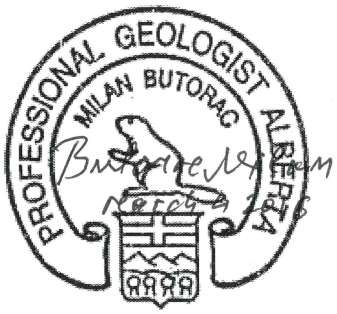
THURBER ENGINEERING LTD.

HYDROGEOLOGICAL ASSESSMENT
VILLAGE OF BAWLF SEWAGE LAGOON

Report

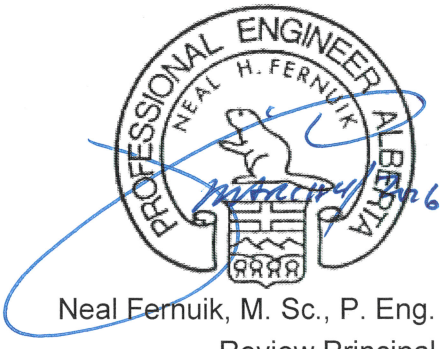
to

Village of Bawlf



Milan Butorac, P. Geo.
Hydrogeologist

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
Signature _____
Date March 4 / 2016
PERMIT NUMBER: P 5186
The Association of Professional Engineers, Geologists and Geophysicists of Alberta



Neal Fernuik, M. Sc., P. Eng.
Review Principal

Date: March 4, 2016
File: 19-6835-1

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1. INTRODUCTION

At the request of the Village of Bawlf, Thurber Engineering Ltd. (Thurber) conducted a hydrogeological investigation to assess if the existing wastewater lagoon ("Site") is leaking. The Site is located within NE ¼ 25-45-18 W4M approximately one kilometer southwest of the Village of Bawlf, Alberta. The approximate Site location is shown on Drawing 19-6835-1-1H in Appendix A .

Authorization to conduct the assessment if the lagoon was leaking was provided by Ms. Tracy M Stewart, Finance Officer of the Village of Bawlf.

It is a condition of this report that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

2. OBJECTIVE AND SCOPE OF WORK

The objective of the hydrogeological investigation, as outlined in Thurber's May 11 2015 proposal to the Village of Bawlf, was to assess if the waste water lagoon was leaking. The proposal was organized for the project to be conducted in two Phases;

- Phase 1 - Hydrogeological Desktop Study and Site Reconnaissance
- Phase 2 - Hydrogeological Program

The Phase 2 assessment comprised of two components; 2-1 assess if the lagoon was leaking and 2-2 establish a long term groundwater monitoring program. This report addresses the Phase 2-1 component as the long term monitoring program (Phase 2-2) was not authorized.

3. PHASE I - HYDROGEOLOGICAL DESKTOP STUDY & SITE RECONNAISSANCE

The Phase 1 desktop assessment and site reconnaissance was addressed in Thurber's December 2014 report[1]. In summary, there was no major visible evidence of leakage trough the wastewater lagoon. However, as the native soil construction material consisted of moraine sandy clay till and the wastewater lagoon does not have a compacted clay liner, leakage would likely be occurring through the base of the wastewater lagoon. This assessment was further supported by the low water levels in the deep pond north of the Site in that there is a significant vertical downward groundwater gradient. The deep pond also did not show visible

[1] Thurber Engineering Ltd., December 9 2014, *Bawlf Existing Sewage Treatment Plant Assessment of the Existing Lagoon Conditions.*

evidence of groundwater seepage from the wastewater lagoon to the pond which indicates low hydraulic conductivity value of the soil. The Phase 2-1 was therefore recommended in order to assess leakage.

4. LAGOON SITE

The wastewater lagoon comprises of two anaerobic cells (cells 1 and 2), primary cell (cell 5) and a secondary cell (cell 6) as shown on Drawing 19-6835-1-2H in Appendix A. The deep and shallow pond are located just to the north of the wastewater lagoon. The depths of the cells from top of the berm to the bottom were approximately 4 m for Cells 1 and 2, 2.3 m for Cell 5 and 3 m for Cell 6. The berms slide slopes were inclined at approximately 3H:1V. Along the south berm of the wastewater lagoon there is an unnamed creek were the treated water is discharged once a year.

5. METHOD OF INVESTIGATION

5.1 Ground Disturbance

Prior to the drilling program, Thurber arranged Alberta One-Call public utility locates for the Site. In addition to Alberta One-Call Thurber conducted a private utility locate to assess the underground utilities at the proposed test hole locations. The private utility locator Tierra Geomatic Services Inc. from Edmonton completed underground locates prior to drilling the test holes.

5.2 Drilling

On December 1, 2015 five test holes (TH15-1 through TH15-5) were advanced under full time observation of Thurber personnel. The test holes were advanced by Mobile Augers and Research Ltd. of Edmonton, Alberta using a track mounted drill rig. The test holes were drilled to depths ranging between approximately 5.3 m to 10.7 m below ground surface (bgs).

The test hole location coordinates were surveyed by Thurber using Total Station and are in NAD 83 UTM 12 coordinates. The approximate test hole locations are shown on Drawing 19-6835-1-2H in Appendix A.

Groundwater seepage and soil sloughing from test hole walls were noted during and after completion of the drilling and are recorded on the test hole logs in Appendix B. Groundwater monitoring wells, 50 mm diameter polyvinyl chloride (PVC) pipe, with machine slotted screens and solid casing were installed in all test holes. Silica sand was placed around the screened

portion of the well and the well casing was sealed above the sand pack with bentonite chips. A lockable metal casing stick-up protector was installed at ground surface at each well location. Monitoring well completion details are shown on the respective test hole logs in Appendix B.

Topsoil was intermixed in the clay fill within the lagoon berms with the exception of test hole TH15-5 drilled within the middle of the lagoon whereby there was a 0.6 m layer of topsoil/clay fill at a depth of 2.3 m within the berm. Seepage within the berms was only encountered in test hole TH15-3 on the western berm. Seepage was otherwise encountered at depths of between 5.5 m and 5.8 m or approximately 701.5 m bgs.

5.3 Insitu Hydraulic Conductivity Testing

The insitu hydrogeological testing was completed on January 11, 2016 in conjunction with measuring static water levels in wells TH15-1 through TH15-5. The insitu bail test was completed by bailing out 10 liter of water and measuring recovery of water level in the well. Measuring of water level was conducted using pressure transducer recorders. Interpretation of the bail data was completed using the Bouwer & Rice and Cooper-Bredehoeft-Papadopulos methods.

Water seepage and water levels measured in open test holes on completion of drilling are summarized on the test-hole logs in Appendix B. The results of water level measurements and interpretation of insitu hydraulic conductivity tests are presented in Table 1 in Appendix C. The graphs of the test data and interpretation generated by the Bower & Rice and Copper-Bredehoeft-Papadopulos methods are shown in Appendix D. Calculated insitu hydrogeological conductivity values are in range from 1.02 E^{-9}m/s to 1.00E^{-6}m/s with a geometric mean of 1.90E^{-08}m/s.

5.4 Groundwater Sampling

Water samples were collected on January 14, 2016 from monitoring wells TH15-1 through TH15-5 and from Cell's 1, 5 and 6. The water samples were placed in laboratory supplied containers and then in an ice-chilled cooler for transport to Exova for chemical analyses. The approximate locations of where the cell samples were taken are shown on Drawing 19-6853-1-2H. Water samples were attempted to be collected from the creek and two ponds but the surface water was completely frozen. Water samples were collected from the monitoring wells using dedicated bailers approximately three days after each well was purged.

6. GEOLOGY

6.1 Regional Geology

The underlying bedrock in the project area consists of the lower Horseshoe Canyon Formation portion that is composed of sandstone, shale and coal layers. Horseshoe Canyon Formation is underlain by marine shale of the Bearpaw Formation. Bedrock topography in the general area around the Site is a plateau with no signs of significant buried valley. The average top of bedrock elevation is between 670m and 690m. The bedrock is overlain by stagnant ice moraine which are, in general area approximately from 15m to 40m thick. The stagnant ice moraine are composed of mixture of clay, silt and sand with locally included stratified glaciolacustrine and glaciofluvial silt and sand.

6.2 Site Stratigraphy

The test holes shows that subsurface stratigraphy is predominantly composed of clay till with traces and lenses of silt, sand and gravel. Based on water well data (Appendix E) in the surrounding area the clay till is underlain by bedrock composed of sandstone, shale and some coal. Approximate depth to the top of bedrock is 22 m bgs.

The lagoon berms are constructed from native compacted clay till. Total depth of berms is between 3 m and 3.5 m. According to the water well records we can expect the clay till unit is present from ground surface to the top of the bedrock.

Bedrock is significant aquifer in the area and it is source for domestic water supply nearby communities.

7. HYDROGEOLOGY

7.1 Regional Hydrogeology

The major groundwater aquifer in the study area is formed in the bedrock within Horseshoe Canyon Formation. Water levels in water wells completed in the uppermost portion of the bedrock, as shown in selected water well logs (Appendix E) is between 3m and 11m bgs. Upper bedrock aquifer is major source for water supply in the region.

The bedrock aquifer is overlain by surficial deposits (clay till) which has a very low permeable and could be classified as an aquitard. These surficial deposits contain groundwater but groundwater movement is very slow. Groundwater origin in the surficial deposits is from

precipitation, and groundwater movement in the surficial deposits is very slow downward toward the bedrock aquifer as further described in Section 7.2.

7.2 Site Hydrogeology

Table 1 in Appendix C summarizes water level measurements taken on January 11, 2016 approximately five weeks after completion of the well installations. Depth to groundwater ranged between 2.82 m below ground surface (bgs) and 7.25 m bgs. Calculated hydrogeological conductivity values are in range from $1.0E^{-9}$m/sec to $1.0E^{-6}$m/sec and that indicates significant heterogeneity of the clay till.

Hydrogeological cross sections north – south and east – west, Drawing 19-6835-1-3H and Drawing 19-6835-1-4H respectively in Appendix A, show that main drainage direction from the wastewater lagoon is through the berms toward the surrounding trenches and creek and below the lagoon generally downward toward the bedrock.

Based on water level in the lagoon (706 masl), approximate water level in the bedrock (698 masl), estimated thickness of clay till (22m) and a geometric mean of the hydraulic conductivity of clay till ($1.9E^{-8}$m/sec) a calculated velocity of groundwater is 0.23 m/year. Based on above values a water particle would take more than 90 years to flow from the lagoon to the bedrock aquifer.

8. GUIDELINES

Thurber used the Canadian Drinking Water Quality (CDWQ) guidelines, Health Canada, October 2014 and Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems, part 3 published by Alberta Government 2013 (SGMW).

9. GROUNDWAER ANALYTICAL RESULTS

Table 2 in Appendix C presents results of the analyses in relation to the CDWQ guidelines. Total coliforms analysis shows that waters collected in the lagoon cells are more than a million CFU/100ml while water collected from monitoring wells shows total coliforms in range from 0 CFU/100ml to 7000 CFU/100ml. The guideline for total coliforms is SGMW. The analyses also shows that lagoon water has significantly less total dissolved (TDS) content. Most of other chemical parameters are distinctively different for water in lagoon and groundwater in the monitoring wells.

Table 3 in Appendix C presents a summary of water chemistry analysis for Village of Bawlf as obtained from Alberta Environment and Parks groundwater database. Two Piper plots “a” and “b” in Appendix A shows water types. Piper plot “a” is from water samples collected from water wells within the project area (bedrock aquifer) while Piper plot “b” is from monitoring wells installed around the lagoon (clay till) and from the lagoon. The Piper plots shows that the water from the bedrock aquifer, surficial deposits (clay till) and lagoon belong to different types of water. The water types are sodium-potassium-bicarbonate, sodium-calcium-sulfate and sodium-bicarbonate respectively.

10. ASSESSEMENT AND CONCLUSIONS

10.1 Assessment

Results of the hydrogeological investigation shows that the lagoon is located at a flat to gently rolling terrain one kilometer southwest from the Village of Bawlf. The lagoon is built over clay till surficial deposits compound of native compacted, clay till and silt material. There were no recorded visible leakage of water from lagoon to surrounding area especially into the deep and shallow ponds directly north of the lagoon.

Surficial deposits in the surrounding area is stagnant ice moraine composed of clay till which is mixture of clay and silt with some lances and pockets of sand and gravel. Surficial deposits (clay till) is approximately 22m thick at the site and it is underlain by bedrock sandstone, shale and some coal. Bedrock is a significant aquifer for the area and this aquifer is in use for water supply for nearby communities.

Insitu hydraulic conductivity tests shows that hydrogeological conductivity of the clay till is in range between $1.0E^{-9}$m/s to $1.0E^{-6}$m/s with geometrical mean as $1.9\ E^{-8}$m/s. Groundwater flow in the study area is generally downward. An estimated time for lagoon water to reach the top of bedrock is more than 90 years. Due to the very slow movement of groundwater through the lagoon berms and base the zone of infiltration is limited. The front of infiltrated zone could be measured in meters or tens of metres in lateral surrounding around the lagoon, and metres downwards below the lagoon.

The Piper Plots and most of the chemical parameters show strong difference of water quality between lagoon water and groundwater even though the completion interval of the monitoring wells are only a few meters deeper than the lagoon base. The presence of total coliforms in the monitoring wells completed in the lagoon berms (TH15-1, TH15-2 and TH15-3) indicates that water from lagoon has not been released as a preferred leakage pathway but as

infiltration. Absence of total coliforms in the deepest monitoring well TH15-5 which is located in the middle of the lagoon indicates very slow vertical advance of water infiltration from the lagoon towards the bedrock aquifer. Total coliforms were not present in well TH15-4 and this well had a higher hydraulic conductivity than wells TH15-1 and TH15-2.

10.2 Conclusions

Based on the groundwater data within the lagoon berm and surrounding area, lack of preferential seepage pathways within the berms and low berm and native clay till hydraulic conductivities Thurber has concluded that water from the lagoon is infiltrating at a very slow rate in a lateral and downward direction from the lagoon but is not leaking via a preferential pathway.

Thurber recommends a continuation of monitoring water levels and doing water chemistry analysis from the monitoring wells as outlined in Standards and Guidelines for Municipal Waterworks and Code of Practice for Wastewater Systems Using a Wastewater Lagoon. We do not recommend the installation of additional monitoring wells as additional wells would not significantly improve the monitoring program. The groundwater analytical testing should be comprised of the following parameters that have been outlined in Code of Practice for Wastewater Systems Using a Wastewater Lagoon;

- Aggregate Organic Constituents (Chemical Oxygen Demands)
- Inorganic Nonmetallic Parameters (Ammonium, Kjeldahl Nitrogen)
- Metals Dissolved
- Routine Water
- Microbiological Analysis.

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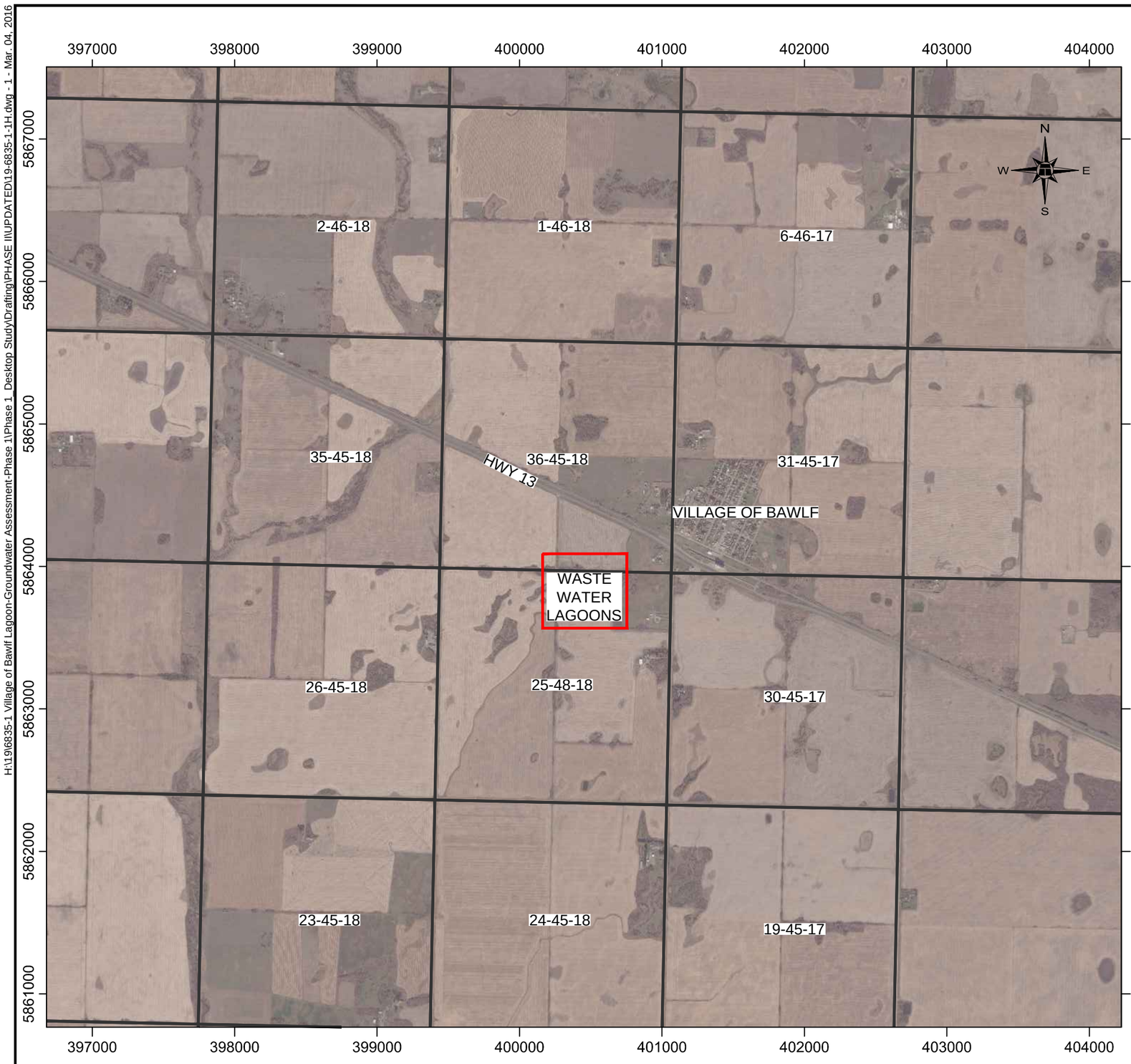
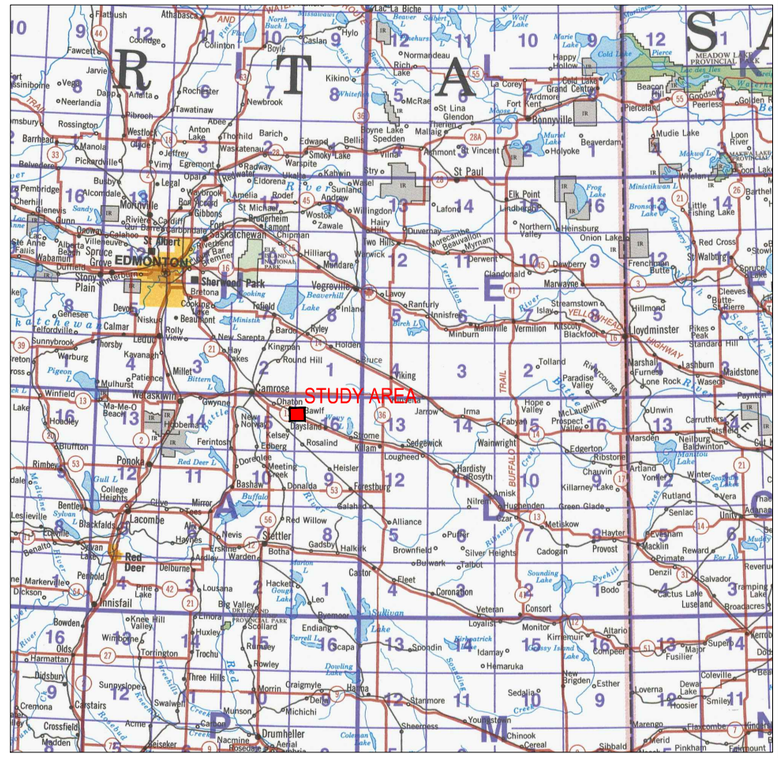
APPENDIX A

Drawings

H:\19\6835-1 Village of Bawlf Lagoon-Groundwater Assessment-Phase 1\Phase 1_Desktop Study\Drafting\PHASE I\UPDATED\19-6835-1-1H.dwg - 1 - Mar. 04, 2016





0 250 500 750 1000 1500 2000 m

SCALE 1:30,000

HYDROGEOLOGICAL ASSESSMENT
VILLAGE OF BAWLF LAGOON

SITE LOCATION MAP

DWG No. 19-6835-1-1H

DRAWN BY	ML
DESIGNED BY	MJB
APPROVED BY	NHF
SCALE	1:30 000
DATE	MARCH 2016
FILE No.	19-6835-1

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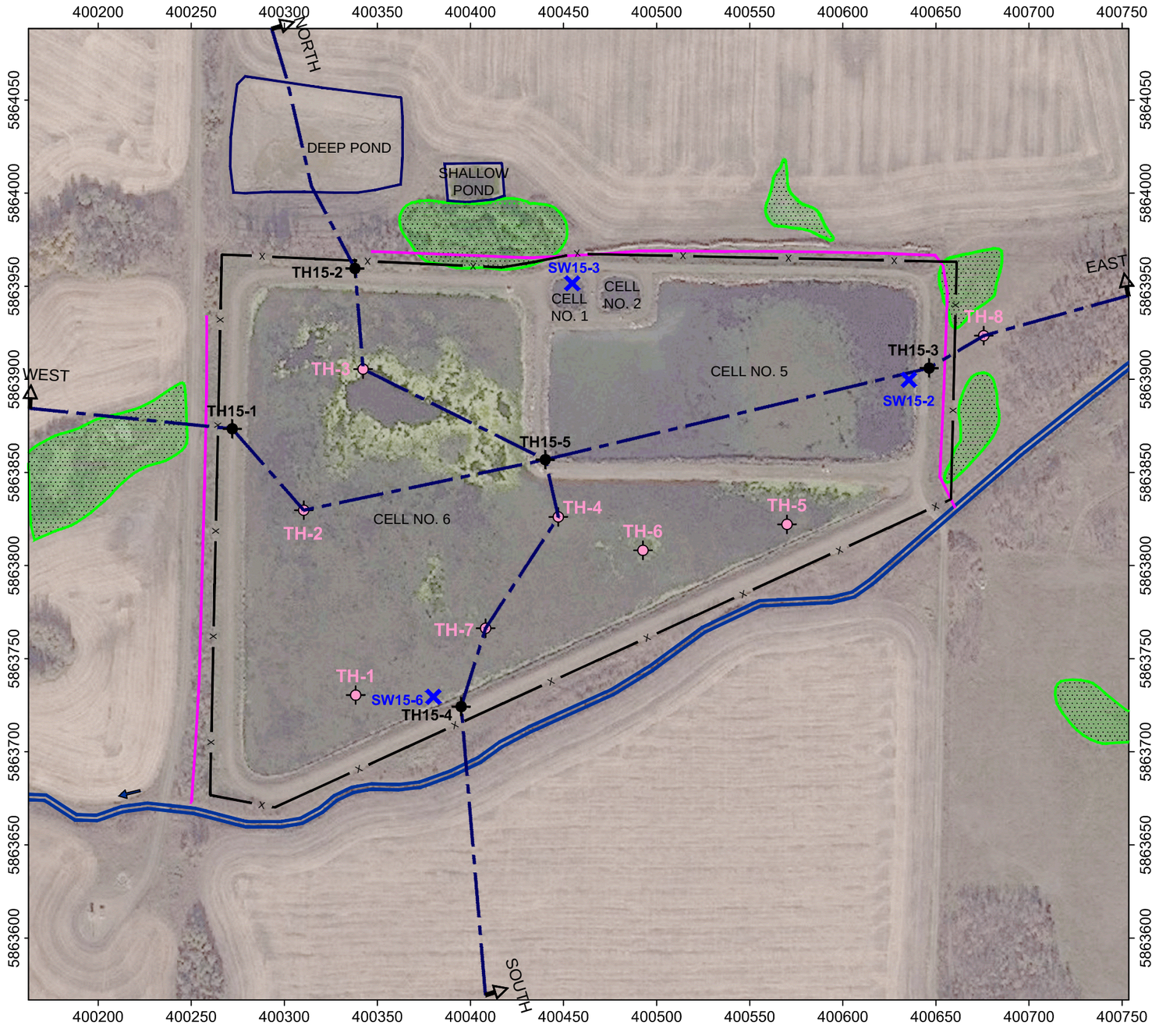
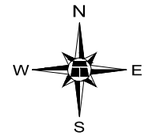




LEGEND

- WETLAND
- CREEK
- TRENCH
- FENCE
- TEST-HOLES DRILLED BEFORE THE LAGOON WAS BUILT
- 2015 MONITORING WELLS
- SURFACE WATER SAMPLING LOCATION

Monitoring Well ID	x (utm 12)	y (utm 12)	z (mbgs)
TH15-1	400272.04	5863873.46	707.56
TH15-2	400337.97	5863959.58	707.65
TH15-3	400646.36	5863906.07	707.34
TH15-4	400395.03	5863724.27	707.42
TH15-5	400440.19	5863856.88	707.93

0 25 50 75 100 125 150m

SCALE 1:2500

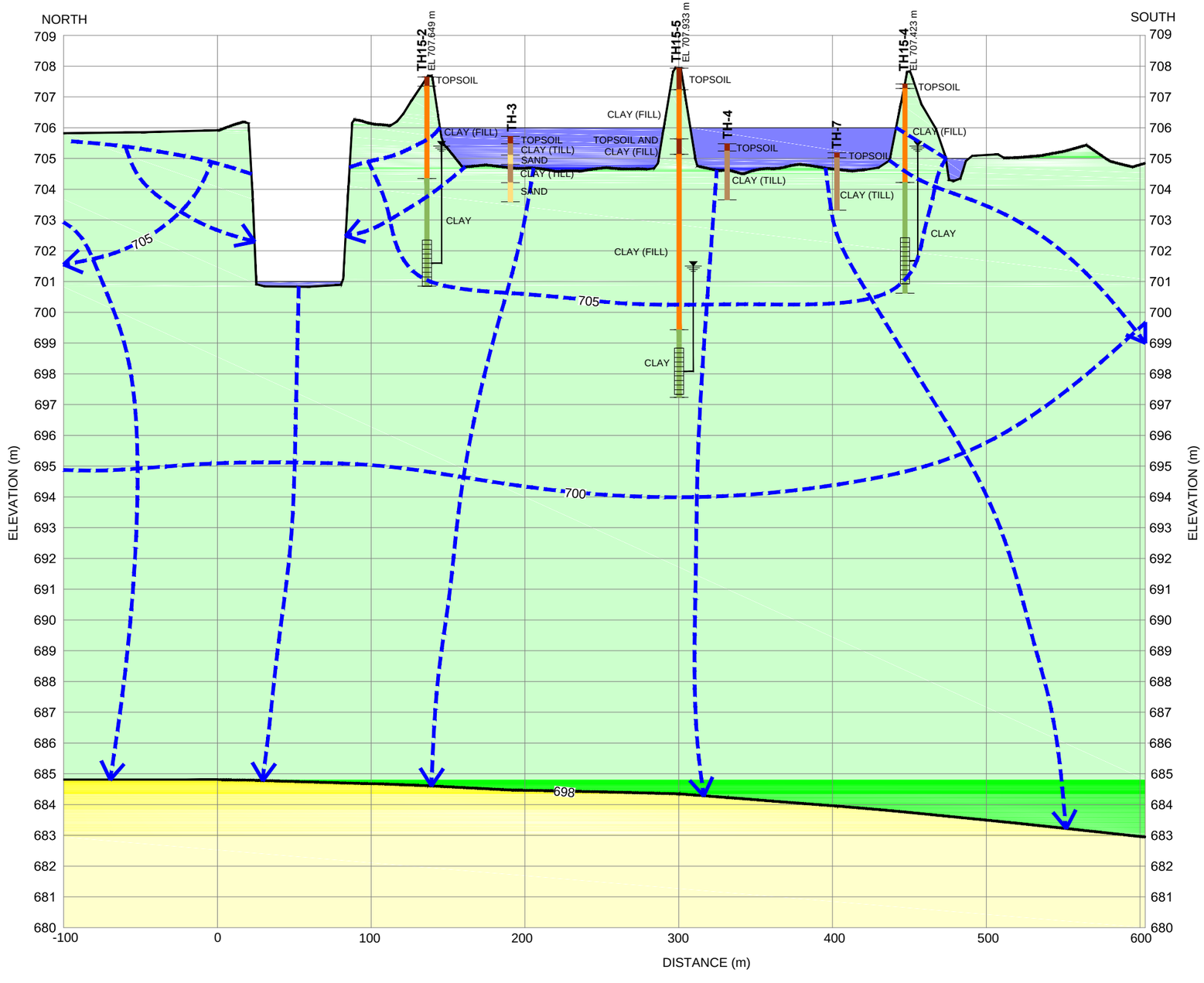
HYDROGEOLOGICAL ASSESSMENT
VILLAGE OF BAWLF LAGOON

LAGOON MAP

DWG No. 19-6835-1-2H

DRAWN BY	ML
DESIGNED BY	MJB
APPROVED BY	NHF
SCALE	1:2500
DATE	MARCH 2016
FILE No.	19-6835-1

THURBER ENGINEERING LTD.



