Groundwater Supply Evaluation

Prepared for:
1842107 Alberta Ltd.

Prepared by:
Stantec Consulting Ltd.

October 2016
110219790

Sign-off Sheet

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Executive Summary

This report summarizes the results of the Groundwater Supply Evaluation program completed by Stantec Consulting Ltd. at the proposed Sandhill Estates (Burbank) subdivision situated at SW-24-39-27 W4M, northeast of Red Deer, Alberta. The installation of two water supply wells was initiated due to the request from Lacombe County to conduct a 72-hour pumping test evaluation in support of the current subdivision application.

The drilling and aquifer pumping test program presented in this report was preceded by a previous desktop study that included the development of a preliminary 3D Conceptual Site Model (Stantec 2016). This preceding desktop study served as a basis to develop the scope of this field investigation and analysis, which involved the following four main components:

- Drilling one test hole to log the lithology and geophysical characteristics of the sedimentary deposits, followed by its completion as a production well (SE-1)
- Completing an adjacent observation well (SE-2) with similar depth and completion as the production well. This observation well is also intended to be used in the future as a domestic well on a separate lot of the proposed subdivision
- Completing the required pumping tests, including a 2h step drawdown test and a 72 hour continuous rate pumping test to fufill with the requirements of the Lacombe County
- Prepare a Groundwater Supply Evaluation report such that the subdivision application requirements could be fulfilled.

The preliminary desktop analysis guided the drilling program, and the bedrock was encountered at 21.64 m below ground surface. The sand and gravel unit directly overlying bedrock was unsaturated, so drilling was completed deeper within bedrock (Lacombe Member of the Paskapoo Formation). Both the production (SE-1) and the observation (SE-2) wells were installed at similar depths and at a 23 m offset distance to each other such that the hydraulic characteristics of the low transmissivity, confined/semiconfined aquifer could be determined.

Stantec procured and installed pressure transducers/data loggers in the production and observation wells, and conducted step drawdown tests, followed by an overnight recovery period. The following day, a 72 hour continuous rate pumping and recovery test was started at a rate of 18 USgpm, which corresponded to the maximum pumping rate achieved during the step drawdown test. The constant rate pumping test was initiated at SE-1 on August 9, 2016 and the water level data yielded from the test was used for estimation of the aquifer's transmissivity, hydraulic conductivity, and storage coefficient. A groundwater sample and a duplicate sample were collected after 71.67 hours of pumping at SE-1.

Potential long-term yield (Q_{20}) was calculated with hydraulic parameters obtained through the analysis of aquifer pumping test data at production well SE-1. Based on the minimum (i.e., most conservative) values for the best fitting solution, the potential long term yield for the aquifer in the vicinity of the well is approximately 109.95 m^3/d. Thus, it appears that the aquifer should be

able to sustain production from a “virtual well” (hypothetical well pumping at a rate of 48 m^3/d, which is equivalent of the sum of 14 individual wells all pumping at a rate of 3.43 m^3/d) for the entire subdivision, while leaving potential for additional production if needed in the future. Further, the simulated cone of depression for a single domestic well pumping at a rate of 3.43 m^3/d for 2.52 hours/d had a drawdown of 0.09 m at a radial distance of approximately 500 m following 1 year of intermittent pumping.

In general, groundwater quality at SE-1 is good with low total dissolved solids, albeit some exceedances of the respective guideline values for health-based and aesthetic parameters for fluoride, pH, and sodium were noted. Total coliforms were detected which indicates a need for shock chlorination prior to domestic use, but no Escherichia coli were detected.

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) was retained by 1842107 Alberta Ltd. (the Client) to install a production well and an observation well to conduct and evaluate a 72-hour pumping test, in accordance with a request from Lacombe County as part of their approval process for a new subdivision. The Dominion Land Survey address for the site is SW-24-39-27 W4M. The site is situated approximately 3 km southeast of Blackfalds, AB and approximately 10 km northeast of the Red Deer city centre, at the intersection of Township Road 393A and Burbank Crescent. The Burbank Subdivision Development (the Site) will occupy the majority of the southern half of SW-24-39-27 W4M (Figure 1).

A preliminary desktop hydrogeological supply evaluation study was previously completed (Stantec 2016), and as such the hydrogeological setting of the Site was reasonably well understood prior to initiation of the project. This preliminary study, based solely on desktop information, involved development of a 3D Conceptual Site Model (3D CSM) to evaluate the groundwater supply potential of the Site and to determine if it was feasible to proceed with the development using groundwater as a raw water supply source. The 3D CSM developed during the desktop study indicated that most of the wells in the region were drilled into bedrock (Paskapoo Formation) at depths ranging from approximately 30 to 110 m below ground surface (m BGS), and that there was a reasonable likelihood of securing a groundwater supply for the development.

Following review of the preliminary desktop hydrogeological study, Lacombe County requested further field-based hydrogeologic investigations to be completed to confirm the groundwater supply available at the Site. As a result, the field-based hydrogeologic investigation as is detailed in this report was initiated by the Client.

In order to address Lacombe County's request, and in addition to support the application for a potential future groundwater diversion license for this well, the following requirements of Alberta Environment and Parks (AEP) as outlined in the *Guide to Groundwater Authorization* (Information Required when Submitting an Application under the Water Act; AENV, 2011), were addressed:

- Carry out a minimum 72 hour pumping test for the production well (also as per the Lacombe County requirement). Monitor water quality throughout the tests;
- Water Quality Analyses following AENV (2011); and,
- Data Interpretation and Reporting.

This report summarizes the results of the drilling program and aquifer pumping tests completed by Stantec. Stantec was present during drilling and installation of the production and observation wells used for this aquifer evaluation. Calibre Drilling Ltd. (Calibre) was retained directly by Stantec to drill and install the production and observation well at the Site. Well development was conducted on both production and the observation wells after their installation to promote hydraulic communication with the aquifer and to obtain preliminary well

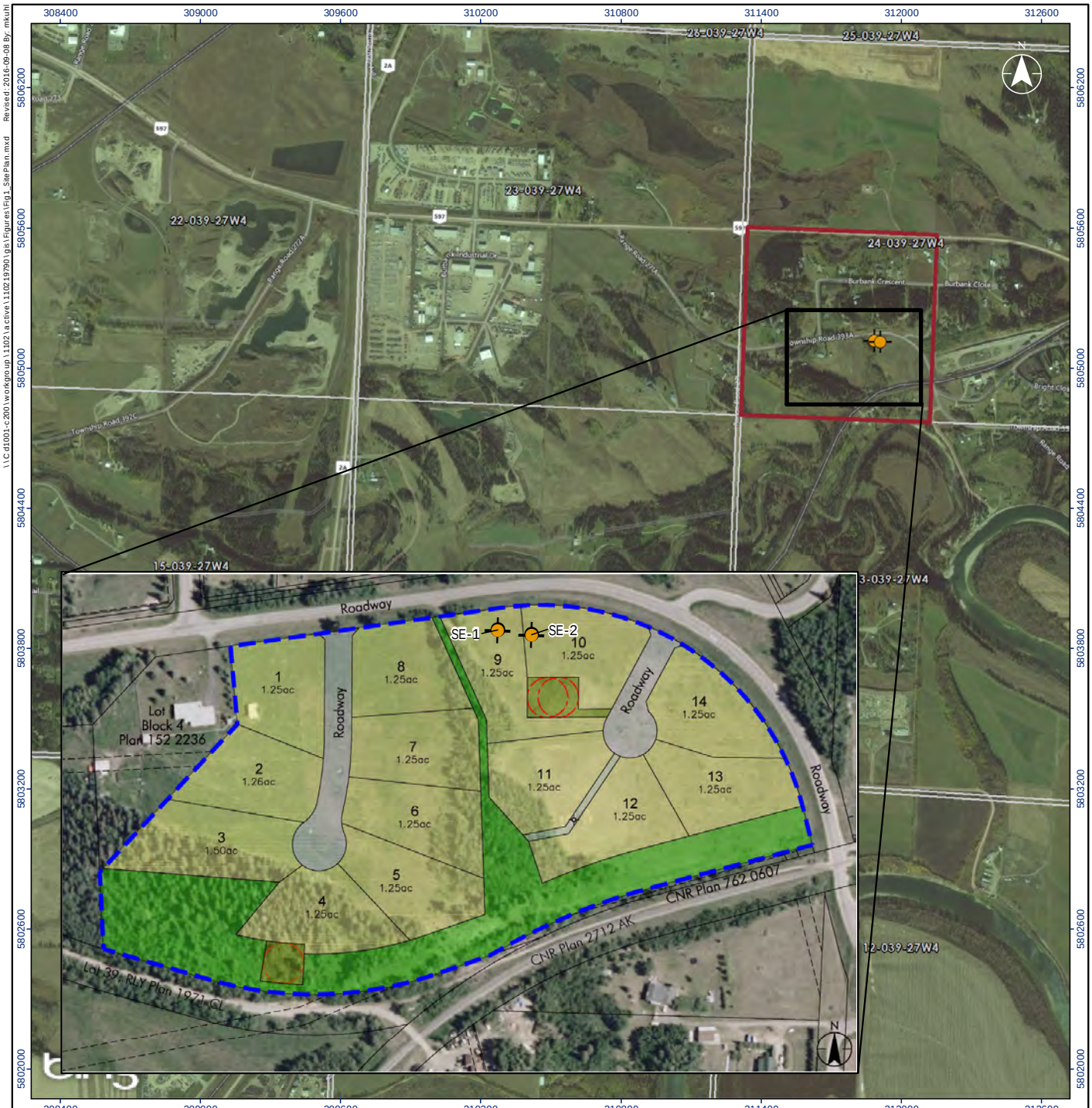
response of the production well. Calibre geophysically logged the test hole such that the appropriate production (screened) interval could be selected. Calibre completed the field services associated with the well completion, pumping tests and final pump installation. Stantec and Calibre collaborated to install the submersible pump, instruments in the production and observation wells, and to complete the aquifer pumping test.

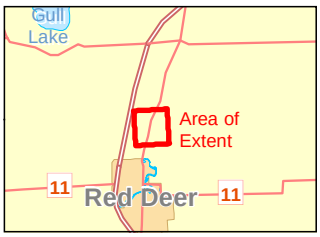
1.1 OBJECTIVE AND SCOPE OF WORK

The main objective of the field program was to install a production and monitoring well such that the aquifer could be tested to demonstrate its long term groundwater supply potential.

The scope of work for the field program was as follows:

- Finalize the location of the production well based on consideration of the following:
  - Preferred drilling locations based upon hydrogeologic considerations
  - Physical constraints at the site including existing and/or future infrastructure
  - Adherence to setbacks from property limits (8 m) in accordance with local bylaws
  - The presence of existing or future above ground and underground utilities
  - Future site uses, access requirements and utility tie in locations
  - Current site accessibility (by heavy drilling equipment) and other potential safety issues
  - Regulatory requirements in the event that the production well will be licensed
- Conduct ground clearance activities, prior to the initiation of the borehole drilling
- Drill and complete a production well and an observation well using mud and air rotary techniques
- Develop the well via air lifting methods
- Estimate production rates during well development
- Obtain water level measurements to observe the recovery rates and estimate an apparent well yield
- Conduct step drawdown tests on the production well to evaluate the maximum pumping rate for the 72 hour continuous rate pumping test
- Conduct a 72 hour pump test at the production well during which manual water level measurements would be taken periodically in addition to data collection via pressure transducers installed within the production and observation well





- Production Well
- Approximate Study Area Location
- Approximate Concept Plan Boundary
- Proposed Green Space
- Section

0 300 600 900 metres

1:25,000 (at original document size of 8.5x11)

Stantec

Project Location
SW 24-39-27-W4M
Lacombe County, Alberta

110219790
Prepared by MK on 2016-09-08
Review by JC on 2016-09-08

Client/Project
1842107 Alberta Ltd.
Hydrogeological Supply Evaluation
Production and Monitoring Well Installation and Pumping Test

Figure No.
1

Title
Site Plan With Well Locations

Notes
1. Coordinate System: NAD 1983 UTM Zone 12N
2. Base features: Geogratis, ©Department of Natural Resources Canada, All rights reserved.
3. Imagery: Microsoft Bing product screen shot(s) reprinted with permission from Microsoft Corporation
4. Concept Plan: Stantec Consulting, Red Deer, Pr. No. 112849578, Fig. 5.0 Concept Plan Sandhill Estates (July 2016)

2.0 FIELD PROGRAM

The following sections provide a summary of the field program completed for this project.

The Client indicated an area favorable for drilling based on the layout of the future subdivision and accessibility for future well maintenance. Following the request of the Lacombe County to conduct a 72-hour pumping test, the Client agreed to drill and install two identical wells, one acting as an observation well, that could be repurposed as individual domestic wells in two adjoining lots of the projected subdivision. Once the first well was installed and it was observed that the aquifer was under confined conditions, it was decided to locate the second well at 23 m distance from the first well to obtain valid drawdown data during the pumping test and evaluate the storage coefficient and follow the minimum distances indicated by the bylaws for the subdivision.

The volumetric testing requirements for the pumping well were targeted at a flow rate close to the double (85.61 m^3/day) of the combined projected 14 individual wells (48 m^3/day) to stress the aquifer over the 72-hour pumping test.

2.1 PRE-FIELD PREPARATION AND DESKTOP REVIEW OF EXISTING DATA

Preliminary desktop analysis and development of the 3D CSM for the site constrained the drilling depth to bedrock targets in in the Lacombe Member (primary target) and Haynes Member (alternate secondary target) of the Paskapoo Formation. Discussions with the Client identified a suitable access route and location for set up of heavy drilling equipment at two drilling locations. Stantec's Geomatic Group staked the limits of the two chosen lots prior to drilling activities to locate both wells at setback distances complying with the subdivision bylaws. In this manner, both wells used in this study could be used in the future to provide water supply to two separate lots.

2.2 GROUND DISTURBANCE CLEARANCE

Prior to the initiation of the borehole drilling, Stantec completed ground disturbance clearance activities. Alberta OneCall was contacted prior to commencing ground disturbance activities. Alberta OneCall contacted the registered owners of the utilities present on site and these owners located and marked utilities where present. As-built drawings of the site were also reviewed. Stantec contracted Clean Harbours Ltd. to independently identify and clearly mark all underground utilities/infrastructure within the proposed work area. Stantec personnel were in attendance when the utilities were located and marked within a 30 m radius around the two proposed borehole locations. Two pipelines belonging to Chain Lakes Gas Co-op were identified in the area, and an abandoned Ember Resources pipeline was identified several

metres to the south of the chosen drilling locations. The ground disturbance report was reviewed to verify that the final drilling location was clear of all known utilities.

2.3 DRILLING AND INSTALLATION OF OBSERVATION AND PRODUCTION WELLS

Between August 2 – 5, 2016 Calibre drilled two separate boreholes and completed them as production/observation wells under Stantec supervision. The drilling program targeted an aquifer that could likely (based on previously reviewed desktop information) sustain production of at least 5 - 15 USgpm (1.14 - 3.41 m^3/hour). The chosen completion interval was within a confined bedrock aquifer above 60 m BGS.

2.3.1 SE-1 Drilling and Production Well Installation

Drilling, geophysical logging and installation of SE-1 was completed between August 2-4, 2016. Mud rotary methodology was used to drill a pilot hole to 38.58 m BGS using a $5^{1/8}$" (130.18 mm) tri-cone drill bit. Following the geophysical logging, the temporary steel casing was pulled out, and mud rotary was used to ream the hole with a $8^{3/4}$" (222.25 mm) tri-cone bit to 48.50 m BGS. Calibre then installed surface casing with a diameter of 6" (152.4 mm) to the bottom of the reamed borehole at 48.50 m BGS. A rubber shale trap was attached to the bottom of the surface casing sealing the outside of the surface casing from the lower portion of the borehole. Bentonite chips were tremied down the annulus of the hole from 0 to 48.5 m BGS and hydrated. Once these bentonite chips had settled, more bentonite was added to surface and they were then covered with a thin layer of sand. The drilling mud was then removed from the inside of the casing.

Following installation of the surface casing, the borehole was drilled with air rotary methodology to 60.96 m BGS with a 5.13" (130.18 mm) bit. This drilling method enabled estimation of the approximate water production of each aquifer unit, when it was intersected as well as collection of drill cuttings for lithologic examination. The lower portion of the borehole was geophysically logged; it did not need to be reamed because the bed rock was consolidated and stable without sloughing into the borehole. A combination of geophysical information combined with lithologic observations and estimated water production from each sandstone interval contributed to the decision of where to install the well screen in SE-1. A 4.5 "(114.3 mm) Schedule 40 PVC well liner was inserted through the surface casing. This liner consisted of an un-slotted spacer running from the bottom of the borehole to the screened interval, a 7.62 m long 0.020" slot PVC screen from 49.99 to 57.61m BGS, and an upper un-slotted portion that extended to 45.40 m BGS, creating an 3.10 m overlap with the surface casing (refer to Figure A-1 in Appendix A for well construction details).

2.3.2 SE-2 Drilling and Observation Well Installation

Drilling and installation of SE-2 took place from August 4-5, 2016. Mud rotary methodology was used to drill a pilot hole to 60.96 m BGS with a $5^{1/8}$" (130.18 mm) tri-cone drill bit. Similar lithology

was encountered to that observed in the SE-1 location, so this hole was not geophysical logged. The pilot hole was then reamed with a 8$^{3/4}$" (222.25 mm) tri-cone bit to 49.07m BGS. Surface casing with a diameter of 6" (152.4 mm) was installed to the bottom of the reamed borehole. A rubber shale trap was attached to the bottom of the surface casing sealing the outside of the surface casing from the lower portion of the borehole. Bentonite grout was tremied down the annulus of the hole from 0 to 49.07 m BGS and hydrated. Once this seal had settled, bentonite chips were added to surface, and were then covered with a thin layer of sand. The drilling mud was then removed from the inside of the casing and the well liner was installed.

The well design of SE-2 is similar to that of SE-1. The well screen was installed in the two lower sandstone units. This zone spanned from 50.60-56.69 m BGS with a total screen length of 6.09 m. The well liner consisted of 4.5"(114.3 mm) Sch. 40 PVC. The liner consisted of an un-slotted spacer running from the bottom of the borehole to the screened interval, a 0.020" slot PVC screen, and an upper un-slotted portion that extended to 46.02 m BGS which created an overlap of 3.05 m with the surface casing (refer to Figure A-2 in Appendix A).

2.3.3 Geophysical Logging of SE-1

As explained in section 2.3.1, geophysical logging was conducted in two separate stages. The first stage was completed once the pilot hole was drilled to a depth of 38.58 m BGS, and the second stage was completed once a temporary surface casing was set in place and drilling reached the total depth of 60.96 m.

Spontaneous Potential (SP)/Single Point Resistance (SPR) and natural gamma radiation logs were obtained and are included with the well completion details in Appendix A (Figures A-3 to A-6). Typically, conductivity is greater for finer matrix grain sizes (i.e., clays are more conductive than sands, and shales are more conductive than sandstones). In addition, high total dissolved solids (TDS) (i.e., "salts") in the pore fluids will increase electrical conductivity. The gamma ray tool measures the amount of natural gamma radiation in the subsurface. The main sources of gamma rays in earth materials are isotopes of potassium, uranium, and thorium, and their decay products, which are generally more abundant in clay or shale. Sand or sandstone, having lower concentrations of these elements, produce lower gamma counts, and thus lower gamma response on the borehole log. Following completion of the geophysical logging, electronic files were reviewed and interpreted by Stantec and intervals were selected for possible development and screen installation.

2.4 WELL LOCATIONS AND NAMING

The locations of the test holes and wells were estimated by Stantec upon completion with a handheld GPS unit. Table 1 presents the Northing and Easting coordinates (UTM Zone 12, NAD83 datum) of the wells. Figure 2 presents the locations of the wells.

The SE prefix was used to indicate "Sandhill Estates", followed by a dash and a number as a unique reference for both wells.

Table 1 Surveyed Well Coordinates

Well Name	Drilling Dates	Well Type	UTM Zone 12 NAD 83	
			Northing (m)	Easting (m)
SE-1	August 2-4, 2016	Production Well	5,805,119	311,883
SE-2	August 4-5, 2016	Observation Well / Future Production Well	5,805,115	311,908
Note: Well coordinates obtained with handheld GPS.				

The distance between SE-1 and SE-2 was measured as 23 m. Borehole lithologs, geophysical logs, and well completion details are presented in Appendix A. Annotated photographs of the drilling operations and production well are provided in Appendix B.

2.4.1 Well Development

Production well SE-1and observation well SE-2 are both installed in competent bedrock and so minimal development was required. SE-1 was developed on August 4, 2016 for 32 minutes and SE-2 was developed for 51 minutes on August 5, 2016. Water produced from both wells was apparently free of solid content (Sand and fines) post development.

2.5 SE-1 PUMPING TESTS

Calibre Drilling installed a 4", 3 HP submersible pump (Goulds Model 80GS) in SE-1 with the bottom of the pump set at a depth of 45.51 m below top of casing (btoc). An electronic digital flow-meter, sampling port, and associated valves were temporarily installed on the wellhead to facilitate the pumping test. Stantec equipped production well SE-1 and observation well SE-2 with vented pressure transducers capable of automatically measuring and recording water level/pressure and temperature fluctuations. Both vented pressure transducers in SE-1 and SE-2 were connected to surface with vented direct read communication cables allowing for periodic data monitoring and reprogramming during the pumping test as required (without having to retrieve and redeploy the transducer). The flow meter measured in USgal/min and therefore, the main references to flow rates in subsequent sections of this report will be in the same units. Periodic manual water level measurements were also obtained with a water level tape to complement and corroborate the pressure transducer data.

Pumping test data from wells SE-1 and SE-2 are shown in graphical format in Appendix C, and raw water level measurements are available upon request due to the large amount of datalogger measurements recorded.

2.5.1 Three-hour Step Drawdown Test

Stantec and Calibre field personnel initiated a two-hour step drawdown test (step test) at well SE-1on August 8, 2016 from approximately 4:00 to 6:00 PM. Observation well SE-2 was used during the step test to monitor the cone of depression around SE-1. The first step of the test commenced at a pumping rate of 10 USgal/min (8 igpm). After 43 minutes of pumping, the second step was started by increasing the flow rate to 20 USgal/min (17 igpm) for 41 minutes. At this point an attempt was made to increase the flow rate further, however the pump could not sustain a higher flow rate due to excessive drawdown in the well. The step test was then continued at 20 USgal/min for another 45 minutes.

Once the pump had been turned off, water level recovery was observed with both manual measurements and Level TROLL 700 data loggers until water levels in SE-1 had recovered to 85% of static levels and water levels in SE-2 had recovered to 58% of static levels. Following this, solely the data loggers were employed to record the remainder of the recovery.

The specific capacities calculated for the three steps are 0.20, 0.16, and 0.15 L/s/m. Based on the step drawdown tests, the transmissivity of the aquifer was determined to be adequate to conduct the pumping test at SE-1 at a rate of 18 USgal/min (15 igpm, 98.16 m^3/d).

2.5.2 72-Hour Constant Rate Pumping Test

Stantec and Calibre field personnel conducted a nominal 72-hour constant rate pumping test at SE-1 consisting of:

- 72.49 hours of pumping between August 9-12, 2016; followed by
- 72.96 hours of water level recovery observation (residual drawdown was 4.9% at production well SE-1 and 8.3% at monitoring well SE-2

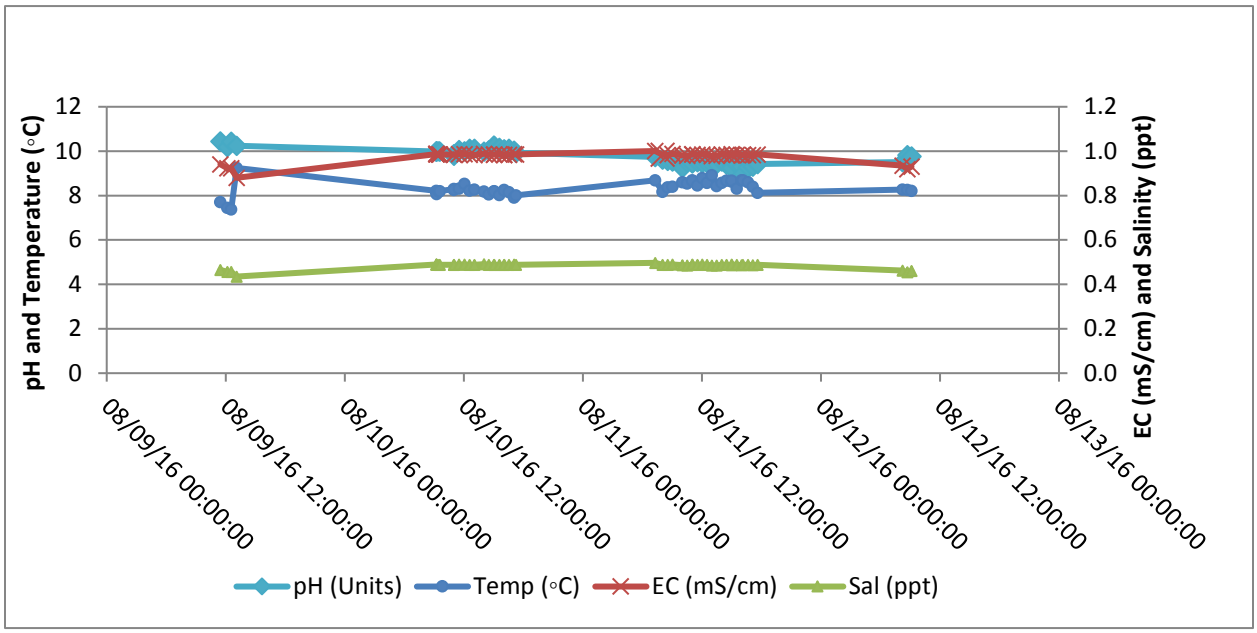
The constant rate pumping test began at a rate of 17.8 USgal/min (14.84 igpm, 97.13 m^3/d) and declined as the water level dropped over the test duration to 15.7 USgpm (13.08 igpm, 85.61 m^3/d). The specific capacity calculated for the 72-hour pumping test is 0.10 L/s/m, lower than the initial values obtained during the step test.

Following the conclusion of the pumping portion of the test, manual water level measurements were collected to monitor the water level recovery in pumping well SE-1 and observation well SE-2.

During the 72-hour pumping test, Stantec field personnel obtained field measurements of temperature (temp), pH, salinity (sal), oxidation-reduction potential (ORP), conductivity (EC) and dissolved oxygen (DO). Field measurements were collected using a YSI multi-parameter water quality probe and flow through cell connected to the sampling port installed on the pump discharge line. Field parameter measurements are presented in graphical form in Figure 4, while the tabular data is included in Appendix C, as Table C.1 for reference. Dissolved oxygen and

ORP data were not included in the graph below as the data reflected the instrument drift and did not allow for any useful correlations to be drawn.

Figure 2 Field Parameter Measurements during Constant Rate Test (SE-1), August 9-12, 2016



The following observations were made based upon examination of the field parameter readings:

- Temp ranged from 7.4 to 9.24 °over the duration of the test
- pH values ranged from 8.98 to 10.44
- Salinity and EC remained relatively stable ranging from 0.44 to 0.50 ppt, and 0.88 to 1.0 mS/cm respectively

Groundwater sampling from this well was completed after 4,300 minutes (71.67 hours) of pumping. Samples for laboratory analysis were collected in pre-cleaned bottles with preservatives (where required) provided by Maxxam Analytics. Samples were kept in coolers with ice to regulate their temperature and delivered to Maxxam lab in Edmonton on the day they were sampled. Groundwater samples were submitted for analyses including routine parameters, fluoride, turbidity, color, Total Kjeldahl Nitrogen, nitrite, nitrate, phosphorus, sulfide, Escherichia coli, total coliforms, trace dissolved metals, and total metals.

3.0 PUMPING TEST ANALYSIS AND DISCUSSION

3.1 AQUIFER PUMPING TEST ANALYSIS

Table 2 Summary of Pumping Test Parameters

Well Name	Well Type	Distance from SE-1	Water Level Before Pumping (BTOC/BGS)	Drawdown at the End of Pumping Period (72 Hours)	Water Level after 72.96 hours Recovery (BTOC)	Residual Drawdown	Residual Drawdown as % of the Total Drawdown After Pumping 72 Hours
		(m)	(m)	(m)	(m)	(m)	%
SE-1	Production	--	27.87/27.24	10.30	28.37	0.50	4.85
SE-2	Monitoring	23	28.74/28.25	6.01	29.24	0.50	8.32

Results from the step drawdown and constant rate pumping tests were analyzed to derive estimates of the aquifer's hydraulic parameters. Various time-drawdown and drawdown-distance curves of both pumping and recovery periods were analyzed to estimate the hydraulic parameters. Theis, Hantush-Jacob, Theis Recovery, and Moench (constant head and no flow) for the step test (Figures C-1 to C-4 in Appendix C) solutions and Cooper-Jacob, Theis Recovery, Theis Agarval, Barker, Hantush-Jacob, Moench (constant head), Moench Derivative (constant head and no flow), Moench Composite Plot (constant head and no flow) for the 72-hour pumping test solutions (Figures C-5 to C-15) were used to estimate the aquifer parameters at well SE-1 (Appendix C). During the step drawdown and constant rate tests for well SE-1, well SE-2 was utilized as observation well. A summary of the estimated hydrogeologic parameters calculated from all pumping and recovery test data is presented in Table 3.

