2012 Field Hydrogeology Report
Pogo Mine
Delta Junction, Alaska

Report Prepared for

Sumitomo Metal Mining Pogo LLC

SUMITOMO METAL MINING CO., LTD.

Report Prepared by

srk consulting

SRK Consulting (U.S.), Inc.
SRK Project Number 147900.020
July 29, 2013

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Sumitomo Metal Mining Pogo LLC

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Table of Contents

List of Tables

List of Figures

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Appendices

1 Introduction

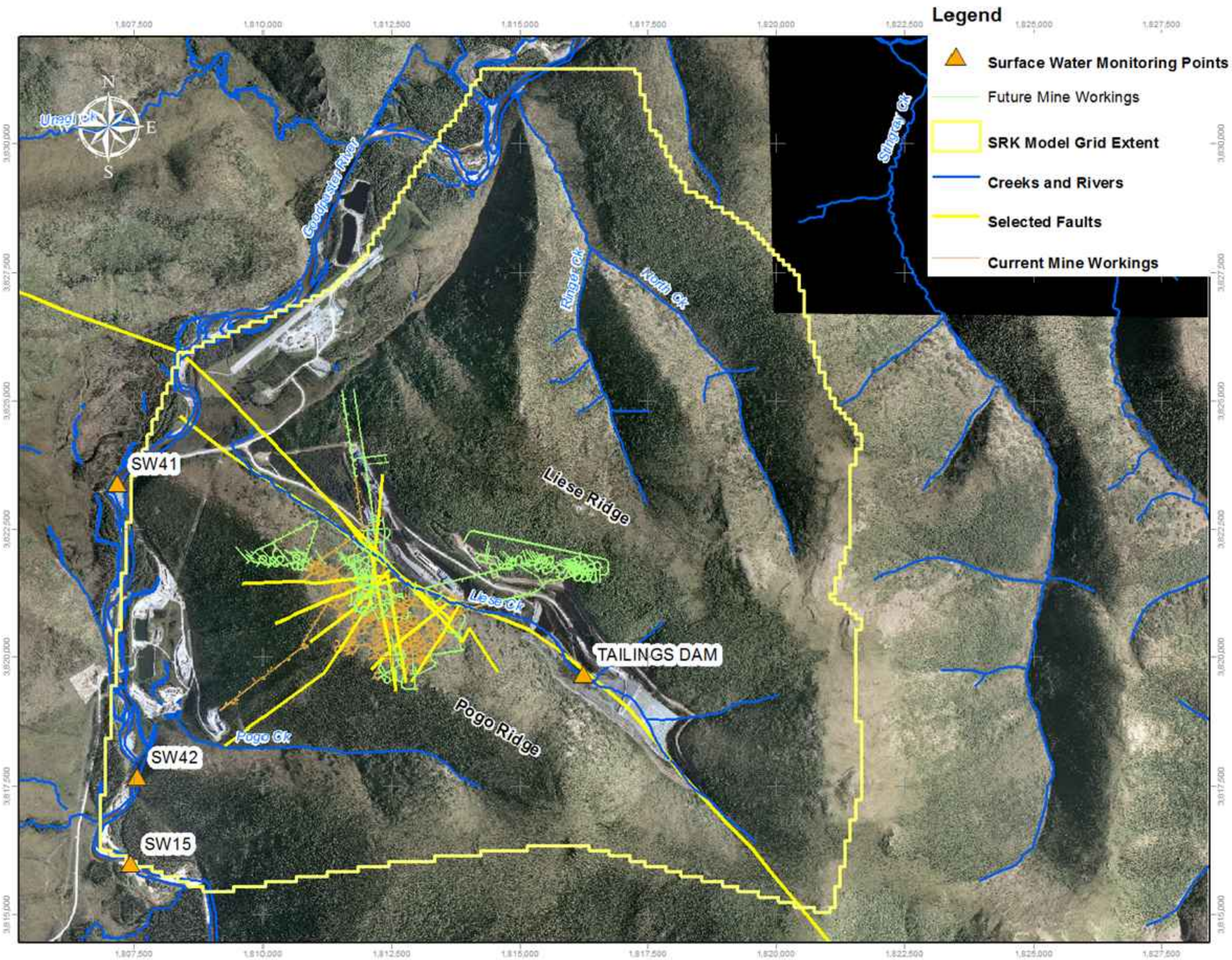
At the request of Sumitomo Metal Mining Pogo LLC (Pogo), SRK Consulting, (U.S.) Inc. (SRK) implemented a limited hydrogeological field investigation at the Pogo mine site near Fairbanks, Alaska. The objective of these activities was to characterize groundwater and surface water resources to the extent needed to construct a numerical groundwater flow model. The purpose of the flow model is to predict groundwater inflow, estimate potential dewatering requirements, and support the permitting of the East Deep Expansion.

This report describes the field program conducted in 2012, and presents the results of that work. SRK began field activities near the end of July, and worked continuously until the onset of freezing weather terminated the season in the second week of October.

The field program, described in detail in the sections that follow, involved the following activities:

- Surface exploration core holes – hydraulic testing, installation of piezometer access tubes, static water level measurements, water quality samples;
- Underground exploration core holes – installation of shut-in assembly, hydraulic testing, static hydraulic pressures, and water quality samples;
- Aquifer pumping tests of the exploration water supply wells;
- Installation, lithologic logging, aquifer pumping test of paired alluvium and bedrock wells, and collection water quality samples;
- Installation of shut-in assemblies, hydraulic testing, and static hydraulic pressures in shallow horizontal core holes at the location of the planned portal for the East Deep tunnel; and
- Measurement of surface water in the North Creek drainage, including Ringer Creek as a tributary, and North Creek above and below the confluence with Ringer Creek. Monitoring involved flow measurement and collection of water quality samples.

The Hydrologeological Study Area, defined by the boundaries of the groundwater numerical flow model is shown on **Figure 1**. The approach taken by SRK relative to both the surface and underground drillholes was to integrate hydrogeological data collection with surface and underground exploratory drilling being conducted by Pogo as part of their exploration of the East Deep deposit. A groundwater flow model requires data that characterize the flow of groundwater through the geologic materials associated with the deposit and surrounding country rock. Given the relatively low and relatively uniform hydraulic conductivity of the bulk country rock, discontinuities in the rock capable of conveying larger volumes of water were the focus of the testing work. Specifically, the margins of the diorite intrusive, the veins of the East Deep deposit, and a number of faults suspected of producing large discrete inflows were tested where exploration drillholes provided the opportunity for interception.



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Pogo Mine

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POGO MINE
DELTA JUNCTION, ALASKA

2012 FIELD REPORT

STUDY AREA

DATE:	APPROVED:	FIGURE:	REVISION NO.
JULY 2013	LC	1	A

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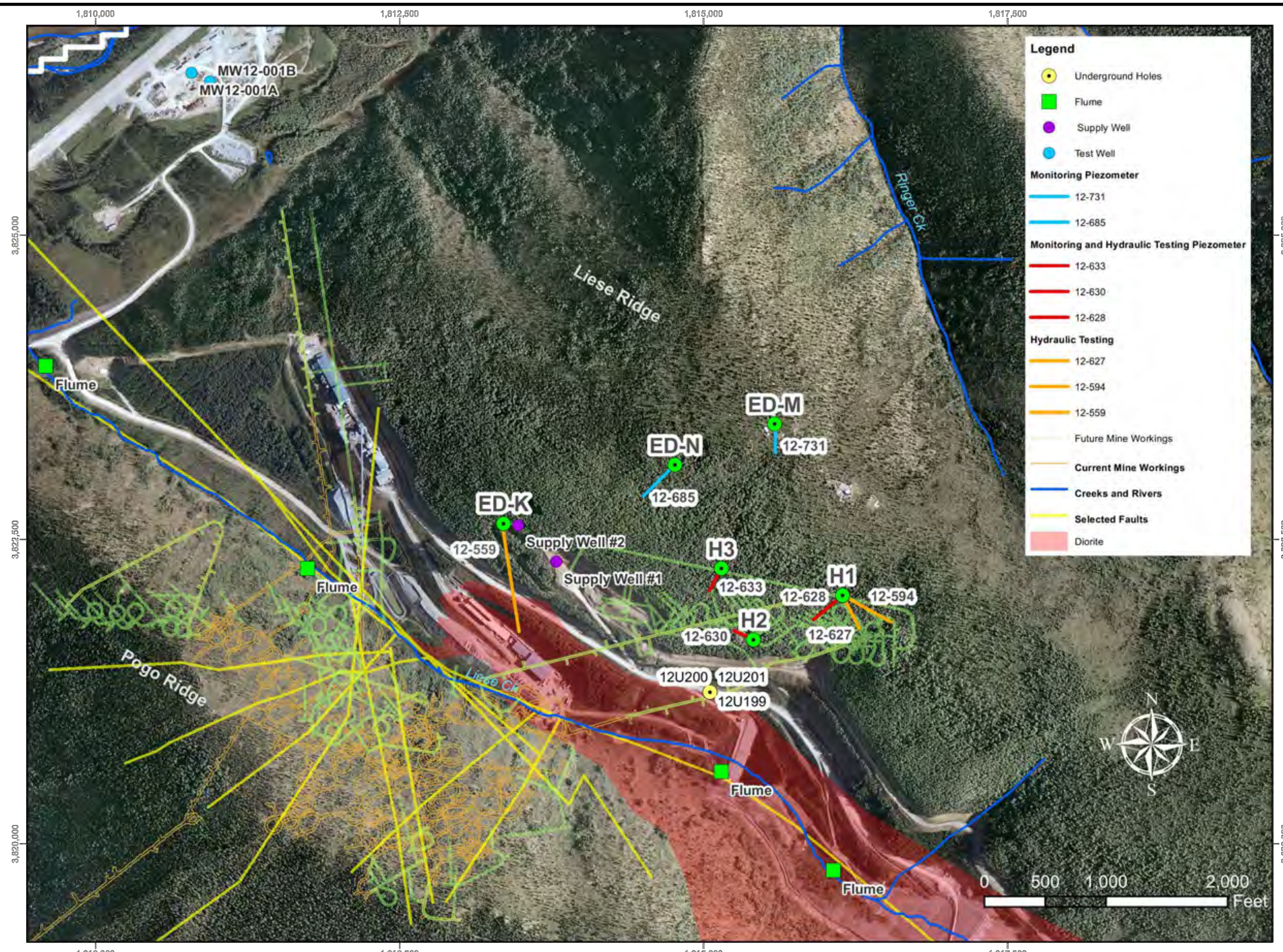
2 Field Activities

2.1 Surface Exploration Drillholes

SRK planned and directed hydraulic testing and the installation of piezometers into six exploration drillholes. The locations were selected to provide static water levels in a variety of slope positions (top of Liese Ridge and on the slopes below the ridge) and to enable testing for hydraulic conductivity of the main rock types (metamorphics, diorite intrusion) and known or suspected groundwater flow features (veins, faults, and the margin of the diorite).

Groundwater testing and installation of piezometers was done in six surface core holes (ED-H1-594, ED-H1-627, ED-H1-628, ED-H2-630, ED-H3-633, EDK-559), details of which are presented in **Table 1**. In addition, access tubes to accommodate water level measurements were installed into open core holes EDN-685 and EDM-731. Location of tested core holes and installed piezometers is shown in **Figure 2**. Testing was coordinated and conducted by SRK staff in conjunction with the Pogo staff in the Environmental Group and the Exploration Group, as well as with the cooperation of Boart Longyear.



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POGO MINE
DELTA JUNCTION, ALASKA

2012 FIELD REPORT

SURFACE LOCATIONS

DATE:	APPROVED:	FIGURE:	REVISION NO.
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Table 1: Summary of Surface Drillholes and Results of Hydraulic Tests

Pad ID	Hole ID	Inteval No.	Test	Name	Depth (ft)		Lenght (ft)	Mid Point of Test (ft)	Depth to Water after test (ft)	Test Type	Flow GPM	Transmisivity (ft^2/day)	Hydraulic Conducitvity (ft/day)
					From	To							
H1	594	1	A	594-1A	396	1216	820	806	132.5	Air Lift Recovery	10.6	22.7	2.76E-02
H1	594	2	B	594-2B	706	1216	510	961	148.0	Air Lift Recovery	9.5	30.0	5.88E-02
H1	627	1	A	627-1A	301	1201	900	751	112.9	Air Lift Recovery	4.3	6.24	6.93E-03
H1	628	1	A	628-1A	205	465	260	335	73.2	Air Lift Recovery	2	3.74	1.44E-02
H1	628	1	B	628-1B	205	465	260	335		Falling Head	---	0.49	1.87E-03
H1	628	1	C	628-1C	205	465	260	335		Pressure Injection	21.7	21.6	8.33E-02
H1	628	2	A	628-2A	465	835	370	650	191.6	Pressure Injection	5.3	2.41	6.50E-03
H1	628	2	B	628-2B	465	835	370	650		Falling Head	---	3.44	8.75E-03
H1	628	3	A	628-3A	835	1115	280	975	108.3	Pressure Injection	19	11.3	4.02E-02
H1	628	3	B	628-3B	835	1115	280	975		Air Lift Recovery	3	3.79	1.35E-02
H1	628	3	C	628-3C	835	1115	280	975		Constant Injection-Recovery	2.5	0.92	3.28E-03
H1	628	3	D	628-3D	835	1115	280	975		Falling Head	---	0.73	2.62E-03
H1	628	3	E	628-3E	835	1115	280	975		Falling Head	---	0.44	1.58E-03
H1	628	4	A	628-4A	1115	1515	400	1315		Falling Head	---	0.57	1.43E-03
H1	628	4	B	628-4B	1115	1515	400	1315		Falling Head	---	0.71	1.77E-03
H1	628	4	C	628-4C	1115	1515	400	1315		Falling Head	---	0.85	2.12E-03
H1	628	4	D	628-4D	1115	1515	400	1315		Pressure Injection	1	0.45	1.12E-03
H2	630	1	A	630-1A	200	417	217	308.5	29.5	Air Lift Recovery	---		
H2	630	2	A	630-2A	400	917	517	658.5	113.2	Air Lift Recovery	5	23.3	4.52E-02
H2	630	2	B	630-2B	400	917	517	658.5		Falling Head	---	1.23	2.37E-03
H2	630	2	C	630-2C	400	917	517	658.5		Pressure Injection	2.1	1.32	2.55E-03
H2	630	3	A	630-3A	200	917	717	558.5	90.9	Air Lift Recovery	8	4.69	6.55E-03
H2	630	4	A	630-4A	907	1450	543	1178.5		Falling Head	---	0.09	1.73E-04
H2	630	4	B	630-4B	907	1450	543	1178.5		Falling Head	---	0.12	2.23E-04
H2	630	4	C	630-4C	907	1450	543	1178.5		Pressure Injection	0.79	0.13	2.42E-04
H2	630	5	A	630-5A	407	1450	1043	928.5	209.0	Air Lift Recovery	3.3	2.04	1.95E-03
H3	633	1	A	633-1A	307	636	329	471.5	116.8	Air Lift Recovery	5	2.43	7.38E-03
H3	633	2	A	633-2A	900	1171	271	1035.5	147.6	Air Lift Recovery	4	82.6	3.05E-01
H3	633	2	B	633-2B	900	1171	271	1035.5		Falling Head	---	0.15	5.46E-04
H3	633	2	C	633-2C	900	1171	271	1035.5		Falling Head	---	0.60	2.23E-03
EDK	559	1	A	559-1A	400	1066	666	733	316.6	Constant Injection-Recovery	10	58.8	8.84E-02
EDK	559	1	B	559-1B	400	1066	666	733		Constant Injection-Recovery	20	37.0	5.56E-02

Testing of the surface core holes was conducted in the months of August through October 2012. **Figure 2** presents a map of the location of the six surface core holes that were tested. Multiple test types in multiple test intervals were conducted in each exploration core hole based on water yield, hydraulic conductivity, and the target depth of the hole, as well as other factors. Testing methods included airlift recovery testing (rising slug), low pressure constant rate injection tests, and pressure-injection (Lugeon) tests. Each test method suited a particular condition of water production in a hole. Specifically:

- Holes with test intervals having low water yields were tested using packer injection or falling head slug tests. Such methods provide estimates of hydraulic conductivity based on short-term tests that are analyzed by the steady-state Thiem equation, an accepted method that provides reliable values, but which owing to the short duration of the tests limit the volume of rock represented by the calculated estimate of hydraulic conductivity;
- Airlift recovery tests were employed when a test interval produced water at a sufficiently high rate to measure the flow rate of the lifted water at the surface. An airlift recovery test involves one to two hours of airlifting, followed by monitoring of recovery for an equal period of time. The longer period and the larger volume of water removed results in a larger volume of rock influenced by test, and a tendency for a more average bulk (large scale) value for hydraulic conductivity. The test data are analyzed using the transient-state Theis recovery solution. Though the airlift test was the method of choice for holes that produced measureable volume of water, field logistics precluded its use at holes that were helicopter supported. The compressor needed to supply the high volume airflow into the hole was too heavy to be lifted by the helicopter; and
- Constant rate injection recovery tests were conducted at productive holes that could not be airlifted. The test was conducted by pumping water into the hole at a constant rate while monitoring the resultant rise in water level in the hole. Following one to two hours of injection, water flow was stopped, and the recovery of the water level measured. Like an airlift recovery test, data from a constant rate injection tests was analyzed by the Theis recovery method.

Data were collected using a pressure transducer datalogger (datalogger), a container with which to measure flow rate, and a water quality meter (YSI). Water samples were collected, preserved, and shipped to Analytical International Laboratory, the contract laboratory for Pogo water analyses. Sample collection, management and shipment was completed using field procedures that adhered strictly to Pogo Environmental protocol.

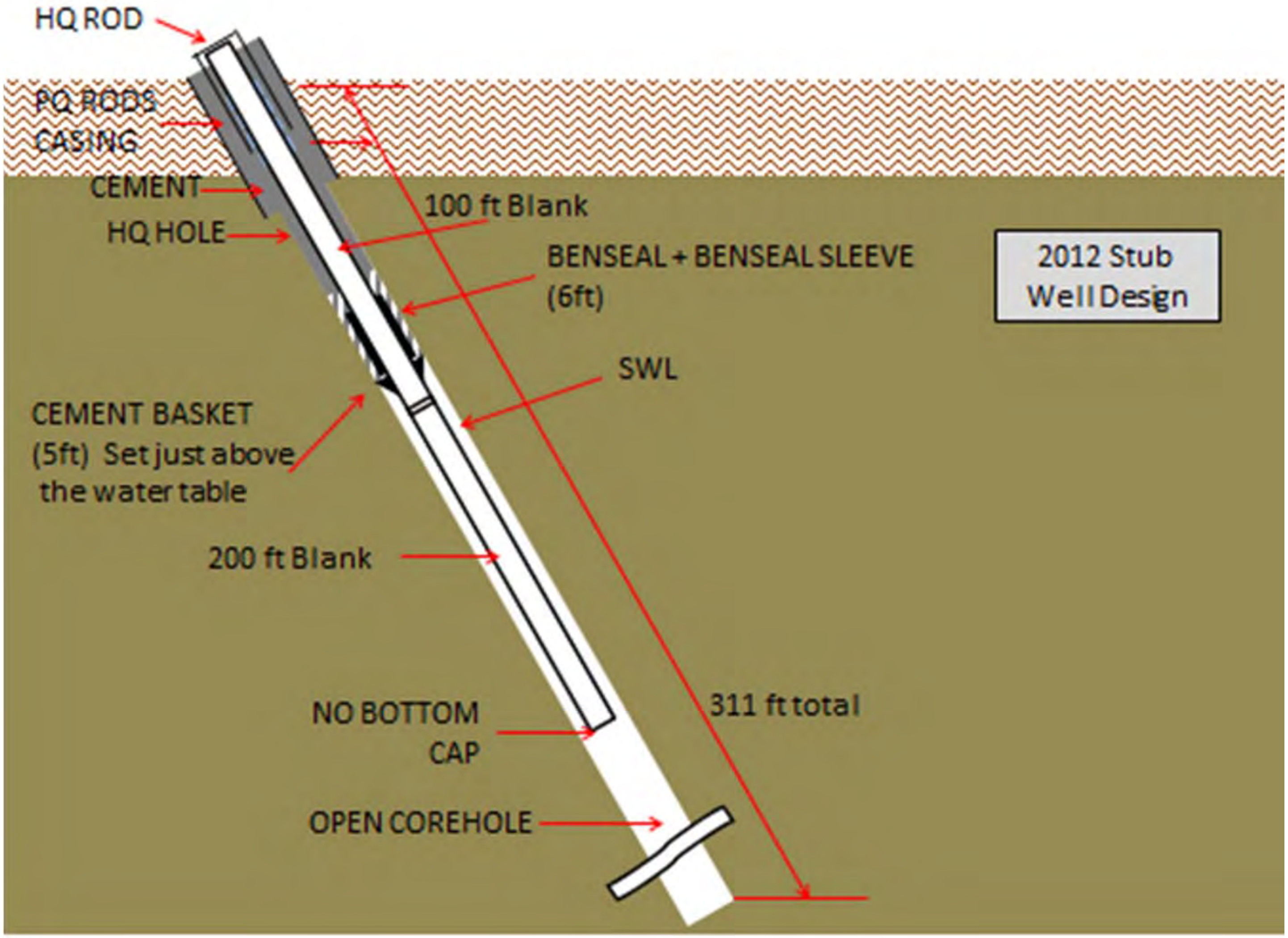
Rising head slug tests were analyzed using the Hvorlsev method. Recovery data from airlift pump-testing were analyzed using the Theis recovery analysis, and low-pressure constant rate injection tests were analyzed using the Cooper-Jacob approximation to the Theis method. Lugeon tests were analyzed using the Thiem method applied to each individual injection pressure. Test data and analytical plots are presented for the surface core holes on **Figures B-1 through B-33** in **Appendix B**.

Values for hydraulic conductivity calculated from the test data are provided in **Table 2**. The table also presents a summary of each test performed in each interval in the surface core holes. The analysis yielded values for hydraulic conductivity with a geometric mean of $5x10^{-3}$ ft/day with a maximum value of 3x10^{-1} ft/day and minimum of 2x10^{-4} ft/day. Values for transmissivity had a geometric mean of 2.2 ft^2/day and ranged between 80 ft^2/day to 0.09 ft^2/day.

Five piezometers were completed by SRK in 2012 in Liese Ridge area. They were installed as open-ended piezometer tubes that extend to below the water table, and provided safe access for placement and retrieval of dedicated water level dataloggers. A schematic drawing of the completions is shown in **Figure 3**. The dataloggers have been monitoring water levels since October 2012. Data over the period October 2012 through June 2013 are presented on **Figure 4**. The time plot of **Figure 4** shows that over the nine months of data compiled to date, water levels ranged in elevation between 2,340 ft amsl and 2,640 ft amsl. Average depths to water ranged between 30.73 ft below ground surface at H2-12-630 and 264.81 ft at N-12-685. The average depth to water in all piezometers is 115 ft below ground surface. Though variable, the water levels are elevated in Liese Ridge, which is indicative of generally low permeability rocks that are resistant to drainage. The exception is the relatively low water level in N-12-685 that may represent drainage into a fractured zone or fault, though none was evident during testing. Seasonal variation in the water level is seen in all but one piezometer (N-12-685) as a rise during the winter and a drop in late spring. As tabulated on **Figure 4**, the variation in water levels over the 9 months of monitoring ranged from a minimum of 17.23 ft in N-2-685 to a maximum of 100.84 ft in M-12-731. The average variation for the five piezometers was 60.29 ft. There is no apparent relationship of the variation with slope position or elevation. For example, piezometers N-12-685 and M-12-731 are both located at high positions on Liese Ridge, yet display dramatically different ranges in the variations in their water levels. It is more likely that the differences in variations are related to the presence or absence of the locally discontinuous permafrost that dictates the amount of infiltration that occurs at any given location.

Table 2: Summary of Measured Water Levels

Pad ID	Hole ID	Coordinates		Elevation (ft amsl)	Inclination	Azimuth	Inclination Depth Adjust	Hole Depth (ft)	Depth to Water (ft)	Adjusted DTW (ft amsl)	Minimum Water Level Elevation (ft)	Maximum Water Level Elevation (ft amsl)	Average Water Level Elevation (ft amsl)
		Easting	Northing										
H1	628	1816140.00	3822047.00	2664	78	230	0.978147601	1515	147.70	144.47	2,495.15	2,533.73	2,521.42
H2	630	1815408.00	3821683.00	2376	83	294	0.992546152	1450	206.00	204.46	2,319.01	2,375.48	2,345.27
H3	633	1815145.00	3822267.00	2544	80	208	0.984807753	1201	143.00	140.83	2,392.98	2,481.31	2,451.46
N	685	1714763.66	3823113.95	2703	75	225	0.965925826	1404	240.00	231.82	2,430.99	2,448.22	2,438.19
M	731	1815006.90	3822745.40	2867	85	0	0.996194698	2715	87.00	86.67	2,767.44	2,868.28	2,822.45



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Alaska

Source: SRK, 2013

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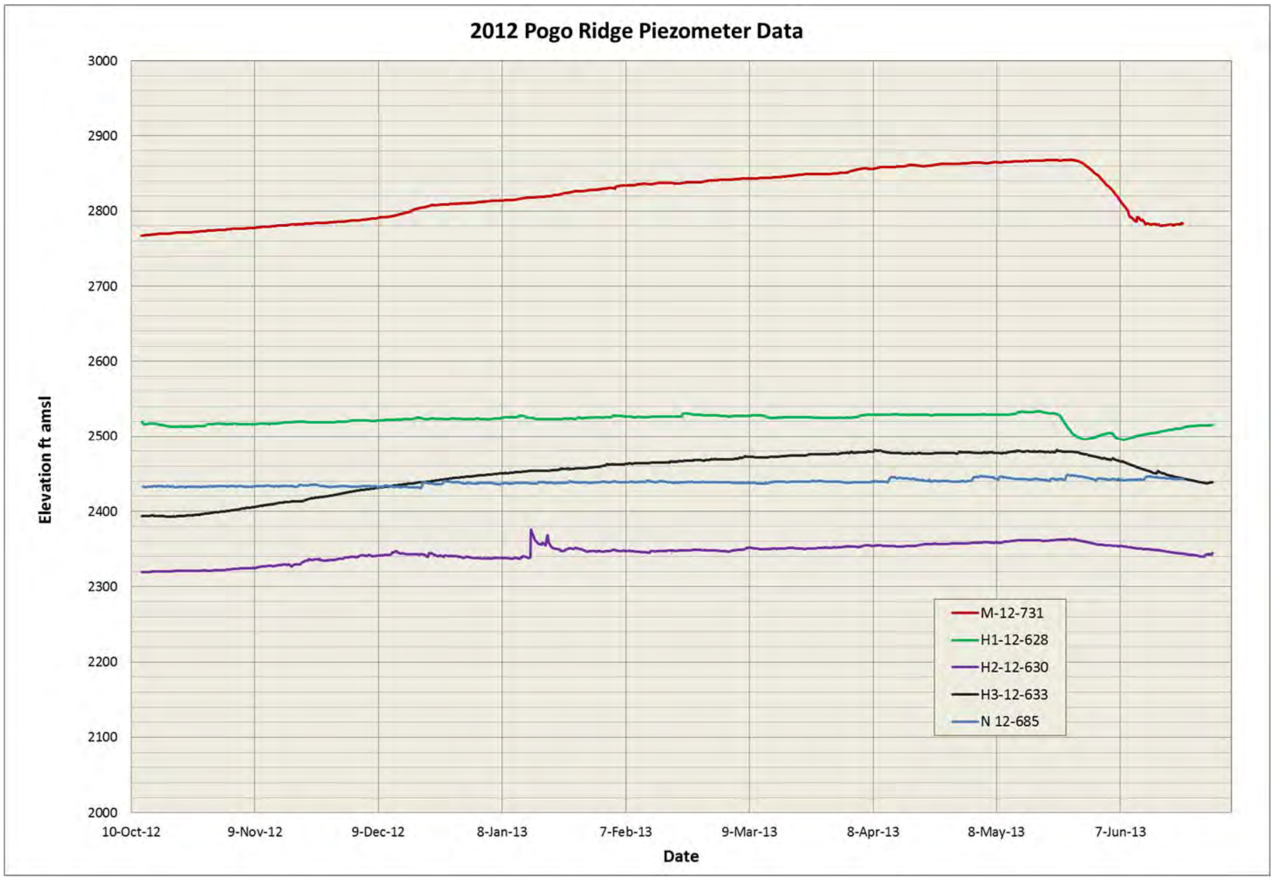
FIGURE 3

Schematic of Piezometer Completions in Surface Drillholes



Hole ID		WT Elevation (ft amsl)	Collar Elevation (ft amsl)	Average DTW (ft amsl)	Max WL Difference (ft)
	Max	2,448.22			
N 12-685	Avg	2,438.19	2,703.00	264.81	17.23
	Min	2,430.99			
	Max	2,868.28			
M-12-731	Avg	2,822.45	2,867.00	44.55	100.84
	Min	2,767.44			
	Max	2,533.73			
H1-12-628	Avg	2,521.42	2,664.00	142.58	38.58
	Min	2,495.15			
	Max	2,375.48			
H2-12-630	Avg	2,345.27	2,376.00	30.73	56.46
	Min	2,319.01			
	Max	2,481.31			
H3-12-633	Avg	2,451.46	2,544.00	92.54	88.33
	Min	2,392.98			

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FIGURE 4

Water Level Data from Pogo Ridge Piezometers

2.2 Underground Core Holes

The underground testing was focused on holes 12U199, 12U200, and 12U201. The holes were drilled by Boart Longyear as part of exploration drilling in the 1170 Level and 1320 Level drifts extending from the Liese mine to the planned East Deep Expansion. Once the holes were completed Margot Plugs were installed. The plugs were equipped with a ball valve and a pressure transducer reading port. The ball valve maintained the static hydraulic pressure keeping the hole sealed allowing the pressure transducer to collect data at a rate of one reading per minute. The Margot plug was left in place, and the pressure transducer as able to continue collecting while the drill rig was able to pivot and continue drilling out the desired targets.

Flow and shut-in testing was also conducted on the finished holes. A test consisted of a flow period of 30 to 60 minutes, followed by recovery of hydrostatic pressure once the valve was closed. The dataloggers automated the collection of pressure data. Flow data (gpm) was collected by timing the discharge to fill a five gallon bucket. Once the plugs were installed, the pressure transducer was set and collecting data, SRK visited periodically, as safety and availability of the Boart Longyear Tool Pusher allowed. Photos of the instrument installations are provided in **Appendix A**.

The test data enabled calculated estimates for hydraulic conductivity using the Theis recovery method. The analyses are presented in **Figures D1 and D2** in **Appendix D**, and the results tabulated in **Table 3**. The tests are considered by SRK to be compromised due to the large number of closely-spaced holes and the fact that water-producing holes were grouted. More than 20 holes were drilled in a conical fan pattern at each of the two drill stations, likely producing an enhanced permeability in the rock by a “Swiss Cheese” effect. This is evidenced by the highly variable pressure steps that are seen in the raw data chart for hole 12U201 (**Figure D-2**, **Appendix D**). As a result of the interference by the large number of drillholes at a single drill station, the analyses for hydraulic conductivity are not considered representative of field-scale in situ conditions, and were not used in the subsequent development of the numerical groundwater flow model of the existing Pogo mine and its proposed expansion into the East Deep area.

Water samples were collected from two holes, 12U201 and 12U209. Laboratory analysis of the samples show that copper, lead, and zinc exceed permit effluent limits in 12U201, and zinc in 12U209 (**Tables F-1 through F-3** in **Appendix F**).

Table 3: Summary of Underground Drillholes and Results of Hydraulic Tests

Hole ID	Coordinates		Elevation (ft amsl)	Max Depth (ft)	Azimuth	Inclination	Type of Test	Transmissivity (ft^2/day)	Hydraulic Conductivity (ft/day)
	Easting	Northing							
12U199	1815052.3	3821250.6	1238.93	245	346.1	-3.2	shut-in	2.55	2.54E-03
12U200	1815052.3	3821250.6	1238.93	330	346.1	-14.6	shut-in		
12U201	1815052.3	3821250.6	1238.93	295	360	-4.1	shut-in	1.29	4.36E-03

Note: Test data for 12U200 is not amenable to analysis due to hydraulic interference from adjacent holes.

2.3 Water Supply Wells

SRK conducted aquifer pump tests in two wells that were drilled and completed to be water supply wells for exploration drilling. Location of the wells is shown on **Figure 2**. The wells were drilled in May 2012 by Arctic Drilling (Arctic) out of Fairbanks and Delta Junction. The wells were drilled and completed prior to SRK commencing work at the site. The description of well construction is provided here as described by Arctic and as presented on the ADNR Water Well Record forms completed by Arctic. The forms are presented in **Appendix E**.

Both boreholes were drilled by conventional air rotary methods using a down hole hammer and button drill bit. Each hole was completed as an open-hole (unlined) well with 8-inch diameter schedule 20 steel casing to above the first zone of water production noted during drilling. Drill cuttings were used to secure the casing in place from the base of the casing to 30 ft below ground surface. A thick granulated bentonite (Benseal) was poured into the annulus to the ground surface. Each well was developed by airlifting methods for 2.5 hours. Recovery of water level following airlift was monitored, the rate of which provided a basis to estimate well production and to size a production pump. A pump was installed into Well #2; however Well #1 was judged to be of lower production, and was to be held without a pump until or if its supply was needed. Both wells produced clear, turbid-free water when pumped.

The sections below describe details of each well, and the testing and the hydraulic testing and analysis conducted on each. **Table 4** shows a summary of the exploration water supply wells and test wells near the airstrip.

Table 4: Summary of Exploration Water Supply Wells and Test Wells Near Airstrip

Name	Test	Depth (ft)		Length (ft)	Mid point of test (ft)	Test type	Flow (gpm)	Transmissivity (ft^2/day)	Hydraulic conductivity (ft/day)	Storativity
		From	To							
Water Supply Well No.2-1	A	440	802	362	621	Pumping Recovery	54.1	16.2	4.46E-02	
Water Supply Well No.2-1	B	440	802	362	621	Constant Pumping	35.2	9.5	2.63E-02	
Water Supply Well No.2-1	C	440	802	362	621	Distance Drawdown				4.03E-04
MW12-001A-1A	A	17	67	50	42	Constant Pumping	194.4	14,572	291.00	

2.3.1 Supply Well #1

The well was drilled to 1,200 ft. Drilling started May 1, 2012 and was completed May 18, 2012. Casing was installed to a depth of 386 ft. As shown on the Water Well Record in **Appendix B** (**Figure B-34**), water production was noted during drilling at a depth of approximately 455 ft from the metamorphic rocks, and at 720 ft from granitic rocks (driller's lithology). The total production during drilling was roughly estimated at 25 gpm.

The water level was measured on May 18, 2012 after development at a depth of 316 ft below ground surface. However, the water level in the well continued to rise, and was measured at 199.71 ft below ground surface at the time the supply wells were tested in July 2012.

The pump intake in Well #1 had been set at a depth of 652 ft, with a static water level measured at 199.71 ft below ground surface, providing an available drawdown of 440 ft assuming the pumping level is kept no closer than 12 ft from the pump intake. Well construction is presented in the ADNR Water Well Record found in **Appendix E**.

2.3.2 Supply Well #2

Well #2 was drilled to a depth of 802 ft. Drilling started May 20, 2012 and was completed June 1, 2012. Casing was installed to a depth of 440 ft. Water production was noted at depths of 380 and

700 ft, both from granitic rocks. Total production during drilling was estimated at 50 gpm, with 40 of that from the higher interval (See **Figure E-2**, **Appendix E**).

Static water was measured on June 1 after development at a depth of 253 ft below ground surface.

The pump intake was set in Well #2 at a depth of 609 ft below ground surface. The pretest static water level was measured at 273.55 ft, providing a maximum available pumping drawdown in the well of about 333 ft. The pump test started with a three-rate step test, then proceeded directly to the long term test without an intervening recovery. The step test is used to evaluate the changes in the efficiency of a well with changes in pumping rate. Efficiency is a measure the quality of well construction and the impact on water level in a well from over pumping.

The step test started at 8:40am July 18. Steps of 29.2 gpm, 61.2 gpm, and 99.5 gpm were run for about 75 minutes each. As shown on **Figure E-4** in **Appendix E**, the linear regression of specific capacity (gpm per ft of drawdown) against flow rate shows a nearly perfect linear relationship (lower graph on **Figure E-4**), indicating that there is no loss of efficiency from turbulence created by the well or restricted flow paths as flow rate is increased. This is consistent with the expected performance of an unlined open borehole.

Between the step test and the subsequent long-term constant rate test, the well was pumped for 7 days, from 8:40am July 18 to 9:02am July 25. Recovery was monitored for an additional 7 days, until 3:23pm August 1. It can be seen on **Figure E-3**, that the flow rate was adjusted numerous times with the objective to maximize drawdown without drawing the water level down to the pump intake. Drawdown became very sensitive to flow rate as fractures were “daylighted” or otherwise stressed with the dropping of the water level. The long-term tests commenced with a target flow rate of 90 to 100 gpm. However, over time production decreased as fracture storage was depleted. Flow rate was adjusted downward to accommodate the depletion.

Though the results of the step test indicate that specific capacity ranges between 1.92 gpm per foot of drawdown (gpm/ft) at 29 gpm to 1.41 gpm/ft at 99.5 gpm, specific capacity can change dramatically over long periods pumping, particularly in fractured-rock flow systems. The value from the testing of Well #2 that more accurately predicts future pumping performance is the relationship of pumping rate to drawdown at the end of the constant rate test. The rate at the end of pumping was about 35 gpm, and drawdown was 206 ft, producing a specific capacity of 0.17 gpm/ft (5.89 ft of drawdown per gpm). With the maximum available drawdown of 325 ft, the well could be expected to produce a rate of 55 gpm. However depletion continued to the end of pumping with no indication of equilibration. It may reasonable to expect that the well can sustain a continuous rate of perhaps 15-20 gpm.

Analysis of the test data for transmissivity was done using the Cooper-Jacobs method of the Theis solution. The approximately two-day period near the end of the test was fitted to the semi-log straight line as it represented the period most representative of long-term well production and an extended interval of constant flow rate. **Figure E-3** presents the analysis for transmissivity for both the pumping period and recovery. Transmissivity is estimated at 9.5 ft^{-2}/day with a value for hydraulic conductivity estimated at 2.6×10^{-2} ft/day. The values are in general consistent with the hydraulic tests performed in the surface core holes.

Well #1 was monitored as an observation well during the pumping of Well #2. The well, located 434 ft from Well #2 displayed 3.5 ft of drawdown over the seven days of pumping. The Distance-

Drawdown analysis presented on the lower graph of **Figure E-5** supplies two additional parameters related to the operation of Well #2:

- One is the cone of influence from the seven days of pumping projects as the straight line that intercepts the "zero" drawdown line. That distance is approximately 500 ft. Since the expansion of the cone of influence grows at a rate that slows exponentially with either distance or time, the long-term operational cone of depression around Well #2 is expected to be much greater than 500 ft; and
- The other parameter estimated from the observation well data is a value for storage coefficient. Data from single well tests (i.e., no observation well) cannot be used to reliably calculate a value for aquifer storage. The value of $4x10^{-4}$ is a value typical of fractured-rock flow systems that display what is effectively a variably confined condition. This is because the variability of fracture apertures and the interconnectedness between fractures result in a flow system that in places may behave as unconfined, and in other places behave as fully confined.

2.4 Test Wells

The test wells, MW12-001A (alluvial) and MW12-001B (bedrock), were placed in the old core storage yard in the airstrip area (location is shown in **Figure 2**), a location to test the hydraulic connection between the riverbed alluvium and the underlying bedrock water bearing structures. Drilling and testing oversight was conducted by Aspen Hydrologic Services (AHS) and SRK staff, respectively: Sherry Gaddy and Brooke Fahrenkrog. The wells were drilled with a Boart Longyear Sonic Rig starting with MW12-001B on September 9, 2012 and both were completed by October 3, 2012 with 6 inch Sch 80 PVC casing. With Pogo Mine assistance, pump testing commenced on October 18, 2012 at 200 gpm constant flow rate. The recovery test began on October 25, 2012 and ended on the October 29, 2012. A water quality sample was taken from MW12-001A at the completion of the constant rate pump test on October 25, 2012. Well construction logs are shown in **Appendix C**.

2.4.1 MW12-001B

The driller's setup for drilling on September 9, 2012 and drilling began on September 10 using an 8 x 9 core barrel and water. The alluvial drilled quickly and bedrock was encountered at 77 ft. Planned Total Depth (TD) was 150 ft below the alluvial/bedrock contact or 227 ft. The bedrock was drilled with mud and the drilling was slow but steady and progressed to 220 ft when the rod above the barrel twisted off. The drillers were unable to fish the barrel out of the well after many attempts. The borehole was reamed to 10 inch ID and completed to 160 ft with 30 ft of screen and 130 ft of blank 6 inch Sch 80 PVC on October 2, 2012. The 8 inch core was photographed and logged. Initial static water level is 9 ft below ground surface, with a production rate of less than one gpm. The well poorly developed as no airlifting was practical in the cold temperatures of October, and the well would only sustain a pumping rate of approximately 1 gpm. No water quality sample was taken because development was not completed and the relatively large volume of water in the well could not be readily purged at that time of year. It is recommended that a sample be taken during the 2013 field program to establish the water quality in the bedrock in that area.

2.4.2 MW12-001A

The drillers setup for drilling on October 2, 2012 and drilled to TD of 67 ft using an 8 x 9 core barrel and no fluids. The borehole was reamed to 10 inch ID and completed to 67 ft with 50 ft of screen and 17 ft of blank 6 inch Sch 80 PVC on October 3, 2012. The 8 inch core was photographed and logged. Initial static water level was 9 ft below ground surface. The well was developed with a small pump at 40 gpm. No water quality sample was taken during development as one was taken at the end of the long term constant rate pump test.

Pogo Mine provided all materials for the pump test and installed the pump on October 18, 2012 in MW12-001A. Electrical hookup delayed start up to late evening. Pressure transducers were installed in both MW12-001A and MW12-001B. Night shift oversight and data collection was conducted by AHS/SRK, and day shift oversight and data collection was conducted by AHS/SRK/Pogo Mine Environmental Dept. The pump test began with a step test and went right into the long-term constant rate of 200 gpm. Water levels were collected with the pressure transducers and period manual water levels taken with a sounder. Flow rate and total gallons was monitored with a flowmeter and regulated with a valve. The test ran for 7 days ending on October 25, 2012 which started the recovery test. Data collection from the pressure transducers continued through the October 29, 2012.

The test data were analyzed to estimate a value to transmissivity and hydraulic conductivity of the saturated alluvial deposits. The analysis is presented on **Figure E-7** in **Appendix E**. The value estimated for transmissivity is 14,572 ft^2/day, equating to a hydraulic conductivity of 291 ft/day. The values are high but similar to the values for the alluvium estimated by previous investigations (Golder, 1999). The water level in the bedrock well of the pair (MW12-001B) was not influenced during the pumping of the adjacent alluvial well (MW12-001A).

2.5 Surface Water Streams

The northern portion of the Hydrogeological Study Area (shown in **Figure 1**) contains the North Creek drainage. The surface water in the drainage had not previously been characterized. To do that, surface water sampling and flow measurement (float velocity and cross-sectional area or bucket test) was completed two times during the fall of 2012; on September 21, 2012 and October 2, 2012. Flows were measured and samples collected from North Creek, Ringer Creek, and North Creek below the confluence with Ringer Creek, as it flows into the Goodpaster River. The September work was conducted by Sherry Gaddy (AHS) and Brooke Fahrenkrog (SRK) and the October was conducted by Sherry Gaddy (AHS) and Stacy Staley (Pogo Mine). The weather had dropped below freezing prior to October's readings/sampling.

The field team was lifted to the sample sites by helicopter due to the lack of surface access to the drainage. Sample and flow was measured at Ringer Creek first, then North Creek and lastly North Creek below the confluence. Photographs of upstream, downstream and of the sample/measure sites were taken (**Appendix A**). Additional photographs of trailheads, etc. were also collected. Collected field data is included in **Table 5**.

Table 5: Site Conditions and Field Data for the North Creek Drainage

Visit of September 21, 2012

Creek	**Ringer Creek**	**North Creek**	**North Creek Below Confluence**
Site Conditions:	Creek drops in steps with deep undercut banks, heavy vegetation and rocky channel	Same as Ringer Crk, Appears to flow faster than Ringer Crk	Bottom of Canyon is broad with more vegetation, deep undercut banks and rocky channel with sediment, sampled ~30ft down from confluence
Weather:	P. Cloudy, Warm, Calm		
Flow Measurement Method:	Bucket Method: 24L Cooler (Ave of 3 measurements)	Measured Cross-Section and velocity (float method)	
Flow (gpm):	~31	~239	~153
Sample Suite:	13g		
Field Instrument:	Pogo YSI Meter 1		
Field pH (SU):	7.67	7.57	7.24
Field Temp (C):	1.85	1.88	1.81
Field Sp Cond (uS):	304	175	212
Field DO (mg/L):	20.72	13.23	12.39
Sample Notes:	Slight Tannin Color, No Odor (not enough sample for dissolved Hg)		

Visit of October 2, 2012

Creek	**Ringer Creek**	**North Creek**	**North Creek Below Confluence**
Site Conditions:	Creek drops in steps with deep undercut banks, heavy vegetation and rocky channel, snow and ice build up	Same as Ringer Crk, Appears to flow faster than Ringer Crk, snow and ice build up	Bottom of Canyon is broad with more vegetation, deep undercut banks and rocky channel with sediment, sampled ~30ft down from confluence, snow and ice build up
Weather:	P. Cloudy, Cool to Cold, Calm		
Flow Measurement Method:	Bucket Method: 1.5gal Cooler (Ave of 3 measurements)	Measured Cross-Section and velocity (Pogo Mine: Swoffer Velocity Meter)	
Flow (gpm):	~22.5	~213	~185
Sample Suite:	13g		
Field Instrument:	Pogo YSI Meter 1		
Field pH (SU):	7.54	7.77	7.19
Field Temp (C):	0.32	0.33	0.42
Field Sp Cond (uS):	311	174	212
Field DO (mg/L):	12.9	13.61	13.45
Sample Notes:	Slight Tannin Color, No Odor		

The majority of the flow comes from North Creek at approximately 240 gpm in September and approximately 215 gpm in October. Ringer Creek flows into North Creek at approximately 30 gpm in September and 20 gpm in October. At and below the confluence, sedimentation has built up over time and the steepness of the creeks lessens significantly. The velocity is much slower and the creek is deeper. Approximately 20 to 40% of the flow becomes subsurface at ~30 ft below the confluence of North and Ringer Creek. The flow in North Creek below the confluence with Ringer Creek was approximately 150 gpm in September and approximately 185 gpm in October.

The samples were analyzed for Pogo environmental compliance suite 12 g, and the results input to the site EDMS database.

2.6 Water Quality Samples

Samples were collected by SRK or the Pogo Environmental department as the work on the various activities was conducted. The samples were prepared and shipped using the standard methods for environmental compliance used by Pogo Environmental. The results show waters of a high quality, with only turbidity exceeded in one sample.

Samples collected were:

- Surface Core holes H2-2012-630 and H3-2012-633;
- Underground Core holes 12U-201 and 12U-209;
- Exploration Water Supply Wells Well#1 and Well#2;
- Test Well MW12-001A. Only field water quality parameters were collected at MW12-001B owing to logistical difficulties. Well MW12-001B is slated to be sampled during the 2013 field season; and
- Surface Water at Ringer Creek, Upper North Creek, and North Creek below confluence with Ringer Creek. Surface water samples were collected two times.

Water quality sample results are presented in Appendices F-1 through F-3. The results are compared in the tables to permitted discharge effluent limits (Outfall 001). Samples from the surface and underground exploration core holes, and to a lesser extent the exploration water supply wells, contained concentrations above the limits and/or standards for a number of metals. Review of the site environmental database (EDMS) indicates that high concentrations are common from underground and monitoring wells when initially sampled after drilling. Subsequent samples from those sample results in the database show a trend of lower concentrations with time, perhaps due to disturbance and grinding of rock materials by drilling. Cuttings remaining in the drillholes are initially oxidized during drilling and flushing, and yield the elevated concentrations of metals.

3 Conclusions and Recommendations

The 2012 field program provided a starting point for the development of the numerical groundwater flow model that is needed for the permitting of the East Deep Expansion. The data collected formed the basis for the conceptual model on which the numerical model was constructed. Those data were compared to hydrogeological data collected during previous investigations on site, including the pre-mining baseline studies conducted by Golder (1998) and AGRA (2000). The data from 2012 were within an order of magnitude of the older data; but they also provided some specific information related to the flow system in the East Deep area. The elevated water levels within Liese Ridge and above the East Deep expansion are indicative of rocks of low permeability that drain poorly. Values for permeability calculated from hydraulic test data are uniformly low, with only occasional zones of drained rock and circulation loss (diorite margin in hole K-12-559) during drilling. Conceptually, water level and permeability test data indicate a flow system that drains from the upland ridges into the valleys, water levels in the rock are higher than in the Goodpaster alluvium supporting the idea that the bedrock discharges into the alluvium.