LEGEND

- WATER LEVEL IN PIEZOMETER
- STANDPIPE PIEZOMETER SCREENED INTERVAL
- CLAY TILL
- BEDROCK
- GROUNDWATER FLOW MAT

NOTE

DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT THE TEST HOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN TEST HOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.

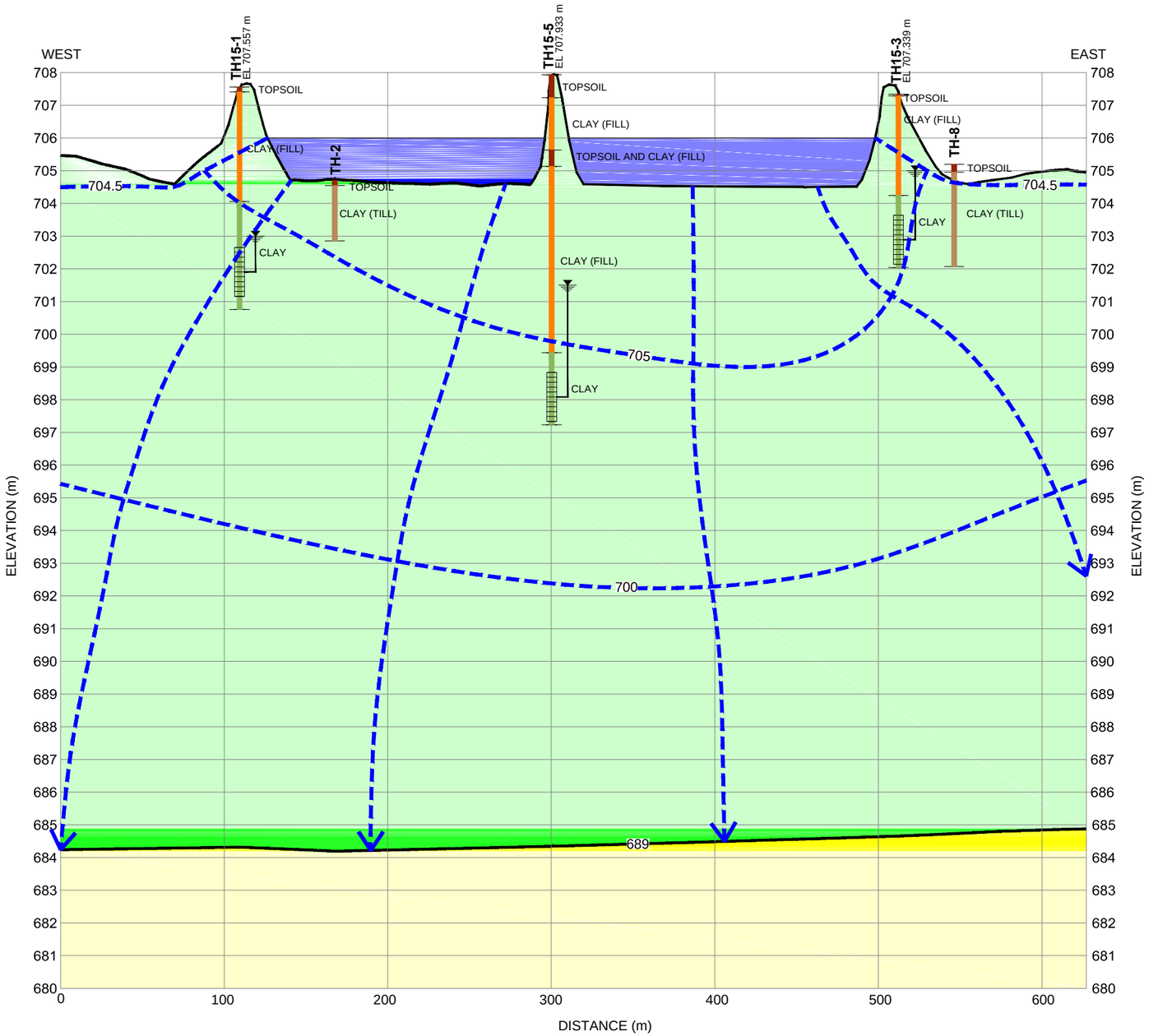
HYDROGEOLOGICAL ASSESSMENT
VILLAGE OF BAWLF LAGOON

HYDROGEOLOGICAL CROSS - SECTION
NORTH TO SOUTH

DWG No. 19-6835-1-3H

DRAWN BY	ML
DESIGNED BY	MJB
APPROVED BY	NHF
SCALE	H 1:3000 V 1:150
DATE	MARCH 2016
FILE No.	19-6835-1

THURBER ENGINEERING LTD.



LEGEND

- WATER LEVEL IN PIEZOMETER
- STANDPIPE PIEZOMETER SCREENED INTERVAL
- CLAY TILL
- BEDROCK
- GROUNDWATER FLOW MAT

NOTE

DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT THE TEST HOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN TEST HOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.

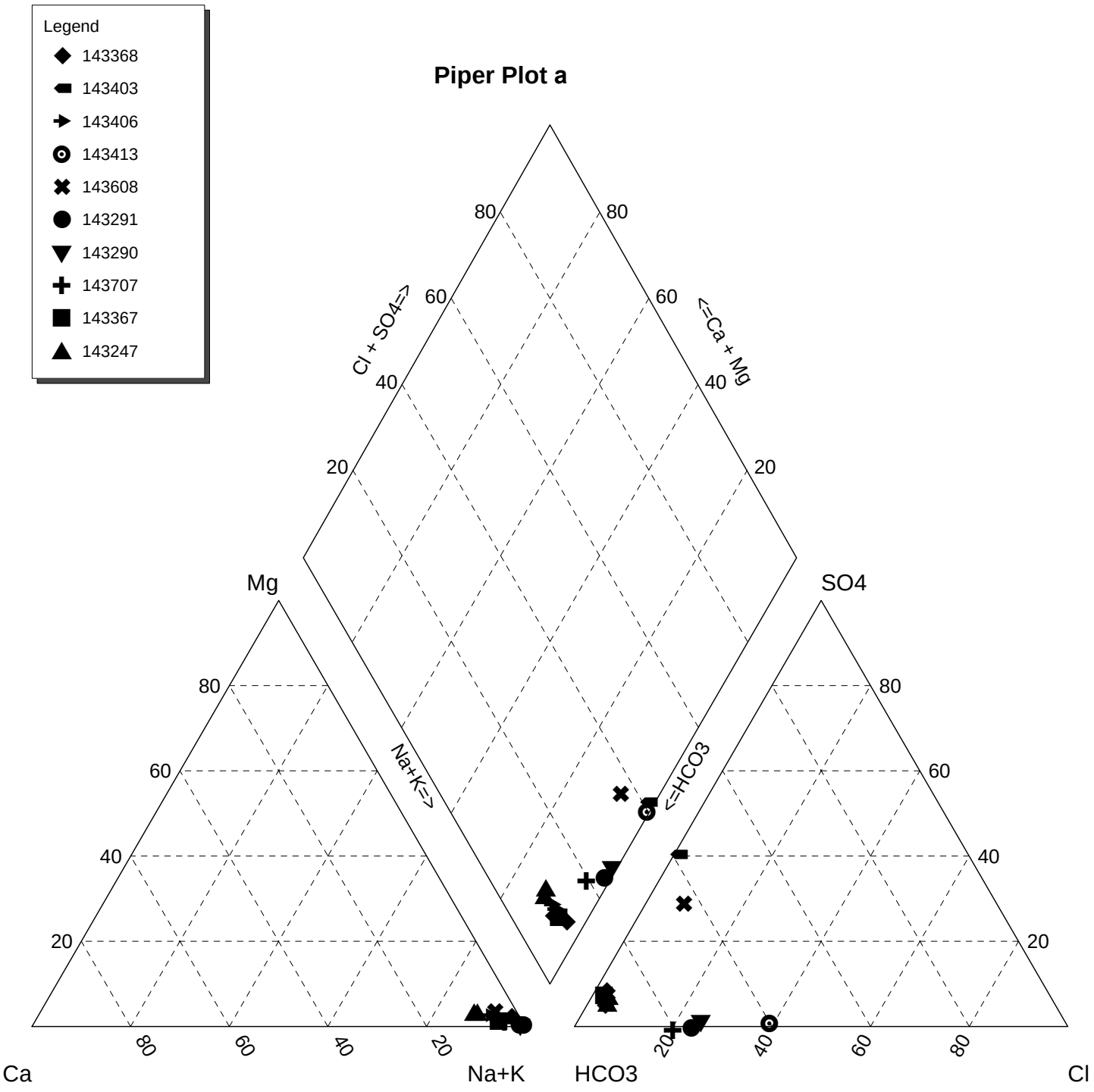
HYDROGEOLOGICAL ASSESSMENT
VILLAGE OF BAWLF LAGOON

HYDROGEOLOGICAL CROSS - SECTION
WEST TO EAST

DWG No. 19-6835-1-4H

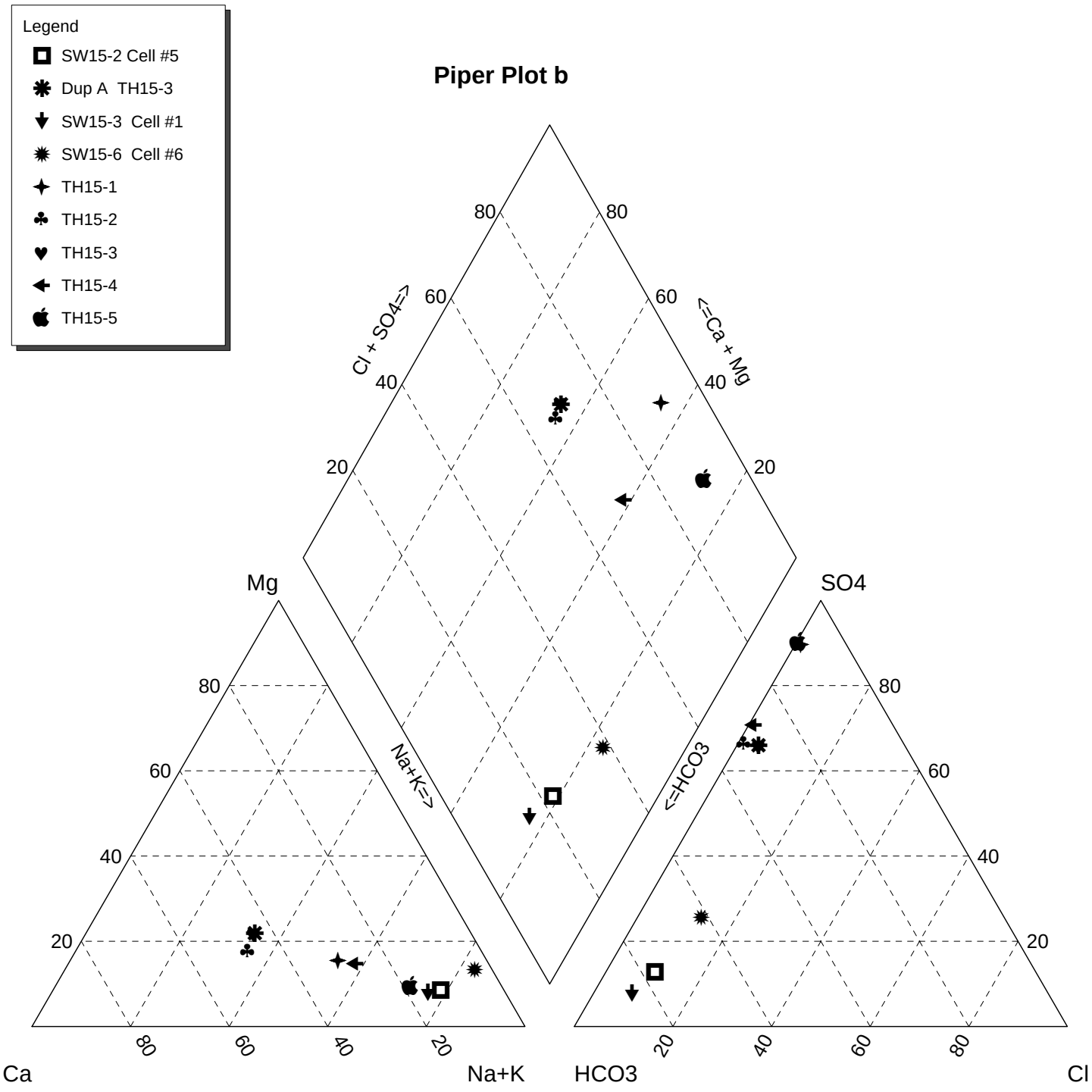
DRAWN BY	ML
DESIGNED BY	MJB
APPROVED BY	NHF
SCALE	H 1:3000 V 1:150
DATE	MARCH 2016
FILE No.	19-6835-1

THURBER ENGINEERING LTD.



DESCRIPTION: Piper Plot - Water Wells

Company Logo	PROJECT: Village of Bawlf	PROJECT NO: 19-6835-1
	CLIENT: Village of Bawlf	DATE: January 14, 2016



DESCRIPTION: Piper Plot - Lagoon and Monitoring Wells

Company Logo	PROJECT: Village of Bawlf	PROJECT NO: 19-6835-1
	CLIENT: Village of Bawlf	DATE: January 14, 2016

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APPENDIX B

Well Logs

CLIENT: VILLAGE OF BAWLF	PROJECT: Village of Bawlf Lagoon-Groundwater Assessment-Phase 1	BOREHOLE NO: **TH15-1**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: December 1, 2015	PROJECT NO: 19-6835-1
DRILL/METHOD: Track / Solid Stem Augers	LOCATION: N5863873.46, E400272.04	ELEVATION: 707.56 (m)

SAMPLE TYPE

BACKFILL TYPE ■ BENTONITE □ SAND ▯ SLOUGH

DEPTH (m)	SAMPLE TYPE	REMARKS	SOIL DESCRIPTION	ELEVATION (m)
0			TOPSOIL, brown, silty clay, roots to 0.1m	
			CLAY (FILL) dark brown, silty, trace topsoil and silt lenses	707
1				
				706
2				
				705
3				
			CLAY mottled grey - brown, silty, trace silt lenses and gravel	704
4				
				703
5			-grey	
				702
6		-Seepage		
				701
7			END OF TEST HOLE AT 6.8m UPON COMPLETION: (Below ground surface) -Slough at 6.5m -No water Standpipe piezometer installed WATER LEVEL BELOW GROUND SURFACE: -December 1, 2015 = Dry	700
8				
				699
9				
				698
10				

THURBER ENGINEERING LTD.

FIELD LOGGED BY: JLM	COMPLETION DEPTH: 6.8 m
PREPARED BY: MJB	COMPLETION DATE: 12/1/15
REVIEWED BY:	Page 1 of 1

BOREHOLE LOG 19-6835-1.GPJ THRBR_AB.GDT 1/25/16- LIBRARY-NEW LOGO - N E.GLB

CLIENT: VILLAGE OF BAWLF	PROJECT: Village of Bawlf Lagoon-Groundwater Assessment-Phase 1	BOREHOLE NO: **TH15-2**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: December 1, 2015	PROJECT NO: 19-6835-1
DRILL/METHOD: Track / Solid Stem Augers	LOCATION: N5863959.58, E400337.97	ELEVATION: 707.65 (m)
SAMPLE TYPE		
BACKFILL TYPE ■ BENTONITE □ SAND		

DEPTH (m)	SAMPLE TYPE	REMARKS	SOIL DESCRIPTION	ELEVATION (m)
0			TOPSOIL, brown, silty clay, roots to 0.2m	
			CLAY (FILL) brown, silty, trace silt lenses and topsoil, occasional gravel	707
1				
				706
2				
				705
3				
			CLAY mottled grey - brown, silty, trace oxides, coal, and gravel	704
4				
				703
5				
		-Seepage		702
6			-fine sand lenses	
				701
7			END OF TEST HOLE AT 6.8m UPON COMPLETION: (Below ground surface) -No slough -Water at 6.6m Standpipe piezometer installed WATER LEVEL BELOW GROUND SURFACE: -December 1, 2015 = 6.06m	700
8				
				699
9				
				698
10				

THURBER ENGINEERING LTD.

FIELD LOGGED BY: JLM	COMPLETION DEPTH: 6.8 m
PREPARED BY: MJB	COMPLETION DATE: 12/1/15
REVIEWED BY:	Page 1 of 1

BOREHOLE LOG 19-6835-1.GPJ THRBR_AB.GDT 1/25/16 - LIBRARY-NEW LOGO - N E.GLB

CLIENT: VILLAGE OF BAWLF	PROJECT: Village of Bawlf Lagoon-Groundwater Assessment-Phase 1	BOREHOLE NO: **TH15-3**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: December 1, 2015	PROJECT NO: 19-6835-1
DRILL/METHOD: Track / Solid Stem Augers	LOCATION: N5863906.07, E400646.36	ELEVATION: 707.34 (m)

SAMPLE TYPE

BACKFILL TYPE ■ BENTONITE □ SAND ▥ SLOUGH

DEPTH (m)	SAMPLE TYPE	REMARKS		SOIL DESCRIPTION	ELEVATION (m)
0				TOPSOIL, dark brown, silty clay	707
				CLAY (FILL) dark brown, silty, roots, trace topsoil and gravel	
1					706
2					705
3		-Seepage			
				CLAY mottled grey - brown, silty, trace gravel and silt lenses	704
4					
				-brown, sandy	703
5					
				END OF TEST HOLE AT 5.3m UPON COMPLETION: (Below ground surface) -Slough at 3.8m -Water at 4.4m Standpipe piezometer installed WATER LEVEL BELOW GROUND SURFACE: -December 1, 2015 = 2.79m	702
6					701
7					700
8					699
9					698
10					

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FIELD LOGGED BY: JLM	COMPLETION DEPTH: 5.3 m
PREPARED BY: MJB	COMPLETION DATE: 12/1/15
REVIEWED BY:	Page 1 of 1

BOREHOLE LOG 19-6835-1.GPJ THRBR_AB.GDT 1/25/16- LIBRARY-NEW LOGO - N E.GLB

CLIENT: VILLAGE OF BAWLF	PROJECT: Village of Bawlf Lagoon-Groundwater Assessment-Phase 1	BOREHOLE NO: **TH15-4**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: December 1, 2015	PROJECT NO: 19-6835-1
DRILL/METHOD: Track / Solid Stem Augers	LOCATION: N5863724.27, E400395.03	ELEVATION: 707.42 (m)

SAMPLE TYPE

BACKFILL TYPE ■ BENTONITE □ SAND ▥ SLOUGH

DEPTH (m)	SAMPLE TYPE	REMARKS	SOIL DESCRIPTION	ELEVATION (m)
0			TOPSOIL, brown, silty clay	
			CLAY (FILL) dark brown, silty, trace topsoil and gravel	707
1				706
2				705
3				
			CLAY mottled grey - brown, silty, trace gravel, silt lenses, oxides, and gypsum	704
4				703
5			-silt lenses	702
6			-grey	701
7			END OF TEST HOLE AT 6.8m UPON COMPLETION: (Below ground surface) -Slough at 6.5m -No water Standpipe piezometer installed WATER LEVEL BELOW GROUND SURFACE: -December 1, 2015 = 3.26m	700
8				699
9				698
10				

THURBER ENGINEERING LTD.

FIELD LOGGED BY: JLM	COMPLETION DEPTH: 6.8 m
PREPARED BY: MJB	COMPLETION DATE: 12/1/15
REVIEWED BY:	Page 1 of 1

BOREHOLE LOG 19-6835-1.GPJ THRBR_AB.GDT 1/25/16- LIBRARY-NEW LOGO - N E.GLB

CLIENT: VILLAGE OF BAWLF	PROJECT: Village of Bawlf Lagoon-Groundwater Assessment-Phase 1	BOREHOLE NO: **TH15-5**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: December 1, 2015	PROJECT NO: 19-6835-1
DRILL/METHOD: Track / Solid Stem Augers	LOCATION: N5863856.88, E400440.19	ELEVATION: 707.93 (m)

SAMPLE TYPE

BACKFILL TYPE ■ BENTONITE □ SAND ▯ SLOUGH

DEPTH (m)	SAMPLE TYPE	REMARKS	SOIL DESCRIPTION	ELEVATION (m)
0			TOPSOIL, brown, silty clay, roots to 0.2m, occasional gravel	
1			CLAY (FILL) mottled light brown - dark brown, silty, occasional gravel and silt lenses	707
2				706
			TOPSOIL AND CLAY (FILL), black, occasional gravel	
3			CLAY (FILL) mottled light brown - dark brown, silty, occasional gravel and silt lenses	705
4			-dark brown	704
5				703
		-Seepage	-grey, occasional dark brown, trace gravel and silt lenses	
6				702
7				701
8				700
			-grey	
			CLAY grey, sandy, trace gravel	
9				699
10				698

BOREHOLE LOG 19-6835-1.GPJ THRBR_AB.GDT 1/25/16- LIBRARY-NEW LOGO - N E.GLB

THURBER ENGINEERING LTD.

FIELD LOGGED BY: JLM	COMPLETION DEPTH: 10.7 m
PREPARED BY: MJB	COMPLETION DATE: 12/1/15
REVIEWED BY:	Page 1 of 2

CLIENT: VILLAGE OF BAWLF	PROJECT: Village of Bawlf Lagoon-Groundwater Assessment-Phase 1	BOREHOLE NO: **TH15-5**
DRILLING COMPANY: Mobile Augers & Research Ltd.	DATE DRILLED: December 1, 2015	PROJECT NO: 19-6835-1
DRILL/METHOD: Track / Solid Stem Augers	LOCATION: N5863856.88, E400440.19	ELEVATION: 707.93 (m)

SAMPLE TYPE

BACKFILL TYPE ■ BENTONITE □ SAND ▥ SLOUGH

DEPTH (m)	SAMPLE TYPE	REMARKS	SLOTTED PIEZOMETER	SOIL DESCRIPTION	ELEVATION (m)
10				CLAY - CONTINUED	
				END OF TEST HOLE AT 10.7m UPON COMPLETION: (Below ground surface) -Slough at 9.7m Standpipe piezometer installed WATER LEVEL BELOW GROUND SURFACE: -December 1, 2015 = 9.20m	
11					697
12					696
13					695
14					694
15					693
16					692
17					691
18					690
19					689
20					688

THURBER ENGINEERING LTD.

FIELD LOGGED BY: JLM	COMPLETION DEPTH: 10.7 m
PREPARED BY: MJB	COMPLETION DATE: 12/1/15
REVIEWED BY:	Page 2 of 2

BOREHOLE LOG 19-6835-1.GPJ THRBR_AB.GDT 1/25/16- LIBRARY-NEW LOGO - N E.GLB

THURBER

APPENDIX C

Tables

THURBER

Table 1 - Monitoring Wells Measurements and Summary of In Situ Testing

Monitoring Well ID	x (utm 12)	y (utm 12)	Ground Surface Elevation	Top of Casing Elevation	Stickout (m)	Water Level Depth-btc- (Jan 11, 2016)	Water Level Elevation-(Jan 11, 2016)	Conductivity- Bouwer & Rice (m/sec)	Conductivity- Cooper & others (m/sec)	Conductivity- Average (m/sec)
TH15-1	400272.04	5863873.46	707.56	708.40	0.84	5.35	703.05	1.19E-09	1.62E-09	1.41E-09
TH15-2	400337.97	5863959.58	707.65	708.49	0.84	3.06	705.43	1.02E-09	1.01E-09	1.02E-09
TH15-3	400646.36	5863906.07	707.34	708.10	0.76	3.10	705.00	8.63E-07	1.14E-06	1.00E-06
TH15-4	400395.03	5863724.27	707.42	708.24	0.82	2.82	705.42	7.66E-07	6.03E-07	6.85E-07
TH15-5	400440.19	5863856.88	707.93	708.74	0.81	7.25	701.49	3.37E-09	1.72E-09	2.55E-09
									Geomean	***1.90E-08***

