REGIONAL MUNICIPALITY OF NIAGARA
SOUTH NIAGARA FALLS WASTEWATER SOLUTIONS

V3.10 – Hydrogeological Investigations

Niagara Region is committed to reviewing its practices, processes and the built environment for barriers to access for persons with disabilities. If you require additional or other formats for communicating the details of the appendices in this attached report, please contact the project team new.treatment.plant@niagararegion.ca

LIST OF APPENDICES

V3.10.1

REGIONAL MUNICIPALITY OF NIAGARA
SOUTH NIAGARA FALLS WASTEWATER SOLUTIONS

Hydrogeological Investigation

Hydrogeological Baseline – Study Area

TECHNICAL MEMORANDUM

DATE May 4, 2020 **Project No.** 18104462

TO Chris Campbell, Infrastructure Planning, Partner
GM BluePlan Engineering Limited

CC Alyson Beal (Golder), Jean-Marc Crew (Golder)

FROM Matt Bowman **EMAIL mbowman@golder.com**
Sean McFarland **smcfarland@golder.com**

HYDROGEOLOGICAL BASELINE CONDITIONS – SOUTH NIAGARA FALLS WASTEWATER SOLUTIONS SCHEDULE C CLASS ENVIRONMENTAL ASSESSMENT, NIAGARA FALLS, ONTARIO

Introduction

The Regional Municipality of Niagara's (the Region) 2041 Growth Plan identified significant growth in residents and employment within the Municipality by 2041. In 2017, Niagara Region updated their Water & Wastewater Master Servicing Plan Update (MSP), which evaluated the ability of existing and planned water and wastewater infrastructure to efficiently and effectively service the Region's existing users, service anticipated growth, and to evaluate and develop recommended strategies. The MSP selected a new Waste Water Treatment Plant (WWTP) within South Niagara Falls as the preferred South Niagara Falls servicing strategy to service the anticipated growth for Niagara Region.

Niagara Region is currently completing a Schedule C Municipal Class Environmental Assessment (EA) for the proposed South Niagara Falls WWTP. Golder Associates Ltd. (Golder) was retained by GM BluePlan (GMBP) on behalf of the Region to provide a hydrogeological baseline description in support of the site selection process for the EA.

The hydrogeological baseline description presented herein is based upon a desktop study of the Regional Study Area (RSA) as outlined in red on Figures 1 to 4. Additional focus is also placed on the preliminary Sites of Interest outlined in black on Figures 1 to 4. It is currently anticipated that the proposed new WWTP would be located on one of the Sites of Interest while associated infrastructure upgrades may take place within the wider RSA.

Regional Study Area

As shown on Figures 1 to 4, the RSA encompasses most of the built-up area of Niagara Falls and has approximate extents reaching from the Welland Canal area to the Niagara River in the east-west direction and from south of Mountain Road to south of Marshall Road in the north-south direction. The Sites of Interest are located in the southern part of the RSA, adjacent to the Welland River and Power Canal.

Physiography and Surficial Geology

The RSA is almost entirely located within the Haldimand Clay Plain physiographic region as defined by Chapman and Putnam (1984). The extreme northwest corner of the RSA falls within the Niagara Escarpment physiographic region.

The Haldimand Clay Plain is a generally level, gently sloping landscape dominated by dense, clayey soils. These clayey soils are represented by the fine-textured glaciolacustrine deposits that are mapped across the majority of the RSA as shown on Figure 1. Coarser-textured soils occur beneath the central part of the Niagara Falls built up area while minor areas of alluvial deposits are found along the region's creeks and rivers. The surficial geology mapping presented on Figure 1 shows several areas of man-made deposits within the RSA. These are interpreted to be areas of fill soils resulting from large scale construction works and industrial sites.

Most of the Sites of Interest are underlain by the fine-textured glaciolacustrine deposits with smaller areas of alluvial deposits along the Welland River/Chippawa Creek. Some of the Sites of Interest near the Power Canal and at the far western end of the Sites of Interest are underlain by, or adjacent to, large areas of man-made deposits.

Bedrock Geology

Bedrock geology beneath the RSA is presented on Figure 2. Three major bedrock units subcrop beneath the RSA in a north to south succession of increasingly younger units of Silurian age. These bedrock units are generally oriented horizontally with a slight dip towards the south (WHI, 2005). From north to south, the bedrock formations comprise the Lockport, Guelph and Salina Formations, all dominantly composed of dolostone.

Oil and Gas Wells

Oil and gas well records from the Ontario Oil, Gas and Salt Resources Library are plotted on Figure 2 and summarized in Tables 1A and 1B. There are 41 wells recorded within the RSA and 35 records for wells that are either abandoned or were not drilled. The oil and gas wells are predominantly located in the southern part of the RSA and, with the exception of Site identification No. 2, outside of the Sites of Interest. Several oil and gas well records are located on and adjacent to Site identification No. 2 to the south of the Welland River.

