogate well, is 685 m away and the groundwater level is approximately at the elevation of the ramp.

Three monitoring wells were chosen to represent the groundwater level trends at the distal end of the adit (shown in blue in Figure 8-1): JP, Long, and Marmot. JP and Long are close to the drill drift, but the bottoms of the drill holes are above the drift level. Marmot is relatively close to the east end of the drill drift and spans the level of the drift.

The annual (water year) variation in groundwater levels are shown for the proximal and distal adit monitoring wells in Figure 8-6 and Figure 8-7, respectively. The mean trend is shown in black. Both show a pattern of high groundwater in the summer, falling groundwater levels in the winter, a winter low in April, and a rapid increase in water level in May. The range of seasonal variation in the well representing the proximal end of the adit is 7 m. The three wells representing the distal portion of the adit show differing amounts of season response, ranging from approximately 6 m in Marmot to a high of 31 m in JP. The seasonal variation of the geometric mean water level of the three wells is approximately 18 m.

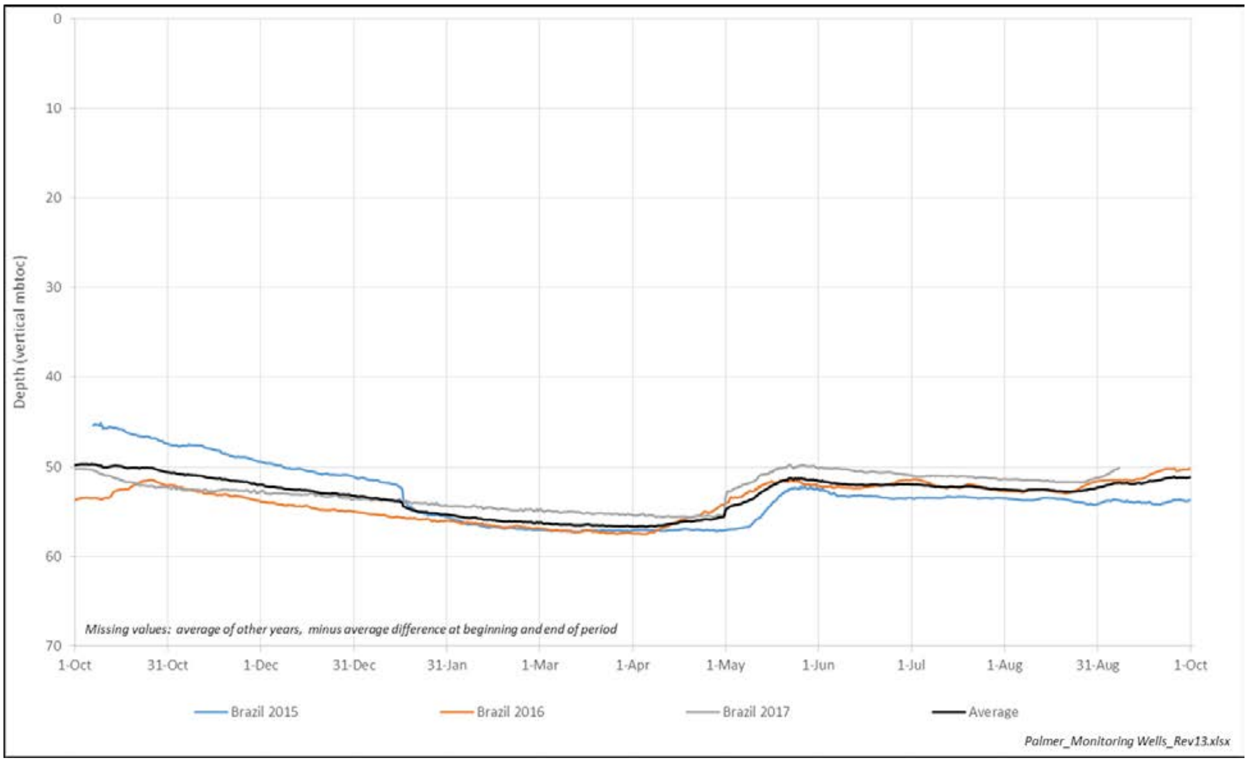


Figure 8-6. Depth to water, proximal adit monitoring well

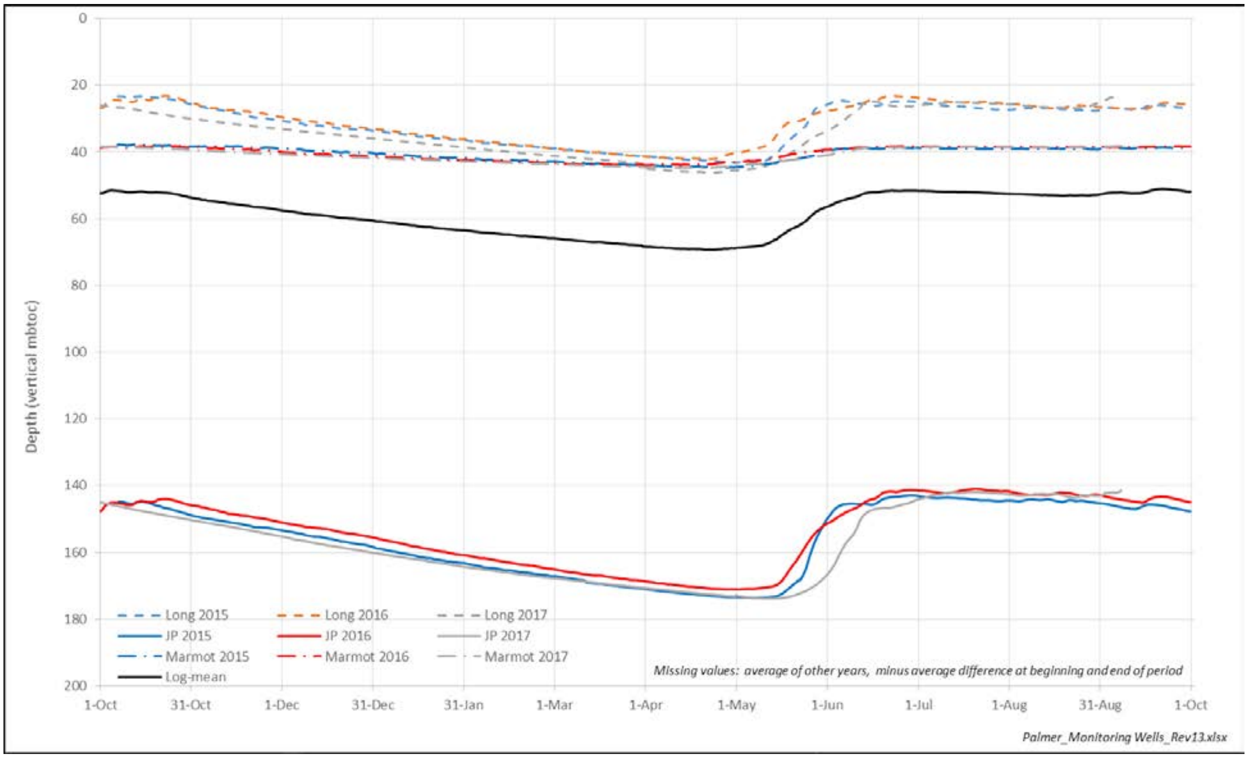


Figure 8-7. Depth to water, distal adit monitoring wells

8.3.3 Water Level

The water levels for the proximal and distal portions of the adit were estimated using different methods due to differing ranges in water levels and variation in the quality of available data. Water levels for the proximal portion of the adit were based on water levels from packer tests, which were judged to be more representative than water levels from a single monitoring well located over 600 m away. Monitoring well data were used to estimate water levels for the distal portion of the adit.

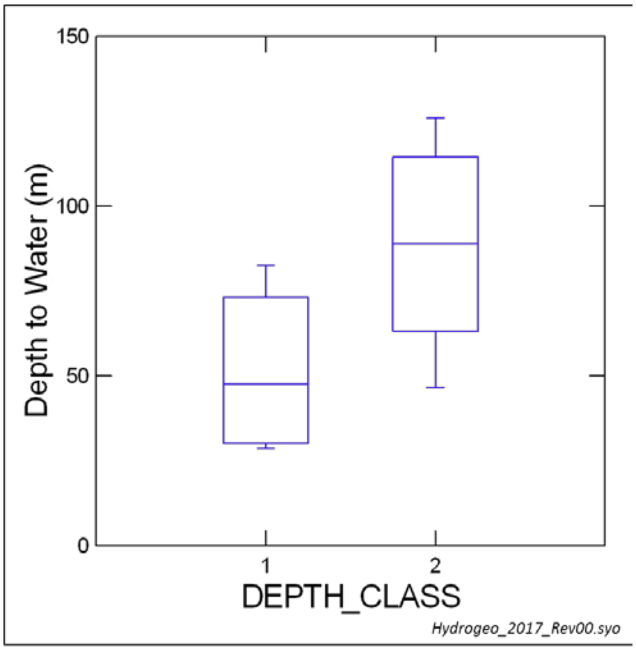
Pressure head recordings from packer tests resulted in 15 water level readings that were used to determine the water levels for the proximal portion of the adit. The data falls in two distinct populations corresponding to the previously defined Jasper Mountain Basalt units (see Section 8.3.1). The mean depth to water for the shallow, higher K Jasper Mountain Basalt (Figure 8-10; Table 8-3) is 44 m and the mean depth to water for the deeper, lower K Jasper Mountain Basalt is 80 m.

The geometric mean water level from the three monitoring wells representing the distal portion of the adit was used. Because water levels show considerable seasonal variation, the water level was determined on a sector basis (sectoring of the adit is discussed in Section 8.3.4). Water levels for this portion of the adit are also shown in Table 8-3.

The flow model requires an input of saturated thickness, which is a function of depth to water, surface elevation, and adit elevation:

$$\text{Saturated Thickness} = \text{Elevation}_{surface} - \text{Elevation}_{adit} - \text{Depth to Water}$$

The saturated thickness for each of the sectors accommodates the variations in these three parameters along the adit. The surface elevation is highly variable due to the steep terrain; the inclined design of the adit; and the seasonal water level variability. For determining the saturated thickness, the elevation of the surface and adit at the mid-point of each sector were used. The depth to water used in the model was the depth for the time (season) of year the sector would be mined. The resulting saturated thickness for each sector is shown in Table 8-4.



Depth Class: 1 = Shallow Jasper Mountain Basalt, 2 = remainder of Jasper Mountain Basalt

Figure 8-8. Boxplots of depth to water, Jasper Mountain Basalt

Table 8-3. Water level

Sector	Mean (Log(X))	St Dev (Log(X))	Mean (mbgs)	St Dev (m)	-1 St Dev (mbgs)	+1 St Dev (mbgs)	Source
1	-	-	44.0	25.8	18.2	69.8	1
2	-	-	79.8	30.2	49.6	110.0	1
3	-	-	79.8	30.2	49.6	110.0	1
4	-	-	79.8	30.2	49.6	110.0	1
5	1.839	0.281	69.1	-	36.2	131.8	2
6	1.782	0.310	60.6	-	29.7	123.7	2
7	1.719	0.318	52.3	-	25.2	108.7	2
8	1.714	0.325	51.7	-	24.5	109.3	2
9	1.725	0.322	53.1	-	25.3	111.4	2
10	1.740	0.315	55.0	-	26.6	113.6	2

Source: 1. Packer test water levels, 2. Distal monitoring wells *Flow analysis setup_180125.xlsx*

Table 8-4. Saturated thickness

Sector	Start	End	Adit El	Surface El (mamsl)	Depth to Water* (m)	Starting Saturated Thickness (m)
1	6/1/2019	7/9/2019	680	760	44.0	36
2	7/10/2019	9/30/2019	696	828	79.5	53
3	10/1/2019	1/4/2020	726	954	79.5	149
4	1/5/2020	4/9/2020	788	1110	79.5	243
5	4/10/2020	4/30/2020	805	1105	69.1	231
6	5/1/2020	6/15/2020	818	1118	60.6	239
7	6/16/2020	9/6/2020	832	1210	52.3	326
8	9/7/2020	9/30/2020	845	1284	51.7	387
9	10/1/2020	11/16/2020	848	1252	53.1	351
10	10/1/2020	12/19/2020	848	1344	55.0	441

8.3.4 Sectors

The water flow analysis for the adit was set up to include ten discrete sectors, which were defined based on the following criteria:

- Mining schedule – for this model, mining is planned to start on June 1 and continue until the adit is completed
- Hydrological unit – sectors do not cross hydrologic unit boundaries
- Seasonal groundwater level periods
  - Summer starts June 1 and ends September 30
  - Early and mid- winter interval starts October 1 and continues until the winter low is approached on March 31. This is a long decreasing interval, so was divided into 2 periods.
  - Winter low – April 1 through April 30
  - Spring rapid increase in water level – May 1 through May 31

The first two criteria were strictly followed. The seasonal groundwater periods were followed as closely as possible, but some leeway was allowed when a unit boundary was near the seasonal change to minimize the number of sectors. The adit sectors are shown in Figure 8-2.

8.3.5 Model Input

The hydraulic conductivity, water level, and seasonality values used for the flow model input are shown in Table 8-5. As discussed in previous sections, these are mean values. Additional input information include adit radius, and advance rate (Bogert, email of November 15, 2017).

Like any mathematical simulation of a real system, the accuracy with which the model will predict conditions in the system depends on how accurately the model input parameters represent the physical characteristics of the system. Hydraulic conductivity and water level data collected from GT17-05 through GT-17-07 are considered data of high confidence. These data represent isolated interval hydraulic testing of rocks in or directly adjacent to the area that the proposed adit will traverse. Other input parameters are based on data collected from drill holes more distant from the proposed adit or are assumed based on these data, and are of too low a confidence for use in the model. In particular, no hydraulic testing was done in the distal portions of the adit, so modeling of this region would require best assumptions based on data collected distant from the proposed adit. Our confidence in the representativeness of these assumptions would be low and any modeling would amount to little more than conjecture. Consequently, the analysis presented here was limited to the proximal portions of the adit, where the modeling is expected to provide a confident estimate of inflow. Additional drilling and testing is needed to provide the data needed to confidently estimate inflow in the distal portion of the adit. The levels of confidence for the available data and best assumptions, shown in Table 8-6, demonstrate that the data confidence is high in model sectors 1 through 4, and that test data are absent or poorly representative for sectors 5-10.

Table 8-5. Flow model input parameters

Sector	Hydro-Geo Unit	Description	Length of sector	Adit Radius	Adit Advance Rate	Time at which adit intersects sector	Time at which adit reaches end of sector	Hydraulic Conduc-tivity	Specific Storage	Starting Saturated Thickness
			L_i	r_i	v_i	t_i	t_{i+1}	K_i	S_i	s
			(m)	(m)	(m/d)	(d)	(d)	(m/d)	(1/m)	(m)
1	1	Jasper Mountain Basalt - shallow	150	2.0	4.0	0	38	1.02E-01	0.001	36
2	2	Jasper Mountain Basalt - deep	332	2.0	4.0	39	121	4.34E-04	0.001	53
3	2	Jasper Mountain Basalt - deep	384	2.0	4.0	122	217	4.34E-04	0.001	149
4	2	Jasper Mountain Basalt - deep	384	2.0	4.0	218	313	4.34E-04	0.001	243

Table 8-6. Data confidence

Sector	Confidence	Comments
1	9	high confidence in water level and K, moderate confidence in seasonal variation
2	8	high confidence in K, moderate confidence in water level, low confidence in seasonal variation, with confidence decreasing with increasing distance from test holes
3	7	high confidence in K, moderate confidence in water level, low confidence in seasonal variation, with confidence decreasing with increasing distance from test holes
4	6	high confidence in K, moderate confidence in water level, low confidence in seasonal variation, with confidence decreasing with increasing distance from test holes
5	1	Low confidence in K (not tested), K based on assumption that it is intermediate between adjacent units, moderately low confidence in water level and seasonality from wells in general area
6	1	Low confidence in K (not tested), K based on assumption that it is intermediate between adjacent units, moderately low confidence in water level and seasonality from wells in general area
7	1	Low confidence in K (not tested), K based on 1 faulted well elsewhere, moderately low confidence in water level and seasonality from wells in general area
8	2	moderate confidence in season variation, moderately low confidence in water level, low confidence in K
9	2	moderate confidence in season variation, moderately low confidence in water level, low confidence in K
10	2	moderate confidence in season variation, moderately low confidence in water level, low confidence in K

8.4 Model Results

The analysis was run using mean values for the input parameters. The results of the analysis are shown on Figure 8-9. Flow to the adit increases rapidly during advance through the shallow, more fractured, Jasper Mountain Basalt, which has a tested K of about three orders of magnitude higher than similar less-fractured dbasalt at depth. The low K of the deeper Jasper Mountain Basalt results in only a minor increase in flow as the adit progresses. The drop in flow as the adit is advance into the deeper and tighter basalt is a function of the water storage in the shallow basalt depleting over time (and therefore contributing less water flow over time) while the deeper Jasper Mountain Basal only makes small contributions to water flow. A decrease in flow is expected during the winter months, but this decrease is not simulated because seasonal variability of the water table in that area has not been monitored. It can be said qualitatively, however that winter flow rates are likely to decrease more in the shallow basalt (the first 150m), than in the less fractured deeper basalt. Based on the modeling, inflows are estimated to peak at almost 13 L/s (200 gpm) and then average about 10 L/s (160 gpm; Figure 8-9).

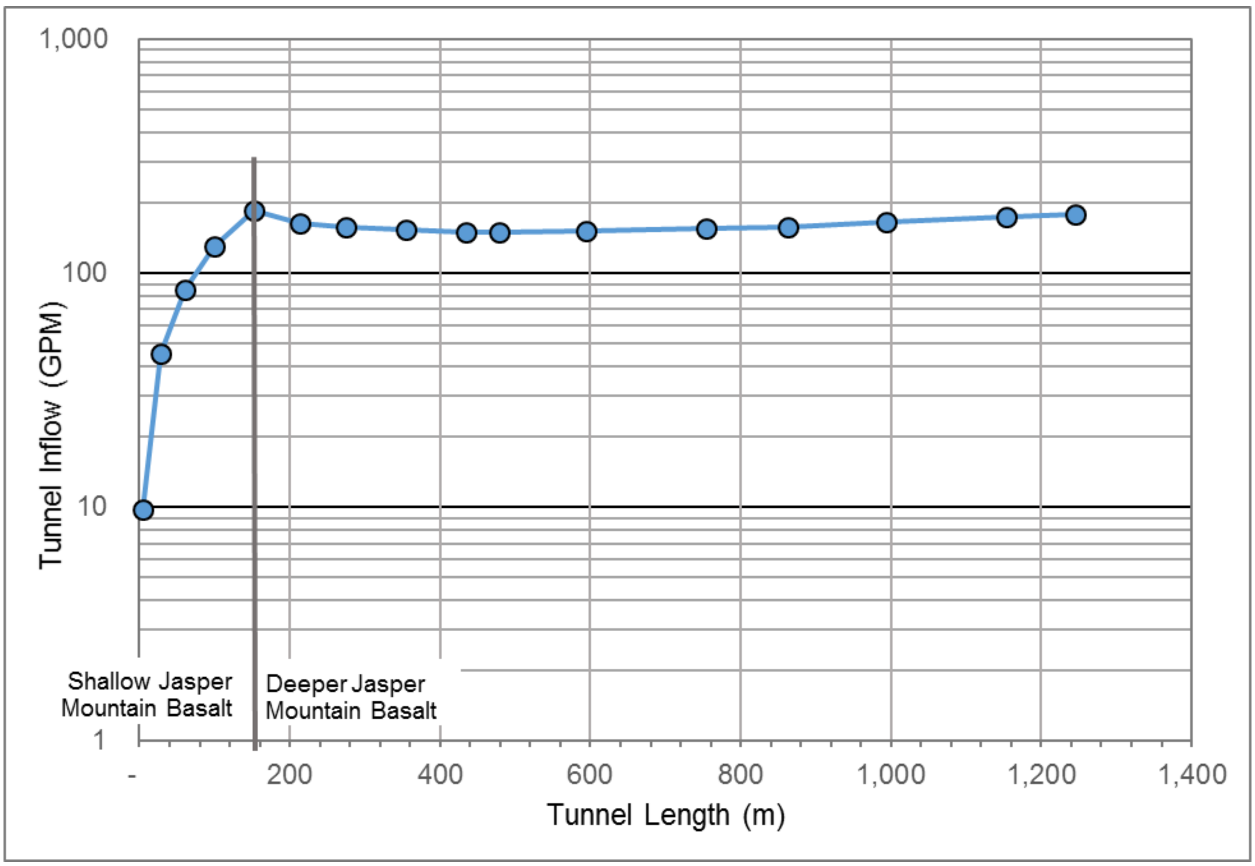


Figure 8-9. Estimated inflow to the proximal portion of the adit

9 Discussion

All of the available data were evaluated for inclusion in the flow model. It is readily apparent that, while there is a robust data set for the Jasper Mountain Basalt, data are insufficient for the remainder of the adit. Therefore, Tundra and CNI agreed that the flow model would include only the Jasper Mountain Basalt portion of the adit at this time. Modeling for the remainder of the adit would require assumptions based on data with an unacceptably high level of uncertainty, and the resulting inflow estimates would be highly speculative and possibly misleading. As mentioned, modeling of the remainder of the adit will require further hydraulic testing of the faulted rocks in its distal portion. Although the model predicts that the first 1,250 m of adit will produce 13 L/s (160 gpm) to 13 L/s (200 gpm) depending on the season, the predictive ability of any model is heavily dependent on the input data and the extent to which it accounts for the complexity of the natural system it represents.

Model results show a seasonally dampened response because the relatively intact rock mass of the Jasper Mountain Basalt drains slowly. While highly fractured rocks were not encountered by drilling in the area of the proximal adit, it is possible that fractured zones may be encountered by the adit. If present, such fracture zones may discharge more water than predicted by the model. Highly fractured rock can produce more inflow, but can also deplete storage or recharge more quickly. Consequently, a more fractured rock would likely produce higher seasonal variations in inflow and lower winter baseflow due to depletion of storage. The flow rate from the portion of the adit that was not modeled could be high. Available data from three tests in the Hanging Wall Basalt suggest that Ks for this unit may be high due to numerous faults and fracture zones. Though not tested, our general understanding of the Kudo Fault Zone lead us to expect that K's will be high in this zone (see the hydrogeological conceptual model – Section 7).

The packer testing (Section 6.1) provides quantified hydraulic conductivity. Testing was performed to clarify the relationship between discrete interval tests and long interval tests. The results suggest that the K determined from a long-interval test is similar to the highest K measured for any interval within the test range. This has multiple implications.

- In general, it is important to consider the objective of the testing and the hydrogeologic regime when choosing a method for hydraulic testing. The hydrogeology at the Palmer project appears to be dominated by fault and fracture flow. Therefore, it is most appropriate to test hydraulic parameters at the discrete interval scale. In contrast, for a project with relatively homogenous flow regime, hydraulic characterization at the rock unit scale would be adequate. Large interval tests are appropriate for certain applications, such as pumping tests (or equivalent flow/shut-in tests) used for water supply evaluation purposes.
- Hydraulic tests are inherently conservative and provide the maximum K for the test interval, not the average. As a result, modeling that is highly dependent on K, such as the adit flow estimate, will tend to also be conservative.
- There are also implications for inflow modeling. Because the long-interval test yields a maximum value, flow modeling that uses these data will result in a maximum value not a mid-range value. The discrete interval and long interval comparison does not show a clear relationship between the discrete interval and long interval water levels. Most of the monitoring wells have long saturated intervals (average of roughly 320 m). These intervals likely include multiple fault and fracture zones, which may partially explain the variation in water levels between wells located in the same general

area (Figure 8-7). Installing wells with discrete screened intervals across a specific feature may not reduce the inter-well variability, but it will allow us to better understand the cause of the observed water level pattern.

10 Recommendations

Tundra recommends that flow modeling for the distal portion of the adit be completed after additional packer testing is performed. We recommend that this additional data be collected through underground drilling after construction has begun on the adit. This will reduce the drilling cost as drilling will begin in the subsurface rather than at the ground surface, decreasing the length of the drill holes. We recommend that a drill station be established to the side of the adit well before entering the Transition Zone. A drill hole from this drill station should parallel the adit centerline. Drilling and packer testing should commence as early as possible and proceed in coordination with advancement of the adit. Early drilling is recommended to allow adequate lead time for analysis, reporting, planning, and action based on the results.

Estimates of adit flow rates are required for water disposal facility design. Model results indicate moderately low flow for the first year of mining. The flow rate from the remainder of the adit is unknown, but is expected to be high if not otherwise controlled by grouting. There is a limited area available for the water disposal system, which will include settling ponds and a land application disposal (LAD) system. Tundra recommends that the disposal system be designed for maximum capacity within the space constraints. We also recommend that the disposal capacity and the modeled flow rate for the distal adit be used as input to the grouting plan for that portion of the adit.

Due to the probability of short term peak flow rates, consideration of surge capacity should be part of the water disposal system design.

11 Summary

The objective of the 2017 hydrogeological program was to estimate the flow from the potential Option 7 adit. To achieve this objective 19 packer tests were performed in four drill holes. Packer test hydraulic conductivity (K) results ranged from a 5.51×10^{-6} m/d to 6.35 m/d. The adit will intersect five rock units: shallow Jasper Mountain Basal (less than 110 m deep), deeper Jasper Mountain Basalt, the “transition unit”, Kudo Fault Zone, and Hanging Wall Basalt. The average K from the shallow Jasper Mountain Basalt (number of samples (n) = 4) is 0.102 m/d, Jasper Mountain Basalt (n = 11) is 4.34×10^{-4} m/d, and the Hanging Wall Basalt (n = 1) is 6.35 m/d. Two additional tests were performed: one each in the South Wall ore zone and the Footwall schist. No tests were performed in the transition unit and the Kudo Fault Zone.

Flow modeling was performed for the first 1250 m of the adit, which represents approximately the first year of mining. Flow from the remainder of the adit was not modeled due to insufficient data.

The transient flow model of Perrochet and Dematteis (2007) was used to estimate a peak inflow 13 L/s (200 gpm) and sustained inflow of 10 L/s (160 gpm). Higher inflows are possible from fracture zones that were not intercepted by drill holes. An intact rock mass produces a low but relatively consistent inflow, whereas the more fractured the rock, the higher the inflow and more seasonal variability might be expected.

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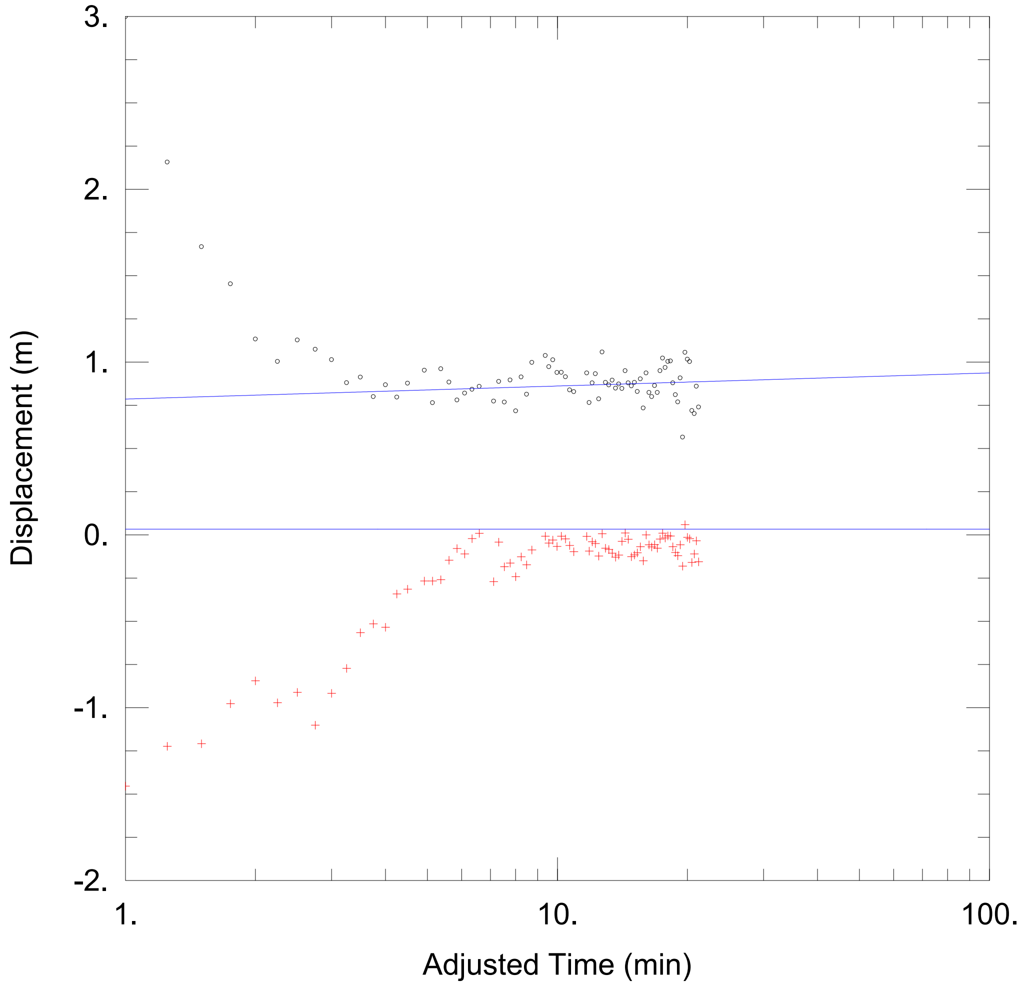
Appendices

Appendix A. Packer Test Analyses

Table A-1. 2017 Packer Test Analyses

Hole ID	Test No.	From (m)	To (m)	Interval (m)	Water Level (vert. m btoc)	Test Type	Analysis Method	T (m^2/day)[B]	K (m/day)[B]	Low K (m/day)	High K (m/day)	Storage Coefficient (S)	Lithologic Unit	Significant Structure	Assessment of Test and Analysis Quality	Comments
CMR17-097	1	231.1	267	35.90	42.5	Injection Test and Recovery	Cooper Jacob Drawdown	*282.20*	*7.86*	-	-	7.28E-09	Primarily "metasedimentary package" overlying VMS. Basalt to 246.5, then variable basalt, sedimentary tuff, and tuffaceous limestone. Top of VMS marked at 260.3 m. Precise contacts are indistinct.	Multiple minor faults and gouge	Good	Could not build pressure for a stepped pressure injection test, so injected water at a high rate (81 L/min) for 25 minutes. Confirmed that the packer stayed inflated by deflating with the E-Pin.
							Theis - Unconfined	*285.90*	*7.96*	-	-	5.59E-09			Fair	
							Theis Residual Drawdown	**228.00**	**6.35**	-	-				Good	
							Moench - Double Porosity[C] Primary	*1.16E-05*	*3.22E-07*	-	-	1.43E-10			Good	
							Secondary	*229.76*	*6.40*	-	-	1.78E-10				
								116.66	*3.25*	-	-				Fair	
	2	279.1	297.2	18.10	46.8	SPI[A]	Theim	**0.60**	**3.29E-02**	2.89E-02	3.63E-02	-	Primarily VMS, grading into Quartz Sericite Pyrite (QSP). Top of QSP marked at about 289.2 m, but contact is indistinct.	Minor clayey fault gouge. Moderate fracture frequency	Good	Good test. No significant issues. The increasing flow rate with time indicates that fractures tended to clean out over the course of the test.
	3	334.1	359.8	25.70	36.4	SPI[A]	Theim	**0.01**	**3.19E-04**	2.08E-04	4.92E-04	-	QSP	No faults or gouge. Low fracture frequency.	Good	Water Level not fully stabilized after 20 minutes prior to initiation of test. The decreasing flow rate with time indicates that fractures tended to become progressively blocked by transported material over the course of the test. No equipment issues.
GT17-05	1	47.8	91.3	43.5	3.9	SPI[1]	Theim/Lugeon	**3.78**	**8.68E-02**	1.95E-02	1.74E-01	-	Fresh Basalt	Minor discrete faults at 52, 56, & 58 m.	Fair	
						Initial Slug	Bouwer Rice	*0.59*	*1.35E-02*	-	-	-			Fair	
						Final Slug	Bouwer Rice	*0.77*	*1.78E-02*	-	-	-			Poor	
	2	107.8	133.5	25.7	21.9	SPI	Theim	**0.051**	**2.00E-03**	1.75E-03	2.28E-03	-	Fresh Basalt	Minor discrete fault at 99.2 m.	Good	
						Initial Slug	Bouwer Rice	*1.46*	*5.69E-02*	-	-	-			Fair	
	3	149.8	175.5	25.7	3.4	SPI	Theim	**0.073**	**2.84E-03**	1.51E-03	2.76E-03	-	Fresh Basalt	No significant structures	Fair	
	4	176.8	198.1	21.3	-10.6	SPI	Theim	**0.080**	**3.74E-03**	3.04E-03	4.65E-03	-	Fresh Basalt	No significant structures	Good	
	5	200.8	230.1	29.3	-11.7	SPI	Theim	**0.077**	**2.62E-03**	1.93E-03	3.29E-03	-	Fresh Basalt	Minor Discrete Fault at 209.75	Good	
						Injection Recovery	Theis - Residual Drawdown	*0.015*	*5.18E-04*	-	-	-			Fair	
	6	233.8	265.5	31.7	-101.6	SPI	Theim	**0.015**	**4.69E-04**	2.71E-04	1.19E-03	-	Fresh Basalt	No significant structures	Good	
	7	263.3	292.5	29.2	-109.4	Shut-In Test	Jacob - Lohman Discharge Decay	*0.29*	*9.79E-03*	-	-	-	Fresh Basalt	No significant structures	Good	
							Aron-Scott Method	**0.25**	**8.53E-03**	-	-	-			Good	
							Cooper Jacob Drawdown	*0.28*	*9.68E-03*	-	3.01E-02	-			Good	
							Neuman - unconfined	*0.28*	*9.73E-03*	-	6.62E-03	-			Good	
							Moench Dual Porosity: Aquifer	*0.10*	*3.35E-03*	-	3.70E-04	-			Good	
							Matrix	*0.56*	*1.91E-02*	-	4.15E-02	-			Good	
							Theis - unconfined	*0.32*	*1.11E-02*	-	4.06E-02	-			Good	
							Theis - Residual Drawdown	*0.30*	*1.02E-02*	-	-	-			Good	
	8	19	292.5	273.5	-4.9	Constant Rate Injection	Thiem	*10.08*	*3.69E-02*	-	-	-	Fresh Basalt	No significant structures	Good	
							Cooper Jacob Drawdown	**22.65**	**8.28E-02**	-	2.75E-08	-			Good	
							Theis - Residual Drawdown	*12.70*	*4.64E-02*	-	-	-			Good	
GT17-06	1	39.1	64.8	25.70	17.5	SPI[A]	Theim/Lugeon	**2.14**	**8.34E-02**	6.91E-02	1.01E-01	-	Terminus Basalt	Calcite seams with voids	Good	
	2	78.1	94.8	16.70	33.7	Constant Rate Injection	Cooper Jacob - Unconfined	**11.82**	**0.71**	-	1.13	-	Terminus Basalt	Broken zone - Rapid loss of drilling fluids at ~81m.	Good	Strong background trend of dropping water level imposed on the dataset. The background trend was modeled and subtracted from the dataset for the analysis.
							Cooper Jacob - Confined	*9.28*	*0.56*	-	1.96	-			Good	
							Theis Residual Drawdown	*9.86*	*0.59*	-	-	-			Good	
							Thiem Constant Head Injection	*33.23*	*1.99*	-	-	-			Fair	
	3	120.1	148.8	28.70	66.6	Constant Rate Injection	Cooper Jacob - Unconfined	*10.98*	*3.83E-01*	-	-	-	Terminus Basalt	Highly broken/gouge zone at about 123 m and progressive drop in water levels.	Good	Strong background trend of dropping water level imposed on the dataset. The background trend was modeled and subtracted from the dataset for the analysis.
							Cooper Jacob - Confined	*1.129*	*3.93E-02*	-	-	-			Good	
							Theis Residual Drawdown	*0.901*	*3.14E-02*	-	-	-			Fair	
							Moench - Double Porosity[C] Primary	*0.251*	*8.75E-03*	-	-	-			Fair	
							Secondary	*1.061*	*3.70E-02*	-	-	-			Fair	
							Bouwer Rice Falling Head	**1.547**	**5.39E-02**	-	-	-			Good	
							Thiem	*2.19*	*7.63E-02*	-	-	-			Fair	
	4	175.1	193.8	18.70	66.1	SPI	Thiem/Lugeon	**0.047**	**2.53E-03**	1.80E-03	3.45E-03	-	Jasper Mountain Fresh Basalt	None	Good	Moving into new hydrologic domain - upward pressure gradient and lower K
	5A	210.1	241.8	31.70	43.0	SPI	Thiem/Lugeon	*3.49E-04*	*1.10E-05*	0.00	2.60E-04	-	Jasper Mountain Fresh Basalt	None	Good	Ran the first test (Test 5A) with very little take from the formation. Upon completion of 5A, initiated 5B at higher injection pressures to compare responses.
	5B							**2.87E-04**	**9.04E-06**	0.00	1.52E-04	-			Good	
GT17-07	1	159.3	182	22.70	71.0	SPI[A]	Theim/Lugeon	**0.03**	**1.42E-03**	1.10E-03	1.70E-03	-	Terminus Basalt	Generally very high RQD rock, but minor fault zone with slightly elevated weathering from 161.4 to 163.6 m.	Good	Good test across a minor structure. The low hydraulic conductivity appears to be in line with a visual assessment of the core. Downward pressure gradient.
	2	192.3	224	31.70	10.5	SPI[A]	Theim/Lugeon	**1.75E-04**	**5.51E-06**	0.00	1.62E-04	-	Primarily Terminus Basalt, with tuffaceous and argillaceous limestones at 200.3 - 203.8 m below Saksaia Glacier	High RQD/Low fracture frequency. No major open structures.	Good	The very low hydraulic conductivity is in line with the very tight rock and high RQD. Lithology contacts are closed and do not take water. Some cycling of the bean pump introduced noise to the hydrograph, but this does not appear to significantly impact the interpretation. Water levels were higher than in the previous test zone.
	3	223.3	251	27.70	14.5	SPI[A]	Theim/Lugeon	**3.75E-04**	**1.35E-05**	0.00	3.18E-04	-	Jasper Mountain Basalt	No major open structures. High RQD and low fracture frequency.	Good	Good test across tight rock. The low hydraulic conductivity reflects the absence of significant open structures. Slightly lower water levels than in the previous test interval. This could be attributable to a greater contribution from the Jasper Mountain groundwater system.