Well efficiency calculated from step test results shows values above the theoretical maximum of 100% (Table 3), possibly induced by the fact that the applied formula includes the flow rate of the last step that in this case was very similar to the previous step. Negative values of the linear well loss coefficient (wellbore skin factor S_w, Table 3) suggest a permeability enhancement in the production zone (theoretical well radius larger than the real well radius).

Calculated transmissivities as were estimated from the various analytical solutions fell within a narrow range of values, from 5.0 to 8.96 m^2/day. Analytical calculations following Moench Derivative and Composite Plot (constant head and no flow) show the best fit to the theoretical curves indicate an average value of 6.74 m^2/day (Table 3), given the semi-confined (leaky) conditions in the alternating mudstone, sandstone, and siltstone units in the bedrock aquifer overlain by sand and gravel (4.88 m) and thick clay and silt (13.41 m) deposits. The average hydraulic conductivity value of 0.9 m/day (1.04 x 10^{-5} m/second) is typical of poorly cemented sandstone deposits (Domenico and Schwartz, 1990).

TABLE 3. SUMMARY OF ESTIMATED HYDROGEOLOGICAL PARAMETERS (SE-1 and SE-2 Wells)

Well	Analytical Method	Software Used for Pumping Test Data Evaluation	Average Transmissivity (T) m^2/d	Average Hydraulic Conductivity m/d	Average Storage Coefficient	Linear Well Loss Coeffcient (Wellbore Skin Factor) /s	Nonlinear Well Loss Coefficient (C) min^2/m^5	Well Efficiency % (Q from Last Step)	S/S'	Comments S = Storativity during pumping S' = Storativity during recovery
SE-1 Step Drawdown Test										
SE-1 / SE-2 Well	Theis (Step Test, Confined Aquifer Solution)	Aqtesolv Pro	10.26	1.3	1.10E-04	-3.03	1.00	(236)		W.E. Maximum is 100%
SE-1 / SE-2 Well	Hantush-Jacob (Step Test, Leaky Aquifer)	Aqtesolv Pro	8.91	1.2	1.20E-04	-3.51	0.01	(321)		W.E. Maximum is 100%
SE-1 / SE-2 Well	Theis Recovery (Confined Aquifer Solution)	Aqtesolv Pro	6.92	0.9					1.07	
SE-1 / SE-2 Well	Moench Case 3 (Constant Head and No Flow, Leaky Aquifer Solution)	Aqtesolv Pro	10.24	1.3	1.30E-04	-2.71				
SE-1 Pumping Well				0.0						
SE-1 Well	Cooper-Jacob (Confined Aquifer Solution)	Aqtesolv Pro	8.02	1.1						
SE-2 Well	Cooper-Jacob (Confined Aquifer Solution)	Aqtesolv Pro	7.64	1.0	1.40E-04					
SE-1 / SE-2 Well	Theis Recovery (Confined Aquifer Solution)	Aqtesolv Pro	5.29	0.7					1.49	
SE-1 / SE-2 Well	Theis Agarval (Confined Aquifer Solution)	Aqtesolv Pro	8.84	1.2	9.97E-05					
SE-1 / SE-2 Well	Barker (Confined Aquifer Solution)	Aqtesolv Pro	7.26	1.0	3.49E-05	-3.85				
SE-1 / SE-2 Well	Hantush-Jacob (Leaky Aquifer)	Aqtesolv Pro	8.96	1.2	1.00E-04					
SE-1 / SE-2 Well	Moench Case 1 (Constant Head)	Aqtesolv Pro	5.00	0.7	9.10E-05	-4.17				
SE-1 / SE-2 Well	Moench Case 3 Derivative (Constant Head and No Flow, Leaky Aquifer Solution)	Aqtesolv Pro	6.74	0.9	2.47E-04	-3.85				
SE-1 / SE-2 Well	Moench Case 3 (Composite Plot, Leaky Aquifer Solution)	Aqtesolv Pro	6.74	0.9	2.47E-04	-3.85				
SE-1 / SE-2 Well	**Values used for Q_{20} and Yearly Calculation**		**6.74**		**2.50E-04**					

Note: Values highlighed in yellow were taken as reference for Q_{20} calculations. Lower or higher Storage Coefficient values are shown for illustrative purposes and were not taken into account for Q_{20} calculations and they were deemed to be non-representative of long term conditions.

Derivative curves obtained from the pumping test analysis data show drawdown departs from unit slope at less than 1 minute of the pumping test, as casing storage is depleted (Figure C-5 and C-13 in Appendix C). After 10 minutes of the pumping test, wellbore storage effects are dissipated after 1.5 log cycles measured from highest point of the derivative peak (Figure C-13 in Appendix C). Partial penetration effects of wells not screened across the entire aquifer unit may affect drawdown at early pumping stages in a similar way as wellbore storage. Derivative curves prepared from the pumping test data (Figure C-13 in Appendix C) show the doubling of the slope of the derivative curves at both wells at about 30 and 113 minutes, which may indicate the presence of linear impermeable boundaries modifying the initial infinitely acting, confined aquifer conditions. A potential recharge boundary was observed at 810 minutes (reduction of the derivative slope), consistent with the geological interpretation of alternating sandstone and mudstone / siltstone units in and above / below the screened area of the wells.

The calculated ratio of storativity during pumping (S) to storativity during recovery (S') from residual drawdown data are higher than 1(1.49; Table 3 and Figure C-8 in Appendix C), suggesting the extent of the aquifer is limited by one or more recharge boundaries (Midwest Geoscience Group, 2013).

3.2 Q_{20} POTENTIAL LONG-TERM YIELD

Following the analytical methods recommended in the AENV guidelines (2011), potential long-term safe yield (Q_{20}) was calculated applying the Modified Moell method (Maathuis and van der Kamp) for confined aquifers. Aquifer parameters used to calculate the long term safe yields were based upon average values derived from the aquifer pumping tests as were summarized in Table 3. The applied parameters are shown in Table 4 along with the calculated long term safe yields as determined through use of the Modified Moell method.

Table 4 Parameters for Q_{20} Evaluation

Well Name	Average Transmissivity	Average Storage Coefficient	H_a	Pumping Rate	$S_{100\ min}$	S_{20yrs} Theor	$S_{100\ min}$ Theor	Q_{20} Modified Moell Method
	m^2/d		m	m^3/d	m	m	m	m^3/d
SE-1 Well	6.74	2.47E-04	22.75	85.61	7.32	12.21	7.13	**109.95**

Notes:
H_a Available head (top of aquifer 49.99 - SWL 27.24 m = 22.75 m)
S Drawdown
Q_{20} Long term safe yield

Based upon the average value calculated in Table 3, the potential long term yield for the aquifer in the vicinity of SE-1 is approximately 109.95 m^3/d (Table 4). Thus it appears that the aquifer should be able to sustain production from a virtual well such as well SE-1 for the whole development (14 lots) at a maximum pumping at a rate of 48 m^3/d while leaving potential for additional production increase, if needed.

Following 20 years of constant pumping at this rate (again, a conservative assumption), the theoretical calculations suggest there remains to be sufficient available head in the aquifer (the theoretical water level would be drawn down to 39.45 m, equivalent to 53.67% of the available head of the aquifer at SE-1). The theoretical calculated drawdown in head would be 12.21 m at SE-1 (Figure C-16, Appendix C).

The development is supposed have one well for domestic use for each of the 14 lots at he maximum allowable (without obtaining a diversion license) withdrawal of 1,250 m^3/year. Table 5 summarizes drawdown at after one day, one week, one year, and 20 years continuous pumping (Figure C-18, Appendix C). The results show drawdown is less than 0.5 m at well SE-1.

Table 5 Parameters for Forward Evaluation at Different Times of Continuous Pumping

Well Name	Average Transmissivity	Average Storage Coefficient	H_a	Pumping Rate	S 1 day Theor	S 1 week Theor	S 1 year Theor	S_{20yrs} Theor
	m^2/d		m	m^3/d	m	m	m	m
SE-1 Well	6.74	2.47E-04	22.75	85.61				12.21
SE-1 Well (1,250 m^3/year)	6.74	2.47E-04	22.75	3.43	0.35	0.44	0.49	0.49

3.3 POTENTIAL IMPACT ON THE AQUIFER AND OTHER USERS

The long term effects of the pumping of the aquifer based on test results described above were calculated at various distances after 20 years of sustained pumping at a pumping rate of 85.61 m^3/day. Calculated drawdowns at various radial distances after 20 years of continuous pumping (Table 6) suggest drawdown of 5.11 m at 100 m distance from pumping well SE-1, 1 m at 1,000 m distance, dissipating to negligible drawdown at distances of about 4,540 m (Figure C-17, Appendix C).

A more realistic approach to evaluate potential impact on the aquifer and other users would simulate intermittent pumping at an individual domestic well. We have assumed a one year intermittent pumping cycle for a pump pumping at 5 igpm (1.36 m^3/hour) during 2.52 hours/day (3.43 m^3/day, 1,250 m^3/year; Figure C-19, Appendix C). Table 6 summarizes maximum drawdown (calculated one minute before turning off the simulated pump) after one year of intermittent

pumping and minimum drawdown (calculated one minute before starting the final simulated pumping cycle).

Calculated drawdowns at various radial distances after one year of intermittent pumping (Table 6) suggest maximum and minimum drawdown of 0.27 m and 0.18 m at 100 m distance from pumping well SE-1, 0.09 m at 500 distance, and 0.04 m at 1,000 m distance (Figures C-20 and C-21, Appendix C). As a result there are no anticipated relevant interference effects expected for other groundwater users. The AEP Water Well Database (AWWID) reports well locations in the centre of quarter sections based on legal land description with a potential error of ±400 m. Seventeen domestic wells may be included within a 500 m radius from SE-1 and are located NW and NE of SE-1. They are installed at depths between 30.5 to 73.2 m from surface with test rates between 5 igpm (1.36 m^3/hour) and 23 igpm (6.27 m^3/hour). This indicates that some of the neighbouring wells are installed in shallower or deeper aquifer units compared to SE-1.

Table 6 Radial Distance Drawdown from Well SE-1

	Pumping Rate	Drawdown (m) at Radial Distance (m)				
	m^3/d	1 m	10 m	100 m	500 m	1000 m
Continuous Pumping for 20 Years	85.61	12.21	9.80	5.11		1.00
Discontinuous Pumping (2.52 Hours/Day at 5 igpm)						
1 Year (last pumping cycle , 1 minute before turning off pump)	3.43	2.70	1.77	0.27	0.09	0.04
1 Year (minimum drawdown after recovery one minute before starting last pumping cycle)	3.43	0.19	0.19	0.18	0.09	0.04

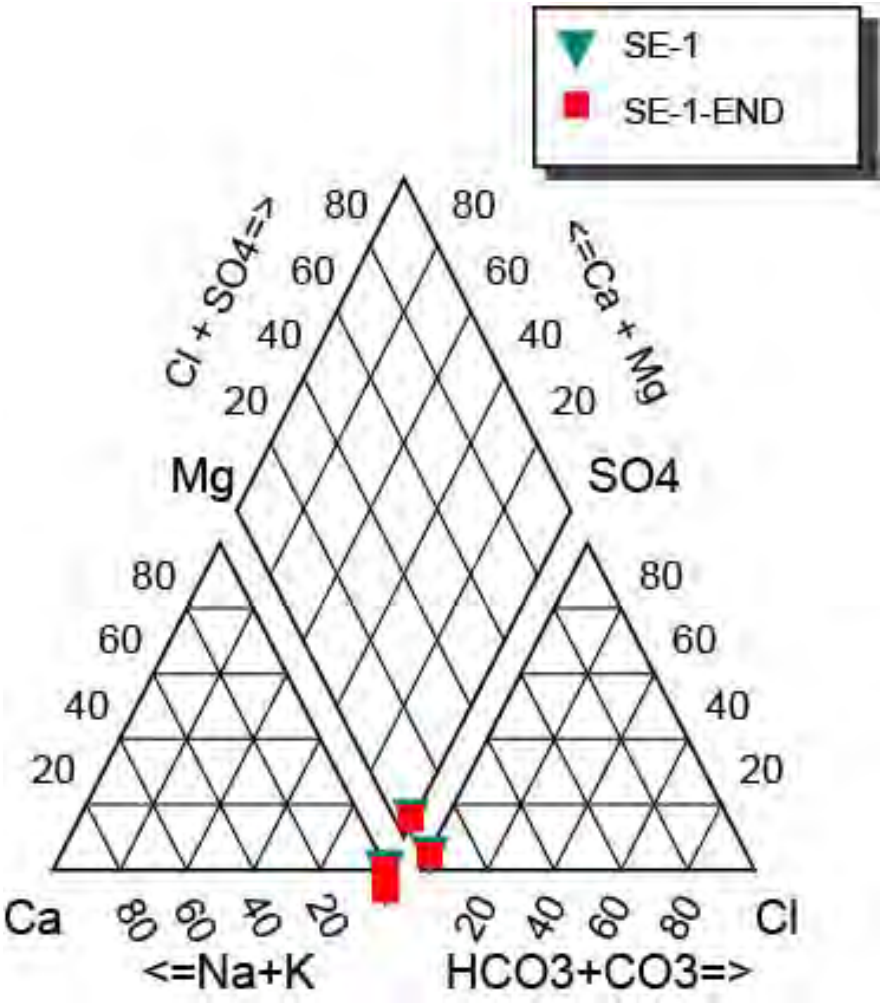
3.4 GROUNDWATER ANALYTICAL RESULTS

On August 12, 2016, one groundwater sample and one duplicate sample were collected from SE-1 after approximately 71.67 hours of pumping. Samples for laboratory analysis were collected in laboratory supplied containers and were filtered and/or preserved as required. Samples were kept in coolers with ice to regulate temperature and delivered to Maxxam Analytics in Edmonton on the day of sampling. Groundwater samples were submitted for analyses including groundwater samples were submitted for analyses including routine parameters, fluoride, turbidity, color, Total Kjeldahl Nitrogen, nitrite, nitrate, phosphorus, sulfide, Escherichia coli, total coliforms, trace dissolved metals, and total metals. These results are summarized in Table E-1 located in Appendix E along with the laboratory reports. Groundwater quality data were compared to the *Guidelines for Canadian Drinking Water Quality* (Health Canada, 2014) (GCDWQ). A summary of the analytical results is presented in the following sections.

3.4.1 MAJOR IONS

The groundwater is considered fresh with a relatively low degree of mineralization. Total dissolved solids (TDS) concentrations for the SE-1 sample and its duplicate are 530 mg/L which exceeds the aesthetic objective of the GCDWQ (500 mg/L). Figure 3 presents a piper plot of the groundwater chemistries. Both sample sets plot in nearly identical positions within the sodium-bicarbonate-facies. The sample and the duplicate have fluoride concentrations of 3.1 and 3.0 mg/L which exceeds the GCDWQ guideline (maximum acceptable concentration of 1.5 mg/L). Though there is no GCDWQ value for bicarbonate these values were elevated at 490 mg/L for both samples. Lab analyzed pH values ranged from 9.07-9.08 for both samples exceeding the alkalinity of guidelines (6.5-8.5). Hydrogen sulfide values ranged from 1.0 to 1.1 mg/L for the two samples which is consistent with the rotten egg odor observed during well installation.

Figure 3 Piper Diagram of Major Cations and Anions



3.5 METALS

3.5.1 Dissolved Metals

Table E-1 presents the dissolved metals concentrations for the sample and duplicate collected from the production well. Sodium concentrations were 220 mg/L for both the sample and duplicate and were higher than the GCDWQ aesthetic objective of 200 mg/L.

Dissolved sulfur concentrations were elevated in relation to the other metals at 19 mg/L for both samples.

3.5.2 Total Metals

Table E-1 presents the total metals concentrations for the sample and duplicate collected from the production well. Total sodium concentrations were 220 mg/L for both the sample and duplicate and were higher than the GCDWQ aesthetic objective of 200 mg/L.

Total sulfur concentrations were elevated in relation to the other total metals with concentrations of 6.6 mg/L for both samples; these are lower concentrations than the dissolved sulfur concentration however re-analysis of these parameters produced similar results.

3.6 MICROBIOLOGICAL PARAMETERS

Table E-1 provides the microbiological analysis results. No Escherichia coli were detected in the pump test sample or duplicate. Total coliforms were detected in both samples, with 1.0 mpn/100 mL noted in the primary sample and 2.0 mpn/100 mL noted in the duplicate sample. The well was shock chlorinated following sampling as per standard procedures.

The well should be resampled in the future to confirm the presence of total coliforms. Should they persist, disinfection (chlorination) of domestic use water as a standard practice will reduce the risk associated with total coliforms.

3.7 QUALITY ASSURANCE/QUALITY CONTROL RESULTS

Sample QA/QC documentation was reviewed including; chain of custody, sample temperatures, certificate of analysis, hold times. No QA/QC issues were noted for the laboratory submissions. The laboratory QA/QC data including; lab duplicate relative percent difference (RPD), lab spike, matrix spike, method blank and surrogate recovery data were reviewed and were generally found to be within acceptable criteria. Laboratory QA/QC procedures and analysis are included with the analytical results in Appendix E.

A duplicate sample was collected as part of the QA/QC program to measure the precision or reproducibility of the analytical data between groundwater samples. Duplicate samples were collected from the production well near the end of the pumping period. The relative percent

difference (RPD) between the sample and duplicate results was calculated. RPD was not calculated when one of the values is not detected or one of the results is less than five times the reportable detection limit. An RPD of 40% or less, or an AD less than or equal to 2 times the laboratory-reporting limit, is generally considered acceptable for duplicate groundwater samples (Maxxam's interpretation of CCME, 2011). Values where the relative percent difference exceeds the 40% guideline should be considered to be estimates. By this method all RPD values fall into the acceptable limit and so all results are taken to be valid.

3.8 STRATIGRAPHIC INTERPRETATION

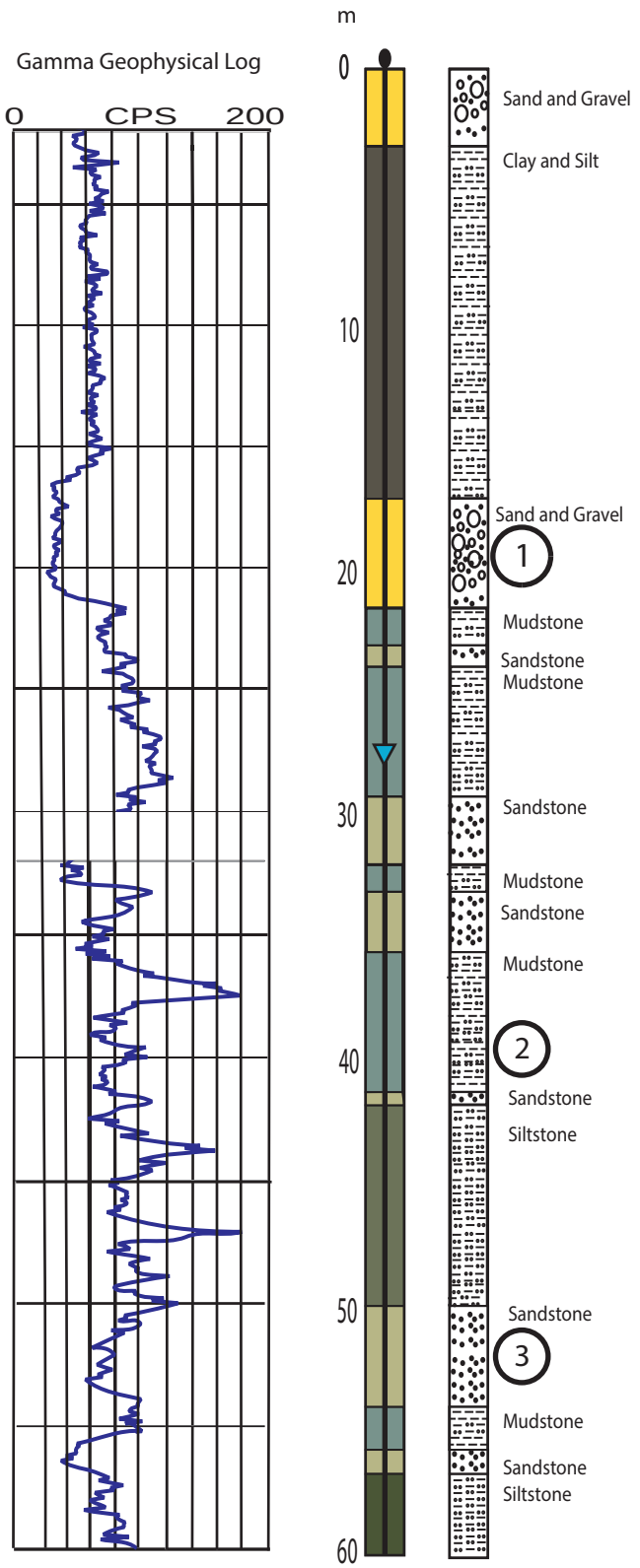
Based upon a review of hydrogeologic drilling and geophysical information, it appears that the two water-bearing sandstone units in which the proposed production well has been completed correspond to the Lacombe member of the Paskapoo Formation (Figures 4, 5, and 6).

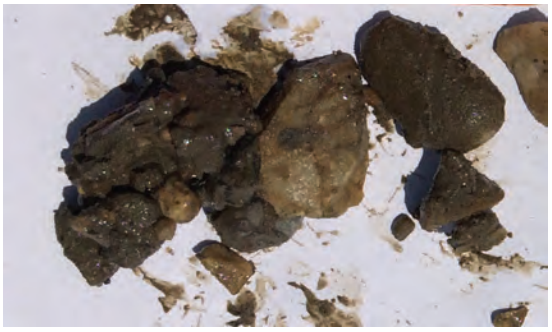
A preliminary geologic model built using publicly available regional geological and hydrogeological data resources (see cross-sections A-A' and B-B' on Figures 5 and 6) was included in Stantec (2016).

Two regional cross-sections have been generated that intersect the site from the northwest to southeast (Figure 5) and from west to east (Figure 6). Both cross-sections illustrate the geology of the site as described above including five hydrostratigraphic units. The five hydrostratigraphic units include the aeolian sand near surface, a till layer beneath the aeolian sand, a variable thickness deposit of sand and gravel on the upper bedrock surface, and the two members of the Paskapoo Formation (i.e., the Lacombe Member composing the upper bedrock surface and the Haynes Member).

Lithologic information from the wells SE-1 and SE-2 indicates that aeolian sand unit is missing at surface and is replaced by a 3.05 m thick alluvial sand and gravel unit, overlaying a 13.41 m thick till (clay and silt), and a 4.88 m thick pre-glacial sand and gravel unit above bedrock that was unsaturated. The bedrock (Lacombe Member of the Paskapoo Formation was drilled between 21.64 m and 60.96 m showing alternating mudstone with sandstone and siltstone units.

Three-dimensional geological modeling software was used to generate a conceptual model of the site geology prior to drilling, and was updated as new data was acquired and interpreted. From the three-dimensional model, two cross-sections were completed through the project site using both existing data from the AWWID, as well as the new data from the project related boreholes. Figure 5 is oriented northwest to southeast through the production well area, and Figure 6 is oriented on a west/east cross-section. Figure 4 shows a synthetic column with the representative geology, natural gamma-ray geophysical log, hydrostratigraphic interpretation of the confined aquifer with representative porous media photographs.





8.9 cm

Unconsolidated sand and gravel

8.9 cm

Color variation in the mudstone

Sand from interval where screen was installed
The pencil lead is 0.7mm

This information is based on SE-1 however the lithology is very similar to SE-2 and representative of the geology in the area around

September 2016
110219790

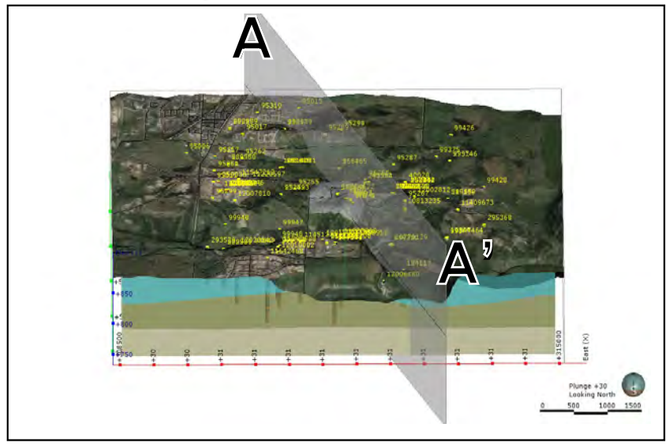
Stantec

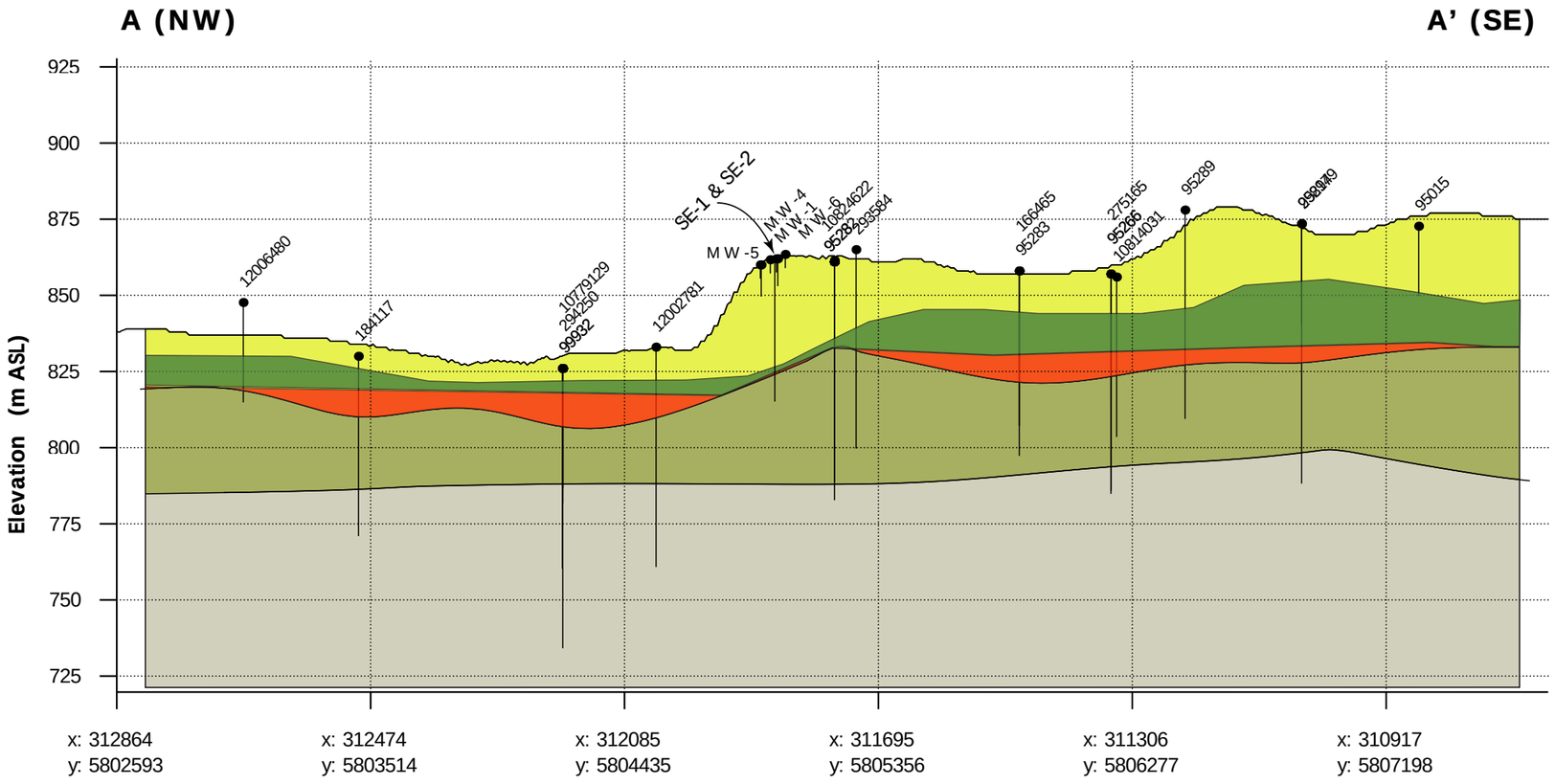
Client/Project
1842107 ALBERTA LTD.

Figure No.
4

Title
Synthetic Column With Geophysical logs and Lithological Photographs at SE-1

Cross-section Key Plan





Position Along Section (NAD83 UTM Z12 Coords.)