The oil and gas well records on Table 1A indicate that, where recorded, the wells were gas wells or dry wells, completed from 60 to 110 years ago and drilled to depths of between 135 m and 857 m below ground surface (mbgs) (with an average depth of 183 mbgs). It is not known if any of these wells are still operational.

Hydrogeology

The hydrogeology of the RSA tends to be controlled by the local geology. The extensive fine-grained glacial deposits generally form aquitard units which can limit infiltration of precipitation. Areas with coarser-grained deposits may form local aquifers and where present at surface, these coarser-grained deposits can enhance infiltration rates. The bedrock units in the RSA are considered to be aquifers, especially in the upper few meters that tend to be more highly weathered (WHI, 2005). Hydraulic conductivities in the bedrock are enhanced by the karstic dissolution of the carbonate rock and the presence of highly-soluble evaporite minerals, especially common in the Salina Formation. This dissolution of the bedrock contributes to higher hydraulic conductivities in

the upper weathered zone of the bedrock but also can contribute to poorer water quality at depth in the bedrock as the dissolved mineral content of the groundwater increases. Shallow groundwater flow is expected to generally follow the ground surface topography with flow towards local surface water bodies like the Welland River/Chippawa Creek, Power Canal and Niagara River.

Provincial Water Well Records and Water Taking Permits

Water well records from the Ontario Ministry of the Environment, Conservation and Parks (MECP) Water Well Information Service have been plotted on Figure 3A and 3B and the records are summarized in Tables 2A and 2B. The records have been divided into two groups based on reported well use. Records for abandoned wells or test/monitoring wells are in one group (Table 2B) as they are considered to be less sensitive to potential changes in groundwater and records for water supply wells or no recorded use are in the other group (Table 2A) that is considered potentially more sensitive to changing groundwater conditions. Water well records occur throughout the RSA however the records within the built-up areas tend to be for abandoned or test/monitoring wells. There are 962 total well records in the RSA with 452 of these in the abandoned or test/monitoring wells group. The well records indicate that the wells in the RSA were completed to depths of 0.9 to 153.9 mbgs with an average depth of about 15 mbgs. Reported depths to bedrock (for 345 out of 962 well records) ranged from 0.3 to 37.8 mbgs and averaged about 14 mbgs. Static water levels (for 426 of 962 well records, with a depth greater than 0 m) were reported from 0.3 to 27 mbgs and averaged about 6.5 mbgs. Well water quality was described as fresh in the most records (350), with a few described as sulfur (71), mineral (12) or salty (1).

In the Sites of Interest area shown on Figure 3B there are 96 total well records located throughout the area, including on and adjacent to many of the Sites of Interest. The well records indicate that the wells in the Sites of Interest area were completed to depths of 3 to 74.7 mbgs with an average depth of about 17 mbgs. Reported depths to bedrock (for 38 out of 96 well records) ranged from 4.9 to 28.3 mbgs and averaged about 18 mbgs. Static water levels (for 45 of 96 well records, with a depth greater than 0 m) were reported from 0.3 to 19.8 mbgs and averaged about 6 mbgs. Well water quality was described as fresh in the most records (33), with a few described as sulfur (10) or salty (1).

Existing Permit to Take Water (PTTW) locations from the MECP database are plotted on Figures 3A and 3B and summarized on Table 3. There are 16 PTTW recorded in the RSA and three of which are located near the Sites of Interest as shown on Figure 3B. PTTW numbers 5415-9TFJ69 and 6133-98BMFV are takings of surface water and groundwater from the Welland River, Chippawa Power Canal and various ponds for the purpose of golf course irrigation. PTTW number 2701-9NBLH8 is for a surface water taking from the Welland River for industrial cooling water. It is also noted that a Niagara Region municipal water supply intake is located to the east of the Sites of Interest locations where it takes water from the Chippawa Creek (PTTW No. 2351-7XFM28).

Source Protection Mapping

The Niagara Peninsula Conservation Authority (NPCA) administers the regional Drinking Water Source Protection process under the Ontario Clean Water Act, 2006 (NPCA, 2013). Part of the Source Protection planning involves the evaluation of vulnerable areas which could contribute to water quality or quantity issues for municipal drinking water sources. Two of these vulnerable areas, Highly Vulnerable Aquifers (HVA) and Significant Groundwater Recharge Areas (SGRA) are shown on Figures 4A and 4B, in the RSA and the Sites of Interest area, respectively.

HVA are assessed based on a semi-quantitative rating system that looks at the thickness and permeability of the surficial overburden units as well as the presence of potential contaminant transport pathways such as high-risk

wells and larger excavations such as aggregate pits and large-scale construction activities. As shown on Figure 4A, the HVAs are present throughout the RSA including extensive areas in the northern part and under the developed areas. HVA within the Sites of Interest area (Figure 4B) are less extensive but do occur on portions of Site identification Nos. 1, 2, 4 and 5 and directly adjacent to identification Nos. 3 and 8.