THURBER

Table 2 Lagoon and Monitoring Wells Water Chemistry

Sample Description				Guideline Limit	TH15-1	TH15-2	TH15-3	Dup A TH15-3	TH15-4	TH15-5	SW15-2 Cell #5	SW15-3 Cell #1	SW15-6 Cell #6
Analyte	**Parameter Description**	**Unit**	**Detection Limit**	**0**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**	**Result**
Aggregate Organic Constituents													
Chemical Oxygen Demand	0	mg/L	5	0	193	308	96	100	35	59	656	17100	2710
Inorganic Nonmetallic Parameters													
Kjeldahl Nitrogen	Total	mg/L	0.07	0	2.97	2.74	2.16	2.67	1.56	3.89	62.5	320	30.4
Metals Dissolved													
Silicon	Dissolved	mg/L	0.05		5.32	11.1	15	14.8	10.4	9.65	8.31	7.73	7.38
Sulfur	Dissolved	mg/L	0.3		975	539	856	849	456	1600	53	28.4	239
Mercury	Dissolved	mg/L	0.000005	0.001*	0.000008	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	0.000019
Aluminum	Dissolved	mg/L	0.002	0.1***	0.051	0.009	<0.01	<0.01	<0.004	<0.01	0.01	0.021	<0.01
Antimony	Dissolved	mg/L	0.0002	0.006*	<0.001	<0.0004	<0.001	<0.001	<0.0004	<0.001	<0.0004	<0.0004	0.002
Arsenic	Dissolved	mg/L	0.0002	0.01*	0.002	0.0007	<0.001	<0.001	0.002	0.0079	0.0036	0.0024	**0.0756**
Barium	Dissolved	mg/L	0.001	1*	0.04	0.066	0.02	0.02	0.05	<0.005	0.049	0.059	0.12
Beryllium	Dissolved	mg/L	0.0001		<0.0005	<0.0002	<0.0005	<0.0005	<0.0002	<0.0005	<0.0002	<0.0002	<0.0005
Bismuth	Dissolved	mg/L	0.0005		<0.002	<0.001	<0.002	<0.002	<0.001	<0.002	<0.001	0.001	<0.002
Boron	Dissolved	mg/L	0.002	5*	0.19	0.225	0.15	0.16	0.339	0.524	0.405	0.331	1.01
Cadmium	Dissolved	mg/L	0.00001	0.005*	0.0001	0.0002	0.00026	0.00023	<0.00002	<0.00005	<0.00002	0.00003	<0.00005
Chromium	Dissolved	mg/L	0.0005	0.05*	<0.002	<0.001	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	<0.002
Cobalt	Dissolved	mg/L	0.0001		0.004	0.006	0.007	0.0069	0.0069	<0.0005	0.0004	0.0009	0.0008
Copper	Dissolved	mg/L	0.001	1**	0.006	0.002	<0.005	<0.005	<0.002	<0.005	0.006	0.003	<0.005
Lead	Dissolved	mg/L	0.0001	0.01*	<0.0005	0.0004	<0.0005	<0.0005	<0.0002	<0.0005	<0.0002	<0.0002	<0.0005
Lithium	Dissolved	mg/L	0.001		0.49	0.319	0.48	0.47	0.294	0.589	0.093	0.078	0.3
Molybdenum	Dissolved	mg/L	0.001		<0.005	<0.002	<0.005	<0.005	<0.002	<0.005	<0.002	<0.002	<0.005
Nickel	Dissolved	mg/L	0.0005		0.019	0.0318	0.036	0.037	0.0062	0.003	0.0023	0.0031	0.013
Selenium	Dissolved	mg/L	0.0002	0.05*	0.001	0.0005	<0.001	<0.001	<0.0004	<0.001	0.0005	0.0005	<0.001
Silver	Dissolved	mg/L	0.00001		<0.00005	<0.00002	<0.00005	<0.00005	<0.00002	<0.00005	<0.00002	<0.00002	<0.00005
Strontium	Dissolved	mg/L	0.001		3.99	2.9	5.47	5.57	2.62	6.82	0.561	0.5	1.01
Thallium	Dissolved	mg/L	0.00005		<0.0003	0.0001	<0.0003	<0.0003	<0.0001	<0.0003	<0.0001	<0.0001	<0.0003
Tin	Dissolved	mg/L	0.001		<0.005	<0.002	<0.005	<0.005	<0.002	<0.005	<0.002	<0.002	<0.005
Titanium	Dissolved	mg/L	0.0005		<0.002	<0.001	<0.002	<0.002	<0.001	<0.002	<0.001	<0.001	0.003
Uranium	Dissolved	mg/L	0.0005	0.02*	**0.032**	**0.0208**	**0.103**	0.0974	0.0033	0.003	0.0054	0.0048	0.0051
Vanadium	Dissolved	mg/L	0.0001		<0.0005	0.0003	<0.0005	<0.0005	<0.0002	<0.0005	0.0004	<0.0002	0.0069
Zinc	Dissolved	mg/L	0.001	5**	0.02	0.02	0.005	0.006	0.007	0.01	0.008	0.009	0.006
Subsample	Field Filtered	0	0		Lab Filtered	Lab Filtered	Lab Filtered	Lab Filtered	Lab Filtered	Lab Filtered	Lab Filtered	Lab Filtered	Lab Filtered
Microbiological Analysis													
Total Coliforms	Membrane Filtration	CFU/100 mL	**1**	0*	**7000**	**300**	**1300**	**900**	0	0	**1100000**	**1600000**	**100**
Fecal Coliforms	Membrane Filtration	CFU/100 mL	1	0*	0	0	0	0	0	0	**200000**	**1600000**	**100**
Fecal Coliforms	MPN	MPN/100 mL	1.8		<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	0	0	0
Routine													
pH	0	0	0	6.5-8.5**	7.78	7.39	7.63	7.45	7.75	7.75	8.15	7.89	**8.63**
Temperature of observed pH	0	°C	0		18.8	18.5	18.7	18.6	19.6	19.1	18.5	21.3	18.7
Electrical Conductivity	at 25 °C	uS/cm	1		5080	3630	5380	5280	3230	8330	2190	2130	4670
Calcium	Dissolved	mg/L	0.2		446	499	750	739	226	440	61.2	65	45
Magnesium	Dissolved	mg/L	0.2		137	112	225	222	74.2	136	24.5	20	97.9
Sodium	Dissolved	mg/L	0.4	200**	**905**	**412**	**654**	**648**	**543**	**1940**	**411**	**346**	**1120**
Potassium	Dissolved	mg/L	0.4		16	14	13	13	17	18	20.4	19	47
Iron	Dissolved	mg/L	0.01	0.3**	<0.05	<0.02	<0.05	<0.05	<0.02	**2.28**	0.03	0.08	0.05
Manganese	Dissolved	mg/L	0.005	0.05**	**1.04**	**4.32**	**1.95**	1.92	**1.7**	**0.26**	**0.404**	**0.428**	**0.27**
Chloride	Dissolved	mg/L	0.4	250**	23.2	19.9	122	121	11.5	9	89.8	60.6	**265**
Nitrate - N	0	mg/L	0.01	10*	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrite - N	0	mg/L	0.005	1*	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.027	0.073	<0.025
Nitrate and Nitrite - N	0	mg/L	0.01	10*	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	0.03	0.07	<0.07
Sulfate (SO4)	Dissolved	mg/L	0.9	500**	**2920**	**1620**	**2570**	**2550**	**1370**	**4790**	159	85	**718**
Hydroxide	0	mg/L	5		<5	<5	<5	<5	<5	<5	<5	<5	<5
Carbonate	0	mg/L	6		<6	<6	<6	<6	<6	<6	<6	<6	119
Bicarbonate	0	mg/L	5		387	1010	1470	1470	696	649	1230	1170	2210
P-Alkalinity	as CaCO3	mg/L	5		<5	<5	<5	<5	<5	<5	<5	<5	99
T-Alkalinity	as CaCO3	mg/L	5		317	829	1200	1210	571	532	1010	957	2010
Total Dissolved Solids	Calculated	mg/L	1	500	**4640**	**3170**	**5050**	5010	**2580**	**7660**	**1370**	**1170**	**3500**
Hardness	Dissolved as CaCO3	mg/L	0		1680	1710	2800	2760	869	1660	254	245	520
Ionic Balance	Dissolved	%	0		108	103	105	104	103	107	91	90	96

Guideline; Health Canada GCDWQ. Guidelines for Canadian Drinking Water Quality. Health Canada.October 2014

* = MAC = Maximum Acceptable Concentration

** = AO = Aesthetic Objective

*** = OG = Operational Guideline for Water Treatment Plants

BOLD Does not meet applicable guidelines

THURBER

Table 3 Summary of Water Well Chemistry from ERCB water well database

WeiiID	Legal Location	SampleDate	Water Level (m)	Depth(m)	EC	F	PH	IONBAL	HCO3	CA	SIO2	F_EC	F_EH	PHEN	TH	K	SO4	NO2_NO3_N	MG	TA	CL	F_FE	NA	TDS	CO3	NO2	NO3
143247	NE-13-045-18W4M	FEB-19-1976	10	15	1200	0.33	0	0	829.0809	26.9999	0	0	0	0	94	3.172	39.0572	0.7994	7.0054	680	21.0302	0	341.0003	848	0	0.7	0
143247	NE-13-045-18W4M	JAN-9-1979	15	20	1292	0.29	0	0	795.0772	24.9999	13.5	0	0	0	87	2.66	50.0721	-0.0504	6.0046	662	17.0222	0	290.0001	788	6	-0.0504	0
143290	NW-34-045-18W4M	JUN-26-1979	10	17	2230	0.58	0	0	1097.1071	4	10	0	0	0	15	1.328	15.0216	-0.0504	1.0008	15	215.304	0	549.999	1338	11.001	-0.0504	0
143291	NW-34-045-18W4M	DEC-2-1986	17	0	2190	0.62	0	0	1111.1065	5	10	0	0	0	17	1.536	-5.0072	-0.0504	-1.0008	911	200.2804	0	520.0001	1279	0	-0.0504	0
143367	SW-19-045-17W4M	DEC-5-1984	9	0	1163	0.29	0	0	730.0723	12.9999	12	0	0	0	41	2.66	46.0654	-0.0504	2.0015	599	11.0156	0	290.0001	724	0	-0.0504	0
143368	SW-19-045-17W4M	AUG-5-1981	27	12	1100	0.32	0	0	709.0672	4	13	0	0	0	22	2.864	52.0779	-0.0504	3.0023	581	10.0146	0	242.9996	663	0	-0.0504	0
143368	SW-19-045-17W4M	DEC-5-1984	9	0	1350	0.27	0	0	859.0874	16.9999	12.7	0	0	0	59	2.66	37.0562	-0.0504	4.0031	705	19.028	0	334.9996	838	0	-0.0504	0
143394	NW-30-045-17W4M	MAR-3-1959	14	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	1040	150.2112	0	0	1422	0	0	0
143394	NW-30-045-17W4M	JUN-3-1959	8	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	690	325.4569	0	0	1236	0	0	0
143400	04-31-045-17W4M	MAR-19-1965	29	0	0	0	0	0	0	0	0	0	0	0	30	0	25.036	0	0	400	1101.5508	0	0	2584	0	0	0
143401	SW-31-045-17W4M	MAR-29-1958	9	0	0	0	0	0	0	0	0	0	0	0	35	0	20.0288	0	0	420	1055.486	0	0	2256	0	0	0
143402	SW-31-045-17W4M	OCT-25-1960	1	0	0	0	0	0	0	0	0	0	0	0	45	0	0	0	0	410	986.3888	0	0	2160	0	0	0
143403	SW-31-045-17W4M	FEB-20-1981	0	0	2220	0.2	0	0	921.0898	6	8.3	0	0	0	18	1.74	497.7244	-0.0504	-1.0008	778	7.0112	0	576.0005	1555	12.999	-0.0504	0
143406	SW-31-045-17W4M	FEB-3-1978	10	0	1350	0.28	0	0	832.0834	14.9999	13	0	0	0	58	2.66	49.0716	0.7	5.0038	687	17.0222	0	319.999	824	-5.001	-0.0994	0
143406	SW-31-045-17W4M	NOV-16-1978	30	0	1324	0.25	0	0	847.0836	17.9999	13.6	0	0	0	64	2.252	52.0779	0.749	5.0038	695	15.02	0	311.9996	825	0	-0.0504	0
143409	04-31-045-17W4M	AUG-17-1957	0	0	0	0	0	0	0	0	0	0	0	0	30	0	37.0562	0	0	870	54.0772	0	0	1108	0	0	0
143409	04-31-045-17W4M	MAR-13-1952	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	445	846.1922	0	0	1896	0	0	0
143410	04-31-045-17W4M	AUG-17-1957	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0	0	0	535	658.9297	0	0	1696	0	0	0
143413	NE-31-045-17W4M	OCT-4-1984	0	0	2160	0.82	0	0	809.0766	-1	7.5	0	0	0	-5	1.636	7.0082	-0.0504	-1.0008	664	305.4314	0	509.9997	1224	0	-0.0504	0
143414	SW-33-045-17W4M	AUG-17-1966	0	0	0	0	0	0	0	0	0	0	0	0	190	0	195.286	0	0	690	22.0313	0	0	1174	0	0	0
143415	05-33-045-17W4M	MAY-2-1966	0	0	0	0	0	0	0	0	0	0	0	0	200	0	145.2091	0	0	710	17.0222	0	0	1156	0	0	0
143608	SW-06-046-17W4M	OCT-19-1972	6	86	2000	0.52	0	0	0	9	0	0	0	0	42	0	53.0784	-0.0994	0	908	64.0917	0	0	1320	0	0	0
143608	SW-06-046-17W4M	JUN-13-1973	27	80	2570	0.4	0	0	1113.1081	23.9999	0	0	0	0	109	3.172	398.5806	0	12.0104	918	78.1106	0	577.9992	2191	0	-0.0504	0.0798
143702	SE-01-046-18W4M	JUN-25-1963	28	160	0	0	0	0	0	0	0	0	0	0	15	0	32.049	0	0	810	45.0637	0	0	1074	0	0	0
143707	SE-03-046-18W4M	FEB-13-1976	3	60	2050	0.42	0	0	1261.1267	18.9999	0	0	0	0	58	2.66	-10.0144	-0.0994	3.0023	1035	184.2592	0	554.001	1382	0	-0.0994	0
143709	SW-03-046-18W4M	DEC-3-1969	18	65	0	0	0	0	0	0	0	0	0	0	52	0	589.8599	0	0	723	40.0546	0	0	1764	0	0	0.6202

THURBER

APPENDIX D

In Situ Hydraulic Conductivity Testing Graphs

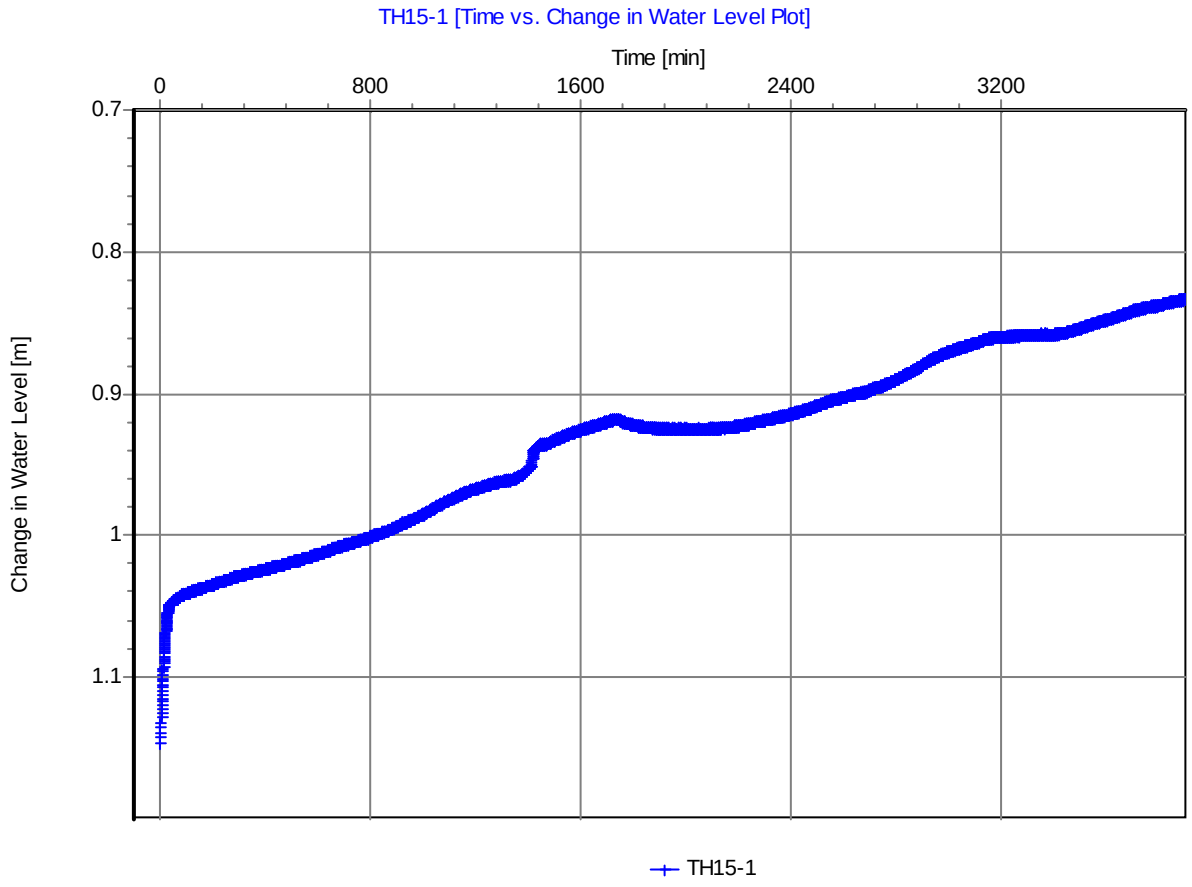
Thurber Engineering Ltd.
4127 Roper Road
Edmonton, Alberta, T6B 3S5
Phone: 780 438-1460

Slug Test Analysis Report

Project: Sewage Lagoon Groundwater Assessment

Number: 19-6835-1

Client: Village of Bawlf



Slug Test: **TH15-1**

Analysis Method: **Time vs. Change in Water Level Plot**

Analysis Results:

Test parameters:

Test Well:	TH15-1	Aquifer Thickness:	1.2 [m]
Casing radius:	0.025 [m]		
Screen length:	1.2 [m]		
Boring radius:	0.08 [m]		

Comments:

Evaluated by: Milan B

Evaluation Date: 1/20/2016

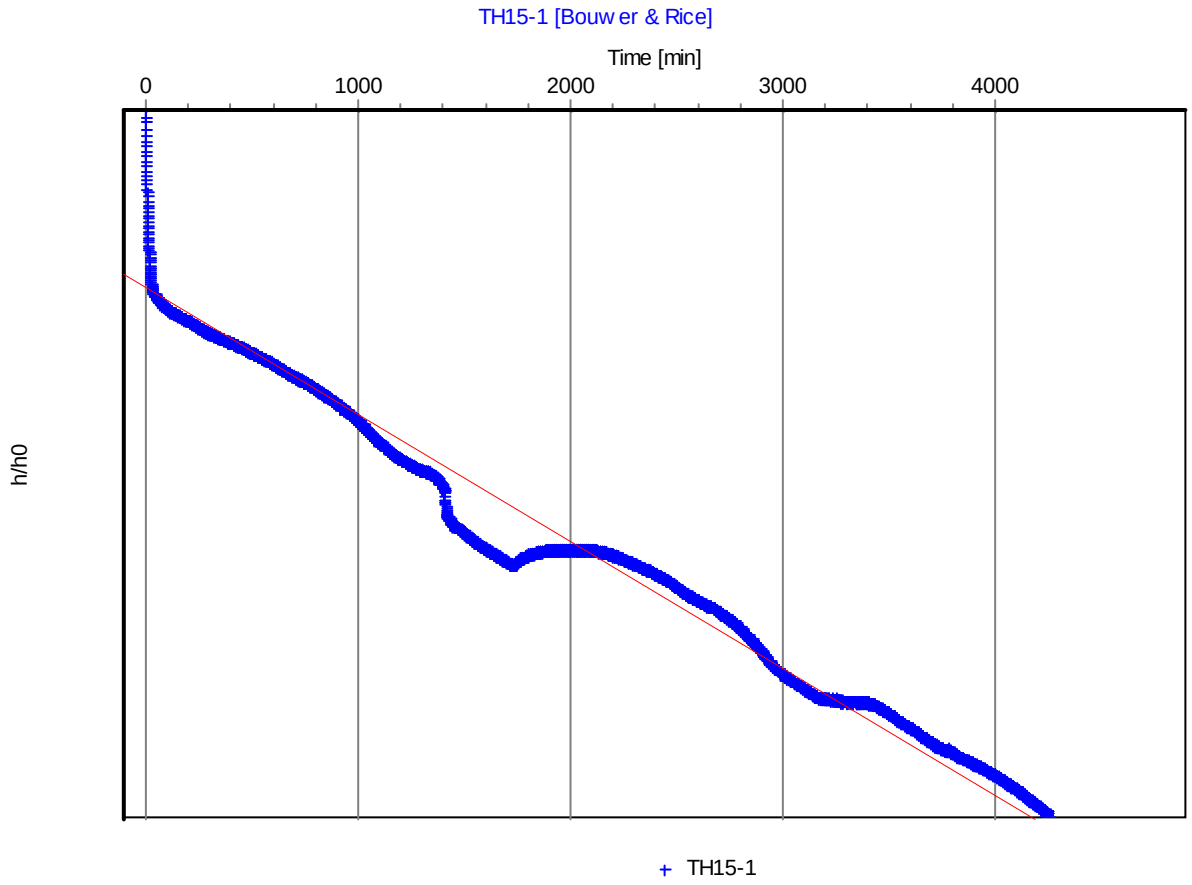
Thurber Engineering Ltd.
4127 Roper Road
Edmonton, Alberta, T6B 3S5
Phone: 780 438-1460

Slug Test Analysis Report

Project: Sewage Lagoon Groundwater Assessment

Number: 19-6835-1

Client: Village of Bawlf



Slug Test: **TH15-1**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 1.19E-9 [m/s]

Test parameters:

Test Well:	TH15-1	Aquifer Thickness:	1.2 [m]
Casing radius:	0.025 [m]	Gravel Pack Porosity (%)	10
Screen length:	1.2 [m]		
Boring radius:	0.08 [m]		
r(eff):	0.035 [m]		

Comments:

Evaluated by: Milan B

Evaluation Date: 1/20/2016

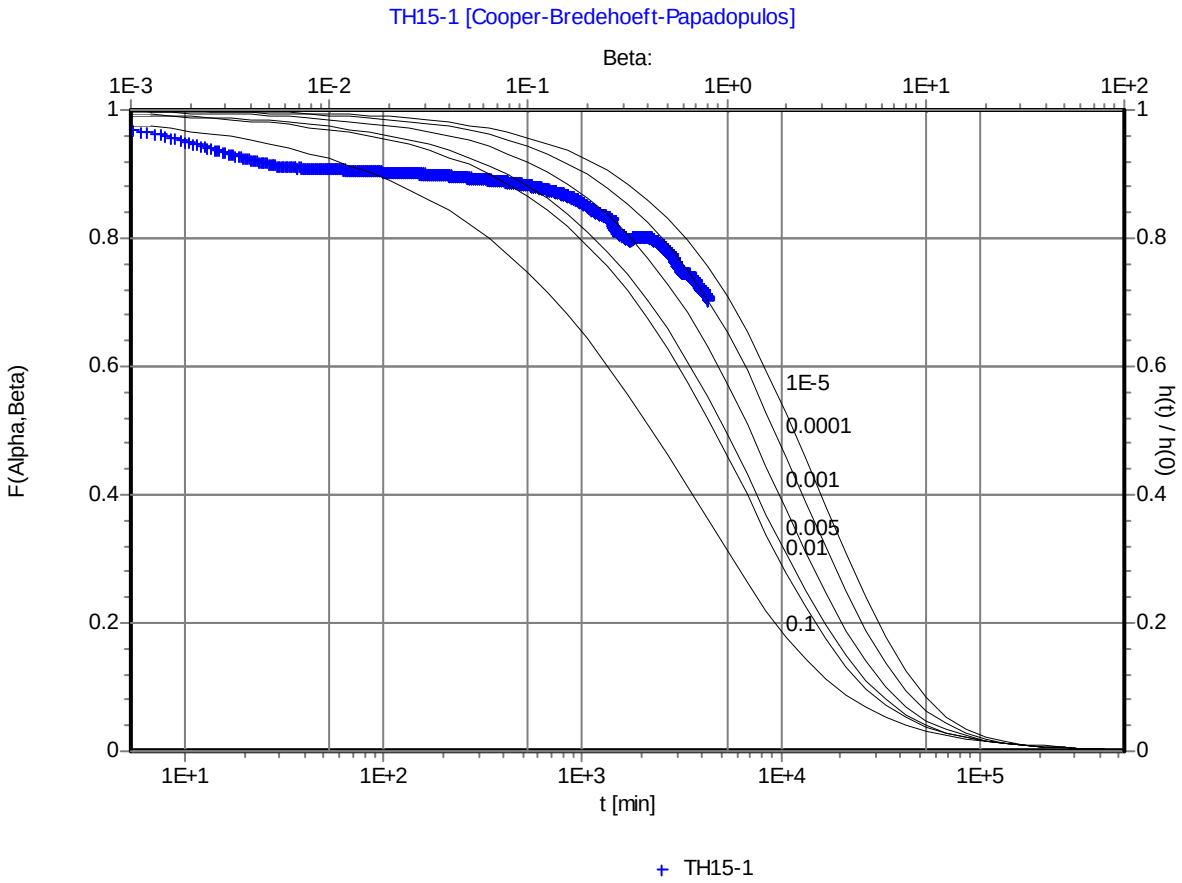
Thurber Engineering Ltd.
4127 Roper Road
Edmonton, Alberta, T6B 3S5
Phone: 780 438-1460

Slug Test Analysis Report

Project: Sewage Lagoon Groundwater Assessment

Number: 19-6835-1

Client: Village of Bawlf



Slug Test: **TH15-1**

Analysis Method: **Cooper-Bredehoeft-Papadopulos**

Analysis Results:	Transmissivity:	1.95E-9 [m²/s]	Conductivity:	1.62E-9 [m/s]
	Storativity:	4.88E-4		
Test parameters:	Test Well:	TH15-1	Aquifer Thickness:	1.2 [m]
	Casing radius:	0.025 [m]	Alpha:	0.005
	Screen length:	1.2 [m]		
	Boring radius:	0.08 [m]		
	r(c):	0.08 [m]		

Comments:

Evaluated by: Milan B

Evaluation Date: 1/26/2016

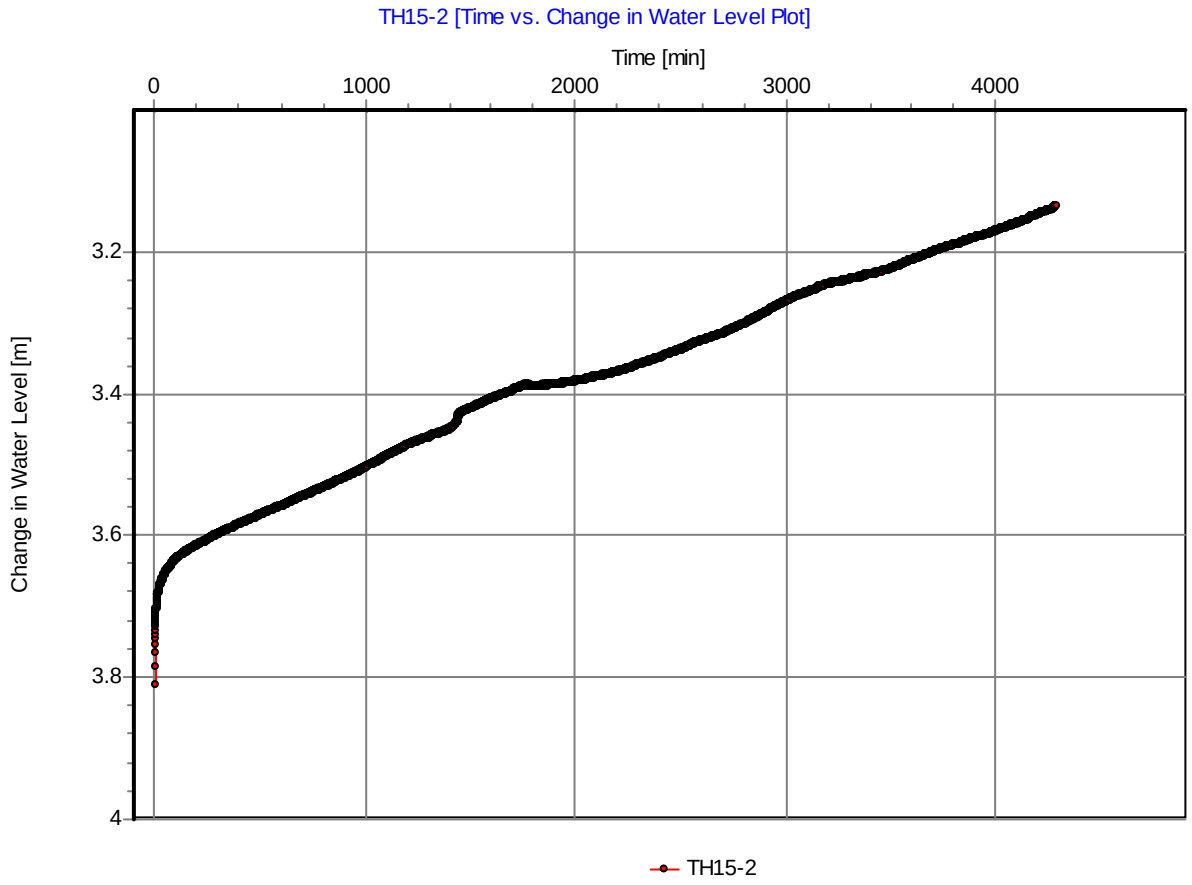
Thurber Engineering Ltd.
4127 Roper Road
Edmonton, Alberta, T6B 3S5
Phone: 780 438-1460

Slug Test Analysis Report

Project: Sewage Lagoon Groundwater Assessment

Number: 19-6835-1

Client: Village of Bawlf



Slug Test: **TH15-2**

Analysis Method: **Time vs. Change in Water Level Plot**

Analysis Results:

Test parameters:				
	Test Well:	TH15-2	Aquifer Thickness:	1.68 [m]
	Casing radius:	0.025 [m]		
	Screen length:	1.68 [m]		
	Boring radius:	0.08 [m]		

Comments:

Evaluated by: Milan B

Evaluation Date: 1/20/2016

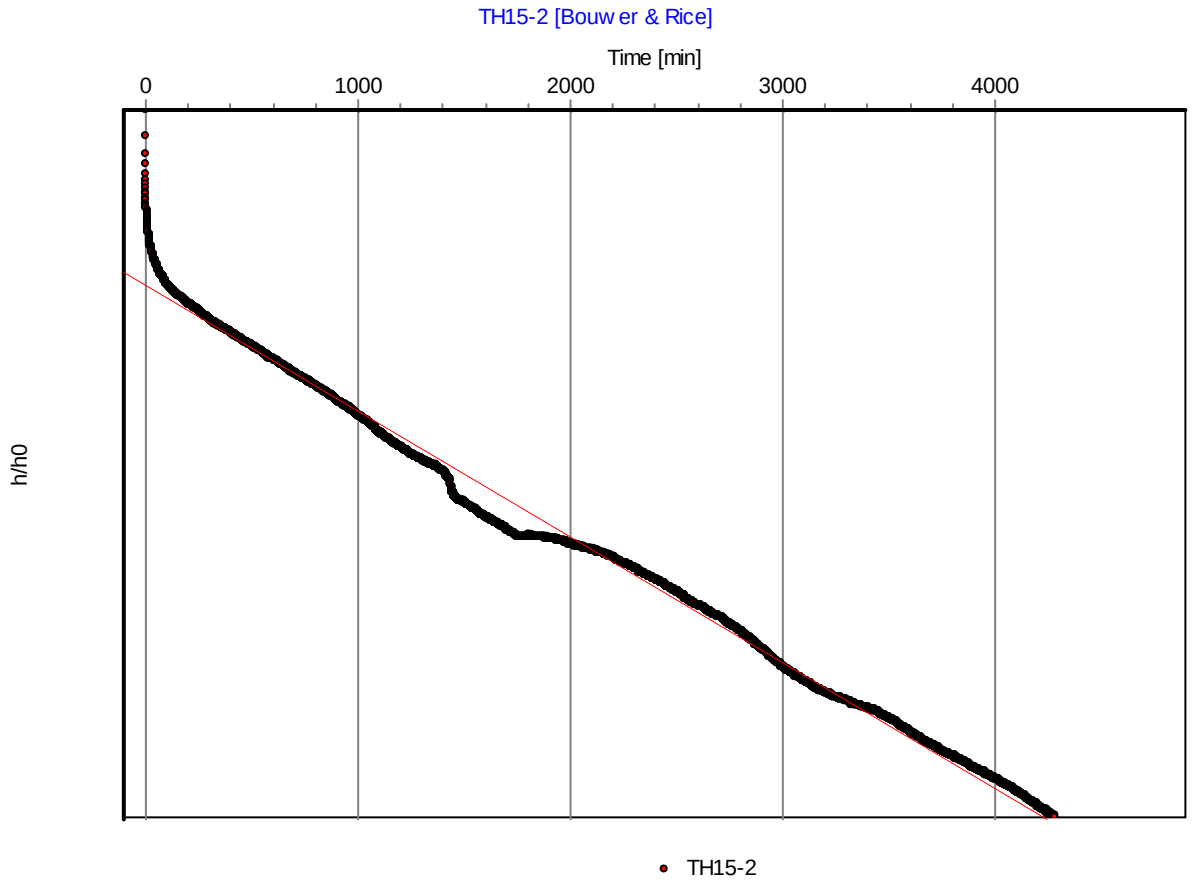
Thurber Engineering Ltd.
4127 Roper Road
Edmonton, Alberta, T6B 3S5
Phone: 780 438-1460

Slug Test Analysis Report

Project: Sewage Lagoon Groundwater Assessment

Number: 19-6835-1

Client: Village of Bawlf



Slug Test: **TH15-2**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 1.02E-9 [m/s]

Test parameters:

Test Well:	TH15-2	Aquifer Thickness:	1.68 [m]
Casing radius:	0.025 [m]	Gravel Pack Porosity (%)	25
Screen length:	1.68 [m]		
Boring radius:	0.08 [m]		
r(eff):	0.045 [m]		

Comments:

Evaluated by: Milan B

Evaluation Date: 1/20/2016

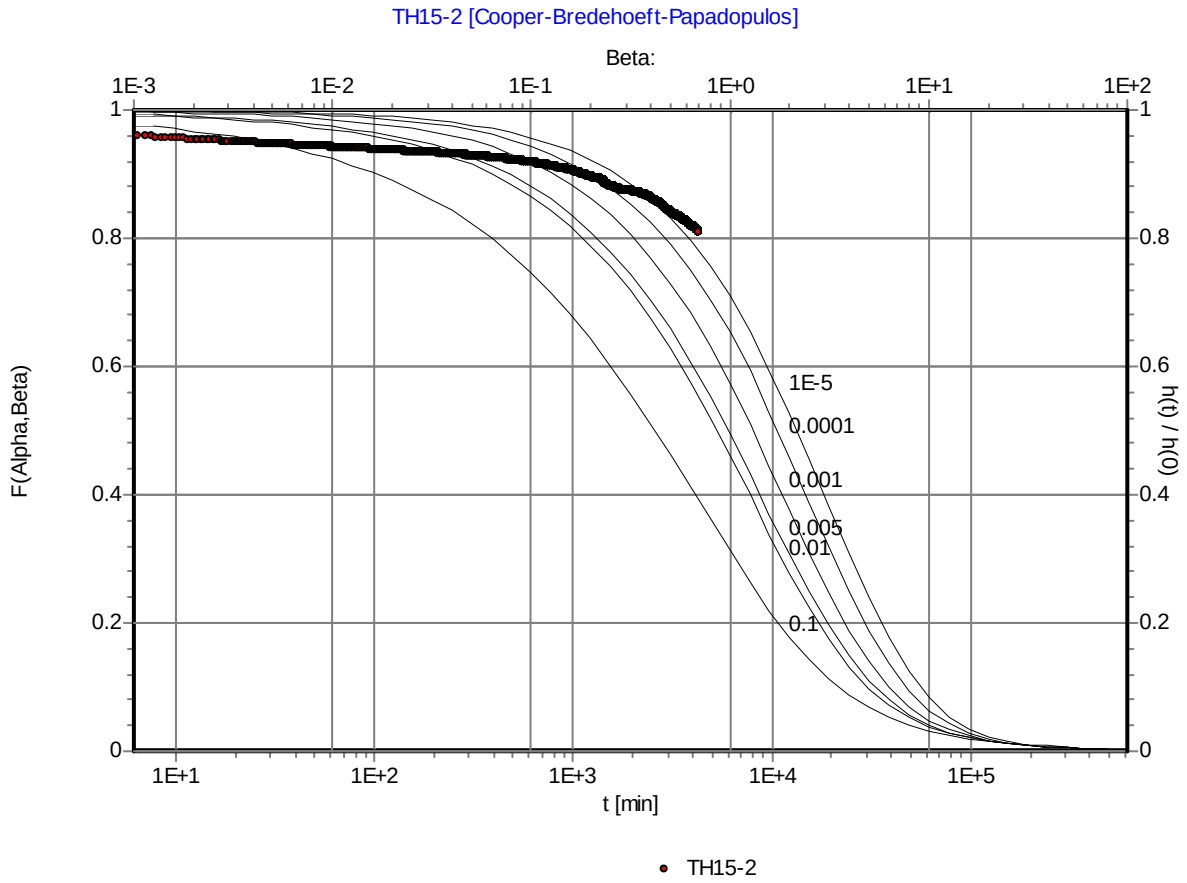
Thurber Engineering Ltd.
4127 Roper Road
Edmonton, Alberta, T6B 3S5
Phone: 780 438-1460

Slug Test Analysis Report

Project: Sewage Lagoon Groundwater Assessment

Number: 19-6835-1

Client: Village of Bawlf



Slug Test: **TH15-2**

Analysis Method: **Cooper-Bredehoeft-Papadopulos**

Analysis Results:	Transmissivity:	1.69E-9 [m²/s]	Conductivity:	1.01E-9 [m/s]
	Storativity:	4.88E-4		
Test parameters:	Test Well:	TH15-2	Aquifer Thickness:	1.68 [m]
	Casing radius:	0.025 [m]	Alpha:	0.005
	Screen length:	1.68 [m]		
	Boring radius:	0.08 [m]		
	r(c):	0.08 [m]		

Comments:

Evaluated by: Milan B

Evaluation Date: 1/26/2016

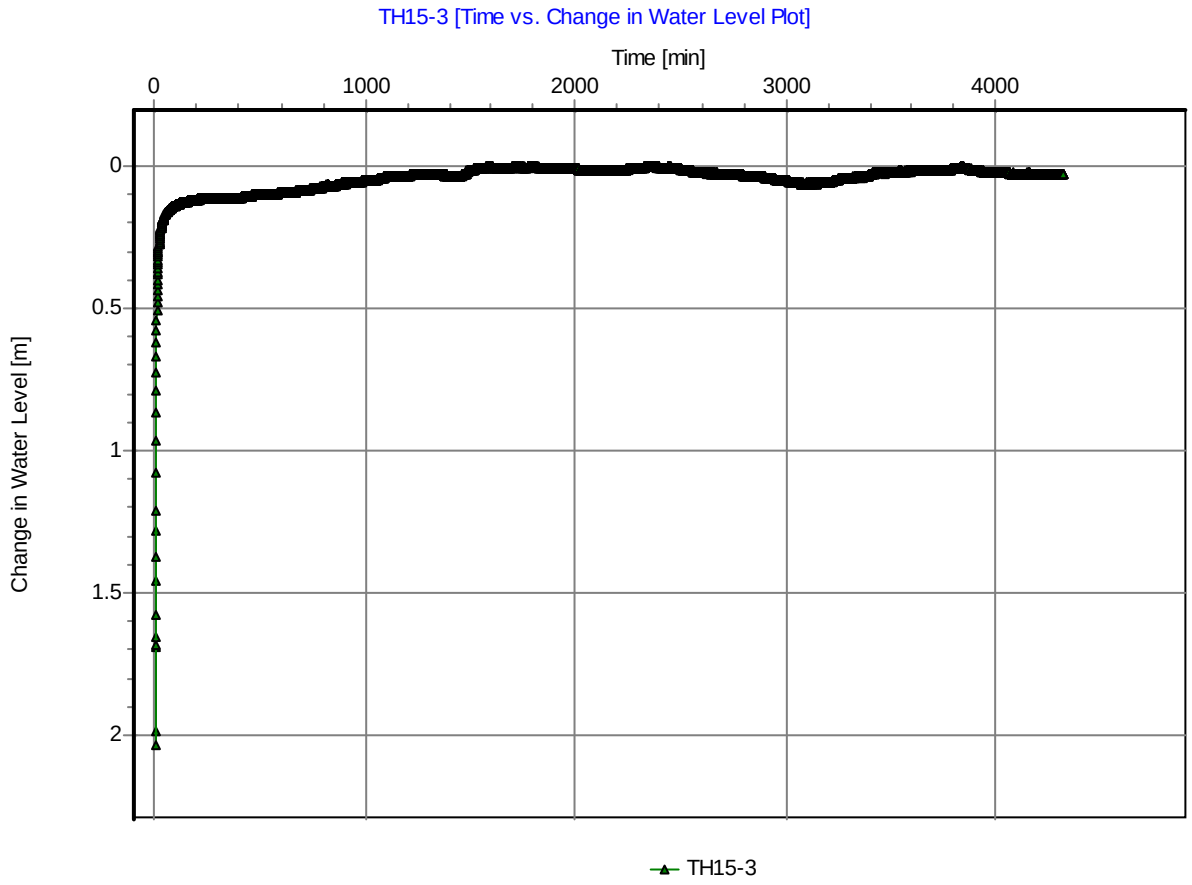
Thurber Engineering Ltd.
4127 Roper Road
Edmonton, Alberta, T6B 3S5
Phone: 780 438-1460

Slug Test Analysis Report

Project: Sewage Lagoon Groundwater Assessment

Number: 19-6835-1

Client: Village of Bawlf



Slug Test: **TH15-3**

Analysis Method: **Time vs. Change in Water Level Plot**

Analysis Results:

Test parameters:

Test Well:	TH15-3	Aquifer Thickness:	1.85 [m]
Casing radius:	0.025 [m]		
Screen length:	1.85 [m]		
Boring radius:	0.08 [m]		

Comments:

Evaluated by: Milan B

Evaluation Date: 1/21/2016

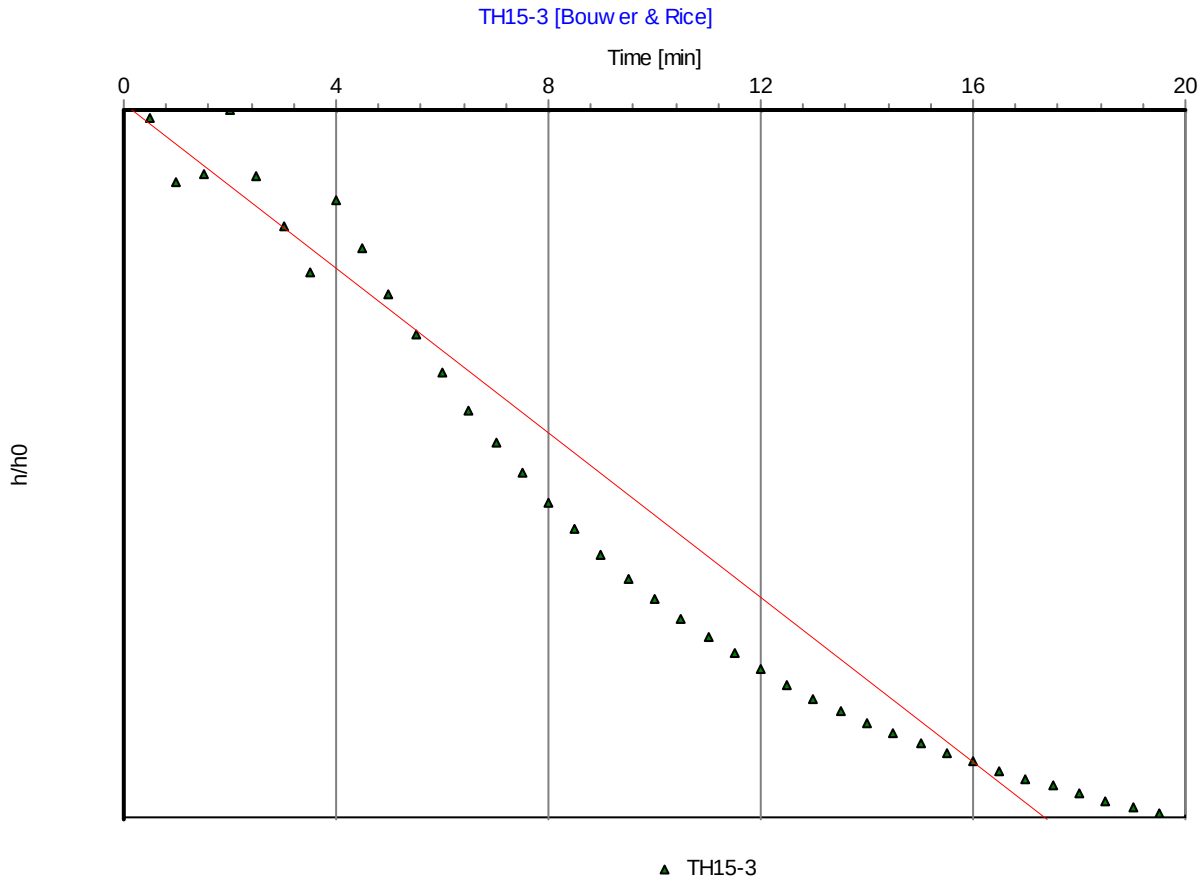
Thurber Engineering Ltd.
4127 Roper Road
Edmonton, Alberta, T6B 3S5
Phone: 780 438-1460

Slug Test Analysis Report

Project: Sewage Lagoon Groundwater Assessment

Number: 19-6835-1

Client: Village of Bawlf



Slug Test: **TH15-3**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 8.63E-7 [m/s]

Test parameters:

Test Well:	TH15-3	Aquifer Thickness:	1.85 [m]
Casing radius:	0.025 [m]	Gravel Pack Porosity (%)	25
Screen length:	1.85 [m]		
Boring radius:	0.08 [m]		
r(eff):	0.045 [m]		

Comments:

Evaluated by: Milan B

Evaluation Date: 1/26/2016

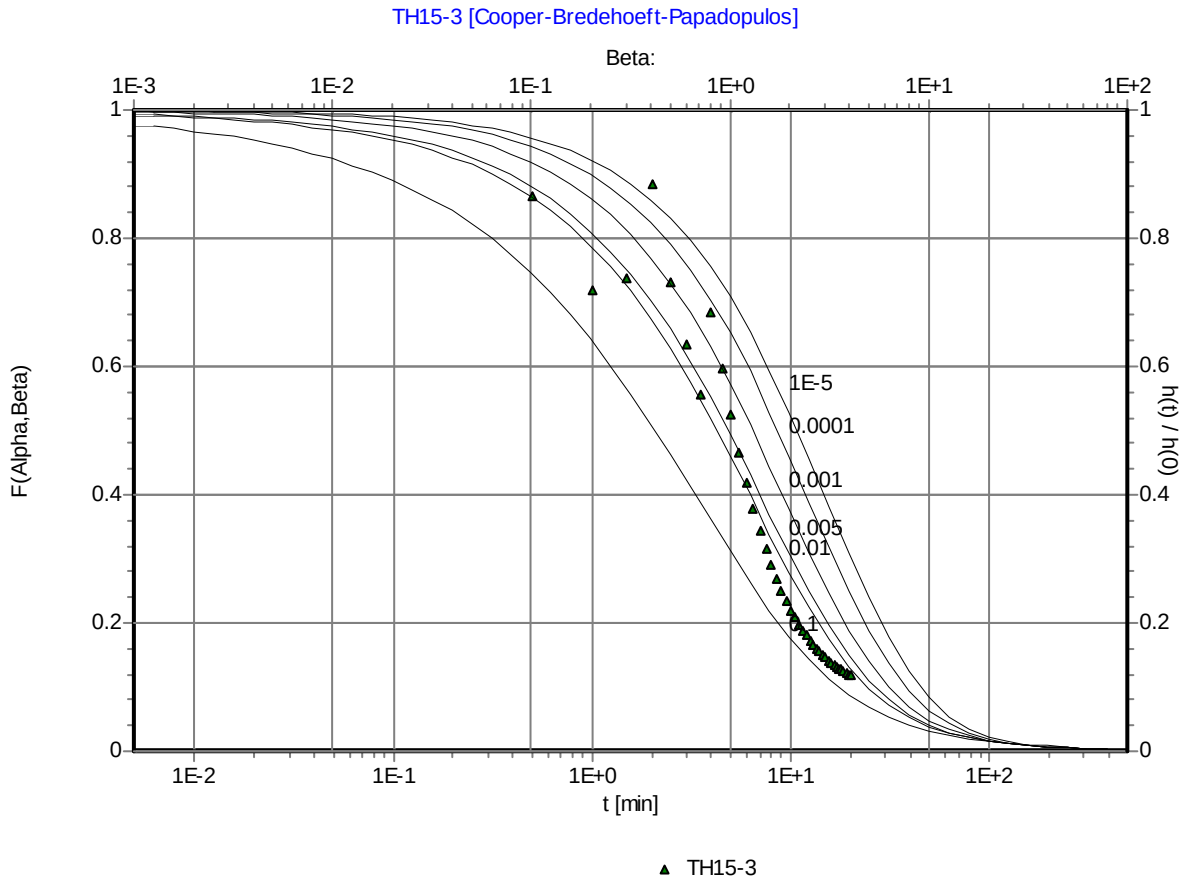
Thurber Engineering Ltd.
4127 Roper Road
Edmonton, Alberta, T6B 3S5
Phone: 780 438-1460

Slug Test Analysis Report

Project: Sewage Lagoon Groundwater Assessment

Number: 19-6835-1

Client: Village of Bawlf



Slug Test: **TH15-3**

Analysis Method: **Cooper-Bredehoeft-Papadopulos**

Analysis Results:	Transmissivity:	2.11E-6 [m²/s]	Conductivity:	1.14E-6 [m/s]
	Storativity:	4.88E-4		
Test parameters:	Test Well:	TH15-3	Aquifer Thickness:	1.85 [m]
	Casing radius:	0.025 [m]	Alpha:	0.005
	Screen length:	1.85 [m]		
	Boring radius:	0.08 [m]		
	r(c):	0.08 [m]		

Comments:

Evaluated by: Milan B

Evaluation Date: 1/21/2016

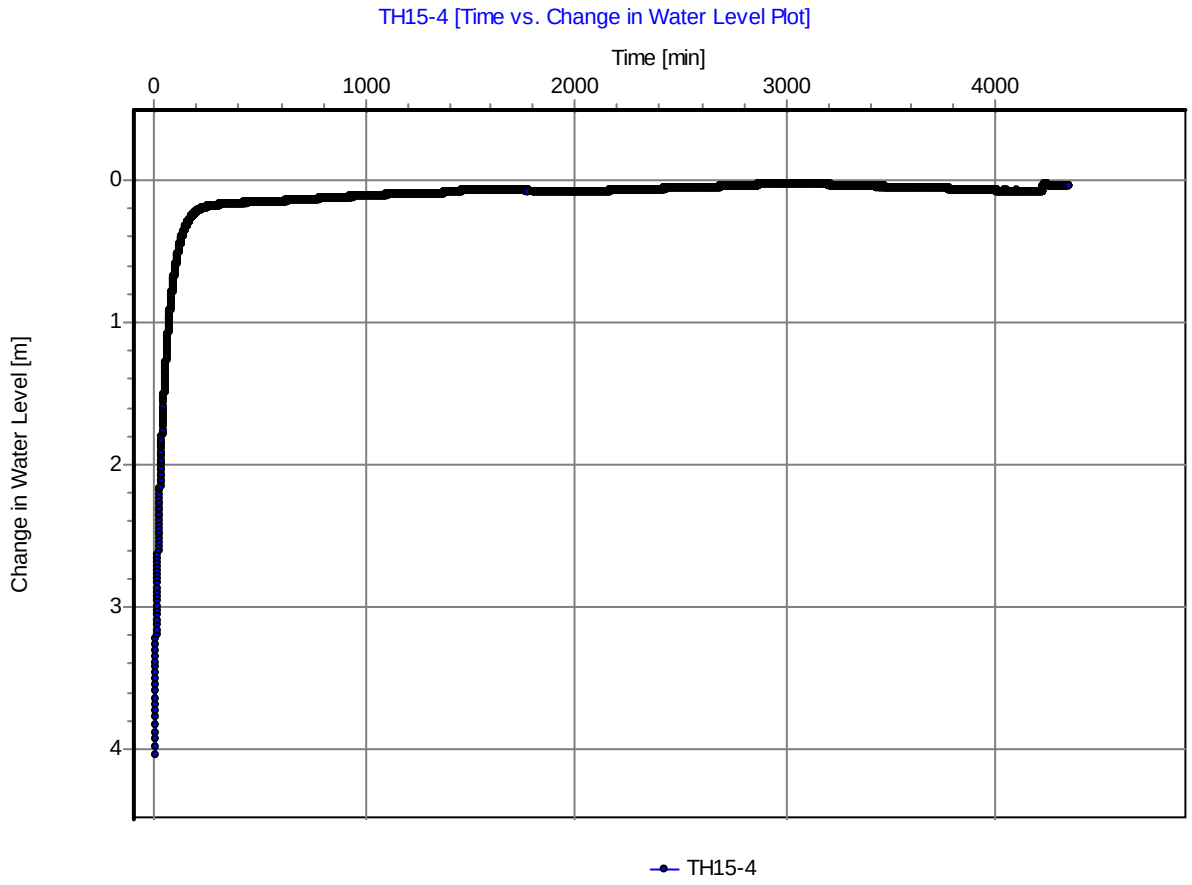
Thurber Engineering Ltd.
4127 Roper Road
Edmonton, Alberta, T6B 3S5
Phone: 780 438-1460

Slug Test Analysis Report

Project: Sewage Lagoon Groundwater Assessment

Number: 19-6835-1

Client: Village of Bawlf



Slug Test: **TH15-4**

Analysis Method: **Time vs. Change in Water Level Plot**

Analysis Results:

Test parameters:

Test Well:	TH15-4	Aquifer Thickness:	1.22 [m]
Casing radius:	0.025 [m]		
Screen length:	1.22 [m]		
Boring radius:	0.08 [m]		

Comments:

Evaluated by: Milan B

Evaluation Date: 1/21/2016

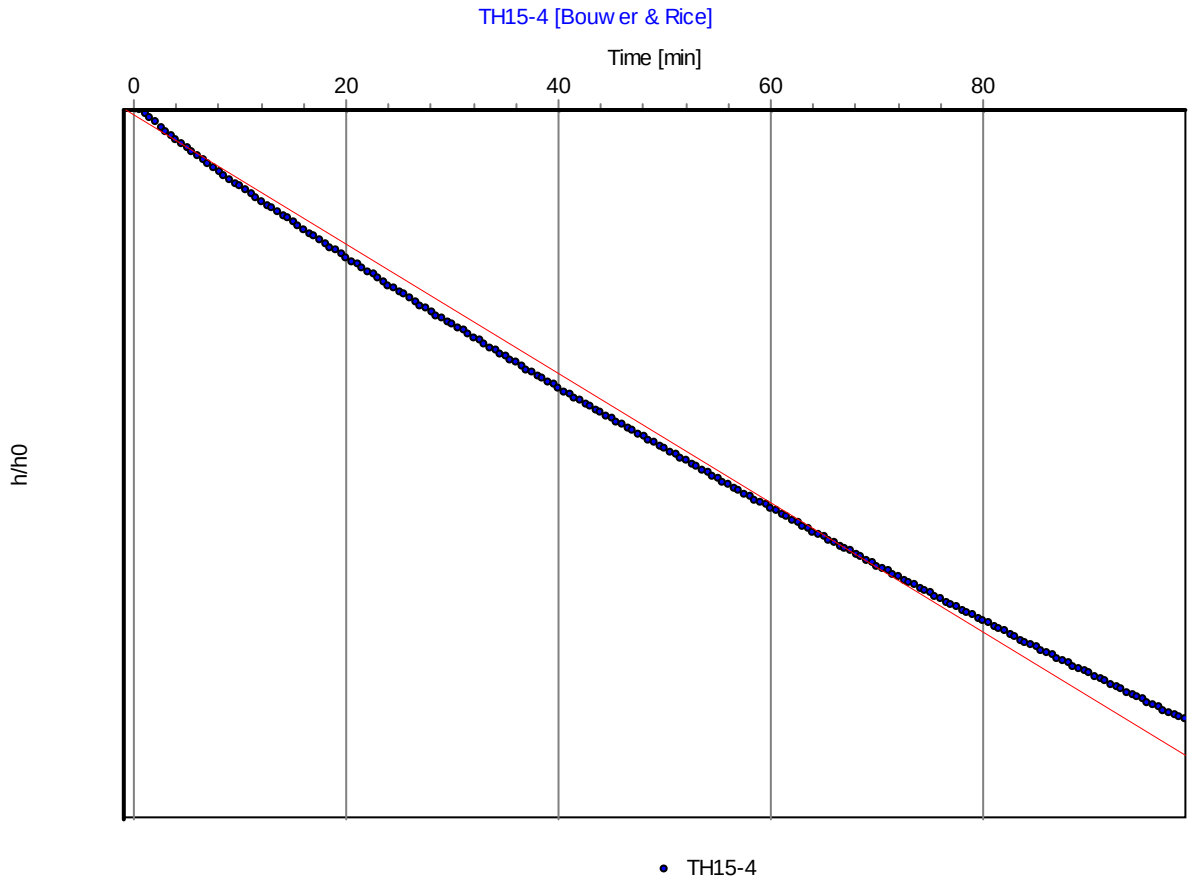
Thurber Engineering Ltd.
4127 Roper Road
Edmonton, Alberta, T6B 3S5
Phone: 780 438-1460

Slug Test Analysis Report

Project: Sewage Lagoon Groundwater Assessment

Number: 19-6835-1

Client: Village of Bawlf



Slug Test: **TH15-4**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 7.66E-7 [m/s]

Test parameters:

Test Well:	TH15-4	Aquifer Thickness:	1.22 [m]
Casing radius:	0.025 [m]	Gravel Pack Porosity (%)	25
Screen length:	1.22 [m]		
Boring radius:	0.08 [m]		
r(eff):	0.045 [m]		