Legend

- Aeolian Sand
- Till
- Sand and Gravel (fluvial)
- Paskapoo Fm. (Lacombe Member - mudstone dominated)
- Paskapoo Fm (Haynes Member - sandstone dominated)

Notes
1. Coordinate System: NAD 1983 UTM Zone 12

Location

A: 312864, 5802593

B: 310668, 5807786

Scale: 1:22,500

Vertical exaggeration: 12x

0m 1000m

Stantec

Project Location
Within SW 24-29-27 W4M
Red Deer, Alberta

1102-19790

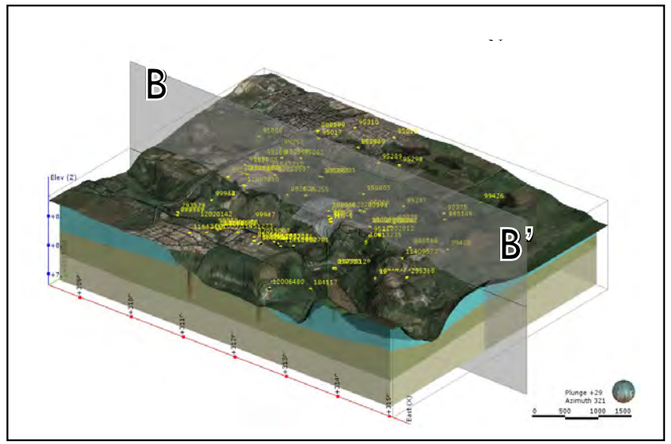
Prepared by JR on 2016-09-28 Review by CN on 2016-09-28

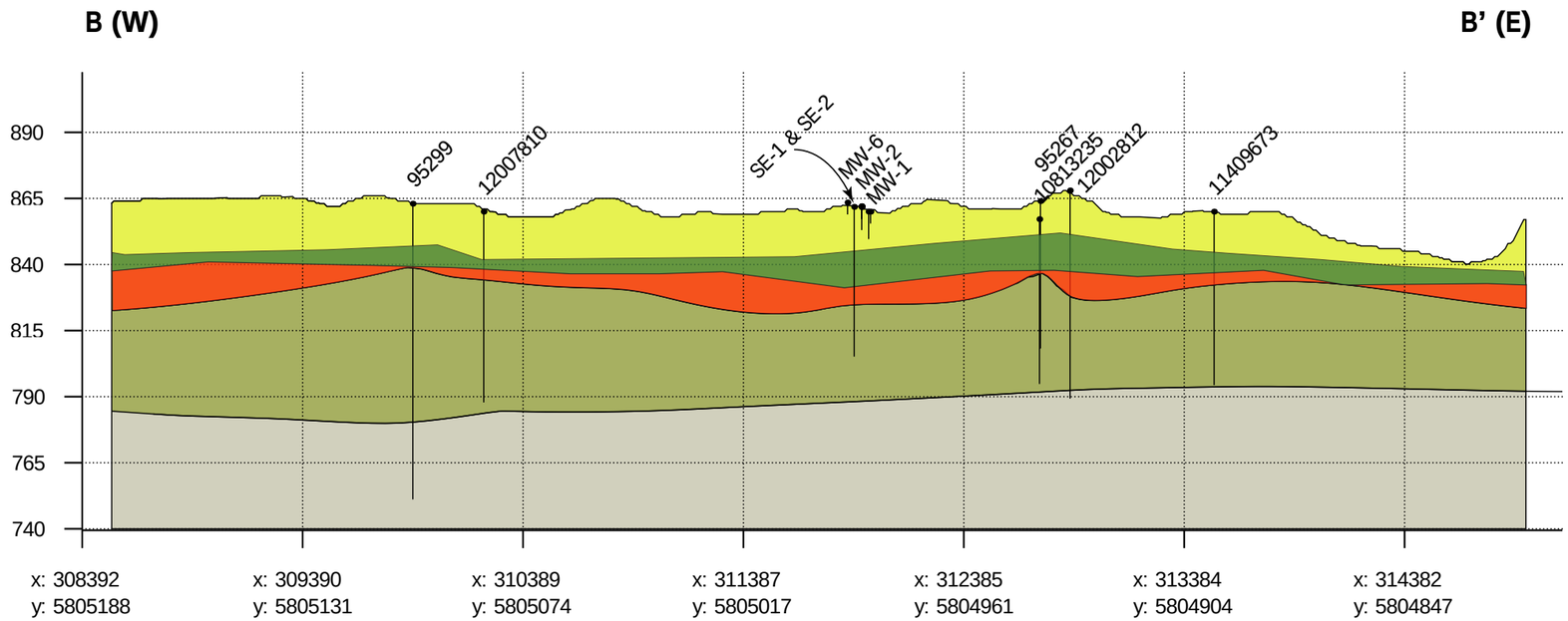
Client/Project
1842107 Alberta Ltd.
Burbank Sub-division
Hydrogeological Supply Evaluation

Figure No.
5

Title
Geological Cross-Section A - A'

Cross-section Key Plan





Position Along Section (NAD83 UTM Z12 Coords.)

Legend

- Aeolian Sand
- Till
- Sand and Gravel (fluvial)
- Paskapoo Fm. (Lacombe Member - mudstone dominated)
- Paskapoo Fm (Haynes Member - sandstone dominated)

Notes
1. Coordinate System: NAD 1983 UTM Zone 12

Location

A: 308392, 5805188

B: 315097, 5804807

Scale: 1:27,000

Vertical exaggeration: 12x

0m 1000m

Stantec

Project Location
Within SW 24-39-27 W4M
Red Deer, Alberta

1102-19790
Prepared by JR on 2016-09-28
Review by CN on 2016-09-28

Client/Project
1842107 Alberta Ltd.
Burbank Sub-division
Hydrogeological Supply Evaluation

Figure No.
6

Title
Geological Cross-Section B - B'

4.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the completion of the scope of work as was described in this report, the following conclusions and recommendations are noted:

- Based upon a review of hydrogeologic drilling and geophysical information, it appears that the two confined sandstone aquifer units in which both SE-1 and SE-2 wells have been completed are part of the Lacombe Member of the Paskapoo Formation.
- Potential long-term yield (Q_{20}) was calculated with hydraulic parameters obtained through the analysis of aquifer pumping test data at production well SE-1. Based on the minimum (i.e., most conservative estimate) transmissivity value for the best fit solution, the potential long term yield for the aquifer in the vicinity of SE-1 pumping well is approximately 109.95 m^3/d. Thus, it appears that the aquifer should be able to sustain production from a virtual well SE-1 for the 14 lots pumping at a rate of 48 m^3/day (7.33 lgpm) while leaving potential for additional production volume, if needed.
- Each lot will have its own domestic water well pumping at a much lower rate, at a maximum of 3.43 m^3/day (0.52 lgpm) to an annual maximum of 1,250 m^3/year with a simulated minimal drawdown (0.09 m at 500 distance from SE-1).
- In general, groundwater quality is good, with low total dissolved solids and exceedances of the respective guideline values for health-based and aesthetic parameters for fluoride (3.1 and 3.0 mg/L), pH (9.07-9.08), sodium (220 mg/L). Total coliforms (1.0 mpn/100ml and 2.0 mpn/100 ml) were detected and disinfection is recommended for domestic water use. No Escherichia coli were detected.
- Groundwater sampling and analysis should continue to be conducted on a regular basis (routine and bacteriological parameters).
- Well maintenance activities should be scheduled and completed on a regular basis to promote ongoing longevity and performance of the production wells (SE-1 and SE-2).
- Surface grading in the vicinity of the well head should be completed such that surface water continues to drain away from the well and toward the site runoff control system.

5.0 REFERENCES

Canadian Council of Ministers of the Environment (CCME). 2011. Protocols Manual for water quality sampling in Canada.

Domenico, P.A. and Schwartz, F.W. 1990. *Physical and Chemical Hydrogeology*, John Wiley & Sons, New York, 824 p.

Health Canada. 2014. Guidelines for Canadian Drinking Water Quality - Summary Table. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.

Midwest Geoscience Group. 2013. Advanced Aquifer Testing Techniques Featuring Aqtesolv™. Calgary, Alberta, June 19-23, 2013

Stantec Consulting Ltd. 2016. Burbank Subdivision Hydrogeologic Summary and Aquifer Potential Evaluation, April 2016.

APPENDIX A
BOREHOLE LOGS, CONSTRUCTION DETAILS, GEOPHYSICAL LOGS, AND DRILLER'S REPORTS

Water Supply: SE-1

Project:	Burbank	**Drilling method:**	Mud Rotary/Air Rotary
Client:	1842107 Alberta Ltd.	**Date started/completed:**	02-Aug-2016 / 03-Aug-2016
Location:	SW 24-39-27 W4M	**Ground surface elevation:**	n/a
Number:	110219790	**Top of casing elevation:**	n/a
Field investigator:	S.Cairns	**Easting:**	311883
Contractor:	Calibre Drilling Ltd.	**Northing:**	5805119

SUBSURFACE PROFILE				INSTALLATION DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Depth (m BGS)	Diagram / Description
0	0		Ground Surface		Stick up: 0.63 m
			TOPSOIL: Black, organic rich	0.00	
			SAND: Brown, fine to medium grained	0.30	Borehole: From 0 to 48.5 m; reamed to 8.75" (222.25 mm)
5	2				
10			GRAVEL: Multilithic gravel, subrounded to rounded, 1 to 3 cm in diameter	2.74	
			CLAY AND SILT: yellow to brown, weathered clay, plastic	3.35	
15	4				
			CLAY AND SILT: Dark grey, plastic	4.88	
20	6				
25	8				
30					
35	10				
40	12				
45	14				

Screen Interval: 49.99 - 57.61 m BGS
Sand Pack Interval: 49.99 - 57.61 m BGS
Well Seal Interval: 0.00 - 48.46 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
n/a - not available

Stantec

Drawn By/Checked By: S.Cairns

Water Supply: SE-1

Project:	Burbank	**Drilling method:**	Mud Rotary/Air Rotary
Client:	1842107 Alberta Ltd.	**Date started/completed:**	02-Aug-2016 / 03-Aug-2016
Location:	SW 24-39-27 W4M	**Ground surface elevation:**	n/a
Number:	110219790	**Top of casing elevation:**	n/a
Field investigator:	S.Cairns	**Easting:**	311883
Contractor:	Calibre Drilling Ltd.	**Northing:**	5805119

SUBSURFACE PROFILE				INSTALLATION DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Depth (m BGS)	Diagram / Description
55	16		CLAY AND SILT: Dark grey, plastic		
60	18		SAND AND GRAVEL: Brown, fine sand with mutilithic gravel, fine clay stringers throughout	16.76	
65	20				
70	22		MUDSTONE: Grey, weathered bedrock	21.64	
75	24		SANDSTONE: Light grey, some clay	23.16	
80	26		MUDSTONE: Red, plastic when wet	24.08	Surface Casing: From 0 to 48.5 m BGS; Sch 40, 6" (152.4 mm) diameter
85	28		MUDSTONE:Light grey to pale green grey, contains clay and silt	24.69	
90					Static Water level at 27.24 m BGS on August 9, 2016
95	30		SANDSTONE: Light grey, very fine sand, contains clay, weakly cemented	29.26	
100					

Screen Interval: 49.99 - 57.61 m BGS
Sand Pack Interval: 49.99 - 57.61 m BGS
Well Seal Interval: 0.00 - 48.46 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
n/a - not available

Stantec

Drawn By/Checked By: S.Cairns

Water Supply: SE-1

Project:	Burbank	**Drilling method:**	Mud Rotary/Air Rotary
Client:	1842107 Alberta Ltd.	**Date started/completed:**	02-Aug-2016 / 03-Aug-2016
Location:	SW 24-39-27 W4M	**Ground surface elevation:**	n/a
Number:	110219790	**Top of casing elevation:**	n/a
Field investigator:	S.Cairns	**Easting:**	311883
Contractor:	Calibre Drilling Ltd.	**Northing:**	5805119

SUBSURFACE PROFILE				INSTALLATION DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Depth (m BGS)	Diagram / Description
			SANDSTONE: Light grey, very fine sand, contains clay, weakly cemented		
105	32		MUDSTONE: Light grey, contains silt and clay, weakly cemented	31.70	
110	34		SANDSTONE: Light grey, fine grained sand	33.22	
115	36		SILTSTONE: Dark green to grey	35.97	
120	38		MUDSTONE: Light grey, well cemented	37.80	
125	40				
130	42		SANDSTONE: Light grey, fine grained sand	41.15	
135	44		SILTSTONE: Dark green to dark grey, lithified	41.76	
140	46				
145					
150					

Screen Interval: 49.99 - 57.61 m BGS
Sand Pack Interval: 49.99 - 57.61 m BGS
Well Seal Interval: 0.00 - 48.46 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
n/a - not available

Stantec

Drawn By/Checked By: S.Cairns

Water Supply: SE-1

Project:	Burbank	**Drilling method:**	Mud Rotary/Air Rotary
Client:	1842107 Alberta Ltd.	**Date started/completed:**	02-Aug-2016 / 03-Aug-2016
Location:	SW 24-39-27 W4M	**Ground surface elevation:**	n/a
Number:	110219790	**Top of casing elevation:**	n/a
Field investigator:	S.Cairns	**Easting:**	311883
Contractor:	Calibre Drilling Ltd.	**Northing:**	5805119

SUBSURFACE PROFILE				INSTALLATION DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Depth (m BGS)	Diagram / Description
155	48		SILTSTONE: Dark green to dark grey, lithified		
160	50		SANDSTONE: Grey and black, salt and pepper appearance, poorly cemented, coarsens downhole	49.99	Casing Liner: From 45.4 to 50 m BGS; Borehole: From 48.5 to 61.0 m; 5.13" (130.18 mm)
165					
170	52				
175	54				Screen: From 50.0 to 57.6 m BGS; Sch 40, slot 020, 4.5" (114.3mm) diameter
180			MUDSTONE: Black to dark grey, lithified	54.25	
	56		SANDSTONE: Light grey, very fine sand, well cemented	56.08	
185					
190	58		SILTSTONE: Dark grey to green	57.61	
195	60				Casing Liner: From 57.6 to 61.0m BGS
200			End of Borehole	60.96	

Screen Interval: 49.99 - 57.61 m BGS
Sand Pack Interval: 49.99 - 57.61 m BGS
Well Seal Interval: 0.00 - 48.46 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
n/a - not available

Stantec

Drawn By/Checked By: S.Cairns

Water Supply: SE-2

Project:	Burbank	**Drilling method:**	Mud Rotary
Client:	1842107 Alberta Ltd.	**Date started/completed:**	04-Aug-2016 / 05-Aug-2016
Location:	SW 24-39-27 W4M	**Ground surface elevation:**	n/a
Number:	110219790	**Top of casing elevation:**	n/a
Field investigator:	S.Cairns/ D.Nisbet	**Easting:**	311908
Contractor:	Calibre Drilling Ltd.	**Northing:**	5805115

SUBSURFACE PROFILE				INSTALLATION DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Depth (m BGS)	Diagram / Description
0	0		Ground Surface		Stick up: 0.49 m
			TOPSOIL: Black, organic rich	0.00	
			GRAVEL AND SAND:	0.30	Borehole: From 0 to 49.07 m; reamed to 8.75" (222.25 mm)
5	2				
10			CLAY AND SILT: Yellow to brown, weathered	3.05	
			CLAY AND SILT: Dark grey, moderately plastic	3.35	
15	4				
20	6				
25	8		@ 7.62 m becomes more clay rich and more plastic		
30					
35	10				
40	12				
45	14				

Screen Interval: 50.60 - 56.69 m BGS
Sand Pack Interval: 50.60 - 56.69 m BGS
Well Seal Interval: 0.00 - 49.07 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
n/a - not available

Stantec

Drawn By/Checked By: S.Cairns

Water Supply: SE-2

Project:	Burbank	**Drilling method:**	Mud Rotary
Client:	1842107 Alberta Ltd.	**Date started/completed:**	04-Aug-2016 / 05-Aug-2016
Location:	SW 24-39-27 W4M	**Ground surface elevation:**	n/a
Number:	110219790	**Top of casing elevation:**	n/a
Field investigator:	S.Cairns/ D.Nisbet	**Easting:**	311908
Contractor:	Calibre Drilling Ltd.	**Northing:**	5805115

SUBSURFACE PROFILE				INSTALLATION DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Depth (m BGS)	Diagram / Description
55	16		CLAY AND SILT: Dark grey, moderately plastic		
60	18		GRAVEL: Multilithic, subangular, fine to coarse gravel, 1 to 8 cm in diameter, thin seams of clay and silt throughout	17.68	
65	20				
70	22				
75			SILTSTONE: Dark green to grey, poorly cemented, weathered bedrock	22.56	
80	24		SANDSTONE: Light grey, very fine grained sand, poorly cemented	23.77	Surface Casing: From 0 to 49.07 m BGS; Sch 40, 6" (152.4 mm) diameter
85	26		MUDSTONE: Dark green to grey, well cemented	25.60	
90	28		SANDSTONE: Light grey, fine grained sand	26.52	Static Water level at 28.25 m BGS on August 9, 2016
95					
100	30		MUDSTONE: Dark grey to green, well cemented	29.87	

Screen Interval: 50.60 - 56.69 m BGS
Sand Pack Interval: 50.60 - 56.69 m BGS
Well Seal Interval: 0.00 - 49.07 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
n/a - not available

Stantec

Drawn By/Checked By: S.Cairns

Water Supply: SE-2

Project:	Burbank	**Drilling method:**	Mud Rotary
Client:	1842107 Alberta Ltd.	**Date started/completed:**	04-Aug-2016 / 05-Aug-2016
Location:	SW 24-39-27 W4M	**Ground surface elevation:**	n/a
Number:	110219790	**Top of casing elevation:**	n/a
Field investigator:	S.Cairns/ D.Nisbet	**Easting:**	311908
Contractor:	Calibre Drilling Ltd.	**Northing:**	5805115

SUBSURFACE PROFILE				INSTALLATION DETAILS	
Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Depth (m BGS)	Diagram / Description
105	32		SANDSTONE: Light grey, fine grained sand	30.78	
110	34		MUDSTONE: dark grey to green	32.61	
115	36				
120					
125	38		SANDSTONE: Light grey, very fine grained sand, some silt	37.80	
130	40		MUDSTONE: Dark grey to green, well cemented, cementation varies locally	39.01	
135					
140	42				
			MUDSTONE: Brown to grey, poorly cemented	42.98	
145	44		MUDSTONE: Dark grey to green, well cemented mudstone, silt content varies locally	43.59	
150	46				

Screen Interval: 50.60 - 56.69 m BGS
Sand Pack Interval: 50.60 - 56.69 m BGS
Well Seal Interval: 0.00 - 49.07 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
n/a - not available

Stantec

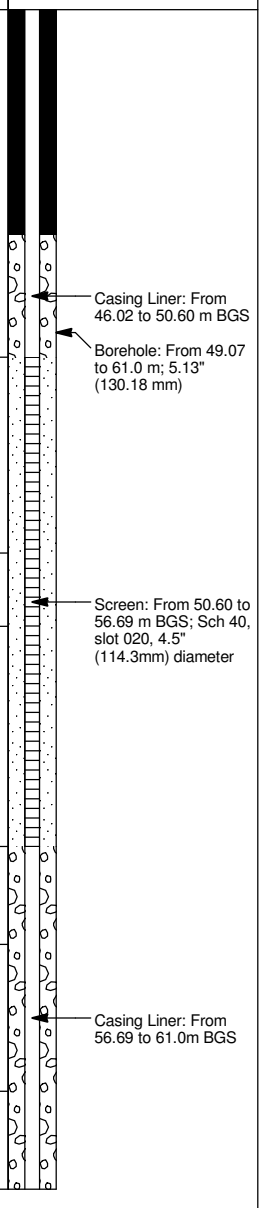
Drawn By/Checked By: S.Cairns

Water Supply: SE-2

Project:	Burbank	**Drilling method:**	Mud Rotary
Client:	1842107 Alberta Ltd.	**Date started/completed:**	04-Aug-2016 / 05-Aug-2016
Location:	SW 24-39-27 W4M	**Ground surface elevation:**	n/a
Number:	110219790	**Top of casing elevation:**	n/a
Field investigator:	S.Cairns/ D.Nisbet	**Easting:**	311908
Contractor:	Calibre Drilling Ltd.	**Northing:**	5805115

SUBSURFACE PROFILE | INSTALLATION DETAILS

Depth (ft)	Depth (m)	Graphic Log	Lithologic Description	Depth (m BGS)
			MUDSTONE: Dark grey to green, well cemented mudstone, silt content varies locally	
155				
	48			
160				
	50			
165			SANDSTONE: Light grey, fine grained sand, moderately well cemented, coarsens downhole to a medium grained sand	50.60
170				
	52			
			MUDSTONE: Green mudstone, well cemented	53.04
175				
	54		SANDSTONE: Light grey, fine grained sand, well cemented	53.95
180				
	56			
185			MUDSTONE: Dark grey, siltstone locally, degreee of cementation varies locally	56.69
190	58		SANDSTONE: Light grey, fine grained to medium grained sand	57.91
195				
	60		MUDSTONE: Dark grey to black	59.74
200			End of Borehole	60.96

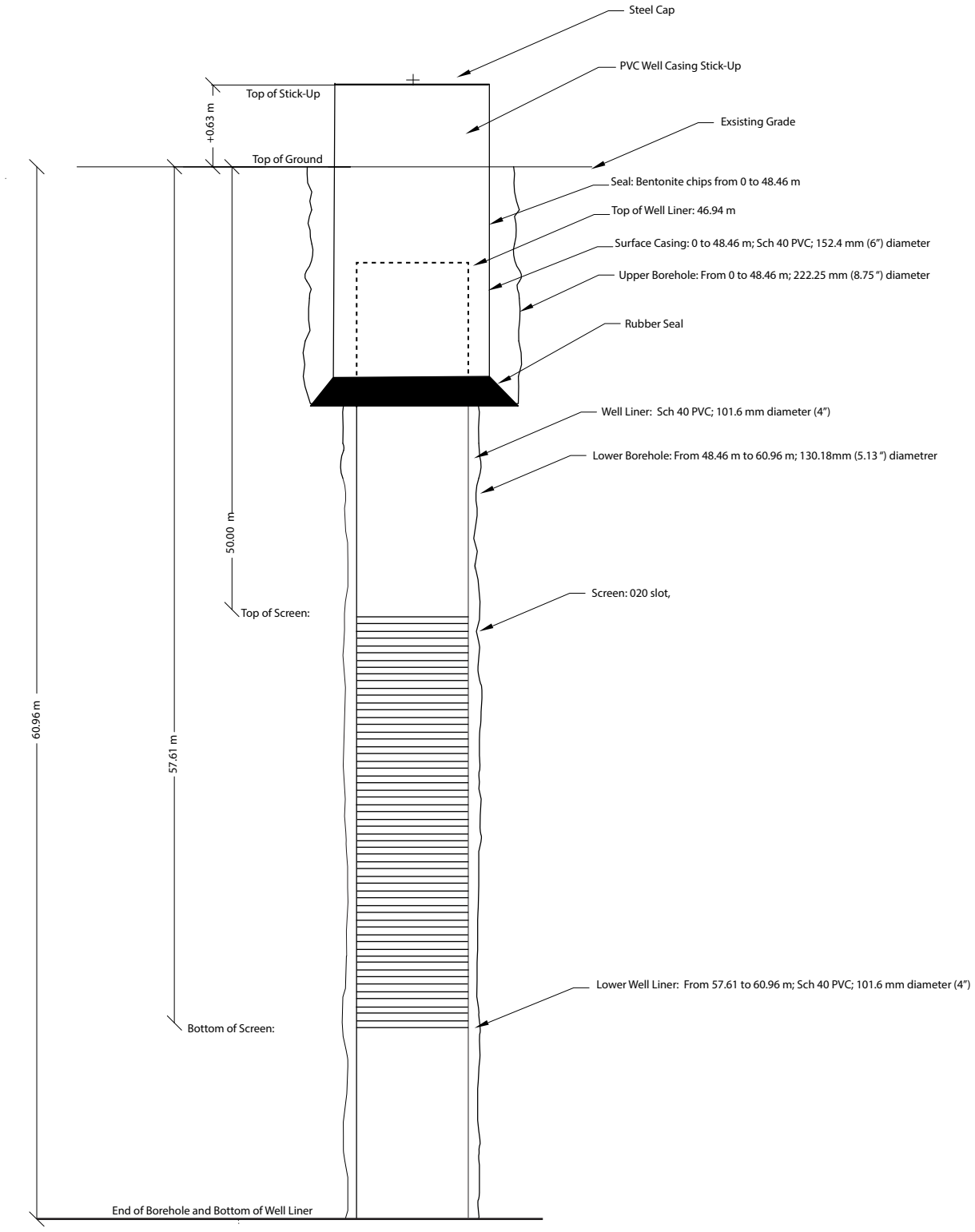


Screen Interval: 50.60 - 56.69 m BGS
Sand Pack Interval: 50.60 - 56.69 m BGS
Well Seal Interval: 0.00 - 49.07 m BGS

Notes:
m AMSL - metres above mean sea level
m BGS - metres below ground surface
n/a - not available

Stantec

Drawn By/Checked By: S.Cairns



Stantec

Well Completion Details

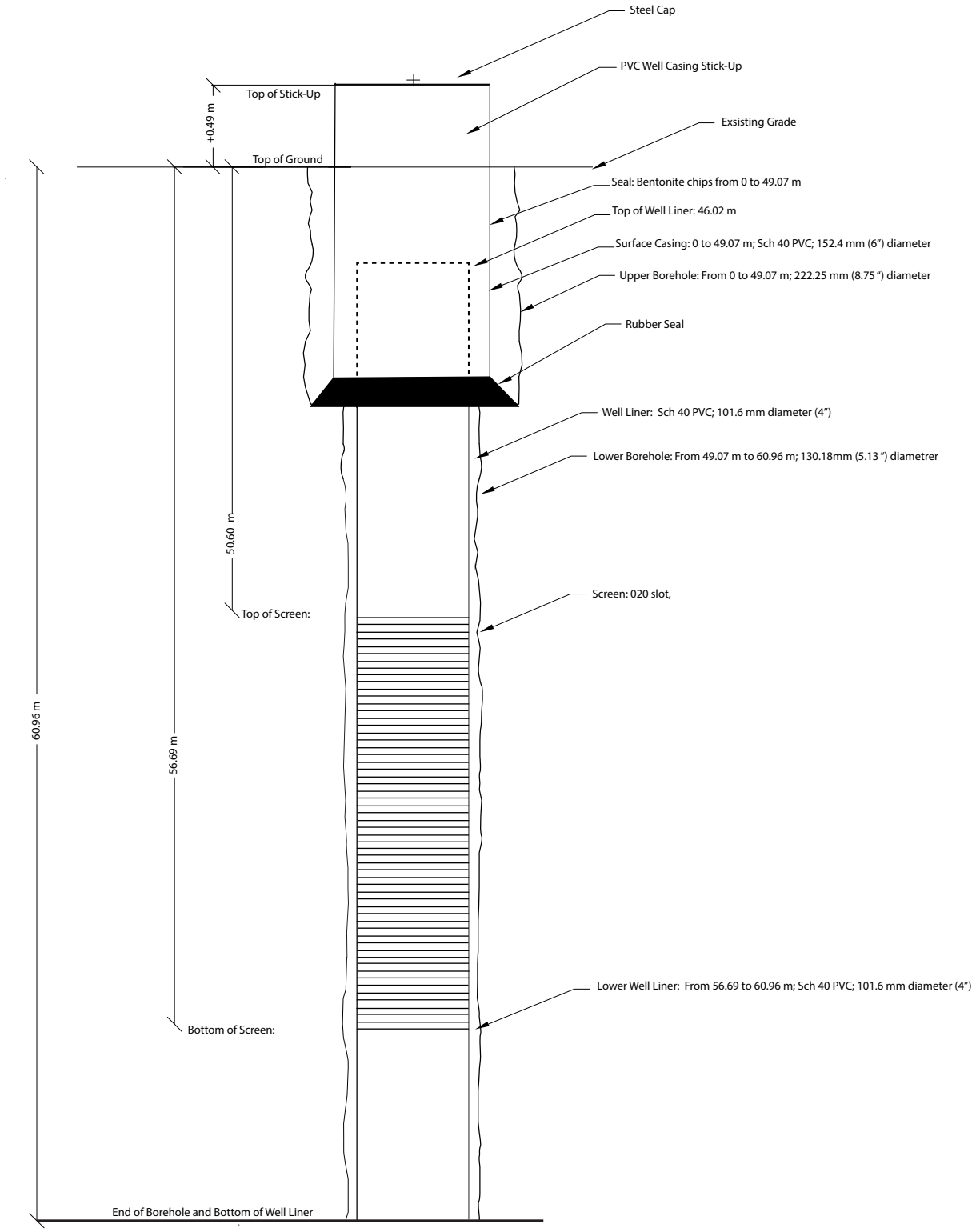
Figure No.

A-1

Title

SE-1 Burbank Pumping Well

Drawn by: S.Cairns



Stantec

Well Completion Details

Figure No.