A: SPI denotes a Stepped Pressure Injection test (occasionally referred to as a Lugeon test).
B: Hydraulic parameters considered most valid are **Bold;** Alternate analyzed values are in *italics*.
C: In double porosity solutions, Primary Porosity refers to the formation and Secondary Porosity refers to the fractures.



TEST 1

Data Set: T:\...\CMR17-097_Test1_231.1-267_CooperJacob.aqt
Date: 01/14/18 Time: 18:45:32

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: CMR17-097
Test Date: 1 August 2017

AQUIFER DATA

Saturated Thickness: 35.9 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
CMR17-097	0	0

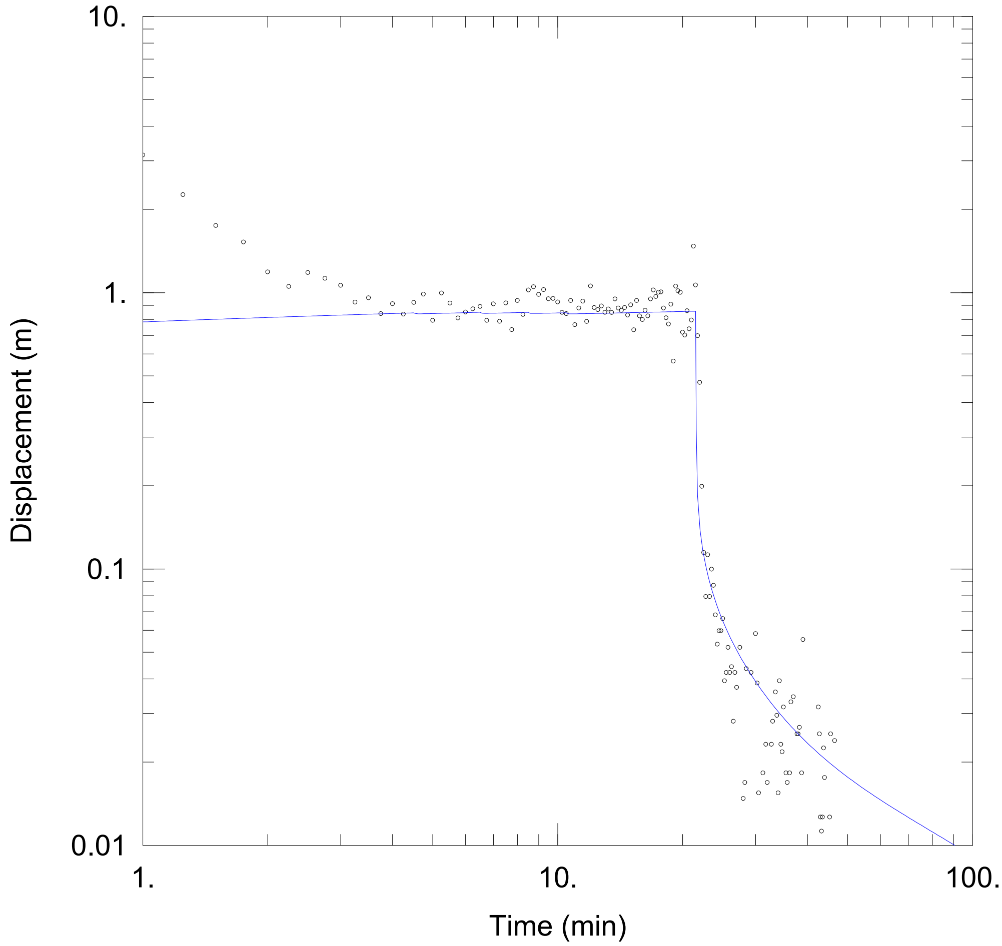
Observation Wells

Well Name	X (m)	Y (m)
◦ CMR17-097	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 282.2 m^2/day S = 7.282E-9



TEST 1

Data Set: T:\...\CMR17-097_Test1_231.1-267_Moench_Fractured.aqt
Date: 01/14/18 Time: 18:56:47

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: CMR17-097
Test Date: 1 August 2017

AQUIFER DATA

Saturated Thickness: 35.9 m Slab Block Thickness: 1. m

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
CMR17-097	0	0

Observation Wells

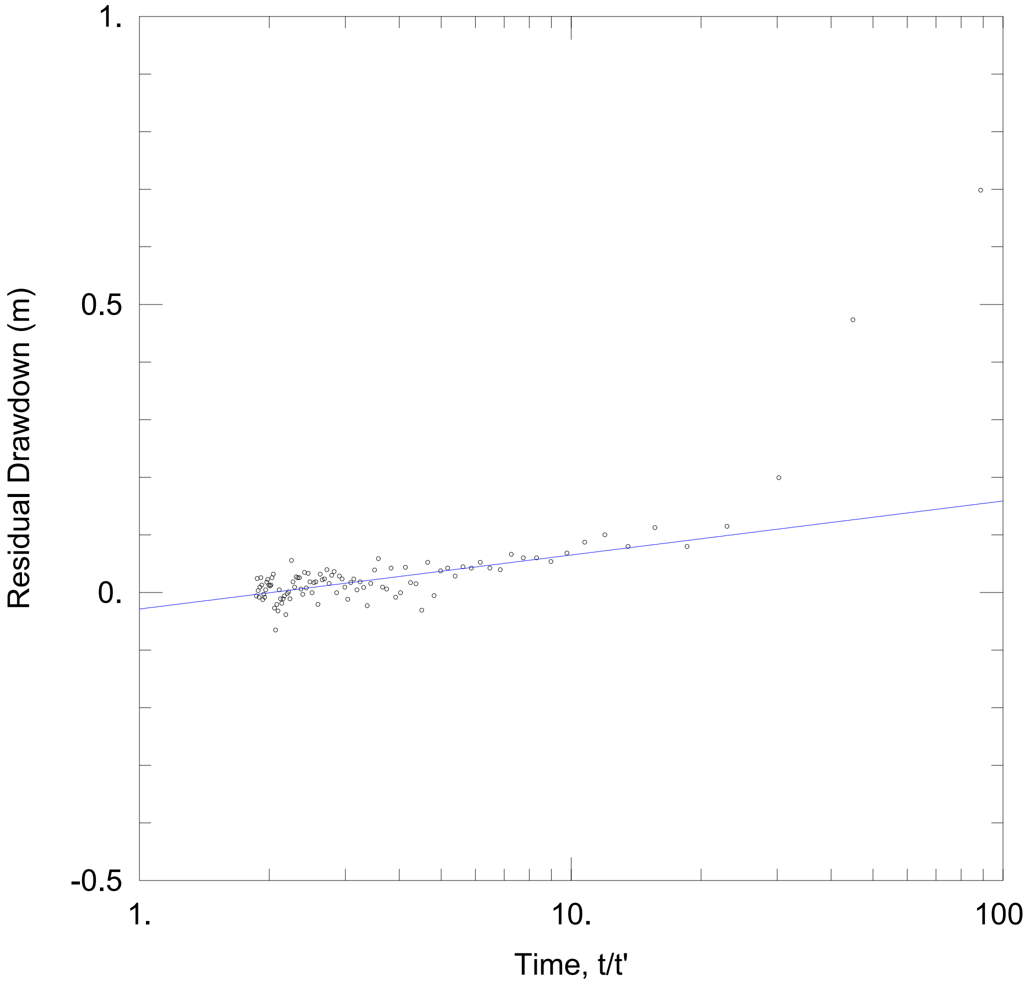
Well Name	X (m)	Y (m)
◦ CMR17-097	0	0

SOLUTION

Aquifer Model: Fractured
Solution Method: Moench w/slab blocks

K = 6.4 m/day
K' = 3.224E-7 m/day
Sw = -2.7
r(w) = 0.0508 m

Ss = 1.429E-10 m^{-1}
Ss' = 1.778E-10 m^{-1}
Sf = 0.45
r(c) = 0.0389 m



TEST 1

Data Set: T:\...\CMR17-097_Test1_231.1-267_TheisRDD.aqt
Date: 01/14/18 Time: 18:51:40

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: CMR17-097
Test Date: 1 August 2017

AQUIFER DATA

Saturated Thickness: 35.9 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
CMR17-097	0	0

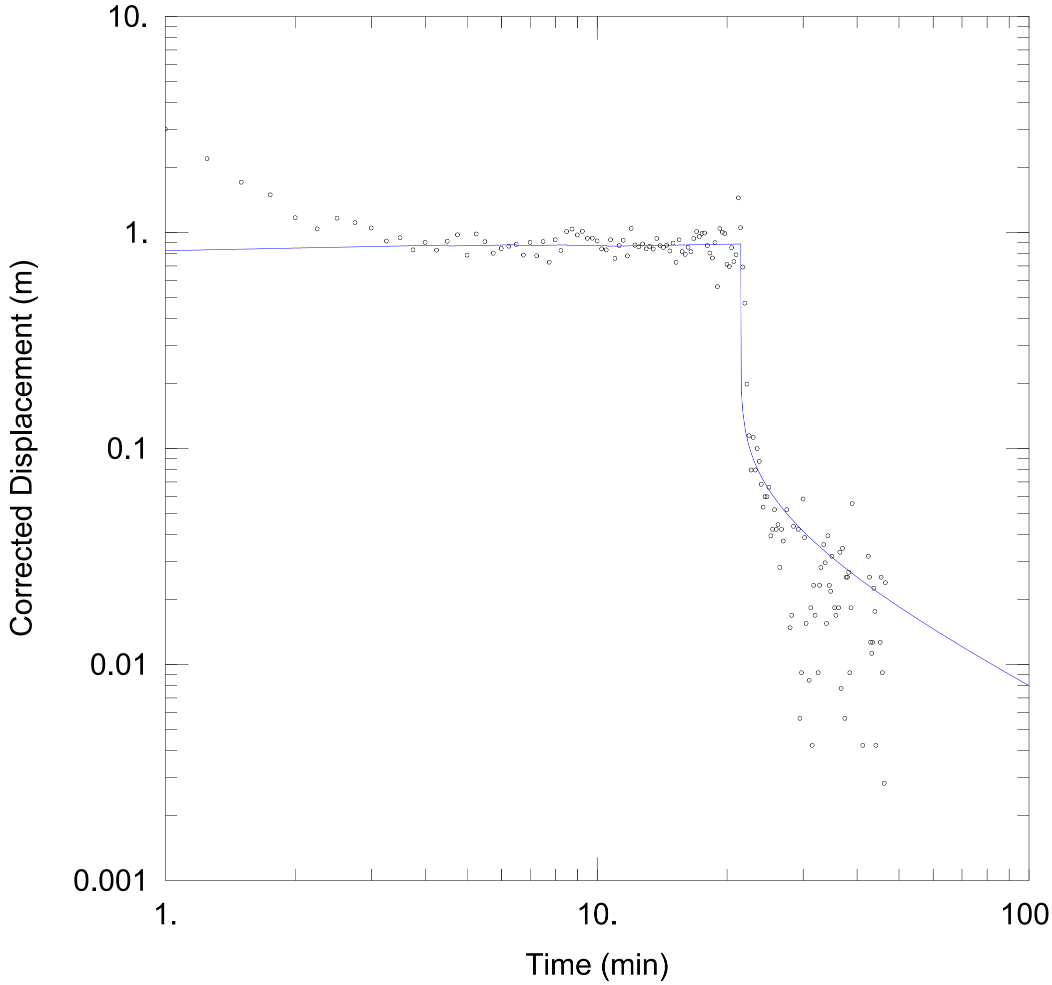
Observation Wells

Well Name	X (m)	Y (m)
◦ CMR17-097	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 228. m^2/day S/S' = 2.029



TEST 1

Data Set: T:\...\CMR17-097_Test1_231.1-267_Theis_Unconfined.aqt
Date: 01/14/18 Time: 18:50:32

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: CMR17-097
Test Date: 1 August 2017

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
CMR17-097	0	0

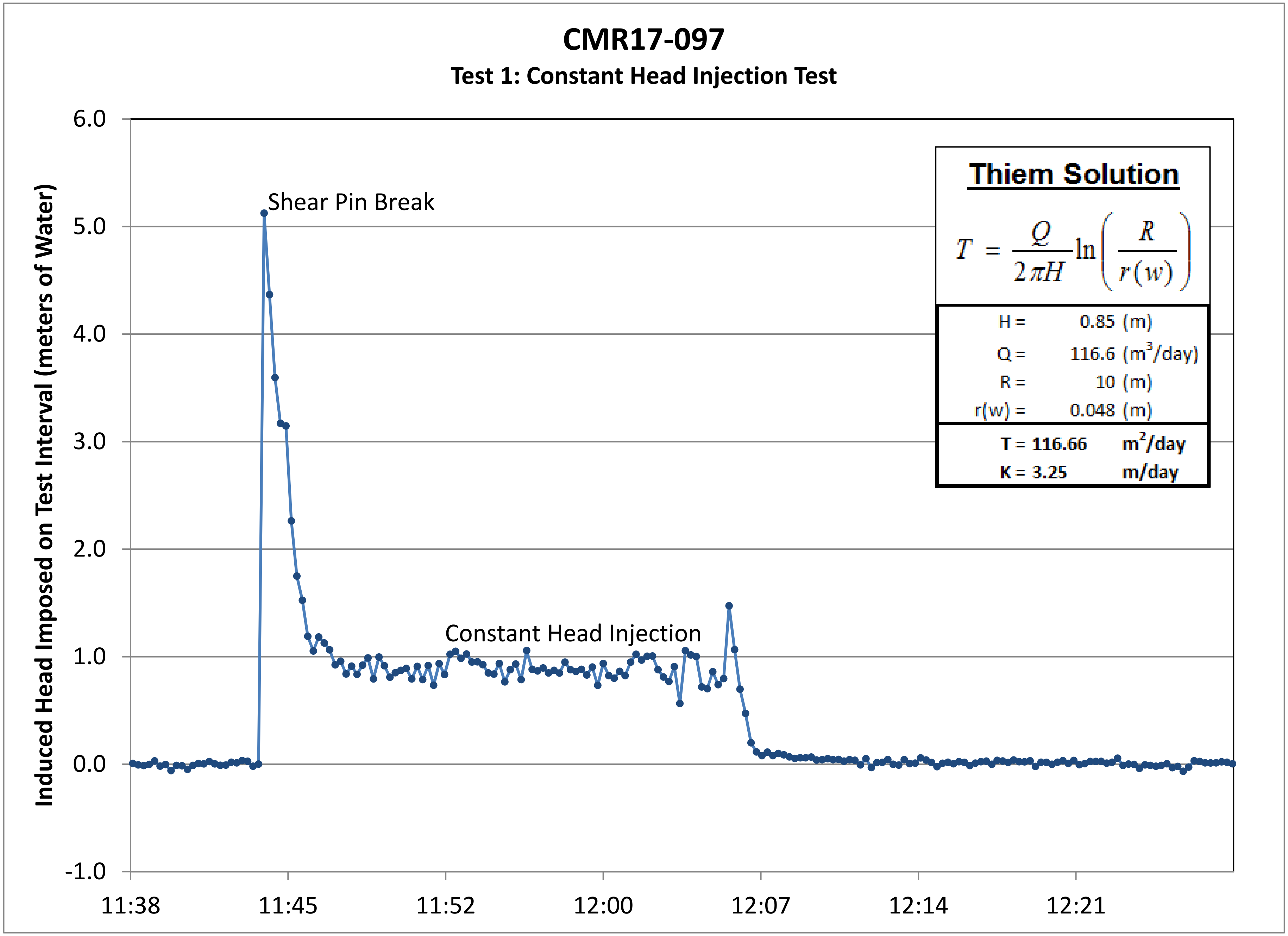
Observation Wells

Well Name	X (m)	Y (m)
◦ CMR17-097	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Theis

T = 285.9 m^2/day
Kz/Kr = 1.
S = 5.593E-9
b = 35.9 m


CMR17-097
Test 1: Constant Head Injection Test
Induced Head Imposed on Test Interval (meters of Water)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
11:38
11:45
11:52
12:00
12:07
12:14
12:21
Shear Pin Break
Constant Head Injection
Thiem Solution
$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{r(w)}\right)$
H = 0.85 (m)
Q = 116.6 (m^3/day)
R = 10 (m)
r(w) = 0.048 (m)
T = 116.66 m^2/day
K = 3.25 m/day

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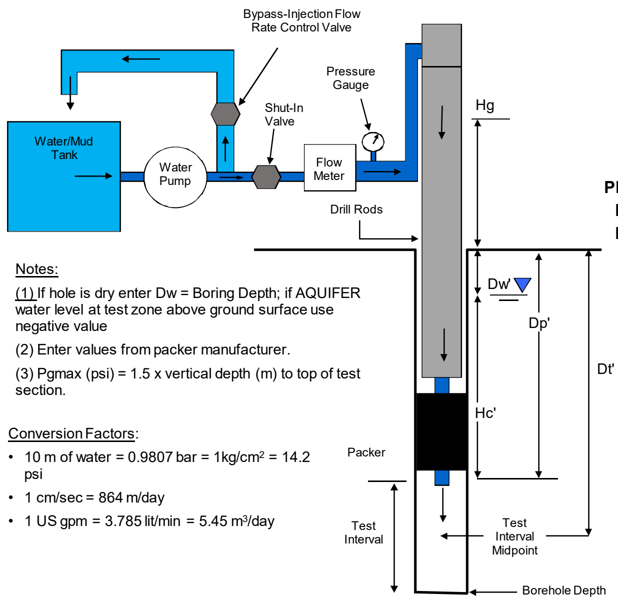
STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	**Constantine Metals**	**Test Interval (m):**	**279.1**	**To:**	**297.2**	**Test Nº**	**2**
Drillhole Nº:	**CMR17-097**	**Start Date:**	**2-Aug-17**	**Time:**	**7:45**	**Drill Bit Depth**	**277.8**
		End Date:	**2-Aug-17**	**Time:**	**10:15**	**DH Depth (m)**	**297.2**
		Supervisor:	**GEB**	**Drill No.**	**17**		

Max Injection P (psi)

301



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:

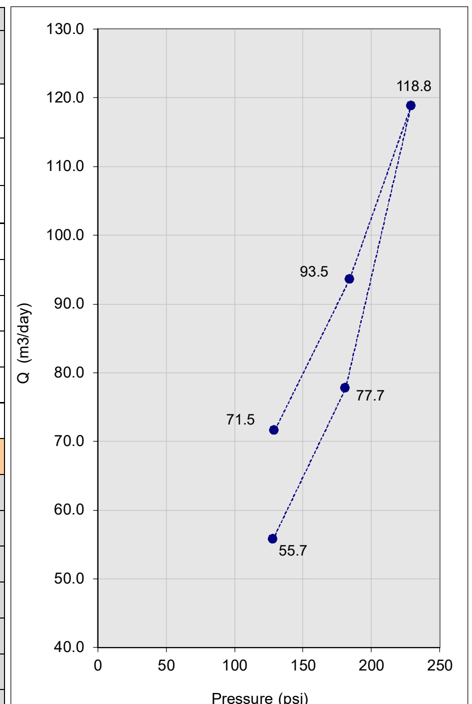
- 10 m of water = 0.9807 bar = 1kg/cm² = 14.2 psi
- 1 cm/sec = 864 m/day
- 1 US gpm = 3.785 lit/min = 5.45 m³/day

Dw	Measured depth of static water level (1)	65.1	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**84.0**	m
Dt	Measured depth to midpoint of test	**288.1**	m
ß	Inclination from horizontal (degrees)	46	º
Dw'	Vertical depth to static water level	**46.8**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**60.4**	m
Dt'	Vertical depth to midpoint of test	**207.3**	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	**86**	psi
Pshear	Estimated differential shear pressure required	**500**	psi
Pgmax	Maximum injection gauge pressure (3)	**311**	psi
Hg	Gauge height	0.5	m
Lp	Length of discharge pipe	9.14	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**	m
Hf	Friction Loss		
Hnit	Net injection head at midpoint of test		
K	Hydraulic conductivity		

Equations:

- $Hf = 8.65x10^{-15} (Q^2*Lp/rp^5)$
- $H_{nit} = (Dw'+Hg-Hf)+Pg/1.42$
- $K = (Q*Ln(R/r_b)) / 2*p*H_{nit}*L)$

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	**128**	**181.0**	**229**	**184.0**	**129.0**
Induced Pressure at Surface Gage	**50**	**100**	**150**	**100**	**50**
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**22.0**	**28.5**	**94.0**	**36.0**	**25.5**
2	**21.5**	**29.0**	**43.5**	**35.0**	**26.0**
3	**21.0**	**29.0**	**43.5**	**34.0**	**26.5**
4	**20.5**	**29.0**	**43.0**	**34.0**	**26.0**
5	**20.5**	**28.5**	**43.0**	**34.0**	**26.0**
Stable Q (L/30sec)	**20.5**	**28.5**	**43.0**	**34.0**	**26.0**
Leak Q (L/30sec)	**1.165**	**1.520**	**1.755**	**1.520**	**1.165**
Q (m³/day)	55.7	77.7	118.8	93.5	71.5
Hf (m)	3.13	6.09	14.23	8.83	5.16
Hnit (m)	90.1	127.5	161.3	129.6	90.8
K (m/day)	2.9E-02	2.9E-02	3.5E-02	3.4E-02	3.7E-02
K (m/s)	**3.4E-07**	**3.3E-07**	**4.0E-07**	**3.9E-07**	**4.3E-07**
+/- (m/s)	8.4E-08	6.0E-08	1.9E-08	-1.0E-09	-8.0E-09
+/- order of mag.	0.10	0.07	0.02	0.00	-0.01

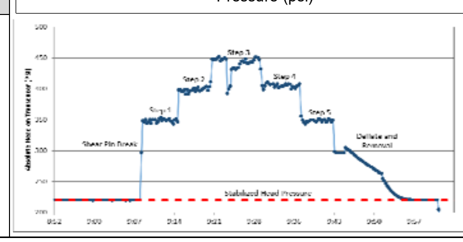


Geology, VMS zone grading into underlying quartz sericite.

RQ-JC-Structures, Moderate fracture frequency. No faults.

Flow Monitoring-System-Test Comments, No equipment issues. Flushed hole with fresh water prior to testing. During the third pressure step (150 psi), the pressure dropped suddenly and the injection rate had to be increased. Suspect a momentary issue with the Bean pump. Deflated the packer using the emergency shear pin after unlocking with the overshot failed.

The increasing flow with time suggests partial cleaning of fractures during the course of the test.



Drillhole Nº	CMR17-097
Test Nº	2

STEPPED PRESSURE INJECTION TEST

(page 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	120	174	224	175	124
Max P during step	136	188	234	193	134
average pressure +/- psi	8	7.0	5	9.0	5

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	1	1	1	1	1

High estimate of K

Q_{avg} (m^3/day)	58.56	80.58	121.67	96.42	74.40
Hf (m)	3.46	6.55	14.93	9.38	5.59
Hnit (m)	84.5	122.5	157.7	123.2	87.3
K (m/sec)	3.8E-07	3.6E-07	4.2E-07	4.3E-07	4.6E-07

Low estimate of K

Q_{avg} (m^3/day)	52.80	74.82	115.91	90.66	68.64
Hf (m)	2.81	5.65	13.55	8.29	4.75
Hnit (m)	95.8	132.4	164.8	135.9	94.4
K (m/sec)	3.0E-07	3.1E-07	3.8E-07	3.6E-07	4.0E-07

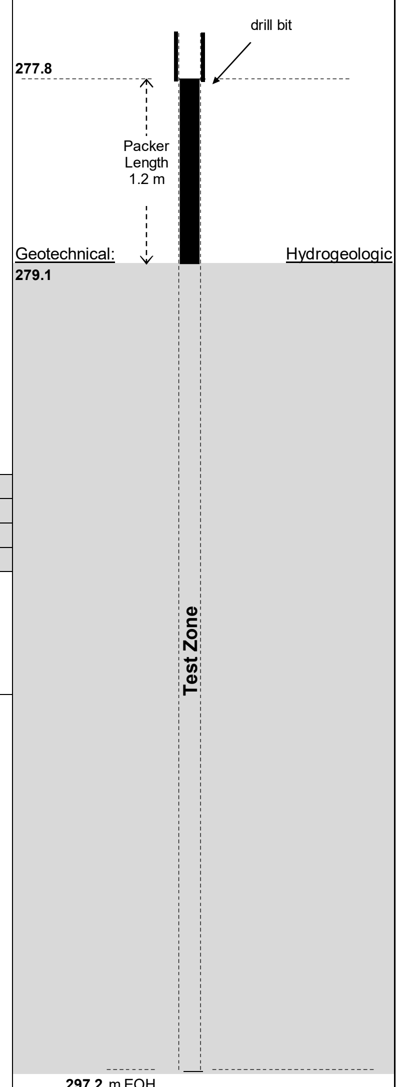
K averages for P step (m/second)

P	128	181	229
high est of K	4.20E-07	3.91E-07	4.19E-07
average K	3.82E-07	3.62E-07	4.00E-07
low est of K	3.47E-07	3.35E-07	3.82E-07

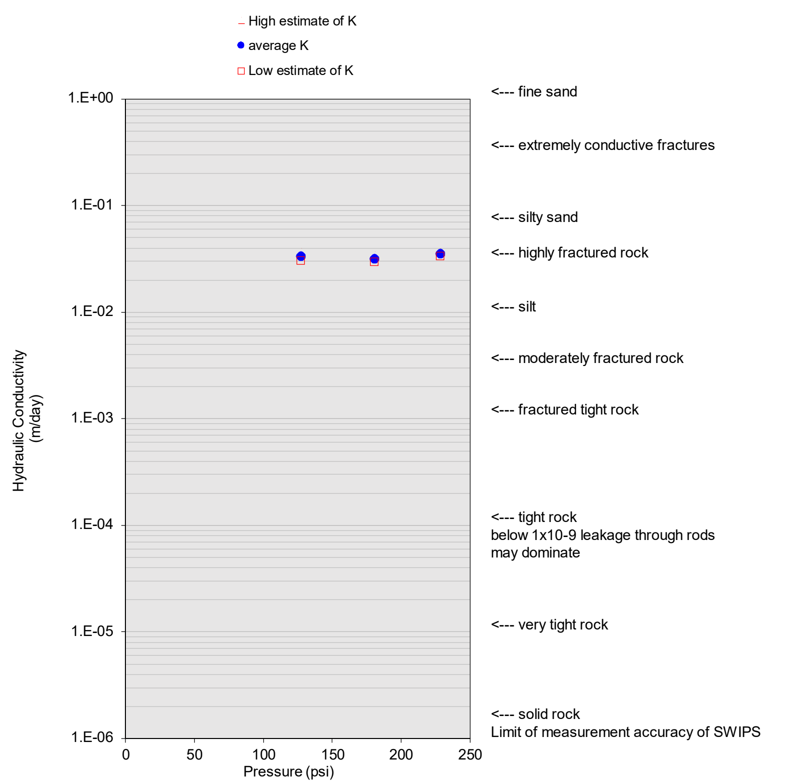
K avg all P steps

	m/day	Ft/Day
MAX	3.63E-02	1.19E-01
geomean	3.29E-02	1.08E-01
MIN	2.89E-02	9.48E-02

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



Graph of estimated hydraulic conductivity and error bounds.



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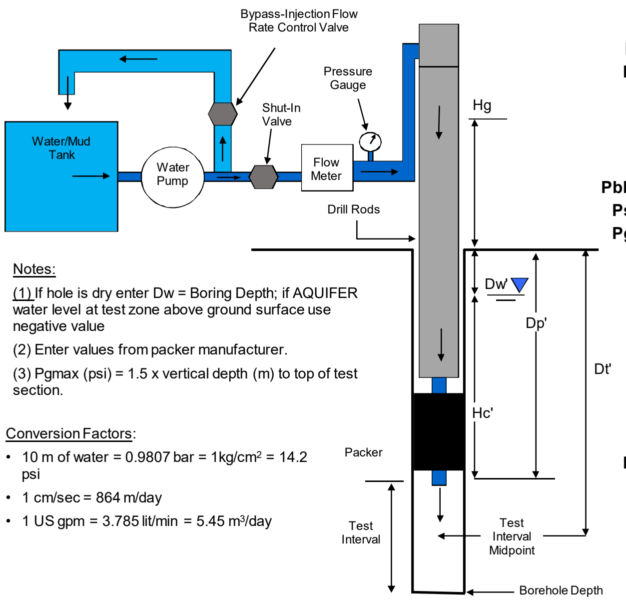
STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	**Constantine Metals**	**Test Interval (m):**	**334.1**	**To:**	**359.8**	**Test Nº**	**3**
Drillhole Nº:	**CMR17-097**	**Start Date:**	**3-Aug-17**	**Time:**	**7:00**	**Drill Bit Depth**	**332.8**
		End Date:	**3-Aug-17**	**Time:**	**10:15**	**DH Depth (m)**	**359.8**
		Supervisor:	**GEB**	**Drill No.**	**17**		

Max Injection P (psi)

360



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:

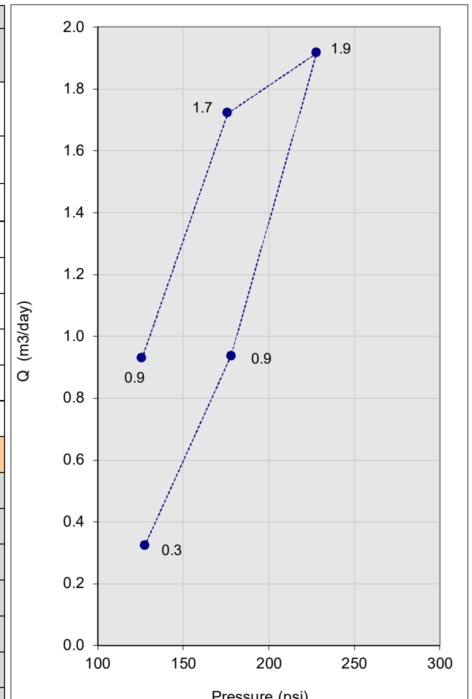
- 10 m of water = 0.9807 bar = 1kg/cm² = 14.2 psi
- 1 cm/sec = 864 m/day
- 1 US gpm = 3.785 lit/min = 5.45 m³/day

Dw	Measured depth of static water level (1)	50.6	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**84.0**	m
Dt	Measured depth to midpoint of test	**346.9**	m
ß	Inclination from horizontal (degrees)	46	°
Dw'	Vertical depth to static water level	**36.4**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**60.4**	m
Dt'	Vertical depth to midpoint of test	**249.6**	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	**86**	psi
Pshear	Estimated differential shear pressure required	**500**	psi
Pgmax	Maximum injection gauge pressure (3)	**374**	psi
Hg	Gauge height	0.5	m
Lp	Length of discharge pipe	9.14	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	**26**	m
Hf	Friction Loss		
Hnit	Net injection head at midpoint of test		
K	Hydraulic conductivity		

Equations:

- $Hf = 8.65x10^{-15} (Q^2*Lp/rp^5)$
- $H_{nit} = (Dw'+Hg-Hf)+Pg/1.42$
- $K = (Q*Ln(R/r_b)) / 2*p*H_{nit}*L)$

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	**125.9**	**176.0**	**228**	**178.0**	**127.5**
Induced Pressure at Surface Gage	**50**	**100**	**150**	**100**	**50**
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**0.967**	**1.320**	**1.570**	**0.890**	**0.570**
2	**0.950**	**1.175**	**1.420**	**0.910**	**0.500**
3	**0.763**	**1.150**	**1.570**	**0.940**	**0.550**
4	**0.830**	**1.205**	**1.285**	**0.900**	**0.545**
5	**0.815**	**1.160**	**1.395**	**0.900**	**0.560**
Stable Q (L/30sec)	**0.763**	**1.173**	**1.395**	**0.900**	**0.552**
Leak Q (L/30sec)	**0.440**	**0.575**	**0.730**	**0.575**	**0.440**
Q (m³/day)	0.9	1.7	1.9	0.9	0.3
Hf (m)	0.00	0.00	0.00	0.00	0.00
Hnit (m)	88.7	123.9	160.6	125.4	89.8
K (m/day)	3.5E-04	4.6E-04	3.9E-04	2.5E-04	1.2E-04
K (m/s)	**4.0E-09**	**5.3E-09**	**4.6E-09**	**2.9E-09**	**1.4E-09**
+/- (m/s)	3.1E-10	4.2E-13	1.1E-09	2.5E-09	2.9E-09
+/- order of mag.	0.03	0.00	0.10	0.27	0.50



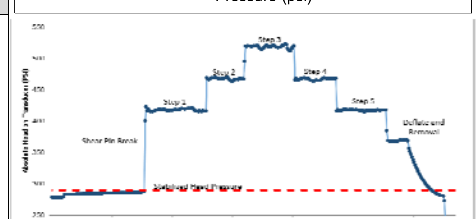
Geology, QMS

RQ-JC-Structures, Low fracture frequency. No faults.

Flow Monitoring-System-Test Comments, No equipment issues. Flushed hole with fresh water prior to testing. Deflated with the overshot. No equipment issues.

The decreasing flow rate with time suggests partial blocking of fractures by transported material.

Standing water was observed in the drill rods following the test and before deflating the packer, providing further evidence of low hydraulic conductivity.



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STEPPED PRESSURE INJECTION TEST
(page 2)

Drillhole Nº	CMR17-097
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	123	172	217	174	126
Max P during step	129	180	239	182	129
average pressure +/- psi	2.61	3.9	11	4.4	1.96

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	0.125	0.125	0.125	0.125	0.125

High estimate of K

Q_{avg} (m^3/day)	1.29	2.08	2.28	1.30	0.68
Hf (m)	0.00	0.00	0.01	0.00	0.00
Hnit (m)	86.8	121.2	152.8	122.3	88.4
K (m/sec)	5.7E-09	6.6E-09	5.7E-09	4.1E-09	2.9E-09

Low estimate of K

Q_{avg} (m^3/day)	0.57	1.36	1.56	0.58	-0.04
Hf (m)	0.00	0.00	0.00	0.00	0.00
Hnit (m)	90.5	126.7	168.3	128.5	91.2
K (m/sec)	2.4E-09	4.1E-09	3.5E-09	1.7E-09	#N/A

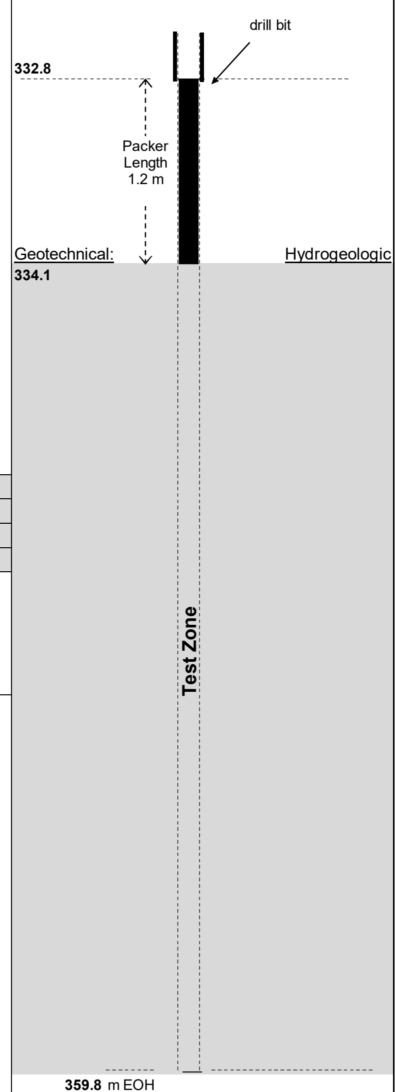
K averages for P step m/second

P	126	176	228
high est of K	4.31E-09	5.31E-09	5.70E-09
average K	2.69E-09	4.08E-09	4.56E-09
low est of K	2.40E-09	2.91E-09	3.54E-09

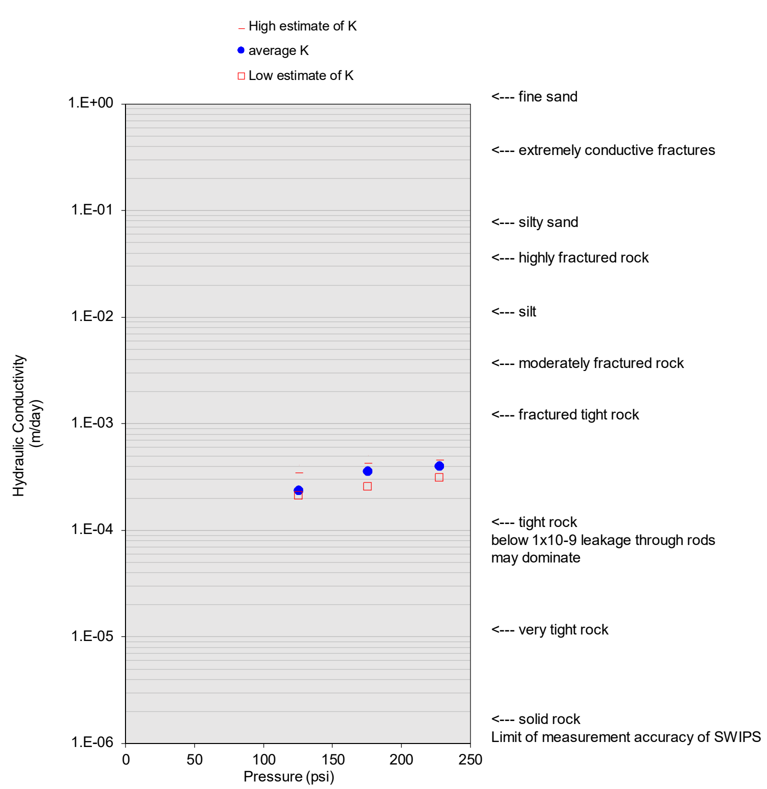
K avg all P steps

	m/day	Ft/Day
MAX	4.92E-04	1.61E-03
geomean	3.19E-04	1.04E-03
MIN	2.08E-04	6.81E-04

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



Graph of estimated hydraulic conductivity and error bounds.