Comments:

Evaluated by: Milan B

Evaluation Date: 1/21/2016

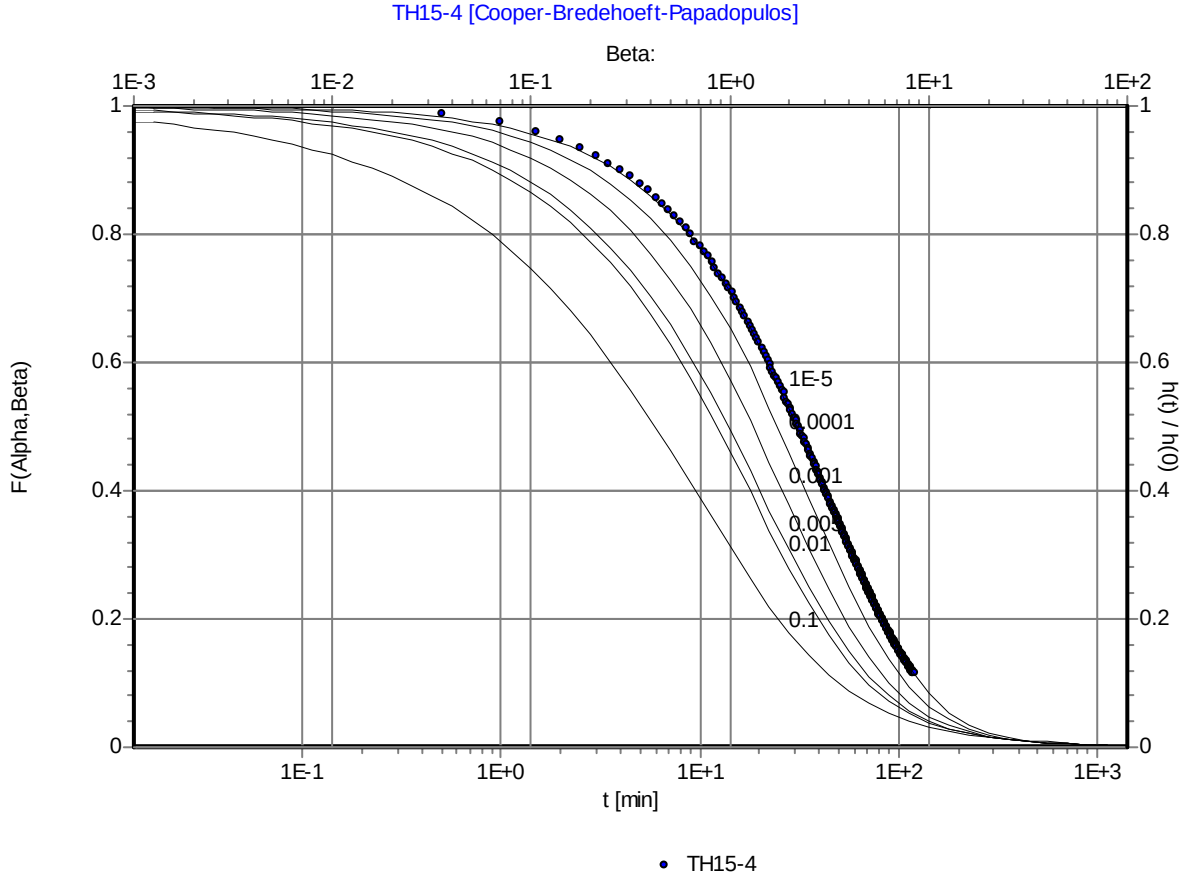
Thurber Engineering Ltd.
4127 Roper Road
Edmonton, Alberta, T6B 3S5
Phone: 780 438-1460

Slug Test Analysis Report

Project: Sewage Lagoon Groundwater Assessment

Number: 19-6835-1

Client: Village of Bawlf



Slug Test: **TH15-4**

Analysis Method: **Cooper-Bredehoeft-Papadopulos**

Analysis Results:	Transmissivity:	7.36E-7 [m²/s]	Conductivity:	6.03E-7 [m/s]
	Storativity:	4.88E-4		
Test parameters:	Test Well:	TH15-4	Aquifer Thickness:	1.22 [m]
	Casing radius:	0.025 [m]	Alpha:	0.005
	Screen length:	1.22 [m]		
	Boring radius:	0.08 [m]		
	r(c):	0.08 [m]		

Comments:

Evaluated by: Milan B

Evaluation Date: 1/21/2016

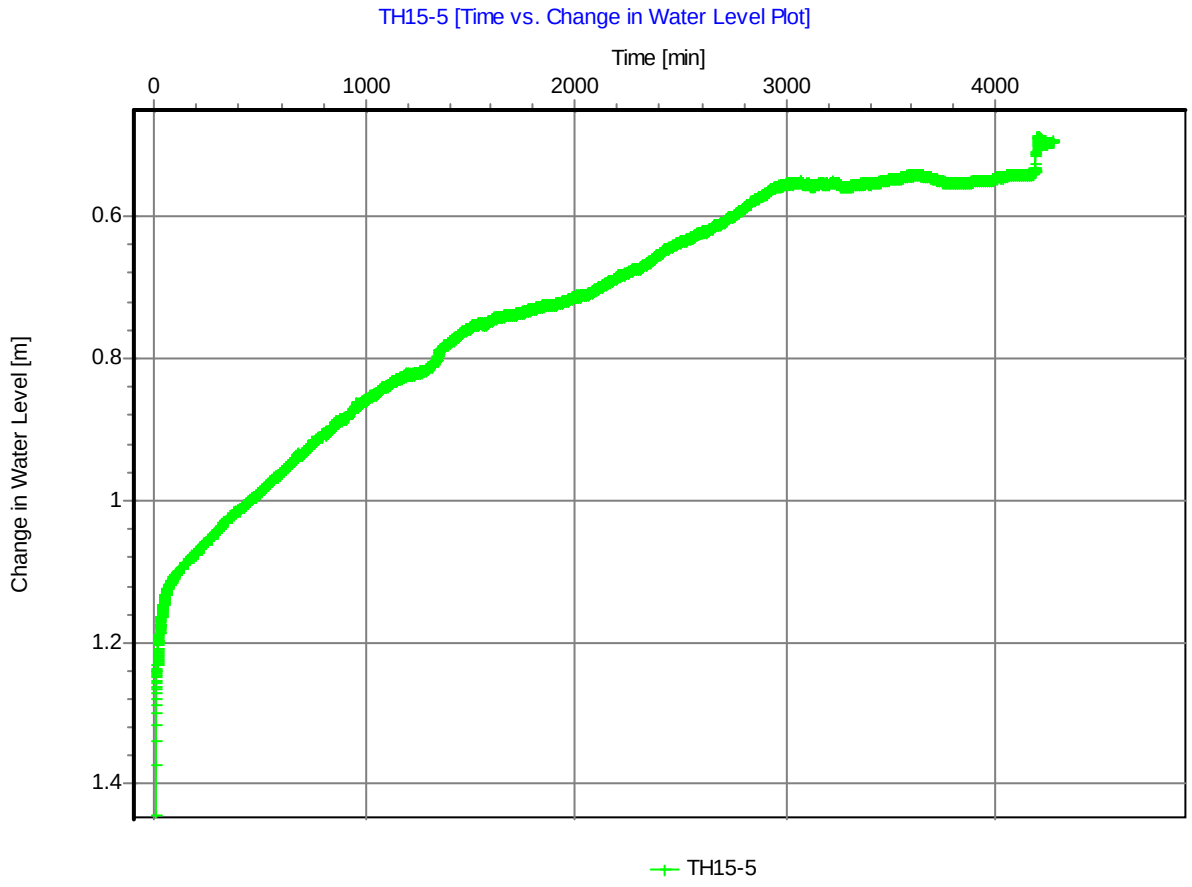
Thurber Engineering Ltd.
4127 Roper Road
Edmonton, Alberta, T6B 3S5
Phone: 780 438-1460

Slug Test Analysis Report

Project: Sewage Lagoon Groundwater Assessment

Number: 19-6835-1

Client: Village of Bawlf



Slug Test: **TH15-5**

Analysis Method: **Time vs. Change in Water Level Plot**

Analysis Results:

Test parameters:

Test Well:	TH15-5	Aquifer Thickness:	1.27 [m]
Casing radius:	0.025 [m]		
Screen length:	1.27 [m]		
Boring radius:	0.08 [m]		

Comments:

Evaluated by: Milan B

Evaluation Date: 1/21/2016

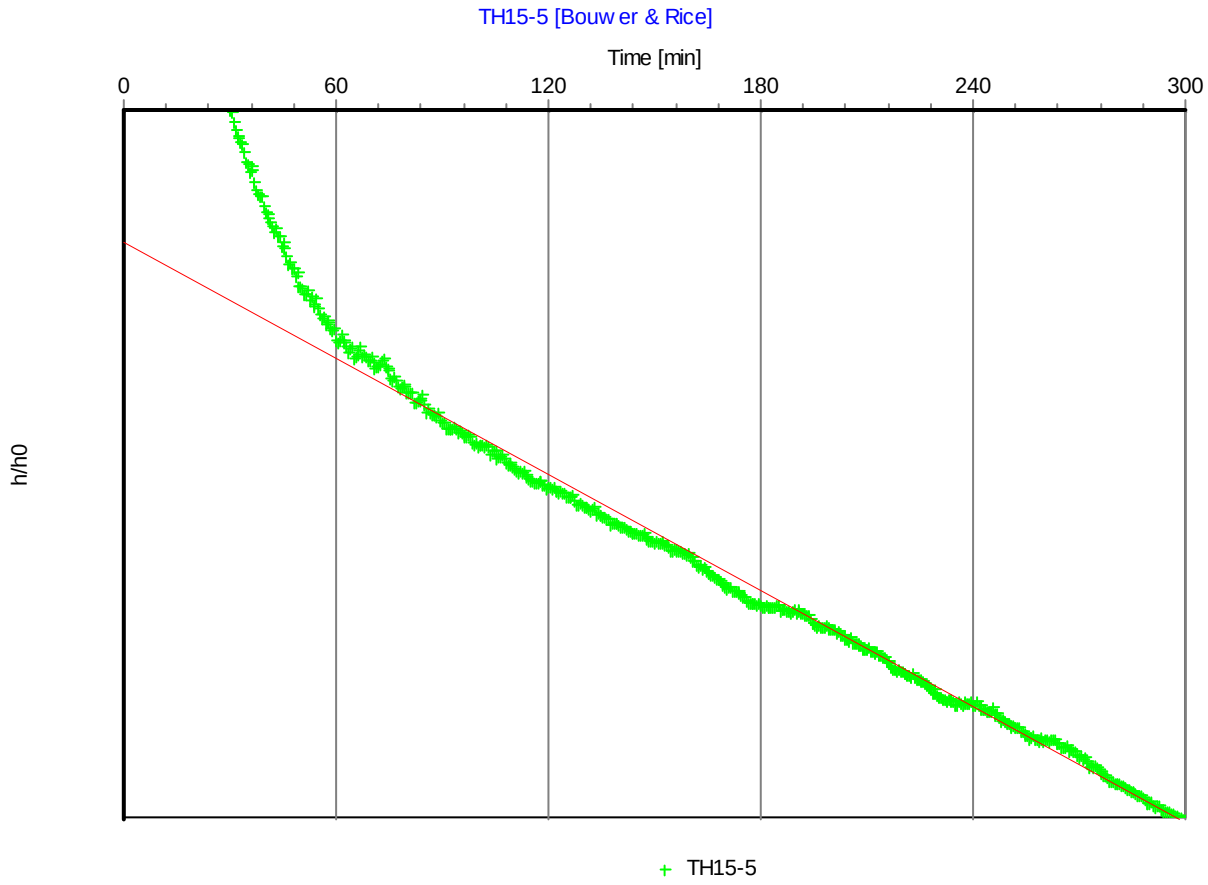
Thurber Engineering Ltd.
4127 Roper Road
Edmonton, Alberta, T6B 3S5
Phone: 780 438-1460

Slug Test Analysis Report

Project: Sewage Lagoon Groundwater Assessment

Number: 19-6835-1

Client: Village of Bawlf



Slug Test: **TH15-5**

Analysis Method: **Bouwer & Rice**

Analysis Results:

Conductivity: 3.37E-9 [m/s]

Test parameters:

Test Well:	TH15-5	Aquifer Thickness:	1.27 [m]
Casing radius:	0.025 [m]	Gravel Pack Porosity (%)	25
Screen length:	1.27 [m]		
Boring radius:	0.08 [m]		
r(eff):	0.045 [m]		

Comments:

Evaluated by: Milan B

Evaluation Date: 1/21/2016

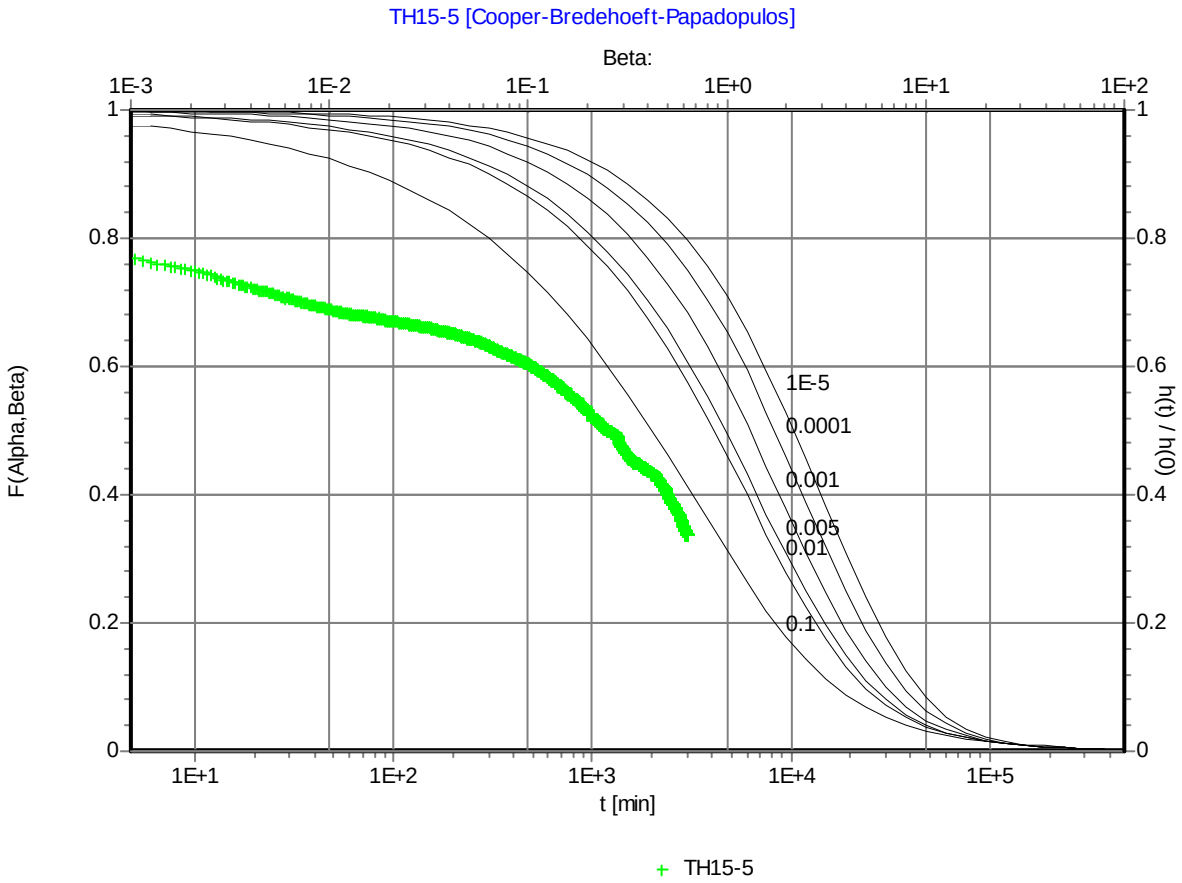
Thurber Engineering Ltd.
4127 Roper Road
Edmonton, Alberta, T6B 3S5
Phone: 780 438-1460

Slug Test Analysis Report

Project: Sewage Lagoon Groundwater Assessment

Number: 19-6835-1

Client: Village of Bawlf



Slug Test: **TH15-5**

Analysis Method: **Cooper-Bredehoeft-Papadopulos**

Analysis Results:	Transmissivity:	2.19E-9 [m²/s]	Conductivity:	1.72E-9 [m/s]
	Storativity:	4.88E-4		
Test parameters:	Test Well:	TH15-5	Aquifer Thickness:	1.27 [m]
	Casing radius:	0.025 [m]	Alpha:	0.005
	Screen length:	1.27 [m]		
	Boring radius:	0.08 [m]		
	r(c):	0.08 [m]		

Comments:

Evaluated by: Milan B

Evaluation Date: 1/21/2016

THURBER

APPENDIX E

Selected Water Well Records

Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

View in Imperial | Export to Excel

GOWN ID

GIC Well ID 134795
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
LEIREN, MORRIS	P.O. BOX 64 BAWLF				T0B 0J0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SW	30	045	17	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.905334 Longitude -112.465181
How Location Obtained: Map

Elevation 707.14 m
How Elevation Obtained: Estimated

Drilling Information

Method of Drilling
Drilled

Proposed Well Use
Domestic & Stock

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
32.00		Clay
33.53	Yes	Water Bearing Coal
35.05		Coal

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 0.00 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1955/07/07		4.57

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
35.05 m		1955/07/04	1955/07/07

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	35.05

Surface Casing (if applicable)
Steel
Size OD : 10.16 cm
Wall Thickness : 0.000 cm
Bottom at : 32.00 m

Well Casing/Liner
Size OD : 0.00 cm
Wall Thickness : 0.000 cm
Top at : 0.00 m
Bottom at : 0.00 m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)

Perforated by

Annular Seal Drive Shoe
Placed from 0.00 m to 0.00 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : 0.00 cm

From (m)	To (m)	Slot Size (cm)

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
SERVOLD, HAROLD

Copy of Well report provided to owner

Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID 134795
GOWN ID
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
LEIREN, MORRIS	P.O. BOX 64 BAWLF				T0B 0J0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SW	30	045	17	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.905334 Longitude -112.465181
How Location Obtained: Map

Elevation 707.14 m
How Elevation Obtained: Estimated

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level: cm
Is Artesian Flow:
Rate: L/min
Is Flow Control Installed:
Describe:

Recommended Pump Rate: 0.00 L/min
Recommended Pump Intake Depth (From TOC): 0.00 m
Pump Installed:
Depth: m
Type:
Make:
H.P.:
Model (Output Rating):

Did you Encounter Saline Water (>4000 ppm TDS):
Depth: m
Gas:
Depth: m
Well Disinfected Upon Completion:
Geophysical Log Taken:
Submitted to ESRD:
Sample Collected for Potability:
Submitted to ESRD:

Additional Comments on Well
SEE VG CHEM SAMPLE #8713467

Yield Test

Taken From Ground Level
Measurement in Metric

Test Date	Start Time	Static Water Level
1955/07/07	12:00 AM	4.57 m

Depth to water level

Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)

Method of Water Removal
Type:
Removal Rate: L/min
Depth Withdrawn From: 0.00 m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
SERVOLD, HAROLD

Copy of Well report provided to owner

Date approval holder signed

Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

View in Imperial | Export to Excel

GOWN ID

GIC Well ID 143264
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1986/04/28

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
LARSON, TED	BAWLF				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NW	23	045	18	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.897914 Longitude -112.513541
How Location Obtained
Map

Elevation m
How Elevation Obtained
Not Obtained

Drilling Information

Method of Drilling
Rotary

Proposed Well Use
Stock

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
12.19		Clay
18.29		Sand

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 31.82 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1985/09/10	31.82	7.92

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
18.29 m		1985/08/28	1985/09/10

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	18.29

Surface Casing (if applicable)
Steel
Size OD : 16.51 cm
Wall Thickness : 0.478 cm
Bottom at : 12.19 m

Well Casing/Liner
Steel
Size OD : 11.43 cm
Wall Thickness : 0.318 cm
Top at : 10.67 m
Bottom at : 18.29 m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)
12.19	18.29	0.000		0.00

Perforated by Torch

Annular Seal Unknown
Placed from 0.00 m to 12.19 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : 0.00 cm

From (m)	To (m)	Slot Size (cm)

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
GENETH CONSTRUCTION/DIVISION OF 305-137 ALBERTA LTD.

Copy of Well report provided to owner
Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GOWN ID

GIC Well ID 143264
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1986/04/28

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
LARSON, TED	BAWLF				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NW	23	045	18	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.897914 Longitude -112.513541
How Location Obtained: Map

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level cm
Is Artesian Flow
Rate L/min
Is Flow Control Installed
Describe

Recommended Pump Rate 31.82 L/min
Recommended Pump Intake Depth (From TOC) 15.24 m
Pump Installed
Depth m
Type
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth m
Gas
Depth m
Well Disinfected Upon Completion
Geophysical Log Taken
Submitted to ESRD

Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well

Yield Test

Taken From Ground Level
Measurement in Metric

Test Date	Start Time	Static Water Level
1985/09/10	12:00 AM	7.92 m

Depth to water level

Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)

Method of Water Removal

Type Bailer
Removal Rate 31.82 L/min
Depth Withdrawn From 16.76 m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
GENETH CONSTRUCTION/DIVISION OF 305-137 ALBERTA LTD.

Copy of Well report provided to owner

Date approval holder signed

Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

View in Imperial | Export to Excel

GOWN ID

GIC Well ID 143265
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1986/04/28

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
LARSON, TED	BAWLF				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NW	23	045	18	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.897914 Longitude -112.513541
How Location Obtained
Map

Elevation m
How Elevation Obtained
Not Obtained

Drilling Information

Method of Drilling
Rotary

Proposed Well Use
Domestic

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
18.29		Clay
21.34		Shale
39.01		Bentonitic Shale
39.62		Coal

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 4.55 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1985/08/27	5.00	3.05

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
39.62 m		1985/03/23	1985/08/27

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	39.62

Surface Casing (if applicable)
Steel
Size OD : 16.51 cm
Wall Thickness : 0.478 cm
Bottom at : 21.34 m

Well Casing/Liner
Steel
Size OD : 11.43 cm
Wall Thickness : 0.318 cm
Top at : 19.81 m
Bottom at : 39.01 m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)

Perforated by Unknown

Annular Seal Unknown
Placed from 0.00 m to 21.34 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : 0.00 cm

From (m)	To (m)	Slot Size (cm)

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
GENETH CONSTRUCTION/DIVISION OF 305-137 ALBERTA LTD.

Copy of Well report provided to owner
Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GOWN ID

GIC Well ID 143265
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1986/04/28

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
LARSON, TED	BAWLF				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NW	23	045	18	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.897914 Longitude -112.513541
How Location Obtained: Map

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level cm
Is Artesian Flow
Rate L/min
Is Flow Control Installed
Describe

Recommended Pump Rate 4.55 L/min
Recommended Pump Intake Depth (From TOC) 33.53 m
Pump Installed
Type
Depth m
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth m
Gas
Depth m
Well Disinfected Upon Completion
Geophysical Log Taken
Submitted to ESRD

Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well

Yield Test

Taken From Ground Level
Measurement in Metric

Test Date	Start Time	Static Water Level
1985/08/27	12:00 AM	3.05 m

Depth to water level

Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)

Method of Water Removal

Type Bailer
Removal Rate 5.00 L/min
Depth Withdrawn From 36.58 m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
GENETH CONSTRUCTION/DIVISION OF 305-137 ALBERTA LTD.

Copy of Well report provided to owner

Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GOWN ID

GIC Well ID 143401
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1958/04/07

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
HIWAY SVC	BAWLF				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SW	31	045	17	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.919817 Longitude -112.465188
How Location Obtained
Not Verified

Elevation m
How Elevation Obtained
Not Obtained

Drilling Information

Method of Drilling
Cable Tool

Proposed Well Use
Domestic

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
18.29		Clay
30.48		Clay
48.77		Clay
53.95	Yes	Water Bearing Sandstone
56.39		Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 0.00 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1955/06/27		10.97

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
56.39 m			1955/06/27

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	56.39

Surface Casing (if applicable)
Steel
Size OD : 7.62 cm
Wall Thickness : 0.000 cm
Bottom at : 51.82 m

Well Casing/Liner
Size OD : 0.00 cm
Wall Thickness : 0.000 cm
Top at : 0.00 m
Bottom at : 0.00 m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)

Perforated by

Annular Seal Drive Shoe
Placed from 0.00 m to 0.00 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : 0.00 cm

From (m)	To (m)	Slot Size (cm)

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
SERVOLD, HAROLD

Copy of Well report provided to owner

Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GOWN ID

GIC Well ID 143401
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1958/04/07

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
HIWAY SVC	BAWLF				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SW	31	045	17	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.919817 Longitude -112.465188
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level cm
Is Artesian Flow
Rate L/min
Is Flow Control Installed
Describe

Recommended Pump Rate 0.00 L/min
Recommended Pump Intake Depth (From TOC) 0.00 m
Pump Installed
Depth m
Type
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth m
Gas
Depth m
Well Disinfected Upon Completion
Geophysical Log Taken
Submitted to ESRD

Sample Collected for Potability
Submitted to ESRD Yes

Additional Comments on Well

Yield Test

Taken From Ground Level
Measurement in Metric

Test Date	Start Time	Static Water Level
1955/06/27	12:00 AM	10.97 m

Depth to water level

Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)

Method of Water Removal

Type
Removal Rate L/min
Depth Withdrawn From 0.00 m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
SERVOLD, HAROLD

Copy of Well report provided to owner

Date approval holder signed

Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

View in Imperial | Export to Excel

GOWN ID

GIC Well ID 143407
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1982/01/27

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
BAWLF, VILLAGE OF	BAWLF				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SW	31	045	17	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.919817 Longitude -112.465188
How Location Obtained: Map

Elevation m
How Elevation Obtained: Not Obtained

Drilling Information

Method of Drilling
Cable Tool

Proposed Well Use
Municipal

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
0.61		Topsoil
5.79		Brown Clay & Rocks
10.67		Black Sandy Clay
19.51		Black Clay
20.42		Light Sand & Gravel
21.03		Clay & Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 0.00 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1981/09/25	272.77	3.35

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
21.03 m		1981/09/20	1981/09/25

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	21.03

Surface Casing (if applicable)
Steel
Size OD : 21.92 cm
Wall Thickness : 0.650 cm
Bottom at : 19.20 m

Well Casing/Liner
Size OD : 0.00 cm
Wall Thickness : 0.000 cm
Top at : 0.00 m
Bottom at : 0.00 m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)

Perforated by

Annular Seal Drive Shoe
Placed from 0.00 m to 19.20 m
Amount

Other Seals

Type	At (m)

Screen Type Stainless Steel
Size OD : 19.05 cm

From (m)	To (m)	Slot Size (cm)
19.20	20.73	0.051

Attachment Telescoped
Top Fittings Packer
Bottom Fittings Plug

Pack
Type
Grain Size
Amount 0.00

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
SERVOLD & SONS DRILLING

Copy of Well report provided to owner

Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GIC Well ID 143407
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1982/01/27

GOWN ID

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
BAWLF, VILLAGE OF	BAWLF				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SW	31	045	17	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.919817 Longitude -112.465188
How Location Obtained: Map

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level cm
Is Artesian Flow
Rate L/min
Is Flow Control Installed
Describe

Recommended Pump Rate 0.00 L/min
Recommended Pump Intake Depth (From TOC) 17.68 m
Pump Installed Yes Depth m
Type SUB Make JACUZZI H.P. 3
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS) Depth m
Gas Depth m
Well Disinfected Upon Completion
Geophysical Log Taken
Submitted to ESRD
Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well

DRILLER REPORTS MED-HARD WATER, SEE VG CHEM SAMPLE #886599

Yield Test

Taken From Ground Level
Measurement in Metric

Test Date	Start Time	Static Water Level
1981/09/25	12:00 AM	3.35 m

Depth to water level

Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)

Method of Water Removal

Type Pump
Removal Rate 272.77 L/min
Depth Withdrawn From 14.02 m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
SERVOLD & SONS DRILLING

Copy of Well report provided to owner

Date approval holder signed

Water Well Drilling Report

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View in Imperial | Export to Excel

GOWN ID

GIC Well ID 143408
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1988/03/21

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
ALTA WHEAT POOL	DAYSLAND				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SW	31	045	17	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.919817 Longitude -112.465188
How Location Obtained
Not Verified

Elevation m
How Elevation Obtained
Not Obtained

Drilling Information

Method of Drilling
Rotary

Proposed Well Use
Domestic

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
10.67		Till & Clay
25.91		Brown Shale
27.43		Shale
30.48		Sandstone

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 0.00 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1987/11/23	22.73	4.57

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
30.48 m			1987/11/23

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	30.48

Surface Casing (if applicable)
Steel
Size OD : 14.12 cm
Wall Thickness : 0.000 cm
Bottom at : 25.91 m

Well Casing/Liner
Size OD : 0.00 cm
Wall Thickness : 0.000 cm
Top at : 0.00 m
Bottom at : 0.00 m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)

Perforated by

Annular Seal Driven
Placed from 0.00 m to 25.91 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : 0.00 cm

From (m)	To (m)	Slot Size (cm)

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
GENETH CONSTRUCTION/DIVISION OF 305-137 ALBERTA LTD.