A-2

Title

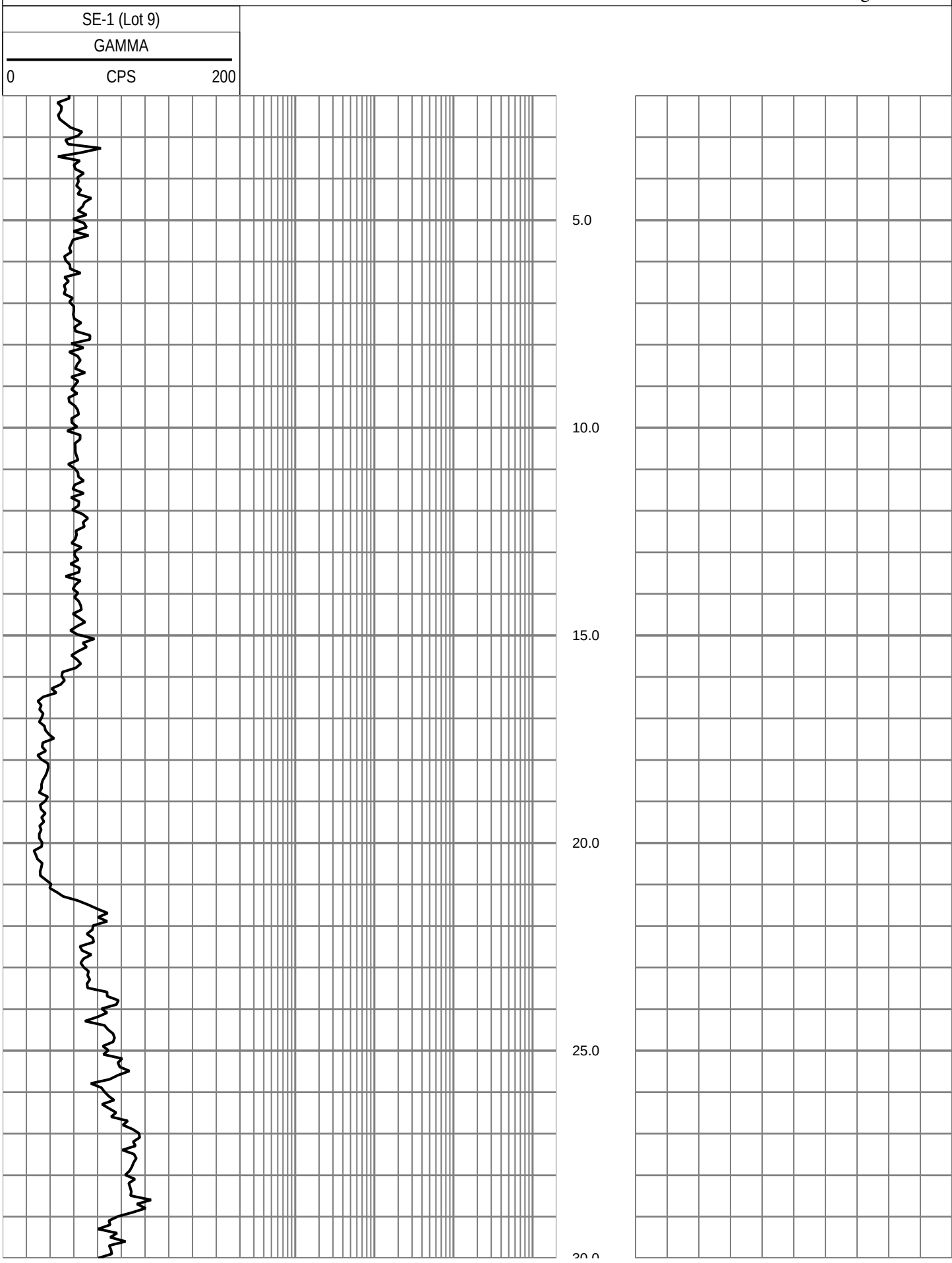
SE-2 Burbank Observation Well

Drawn by: S.Cairns

Description: RHOB; GR; ROSI; Dips Format: LWD Index Scale: 1 cm per 1.2 m Index Unit: m Index Type: Measured Depth Creation Date: 03-Aug-2016 15:24:59

GAMMA

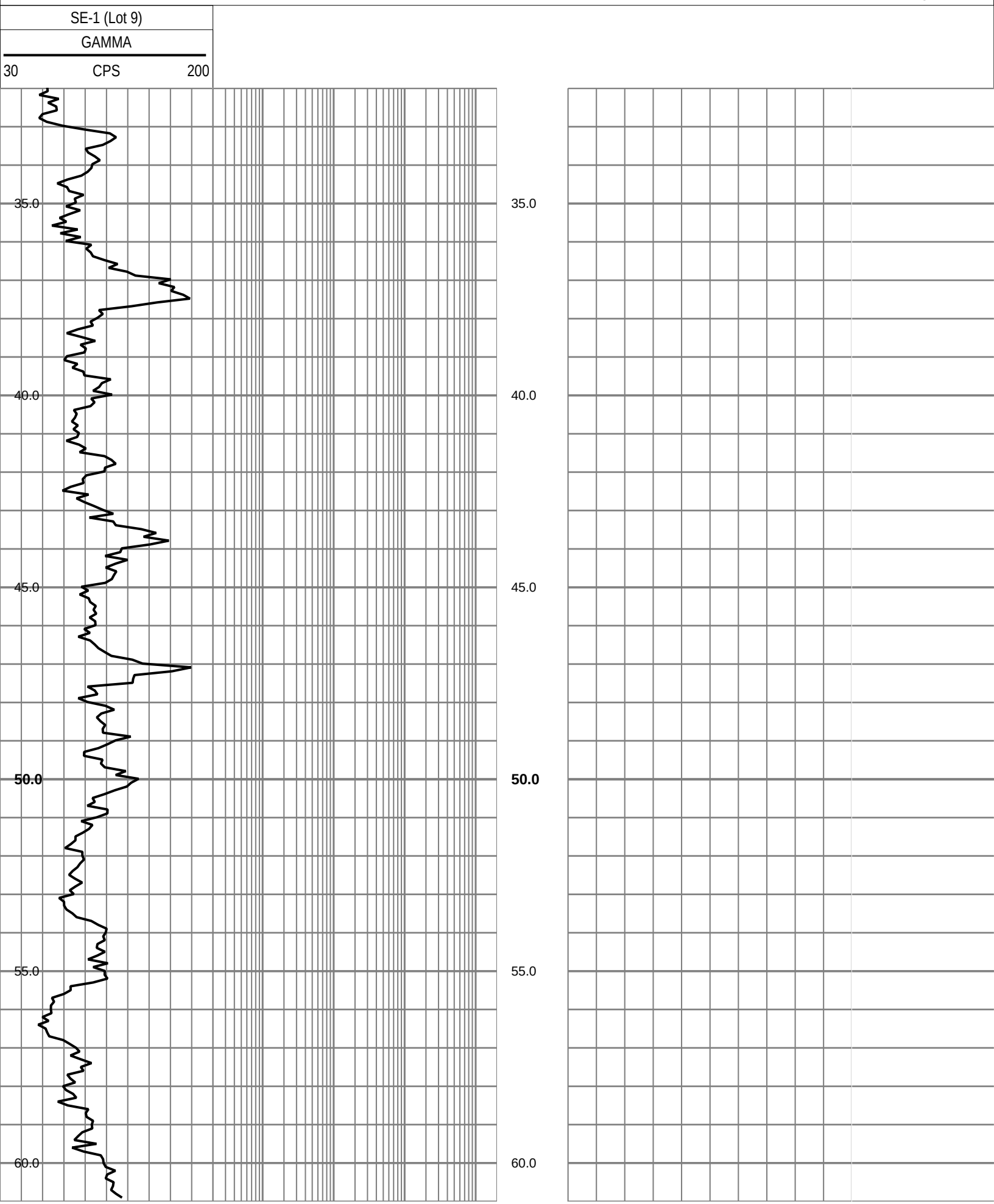
Fig. A-3



Description: RHOB; GR; ROSI; Dips Format: LWD Index Scale: 1 cm per 1.2 m Index Unit: m Index Type: Measured Depth Creation Date: 03-Aug-2016 14:53:51

GAMMA

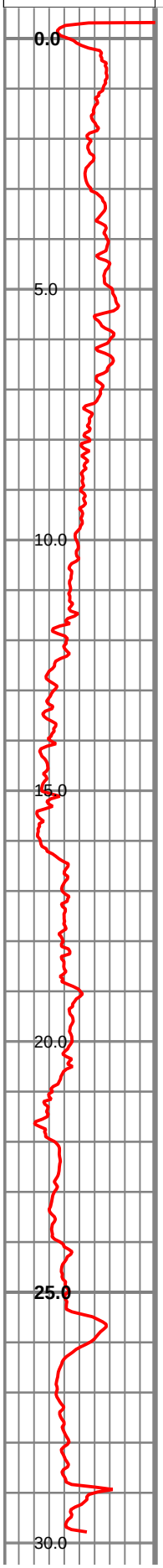
Fig. A-4



Description: GVR Image with Dips Format: LWD Index Scale: 1 cm per 1.20000004768372 m Index Unit: m Index Type: Measured Depth Creation Date: 13-Oct-2016 15:44:38

SPR

Fig. A-6

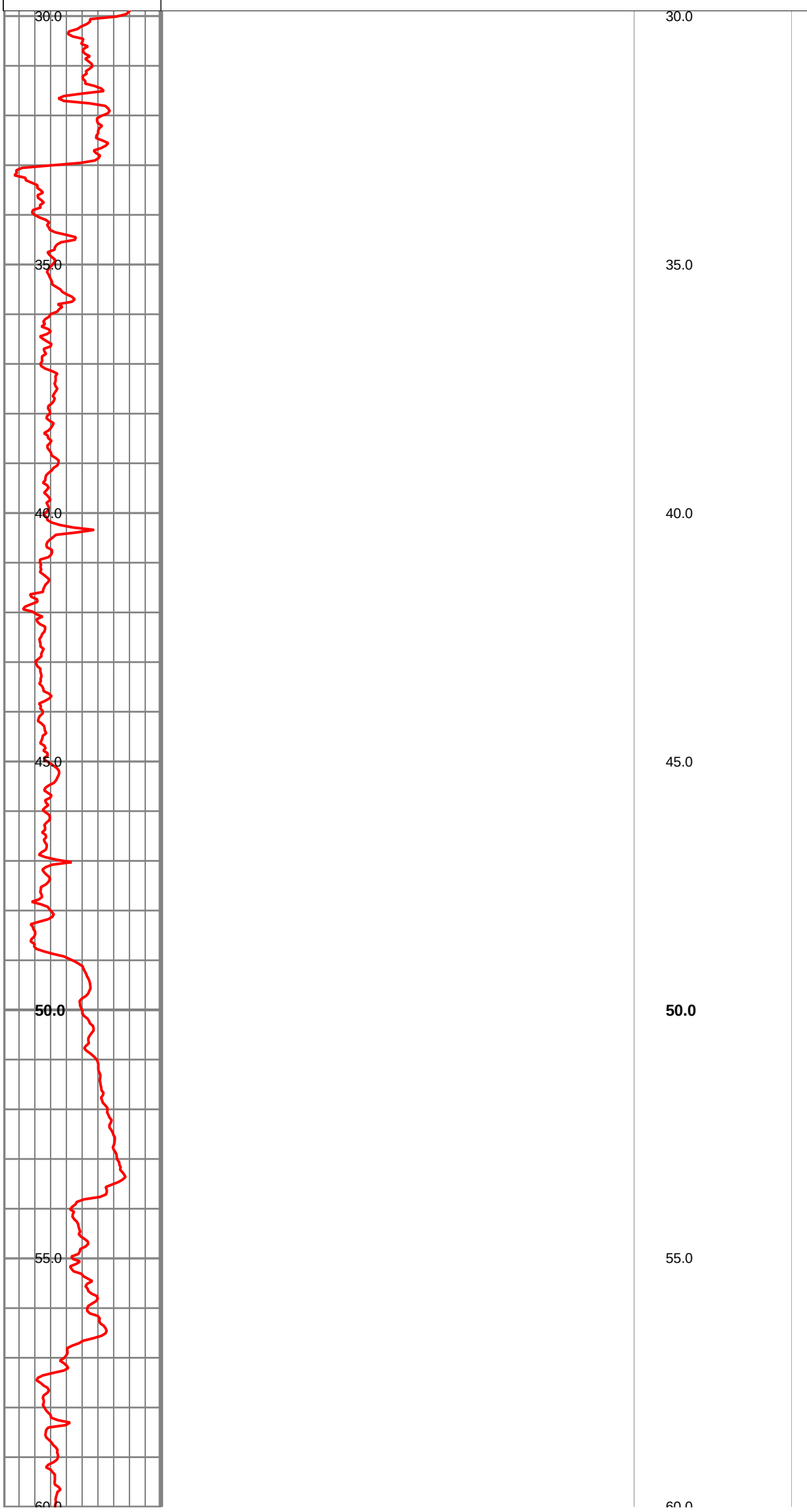


0.0
5.0
10.0
15.0
20.0
25.0
30.0

Description: GVR Image with Dips Format: LWD Index Scale: 1.20000004768372 cm per 1.20000004768372 m Index Unit: m Index Type: Measured Depth Creation Date: 13-Oct-2016 15:51:58

SPR

Fig. A-5



APPENDIX B
PHOTOGRAPHIC DETAILS OF DRILLING AND PUMPING TEST ACTIVITIES

Drilling on August 3, 2016 at SE-1

Rubber shale trap at the bottom of reamed 8 ¾ "(222.25 mm) BH; used in SE-1 and SE-2

020 Slot 4.5 “(114.3 mm) Sch. 40 PVC Screen

Installing the screen at SE-1 on August 4, 2016

Set up for Step Test/Pumping Test at SE-1

YSI set up during pumping Test

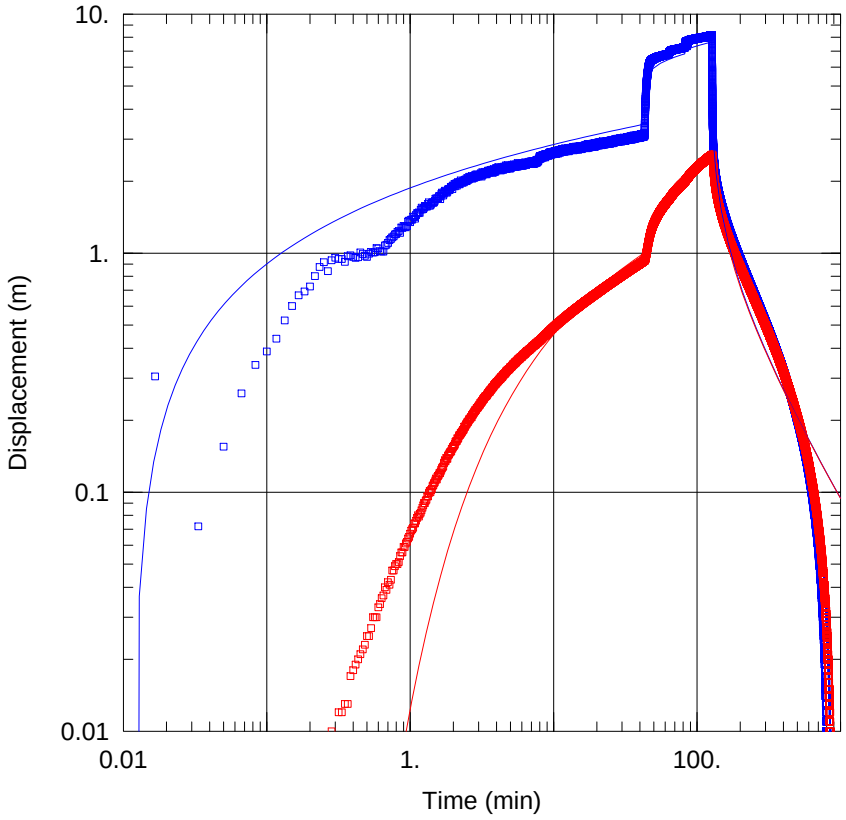
Flow rate meter used in all pumping test measures USgpm

Discharge from pumping test

Lights run during the day and night during Pumping Test to check on pumping rate

Recovery after pumping test at SE-1

APPENDIX C
PUMPING TEST DATA AND FIELD PARAMETERS



STEP DRAWDOWN TEST

Data Set: V:\1102\active\110219790\analysis\Aqtesolv\anl_SE-1_step_test.aqt
Date: 09/19/16 Time: 18:14:44

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 8 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.586 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

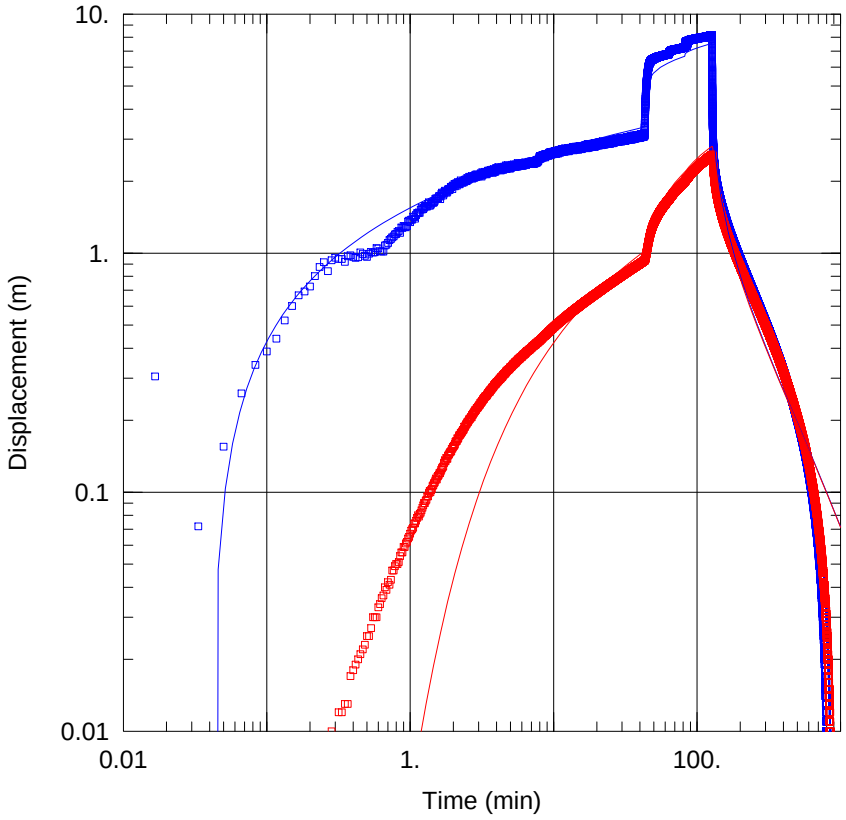
SOLUTION

Aquifer Model: Confined Solution Method: Theis (Step Test)

T = 10.26 m^2/day S = 0.0001058
Sw = -3.033 C = 1. min^2/m^5
P = 1.5

Step Test Model: Jacob-Rorabaugh $s(t) = 49.35Q + 1.Q^{1.5}$
Time (t) = 1. min Rate (Q) in cu. m/min W.E. = 236.% (Q from last step). Error! Max is 100%

Fig. C-1



STEP DRAWDOWN TEST

Data Set: V:\1102\active\110219790\analysis\Aqtesolv\anl_SE-1_step_test.aqt
Date: 09/20/16 Time: 11:55:59

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 8 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m
Aquitard Thickness (b'): 1. m
Anisotropy Ratio (Kz/Kr): 1.
Aquitard Thickness (b"): 1. m

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

SOLUTION

Aquifer Model: Leaky
Solution Method: Hantush-Jacob

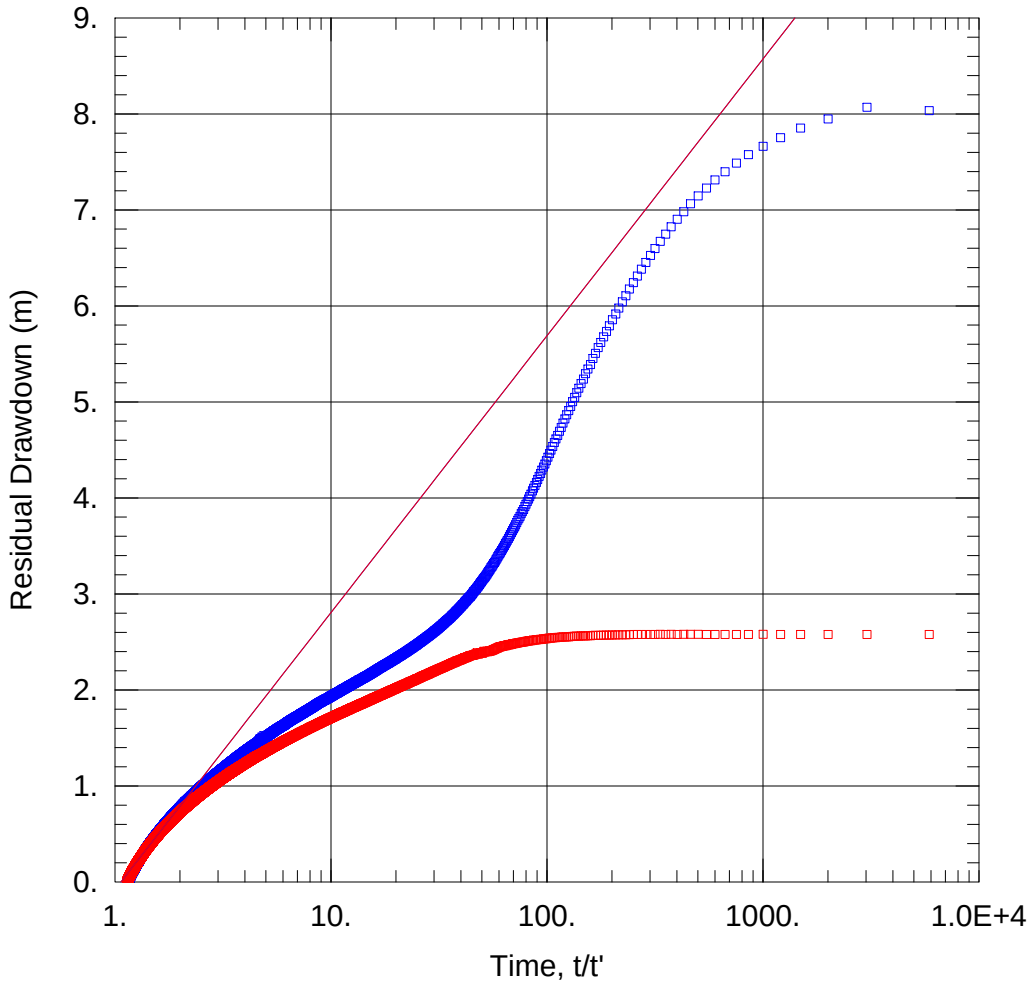
T = 8.906 m^2/day
1/B = 0.002982 m^{-1}
C = 0.01 min^2/m^5

S = 0.0001218
Sw = -3.51
P = 1.5

Step Test Model: Jacob-Rorabaugh
Time (t) = 1. min Rate (Q) in cu. m/min

$s(t) = 40.91Q + 0.01Q^{1.5}$
W.E. = 320.8% (Q from last step). Error! Max. is 100%.

Fig. C-2



STEP DRAWDOWN TEST

Data Set: V:\1102\active\110219790\analysis\Aqtesolv\anl_SE-1_step_test.aqt
Date: 09/20/16 Time: 14:58:23

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 8 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

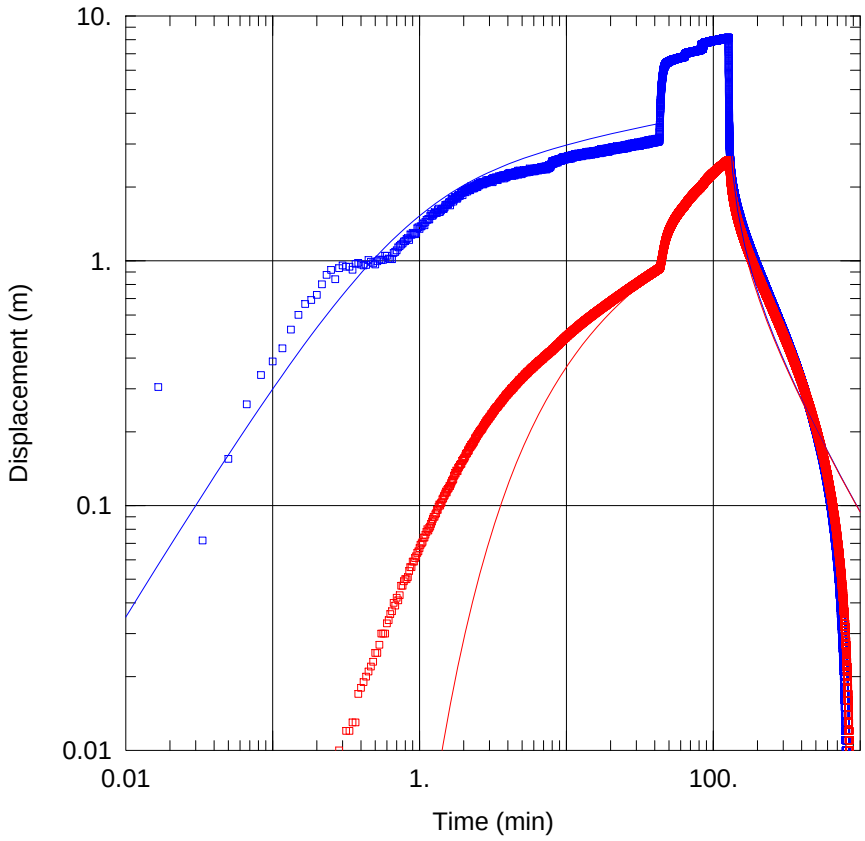
Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 6.923 m^2/day S/S' = 1.067

Fig. C-3



STEP DRAWDOWN TEST

Data Set: V:\1102\active\110219790\analysis\Aqtesolv\anl_SE-1_step_test.aqt
Date: 09/20/16 Time: 11:49:41

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 8 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m
Aquitard Thickness (b'): 1. m
Anisotropy Ratio (Kz/Kr): 1.
Aquitard Thickness (b"): 1. m

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

Well Name	X (m)	Y (m)
▫ SE-1	311883	5805119
▫ SE-2	311908	5805115

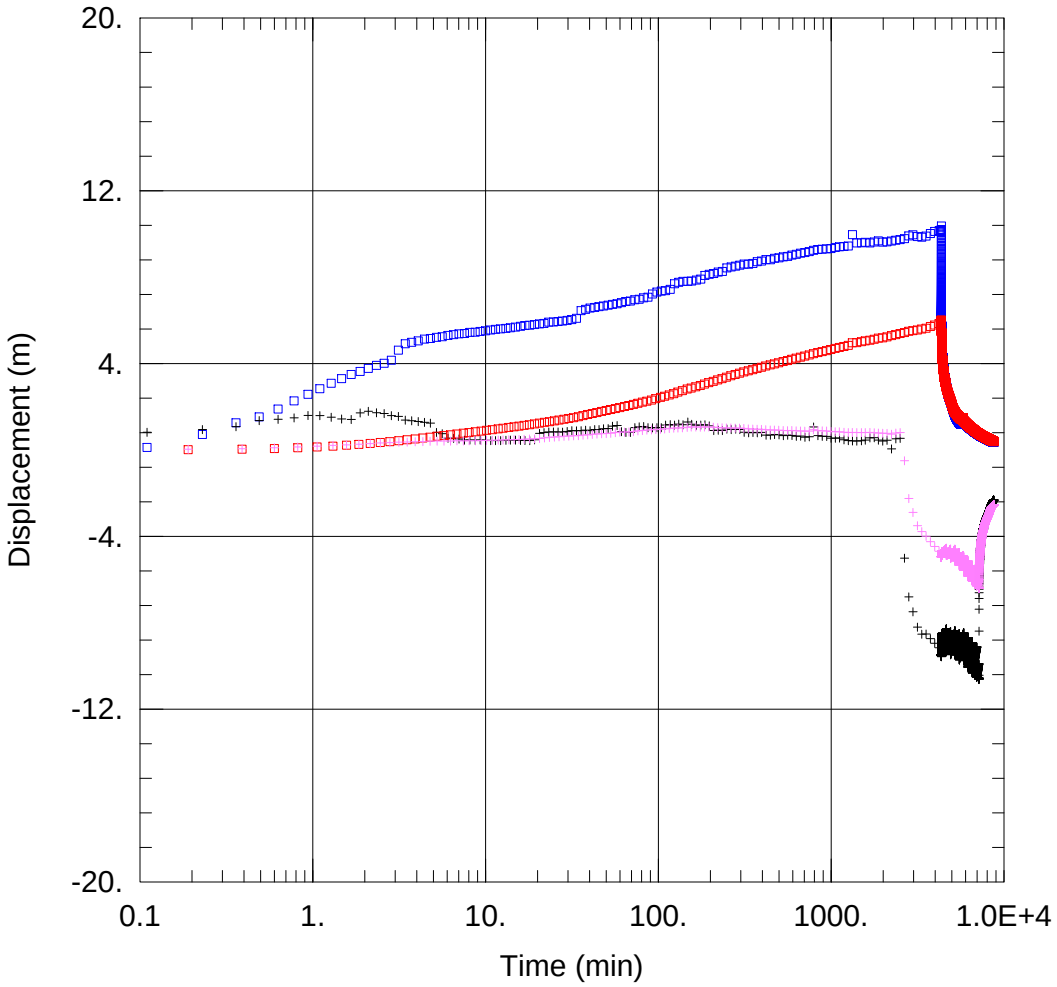
SOLUTION

Aquifer Model: Leaky
Solution Method: Moench (Case 3)