CMR17-97_Test3_334.1-359.8_Analysis.xlsx / Analysis 1/14/2018

SRK Consulting — Engineers and Scientists

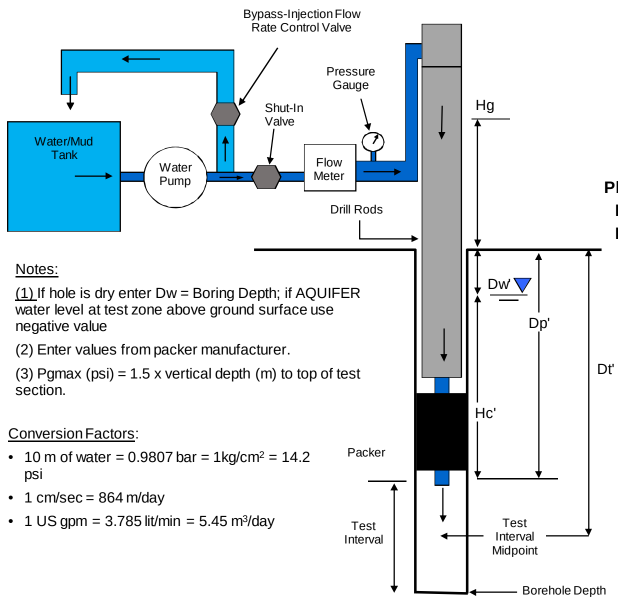
STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	**Constantine Metals**	**Test Interval (m):**	**47.8**	**To:**	**91.3**	**Test Nº**	**1**
Drillhole Nº:	**GT17-05**	**Start Date:**	**27-Jun-17**	**Time:**	**9:15**	**Drill Bit Depth**	**46.5**
		End Date:	**27-Jun-17**	**Time:**	**14:45**	**DH Depth (m)**	**91.3**
		Supervisor:	**GEB**	**Rig:**	**Hari**		

Max Injection P (psi)

72

Symbol	Description	Value	Unit
Dw	Measured depth of static water level (1)	45.0	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**84.0**	m
Dt	Measured depth to midpoint of test	**69.5**	m
ß	Inclination from horizontal (degrees)	15	°
Dw'	Vertical depth to static water level	**11.6**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**21.7**	m
Dt'	Vertical depth to midpoint of test	**18.0**	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	**500**	psi
Pgmax	Maximum injection gauge pressure (3)	**27**	psi
Hg	Gauge height	1.0	m
Lp	Length of discharge pipe	9.14	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0191	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	**44**	m
Hf	Friction Loss		
Hnit	Net injection head at midpoint of test		
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.

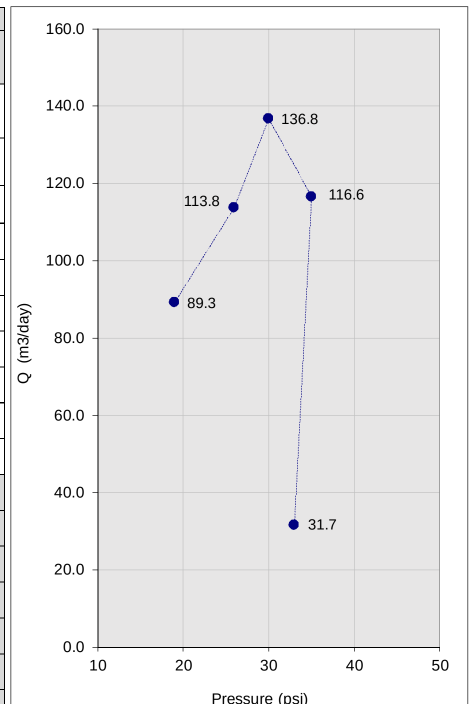
Conversion Factors:

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

Equations:

- $H_f = 8.65 \times 10^{-15} (Q^2 \cdot L_p / r_p^5)$
- $H_{nit} = (D_w' + H_g - H_f) + P_g / 1.42$
- $K = (Q \cdot \ln(R/r_b)) / 2 \cdot p \cdot H_{nit} \cdot L)$

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	33	35	30	26	19
Induced Pressure at Surface Gage	25	50	50	35	20
Marsh Funnel Secs. (Clean Water = 26)	26	26	26	26	26
1	9.50	35.50	47.00	40.00	31.50
2	10.50	40.50	47.50	39.50	30.50
3	11.00	46.00	47.50	39.50	31.00
4	11.50	47.50	47.00	40.00	31.00
5	13.50	48.00	47.50	39.50	31.00
Stable Q (L/30sec)	11.00	40.50	47.50	39.50	31.00
Leak Q (L/30sec)	0	0	0	0	0
Q (m³/day)	31.7	116.6	136.8	113.8	89.3
Hf (m)	0.03	0.43	0.59	0.41	0.25
Hnit (m)	35.9	36.9	33.2	30.5	25.8
K (m/day)	1.7E-02	6.2E-02	8.1E-02	7.3E-02	6.8E-02
K (m/s)	2.0E-07	7.2E-07	9.3E-07	8.4E-07	7.8E-07
+/- (m/s)	1.8E-08	3.8E-08	1.2E-07	-8.9E-08	-5.7E-07
+/- order of mag.	0.04	0.02	0.05	-0.05	-0.56

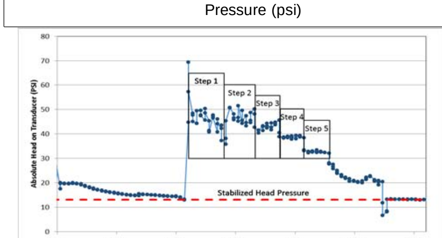


Geology, Basalt with minor dikes. Minor to moderate alteration to chlorite.

RQ-JC-Structures, Low FF, High RQD, Low weathering/alteration, some minor faulting and fault gouge.

Flow Monitoring-System-Test Comments, Very low leak rate. Clear signiture from breaking the 500 psi shear pin. Initially easy to build pressure for test steps, but strongly increasing flow rate with time and unable to build pressure past 50 psi after about 15 minutes. Attempted to break Emergency shear pin after the test to ensure that the packer had stayed inflated, but did not feel the pin break. However, the E-pin was broken upon retrievel of the packer. Suspect that the packer functioned correctly and that the shock of the pin breaking was dampened in the horizontal hole. Also suspect that the increasing flow rate with time is due to cleaning out of fractures.

Injected clean water with no polymer.



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Engineers and Scientists

STEPPED PRESSURE INJECTION TEST
(page 2)

Drillhole Nº	GT17-05
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	23	48	45	33	18
Max P during step	27	52	55	37	22
average pressure +/- psi	**2**	**2**	**5**	**2**	**2**

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**

High estimate of K

Q_{avg} (m^3/day)	33.12	118.08	138.24	115.20	90.72
Hf (m)	0.03	0.44	0.60	0.42	0.26
Hnit (m)	34.4	35.4	29.7	29.1	24.4
K (m/sec)	2.2E-07	7.5E-07	1.1E-06	8.9E-07	8.4E-07

Low estimate of K

Q_{avg} (m^3/day)	30.24	115.20	135.36	112.32	87.84
Hf (m)	0.03	0.42	0.58	0.40	0.24
Hnit (m)	37.3	38.3	36.7	32.0	27.2
K (m/sec)	1.8E-07	6.8E-07	8.3E-07	7.9E-07	7.3E-07

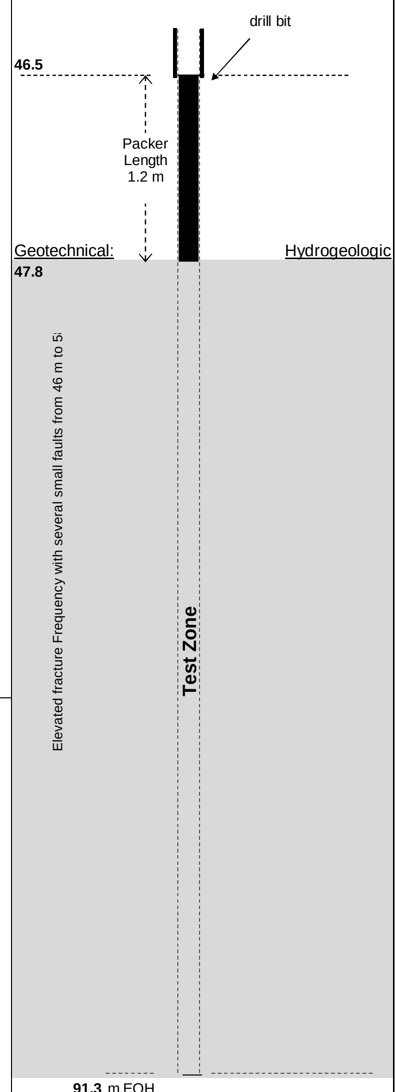
K averages for P step — m/second

P	33	35	30	26	19
high est of K	2.2E-07	7.5E-07	1.1E-06	8.9E-07	8.4E-07
average K	2.0E-07	7.2E-07	9.3E-07	8.4E-07	7.8E-07
low est of K	1.8E-07	6.8E-07	8.3E-07	7.9E-07	7.3E-07

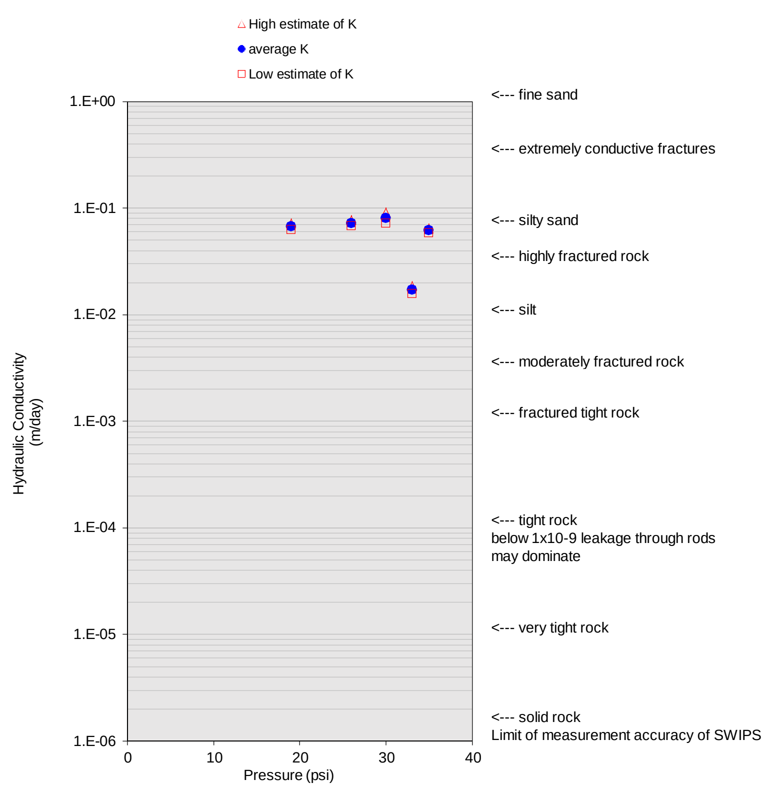
K avg all P steps

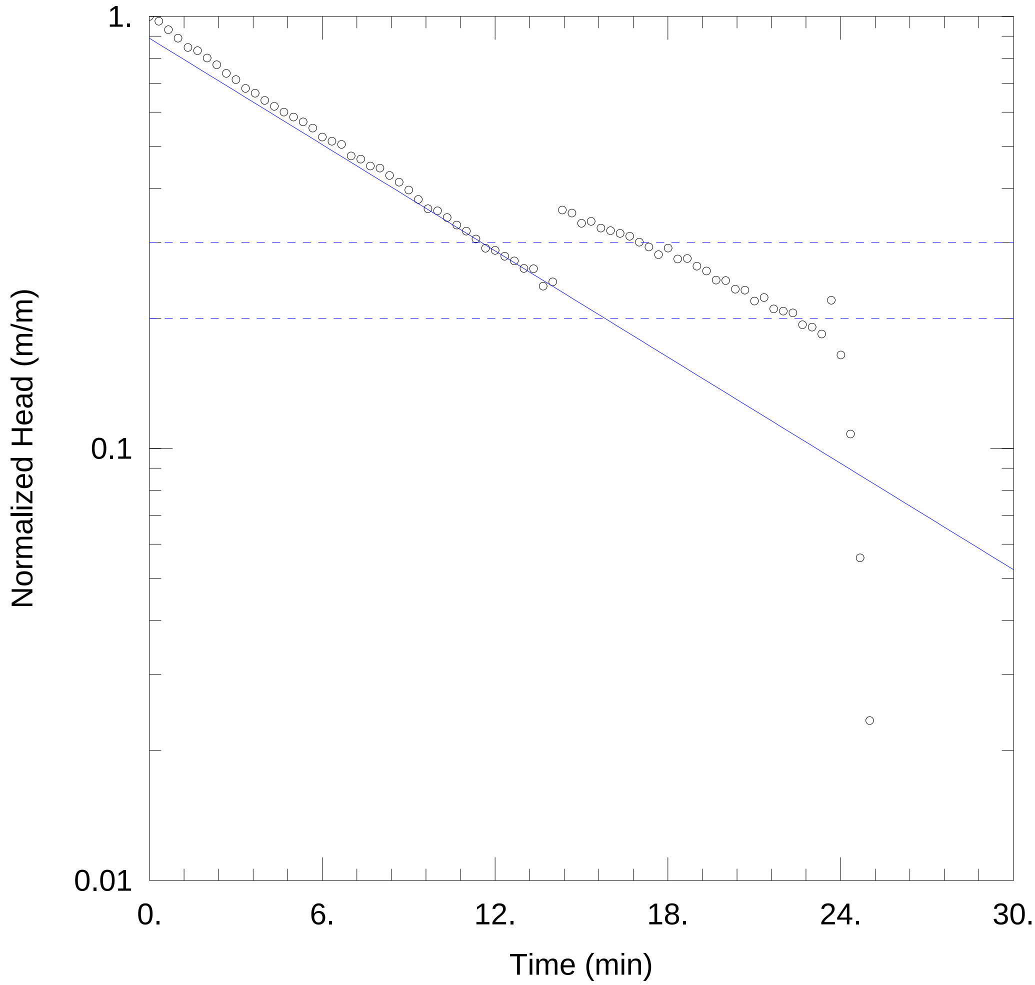
	m/day	Ft/Day
MAX	9.1.E-02	3.0.E-01
geomean	5.3.E-02	1.7.E-01
MIN	1.6.E-02	5.2.E-02

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



Graph of estimated hydraulic conductivity and error bounds.





TEST 1 - SLUG 1

Data Set: C:\Users\gbaldwin\Desktop\Palmer\Test 1\Slug 1\Slug1_BouwerRice.aqt
Date: 07/07/17 Time: 16:12:55

PROJECT INFORMATION

Company: SRK
Client: Palmer
Location: Palmer, AK
Test Well: GT-17-05
Test Date: 27 June 2017

AQUIFER DATA

Saturated Thickness: 43.5 m Anisotropy Ratio (Kz/Kr): 1.

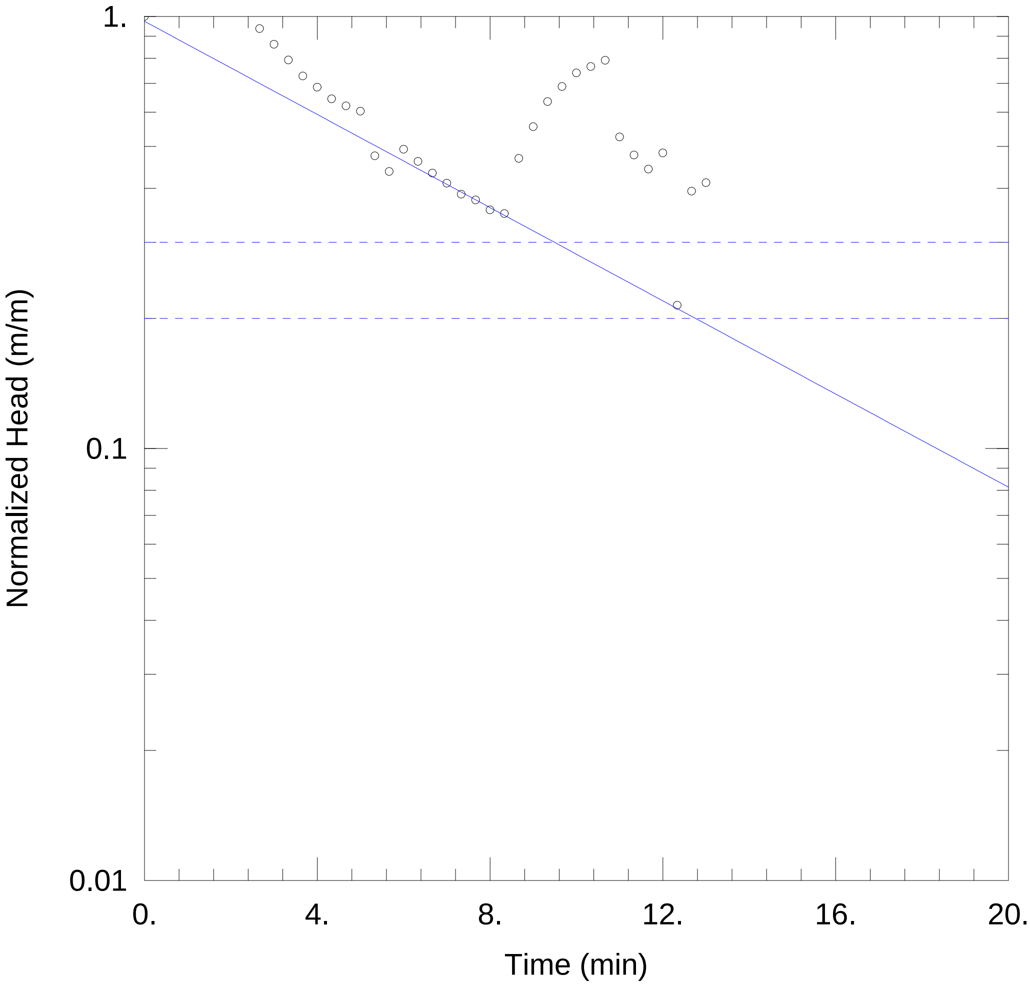
WELL DATA (GT-17-05)

Initial Displacement: 4.543 m
Total Well Penetration Depth: 43.5 m
Casing Radius: 0.0389 m
Static Water Column Height: 43.5 m
Screen Length: 43.5 m
Well Radius: 0.048 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01351 m/day y0 = 4.043 m



TEST 1 - SLUG 1

Data Set: C:\Users\gbaldwin\Desktop\Palmer\Test 1\Slug 2\Slug2_BouwerRice.aqt
Date: 07/07/17 Time: 16:14:06

PROJECT INFORMATION

Company: SRK
Client: Palmer
Location: Palmer, AK
Test Well: GT-17-05
Test Date: 27 June 2017

AQUIFER DATA

Saturated Thickness: 43.5 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GT-17-05)

Initial Displacement: 4.543 m
Total Well Penetration Depth: 43.5 m
Casing Radius: 0.0389 m
Static Water Column Height: 43.5 m
Screen Length: 43.5 m
Well Radius: 0.048 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.01776 m/day y0 = 4.426 m

SRK Consulting — Engineers and Scientists

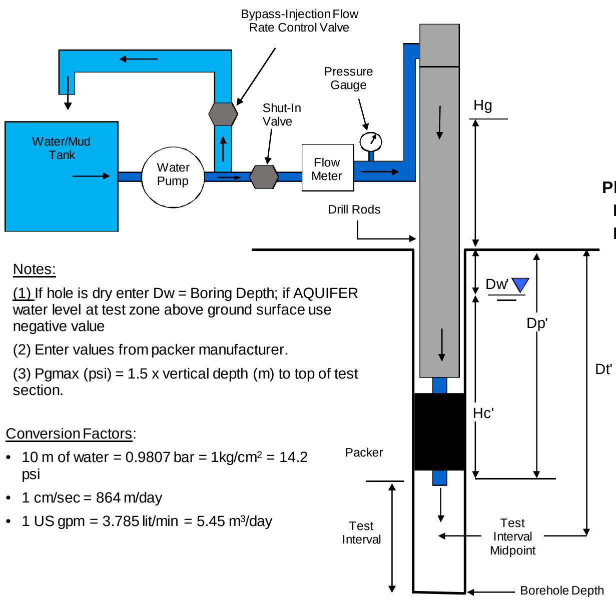
STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	**Constantine Metals**	**Test Interval (m):**	**107.8**	**To:**	**133.5**	**Test Nº**	**2**
Drillhole Nº:	**GT17-05**	**Start Date:**	**28-Jun-17**	**Time:**	**9:00**	**Drill Bit Depth**	**106.5**
		End Date:	**28-Jun-17**	**Time:**	**12:15**	**DH Depth (m)**	**133.5**
		Supervisor:	**GEB**	**Rig:**	**Hari**		

Max Injection P (psi)

162

Symbol	Description	Value	Unit
Dw	Measured depth of static water level (1)	51.0	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**84.0**	m
Dt	Measured depth to midpoint of test	**120.6**	m
ß	Inclination from horizontal (degrees)	15	º
Dw'	Vertical depth to static water level	**13.2**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**21.7**	m
Dt'	Vertical depth to midpoint of test	**31.2**	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	**500**	psi
Pgmax	Maximum injection gauge pressure (3)	**47**	psi
Hg	Gauge height	1.0	m
Lp	Length of discharge pipe	9.14	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0190	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	**26**	m
Hf	Friction Loss		
Hnit	Net injection head at midpoint of test		
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.

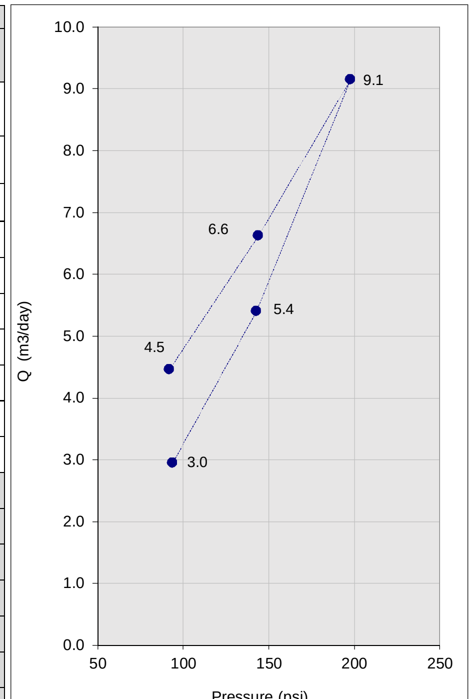
Conversion Factors:

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

Equations:

- $Hf = 8.65 \times 10^{-15} (Q^2 * Lp/rp^5)$
- $H_{nit} = (Dw' + Hg - Hf) + Pg/1.42$
- $K = (Q * Ln(R/r_b)) / 2 * p * H_{nit} * L)$

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	**94**	**143**	**198**	**144**	**92**
Induced Pressure at Surface Gage	**50**	**100**	**150**	**100**	**50**
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**1.09**	**1.82**	**3.17**	**2.30**	**1.55**
2	**1.08**	**1.88**	**3.18**	**2.33**	**1.52**
3	**1.05**	**1.87**	**3.20**	**2.30**	**1.55**
4	**1.03**	**1.89**	**3.15**	**2.28**	**1.55**
5	**1.02**	**1.86**	**3.17**	**2.30**	**1.55**
Stable Q (L/30sec)	**1.02**	**1.87**	**3.17**	**2.30**	**1.55**
Leak Q (L/30sec)	**0**	**0**	**0**	**0**	**0**
Q (m³/day)	3.0	5.4	9.1	6.6	4.5
Hf (m)	0.00	0.00	0.00	0.00	0.00
Hnit (m)	80.4	114.9	153.6	115.6	79.0
K (m/day)	1.2E-03	1.6E-03	2.0E-03	1.9E-03	1.9E-03
K (m/s)	**1.4E-08**	**1.8E-08**	**2.3E-08**	**2.2E-08**	**2.2E-08**
+/- (m/s)	4.5E-09	2.7E-09	6.1E-10	-1.2E-09	-3.1E-09
+/- order of mag.	0.12	0.06	0.01	-0.02	-0.07

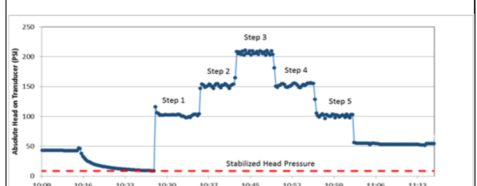


Geology, Primarily Basalt with some dikes

RQ-JC-Structures, Low FF, High RQD, Low weathering/alteration, no faults.

Flow Monitoring-System-Test Comments, No measurable leak rate. No issues with test equipment.

Injected clean water with no polymer after flushing with about 250 gallons of fresh water.



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STEPPED PRESSURE INJECTION TEST
(page 2)

Drillhole Nº	GT17-05
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	48	96	146	96	48
Max P during step	52	104	154	104	52
average pressure +/- psi	2	4	4	4	2

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	0.025	0.025	0.025	0.025	0.025

High estimate of K

Q_{avg} (m^3/day)	3.02	5.47	9.22	6.70	4.54
Hf (m)	0.00	0.00	0.00	0.00	0.00
Hnit (m)	79.0	112.1	150.8	112.8	77.6
K (m/sec)	1.5E-08	1.9E-08	2.3E-08	2.3E-08	2.2E-08

Low estimate of K

Q_{avg} (m^3/day)	2.88	5.33	9.07	6.55	4.39
Hf (m)	0.00	0.00	0.00	0.00	0.00
Hnit (m)	81.8	117.7	156.5	118.4	80.4
K (m/sec)	1.3E-08	1.7E-08	2.2E-08	2.1E-08	2.1E-08

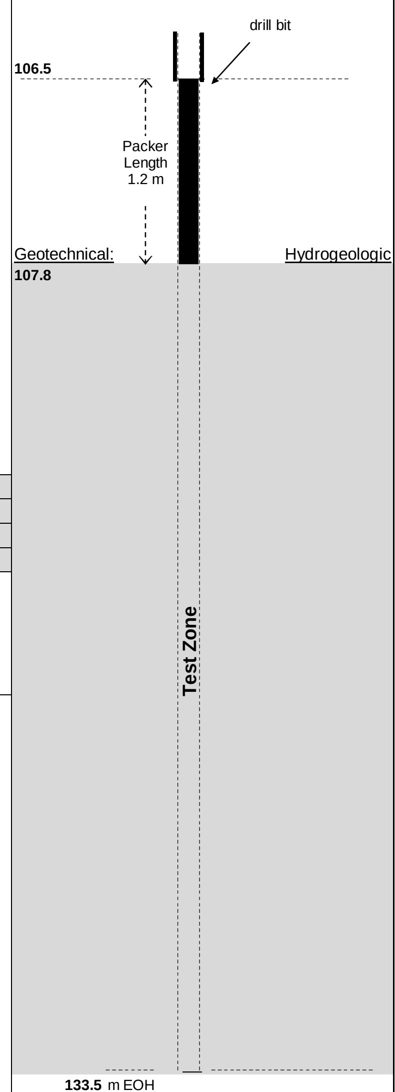
K averages for P step (m/second)

P	94	143	198
high est of K	2.E-08	2.E-08	2.E-08
average K	2.E-08	2.E-08	2.E-08
low est of K	2.E-08	2.E-08	2.E-08

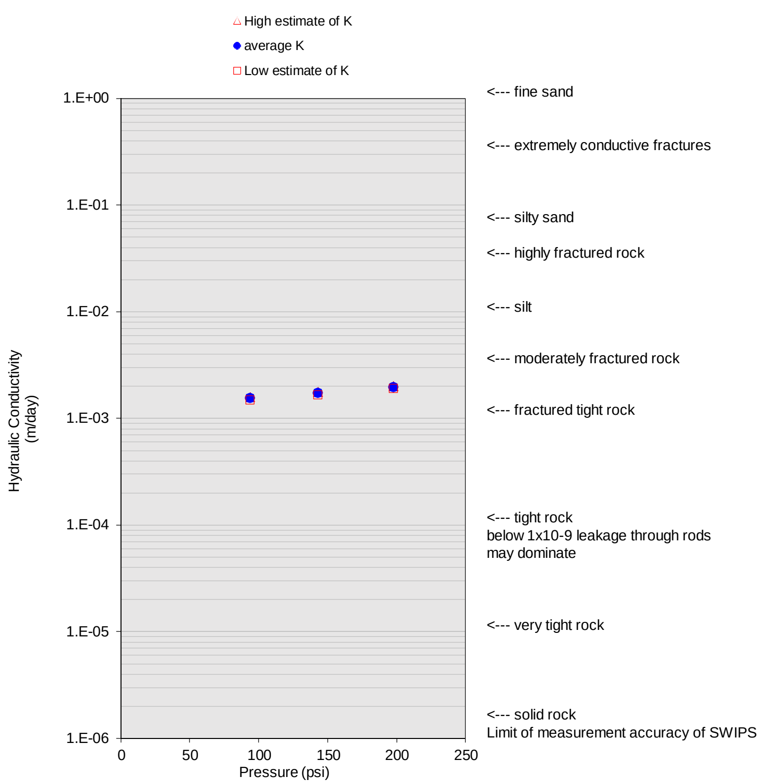
K avg all P steps

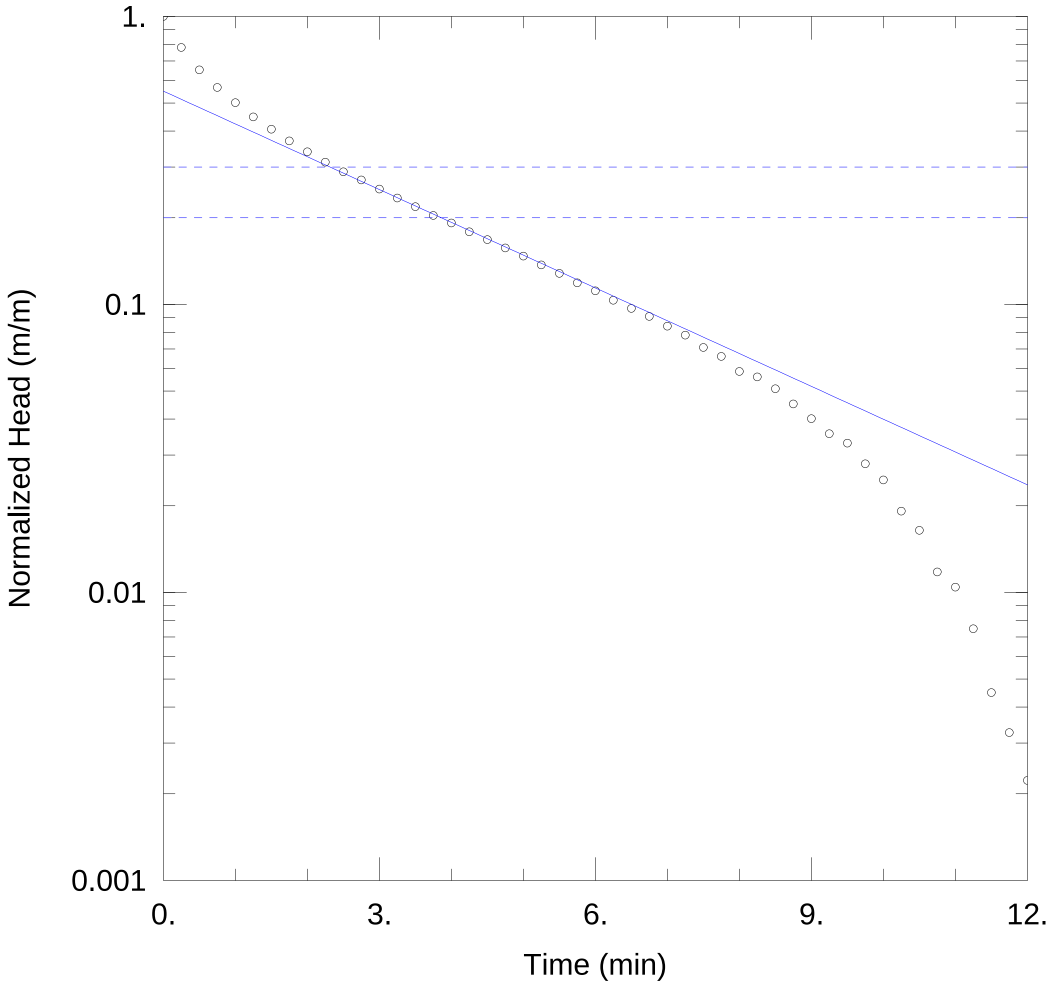
	m/day	Ft/Day
MAX	2.0.E-03	6.6.E-03
geomean	1.7.E-03	5.7.E-03
MIN	1.5.E-03	4.9.E-03

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



Graph of estimated hydraulic conductivity and error bounds.