Copy of Well report provided to owner
Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

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GIC Well ID 143408
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1988/03/21

GOWN ID

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
ALTA WHEAT POOL	DAYSLAND				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SW	31	045	17	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.919817 Longitude -112.465188
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level cm
Is Artesian Flow
Rate L/min
Is Flow Control Installed
Describe

Recommended Pump Rate 0.00 L/min
Recommended Pump Intake Depth (From TOC) 0.00 m
Pump Installed
Depth m
Type
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth m
Gas
Depth m
Well Disinfected Upon Completion
Geophysical Log Taken
Submitted to ESRD

Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well

Yield Test

Taken From Ground Level
Measurement in Metric

Test Date	Start Time	Static Water Level
1987/11/23	12:00 AM	4.57 m

Depth to water level

Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)

Method of Water Removal

Type Bailer
Removal Rate 22.73 L/min
Depth Withdrawn From 21.34 m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
GENETH CONSTRUCTION/DIVISION OF 305-137 ALBERTA LTD.

Copy of Well report provided to owner

Date approval holder signed

Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

View in Imperial | Export to Excel

GOWN ID

GIC Well ID 1685004
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
FENSKE, BLAINE	P.O. BOX 56	BAWLF	AB	CA	T0B 0J0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	16	24	045	18	4				

Measured from Boundary of
304.80 m from North
60.96 m from East

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.899710 Longitude -112.475190
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Drilling Information

Method of Drilling
Cable Tool

Proposed Well Use
Domestic & Stock

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
0.15		Black Topsoil
1.83		Brown Hard Clay
4.27		Brown Sandy Clay
12.80		Black Clay
17.07	Yes	Brown Water Bearing Sand
26.52		Black Soft Clay & Sand
29.26		Clay & Shale
30.48		Dark Brown Clay
32.00		Brown Clay
33.53		Coal

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 15.91 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
2003/07/14	22.73	4.88

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
33.53 m		2003/06/27	2003/07/03

Borehole

Diameter (cm)	From (m)	To (m)
12.70	0.00	33.53

Surface Casing (if applicable)
Steel
Size OD : 14.13 cm
Wall Thickness : 0.478 cm
Bottom at : 29.87 m

Well Casing/Liner
Plastic
Size OD : 11.43 cm
Wall Thickness : 0.635 cm
Top at : 26.82 m
Bottom at : 32.92 m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)
26.82	32.92	0.051		

Perforated by Saw

Annular Seal Driven
Placed from 26.82 m to 33.53 m
Amount

Other Seals

Type	At (m)

Screen Type Plastic
Size OD : cm

From (m)	To (m)	Slot Size (cm)

Attachment Unknown
Top Fittings Unknown
Bottom Fittings Unknown

Pack
Type Silica Sand
Grain Size 10/20
Amount 80.00 Pounds

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
IRVIN SERVOLD

Certification No
VA3263

Company Name
SERVOLD & SONS DRILLING

Copy of Well report provided to owner

Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GOWN ID

GIC Well ID 1685004
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
FENSKE, BLAINE	P.O. BOX 56	BAWLF	AB	CA	T0B 0J0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	16	24	045	18	4				

Measured from Boundary of
304.80 m from North
60.96 m from East

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.899710 Longitude -112.475190
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level 45.72 cm
Is Artesian Flow
Rate L/min
Is Flow Control Installed
Describe

Recommended Pump Rate 15.91 L/min
Recommended Pump Intake Depth (From TOC) 12.19 m
Pump Installed
Depth m
Type
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth m
Well Disinfected Upon Completion
Gas
Depth m
Geophysical Log Taken
Submitted to ESRD

Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well

Yield Test

Taken From Ground Level
Measurement in Metric

Test Date	Start Time	Static Water Level
2003/07/14	12:00 AM	4.88 m

Method of Water Removal

Type Bailer
Removal Rate 22.73 L/min
Depth Withdrawn From 12.19 m

If water removal period was < 2 hours, explain why
PUMP INSTALLED TO TEST ONLY

Depth to water level

Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)
4.88	0:00	7.62
5.79	1:00	6.10
6.71	2:00	5.49
7.01	3:00	5.18
7.32	4:00	5.18
7.62	5:00	5.03
7.62	6:00	5.03
7.62	7:00	5.03
7.62	8:00	5.03
7.62	9:00	5.03
7.62	10:00	4.88
	12:00	4.88
	14:00	4.88
	16:00	4.88
	20:00	4.88

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
IRVIN SERVOLD

Certification No
VA3263

Company Name
SERVOLD & SONS DRILLING

Copy of Well report provided to owner

Date approval holder signed

Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

View in Imperial | Export to Excel

GOWN ID

GIC Well ID 1685014
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
BELLINGHAM, ROGER	P.O. BOX 148	BAWLF	AB	CA	T0B 0J0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	08	23	045	18	4				

Measured from Boundary of
213.36 m from North
121.92 m from East

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.892510 Longitude -112.500190
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Drilling Information

Method of Drilling
Cable Tool

Proposed Well Use
Domestic & Stock

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
0.61		Topsoil
4.57		Brown Clay
13.72		Blue Sandy Clay & Rocks
19.81		Blue Gray Firm Sand
22.25		Fine Grained Sand & Gravel

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 3.41 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
2003/08/13	68.19	5.18

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
22.25 m		2003/08/13	2003/08/13

Borehole

Diameter (cm)	From (m)	To (m)
12.70	0.00	22.25

Surface Casing (if applicable)
Steel
Size OD : 14.13 cm
Wall Thickness : 0.478 cm
Bottom at : 21.79 m

Well Casing/Liner
Unknown
Size OD : cm
Wall Thickness : cm
Top at : m
Bottom at : m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)

Perforated by Unknown

Annular Seal Driven
Placed from 0.00 m to 21.79 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : cm

From (m)	To (m)	Slot Size (cm)

Attachment
Top Fittings Bottom Fittings

Pack
Type Unknown Grain Size
Amount Unknown

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
IRVIN SERVOLD

Certification No
VA3263

Company Name
SERVOLD & SONS DRILLING

Copy of Well report provided to owner Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

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GIC Well ID 1685014
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

GOWN ID

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
BELLINGHAM, ROGER	P.O. BOX 148	BAWLF	AB	CA	T0B 0J0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	08	23	045	18	4				

Measured from Boundary of
213.36 m from North
121.92 m from East

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.892510 Longitude -112.500190
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level 45.72 cm
Is Artesian Flow
Rate L/min
Is Flow Control Installed
Describe

Recommended Pump Rate 3.41 L/min
Recommended Pump Intake Depth (From TOC) 12.19 m
Pump Installed Yes
Type SUB
Depth m
Make
H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth m
Gas
Depth m
Well Disinfected Upon Completion
Geophysical Log Taken
Submitted to ESRD
Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well

45' - 65' ALSO SOFT LAYERS, 65' - 73' SMALL GRAVEL TO VARIOUS LARGER AT BOTTOM, WATER OF GOOD QUALITY

Yield Test

Taken From Ground Level
Depth to water level

Measurement in Metric

Test Date	Start Time	Static Water Level
2003/08/13	12:00 AM	5.18 m

Method of Water Removal

Type Bailer & Pump
Removal Rate 68.19 L/min
Depth Withdrawn From 12.19 m

If water removal period was < 2 hours, explain why

Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)
5.18	0:00	7.01
5.79	1:00	6.10
6.10	2:00	5.79
6.40	3:00	5.49
7.01	4:00	5.49
7.01	5:00	5.49
7.01	6:00	5.49
7.01	7:00	5.49
7.01	8:00	5.49
7.01	9:00	5.49
7.01	10:00	5.18
7.01	12:00	5.18
7.01	14:00	5.18
7.01	16:00	5.18
7.01	20:00	5.18
7.01	25:00	5.18
7.01	30:00	5.18
7.01	35:00	5.18
7.01	40:00	5.18
7.01	50:00	5.18
7.01	60:00	5.18
7.01	75:00	5.18
7.01	90:00	5.18
7.01	105:00	5.18
7.01	120:00	5.18

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well: IRVIN SERVOLD
Certification No: VA3263
Company Name: SERVOLD & SONS DRILLING
Copy of Well report provided to owner
Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GOWN ID

GIC Well ID 197063
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1986/02/17

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
ARC# TH 32-75					

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	13	23	045	18	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.899722 Longitude -112.516532

How Location Obtained
Field

Elevation 702.87 m

How Elevation Obtained
Survey-Transit

Drilling Information

Method of Drilling
Unknown

Proposed Well Use
Other

Type of Work
Coal Test Hole

Plugged 1975/06/23
Plugged with Unknown
Amount

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
1.52		Light Brown Sandy Clay
4.57		Light Brown Clay
7.62		Light Brown Sandy Clay
10.67		Gray Shale
12.19		Gray Silt
16.76		Gray Shale
18.29		Gray Shale
21.34		Gray Shale & Sandy Stringers
22.86		Gray Shale & Silt
27.43		Sandy Unknown
28.96		Light Gray Sandy Shale
32.00		Light Gray Shale
33.53		Brown Shale
35.05		Dark Brown Carbonaceous Shale & Coal
36.58		Light Brown Shale
38.10		Gray Shale
41.15		Dark Brown Carbonaceous Shale & Coal
42.67		Light Gray Shale
44.20		Light Gray Shale & Sandstone
45.72		Light Gray Fine Grained Sandstone
47.24		Gray Shale
48.77		Light Gray Fine Grained Shale & Sandstone
53.34		Greenish Gray Shale & Silt
57.91		Light Gray Fine Grained Sandstone
59.44		Gray Shale
60.96		Gray Sandy Shale
64.01		Greenish Gray Shale
65.53		Gray Shale
67.06		Light Gray Fine Grained Shale & Sandstone
68.58		Gray Shale
74.68		Gray Fine Grained Shale & Sandstone
77.72		Dark Gray Silty Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
120.40 m			1975/06/23

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	120.40

Surface Casing (if applicable)

Size OD : 0.00 cm
Wall Thickness : 0.000 cm
Bottom at : 0.00 m

Well Casing/Liner

Size OD : 0.00 cm
Wall Thickness : 0.000 cm
Top at : 0.00 m
Bottom at : 0.00 m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)

Perforated by

Annular Seal

Placed from 0.00 m to 0.00 m
Amount

Other Seals

Type	At (m)

Screen Type

Size OD : 0.00 cm

From (m)	To (m)	Slot Size (cm)

Attachment
Top Fittings
Bottom Fittings

Pack

Type
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner

Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GOWN ID

GIC Well ID 197063
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1986/02/17

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
ARC# TH 32-75					

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	13	23	045	18	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.899722 Longitude -112.516532
How Location Obtained
Field

Elevation 702.87 m
How Elevation Obtained
Survey-Transit

Depth from ground level (m)	Water Bearing	Lithology Description
79.25		Dark Gray Carbonaceous Shale & Coal
82.30		Gray Shale
83.82		Dark Gray Shale
85.34		Dark Gray Shale & Sandstone
86.87		Dark Gray Dirty Sandstone
88.39		Dark Gray Shale & Siltstone
89.92		Dark Gray Cemented Sandstone
91.44		Gray Silty Shale
94.49		Dark Gray Calcareous Shale
96.01		Gray Soft Shale
97.54		Gray Dirty Sandstone
99.06		Gray Sandstone
100.58		Gray Dirty Shale & Sandstone
102.11		Gray Shale
103.63		Gray Calcareous Shale
108.20		Gray Soft Shale
111.25		Dark Gray Soft Shale
114.30		Dark Gray Soft Shale & Gravel
115.82		Gray Calcareous Shale
120.40		Dark Gray Calcareous Shale & Sandstone Ledges

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner

Date approval holder signed

Water Well Drilling Report

View in Imperial | Export to Excel

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GIC Well ID 197063
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1986/02/17

GOWN ID

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
ARC# TH 32-75					

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	13	23	045	18	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.899722 Longitude -112.516532
How Location Obtained: Field

Elevation 702.87 m
How Elevation Obtained: Survey-Transit

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level ____ cm
Is Artesian Flow ____
Rate ____ L/min
Is Flow Control Installed ____
Describe ____

Recommended Pump Rate ____ L/min
Recommended Pump Intake Depth (From TOC) ____ m
Pump Installed ____ Depth ____ m
Type ____ Make ____ H.P. ____
Model (Output Rating) ____

Did you Encounter Saline Water (>4000 ppm TDS) ____ Depth ____ m
Gas ____ Depth ____ m
Well Disinfected Upon Completion ____
Geophysical Log Taken ____
Submitted to ESRD

Sample Collected for Potability ____ Submitted to ESRD ____

Additional Comments on Well

Yield Test

Taken From Ground Level | Measurement in Metric

Test Date	Start Time	Static Water Level
		m

Method of Water Removal

Type ____
Removal Rate ____ L/min
Depth Withdrawn From ____ m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner

Date approval holder signed

Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

View in Imperial | Export to Excel

GOWN ID

GIC Well ID 1190090
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2009/12/10

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
CUNNINGHAM, SCOTT	P.O. BOX 1264	CAMROSE	ALBERTA	CANADA	T4Y 1X2

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NE	24	45	18	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.897922 Longitude -112.477377
How Location Obtained
Not Verified

Elevation m
How Elevation Obtained
Not Obtained

Drilling Information

Method of Drilling
Rotary - Mud

Proposed Well Use
Domestic

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
3.96		Brown Clay
19.51		Gray Clay
20.73		Sand & Coal
26.82		Gray Clay
31.70	Yes	Sandy Shale
32.92	Yes	Coal
33.53	Yes	Gray Sand
36.58		Gray Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 4.55 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
2009/08/14	4.55	3.79

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
36.58 m	33.53 m	2009/08/11	2009/08/12

Borehole

Diameter (cm)	From (m)	To (m)
17.15	0.00	33.53

Surface Casing (if applicable)
Size OD : cm
Wall Thickness : cm
Bottom at : m

Well Casing/Liner
Plastic
Size OD : 12.70 cm
Wall Thickness : 0.630 cm
Top at : 0.00 m
Bottom at : 33.53 m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)

Perforated by

Annular Seal Bentonite Chips/Tablets
Placed from 0.00 m to 22.86 m
Amount 4.00 Bags

Other Seals

Type	At (m)

Screen Type Plastic
Size OD : 12.70 cm

From (m)	To (m)	Slot Size (cm)
24.38	33.53	0.025

Attachment Attached To Casing
Top Fittings
Bottom Fittings Plug

Pack
Type Artificial
Grain Size 10/20
Amount 10.00 Bags

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
ROBERT GROVE

Certification No
26857A

Company Name
CHRIS'S WATERWELL SERVICING LTD.

Copy of Well report provided to owner
Yes

Date approval holder signed
2009/08/14

Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

View in Imperial | Export to Excel

GIC Well ID 1190090
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2009/12/10

GOWN ID

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
CUNNINGHAM, SCOTT	P.O. BOX 1264	CAMROSE	ALBERTA	CANADA	T4Y 1X2

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NE	24	45	18	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.897922 Longitude -112.477377
How Location Obtained
Not Verified

Elevation m
How Elevation Obtained
Not Obtained

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level 60.96 cm
Is Artesian Flow
Rate L/min
Is Flow Control Installed
Describe

Recommended Pump Rate 4.55 L/min
Recommended Pump Intake Depth (From TOC) 33.22 m
Pump Installed Yes
Type Submersible
Depth 33.22 m
Make Grundfos
H.P. 0.5
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth m
Gas
Depth m
Well Disinfected Upon Completion Yes
Geophysical Log Taken
Submitted to ESRD

Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well

Yield Test

Taken From Top of Casing
Measurement in Metric

Test Date	Start Time	Static Water Level
2009/08/14	10:00 AM	3.79 m

Method of Water Removal

Type Pump
Removal Rate 4.55 L/min
Depth Withdrawn From 33.22 m

If water removal period was < 2 hours, explain why

Depth to water level

Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)
3.79	0:00	32.23
4.31	1:00	31.91
5.03	2:00	31.87
5.80	3:00	31.80
6.48	4:00	31.70
7.16	5:00	31.59
7.84	6:00	31.53
8.53	7:00	31.43
9.17	8:00	31.34
9.82	9:00	31.25
10.43	10:00	31.18
11.69	12:00	31.01
12.92	14:00	30.80
14.15	16:00	30.64
16.61	20:00	30.35
19.64	25:00	29.93
22.29	30:00	29.54
24.98	35:00	29.16
27.41	40:00	28.76
30.90	50:00	28.03
31.40	60:00	27.36
31.87	75:00	26.89
32.00	90:00	26.21
32.21	105:00	25.03
32.23	120:00	24.07

Water Diverted for Drilling

Water Source	Amount Taken		Diversion Date & Time
DUG OUT	9092.18	L	2009/08/12 12:00 AM

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
ROBERT GROVE

Certification No
26857A

Company Name
CHRIS'S WATERWELL SERVICING LTD.

Copy of Well report provided to owner
Yes

Date approval holder signed
2009/08/14

Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

View in Imperial | Export to Excel

GIC Well ID 2029708
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2012/04/23

GOWN ID

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
MICIAK, RONALD	P.O. BOX 102	BAWLF	ALBERTA	CANADA	T0B 0J0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	1	36	45	18	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.917340 Longitude -112.472690
How Location Obtained
Hand held autonomous GPS 20-30m

Elevation 708.05 m
How Elevation Obtained
Hand held autonomous GPS 20-30m

Drilling Information

Method of Drilling
Combination

Type of Work
New Well

Proposed Well Use
Domestic

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
4.88		Brown Till
19.81		Gray Till
26.52		Gray Shale
27.13		Coal
30.78		Gray Shale
31.70		Soft Coal
46.02		Brown Shale
55.78		Gray Shale & Sandstone Ledges
56.39	Yes	Gray Coarse Grained Sandstone
56.69	Yes	Hard Sandstone
59.74	Yes	Gray Coarse Grained Sandstone
60.66	Yes	Green Sandstone
61.26		Hard Ledges
63.40		Gray Shale
79.25		Gray Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 45.46 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
2012/01/06	45.46	8.66

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
79.25 m	60.96 m	2012/01/02	2012/01/05

Borehole

Diameter (cm)	From (m)	To (m)
20.00	0.00	60.96
13.02	60.96	79.25

Surface Casing (if applicable)
Size OD : cm
Wall Thickness : cm
Bottom at : m

Well Casing/Liner
Plastic
Size OD : 12.70 cm
Wall Thickness : 0.800 cm
Top at : -0.61 m
Bottom at : 60.96 m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)
54.86	60.96	0.051		5.08

Perforated by Machine

Annular Seal Bentonite Chips/Tablets
Placed from 0.00 m to 50.29 m
Amount 10.00 Bags

Other Seals

Type	At (m)

Screen Type
Size OD : cm

From (m)	To (m)	Slot Size (cm)

Attachment
Top Fittings
Bottom Fittings

Pack
Type Artificial
Grain Size 10-20
Amount 16.00 Bags

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
LEONARD ODEGARD

Certification No
42243A

Company Name
LOSNESS DRILLING (2005)

Copy of Well report provided to owner
Yes

Date approval holder signed
2012/01/10

Water Well Drilling Report

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

View in Imperial | Export to Excel

GIC Well ID 2029708
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2012/04/23

GOWN ID

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
MICIAK, RONALD	P.O. BOX 102	BAWLF	ALBERTA	CANADA	T0B 0J0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	1	36	45	18	4				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 52.917340 Longitude -112.472690
How Location Obtained
Hand held autonomous GPS 20-30m

Elevation 708.05 m
How Elevation Obtained
Hand held autonomous GPS 20-30m

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level 60.96 cm
Is Artesian Flow
Rate L/min
Is Flow Control Installed
Describe

Recommended Pump Rate 45.46 L/min
Recommended Pump Intake Depth (From TOC) 40.23 m
Pump Installed Yes
Type Submersible
Depth 40.23 m
Make 3" 10SQE07-240
H.P. 0.75
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS)
Depth m
Gas
Depth m
Well Disinfected Upon Completion Yes
Geophysical Log Taken
Submitted to ESRD
Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well

COMBINATION ROTARY AIR & MUD DRILLING, 201' - 208' ALSO HARD LEDGES, ANNULAR SEAL : ALSO CUTTINGS, TDS 1900, IRON 0.01 PPM, HARDNESS 2 GRAINS, PH 7.8, WATER DIVERTED FOR DRILLING 2012/01/02-06

Yield Test

Taken From Top of Casing
Measurement in Metric

Test Date	Start Time	Static Water Level
2012/01/06	10:30 AM	8.66 m

Method of Water Removal

Type Pump
Removal Rate 45.46 L/min
Depth Withdrawn From 39.62 m

If water removal period was < 2 hours, explain why

AIR TEST @ 15 GPM @ 145, 90% RECOVERY @ 50 MINUTES, SOUNDER STUCK FROM 2 TO 4 MINUTES DURING PUMPING

Depth to water level

Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)
8.66	0:00	22.92
14.20	1:00	20.15
	2:00	18.19
	3:00	16.59
	4:00	15.32
19.76	5:00	14.37
20.08	6:00	13.61
20.33	7:00	13.02
20.56	8:00	12.62
20.79	9:00	12.32
20.91	10:00	11.96
21.20	12:00	11.57
21.43	14:00	11.22
21.47	16:00	11.00
21.55	18:00	10.54
21.67	20:00	10.71
21.93	25:00	10.48
22.10	30:00	10.30
22.22	35:00	10.16
22.33	40:00	10.00
22.47	50:00	
22.54	60:00	
22.60	75:00	
22.69	90:00	
22.82	105:00	
22.92	120:00	

Water Diverted for Drilling

Water Source	Amount Taken		Diversion Date & Time
LOSNESS SHOP	22730.46	L	2012/01/02 8:00 AM

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
LEONARD ODEGARD

Certification No
42243A

Company Name
LOSNESS DRILLING (2005)

Copy of Well report provided to owner
Yes

Date approval holder signed
2012/01/10

THURBER

APPENDIX F

Exova Analytical Report

Exova
7217 Roper Road NW
Edmonton, Alberta
T6B 3J4, Canada

T: +1 (780) 438-5522
F: +1 (780) 434-8586
E: Edmonton@exova.com
W: www.exova.com

Exova

Analytical Report

Bill To:	Thurber Engineering Ltd.	Project:	
Report To:	Thurber Engineering Ltd.	ID:	19-6835-1
	4127 Roper Road	Name:	Bawlf Lagoon
	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Reference Number	1116288-1
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	TH15-1 / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Aggregate Organic Constituents						
Chemical Oxygen Demand		mg/L	193	5		
Inorganic Nonmetallic Parameters						
Kjeldahl Nitrogen	Total	mg/L	2.97	0.07		
Metals Dissolved						
Silicon	Dissolved	mg/L	5.32	0.05		
Sulfur	Dissolved	mg/L	975	0.3		
Mercury	Dissolved	mg/L	0.000008	0.000005	0.001	Below MAC
Aluminum	Dissolved	mg/L	0.051	0.002	0.1	Below OG
Antimony	Dissolved	mg/L	<0.001	0.0002	0.006	Below MAC
Arsenic	Dissolved	mg/L	0.002	0.0002	0.01	Below MAC
Barium	Dissolved	mg/L	0.04	0.001	1	Below MAC
Beryllium	Dissolved	mg/L	<0.0005	0.0001		
Bismuth	Dissolved	mg/L	<0.002	0.0005		
Boron	Dissolved	mg/L	0.19	0.002	5	Below MAC
Cadmium	Dissolved	mg/L	0.00010	0.00001	0.005	Below MAC
Chromium	Dissolved	mg/L	<0.002	0.0005	0.05	Below MAC
Cobalt	Dissolved	mg/L	0.004	0.0001		
Copper	Dissolved	mg/L	0.006	0.001	1	Below AO
Lead	Dissolved	mg/L	<0.0005	0.0001	0.01	Below MAC
Lithium	Dissolved	mg/L	0.49	0.001		
Molybdenum	Dissolved	mg/L	<0.005	0.001		
Nickel	Dissolved	mg/L	0.019	0.0005		
Selenium	Dissolved	mg/L	0.001	0.0002	0.05	Below MAC
Silver	Dissolved	mg/L	<0.00005	0.00001		
Strontium	Dissolved	mg/L	3.99	0.001		
Thallium	Dissolved	mg/L	<0.0003	0.00005		
Tin	Dissolved	mg/L	<0.005	0.001		
Titanium	Dissolved	mg/L	<0.002	0.0005		
Uranium	Dissolved	mg/L	0.032	0.0005	0.02	Above MAC
Vanadium	Dissolved	mg/L	<0.0005	0.0001		
Zinc	Dissolved	mg/L	0.02	0.001	5	Below AO
Subsample	Field Filtered		Lab Filtered			
Microbiological Analysis						
Total Coliforms	Membrane Filtration	CFU/100 mL	7000	1	0	Above MAC
Fecal Coliforms	MPN	MPN/100 mL	<1.8	1.8		

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Analytical Report

Bill To:	Thurber Engineering Ltd.	Project:		Lot ID:	**1116288**
Report To:	Thurber Engineering Ltd.	ID:	19-6835-1	Control Number:	C0078186
	4127 Roper Road	Name:	Bawlf Lagoon	Date Received:	Jan 14, 2016
	Edmonton, AB, Canada	Location:	Bawlf	Date Reported:	Jan 20, 2016
	T6B 3S5	LSD:		Report Number:	2074893
Attn:	Milan Butorac	P.O.:			
Sampled By:	JLM	Acct code:			
Company:	TEL				

Reference Number	1116288-1
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	TH15-1 / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Routine Water						
pH			7.78		6.5 - 8.5	Within AO
Temperature of observed pH		°C	18.8			
Electrical Conductivity	at 25 °C	uS/cm	5080	1		
Calcium	Dissolved	mg/L	446	0.2		
Magnesium	Dissolved	mg/L	137	0.2		
Sodium	Dissolved	mg/L	905	0.4	200	Above AO
Potassium	Dissolved	mg/L	16	0.4		
Iron	Dissolved	mg/L	<0.05	0.01	0.3	Below AO
Manganese	Dissolved	mg/L	1.04	0.005	0.05	Above AO
Chloride	Dissolved	mg/L	23.2	0.4	250	Below AO
Nitrate - N		mg/L	<0.05	0.01	10	Below MAC
Nitrite - N		mg/L	<0.025	0.005	1	Below MAC
Nitrate and Nitrite - N		mg/L	<0.07	0.01	10	Below MAC
Sulfate (SO4)	Dissolved	mg/L	2920	0.9	500	Above AO
Hydroxide		mg/L	<5	5		
Carbonate		mg/L	<6	6		
Bicarbonate		mg/L	387	5		
P-Alkalinity	as CaCO3	mg/L	<5	5		
T-Alkalinity	as CaCO3	mg/L	317	5		
Total Dissolved Solids	Calculated	mg/L	4640	1	500	Above AO
Hardness	Dissolved as CaCO3	mg/L	1680			
Ionic Balance	Dissolved	%	108			