The results of permeability test indicate that the rocks of Liese Ridge in the area of the East Deep expansion are on the average no more permeable than the rocks of Pogo Ridge and the current mine. The caveat to that conclusion is the fact that more discrete large inflows have been encountered as workings have encroached and intersected the margins of the diorite intrusive and East Deep area. These inflows were shown to be of larger rate and higher pressure than those that had been encountered in the current mine workings which occur as isolated discrete points of inflow, rather than an extensive feature that drains across a large area.

The testing of the structures done in the surface and underground core holes was defined by exploration needs, and not planned with the objective of intercepting specific hydraulic features of interest. SRK is currently conducting the 2013 field program that has been designed to collect the specific information needed to evaluate the hydraulic behavior of those features and to more reliably simulate them with the numerical flow model. The numerical flow model was calibrated to steady-state, a condition which provides a reliable simulation of the groundwater flow system without the influences of transient conditions from mining operations. Those influences include the affect of dewatering the mine has on the water table within Pogo and Liese ridges, and the degree to which the drainage of the larger discrete flow features has on the flow system. For the numerical model to be defensible in a review by experts at the agencies or by contractors to the agencies, the effect of these transient influences during mining must be evaluated. Specifically, data needed to complete the transient calibration and account for transient influences are to:

- Document the change in the elevation of the water table in Pogo Ridge since mining commenced. This is being done during the current 2013 field program by installing a groundwater well into Pogo Ridge above the current workings; and
- Evaluate the drainage rates and hydraulic conductivities of the more significant discrete features of inflow in the flow system. This is being done during the current field program by drilling and testing core holes that target those features and include the fractured margin of the diorite intrusive at multiple locations, the D3 fault package (Liese and Graphite faults, and various splays of the D3 fault), and the NE-2 fault. Seven core holes target those features. Each hole is designed to be drilled as a solitary hole not subject to the cross-hole interference that precluded effective testing during the 2012 field program.

The purpose of the 2013 field program is to supply the detailed information needed to complete a transient calibration of the numerical groundwater flow model that produces a final updated model that can be defended in a robust expert review.

4 References

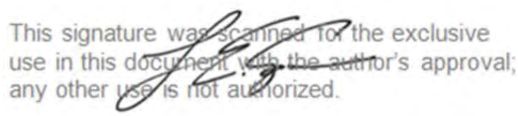
AGRA, 2000. Hydrology Section in Volume 3 of Pogo Environmental Baseline Document, March 20, 2000.

Golder Associates Ltd, 1998. Draft report on hydrogeological investigations Pogo Project, Alaska, February 1998.

5 Date and Signature Page

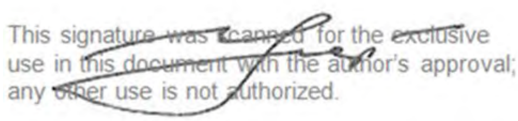
Signed on this 29 Day of July, 2013.

Prepared by



Larry Cope, Principal Consultant, Hydrogeologist

Reviewed by



Vladimir Ugorets, Principal Consultant, Hydrogeologist

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted industry practices.

Disclaimer

The opinions expressed in this Report have been based on the information supplied to SRK Consulting (U.S.), Inc. (SRK) by Sumitomo Metal Mining Pogo LLC (Pogo). These opinions are provided in response to a specific request from Pogo to do so, and are subject to the contractual terms between SRK and Pogo. SRK has exercised all due care in reviewing the supplied information. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report.

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Appendices

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Appendix A

Surface Corehole Photos

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A-1:

Piezometer Installation

Picture 1: Finished core hole. All rods pulled, only casing left in hole.

Picture 2: Drill pad, rods on rod rack.

Picture 3: Rig and Helicopter basket with well/testing supplies

Picture 4: Remaining Casing from hole

Picture 5: 2" Schedule 40 PVC threaded well pipe.

Picture 6: Layout of drill rig, testing materials and well materials

Picture 7: Assembling Cement basket, and Benseal Sleeves

Picture 8: Cement Basket

Picture 9: Benseal Sleeves

Picture 10: Threading into pipe string

Picture 11: Securing cement basket

Picture 12: Lowering string. Note the lifting bell.

Picture 13: Mixing benseal slurry. Will cure the benseal sleeves.

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A-2:

Hydraulic Testing

Picture 1: airline set up for testing

Picture 2: Diverter head

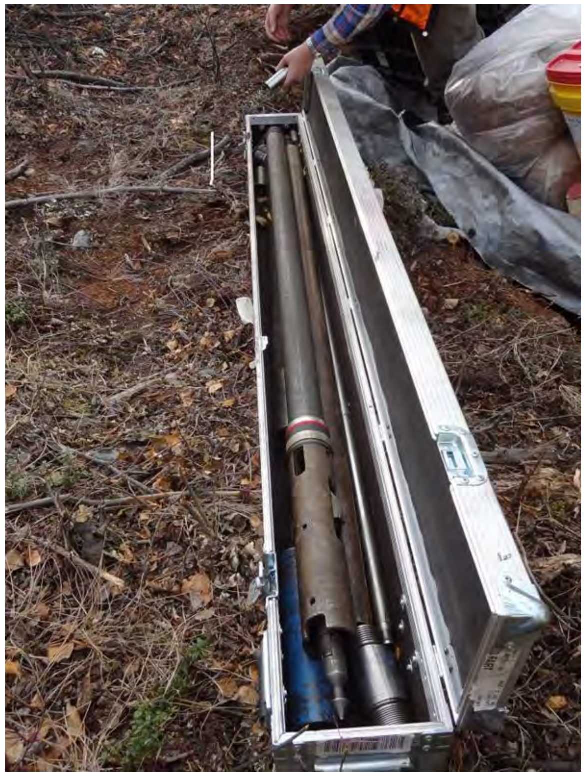
Picture 3: Set up for discharge line

Picture 4: Airline installation

Picture 5: Airline regulation for testing

A-3:

Packer Testing



Picture 1: Packer in box

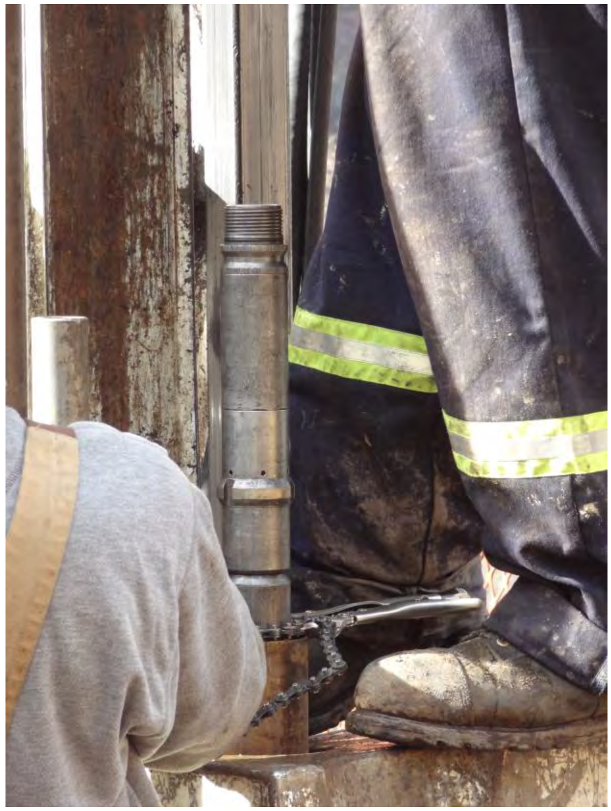
Picture 2: Packer bladder and Mandrel

Picture 3: Attaching bullet to Mandrel

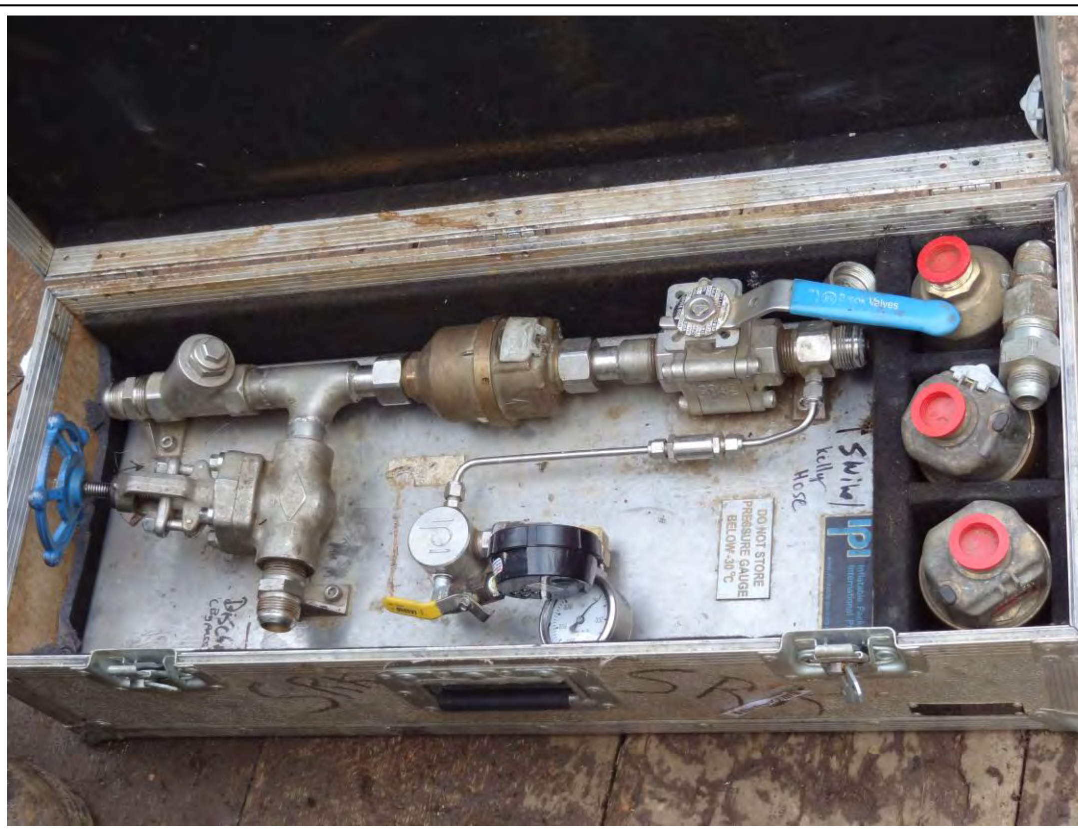
Picture 4: Complete packer assembly, minus Transducer Sub

Picture 5: Programed Transducer in housing

Picture 6: Prep for down hole



Picture 7: Packer in rods



Picture 8: Flow manifold for packer

Picture 9: allowing packer to inflate and then pressurizing to blow shear pin

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A-4:

Test Wells

Picture 1: MW12-001A Pump test

Picture 2: MW12-001A Discharge line

Picture 3: Flow meter

Picture 4: MW12-001A pump test set-up

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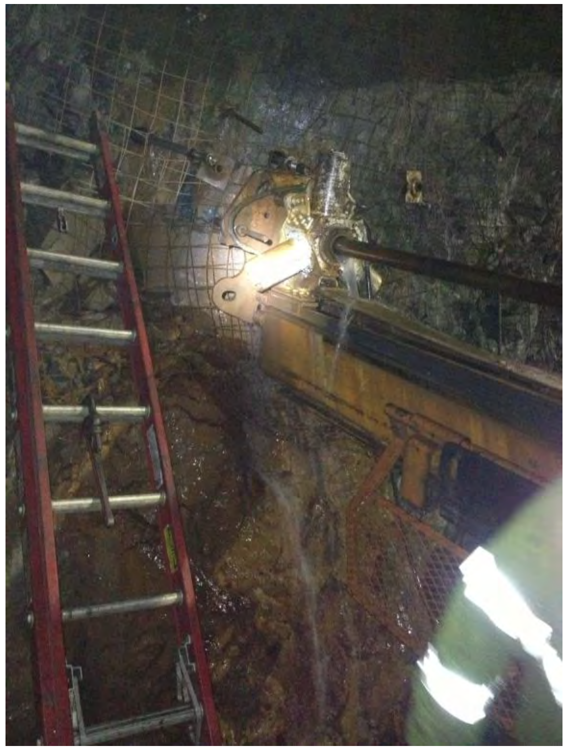
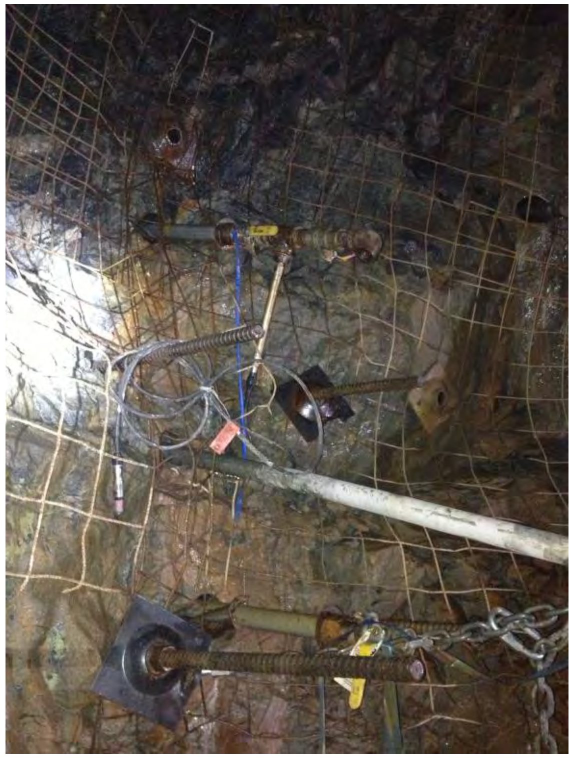
A-5:

Underground Testing



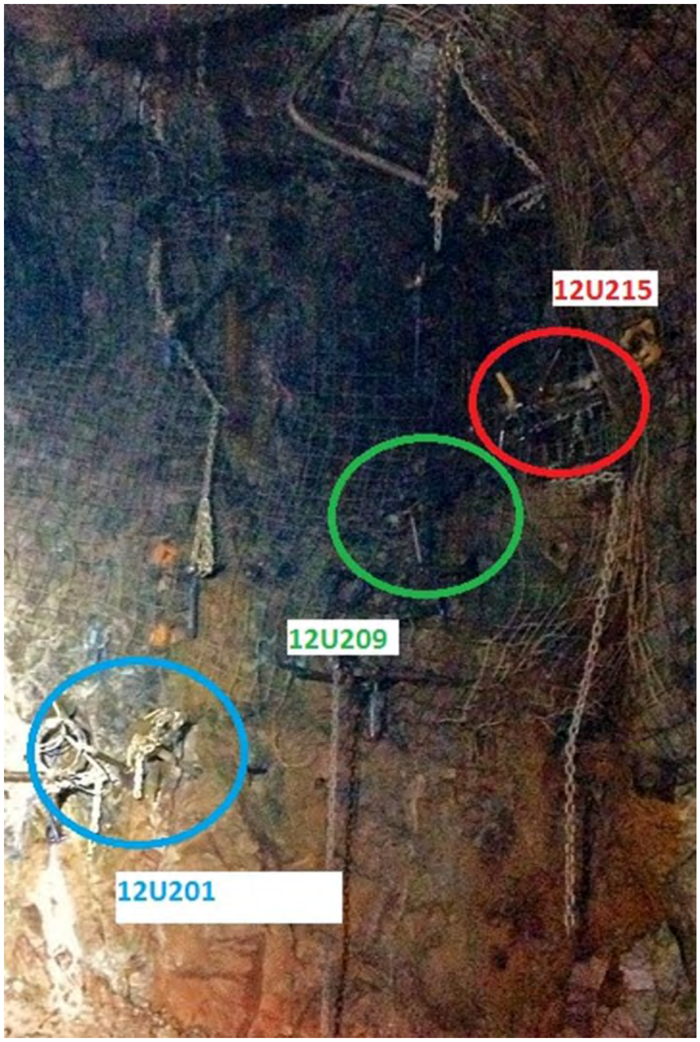
Picture 1: Drilling Underground Sites

Picture 2: Final set up of margot plug



Picture 3: 12U215 final install

Picture 4: 12U201 final install



Picture 5: finalized monitoring locations

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A-6:

Creek Sampling

Picture 1: North Creek Flow Measurement

Picture 2: North Creek Flow Measurement

Picture 3: North Creek, collecting parameters

Picture 4: Ringer Creek, collecting flow measurements

Picture 5: Ringer Creek, collecting data

Appendix B: Results of Hydraulic Testing

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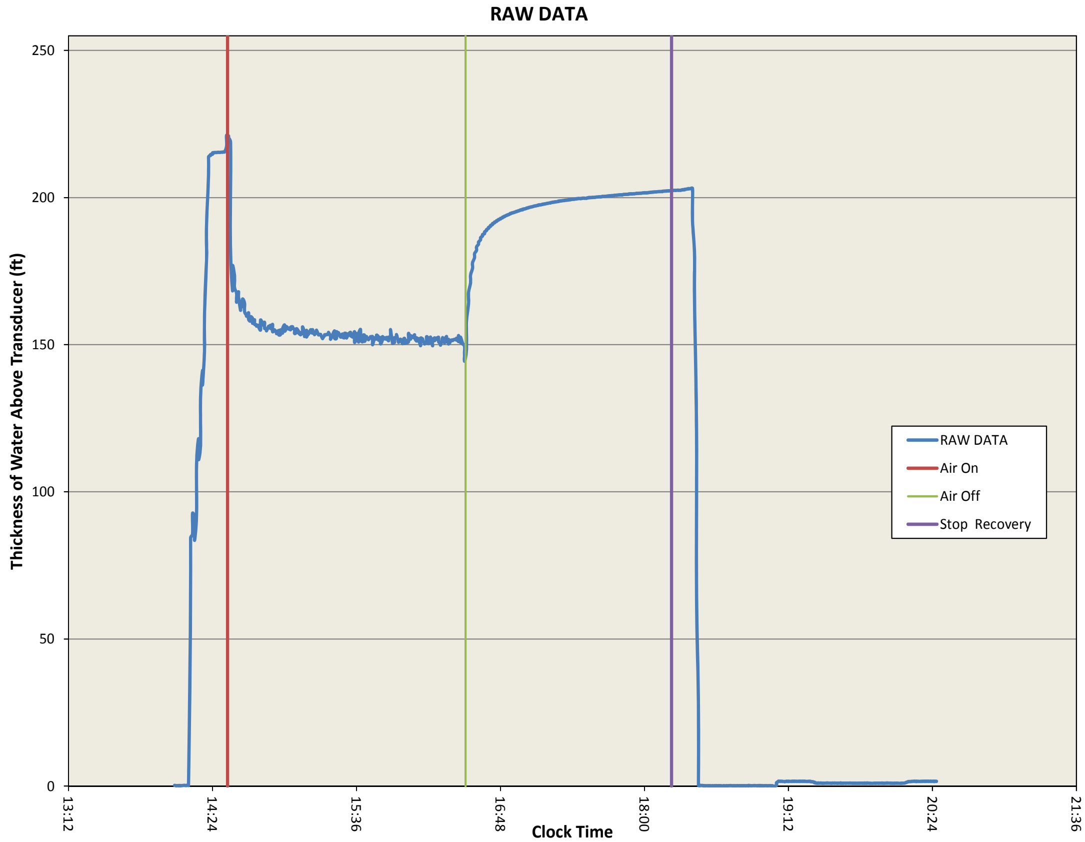
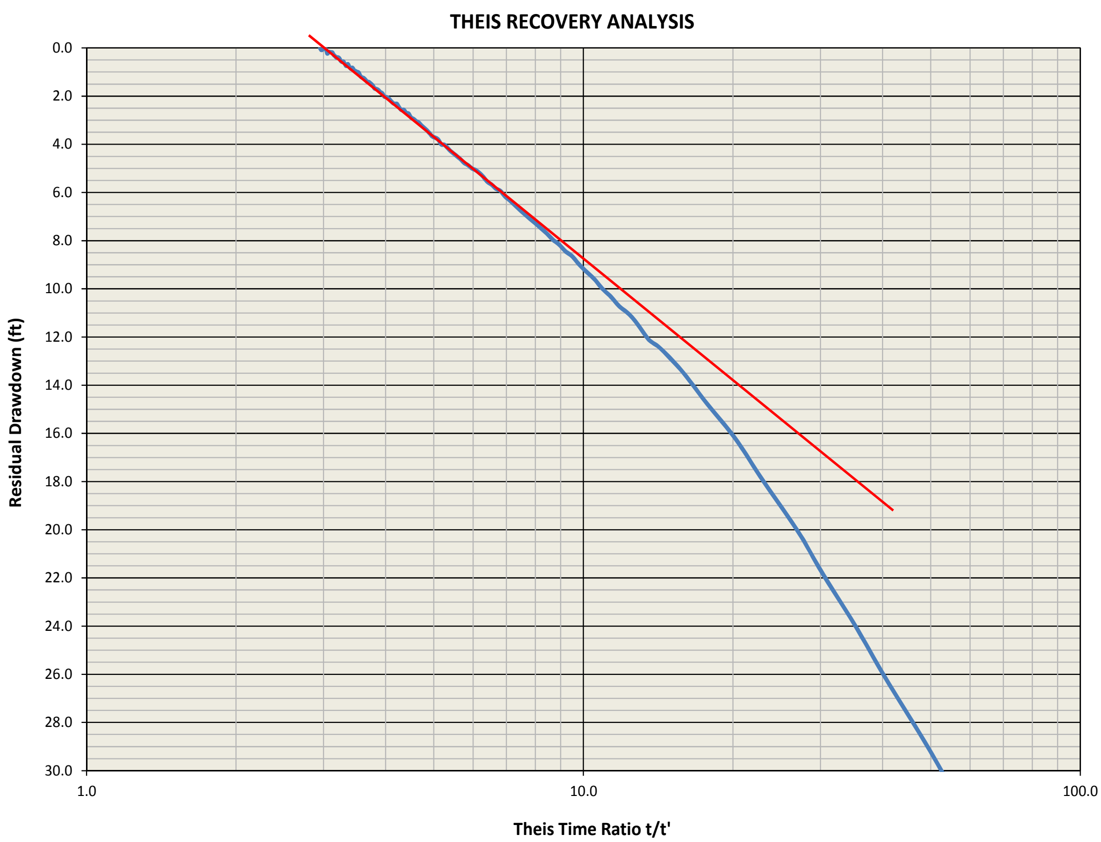
Surface Corehole Hydraulic Tests



Depth of Test Interval:
396 – 1216 ft

Pumping Test Duration: 119 min

Pumping Rate (Q) = 10.6 gpm
Pumping Rate (Q) = 2,031 ft^3/d



Theis Equation:

$$T = \frac{2.3\,Q}{4\pi\Delta s}$$

Where:
T = Transmissivity (ft^2/d)
Q = Pumping Rate (ft^3/d)
$\Delta(s)$ = Drawdown per Log Cycle (ft)

$$T = \frac{2.3\,(2{,}031)}{4\pi(16.4)} = 22.7\ ft^2/d$$

$$K = \frac{T}{b}$$

Where:
K= Estimate for Hydraulic Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(22.7)}{(820)} = 2.76x10^{-2}\ ft/d$$

T = 22.7 ft^2/d
K = 2.76x10^{-2} ft/d

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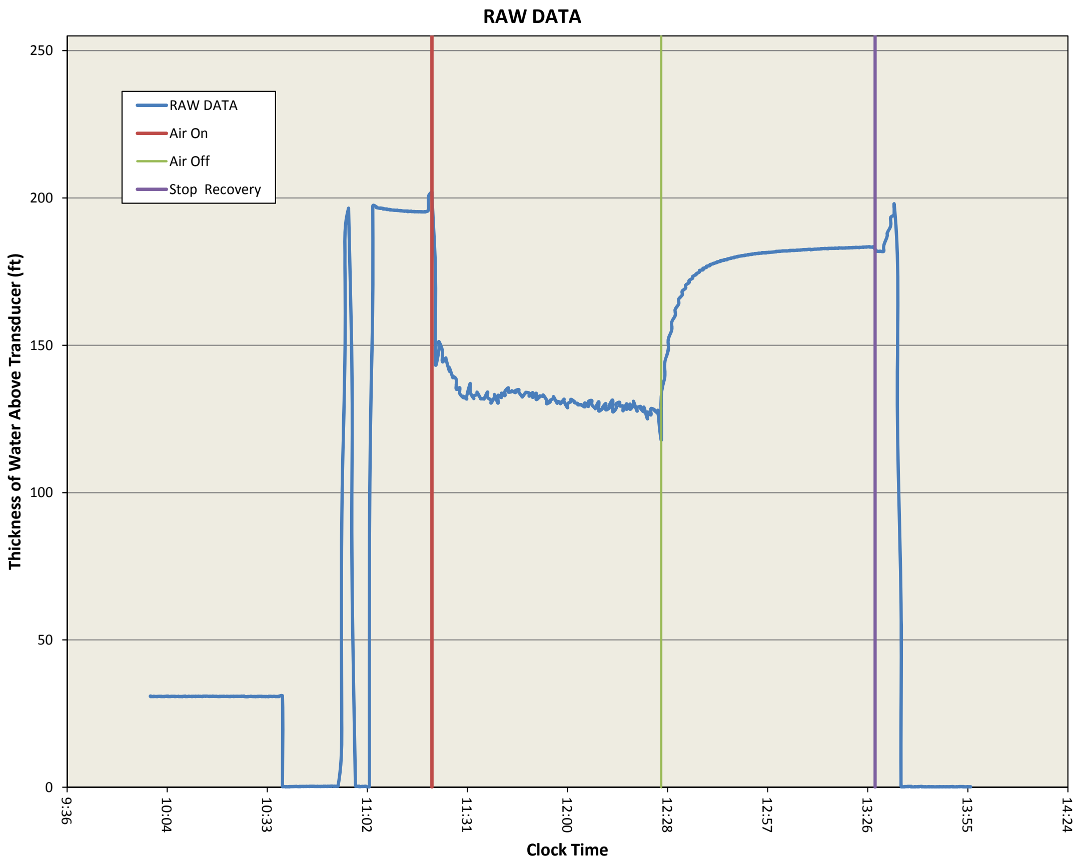
147900.02	July, 2013	1.0

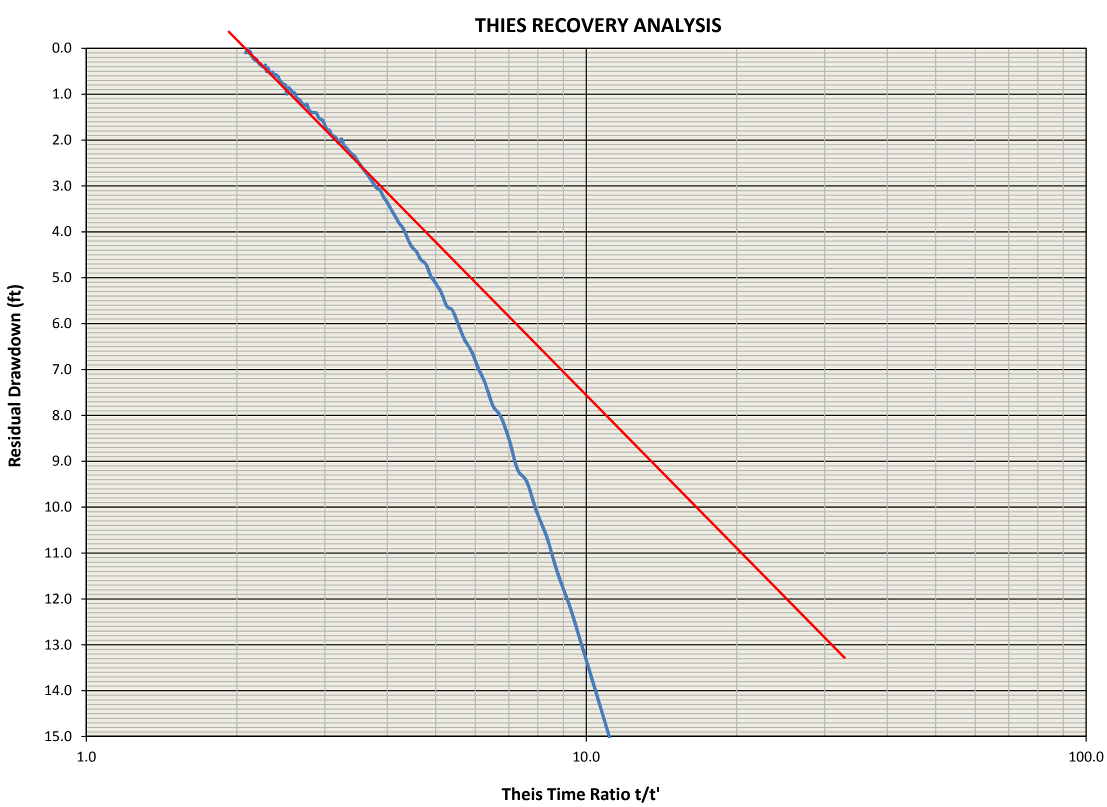
FIGURE B-1
Airlift Recovery Test Analysis
Drillhole ED-H1-594-1A
396 ft – 1,216 ft



Depth of Test Interval:
706 – 1216.2 ft

Pumping Test Duration: 66 min

Pumping Rate (Q) = 9.5 gpm
Pumping Rate (Q) = 1,829 ft^3/d



Theis Equation:

$$T = \frac{2.3\,Q}{4\pi\Delta s}$$

Where:
T = Transmissivity (ft^2/d)
Q = Pumping Rate (ft^3/d)
$\Delta(s)$ = Drawdown per Log Cycle (ft)

$$T = \frac{2.3\,(1{,}829)}{4\pi(11.2)} = 30.0\ ft^2/d$$

$$K = \frac{T}{b}$$

Where:
K= Estimate for Hydraulic Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(30.0)}{(510.2)} = 5.88\text{x}10^{-2}\ ft/d$$

T = 30.0 ft^2/d
K = 5.88x10^{-2} ft/d

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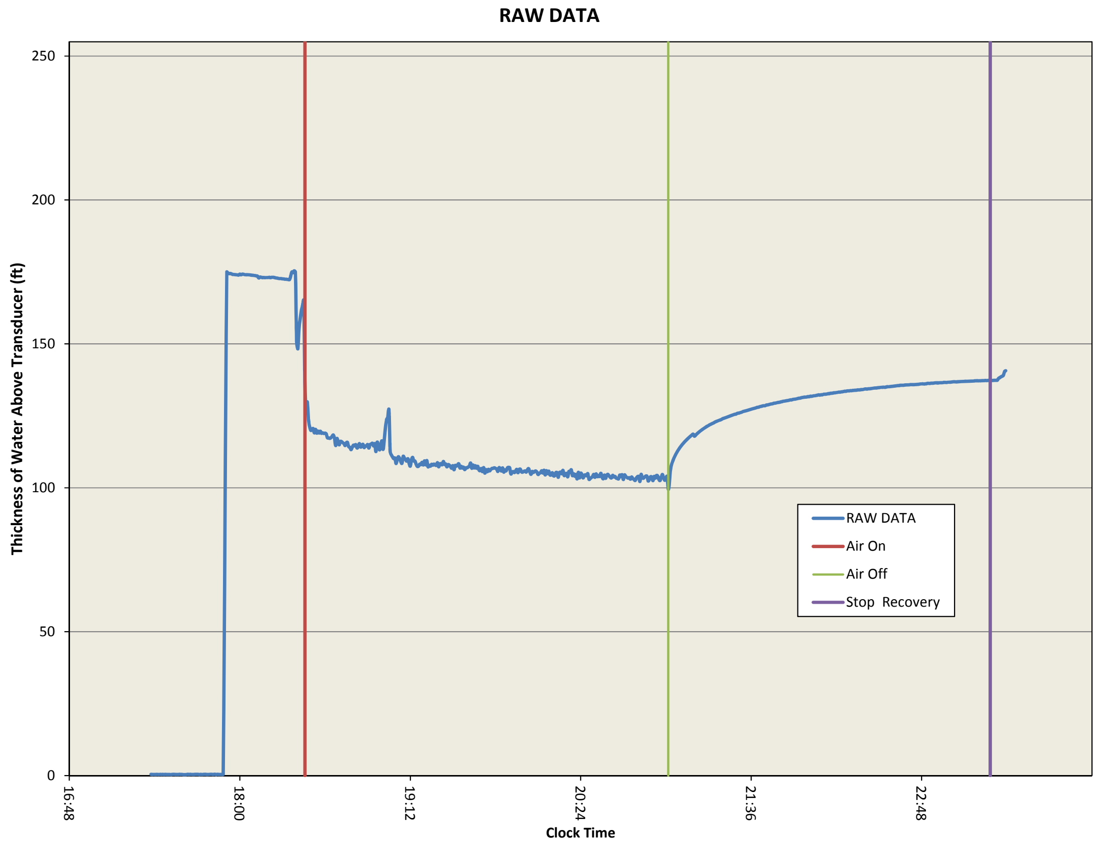
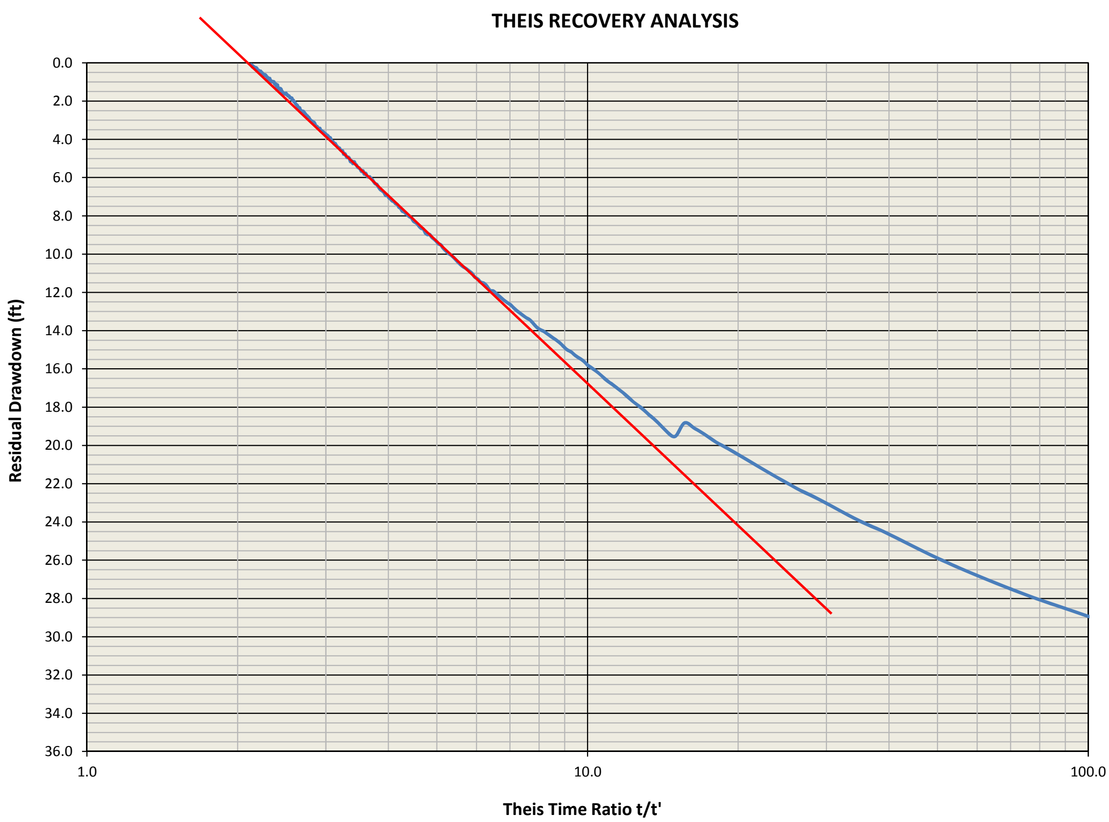
FIGURE B-2
Airlift Recovery Test Analysis
Drillhole ED-H1-594-2B
706 ft – 1,216.2 ft



Depth of Test Interval:
301 – 1201 ft

Pumping Test Duration: 154 min

Pumping Rate (Q) = 4.3 gpm
Pumping Rate (Q) = 828 ft^3/d



Theis Equation:

$$T = \frac{2.3\,Q}{4\pi\Delta s}$$

Where:
T = Transmissivity (ft^2/d)
Q = Pumping Rate (ft^3/d)
$\Delta(s)$ = Drawdown per Log Cycle (ft)

$$T = \frac{2.3\ (828)}{4\pi(24.3)} = 6.24\ ft^2/d$$

$$K = \frac{T}{b}$$

Where:
K= Estimate for Hydraulic Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(6.24)}{(900)} = 6.93x10^{-3}\ ft/d$$

T = 6.24 ft^2/d
K = 6.93x10^{-3} ft/d

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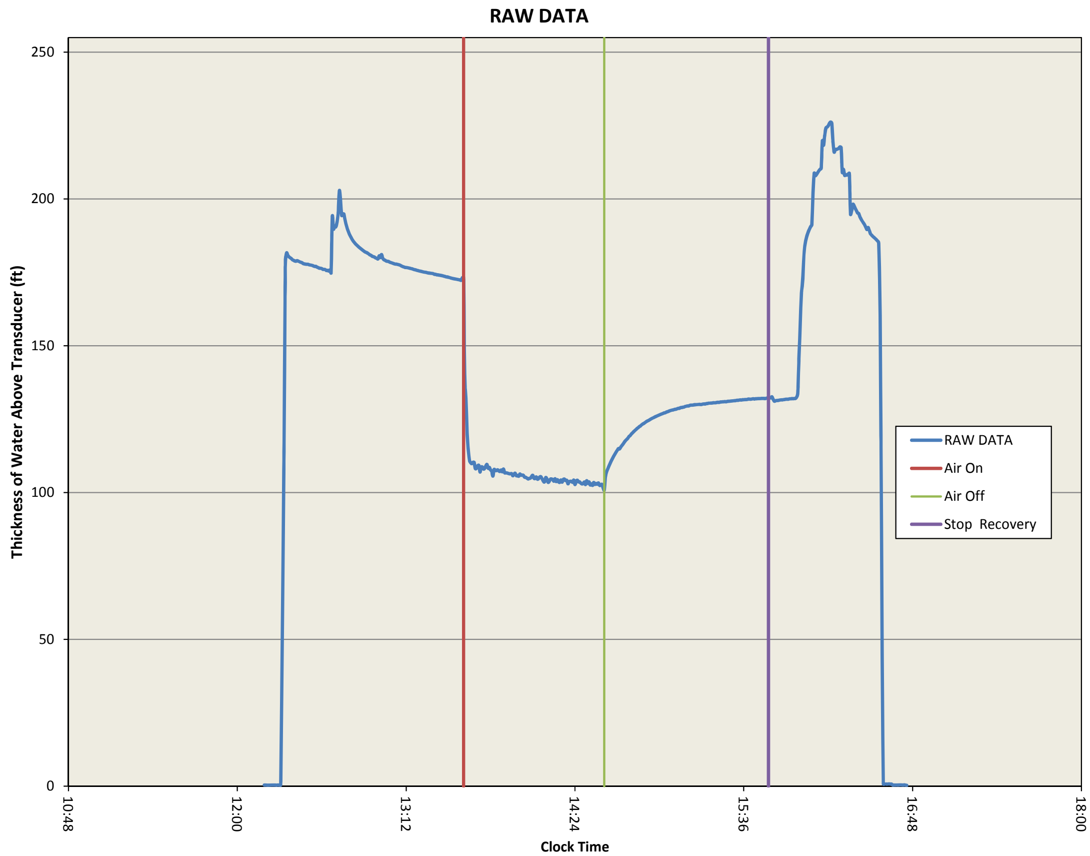
147900.02	July, 2013	1.0

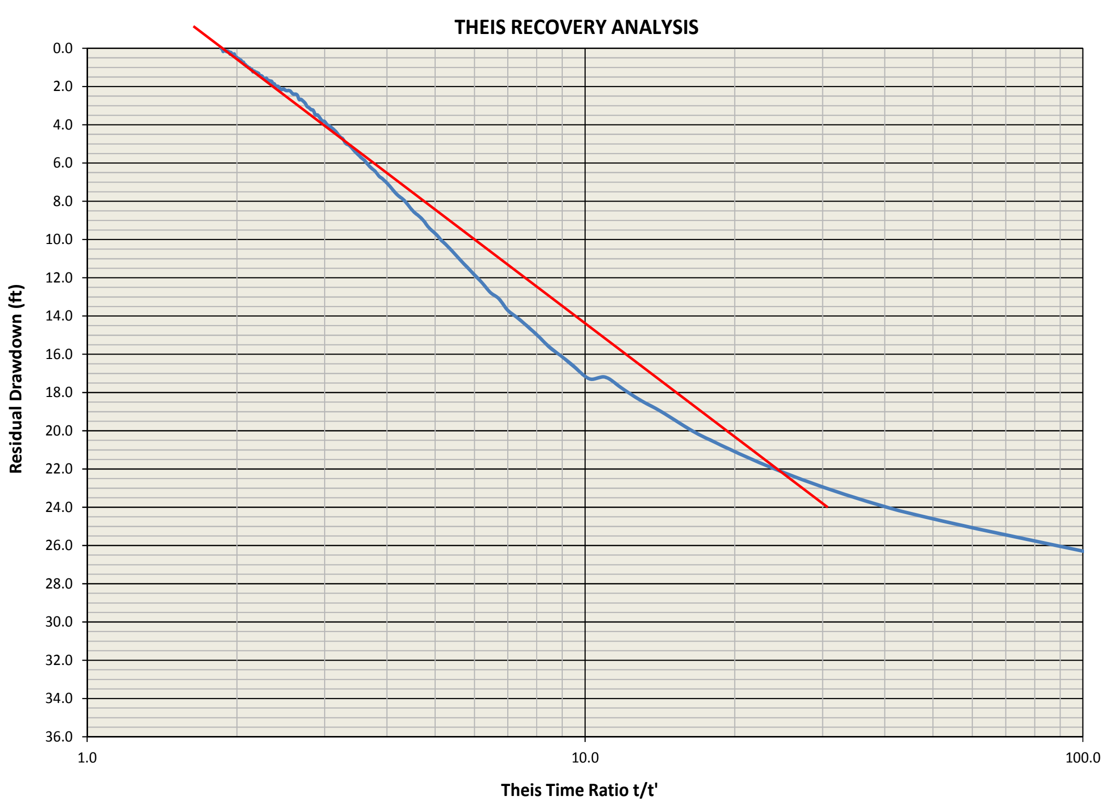
FIGURE B-3
Airlift Recovery Test Analysis
Drillhole ED-H1-627-1A
301 ft – 1,201 ft



Depth of Test Interval:
205 – 465 ft

Pumping Test Duration: 60 min

Pumping Rate (Q) = 2.0 gpm
Pumping Rate (Q) = 385 ft^3/d



Theis Equation:

$$T = \frac{2.3\,Q}{4\pi\Delta s}$$

Where:
T = Transmissivity (ft^2/d)
Q = Pumping Rate (ft^3/d)
$\Delta(s)$ = Drawdown per Log Cycle (ft)

$$T = \frac{2.3\ (385)}{4\pi(18.9)} = 3.74\ ft^2/d$$

$$K = \frac{T}{b}$$

Where:
K= Estimate for Hydraulic Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(3.74)}{(260)} = 1.44x10^{-2}\ ft/d$$

T = 3.74 ft^2/d
K = 1.44x10^{-2} ft/d

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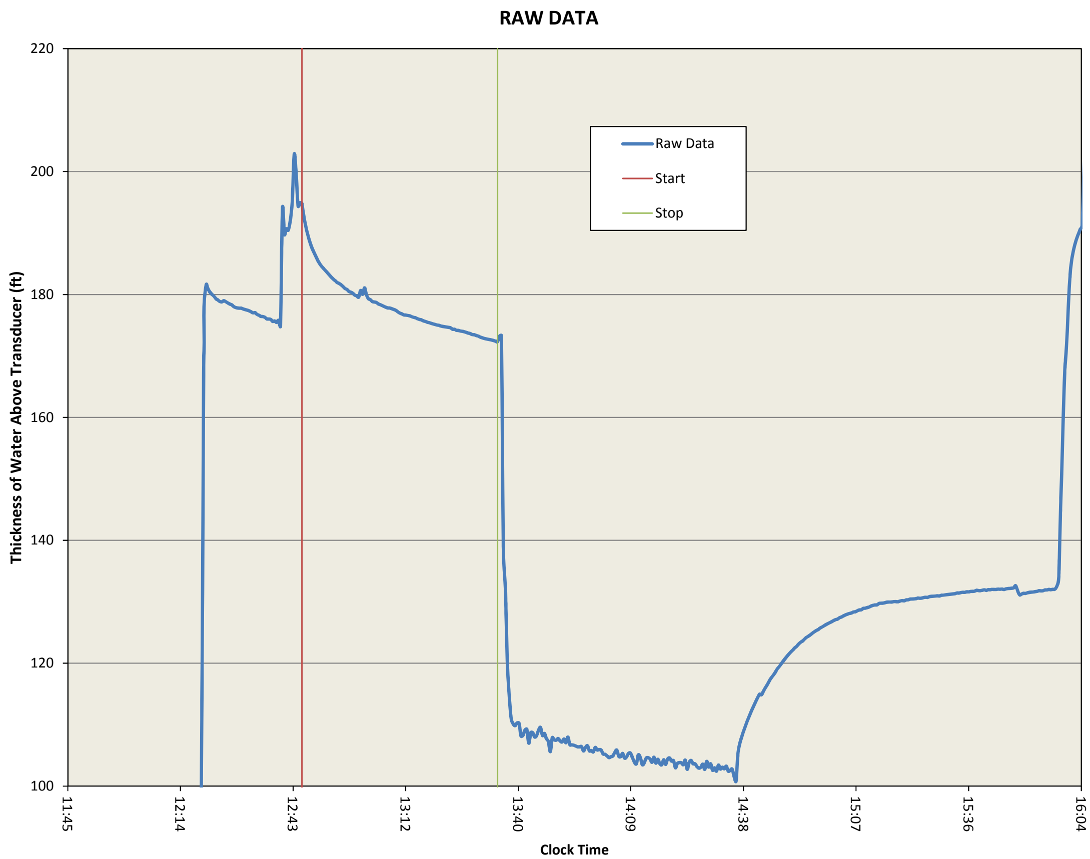
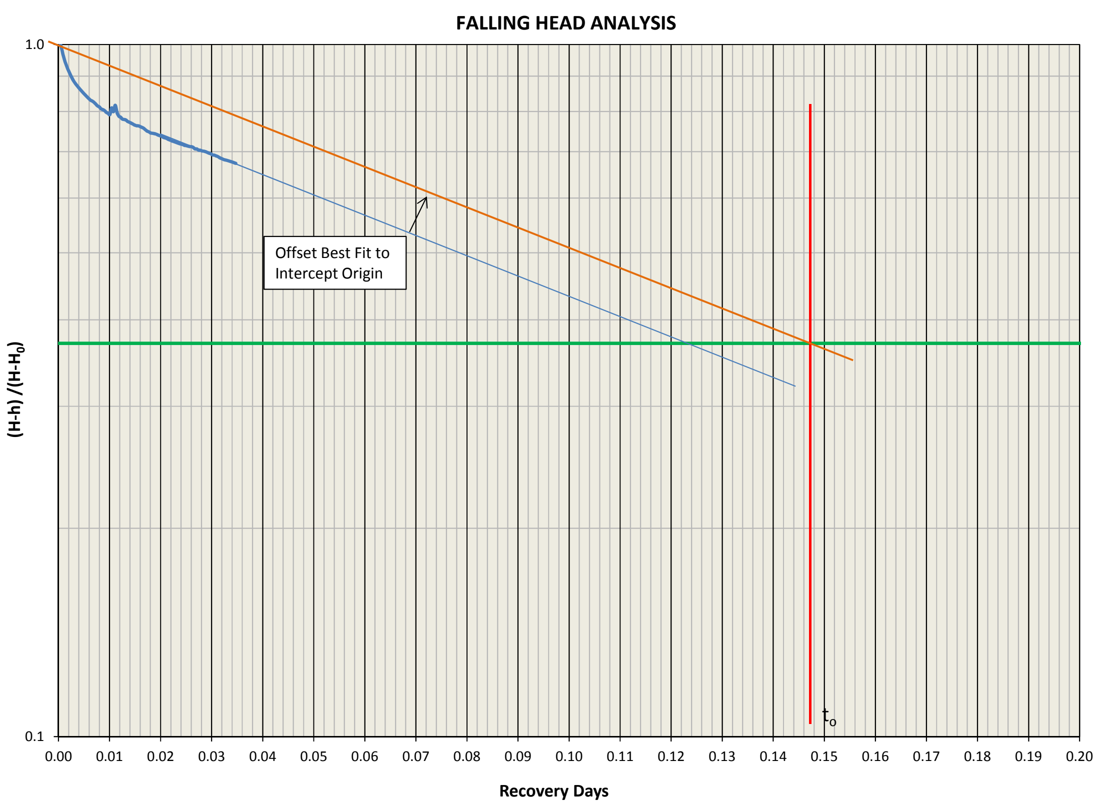
FIGURE B-4
Airlift Recovery Test Analysis
Drillhole ED-H1-628-1A
205 ft – 465 ft



Depth of Test Interval:
205 – 465 ft

Length of Test Interval: 260 ft



Hvorslev Equation:

$$K = \frac{r^2 \ln(\frac{L}{R})}{2Lto}$$

Where:
K = Estimate of Hydraulic Conductivity (ft/d)
r = Radius of Well Casing (ft)
R = Radius of Well Screen (ft)
L = Length of Test Interval (ft)
t_o = Time for Water Level to Fall 37% of Initial Change (days)

$$K = \frac{(3.1")^2 \ln(260'/3.8")}{2(260')(0.127)}$$

K = 1.87x10^{-3} ft/d

$$T = Kb$$

Where:
T = Transmissivity (ft^2/d)
b = Test Interval Length (ft)

T = 0.49 ft^2/d
K = 1.87x10^{-3} ft/d

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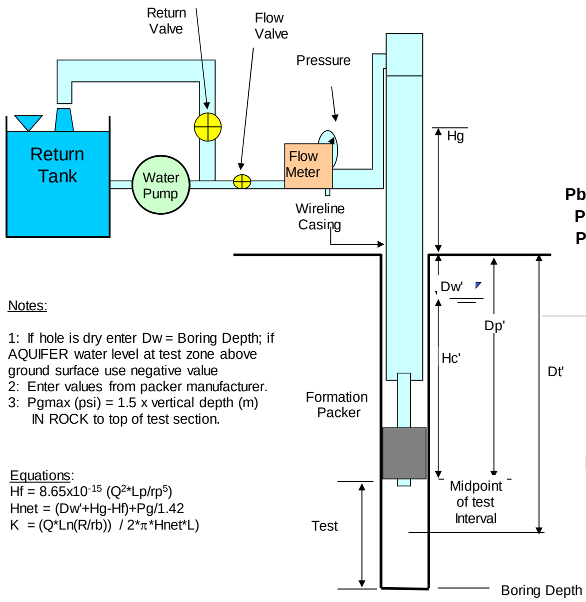
147900.02	July, 2013	1.0

FIGURE B-5
Falling Head Test Analysis
Drillhole ED-H1-628-1B
205 ft – 465 ft

Project:	POGO	Test Interval (m):	62.5	to:	141.8	Drillhole Nº	ED-H1-12-628
UTM (x,y)		Start Date:	10-Sep-12	Time:	8:00		
Datum:	WGS 84	End Date:	10-Sep-12	Time:	16:00	Test No.	1
GS Elevation:		Personnel:	CGB JB			DH Depth (m)	141.8

Max Injection Pressure (psi)

92



Notes:

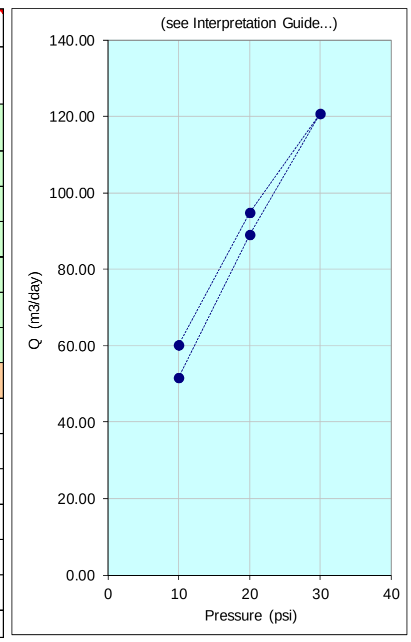
1: If hole is dry enter Dw = Boring Depth; if AQUIFER water level at test zone above ground surface use negative value
2: Enter values from packer manufacturer.
3: Pgmax (psi) = 1.5 x vertical depth (m) IN ROCK to top of test section.