SGRA are assessed based on an evaluation of areas that recharge water to underlying aquifers at rates greater than the surrounding areas. To be defined as a SGRA the underlying aquifer must also supply water to a surface water body or aquifer that is used as a drinking water source. SGRA are also subdivided into vulnerability scores of high, medium or low. The only SGRA in the RSA occur in the south and southwest part of the RSA as shown on Figure 4A. The largest SGRA is located south of the Welland River and south and west of the Sites of Interest, with Site identification No. 2 within its northeast corner. Other, smaller SGRA occur further west along the Welland River and to the south along creeks and wetland areas. SGRA within the RSA are rated as low vulnerability with the exception of some small areas within and adjacent to Site of Interest No. 2 that overlap with HVA and are rated as high vulnerability.

Wellhead Protection Areas (WHPA) are another category of groundwater-related vulnerable area defined by the Clean Water Act (2006). There are no WHPA in the Niagara Source Protection Area (NPCA, 2013), which includes the RSA.

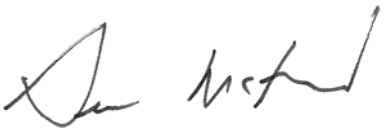
NPCA Groundwater Monitoring

The NPCA monitors groundwater levels and quality in three monitoring wells located in, or near to, the RSA as shown on Figures 3A and 3B. These wells are all installed into the upper bedrock or overburden/bedrock interface to depths of approximately 27 to 30 mbgs. Groundwater level monitoring at the wells has been carried out since October 2014 and the records show that the groundwater levels in each well have been relatively steady with gradual fluctuations of up to about 0.5 m. The average depth to groundwater in each well over the monitoring period is 9.5 mbgs at the Young Matthews well, 4.6 mbgs at the Baden Powell well and 14.7 mbgs at the Oak Hall well. The Young Matthews well has been noted to vent gas which causes some fluctuation in water levels.

Selected chemical analysis results for water samples from the wells are summarized on Table 4. The presence of sulphur compounds in groundwater of the area has been noted (WHI, 2005) especially in groundwater in contact with the Salina Formation which contains extensive gypsum deposits. This is also observed in the shallow groundwater samples shown on Table 4 where the wells completed in the Salina (Young Matthews and Baden Powell wells) have groundwater with sulphate levels approximately twice as high as the well completed in the Guelph Formation (Oak Hall well). Water samples collected from these wells were consistently noted to have a hydrogen sulphide (H_2S) odour and the analyses indicate that there is detectable hydrogen sulphide in the water at all wells, though in smaller amounts at the Oak Hall well. Given the historical presence of natural gas wells in the southern part of the RSA and the observations of gas venting from the Young Matthews well it is noted that the percentage saturation of methane (CH_4) in this well is markedly higher than the other wells.

Closure

We trust this report meets your current needs. If you have any questions, please contact the undersigned.



Matt Bowman, BSc
Environmental Scientist

Sean McFarland, PhD, PGeo
Principal, Senior Hydrogeologist

MB/PMMC/SM/mp

Attachments

Tables

Table 1A – Ontario Oil, Gas and Salt Resources Library Well Records

Table 1B – Ontario Oil, Gas and Salt Resources Library Well Records (Abandoned Wells)

Table 2A – MECP Water Well Records

Table 2B – MECP Water Well Records (Abandoned and Test/Monitoring Wells)

Table 3 – MECP Permits to Take Water

Table 4 – NPCA Groundwater Quality Results

Figures

Figure 1 – Surficial Geology

Figure 2 – Bedrock Geology and Gas Wells

Figure 3A – Water Wells and Water Taking Permits

Figure 3B – Water Wells and Water Taking Permits – Sites of Interest Area

Figure 4A – Groundwater Recharge and Vulnerability

Figure 4B – Groundwater Recharge and Vulnerability – Sites of Interest Area

REFERENCES

Chapman, L.J. and Putnam, D.F. 1984. The Physiography of Southern Ontario, Third Edition. Ontario Geological Survey, Special Volume 2. 270 pp.

Niagara Peninsula Conservation Authority (NPCA), 2013. Updated Assessment Report Niagara Peninsula Source Protection Area. 232 pp.

Waterloo Hydrogeologic Inc. (WHI). 2005. NPCA Groundwater Study Final Report. October 2005.