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Analytical Report

Bill To:	Thurber Engineering Ltd.	Project:	
Report To:	Thurber Engineering Ltd.	ID:	19-6835-1
	4127 Roper Road	Name:	Bawlf Lagoon
	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Reference Number	1116288-2
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	TH15-2 / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Aggregate Organic Constituents						
Chemical Oxygen Demand		mg/L	308	5		
Inorganic Nonmetallic Parameters						
Kjeldahl Nitrogen	Total	mg/L	2.74	0.07		
Metals Dissolved						
Silicon	Dissolved	mg/L	11.1	0.05		
Sulfur	Dissolved	mg/L	539	0.3		
Mercury	Dissolved	mg/L	<0.000005	0.000005	0.001	Below MAC
Aluminum	Dissolved	mg/L	0.009	0.002	0.1	Below OG
Antimony	Dissolved	mg/L	<0.0004	0.0002	0.006	Below MAC
Arsenic	Dissolved	mg/L	0.0007	0.0002	0.01	Below MAC
Barium	Dissolved	mg/L	0.066	0.001	1	Below MAC
Beryllium	Dissolved	mg/L	<0.0002	0.0001		
Bismuth	Dissolved	mg/L	<0.001	0.0005		
Boron	Dissolved	mg/L	0.225	0.002	5	Below MAC
Cadmium	Dissolved	mg/L	0.00020	0.00001	0.005	Below MAC
Chromium	Dissolved	mg/L	<0.001	0.0005	0.05	Below MAC
Cobalt	Dissolved	mg/L	0.0060	0.0001		
Copper	Dissolved	mg/L	0.002	0.001	1	Below AO
Lead	Dissolved	mg/L	0.0004	0.0001	0.01	Below MAC
Lithium	Dissolved	mg/L	0.319	0.001		
Molybdenum	Dissolved	mg/L	<0.002	0.001		
Nickel	Dissolved	mg/L	0.0318	0.0005		
Selenium	Dissolved	mg/L	0.0005	0.0002	0.05	Below MAC
Silver	Dissolved	mg/L	<0.00002	0.00001		
Strontium	Dissolved	mg/L	2.90	0.001		
Thallium	Dissolved	mg/L	0.0001	0.00005		
Tin	Dissolved	mg/L	<0.002	0.001		
Titanium	Dissolved	mg/L	<0.001	0.0005		
Uranium	Dissolved	mg/L	0.0208	0.0005	0.02	Above MAC
Vanadium	Dissolved	mg/L	0.0003	0.0001		
Zinc	Dissolved	mg/L	0.02	0.001	5	Below AO
Subsample	Field Filtered		Lab Filtered			
Microbiological Analysis						
Total Coliforms	Membrane Filtration	CFU/100 mL	300	1	0	Above MAC
Fecal Coliforms	MPN	MPN/100 mL	<1.8	1.8		

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Analytical Report

Bill To:	Thurber Engineering Ltd.	Project:	
Report To:	Thurber Engineering Ltd.	ID:	19-6835-1
	4127 Roper Road	Name:	Bawlf Lagoon
	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Reference Number	1116288-2
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	TH15-2 / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Routine Water						
pH			7.39		6.5 - 8.5	Within AO
Temperature of observed pH		°C	18.5			
Electrical Conductivity	at 25 °C	uS/cm	3630	1		
Calcium	Dissolved	mg/L	499	0.2		
Magnesium	Dissolved	mg/L	112	0.2		
Sodium	Dissolved	mg/L	412	0.4	200	Above AO
Potassium	Dissolved	mg/L	14	0.4		
Iron	Dissolved	mg/L	<0.02	0.01	0.3	Below AO
Manganese	Dissolved	mg/L	4.32	0.005	0.05	Above AO
Chloride	Dissolved	mg/L	19.9	0.4	250	Below AO
Nitrate - N		mg/L	<0.05	0.01	10	Below MAC
Nitrite - N		mg/L	<0.025	0.005	1	Below MAC
Nitrate and Nitrite - N		mg/L	<0.07	0.01	10	Below MAC
Sulfate (SO4)	Dissolved	mg/L	1620	0.9	500	Above AO
Hydroxide		mg/L	<5	5		
Carbonate		mg/L	<6	6		
Bicarbonate		mg/L	1010	5		
P-Alkalinity	as CaCO3	mg/L	<5	5		
T-Alkalinity	as CaCO3	mg/L	829	5		
Total Dissolved Solids	Calculated	mg/L	3170	1	500	Above AO
Hardness	Dissolved as CaCO3	mg/L	1710			
Ionic Balance	Dissolved	%	103			

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	4127 Roper Road	Name:	Bawlf Lagoon
	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Reference Number	1116288-3
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	TH15-3 / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Aggregate Organic Constituents						
Chemical Oxygen Demand		mg/L	96	5		
Inorganic Nonmetallic Parameters						
Kjeldahl Nitrogen	Total	mg/L	2.16	0.07		
Metals Dissolved						
Silicon	Dissolved	mg/L	15.0	0.05		
Sulfur	Dissolved	mg/L	856	0.3		
Mercury	Dissolved	mg/L	<0.000005	0.000005	0.001	Below MAC
Aluminum	Dissolved	mg/L	<0.01	0.002	0.1	Below OG
Antimony	Dissolved	mg/L	<0.001	0.0002	0.006	Below MAC
Arsenic	Dissolved	mg/L	<0.001	0.0002	0.01	Below MAC
Barium	Dissolved	mg/L	0.02	0.001	1	Below MAC
Beryllium	Dissolved	mg/L	<0.0005	0.0001		
Bismuth	Dissolved	mg/L	<0.002	0.0005		
Boron	Dissolved	mg/L	0.15	0.002	5	Below MAC
Cadmium	Dissolved	mg/L	0.00026	0.00001	0.005	Below MAC
Chromium	Dissolved	mg/L	<0.002	0.0005	0.05	Below MAC
Cobalt	Dissolved	mg/L	0.0070	0.0001		
Copper	Dissolved	mg/L	<0.005	0.001	1	Below AO
Lead	Dissolved	mg/L	<0.0005	0.0001	0.01	Below MAC
Lithium	Dissolved	mg/L	0.48	0.001		
Molybdenum	Dissolved	mg/L	<0.005	0.001		
Nickel	Dissolved	mg/L	0.036	0.0005		
Selenium	Dissolved	mg/L	<0.001	0.0002	0.05	Below MAC
Silver	Dissolved	mg/L	<0.00005	0.00001		
Strontium	Dissolved	mg/L	5.47	0.001		
Thallium	Dissolved	mg/L	<0.0003	0.00005		
Tin	Dissolved	mg/L	<0.005	0.001		
Titanium	Dissolved	mg/L	<0.002	0.0005		
Uranium	Dissolved	mg/L	0.103	0.0005	0.02	Above MAC
Vanadium	Dissolved	mg/L	<0.0005	0.0001		
Zinc	Dissolved	mg/L	0.005	0.001	5	Below AO
Subsample	Field Filtered		Lab Filtered			
Microbiological Analysis						
Total Coliforms	Membrane Filtration	CFU/100 mL	1300	1	0	Above MAC
Fecal Coliforms	MPN	MPN/100 mL	<1.8	1.8		

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Analytical Report

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Report To:	Thurber Engineering Ltd.	ID:	19-6835-1
	4127 Roper Road	Name:	Bawlf Lagoon
	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Reference Number	1116288-3
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	TH15-3 / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Routine Water						
pH			7.63		6.5 - 8.5	Within AO
Temperature of observed pH		°C	18.7			
Electrical Conductivity	at 25 °C	uS/cm	5380	1		
Calcium	Dissolved	mg/L	750	0.2		
Magnesium	Dissolved	mg/L	225	0.2		
Sodium	Dissolved	mg/L	654	0.4	200	Above AO
Potassium	Dissolved	mg/L	13	0.4		
Iron	Dissolved	mg/L	<0.05	0.01	0.3	Below AO
Manganese	Dissolved	mg/L	1.95	0.005	0.05	Above AO
Chloride	Dissolved	mg/L	122	0.4	250	Below AO
Nitrate - N		mg/L	<0.05	0.01	10	Below MAC
Nitrite - N		mg/L	<0.025	0.005	1	Below MAC
Nitrate and Nitrite - N		mg/L	<0.07	0.01	10	Below MAC
Sulfate (SO4)	Dissolved	mg/L	2570	0.9	500	Above AO
Hydroxide		mg/L	<5	5		
Carbonate		mg/L	<6	6		
Bicarbonate		mg/L	1470	5		
P-Alkalinity	as CaCO3	mg/L	<5	5		
T-Alkalinity	as CaCO3	mg/L	1200	5		
Total Dissolved Solids	Calculated	mg/L	5050	1	500	Above AO
Hardness	Dissolved as CaCO3	mg/L	2800			
Ionic Balance	Dissolved	%	105			

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	4127 Roper Road	Name:	Bawlf Lagoon
	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Reference Number	1116288-4
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	TH15-4 / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Aggregate Organic Constituents						
Chemical Oxygen Demand		mg/L	35	5		
Inorganic Nonmetallic Parameters						
Kjeldahl Nitrogen	Total	mg/L	1.56	0.07		
Metals Dissolved						
Silicon	Dissolved	mg/L	10.4	0.05		
Sulfur	Dissolved	mg/L	456	0.3		
Mercury	Dissolved	mg/L	<0.000005	0.000005	0.001	Below MAC
Aluminum	Dissolved	mg/L	<0.004	0.002	0.1	Below OG
Antimony	Dissolved	mg/L	<0.0004	0.0002	0.006	Below MAC
Arsenic	Dissolved	mg/L	0.002	0.0002	0.01	Below MAC
Barium	Dissolved	mg/L	0.050	0.001	1	Below MAC
Beryllium	Dissolved	mg/L	<0.0002	0.0001		
Bismuth	Dissolved	mg/L	<0.001	0.0005		
Boron	Dissolved	mg/L	0.339	0.002	5	Below MAC
Cadmium	Dissolved	mg/L	<0.00002	0.00001	0.005	Below MAC
Chromium	Dissolved	mg/L	<0.001	0.0005	0.05	Below MAC
Cobalt	Dissolved	mg/L	0.0069	0.0001		
Copper	Dissolved	mg/L	<0.002	0.001	1	Below AO
Lead	Dissolved	mg/L	<0.0002	0.0001	0.01	Below MAC
Lithium	Dissolved	mg/L	0.294	0.001		
Molybdenum	Dissolved	mg/L	<0.002	0.001		
Nickel	Dissolved	mg/L	0.0062	0.0005		
Selenium	Dissolved	mg/L	<0.0004	0.0002	0.05	Below MAC
Silver	Dissolved	mg/L	<0.00002	0.00001		
Strontium	Dissolved	mg/L	2.62	0.001		
Thallium	Dissolved	mg/L	<0.0001	0.00005		
Tin	Dissolved	mg/L	<0.002	0.001		
Titanium	Dissolved	mg/L	<0.001	0.0005		
Uranium	Dissolved	mg/L	0.0033	0.0005	0.02	Below MAC
Vanadium	Dissolved	mg/L	<0.0002	0.0001		
Zinc	Dissolved	mg/L	0.007	0.001	5	Below AO
Subsample	Field Filtered		Lab Filtered			
Microbiological Analysis						
Total Coliforms	MPN	MPN/100 mL	79	1.8		
Fecal Coliforms	MPN	MPN/100 mL	<1.8	1.8		

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Analytical Report

Bill To:	Thurber Engineering Ltd.	Project:	
Report To:	Thurber Engineering Ltd.	ID:	19-6835-1
	4127 Roper Road	Name:	Bawlf Lagoon
	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Reference Number	1116288-4
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	TH15-4 / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Routine Water						
pH			7.75		6.5 - 8.5	Within AO
Temperature of observed pH		°C	19.6			
Electrical Conductivity	at 25 °C	uS/cm	3230	1		
Calcium	Dissolved	mg/L	226	0.2		
Magnesium	Dissolved	mg/L	74.2	0.2		
Sodium	Dissolved	mg/L	543	0.4	200	Above AO
Potassium	Dissolved	mg/L	17	0.4		
Iron	Dissolved	mg/L	<0.02	0.01	0.3	Below AO
Manganese	Dissolved	mg/L	1.70	0.005	0.05	Above AO
Chloride	Dissolved	mg/L	11.5	0.4	250	Below AO
Nitrate - N		mg/L	<0.05	0.01	10	Below MAC
Nitrite - N		mg/L	<0.025	0.005	1	Below MAC
Nitrate and Nitrite - N		mg/L	<0.07	0.01	10	Below MAC
Sulfate (SO4)	Dissolved	mg/L	1370	0.9	500	Above AO
Hydroxide		mg/L	<5	5		
Carbonate		mg/L	<6	6		
Bicarbonate		mg/L	696	5		
P-Alkalinity	as CaCO3	mg/L	<5	5		
T-Alkalinity	as CaCO3	mg/L	571	5		
Total Dissolved Solids	Calculated	mg/L	2580	1	500	Above AO
Hardness	Dissolved as CaCO3	mg/L	869			
Ionic Balance	Dissolved	%	103			

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	4127 Roper Road	Name:	Bawlf Lagoon
	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Reference Number	1116288-5
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	TH15-5 / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Aggregate Organic Constituents						
Chemical Oxygen Demand		mg/L	59	5		
Inorganic Nonmetallic Parameters						
Kjeldahl Nitrogen	Total	mg/L	3.89	0.07		
Metals Dissolved						
Silicon	Dissolved	mg/L	9.65	0.05		
Sulfur	Dissolved	mg/L	1600	0.3		
Mercury	Dissolved	mg/L	<0.000005	0.000005	0.001	Below MAC
Aluminum	Dissolved	mg/L	<0.01	0.002	0.1	Below OG
Antimony	Dissolved	mg/L	<0.001	0.0002	0.006	Below MAC
Arsenic	Dissolved	mg/L	0.0079	0.0002	0.01	Below MAC
Barium	Dissolved	mg/L	<0.005	0.001	1	Below MAC
Beryllium	Dissolved	mg/L	<0.0005	0.0001		
Bismuth	Dissolved	mg/L	<0.002	0.0005		
Boron	Dissolved	mg/L	0.524	0.002	5	Below MAC
Cadmium	Dissolved	mg/L	<0.00005	0.00001	0.005	Below MAC
Chromium	Dissolved	mg/L	<0.002	0.0005	0.05	Below MAC
Cobalt	Dissolved	mg/L	<0.0005	0.0001		
Copper	Dissolved	mg/L	<0.005	0.001	1	Below AO
Lead	Dissolved	mg/L	<0.0005	0.0001	0.01	Below MAC
Lithium	Dissolved	mg/L	0.589	0.001		
Molybdenum	Dissolved	mg/L	<0.005	0.001		
Nickel	Dissolved	mg/L	0.003	0.0005		
Selenium	Dissolved	mg/L	<0.001	0.0002	0.05	Below MAC
Silver	Dissolved	mg/L	<0.00005	0.00001		
Strontium	Dissolved	mg/L	6.82	0.001		
Thallium	Dissolved	mg/L	<0.0003	0.00005		
Tin	Dissolved	mg/L	<0.005	0.001		
Titanium	Dissolved	mg/L	<0.002	0.0005		
Uranium	Dissolved	mg/L	0.003	0.0005	0.02	Below MAC
Vanadium	Dissolved	mg/L	<0.0005	0.0001		
Zinc	Dissolved	mg/L	0.01	0.001	5	Below AO
Subsample	Field Filtered		Lab Filtered			
Microbiological Analysis						
Total Coliforms	MPN	MPN/100 mL	22	1.8		
Fecal Coliforms	MPN	MPN/100 mL	<1.8	1.8		

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Bill To:	Thurber Engineering Ltd.	Project:	
Report To:	Thurber Engineering Ltd.	ID:	19-6835-1
	4127 Roper Road	Name:	Bawlf Lagoon
	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Reference Number	1116288-5
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	TH15-5 / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Routine Water						
pH			7.75		6.5 - 8.5	Within AO
Temperature of observed pH		°C	19.1			
Electrical Conductivity	at 25 °C	uS/cm	8330	1		
Calcium	Dissolved	mg/L	440	0.2		
Magnesium	Dissolved	mg/L	136	0.2		
Sodium	Dissolved	mg/L	1940	0.4	200	Above AO
Potassium	Dissolved	mg/L	18	0.4		
Iron	Dissolved	mg/L	2.28	0.01	0.3	Above AO
Manganese	Dissolved	mg/L	0.26	0.005	0.05	Above AO
Chloride	Dissolved	mg/L	9.0	0.4	250	Below AO
Nitrate - N		mg/L	<0.05	0.01	10	Below MAC
Nitrite - N		mg/L	<0.025	0.005	1	Below MAC
Nitrate and Nitrite - N		mg/L	<0.07	0.01	10	Below MAC
Sulfate (SO4)	Dissolved	mg/L	4790	0.9	500	Above AO
Hydroxide		mg/L	<5	5		
Carbonate		mg/L	<6	6		
Bicarbonate		mg/L	649	5		
P-Alkalinity	as CaCO3	mg/L	<5	5		
T-Alkalinity	as CaCO3	mg/L	532	5		
Total Dissolved Solids	Calculated	mg/L	7660	1	500	Above AO
Hardness	Dissolved as CaCO3	mg/L	1660			
Ionic Balance	Dissolved	%	107			

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Analytical Report

Bill To:	Thurber Engineering Ltd.	Project:	
Report To:	Thurber Engineering Ltd.	ID:	19-6835-1
	4127 Roper Road	Name:	Bawlf Lagoon
	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Reference Number	1116288-6
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	SW15-2 / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Aggregate Organic Constituents						
Chemical Oxygen Demand		mg/L	656	5		
Inorganic Nonmetallic Parameters						
Kjeldahl Nitrogen	Total	mg/L	62.5	0.07		
Metals Dissolved						
Silicon	Dissolved	mg/L	8.31	0.05		
Sulfur	Dissolved	mg/L	53.0	0.3		
Mercury	Dissolved	mg/L	<0.000005	0.000005	0.001	Below MAC
Aluminum	Dissolved	mg/L	0.01	0.002	0.1	Below OG
Antimony	Dissolved	mg/L	<0.0004	0.0002	0.006	Below MAC
Arsenic	Dissolved	mg/L	0.0036	0.0002	0.01	Below MAC
Barium	Dissolved	mg/L	0.049	0.001	1	Below MAC
Beryllium	Dissolved	mg/L	<0.0002	0.0001		
Bismuth	Dissolved	mg/L	<0.001	0.0005		
Boron	Dissolved	mg/L	0.405	0.002	5	Below MAC
Cadmium	Dissolved	mg/L	<0.00002	0.00001	0.005	Below MAC
Chromium	Dissolved	mg/L	<0.001	0.0005	0.05	Below MAC
Cobalt	Dissolved	mg/L	0.0004	0.0001		
Copper	Dissolved	mg/L	0.006	0.001	1	Below AO
Lead	Dissolved	mg/L	<0.0002	0.0001	0.01	Below MAC
Lithium	Dissolved	mg/L	0.093	0.001		
Molybdenum	Dissolved	mg/L	<0.002	0.001		
Nickel	Dissolved	mg/L	0.0023	0.0005		
Selenium	Dissolved	mg/L	0.0005	0.0002	0.05	Below MAC
Silver	Dissolved	mg/L	<0.00002	0.00001		
Strontium	Dissolved	mg/L	0.561	0.001		
Thallium	Dissolved	mg/L	<0.0001	0.00005		
Tin	Dissolved	mg/L	<0.002	0.001		
Titanium	Dissolved	mg/L	<0.001	0.0005		
Uranium	Dissolved	mg/L	0.0054	0.0005	0.02	Below MAC
Vanadium	Dissolved	mg/L	0.0004	0.0001		
Zinc	Dissolved	mg/L	0.008	0.001	5	Below AO
Subsample	Field Filtered		Lab Filtered			
Microbiological Analysis						
Total Coliforms	Membrane Filtration	CFU/100 mL	1100000	1	0	Above MAC
Fecal Coliforms	Membrane Filtration	CFU/100 mL	200000	1		

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Analytical Report

Bill To:	Thurber Engineering Ltd.	Project:		Lot ID:	**1116288**
Report To:	Thurber Engineering Ltd.	ID:	19-6835-1	Control Number:	C0078186
	4127 Roper Road	Name:	Bawlf Lagoon	Date Received:	Jan 14, 2016
	Edmonton, AB, Canada	Location:	Bawlf	Date Reported:	Jan 20, 2016
	T6B 3S5	LSD:		Report Number:	2074893
Attn:	Milan Butorac	P.O.:			
Sampled By:	JLM	Acct code:			
Company:	TEL				

Reference Number	1116288-6
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	SW15-2 / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Routine Water						
pH			8.15		6.5 - 8.5	Within AO
Temperature of observed pH		°C	18.5			
Electrical Conductivity	at 25 °C	uS/cm	2190	1		
Calcium	Dissolved	mg/L	61.2	0.2		
Magnesium	Dissolved	mg/L	24.5	0.2		
Sodium	Dissolved	mg/L	411	0.4	200	Above AO
Potassium	Dissolved	mg/L	20.4	0.4		
Iron	Dissolved	mg/L	0.03	0.01	0.3	Below AO
Manganese	Dissolved	mg/L	0.404	0.005	0.05	Above AO
Chloride	Dissolved	mg/L	89.8	0.4	250	Below AO
Nitrate - N		mg/L	<0.05	0.01	10	Below MAC
Nitrite - N		mg/L	0.027	0.005	1	Below MAC
Nitrate and Nitrite - N		mg/L	0.03	0.01	10	Below MAC
Sulfate (SO4)	Dissolved	mg/L	159	0.9	500	Below AO
Hydroxide		mg/L	<5	5		
Carbonate		mg/L	<6	6		
Bicarbonate		mg/L	1230	5		
P-Alkalinity	as CaCO3	mg/L	<5	5		
T-Alkalinity	as CaCO3	mg/L	1010	5		
Total Dissolved Solids	Calculated	mg/L	1370	1	500	Above AO
Hardness	Dissolved as CaCO3	mg/L	254			
Ionic Balance	Dissolved	%	91			

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Analytical Report

Bill To:	Thurber Engineering Ltd.	Project:	
Report To:	Thurber Engineering Ltd.	ID:	19-6835-1
	4127 Roper Road	Name:	Bawlf Lagoon
	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Reference Number	1116288-7
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	SW15-3 / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Aggregate Organic Constituents						
Chemical Oxygen Demand		mg/L	17100	5		
Inorganic Nonmetallic Parameters						
Kjeldahl Nitrogen	Total	mg/L	320	0.07		
Metals Dissolved						
Silicon	Dissolved	mg/L	7.73	0.05		
Sulfur	Dissolved	mg/L	28.4	0.3		
Mercury	Dissolved	mg/L	<0.000005	0.000005	0.001	Below MAC
Aluminum	Dissolved	mg/L	0.021	0.002	0.1	Below OG
Antimony	Dissolved	mg/L	<0.0004	0.0002	0.006	Below MAC
Arsenic	Dissolved	mg/L	0.0024	0.0002	0.01	Below MAC
Barium	Dissolved	mg/L	0.059	0.001	1	Below MAC
Beryllium	Dissolved	mg/L	<0.0002	0.0001		
Bismuth	Dissolved	mg/L	0.001	0.0005		
Boron	Dissolved	mg/L	0.331	0.002	5	Below MAC
Cadmium	Dissolved	mg/L	0.00003	0.00001	0.005	Below MAC
Chromium	Dissolved	mg/L	<0.001	0.0005	0.05	Below MAC
Cobalt	Dissolved	mg/L	0.0009	0.0001		
Copper	Dissolved	mg/L	0.003	0.001	1	Below AO
Lead	Dissolved	mg/L	<0.0002	0.0001	0.01	Below MAC
Lithium	Dissolved	mg/L	0.078	0.001		
Molybdenum	Dissolved	mg/L	<0.002	0.001		
Nickel	Dissolved	mg/L	0.0031	0.0005		
Selenium	Dissolved	mg/L	0.0005	0.0002	0.05	Below MAC
Silver	Dissolved	mg/L	<0.00002	0.00001		
Strontium	Dissolved	mg/L	0.500	0.001		
Thallium	Dissolved	mg/L	<0.0001	0.00005		
Tin	Dissolved	mg/L	<0.002	0.001		
Titanium	Dissolved	mg/L	<0.001	0.0005		
Uranium	Dissolved	mg/L	0.0048	0.0005	0.02	Below MAC
Vanadium	Dissolved	mg/L	<0.0002	0.0001		
Zinc	Dissolved	mg/L	0.009	0.001	5	Below AO
Subsample	Field Filtered		Lab Filtered			
Microbiological Analysis						
Total Coliforms	Membrane Filtration	CFU/100 mL	1600000	1	0	Above MAC
Fecal Coliforms	Membrane Filtration	CFU/100 mL	1600000	1		

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Analytical Report

Bill To:	Thurber Engineering Ltd.	Project:		Lot ID:	**1116288**
Report To:	Thurber Engineering Ltd.	ID:	19-6835-1	Control Number:	C0078186
	4127 Roper Road	Name:	Bawlf Lagoon	Date Received:	Jan 14, 2016
	Edmonton, AB, Canada	Location:	Bawlf	Date Reported:	Jan 20, 2016
	T6B 3S5	LSD:		Report Number:	2074893
Attn:	Milan Butorac	P.O.:			
Sampled By:	JLM	Acct code:			
Company:	TEL				

Reference Number	1116288-7
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	SW15-3 / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Routine Water						
pH			7.89		6.5 - 8.5	Within AO
Temperature of observed pH		°C	21.3			
Electrical Conductivity	at 25 °C	uS/cm	2130	1		
Calcium	Dissolved	mg/L	65.0	0.2		
Magnesium	Dissolved	mg/L	20	0.2		
Sodium	Dissolved	mg/L	346	0.4	200	Above AO
Potassium	Dissolved	mg/L	19	0.4		
Iron	Dissolved	mg/L	0.08	0.01	0.3	Below AO
Manganese	Dissolved	mg/L	0.428	0.005	0.05	Above AO
Chloride	Dissolved	mg/L	60.6	0.4	250	Below AO
Nitrate - N		mg/L	<0.05	0.01	10	Below MAC
Nitrite - N		mg/L	0.073	0.005	1	Below MAC
Nitrate and Nitrite - N		mg/L	0.07	0.01	10	Below MAC
Sulfate (SO4)	Dissolved	mg/L	85.0	0.9	500	Below AO
Hydroxide		mg/L	<5	5		
Carbonate		mg/L	<6	6		
Bicarbonate		mg/L	1170	5		
P-Alkalinity	as CaCO3	mg/L	<5	5		
T-Alkalinity	as CaCO3	mg/L	957	5		
Total Dissolved Solids	Calculated	mg/L	1170	1	500	Above AO
Hardness	Dissolved as CaCO3	mg/L	245			
Ionic Balance	Dissolved	%	90			

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Analytical Report

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	4127 Roper Road	Name:	Bawlf Lagoon
	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Reference Number	1116288-8
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	SW15-6 / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Aggregate Organic Constituents						
Chemical Oxygen Demand		mg/L	2710	5		
Inorganic Nonmetallic Parameters						
Kjeldahl Nitrogen	Total	mg/L	30.4	0.07		
Metals Dissolved						
Silicon	Dissolved	mg/L	7.38	0.05		
Sulfur	Dissolved	mg/L	239	0.3		
Mercury	Dissolved	mg/L	0.000019	0.000005	0.001	Below MAC
Aluminum	Dissolved	mg/L	<0.01	0.002	0.1	Below OG
Antimony	Dissolved	mg/L	0.002	0.0002	0.006	Below MAC
Arsenic	Dissolved	mg/L	0.0756	0.0002	0.01	Above MAC
Barium	Dissolved	mg/L	0.12	0.001	1	Below MAC
Beryllium	Dissolved	mg/L	<0.0005	0.0001		
Bismuth	Dissolved	mg/L	<0.002	0.0005		
Boron	Dissolved	mg/L	1.01	0.002	5	Below MAC
Cadmium	Dissolved	mg/L	<0.00005	0.00001	0.005	Below MAC
Chromium	Dissolved	mg/L	<0.002	0.0005	0.05	Below MAC
Cobalt	Dissolved	mg/L	0.0008	0.0001		
Copper	Dissolved	mg/L	<0.005	0.001	1	Below AO
Lead	Dissolved	mg/L	<0.0005	0.0001	0.01	Below MAC
Lithium	Dissolved	mg/L	0.30	0.001		
Molybdenum	Dissolved	mg/L	<0.005	0.001		
Nickel	Dissolved	mg/L	0.013	0.0005		
Selenium	Dissolved	mg/L	<0.001	0.0002	0.05	Below MAC
Silver	Dissolved	mg/L	<0.00005	0.00001		
Strontium	Dissolved	mg/L	1.01	0.001		
Thallium	Dissolved	mg/L	<0.0003	0.00005		
Tin	Dissolved	mg/L	<0.005	0.001		
Titanium	Dissolved	mg/L	0.003	0.0005		
Uranium	Dissolved	mg/L	0.0051	0.0005	0.02	Below MAC
Vanadium	Dissolved	mg/L	0.0069	0.0001		
Zinc	Dissolved	mg/L	0.006	0.001	5	Below AO
Subsample	Field Filtered		Lab Filtered			
Microbiological Analysis						
Total Coliforms	Membrane Filtration	CFU/100 mL	100	1	0	Above MAC
Fecal Coliforms	Membrane Filtration	CFU/100 mL	100	1		