Equations:
$Hf = 8.65 \times 10^{-15} (Q^2 * Lp/rp^5)$
$Hnet = (Dw' + Hg - Hf) + Pg/1.42$
$K = (Q * Ln(R/rb)) / 2 * \pi * Hnet * L)$

Dw	Measured depth of static water level (1)	22.9	m
Dbr	Measured depth to bedrock	6.1	m
Dp	Measured depth to packer	62.5	m
Dt	Measured depth to midpoint of test	102.2	m
ß	Inclination from horizontal (degrees)	80	º
Dw'	Vertical depth to static water level	22.5	m
Dbr'	Vertical depth to bedrock	6.0	m
Dp'	Vertical depth to packer	61.6	m
Dt'	Vertical depth to midpoint of test	100.6	m
SP	Shear Pin Rating (psi)	500	psi
Pblowout	Water column pressure in drill rods at plug	87	psi
Pshear	Est. differential shear pressure required	500	psi
Pgmax	Maximum injection gauge pressure (3)	142	psi
Hg	Gauge height	2.0	m
Lp	Length of discharge pipe	10.00	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0127	m
R	Radius of influence (10 m is standard value)	10	m
rb	BH radius (HQ=0.048m, NQ=0.038m)	0.048	m
L	Length of test section	79.3	m
Hf	Friction Loss		
Hnet	Net injection head at midpoint of test		
K	Hydraulic conductivity		

Conversion Factors:
10 m of water = 0.9807 bar = 1kg/cm² = 14.2 psi
1 cm/sec = 864 m/day
1 Lugeon = 1 lit/min per meter at 10 bar, which is approx. 1.4 x 10^{-5} cm/sec

Measurement (show last 3 to 5 flow meter 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
	10	20	30	20	10
1	18.00	31.00	42.00	33.00	21.00
2	18.00	32.00	42.00	32.00	21.00
3	18.00	31.00	42.00	33.00	21.00
4	17.00	31.00	42.00	33.00	21.00
5			43.00		
Stable Q (L/30sec)	18.00	31.00	42.00	33.00	21.00
Leak Q (L/30sec)	0.10	0.10	0.10	0.10	0.10
Q (m³/day)	51.6	89.0	120.7	94.8	60.2
Hf (m)	0.70	2.07	3.81	2.35	0.95
Hnet (m)	30.9	36.5	41.8	36.3	30.6
K (m/day)	1.8E-02	2.6E-02	3.1E-02	2.8E-02	2.1E-02
K (m/s)	**2.1E-07**	**3.0E-07**	**3.6E-07**	**3.2E-07**	**2.4E-07**
+/- (m/s)	3.0E-08	2.5E-08	3.4E-08	2.8E-09	-6.2E-09
+/- order of mag.	0.06	0.03	0.04	0.00	-0.01



Test Interval	
Geology	
Fracture Freq-Rock Quality	
Packer Seal	
Flow Meter Problems	
Measurement Accuracy	
Temperature	
Other Problems	

Test Interpretation
K Value (m/day)
2.5.E-02
K Value (ft/day)
8.3.E-02
"Type Curve Interpretation"

Pogo Mine

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PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

FIGURE B-6, Pg.1
Pressure Injection Test Analysis
Drillhole ED-H1-628-1C
205 ft – 465 ft

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	8	18	25	18	8
Max P during step	12	22	35	22	12
average pressure +/- psi	**2**	**2**	**5**	**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)	51.84	89.28	120.96	95.04	60.48
Hf (m)	0.70	2.09	3.83	2.36	0.96
Hnet (m)	29.4	35.1	38.3	34.8	29.2
K (m/sec)	2.2E-07	3.2E-07	3.9E-07	3.4E-07	2.6E-07

Low estimate of K

Q_{avg} (m^3/day)	51.26	88.70	120.38	94.46	59.90
Hf (m)	0.69	2.06	3.79	2.34	0.94
Hnet (m)	32.3	38.0	45.4	37.7	32.0
K (m/sec)	2.0E-07	2.9E-07	3.3E-07	3.1E-07	2.3E-07

K averages for P step

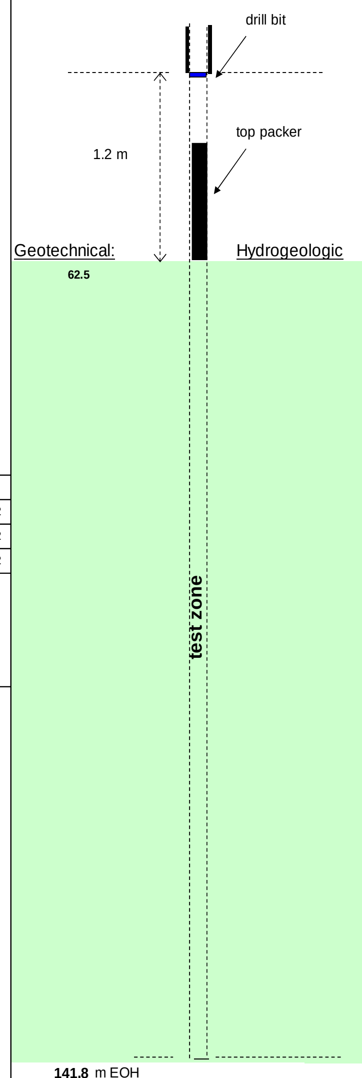
P	10	20	30
high est of K	2.E-07	3.E-07	4.E-07
average K	2.E-07	3.E-07	4.E-07
low est of K	2.E-07	3.E-07	3.E-07

K avg all P steps

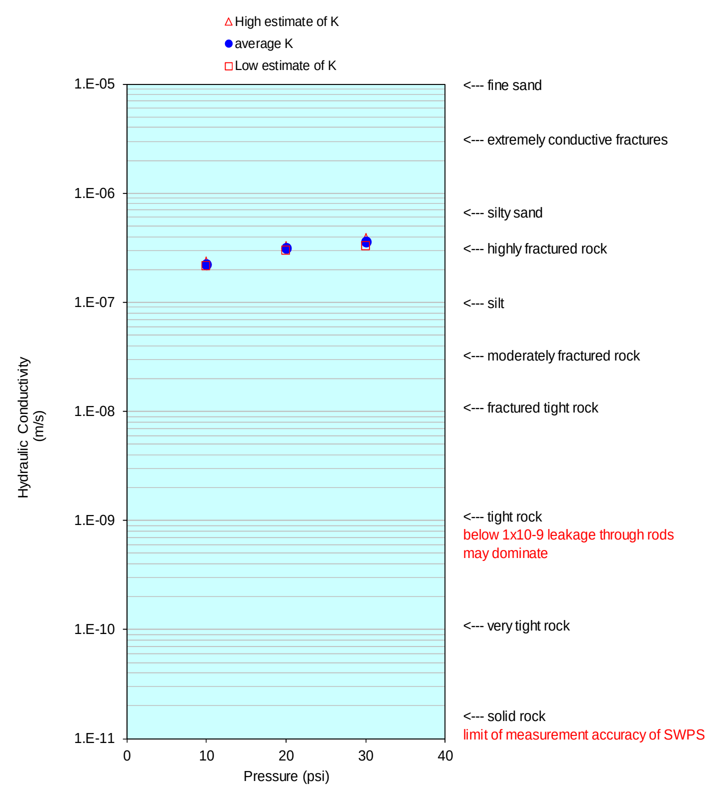
	m/sec	m/day
MAX	**3.9.E-07**	3.4.E-02
geomean	**2.9.E-07**	2.5.E-02
MIN	**2.1.E-07**	1.9.E-02

Test Comments	

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



Graph of estimated hydraulic conductivity and error bounds.

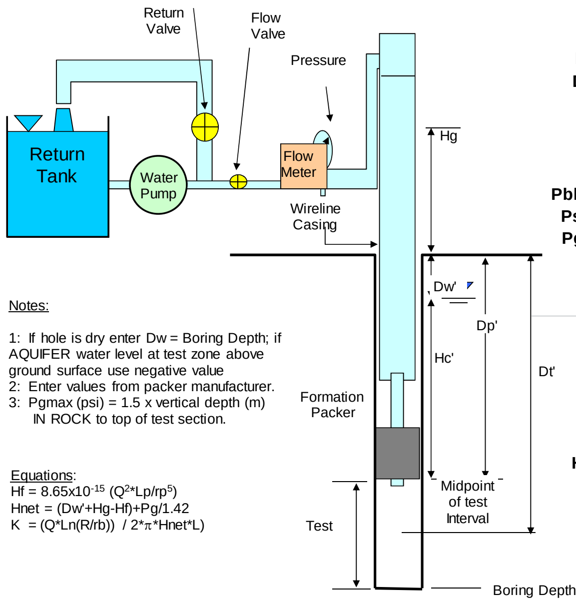


Pogo Mine	srk consulting			FIGURE B-6, Pg.2 Pressure Injection Test Analysis Drillhole ED-H1-628-1C 205 ft – 465 ft
	PROJECT NO. 147900.02	DATE July, 2013	VERSION 1.0	

Project:	POGO	Test Interval (m):	141.8	to:	254.6	Drillhole Nº	ED-H1-12-628
UTM (x,y)		Start Date:	12-Sep-12	Time:	0:00		
Datum:	WGS 84	End Date:	12-Sep-12	Time:	0:00	Test No.	2
GS Elevation:		Personnel:	CGB JB			DH Depth (m)	254.6

Max Injection Pressure (psi)
209

Symbol	Description	Value	Unit
Dw	Measured depth of static water level (1)	57.9	m
Dbr	Measured depth to bedrock	6.1	m
Dp	Measured depth to packer	141.8	m
Dt	Measured depth to midpoint of test	198.2	m
ß	Inclination from horizontal (degrees)	80	º
Dw'	Vertical depth to static water level	57.0	m
Dbr'	Vertical depth to bedrock	6.0	m
Dp'	Vertical depth to packer	139.6	m
Dt'	Vertical depth to midpoint of test	195.2	m
SP	Shear Pin Rating (psi)	500	psi
Pblowout	Water column pressure in drill rods at plug	198	psi
Pshear	Est. differential shear pressure required	500	psi
Pgmax	Maximum injection gauge pressure (3)	284	psi
Hg	Gauge height	2.0	m
Lp	Length of discharge pipe	10.00	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0127	m
R	Radius of influence (10 m is standard value)	10	m
rb	BH radius (HQ=0.048m, NQ=0.038m)	0.048	m
L	Length of test section	112.8	m
Hf	Friction Loss		
Hnet	Net injection head at midpoint of test		
K	Hydraulic conductivity		



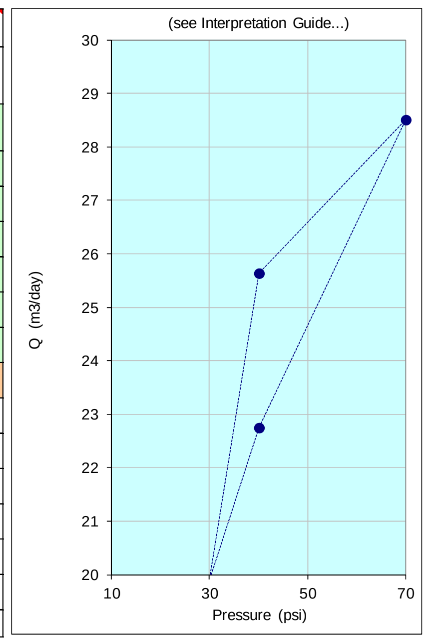
Notes:

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) IN ROCK to top of test section.

Equations:
$Hf = 8.65x10^{-15} (Q^2*Lp/rp^5)$
$Hnet = (Dw'+Hg-Hf)+Pg/1.42$
$K = (Q*Ln(R/rb)) / 2*\pi*Hnet*L)$

Conversion Factors:
10 m of water = 0.9807 bar = 1kg/cm² = 14.2 psi
1 cm/sec = 864 m/day
1 Lugeon = 1 lit/min per meter at 10 bar, which is approx. 1.4 x 10^{-5} cm/sec

Measurement (show last 3 to 5 flow meter 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
	30	40	70	40	30
1	9.00	9.00	10.00	9.00	7.00
2	8.00	8.00	11.00	9.00	7.00
3	8.00	9.00	10.00	9.00	7.00
4	8.00	8.00	10.00	9.00	
5	7.00	8.00	10.00	9.00	
Stable Q (L/30sec)	7.00	8.00	10.00	9.00	7.00
Leak Q (L/30sec)	0.10	0.10	0.10	0.10	0.10
Q (m^3/day)	19.9	22.8	28.5	25.6	19.9
Hf (m)	0.10	0.14	0.21	0.17	0.10
Hnet (m)	80.1	87.1	108.1	87.0	80.1
K (m/day)	1.9E-03	2.0E-03	2.0E-03	2.2E-03	1.9E-03
K (m/s)	**2.2E-08**	**2.3E-08**	**2.3E-08**	**2.6E-08**	**2.2E-08**
+/- (m/s)	4.2E-10	1.9E-09	8.0E-10	-1.0E-09	4.2E-10
+/- order of mag.	0.01	0.03	0.01	-0.02	0.01



Test Interval	
Geology	
Fracture Freq-Rock Quality	
Packer Seal	
Flow Meter Problems	
Measurement Accuracy	
Temperature	
Other Problems	

Test Interpretation
K Value (m/day)
2.0.E-03
K Value (ft/day)
6.5.E-03
"Type Curve Interpretation"

Pogo Mine

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PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

FIGURE B-7
Pressure Injection Test Analysis, Pg.1
Drillhole ED-H1-628-2A
465 ft – 835 ft

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	28	38	65	38	28
Max P during step	32	42	75	42	32
average pressure +/- psi	**2**	**2**	**5**	**2**	**2**

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)	19.90	22.78	28.54	25.66	19.90
Hf (m)	0.10	0.14	0.21	0.17	0.10
Hnet (m)	78.7	85.7	104.6	85.6	78.7
K (m/sec)	2.2E-08	2.3E-08	2.4E-08	2.6E-08	2.2E-08

Low estimate of K

Q_{avg} (m^3/day)	19.84	22.72	28.48	25.60	19.84
Hf (m)	0.10	0.14	0.21	0.17	0.10
Hnet (m)	81.5	88.5	111.7	88.5	81.5
K (m/sec)	2.1E-08	2.2E-08	2.2E-08	2.5E-08	2.1E-08

K averages for P step

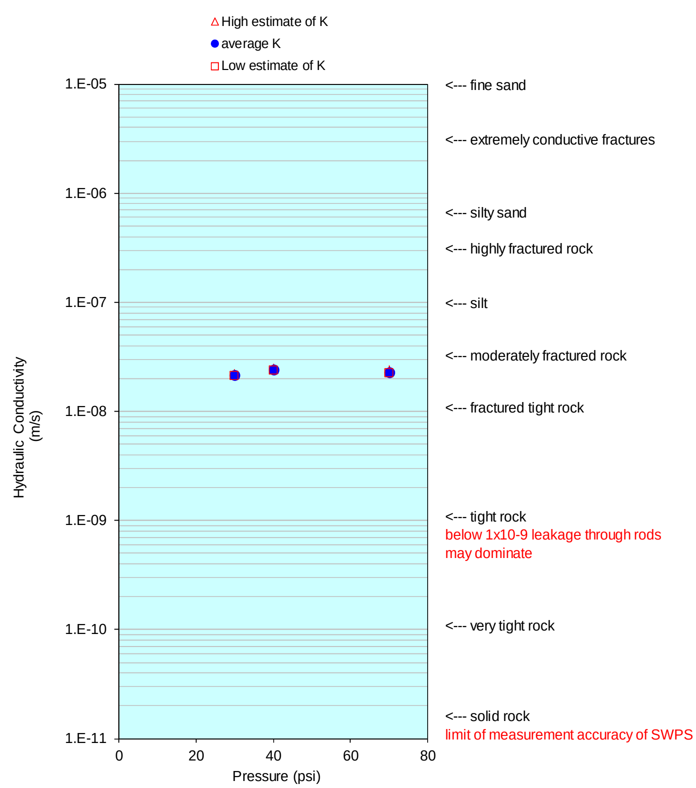
P	30	40	70
high est of K	2.E-08	2.E-08	2.E-08
average K	2.E-08	2.E-08	2.E-08
low est of K	2.E-08	2.E-08	2.E-08

K avg all P steps

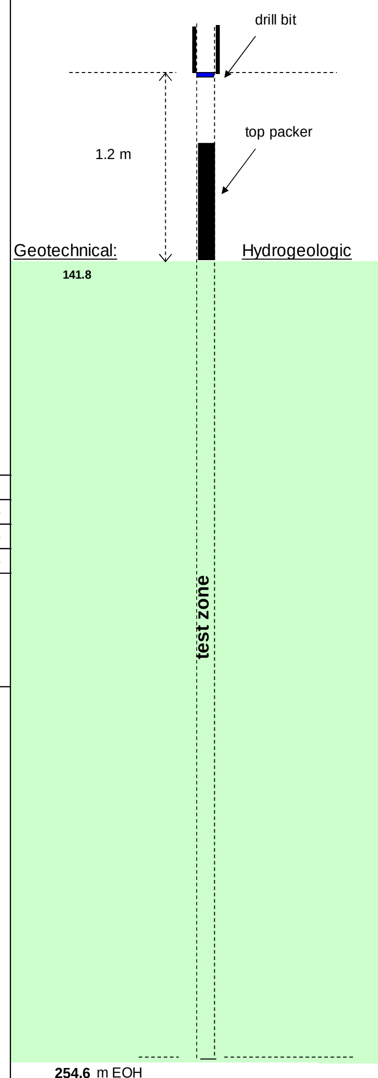
	m/sec	m/day
MAX	**2.5.E-08**	2.1.E-03
geomean	**2.3.E-08**	2.0.E-03
MIN	**2.1.E-08**	1.8.E-03

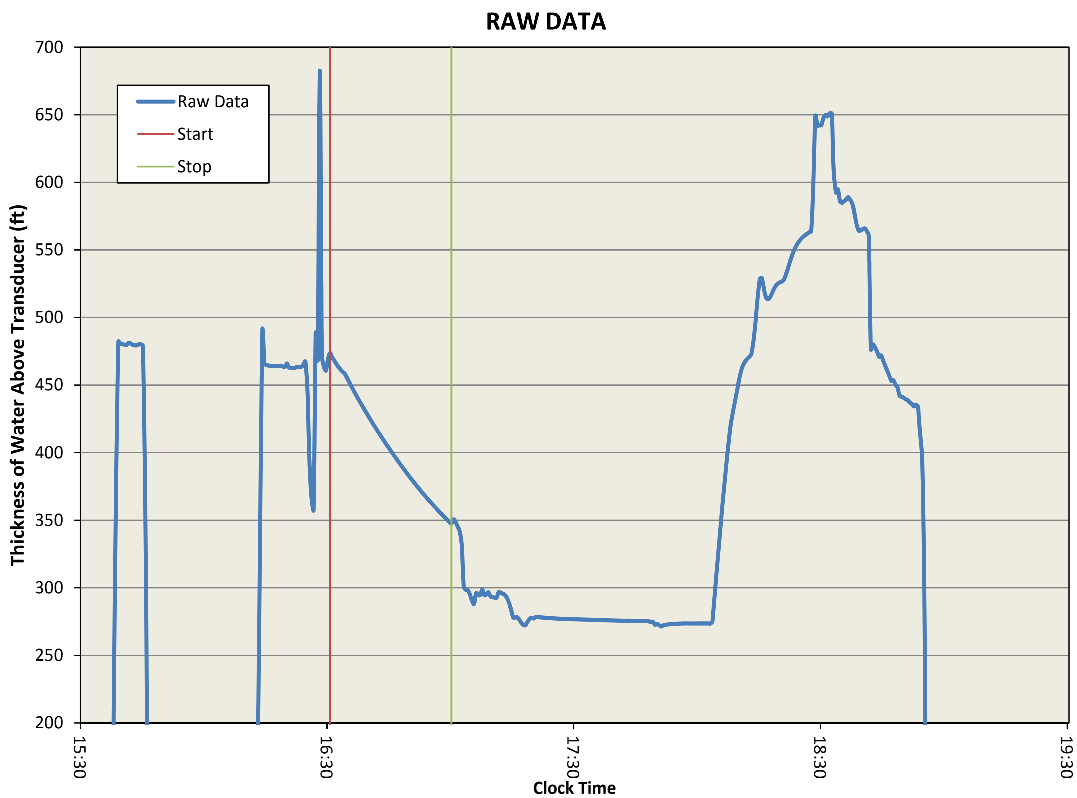
Test Comments	

Graph of estimated hydraulic conductivity and error bounds.



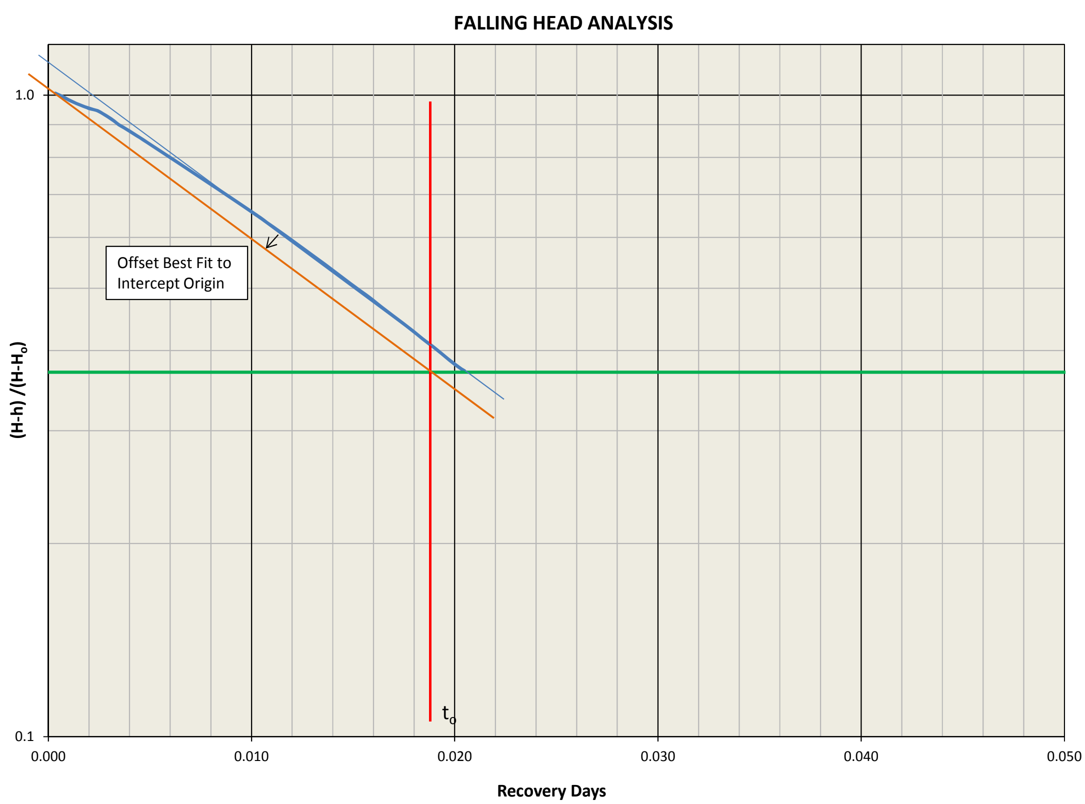
Drawing of zone tested, including geotech / hydrogeo. conditions:





Depth of Test Interval:
465 – 835 ft

Length of Test Interval: 370 ft



Hvorslev Equation:

$$K = \frac{r^2 \ln(\frac{L}{R})}{2Lto}$$

Where:
K = Estimate of Hydraulic Conductivity (ft/d)
r = Radius of Well Casing (ft)
R = Radius of Well Screen (ft)
L = Length of Test Interval (ft)
t_o = Time for Water Level to Fall 37% of Initial Change (days)

$$K = \frac{(3.1")^2 \ln(370'/3.8")}{2(370')(0.188)}$$

$K = 9.31 \times 10^{-3}$ ft/d

$$T = Kb$$

Where:
T = Transmissivity (ft^2/d)
b = Test Interval Length (ft)

$T = 3.44\ ft^2/d$
$K = 9.31 \times 10^{-3}$ ft/d

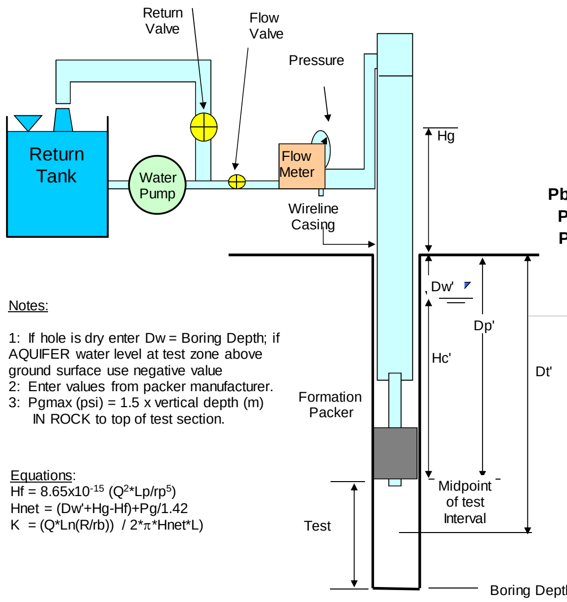
PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

FIGURE B-9
Falling Head Test Analysis
Drillhole ED-H1-628-2B
465 ft – 835 ft

Project:	**POGO**	**Test Interval (m):**	**254.6**	**to:**	**339.9**	**Drillhole Nº**	**ED-H1-12-628**
UTM (x,y)		**Start Date:**	**14-Sep-12**	**Time:**	**8:00**		
Datum:	**WGS 84**	**End Date:**	**14-Sep-12**	**Time:**	**19:00**	**Test No.**	**3**
GS Elevation:		**Personnel:**	**CGB JB**			**DH Depth (m)**	**339.9**

Max Injection Pressure (psi)

376



Notes:

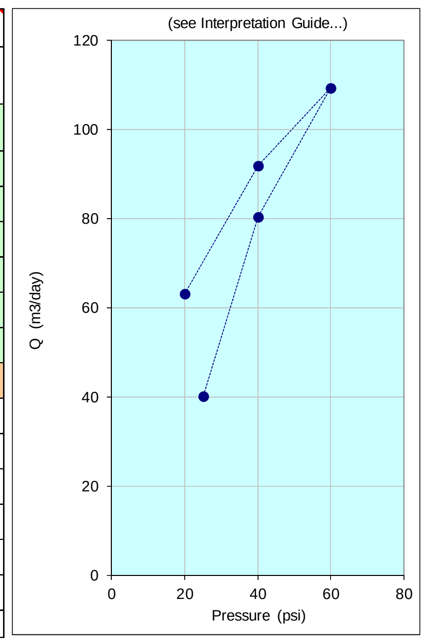
1: If hole is dry enter Dw = Boring Depth; if AQUIFER water level at test zone above ground surface use negative value
2: Enter values from packer manufacturer.
3: Pgmax (psi) = 1.5 x vertical depth (m) IN ROCK to top of test section.

Equations:
$Hf = 8.65 \times 10^{-15} (Q^2 * Lp/rp^5)$
$Hnet = (Dw'+Hg-Hf)+Pg/1.42$
$K = (Q*Ln(R/rb)) / 2*\pi*Hnet*L)$

Dw	Measured depth of static water level (1)	36.6	m
Dbr	Measured depth to bedrock	6.1	m
Dp	Measured depth to packer	**254.6**	m
Dt	Measured depth to midpoint of test	**297.3**	m
ß	Inclination from horizontal (degrees)	80	º
Dw'	Vertical depth to static water level	**36.0**	m
Dbr'	Vertical depth to bedrock	**6.0**	m
Dp'	Vertical depth to packer	**250.7**	m
Dt'	Vertical depth to midpoint of test	**292.7**	m
SP	Shear Pin Rating (psi)	500	psi
Pblowout	Water column pressure in drill rods at plug	**356**	psi
Pshear	Est. differential shear pressure required	**500**	psi
Pgmax	Maximum injection gauge pressure (3)	**430**	psi
Hg	Gauge height	2.0	m
Lp	Length of discharge pipe	10.00	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0127	m
R	Radius of influence (10 m is standard value)	10	m
rb	BH radius (HQ=0.048m, NQ=0.038m)	0.048	m
L	Length of test section	**85.4**	m
Hf	Friction Loss		
Hnet	Net injection head at midpoint of test		
K	Hydraulic conductivity		

Conversion Factors:
10 m of water = 0.9807 bar = 1kg/cm² = 14.2 psi
1 cm/sec = 864 m/day
1 Lugeon = 1 lit/min per meter at 10 bar, which is approx. 1.4×10^{-5} cm/sec

Measurement (show last 3 to 5 flow meter 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**
	20	**40**	**60**	**40**	**25**
1	**24.00**	**32.00**	**40.00**	**28.00**	**14.00**
2	**22.00**	**35.00**	**38.00**	**28.00**	**14.00**
3	**23.00**	**32.00**	**37.00**	**28.00**	
4	**21.00**	**31.00**	**39.00**	**28.00**	
5	**23.00**	**32.00**	**38.00**	**29.00**	
Stable Q (L/30sec)	**22.00**	**32.00**	**38.00**	**28.00**	**14.00**
Leak Q (L/30sec)	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**
Q (m^3/day)	63.1	91.9	109.2	80.4	40.0
Hf (m)	1.04	2.21	3.12	1.69	0.42
Hnet (m)	51.1	64.0	77.2	64.5	55.2
K (m/day)	1.2E-02	1.4E-02	1.4E-02	1.2E-02	7.2E-03
K (m/s)	**1.4E-07**	**1.7E-07**	**1.6E-07**	**1.4E-07**	**8.4E-08**
+/- (m/s)	-2.6E-08	-6.9E-09	7.8E-09	1.5E-08	3.3E-08
+/- order of mag.	-0.09	-0.02	0.02	0.04	0.15



Test Interval	
Geology	
Fracture Freq-Rock Quality	
Packer Seal	
Flow Meter Problems	
Measurement Accuracy	
Temperature	
Other Problems	

Test Interpretation
K Value (m/day)
1.2.E-02
K Value (ft/day)
4.0.E-02
"Type Curve Interpretation"

Pogo Mine

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PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

FIGURE B-10, Pg.1
Pressure Injection Test Analysis
Drillhole ED-H1-628-3A
835 ft – 1,115 ft

Pressure oscillation during test

Pressure step	P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Min P during step	18	38	55	38	23
Max P during step	22	42	65	42	27
average pressure +/- psi	2	2	5	2	2

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec	0.1	0.1	0.01	0.1	0.1

High estimate of K

Q_{avg} (m^3/day)	63.36	92.16	109.18	80.64	40.32
Hf (m)	1.05	2.22	3.12	1.70	0.43
Hnet (m)	49.7	62.6	73.6	63.1	53.8
K (m/sec)	1.5E-07	1.7E-07	1.7E-07	1.5E-07	8.6E-08

Low estimate of K

Q_{avg} (m^3/day)	62.78	91.58	109.12	80.06	39.74
Hf (m)	1.03	2.20	3.12	1.68	0.41
Hnet (m)	52.5	65.4	80.7	65.9	56.6
K (m/sec)	1.4E-07	1.6E-07	1.6E-07	1.4E-07	8.1E-08

K averages for P step

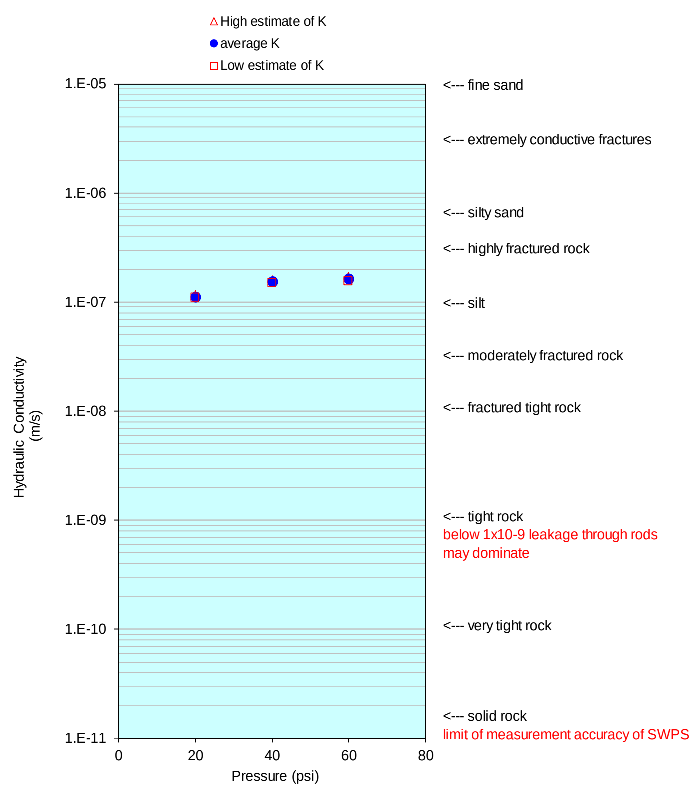
P	20	40	60
high est of K	1.E-07	2.E-07	2.E-07
average K	1.E-07	2.E-07	2.E-07
low est of K	1.E-07	2.E-07	2.E-07

K avg all P steps

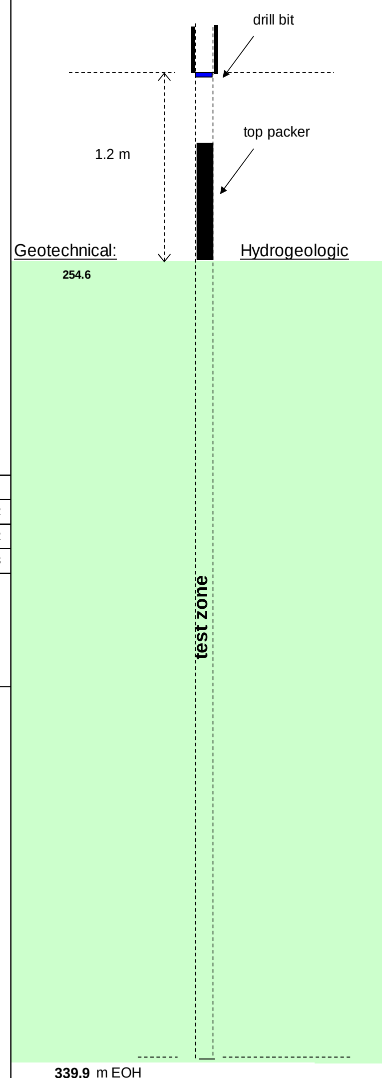
	m/sec	m/day
MAX	1.7.E-07	1.5.E-02
geomean	1.4.E-07	1.2.E-02
MIN	1.1.E-07	9.5.E-03

Test Comments	

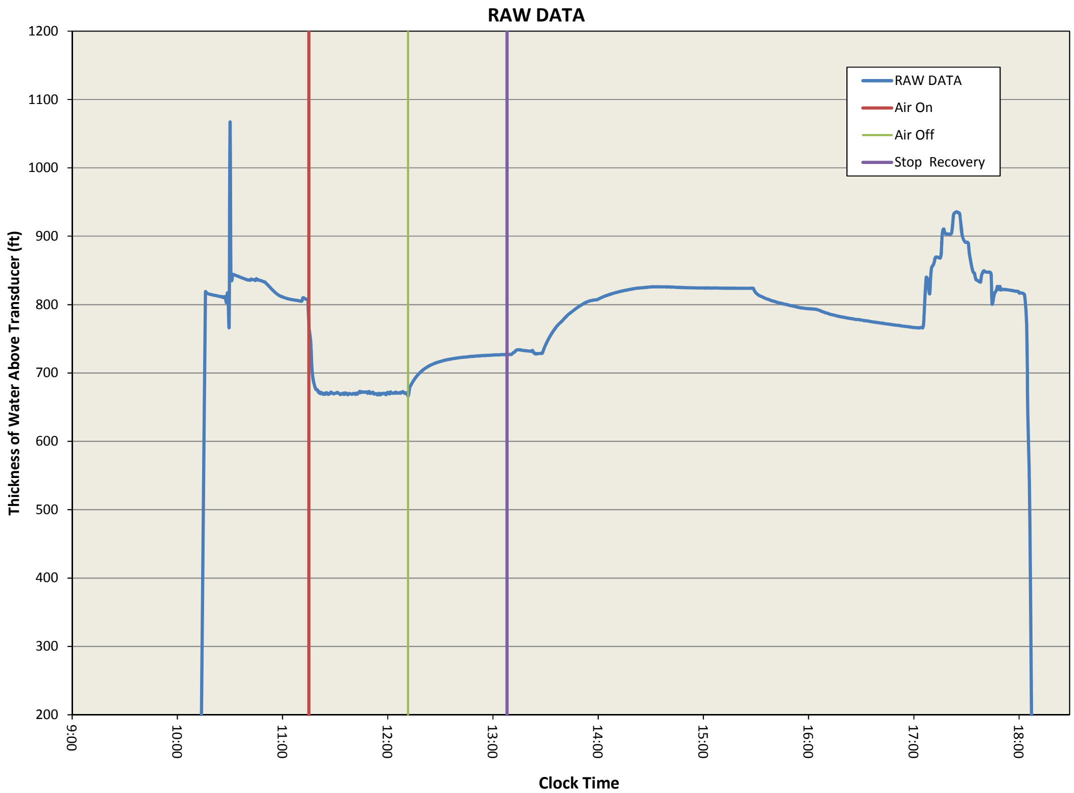
Graph of estimated hydraulic conductivity and error bounds.



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



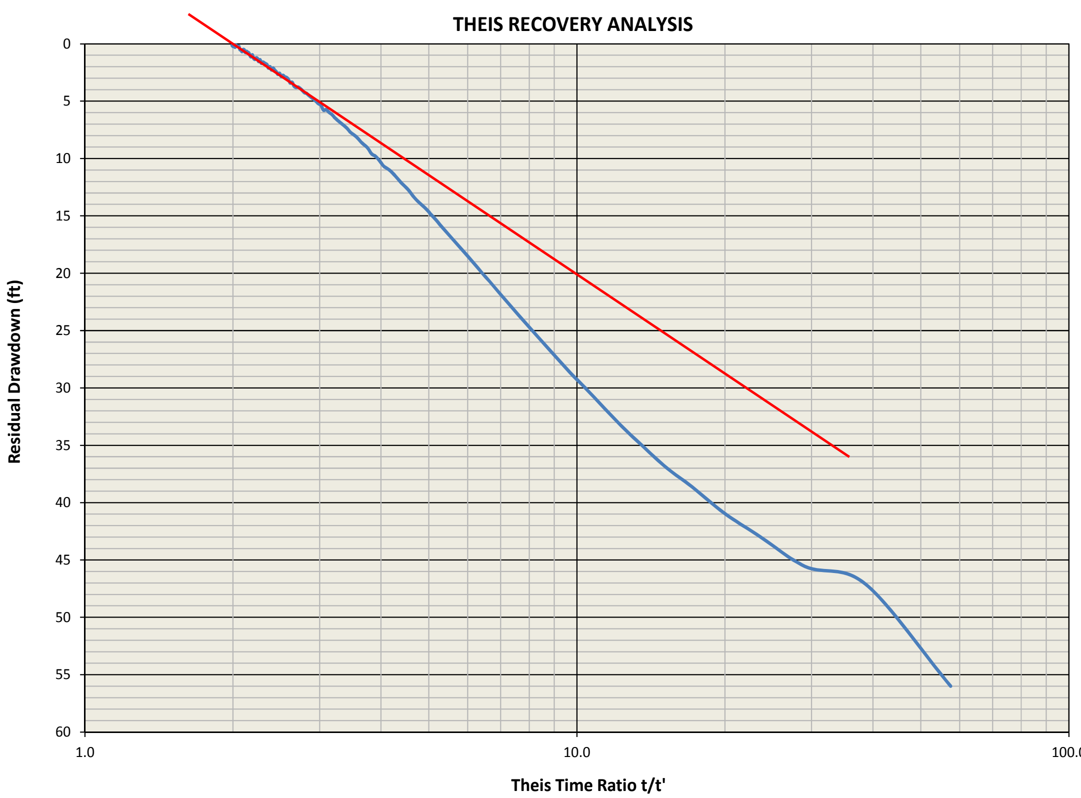
Pogo Mine	srk consulting			**FIGURE B-10, Pg.2** **Pressure Injection Test Analysis** **Drillhole ED-H1-628-3A** **835 ft – 1,115 ft**
	PROJECT NO. 147900.02	DATE July, 2013	VERSION 1.0	



Depth of Test Interval:
835 – 1,115 ft

Pumping Test Duration: 57 min

Pumping Rate (Q) = 3.0 gpm
Pumping Rate (Q) = 578 ft^3/d



Theis Equation:

$$T = \frac{2.3\,Q}{4\pi\Delta s}$$

Where:
T = Transmissivity (ft^2/d)
Q = Pumping Rate (ft^3/d)
$\Delta(s)$ = Drawdown per Log Cycle (ft)

$$T = \frac{2.3\,(578)}{4\pi(27.9)} = 3.79 \text{ ft}^2/\text{d}$$

$$K = \frac{T}{b}$$

Where:
K= Estimate for Hydraulic Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(3.79)}{(280)} = 1.35\text{x}10^{-2} \text{ ft/d}$$

T = 3.79 ft^2/d
K = 1.35x10^{-2} ft/d

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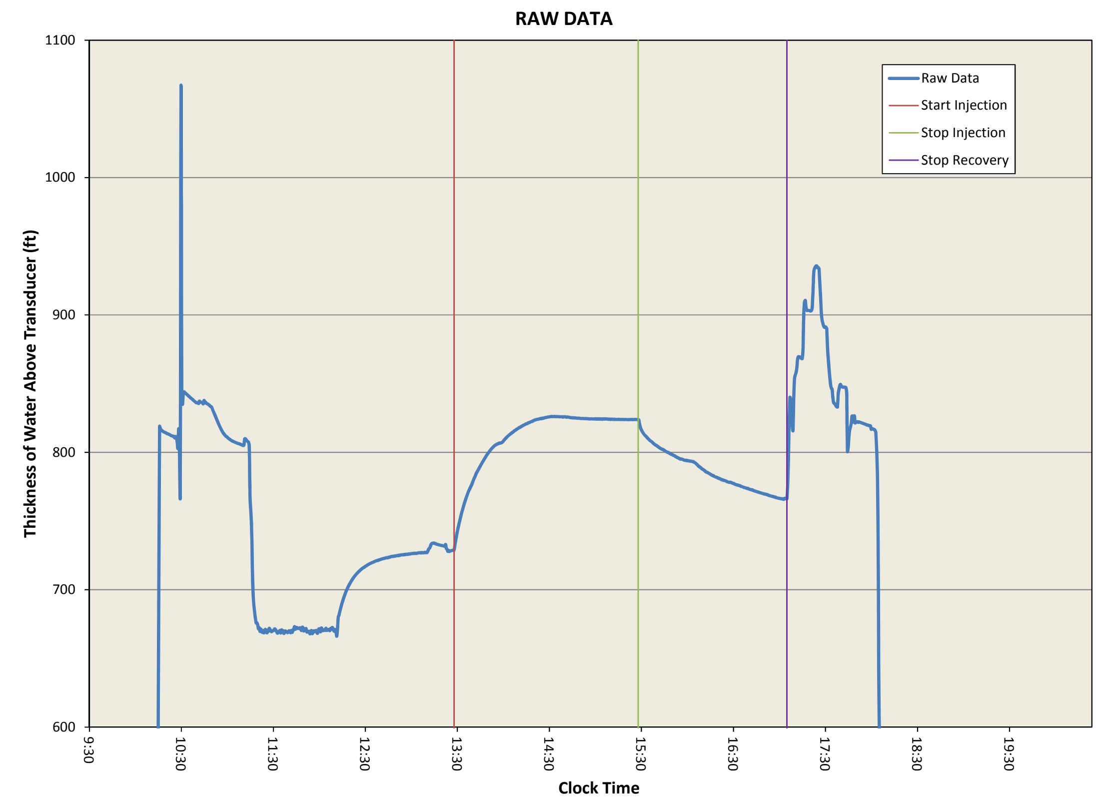
PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

FIGURE B-11
Airlift Recovery Test Analysis
Drillhole ED-H1-628-3B
835 ft – 1,115 ft