TEST 2 - FHT

Data Set: C:\Users\gbaldwin\Desktop\Palmer\Test 2\GT-17-05_Test2_107.8-133.5_BouwerRice.aqt
Date: 07/07/17 Time: 16:15:10

PROJECT INFORMATION

Company: SRK
Client: Palmer
Location: Palmer Project, AK
Test Well: GT-17-05
Test Date: 28 June 2017

AQUIFER DATA

Saturated Thickness: 25.7 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GT-17-05)

Initial Displacement: 26.09 m
Total Well Penetration Depth: 25.7 m
Casing Radius: 0.0389 m
Static Water Column Height: 25.7 m
Screen Length: 25.7 m
Well Radius: 0.048 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.05693 m/day
y0 = 14.35 m

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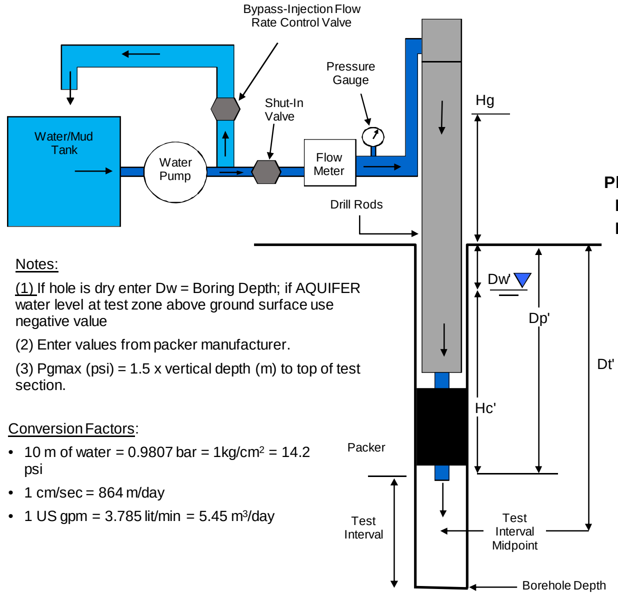
STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	**Constantine Metals**	**Test Interval (m):**	**149.8**	**To:**	**175.5**	**Test Nº**	**3**
Drillhole Nº:	**GT17-05**	**Start Date:**	**29-Jun-17**	**Time:**	**8:00**	**Drill Bit Depth**	**148.5**
		End Date:	**29-Jun-17**	**Time:**	**17:00**	**DH Depth (m)**	**175.5**
		Supervisor:	**GEB**	**Rig:**	**Hari**		

Max Injection P (psi)

225



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:

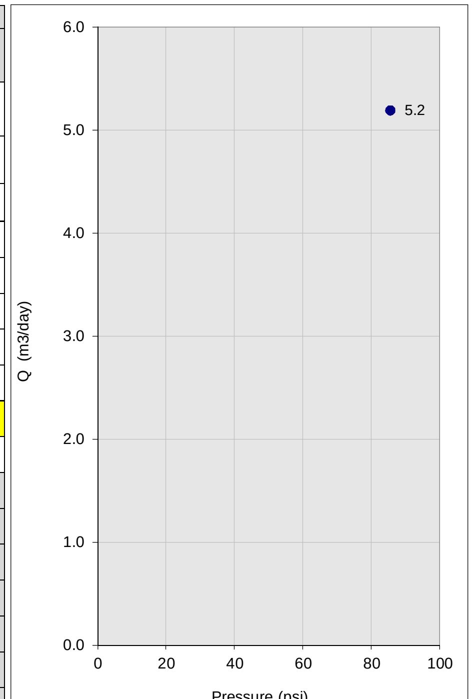
- 10 m of water = 0.9807 bar = 1kg/cm² = 14.2 psi
- 1 cm/sec = 864 m/day
- 1 US gpm = 3.785 lit/min = 5.45 m³/day

Dw	Measured depth of static water level (1)	75.0	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**84.0**	m
Dt	Measured depth to midpoint of test	**162.6**	m
ß	Inclination from horizontal (degrees)	15	º
Dw'	Vertical depth to static water level	**19.4**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**21.7**	m
Dt'	Vertical depth to midpoint of test	**42.1**	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	**500**	psi
Pgmax	Maximum injection gauge pressure (3)	**63**	psi
Hg	Gauge height	1.0	m
Lp	Length of discharge pipe	9.14	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0190	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	**26**	m
Hf	Friction Loss		
Hnit	Net injection head at midpoint of test		
K	Hydraulic conductivity		

Equations:

- $H_f = 8.65 \times 10^{-15} (Q^2 \cdot Lp/rp^5)$
- $H_{nit} = (Dw' + Hg - Hf) + Pg/1.42$
- $K = (Q \cdot \ln(R/r_b)) / 2 \cdot p \cdot H_{nit} \cdot L)$

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	**85.7**				
Induced Pressure at Surface Gage	**50**				
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**2.15**				
2	**2.03**				
3	**2.02**				
4	**2.50**				
5					
Stable Q (L/30sec)	**2.03**				
Leak Q (L/30sec)	**0.225**				
Q (m³/day)	5.2	#N/A	#N/A	#N/A	#N/A
Hf (m)	0.00	#N/A	#N/A	#N/A	#N/A
Hnit (m)	80.8	#N/A	#N/A	#N/A	#N/A
K (m/day)	2.1E-03	#N/A	#N/A	#N/A	#N/A
K (m/s)	**2.5E-08**	**#N/A**	**#N/A**	**#N/A**	**#N/A**
+/- (m/s)	7.4E-09	#VALUE!	#VALUE!	#VALUE!	#N/A
+/- order of mag.	0.11	#VALUE!	#VALUE!	#VALUE!	#N/A

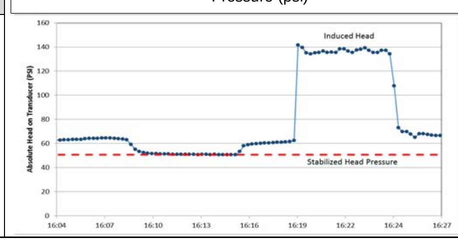


Geology, Primarily Basalt with some dikes.

RQ-JC-Structures, Low FF, High RQD, Low weathering/alteration, no faults.

Flow Monitoring-System-Test Comments, Measured a low leak rate. The packer lost seal at the end of the first pressure step. Since the whole shift had been spent trying to seat the packer, it was decided to end testing efforts for the day with the one pressure step.

Injected clean water with no polymer.



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STEPPED PRESSURE INJECTION TEST
(page 2)

Drillhole Nº	GT17-05
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	48	0	0	0	0
Max P during step	52	0	0	0	0
average pressure +/- psi	2				

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	0.5				

High estimate of K

Q_{avg} (m^3/day)	6.62	#N/A	#N/A	#N/A	#N/A
Hf (m)	0.00	#N/A	#N/A	#N/A	#N/A
Hnit (m)	79.4	#N/A	#N/A	#N/A	#N/A
K (m/sec)	3.2E-08	#N/A	#N/A	#N/A	#N/A

Low estimate of K

Q_{avg} (m^3/day)	3.74	#N/A	#N/A	#N/A	#N/A
Hf (m)	0.00	#N/A	#N/A	#N/A	#N/A
Hnit (m)	82.2	#N/A	#N/A	#N/A	#N/A
K (m/sec)	1.7E-08	#N/A	#N/A	#N/A	#N/A

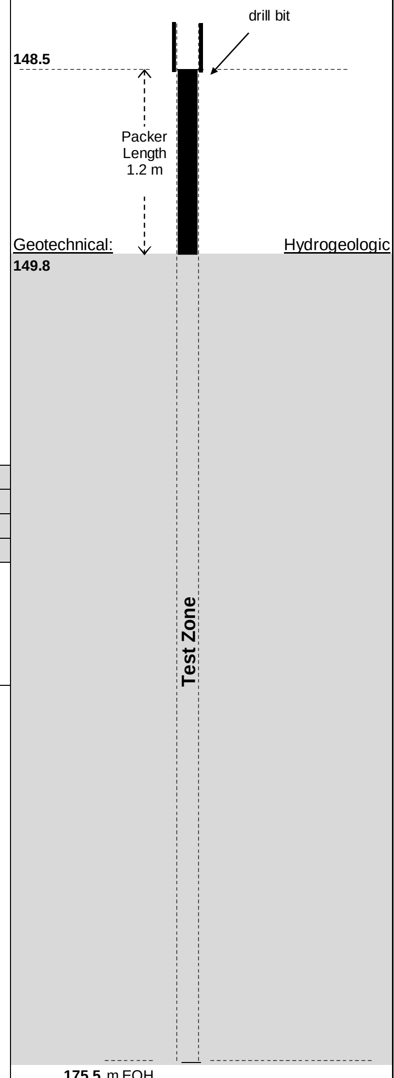
K averages for P step m/second

P	86	#N/A	#N/A
high est of K	3.E-08		
average K	2.E-08		
low est of K	2.E-08		

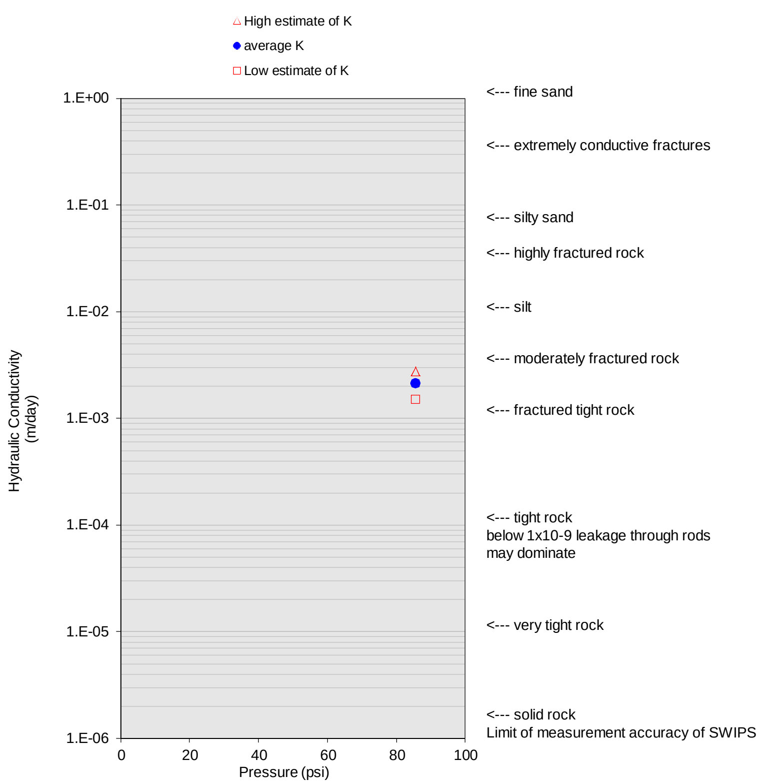
K avg all P steps

	m/day	Ft/Day
MAX	2.8.E-03	9.1.E-03
geomean	2.1.E-03	7.0.E-03
MIN	1.5.E-03	4.9.E-03

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



Graph of estimated hydraulic conductivity and error bounds.



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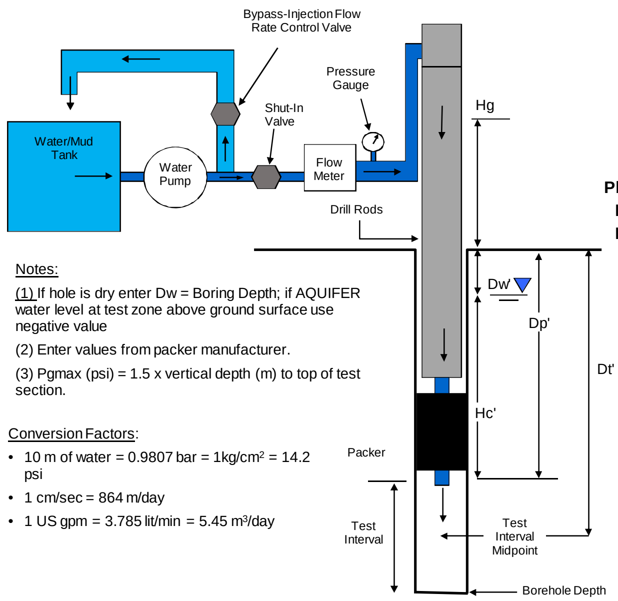
STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	**Constantine Metals**	**Test Interval (m):**	**176.8**	**To:**	**191.8**	**Test Nº**	**4**
Drillhole Nº:	**GT17-05**	**Start Date:**	**30-Jun-17**	**Time:**	**7:45**	**Drill Bit Depth**	**175.5**
		End Date:	**30-Jun-17**	**Time:**	**13:00**	**DH Depth (m)**	**191.8**
		Supervisor:	**S. Teller**	**Rig:**	**Hari**		

Max Injection P (psi)

265



Dw	Measured depth of static water level (1)	75.0	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**84.0**	m
Dt	Measured depth to midpoint of test	**184.3**	m
ß	Inclination from horizontal (degrees)	15	º
Dw'	Vertical depth to static water level	**19.4**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**21.7**	m
Dt'	Vertical depth to midpoint of test	**47.7**	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	**500**	psi
Pgmax	Maximum injection gauge pressure (3)	**72**	psi
Hg	Gauge height	1.0	m
Lp	Length of discharge pipe	9.14	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0190	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	**15**	m
Hf	Friction Loss		
Hnit	Net injection head at midpoint of test		
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.

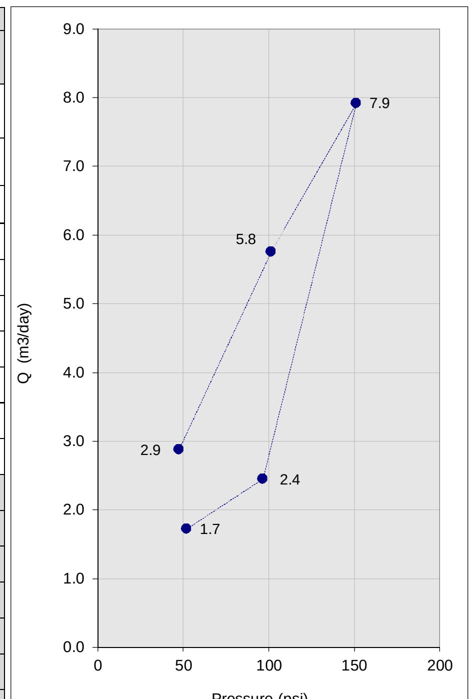
Conversion Factors:

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

Equations:

- Hf = 8.65x10^{-15} (Q^2*Lp/rp^5)
- H_{nit} = (Dw'+Hg-Hf)+Pg/1.42
- K = (Q*Ln(R/r_b)) / 2*p*H_{nit}*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	**47.5**	**101.47**	**151.4**	**96.77**	**52.28**
Induced Pressure at Surface Gage	**50**	**100**	**150**	**100**	**50**
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**1.20**	**2.10**	**2.95**	**0.80**	**0.60**
2	**1.20**	**2.15**	**2.90**	**0.85**	**0.60**
3	**1.00**	**1.95**	**2.80**	**0.75**	**0.65**
4	**1.10**	**2.00**	**2.80**	**0.85**	**0.55**
5	**1.00**	**2.00**	**2.75**	**0.85**	**0.60**
Stable Q (L/30sec)	**1.00**	**2.00**	**2.75**	**0.85**	**0.60**
Leak Q (L/30sec)	**0**	**0**	**0**	**0**	**0**
Q (m^3/day)	2.9	5.8	7.9	2.4	1.7
Hf (m)	0.00	0.00	0.00	0.00	0.00
Hnit (m)	53.9	91.9	127.0	88.6	57.2
K (m/day)	3.0E-03	3.6E-03	3.5E-03	1.6E-03	1.7E-03
K (m/s)	**3.5E-08**	**4.1E-08**	**4.1E-08**	**1.8E-08**	**2.0E-08**
+/- (m/s)	-6.9E-09	-1.1E-08	6.1E-10	1.2E-08	8.3E-09
+/- order of mag.	-0.10	-0.14	0.01	0.22	0.15

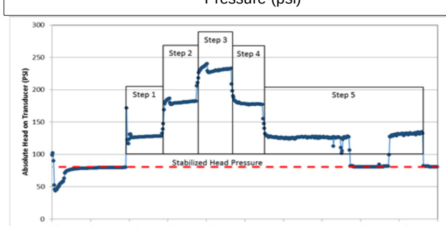


Geology, Primarily Basalt with some dikes

HQ-JC-Structures, Low FF, High RQD, Low weathering/alteration, no faults.

Flow Monitoring-System-Test Comments, No measurable leak rate. Equipment worked well with no issues. On the final pressure step, water was initially flowing backwards out of the hole, even with the pressure held at 50 psi for about 30 minutes. After holding the pressure for some time, we stopped pumping and let the hole discharge for about 15 minutes before resuming the final pressure step. As evidenced in the hydrograph, it appears that the isolated interval has flowing artesian pressure.

Injected clean water with no polymer.



GT17-05_Test4_176.8-198.1_Analysis_Rev1 / Analysis 7/7/2017

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STEPPED PRESSURE INJECTION TEST
(page 2)

Drillhole Nº	GT17-05
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	49	99	148	99	49
Max P during step	51	101	152	101	51
average pressure +/- psi	1	1	2	1	1

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	0.01	0.01	0.01	0.01	0.01

High estimate of K

Q_{avg} (m^3/day)	2.91	5.79	7.95	2.48	1.76
Hf (m)	0.00	0.00	0.00	0.00	0.00
Hnit (m)	53.2	91.2	125.6	87.9	56.5
K (m/sec)	3.6E-08	4.2E-08	4.1E-08	1.8E-08	2.0E-08

Low estimate of K

Q_{avg} (m^3/day)	2.85	5.73	7.89	2.42	1.70
Hf (m)	0.00	0.00	0.00	0.00	0.00
Hnit (m)	54.6	92.6	128.4	89.3	57.9
K (m/sec)	3.4E-08	4.1E-08	4.0E-08	1.8E-08	1.9E-08

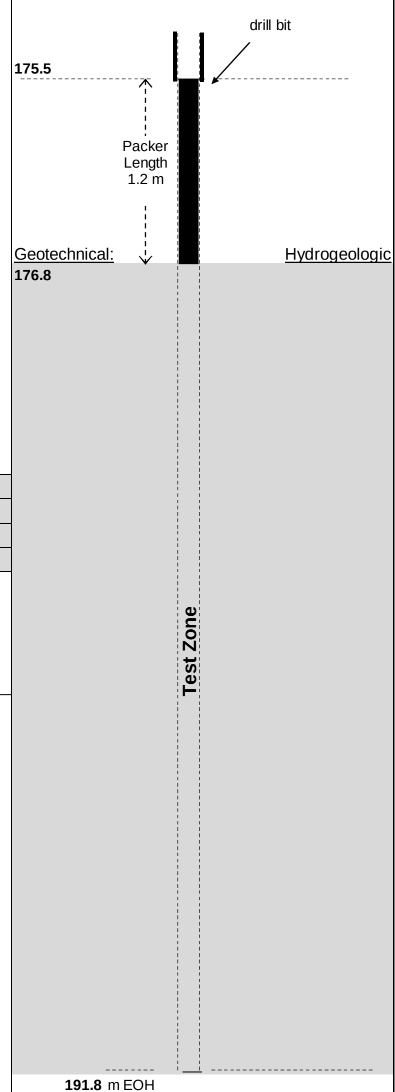
K averages for P step (m/second)

P	48	101	151
high est of K	3.E-08	3.E-08	4.E-08
average K	3.E-08	3.E-08	4.E-08
low est of K	3.E-08	3.E-08	4.E-08

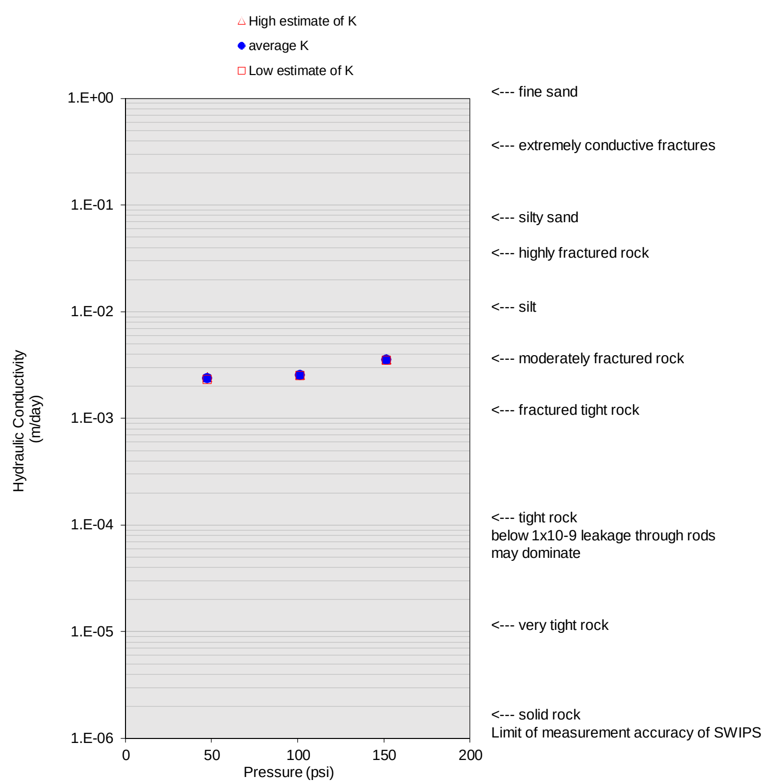
K avg all P steps

	m/day	Ft/Day
MAX	3.6E-03	1.2E-02
geomean	2.8E-03	9.1E-03
MIN	2.3E-03	7.6E-03

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



Graph of estimated hydraulic conductivity and error bounds.



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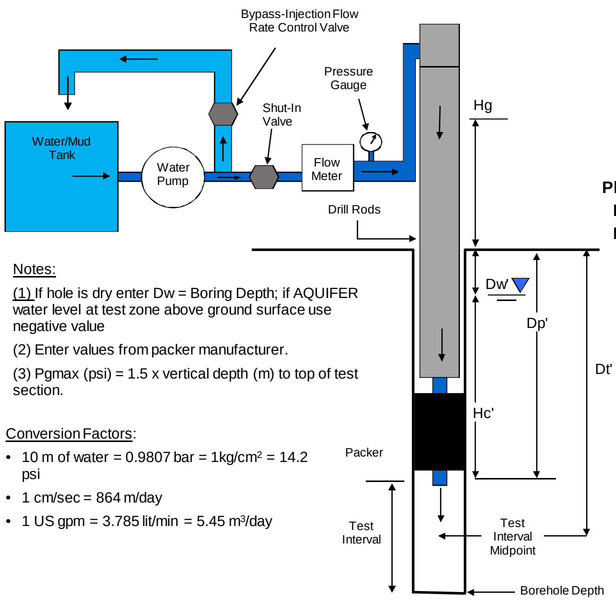
STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	**Constantine Metals**	**Test Interval (m):**	**200.8**	**To:**	**230.1**	**Test Nº**	**5**
Drillhole Nº:	**GT17-05**	**Start Date:**	**1-Jul-17**	**Time:**	**8:30**	**Drill Bit Depth**	**175.5**
		End Date:	**1-Jul-17**	**Time:**	**13:30**	**DH Depth (m)**	**230.1**
		Supervisor:	**S. Teller**	**Rig:**	**Hari**		

Max Injection P (psi)

301



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:

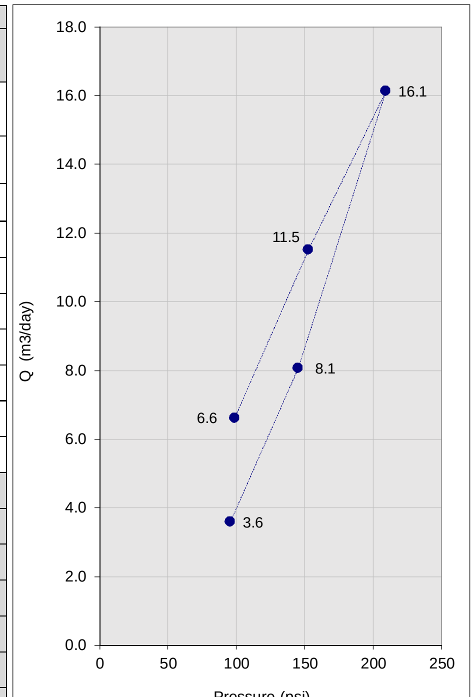
- 10 m of water = 0.9807 bar = 1kg/cm² = 14.2 psi
- 1 cm/sec = 864 m/day
- 1 US gpm = 3.785 lit/min = 5.45 m³/day

Symbol	Description	Value	Unit
Dw	Measured depth of static water level (1)	-45.0	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**84.0**	m
Dt	Measured depth to midpoint of test	**215.4**	m
ß	Inclination from horizontal (degrees)	15	º
Dw'	Vertical depth to static water level	**0.0**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**21.7**	m
Dt'	Vertical depth to midpoint of test	**55.8**	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	**564**	psi
Pgmax	Maximum injection gauge pressure (3)	**84**	psi
Hg	Gauge height	1.0	m
Lp	Length of discharge pipe	9.14	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0190	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**	m
Hf	Friction Loss		
Hnit	Net injection head at midpoint of test		
K	Hydraulic conductivity		

Equations:

- $Hf = 8.65 \times 10^{-15} (Q^2 * Lp/rp^5)$
- $H_{nit} = (Dw' + Hg - Hf) + Pg/1.42$
- $K = (Q * Ln(R/r_b)) / 2 * p * H_{nit} * L)$

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	**98.8**	**152.5**	**209.4**	**145.3**	**95.6**
Induced Pressure at Surface Gage	**100**	**150**	**200**	**150**	**100**
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**3.00**	**4.25**	**5.55**	**2.55**	**1.05**
2	**2.30**	**3.95**	**5.65**	**2.70**	**1.15**
3	**2.30**	**4.05**	**5.60**	**2.75**	**1.15**
4	**2.35**	**3.95**	**5.55**	**2.80**	**1.30**
5	**2.30**	**4.05**	**5.60**	**2.80**	**1.25**
Stable Q (L/30sec)	**2.30**	**4.00**	**5.60**	**2.80**	**1.25**
Leak Q (L/30sec)	**0**	**0**	**0**	**0**	**0**
Q (m^3/day)	6.6	11.5	16.1	8.1	3.6
Hf (m)	0.00	0.00	0.01	0.00	0.00
Hnit (m)	70.6	108.4	148.5	103.3	68.3
K (m/day)	2.7E-03	3.1E-03	3.2E-03	2.3E-03	1.5E-03
K (m/s)	**3.1E-08**	**3.6E-08**	**3.6E-08**	**2.6E-08**	**1.8E-08**
+/- (m/s)	-5.0E-09	-3.4E-09	1.0E-09	6.1E-09	8.8E-09
+/- order of mag.	-0.07	-0.04	0.01	0.09	0.18

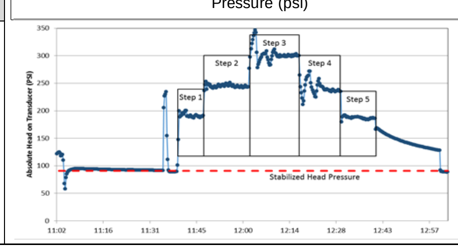


Geology, Basalt with minor dikes. Minor to moderate alteration to chlorite.

RQ-JC-Structures, Moderate fracture frequency and moderate RQD. Rock strength ranging from weak in the altered/weathered zones, to strong. Generally, fairly good rock. Most of the joints have chlorite infil. Some slickensides noted, but no fault gouge.

Flow Monitoring-System-Test Comments, No packer issues, except had difficulty shearing the E-pin. Upon inspection, pin was partially sheared. Replaced seals that mate against the mandrel following the test.

Injected clean water with no polymer.



GT-17-05_Test5_200.8-230.1_Analysis_Rev1 / Analysis 7/7/2017

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STEPPED PRESSURE INJECTION TEST
(page 2)

Drillhole Nº	GT17-05
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	98	148	198	148	98
Max P during step	102	152	202	152	102
average pressure +/- psi	2	2	2	2	2

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	0.1	0.1	0.1	0.1	0.1

High estimate of K

Q_{avg} (m^3/day)	6.91	11.81	16.42	8.35	3.89
Hf (m)	0.00	0.00	0.01	0.00	0.00
Hnit (m)	69.2	107.0	147.0	101.9	66.9
K (m/sec)	3.4E-08	3.7E-08	3.7E-08	2.8E-08	2.0E-08

Low estimate of K

Q_{avg} (m^3/day)	6.34	11.23	15.84	7.78	3.31
Hf (m)	0.00	0.00	0.01	0.00	0.00
Hnit (m)	72.0	109.8	149.9	104.7	69.7
K (m/sec)	3.0E-08	3.4E-08	3.5E-08	2.5E-08	1.6E-08

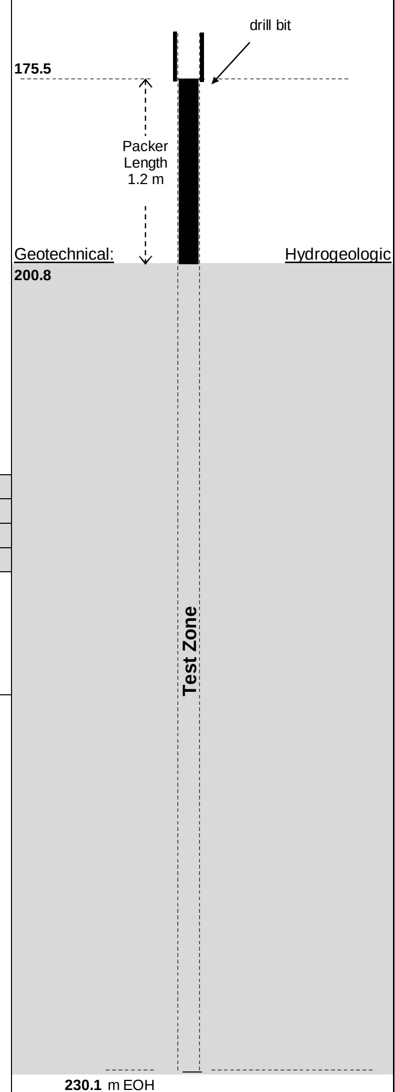
K averages for P step — m/second

P	99	153	209
high est of K	3.E-08	3.E-08	4.E-08
average K	2.E-08	3.E-08	4.E-08
low est of K	2.E-08	3.E-08	4.E-08

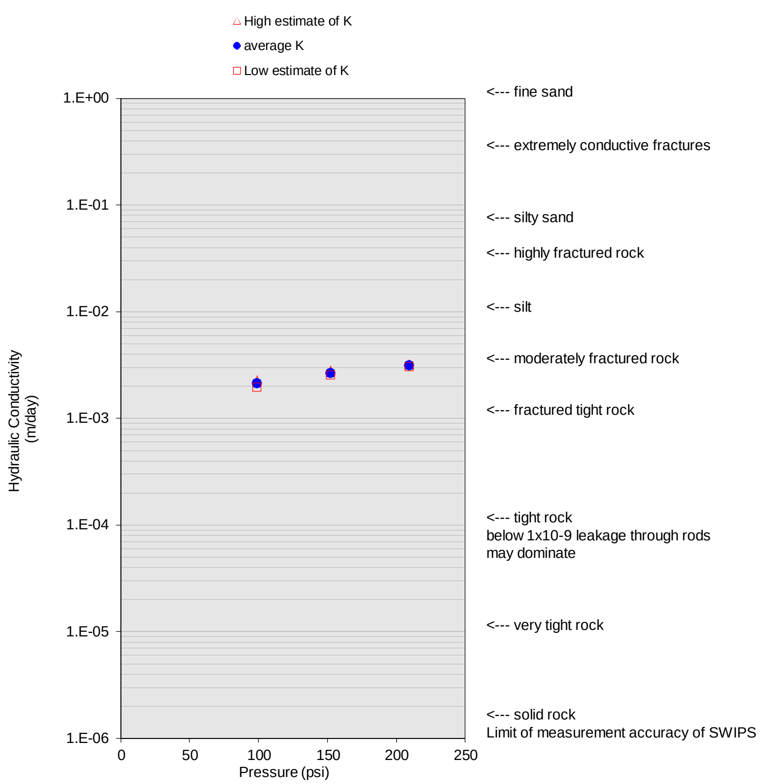
K avg all P steps

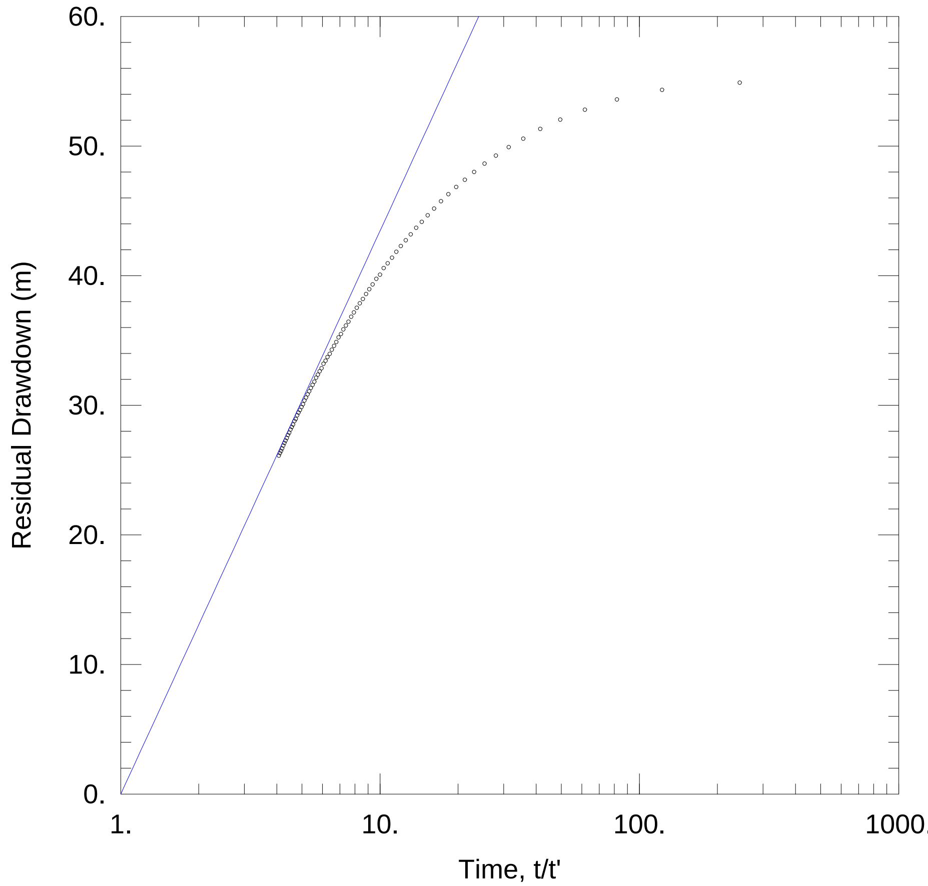
	m/day	Ft/Day
MAX	3.2E-03	1.1E-02
geomean	2.6E-03	8.6E-03
MIN	2.0E-03	6.4E-03

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



Graph of estimated hydraulic conductivity and error bounds.





TEST 5 - INJECTION

Data Set: C:\Users\gbaldwin\Desktop\Palmer\Test 5\GT17-05_Test5_TheisRDD.aqt
Date: 07/07/17 Time: 16:24:17

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: GT17-05
Test Date: 1 July 2017

AQUIFER DATA

Saturated Thickness: 200.8 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
GT17-05	0	0

Observation Wells

Well Name	X (m)	Y (m)
◦ GT17-05	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 0.01518 m^2/day S/S' = 1.001

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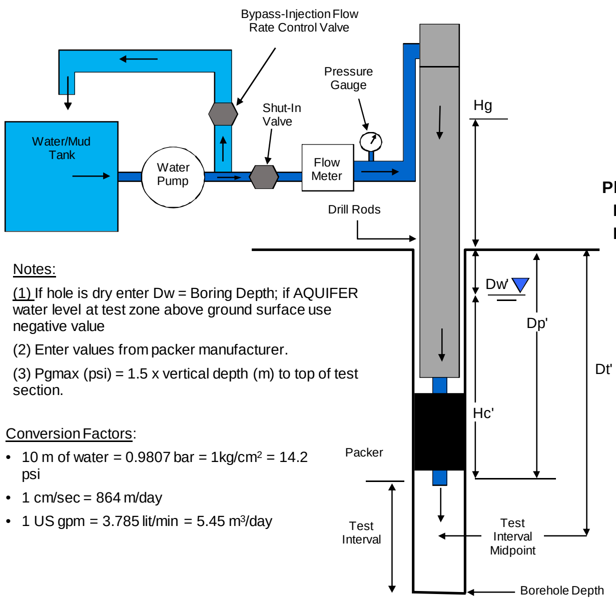
STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	Constantine Metals	Test Interval (m):	233.8	To:	262.5	Test Nº	6
Drillhole Nº:	GT17-05	Start Date:	2-Jul-17	Time:	7:30	Drill Bit Depth	232.5
		End Date:	2-Jul-17	Time:	13:30	DH Depth (m)	262.5
		Supervisor:	GEB	Rig:	Hari		

Max Injection P (psi)
351



Dw	Measured depth of static water level (1)	75.0	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	84.0	m
Dt	Measured depth to midpoint of test	248.1	m
ß	Inclination from horizontal (degrees)	15	º
Dw'	Vertical depth to static water level	19.4	m
Dbr'	Vertical dept to bedrock	0.0	m
Dp'	Vertical depth to packer	21.7	m
Dt'	Vertical depth to midpoint of test	64.2	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	500	psi
Pgmax	Maximum injection gauge pressure (3)	96	psi
Hg	Gauge height	1.0	m
Lp	Length of discharge pipe	9.14	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0190	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	m
Hf	Friction Loss		
Hnit	Net injection head at midpoint of test		
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.

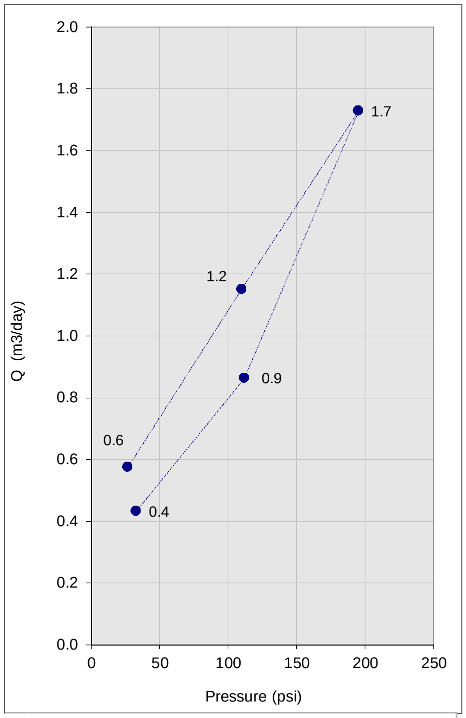
Conversion Factors:

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

Equations:

- $Hf = 8.65x10^{-15} (Q^2*Lp/rp^5)$
- $H_{nit} = (Dw'+Hg-Hf)+Pg/1.42$
- $K = (Q*Ln(R/r_b)) / 2*p*H_{nit}*L)$

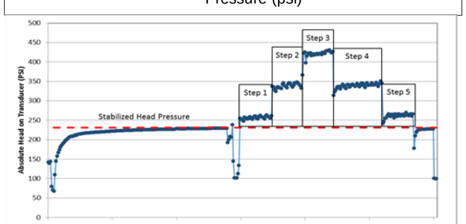
Measurement (last 3 to 5 stable readings)	Q (Liters / 30sec)				
	P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Induced Pressure at TDX	27	110	195	112	33
Induced Pressure at Surface Gage	150	225	300	225	150
Marsh Funnel Secs. (Clean Water = 26)	26	26	26	26	26
1	0.25	0.50	0.80	0.40	0.15
2	0.20	0.50	0.50	0.35	0.20
3	0.20	0.45	0.60	0.30	0.15
4	0.25	0.40	0.60	0.30	0.15
5	0.20	0.40	0.60	0.30	0.20
Stable Q (L/30sec)	0.20	0.40	0.60	0.30	0.15
Leak Q (L/30sec)	0	0	0	0	0
Q (m³/day)	0.6	1.2	1.7	0.9	0.4
Hf (m)	0.00	0.00	0.00	0.00	0.00
Hnit (m)	39.4	97.9	157.7	99.3	43.7
K (m/day)	4.3E-04	3.5E-04	3.2E-04	2.6E-04	2.9E-04
K (m/s)	5.0E-09	4.0E-09	3.8E-09	3.0E-09	3.4E-09
+/- (m/s)	1.8E-09	5.4E-10	6.7E-10	1.6E-09	3.4E-09
+/- order of mag.	0.13	0.05	0.07	0.19	0.30



Geology, Basalt with minor dikes. Minor to moderate alteration to chlorite.