T = 10.24 m^2/day
1/B' = 0.002648 m^{-1}
1/B" = 0. m^{-1}
Sw = -2.709
r(c) = 0.05715 m

S = 0.000128
ß'/r = 0.0001536 m^{-1}
ß"/r = 0. m^{-1}
r(w) = 0.06509 m

Fig. C-4



72-HOUR CONSTANT RATE TEST

Data Set: V:\1102\active\110219790\analysis\Aqtesolv\anl_SE-1_pumping_test.aqt
Date: 09/07/16 Time: 16:56:50

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 9 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

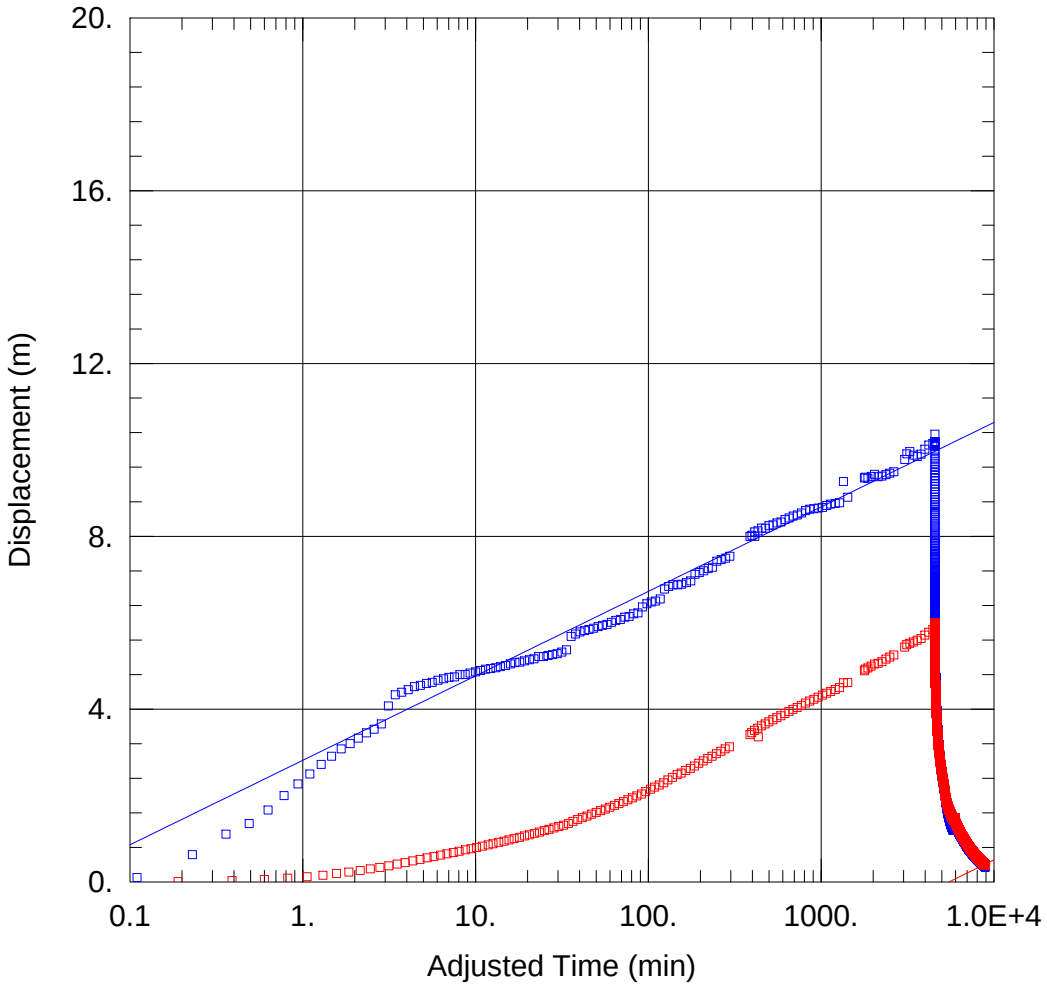
Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

Fig. C-5



72-HOUR CONSTANT RATE TEST

Data Set: C:\Users\cnageli\Desktop\Burbank\Aqtesolv\anl_SE-1_pumping_test.aqt
Date: 09/18/16 Time: 18:47:42

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 9 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

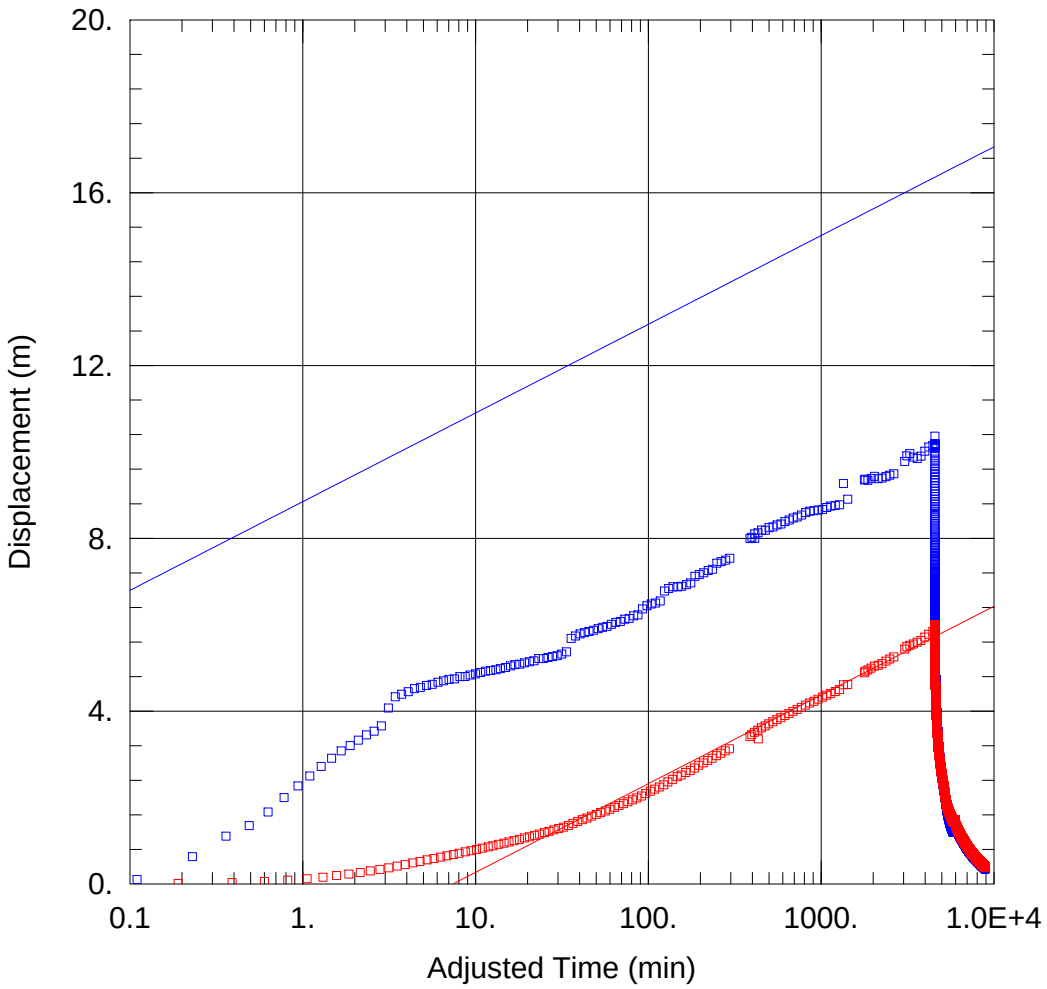
Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 8.023 m^2/day S = 0.1073

Fig. C-6



72-HOUR CONSTANT RATE TEST

Data Set: C:\Users\cnageli\Desktop\Burbank\Aqtesolv\anl_SE-1_pumping_test.aqt
Date: 09/18/16 Time: 18:48:46

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 9 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

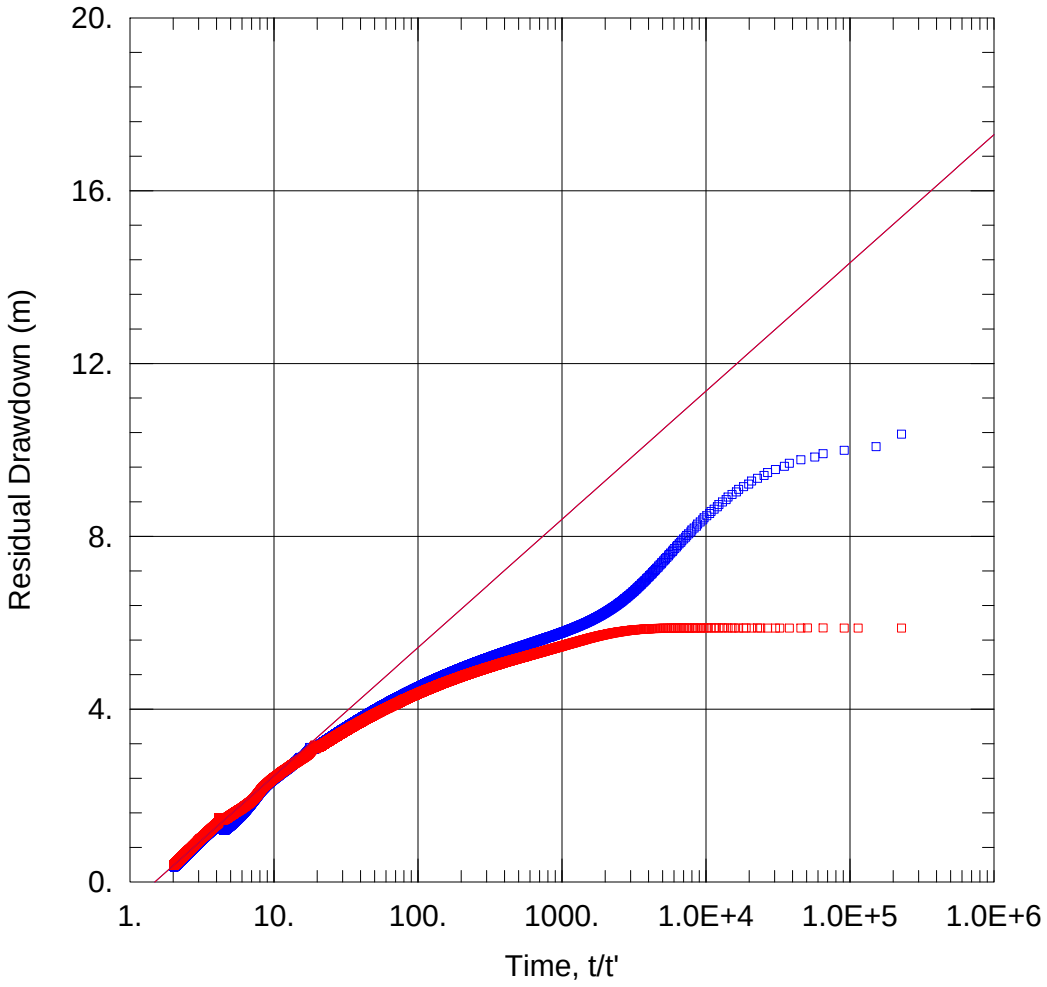
Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 7.641 m^2/day S = 0.0001377

Fig. C-7



72-HOUR CONSTANT RATE TEST

Data Set: C:\Users\cnageli\Desktop\Burbank\Aqtesolv\anl_SE-1_pumping_test.aqt
Date: 09/18/16 Time: 19:38:40

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 9 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

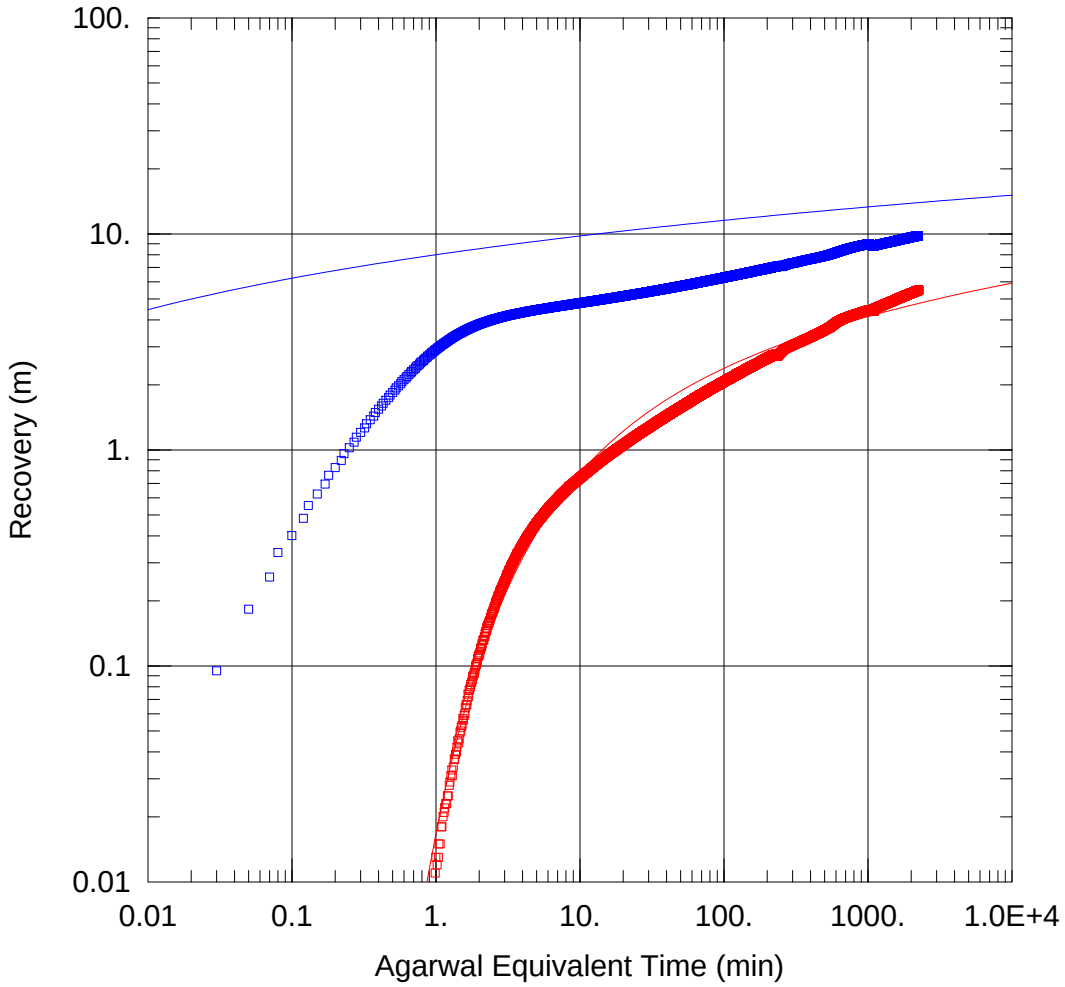
Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 5.286 m^2/day S/S' = 1.488

Fig. C-8



72-HOUR CONSTANT RATE TEST

Data Set: C:\Users\cnageli\Desktop\Burbank\Aqtesolv\anl_SE-1_pumping_test.aqt
Date: 09/18/16 Time: 19:42:10

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 9 Aug 2016

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

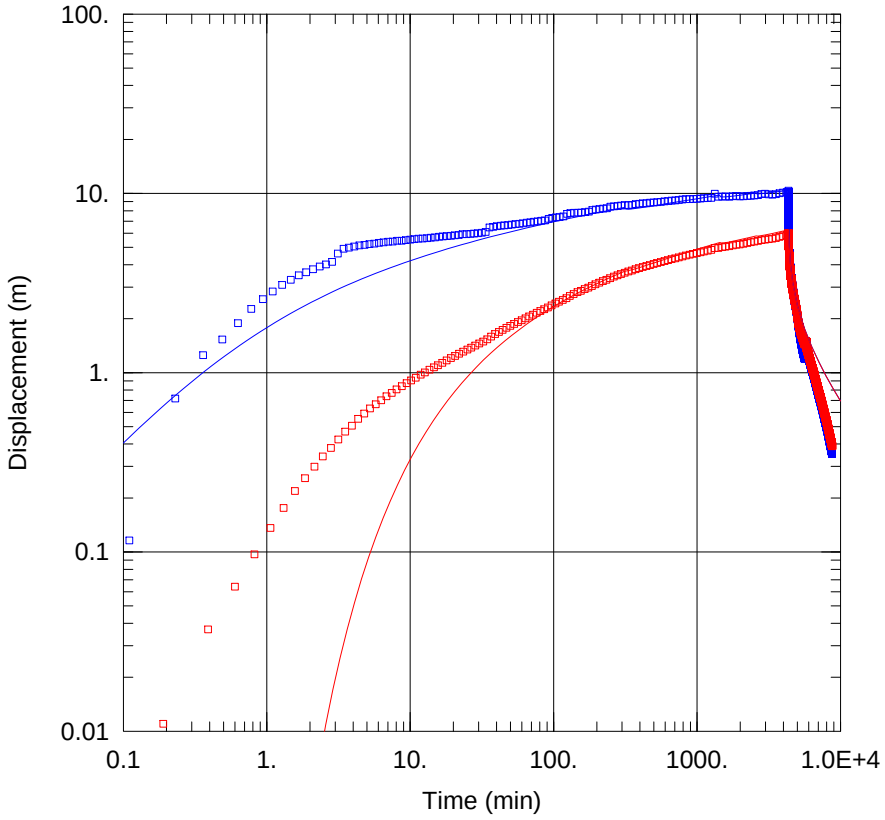
Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

SOLUTION

Aquifer Model: Confined
Solution Method: Theis - Agarval

T = 8.841 m^2/day
S = 9.969E-5
Kz/Kr = 1.
b = 7.62 m

Fig. C-9



72-HOUR CONSTANT RATE TEST

Data Set: V:\1102\active\110219790\analysis\Aqtesolv\anl_SE-1_pumping_test.aqt
Date: 09/20/16 Time: 16:37:50

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 9 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

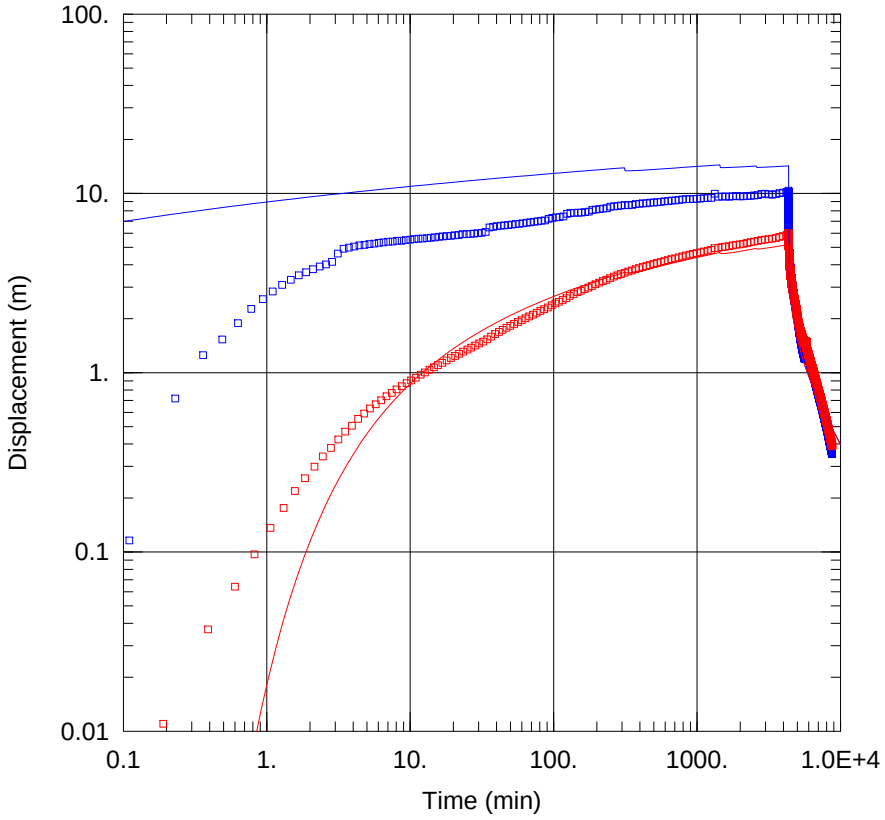
SOLUTION

Aquifer Model: Confined Solution Method: Barker

K = 0.9533 m/day
n = 1.955
Sw = -3.85
r(c) = 0.05715 m

Ss = 3.493E-5
b = 7.62 m
r(w) = 0.06509 m

Fig. C-10



72-HOUR CONSTANT RATE TEST

Data Set: V:\1102\active\110219790\analysis\Aqtesolv\anl_SE-1_pumping_test.aqt
Date: 09/20/16 Time: 16:23:28

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 9 Aug 2016

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

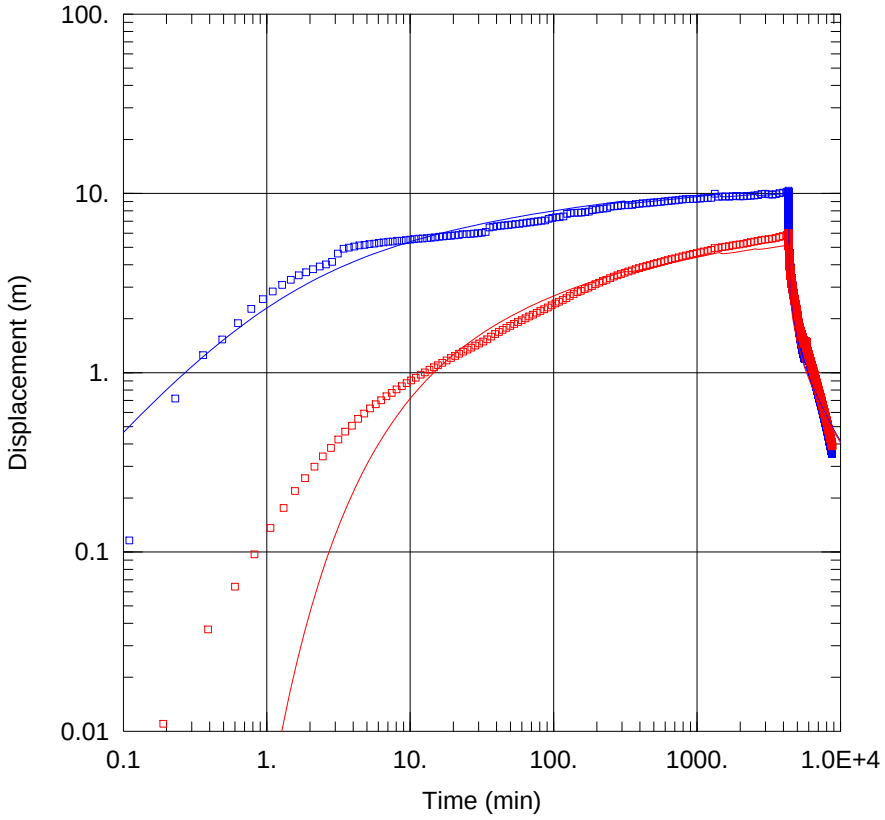
Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

SOLUTION

Aquifer Model: Leaky
Solution Method: Hantush-Jacob

T = 8.964 m^2/day
1/B = 0.0004971 m^{-1}
b = 7.62 m
S = 0.0001021
Kz/Kr = 1.

Fig. C-11



72-HOUR CONSTANT RATE TEST

Data Set: V:\1102\active\110219790\analysis\Aqtesolv\anl_SE-1_pumping_test.aqt
Date: 09/20/16 Time: 16:29:06

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 9 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m
Aquitard Thickness (b'): 1. m
Anisotropy Ratio (Kz/Kr): 1.
Aquitard Thickness (b"): 1. m

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

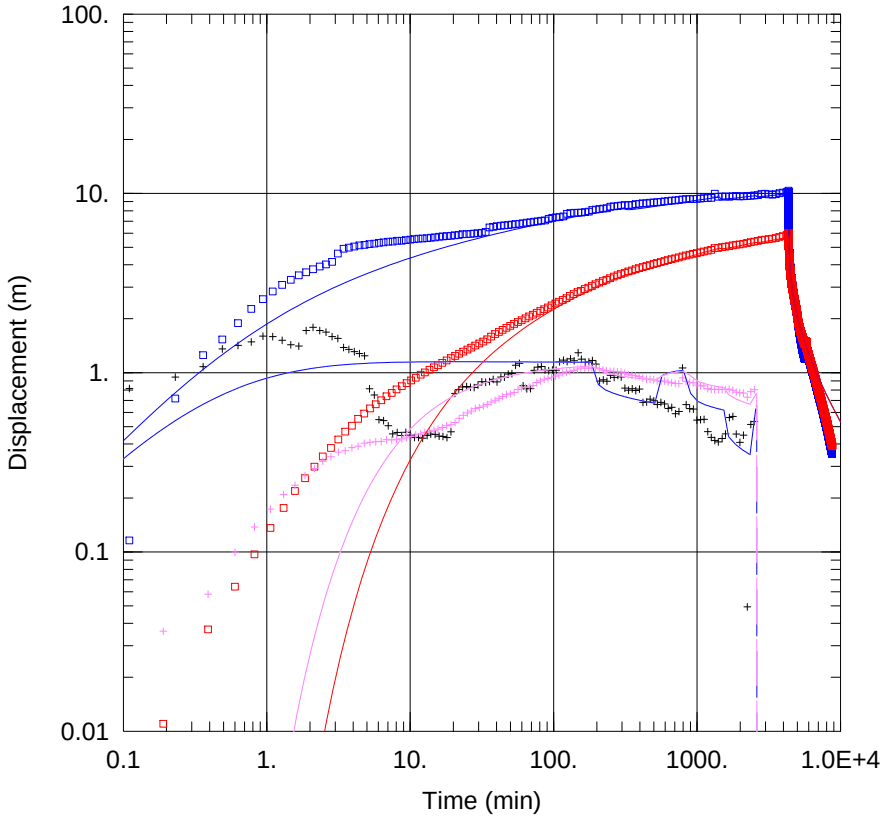
SOLUTION

Aquifer Model: Leaky
Solution Method: Moench (Case 1, Constant Head)

T = 4.997 m^2/day
1/B' = 0.00174 m^{-1}
1/B" = 0. m^{-1}
Sw = -4.167
r(c) = 0.05715 m

S = 9.131E-5
ß'/r = 0.3978 m^{-1}
ß"/r = 0. m^{-1}
r(w) = 0.06509 m

Fig. C-12



72-HOUR CONSTANT RATE TEST

Data Set: V:\1102\active\110219790\analysis\Aqtesolv\anl_SE-1_pumping_test.aqt
Date: 09/20/16 Time: 16:33:05

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 9 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m
Aquitard Thickness (b'): 1. m
Anisotropy Ratio (Kz/Kr): 1.
Aquitard Thickness (b"): 1. m

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

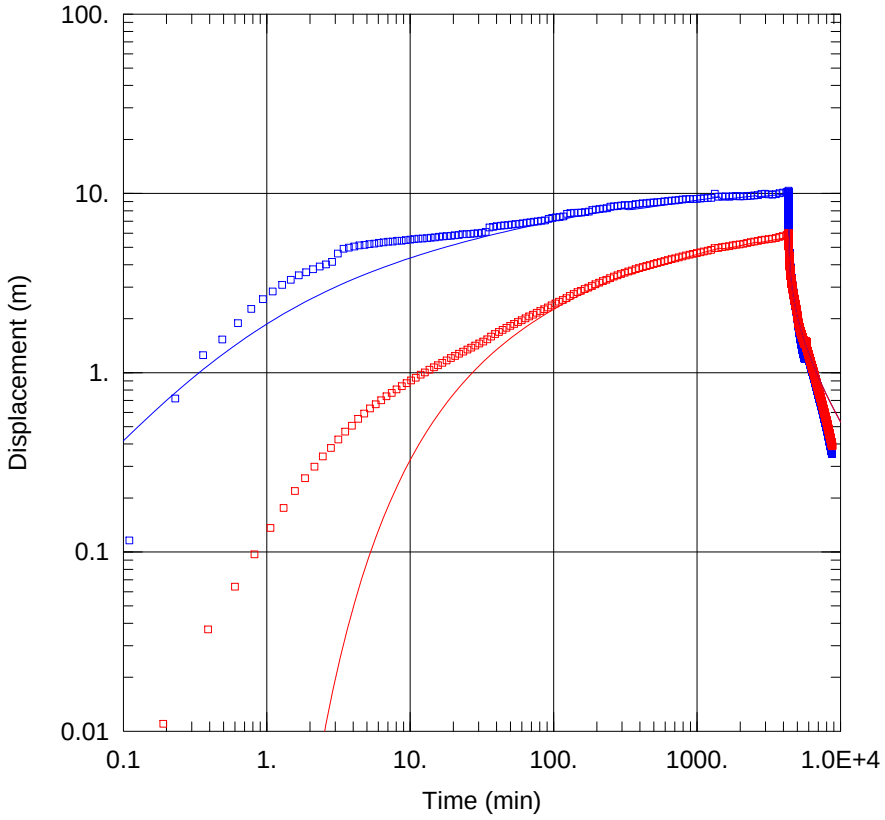
SOLUTION

Aquifer Model: Leaky
Solution Method: Moench (Case 3)