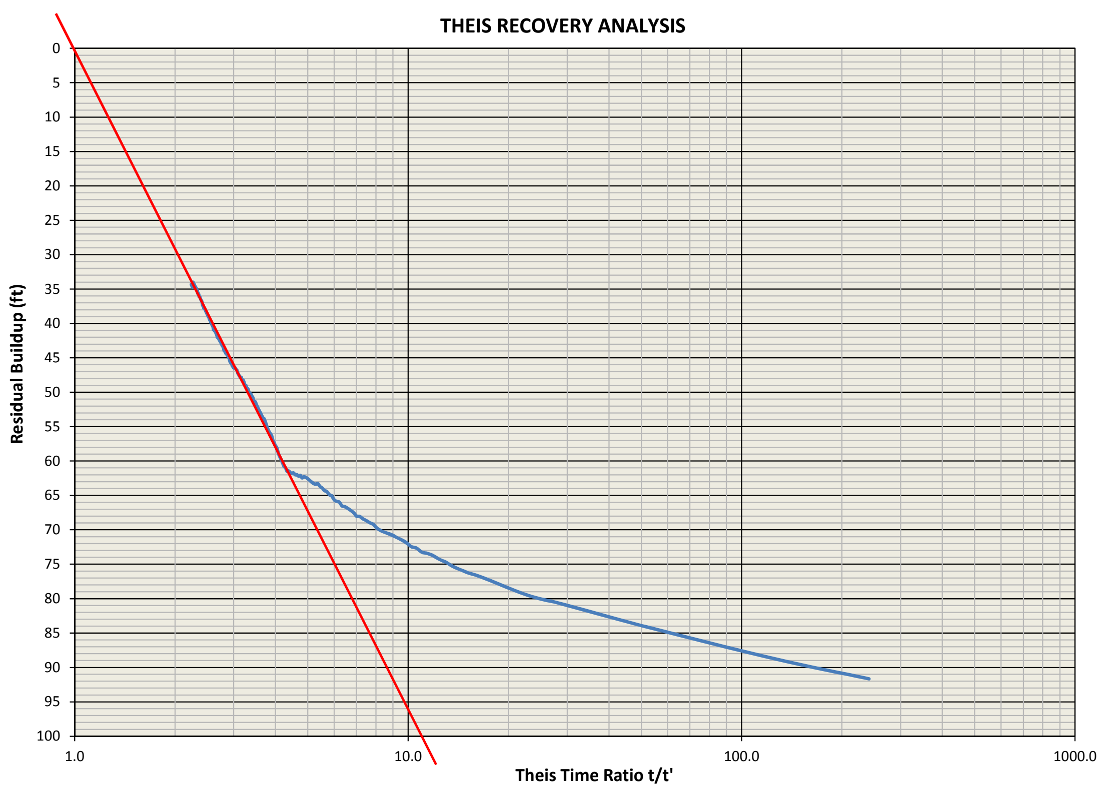


Depth of Test Interval:
835 – 1115 ft

Length of Test Interval: 280 ft

Pumping Test Duration: 120 min

Pumping Rate (Q) = 2.5 gpm
Pumping Rate (Q) = 481 ft^3/d



Theis Equation:

$$T = \frac{2.3\,Q}{4\pi \Delta s}$$

Where:
T = Transmissivity (ft^2/d)
Q = Injection Rate (ft^3/d)
$\Delta(s)$ = Buildup per Log Cycle (ft)

$$T = \frac{2.3\,(481)}{4\pi(96)} = 0.92\ ft^2/d$$

$$K = \frac{T}{b}$$

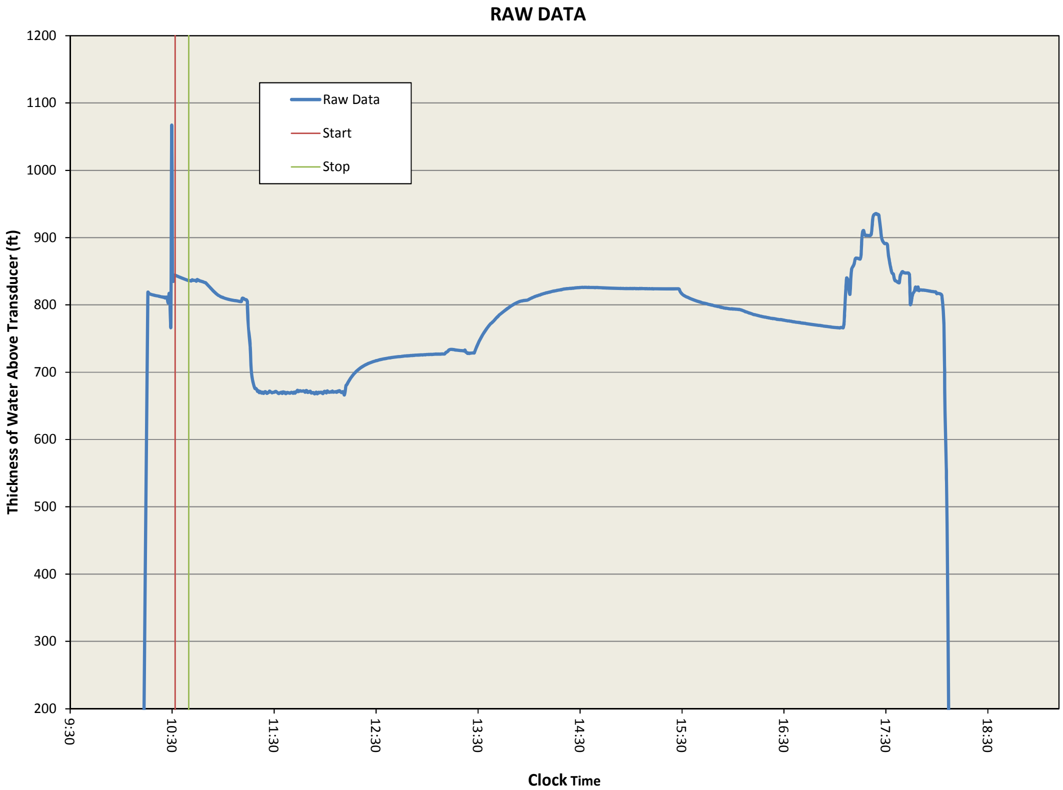
Where:
K= Estimate for Hydraulic Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(0.92)}{(280)} = 3.28\text{x}10^{-3}\ ft/d$$

T = 0.92 ft^2/d
K = 3.28x10^{-3} ft/d

Pogo Mine	srk consulting			FIGURE B-12 Injection Recovery Test Analysis Drillhole ED-H1-628-3C 835 ft – 1,115 ft
	PROJECT NO. 147900.02	DATE July, 2013	VERSION 1.0	

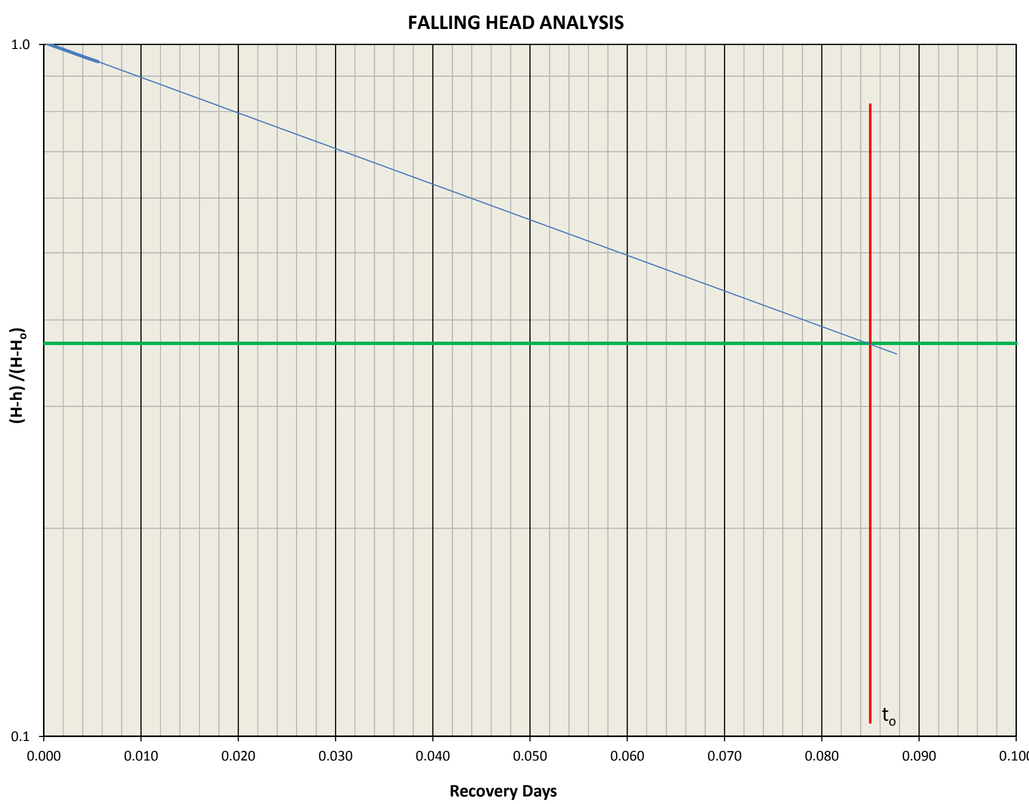
RAW DATA



Depth of Test Interval:
835 – 1,115 ft

Length of Test Interval: 280 ft

FALLING HEAD ANALYSIS



Hvorslev Equation:

$$K = \frac{r^2 \ln(\frac{L}{R})}{2Lto}$$

Where:
K = Estimate of Hydraulic Conductivity (ft/d)
r = Radius of Well Casing (ft)
R = Radius of Well Screen (ft)
L = Length of Test Interval (ft)
t_o = Time for Water Level to Fall 37% of Initial Change (days)

$$K = \frac{(3.1")^2 \ln(280'/3.8")}{2(280')(0.141)}$$

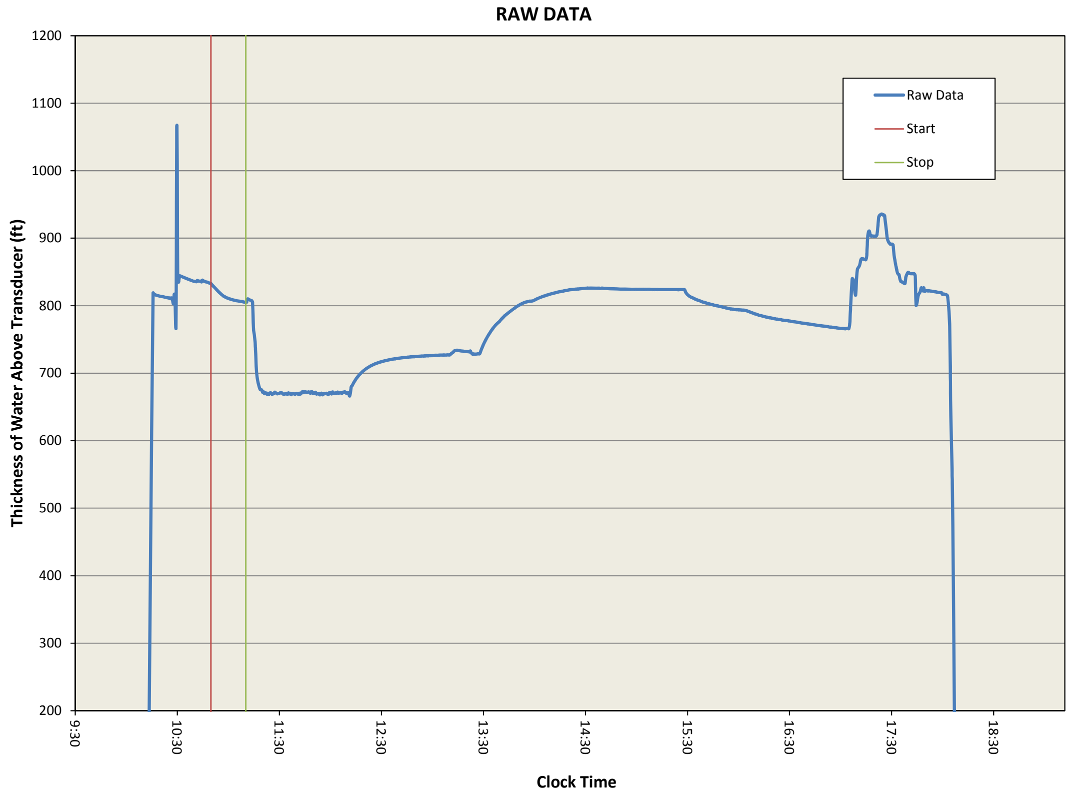
K = 2.62x10^{-3} ft/d

$$T = Kb$$

Where:
T = Transmissivity (ft^2/d)
b = Test Interval Length (ft)

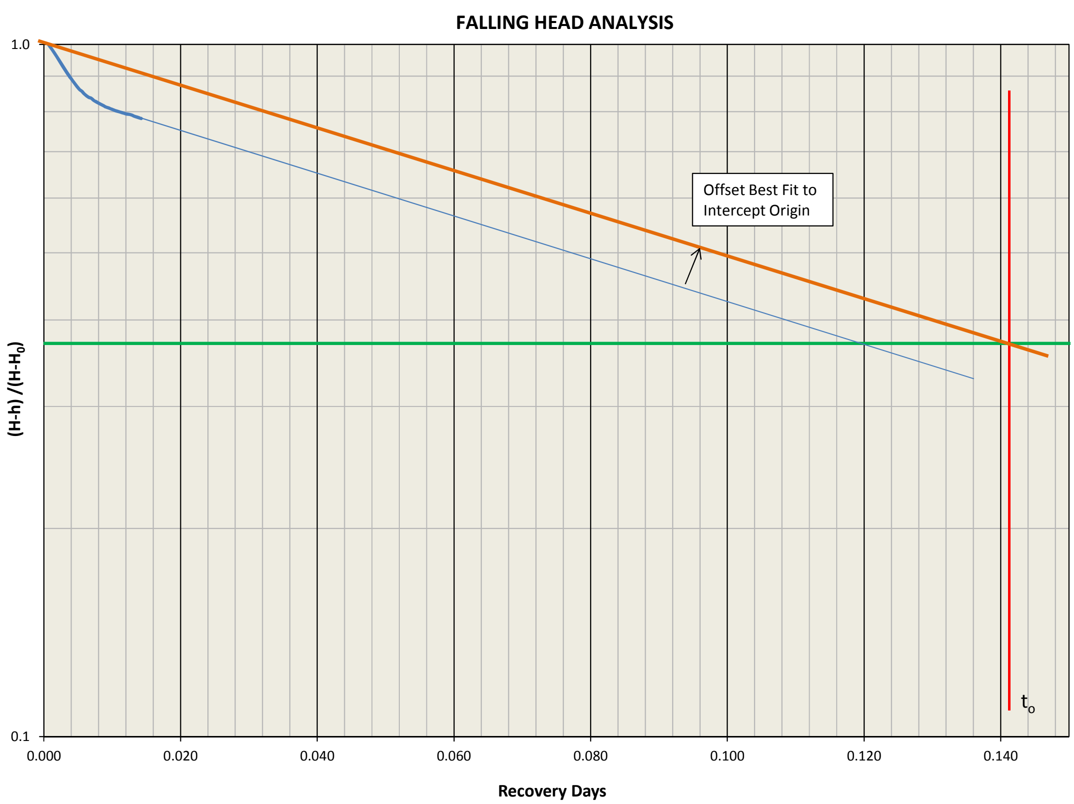
T = 0.73 ft^2/d
K = 2.62x10^{-3} ft/d

Pogo Mine	srk consulting			**FIGURE B-13** Falling Head Test Analysis Drillhole ED-H1-628-3D 835 ft – 1,115 ft
	PROJECT NO. 147900.02	DATE July, 2013	VERSION 1.0	



Depth of Test Interval:
835 – 1115 ft

Length of Test Interval: 280 ft



Hvorslev Equation:

$$K = \frac{r^2 \ln(\frac{L}{R})}{2Lto}$$

Where:
K = Estimate of Hydraulic Conductivity (ft/d)
r = Radius of Well Casing (ft)
R = Radius of Well Screen (ft)
L = Length of Test Interval (ft)
t_o = Time for Water Level to Fall 37% of Initial Change (days)

$$K = \frac{(3.1")^2 \ln(280'/3.8")}{2(280')(0.141)}$$

$K = 1.58x10^{-3}$ ft/d

$$T = Kb$$

Where:
T = Transmissivity (ft^2/d)
b = Test Interval Length (ft)

T = 0.44 ft^2/d
K = 1.58x10^{-3} ft/d

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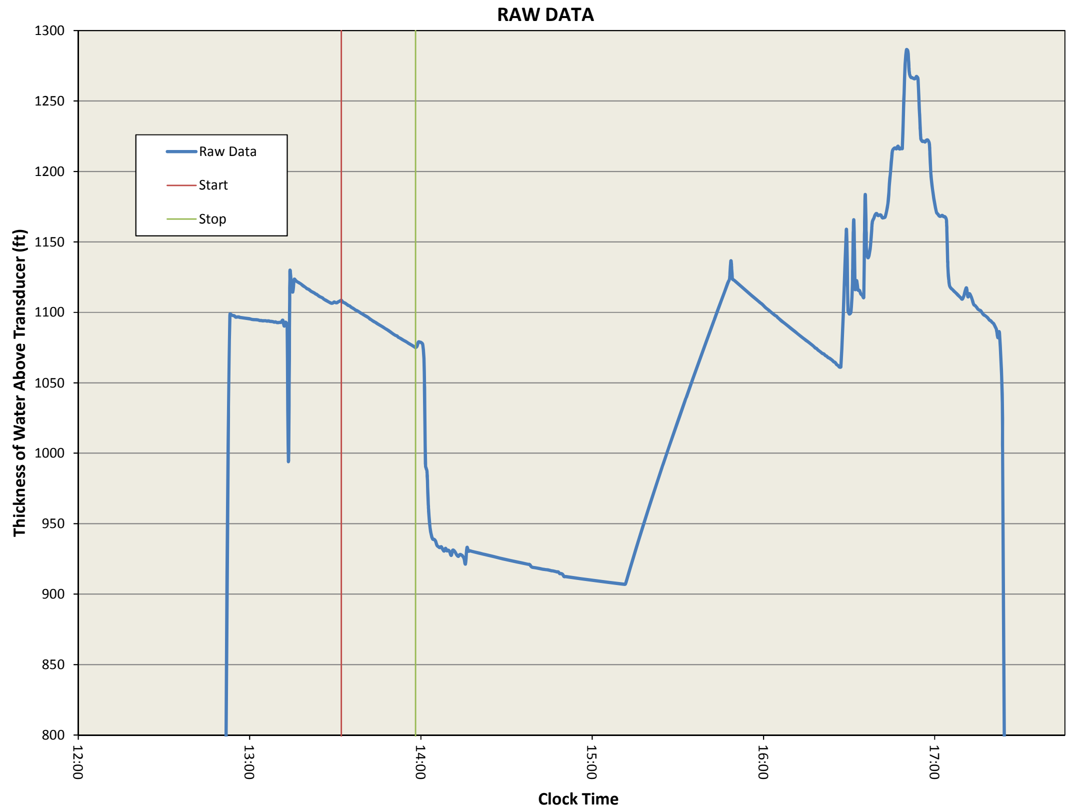
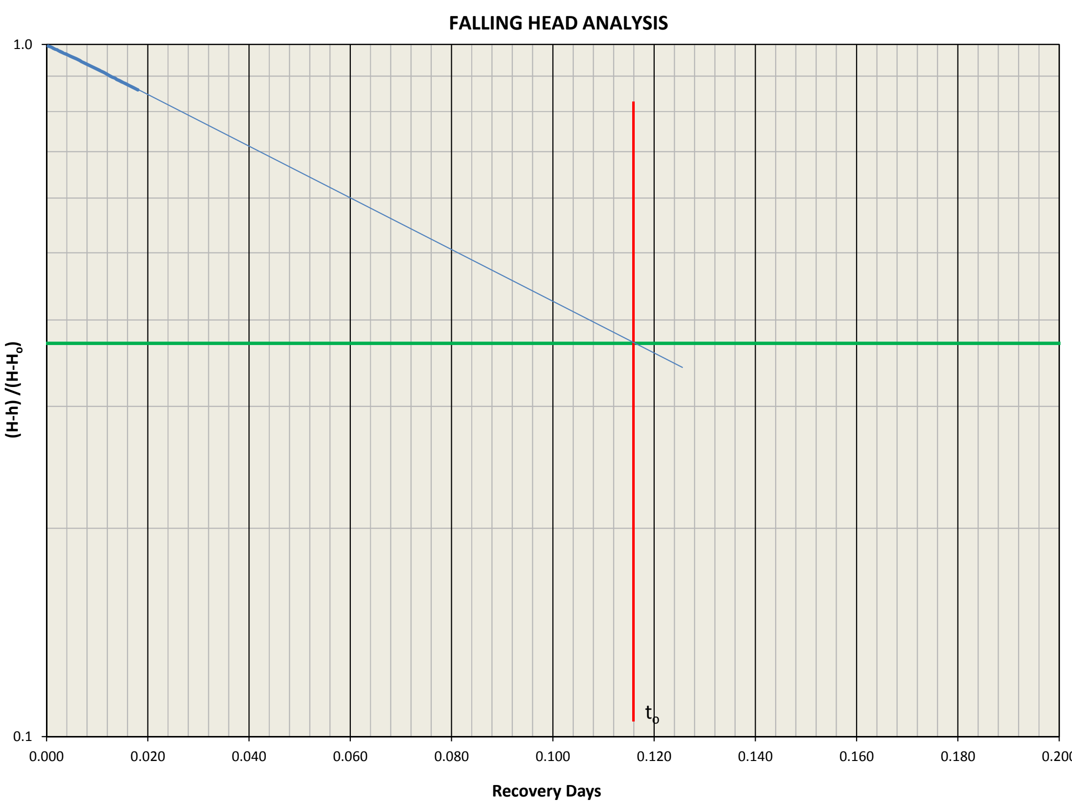
PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

FIGURE B-14
Falling Head Test Analysis
Drillhole ED-H1-628-3E
835 ft – 1115 ft



Depth of Test Interval:
1,115 – 1,515 ft

Length of Test Interval: 400 ft



Hvorslev Equation:

$$K = \frac{r^2 \ln(\frac{L}{R})}{2Lto}$$

Where:
K = Estimate of Hydraulic Conductivity (ft/d)
r = Radius of Well Casing (ft)
R = Radius of Well Screen (ft)
L = Length of Test Interval (ft)
t_o = Time for Water Level to Fall 37% of Initial Change (days)

$$K = \frac{(3.1")^2 \ln(400'/3.8")}{2(400')(0.116)}$$

K = 1.43x10^{-3} ft/d

$$T = Kb$$

Where:
T = Transmissivity (ft^2/d)
b = Test Interval Length (ft)

T = 0.57 ft^2/d
K = 1.43x10^{-3} ft/d

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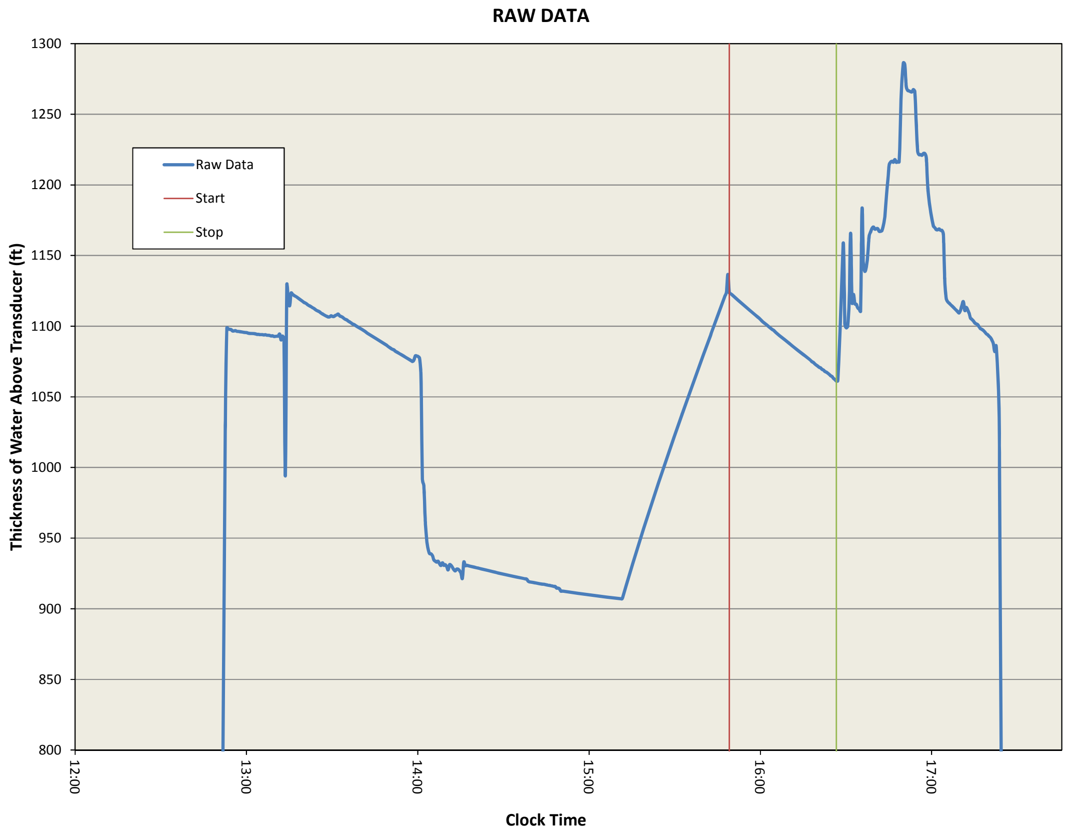
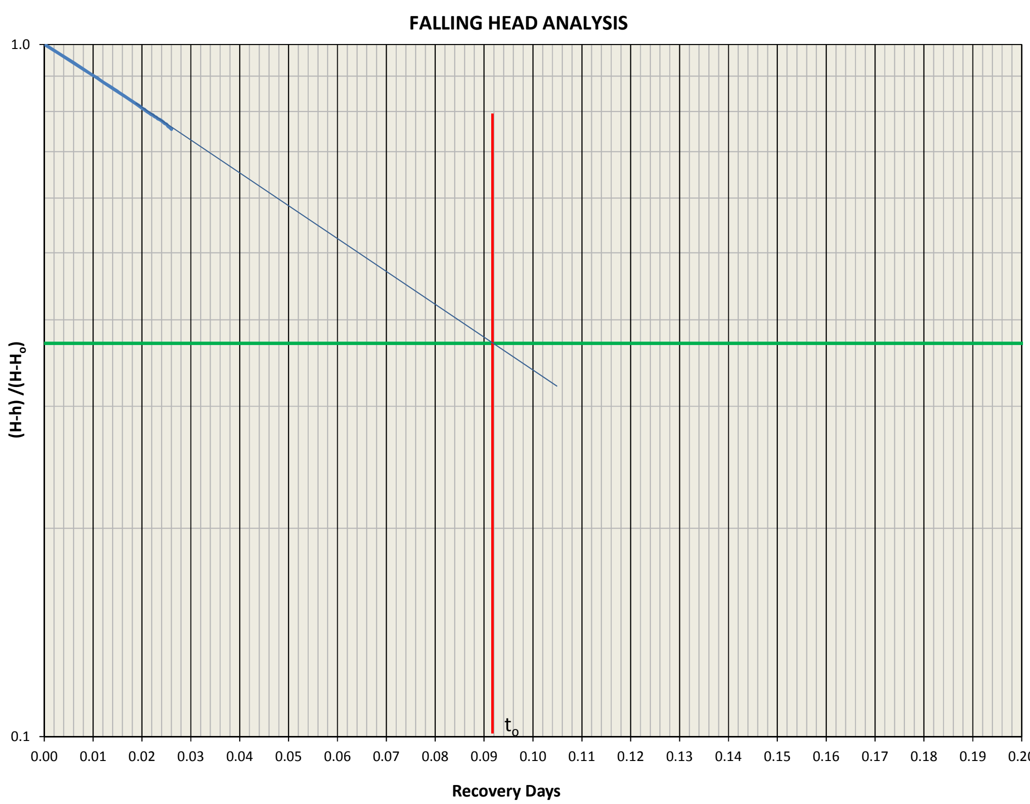
PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

FIGURE B-15
Falling Head Test Analysis
Drillhole ED-H1-628-4A
1,115 ft – 1,515 ft



Depth of Test Interval:
1,115 – 1,515 ft

Length of Test Interval: 400 ft



Hvorslev Equation:

$$K = \frac{r^2 \ln(\frac{L}{R})}{2Lto}$$

Where:
K = Estimate of Hydraulic Conductivity (ft/d)
r = Radius of Well Casing (ft)
R = Radius of Well Screen (ft)
L = Length of Test Interval (ft)
t_o = Time for Water Level to Fall 37% of Initial Change (days)

$$K = \frac{(3.1")^2 \ln(400'/3.8")}{2(400')(0.092)}$$

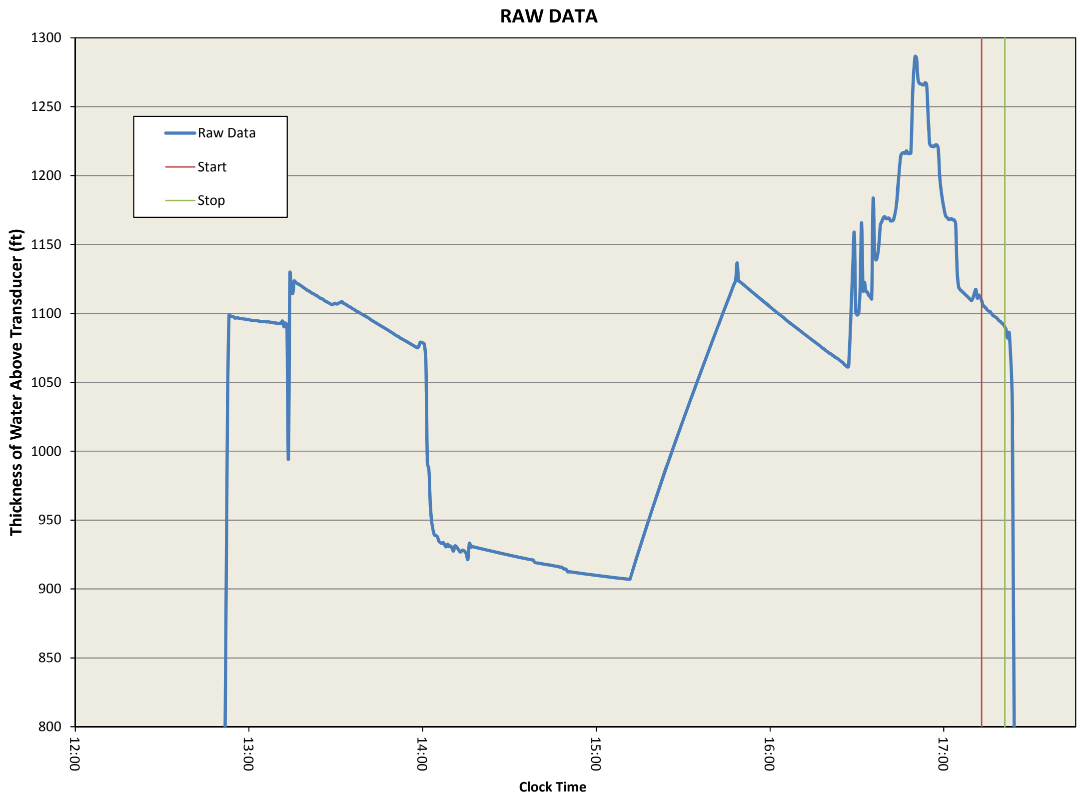
K = 1.77x10^{-3} ft/d

$$T = Kb$$

Where:
T = Transmissivity (ft^2/d)
b = Test Interval Length (ft)

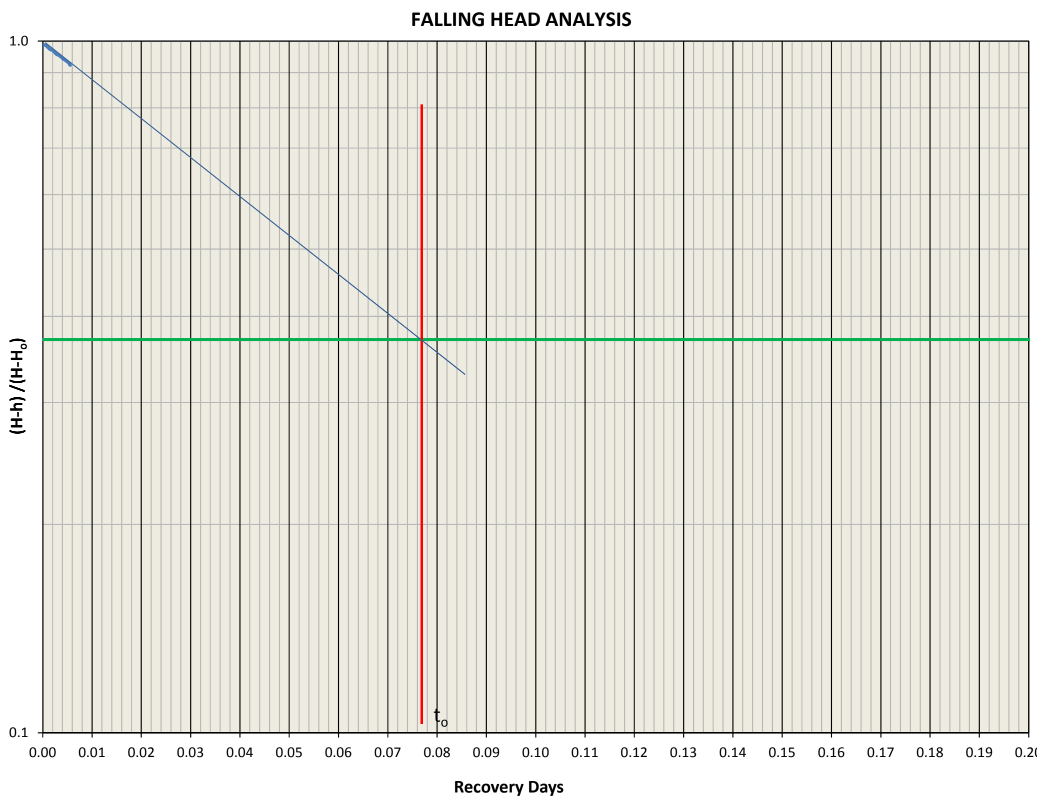
T = 0.71 ft^2/d
K = 1.77x10^{-3} ft/d

Pogo Mine	srk consulting			**FIGURE B-16 Falling Head Test Analysis Drillhole ED-H1-628-4B 1,115 ft – 1,515 ft**
	PROJECT NO. 147900.02	DATE July, 2013	VERSION 1.0	



Depth of Test Interval:
1,115 – 1,515 ft

Length of Test Interval: 400 ft



Hvorslev Equation:

$$K = \frac{r^2 \ln(\frac{L}{R})}{2Lto}$$

Where:
K = Estimate of Hydraulic Conductivity (ft/d)
r = Radius of Well Casing (ft)
R = Radius of Well Screen (ft)
L = Length of Test Interval (ft)
t_o = Time for Water Level to Fall 37% of Initial Change (days)

$$K = \frac{(3.1")^2 \ln(400'/3.8")}{2(400')(0.077)}$$

$K = 2.12 \times 10^{-3}$ ft/d

$$T = Kb$$

Where:
T = Transmissivity (ft^2/d)
b = Test Interval Length (ft)

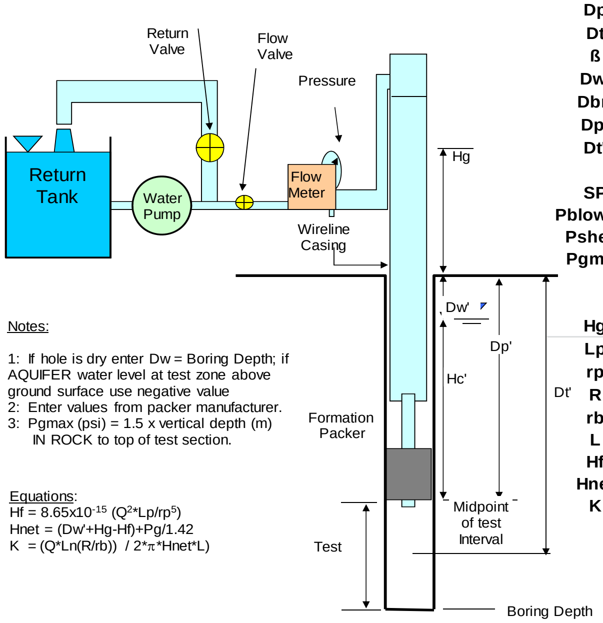
T = 0.85 ft^2/d
K = 2.12×10^{-3} ft/d

Pogo Mine	srk consulting			**FIGURE B-17** **Falling Head Test Analysis** **Drillhole ED-H1-628-4C** **1,115 ft – 1,515 ft**
	PROJECT NO. 147900.02	DATE July, 2013	VERSION 1.0	

Project:	Pogo	Test Interval (m):	339.9	to:	461.9	Drillhole Nº	ED-H1-12-628
UTM (x,y)		Start Date:	18-Sep-12	Time:	13:00		
Datum:	WGS 84	End Date:	18-Sep-12	Time:	15:00	Test No.	4
GS Elevation:		Personnel:	JB, BF, SG			DH Depth (m)	461.9

Max Injection Pressure (psi): 502

Symbol	Description	Value	Unit
Dw	Measured depth of static water level (1)	65.5	m
Dbr	Measured depth to bedrock	6.1	m
Dp	Measured depth to packer	339.9	m
Dt	Measured depth to midpoint of test	400.9	m
ß	Inclination from horizontal (degrees)	80	º
Dw'	Vertical depth to static water level	64.6	m
Dbr'	Vertical depth to bedrock	6.0	m
Dp'	Vertical depth to packer	334.8	m
Dt'	Vertical depth to midpoint of test	394.8	m
SP	Shear Pin Rating (psi)	500	psi
Pblowout	Water column pressure in drill rods at plug	475	psi
Pshear	Est. differential shear pressure required	500	psi
Pgmax	Maximum injection gauge pressure (3)	583	psi
Hg	Gauge height	2.0	m
Lp	Length of discharge pipe	10.00	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0127	m
R	Radius of influence (10 m is standard value)	10	m
rb	BH radius (HQ=0.048m, NQ=0.038m)	0.048	m
L	Length of test section	122.0	m
Hf	Friction Loss		
Hnet	Net injection head at midpoint of test		
K	Hydraulic conductivity		



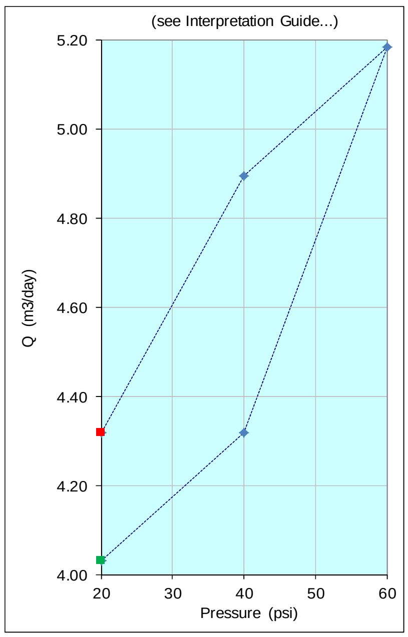
Notes:

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) IN ROCK to top of test section.

Equations:
$Hf = 8.65x10^{-15} (Q^2*Lp/rp^5)$
$Hnet = (Dw'+Hg-Hf)+Pg/1.42$
$K = (Q*Ln(R/rb)) / 2*\pi*Hnet*L)$

Conversion Factors:
10 m of water = 0.9807 bar = 1kg/cm² = 14.2 psi
1 cm/sec = 864 m/day
1 Lugeon = 1 lit/min per meter at 10 bar, which is approx. 1.4 x 10⁻⁵ cm/sec

Measurement (show last 3 to 5 flow meter 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
	20	40	60	40	20
1	1.6	1.8	2.0	1.5	1.5
2	1.5	1.8	1.9	2.0	1.6
3	1.5	1.6	2.1	1.7	1.6
4	1.5	2.0	2.2	1.8	1.6
5	1.5	1.6	1.9	1.9	1.6
Stable Q (L/30sec)	1.5	1.6	1.9	1.8	1.6
Leak Q (L/30sec)	0.10	0.10	0.10	0.10	0.10
Q (m³/day)	4.0	4.3	5.2	4.9	4.3
Hf (m)	0.00	0.00	0.01	0.01	0.00
Hnet (m)	80.6	94.7	108.8	94.7	80.6
K (m/day)	3.5E-04	3.2E-04	3.3E-04	3.6E-04	3.7E-04
K (m/s)	**4.0E-09**	**3.7E-09**	**3.8E-09**	**4.2E-09**	**4.3E-09**
+/- (m/s)	4.8E-10	5.7E-10	3.2E-10	8.0E-11	1.9E-10
+/- order of mag.	0.05	0.06	0.03	0.01	0.02



Test Interval	
Geology	
Fracture Freq-Rock Quality	
Packer Seal	
Flow Meter Problems	
Measurement Accuracy	
Temperature	
Other Problems	

Test Interpretation
K Value (m/day)
3.4.E-04
K Value (ft/day)
1.1.E-03
"Type Curve Interpretation"

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PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

FIGURE B-18, Pg.1
Pressure Injection Test Analysis
Drillhole ED-H1-628-4D
1,115 ft – 1,515 ft

Pressure oscillation during test

Pressure step	P_g (psi) Step 1	P_g (psi) Step 2	P_g (psi) Step 3	P_g (psi) Step 4	P_g (psi) Step 5
Min P during step	19	38	56	37	19
Max P during step	22	42	64	43	21
average pressure +/- psi	1.5	2	4	3	1

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)	4.32	4.61	5.47	5.18	4.61
Hf (m)	0.00	0.01	0.01	0.01	0.01
Hnet (m)	79.6	93.3	106.0	92.6	79.9
K (m/sec)	4.4E-09	4.0E-09	4.2E-09	4.5E-09	4.6E-09

Low estimate of K

Q_{avg} (m^3/day)	3.74	4.03	4.90	4.61	4.03
Hf (m)	0.00	0.00	0.01	0.01	0.00
Hnet (m)	81.7	96.1	111.6	96.8	81.3
K (m/sec)	3.7E-09	3.4E-09	3.5E-09	3.8E-09	4.0E-09

K averages for P step

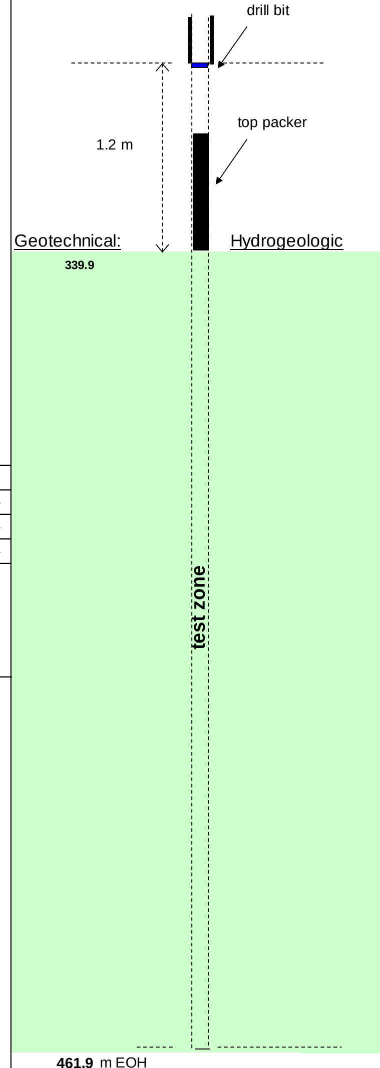
P	20	40	60
high est of K	5.E-09	4.E-09	4.E-09
average K	4.E-09	4.E-09	4.E-09
low est of K	4.E-09	4.E-09	4.E-09

K avg all P steps

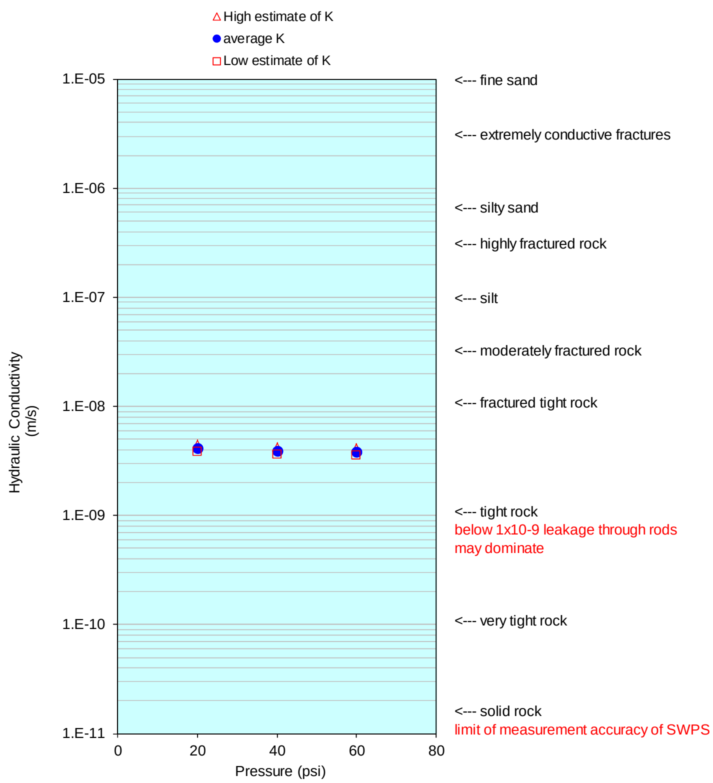
	m/sec	m/day
MAX	4.5.E-09	3.9.E-04
geomean	4.0.E-09	3.4.E-04
MIN	3.5.E-09	3.1.E-04

Test Comments	

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



Graph of estimated hydraulic conductivity and error bounds.