RQ-JC-Structures, Moderate fracture frequency and moderate RQD. Rock strength R3 to R4. Most of the joints have chlorite infill. No fault gouge.

Flow Monitoring-System-Test Comments, No equipment issues.



GT-17-05_Test6_233.8-262.5_Analysis_Rev1 / Analysis 7/7/2017

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STEPPED PRESSURE INJECTION TEST
(page 2)

Drillhole Nº	GT17-05
Test Nº	6

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	148	223	298	223	148
Max P during step	152	227	302	227	152
average pressure +/- psi	2	2	2	2	2

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	0.1	0.1	0.1	0.1	0.1

High estimate of K

Q_{avg} (m^3/day)	0.86	1.44	2.02	1.15	0.72
Hf (m)	0.00	0.00	0.00	0.00	0.00
Hnit (m)	38.0	96.5	156.3	97.9	42.2
K (m/sec)	7.8E-09	5.1E-09	4.4E-09	4.0E-09	5.8E-09

Low estimate of K

Q_{avg} (m^3/day)	0.29	0.86	1.44	0.58	0.14
Hf (m)	0.00	0.00	0.00	0.00	0.00
Hnit (m)	40.8	99.3	159.1	100.7	45.1
K (m/sec)	2.4E-09	3.0E-09	3.1E-09	2.0E-09	1.1E-09

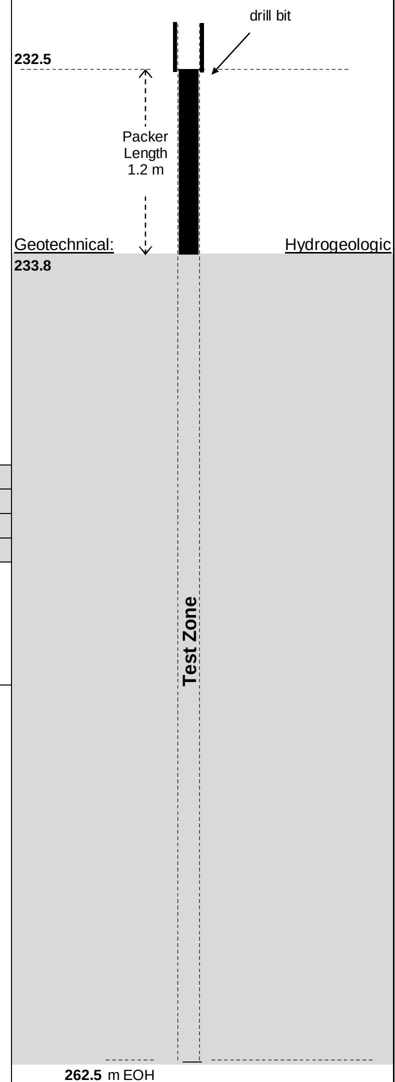
K averages for P step m/second

P	27	110	195
high est of K	7.E-09	5.E-09	4.E-09
average K	4.E-09	4.E-09	4.E-09
low est of K	2.E-09	2.E-09	3.E-09

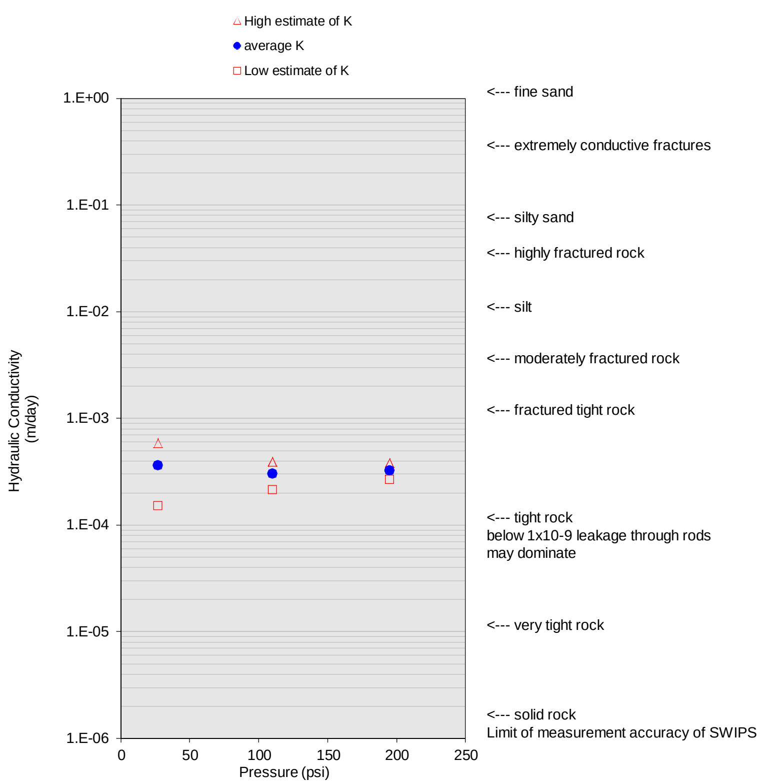
K avg all P steps

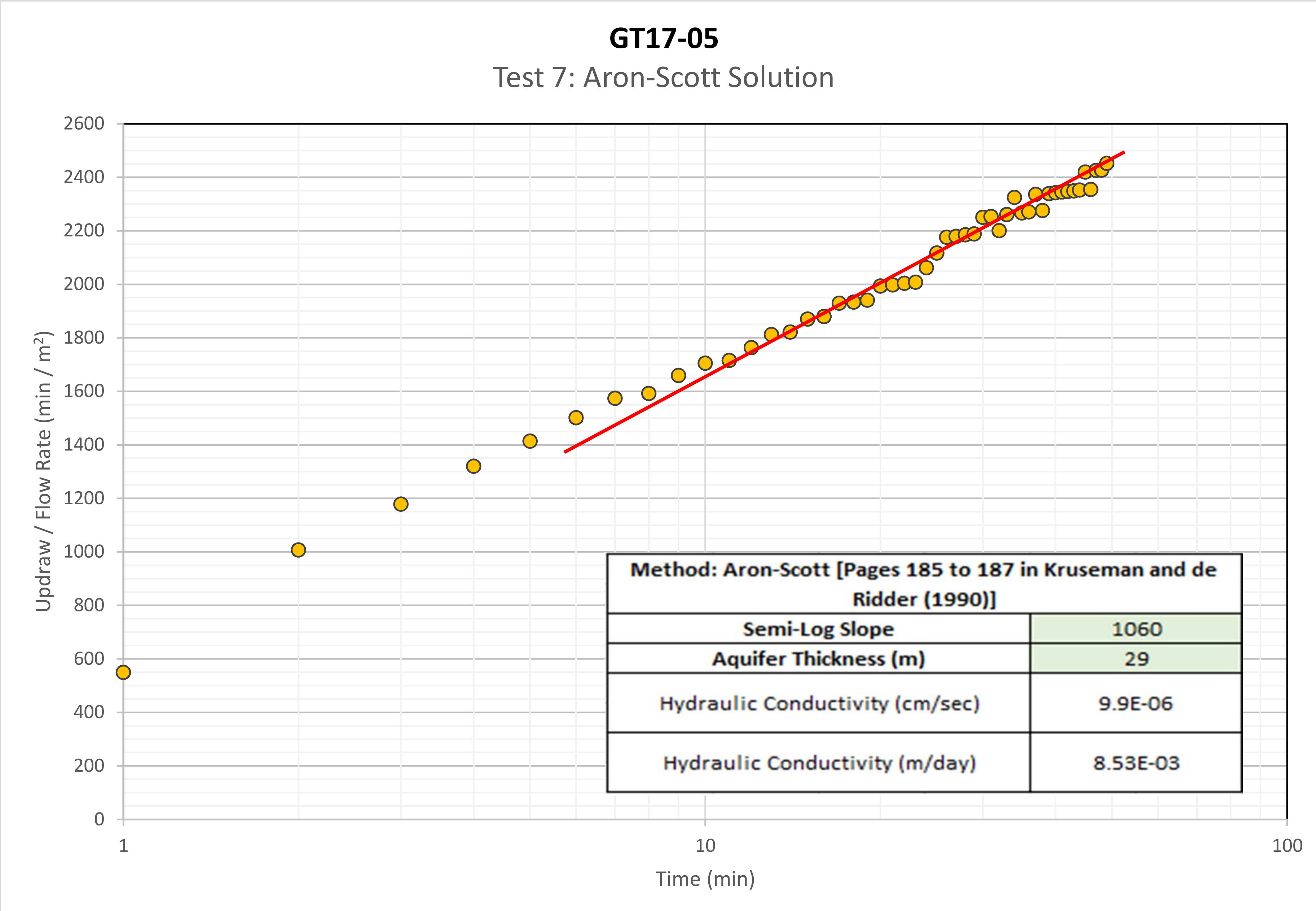
	m/day	Ft/Day
MAX	5.9.E-04	1.9.E-03
geomean	3.3.E-04	1.1.E-03
MIN	1.5.E-04	5.0.E-04

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

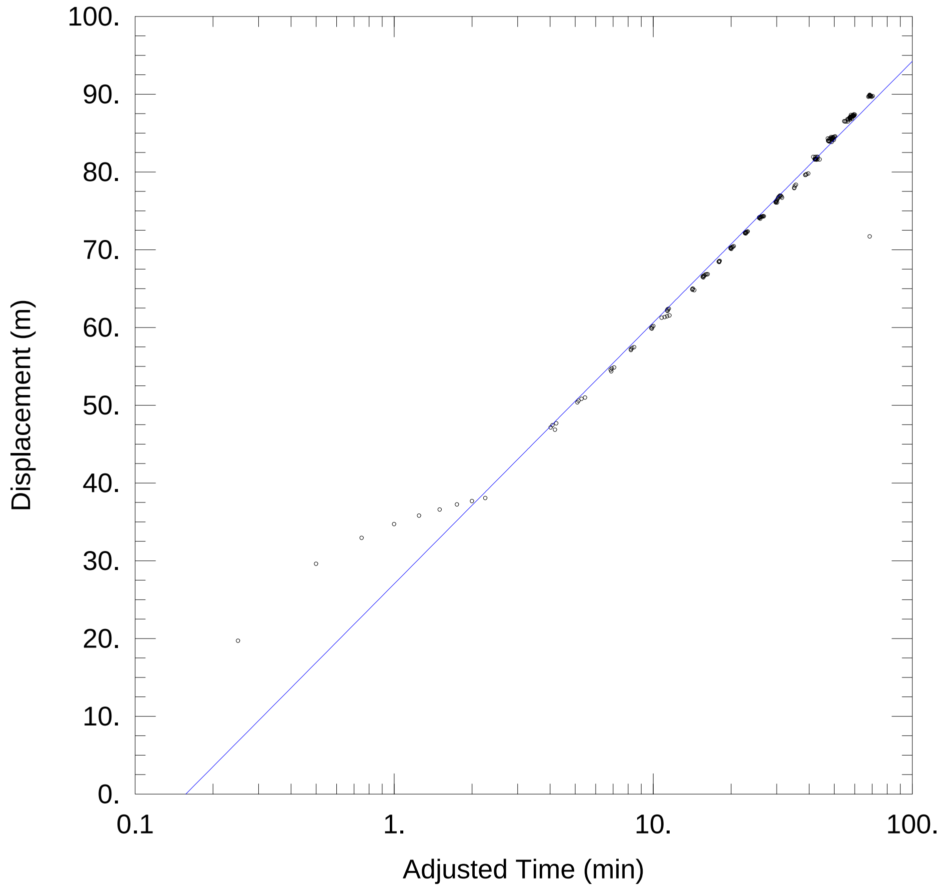


Graph of estimated hydraulic conductivity and error bounds.





Method: Aron-Scott [Pages 185 to 187 in Kruseman and de Ridder (1990)]	
Semi-Log Slope	1060
Aquifer Thickness (m)	29
Hydraulic Conductivity (cm/sec)	9.9E-06
Hydraulic Conductivity (m/day)	8.53E-03



TEST 7 SHUT-IN

Data Set: C:\...\GT17-05_Test7_263.3-292.5_CooperJacob Variable Rate.aqt
Date: 07/07/17 Time: 16:26:30

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: GT17-05
Test Date: 3 July 2017

AQUIFER DATA

Saturated Thickness: 29.2 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
GT17-05	0	0

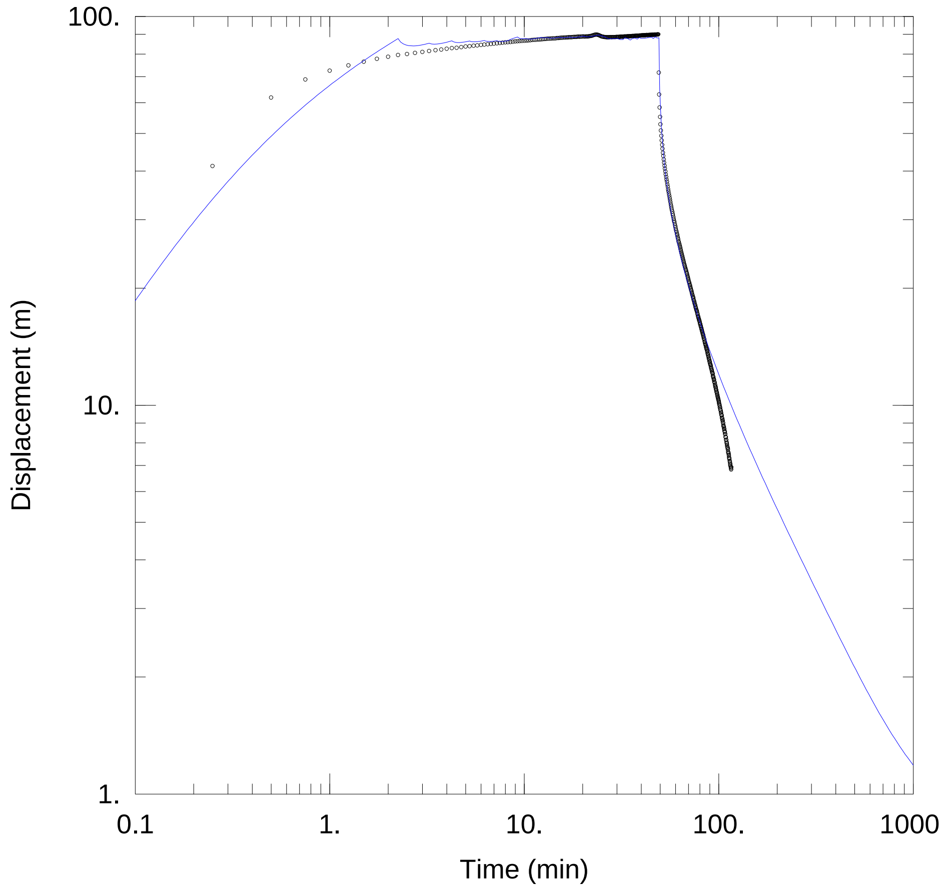
Observation Wells

Well Name	X (m)	Y (m)
◦ GT17-05	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 0.2827 m^2/day S = 0.03006



TEST 7 SHUT-IN

Data Set: C:\Users\gbaldwin\Desktop\Palmer\Test 7\GT17-05_Test7_263.3-292.5_Moench.aqt
Date: 07/07/17 Time: 16:27:34

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: GT17-05
Test Date: 3 July 2017

AQUIFER DATA

Saturated Thickness: 29.2 m Slab Block Thickness: 1. m

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
GT17-05	0	0

Observation Wells

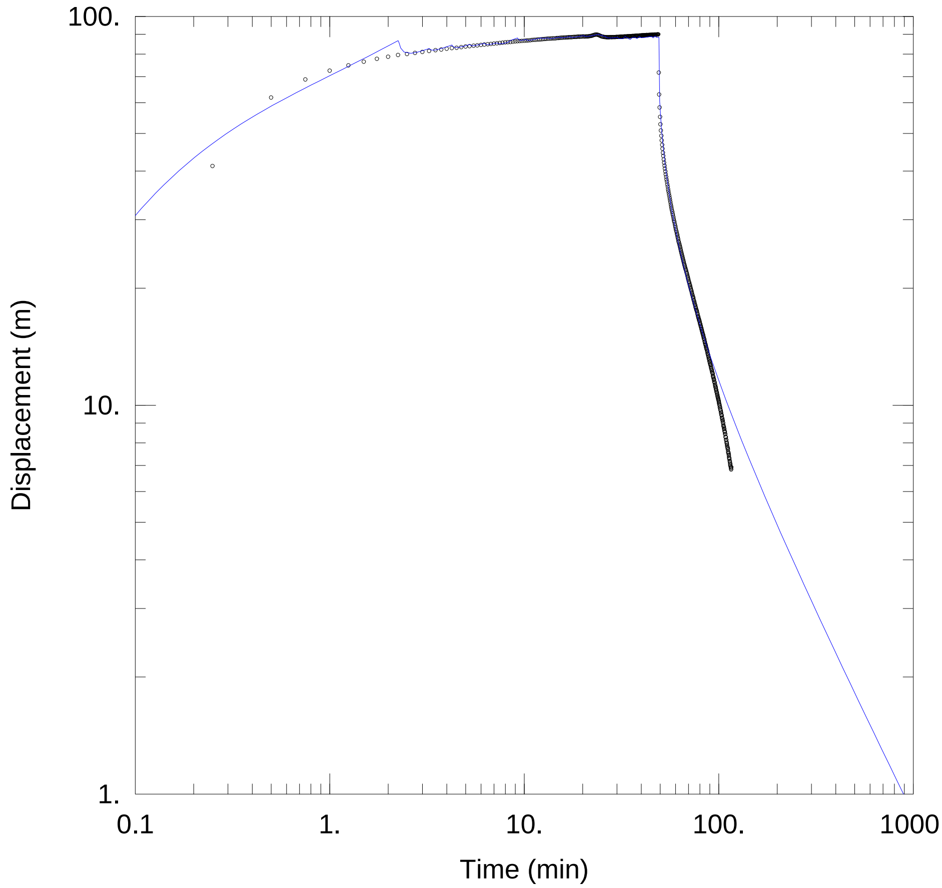
Well Name	X (m)	Y (m)
◦ GT17-05	0	0

SOLUTION

Aquifer Model: Fractured Solution Method: Moench w/slab blocks

K = 0.003345 m/day
K' = 0.01912 m/day
Sw = -0.75
r(w) = 0.048 m

Ss = 0.0003697 m^{-1}
Ss' = 0.04155 m^{-1}
Sf = 0.
r(c) = 0.00851 m



TEST 7 SHUT-IN

Data Set: C:\...\GT17-05_Test7_263.3-292.5_Neuman unconfined.aqt
Date: 07/07/17 Time: 16:29:16

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: GT17-05
Test Date: 3 July 2017

AQUIFER DATA

Saturated Thickness: 91. m

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
GT17-05	0	0

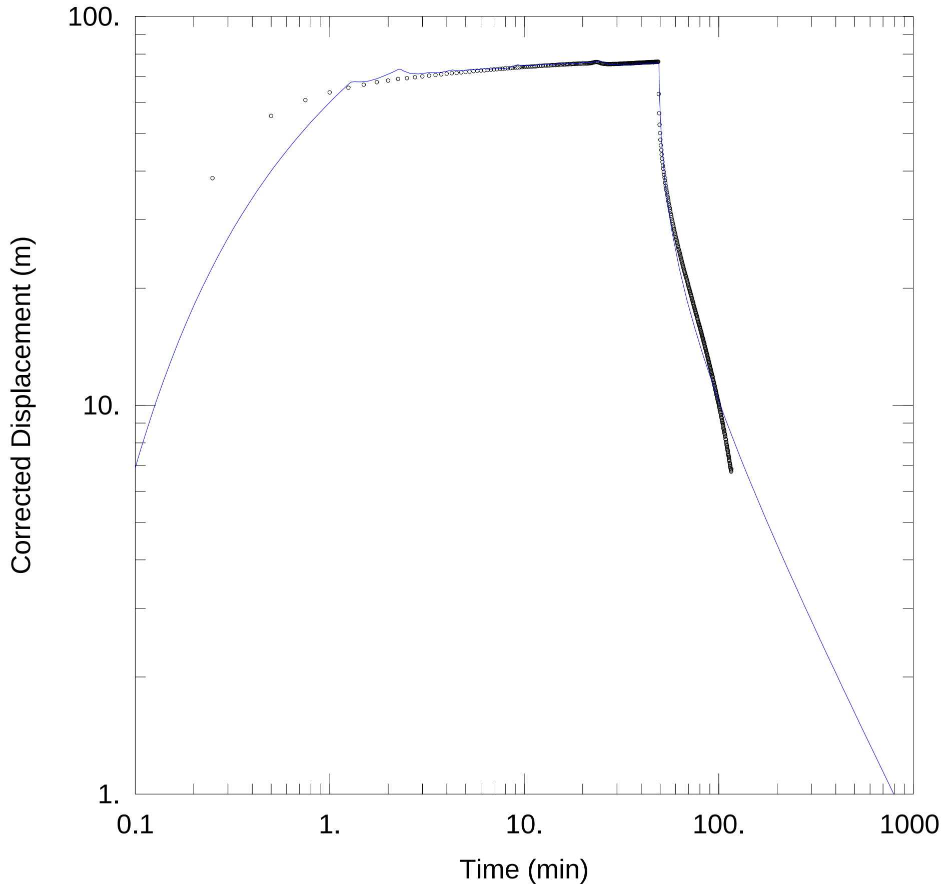
Observation Wells

Well Name	X (m)	Y (m)
◦ GT17-05	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Neuman

T = 0.2842 m^2/day
S = 0.006619
Sy = 0.02318
ß = 0.05783



TEST 7 SHUT-IN

Data Set: C:\...\GT17-05_Test7_263.3-292.5_Theis Unconfined.aqt
Date: 07/07/17 Time: 16:30:50

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: GT17-05
Test Date: 3 July 2017

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
GT17-05	0	0

Observation Wells

Well Name	X (m)	Y (m)
◦ GT17-05	0	0

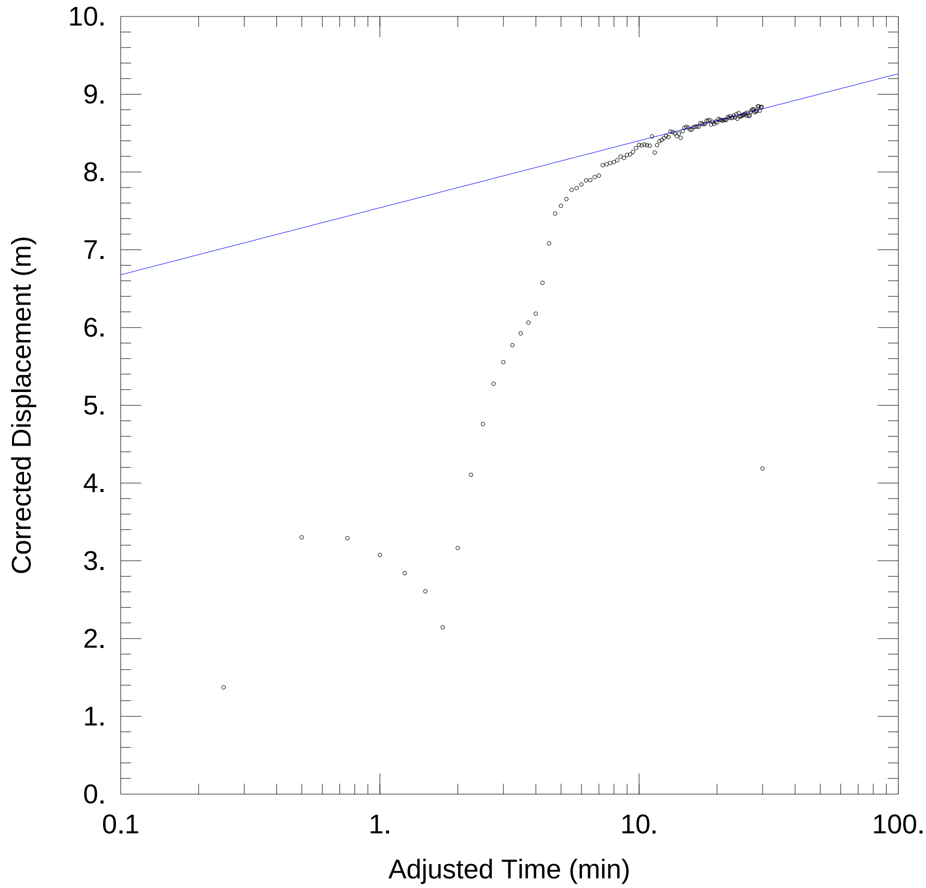
SOLUTION

Aquifer Model: Unconfined

Solution Method: Theis

T = 0.3234 m^2/day
Kz/Kr = 1.

S = 0.04063
b = 300. m



TEST 8 - CONSTANT RATE INJECTION

Data Set: C:\Users\gbaldwin\Desktop\Palmer\Test 8\GT17-05_Test8_21-292.5_CooperJacob.aqt
Date: 07/07/17 Time: 16:48:20

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: GT17-05
Test Date: 4 July 2017

AQUIFER DATA

Saturated Thickness: 271.5 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
GT17-05	0	0

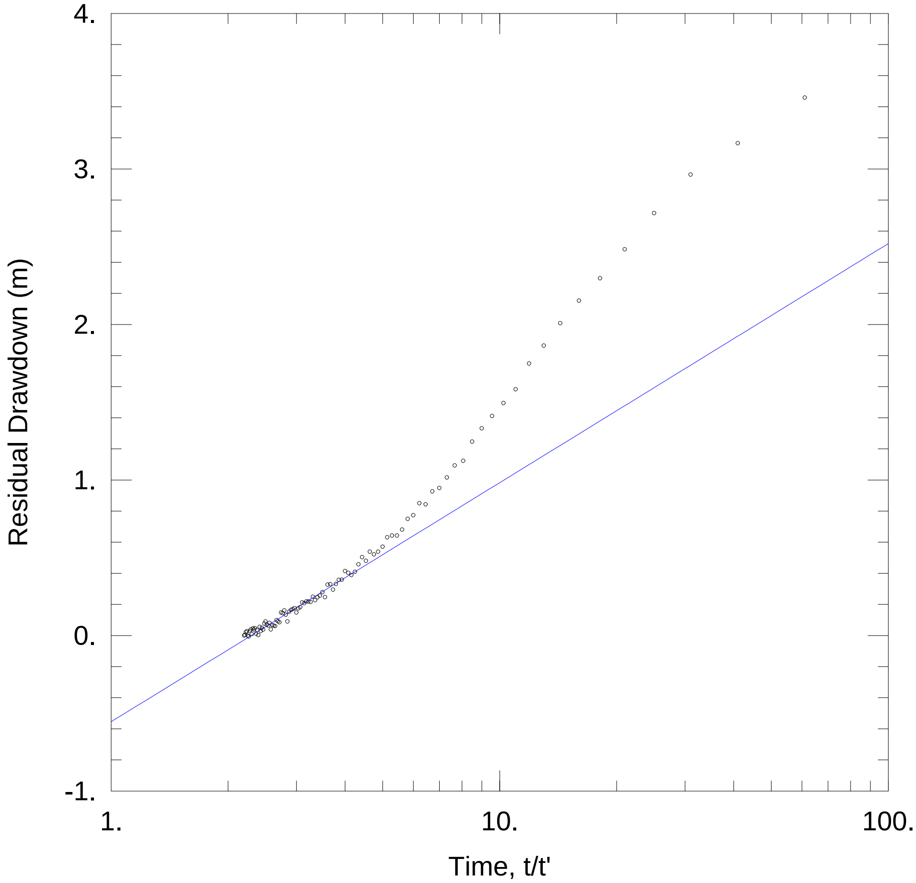
Observation Wells

Well Name	X (m)	Y (m)
◦ GT17-05	0	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Cooper-Jacob

T = 22.65 m^2/day S = 2.746E-8



TEST 8 - CONSTANT RATE INJECTION

Data Set: C:\Users\gbaldwin\Desktop\Palmer\Test 8\GT17-05_Test8_21-292.5_Theis RDD.aqt
Date: 07/07/17 Time: 16:58:47

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: GT17-05
Test Date: 4 July 2017

AQUIFER DATA

Saturated Thickness: 271.5 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
GT17-05	0	0

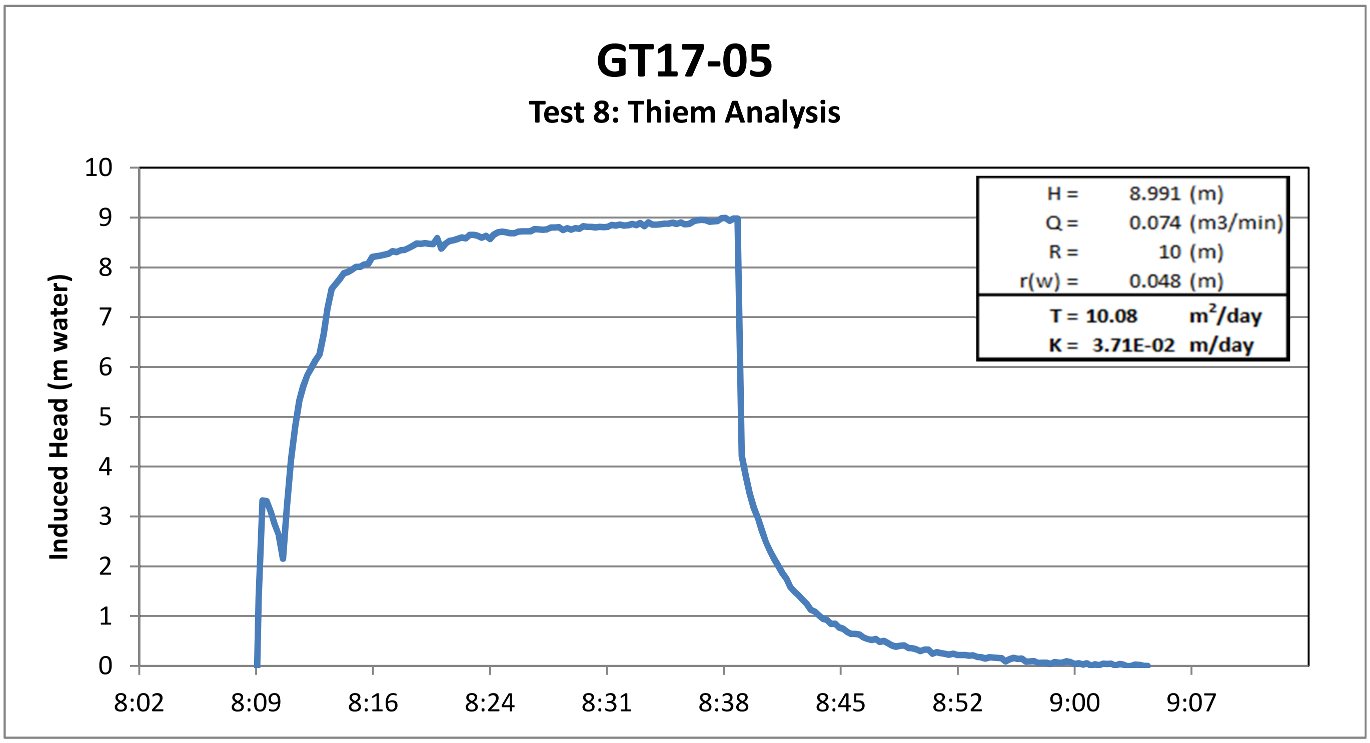
Observation Wells

Well Name	X (m)	Y (m)
◦ GT17-05	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 12.7 m^2/day S/S' = 2.296


GT17-05
Test 8: Thiem Analysis
Induced Head (m water)
10
9
8
7
6
5
4
3
2
1
0
8:02
8:09
8:16
8:24
8:31
8:38
8:45
8:52
9:00
9:07
H = 8.991 (m)
Q = 0.074 (m3/min)
R = 10 (m)
r(w) = 0.048 (m)
T = 10.08 m2/day
K = 3.71E-02 m/day

SRK Consulting Engineers and Scientists

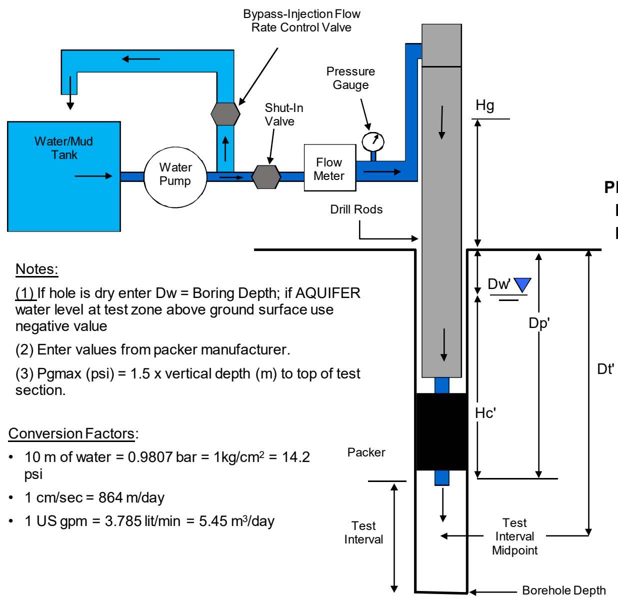
STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	**Constantine Metals**	**Test Interval (m):**	**39.1**	**To:**	**64.8**	**Test Nº**	**1**
Drillhole Nº:	**GT17-06**	**Start Date:**	**9-Jul-17**	**Time:**	**8:15**	**Drill Bit Depth**	**64.8**
		End Date:	**9-Jul-17**	**Time:**	**10:30**	**DH Depth (m)**	**64.8**
		Supervisor:	**GEB**	**Rig:**	**17**		

Max Injection P (psi)

38

Symbol	Description	Value	Unit
Dw	Measured depth of static water level (1)	35.6	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**84.0**	m
Dt	Measured depth to midpoint of test	**51.9**	m
ß	Inclination from horizontal (degrees)	40	°
Dw'	Vertical depth to static water level	**22.9**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**54.0**	m
Dt'	Vertical depth to midpoint of test	**33.4**	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	**77**	psi
Pshear	Estimated differential shear pressure required	**500**	psi
Pgmax	Maximum injection gauge pressure (3)	**50**	psi
Hg	Gauge height	1.0	m
Lp	Length of discharge pipe	9.14	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	**26**	m
Hf	Friction Loss		
Hnit	Net injection head at midpoint of test		
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.

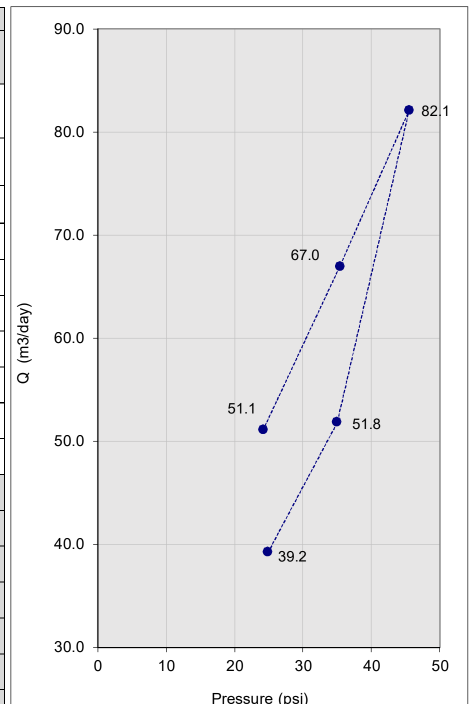
Conversion Factors:

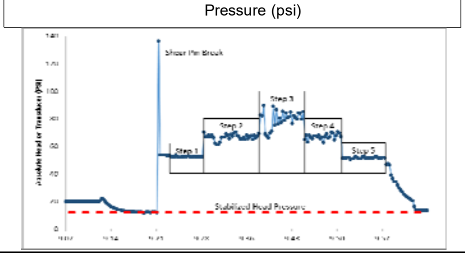
- 10 m of water = 0.9807 bar = 1kg/cm² = 14.2 psi
- 1 cm/sec = 864 m/day
- 1 US gpm = 3.785 lit/min = 5.45 m³/day

Equations:

- $H_f = 8.65 \times 10^{-15} (Q^2 * Lp / rp^5)$
- $H_{nit} = (Dw' + Hg - Hf) + Pg/1.42$
- $K = (Q * Ln(R/r_b)) / 2 * p * H_{nit} * L)$

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	**24.9**	**35**	**45.5**	**35.4**	**24.2**
Induced Pressure at Surface Gage	**10**	**25**	**40**	**25**	**10**
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**13.65**	**19.20**	**29.00**	**23.00**	**18.00**
2	**14.00**	**19.00**	**28.50**	**23.25**	**18.00**
3	**13.70**	**18.25**	**28.50**	**23.25**	**18.00**
4	**13.55**	**18.25**	**28.50**	**23.25**	**17.75**
5	**13.70**	**18.00**	**28.50**	**23.25**	**17.75**
Stable Q (L/30sec)	**13.63**	**18.00**	**28.50**	**23.25**	**17.75**
Leak Q (L/30sec)	**0**	**0**	**0**	**0**	**0**
Q (m³/day)	39.2	51.8	82.1	67.0	51.1
Hf (m)	1.55	2.71	6.80	4.52	2.64
Hnit (m)	17.5	24.6	32.0	24.9	17.0
K (m/day)	7.4E-02	7.0E-02	8.5E-02	8.9E-02	9.9E-02
K (m/s)	**8.6E-07**	**8.0E-07**	**9.8E-07**	**1.0E-06**	**1.1E-06**
+/- (m/s)	1.9E-07	2.6E-07	1.9E-07	4.1E-08	-1.0E-07
+/- order of mag.	0.09	0.12	0.08	0.02	-0.04





Geology, Basalt. Calcite veins with large, interconnected vugs and voids.