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Analytical Report

Bill To:	Thurber Engineering Ltd.	Project:	
Report To:	Thurber Engineering Ltd.	ID:	19-6835-1
	4127 Roper Road	Name:	Bawlf Lagoon
	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Reference Number	1116288-8
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	SW15-6 / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Routine Water						
pH			8.63		6.5 - 8.5	Above AO
Temperature of observed pH		°C	18.7			
Electrical Conductivity	at 25 °C	uS/cm	4670	1		
Calcium	Dissolved	mg/L	45	0.2		
Magnesium	Dissolved	mg/L	97.9	0.2		
Sodium	Dissolved	mg/L	1120	0.4	200	Above AO
Potassium	Dissolved	mg/L	47	0.4		
Iron	Dissolved	mg/L	0.05	0.01	0.3	Below AO
Manganese	Dissolved	mg/L	0.27	0.005	0.05	Above AO
Chloride	Dissolved	mg/L	265	0.4	250	Above AO
Nitrate - N		mg/L	<0.05	0.01	10	Below MAC
Nitrite - N		mg/L	<0.025	0.005	1	Below MAC
Nitrate and Nitrite - N		mg/L	<0.07	0.01	10	Below MAC
Sulfate (SO4)	Dissolved	mg/L	718	0.9	500	Above AO
Hydroxide		mg/L	<5	5		
Carbonate		mg/L	119	6		
Bicarbonate		mg/L	2210	5		
P-Alkalinity	as CaCO3	mg/L	99	5		
T-Alkalinity	as CaCO3	mg/L	2010	5		
Total Dissolved Solids	Calculated	mg/L	3500	1	500	Above AO
Hardness	Dissolved as CaCO3	mg/L	520			
Ionic Balance	Dissolved	%	96			

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Analytical Report

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Report To:	Thurber Engineering Ltd.	ID:	19-6835-1
	4127 Roper Road	Name:	Bawlf Lagoon
	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Reference Number	1116288-9
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	Dup A / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Aggregate Organic Constituents						
Chemical Oxygen Demand		mg/L	100	5		
Inorganic Nonmetallic Parameters						
Kjeldahl Nitrogen	Total	mg/L	2.67	0.07		
Metals Dissolved						
Silicon	Dissolved	mg/L	14.8	0.05		
Sulfur	Dissolved	mg/L	849	0.3		
Mercury	Dissolved	mg/L	<0.000005	0.000005	0.001	Below MAC
Aluminum	Dissolved	mg/L	<0.01	0.002	0.1	Below OG
Antimony	Dissolved	mg/L	<0.001	0.0002	0.006	Below MAC
Arsenic	Dissolved	mg/L	<0.001	0.0002	0.01	Below MAC
Barium	Dissolved	mg/L	0.02	0.001	1	Below MAC
Beryllium	Dissolved	mg/L	<0.0005	0.0001		
Bismuth	Dissolved	mg/L	<0.002	0.0005		
Boron	Dissolved	mg/L	0.16	0.002	5	Below MAC
Cadmium	Dissolved	mg/L	0.00023	0.00001	0.005	Below MAC
Chromium	Dissolved	mg/L	<0.002	0.0005	0.05	Below MAC
Cobalt	Dissolved	mg/L	0.0069	0.0001		
Copper	Dissolved	mg/L	<0.005	0.001	1	Below AO
Lead	Dissolved	mg/L	<0.0005	0.0001	0.01	Below MAC
Lithium	Dissolved	mg/L	0.47	0.001		
Molybdenum	Dissolved	mg/L	<0.005	0.001		
Nickel	Dissolved	mg/L	0.037	0.0005		
Selenium	Dissolved	mg/L	<0.001	0.0002	0.05	Below MAC
Silver	Dissolved	mg/L	<0.00005	0.00001		
Strontium	Dissolved	mg/L	5.57	0.001		
Thallium	Dissolved	mg/L	<0.0003	0.00005		
Tin	Dissolved	mg/L	<0.005	0.001		
Titanium	Dissolved	mg/L	<0.002	0.0005		
Uranium	Dissolved	mg/L	0.0974	0.0005	0.02	Above MAC
Vanadium	Dissolved	mg/L	<0.0005	0.0001		
Zinc	Dissolved	mg/L	0.006	0.001	5	Below AO
Subsample	Field Filtered		Lab Filtered			
Microbiological Analysis						
Total Coliforms	Membrane Filtration	CFU/100 mL	900	1	0	Above MAC
Fecal Coliforms	MPN	MPN/100 mL	<1.8	1.8		

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Analytical Report

Bill To:	Thurber Engineering Ltd.	Project:	
Report To:	Thurber Engineering Ltd.	ID:	19-6835-1
	4127 Roper Road	Name:	Bawlf Lagoon
	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Reference Number	1116288-9
Sample Date	January 14, 2016
Sample Time	NA
Sample Location	
Sample Description	Dup A / 4.1°C
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Routine Water						
pH			7.45		6.5 - 8.5	Within AO
Temperature of observed pH		°C	18.6			
Electrical Conductivity	at 25 °C	uS/cm	5280	1		
Calcium	Dissolved	mg/L	739	0.2		
Magnesium	Dissolved	mg/L	222	0.2		
Sodium	Dissolved	mg/L	648	0.4	200	Above AO
Potassium	Dissolved	mg/L	13	0.4		
Iron	Dissolved	mg/L	<0.05	0.01	0.3	Below AO
Manganese	Dissolved	mg/L	1.92	0.005	0.05	Above AO
Chloride	Dissolved	mg/L	121	0.4	250	Below AO
Nitrate - N		mg/L	<0.05	0.01	10	Below MAC
Nitrite - N		mg/L	<0.025	0.005	1	Below MAC
Nitrate and Nitrite - N		mg/L	<0.07	0.01	10	Below MAC
Sulfate (SO4)	Dissolved	mg/L	2550	0.9	500	Above AO
Hydroxide		mg/L	<5	5		
Carbonate		mg/L	<6	6		
Bicarbonate		mg/L	1470	5		
P-Alkalinity	as CaCO3	mg/L	<5	5		
T-Alkalinity	as CaCO3	mg/L	1210	5		
Total Dissolved Solids	Calculated	mg/L	5010	1	500	Above AO
Hardness	Dissolved as CaCO3	mg/L	2760			
Ionic Balance	Dissolved	%	104			

Approved by:

Anthony Neumann, MSc
Laboratory Operations Manager

Data have been validated by Analytical Quality Control and Exova's Integrated Data Validation System (IDVS).
Generation and distribution of the report, and approval by the digitized signature above, are performed through a secure and controlled automatic process.

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Quality Control

Bill To:	Thurber Engineering Ltd.	Project:		Lot ID:	**1116288**
Report To:	Thurber Engineering Ltd.	ID:	19-6835-1	Control Number:	C0078186
	4127 Roper Road	Name:	Bawlf Lagoon	Date Received:	Jan 14, 2016
	Edmonton, AB, Canada	Location:	Bawlf	Date Reported:	Jan 20, 2016
	T6B 3S5	LSD:		Report Number:	2074893
Attn:	Milan Butorac	P.O.:			
Sampled By:	JLM	Acct code:			
Company:	TEL				

Aggregate Organic Constituents

Blanks	Units	Measured	Lower Limit	Upper Limit		Passed QC
Chemical Oxygen Demand	mg/L	-1.88	-7	8		yes
Date Acquired: January 15, 2016						
Client Sample Replicates	**Units**	**Replicate 1**	**Replicate 2**	**% RSD Criteria**	**Absolute Criteria**	**Passed QC**
Chemical Oxygen Demand	mg/L	2140	2170	10	2	yes
Date Acquired: January 15, 2016						
Control Sample	**Units**	**Measured**	**Lower Limit**	**Upper Limit**		**Passed QC**
Chemical Oxygen Demand	mg/L	293	286	316		yes
Date Acquired: January 15, 2016						
Chemical Oxygen Demand	mg/L	74	67	85		yes
Date Acquired: January 15, 2016						
Chemical Oxygen Demand	mg/L	19	16	25		yes
Date Acquired: January 15, 2016						

Inorganic Nonmetallic Parameters

Blanks	Units	Measured	Lower Limit	Upper Limit		Passed QC
Nitrogen	mg/L	0	-0.04	0.08		yes
Date Acquired: January 15, 2016						
Client Sample Replicates	**Units**	**Replicate 1**	**Replicate 2**	**% RSD Criteria**	**Absolute Criteria**	**Passed QC**
Nitrogen	mg/L	3.78	3.79	10	0.06	yes
Date Acquired: January 15, 2016						
Control Sample	**Units**	**Measured**	**Lower Limit**	**Upper Limit**		**Passed QC**
Nitrogen	mg/L	116	103.74	137.28		yes
Date Acquired: January 15, 2016						
Nitrogen	mg/L	14.3	13.27	16.93		yes
Date Acquired: January 15, 2016						
Nitrogen	mg/L	1.07	0.89	1.25		yes
Date Acquired: January 15, 2016						

Metals Dissolved

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Silicon	mg/L	-0.0176	-0.04	0.05	yes
Sulfur	mg/L	-0.024	-0.3	0.2	yes
Mercury	ug/L	0.0021	-0.038000	0.064000	yes
Aluminum	ug/L	0.244988	-2	2	yes
Antimony	ug/L	0.00974946	-0.2	0.2	yes
Arsenic	ug/L	0.00130268	-0.2	0.2	yes
Barium	ug/L	-0.0529903	-1	1	yes
Beryllium	ug/L	0.00341401	-0.0	0.1	yes
Bismuth	ug/L	0.00134404	-1.5	1.5	yes
Boron	ug/L	0.563677	-2	2	yes

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Quality Control

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	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Metals Dissolved - Continued

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Cadmium	ug/L	0.000925456	-0.01	0.01	yes
Chromium	ug/L	-0.000381963	-0.3	0.3	yes
Cobalt	ug/L	-5.5275e-005	-0.1	0.1	yes
Copper	ug/L	0.0185757	-1	1	yes
Lead	ug/L	0.00605492	-0.1	0.1	yes
Lithium	ug/L	0.0340441	-1	1	yes
Molybdenum	ug/L	0.0121069	-1	1	yes
Nickel	ug/L	0.0192031	-0.5	0.5	yes
Selenium	ug/L	-0.0223813	-0.2	0.2	yes
Silver	ug/L	0.000824007	-0.10	0.10	yes
Strontium	ug/L	0.0305279	-1	1	yes
Thallium	ug/L	9.17899e-005	-0.05	0.05	yes
Tin	ug/L	-0.00370881	-1	1	yes
Titanium	ug/L	0.0261145	-0.5	0.5	yes
Uranium	ug/L	0.000690339	-0.5	0.5	yes
Vanadium	ug/L	-0.00221815	-0.1	0.1	yes
Zinc	ug/L	0.189486	-0	2	yes
Date Acquired:	January 15, 2016				

Client Sample Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Mercury	mg/L	<0.000005	<0.000005	10	0.000300	yes
Aluminum	ug/L	<4	<4	10	11	yes
Antimony	ug/L	<0.4	<0.4	10	0.4	yes
Arsenic	ug/L	0.7	0.6	10	0.4	yes
Barium	ug/L	24	24	10	2	yes
Boron	ug/L	341	338	10	4	yes
Cadmium	ug/L	0.33	0.33	10	0.02	yes
Chromium	ug/L	<1	<1	10	1.1	yes
Copper	ug/L	4	4	10	2	yes
Lead	ug/L	<0.2	<0.2	10	0.2	yes
Nickel	ug/L	45.7	45.7	10	1.1	yes
Selenium	ug/L	0.6	0.5	10	0.4	yes
Silver	ug/L	0.02	<0.02	10	0.22	yes
Uranium	ug/L	63.9	64.8	10	1.1	yes
Zinc	ug/L	10	10	10	2	yes
Date Acquired:	January 15, 2016					

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
Mercury	mg/L	0.000757	0.000600	0.000960	yes
Date Acquired:	January 15, 2016				
Mercury	mg/L	0.00288	0.002610	0.003210	yes
Aluminum	ug/L	1020	938	1092	yes
Antimony	ug/L	37.8	35.2	43.0	yes

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Quality Control

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	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Metals Dissolved - Continued

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
Arsenic	ug/L	39.0	36.7	43.3	yes
Barium	ug/L	207	191	214	yes
Beryllium	ug/L	19.5	17.3	22.1	yes
Bismuth	ug/L	105	98.5	113.5	yes
Boron	ug/L	390	344	434	yes
Cadmium	ug/L	2.05	1.86	2.26	yes
Chromium	ug/L	99.4	92.2	110.2	yes
Cobalt	ug/L	19.3	18.0	21.2	yes
Copper	ug/L	196	184	208	yes
Lead	ug/L	20.4	18.4	22.0	yes
Lithium	ug/L	200	175	223	yes
Molybdenum	ug/L	200	187	226	yes
Nickel	ug/L	98.6	93.3	105.5	yes
Selenium	ug/L	39.6	35.8	43.0	yes
Silver	ug/L	20.2	18.40	22.00	yes
Strontium	ug/L	198	180	216	yes
Thallium	ug/L	10.1	9.40	11.20	yes
Tin	ug/L	206	180	220	yes
Titanium	ug/L	101	88.9	108.7	yes
Uranium	ug/L	99.1	92.7	107.5	yes
Vanadium	ug/L	19.9	18.0	22.0	yes
Zinc	ug/L	199	183	219	yes
Date Acquired:	January 15, 2016				
Mercury	mg/L	0.000784	0.000715	0.000865	yes
Date Acquired:	January 15, 2016				
Mercury	mg/L	0.000080	0.000065	0.000089	yes
Aluminum	ug/L	53	45	55	yes
Antimony	ug/L	2.0	1.8	2.3	yes
Arsenic	ug/L	2.0	1.8	2.2	yes
Barium	ug/L	10	9	11	yes
Beryllium	ug/L	1	0.9	1.1	yes
Bismuth	ug/L	4.3	4.1	5.5	yes
Boron	ug/L	20	18	22	yes
Cadmium	ug/L	0.10	0.09	0.11	yes
Chromium	ug/L	4.9	4.5	5.5	yes
Cobalt	ug/L	1	0.9	1.1	yes
Copper	ug/L	10	9	11	yes
Lead	ug/L	1.0	0.9	1.1	yes
Lithium	ug/L	10	9	11	yes
Molybdenum	ug/L	10	9	10	yes
Nickel	ug/L	4.9	4.4	5.5	yes
Selenium	ug/L	2.0	1.7	2.2	yes

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	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Metals Dissolved - Continued

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
Silver	ug/L	1.06	0.84	1.08	yes
Strontium	ug/L	10	9	11	yes
Thallium	ug/L	0.51	0.47	0.56	yes
Tin	ug/L	10	9	11	yes
Titanium	ug/L	5.0	4.5	5.5	yes
Uranium	ug/L	5.2	4.5	5.5	yes
Vanadium	ug/L	1	0.9	1.1	yes
Zinc	ug/L	10	9	11	yes
Date Acquired:	January 15, 2016				
Silicon	mg/L	9.77	8.98	10.78	yes
Sulfur	mg/L	143	138.5	155.3	yes
Date Acquired:	January 15, 2016				
Silicon	mg/L	2.02	1.80	2.20	yes
Sulfur	mg/L	9.5	9.2	11.0	yes
Date Acquired:	January 15, 2016				
Silicon	mg/L	0.19	0.18	0.22	yes
Sulfur	mg/L	3.1	2.7	3.2	yes
Date Acquired:	January 15, 2016				

Routine Water

Blanks	Units	Measured	Lower Limit	Upper Limit	Passed QC
Calcium	mg/L	-0.0543	-0.2	0.2	yes
Magnesium	mg/L	0.0463	-0.1	0.1	yes
Sodium	mg/L	0.0503	-0.4	0.4	yes
Potassium	mg/L	-0.0023	-0.4	0.4	yes
Iron	mg/L	-0.0057	-0.01	0.01	yes
Manganese	mg/L	-0.0006	-0.004	0.004	yes
Chloride	mg/L	0.19	-0.4	0.4	yes
Nitrate - N	mg/L	0	-0.01	0.01	yes
Nitrite - N	mg/L	0.00106322	-0.005	0.005	yes
Date Acquired:	January 15, 2016				

Client Sample Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
pH		8.63	8.63	10	0.10	yes
Electrical Conductivity	dS/m	4.67	4.65	10	0.002	yes
Calcium	mg/L	13	12	10	0.6	yes
Magnesium	mg/L	3	3	10	0.7	yes
Sodium	mg/L	1590	1550	10	1.2	yes
Potassium	mg/L	5.2	5	10	1.2	yes
Iron	mg/L	0.11	0.08	10	0.05	yes
Chloride	mg/L	1150	1130	10	0.5	yes
Nitrate - N	mg/L	0.15	0.15	10	0.01	yes

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Quality Control

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	Edmonton, AB, Canada	Location:	Bawlf
	T6B 3S5	LSD:	
Attn:	Milan Butorac	P.O.:	
Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Routine Water - Continued

Client Sample Replicates	Units	Replicate 1	Replicate 2	% RSD Criteria	Absolute Criteria	Passed QC
Nitrite - N	mg/L	0.061	0.061	10	0.010	yes
Hydroxide	mg/L	<5	<5	10		yes
Carbonate	mg/L	119	119	10	6	yes
Bicarbonate	mg/L	2210	2220	10	6	yes
P-Alkalinity	mg/L	99	99	10	5	yes
T-Alkalinity	mg/L	2010	2020	10	5	yes
Date Acquired:	January 15, 2016					

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
Chloride	mg/L	2060	1856.0	2126.0	yes
Date Acquired:	January 15, 2016				
pH		9.13	9.05	9.25	yes
Electrical Conductivity	dS/m	2.67	2.600	2.858	yes
Calcium	mg/L	244	228.0	258.0	yes
Magnesium	mg/L	95.2	92.3	102.0	yes
Sodium	mg/L	245	233.3	257.3	yes
Potassium	mg/L	246	233.0	263.0	yes
Iron	mg/L	9.47	8.91	10.20	yes
Manganese	mg/L	2.36	2.240	2.540	yes
Nitrate - N	mg/L	10.0	9.58	10.58	yes
Nitrite - N	mg/L	10.0	9.460	10.600	yes
Nitrate and Nitrite - N	mg/L	20.1	19.27	20.97	yes
P-Alkalinity	mg/L	434	423	549	yes
T-Alkalinity	mg/L	1010	956	1056	yes
Date Acquired:	January 15, 2016				
pH		6.86	6.78	6.96	yes
Electrical Conductivity	dS/m	0.080	0.070	0.083	yes
Calcium	mg/L	51.5	44.9	56.9	yes
Magnesium	mg/L	19.8	18.0	22.0	yes
Sodium	mg/L	51.4	47.7	55.5	yes
Potassium	mg/L	51.9	45.0	55.0	yes
Iron	mg/L	1.92	1.89	2.25	yes
Manganese	mg/L	0.493	0.488	0.572	yes
Chloride	mg/L	82.4	74.9	86.9	yes
Nitrate - N	mg/L	4.87	4.48	5.24	yes
Nitrite - N	mg/L	5.02	4.488	5.292	yes
Nitrate and Nitrite - N	mg/L	9.89	9.06	10.42	yes
P-Alkalinity	mg/L	27	22	67	yes
T-Alkalinity	mg/L	128	113	137	yes
Date Acquired:	January 15, 2016				
Calcium	mg/L	5.2	4.6	5.7	yes
Magnesium	mg/L	2.0	1.8	2.2	yes

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Sampled By:	JLM	Acct code:	
Company:	TEL		

Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
Date Reported:	Jan 20, 2016
Report Number:	2074893

Routine Water - Continued

Control Sample	Units	Measured	Lower Limit	Upper Limit	Passed QC
Sodium	mg/L	5.2	4.7	5.7	yes
Potassium	mg/L	5.2	4.5	5.5	yes
Iron	mg/L	0.23	0.19	0.24	yes
Manganese	mg/L	0.052	0.046	0.056	yes
Chloride	mg/L	13.7	13.3	16.5	yes
Nitrate - N	mg/L	0.51	0.44	0.58	yes
Nitrite - N	mg/L	0.501	0.453	0.567	yes
Nitrate and Nitrite - N	mg/L	1.01	0.93	1.11	yes

Date Acquired: January 15, 2016

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Methodology and Notes

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Method of Analysis

Method Name	Reference		Method	Date Analysis Started	Location
Alkalinity, pH, and EC in water	APHA	*	Alkalinity - Titration Method, 2320 B	15-Jan-16	Exova Edmonton
Alkalinity, pH, and EC in water	APHA	*	Conductivity, 2510 B	15-Jan-16	Exova Edmonton
Alkalinity, pH, and EC in water	APHA	*	pH - Electrometric Method, 4500-H+ B	15-Jan-16	Exova Edmonton
Anions (Routine) by Ion Chromatography	APHA	*	Ion Chromatography with Chemical Suppression of Eluent Cond., 4110 B	15-Jan-16	Exova Edmonton
Approval-Edmonton	APHA		Checking Correctness of Analyses, 1030 E	15-Jan-16	Exova Edmonton
Chemical Oxygen Demand in water	APHA	*	Closed Reflux, Colorimetric Method, 5220 D	15-Jan-16	Exova Edmonton
Chloride in Water	APHA	*	Automated Ferricyanide Method, 4500-Cl- E	15-Jan-16	Exova Edmonton
Coliforms - Membrane Filtration	APHA		Fecal Coliform Membrane Filter Procedure, 9222 D	15-Jan-16	Exova Calgary
Coliforms - Membrane Filtration	APHA		Standard Total Coliform Membrane Filter Procedure, 9222 B	15-Jan-16	Exova Calgary
Coliforms- MPN (Enviro)	APHA		Fecal Coliform Procedure, 9221 E	16-Jan-16	Exova Calgary
Coliforms- MPN (Enviro)	APHA		Standard Total Coliform Fermentation Technique, 9221 B	16-Jan-16	Exova Calgary
Mercury (Dissolved) in water	APHA	*	Cold Vapour Atomic Absorption Spectrometric Method, 3112 B	15-Jan-16	Exova Edmonton
Metals ICP-MS (Dissolved) in water	APHA/USEPA	*	Metals By Inductively Coupled Plasma/Mass Spectrometry, APHA 3125 B / USEPA 200.2, 200.8	15-Jan-16	Exova Edmonton
Metals Trace (Dissolved) in water	APHA		Hardness by Calculation, 2340 B	15-Jan-16	Exova Edmonton
Metals Trace (Dissolved) in water	APHA	*	Inductively Coupled Plasma (ICP) Method, 3120 B	15-Jan-16	Exova Edmonton
Total and Kjeldahl Nitrogen (Total) in Water	ISO	*	Water Quality - Determination of nitrogen, ISO/TR 11905-2	15-Jan-16	Exova Edmonton

** Reference Method Modified*

References

APHA	Standard Methods for the Examination of Water and Wastewater
ISO	International Organization for Standardization
US EPA	US Environmental Protection Agency Test Methods

Guidelines

Guideline Description	Health Canada GCDWQ
Guideline Source	Guidelines for Canadian Drinking Water Quality, Health Canada, October 2014
Guideline Comments	MAC = Maximum Acceptable Concentration AO = Aesthetic Objective OG = Operational Guideline for Water Treatment Plants Refer to Health Canada GCDWQ for complete guidelines and additional drinking water information at www.hc-sc.gc.ca

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Lot ID:	**1116288**
Control Number:	C0078186
Date Received:	Jan 14, 2016
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Comments:

- Analysis for Total coliforms and Fecal coliforms was performed by both a membrane filtration method and a multi tube fermentation method as the samples contained sediment that affected volume of sample able to be filtered.

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ED 120-02

Project Information

Project ID:	19-6835-1
Project Name:	BAWLF LAGOON
Project Location:	BAWLF
Legal Location:	–
PO/AFE#:	–
Proj. Acct. Code:	–
Quote #	–

Invoice to:

Company:	Thurber Engineering
Address:	4127 Roper Rd NW Edm AB T6B 3S5
Attention:	Milan Butorac
Phone:	780-438-9460
Cell:	587-337-1318
Fax:	780-437-7125
E-mail:	mbutorac@thurber.ca
Agreement ID:	–
Copy of report:	YES

Report To:

Company:	Same
Address:	
Attention:	
Phone:	
Cell:	
Fax:	
E-mail 1:	
E-mail 2:	
Copy of invoice:	YES Demand

Report Results		Regulatory Requirement	
E-Mail	✓	HCDWQG	
Mail		Ab Tier 1	
Online		SPIGEC	
Fax		BCCSR	
PDF	✓	Other (list below)	
Excel	✓		
QA/QC	✓		

Sample Custody (please print)

Sampled by: JLM

Company: TEL

RUSH Priority

- Emergency (contact lab for turnaround and pricing)
- Priority 1-2 working days (100% surcharge)
- Urgent 2-3 working days (50% surcharge)

When "ASAP" is requested, turn around will default to a 100% RUSH priority, with pricing and turn around time to match. Please contact the lab prior to submitting RUSH samples. If not all samples require RUSH, please indicate in the special instructions.

Date Required: _____ Signature: _____

Special Instructions/Comments (please include contact information including ph. # if different from above).

N = NITROGEN CONTACT MILAN W/ ANY QUESTIONS

This section for Lab use only

Date/Time stamp:

JAN 14 PM 3:05

	Site I.D.	Sample Description	Depth start in	Depth start cm	Depth end m	Date/Time Sampled	Matrix	Sampling Method	Number of Containers	Routine Potability	Dissolved Metals	Total Kjeldahl N	Chemical Oxygen Demand	Total Coliforms	Fecal Coliforms				
1		THIS-1			–	JAN 14/16	WTR	BLR	5	X	X	X	X	X	X				
2		THIS-2								X	X	X	X	X	X				
3		THIS-3								X	X	X	X	X	X				
4		THIS-4								X	X	X	X	X	X				
5		THIS-5								X	X	X	X	X	X				
6		SW15-2								X	X	X	X	X	X				
7		SW15-3								X	X	X	X	X	X				
8		SW15-6								X	X	X	X	X	X				
9		DUP. A								X	X	X	X	X	X				
10																			
11																			
12																			
13																			
14																			
15																			

Enter tests above (√ relevant samples below)

* NOT FILTERED, NOT PRESERVED

Indicate in the space allotted any deficiencies by the corresponding number.

1. Indicate any samples that were not packaged well
2. Indicate any samples not received in Exova supplies
3. Indicate any samples that were not clearly labeled
4. Indicate any samples not received within the required hold time or temp.
5. Indicate any missing or extra samples
6. Indicate any samples that were received broken
7. Indicate any samples where sufficient volume was not received
8. Indicate any samples received in an inappropriate container

Submission of this form acknowledges acceptance of Exova's Standard Terms and Conditions (http://www.exova.com/about/terms-and-conditions/)

Please indicate any potentially hazardous samples

Page 1 of 1 Control # C 0078186

Lot: 1116288 COC

Shipping: COD Y/ N

and size of coolers

Temp. received: 4.1

Delivery Method: HAND

Waybill:

Received by: NUNEZ

ED 120-02