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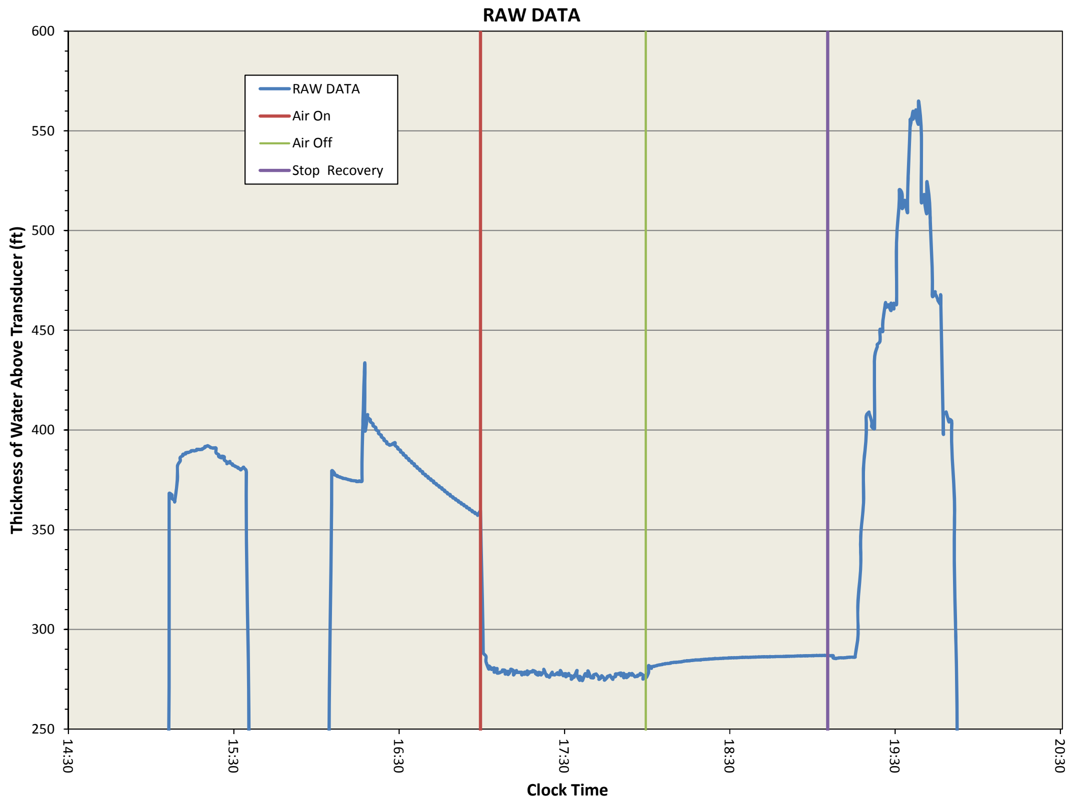
PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

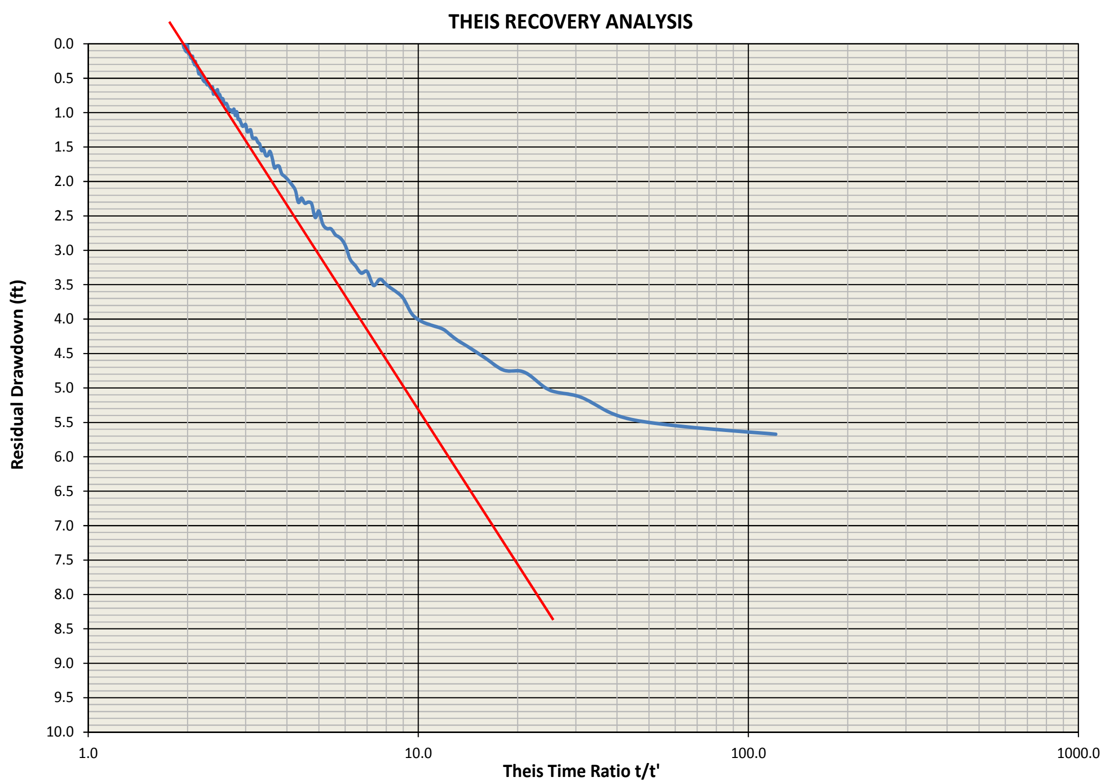
FIGURE B-18, Pg.2
Pressure Injection Test Analysis
Drillhole ED-H1-628-4D
1,115 ft – 1,515 ft



Depth of Test Interval:
400 – 917 ft

Pumping Test Duration: 60 min

Pumping Rate (Q) = 5.0 gpm
Pumping Rate (Q) = 963 ft^3/d



Theis Equation:

$$T = \frac{2.3\ Q}{4\pi\Delta s}$$

Where:
T = Transmissivity (ft^2/d)
Q = Pumping Rate (ft^3/d)
$\Delta(s)$ = Drawdown per Log Cycle (ft)

$$T = \frac{2.3\ (963)}{4\pi(7.5)} = 23.3\ ft^2/d$$

$$K = \frac{T}{b}$$

Where:
K= Estimate for Hydraulic Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(23.3)}{(517)} = 4.52x10^{-2}\ ft/d$$

T = 23.3 ft^2/d
K = 4.52x10^{-2} ft/d

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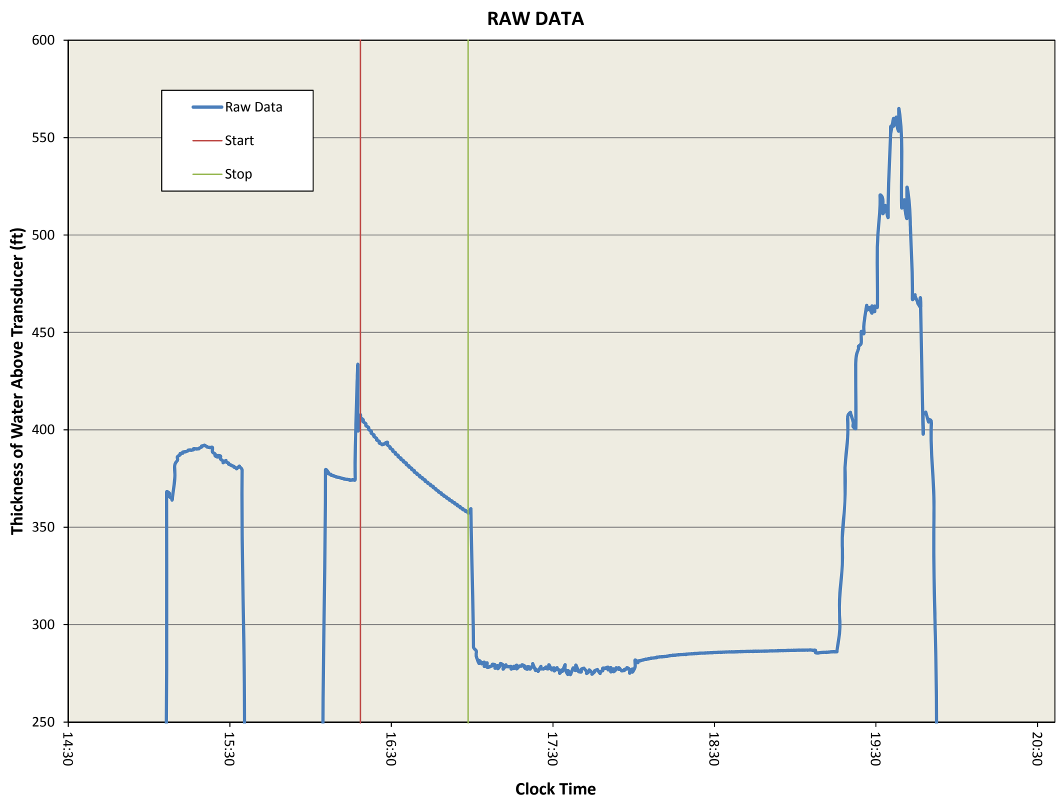
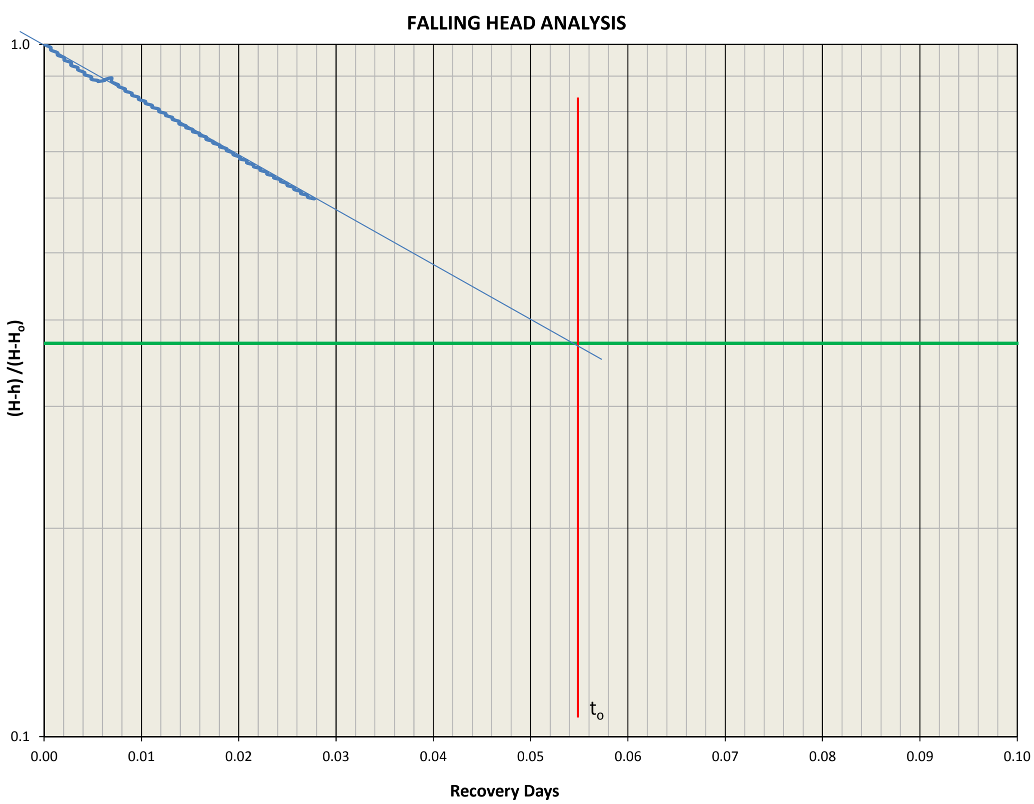
PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

FIGURE B-19
Airlift Recovery Test Analysis
Drillhole ED-H2-630-2A
400 ft – 917 ft



Depth of Test Interval:
400 – 917 ft

Length of Test Interval: 517 ft



Hvorslev Equation:

$$K = \frac{r^2 \ln(\frac{L}{R})}{2Lto}$$

Where:
K = Estimate of Hydraulic Conductivity (ft/d)
r = Radius of Well Casing (ft)
R = Radius of Well Screen (ft)
L = Length of Test Interval (ft)
t_o = Time for Water Level to Fall 37% of Initial Change (days)

$$K = \frac{(3.1")^2 \ln(517'/3.8")}{2(517')(0.055)}$$

$K = 2.37\text{x}10^{-3}$ ft/d

$$T = Kb$$

Where:
T = Transmissivity (ft^2/d)
b = Test Interval Length (ft)

T = 1.23 ft^2/d
K = $2.37\text{x}10^{-3}$ ft/d

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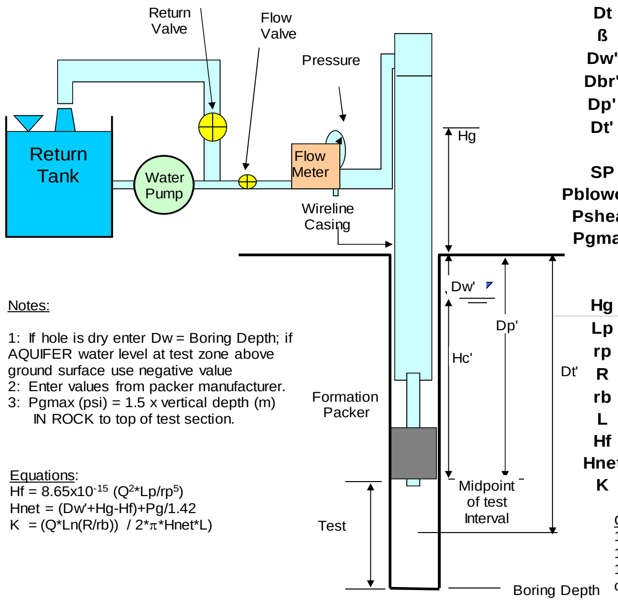
PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

FIGURE B-20
Falling Head Test Analysis
Drillhole ED-H2-630-2B
400 ft – 917 ft

Project:	**POGO**	**Test Interval (m):**	**122.0**	**to:**	**279.6**	**Drillhole Nº**	**ED-H2-12-630**
UTM (x,y)		**Start Date:**	**24-Sep-12**	**Time:**	**18:00**		
Datum:	**WGS 84**	**End Date:**	**24-Sep-12**	**Time:**	**18:30**	**Test No.**	**2**
GS Elevation:		**Personnel:**	**BF**			**DH Depth (m)**	**279.6**

Max Injection Pressure (psi)

180



Dw	Measured depth of static water level (1)	34.6	m
Dbr	Measured depth to bedrock	6.1	m
Dp	Measured depth to packer	**122.0**	m
Dt	Measured depth to midpoint of test	**200.8**	m
ß	Inclination from horizontal (degrees)	80	º
Dw'	Vertical depth to static water level	**34.1**	m
Dbr'	Vertical depth to bedrock	**6.0**	m
Dp'	Vertical depth to packer	**120.1**	m
Dt'	Vertical depth to midpoint of test	**197.7**	m
SP	Shear Pin Rating (psi)	500	psi
Pblowout	Water column pressure in drill rods at plug	**171**	psi
Pshear	Est. differential shear pressure required	**500**	psi
Pgmax	Maximum injection gauge pressure (3)	**288**	psi
Hg	Gauge height	2.0	m
Lp	Length of discharge pipe	10.00	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0127	m
R	Radius of influence (10 m is standard value)	10	m
rb	BH radius (HQ=0.048m, NQ=0.038m)	0.048	m
L	Length of test section	**157.6**	m
Hf	Friction Loss		
Hnet	Net injection head at midpoint of test		
K	Hydraulic conductivity		

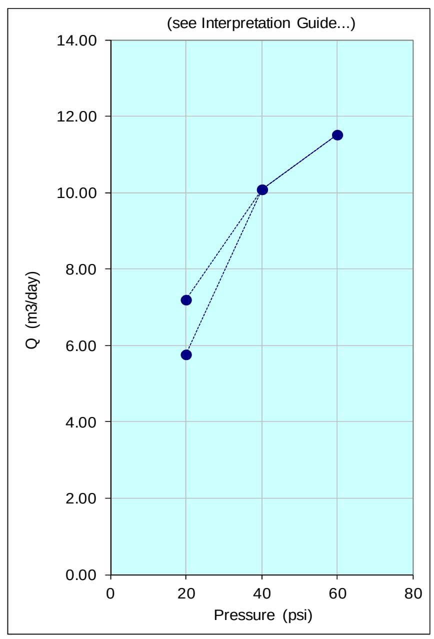
Notes:

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) IN ROCK to top of test section.

Equations:
$Hf = 8.65 \times 10^{-15} (Q^2 * Lp/rp^5)$
$Hnet = (Dw' + Hg - Hf) + Pg/1.42$
$K = (Q * Ln(R/rb)) / 2 * \pi * Hnet * L)$

Conversion Factors:
10 m of water = 0.9807 bar = 1kg/cm^2 = 14.2 psi
1 cm/sec = 864 m/day
1 Lugeon = 1 lit/min per meter at 10 bar, which is approx. 1.4 x 10^{-5} cm/sec

Measurement (show last 3 to 5 flow meter 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**
	20	**40**	**60**	**40**	**20**
1	**3.00**	**3.00**	**5.00**	**4.00**	**2.00**
2	**2.00**	**4.00**	**4.00**	**3.00**	**2.00**
3	**3.00**	**3.00**	**4.00**	**4.00**	**3.00**
4	**2.00**	**3.00**	**4.00**	**3.00**	**2.00**
5	**3.00**	**4.00**	**4.00**	**3.00**	**3.00**
Stable Q (L/30sec)	**2.50**	**3.50**	**4.00**	**3.50**	**2.00**
Leak Q (L/30sec)					
Q (m^3/day)	7.2	10.1	11.5	10.1	5.8
Hf (m)	0.01	0.03	0.03	0.03	0.01
Hnet (m)	50.1	64.2	78.3	64.2	50.2
K (m/day)	7.7E-04	8.5E-04	7.9E-04	8.5E-04	6.2E-04
K (m/s)	**9.0E-09**	**9.8E-09**	**9.2E-09**	**9.8E-09**	**7.2E-09**
+/- (m/s)	-9.0E-10	0.0E+00	0.0E+00	0.0E+00	9.0E-10
+/- order of mag.	-0.05	0.00	0.00	0.00	0.05



Test Interval	
Geology	
Fracture Freq-Rock Quality	
Packer Seal	
Flow Meter Problems	
Measurement Accuracy	
Temperature	
Other Problems	

Test Interpretation
K Value (m/day)
7.8.E-04
K Value (ft/day)
2.5.E-03
"Type Curve Interpretation"

Pogo Mine

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PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

FIGURE B-21, Pg.1
Pressure Injection Test Analysis
Drillhole ED-H2-630-2C
400 ft – 917 ft

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	20	40	60	40	20
Max P during step	20	40	60	40	20
average pressure +/- psi					

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec					

High estimate of K

Q_{avg} (m^3/day)	7.20	10.08	11.52	10.08	5.76
Hf (m)	0.01	0.03	0.03	0.03	0.01
Hnet (m)	50.1	64.2	78.3	64.2	50.2
K (m/sec)	9.0E-09	9.8E-09	9.2E-09	9.8E-09	7.2E-09

Low estimate of K

Q_{avg} (m^3/day)	7.20	10.08	11.52	10.08	5.76
Hf (m)	0.01	0.03	0.03	0.03	0.01
Hnet (m)	50.1	64.2	78.3	64.2	50.2
K (m/sec)	9.0E-09	9.8E-09	9.2E-09	9.8E-09	7.2E-09

K averages for P step

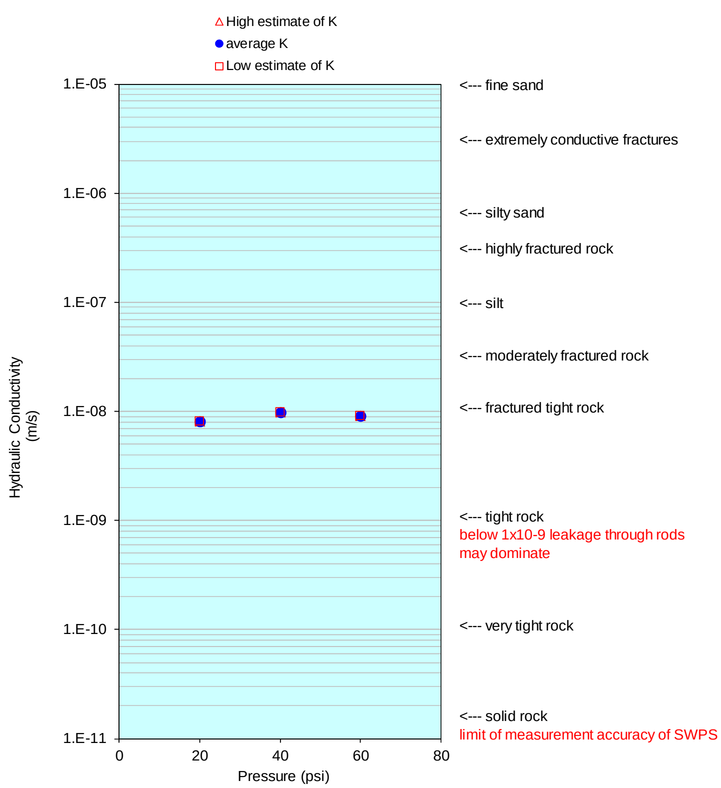
P	20	40	60
high est of K	8.E-09	1.E-08	9.E-09
average K	8.E-09	1.E-08	9.E-09
low est of K	8.E-09	1.E-08	9.E-09

K avg all P steps

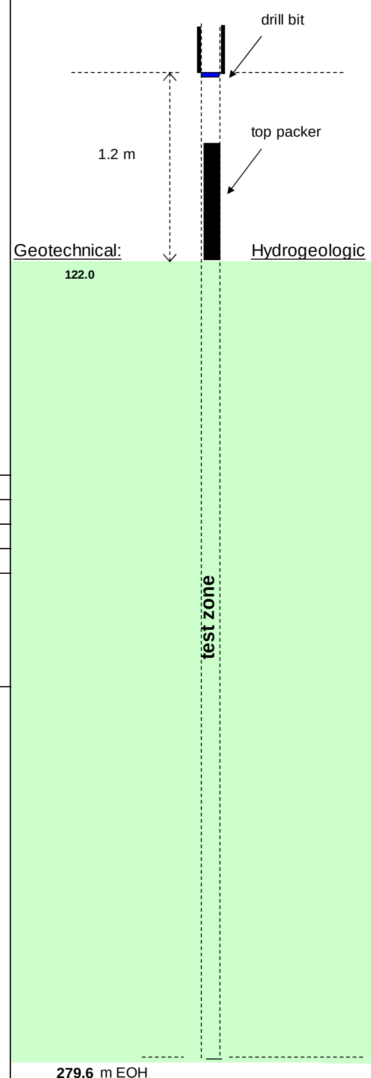
	m/sec	m/day
MAX	9.8.E-09	8.5.E-04
geomean	9.0.E-09	7.8.E-04
MIN	8.1.E-09	7.0.E-04

Test Comments	

Graph of estimated hydraulic conductivity and error bounds.



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



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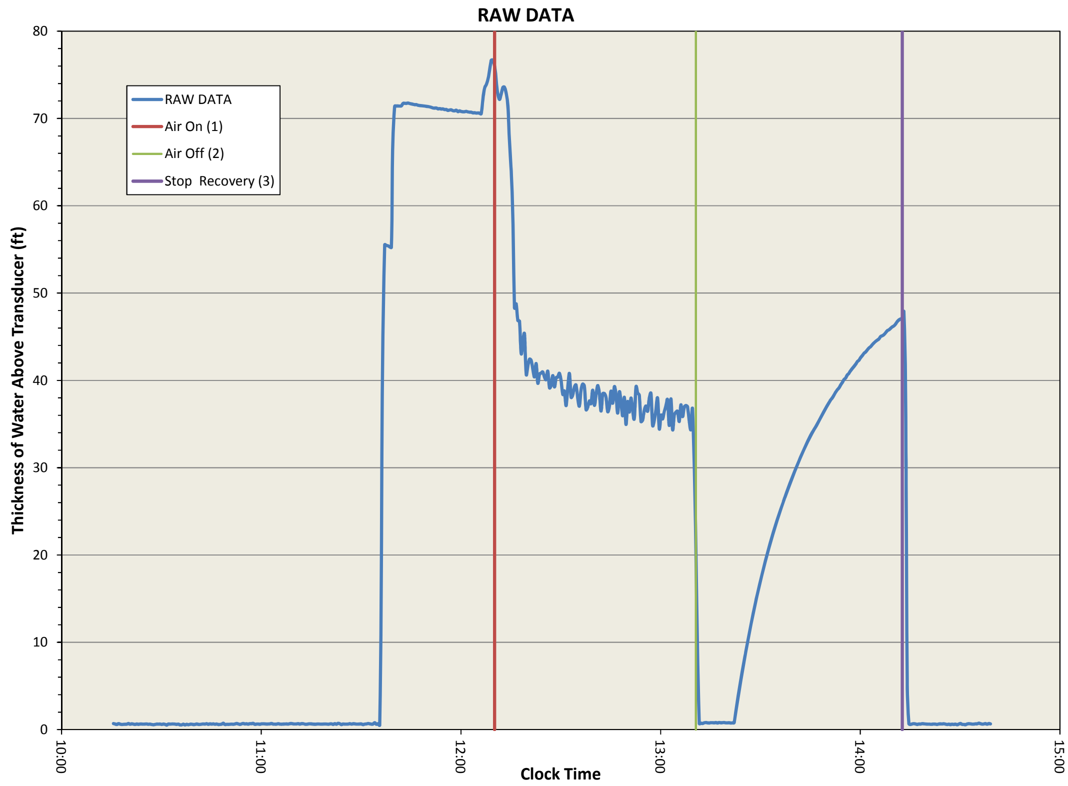
147900.02	July, 2013	1.0

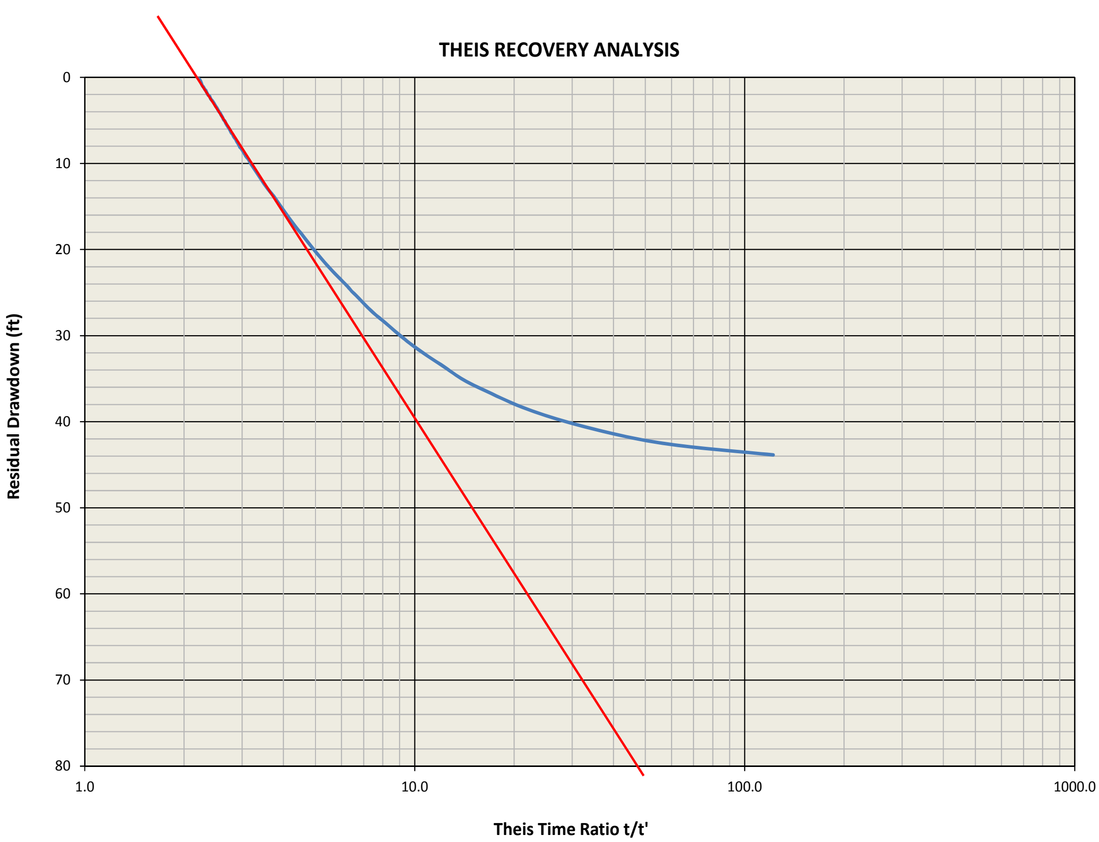
FIGURE B-21, Pg.2
Pressure Injection Test Analysis, Pg.2
Drillhole ED-H2-630-2C
400 ft – 917 ft



Depth of Test Interval:
200 – 917 ft

Pumping Test Duration: 61 min

Pumping Rate (Q) = 8.0 gpm
Pumping Rate (Q) = 1,540 ft^3/d



Theis Equation:

$$T = \frac{2.3\,Q}{4\pi\Delta s}$$

Where:
T = Transmissivity (ft^2/d)
Q = Pumping Rate (ft^3/d)
$\Delta(s)$ = Drawdown per Log Cycle (ft)

$$T = \frac{2.3\,(1{,}540)}{4\pi(60)} = 4.69\ ft^2/d$$

$$K = \frac{T}{b}$$

Where:
K= Estimate for Hydraulic Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(4.69)}{(717)} = 6.55x10^{-3}\ ft/d$$

T = 4.69 ft^2/d
K = 6.55x10^{-3} ft/d

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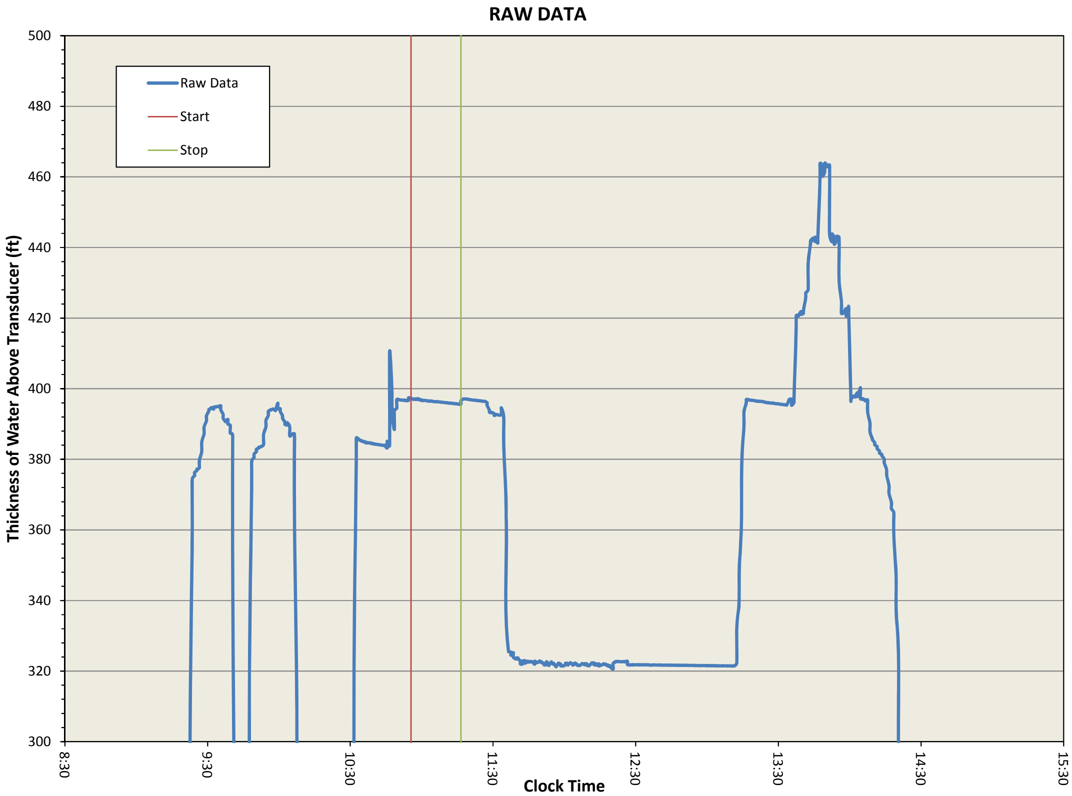
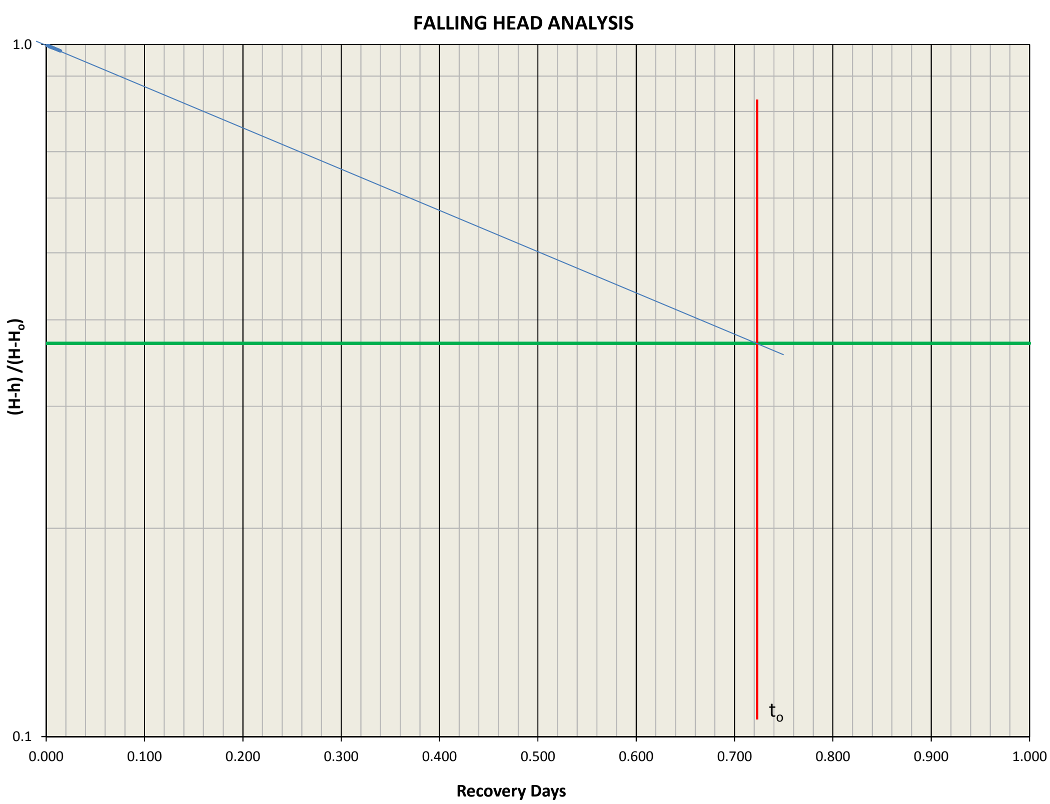
147900.02	July, 2013	1.0

FIGURE B-22
Airlift Recovery Test Analysis
Drillhole ED-H2-630-3A
200 ft – 917 ft



Depth of Test Interval:
907 – 1,450 ft

Length of Test Interval: 543 ft



Hvorslev Equation:

$$K = \frac{r^2 \ln(\frac{L}{R})}{2Lto}$$

Where:
K = Estimate of Hydraulic Conductivity (ft/d)
r = Radius of Well Casing (ft)
R = Radius of Well Screen (ft)
L = Length of Test Interval (ft)
t_o = Time for Water Level to Fall 37% of Initial Change (days)

$$K = \frac{(3.1")^2 \ln(543'/3.8")}{2(543')(0.722)}$$

$K = 1.73\text{x}10^{-4}$ ft/d

$$T = Kb$$

Where:
T = Transmissivity (ft^2/d)
b = Test Interval Length (ft)

T = 0.09 ft^2/d
K = $1.73\text{x}10^{-4}$ ft/d

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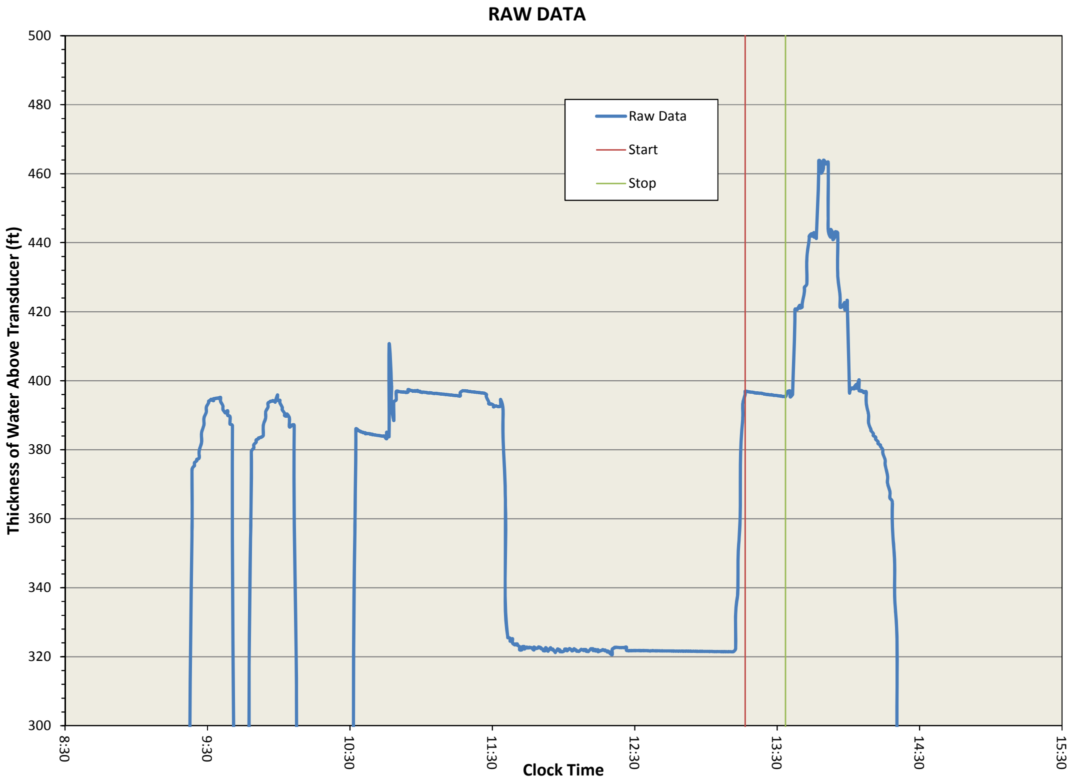
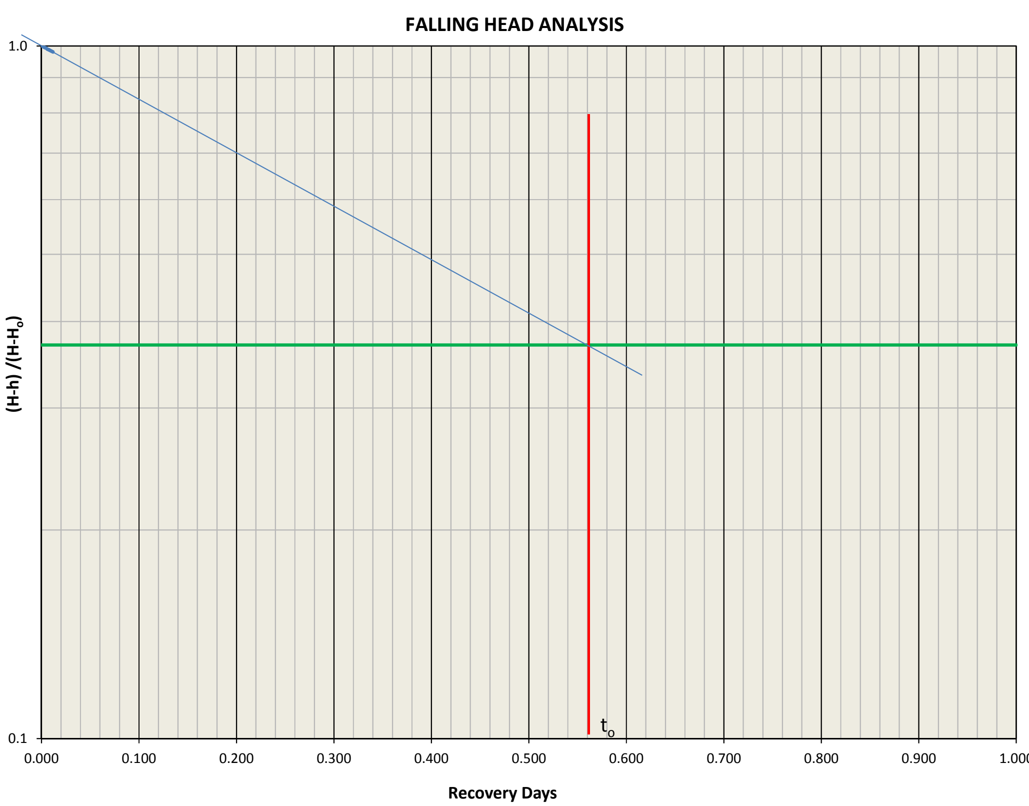
PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

FIGURE B-23
Falling Head Test Analysis
Drillhole ED-H2-630-4A
907 ft – 1,450 ft



Depth of Test Interval: 907 – 1,450 ft

Length of Test Interval: 543 ft



Hvorslev Equation:

$$K = \frac{r^2 \ln(\frac{L}{R})}{2Lto}$$

Where:
K = Estimate of Hydraulic Conductivity (ft/d)
r = Radius of Well Casing (ft)
R = Radius of Well Screen (ft)
L = Length of Test Interval (ft)
t_o = Time for Water Level to Fall 37% of Initial Change (days)

$$K = \frac{(3.1")^2 \ln(543'/3.8")}{2(543')(0.56)}$$

K = 2.23x10^{-4} ft/d

$$T = Kb$$

Where:
T = Transmissivity (ft^2/d)
b = Test Interval Length (ft)

T = 0.12 ft^2/d
K = 2.23x10^{-4} ft/d

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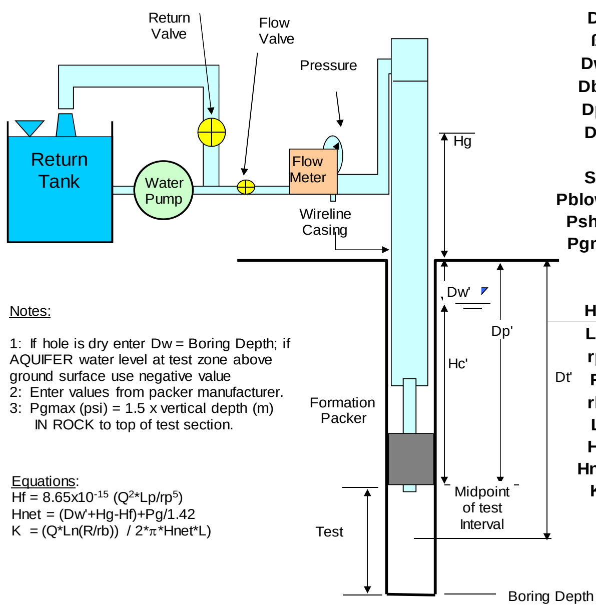
PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

FIGURE B-24
Falling Head Test Analysis
Drillhole ED-H2-630-4B
907 ft – 1,450 ft

Project:	POGO	Test Interval (m):	276.5	to:	442.1	Drillhole Nº	ED-H2-12-630
UTM (x,y)		Start Date:	29-Sep-12	Time:	13:40		
Datum:	WGS 84	End Date:	29-Sep-12	Time:	16:00	Test No.	4
GS Elevation:		Personnel:	BF			DH Depth (m)	442.1

Max Injection Pressure (psi)

408



Dw	Measured depth of static water level (1)	179.0	m
Dbr	Measured depth to bedrock	6.1	m
Dp	Measured depth to packer	276.5	m
Dt	Measured depth to midpoint of test	359.3	m
ß	Inclination from horizontal (degrees)	80	º
Dw'	Vertical depth to static water level	176.3	m
Dbr'	Vertical depth to bedrock	6.0	m
Dp'	Vertical depth to packer	272.3	m
Dt'	Vertical depth to midpoint of test	353.8	m
SP	Shear Pin Rating (psi)	500	psi
Pblowout	Water column pressure in drill rods at plug	387	psi
Pshear	Est. differential shear pressure required	500	psi
Pgmax	Maximum injection gauge pressure (3)	522	psi
Hg	Gauge height	2.0	m
Lp	Length of discharge pipe	10.00	m
rp	Radius of discharge pipe (1"=0.0127m)	0.0127	m
R	Radius of influence (10 m is standard value)	10	m
rb	BH radius (HQ=0.048m, NQ=0.038m)	0.048	m
L	Length of test section	165.5	m
Hf	Friction Loss		
Hnet	Net injection head at midpoint of test		
K	Hydraulic conductivity		

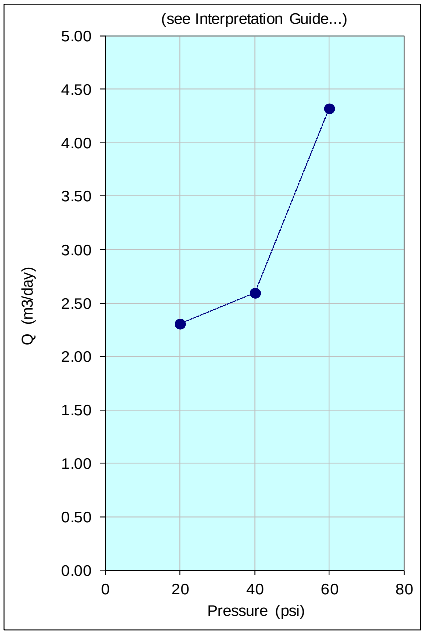
Notes:

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) IN ROCK to top of test section.

Equations:
$Hf = 8.65x10^{-15} (Q^2*Lp/rp^5)$
$Hnet = (Dw'+Hg-Hf)+Pg/1.42$
$K = (Q*Ln(R/rb)) / 2*\pi*Hnet*L)$

Conversion Factors:
10 m of water = 0.9807 bar = 1kg/cm² = 14.2 psi
1 cm/sec = 864 m/day
1 Lugeon = 1 lit/min per meter at 10 bar, which is approx. 1.4×10^{-5} cm/sec

Measurement (show last 3 to 5 flow meter 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
	20	40	60	40	20
1	1.00	1.00	1.00	1.00	1.00
2	1.00	1.00	1.00	1.00	1.00
3	1.00	1.00	1.00	1.00	1.00
4	1.00	1.00	1.00	1.00	1.00
5	1.00	1.00	1.00	1.00	1.00
Stable Q (L/30sec)	0.80	0.90	1.50	0.90	0.80
Leak Q (L/30sec)					
Q (m³/day)	2.3	2.6	4.3	2.6	2.3
Hf (m)	0.00	0.00	0.00	0.00	0.00
Hnet (m)	192.4	206.4	220.5	206.4	192.4
K (m/day)	6.1E-05	6.4E-05	1.0E-04	6.4E-05	6.1E-05
K (m/s)	**7.1E-10**	**7.5E-10**	**1.2E-09**	**7.5E-10**	**7.1E-10**
+/- (m/s)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
+/- order of mag.	0.00	0.00	0.00	0.00	0.00



Test Interval	
Geology	
Fracture Freq-Rock Quality	
Packer Seal	
Flow Meter Problems	
Measurement Accuracy	
Temperature	
Other Problems	

Test Interpretation
K Value (m/day)
7.4.E-05
K Value (ft/day)
2.4.E-04
"Type Curve Interpretation"

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PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

FIGURE B-25
Pressure Injection Test Analysis, Pg.1
Drillhole ED-H2-630-4C
907 ft – 1,450 ft

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	20	40	60	40	20
Max P during step	20	40	60	40	20
average pressure +/- psi					

Flowmeter measurement reading accuracy

volume +/- Liters / 30 sec					

High estimate of K

Q_{avg} (m^3/day)	2.30	2.59	4.32	2.59	2.30
Hf (m)	0.00	0.00	0.00	0.00	0.00
Hnet (m)	192.4	206.4	220.5	206.4	192.4
K (m/sec)	7.1E-10	7.5E-10	1.2E-09	7.5E-10	7.1E-10

Low estimate of K

Q_{avg} (m^3/day)	2.30	2.59	4.32	2.59	2.30
Hf (m)	0.00	0.00	0.00	0.00	0.00
Hnet (m)	192.4	206.4	220.5	206.4	192.4
K (m/sec)	7.1E-10	7.5E-10	1.2E-09	7.5E-10	7.1E-10

K averages for P step

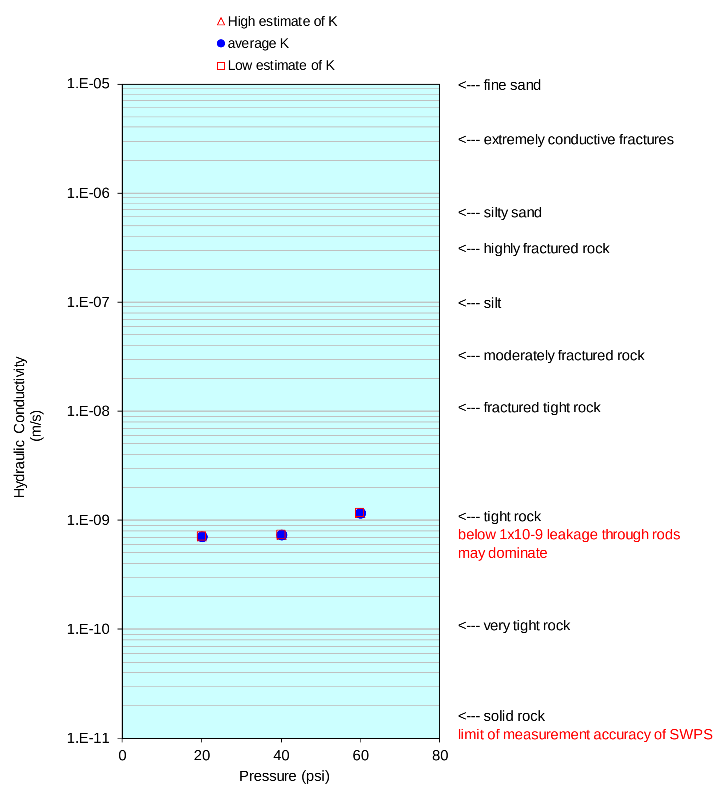
P	20	40	60
high est of K	7.E-10	7.E-10	1.E-09
average K	7.E-10	7.E-10	1.E-09
low est of K	7.E-10	7.E-10	1.E-09

K avg all P steps

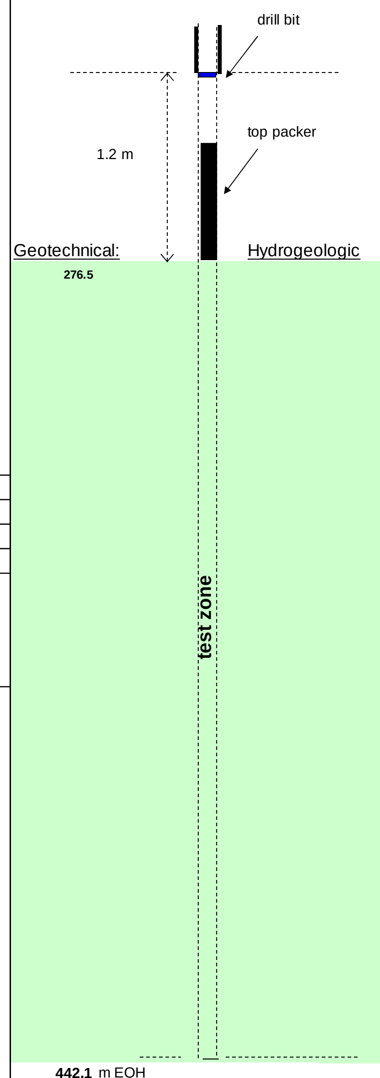
	m/sec	m/day
MAX	**1.2.E-09**	1.0.E-04
geomean	**8.5.E-10**	7.4.E-05
MIN	**7.1.E-10**	6.2.E-05

Test Comments	

Graph of estimated hydraulic conductivity and error bounds.