RQ-JC-Structures, Low to moderate fracture frequency and high RQD. Rock strength R3 to R4. No fault gouge.

Flow Monitoring-System-Test Comments, No equipment issues. Washed hole prior to testing with fresh water for 45 minutes. During third pressure step, the take increased abruptly and pressure dropped. Likely due to cleaning out of interconnected voids. Successfully deflated packer using E-pin to verify that it had stayed inflated for the duration of the test.

SRK Consulting
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STEPPED PRESSURE INJECTION TEST
(page 2)

Drillhole Nº	GT17-06
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	25	33	40	30	24
Max P during step	25	37	51	41	25
average pressure +/- psi	**0.4**	**2.3**	**5.9**	**5.7**	**0.5**

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	**0.5**	**0.5**	**1**	**0.5**	**0.3**

High estimate of K

Q_{avg} (m^3/day)	40.68	53.28	84.96	68.40	51.98
Hf (m)	1.67	2.86	7.28	4.72	2.73
Hnit (m)	17.3	23.0	27.9	20.9	16.7
K (m/sec)	9.0E-07	8.9E-07	1.2E-06	1.3E-06	1.2E-06

Low estimate of K

Q_{avg} (m^3/day)	37.80	50.40	79.20	65.52	50.26
Hf (m)	1.44	2.56	6.33	4.33	2.55
Hnit (m)	17.8	26.3	36.2	28.9	17.4
K (m/sec)	8.1E-07	7.3E-07	8.4E-07	8.7E-07	1.1E-06

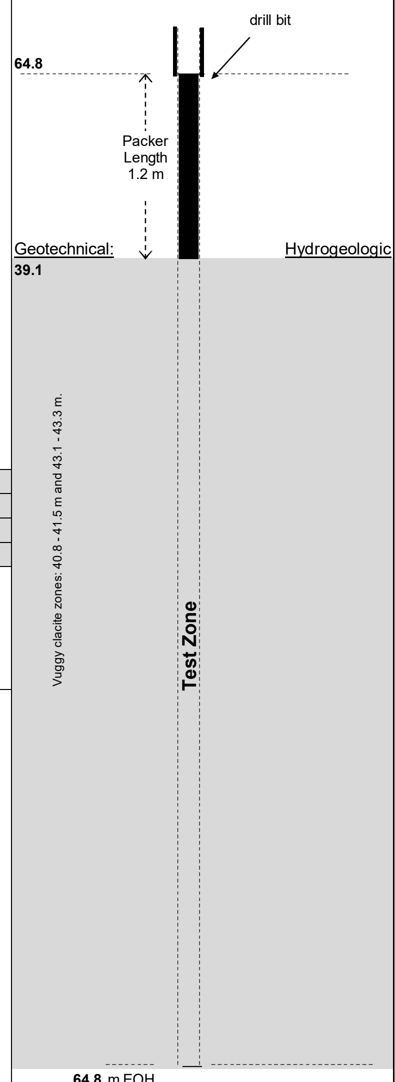
K averages for P step (m/second)

P	25	35	46
high est of K	1.E-06	1.E-06	1.E-06
average K	1.E-06	9.E-07	1.E-06
low est of K	1.E-06	8.E-07	8.E-07

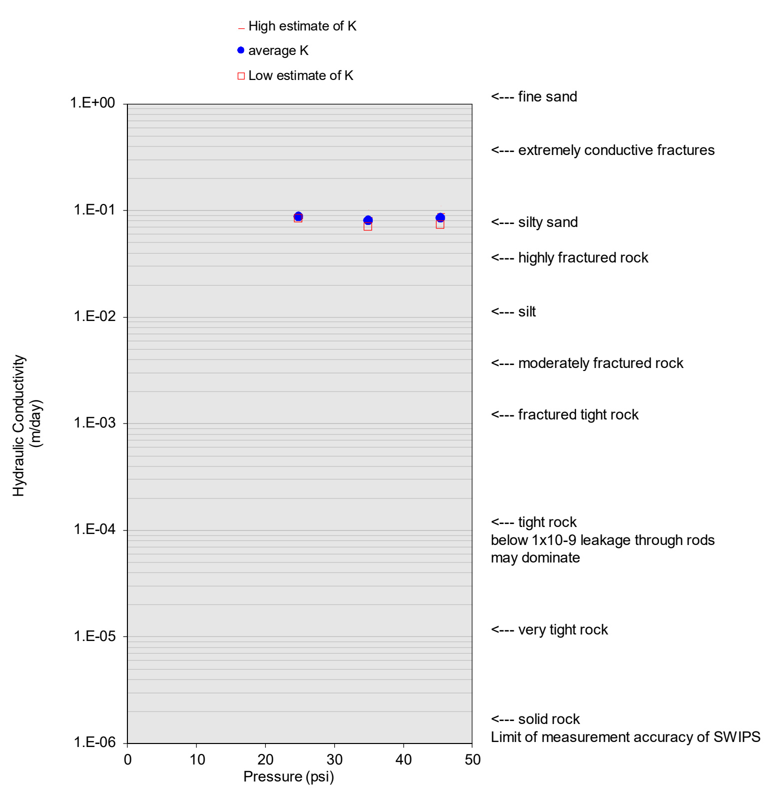
K avg all P steps

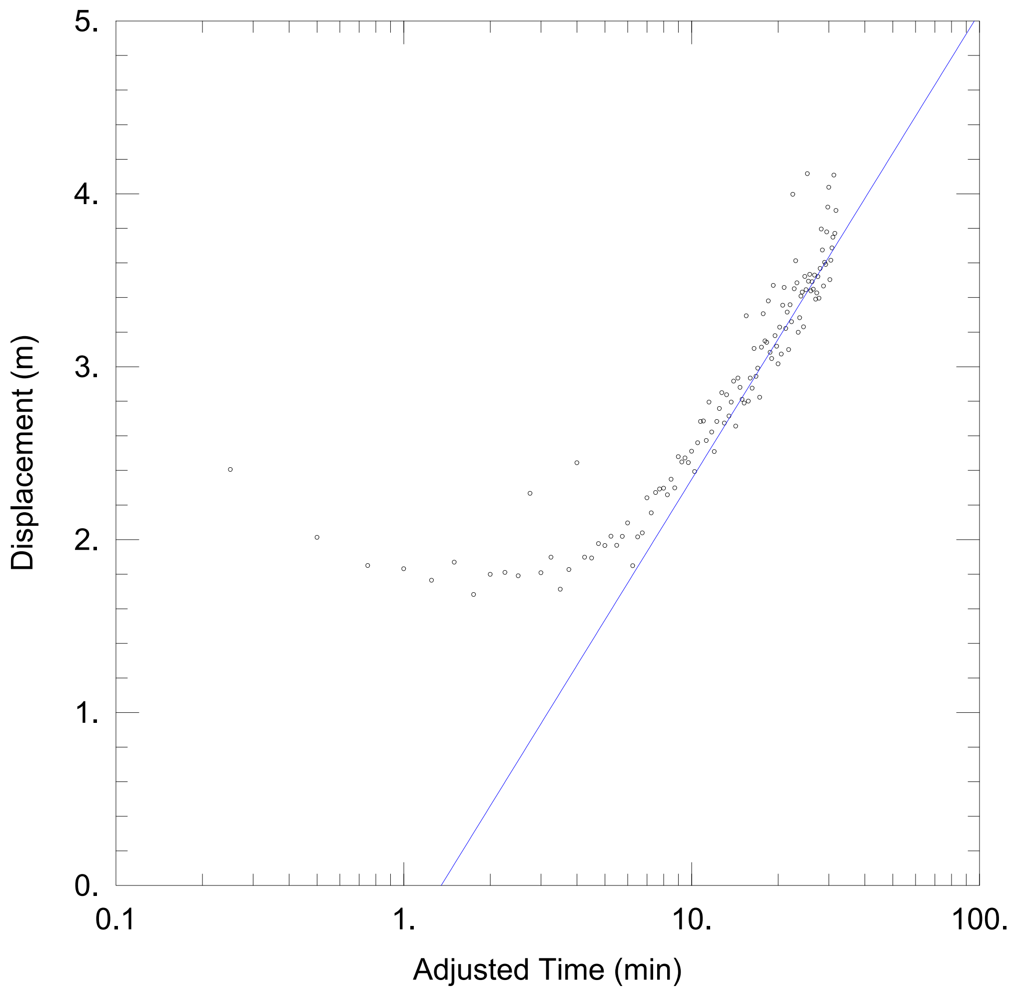
	m/day	Ft/Day
MAX	1.01E-01	3.30E-01
geomean	8.34E-02	2.74E-01
MIN	6.91E-02	2.27E-01

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



Graph of estimated hydraulic conductivity and error bounds.





TEST 2

Data Set: T:\...\GT17-06_Test2_75.1-94.8_Compensated CJ Confined.aqt
Date: 01/14/18 Time: 18:07:57

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: GT17-06
Test Date: 9 July 2017

AQUIFER DATA

Saturated Thickness: 16.7 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
GT17-06	0	0

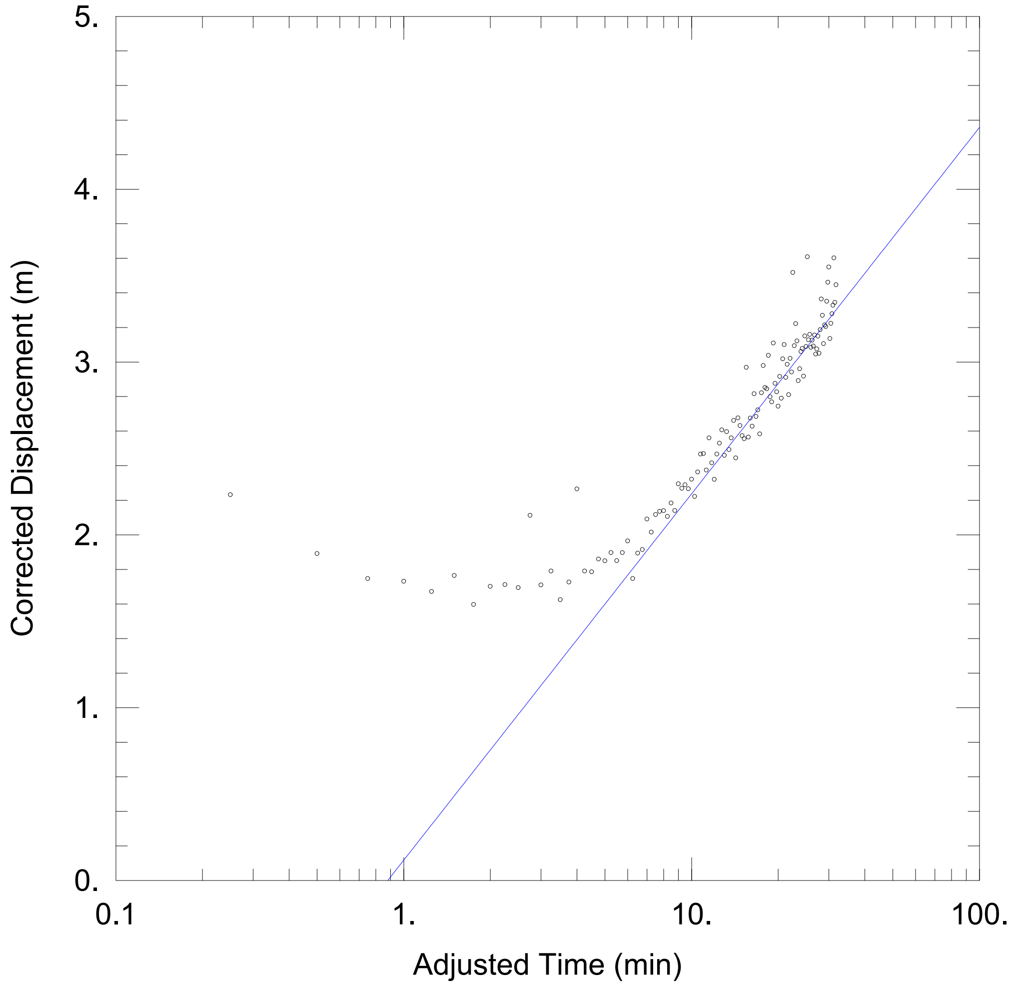
Observation Wells

Well Name	X (m)	Y (m)
◦ GT17-06	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 9.284 m^2/day S = 8.481



TEST 2

Data Set: T:\...\GT17-06_Test2_75.1-94.8_Compensated CJ UnConfined.aqt
Date: 01/14/18 Time: 18:05:20

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: GT17-06
Test Date: 9 July 2017

AQUIFER DATA

Saturated Thickness: 16.7 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
GT17-06	0	0

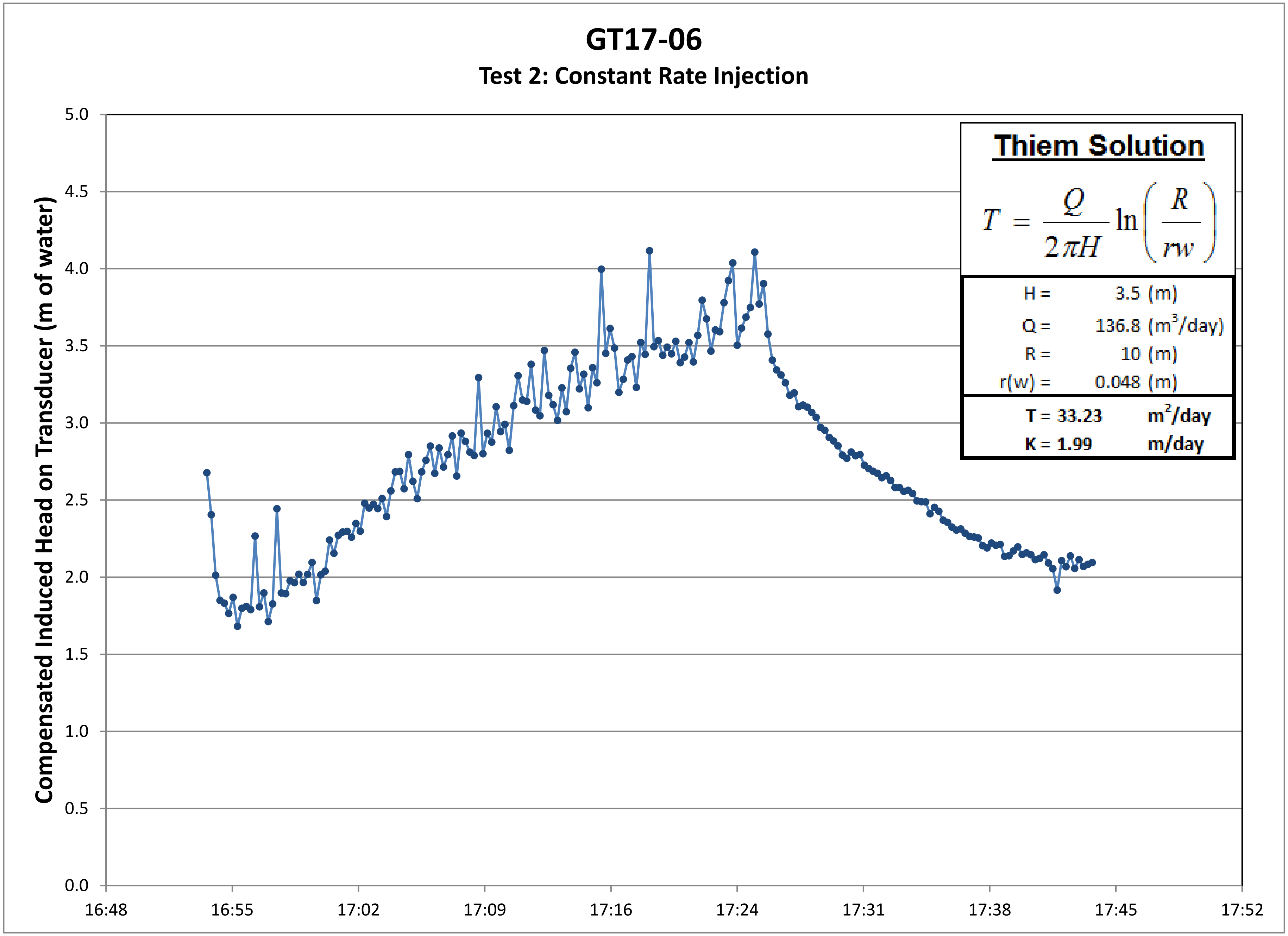
Observation Wells

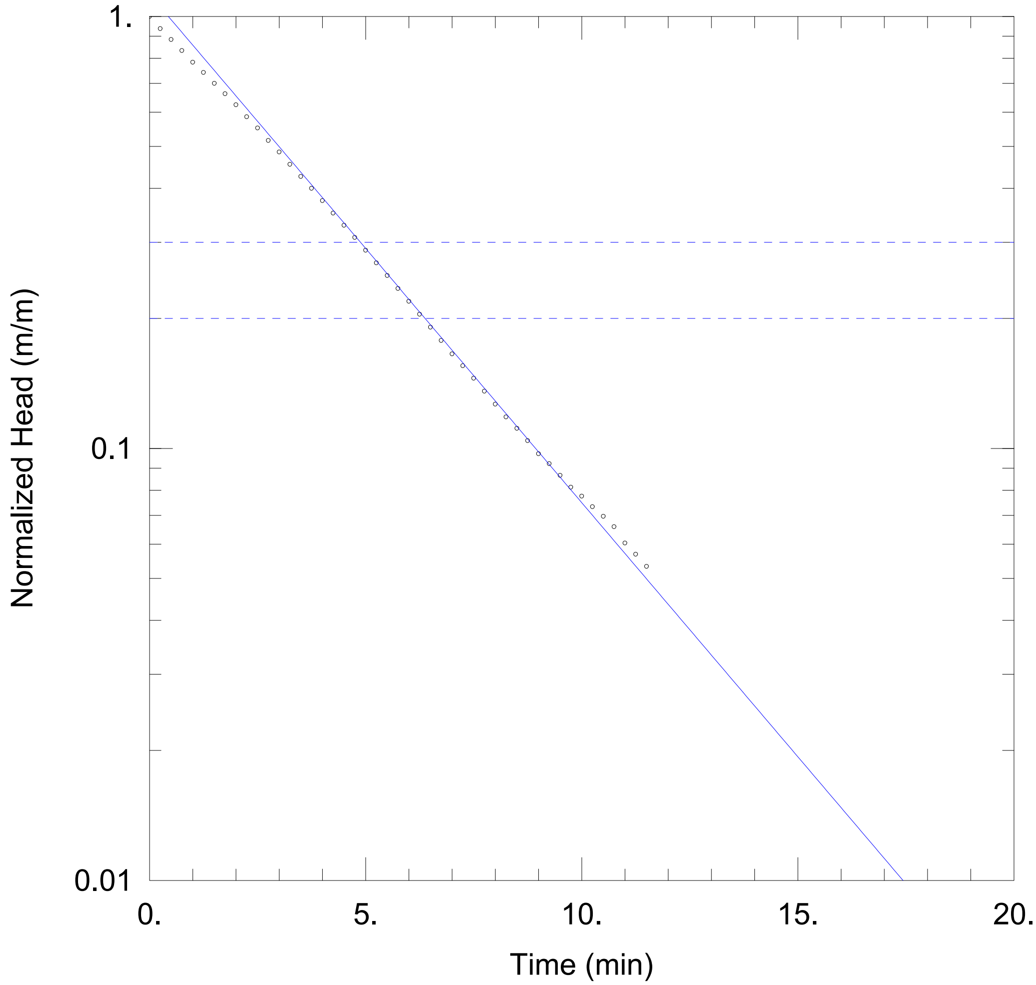
Well Name	X (m)	Y (m)
◦ GT17-06	0	0

SOLUTION

Aquifer Model: Unconfined
Solution Method: Cooper-Jacob

T = 11.82 m^2/day
S = 7.045


GT17-06
Test 2: Constant Rate Injection
Compensated Induced Head on Transducer (m of water)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
16:48
16:55
17:02
17:09
17:16
17:24
17:31
17:38
17:45
17:52
Thiem Solution
$T = \frac{Q}{2\pi H} \ln\left(\frac{R}{rw}\right)$
H = 3.5 (m)
Q = 136.8 (m^3/day)
R = 10 (m)
r(w) = 0.048 (m)
T = 33.23 m^2/day
K = 1.99 m/day



TEST 3 - FALLING HEAD

Data Set: T:\...\GT17-06_Test3_120.1-148.8_Compensated Bouwer-Rice Unconfined.aqt
Date: 01/14/18 Time: 18:24:06

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: GT17-06
Test Date: 10 July 2017

AQUIFER DATA

Saturated Thickness: 28.7 m
Anisotropy Ratio (Kz/Kr): 1.

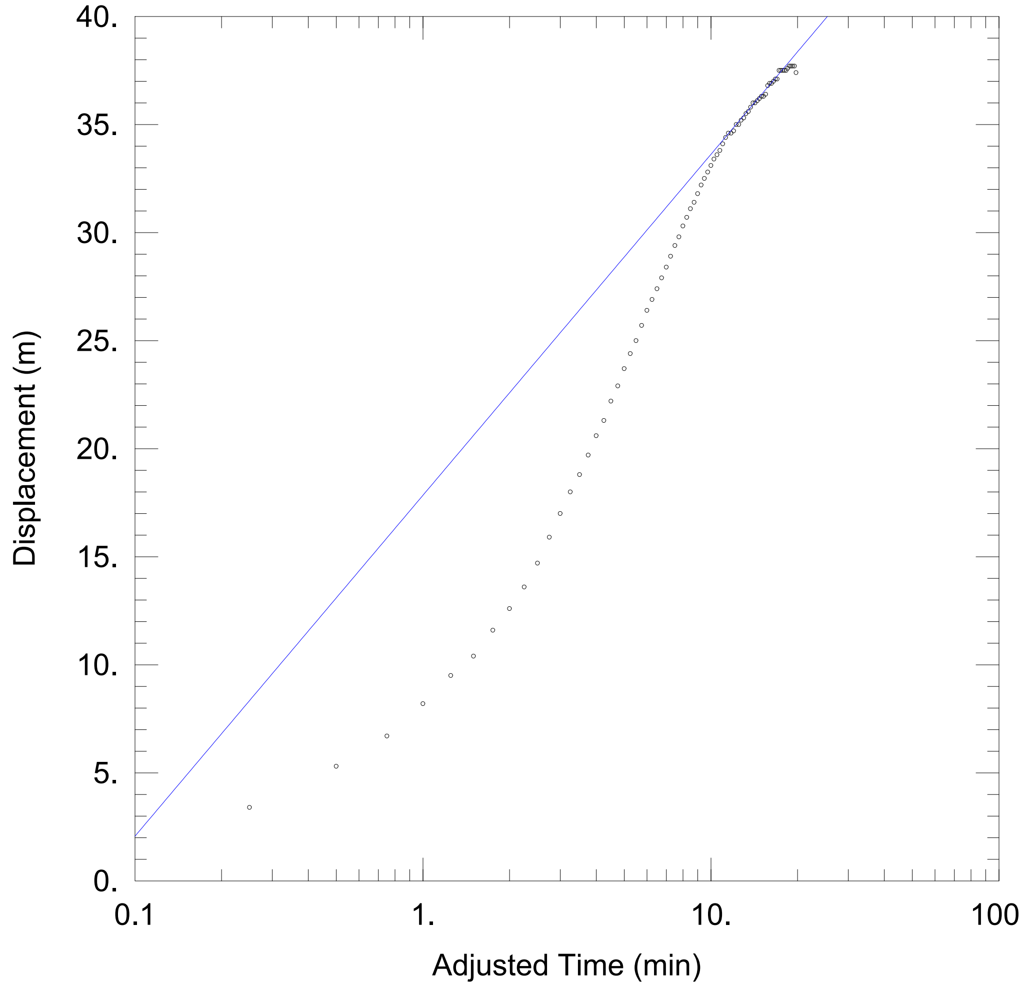
WELL DATA (GT17-06)

Initial Displacement: 62.36 m
Total Well Penetration Depth: 28.7 m
Casing Radius: 0.0389 m
Static Water Column Height: 28.7 m
Screen Length: 28.7 m
Well Radius: 0.048 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.05391 m/day
y0 = 70.16 m



TEST 3

Data Set: T:\...\GT17-06_Test3_120.1-148.8_CooperJacob Confined.aqt
Date: 01/14/18 Time: 18:16:46

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: GT17-06
Test Date: 10 July 2017

AQUIFER DATA

Saturated Thickness: 28.7 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
GT17-06	0	0

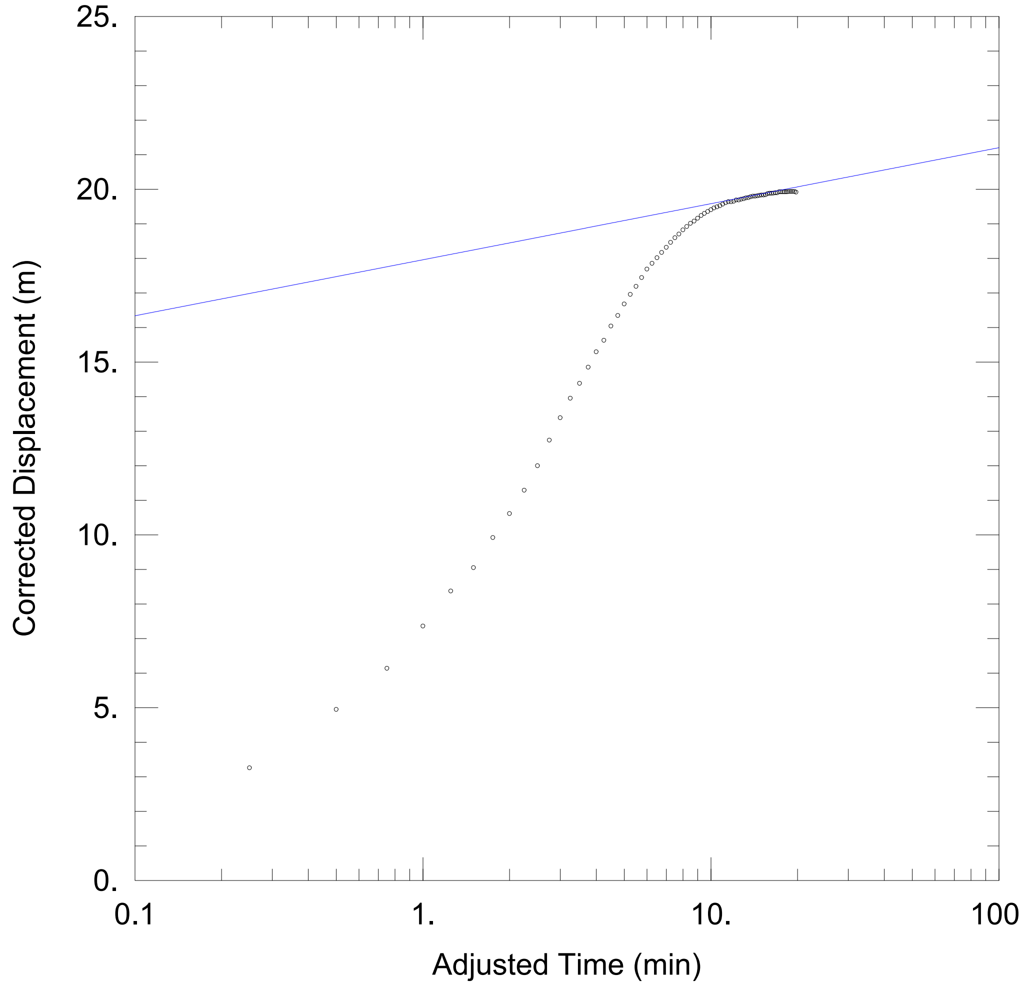
Observation Wells

Well Name	X (m)	Y (m)
GT17-06	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 1.129 m^2/day S = 0.05652



TEST 3

Data Set: T:\...\GT17-06_Test3_120.1-148.8_CooperJacob Unconf.aqt
Date: 01/14/18 Time: 18:14:43

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: GT17-06
Test Date: 10 July 2017

AQUIFER DATA

Saturated Thickness: 40. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
GT17-06	0	0

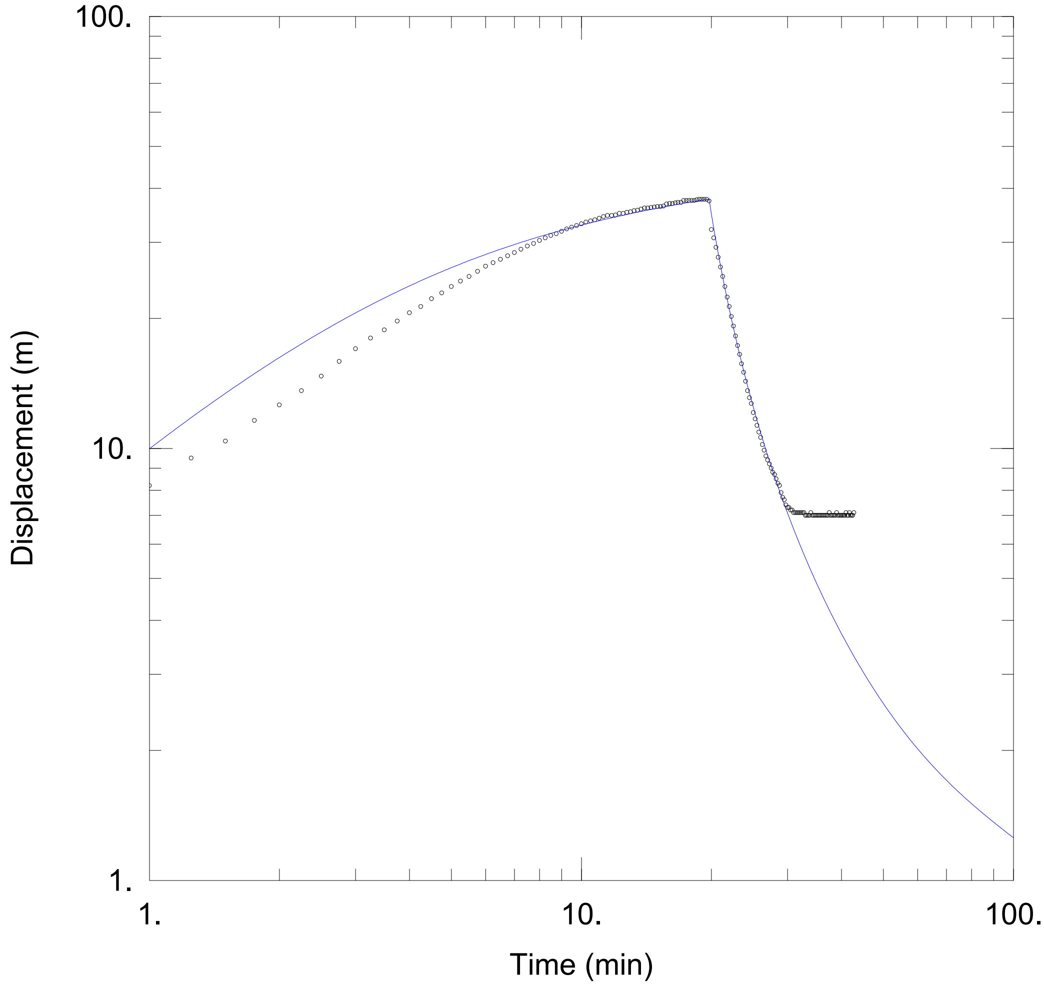
Observation Wells

Well Name	X (m)	Y (m)
◦ GT17-06	0	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Cooper-Jacob

T = 10.98 m^2/day S = 6.259E-11



TEST 3

Data Set: T:\...\GT17-06_Test3_120.1-148.8_Compensated Moench.aqt
Date: 01/14/18 Time: 18:22:44

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: GT17-06
Test Date: 10 July 2017

AQUIFER DATA

Saturated Thickness: 28.7 m Slab Block Thickness: 1. m

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
GT17-06	0	0

Observation Wells

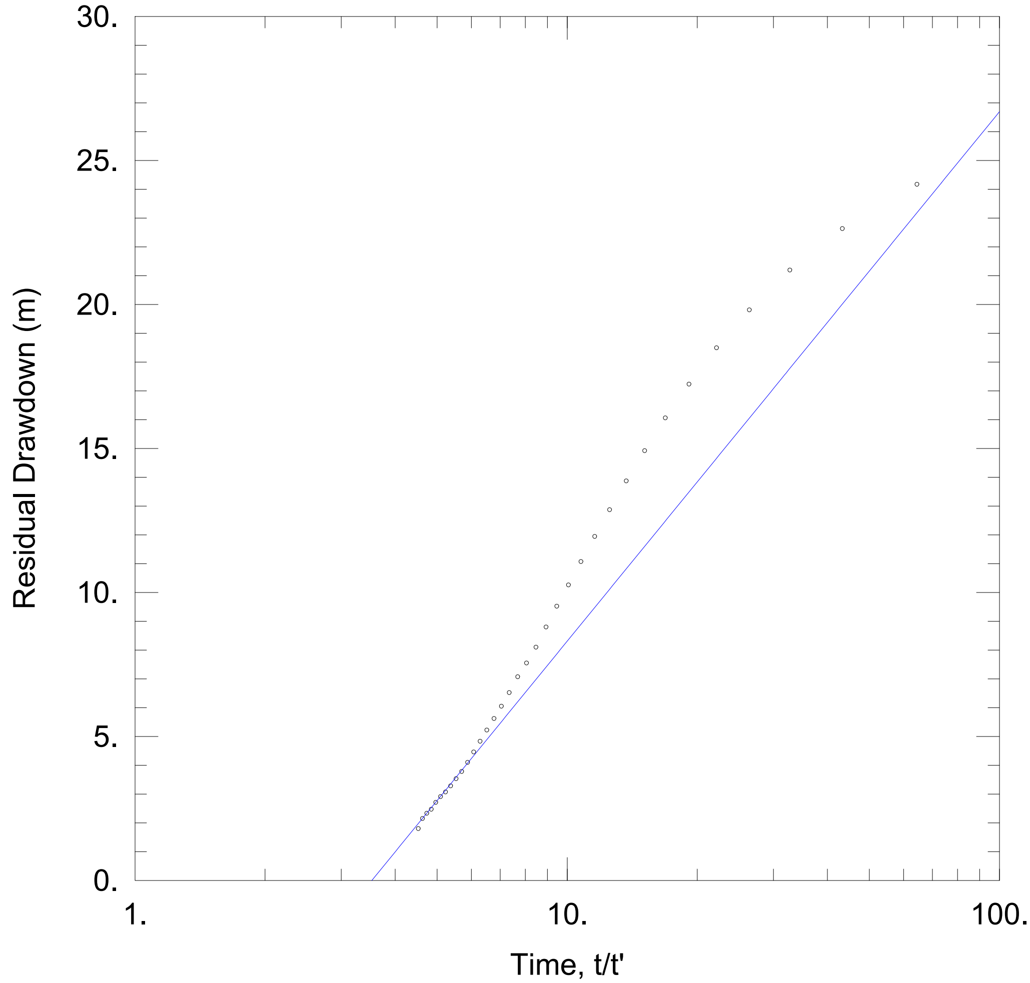
Well Name	X (m)	Y (m)
◦ GT17-06	0	0

SOLUTION

Aquifer Model: Fractured Solution Method: Moench w/slab blocks

K = 0.03697 m/day
K' = 0.008746 m/day
Sw = 0.
r(w) = 0.048 m

Ss = 0.0006589 m^{-1}
Ss' = 0.003865 m^{-1}
Sf = 0.
r(c) = 0.0389 m



TEST 3

Data Set: T:\...\GT17-06_Test3_120.1-148.8_Theis RDD.aqt
Date: 01/14/18 Time: 18:18:45

PROJECT INFORMATION

Company: SRK
Client: Constantine Metals
Location: Palmer Project, AK
Test Well: GT17-06
Test Date: 10 July 2017

AQUIFER DATA

Saturated Thickness: 48.7 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
GT17-06	0	0