T = 6.739 m^2/day
1/B' = 0.04131 m^{-1}
1/B" = 0. m^{-1}
Sw = -3.85
r(c) = 0.05715 m

S = 0.0002469
ß'/r = 0.001649 m^{-1}
ß"/r = 0. m^{-1}
r(w) = 0.06509 m

Fig. C-13



72-HOUR CONSTANT RATE TEST

Data Set: V:\1102\active\110219790\analysis\Aqtesolv\anl_SE-1_pumping_test.aqt
Date: 09/20/16 Time: 16:19:42

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 9 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m
Aquitard Thickness (b'): 1. m
Anisotropy Ratio (Kz/Kr): 1.
Aquitard Thickness (b"): 1. m

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

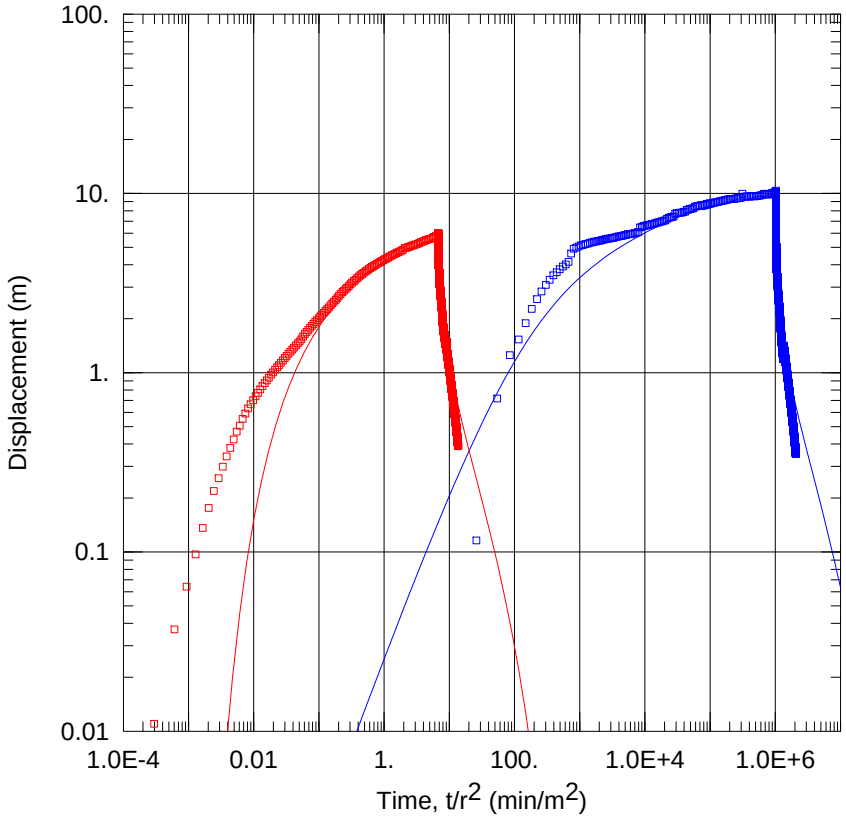
SOLUTION

Aquifer Model: Leaky
Solution Method: Moench (Case 3, Constant Head and No Flow)

T = 6.739 m^2/day
1/B' = 0.04131 m^{-1}
1/B" = 0. m^{-1}
Sw = -3.85
r(c) = 0.05715 m

S = 0.0002469
ß'/r = 0.001649 m^{-1}
ß"/r = 0. m^{-1}
r(w) = 0.06509 m

Fig. C-14



72-HOUR CONSTANT RATE TEST

Data Set: V:\1102\active\110219790\analysis\Aqtesolv\anl_SE-1_pumping_test.aqt
Date: 09/20/16 Time: 16:34:18

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 9 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m
Aquitard Thickness (b'): 1. m
Anisotropy Ratio (Kz/Kr): 1.
Aquitard Thickness (b"): 1. m

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

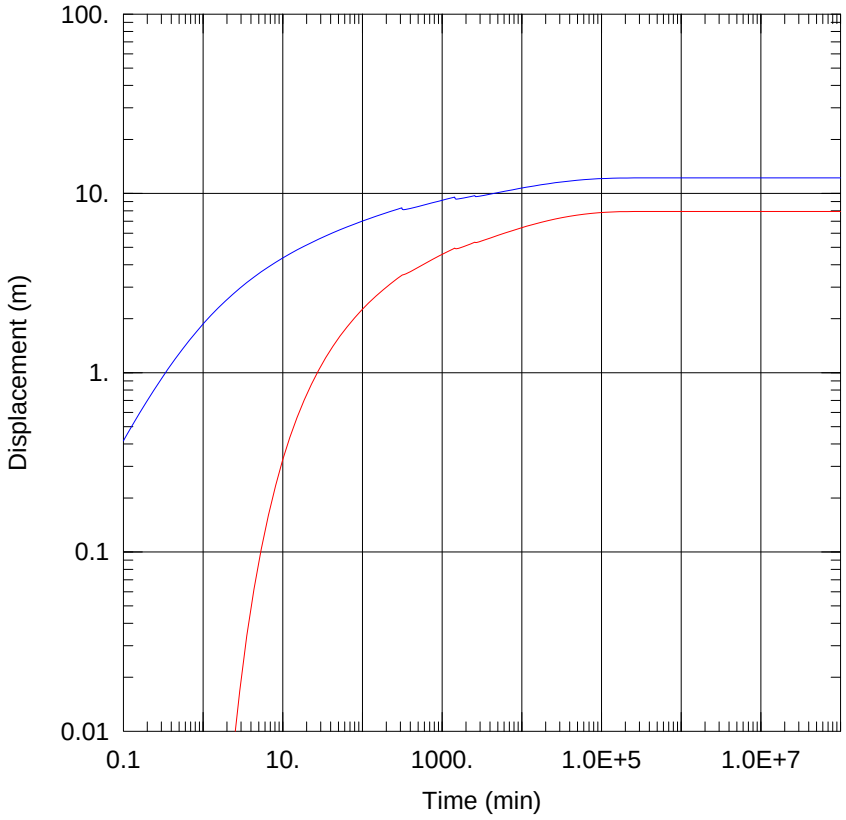
SOLUTION

Aquifer Model: Leaky
Solution Method: Moench (Case 3) - Composite

T = 6.739 m^2/day
1/B' = 0.04131 m^{-1}
1/B" = 0. m^{-1}
Sw = -3.85
r(c) = 0.05715 m

S = 0.0002469
ß'/r = 0.001649 m^{-1}
ß"/r = 0. m^{-1}
r(w) = 0.06509 m

Fig. C-15



20 YEARS FORWARD SOLUTION

Data Set: V:\1102\active\110219790\analysis\Aqtesolv\anl_SE-1_pumping_test_forward_solution.aqt
Date: 09/20/16 Time: 15:49:48

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 9 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m
Aquitard Thickness (b'): 1. m
Anisotropy Ratio (Kz/Kr): 1.
Aquitard Thickness (b"): 1. m

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

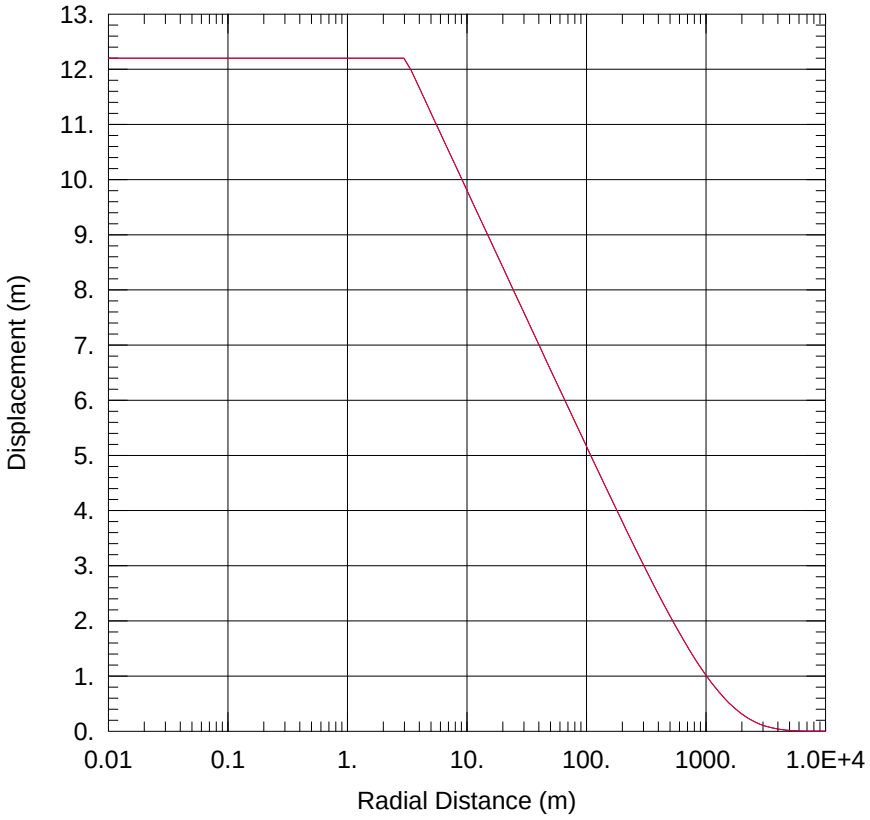
SOLUTION

Aquifer Model: Leaky
Solution Method: Moench (Case 3)

T = 6.739 m^2/day
1/B' = 0.04131 m^{-1}
1/B" = 0. m^{-1}
Sw = -3.85
r(c) = 0.05715 m

S = 0.0002469
ß'/r = 0.001649 m^{-1}
ß"/r = 0. m^{-1}
r(w) = 0.06509 m

Fig. C-16



20 YEARS FORWARD SOLUTION

Data Set: V:\1102\active\110219790\analysis\Aqtesolv\anl_SE-1_pumping_test_forward_solution.aqt
Date: 09/20/16 Time: 15:50:55

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 9 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m
Aquitard Thickness (b'): 1. m
Anisotropy Ratio (Kz/Kr): 1.
Aquitard Thickness (b"): 1. m

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

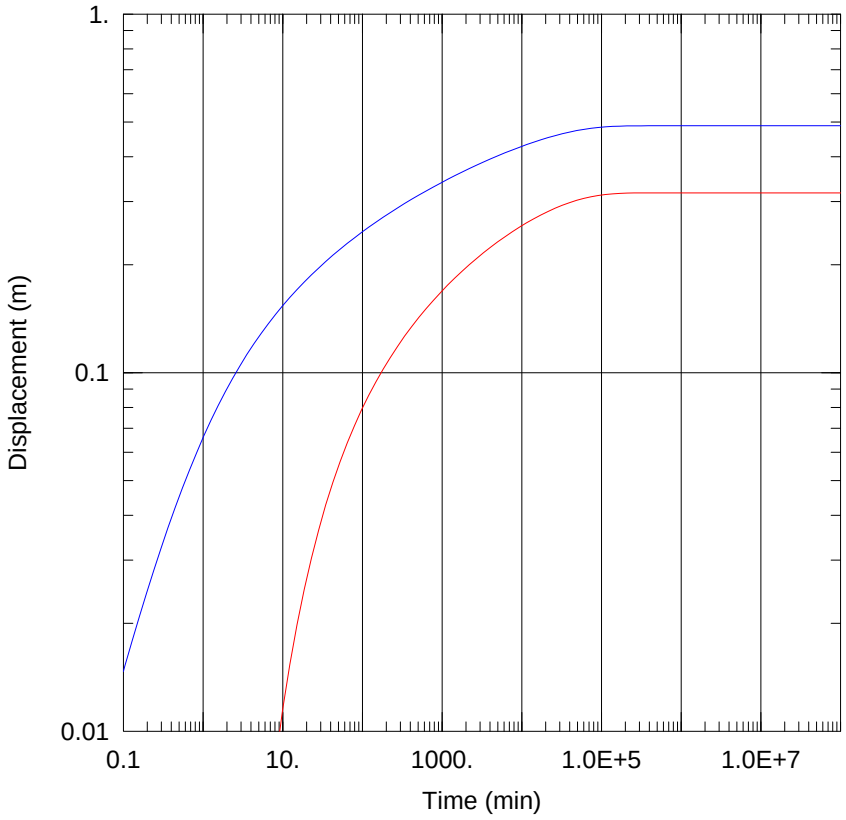
SOLUTION

Aquifer Model: Leaky
Solution Method: Moench (Case 3)

T = 6.739 m^2/day
1/B' = 0.04131 m^{-1}
1/B" = 0. m^{-1}
Sw = -3.85
r(c) = 0.05715 m

S = 0.0002469
ß'/r = 0.001649 m^{-1}
ß"/r = 0. m^{-1}
r(w) = 0.06509 m

Fig. C-17



20 YEARS FORWARD SOLUTION (1250 m^3/year)

Data Set: V:\...\anl_SE-1_pumping_test_forward_solution_3.4m3_day.aqt Date: 09/20/16 Time: 15:53:02

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 9 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m
Aquitard Thickness (b'): 1. m
Anisotropy Ratio (Kz/Kr): 1.
Aquitard Thickness (b"): 1. m

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

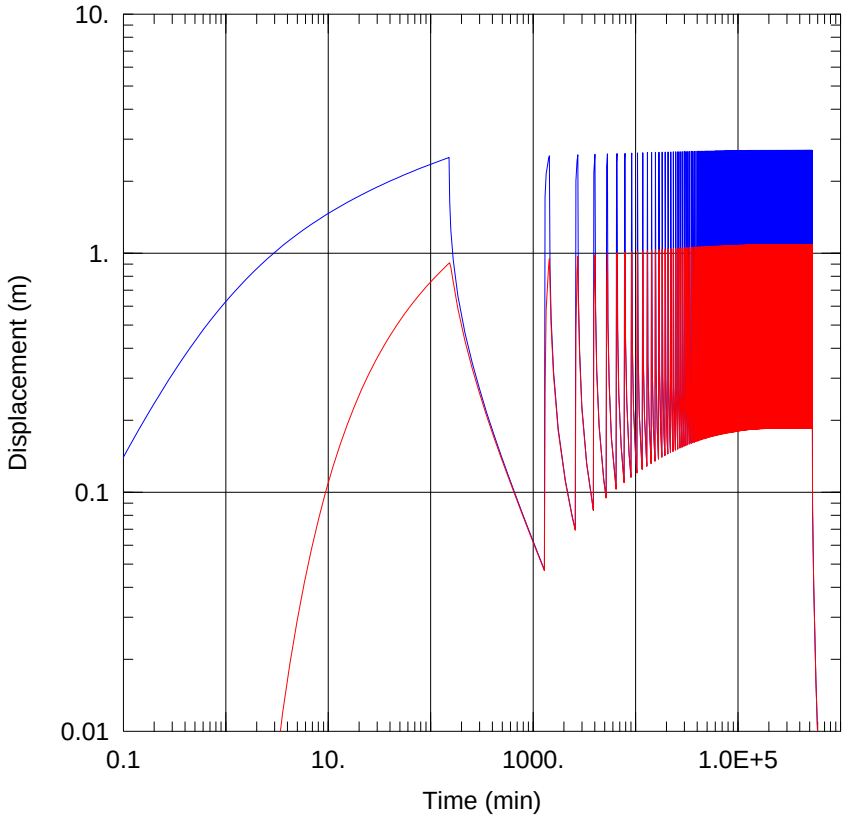
SOLUTION

Aquifer Model: Leaky
Solution Method: Moench (Case 3)

T = 6.739 m^2/day
1/B' = 0.04131 m^{-1}
1/B" = 0. m^{-1}
Sw = -3.85
r(c) = 0.05715 m

S = 0.0002469
ß'/r = 0.001649 m^{-1}
ß"/r = 0. m^{-1}
r(w) = 0.06509 m

Fig. C-18



ONE YEAR FORWARD SOLUTION (5 igpm, 1.36 m^3/hr, 2.52 hrs/day)

Data Set: V:\...\anl_SE-1_pumping_test_forward_solution_1.36m3_hour.aqt Date: 09/20/16 Time: 16:43:40

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 9 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m
Aquitard Thickness (b'): 1. m
Anisotropy Ratio (Kz/Kr): 1.
Aquitard Thickness (b"): 1. m

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119
SE-2	311908	5805115

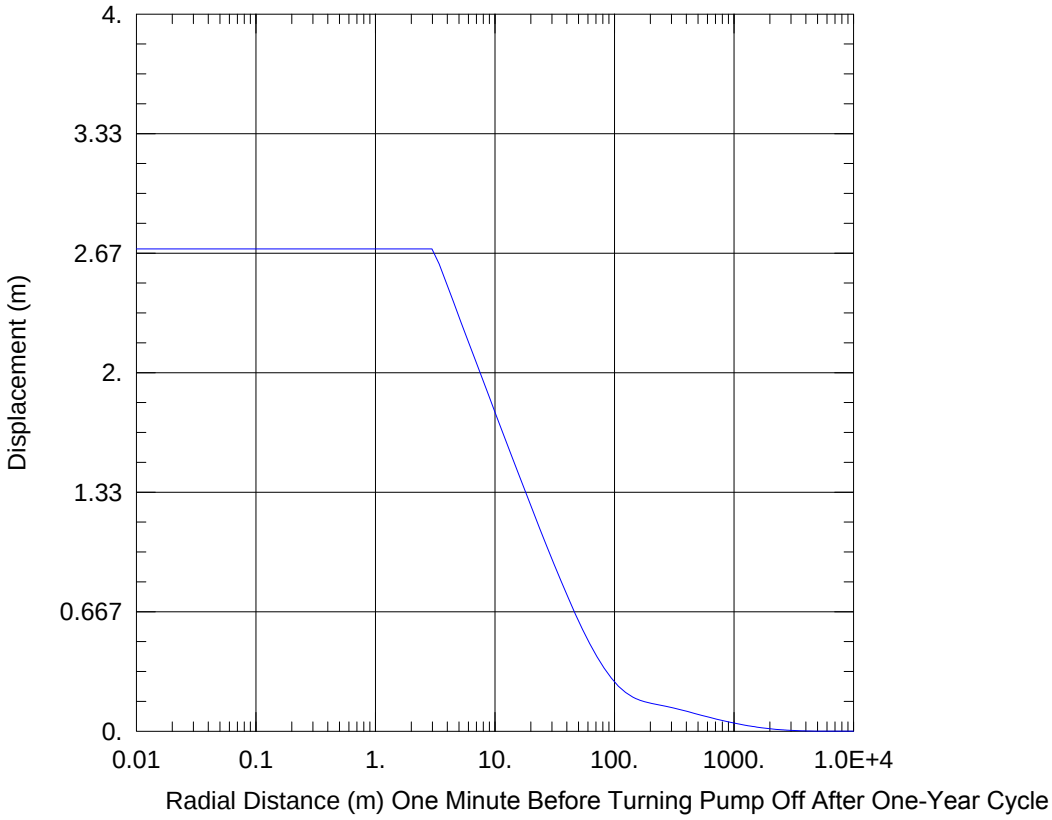
SOLUTION

Aquifer Model: Leaky
Solution Method: Moench (Case 3)

T = 6.739 m^2/day
1/B' = 0.04131 m^{-1}
1/B" = 0. m^{-1}
Sw = -3.85
r(c) = 0.05715 m

S = 0.0002469
ß'/r = 0.001649 m^{-1}
ß"/r = 0. m^{-1}
r(w) = 0.06509 m

Fig. C-19



ONE YEAR FORWARD SOLUTION (5 igpm, 1.36 m3/hr, 2.52 hrs/day)

Data Set: V:\...\anl_SE-1_pumping_test_forward_solution_1.36m3_hour.aqt Date: 09/20/16 Time: 16:46:47

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 9 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m
Aquitard Thickness (b'): 1. m
Anisotropy Ratio (Kz/Kr): 1.
Aquitard Thickness (b"): 1. m

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

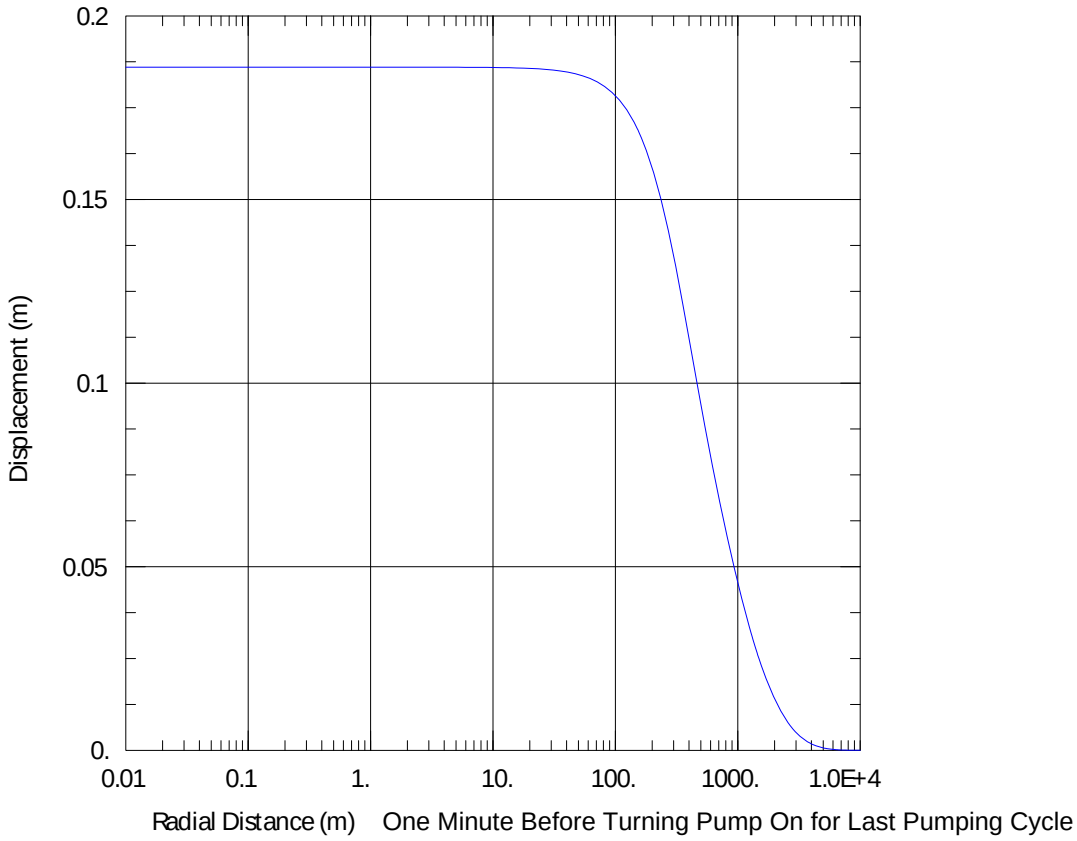
SOLUTION

Aquifer Model: Leaky
Solution Method: Moench (Case 3)

T = 6.739 m^2/day
1/B' = 0.04131 m^{-1}
1/B" = 0. m^{-1}
Sw = -3.85
r(c) = 0.05715 m

S = 0.0002469
ß'/r = 0.001649 m^{-1}
ß"/r = 0. m^{-1}
r(w) = 0.06509 m

Fig. C-20



ONE YEAR FORWARD SOLUTION

Data Set: V:\...\anl_SE-1_pumping_test_forward_solution_1.36m3_hour.aqt
Date: 09/27/16 Time: 12:03:45

PROJECT INFORMATION

Company: Stantec Consulting. Ltd.
Client: 1842107
Project: 110219790
Location: SW 24--39-27 W4M
Test Well: SE-1
Test Date: 9 Aug 2016

AQUIFER DATA

Saturated Thickness: 7.62 m
Aquitard Thickness (b'): 1. m
Anisotropy Ratio (Kz/Kr): 1.
Aquitard Thickness (b''): 1. m

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

Observation Wells

Well Name	X (m)	Y (m)
SE-1	311883	5805119

SOLUTION

Aquifer Model: Leaky
Solution Method: Moench (Case 3)

T = 6.739 m^2/day
1/B' = 0.04131 m^{-1}
1/B'' = 0. m^{-1}
Sw = -3.85
r(c) = 0.05715 m

S = 0.0002469
ß'/r = 0.001649 m^{-1}
ß''/r = 0. m^{-1}
r(w) = 0.06509 m

Fig. C-21

Table C-1 Field Parameters

Date Time M/D/Y HH:MM:SS	Temp C	EC uS	EC mS	Sal ppt	DOsat %	DO mg/L	pH	pH mV	Orp mV
08/09/16 11:27:35	7.70	941	0.941	0.47	1770.2	210.57	10.44	-170.6	-306.3
08/09/16 12:09:16	7.45	923	0.923	0.46	301.5	36.09	10.19	-157.8	-239.0
08/09/16 12:32:31	7.38	924	0.924	0.46	31.9	3.82	10.43	-169.5	-267.1
08/09/16 13:06:30	9.25	880	0.880	0.44	122.4	14.03	10.25	-161.8	-226.9
08/10/16 09:14:02	8.21	987	0.987	0.49	2.5	0.29	9.98	-172.8	-277.1
08/10/16 09:14:17	8.16	988	0.988	0.49	2.5	0.30	9.98	-172.8	-277.0
08/10/16 09:15:21	8.15	987	0.987	0.49	2.5	0.30	10.00	-173.4	-279.0
08/10/16 09:16:29	8.07	987	0.987	0.49	2.7	0.32	10.00	-173.4	-278.6
08/10/16 09:29:35	8.18	985	0.985	0.49	2.3	0.27	9.99	-173.2	-283.3
08/10/16 09:34:44	8.20	985	0.985	0.49	2.4	0.28	9.98	-172.6	-284.6
08/10/16 11:00:05	8.31	985	0.985	0.49	344.6	40.38	9.80	-164.9	-231.5
08/10/16 11:00:50	8.26	985	0.985	0.49	69.3	8.13	9.87	-168.2	-245.3
08/10/16 11:30:50	8.32	987	0.987	0.49	3.6	0.42	10.05	-175.8	-265.7
08/10/16 12:05:00	8.52	987	0.987	0.49	10.5	1.22	10.00	-173.5	-261.1
08/10/16 12:35:00	8.23	984	0.984	0.49	2.8	0.33	10.12	-178.4	-261.4
08/10/16 13:05:00	8.28	983	0.983	0.49	2.1	0.25	10.11	-178.3	-262.9
08/10/16 14:02:09	8.18	988	0.988	0.49	25.4	2.98	9.99	-172.9	-245.6
08/10/16 14:32:09	8.05	985	0.985	0.49	2.7	0.32	10.04	-175.0	-253.6
08/10/16 15:02:09	8.18	985	0.985	0.49	2.0	0.24	10.26	-184.5	-252.9
08/10/16 15:04:31	8.20	985	0.985	0.49	18.7	2.20	10.24	-183.4	-250.8
08/10/16 15:34:31	8.03	986	0.986	0.49	1.9	0.22	10.16	-180.1	-256.7
08/10/16 16:03:25	8.26	983	0.983	0.49	1.5	0.18	10.08	-176.8	-257.2
08/10/16 16:03:32	8.23	984	0.984	0.49	1.6	0.19	10.09	-177.2	-256.1
08/10/16 16:33:32	8.16	984	0.984	0.49	1.2	0.15	10.12	-178.3	-253.1
08/10/16 17:03:32	7.91	987	0.987	0.49	1.1	0.13	10.03	-174.6	-247.8
08/10/16 17:14:57	8.01	985	0.985	0.49	209.1	24.68	9.92	-170.0	-229.8
08/11/16 07:17:29	8.69	1001	1.001	0.50	130.1	15.10	9.74	-162.8	-279.4
08/11/16 08:02:53	8.17	984	0.984	0.49	3.1	0.37	9.63	-157.8	-275.6
08/11/16 08:32:53	8.37	983	0.983	0.49	2.2	0.25	9.57	-155.4	-285.3
08/11/16 09:02:53	8.40	988	0.988	0.49	1.8	0.22	9.54	-154.1	-290.4
08/11/16 10:02:08	8.60	982	0.982	0.49	267.5	31.12	9.25	-142.0	-232.8
08/11/16 10:32:08	8.54	979	0.979	0.49	3.0	0.35	9.50	-152.4	-290.8
08/11/16 11:02:08	8.68	985	0.985	0.49	2.2	0.26	9.48	-151.8	-292.4
08/11/16 11:02:55	8.66	987	0.987	0.49	103.8	12.06	9.45	-150.4	-280.0
08/11/16 11:32:55	8.45	984	0.984	0.49	2.1	0.25	9.51	-152.8	-291.3
08/11/16 12:02:03	8.79	986	0.986	0.49	1.9	0.21	9.47	-151.4	-296.5
08/11/16 12:32:03	8.57	984	0.984	0.49	1.7	0.19	9.46	-150.9	-300.9
08/11/16 13:00:21	8.92	978	0.978	0.49	1.6	0.19	9.42	-149.2	-299.7
08/11/16 13:30:21	8.43	980	0.980	0.49	1.3	0.16	9.43	-149.5	-298.8
08/11/16 13:59:57	8.58	985	0.985	0.49	1.2	0.14	9.53	-153.9	-288.1
08/11/16 14:29:57	8.67	985	0.985	0.49	1.4	0.16	9.40	-148.3	-301.3
08/11/16 14:59:57	8.63	981	0.981	0.49	1.3	0.15	9.35	-146.4	-313.4
08/11/16 15:00:59	8.67	986	0.986	0.49	351.1	40.78	9.24	-141.7	-274.0
08/11/16 15:30:59	8.32	984	0.984	0.49	1.7	0.19	9.39	-147.8	-312.4
08/11/16 16:00:59	8.68	981	0.981	0.49	1.3	0.16	9.31	-144.5	-327.9
08/11/16 16:08:19	8.69	985	0.985	0.49	289.2	33.58	8.98	-130.7	-253.1
08/11/16 16:38:19	8.60	982	0.982	0.49	2.1	0.24	9.27	-143.0	-342.6
08/11/16 17:08:16	8.40	982	0.982	0.49	1.5	0.17	9.31	-144.4	-344.3
08/11/16 17:37:41	8.13	985	0.985	0.49	1.3	0.15	9.42	-148.9	-327.9
08/12/16 08:14:01	8.27	935	0.935	0.46	21.1	2.48	9.51	-154.1	-297.8
08/12/16 08:43:59	8.26	920	0.920	0.46	3.1	0.36	9.82	-164.4	-290.3
08/12/16 09:07:49	8.22	931	0.931	0.46	6.0	0.70	9.77	-162.8	-286.3

APPENDIX D
GROUNDWATER SAMPLING PROTOCOLS

APPENDIX D
GROUNDWATER SAMPLING PROTOCOLS

Groundwater Sampling

Groundwater samples were collected near the end of the pumping test of well SE-1 after approximately 4,300 minutes (71.67 hours) continuous pumping on August 12, 2016. The following procedures were followed during sampling of the projected concrete plant as part of this project.