TABLES

Ontario Oil, Gas and Salt Resources Library Well Records

Well ID#	Well Licence #	Well Type	Well Mode	Ground Surface Elevation (m)	Total Depth (m)	Vertical Well?	Well Latitude	Well Longitude	Top of Production Zone (m)	Well Name	Total Depth Date
23606	N002812	Dry Hole	Unknown	179.83	857.1	Y	43.067666	-79.122177	0	Provincial Natural Gas No. 262	06-08-1908
25853	F013944	Natural Gas Well	Unknown	184.54	138.68	Y	43.068468	-79.084493	94.18	Falls View Gas Syndicate No. 1	18-04-1946
25854	F013945	Natural Gas Well	Unknown	184.14	138.68	Y	43.069886	-79.084504	102.11	Falls View Gas Syndicate No. 2	25-05-1946
25855	F013946	Natural Gas Well	Unknown	183.4	137.16	Y	43.070082	-79.087396	121.92	Falls View Gas Syndicate No. 3	13-07-1946
25856	F013947	Natural Gas Well	Unknown	183.3	137.77	Y	43.069156	-79.086359	120.4	Falls View Gas Syndicate No. 4	20-09-1946
25857	F013948	Natural Gas Well	Unknown	182.74	137.16	Y	43.068294	-79.087062	121.92	Falls View Gas Syndicate No. 5	07-11-1946
25891	F013981	Dry Hole	Unknown	175.4	135.03	Y	43.036423	-79.152677	0	Dell Burn Gas Ltd. G.A. Biggar #4	28-06-1952
25892	F013982	Natural Gas Well	Unknown	175.07	151.79	Y	43.038142	-79.149976	135.6	W.C. Patterson Gas Co. - G.A. Biggar No. 1	20-07-1948
25925	F014013	Natural Gas Well	Unknown	175.02	151.18	Y	43.040582	-79.150342	134.72	W.C. Patterson Gas Co. G.A. Biggar #3	15-10-1948
25926	F014014	Natural Gas Well	Unknown	175.04	147.22	Y	43.040268	-79.152972	0	Provincial Gas Co. John Biggar	17-11-1926
25927	F014015	Natural Gas Well	Unknown	174.46	161.85	Y	43.035384	-79.149939	145.69	John C. Biggar #1	08-09-1948
25928	F014016	Gas Show	Unknown	0	168.25	Y	43.018554	-79.149771	0	Pilkington Brs. Pipe North Well	<Null>
25931	F014019	Natural Gas Well	Unknown	171.67	143.26	Y	43.042784	-79.157595	131.06	John Horton #1	28-06-1952
25940	F014028	Natural Gas Well	Unknown	170.69	170.69	Y	43.017483	-79.166414	0	Pilkington Bros. C.M. Young	<Null>
26016	F014098	Dry Hole	Unknown	179.11	158.5	Y	43.023238	-79.193143	132.59	Crowland Gas Syndicate #49 J. Hagar #1	08-01-1954
26063	F014144	Natural Gas Well	Unknown	141.43	141.43	Y	43.037895	-79.146111	110.03	W.C. Patterson C.A. Biggar #2	20-08-1948
26116	F014193	Natural Gas Well	Unknown	178.6	152.7	Y	43.030709	-79.142112	121.31	E & A. Cruickshank #1	09-06-1948
26163	F014223	Natural Gas Well	Unknown	190	256.03	Y	43.080009	-79.097531	65.53	McGlashan Farm - Well No. 1	<Null>
26667	F014661	Natural Gas Well	Unknown	179.5	154.84	Y	43.024979	-79.052146	115.21	Provincial Gas Co. #369 - A J Weaver	30-07-1913