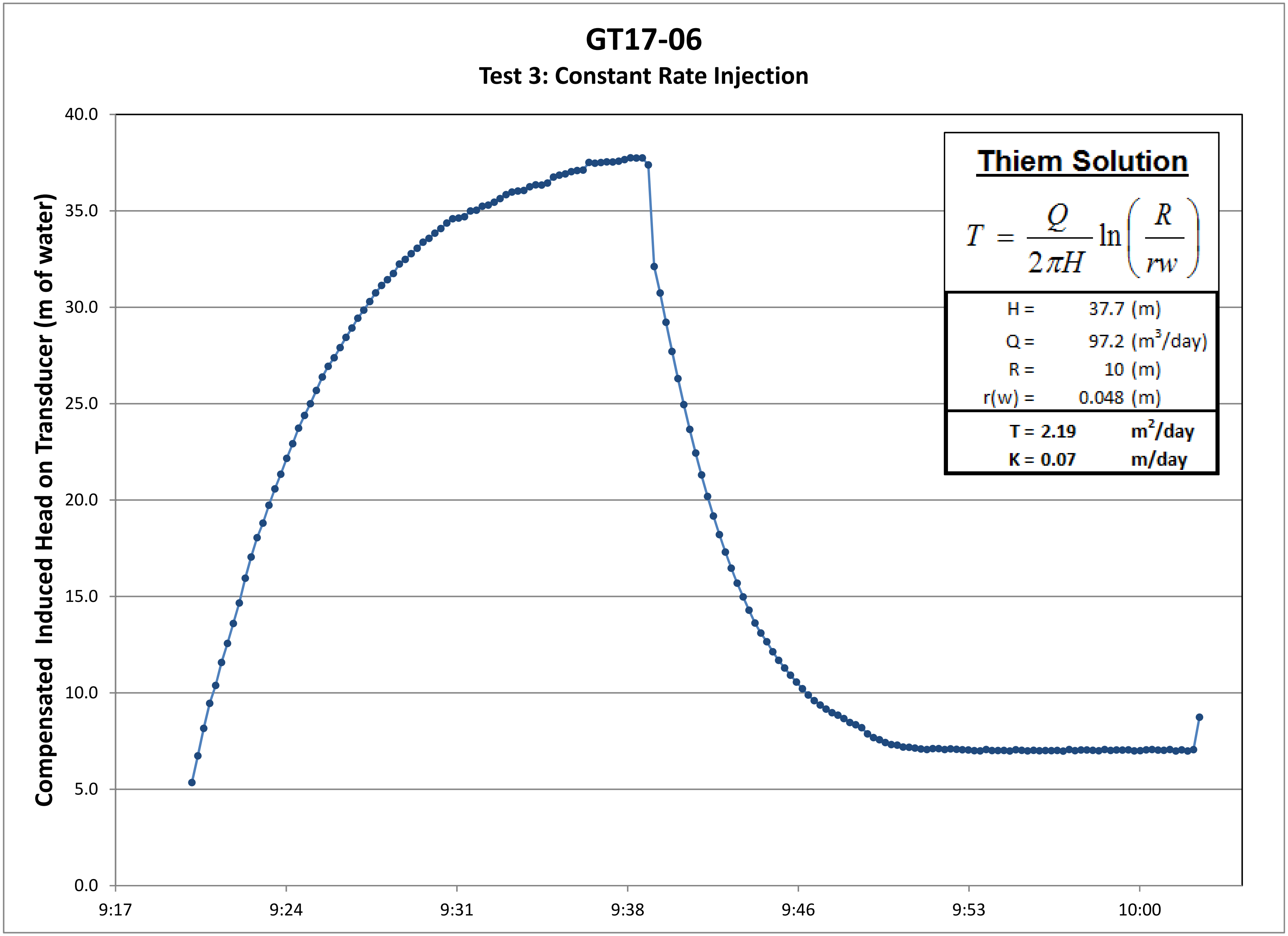
Observation Wells

Well Name	X (m)	Y (m)
◦ GT17-06	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 0.9693 m^2/day S/S' = 3.531


GT17-06
Test 3: Constant Rate Injection
Compensated Induced Head on Transducer (m of water)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
9:17
9:24
9:31
9:38
9:46
9:53
10:00
Thiem Solution
$$T = \frac{Q}{2\pi H}\ln\left(\frac{R}{rw}\right)$$
H = 37.7 (m)
Q = 97.2 (m^3/day)
R = 10 (m)
r(w) = 0.048 (m)
T = 2.19 m^2/day
K = 0.07 m/day

SRK Consulting — Engineers and Scientists

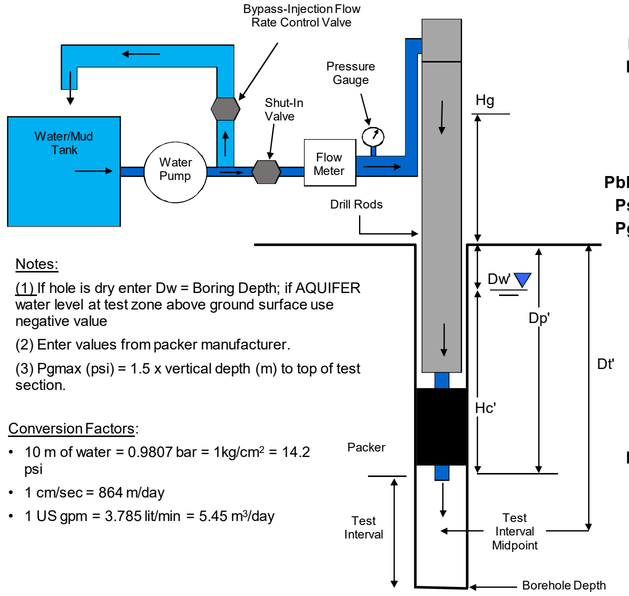
STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	**Constantine Metals**	**Test Interval (m):**	**175.1**	**To:**	**193.8**	**Test Nº**	**4**
Drillhole Nº:	**GT17-06**	**Start Date:**	**11-Jul-17**	**Time:**	**17:00**	**Drill Bit Depth**	**173.8**
		End Date:	**11-Jul-17**	**Time:**	**18:45**	**DH Depth (m)**	**193.8**
		Supervisor:	**GEB**	**Rig:**	**17**		

Max Injection P (psi)

169

Symbol	Description	Value	Unit
Dw	Measured depth of static water level (1)	84.1	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**84.0**	m
Dt	Measured depth to midpoint of test	**184.4**	m
ß	Inclination from horizontal (degrees)	40	°
Dw'	Vertical depth to static water level	**54.1**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**54.0**	m
Dt'	Vertical depth to midpoint of test	**118.6**	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	**77**	psi
Pshear	Estimated differential shear pressure required	**500**	psi
Pgmax	Maximum injection gauge pressure (3)	**178**	psi
Hg	Gauge height	1.0	m
Lp	Length of discharge pipe	9.14	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	**19**	m
Hf	Friction Loss		
Hnit	Net injection head at midpoint of test		
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.

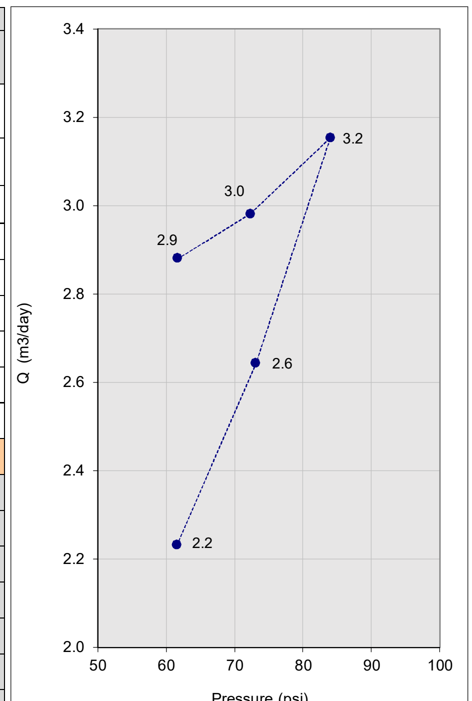
Conversion Factors:

- 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

Equations:

- Hf = 8.65x10^{-15} (Q^2*Lp/rp^5)
- H_{nit} = (Dw'+Hg-Hf)+Pg/1.42
- K = (Q*Ln(R/r_b)) / 2*p*H_{nit}*L)

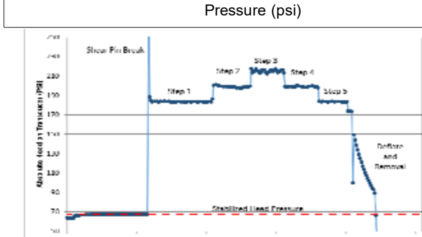
Measurement (last 3 to 5 stable readings)	Q (Liters / 30sec)				
	P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Induced Pressure at TDX	**61.7**	**72.3**	**84**	**73.1**	**61.6**
Induced Pressure at Surface Gage	**15**	**30**	**45**	**30**	**15**
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**1.29**	**1.31**	**1.400**	**1.140**	**0.938**
2	**1.26**	**1.31**	**1.425**	**1.135**	**0.960**
3	**1.23**	**1.28**	**1.375**	**1.143**	**0.965**
4	**1.21**	**1.27**	**1.355**	**1.148**	**0.975**
5	**1.20**	**1.26**	**1.345**	**1.140**	**0.975**
Stable Q (L/30sec)	**1.20**	**1.26**	**1.35**	**1.14**	**0.98**
Leak Q (L/30sec)	**0.200**	**0.225**	**0.250**	**0.225**	**0.200**
Q (m^3/day)	2.9	3.0	3.2	2.6	2.2
Hf (m)	0.01	0.01	0.01	0.01	0.01
Hnit (m)	43.5	50.9	59.2	51.5	43.4
K (m/day)	3.0E-03	2.7E-03	2.4E-03	2.3E-03	2.3E-03
K (m/s)	**3.5E-08**	**3.1E-08**	**2.8E-08**	**2.7E-08**	**2.7E-08**
+/- (m/s)	5.0E-09	6.1E-09	7.8E-09	9.9E-09	1.3E-08
+/- order of mag.	0.06	0.08	0.11	0.14	0.17



Geology, Basalt.

RQ-JC-Structures, Low to moderate fracture frequency and high RQD. Rock strength R3 to R4.

Flow Monitoring-System-Test Comments, Test conducted at low pressure steps to minimize the risk of hydro-fraccing due to the test interval proximity to the sub-glacier creek. The hydrograph suggests progressive blocking of fractures and flow paths with transported material during the course of the test. No equipment issues. Washed hole prior to testing with fresh water.



GT17-06_Test4_175.1-193.8_Analysis_Rev1.xlsx / Analysis 1/14/2018

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STEPPED PRESSURE INJECTION TEST
(page 2)

Drillhole Nº	GT17-06
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	61	71	81	72	61
Max P during step	62	74	87	74	62
average pressure +/- psi	0.4	1.3	3.3	1	0.2

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	0.25	0.25	0.25	0.25	0.25

High estimate of K

Q_{avg} (m^3/day)	3.60	3.70	3.87	3.36	2.95
Hf (m)	0.01	0.01	0.02	0.01	0.01
Hnit (m)	43.2	50.0	56.8	50.8	43.2
K (m/sec)	4.4E-08	3.9E-08	3.6E-08	3.5E-08	3.6E-08

Low estimate of K

Q_{avg} (m^3/day)	2.16	2.26	2.43	1.92	1.51
Hf (m)	0.00	0.01	0.01	0.00	0.00
Hnit (m)	43.7	51.8	61.5	52.2	43.5
K (m/sec)	2.6E-08	2.3E-08	2.1E-08	1.9E-08	1.8E-08

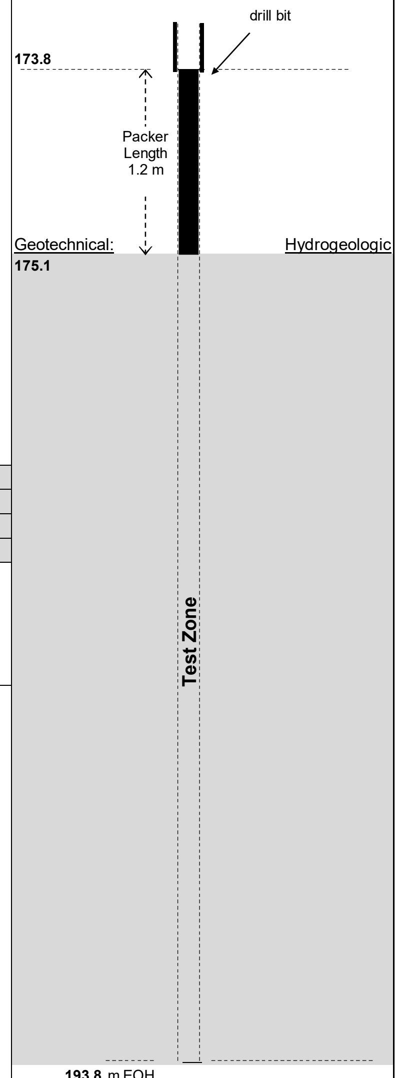
K averages for P step — m/second

P	62	72	84
high est of K	3.99E-08	3.69E-08	3.58E-08
average K	3.10E-08	2.89E-08	2.80E-08
low est of K	2.21E-08	2.12E-08	2.08E-08

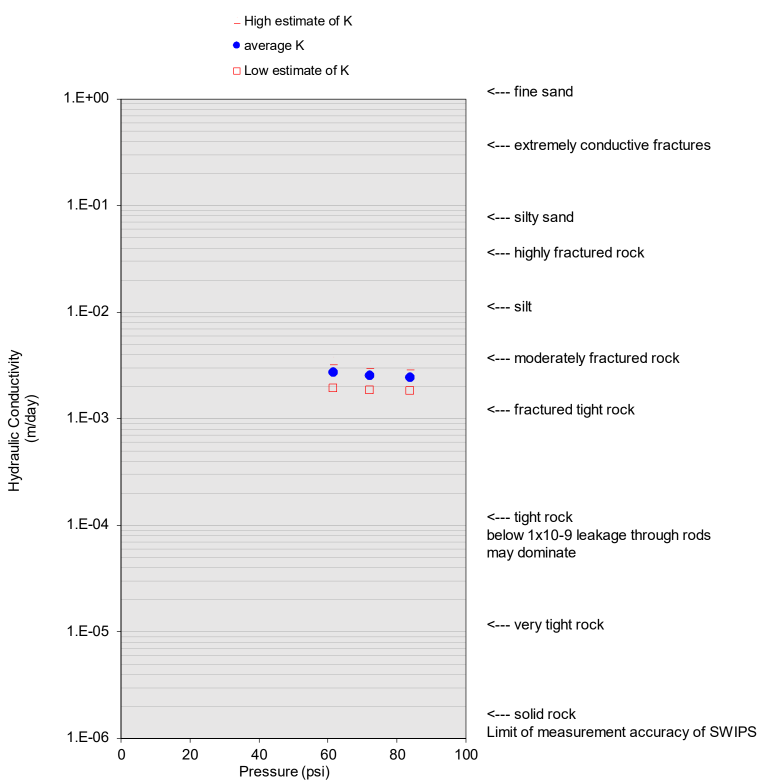
K avg all P steps

	m/day	Ft/Day
MAX	3.45E-03	1.13E-02
geomean	2.53E-03	8.29E-03
MIN	1.80E-03	5.90E-03

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



Graph of estimated hydraulic conductivity and error bounds.



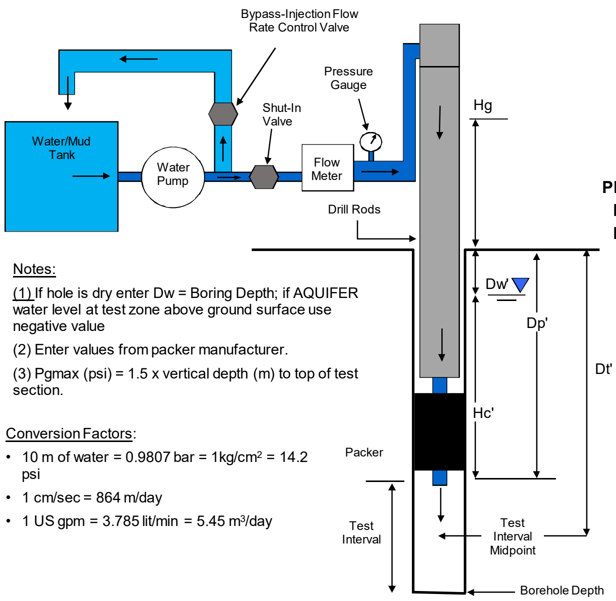
SRK Consulting — Engineers and Scientists

STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	**Constantine Metals**	**Test Interval (m):**	**210.1**	**To:**	**241.8**	**Test Nº**	**5A**
Drillhole Nº:	**GT17-06**	**Start Date:**	**12-Jul-17**	**Time:**	**16:30**	**Drill Bit Depth**	**208.8**
		End Date:	**13-Jul-17**	**Time:**	**3:12**	**DH Depth (m)**	**241.8**
		Supervisor:	**GEB**	**Drill No.**	**17**		

Max Injection P (psi)

203



Dw	Measured depth of static water level (1)	95	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**84.0**	m
Dt	Measured depth to midpoint of test	**225.9**	m
ß	Inclination from horizontal (degrees)	40	º
Dw'	Vertical depth to static water level	**61.1**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**54.0**	m
Dt'	Vertical depth to midpoint of test	**145.2**	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	**77**	psi
Pshear	Estimated differential shear pressure required	**500**	psi
Pgmax	Maximum injection gauge pressure (3)	**218**	psi
Hg	Gauge height	1.0	m
Lp	Length of discharge pipe	9.14	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	**32**	m
Hf	Friction Loss		
Hnit	Net injection head at midpoint of test		
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.

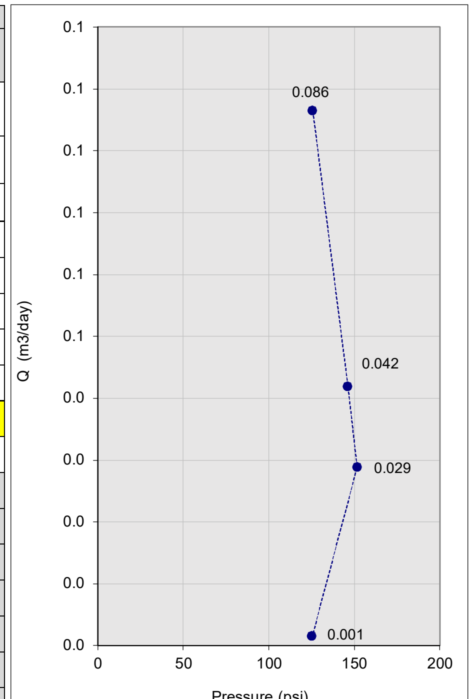
Conversion Factors:

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

Equations:

- $Hf = 8.65 \times 10^{-15} (Q^2 * Lp/rp^5)$
- $H_{nit} = (Dw' + Hg - Hf) + Pg/1.42$
- $K = (Q * Ln(R/r_b)) / 2 * p * H_{nit} * L)$

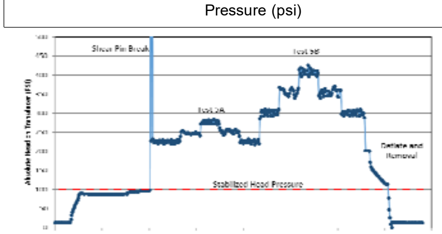
Measurement (last 3 to 5 stable readings)	**Q (Liters / 30sec)**				
	P_g (psi) Step 1	**P_g (psi) Step 2**	**P_g (psi) Step 3**	**P_g (psi) Step 4**	**P_g (psi) Step 5**
Induced Pressure at TDX	**125.7**	**146.4**	**176.5**	**151.7**	**125.4**
Induced Pressure at Surface Gage	**25**	**50**	**75**	**50**	**25**
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**0.03**	**0.06**	**0.085**	**0.045**	**0.000**
2	**0.04**	**0.05**	**0.075**	**0.050**	**0.000**
3	**0.03**	**0.05**	**0.075**	**0.053**	**0.010**
4	**0.02**	**0.06**	**0.075**	**0.050**	**0.000**
5	**0.03**	**0.05**	**0.075**	**0.050**	**0.005**
Stable Q (L/30sec)	**0.03**	**0.05**	**0.08**	**0.05**	**0.00**
Leak Q (L/30sec)	**0.000**	**0.040**	**0.085**	**0.040**	**0.000**
Q (m³/day)	0.086	0.042	#N/A	0.029	0.001
Hf (m)	0.00	0.00	#N/A	0.00	0.00
Hnit (m)	88.5	103.1	124.3	106.8	88.3
K (m/day)	2.6E-05	1.1E-05	#N/A	7.2E-06	4.4E-07
K (m/s)	**3.0E-10**	**1.3E-10**	**#N/A**	**8.4E-11**	**5.1E-12**
+/- (m/s)	2.7E-09	2.3E-09	#VALUE!	2.3E-09	3.0E-09
+/- order of mag.	1.00	1.28	#VALUE!	1.46	2.77



Geology, Jasper Mountain basalt.

RQ-JC-Structures, Low to fracture frequency and high RQD. No major structures

Flow Monitoring-System-Test Comments, Test conducted at low pressure steps to minimize the risk of hydro-fraccing due to the test interval proximity to the sub-glacier creek. Initially, had issues with packer setting, then packer sealing with the out-of-spec O-rings on the Straddle Inner Case. Came up with a workaround solution. The leak rate was within reading error of the injection rate and likely dominates portions of the test. A progressive decrease in the formation take indicates that flow paths became partially blocked by transported material during the course of the test. Deflated with Emergency Shear Pin to ensure that the packer had correctly stayed inflated.



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STEPPED PRESSURE INJECTION TEST
(page 2)

Drillhole Nº	GT17-06
Test Nº	5A

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	114	137	164	141	110
Max P during step	138	156	189	163	141
average pressure +/- psi	**11.8**	**9.1**	**12.7**	**10.8**	**15.5**

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**

High estimate of K

Q_{avg} (m^3/day)	0.81	0.76	#N/A	0.75	0.72
Hf (m)	0.00	0.00	#N/A	0.00	0.00
Hnit (m)	80.2	96.7	115.4	99.2	77.4
K (m/sec)	3.1E-09	2.4E-09	#N/A	2.3E-09	2.9E-09

Low estimate of K

Q_{avg} (m^3/day)	-0.63	-0.68	#N/A	-0.69	-0.72
Hf (m)	0.00	0.00	#N/A	0.00	0.00
Hnit (m)	96.8	109.5	133.2	114.4	99.2
K (m/sec)	#N/A	#N/A	#N/A	#N/A	#N/A

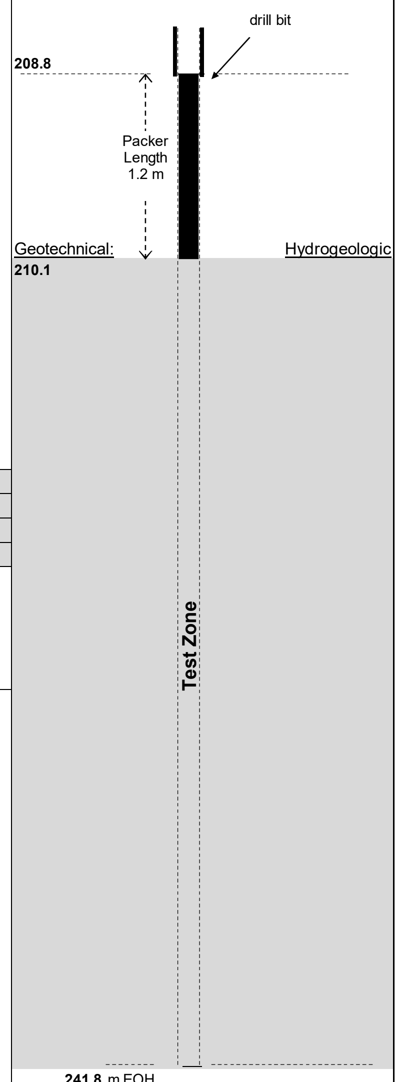
K averages for P step (m/second)

P	126	146	177
high est of K	3.01E-09	2.39E-09	
average K	1.54E-10	1.05E-10	
low est of K			

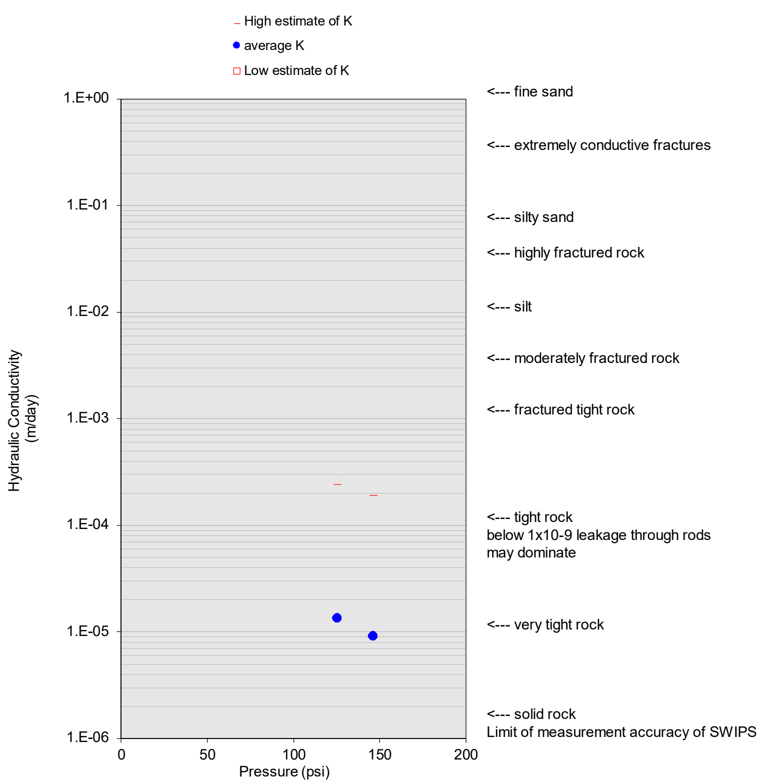
K avg all P steps

	m/day	Ft/Day
MAX	2.60E-04	8.52E-04
geomean	1.10E-05	3.60E-05
MIN	#N/A	#N/A

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



Graph of estimated hydraulic conductivity and error bounds.



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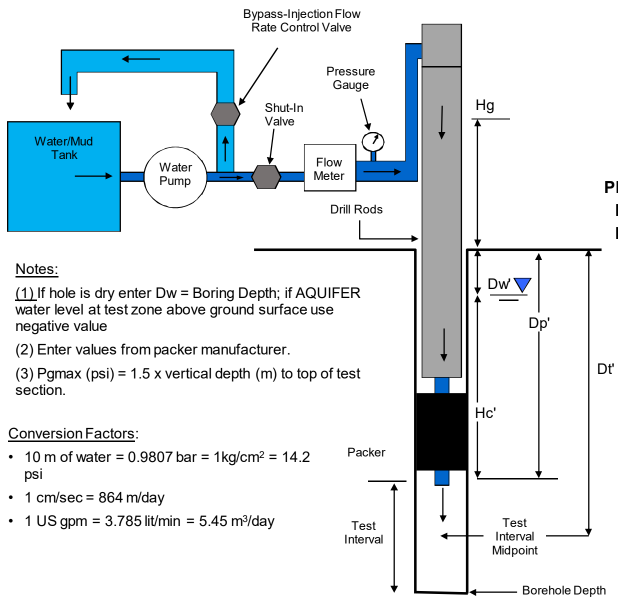
STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	**Constantine Metals**	**Test Interval (m):**	**210.1**	**To:**	**241.8**	**Test Nº**	**5B**
Drillhole Nº:	**GT17-06**	**Start Date:**	**13-Jul-17**	**Time:**	**3:12**	**Drill Bit Depth**	**208.8**
		End Date:	**13-Jul-17**	**Time:**	**4:00**	**DH Depth (m)**	**241.8**
		Supervisor:	**GEB**	**Drill No.**	**17**		

Max Injection P (psi)

203

Symbol	Description	Value	Unit
Dw	Measured depth of static water level (1)	95	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**84.0**	m
Dt	Measured depth to midpoint of test	**225.9**	m
ß	Inclination from horizontal (degrees)	40	°
Dw'	Vertical depth to static water level	**61.1**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**54.0**	m
Dt'	Vertical depth to midpoint of test	**145.2**	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	**77**	psi
Pshear	Estimated differential shear pressure required	**500**	psi
Pgmax	Maximum injection gauge pressure (3)	**218**	psi
Hg	Gauge height	1.0	m
Lp	Length of discharge pipe	9.14	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	**32**	m
Hf	Friction Loss		
Hnit	Net injection head at midpoint of test		
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.

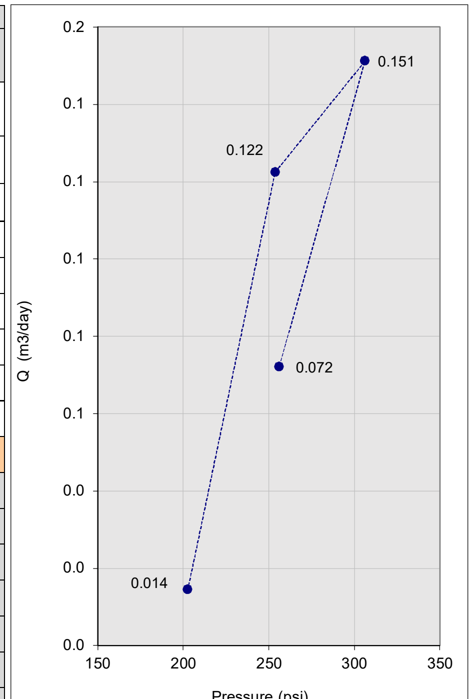
Conversion Factors:

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

Equations:

- $H_f = 8.65 \times 10^{-15} (Q^2 * L_p / r_p^5)$
- $H_{nit} = (Dw' + Hg - Hf) + Pg/1.42$
- $K = (Q * \ln(R/r_b)) / 2 * p * H_{nit} * L)$

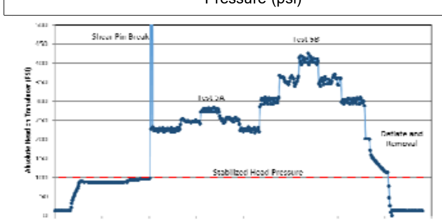
Measurement (last 3 to 5 stable readings)	Q (Liters / 30sec) P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Induced Pressure at TDX	**202.7**	**253.8**	**306.3**	**256.1**	**201.2**
Induced Pressure at Surface Gage	**100**	**150**	**200**	**150**	**100**
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**0.10**	**0.13**	**0.163**	**0.122**	**0.080**
2	**0.10**	**0.13**	**0.163**	**0.113**	**0.075**
3	**0.09**	**0.14**	**0.160**	**0.110**	**0.067**
4	**0.09**	**0.13**	**0.153**	**0.125**	**0.075**
5	**0.09**	**0.13**	**0.153**	**0.115**	**0.075**
Stable Q (L/30sec)	**0.09**	**0.13**	**0.15**	**0.12**	**0.07**
Leak Q (L/30sec)	**0.085**	**0.090**	**0.100**	**0.090**	**0.085**
Q (m³/day)	0.014	0.122	0.151	0.072	#N/A
Hf (m)	0.00	0.00	0.00	0.00	#N/A
Hnit (m)	142.7	178.7	215.7	180.4	141.7
K (m/day)	2.7E-06	1.8E-05	1.9E-05	1.1E-05	#N/A
K (m/s)	**3.1E-11**	**2.1E-10**	**2.2E-10**	**1.2E-10**	**#N/A**
+/- (m/s)	1.7E-09	1.4E-09	1.1E-09	1.5E-09	#N/A
+/- order of mag.	1.75	0.87	0.78	1.11	#N/A



Geology, Jasper Mountain basalt.

RQ-JC-Structures, Low to fracture frequency and high RQD. No major structures

Flow Monitoring-System-Test Comments, After completing the Test 5A with very little take from the formation, a second test was immediately started at higher injection pressures. No leak rate was measured for this unanticipated test, so leak values are estimated based upon the earlier leak rate at lower pressures. The leak rate was within reading error of the injection rate and likely dominates portions of the test. A progressive decrease in the formation take indicates that flow paths became partially blocked by transported material during the course of the test. Deflated with Emergency Shear Pin to ensure that the packer had correctly stayed inflated.



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STEPPED PRESSURE INJECTION TEST
(page 2)

Drillhole Nº	GT17-06
Test Nº	5B

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	184	227	291	228	183
Max P during step	221	281	322	284	220
average pressure +/- psi	**18.5**	**26.7**	**15.2**	**28.1**	**18.7**

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**

High estimate of K

Q_{avg} (m^3/day)	0.73	0.84	0.87	0.79	#N/A
Hf (m)	0.00	0.00	0.00	0.00	#N/A
Hnit (m)	129.7	159.9	205.0	160.6	128.5
K (m/sec)	1.8E-09	1.6E-09	1.3E-09	1.5E-09	#N/A

Low estimate of K

Q_{avg} (m^3/day)	-0.71	-0.60	-0.57	-0.65	#N/A
Hf (m)	0.00	0.00	0.00	0.00	#N/A
Hnit (m)	155.8	197.5	226.4	200.1	154.9
K (m/sec)	#N/A	#N/A	#N/A	#N/A	#N/A

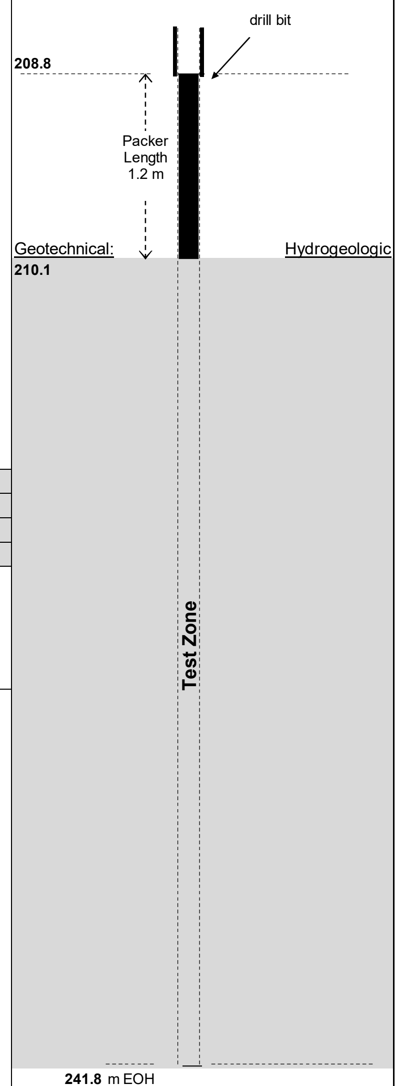
K averages for P step
m/second

P	203	254	306
high est of K	1.76E-09	1.58E-09	1.32E-09
average K	3.13E-11	1.68E-10	2.17E-10
low est of K			

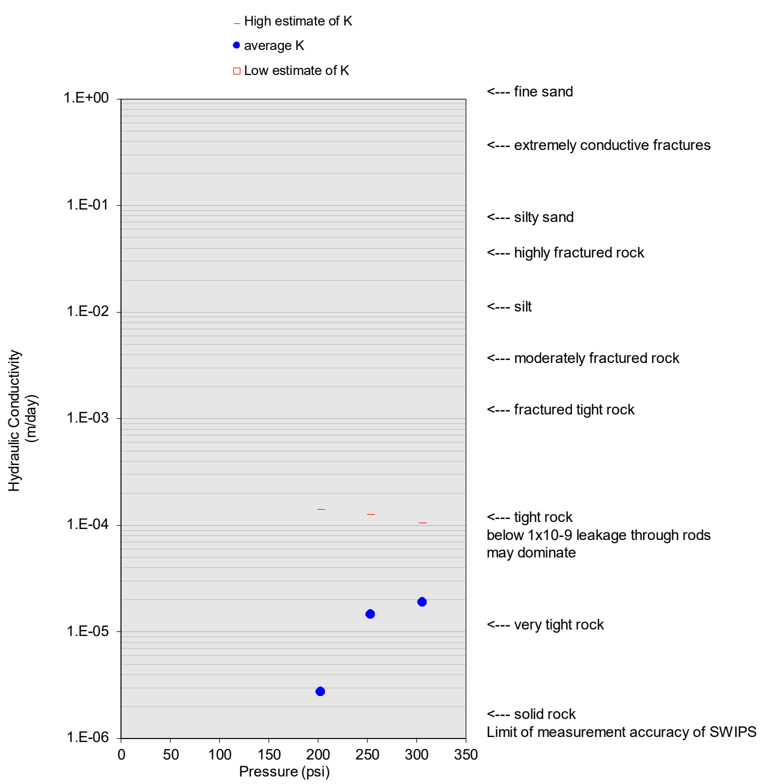
K avg all P steps

	m/day	Ft/Day
MAX	1.52E-04	4.98E-04
geomean	9.04E-06	2.96E-05
MIN	#N/A	#N/A

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



Graph of estimated hydraulic conductivity and error bounds.