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



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PROJECT NO.	DATE	VERSION
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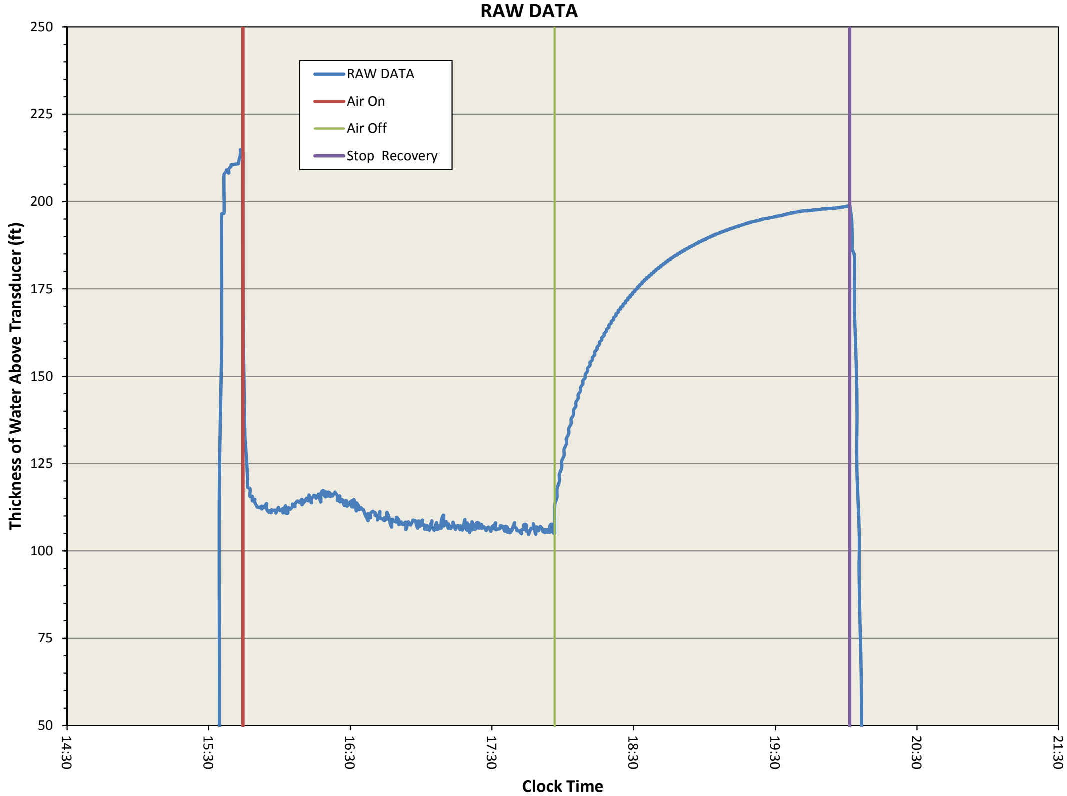
FIGURE B-26
Pressure Injection Test Analysis, Pg.2
Drillhole ED-H2-630-4C
907 ft – 1,450 ft

RAW DATA

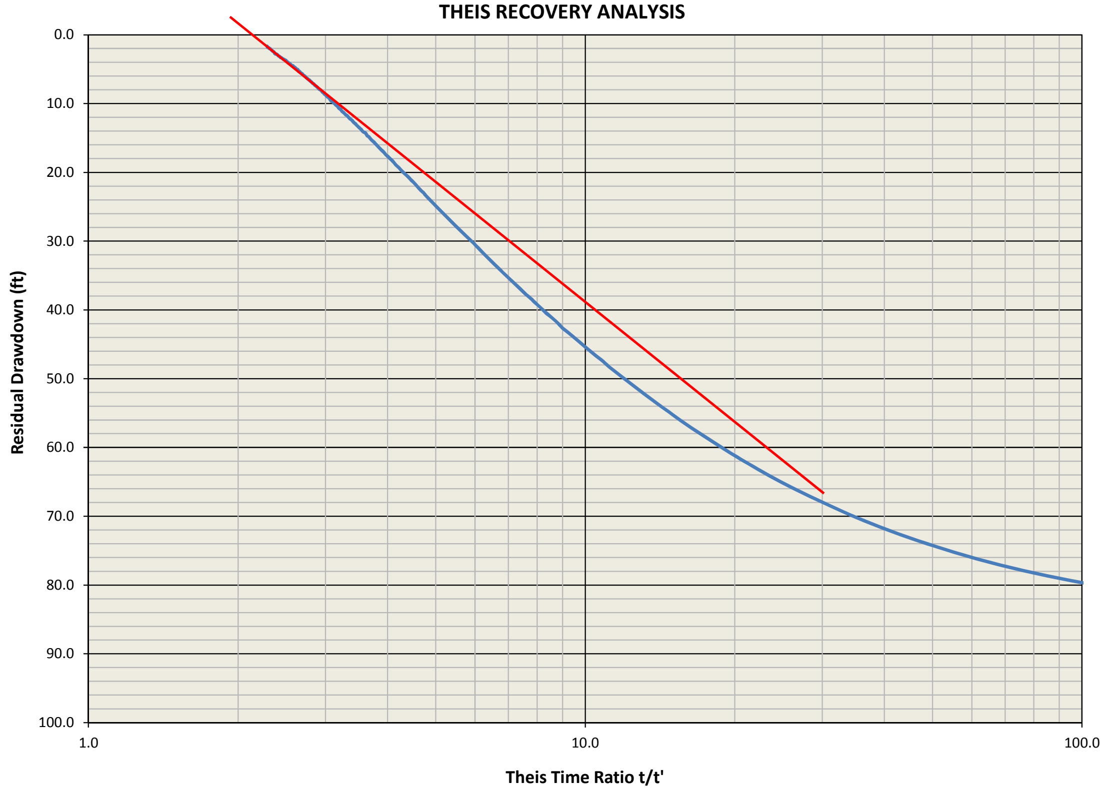


Depth of Test Interval:
407 – 1,450 ft

Pumping Test Duration: 132 min

Pumping Rate (Q) = 3.3 gpm
Pumping Rate (Q) = 635 ft^3/d

THEIS RECOVERY ANALYSIS



Theis Equation:

$$T = \frac{2.3\,Q}{4\pi\Delta s}$$

Where:
T = Transmissivity (ft^2/d)
Q = Pumping Rate (ft^3/d)
$\Delta(s)$ = Drawdown per Log Cycle (ft)

$$T = \frac{2.3\,(635)}{4\pi(57)} = 2.04 \text{ ft}^2/\text{d}$$

$$K = \frac{T}{b}$$

Where:
K= Estimate for Hydraulic Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(2.04)}{(1{,}043)} = 1.95\text{x}10^{-3} \text{ ft/d}$$

T = 2.04 ft^2/d
K = 1.95x10^{-3} ft/d

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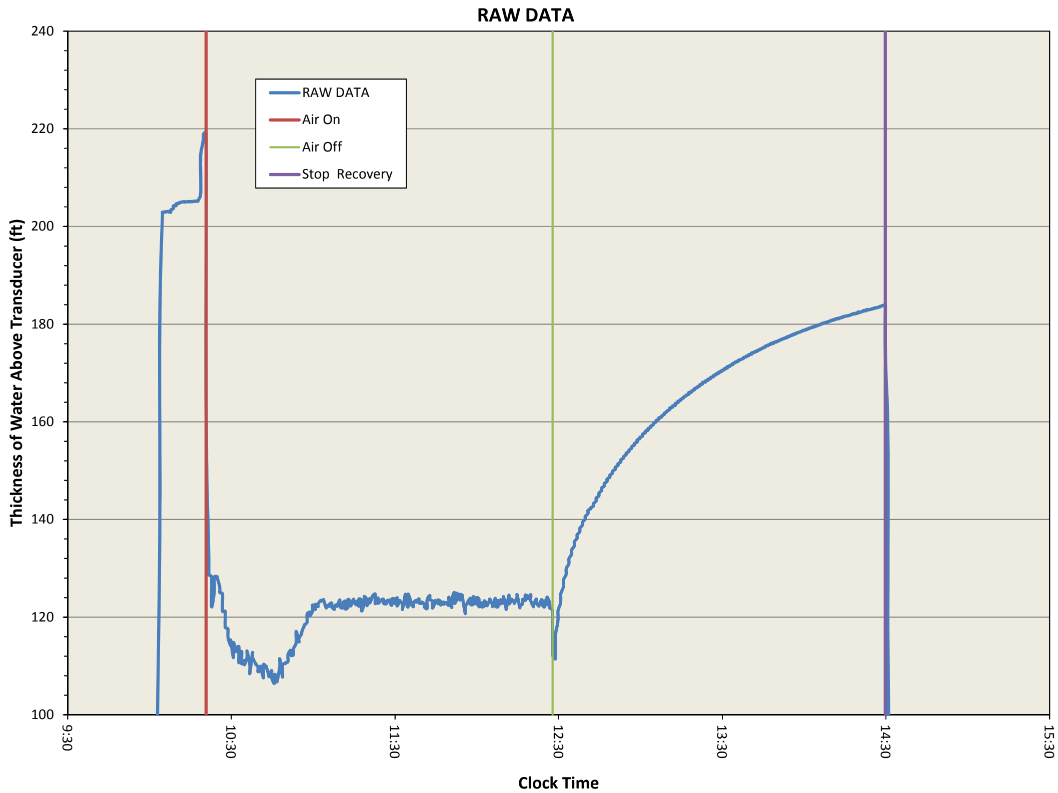
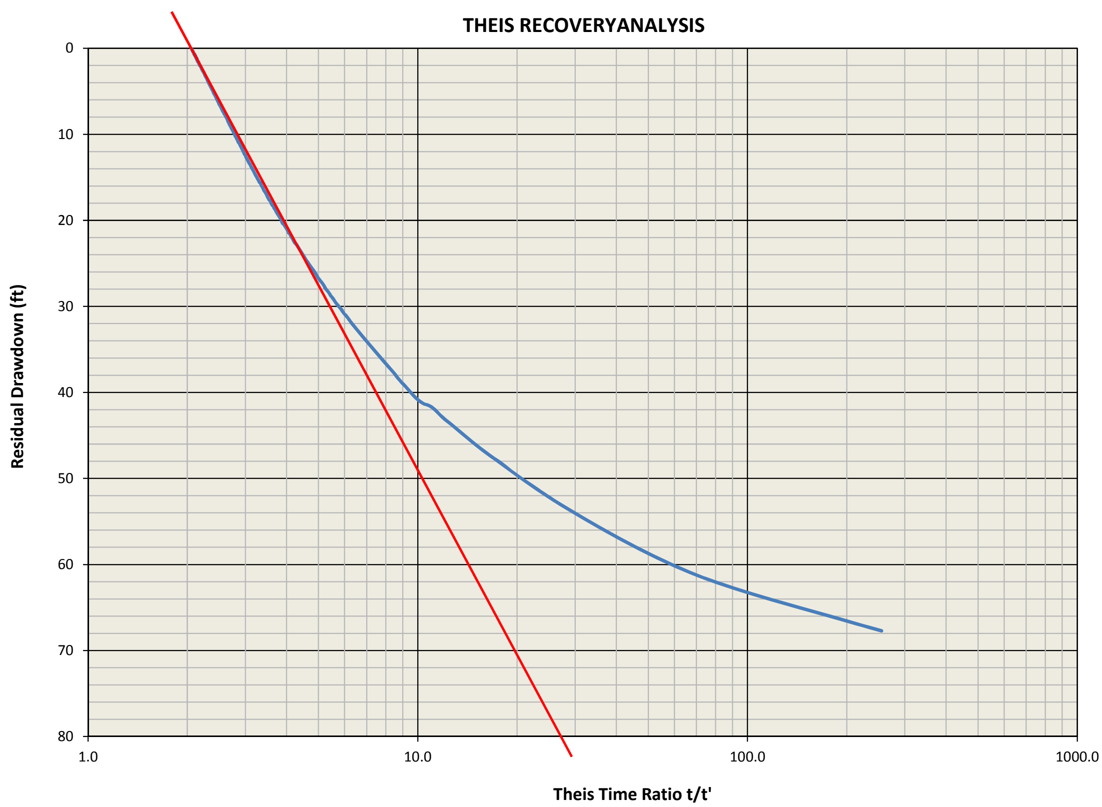
FIGURE B-27
Airlift Recovery Test Analysis
Drillhole ED-H2-630-5A
407 ft – 1,450 ft



Depth of Test Interval:
307 – 636 ft

Pumping Test Duration: 127 min

Pumping Rate (Q) = 5.0 gpm
Pumping Rate (Q) = 963 ft³/d



Theis Equation:

$$T = \frac{2.3\,Q}{4\pi\Delta s}$$

Where:
T = Transmissivity (ft^2/d)
Q = Pumping Rate (ft^3/d)
$\Delta(s)$ = Drawdown per Log Cycle (ft)

$$T = \frac{2.3\,(963)}{4\pi(72.5)} = 2.43\ ft^2/d$$

$$K = \frac{T}{b}$$

Where:
K= Estimate for Hydraulic Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(2.43)}{(329)} = 7.38\times10^{-3}\ ft/d$$

T = 2.43 ft^2/d
K = 7.38x10^{-3} ft/d

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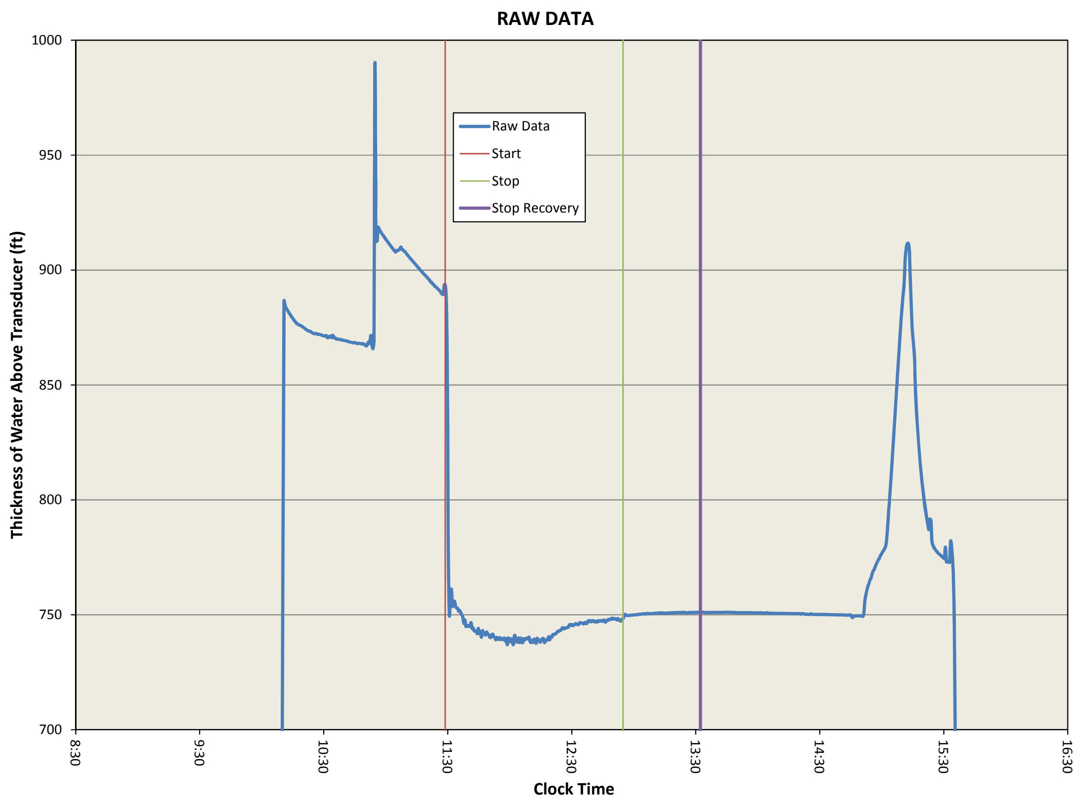
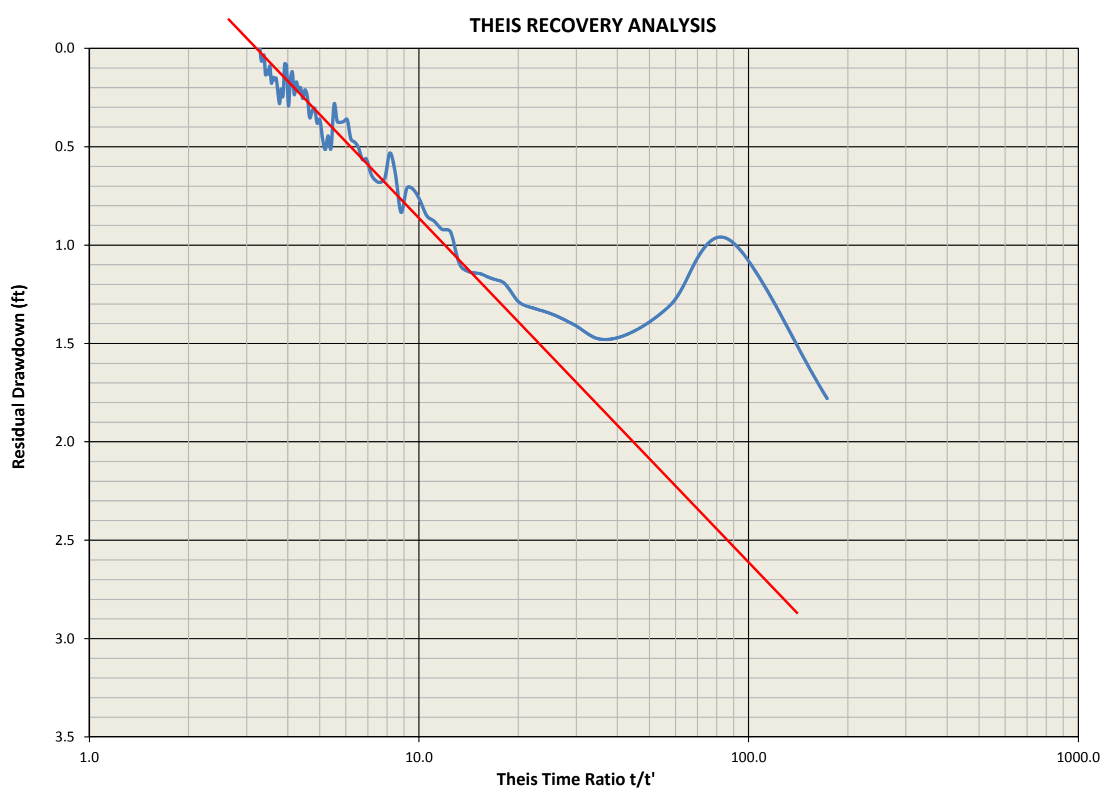
FIGURE B-28
Airlift Recovery Test Analysis
Drillhole ED-H3-633-1A
307 ft – 636 ft



Depth of Test Interval:
900 – 1,171 ft

Pumping Test Duration: 86 min

Pumping Rate (Q) = 4.0 gpm
Pumping Rate (Q) = 770 ft^3/d



Theis Equation:

$$T = \frac{2.3\,Q}{4\pi \Delta s}$$

Where:
T = Transmissivity (ft^2/d)
Q = Pumping Rate (ft^3/d)
$\Delta(s)$ = Drawdown per Log Cycle (ft)

$$T = \frac{2.3\,(770)}{4\pi(1.7)} = 82.6\ ft^2/d$$

$$K = \frac{T}{b}$$

Where:
K= Estimate for Hydraulic Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(2.43)}{(329)} = 3.05\text{x}10^{-1}\ ft/d$$

T = 82.6 ft^2/d
K = 3.05x10^{-1} ft/d

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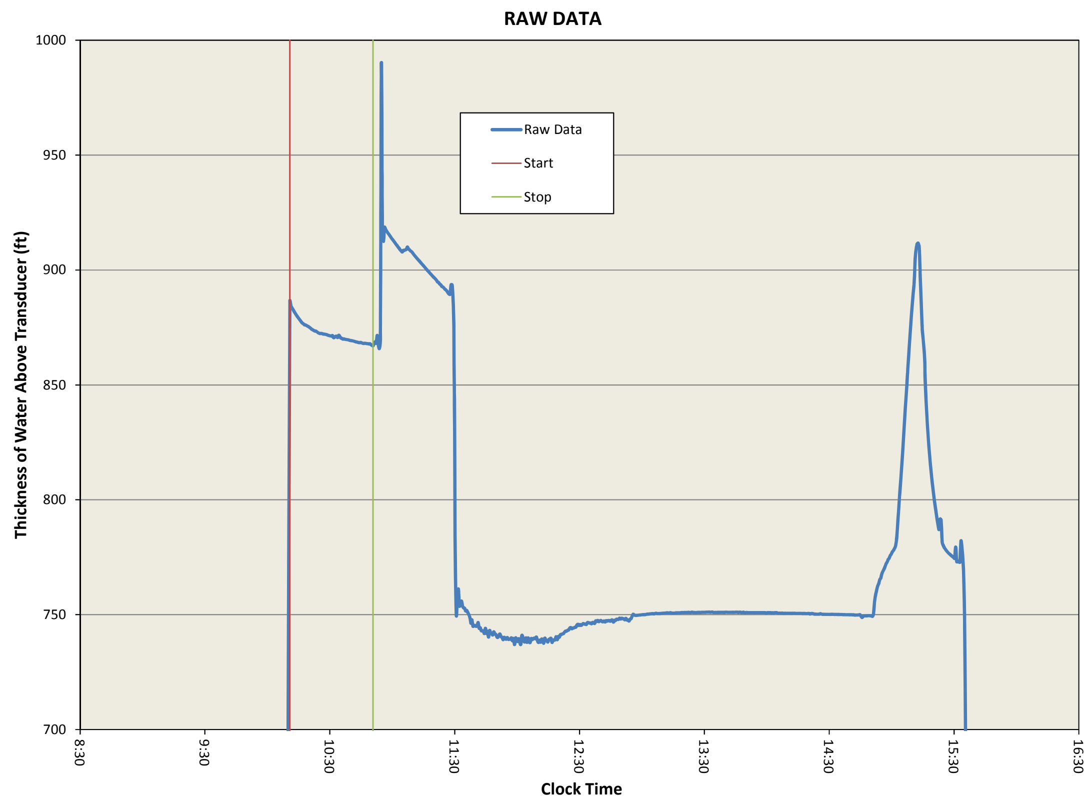
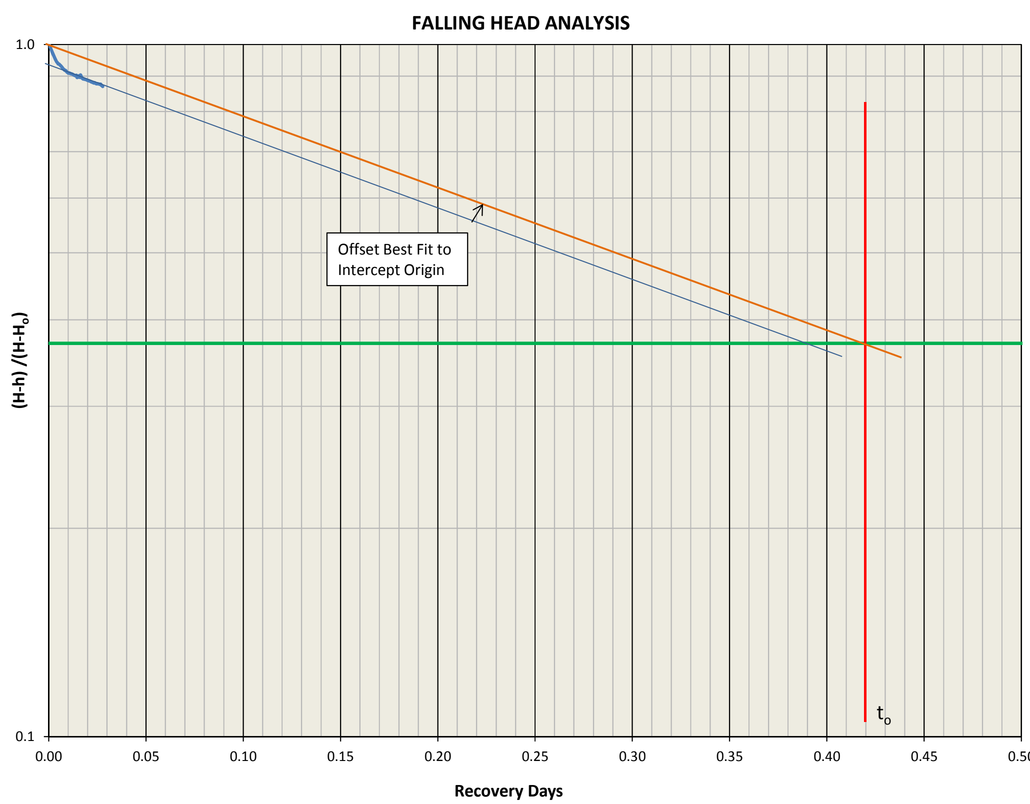
FIGURE B-29
Airlift Recovery Test Analysis
Drillhole ED-H3-633-2A
900 ft – 1,171 ft



Depth of Test Interval:
900 – 1,171 ft

Length of Test Interval: 271 ft



Hvorslev Equation:

$$K = \frac{r^2 \ln(\frac{L}{R})}{2Lto}$$

Where:
K = Estimate of Hydraulic Conductivity (ft/d)
r = Radius of Well Casing (ft)
R = Radius of Well Screen (ft)
L = Length of Test Interval (ft)
t_o = Time for Water Level to Fall 37% of Initial Change (days)

$$K = \frac{(3.1")^2 \ln(271'/3.8")}{2(271')(0.42)}$$

$K = 5.46 \times 10^{-4}$ ft/d

$$T = Kb$$

Where:
T = Transmissivity (ft^2/d)
b = Test Interval Length (ft)

T = 0.15 ft^2/d
K = 5.46x10^{-4} ft/d

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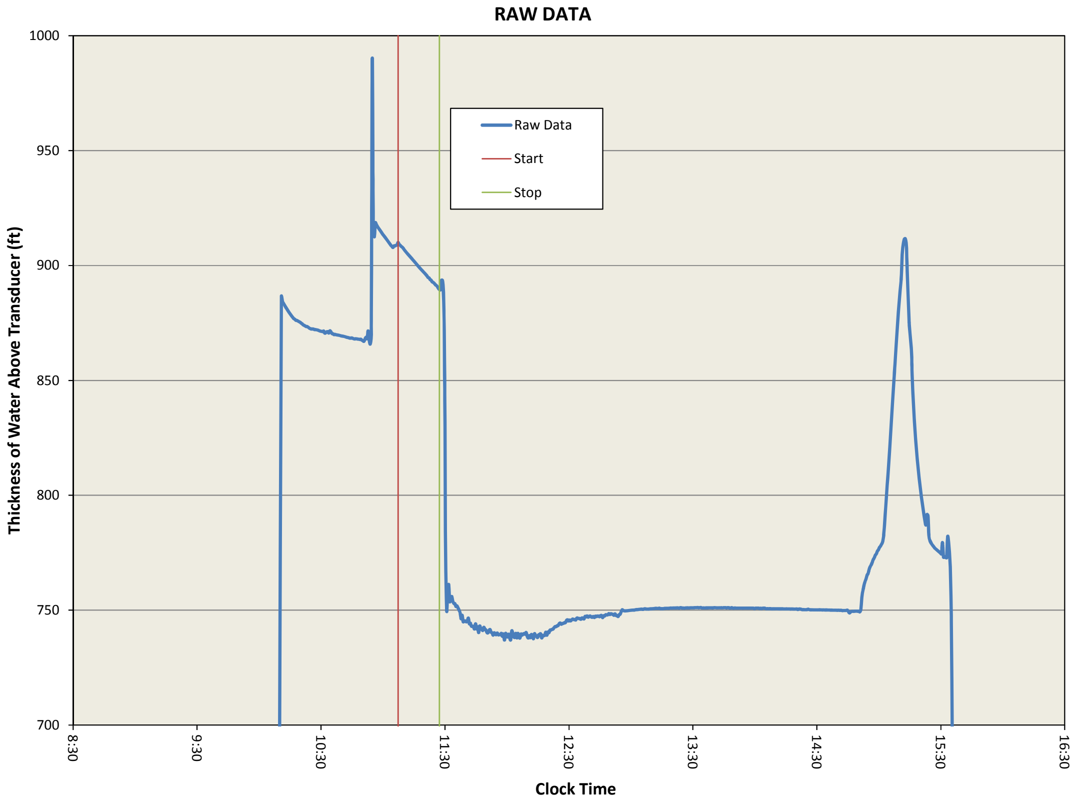
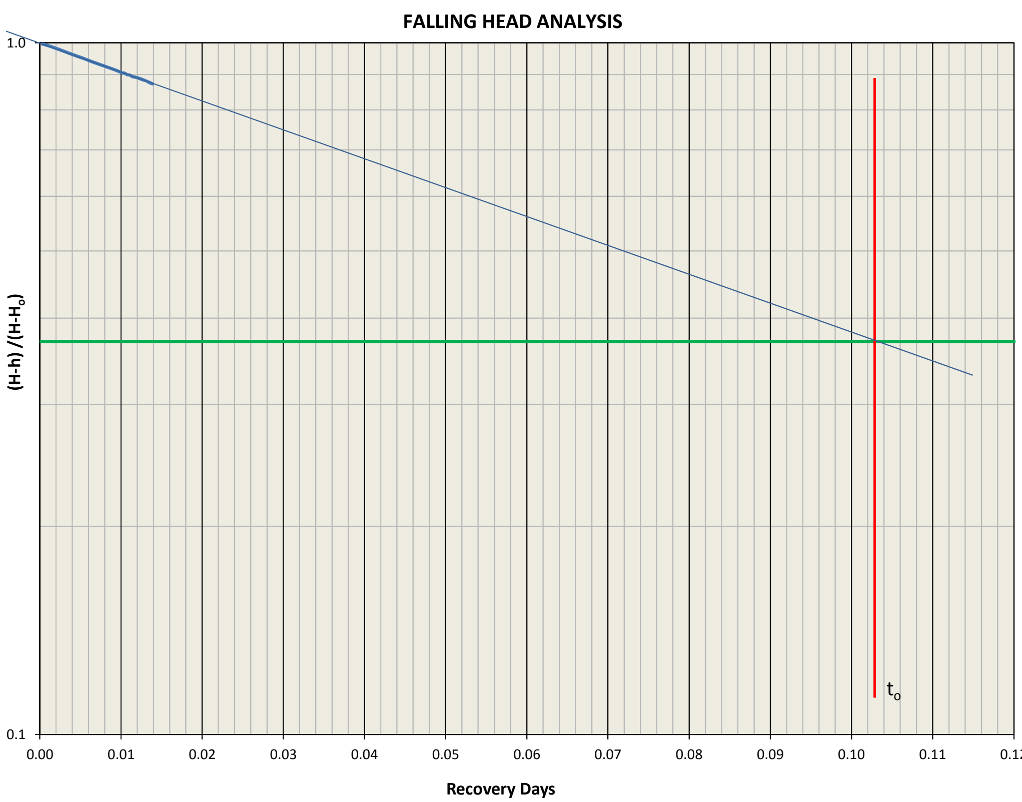
PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

FIGURE B-30
Falling Head Test Analysis
Drillhole ED-H3-633-2B
900 ft – 1,171 ft



Depth of Test Interval:
900 – 1,171 ft

Length of Test Interval: 271 ft



Hvorslev Equation:

$$K = \frac{r^2 \ln(\frac{L}{R})}{2Lto}$$

Where:
K = Estimate of Hydraulic Conductivity (ft/d)
r = Radius of Well Casing (ft)
R = Radius of Well Screen (ft)
L = Length of Test Interval (ft)
t_o = Time for Water Level to Fall 37% of Initial Change (days)

$$K = \frac{(3.1")^2 \ln(271'/3.8")}{2(271')(0.103)}$$

$K = 2.23 \times 10^{-3}$ ft/d

$$T = Kb$$

Where:
T = Transmissivity (ft^2/d)
b = Test Interval Length (ft)

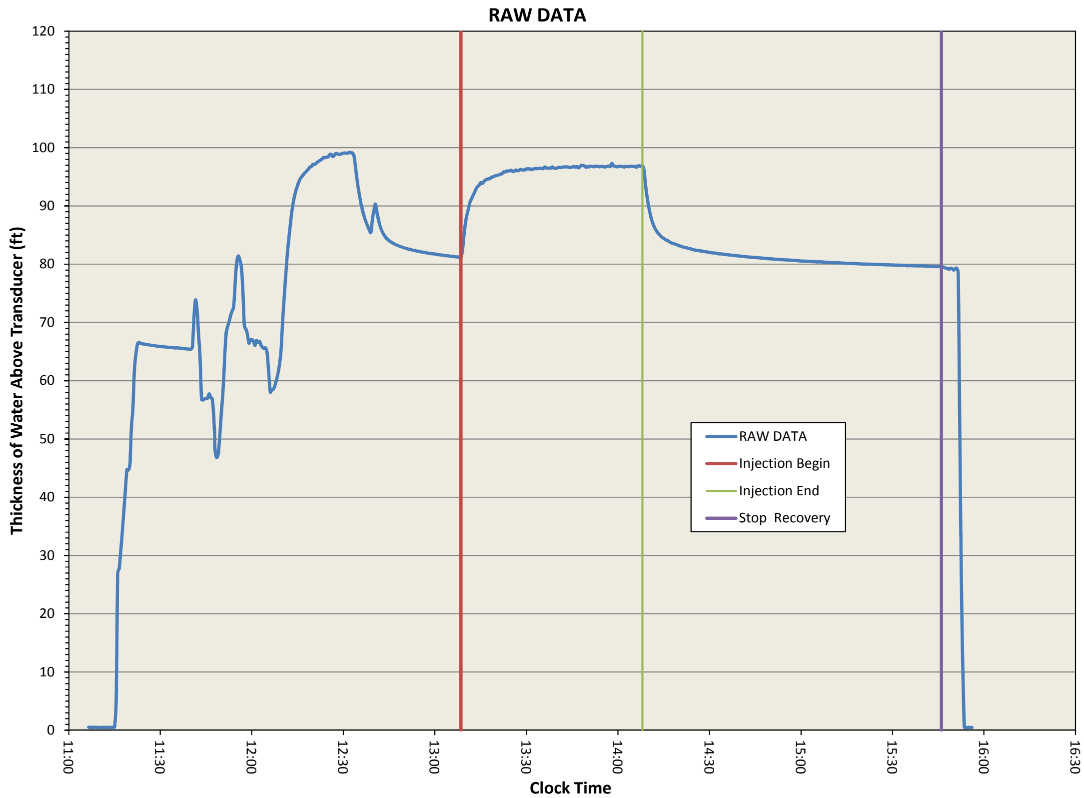
T = 0.60 ft^2/d
K = 2.23×10^{-3} ft/d

Pogo Mine

srk consulting

PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

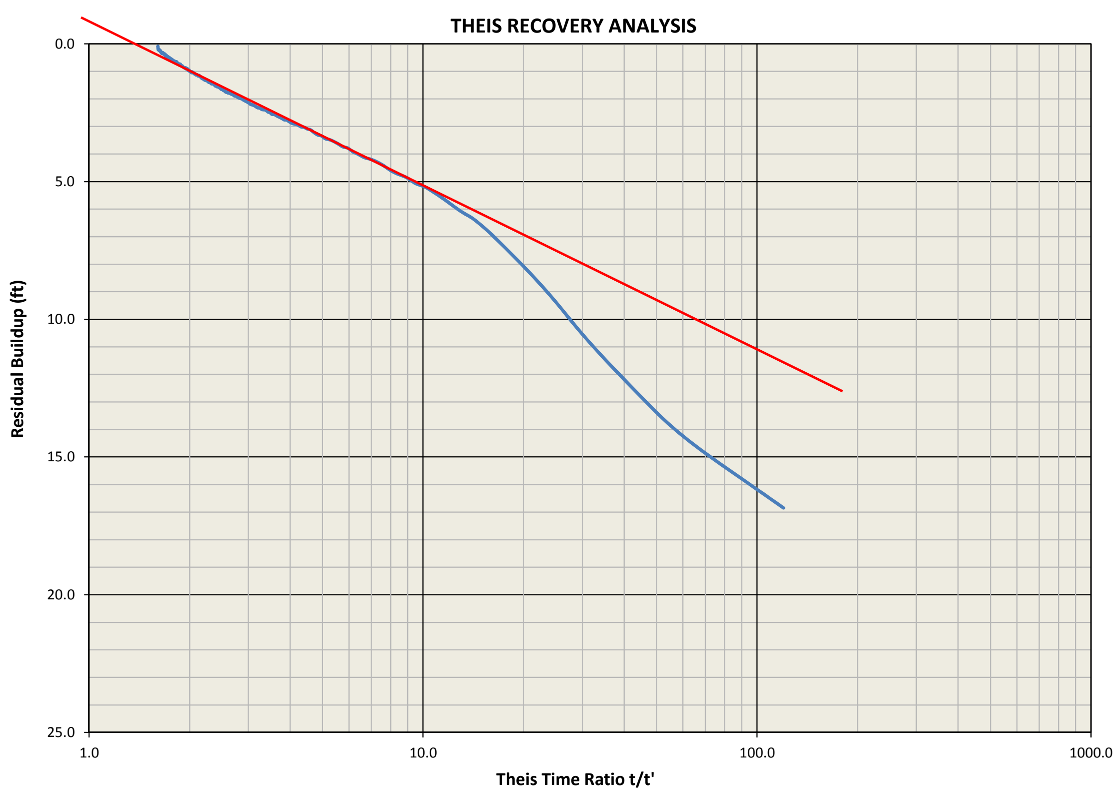
FIGURE B-31
Falling Head Test Analysis
Drillhole ED-H3-633-2C
900 ft – 1,171 ft



Depth of Test Interval:
400 – 1,066 ft

Injection Test Duration: 60 min

Injection Rate (Q) = 10 gpm
Injection Rate (Q) = 1,925 ft^3/d



Theis Equation:

$$T = \frac{2.3\,Q}{4\pi\Delta s}$$

Where:
T = Transmissivity (ft^2/d)
Q = Injection Rate (ft^3/d)
$\Delta(s)$ = Buildup per Log Cycle (ft)

$$T = \frac{2.3\,(1{,}925)}{4\pi(6)} = 58.8\ ft^2/d$$

$$K = \frac{T}{b}$$

Where:
K= Estimate for Hydraulic Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(58.8)}{(666)} = 8.84\text{x}10^{-2}\ ft/d$$

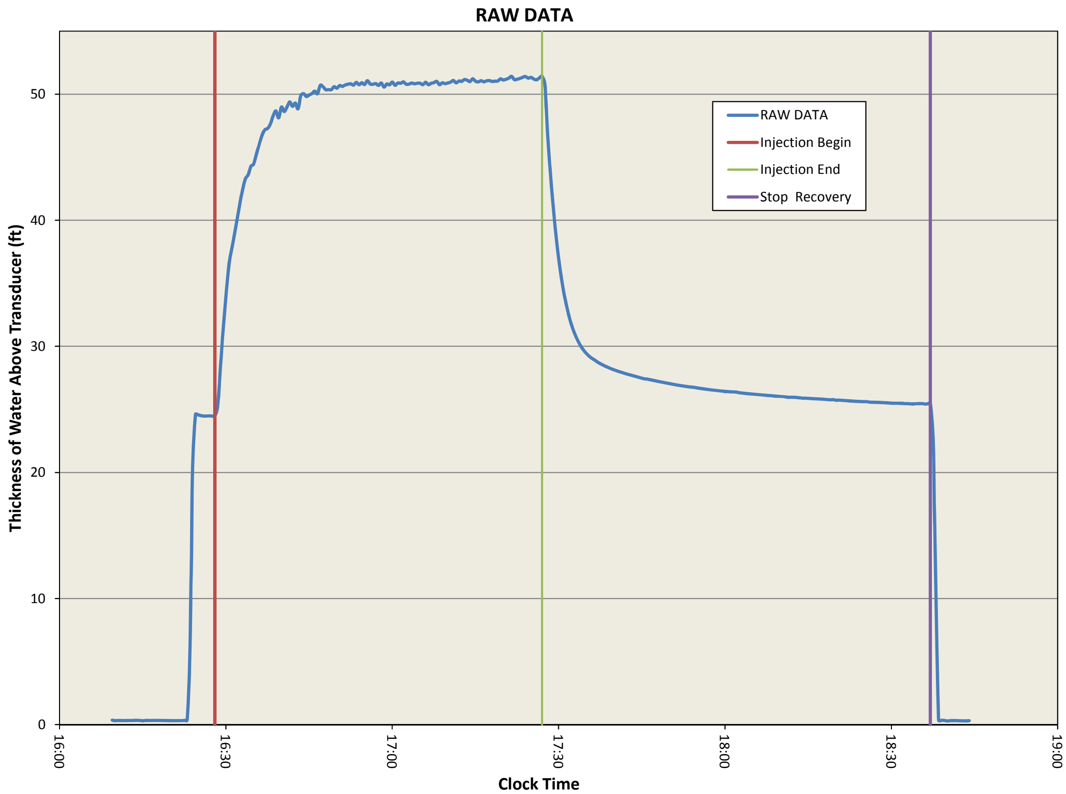
T = 58.8 ft^2/d
K = 8.84x10^{-2} ft/d

Pogo Mine

srk consulting

PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

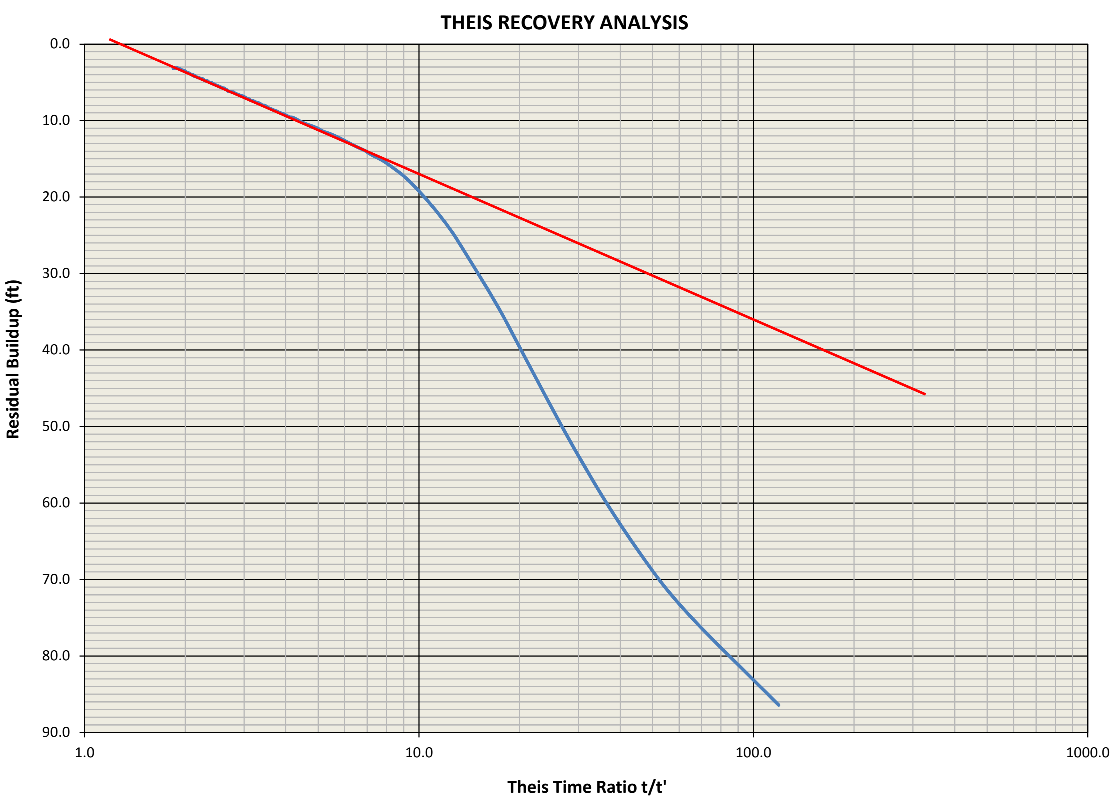
FIGURE B-32
Injection Recovery Test Analysis
Drillhole EDK-559-1A
400 ft – 1,066 ft



Depth of Test Interval:
400 – 1,066 ft

Injection Test Duration: 59 min

Injection Rate (Q) = 20 gpm
Injection Rate (Q) = 3,850 ft^3/d



Theis Equation:

$$T = \frac{2.3\,Q}{4\pi\Delta s}$$

Where:
T = Transmissivity (ft^2/d)
Q = Injection Rate (ft^3/d)
$\Delta(s)$ = Buildup per Log Cycle (ft)

$$T = \frac{2.3\,(3{,}850)}{4\pi(19)} = 37.0\ ft^2/d$$

$$K = \frac{T}{b}$$

Where:
K= Estimate for Hydraulic Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(37.0)}{(666)} = 5.56\times10^{-2}\ ft/d$$

T = 37.0 ft^2/d
K = 5.56x10^{-2} ft/d

Pogo Mine

srk consulting

PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

FIGURE B-33
Injection Recovery Test Analysis
Drillhole EDK-559-1B
400 ft – 1,066 ft

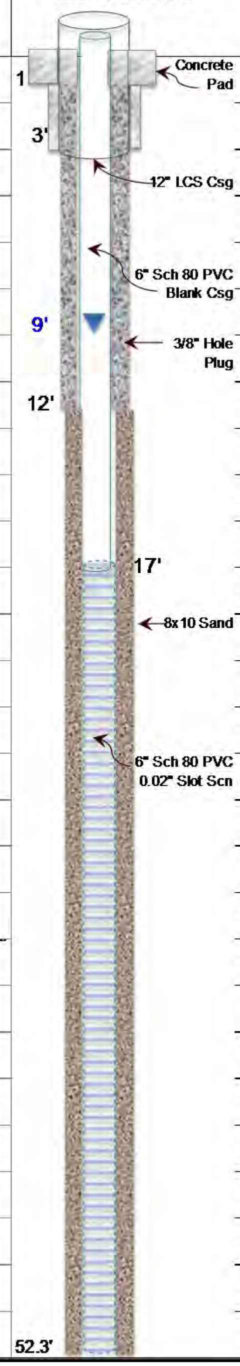
Appendix C: Construction of Test Wells and Stub Piezometers

srk consulting	**Pogo Mine**	**Well Name: MW12-001A**	**Page: 1 of: 2**
	Sumitomo Metal Mining Co.	**Geologist : Sherry L Gaddy, AHS**	**Date : 9/8/2012**

Hole Diameter(s) : 8"x9" Corehole Drilled Dry	**Drill Rig :** BL Sonic	**Date Hole Commenced :**	10/2/2012
Location Description : Core Yard at Airstrip	**Driller :** Sean Adams	**Date Hole Finished :**	10/2/2012
Coordinates :	Eric Skogan and KC	**Date Well Installed :**	10/3/2012

Depth (ft)	Core/ Cuttings Recovery	Graphic	Description and Comments
1.5			Fill
3.0			Sandy gravel; ~60% hard, well-rounded to angular gravels 3in max size; well-rounded to sub-angular sand, coarse to fine; <5% non-plastic fines; v. loose, dry alluvium (could be fill); GM
4.0			Sandy gravel; ~90% hard, well-rounded to angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; <5% non-plastic fines; v. loose, damp alluvium (could be fill); GM
5.0			Gravelly sand silty; ~20% hard, well-rounded to sub-angular gravels 3in max size; well-rounded to sub-angular sand, coarse to fine; ~5% non-plastic fines; v. loose, damp alluvium (could be fill); SM
7.0			Gravelly sand; ~45% hard, well-rounded to sub-angular gravels 8in max size; well-rounded to sub-angular sand, coarse to fine; <5% non-plastic fines; v. loose, dry to sl. damp alluvium (could be fill); SM
9.0			Sandy gravel; ~55% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; <5% non-plastic fines; v. loose, dry to sl. damp alluvium (could be fill); GM
10.0			Sandy gravel; ~60% hard, well-rounded to sub-angular gravels 5in max size; well-rounded to sub-angular sand, coarse to fine; <5% non-plastic fines; v. loose, wet alluvium; GM
13.0			Sandy gravel silty; ~80% hard, well-rounded to sub-angular gravels 7in max size; well-rounded to sub-angular sand, coarse to fine; ~5% non-plastic fines; v. loose, wet alluvium; GM
13.5			Sandy gravel; ~80% hard, well-rounded to sub-angular gravels 4in max size; well-rounded to sub-angular sand, coarse to fine; <5% non-plastic fines; v. loose, wet alluvium; GM
16.5			Sandy gravel silty; ~70% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; ~10% non-plastic fines; v. loose, wet alluvium; GM
17.0			Gravelly sand; ~10% hard, well-rounded to sub-angular gravels 1in max size; well-rounded to sub-angular sand, coarse to fine; <5% non-plastic fines; v. loose, wet alluvium; SP
18.5			Gravelly sand silty; ~30% hard, well-rounded to sub-angular gravels 4in max size; well-rounded to sub-angular sand, coarse to fine; ~10% non-plastic fines; loose, wet alluvium; SW
19.0			Sandy gravel; ~90% hard, well-rounded to angular gravels 7in max size; well-rounded to sub-angular sand, coarse to fine; <5% non-plastic fines; v. loose, wet alluvium; GM
22.0			Gravelly sand silty; ~35% hard, well-rounded to sub-angular gravels 5in max size; well-rounded to sub-angular sand, coarse to fine; ~5% non-plastic fines; loose, wet alluvium; SM
23.0			Gravelly sand silty; ~20% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; ~5% non-plastic fines; loose, wet alluvium; SM
23.3			Sandy gravel; ~75% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; <5% non-plastic fines; v. loose, wet alluvium; GM
24.0			Sandy gravel; ~90% hard, well-rounded to sub-angular gravels 6in max size to 2in; well-rounded to sub-angular sand, coarse to fine; ~5% non-plastic fines; loose, wet alluvium; GM
25.0			Sandy gravel silty; ~80% hard, well-rounded to sub-angular gravels 4in max size; well-rounded to sub-angular sand, coarse to fine; ~5% non-plastic fines; loose, wet alluvium; GM
28.0			Sandy gravel; ~80% hard, well-rounded to sub-angular gravels 8in max size; well-rounded to sub-angular sand, coarse to fine; ~10% non-plastic fines; loose, wet alluvium; GM
28.5			angular sand, coarse to fine; ~10% non-plastic fines; ~15% gry/brn/redish plastic fines, sl. Stiff alluvium; GW
37.0			Sandy gravel; ~55% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; ~5% non-plastic fines; loose, wet alluvium; GM
38.5			Sand; 100% well-rounded to sub-angular sand, fine; <2% non-plastic fines; v. loose, wet alluvium; SP
40.5			Sandy gravel; ~70% hard, well-rounded to angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; ~5% non-plastic fines; loose, wet alluvium; GM
42.0			Sandy gravel silty; ~80% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; ~15% non-plastic fines; loose, wet alluvium; GM
42.5			Sandy gravel; ~80% hard, well-rounded to angular gravels 4in max size; well-rounded to sub-angular sand, coarse to fine; ~5% non-plastic fines; loose, wet alluvium; GM
45.0			Silty gravel sandy; ~80% hard, well-rounded to sub-angular gravels 8in max size; well-rounded to sub-angular sand, coarse to fine; ~15% non-plastic fines; loose, wet alluvium; GM
52.0			Sandy gravel; ~55% hard, well-rounded to sub-angular gravels 8in max size; well-rounded to sub-angular sand, coarse to fine; ~5% non-plastic fines; loose, wet alluvium; GM
52.3			Sandy gravel; ~95% hard, well-rounded to sub-angular gravels 4in max size; well-rounded to sub-angular sand, coarse to fine; ~5% non-plastic fines; loose, wet alluvium; GM