26669	F014663	Natural Gas Well	Unknown	174.72	158.5	Y	43.024505	-79.111174	135.64	Ralph Sider & Associates #2 - Thos Dell #1	03-04-1959
26671	F014665	Natural Gas Well	Unknown	175.05	180.44	Y	43.022937	-79.086967	165.81	Eugene Tanke #7 - Robert Willick #1	18-08-1952
26672	F014666	Natural Gas Well	Unknown	175.05	157.58	Y	43.024155	-79.086307	156.67	Chippawa Creek Gas Syndicate #1A - Maude Logan #1	08-03-1947
26674	F014668	Natural Gas Well	Unknown	177.5	182.27	Y	43.019871	-79.053152	164.29	T A DiMartile #12 - Harold Collins #2	23-02-1950
26675	F014669	Natural Gas Well	Unknown	174	175.87	Y	43.020539	-79.05655	3.05	T A DiMertile - H. Collins #1	04-02-1950
26679	F014673	Natural Gas Well	Unknown	173.6	167.64	Y	43.020822	-79.076866	125.58	Provincial Gas Co. #321 - D & R Somerville	<Null>
26680	F014674	Natural Gas Well	Unknown	172.9	163.37	Y	43.020813	-79.077164	120.7	Provincial Gas Co. - D & R Somerville	22-08-1910
26764	F014760	Private Gas Well	Unknown	174.25	152.4	Y	43.050856	-79.029235	132.59	PRIVATE WILLOUGHBY 21-BFCNR	26-08-1947
26770	F014766	Location	Unknown	175	200.25	Y	43.043611	-79.039917	0	Privincial Gas Co. #203	07-06-1904
26773	F014770	Natural Gas Well	Unknown	175.01	175.26	Y	43.033876	-79.084123	142.04	Manock Gas Syndicate #10, John Kane #1	25-05-1953
26774	F014771	Natural Gas Well	Unknown	175	159.41	Y	43.034477	-79.089848	151.49	Pleasant Beach Gas Synd., J.Vanderburg #3	06-08-1958
26777	F014774	Natural Gas Well	Unknown	176.05	0	Y	43.032114	-79.06389	106.68	Provincial Gas Co., Michael Miller	27-06-1914
26783	F014780	Natural Gas Well	Unknown	179.8	160.02	Y	43.032913	-79.112388	146.91	S.Fleming (Patterson & Culver), Roy J. Bynon #1	30-08-1954
27063	F014660	Natural Gas Well	Unknown	175.14	169.16	Y	43.024698	-79.070164	135.64	Queenston Gas & Oil Co. No. 1 - Albert Miller No.1	08-08-1946
32649	F020238	Natural Gas Well	Unknown	180	0	Y	43.066444	-79.063361	0	Consumer's 6056	<Null>
32650	F020239	Natural Gas Well	Unknown	179	0	Y	43.067111	-79.062944	0	Consumer's 6080	<Null>
32651	F020240	Natural Gas Well	Unknown	175	0	Y	43.066444	-79.058583	0	Consumer's 6052	<Null>
32652	F020241	Natural Gas Well	Unknown	175	0	Y	43.067944	-79.057472	0	Consumer's 6057	<Null>
32653	F020242	Natural Gas Well	Unknown	175	0	Y	43.066639	-79.054722	0	Consumer's 6050	<Null>
32654	F020243	Natural Gas Well	Unknown	174	0	Y	43.066333	-79.055167	0	Consumer's 6059	<Null>
32655	F02024	Natural Gas Well	Unknown	0	0		43.066639	-79.054139	0	Consumer's 6060	<Null>
32656	F020244	Natural Gas Well	Unknown	174	0	Y	43.066639	-79.054139	0	Consumer's 6060	<Null>