- A YSI multiparameter water quality probe was rented from Pine-Environmental (Pine) for use during the pumping test. This instrument was fully calibrated by Pine using factory calibration solutions prior to being acquired for use on site.
- Throughout the pumping test, groundwater quality parameters were measured at varying intervals using the YSI probe and a flow through cell. The parameters measured included pH, electrical conductivity, redox potential (ORP), dissolved oxygen and temperature. A set of measurements were conducted immediately prior to the collection of groundwater samples.
- Sample bottles were rinsed with formation water prior to sample collection.
- Sterilized nitrile gloves were worn during sampling to minimize the risk of sample contamination
- Groundwater samples were collected into designated HDPE plastic, glass bottles and were stored in a cooler on ice until submission to the laboratory.
- Upon completion of sampling all equipment was thoroughly rinsed with distilled water.
- Samples were promptly delivered to the Maxxam Analytics Laboratory (Edmonton, Alberta) for regular turnaround analysis.

Quality Assurance/Quality Control

Quality assurance/quality control procedures included:

- thorough rinsing with distilled water of all equipment entering a well or in contact with the pumped water (e.g. datalogger, water level probe, and YSI);
- use of disposable, nitrile gloves, which were discarded between samples;
- use of sample containers provided by the laboratory;
- labelling of samples with company name, project number, sample number, date, and sampler initials;
- collecting of duplicate samples;
- storing of samples in ice chests cooled to approximately 4°C and transportation to the laboratory within 24 hours of collection;
- documentation of sample handling, transport, and delivery to the laboratory using appropriate chain-of-custody procedures and documentation; and
- data tracking and management.

APPENDIX E
ANALYTICAL RESULTS

Table E-1
Summary of Groundwater Analytical Results
Hydrogeological Supply Evaluation
1842107 Alberta Ltd.

Sample Location			SE-1			
Sample Date			12-Aug-16	12-Aug-16		12-Aug-16
Sample ID			SE-1	SE-1-END		SE-1-END Lab-Dup
Sampling Company			STANTEC	STANTEC		STANTEC
Laboratory			MAXX	MAXX		MAXX
Laboratory Work Order			B667918	B667918		B667918
Laboratory Sample ID			PG2321	PG2320	RPD	PG2320
Sample Type	Units	Health Canada		Field Duplicate	(%)	Lab Replicate
General Chemistry						
Alkalinity (P as CaCO3)	mg/L	n/v	37	36	3 %	-
Alkalinity, Bicarbonate (as CaCO3)	mg/L	n/v	490	490	0 %	-
Alkalinity, Carbonate (as CaCO3)	mg/L	n/v	45	43	5 %	-
Alkalinity, Hydroxide (as CaCO3)	mg/L	n/v	<0.50	<0.50	nc	-
Alkalinity, Total (as CaCO3)	mg/L	n/v	480	470	2 %	-
Anion Sum	meq/L	n/v	10	10	nc	-
Cation Sum	meq/L	n/v	9.5	9.6	nc	-
Chloride	mg/L	≤250[A]	2.3	2.3	nc	-
Color, True	TCU	n/v	2.0	2.0	nc	-
Electrical Conductivity, Lab	µS/cm	n/v	920	920	0 %	-
Fluoride	mg/L	1.5[B]	**3.1[B]**	**3.0[B]**	3 %	-
Hardness (as CaCO3)	mg/L	n/v	3.1	2.8	10 %	-
Hydrogen Sulfide	mg/L	n/v	1.0	1.1	10 %	-
Ion Balance	none	n/v	0.93	0.95	2 %	-
Nitrate	mg/L	45[B]	<0.044	<0.044	nc	-
Nitrate (as N)	mg/L	10[B]	<0.010	<0.010	nc	-
Nitrate + Nitrite (as N)	mg/L	n/v	<0.020	<0.020	nc	-
Nitrite	mg/L	3[B]	<0.033	<0.033	nc	-
Nitrite (as N)	mg/L	1[B]	<0.010	<0.010	nc	-
pH	S.U.	6.5-8.5[A]	**9.08[A]**	**9.07[A]**	nc	-
Sulfate	mg/L	≤500[A]	21	21	0 %	-
Sulfide	mg/L	n/v	0.94 CD	0.99 CD	5 %	-
Total Dissolved Solids	mg/L	≤500[A]	**530[A]**	**530[A]**	0 %	-
Turbidity, Lab	ntu	≤0.3/1.0/0.1[C]	0.14	0.14	nc	-
Ammonia (as N)	mg/L	n/v	0.27	0.26	4 %	-
Phosphorus, Total	mg/L	n/v	0.036	0.038	5 %	-
Total Kjeldahl Nitrogen	mg/L	n/v	0.34	0.34	0 %	-
Metals, dissolved						
Aluminum	mg/L	0.1/0.2$_a$[A]	0.0061	0.0065	nc	-
Antimony	mg/L	0.006[B]	<0.00060	<0.00060	nc	-
Arsenic	mg/L	0.010[B]	0.00042	0.00046	nc	-
Barium	mg/L	1.0[B]	0.042	0.042	nc	0.042
Beryllium	mg/L	n/v	<0.0010	<0.0010	nc	-
Boron	mg/L	5[B]	0.50	0.50	0 %	0.50
Cadmium	mg/L	0.005[B]	<0.000020	<0.000020	nc	-
Calcium	mg/L	n/v	1.3 MD	1.1	nc	1.1
Chromium	mg/L	0.05[B]	<0.0010	<0.0010	nc	-
Cobalt	mg/L	n/v	<0.00030	<0.00030	nc	-
Copper	mg/L	≤1.0[A]	<0.00020	<0.00020	nc	-
Iron	mg/L	≤0.3[A]	<0.060	<0.060	nc	<0.060
Lead	mg/L	0.010[B]	<0.00020	<0.00020	nc	-
Lithium	mg/L	n/v	0.027	0.027	nc	0.026
Magnesium	mg/L	n/v	<0.20	<0.20	nc	<0.20
Manganese	mg/L	≤0.05[A]	<0.0040	<0.0040	nc	<0.0040
Mercury	µg/L	1[B]	0.0052	0.011	nc	-
Molybdenum	mg/L	n/v	0.0022	0.0023	4 %	-
Nickel	mg/L	n/v	<0.00050	<0.00050	nc	-
Phosphorus	mg/L	n/v	<0.10	<0.10	nc	<0.10
Potassium	mg/L	n/v	0.52 MD	0.53 MD	nc	0.51
Selenium	mg/L	0.05[B]	0.0091 RD	0.0075 RD	19 %	-
Silicon	mg/L	n/v	3.3	3.3	0 %	3.3
Silver	mg/L	n/v	<0.00010	<0.00010	nc	-
Sodium	mg/L	≤200[A]	**220[A]**	**220[A]**	0 %	**210[A]**
Strontium	mg/L	n/v	0.035 MD	0.035 MD	nc	0.034
Sulfur	mg/L	n/v	19 RD	19 RD	0 %	19
Thallium	mg/L	n/v	<0.00020	<0.00020	nc	-
Tin	mg/L	n/v	<0.0010	<0.0010	nc	-
Titanium	mg/L	n/v	<0.0010	<0.0010	nc	-
Uranium	mg/L	0.02[B]	<0.00010	<0.00010	nc	-
Vanadium	mg/L	n/v	<0.0010	<0.0010	nc	-
Zinc	mg/L	≤5.0[A]	<0.0030	<0.0030	nc	-
Metals, total						
Aluminum	mg/L	0.1/0.2$_a$[A]	0.015	0.015	0 %	-
Antimony	mg/L	0.006[B]	<0.00060	<0.00060	nc	-
Arsenic	mg/L	0.010[B]	0.00044	0.00047	nc	-
Barium	mg/L	1.0[B]	0.044	0.043	nc	-
Beryllium	mg/L	n/v	<0.0010	<0.0010	nc	-
Boron	mg/L	5[B]	0.51	0.51	0 %	-
Cadmium	mg/L	0.005[B]	<0.000020	<0.000020	nc	-
Calcium	mg/L	n/v	1.1	1.2	nc	-
Chromium	mg/L	0.05[B]	<0.0010	<0.0010	nc	-
Cobalt	mg/L	n/v	<0.00030	<0.00030	nc	-
Copper	mg/L	≤1.0[A]	<0.00020	0.00088	nc	-
Iron	mg/L	≤0.3[A]	<0.060	<0.060	nc	-
Lead	mg/L	0.010[B]	<0.00020	<0.00020	nc	-
Lithium	mg/L	n/v	0.027	0.028	nc	-
Magnesium	mg/L	n/v	<0.20	<0.20	nc	-
Manganese	mg/L	≤0.05[A]	<0.0040	<0.0040	nc	-
Mercury	µg/L	1[B]	<0.0020	0.0022	nc	0.0021
Molybdenum	mg/L	n/v	0.0024	0.0025	4 %	-
Nickel	mg/L	n/v	<0.00050	<0.00050	nc	-
Phosphorus	mg/L	n/v	<0.10	<0.10	nc	-
Potassium	mg/L	n/v	0.50	0.52	nc	-
Selenium	mg/L	0.05[B]	<0.00020	<0.00020	nc	-
Silicon	mg/L	n/v	3.3	3.3	0 %	-
Silver	mg/L	n/v	<0.00010	<0.00010	nc	-
Sodium	mg/L	≤200[A]	**220[A]**	**220[A]**	0 %	-
Strontium	mg/L	n/v	0.034	0.034	nc	-
Sulfur	mg/L	n/v	6.6	6.6	0 %	-
Thallium	mg/L	n/v	<0.00020	<0.00020	nc	-
Tin	mg/L	n/v	<0.0010	<0.0010	nc	-
Titanium	mg/L	n/v	0.0013	0.0021	nc	-
Uranium	mg/L	0.02[B]	<0.00010	<0.00010	nc	-
Vanadium	mg/L	n/v	<0.0010	<0.0010	nc	-
Zinc	mg/L	≤5.0[A]	<0.0030	<0.0030	nc	-
Microbiological Analysis						
Escherichia coli (E.Coli)	mpn/100mL	0[C]	***<1.0***	***<1.0***	nc	-
Total Coliforms	mpn/100mL	0[C]	**1.0[C]**	**2.0[C]**	nc	-

Table 3
Summary of Groundwater Analytical Results
Hydrogeological Supply Evaluation
1842107 Alberta Ltd.

Notes:

Health Canada	Health Canada (2014). Guidelines for Canadian Drinking Water Quality - Summary Table. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario.
A	Guidelines for Canadian Drinking Water Quality - Aesthetic Objectives/ Operational Guidelines
B	Guidelines for Canadian Drinking Water Quality - Maximum Acceptable Concentration
C	Guidelines for Canadian Drinking Water Quality - Microbial Parameters
6.5[A]	Concentration exceeds the indicated standard.
15.2	Measured concentration did not exceed the indicated standard.
<0.50	Laboratory reporting limit was greater than the applicable standard.
<0.03	Analyte was not detected at a concentration greater than the laboratory reporting limit.
n/v	No standard/guideline value.
-	Parameter not analyzed / not available.
a	This is an operational guidance value, designed to apply only to drinking water treatment plants using aluminum-based coagulants; it does not apply to naturally occuring aluminum found in groundwater. The operational guidance values of 0.1 mg/L applies to conventional treatment plants, and 0.2 mg/L applies to other types of treatment systems.
j	High levels (above 500 mg/L) can cause physiological effects such as diarrhoea or dehyrdration.
CD	Detection limits raised due to dilution to bring analyte within the calibrated range.
MD	Dissolved greater than total. Results are within limits of uncertainty.
RD	Dissolved greater than total. Reanalysis yields similar results.
RPD	Relative Percent Difference
nc	RPD is not calculated if one or more values is non detect or if one or more values is less than five times the reportable detection limit.

Maxxam
A Bureau Veritas Group Company

Success Through Science®

Your Project #: 110219790
Site Location: BURBANK
Your C.O.C. #: M17506

Attention:CHRISTIAN NAGELI

STANTEC CONSULTING LTD
10160-112 STREET
EDMONTON, AB
CANADA T5K 2L6

Report Date: 2016/08/21
Report #: R2242795
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B667918
Received: 2016/08/12, 17:20

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH	2	N/A	2016/08/15	AB SOP-00005	SM 22 2320 B m
Chloride by Automated Colourimetry	2	N/A	2016/08/17	AB SOP-00020	SM 22 4500-Cl G m
True Colour	1	N/A	2016/08/13	EENVSOP-00065	SM 22 2120 C m
True Colour	1	N/A	2016/08/20	EENVSOP-00065	SM 22 2120 C m
Total Coliforms and E.Coli	2	2016/08/13	2016/08/14	EENVSOP-00162	SM 22 9223 A,B m
Conductivity @25C	2	N/A	2016/08/15	AB SOP-00005	SM 22 2510 B m
Fluoride	2	N/A	2016/08/15	AB SOP-00005	SM 22 4500-F C m
Sulphide (as H2S)	2	N/A	2016/08/15	AB WI-00065	Auto Calc
Hardness	2	N/A	2016/08/15	AB WI-00065	Auto Calc
Mercury - Low Level (Dissolved)	2	2016/08/17	2016/08/17	EENVSOP-00031	EPA 1631E/245.1 R3 m
Mercury - Low Level (Total)	2	2016/08/17	2016/08/17	EENVSOP-00031	EPA 1631E/245.1 R3 m
Elements by ICP - Dissolved	2	N/A	2016/08/14	AB SOP-00042	EPA 200.7 CFR 2012 m
Elements by ICP - Total	2	2016/08/14	2016/08/14	AB SOP-00014 / AB SOP-00042	EPA 200.7 CFR 2012 m
Elements by ICPMS - Dissolved	2	N/A	2016/08/15	AB SOP-00043	EPA 200.8 R5.4 m
Elements by ICPMS - Total	2	2016/08/14	2016/08/14	AB SOP-00014 / AB SOP-00043	EPA 200.8 R5.4 m
Ion Balance	2	N/A	2016/08/17	AB WI-00065	Auto Calc
Sum of cations, anions	2	N/A	2016/08/15	AB WI-00065	Auto Calc
Ammonia-N (Total)	2	N/A	2016/08/15	AB SOP-00007	EPA 350.1 R2.0 m
Nitrate and Nitrite	2	N/A	2016/08/16	AB WI-00065	Auto Calc
Nitrate + Nitrite-N (calculated)	2	N/A	2016/08/16	AB WI-00065	Auto Calc
Nitrogen, (Nitrite, Nitrate) by IC	2	N/A	2016/08/15	AB SOP-00023	SM 22 4110 B m
pH @25°C	2	N/A	2016/08/15	AB SOP-00005	SM 22 4500 H+ B m
Sulphide	2	N/A	2016/08/15	EENVSOP-00096	SM 22 4500-S2 D m
Sulphate by Automated Colourimetry	2	N/A	2016/08/17	AB SOP-00018	SM 22 4500-SO4 E m
Total Dissolved Solids (Calculated)	2	N/A	2016/08/17	AB WI-00065	Auto Calc
Total Kjeldahl Nitrogen	2	2016/08/17	2016/08/18	AB SOP-00008	EPA 351.1 R 1978 m
Total Phosphorus	2	2016/08/16	2016/08/17	AB SOP-00024	SM 22 4500-P A,B,F m
Turbidity	2	N/A	2016/08/15	EENVSOP-00066	SM 22 2130 B m

Maxxam Analytics International Corporation o/a Maxxam Analytics Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

Your Project #: 110219790
Site Location: BURBANK
Your C.O.C. #: M17506

Attention:CHRISTIAN NAGELI

STANTEC CONSULTING LTD
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CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B667918
Received: 2016/08/12, 17:20

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Wendy Sears, Project manager
Email: WSears@maxxam.ca
Phone# (403)735-2277
==========
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B667918
Report Date: 2016/08/21

STANTEC CONSULTING LTD
Client Project #: 110219790
Site Location: BURBANK
Sampler Initials: SS

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		PG2320	PG2320	PG2321		
Sampling Date		2016/08/12 08:40	2016/08/12 08:40	2016/08/12 08:50		
COC Number		M17506	M17506	M17506		
	UNITS	SE-1-END	SE-1-END Lab-Dup	SE-1	RDL	QC Batch
Calculated Parameters						
Anion Sum	meq/L	10	N/A	10	N/A	8361810
Cation Sum	meq/L	9.6	N/A	9.5	N/A	8361810
Hardness (CaCO3)	mg/L	2.8	N/A	3.1	0.50	8361808
Ion Balance	N/A	0.95	N/A	0.93	0.010	8361809
Dissolved Nitrate (NO3)	mg/L	<0.044	N/A	<0.044	0.044	8361811
Nitrate plus Nitrite (N)	mg/L	<0.020	N/A	<0.020	0.020	8361812
Dissolved Nitrite (NO2)	mg/L	<0.033	N/A	<0.033	0.033	8361811
Calculated Total Dissolved Solids	mg/L	530	N/A	530	10	8361813
Misc. Inorganics						
Conductivity	uS/cm	920	N/A	920	1.0	8363623
pH	pH	9.07	N/A	9.08	N/A	8363612
Anions						
Alkalinity (PP as CaCO3)	mg/L	36	N/A	37	0.50	8363622
Alkalinity (Total as CaCO3)	mg/L	470	N/A	480	0.50	8363622
Bicarbonate (HCO3)	mg/L	490	N/A	490	0.50	8363622
Carbonate (CO3)	mg/L	43	N/A	45	0.50	8363622
Hydroxide (OH)	mg/L	<0.50	N/A	<0.50	0.50	8363622
Dissolved Sulphate (SO4)	mg/L	21	N/A	21	1.0	8363818
Dissolved Chloride (Cl)	mg/L	2.3	N/A	2.3	1.0	8363814
Nutrients						
Dissolved Nitrite (N)	mg/L	<0.010	N/A	<0.010	0.010	8362515
Dissolved Nitrate (N)	mg/L	<0.010	N/A	<0.010	0.010	8362515
Elements						
Dissolved Aluminum (Al)	mg/L	0.0065	N/A	0.0061	0.0030	8362555
Dissolved Antimony (Sb)	mg/L	<0.00060	N/A	<0.00060	0.00060	8362555
Dissolved Arsenic (As)	mg/L	0.00046	N/A	0.00042	0.00020	8362555
Dissolved Barium (Ba)	mg/L	0.042	0.042	0.042	0.010	8362563
Dissolved Beryllium (Be)	mg/L	<0.0010	N/A	<0.0010	0.0010	8362555
Dissolved Boron (B)	mg/L	0.50	0.50	0.50	0.020	8362563
Dissolved Cadmium (Cd)	mg/L	<0.000020	N/A	<0.000020	0.000020	8362555

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

Maxxam Job #: B667918
Report Date: 2016/08/21

STANTEC CONSULTING LTD
Client Project #: 110219790
Site Location: BURBANK
Sampler Initials: SS

ROUTINE WATER & DISS. REGULATED METALS (WATER)

Maxxam ID		PG2320	PG2320	PG2321		
Sampling Date		2016/08/12 08:40	2016/08/12 08:40	2016/08/12 08:50		
COC Number		M17506	M17506	M17506		
	UNITS	SE-1-END	SE-1-END Lab-Dup	SE-1	RDL	QC Batch
Dissolved Calcium (Ca)	mg/L	1.1	1.1	1.3 (1)	0.30	8362563
Dissolved Chromium (Cr)	mg/L	<0.0010	N/A	<0.0010	0.0010	8362555
Dissolved Cobalt (Co)	mg/L	<0.00030	N/A	<0.00030	0.00030	8362555
Dissolved Copper (Cu)	mg/L	<0.00020	N/A	<0.00020	0.00020	8362555
Dissolved Iron (Fe)	mg/L	<0.060	<0.060	<0.060	0.060	8362563
Dissolved Lead (Pb)	mg/L	<0.00020	N/A	<0.00020	0.00020	8362555
Dissolved Lithium (Li)	mg/L	0.027	0.026	0.027	0.020	8362563
Dissolved Magnesium (Mg)	mg/L	<0.20	<0.20	<0.20	0.20	8362563
Dissolved Manganese (Mn)	mg/L	<0.0040	<0.0040	<0.0040	0.0040	8362563
Dissolved Molybdenum (Mo)	mg/L	0.0023	N/A	0.0022	0.00020	8362555
Dissolved Nickel (Ni)	mg/L	<0.00050	N/A	<0.00050	0.00050	8362555
Dissolved Phosphorus (P)	mg/L	<0.10	<0.10	<0.10	0.10	8362563
Dissolved Potassium (K)	mg/L	0.53 (1)	0.51	0.52 (1)	0.30	8362563
Dissolved Selenium (Se)	mg/L	0.0075 (2)	N/A	0.0091 (2)	0.00020	8362555
Dissolved Silicon (Si)	mg/L	3.3	3.3	3.3	0.10	8362563
Dissolved Silver (Ag)	mg/L	<0.00010	N/A	<0.00010	0.00010	8362555
Dissolved Sodium (Na)	mg/L	220	210	220	0.50	8362563
Dissolved Strontium (Sr)	mg/L	0.035 (1)	0.034	0.035 (1)	0.020	8362563
Dissolved Sulphur (S)	mg/L	19 (2)	19	19 (2)	0.20	8362563
Dissolved Thallium (Tl)	mg/L	<0.00020	N/A	<0.00020	0.00020	8362555
Dissolved Tin (Sn)	mg/L	<0.0010	N/A	<0.0010	0.0010	8362555
Dissolved Titanium (Ti)	mg/L	<0.0010	N/A	<0.0010	0.0010	8362555
Dissolved Uranium (U)	mg/L	<0.00010	N/A	<0.00010	0.00010	8362555
Dissolved Vanadium (V)	mg/L	<0.0010	N/A	<0.0010	0.0010	8362555
Dissolved Zinc (Zn)	mg/L	<0.0030	N/A	<0.0030	0.0030	8362555

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
(1) Dissolved greater than total. Results are within limits of uncertainty(MU).
(2) Dissolved greater than total. Reanalysis yields similar results.

Maxxam Analytics International Corporation o/a Maxxam Analytics Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

Maxxam Job #: B667918
Report Date: 2016/08/21

STANTEC CONSULTING LTD
Client Project #: 110219790
Site Location: BURBANK
Sampler Initials: SS

REGULATED METALS (CCME/AT1) - TOTAL

Maxxam ID		PG2320	PG2321		
Sampling Date		2016/08/12 08:40	2016/08/12 08:50		
COC Number		M17506	M17506		
	UNITS	SE-1-END	SE-1	RDL	QC Batch
Elements					
Total Aluminum (Al)	mg/L	0.015	0.015	0.0030	8362391
Total Antimony (Sb)	mg/L	<0.00060	<0.00060	0.00060	8362391
Total Arsenic (As)	mg/L	0.00047	0.00044	0.00020	8362391
Total Barium (Ba)	mg/L	0.043	0.044	0.010	8362390
Total Beryllium (Be)	mg/L	<0.0010	<0.0010	0.0010	8362391
Total Boron (B)	mg/L	0.51	0.51	0.020	8362390
Total Cadmium (Cd)	mg/L	<0.000020	<0.000020	0.000020	8362391
Total Calcium (Ca)	mg/L	1.2	1.1	0.30	8362390
Total Chromium (Cr)	mg/L	<0.0010	<0.0010	0.0010	8362391
Total Cobalt (Co)	mg/L	<0.00030	<0.00030	0.00030	8362391
Total Copper (Cu)	mg/L	0.00088	<0.00020	0.00020	8362391
Total Iron (Fe)	mg/L	<0.060	<0.060	0.060	8362390
Total Lead (Pb)	mg/L	<0.00020	<0.00020	0.00020	8362391
Total Lithium (Li)	mg/L	0.028	0.027	0.020	8362390
Total Magnesium (Mg)	mg/L	<0.20	<0.20	0.20	8362390
Total Manganese (Mn)	mg/L	<0.0040	<0.0040	0.0040	8362390
Total Molybdenum (Mo)	mg/L	0.0025	0.0024	0.00020	8362391
Total Nickel (Ni)	mg/L	<0.00050	<0.00050	0.00050	8362391
Total Phosphorus (P)	mg/L	<0.10	<0.10	0.10	8362390
Total Potassium (K)	mg/L	0.52	0.50	0.30	8362390
Total Selenium (Se)	mg/L	<0.00020	<0.00020	0.00020	8362391
Total Silicon (Si)	mg/L	3.3	3.3	0.10	8362390
Total Silver (Ag)	mg/L	<0.00010	<0.00010	0.00010	8362391
Total Sodium (Na)	mg/L	220	220	0.50	8362390
Total Strontium (Sr)	mg/L	0.034	0.034	0.020	8362390
Total Sulphur (S)	mg/L	6.6	6.6	0.20	8362390
Total Thallium (Tl)	mg/L	<0.00020	<0.00020	0.00020	8362391
Total Tin (Sn)	mg/L	<0.0010	<0.0010	0.0010	8362391
Total Titanium (Ti)	mg/L	0.0021	0.0013	0.0010	8362391
Total Uranium (U)	mg/L	<0.00010	<0.00010	0.00010	8362391
Total Vanadium (V)	mg/L	<0.0010	<0.0010	0.0010	8362391
RDL = Reportable Detection Limit					

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REGULATED METALS (CCME/AT1) - TOTAL

Maxxam ID		PG2320	PG2321		
Sampling Date		2016/08/12 08:40	2016/08/12 08:50		
COC Number		M17506	M17506		
	UNITS	SE-1-END	SE-1	RDL	QC Batch
Total Zinc (Zn)	mg/L	<0.0030	<0.0030	0.0030	8362391
RDL = Reportable Detection Limit					

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RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		PG2320		PG2321		
Sampling Date		2016/08/12 08:40		2016/08/12 08:50		
COC Number		M17506		M17506		
	UNITS	SE-1-END	QC Batch	SE-1	RDL	QC Batch
Calculated Parameters						
Sulphide (as H2S)	mg/L	1.1	8361807	1.0	0.0040	8361807
Anions						
Dissolved Fluoride (F)	mg/L	3.0	8363624	3.1	0.050	8363624
Sulphide	mg/L	0.99 (1)	8363075	0.94 (1)	0.0038	8363075
Microbiological Param.						
E.Coli DST	mpn/100mL	<1.0	8361794	<1.0	1.0	8361794
Total Coliforms DST	mpn/100mL	2.0	8361794	1.0	1.0	8361794
Nutrients						
Total Ammonia (N)	mg/L	0.26	8363192	0.27	0.050	8363192
Total Kjeldahl Nitrogen	mg/L	0.34	8366237	0.34	0.050	8366237
Total Phosphorus (P)	mg/L	0.038	8364537	0.036	0.0030	8364537
Physical Properties						
True Colour	PtCo units	2.0	8362222	2.0	2.0	8370668
Physical Properties						
Turbidity	NTU	0.14	8363079	0.14	0.10	8363079

RDL = Reportable Detection Limit
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		PG2320	PG2320	PG2321		
Sampling Date		2016/08/12 08:40	2016/08/12 08:40	2016/08/12 08:50		
COC Number		M17506	M17506	M17506		
	UNITS	SE-1-END	SE-1-END Lab-Dup	SE-1	RDL	QC Batch
Low Level Elements						
Dissolved Mercury (Hg)	ug/L	0.011	N/A	0.0052	0.0020	8365831
Total Mercury (Hg)	ug/L	0.0022	0.0021	<0.0020	0.0020	8365833