Well Construction



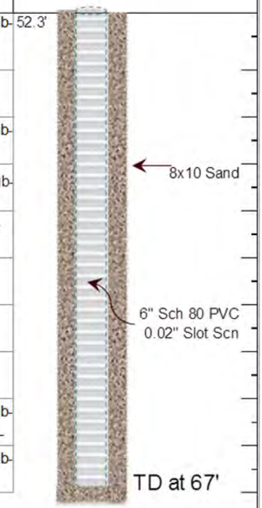
Pogo Mine	srk consulting		**FIGURE C-1 (pg 1)**
	PROJECT NO. 147900.02	DATE July, 2013	VERSION 1.0

Installation Log of Test Well MW12-001A

srk consulting	Pogo Mine	Well Name: MW12-001A	Page: 2 of: 2
	Sumitomo Metal Mining Co.	Geologist : Sherry L Gaddy, AHS	Date : 9/8/2012

Depth (ft)	Core/ Cuttings Recovery	Description and Comments
54.5		Gravelly Clay silty/sandy; ~40% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; ~10% non-plastic fines; ~50% gry/brn plastic fines, sl. stiff, moist to wet alluvium; CL
55.0		Sandy gravel silty; ~60% hard, well-rounded to sub-angular gravels 4in max size; well-rounded to sub-angular sand, coarse to fine; ~20% non-plastic fines; loose, wet alluvium; GM
56.0		Gravelly Clay silty/sandy; ~40% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; ~20% non-plastic fines; ~40% gry/brn plastic fines, stiff, moist alluvium; CL
57.0		Sandy gravel silty/clayey; ~60% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; ~25% non-plastic fines; ~15% brn plastic fines; sl. stiff, moist alluvium; GM
58.0		Gravelly sand; ~10% hard, well-rounded to sub-angular gravels 1/2in max size; well-rounded to sub-angular sand, coarse to fine; <5% non-plastic fines; v. loose, wet alluvium; SP
61.0		Sandy gravel silty; ~80% hard, well-rounded to sub-angular gravels 5in max size; well-rounded to sub-angular sand, coarse to fine; ~5% non-plastic fines; loose, wet alluvium; GM
63.0		Silty gravel sandy; ~80% hard, well-rounded to sub-angular gravels 7in max size; well-rounded to sub-angular sand, coarse to fine; ~20% non-plastic fines; loose, wet alluvium; GM
64.0		Silty sand gravelly; ~35% hard, well-rounded to sub-angular gravels 3in max size; well-rounded to sub-angular sand, coarse to fine; ~35% non-plastic fines, sl. stiff, wet alluvium; SM
65.0		Gravelly Clay silty/sandy; ~15% hard, well-rounded to sub-angular gravels 3in max size; well-rounded to sub-angular sand, coarse to fine; ~20% non-plastic fines; ~50% Lt Brn/gry plastic fines, stiff, moist alluvium; CL
67.0		Gravelly Clay silty/sandy; ~10% hard, well-rounded to sub-angular gravels 4in max size; well-rounded to sub-angular sand, coarse to fine; ~20% non-plastic fines; ~60% grey/brn plastic fines, stiff, moist alluvium; CL

Well Construction



Pogo Mine	srk consulting	FIGURE C-1 (pg 2)
	PROJECT NO. 147900.02 / DATE July, 2013 / VERSION 1.0	Installation Log of Test Well MW12-001A

srk consulting	Pogo Mine	Well Name **MW12-001B**	Page: 1 of: 2
	Sumitomo Metal Mining Co.	Geologist : Sherry L Gaddy, AHS	Date : 9/8/2012

Hole Diameter(s) : 8"x9" Corehole - Ream to 10"
Drill w/Water - Bedrock w/mud
Drill Rig : BL Sonic
Location Description : Old Core Yard at Airstrip
Driller : Sean Adams
Erik Skogan
Casey Wallace
Coordinates : NAD 83: Lat, Long, TOC (MP) Elev, GS Elev
64-28-03.82301, 144-54-58.59117, 1359.29', 1357.76'

Date Hole Commenced : 9/8/2012
Driller on Break : 9/14-9/23
Date Hole Finished : 9/26/2012
Fishing for Core Barrel : 9/26-9/28
Date Well Installed : 10/2/2012

Depth (ft)	Core/ Cuttings Recovery	Graphic	Description and Comments
3.5			Fill
8.0			Sandy gravel; ~60% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; <5% non-plastic fines; v. loose, dry alluvium; GM
12.0			Sandy gravel; ~80% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; <5% non-plastic fines; v. loose, wet alluvium; GM
15.0			Sandy gravel; ~80% hard, well-rounded to sub-angular gravels 8in max size; well-rounded to sub-angular sand, coarse to fine; <5% non-plastic fines; v. loose, wet alluvium; GM
18.0			Sandy gravel silty; ~80% hard, well-rounded to sub-angular gravels 8in max size; well-rounded to sub-angular sand, coarse to fine; ~5% non-plastic fines; v. loose, wet alluvium; GM
18.5			Sand; 100% well-rounded to sub-angular sand, fine; <2% non-plastic fines; v. loose, wet alluvium; SP
20.5			Sandy gravel; ~60% hard, well-rounded to sub-angular gravels 4in max size; well-rounded to sub-angular sand, coarse to fine; <5% non-plastic fines; v. loose, wet alluvium; GM
24.5			Sandy gravel; ~60% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; <5% non-plastic fines; v. loose, wet alluvium; GM
25.0			Gravelly sand; ~40% hard, well-rounded to sub-angular gravels 4in max size; well-rounded to sub-angular sand, coarse to fine; <5% non-plastic fines; v. loose, wet alluvium; SW
27.5			Sandy gravel silty; ~60% hard, well-rounded to sub-angular gravels 4in max size; well-rounded to sub-angular sand, coarse to fine; ~5% non-plastic fines; v. loose, wet alluvium; GM
30.0			Sandy gravel silty; ~55% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; ~8% non-plastic fines; v. loose, wet alluvium; GM
35.0			Gravelly sand silty; ~30% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; ~10% non-plastic fines; loose, wet alluvium; SW
36.5			Gravelly sand silty; ~30% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; ~15% non-plastic fines; loose, wet alluvium; SM
37.0			Gravelly sand silty; ~35% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; ~5% non-plastic fines; loose, wet alluvium; SW
37.5			Gravel; ~100% hard, well-rounded to sub-angular gravels 4in max size to 3/4in; v. loose, wet alluvium; GW
41.5			Sandy gravel; ~55% hard, well-rounded to sub-angular gravels 8in max size; well-rounded to sub-angular sand, coarse to fine; <5% non-plastic fines; v. loose, wet alluvium; GM
42.0			Sandy gravel; ~90% hard, well-rounded to sub-angular gravels 6in max size to 2in; <5% rounded, fine sand, silty; v. loose, wet alluvium; GM
43.0			Sandy gravel silty; ~80% hard, well-rounded to sub-angular gravels 8in max size; well-rounded to sub-angular sand, coarse to fine; ~5% non-plastic fines; v. loose, wet alluvium; GM
47.0			Gravelly sand silty; ~30% hard, well-rounded to sub-angular gravels 8in max size; well-rounded to sub-angular sand, coarse to fine; ~10% non-plastic fines; loose, wet alluvium; SW
50.0			Gravel; ~100% hard, well-rounded to sub-angular gravels 8in max size to 1/4in; v. loose, wet alluvium; GW
53.0			Sandy gravel silty; ~50% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; ~10% non-plastic fines; loose, wet alluvium; GM
54.0			Sandy gravel silty; ~50% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; ~35% non-plastic fines; loose, wet alluvium; GM
57.0			Silty gravel sandy; ~50% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; ~35% non-plastic fines; ~5% plastic fines, stiff, moist alluvium; GM
61.5			Gravelly sand silty; ~20% hard, well-rounded to sub-angular gravels 5in max size; well-rounded to sub-angular sand, coarse to fine; ~10% non-plastic fines; loose, wet alluvium; SW
64.5			Gravelly Clay silty/sandy; ~15% hard, well-rounded to sub-angular gravels 6in max size; well-rounded to sub-angular sand, coarse to fine; ~20% non-plastic fines; ~50% Lt Brn plastic fines, stiff, moist alluvium; CL
66.8			Gravelly Clay silty/sandy; ~15% hard, well-rounded to sub-angular gravels 8in max size; well-rounded to sub-angular sand, coarse to fine; ~10% non-plastic fines; ~60% grey/brn plastic fines, stiff, moist alluvium; CL
67.0			Sand; ~100% well-rounded to sub-angular sand, fine; <5% non-plastic fines; loose, wet alluvium; appears iron stained, noticably cold; SP
67.3			Gravel; ~100% hard, well-rounded to sub-angular gravels 8in max size; v. loose, wet alluvium; GW

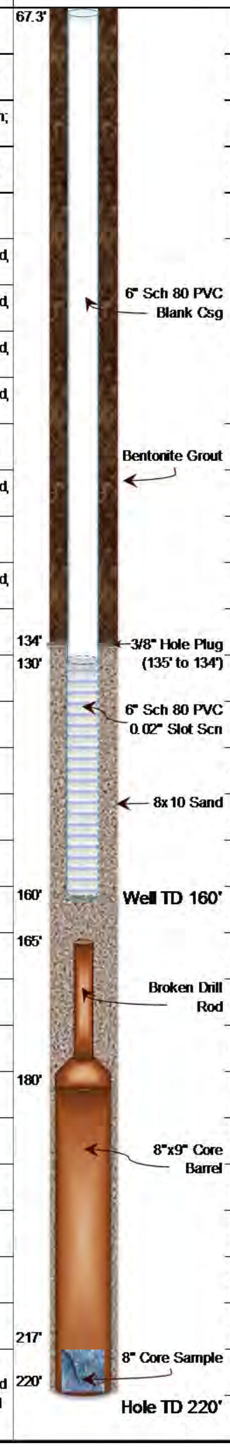
Well Construction

Pogo Mine	srk consulting			**FIGURE C-2 (pg 1)**
	PROJECT NO. 147900.02	DATE July, 2013	VERSION 1.0	**Installation Log of Test Well MW12-001B**

srk consulting	Pogo Mine	Well Name: MW12-001B	Page: 2 of: 2
	Sumitomo Metal Mining Co.	Geologist : Sherry L Gaddy AHS	Date : 9/8/2012

Depth (ft)	RQD	FF	FD	Graphic	Description and Comments
71.0					Silty Clay; ~20% non-plastic fines; ~80% White/Blue-Gray to Gray-Brn plastic fines, v. stiff, damp to dry alluvium; CL
73.5					Silty Clay sandy; angular to sub-angular, coarse sand; ~25% non-plastic fines; ~65%Gray-Brn plastic fines, v. stiff, damp to dry alluvium; CL
76.0					Clayey silt; Lt Gray, ~90% non-plastic fines; ~10% plastic fines, broken but v. stiff, dry alluvium; ML
77.0					Clayey silt; Lt Tan, ~90% non-plastic fines; ~10% plastic fines, broken but v. stiff, dry alluvium; ML
84.0	1.55/10'	8/10'	2" to 1'		**Bedrock at 77'** Biotite, Quartz, Feldspar, Gneiss (BQFG - Pogo designation), Highly fractured, hard, weathered, slickensides evident, calcite and chlorite alterations
87.0					Biotite, Quartz, Feldspar, Gneiss (BQFG - Pogo designation), Highly fractured, hard, weathered, slickensides evident, calcite and chlorite alterations
93.0	0.77/10'	16/10'	2" to 1'		Biotite, Quartz, Feldspar, Gneiss (BQFG - Pogo designation), Highly fractured, hard, weathered, slickensides evident, calcite and chlorite alterations
96.0					Biotite, Quartz, Feldspar, Gneiss (BQFG - Pogo designation), Highly fractured, hard, weathered, slickensides evident, calcite and chlorite alterations
97.0					Biotite, Quartz, Feldspar, Gneiss (BQFG - Pogo designation), Highly fractured, hard, weathered, slickensides evident, calcite and chlorite alterations
107.0	5.4' / 10'	12 / 10'	2" to 1'		9/9/12; Biotite, Quartz, Feldspar, Gneiss (BQFG - Pogo designation), Highly fractured, hard, weathered, slickensides evident, calcite and chlorite alterations
110.0	4.8/10'	7/10'	2" to 1'		Biotite, Quartz, Feldspar, Gneiss (BQFG - Pogo designation), Highly fractured, hard, weathered, slickensides evident, calcite and chlorite alterations
116.0			1' to 3'		Biotite, Quartz, Feldspar, Gneiss (BQFG - Pogo designation), Blocky, hard, weathered, slickensides evident, calcite and chlorite alterations
117.0			2" to 1'		Biotite, Quartz, Feldspar, Gneiss (BQFG - Pogo designation), Highly fractured, hard, weathered, slickensides evident, calcite and chlorite alterations
127.0	4.9' / 10'	15 / 10'	2" to 1'		Biotite, Quartz, Feldspar, Gneiss (BQFG - Pogo designation), Highly fractured, hard, less weathered, slickensides evident, calcite and chlorite alterations
135.0	5.1/10'	15/10'	2" to 1'		Biotite, Quartz, Feldspar, Gneiss (BQFG - Pogo designation), Highly fractured, hard, less weathered, slickensides evident, calcite and chlorite alterations
136.5			1' to 3'		Biotite, Quartz, Feldspar, Gneiss (BQFG - Pogo designation), Blocky, hard, less weathered, slickensides evident, calcite and chlorite alterations
137.0			2" to 1'		Biotite, Quartz, Feldspar, Gneiss (BQFG - Pogo designation), Highly fractured, hard, less weathered, slickensides evident, calcite and chlorite alterations
147.0	4.5' / 10'	13 / 10'	2" to 1'		Biotite, Quartz, Feldspar, Gneiss (BQFG - Pogo designation), Highly fractured, hard, less weathered, slickensides evident, calcite and chlorite alterations; 9/10/12
157.0	3.9' / 10'	12 / 10'	2" to 1'		9/11/12; BQFG - Pogo designation, Highly fractured, hard, slickensides evident, calcite and chlorite alterations; increase in Qtz/Kspar banding and Biotite
164.0	4.4/10'	7/10'	2" to 1'		BQFG - Pogo designation, Highly fractured, hard, slickensides evident, calcite and chlorite alterations; increase in Qtz/Kspar banding and Biotite
167.0			1' to 3'		BQFG - Pogo designation, Blocky, hard, slickensides evident, calcite and chlorite alterations; increase in Qtz/Kspar banding and Biotite
175.0	4.9/10'	13/10'	1' to 3'		BQFG - Pogo designation, Blocky, hard, slickensides evident, calcite and chlorite alterations; increase in Qtz/Kspar banding and Biotite
177.0			2" to 1'		BQFG - Pogo designation, Highly fractured, hard, slickensides evident, calcite and chlorite alterations; increase in Qtz/Kspar banding and Biotite
187.0	4' / 10'	12 / 10'	2" to 1'		BQFG - Pogo designation, Highly fractured, hard, slickensides evident, calcite and chlorite alterations; increase in Qtz/Kspar banding and Biotite
192.0	5.9/10'	8/10'	2" to 1'		BQFG - Pogo designation, Highly fractured, hard, slickensides evident, calcite and chlorite alterations; increase in Qtz/Kspar banding and Biotite
197.0			1' to 3'		BQFG - Pogo designation, Blocky, hard, slickensides evident, calcite and chlorite alterations; increase in Qtz/Kspar banding and Biotite
201.0	3.1/10'	14/10'	1' to 3'		BQFG - Pogo designation, Blocky, hard, slickensides evident, calcite and chlorite alterations; increase in Qtz/Kspar banding and Biotite
207.0			2" to 1'		BQFG - Pogo designation, Highly fractured, hard, slickensides evident, calcite and chlorite alterations; increase in Qtz/Kspar banding and Biotite
217.0	3.8' / 10'	17 / 10'	2" to 1'		BQFG - Pogo designation, Highly fractured, hard, slickensides evident, calcite and chlorite alterations; increase in Qtz/Kspar banding and Biotite
220.0	n/a	n/a	n/a		Rod connected to core barrel broke above the threads. Fishing was unsuccessful - core barrel not stuck, but fish could not hold onto it for more than 5 ft. Left 40ft of core barrel and 15ft of rod in the ground. Washed mud and cuttings out of the hole - installed well material and completed well

Well Construction



Pogo Mine	srk consulting			FIGURE C-2 (pg 2)
	PROJECT NO. 147900.02	DATE July, 2013	VERSION 1.0	Installation Log of Test Well MW12-001B

PROJECT	CLIENT	BORING LOCATION (E-N)	ELEVATION (ft)	INC.	AZI.	EOH (FT)	DRILLING METHOD	DRILLING CONTRACTOR	SRK HOLE ID
Pogo	Sumitomo Metal Mining	1816140 - 3822047	2664	-78	230	1515	Core	Boart Longyear	12-628

PROJECT NO.	LOGGED BY	WELL DEPTH (FT)	CASING DIA (in)	SCREEN DIA (in)	SCREEN SLOT (in)	PVC MATERIAL
147900.02	Sumitomo	307	2	2	0.01	Schedule 80

Depth / Elev (FT)

Well Construction Material: Bentonite Sleeves, PVC Casing, Screen, Cement Basket, Bentonite Chips, Cement, Grout

WELL TYPE

Stub Piezometer Installation

Material	From	To	COMMENTS
PVC Casing	0	100	
Cement Basket	100	102	
Bentonite Sleeves	102	107	
Screen	107	307	

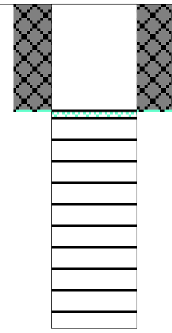
0

No Water

100

200

300



400

500

600

700

800

Water

900

1000

1100

1200

1300

1400

1500

1600

NOTES: ALL DEPTHS REPRESENT LENGTH ALONG COREHOLE
DEPTH TO WATER MEASURED AT TOP OF CASING
ELEVATION MEASURED AT TOP OF CASING

DEPTH TO WATER (ft): **147.7**

DATE MEASURED:

srk consulting

PROJECT	CLIENT	BORING LOCATION (E-N)	ELEVATION (ft)	INC.	AZI.	EOH (FT)	DRILLING METHOD	DRILLING CONTRACTOR	SRK HOLE ID
Pogo	**Sumitomo Metal Mining**	**1815408 - 3821683**	**2376**	**-83**	**294**	**1450**	**Core**	**Boart Longyear**	**12-630**

PROJECT NO.	LOGGED BY	WELL DEPTH (FT)	CASING DIA (in)	SCREEN DIA (in)	SCREEN SLOT (in)	PVC MATERIAL
147900.02	**Sumitomo**	**307**	**2**	**2**	**0.01**	**Schedule 80**

Depth / Elev (FT)

Well Construction Material: Bentonite Sleeves, PVC Casing, Screen, Cement Basket, Bentonite Chips, Cement, Grout

WELL TYPE

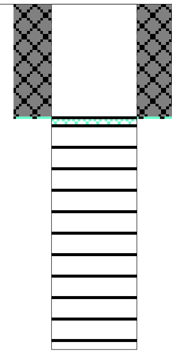
Stub Piezometer Installation

Material	From	To	COMMENTS
PVC Casing	0	100	
Cement Basket	100	102	
Bentonite Sleeves	102	107	
Screen	107	307	

Depth scale: 0, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100, 1200, 1300, 1400, 1500

No Water

Water



NOTES: ALL DEPTHS REPRESENT LENGTH ALONG COREHOLE
DEPTH TO WATER MEASURED AT TOP OF CASING
ELEVATION MEASURED AT TOP OF CASING

DEPTH TO WATER (ft): **206**

DATE MEASURED:

srk consulting

PROJECT	CLIENT	BORING LOCATION (E-N)	ELEVATION (ft)	INC.	AZI.	EOH (FT)	DRILLING METHOD	DRILLING CONTRACTOR	SRK HOLE ID
Pogo	**Sumitomo Metal Mining**	**1815145 - 3822267**	**2544**	**-80**	**208**	**1201**	**Core**	**Boart Longyear**	**12-633**

PROJECT NO.	LOGGED BY	WELL DEPTH (FT)	CASING DIA (in)	SCREEN DIA (in)	SCREEN SLOT (in)	PVC MATERIAL
147900.02	**Sumitomo**	**307**	**2**	**2**	**0.01**	**Schedule 80**

Depth / Elev (FT)

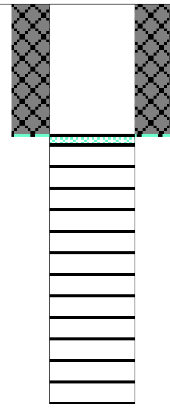
Well Construction Material: Bentonite Sleeves, PVC Casing, Screen, Cement Basket, Bentonite Chips, Cement, Grout

WELL TYPE

Stub Piezometer Installation

Material	From	To	COMMENTS
PVC Casing	0	100	
Cement Basket	100	102	
Bentonite Sleeves	102	107	
Screen	107	307	

0
No Water
100
200
300
400
500
600
Water
700
800
900
1000
1100
1200
1300



NOTES: ALL DEPTHS REPRESENT LENGTH ALONG COREHOLE
DEPTH TO WATER MEASURED AT TOP OF CASING
ELEVATION MEASURED AT TOP OF CASING

DEPTH TO WATER (ft): **143**

DATE MEASURED:

srk consulting

PROJECT	CLIENT	BORING LOCATION (E-N)	ELEVATION (ft)	INC.	AZI.	EOH (FT)	DRILLING METHOD	DRILLING CONTRACTOR	SRK HOLE ID
Pogo	Sumitomo Metal Mining	1714763.66 - 3823113.95	2703	-76	134	2505	Core	Boart Longyear	12-684

PROJECT NO.	LOGGED BY	WELL DEPTH (FT)	CASING DIA (in)	SCREEN DIA (in)	SCREEN SLOT (in)	PVC MATERIAL
147900.02	Sumitomo	307	2	2	0.01	Schedule 80

Depth / Elev (FT)

Well Construction Material: Bentonite Sleeves, PVC Casing, Screen, Cement Basket, Bentonite Chips, Cement, Grout

WELL TYPE

Stub Piezometer Installation

Material	From	To	COMMENTS
PVC Casing	0	60	
Cement Basket	60	62	
Bentonite Sleeves	62	67	
Screen	67	307	

Depth scale: 0, 200, 400, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000, 2200, 2400, 2600

No Water

Water

NOTES: ALL DEPTHS REPRESENT LENGTH ALONG COREHOLE
DEPTH TO WATER MEASURED AT TOP OF CASING
ELEVATION MEASURED AT TOP OF CASING

DEPTH TO WATER (ft): 134

DATE MEASURED:

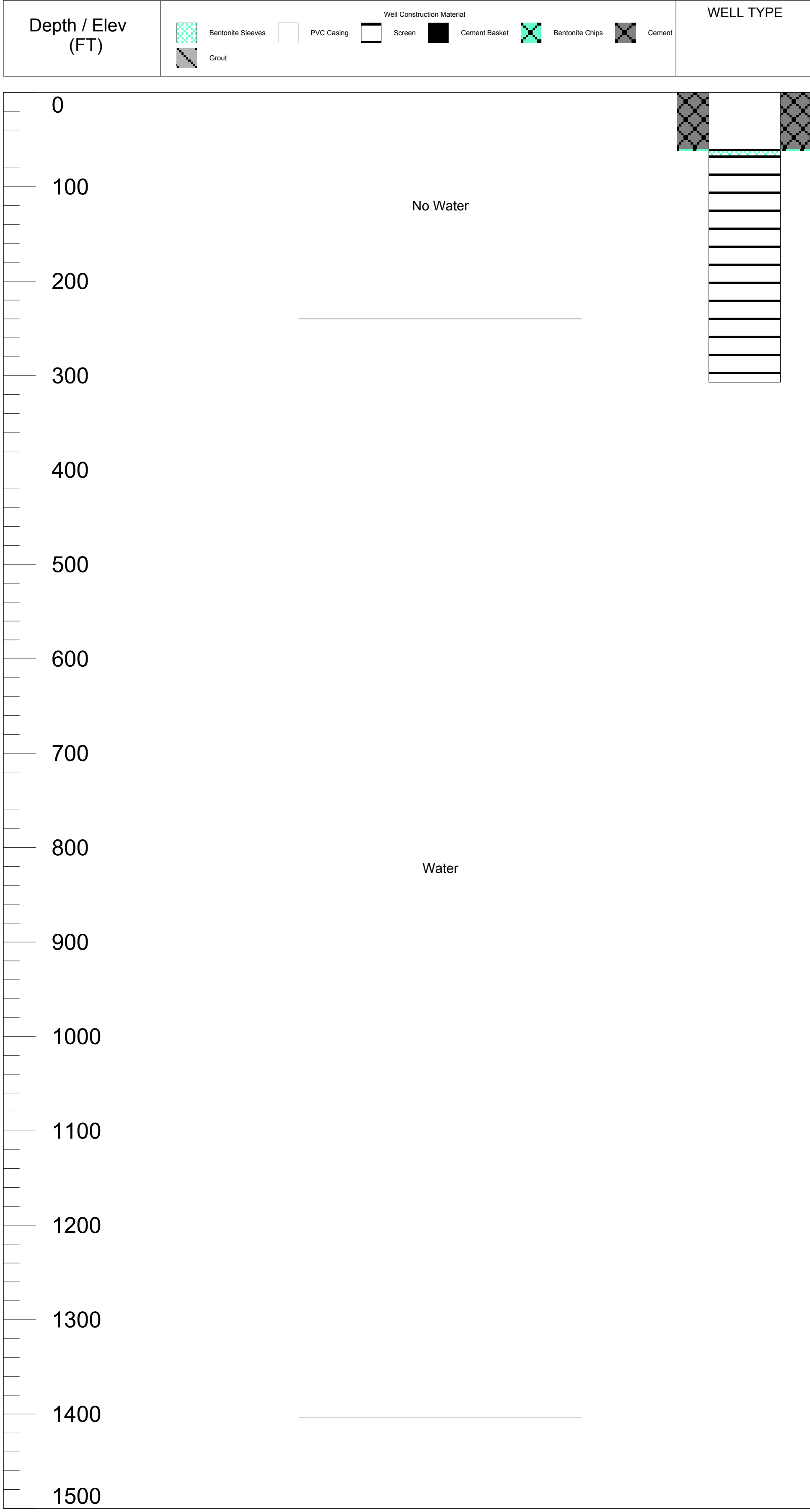
srk consulting

PROJECT	CLIENT	BORING LOCATION (E-N)	ELEVATION (ft)	INC.	AZI.	EOH (FT)	DRILLING METHOD	DRILLING CONTRACTOR	SRK HOLE ID
Pogo	Sumitomo Metal Mining	1714763.66 - 3823113.95	2703	-75	225	1404	Core	Boart Longyear	12-685

PROJECT NO.	LOGGED BY	WELL DEPTH (FT)	CASING DIA (in)	SCREEN DIA (in)	SCREEN SLOT (in)	PVC MATERIAL
147900.02	Sumitomo	307	2	2	0.01	Schedule 80

WELL TYPE

Stub Piezometer Installation



Material	From	To	COMMENTS
PVC Casing	0	60	
Cement Basket	60	62	
Bentonite Sleeves	62	67	
Screen	67	307	

NOTES: ALL DEPTHS REPRESENT LENGTH ALONG COREHOLE
DEPTH TO WATER MEASURED AT TOP OF CASING
ELEVATION MEASURED AT TOP OF CASING

DEPTH TO WATER (ft): 240

DATE MEASURED:

srk consulting

PROJECT	CLIENT	BORING LOCATION (E-N)	ELEVATION (ft)	INC.	AZI.	EOH (FT)	DRILLING METHOD	DRILLING CONTRACTOR	SRK HOLE ID
Pogo	**Sumitomo Metal Mining**	**1815006.9 - 3822745.4**	**2646**	**-85**	**0**	**2715**	**Core**	**Boart Longyear**	**12-731**

PROJECT NO.	LOGGED BY	WELL DEPTH (FT)	CASING DIA (in)	SCREEN DIA (in)	SCREEN SLOT (in)	PVC MATERIAL
147900.02	**Sumitomo**	**307**	**2**	**2**	**0.01**	**Schedule 80**

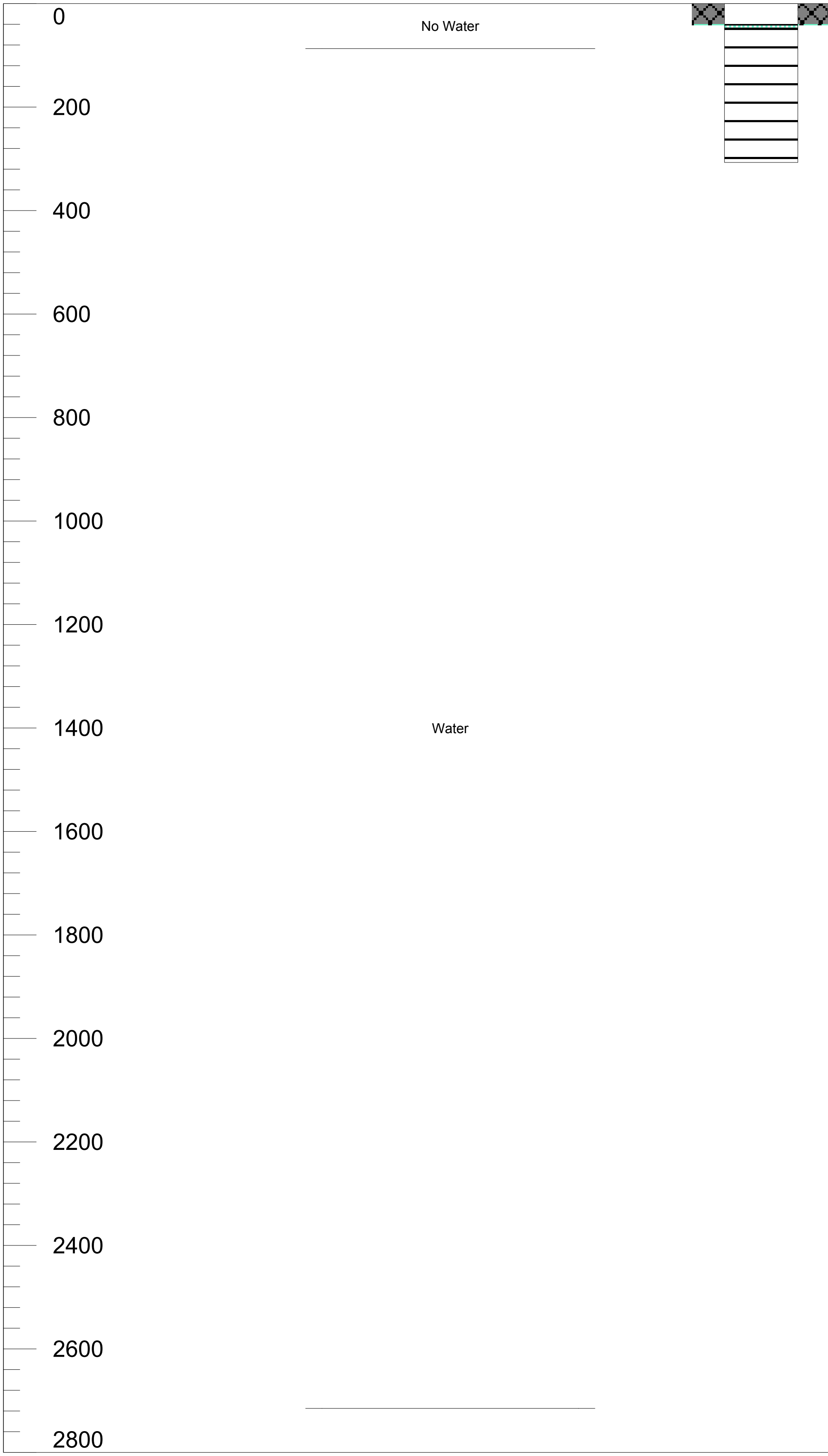
Depth / Elev (FT)

Well Construction Material: Bentonite Sleeves, PVC Casing, Screen, Cement Basket, Bentonite Chips, Cement, Grout

WELL TYPE

Stub Piezometer Installation

Material	From	To	COMMENTS
PVC Casing	0	40	
Cement Basket	40	42	
Bentonite Sleeves	42	47	
Screen	47	307	



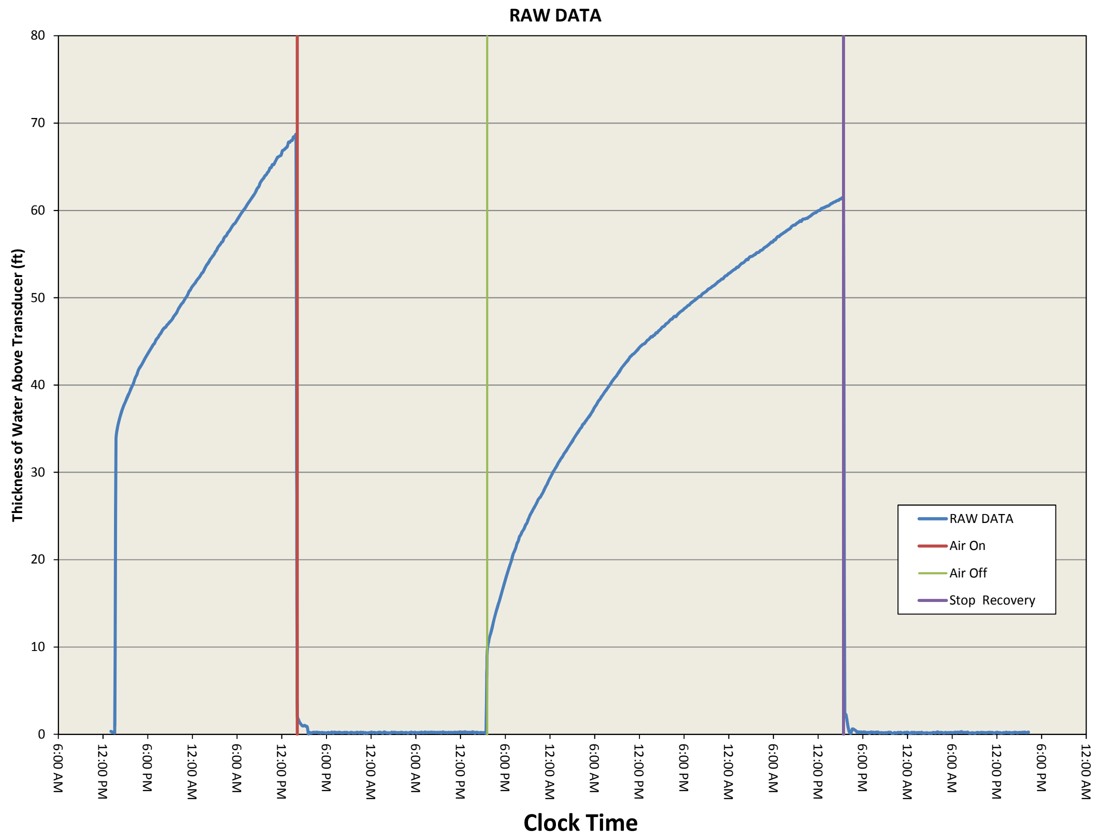
NOTES: ALL DEPTHS REPRESENT LENGTH ALONG COREHOLE
DEPTH TO WATER MEASURED AT TOP OF CASING
ELEVATION MEASURED AT TOP OF CASING

DEPTH TO WATER (ft): **87**

DATE MEASURED:

srk consulting

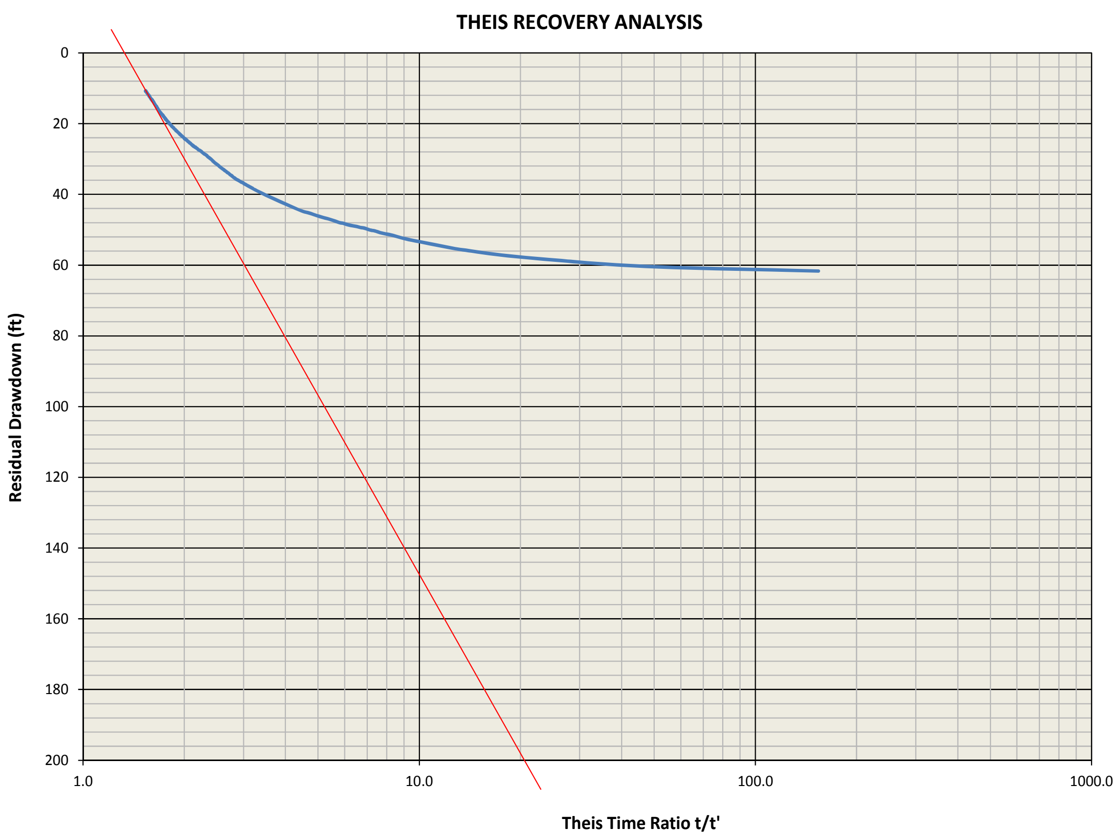
Appendix D: Results of Underground Core Hole Hydraulic Testing



Depth of Test Interval:
0 – 1,004 ft

Pumping Test Duration: 25.5 Hrs

Avg. Pumping Rate (Q) = 12 gpm
Avg. Pumping Rate (Q) = 2,310 ft^3/d



Theis Equation:

$$T = \frac{2.3\,Q}{4\pi\Delta s}$$

Where:
T = Transmissivity (ft^2/d)
Q = Pumping Rate (ft^3/d)
$\Delta(s)$ = Drawdown per Log Cycle (ft)

$$T = \frac{2.3\,(2{,}310)}{4\pi(166)} = 2.55\ ft^2/d$$

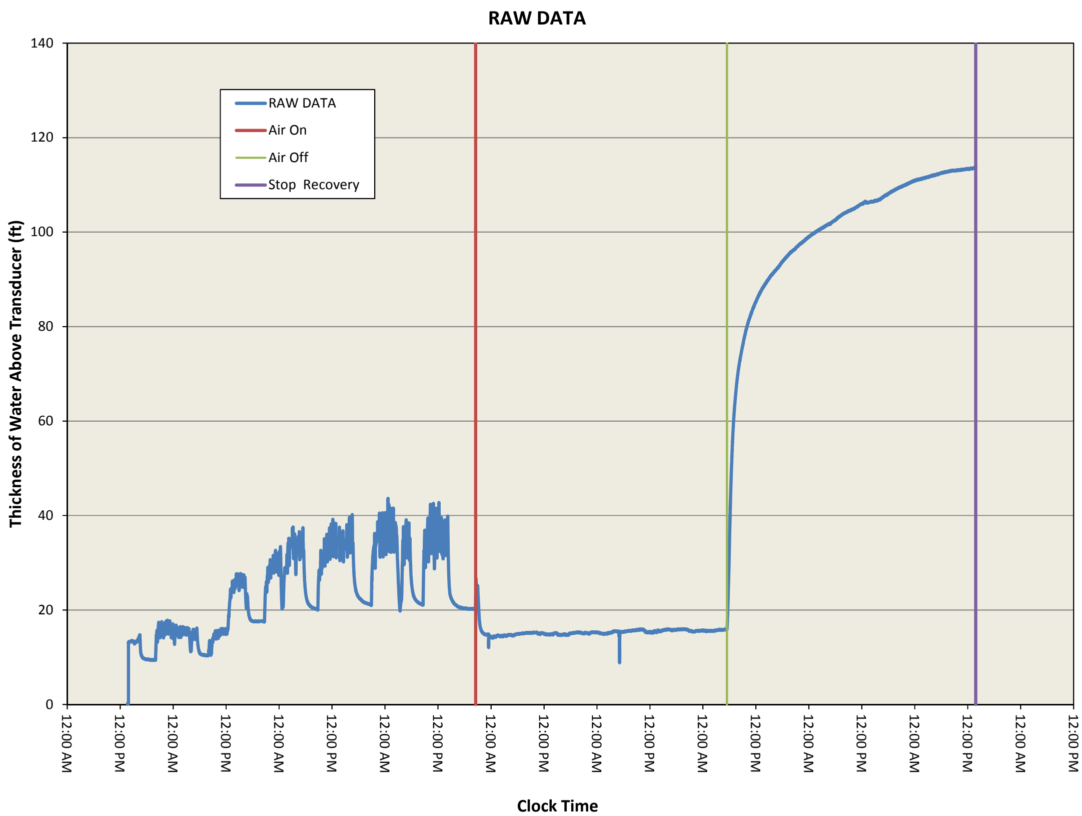
$$K = \frac{T}{b}$$

Where:
K= Estimate for Hydraulic Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(2.55)}{(1004)} = 2.54\text{x}10^{-3}\ ft/d$$

T = 2.55 ft^2/d
K = 2.54x10^{-3} ft/d

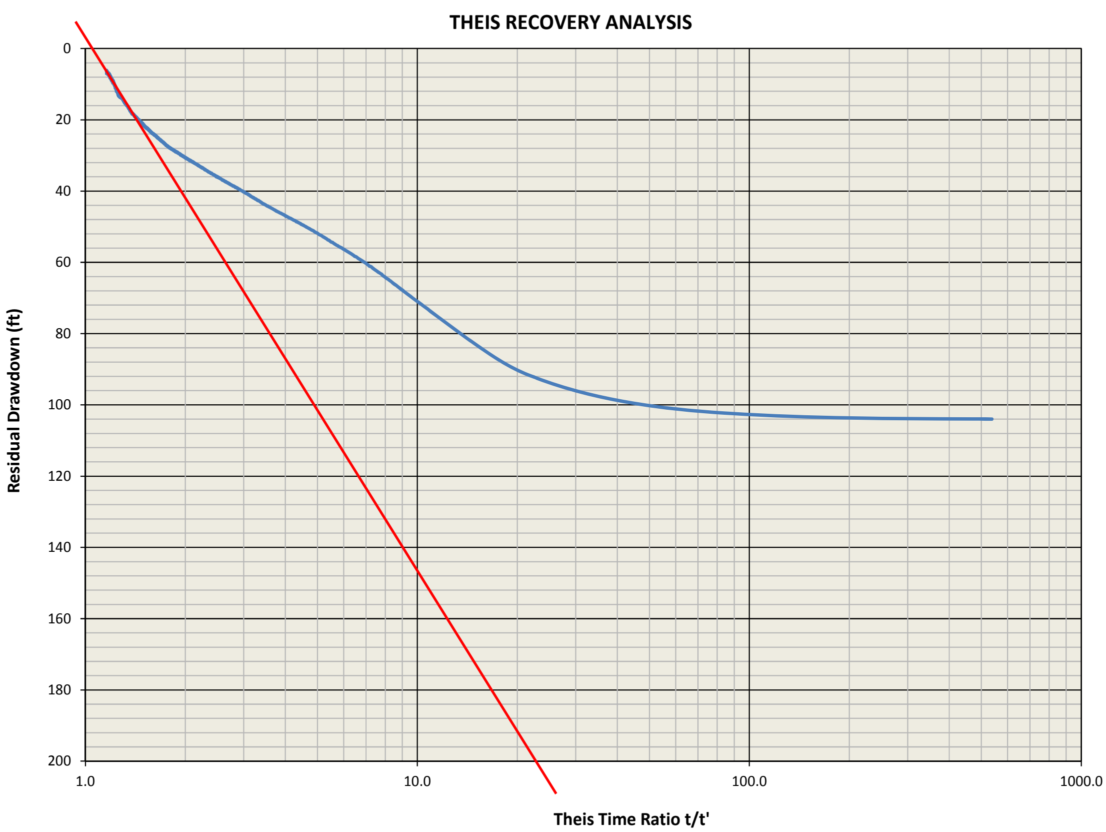
Pogo Mine	srk consulting			FIGURE D-1 Pumping Recovery Test Analysis 12-UG-199
	PROJECT NO. 147900.02	DATE July, 2013	VERSION 1.0	



Depth of Test Interval:
0 –x ft

Pumping Test Duration: 22.4 Hrs

Avg. Pumping Rate (Q) = x gpm
Avg. Pumping Rate (Q) = x ft^3/d



Theis Equation:

$$T = \frac{2.3\,Q}{4\pi\Delta s}$$

Where:
T = Transmissivity (ft^2/d)
Q = Pumping Rate (ft^3/d)
Δ(s) = Drawdown per Log Cycle (ft)

$$T = \frac{2.3\,(1{,}040)}{4\pi(148)} = 1.29\ ft^2/d$$

$$K = \frac{T}{b}$$

Where:
K= Estimate for Hydraulic Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(1.29)}{(295)} = 4.36x10^{-3}\ ft/d$$

T = 1.29 ft^2/d
K = 4.36x10^{-3} ft/d

Pogo Mine

srk consulting

PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

FIGURE D-2
Pumping Recovery Test Analysis
12-UG-201

Appendix E: Results of Pumping Tests in Water Supply Wells and Test Wells

E-1

ARCTIC DRILLING, INC.
P.O. BOX 58317
FAIRBANKS, ALASKA 99711
Phone: (907) 451-8706 Fax: (907) 452-4465

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINING, LAND & WATER
WATER WELL RECORD

Drilling Started: 5 / 1 / 2012, Completed: 5 / 18 / 2012

Legal Description:		BLOCK	LOT	Property Owner Name & Address:
City/Borough:	Subdivision:			POGO MINE, WELL #1
Pogo Mine				

Meridian ______ Township ______ Range ______ Section ______, ______ ¼ of ______ ¼ of ______ ¼ of ______ ¼

BOREHOLE DATA: (from ground surface) Material: Type, Color & wetness

Material	Depth From	Depth To
Dirt and broken rock	0	12
Schist	12	358
Granite	358	440
Schist	440	455
> Water est 15 gpm	455	
Schist	455	475
Granite	475	720
> Water, est 10 gpm	720	
Granite	720	1200

Drilling method: ☒ Air rotary, ☐ Cable tool ☐ Other DTH
Well use: ☐ Public supply, ☐ Domestic, ☒ Other test hole

Depth of hole: 1200 ft, Casing stickup: 2 ft
Casing type: STEEL Thickness .250 inches
Casing diameter: 8 inches Casing depth 386 ft
Liner type: None Diameter: ____ inches Depth: ____ ft

Static water (from top of casing): 316 ft on 5 / 18 / 2012
Pumping level & yield: 1200 feet after 2 hours at 25 gpm
Recovery rate: 25 gpm, Method of testing: AIR LIFT
Development method: AIR SURGE Duration: 2.5 HOURS

Well intake opening type: ☐ Open end ☒ Open hole
☐ Screened; Start: N/A ft, Stopped ______ ft
Screen type: ______ Slot/mesh size ______
☐ Perforated; Start: ______ ft, Stopped ______ ft
Start: ______ ft, Stopped ______ ft
Note: ......