Data accesssed May 9, 2019

Ontario Oil, Gas and Salt Resources Library Well Records (Abandoned Wells)

Well ID#	Well Licence #	Well Type	Well Mode	Ground Surface Elevation (m)	Total Depth (m)	Vertical Well?	Well Latitude	Well Longitude	Top of Production Zone (m)	Well Name	Total Depth Date
193	T007923	Stratigraphic Test	Abandoned Well	186.23	300.28	Y	43.077283	-79.085428	0	92-A	16-06-1992
194	T007932	Stratigraphic Test	Abandoned Well	182.22	220.43	Y	43.128052	-79.087018	0	92-B	10-06-1992
2037	F010831	Gas Show	Abandoned Well	175.02	575	Y	43.020336	-79.082563	0	Campus Gas Syndicate No. 1 - F. Somerville No. 1	17-10-1961
2038	F010835	Natural Gas Well	Abandoned Well	174.96	182.88	Y	43.020614	-79.077841	142.34	Campus Gas Syndicate No. 2 - F. Somerville No. 2	13-12-1961
2039	F010830	Gas Show	Abandoned Well	174.98	173.74	Y	43.020336	-79.074229	0	Campus Gas 3 - Sommerville No. 3	26-07-1962
16017	T001221	Dry Hole	Abandoned Well	175	175.26	Y	43.020058	-79.081174	0	Campus Gas Syndicate No. 4	01-06-1963
23605	N002811	Gas Show	Abandoned Well	184.71	327.66	Y	43.074405	-79.097194	0	Consumer No. 1444 - Cadman Farm - Well No. 2	<Null>
23741	N002952	Natural Gas Well	Abandoned Well	174.7	218.54	Y	43.057018	-79.033261	160.93	Provincial No. 142 - Consumers No. 142 - E. Winger	<Null>
24188	T010011	Private Gas Well	Abandoned Well	174.96	152.4	Y	43.036644	-79.153974	0	PRIVATE CROWLAND 6-7-BFC	15-10-1927
25852	F013943	Gas Show	Abandoned Well	194.95	113.08	Y	43.090602	-79.126884	0	Robert J. Thompson H. E. Mashford #1	02-06-1950
25858	F013949	Dry Hole	Abandoned Well	182.75	132.59	Y	43.055071	-79.083947	0	E.W. Tyrrill No. 1 Welland Securities No. 1	17-12-1946
25893	T012327	Natural Gas Well	Abandoned Well	174.98	139.29	Y	43.039399	-79.154135	110.03	Dell burn Gas Ltd. #1 C. Cebrinski #2	05-06-1952
26113	F014190	Dry Hole	Abandoned Well	153.92	153.92	Y	43.030474	-79.134617	0	W. C. Patterson Gas Co. A & E Woodgate	19-05-1948
26162	F014222	Stratigraphic Test	Abandoned Well	160.3	0	Y	43.091949	-79.07	0	Niagara Bridge Hole No. 1	<Null>
26670	F014664	Gas Show	Abandoned Well	175.04	163.37	Y	43.026116	-79.092634	159.72	Eugene Tanke - Robert Willock #2	13-10-1952
26673	F014667	Natural Gas Well	Abandoned Well	175	163.37	Y	43.019455	-79.064629	0	Consumer's Gas #313 - J Plyley	01-01-1911
26676	F014670	Gas Show	Abandoned Well	179.2	197.51	Y	43.020673	-79.045281	196.6	W C Patterson Gas Co. Ltd. - E Beam #2	28-09-1939
26677	F014671	Gas Show	Abandoned Well	175.96	162.15	Y	43.020461	-79.112195	129.24	Ralph Sider & Associates - T Dell #2	29-04-1959
26678	F014672	Dry Hole	Abandoned Well	175.1	198.42	Y	43.022251	-79.09016	0	W C Patterson Gas Co. - Ort #1	24-01-1940
26681	F014675	Natural Gas Well	Abandoned Well	175	195.07	Y	43.022551	-79.071246	0	Township of Willoughby	01-01-1900
26690	F014684	Location	Abandoned Well	175	164.59	Y	43.018579	-79.076473	0	Consumers Gas #319	01-01-1911
26766	F014762	Natural Gas Well	Abandoned Well	175	218.54	Y	43.047114	-79.036814	178.92	B.&D. Developement #2	24-09-1950
26767	F014763	Dry Hole	Abandoned Well	175.15	149.35	Y	43.042668	-79.039498	0	T. Dimartile, Welland Securities #2	08-05-1950
26768	F014764	Natural Gas Well	Abandoned Well	175.12	212.75	Y	43.045216	-79.033859	181.97	B.&D.Developement , B.&D.Developement #1	04-07-1950
26769	F014765	Natural Gas Well	Abandoned Well	174.9	168.25	Y	43.042631	-79.044541	149.96	T.D.DiMartile, Welland Securities Ltd. #1	06-04-1950
26772	F014769	Gas Show	Abandoned Well	174.79	152.4	Y	43.034365	-79.109216	0	Ralph Sider & Associates #1, E.&H. Thomas	13-03-1959
26775	F014772	Dry Hole	Abandoned Well	175.7	152.7	Y	43.036579	-79.092775	0	Pleasant Beach Gas Synd.	03-07-1958
26776	F014773	Dry Hole	Abandoned Well	175	155.75	Y	43.035873	-79.080164	0	Manock Gas Syndicate #11, C.Somerville #1	15-07-1953
26778	F014775	Dry Hole	Abandoned Well	175.9	144.17	Y	43.033648	-79.043509	0	T.DiMartile, Geo.Willick #1	24-05-1950
26782	F014779	Dry Hole	Abandoned Well	175	152.4	Y	43.032737	-79.121617	0	W.C.Patterson Gas Co. Ltd., Henry J. Thomas #1	26-06-1948
26786	F014783	Gas Show	Abandoned Well	175.1	156.36	Y	43.027128	-79.111357	154.23	Ralph Sider & Associates, Thos. Dell #3	21-05-1959
32616	T012542	Licensed	Not Drilled	179	36.2	Y	43.116039	-79.1982	27.8	pGT17-01	30-10-2017
32617	T012543	Licensed	Not Drilled	0	0		43.11615	-79.190297	0	pGT17-04	<Null>
32700	T012549	Licensed	Not Drilled	0	0		43.115631	-79.196619	0	pGT17-02	<Null>
32701	T012550	Licensed	Not Drilled	0	0		43.116231	-79.194311	0	pGT17-03	<Null>