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	6.0°C

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
8361794	MHD	Method Blank	E.Coli DST	2016/08/14	<1.0		mpn/100	
			Total Coliforms DST	2016/08/14	<1.0		mpn/100	
8361794	MHD	RPD	E.Coli DST	2016/08/14	NC		%	N/A
			Total Coliforms DST	2016/08/14	NC		%	N/A
8362222	KPG	Spiked Blank	True Colour	2016/08/13		101	%	80 - 120
8362222	KPG	Method Blank	True Colour	2016/08/13	<2.0		PtCo unit	
8362222	KPG	RPD	True Colour	2016/08/13	NC		%	20
8362390	CJ5	Matrix Spike [PG2321-05]	Total Barium (Ba)	2016/08/14		94	%	80 - 120
			Total Boron (B)	2016/08/14		107	%	80 - 120
			Total Calcium (Ca)	2016/08/14		100	%	80 - 120
			Total Iron (Fe)	2016/08/14		104	%	80 - 120
			Total Lithium (Li)	2016/08/14		100	%	80 - 120
			Total Magnesium (Mg)	2016/08/14		100	%	80 - 120
			Total Manganese (Mn)	2016/08/14		98	%	80 - 120
			Total Phosphorus (P)	2016/08/14		94	%	80 - 120
			Total Potassium (K)	2016/08/14		105	%	80 - 120
			Total Silicon (Si)	2016/08/14		99	%	80 - 120
			Total Sodium (Na)	2016/08/14		NC	%	80 - 120
			Total Strontium (Sr)	2016/08/14		94	%	80 - 120
8362390	CJ5	Spiked Blank	Total Barium (Ba)	2016/08/14		96	%	80 - 120
			Total Boron (B)	2016/08/14		106	%	80 - 120
			Total Calcium (Ca)	2016/08/14		101	%	80 - 120
			Total Iron (Fe)	2016/08/14		106	%	80 - 120
			Total Lithium (Li)	2016/08/14		102	%	80 - 120
			Total Magnesium (Mg)	2016/08/14		103	%	80 - 120
			Total Manganese (Mn)	2016/08/14		99	%	80 - 120
			Total Phosphorus (P)	2016/08/14		95	%	80 - 120
			Total Potassium (K)	2016/08/14		106	%	80 - 120
			Total Silicon (Si)	2016/08/14		101	%	80 - 120
			Total Sodium (Na)	2016/08/14		102	%	80 - 120
			Total Strontium (Sr)	2016/08/14		96	%	80 - 120
			Total Sulphur (S)	2016/08/14		101	%	80 - 120
8362390	CJ5	Method Blank	Total Barium (Ba)	2016/08/14	<0.010		mg/L	
			Total Boron (B)	2016/08/14	<0.020		mg/L	
			Total Calcium (Ca)	2016/08/14	<0.30		mg/L	
			Total Iron (Fe)	2016/08/14	<0.060		mg/L	
			Total Lithium (Li)	2016/08/14	<0.020		mg/L	
			Total Magnesium (Mg)	2016/08/14	<0.20		mg/L	
			Total Manganese (Mn)	2016/08/14	<0.0040		mg/L	
			Total Phosphorus (P)	2016/08/14	<0.10		mg/L	
			Total Potassium (K)	2016/08/14	<0.30		mg/L	
			Total Silicon (Si)	2016/08/14	<0.10		mg/L	
			Total Sodium (Na)	2016/08/14	<0.50		mg/L	
			Total Strontium (Sr)	2016/08/14	<0.020		mg/L	
			Total Sulphur (S)	2016/08/14	<0.20		mg/L	
8362390	CJ5	RPD	Total Barium (Ba)	2016/08/14	1.0		%	20
			Total Boron (B)	2016/08/14	NC		%	20
			Total Calcium (Ca)	2016/08/14	0.96		%	20
			Total Iron (Fe)	2016/08/14	0.15		%	20
			Total Lithium (Li)	2016/08/14	NC		%	20
			Total Magnesium (Mg)	2016/08/14	1.2		%	20
			Total Manganese (Mn)	2016/08/14	1.2		%	20

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Phosphorus (P)	2016/08/14	1.2		%	20
			Total Potassium (K)	2016/08/14	1.0		%	20
			Total Silicon (Si)	2016/08/14	1.7		%	20
			Total Sodium (Na)	2016/08/14	0.89		%	20
			Total Strontium (Sr)	2016/08/14	0.74		%	20
			Total Sulphur (S)	2016/08/14	0.61		%	20
8362391	JPG	Matrix Spike [PG2320-05]	Total Aluminum (Al)	2016/08/14		102	%	80 - 120
			Total Antimony (Sb)	2016/08/14		105	%	80 - 120
			Total Arsenic (As)	2016/08/14		102	%	80 - 120
			Total Beryllium (Be)	2016/08/14		101	%	80 - 120
			Total Cadmium (Cd)	2016/08/14		105	%	80 - 120
			Total Chromium (Cr)	2016/08/14		94	%	80 - 120
			Total Cobalt (Co)	2016/08/14		96	%	80 - 120
			Total Copper (Cu)	2016/08/14		93	%	80 - 120
			Total Lead (Pb)	2016/08/14		101	%	80 - 120
			Total Molybdenum (Mo)	2016/08/14		105	%	80 - 120
			Total Nickel (Ni)	2016/08/14		96	%	80 - 120
			Total Selenium (Se)	2016/08/14		95	%	80 - 120
			Total Silver (Ag)	2016/08/14		102	%	80 - 120
			Total Thallium (Tl)	2016/08/14		102	%	80 - 120
			Total Tin (Sn)	2016/08/14		111	%	80 - 120
			Total Titanium (Ti)	2016/08/14		91	%	80 - 120
			Total Uranium (U)	2016/08/14		99	%	80 - 120
			Total Vanadium (V)	2016/08/14		98	%	80 - 120
			Total Zinc (Zn)	2016/08/14		97	%	80 - 120
8362391	JPG	Spiked Blank	Total Aluminum (Al)	2016/08/14		100	%	80 - 120
			Total Antimony (Sb)	2016/08/14		99	%	80 - 120
			Total Arsenic (As)	2016/08/14		99	%	80 - 120
			Total Beryllium (Be)	2016/08/14		96	%	80 - 120
			Total Cadmium (Cd)	2016/08/14		99	%	80 - 120
			Total Chromium (Cr)	2016/08/14		95	%	80 - 120
			Total Cobalt (Co)	2016/08/14		96	%	80 - 120
			Total Copper (Cu)	2016/08/14		96	%	80 - 120
			Total Lead (Pb)	2016/08/14		102	%	80 - 120
			Total Molybdenum (Mo)	2016/08/14		102	%	80 - 120
			Total Nickel (Ni)	2016/08/14		95	%	80 - 120
			Total Selenium (Se)	2016/08/14		100	%	80 - 120
			Total Silver (Ag)	2016/08/14		102	%	80 - 120
			Total Thallium (Tl)	2016/08/14		103	%	80 - 120
			Total Tin (Sn)	2016/08/14		107	%	80 - 120
			Total Titanium (Ti)	2016/08/14		102	%	80 - 120
			Total Uranium (U)	2016/08/14		99	%	80 - 120
			Total Vanadium (V)	2016/08/14		97	%	80 - 120
			Total Zinc (Zn)	2016/08/14		94	%	80 - 120
8362391	JPG	Method Blank	Total Aluminum (Al)	2016/08/14	0.0040, RDL=0.0030		mg/L	
			Total Antimony (Sb)	2016/08/14	<0.00060		mg/L	
			Total Arsenic (As)	2016/08/14	<0.00020		mg/L	
			Total Beryllium (Be)	2016/08/14	<0.0010		mg/L	
			Total Cadmium (Cd)	2016/08/14	<0.000020		mg/L	
			Total Chromium (Cr)	2016/08/14	<0.0010		mg/L	
			Total Cobalt (Co)	2016/08/14	<0.00030		mg/L	

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QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Copper (Cu)	2016/08/14	<0.00020		mg/L	
			Total Lead (Pb)	2016/08/14	<0.00020		mg/L	
			Total Molybdenum (Mo)	2016/08/14	<0.00020		mg/L	
			Total Nickel (Ni)	2016/08/14	<0.00050		mg/L	
			Total Selenium (Se)	2016/08/14	<0.00020		mg/L	
			Total Silver (Ag)	2016/08/14	<0.00010		mg/L	
			Total Thallium (Tl)	2016/08/14	<0.00020		mg/L	
			Total Tin (Sn)	2016/08/14	<0.0010		mg/L	
			Total Titanium (Ti)	2016/08/14	<0.0010		mg/L	
			Total Uranium (U)	2016/08/14	<0.00010		mg/L	
			Total Vanadium (V)	2016/08/14	<0.0010		mg/L	
			Total Zinc (Zn)	2016/08/14	<0.0030		mg/L	
8362391	JPG	RPD	Total Aluminum (Al)	2016/08/14	4.0		%	20
			Total Antimony (Sb)	2016/08/14	NC		%	20
			Total Arsenic (As)	2016/08/14	1.5		%	20
			Total Beryllium (Be)	2016/08/14	NC		%	20
			Total Chromium (Cr)	2016/08/14	NC		%	20
			Total Cobalt (Co)	2016/08/14	NC		%	20
			Total Copper (Cu)	2016/08/14	NC		%	20
			Total Lead (Pb)	2016/08/14	NC		%	20
			Total Molybdenum (Mo)	2016/08/14	NC		%	20
			Total Nickel (Ni)	2016/08/14	NC		%	20
			Total Selenium (Se)	2016/08/14	NC		%	20
			Total Silver (Ag)	2016/08/14	NC		%	20
			Total Thallium (Tl)	2016/08/14	NC		%	20
			Total Tin (Sn)	2016/08/14	NC		%	20
			Total Titanium (Ti)	2016/08/14	NC		%	20
			Total Uranium (U)	2016/08/14	NC		%	20
			Total Vanadium (V)	2016/08/14	NC		%	20
			Total Zinc (Zn)	2016/08/14	NC		%	20
8362515	MPH	Matrix Spike	Dissolved Nitrite (N)	2016/08/15		100	%	80 - 120
			Dissolved Nitrate (N)	2016/08/15		NC	%	80 - 120
8362515	MPH	Spiked Blank	Dissolved Nitrite (N)	2016/08/15		101	%	80 - 120
			Dissolved Nitrate (N)	2016/08/15		103	%	80 - 120
8362515	MPH	Method Blank	Dissolved Nitrite (N)	2016/08/15	<0.010		mg/L	
			Dissolved Nitrate (N)	2016/08/15	<0.010		mg/L	
8362515	MPH	RPD	Dissolved Nitrite (N)	2016/08/15	NC		%	20
			Dissolved Nitrate (N)	2016/08/15	1.6		%	20
8362555	JPG	Matrix Spike	Dissolved Aluminum (Al)	2016/08/14		NC	%	80 - 120
			Dissolved Antimony (Sb)	2016/08/14		90	%	80 - 120
			Dissolved Arsenic (As)	2016/08/14		94	%	80 - 120
			Dissolved Beryllium (Be)	2016/08/14		92	%	80 - 120
			Dissolved Cadmium (Cd)	2016/08/14		96	%	80 - 120
			Dissolved Chromium (Cr)	2016/08/14		87	%	80 - 120
			Dissolved Cobalt (Co)	2016/08/14		86	%	80 - 120
			Dissolved Copper (Cu)	2016/08/14		84	%	80 - 120
			Dissolved Lead (Pb)	2016/08/14		89	%	80 - 120
			Dissolved Molybdenum (Mo)	2016/08/14		97	%	80 - 120
			Dissolved Nickel (Ni)	2016/08/14		85	%	80 - 120
			Dissolved Selenium (Se)	2016/08/14		98	%	80 - 120
			Dissolved Silver (Ag)	2016/08/14		94	%	80 - 120
			Dissolved Thallium (Tl)	2016/08/14		92	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Tin (Sn)	2016/08/14		100	%	80 - 120
			Dissolved Titanium (Ti)	2016/08/14		98	%	80 - 120
			Dissolved Uranium (U)	2016/08/14		89	%	80 - 120
			Dissolved Vanadium (V)	2016/08/14		91	%	80 - 120
			Dissolved Zinc (Zn)	2016/08/14		87	%	80 - 120
8362555	JPG	Spiked Blank	Dissolved Aluminum (Al)	2016/08/14		98	%	80 - 120
			Dissolved Antimony (Sb)	2016/08/14		93	%	80 - 120
			Dissolved Arsenic (As)	2016/08/14		96	%	80 - 120
			Dissolved Beryllium (Be)	2016/08/14		98	%	80 - 120
			Dissolved Cadmium (Cd)	2016/08/14		100	%	80 - 120
			Dissolved Chromium (Cr)	2016/08/14		90	%	80 - 120
			Dissolved Cobalt (Co)	2016/08/14		92	%	80 - 120
			Dissolved Copper (Cu)	2016/08/14		92	%	80 - 120
			Dissolved Lead (Pb)	2016/08/14		97	%	80 - 120
			Dissolved Molybdenum (Mo)	2016/08/14		98	%	80 - 120
			Dissolved Nickel (Ni)	2016/08/14		92	%	80 - 120
			Dissolved Selenium (Se)	2016/08/14		99	%	80 - 120
			Dissolved Silver (Ag)	2016/08/14		99	%	80 - 120
			Dissolved Thallium (Tl)	2016/08/14		97	%	80 - 120
			Dissolved Tin (Sn)	2016/08/14		104	%	80 - 120
			Dissolved Titanium (Ti)	2016/08/14		96	%	80 - 120
			Dissolved Uranium (U)	2016/08/14		94	%	80 - 120
			Dissolved Vanadium (V)	2016/08/14		94	%	80 - 120
			Dissolved Zinc (Zn)	2016/08/14		96	%	80 - 120
8362555	JPG	Method Blank	Dissolved Aluminum (Al)	2016/08/14	<0.0030		mg/L	
			Dissolved Antimony (Sb)	2016/08/14	<0.00060		mg/L	
			Dissolved Arsenic (As)	2016/08/14	<0.00020		mg/L	
			Dissolved Beryllium (Be)	2016/08/14	<0.0010		mg/L	
			Dissolved Cadmium (Cd)	2016/08/14	<0.000020		mg/L	
			Dissolved Chromium (Cr)	2016/08/14	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2016/08/14	<0.00030		mg/L	
			Dissolved Copper (Cu)	2016/08/14	<0.00020		mg/L	
			Dissolved Lead (Pb)	2016/08/14	<0.00020		mg/L	
			Dissolved Molybdenum (Mo)	2016/08/14	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2016/08/14	<0.00050		mg/L	
			Dissolved Selenium (Se)	2016/08/14	<0.00020		mg/L	
			Dissolved Silver (Ag)	2016/08/14	<0.00010		mg/L	
			Dissolved Thallium (Tl)	2016/08/14	<0.00020		mg/L	
			Dissolved Tin (Sn)	2016/08/14	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2016/08/14	<0.0010		mg/L	
			Dissolved Uranium (U)	2016/08/14	<0.00010		mg/L	
			Dissolved Vanadium (V)	2016/08/14	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2016/08/14	<0.0030		mg/L	
8362555	JPG	RPD	Dissolved Aluminum (Al)	2016/08/14	1.8		%	20
			Dissolved Antimony (Sb)	2016/08/14	NC		%	20
			Dissolved Arsenic (As)	2016/08/14	NC		%	20
			Dissolved Beryllium (Be)	2016/08/14	NC		%	20
			Dissolved Cadmium (Cd)	2016/08/14	0.97		%	20
			Dissolved Chromium (Cr)	2016/08/14	NC		%	20
			Dissolved Cobalt (Co)	2016/08/14	NC		%	20
			Dissolved Copper (Cu)	2016/08/14	4.3		%	20
			Dissolved Lead (Pb)	2016/08/14	NC		%	20

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Client Project #: 110219790
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Sampler Initials: SS

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Molybdenum (Mo)	2016/08/14	NC		%	20
			Dissolved Nickel (Ni)	2016/08/14	NC		%	20
			Dissolved Selenium (Se)	2016/08/14	0.098		%	20
			Dissolved Silver (Ag)	2016/08/14	NC		%	20
			Dissolved Thallium (Tl)	2016/08/14	NC		%	20
			Dissolved Tin (Sn)	2016/08/14	NC		%	20
			Dissolved Titanium (Ti)	2016/08/14	6.1		%	20
			Dissolved Uranium (U)	2016/08/14	1.0		%	20
			Dissolved Vanadium (V)	2016/08/14	NC		%	20
			Dissolved Zinc (Zn)	2016/08/14	NC		%	20
8362563	CJ5	Matrix Spike [PG2320-06]	Dissolved Barium (Ba)	2016/08/14		91	%	80 - 120
			Dissolved Boron (B)	2016/08/14		106	%	80 - 120
			Dissolved Calcium (Ca)	2016/08/14		96	%	80 - 120
			Dissolved Iron (Fe)	2016/08/14		100	%	80 - 120
			Dissolved Lithium (Li)	2016/08/14		95	%	80 - 120
			Dissolved Magnesium (Mg)	2016/08/14		101	%	80 - 120
			Dissolved Manganese (Mn)	2016/08/14		95	%	80 - 120
			Dissolved Phosphorus (P)	2016/08/14		97	%	80 - 120
			Dissolved Potassium (K)	2016/08/14		101	%	80 - 120
			Dissolved Silicon (Si)	2016/08/14		101	%	80 - 120
			Dissolved Sodium (Na)	2016/08/14		NC	%	80 - 120
			Dissolved Strontium (Sr)	2016/08/14		92	%	80 - 120
8362563	CJ5	Spiked Blank	Dissolved Barium (Ba)	2016/08/14		95	%	80 - 120
			Dissolved Boron (B)	2016/08/14		107	%	80 - 120
			Dissolved Calcium (Ca)	2016/08/14		99	%	80 - 120
			Dissolved Iron (Fe)	2016/08/14		104	%	80 - 120
			Dissolved Lithium (Li)	2016/08/14		98	%	80 - 120
			Dissolved Magnesium (Mg)	2016/08/14		105	%	80 - 120
			Dissolved Manganese (Mn)	2016/08/14		99	%	80 - 120
			Dissolved Phosphorus (P)	2016/08/14		101	%	80 - 120
			Dissolved Potassium (K)	2016/08/14		104	%	80 - 120
			Dissolved Silicon (Si)	2016/08/14		107	%	80 - 120
			Dissolved Sodium (Na)	2016/08/14		97	%	80 - 120
			Dissolved Strontium (Sr)	2016/08/14		96	%	80 - 120
			Dissolved Sulphur (S)	2016/08/14		101	%	80 - 120
8362563	CJ5	Method Blank	Dissolved Barium (Ba)	2016/08/14	<0.010		mg/L	
			Dissolved Boron (B)	2016/08/14	<0.020		mg/L	
			Dissolved Calcium (Ca)	2016/08/14	<0.30		mg/L	
			Dissolved Iron (Fe)	2016/08/14	<0.060		mg/L	
			Dissolved Lithium (Li)	2016/08/14	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2016/08/14	<0.20		mg/L	
			Dissolved Manganese (Mn)	2016/08/14	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2016/08/14	<0.10		mg/L	
			Dissolved Potassium (K)	2016/08/14	<0.30		mg/L	
			Dissolved Silicon (Si)	2016/08/14	<0.10		mg/L	
			Dissolved Sodium (Na)	2016/08/14	<0.50		mg/L	
			Dissolved Strontium (Sr)	2016/08/14	<0.020		mg/L	
			Dissolved Sulphur (S)	2016/08/14	<0.20		mg/L	
8362563	CJ5	RPD [PG2320-06]	Dissolved Barium (Ba)	2016/08/14	NC		%	20
			Dissolved Boron (B)	2016/08/14	0.34		%	20
			Dissolved Calcium (Ca)	2016/08/14	NC		%	20
			Dissolved Iron (Fe)	2016/08/14	NC		%	20

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Lithium (Li)	2016/08/14	NC		%	20
			Dissolved Magnesium (Mg)	2016/08/14	NC		%	20
			Dissolved Manganese (Mn)	2016/08/14	NC		%	20
			Dissolved Phosphorus (P)	2016/08/14	NC		%	20
			Dissolved Potassium (K)	2016/08/14	NC		%	20
			Dissolved Silicon (Si)	2016/08/14	0.54		%	20
			Dissolved Sodium (Na)	2016/08/14	1.6		%	20
			Dissolved Strontium (Sr)	2016/08/14	NC		%	20
			Dissolved Sulphur (S)	2016/08/14	1.4		%	20
8363075	MRD	Spiked Blank	Sulphide	2016/08/15		97	%	80 - 120
8363075	MRD	Method Blank	Sulphide	2016/08/15	<0.0019		mg/L	
8363075	MRD	RPD	Sulphide	2016/08/15	0		%	20
8363079	MRD	Spiked Blank	Turbidity	2016/08/15		100	%	80 - 120
8363079	MRD	Method Blank	Turbidity	2016/08/15	<0.10		NTU	
8363079	MRD	RPD	Turbidity	2016/08/15	2.2		%	20
8363192	AL2	Matrix Spike	Total Ammonia (N)	2016/08/15		107	%	80 - 120
8363192	AL2	Spiked Blank	Total Ammonia (N)	2016/08/15		109	%	80 - 120
8363192	AL2	Method Blank	Total Ammonia (N)	2016/08/15	<0.050		mg/L	
8363192	AL2	RPD	Total Ammonia (N)	2016/08/15	NC		%	20
8363612	MA4	Spiked Blank	pH	2016/08/15		100	%	97 - 103
8363612	MA4	RPD	pH	2016/08/15	0.37		%	N/A
8363622	MA4	Spiked Blank	Alkalinity (Total as CaCO3)	2016/08/15		101	%	80 - 120
8363622	MA4	Method Blank	Alkalinity (PP as CaCO3)	2016/08/15	<0.50		mg/L	
			Alkalinity (Total as CaCO3)	2016/08/15	<0.50		mg/L	
			Bicarbonate (HCO3)	2016/08/15	<0.50		mg/L	
			Carbonate (CO3)	2016/08/15	<0.50		mg/L	
			Hydroxide (OH)	2016/08/15	<0.50		mg/L	
8363622	MA4	RPD	Alkalinity (PP as CaCO3)	2016/08/15	NC		%	20
			Alkalinity (Total as CaCO3)	2016/08/15	0.43		%	20
			Bicarbonate (HCO3)	2016/08/15	0.43		%	20
			Carbonate (CO3)	2016/08/15	NC		%	20
			Hydroxide (OH)	2016/08/15	NC		%	20
8363623	MA4	Spiked Blank	Conductivity	2016/08/15		99	%	90 - 110
8363623	MA4	Method Blank	Conductivity	2016/08/15	1.4, RDL=1.0		uS/cm	
8363623	MA4	RPD	Conductivity	2016/08/15	0.37		%	20
8363624	MA4	Matrix Spike	Dissolved Fluoride (F)	2016/08/15		103	%	80 - 120
8363624	MA4	Spiked Blank	Dissolved Fluoride (F)	2016/08/15		98	%	80 - 120
8363624	MA4	Method Blank	Dissolved Fluoride (F)	2016/08/15	<0.050		mg/L	
8363624	MA4	RPD	Dissolved Fluoride (F)	2016/08/15	NC		%	20
8363814	KD5	Matrix Spike	Dissolved Chloride (Cl)	2016/08/17		107	%	80 - 120
8363814	KD5	Spiked Blank	Dissolved Chloride (Cl)	2016/08/17		105	%	80 - 120
8363814	KD5	Method Blank	Dissolved Chloride (Cl)	2016/08/17	<1.0		mg/L	
8363814	KD5	RPD	Dissolved Chloride (Cl)	2016/08/17	0.73		%	20
8363818	KD5	Matrix Spike	Dissolved Sulphate (SO4)	2016/08/17		NC	%	80 - 120
8363818	KD5	Spiked Blank	Dissolved Sulphate (SO4)	2016/08/17		105	%	80 - 120
8363818	KD5	Method Blank	Dissolved Sulphate (SO4)	2016/08/17	<1.0		mg/L	
8363818	KD5	RPD	Dissolved Sulphate (SO4)	2016/08/17	1.0		%	20
8364537	AL2	Matrix Spike	Total Phosphorus (P)	2016/08/17		99	%	80 - 120
8364537	AL2	QC Standard	Total Phosphorus (P)	2016/08/17		93	%	80 - 120
8364537	AL2	Spiked Blank	Total Phosphorus (P)	2016/08/17		100	%	80 - 120
8364537	AL2	Method Blank	Total Phosphorus (P)	2016/08/17	<0.0030		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
8364537	AL2	RPD	Total Phosphorus (P)	2016/08/17	2.5		%	20
8365831	JLO	Matrix Spike	Dissolved Mercury (Hg)	2016/08/17		NC	%	85 - 115
8365831	JLO	QC Standard	Dissolved Mercury (Hg)	2016/08/17		104	%	85 - 115
8365831	JLO	Spiked Blank	Dissolved Mercury (Hg)	2016/08/17		97	%	85 - 115
8365831	JLO	Method Blank	Dissolved Mercury (Hg)	2016/08/17	0.0024, RDL=0.0020		ug/L	
8365831	JLO	RPD	Dissolved Mercury (Hg)	2016/08/17	NC		%	20
8365833	JLO	Matrix Spike	Total Mercury (Hg)	2016/08/17		NC	%	85 - 115
8365833	JLO	QC Standard	Total Mercury (Hg)	2016/08/17		105	%	85 - 115
8365833	JLO	Spiked Blank	Total Mercury (Hg)	2016/08/17		99	%	85 - 115
8365833	JLO	Method Blank	Total Mercury (Hg)	2016/08/17	<0.0020		ug/L	
8365833	JLO	RPD [PG2320-07]	Total Mercury (Hg)	2016/08/17	NC		%	20
8366237	AL2	Matrix Spike	Total Kjeldahl Nitrogen	2016/08/18		NC	%	80 - 120
8366237	AL2	QC Standard	Total Kjeldahl Nitrogen	2016/08/18		98	%	80 - 120
8366237	AL2	Spiked Blank	Total Kjeldahl Nitrogen	2016/08/18		101	%	80 - 120
8366237	AL2	Method Blank	Total Kjeldahl Nitrogen	2016/08/18	<0.050		mg/L	
8366237	AL2	RPD	Total Kjeldahl Nitrogen	2016/08/18	1.1		%	20
8370668	KPG	Spiked Blank	True Colour	2016/08/20		100	%	80 - 120
8370668	KPG	Method Blank	True Colour	2016/08/20	<2.0		PtCo unit	
8370668	KPG	RPD	True Colour	2016/08/20	0		%	20

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

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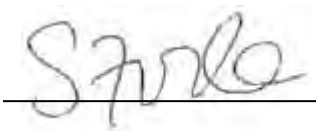
VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Suwan Fock, B.Sc., QP, Inorganics Senior Analyst

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Maxxam
A Bureau Veritas Group Company

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maxxam.ca

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CHAIN OF CUSTODY RECORD

M 17506

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Invoice Information	Report Information (if differs from invoice)	Project Information	Turnaround Time (TAT) Required
Company: Stantec	Company:	Quotation #:	☑ 5 - 7 Days Regular (Most analyses)
Contact Name: Christian Nagel	Contact Name:	P.O. #/ AFE#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 10160 112 St. Edmonton AB T5K 2L6	Address:	Project #: 160219790	Rush TAT (Surcharges will be applied)
Phone: 780 (233) 4206	Phone:	Site Location: Burbank	☐ Same Day ☐ 2 Days ☐ 1 Day ☐ 3-4 Days
Email: Christian.nagel@stantec.com	Email:	Site #:	Date Required: Time Sensitive Bacteria - Rush
Copies:	Copies:	Sampled By: S. Nagel	Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID			
Seal Present			Temp	6	6	6
Seal Intact						
Cooling Media						
	YES	NO	Cooler ID			
Seal Present			Temp			
Seal Intact						
Cooling Media						
	YES	NO	Cooler ID			
Seal Present			Temp			
Seal Intact						
Cooling Media						

Depot Reception

Analysis Requested

	Sample Identification	Depth (Unit)	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	# of containers	BTEX F1 ☐ VOC ☐	BTEX F1-F2	BTEX F1-F4	Routine Water	Regulated Metals Tot ☐ Diss ☐	Mercury Total ☐ Dissolved ☐	Salinity 4	Sieve (75 micron)	Texture (% Sand, Silt, Clay)	Basic Class II Landfill	Routine / Fluoride	Turbidity / Color	TKN	Nitrite + Nitrate	Nitrogen - Ammonia	Phosphorus / Sulphide	Dissolved metals + mercury	Total metals + mercury	Bacteriological (E. coli + Coliforms)	HOLD - DO NOT ANALYZE
1	SF-1-END		2016/08/12	8:40	GW	9											X	X	X	X	X	X	X	X	X	
2	SF-1		2016/08/12	8:50	GW	9											X	X	X	X	X	X	X	X	X	
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										

Please indicate Filtered, Preserved or Both (F, P, F/P) →

Regulatory Criteria

- ☐ AT1/CCME
- ☑ Drinking Water
- ☐ Saskatchewan
- ☐ D50 (Drilling Waste)
- ☐ Other:

Special Instructions

- Some parameters time sensitive - Rush as necessary

Relinquished by: (Signature/ Print)	DATE (YYYY/MM/DD)	Time (HH:MM)	Received by: (Signature/ Print)	DATE (YYYY/MM/DD)	Time (HH:MM)	Maxxam Job #
S. Nagel	2016/08/12	17:20	David Tidmarsh	2016/08/12	17:20	B667918 D_T

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