Grout type: Benseal Volume 4 cf
Depth; from 0 ft, to 30 ft

Pump intake depth: N/A ft
Pump size ______ hp Brand name ______

Was well disinfected upon completion? ☐ Yes ☒ No
Method of disinfection: ......

Driller comments/ disclaimers:
8" casing is backfilled with cuttings from 30 feet to bottom and grouted with Benseal top 30 feet

Well driller name: Sebastian Donellan
Company name: ARCTIC DRILLING, INC.
Mailing address: P.O. BOX 58317
City: FAIRBANKS State: AK Zip 99711
Phone number : (907) 451 - 8706
Drillers signature:

Date: 5 / 18 / 2012

State law requires that a copy of this well log be submitted to the state of Alaska within 45 days. CITY OF ANCHORAGE ONLY

(Alaska statutes: 38.05.020, 38.05.035, 41.08.020, 46.15.020 and regulations 11 AAC 93.140.)

DNR/DIVISION OF MINING, LAND & WATER
550 West 7th Ave., Suite 900A
ANCHORAGE AK 99501-3577

Phone (907)269-8503, Fax (907) 269-8947

The City of Anchorage requires that a copy of this log be sent to the city within 60 days and a copy of this log be sent to the owner of the property on which the well is located within 30 days.

REQUIRED BY THE CITY OF ANCHORAGE ONLY:
Permit Number: ______
Date of Issue: ____/____/______
Parcel Identification Number: ______-______-______
Is well located at approved permit location? ☐ Yes ☐ No

E-2

ARCTIC DRILLING, INC.
P.O. BOX 58317
FAIRBANKS, ALASKA 99711
Phone: (907) 451-8706 Fax: (907) 452-4465

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINING, LAND & WATER
WATER WELL RECORD

Drilling Started: 5 / 20 / 2012, Completed: 6 / 1 / 2012

Legal Description:		BLOCK	LOT	Property Owner Name & Address:
City/Borough: Pogo	Subdivision:			POGO MINE, WELL #2

Meridian ______ Township ______ Range ______ Section ______, ______ ¼ of ______ ¼ of ______ ¼ of ______ ¼

BOREHOLE DATA: (from ground surface) Material: Type, Color & wetness

Material: Type, Color & wetness	Depth From	Depth To
Dirt and broken schist	1	8
Schist	8	340
Granite,	340	380
> water , est 40 gpm	380	
Granite,	380	700
> water , est 10 gpm	700	
Granite	700	802

Drilling method: ☒ Air rotary, ☐ Cable tool ☐ Other DTH
Well use: ☐ Public supply, ☐ Domestic, ☒ Other test hole

Depth of hole: 802 ft, Casing stickup: 2 ft
Casing type: STEEL Thickness .250 inches
Casing diameter: 8 inches Casing depth 440 ft
Liner type: None Diameter: ____ inches Depth: ____ ft

Static water (from top of casing): 253 ft on 6 / 1 / 2012
Pumping level & yield: 800 feet after 2 hours at 50 gpm
Recovery rate: 50 gpm, Method of testing: AIR LIFT
Development method: AIR SURGE Duration: 2.5 HOURS

Well intake opening type: ☐ Open end ☒ Open hole
☐ Screened; Start: N/A ft, Stopped ______ ft
Screen type: ______ Slot/mesh size ______
☒ Perforated; Start: 360 ft, Stopped 420 ft
Start: ______ ft, Stopped ______ ft
Note:

Grout type: Benseal Volume 4 cf
Depth; from 0 ft, to 30 ft

Pump intake depth: N/A ft
Pump size ______ hp Brand name ______

Was well disinfected upon completion? ☐ Yes ☒ No
Method of disinfection:

Driller comments/ disclaimers:
8" casing is backfilled with cuttings from 30 ft to 300 ft,
Formation packer is set at 300 feet, casing is perfed 360 to 440 ft
440 to 802 is open hole

Well driller name: Sebastian Donnellan
Company name: ARCTIC DRILLING, INC.
Mailing address: P.O. BOX 58317
City: FAIRBANKS State: AK Zip 99711
Phone number : (907) 451 - 8706
Drillers signature:

Date: 6 / 1 / 2012

State law requires that a copy of this well log be submitted to the state of Alaska within 45 days. CITY OF ANCHORAGE ONLY

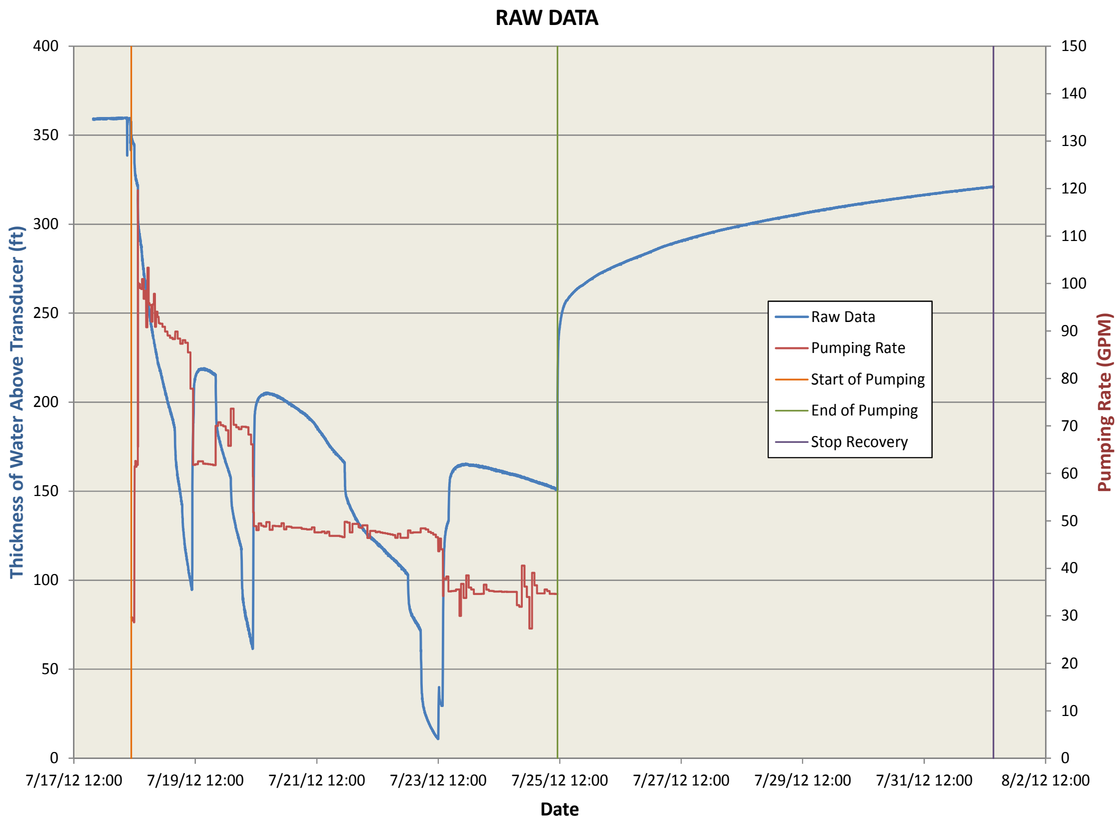
(Alaska statutes: 38.05.020, 38.05.035, 41.08.020, 46.15.020 and regulations 11 AAC 93.140.)

DNR/DIVISION OF MINING, LAND & WATER
550 West 7th Ave., Suite 900A
ANCHORAGE AK 99501-3577

Phone (907)269-8503, Fax (907) 269-8947

The City of Anchorage requires that a copy of this log be sent to the city within 60 days and a copy of this log be sent to the owner of the property on which the well is located within 30 days.

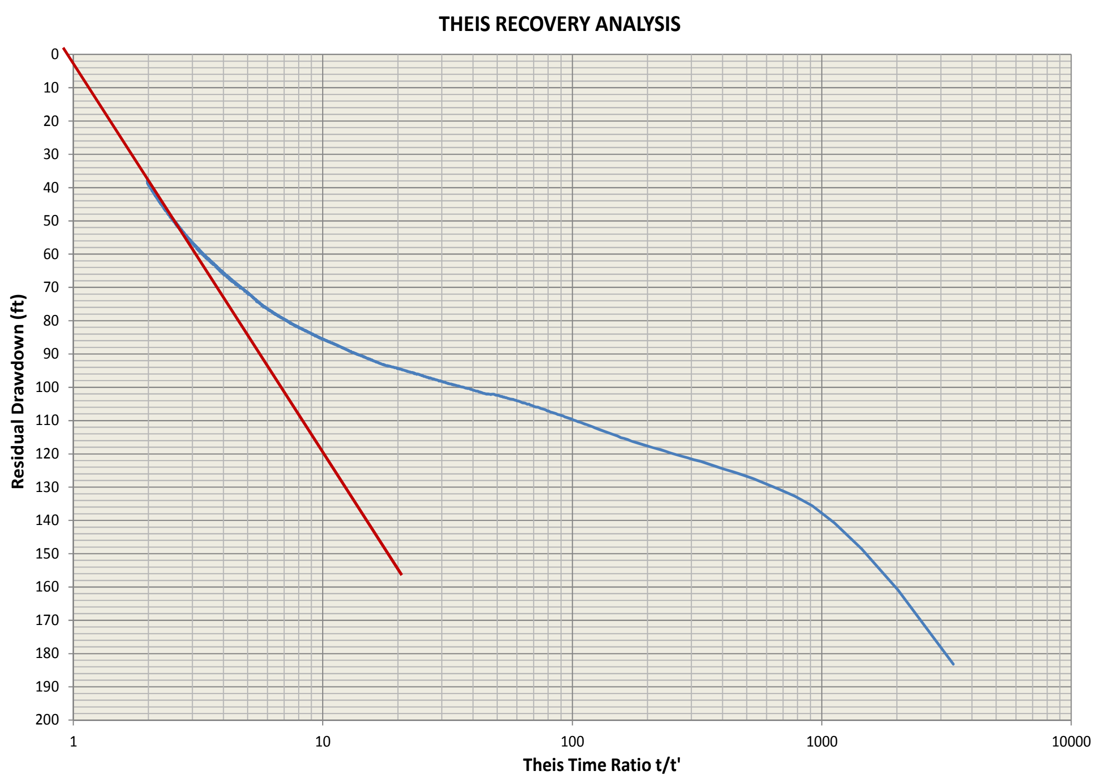
REQUIRED BY THE CITY OF ANCHORAGE ONLY:
Permit Number: ______
Date of Issue: ____/____/______
Parcel Identification Number: ______-______-______
Is well located at approved permit location? ☐ Yes ☐ No



Depth of Test Interval:
440 – 802 ft

Pumping Test Duration: 7 days

Avg. Pumping Rate (Q) = 54.1 gpm
Avg. Pumping Rate (Q) = 10,411 ft^3/d



Theis Equation:

$$T = \frac{2.3\,Q}{4\pi\Delta s}$$

Where:
T = Transmissivity (ft^2/d)
Q = Pumping Rate (ft^3/d)
$\Delta(s)$ = Drawdown per Log Cycle (ft)

$$T = \frac{2.3\,(10{,}411)}{4\pi(118)} = 16.2\ ft^2/d$$

$$K = \frac{T}{b}$$

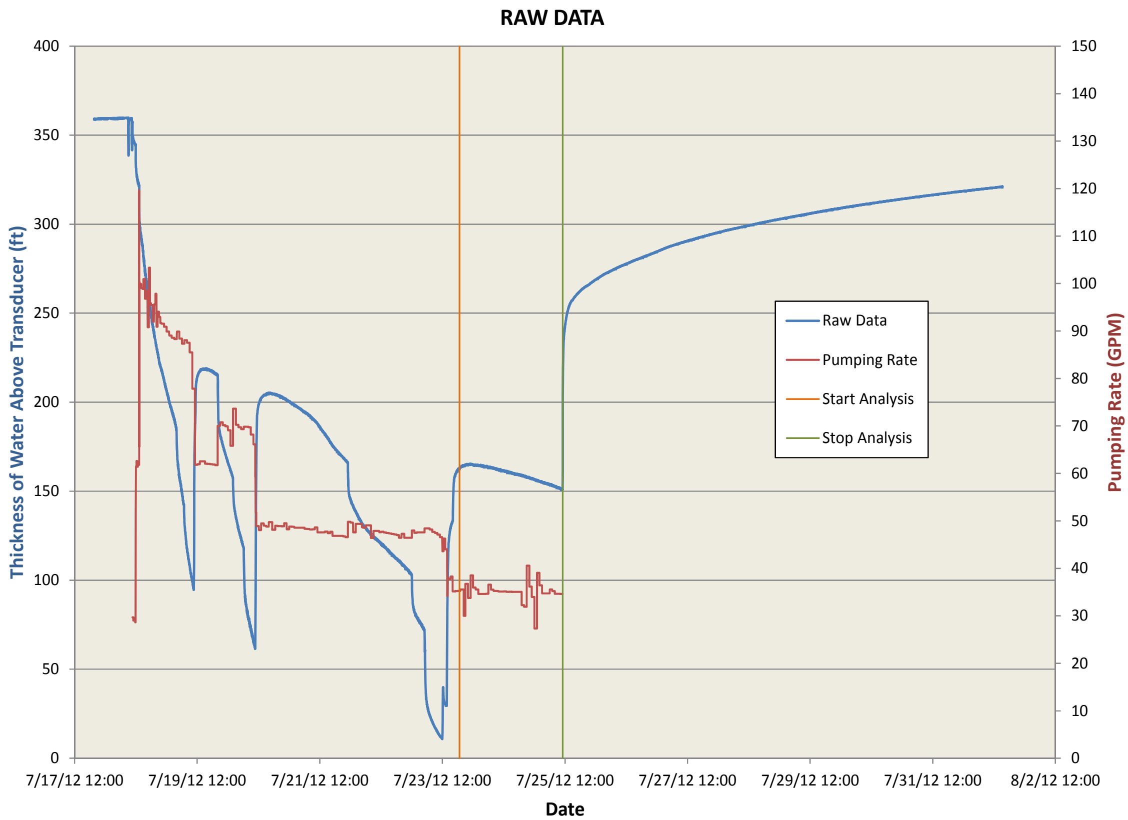
Where:
K= Estimate for Hydraulic Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(16.2)}{(362)} = 4.46\text{x}10^{-2}\ ft/d$$

T = 16.2 ft^2/d
K = 4.46x10^{-2} ft/d

Pogo Mine	srk consulting		
PROJECT NO. 147900.02	DATE July, 2013	VERSION 1.0	

E-3
Pumping Recovery Test Analysis
Water Supply Well No.2-1A

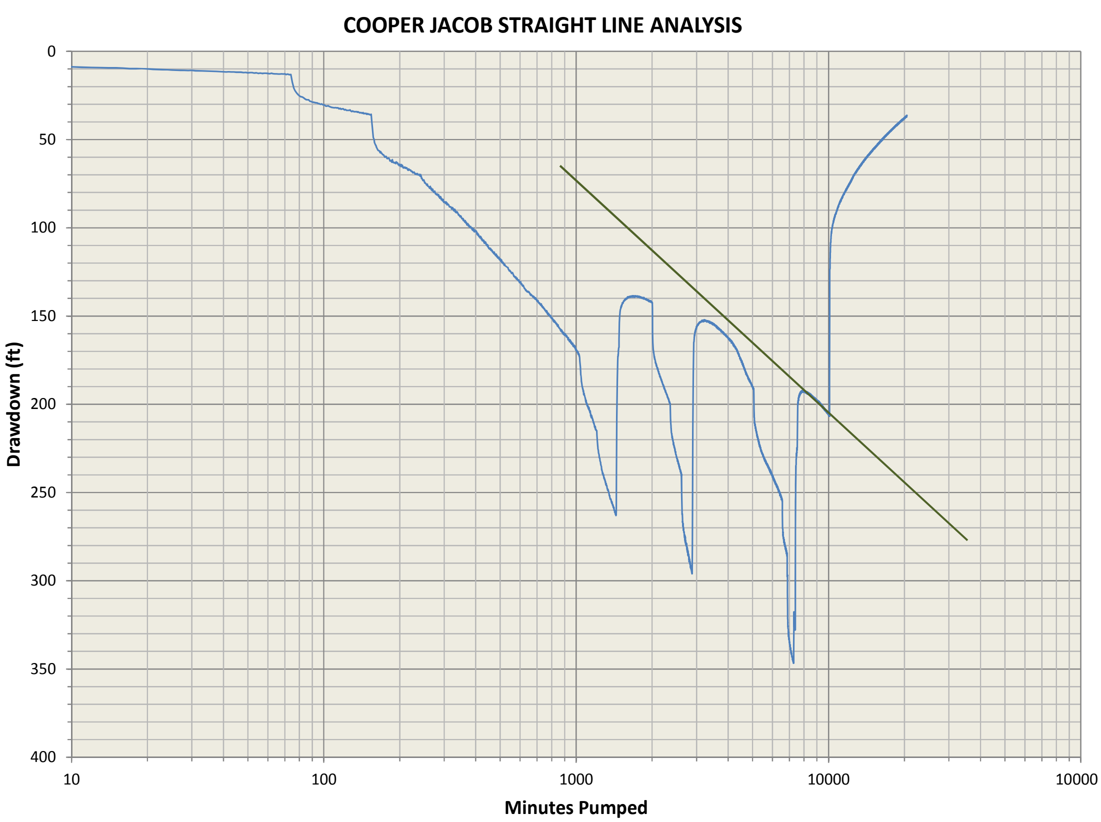


Depth of Test Interval:
440 – 802 ft

Pumping Duration of Analysis
Period: 1.88 days

Avg. Pumping Rate of Analysis
Period: (Q) = 35.2 gpm

Avg. Pumping Rate of Analysis
Period: (Q) = 6,769 ft³/d



Cooper Jacob Straight Line
Time-Drawdown:

$$T = \frac{2.3\,Q}{4\pi\Delta s}$$

Where:
T = Transmissivity (ft²/d)
Q = Pumping Rate (ft³/d)
$\Delta(s)$ = Drawdown per Log Cycle (ft)

$$T = \frac{2.3\,(6{,}769)}{4\pi(130)} = 9.5 \text{ ft}^2\text{/d}$$

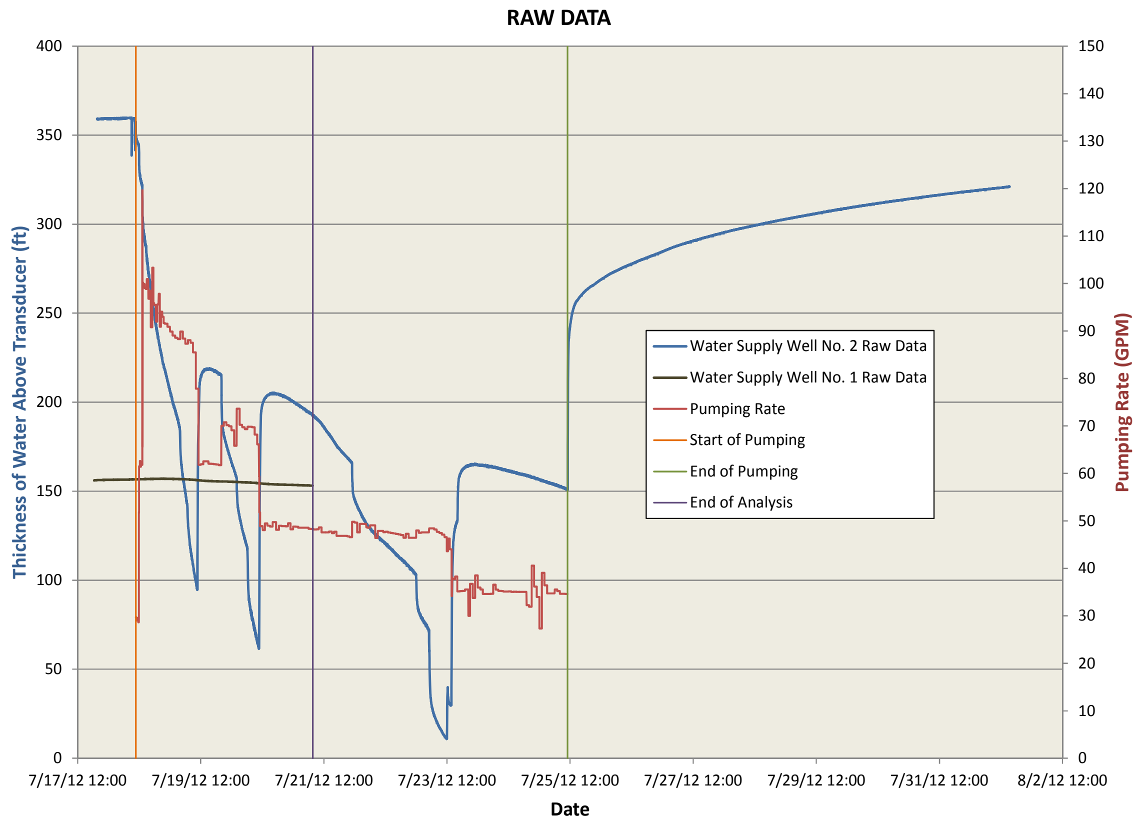
$$K = \frac{T}{b}$$

Where:
K= Estimate for Hydraulic
Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(9.5)}{(362)} = 2.63\text{x}10^{-2} \text{ ft/d}$$

T = 9.5 ft²/d
K = 2.63x10⁻² ft/d

Pogo Mine	srk consulting		**E-4**
PROJECT NO. 147900.02	DATE July, 2013	VERSION 1.0	**Cooper Jacob Straight Line Analysis Water Supply Well No.2-1B**

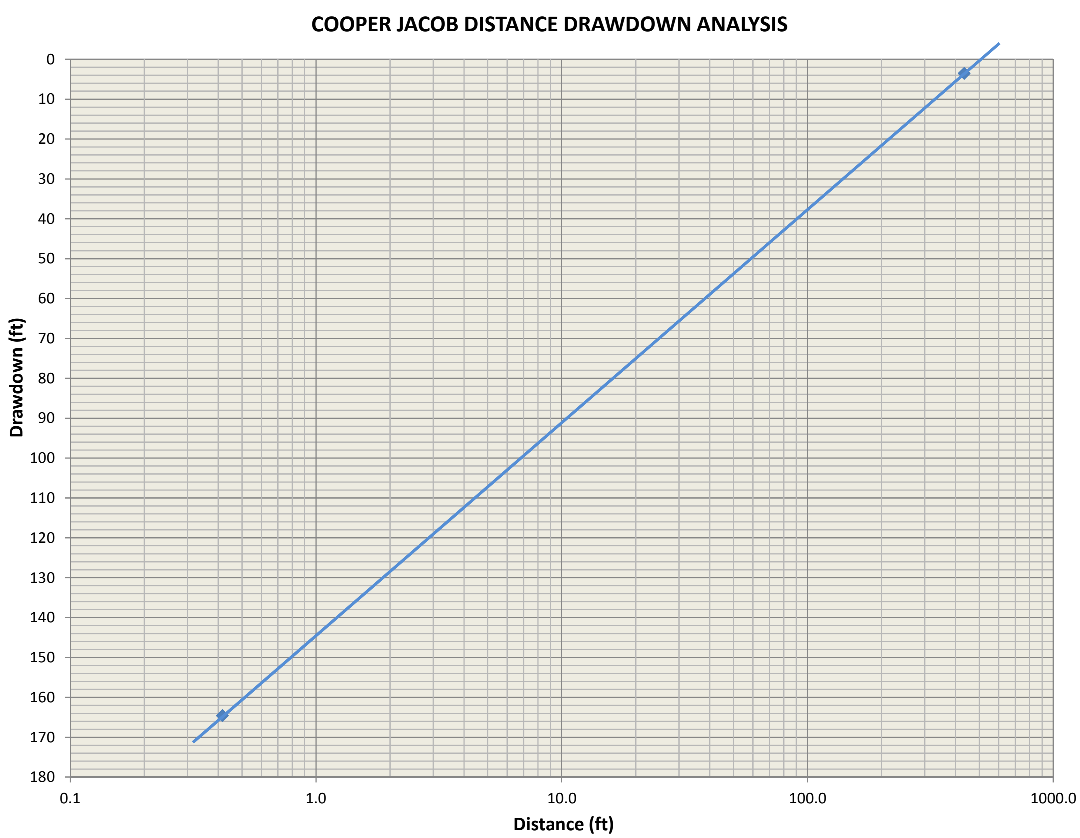


Depth of Test Interval:
440 – 802 ft

Pumping Duration of Analysis
Period: 2.88 days

Avg. Pumping Rate of Analysis
Period: (Q) = 69.7 gpm

Avg. Pumping Rate of Analysis
Period: (Q) = 13,422 ft^3/d



Cooper Jacob Distance Drawdown:

$$S = \frac{2.25\,T\,t}{r_o^2}$$

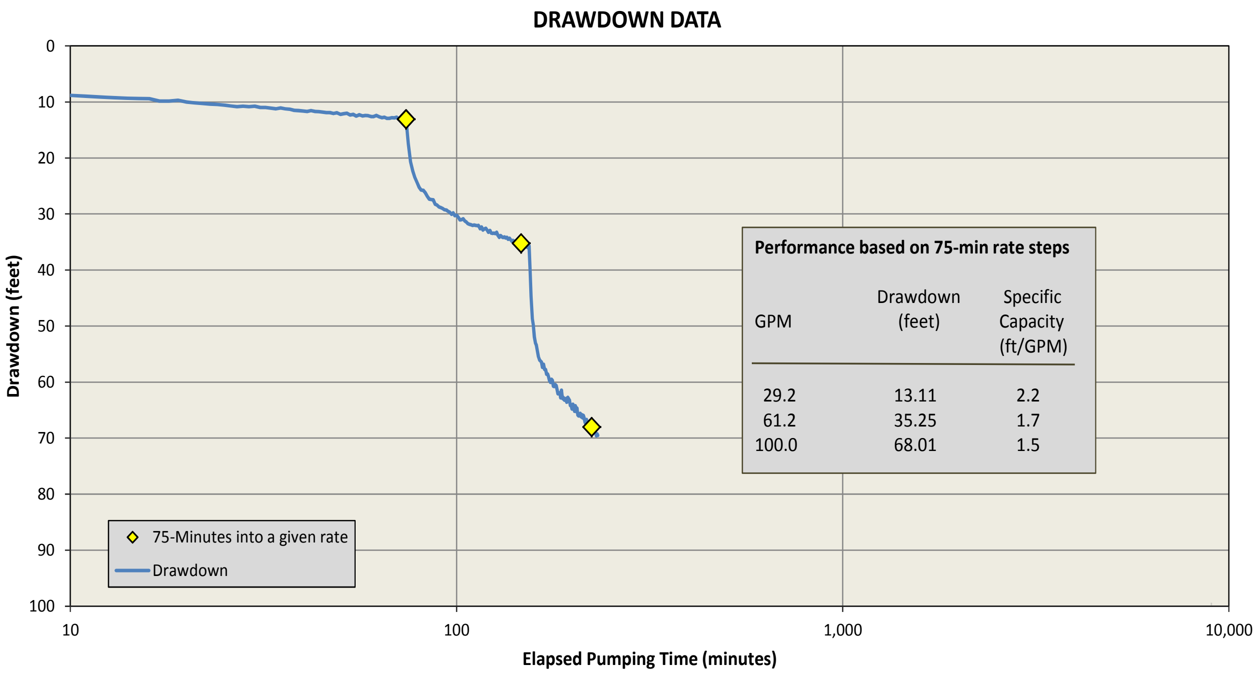
Where:
S = Storativity
T = Transmissivity (ft^2/d)
t = Time of Analysis (days)
r_o = Distance where straight line intersects zero drawdown (ft)

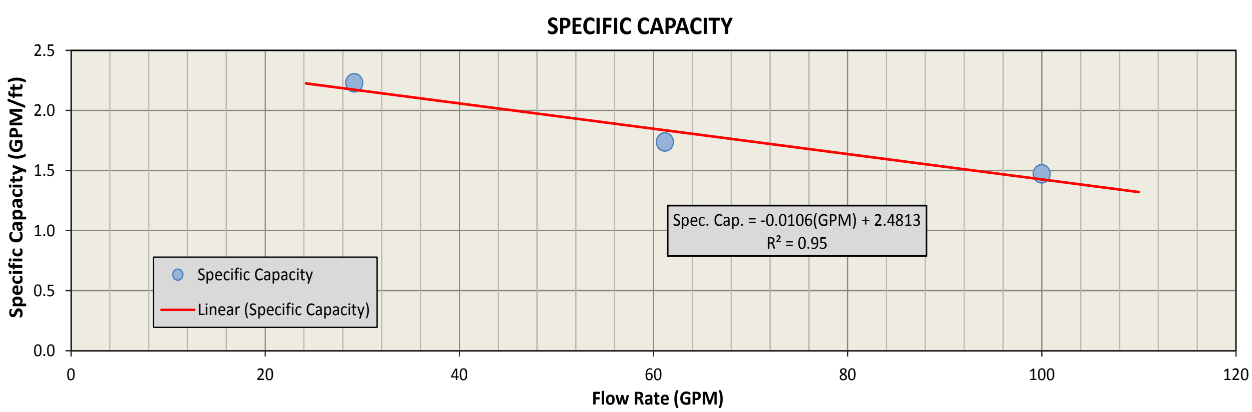
$$S = \frac{2.25\,(16.2)(2.88)}{(510)} = 4.03\text{x}10{-}4$$

S = 4.03x10^{-4}

Pogo Mine	srk consulting		
	PROJECT NO. 147900.02	DATE July, 2013	VERSION 1.0

E-5
Cooper Jacob Distance Drawdown Analysis
Water Supply Well No.2-1C

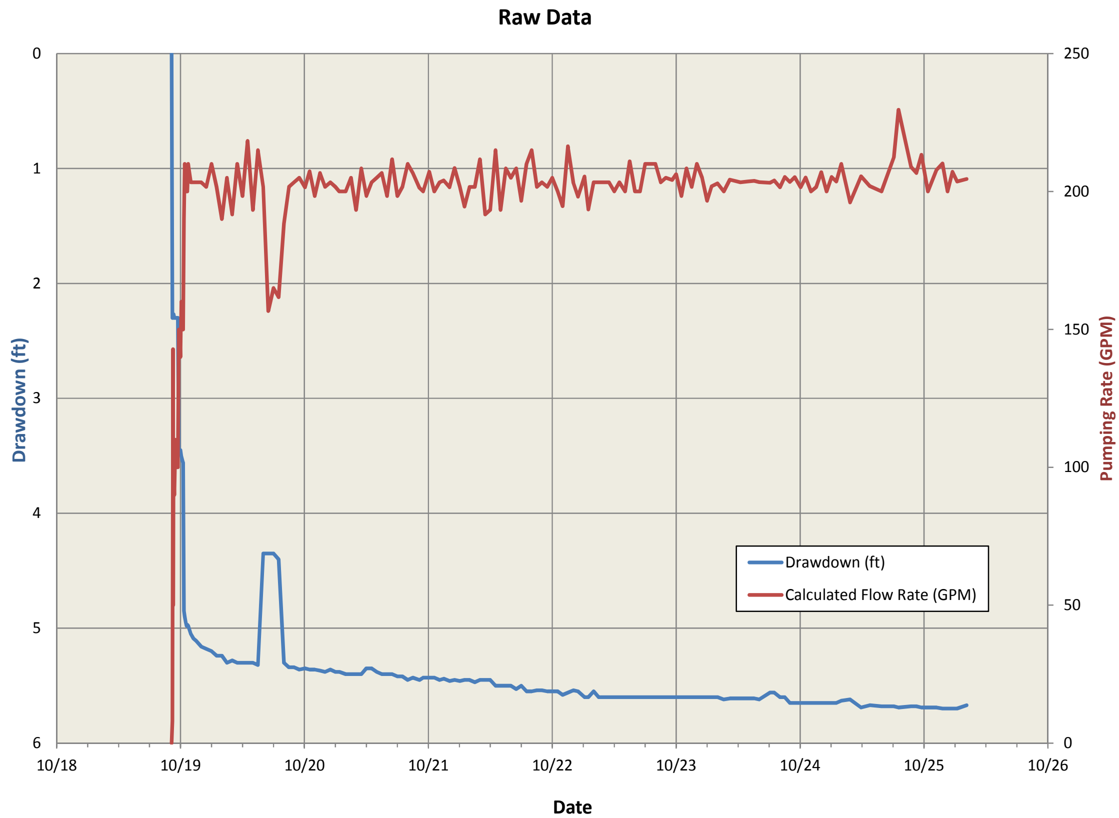




PROJECT NO.	DATE	VERSION
147900.02	July, 2013	1.0

E-6
Specific Capacity Analysis
Water Supply Well No.2

Raw Data



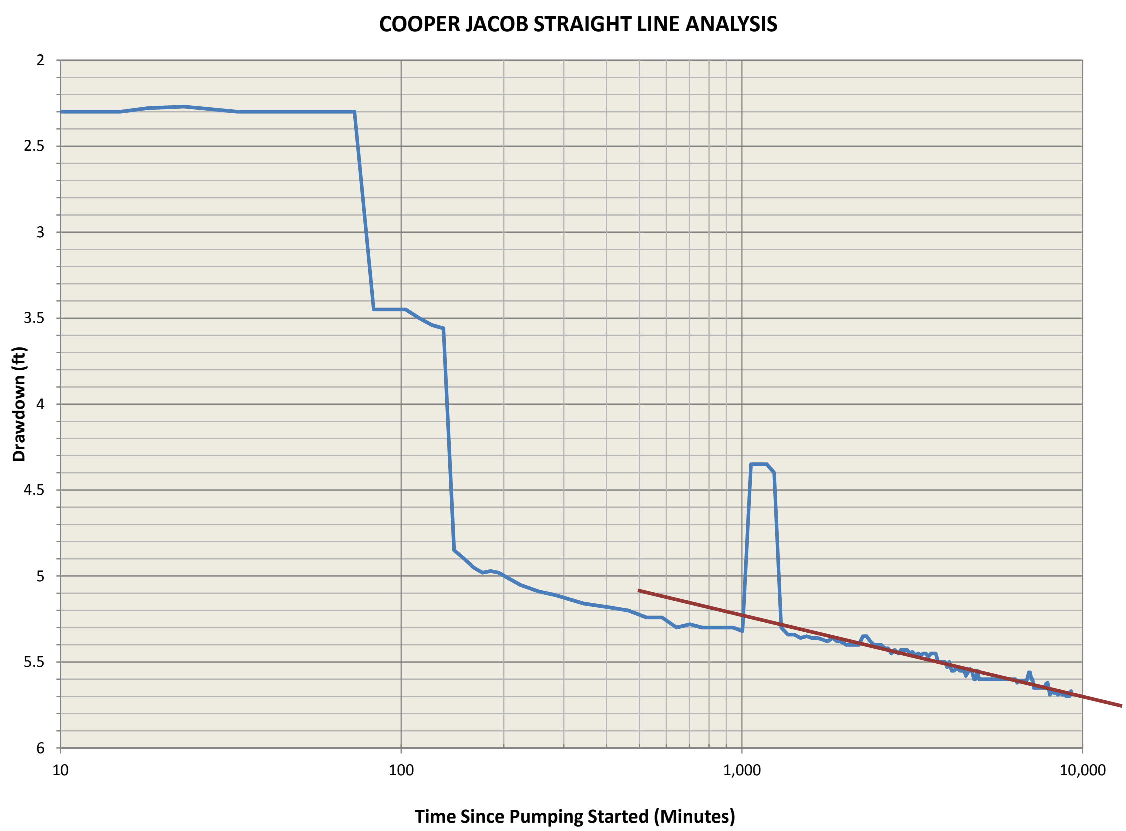
Depth of Test Interval:
17 – 57 ft

Pumping Duration of Analysis Period: 6.4 days

Avg. Pumping Rate of Analysis Period: (Q) = 194.4 gpm

Avg. Pumping Rate of Analysis Period: (Q) = 37,419 ft^3/d

COOPER JACOB STRAIGHT LINE ANALYSIS



Cooper Jacob Straight Line Time-Drawdown:

$$T = \frac{2.3\ Q}{4\pi \Delta s}$$

Where:
T = Transmissivity (ft^2/d)
Q = Pumping Rate (ft^3/d)
$\Delta(s)$ = Drawdown per Log Cycle (ft)

$$T = \frac{2.3\ (37{,}419)}{4\pi(0.47)} = 14{,}572\ ft^2/d$$

$$K = \frac{T}{b}$$

Where:
K= Estimate for Hydraulic Conductivity (ft/d)
b = Test Interval Length (ft)

$$K = \frac{(14{,}572)}{(50)} = 291\ ft/d$$

T = 14,572 ft^2/d
K = 291 ft/d

Pogo Mine	srk consulting			E-7 Cooper Jacob Straight Line Analysis MW12-001A-1A
	PROJECT NO. 147900.02	DATE July, 2013	VERSION 1.0	

E-7
Cooper Jacob Straight Line Analysis
MW12-001A-1A

Appendix F: Water Quality Results

Table F-1. Water Quality Results for Samples from Surface and Underground Drill Holes

Ground Water	Outfall 001 Effluent Limits (Mon. Avg)	Surface Core Hole	Surface Core Hole	UG Core Hole	UG Core Hole
Site Number in EDMS		H212630	H312633	I2U201	I2U209
Sample Date		09/28/2012	10/07/2012	11/20/2012	11/20/2012
Sample Time		17:00	15:40	14:45	14:00
Alkalinity, Bicarbonate (mg/l as CaCO3)		200	160	230	310
Alkalinity, Carbonate (mg/l as CaCO3)		-1.2	-1.2	-1.2	-1.2
Alkalinity, Hydroxide (mg/l as CaCO3)		-1.5	-1.5	-1.5	-1.5
Alkalinity, Total (mg/l as CaCO3)		200	160	230	310
Aluminum, Total			12900		
Antimony, Dissolved		10.9		0.0989	0.113
Antimony, Total			3.06	0.104	0.123
Arsenic Dissolved		125	82.7	530	973
Arsenic, Total				551	923
Cadmium, Dissolved	0.2	0.176	-0.045	0.0761	0.0627
Cadmium, Total				0.0827	-0.066
Calcium, Dissolved		50	50	110	150
Calcium, Total				100	140
Chloride mg/l		0.707	0.507	0.573	0.397
Chromium, Dissolved		26.4	11.8	0.541	0.776
Chromium, Total				4.19	2.03
Copper, Dissolved		16.4	12.2	0.932	0.835
Copper, Total	2.2			4.95	0.734
Fluoride, Total (mg/l)		0.176		0.0882	0.0617
Hardness, Total (mg/l)		200	190	580	650
Iron, Dissolved		7300		840	1900
Iron, Total			40000	1900	1800
Lead, Dissolved		6.28	1.99	-0.03	-0.03
Lead, Total	0.5			0.594	0.086
Magnesium, Dissolved (mg/l)		17	15	75	69
Magnesium, Total (mg/l)				69	67
Manganese, Dissolved		245		24.1	62
Manganese, Total			464	31.9	58.2
Mercury, Dissolved	0.01	0.00404	0.00181	-0.00013	-0.00013
Nickel, Dissolved		38.6	10.2	5.14	8.19
Nickel, Total				5.29	6.7
Oxygen, Dissolved mg/l			7.72		
pH, Field, Standard Units	6.5 - 8.5		7.76		
Potassium, Dissolved (mg/l)		5.6		0.41	-0.31
Potassium, Total mg/l)				3.9	1.4
Selenium, Dissolved		1.37		-0.14	-0.14
Selenium, Total			0.687	-0.3	-0.3
Silver, Dissolved		0.296	0.622	-0.028	-0.028
Silver, Total				-0.086	-0.086
Sodium, Dissolved (mg/l)		33		34	19
Sodium, Total (mg/l)				32	20
Specific Conductance,Field (umhos/cm @ 25C)			318		
Sulfate, Total (mg/l)		95.8	90.8	433	455
TDS (mg/l)		889	941	919	997
TSS (mg/l)			686		
Nitrite plus Nitrate, Total (mg/l)		0.062	0.072	-0.015	-0.015
Total Nitrogen (mg/l)		16	8.12	0.342	0.281
Turbidity,Lab (NTU)	<20		680		
WAD Cyanide		-1.2	-1.2	-1.2	-1.2
Zinc, Dissolved		25.2	35	0.7	1.4
Zinc, Total	16.8			3.07	1.7

Notes:

Units in ug/l unless otherwise indicated.

Values that exceed effluent limits or groundwater standards are bolded and shaded.

Table F-2. Water Quality Results for Samples from Exploration Water Supply Wells and Test Wells

Ground Water	Outfall 001 Effluent Limits (Mon. Avg)	Exploration Water Supply Well #1 Material Site B		Exploration Water Supply Well #2 Material Site B				Test Well Near Airstrip (Alluvial)	Test Well near Airstrip (Bedrock)
Site Number in EDMS		Exp12-01	Exp12-01	Exp12-02	Exp12-02	Exp12-02	Exp12-02	MW12-001A	MW12-001B
Sample Date		08/04/2012	08/15/2012	07/25/2012	08/16/2012	09/12/2012	10/16/2012	10/24/2012	01/22/2013
Sample Time		09:00	12:35	08:30	17:00	09:00	15:20	09:50	17:00
Alkalinity, Bicarbonate (mg/l as CaCO3)		220	220	230	180	250	250	50	
Alkalinity, Carbonate (mg/l as CaCO3)		-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	
Alkalinity, Hydroxide (mg/l as CaCO3)		-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	
Alkalinity, Total (mg/l as CaCO3)		220	220	230	180	250	250	50	
Aluminum, Total								18.7	
Antimony, Dissolved		1.82	9.5	0.0486	0.172	0.0794	0.161		
Antimony, Total								0.0908	
Arsenic, Dissolved		15.6	76.6	13	12.3	16	9.08	1.07	
Arsenic, Total									
Cadmium, Dissolved	0.2	-0.045	-0.045	-0.045	-0.045	-0.045	-0.045	-0.045	
Cadmium, Total									
Calcium, Dissolved		95	91	93	77	93	89	18	
Calcium, Total									
Chloride mg/l		0.267	0.471	0.267	0.293	0.427	0.445	0.3	
Chromium, Dissolved		1.1	0.312	0.722	0.338	1.07	0.887	0.277	
Chromium, Total									
Copper, Dissolved		0.707	3.01	1.71	0.862	10.9	1.63	0.737	
Copper, Total	2.2								
Fluoride, Total (mg/l)		0.105	0.112	0.163	0.083	0.364	0.108		
Hardness, Total (mg/l)		410	390	420	320	420	410	63	
Iron, Dissolved		310	73	-2.7	5.5	35	-2.7		
Iron, Total								320	
Lead, Dissolved		-0.03	0.0774	-0.03	-0.03	0.559	-0.03	0.583	
Lead, Total	0.5								
Magnesium, Dissolved (mg/l)		41	40	46	31	45	45	4.2	
Magnesium, Total (mg/l)									
Manganese, Dissolved		137	69	64.3	31.4	74.5	90.4		
Manganese, Total								170	
Mercury, Dissolved	0.01	0.000594	0.000187	0.000328	-0.00013	-0.00013	0.000163	0.000509	
Nickel, Dissolved		7.93	29.3	5.98	4.9	6.27	5.02	1.16	
Nickel, Total									
Oxygen, Dissolved mg/l		970		23.08			13.52		8
pH, Field, Standard Units	6.5 - 8.5	7.34		7.62		6.89	6.95		7
Potassium, Dissolved (mg/l)		1.3	1.8	2.1	1.5	2	1		
Potassium, Total mg/l)									
Selenium, Dissolved		1.88	1.38	2.14	2.89	2.1	1.92		
Selenium, Total								0.174	
Silver, Dissolved		-0.028	-0.028	-0.028	-0.028	0.0335	0.0736	-0.028	
Silver, Total									
Sodium, Dissolved (mg/l)		6.7	6.9	7.3	5	7.6	7.9		
Sodium, Total (mg/l)									
Specific Conductance,Field (umhos/cm @ 25C)		641		704		671	482		363
Sulfate, Total (mg/l)		194	191	202	151	184	194	19.9	
TDS (mg/l)		494	513	538	329	479	520	103	
TSS (mg/l)								2.04	
Nitrite plus Nitrate, Total (mg/l)		0.06	0.099	0.167	0.346	0.125	0.152	0.585	
Total Nitrogen (mg/l)		0.119	-0.112	0.264	-0.112	0.172	0.33	0.261	
Turbidity,Lab (NTU)	<20							0.68	
WAD Cyanide		-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	
Zinc, Dissolved		667	2200	76.9	536	82.5	203	8.92	
Zinc, Total	16.8								

Notes:

Units in ug/l unless otherwise indicated.

Values that exceed effluent limits or groundwater standards are bolded and shaded.

Only field parameters measured in the bedrock test well near airstrip. No laboratory sample collected from that well.

Table F-3. Water Quality Results for Surface Water Samples from North Creek Drainage

Ground Water	Outfall 001 Effluent Limits (Mon. Avg)	Ringer Creek		Upper North Creek		North Creek Below its Confluence with Ringer Creek	
Site Number in EDMS		SW46		SW48		SW47	
Sample Date		09/21/2012	10/02/2012	09/21/2012	10/02/2012	09/21/2012	10/02/2012
Sample Time		14:25	14:15	14:45	14:50	15:10	15:15
Alkalinity, Bicarbonate (mg/l as CaCO3)		58	61	44	50	48	52
Alkalinity, Carbonate (mg/l as CaCO3)		-1.2	-1.2	-1.2	-1.2	-1.2	-1.2
Alkalinity, Hydroxide (mg/l as CaCO3)		-1.5	-1.5	-1.5	-1.5	-1.5	-1.5
Alkalinity, Total (mg/l as CaCO3)		58	61	44	50	48	52
Aluminum, Total			45.7		409		245
Antimony, Dissolved		0.112		0.0744		0.0888	
Antimony, Total		0.114	0.117	0.0762	0.0992	0.0957	0.101
Arsenic, Dissolved		2.04	2.37	0.281	0.465	0.693	0.849
Arsenic, Total		2.38		0.4		1.47	
Cadmium, Dissolved	0.2	-0.045	-0.045	-0.045	-0.045	-0.045	-0.045
Cadmium, Total		-0.066		-0.066		-0.066	
Calcium, Dissolved		74	78	41	44	51	55
Calcium, Total		72		40		49	
Chloride mg/l		0.259	0.275	0.174	0.205	0.191	0.193
Chromium, Dissolved		0.556	0.354	0.562	0.475	0.576	0.356
Chromium, Total		0.338		0.503		0.831	
Copper, Dissolved		2.09	2.17	1.29	1.41	1.57	1.69
Copper, Total	2.2	1.99		1.4		2.15	
Fluoride, Total (mg/l)		0.0409		0.0606		0.0556	
Hardness, Total (mg/l)		260	280	140	140	180	190
Iron, Dissolved		15		58		39	
Iron, Total		56	9.5	190	600	490	360
Lead, Dissolved		-0.03	-0.03	0.0302	0.0851	-0.03	0.0569
Lead, Total	0.5	-0.073		0.119		0.425	
Magnesium, Dissolved (mg/l)		19	20	8.6	8.5	12	12
Magnesium, Total (mg/l)		20		8.7		12	
Manganese, Dissolved		2.04		17.8		10.1	
Manganese, Total		4.31	2.89	19.3	18.7	16.1	11
Mercury, Dissolved	0.01		0.00151		0.0018		0.00181
Nickel, Dissolved		3.59	5.28	2.73	3.38	2.88	3.81
Nickel, Total		3.41		2.7		3.07	
Oxygen, Dissolved mg/l		20.72	12.9	13.23	13.61	12.39	13.45
pH, Field, Standard Units	6.5 - 8.5	7.67	7.54	7.57	7.77	7.24	7.19
Potassium, Dissolved (mg/l)		2.1		1.4		3	
Potassium, Total mg/l)		2.2		1.2		1.4	
Selenium, Dissolved		0.228		0.337		0.459	
Selenium, Total		-0.3	-0.14	-0.3	-0.14	-0.3	0.193
Silver, Dissolved		-0.028	-0.028	-0.028	-0.028	-0.028	-0.028
Silver, Total		-0.086		-0.086		-0.086	
Sodium, Dissolved (mg/l)		5		5.4		6	
Sodium, Total (mg/l)		5.1		5.5		5.2	
Specific Conductance,Field (umhos/cm @ 25C)		304	311	13.23	174	212	212
Sulfate, Total (mg/l)		214	235	98.9	105	130	140
TDS (mg/l)		385	412	209	223	225	274
TSS (mg/l)			-0.5		44.7		18.5
Nitrite plus Nitrate, Total (mg/l)		0.559	0.587	0.753	0.828	0.647	0.714
Total Nitrogen (mg/l)		0.182	0.314	0.596	0.546	0.307	0.681
Turbidity,Lab (NTU)	<20		0.42		7.7		3.7
WAD Cyanide		-1.2	-1.2	-1.2	-1.2	-1.2	-1.2
Zinc, Dissolved		1.54	1.1	1.32	0.561	0.838	0.77
Zinc, Total	16.8	-0.55		-0.55		-0.55	

Notes:

Units in ug/l unless otherwise indicated.

Values that exceed effluent limits or groundwater standards are bolded and shaded.