Data accesssed May 9, 2019

Well ID#	Well Depth (m)	Bedrock Depth (m)	Static Water Level (m)	Well Type	Date Completed	Ground Surface Elevation	Water Found Depth (m)	Well Casing Material	Water Description	Well Status	Well Use (1)	Well Use (2)	Recommended Pump Rate (GPM)
7120522	31.7	0	0	NULL	09-12-2008	178.03	NULL	PLASTIC	NULL	Alteration	NULL	NULL	NULL
7225923	16.5	0	2.4	NULL	30-07-2014	158.81	13.716	STEEL	Untested	Dewatering	Dewatering	NULL	NULL
7225924	16.8	0	2.6	NULL	30-07-2014	169.33	13.716	STEEL	Untested	Dewatering	Dewatering	NULL	NULL
7225925	16.2	0	2.4	NULL	30-07-2014	173.67	13.716	STEEL	Untested	Dewatering	Dewatering	NULL	NULL
7225927	13.7	0	2.4	NULL	30-07-2014	151.10	13.716	STEEL	Untested	Dewatering	Dewatering	NULL	NULL
7145930	10.5	0	0	NULL	10-05-2010	185.05	NULL	PLASTIC	FRESH	Dewatering	Domestic	NULL	NULL
7244394	21.3	0	11.6	NULL	02-07-2015	157.81	13.1064	STEEL	Untested	NULL	Dewatering	NULL	NULL
6603480	15.2	6.7	3.7	Bedrock	02-06-1981	189.71	7.0104	NULL	FRESH	NULL	Domestic	Livestock	NULL
7168532	25.9	0	10.7	NULL	20-08-2011	179.98	13.716	STEEL	SULPHUR	NULL	Domestic	NULL	10
7128689	4.5	0	3.6	NULL	14-01-2008	193.57	2.5	PLASTIC	NULL	NULL	Not Used	NULL	NULL
6603873	82.6	0	0	Overburden	09-03-1989	170.34	NULL	STEEL	NULL	NULL	NULL	NULL	NULL
6604629	0	0	0	NULL	15-10-2001	177.16	NULL	NULL	NULL	NULL	NULL	NULL	NULL
6604762	6	0	0	Overburden	13-01-2004	181.79	NULL	PLASTIC	NULL	NULL	NULL	NULL	NULL
6604765	4.5	0	0	Overburden	01-03-2004	173.95	NULL	PLASTIC	NULL	NULL	NULL	NULL	NULL
7160195	0	0	0	NULL	01-12-2010	200.01	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7163355	0	0	0	NULL	02-05-2011	196.95	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7163906	0	0	0	NULL	16-03-2011	184.99	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7168469	0	0	0	NULL	NULL	174.77	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7168531	0	0	0	NULL	NULL	184.24	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7168755	0	0	0	NULL	20-07-2011	205.36	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7171093	0	0	0	NULL	01-10-2011	182.40	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7178733	0	0	0	NULL	07-09-2011	179.25	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7188613	0	0	0	NULL	29-03-2012	202.85	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7189739	0	0	0	NULL	17-09-2012	174.60	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7190392	0	0	0	NULL	21-06-2012	186.21	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7194414	0	0	0	NULL	14-06-2012	191.11	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7199250	0	0	0	NULL	15-03-2013	177.55	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7200762	0	0	0	NULL	04-01-2013	177.88	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7201173	0	0	0	NULL	31-07-2012	186.28	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7203980	0	0	0	NULL	30-05-2013	180.42	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7205012	0	0	0	NULL	24-06-2013	185.33	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7206054	25.3	0	13.1	NULL	31-07-2013	185.10	13.1064	STEEL	Untested	NULL	NULL	NULL	30
7206134	0	0	0	NULL	24-01-2013	190.23	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7207357	3.2	0	0	NULL	26-08-2013	172.88	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7207358	7.9	0	0	NULL	26-08-2013	174.86	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7207359	3.5	0	0	NULL	26-08-2013	171.86	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7213319	0	0	0	NULL	30-10-2013	179.43	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7214400	0	0	0	NULL	02-10-2013	193.81	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7215906	0	0	0	NULL	14-01-2014	180.30	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7217278	0	0	0	NULL	17-10-2013	182.67	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7218573	0	0	0	NULL	26-10-2013	192.18	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7219157	0	0	0	NULL	11-10-2013	209.61	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7220631	0	0	0	NULL	25-04-2014	168.69	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7225140	0	0	0	NULL	21-10-2013	194.96	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7225158	0	0	0	NULL	21-10-2013	194.98	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7225771	0	0	0	NULL	22-07-2014	194.05	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7226746	0	0	0	NULL	10-05-2010	189.40	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7228310	0	0	0	NULL	31-07-2014	183.53	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7229606	0	0	0	NULL	29-08-2014	193.08	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7231853	0	0	0	NULL	29-04-2014	179.11	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7236642	0	0	0	NULL	24-10-2014	194.01	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7239229	0	0	0	NULL	10-12-2014	185.29	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7241154	0	0	0	NULL	15-04-2015	168.92	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7243131	0	0	0	NULL	07-01-2015	197.34	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7246491	0	0	0	NULL	06-07-2015	183.83	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7250125	0	0	0	NULL	29-09-2014	191.18	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7250804	0	0	0	NULL	27-08-2015	186.03	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7256001	0	0	0	NULL	01-04-2015	173.12	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7256002	0	0	0	NULL	31-03-2015	150.43	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7256003	0	0	0	NULL	01-04-2015	181.96	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7256004	0	0	0	NULL	11-04-2015	149.47	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7256005	0	0	0	NULL	02-04-2015	162.03	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7256025	0	0	0	NULL	20-05-2015	179.28	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7258230	0	0	0	NULL	10-12-2015	179.35	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7258421	0	0	0	NULL	12-02-2016	172.37	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7258439	0	0	0	NULL	17-11-2015	167.59	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7259044	0	0	0	NULL	01-10-2015	203.29	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7260100	0	0	0	NULL	07-12-2015	193.08	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7260185	0	0	0	NULL	25-09-2015	177.39	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Well ID#	Well Depth (m)	Bedrock Depth (m)	Static Water Level (m)	Well Type	Date Completed	Ground Surface Elevation	Water Found Depth (m)	Well Casing Material	Water Description	Well Status	Well Use (1)	Well Use (2)	Recommended Pump Rate (GPM)