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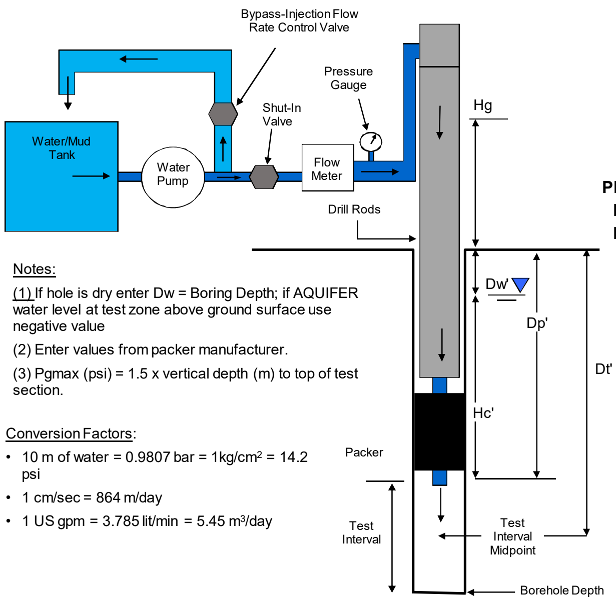
STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	**Constantine Metals**	**Test Interval (m):**	**159.3**	**To:**	**182.0**	**Test Nº**	**1**
Drillhole Nº:	**GT17-07**	**Start Date:**	**15-Jul-17**	**Time:**	**9:10**	**Drill Bit Depth**	**158.0**
		End Date:	**15-Jul-17**	**Time:**	**11:30**	**DH Depth (m)**	**182**
		Supervisor:	**GEB**	**Drill No.**	**17**		

Max Injection P (psi)

183



Dw	Measured depth of static water level (1)	71	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**84.0**	m
Dt	Measured depth to midpoint of test	**170.6**	m
ß	Inclination from horizontal (degrees)	50	°
Dw'	Vertical depth to static water level	**54.4**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**64.3**	m
Dt'	Vertical depth to midpoint of test	**130.7**	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	**91**	psi
Pshear	Estimated differential shear pressure required	**500**	psi
Pgmax	Maximum injection gauge pressure (3)	**196**	psi
Hg	Gauge height	1.0	m
Lp	Length of discharge pipe	9.14	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	**23**	m
Hf	Friction Loss		
Hnit	Net injection head at midpoint of test		
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.

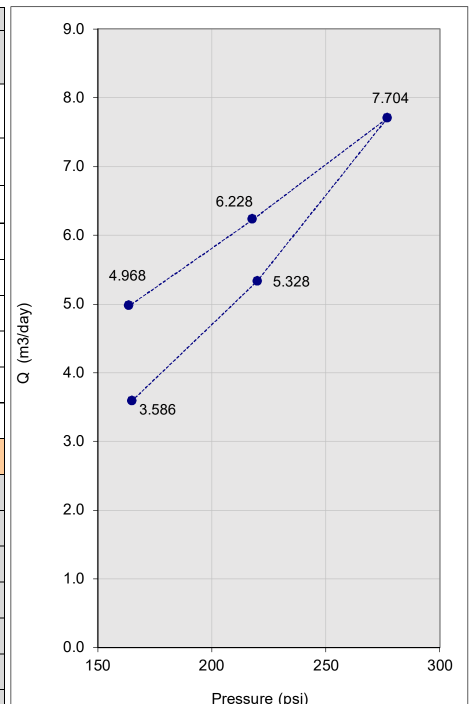
Conversion Factors:

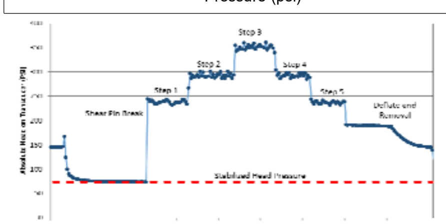
- 10 m of water = 0.9807 bar = 1kg/cm² = 14.2 psi
- 1 cm/sec = 864 m/day
- 1 US gpm = 3.785 lit/min = 5.45 m³/day

Equations:

- $H_f = 8.65 \times 10^{-15} (Q^2 * L_p / r_p^5)$
- $H_{nit} = (Dw' + Hg - Hf) + Pg/1.42$
- $K = (Q * \ln(R/r_b)) / 2 * p * H_{nit} * L)$

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	165	220.0	277	218.0	163.7
Induced Pressure at Surface Gage	50	100	150	100	50
Marsh Funnel Secs. (Clean Water = 26)	26	26	26	26	26
1	1.33	2.08	2.975	2.288	1.763
2	1.33	2.08	2.900	2.300	1.800
3	1.35	2.06	2.900	2.300	1.825
4	1.34	2.01	2.875	2.350	1.825
5	1.35	2.01	2.875	2.325	1.825
Stable Q (L/30sec)	1.35	2.01	2.88	2.33	1.83
Leak Q (L/30sec)	0.100	0.163	0.200	0.163	0.100
Q (m³/day)	3.586	5.328	7.704	6.228	4.968
Hf (m)	0.01	0.03	0.06	0.04	0.02
Hnit (m)	116.2	154.9	195.1	153.5	115.3
K (m/day)	1.2E-03	1.3E-03	1.5E-03	1.5E-03	1.6E-03
K (m/s)	**1.3E-08**	**1.5E-08**	**1.7E-08**	**1.8E-08**	**1.9E-08**
+/- (m/s)	6.4E-09	4.6E-09	2.3E-09	1.9E-09	1.1E-09
+/- order of mag.	0.17	0.12	0.05	0.05	0.02





Geology, Terminus Basalt.

RQ-JC-Structures, Generally low fracture frequency and high RQD, but test interval includes a highly broken zone with elevated weathering.

Flow Monitoring-System-Test Comments, No equipment issues. Flushed hole with fresh water prior to testing.

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STEPPED PRESSURE INJECTION TEST
(page 2)

Drillhole Nº	GT17-07
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	156	206	267	204	156
Max P during step	174	234	287	232	172
average pressure +/- psi	9	14.0	10	14.0	8

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	0.25	0.25	0.25	0.25	0.25

High estimate of K

Q_{avg} (m^3/day)	4.31	6.05	8.42	6.95	5.69
Hf (m)	0.02	0.04	0.07	0.05	0.03
Hnit (m)	109.9	145.1	188.0	143.7	109.6
K (m/sec)	1.7E-08	1.8E-08	1.9E-08	2.1E-08	2.2E-08

Low estimate of K

Q_{avg} (m^3/day)	2.87	4.61	6.98	5.51	4.25
Hf (m)	0.01	0.02	0.05	0.03	0.02
Hnit (m)	122.5	164.8	202.1	163.4	120.9
K (m/sec)	1.0E-08	1.2E-08	1.5E-08	1.5E-08	1.5E-08

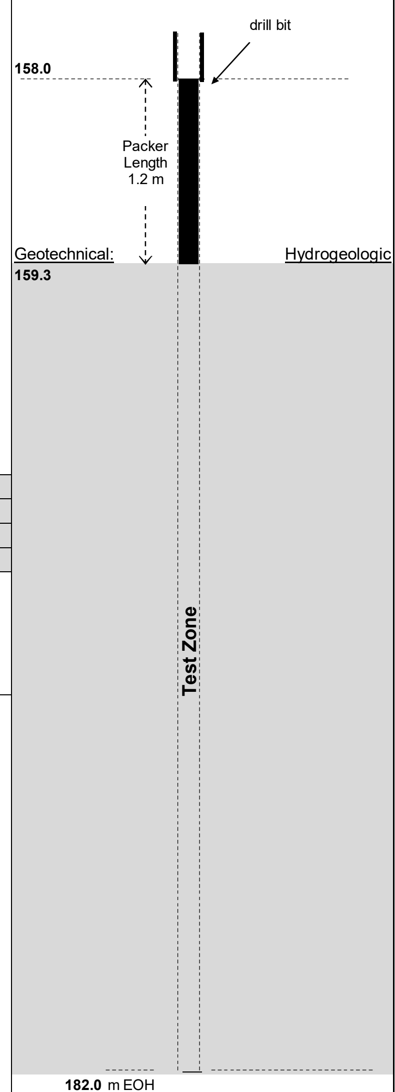
K averages for P step m/second

P	165	220	277
high est of K	1.97E-08	1.95E-08	1.94E-08
average K	1.60E-08	1.62E-08	1.71E-08
low est of K	1.27E-08	1.34E-08	1.50E-08

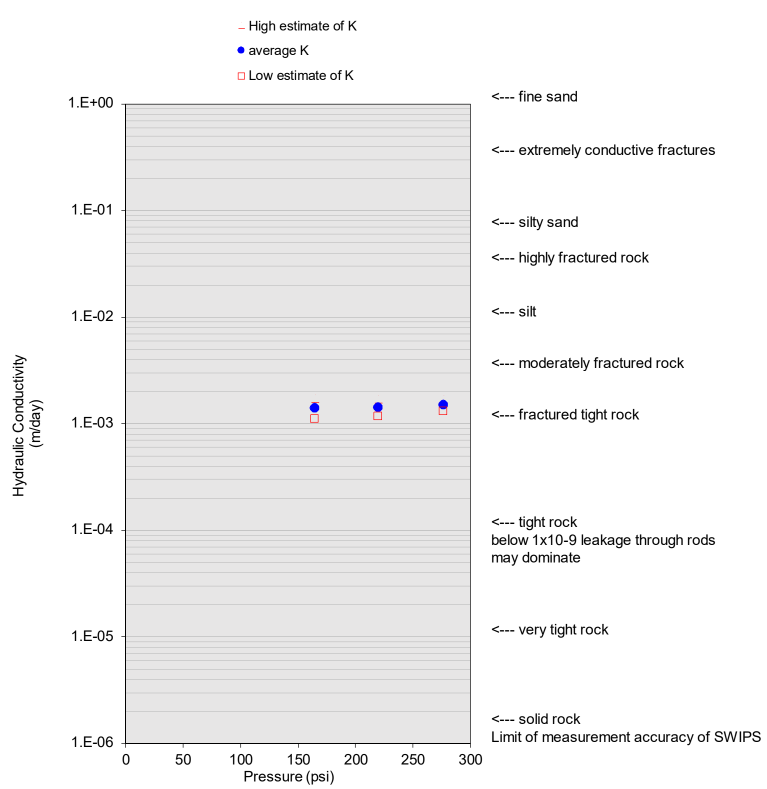
K avg all P steps

	m/day	Ft/Day
MAX	1.70E-03	5.59E-03
geomean	1.42E-03	4.66E-03
MIN	1.10E-03	3.59E-03

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



Graph of estimated hydraulic conductivity and error bounds.



GT17-07_Test1_159.3-182_Analysis.xlsx / Analysis
1/14/2018

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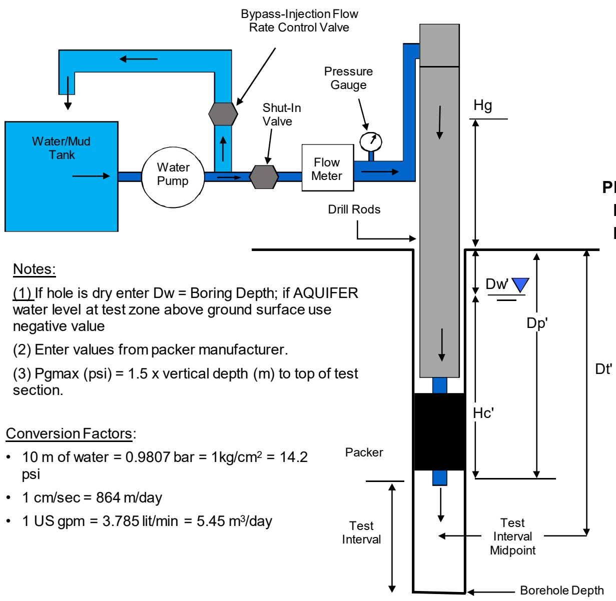
STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	Constantine Metals	Test Interval (m):	192.3	To:	224.0	Test Nº	2
Drillhole Nº:	GT17-07	Start Date:	15-Jul-17	Time:	20:35	Drill Bit Depth	191.0
		End Date:	15-Jul-17	Time:	22:45	DH Depth (m)	224
		Supervisor:	GEB	Drill No.	17		

Max Injection P (psi)

221



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:

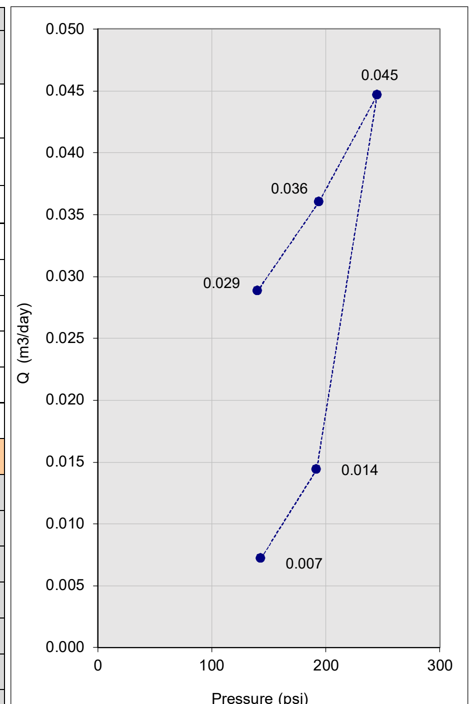
- 10 m of water = 0.9807 bar = 1kg/cm² = 14.2 psi
- 1 cm/sec = 864 m/day
- 1 US gpm = 3.785 lit/min = 5.45 m³/day

Symbol	Description	Value	Unit
Dw	Measured depth of static water level (1)	70.5	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	84.0	m
Dt	Measured depth to midpoint of test	208.1	m
ß	Inclination from horizontal (degrees)	50	°
Dw'	Vertical depth to static water level	54.0	m
Dbr'	Vertical dept to bedrock	0.0	m
Dp'	Vertical depth to packer	64.3	m
Dt'	Vertical depth to midpoint of test	159.5	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	91	psi
Pshear	Estimated differential shear pressure required	500	psi
Pgmax	Maximum injection gauge pressure (3)	239	psi
Hg	Gauge height	1.0	m
Lp	Length of discharge pipe	9.14	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	32	m
Hf	Friction Loss		
Hnit	Net injection head at midpoint of test		
K	Hydraulic conductivity		

Equations:

- $Hf = 8.65\times10^{-15} (Q^2 \cdot Lp/rp^5)$
- $H_{nit} = (Dw'+Hg-Hf)+Pg/1.42$
- $K = (Q \cdot Ln(R/r_b)) / 2 \cdot p \cdot H_{nit} \cdot L)$

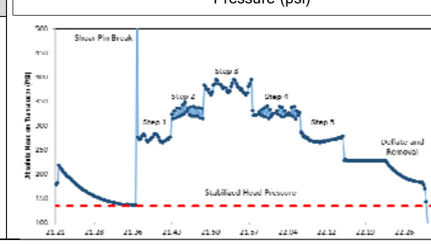
Measurement (last 3 to 5 stable readings)	Q (Liters / 30sec)				
	P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Induced Pressure at TDX	140	194.0	245	192.0	143.0
Induced Pressure at Surface Gage	50	100	150	100	50
Marsh Funnel Secs. (Clean Water = 26)	26	26	26	26	26
1	0.1000	0.1375	0.1450	0.1125	0.0650
2	0.0925	0.1350	0.1375	0.1025	0.0800
3	0.0950	0.1100	0.1500	0.1200	0.0750
4	0.0875	0.1175	0.1375	0.1150	0.0800
5	0.0875	0.1175	0.1450	0.1100	0.0800
Stable Q (L/30sec)	0.0875	0.1175	0.1430	0.1100	0.0800
Leak Q (L/30sec)	0.078	0.105	0.128	0.105	0.078
Q (m³/day)	0.029	0.036	0.045	0.014	0.007
Hf (m)	0.00	0.00	0.00	0.00	0.00
Hnit (m)	98.6	136.6	172.5	135.2	100.7
K (m/day)	7.8E-06	7.1E-06	6.9E-06	2.9E-06	1.9E-06
K (m/s)	9.1E-11	8.2E-11	8.0E-11	3.3E-11	2.2E-11
+/- (m/s)	1.8E-09	1.3E-09	1.0E-09	1.4E-09	1.8E-09
+/- order of mag.	1.31	1.23	1.15	1.62	1.93



Geology, Terminus Basalt. Possible zone of Metasediments (argillite)?

RQ-JC-Structures, Generally low fracture frequency and high RQD,

Flow Monitoring-System-Test Comments, No equipment issues. Flushed hole with fresh water prior to testing.



GT17-07_Test2_192.3-224_Analysis.xlsx / Analysis 1/14/2018

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STEPPED PRESSURE INJECTION TEST

(page 2)

Drillhole Nº	GT17-07
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	121	169	214	166	125
Max P during step	159	219	276	218	161
average pressure +/- psi	**19**	**25.0**	**31**	**26.0**	**18**

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	**0.175**	**0.175**	**0.175**	**0.175**	**0.175**

High estimate of K

Q_{avg} (m^3/day)	0.53	0.54	0.55	0.52	0.51
Hf (m)	0.00	0.00	0.00	0.00	0.00
Hnit (m)	85.2	119.0	150.7	116.9	88.0
K (m/sec)	1.9E-09	1.4E-09	1.1E-09	1.4E-09	1.8E-09

Low estimate of K

Q_{avg} (m^3/day)	-0.48	-0.47	-0.46	-0.49	-0.50
Hf (m)	0.00	0.00	0.00	0.00	0.00
Hnit (m)	112.0	154.2	194.4	153.5	113.4
K (m/sec)	#N/A	#N/A	#N/A	#N/A	#N/A

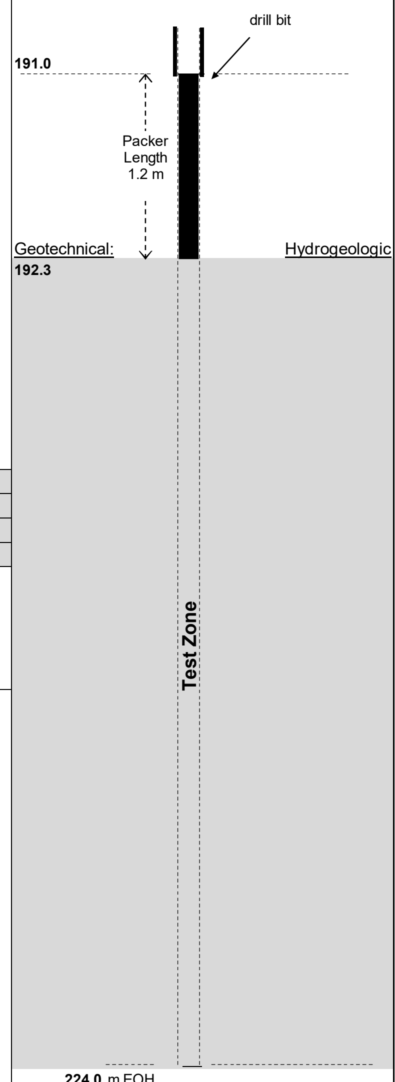
K averages for P step m/second

P	140	194	245
high est of K	1.87E-09	1.39E-09	1.13E-09
average K	5.64E-11	5.74E-11	8.03E-11
low est of K			

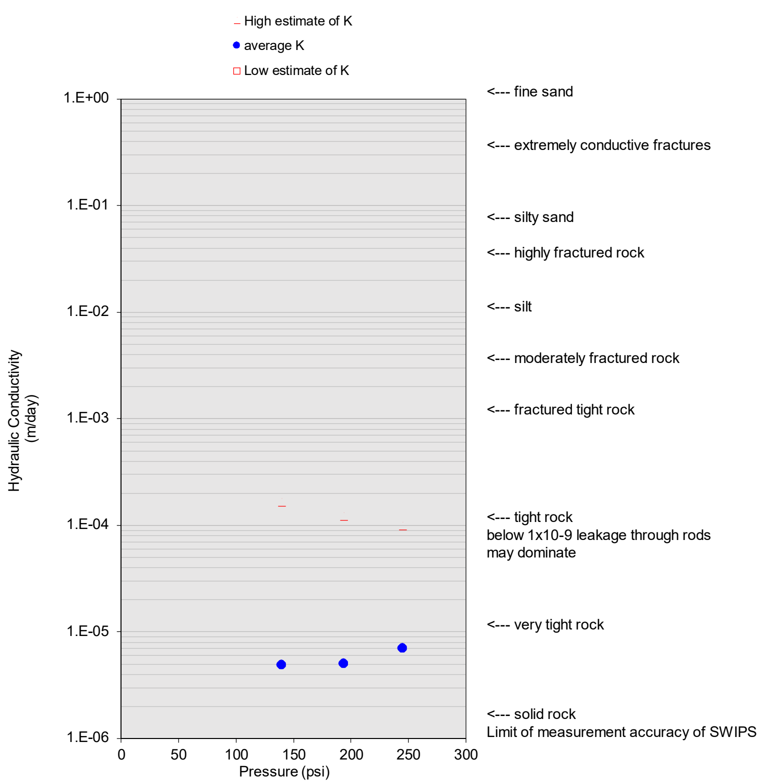
K avg all P steps

	m/day	Ft/Day
MAX	1.62E-04	5.30E-04
geomean	5.51E-06	1.81E-05
MIN	#N/A	#N/A

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



Graph of estimated hydraulic conductivity and error bounds.



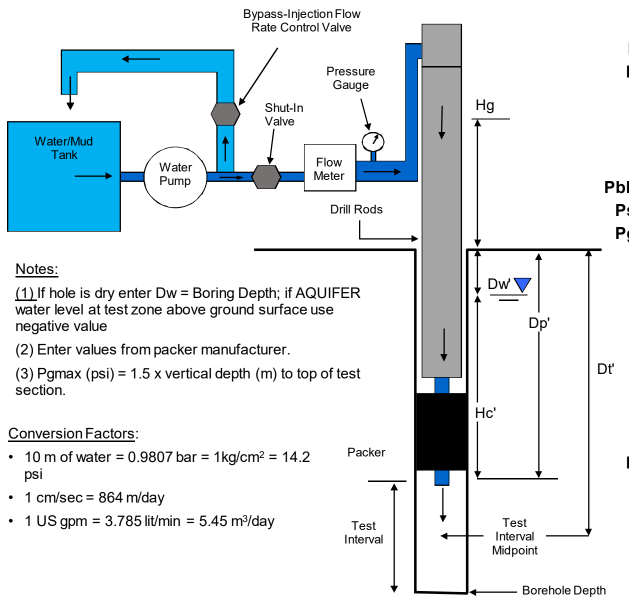
STEPPED PRESSURE INJECTION TEST *(modified from HCI)*

Project:	**Constantine Metals**	**Test Interval (m):**	**223.3**	**To:**	**251.0**	**Test Nº**	**3**
Drillhole Nº:	**GT17-07**	**Start Date:**	**16-Jul-17**	**Time:**	**7:10**	**Drill Bit Depth**	**222.0**
		End Date:	**16-Jul-17**	**Time:**	**9:15**	**DH Depth (m)**	**251**
		Supervisor:	**GEB**	**Drill No.**	**17**		

Max Injection P (psi)

257

Symbol	Description	Value	Unit
Dw	Measured depth of static water level (1)	14.5	m
Dbr	Measured depth to bedrock	0.0	m
Dp	Measured depth to packer	**84.0**	m
Dt	Measured depth to midpoint of test	**237.1**	m
ß	Inclination from horizontal (degrees)	50	°
Dw'	Vertical depth to static water level	**11.1**	m
Dbr'	Vertical dept to bedrock	**0.0**	m
Dp'	Vertical depth to packer	**64.3**	m
Dt'	Vertical depth to midpoint of test	**181.7**	m
SP	Shear Pin Rating (2)	500	psi
Pblowout	Water column pressure in drill rods at plug	**91**	psi
Pshear	Estimated differential shear pressure required	**500**	psi
Pgmax	Maximum injection gauge pressure (3)	**272**	psi
Hg	Gauge height	1.0	m
Lp	Length of discharge pipe	9.14	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	**28**	m
Hf	Friction Loss		
Hnit	Net injection head at midpoint of test		
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.

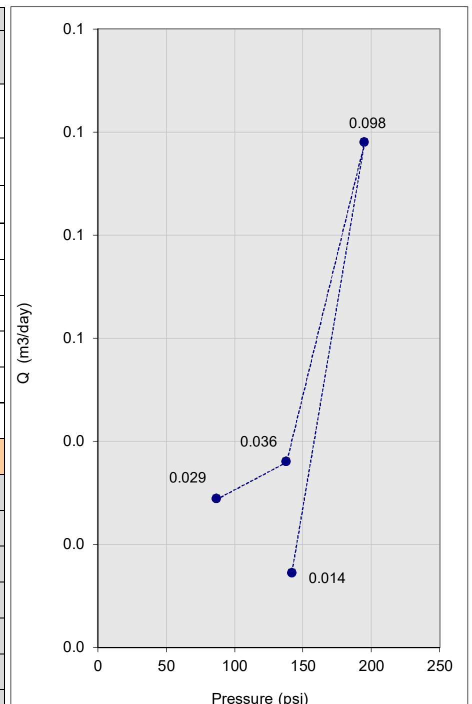
Conversion Factors:

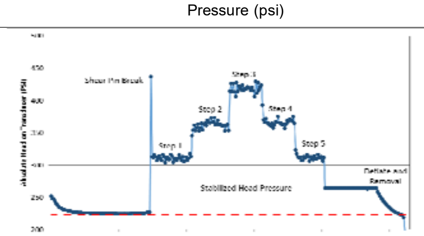
- 10 m of water = 0.9807 bar = 1kg/cm² = 14.2 psi
- 1 cm/sec = 864 m/day
- 1 US gpm = 3.785 lit/min = 5.45 m³/day

Equations:

- $H_f = 8.65 \times 10^{-15} (Q^2 \cdot L_p / r_p^5)$
- $H_{nit} = (D_w' + H_g - H_f) + P_g/1.42$
- $K = (Q \cdot \ln(R/r_b)) / 2 \cdot p \cdot H_{nit} \cdot L)$

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	**87**	**138.0**	**195**	**142.0**	**87.0**
Induced Pressure at Surface Gage	**50**	**100**	**150**	**100**	**50**
Marsh Funnel Secs. (Clean Water = 26)	**26**	**26**	**26**	**26**	**26**
1	**0.1400**	**0.2075**	**0.2625**	**0.1875**	**0.1200**
2	**0.1375**	**0.2050**	**0.2750**	**0.2000**	**0.1225**
3	**0.1450**	**0.2025**	**0.2650**	**0.1950**	**0.1225**
4	**0.1300**	**0.2000**	**0.2700**	**0.1900**	**0.1250**
5	**0.1450**	**0.2000**	**0.2650**	**0.1950**	**0.1250**
Stable Q (L/30sec)	**0.1375**	**0.2000**	**0.2675**	**0.1925**	**0.1250**
Leak Q (L/30sec)	**0.128**	**0.188**	**0.234**	**0.188**	**0.128**
Q (m³/day)	0.029	0.036	0.098	0.014	#N/A
Hf (m)	0.00	0.00	0.00	0.00	#N/A
Hnit (m)	61.3	97.2	137.3	100.0	61.3
K (m/day)	1.4E-05	1.1E-05	2.2E-05	4.4E-06	#N/A
K (m/s)	**1.7E-10**	**1.3E-10**	**2.5E-10**	**5.1E-11**	**#N/A**
+/- (m/s)	3.5E-09	2.0E-09	1.5E-09	2.1E-09	#N/A
+/- order of mag.	1.34	1.22	0.84	1.63	#N/A





Geology, Jasper Mountain Basalt.

RQ-JC-Structures, Low fracture frequency and high RQD.

Flow Monitoring-System-Test Comments, No equipment issues. Flushed hole with fresh water prior to testing.

GT17-07_Test3_223.3-251_Analysis.xlsx / Analysis 1/14/2018

SRK Consulting
Engineers and Scientists

STEPPED PRESSURE INJECTION TEST
(page 2)

Drillhole Nº	GT17-07
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	73	122	171	124	77
Max P during step	101	154	219	160	97
average pressure +/- psi	14	16.0	23.7	18.0	10

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	0.175	0.175	0.175	0.175	0.175

High estimate of K

Q_{avg} (m^3/day)	0.53	0.54	0.60	0.52	#N/A
Hf (m)	0.00	0.00	0.00	0.00	#N/A
Hnit (m)	51.4	85.9	120.6	87.3	54.2
K (m/sec)	3.7E-09	2.2E-09	1.8E-09	2.1E-09	#N/A

Low estimate of K

Q_{avg} (m^3/day)	-0.48	-0.47	-0.41	-0.49	#N/A
Hf (m)	0.00	0.00	0.00	0.00	#N/A
Hnit (m)	71.1	108.5	154.0	112.7	68.3
K (m/sec)	#N/A	#N/A	#N/A	#N/A	#N/A

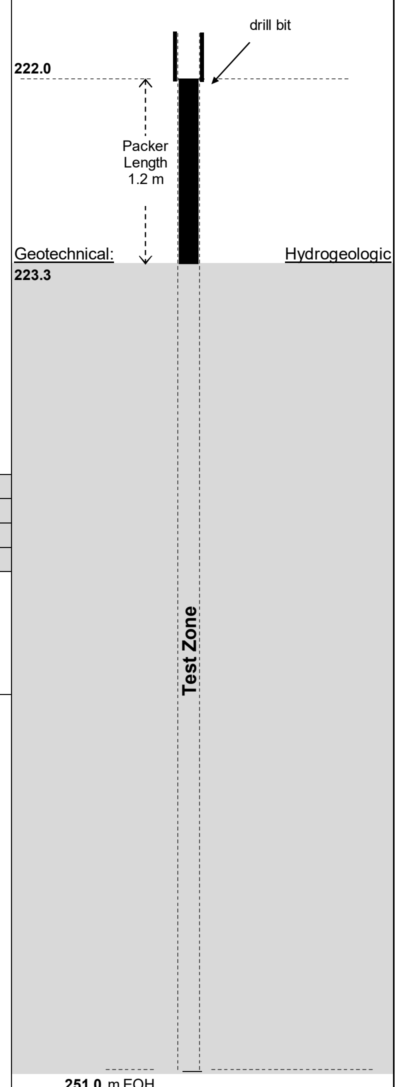
K averages for P step (m/second)

P	87	138	195
high est of K	3.68E-09	2.17E-09	1.77E-09
average K	1.67E-10	9.13E-11	2.53E-10
low est of K			

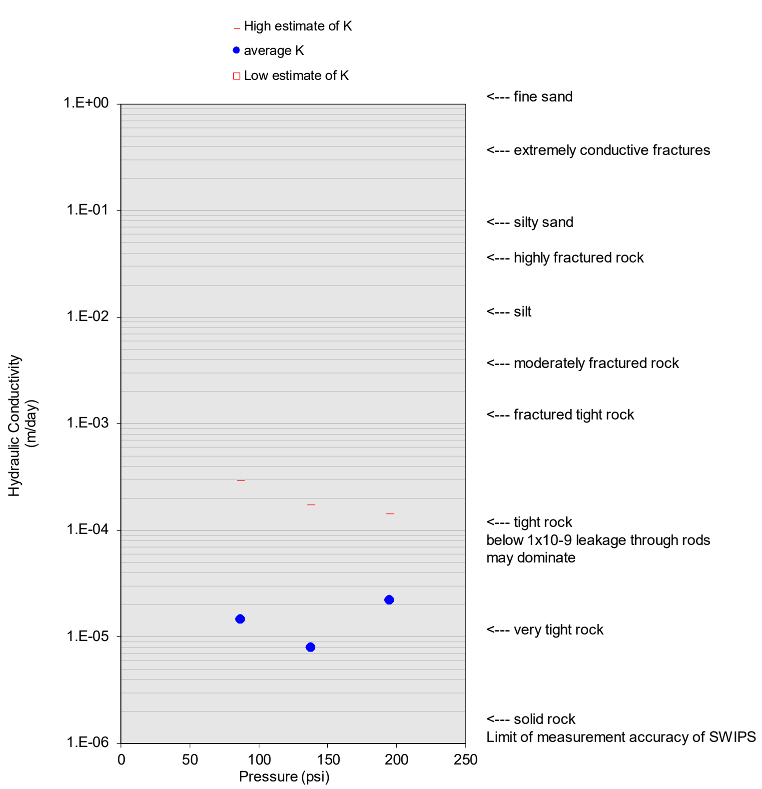
K avg all P steps

	m/day	Ft/Day
MAX	3.18E-04	1.04E-03
geomean	1.35E-05	4.44E-05
MIN	#N/A	#N/A

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



Graph of estimated hydraulic conductivity and error bounds.

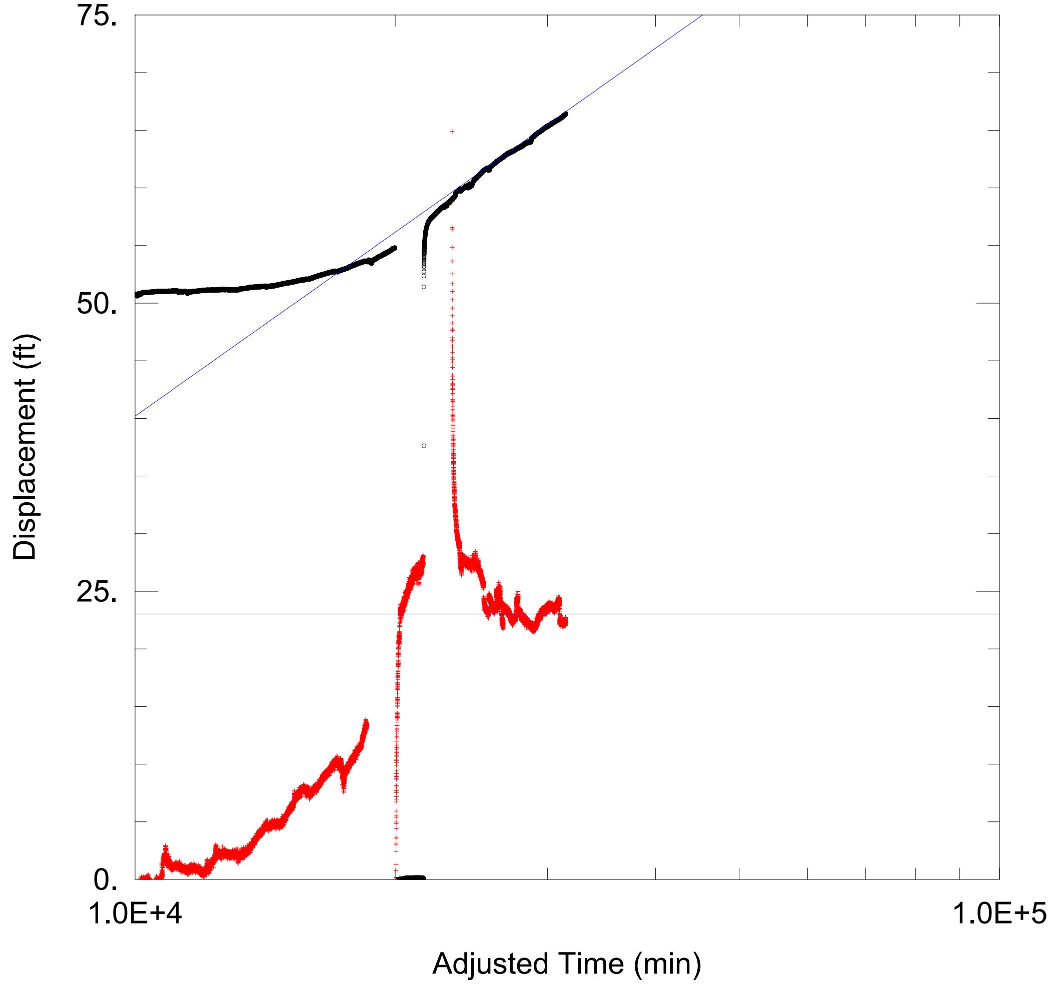


Appendix B. GT17-05 Flow/Shut-in Test Analysis

Table B-1. GT17-05 Flow rate summary

Date	Fill Time (min)	Volume (L)	Volume (gal)	Rate (gpm)	Comment
8/16/2017	3.75	20.0	5.28	1.41	End of flow period
8/16/2017	3.71	20.0	5.28	1.43	
8/16/2017	3.63	20.0	5.28	1.46	
8/16/2017	3.58	20.0	5.28	1.48	
8/16/2017	3.64	20.0	5.28	1.45	
Mean				**1.44**	
8/30/2017	3.30	20.0	5.28	1.60	Beginning of interim flow period
8/30/2017	3.22	20.0	5.28	1.64	
8/30/2017	3.42	20.0	5.28	1.55	
8/30/2017	3.38	20.0	5.28	1.56	
8/30/2017	3.37	20.0	5.28	1.57	
Maximum				**1.64**	
8/31/2017	3.51	20.0	5.28	1.51	End of interim flow period
8/31/2017	3.52	20.0	5.28	1.50	
8/31/2017	3.51	20.0	5.28	1.50	
8/31/2017	3.55	20.0	5.28	1.49	
8/31/2017	3.52	20.0	5.28	1.50	
Mean				**1.50**	
9/7/2017	1.60	15.0	3.96	2.48	End of of Shut-in period
9/7/2017	1.85	15.0	3.96	2.14	
9/7/2017	1.93	15.0	3.96	2.05	
9/7/2017	1.87	15.0	3.96	2.12	
9/7/2017	1.93	15.0	3.96	2.05	
Maximum				**2.48**	

Mean used at end of flow, beginning of shut-in period
First reading (maximum) used at end of shut-in, beginning of flow period



2017 SHUT-IN TEST

Data Set: C:\...\GT17-05_CooperJacobConfined.aqt
Date: 12/29/17 Time: 14:35:13

PROJECT INFORMATION

Company: Tundra/SRK
Client: Constantine Metal Resources
Location: Palmer Project
Test Well: GT17-05
Test Date: Aug.-Sept. 2017

AQUIFER DATA

Saturated Thickness: 68. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
GT17-05	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
◦ GT17-05	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 1.65 ft^2/day S = 180.9