7260618	0	0	0	NULL	27-01-2016	197.61	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7265625	0	0	0	NULL	02-03-2016	177.32	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7267077	0	0	0	NULL	15-10-2014	166.95	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7267237	0	0	0	NULL	12-08-2013	178.86	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7270648	0	0	0	NULL	14-03-2013	184.60	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7270714	0	0	0	NULL	25-08-2015	179.63	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7275731	0	0	0	NULL	19-10-2016	179.21	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7276125	0	0	0	NULL	28-07-2016	177.76	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7278160	0	0	0	NULL	20-12-2016	174.70	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7278162	0	0	0	NULL	20-12-2016	157.81	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7278163	0	0	0	NULL	20-12-2016	173.67	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7278164	0	0	0	NULL	20-12-2016	151.10	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7278165	0	0	0	NULL	20-12-2016	169.33	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7278166	0	0	0	NULL	20-12-2016	158.81	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7278859	0	0	0	NULL	17-11-2016	191.49	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7279201	0	0	0	NULL	21-07-2016	185.03	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7281079	0	0	0	NULL	22-12-2016	179.64	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7281176	0	0	0	NULL	16-12-2016	215.75	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7281200	0	0	0	NULL	06-01-2017	204.28	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7282158	0	0	0	NULL	07-12-2016	165.41	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7283871	0	0	0	NULL	17-11-2016	180.63	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7283872	0	0	0	NULL	09-11-2016	183.07	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7283873	0	0	0	NULL	28-11-2016	187.02	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7284529	0	0	0	NULL	13-03-2017	182.55	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7285548	0	0	0	NULL	27-02-2017	186.46	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7285549	0	0	0	NULL	09-03-2017	185.80	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7286144	0	0	0	NULL	17-11-2016	184.98	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7289500	0	0	0	NULL	01-05-2017	175.69	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7289552	0	0	0	NULL	18-05-2017	151.44	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7290858	10.1	0	0	NULL	01-07-2017	187.88	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7292301	0	0	0	NULL	05-07-2017	179.83	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7293749	0	0	0	NULL	08-08-2017	187.04	NULL	NULL	NULL	NULL	NULL	NULL	NULL
7295452	0	0	0	NULL	10-08-2017	185.60	NULL	NULL	NULL	NULL	NULL	NULL	NULL
6602547	83.8	11.3	9.4	Bedrock	05-07-1970	192.84	13.4112	STEEL	FRESH	Recharge Well	Cooling And A/C	NULL	NULL
6602689	61	10.1	9.1	Bedrock	30-06-1971	191.33	12.192	STEEL	SULPHUR	Recharge Well	Not Used	NULL	NULL
7259307	6.1	0	0	NULL	03-03-2016	175.89	NULL	PLASTIC	NULL	Replacement Well	Monitoring and Test Hole	NULL	NULL
7041806	107	15.5	0	Bedrock	07-02-2007	182.00	NULL	PLASTIC	NULL	Replacement Well	NULL	NULL	NULL
6601329	14	10.1	4.6	Bedrock	30-06-1965	185.74	13.716	STEEL	SULPHUR	Water Supply	Commerical	NULL	10
6601373	13.1	8.2	7.9	Bedrock	11-05-1954	180.02	8.5344	STEEL	FRESH	Water Supply	Commerical	NULL	NULL
6601396	24.1	23.8	5.2	Bedrock	10-04-1964	175.96	23.7744	STEEL	SULPHUR	Water Supply	Commerical	NULL	NULL
6601628	15.8	15.2	3	Bedrock	08-07-1950	177.19	15.8496	STEEL	SULPHUR	Water Supply	Commerical	NULL	NULL
6601641	15.2	7	4.9	Bedrock	06-07-1967	175.36	14.3256	STEEL	FRESH	Water Supply	Commerical	NULL	1
6601642	11.6	8.8	6.7	Bedrock	29-07-1967	179.93	10.9728	STEEL	FRESH	Water Supply	Commerical	NULL	5
6601684	14.9	13.4	6.7	Bedrock	06-04-1955	185.06	14.6304	STEEL	FRESH	Water Supply	Commerical	NULL	NULL
6601685	21	15.2	8.5	Bedrock	23-10-1957	185.16	18.5928	STEEL	SULPHUR	Water Supply	Commerical	Domestic	NULL
6601686	18.3	13.4	0	Bedrock	13-03-1962	185.06	18.288	STEEL	SULPHUR	Water Supply	Commerical	NULL	2
6601687	12.5	8.5	8.8	Bedrock	08-09-1953	182.00	11.8872	STEEL	FRESH	Water Supply	Commerical	NULL	NULL
6601688	11	9.1	8.2	Bedrock	30-08-1956	181.77	10.668	STEEL	FRESH	Water Supply	Commerical	NULL	NULL
6601689	18.3	9.1	9.1	Bedrock	05-04-1958	182.02	14.3256	OPEN HOLE	FRESH	Water Supply	Commerical	NULL	NULL
6601690	18.3	8.2	9.1	Bedrock	19-04-1958	182.01	14.3256	OPEN HOLE	FRESH	Water Supply	Commerical	NULL	NULL
6601694	15.5	13.4	7.3	Bedrock	27-08-1954	179.94	14.9352	STEEL	FRESH	Water Supply	Commerical	NULL	NULL
6601718	11.3	9.1	8.5	Bedrock	24-05-1961	182.68	11.2776	STEEL	FRESH	Water Supply	Commerical	NULL	17
6601719	16.5	10.4	11	Bedrock	13-09-1963	184.69	15.8496	STEEL	SULPHUR	Water Supply	Commerical	NULL	10
6601720	16.5	10.1	10.1	Bedrock	25-05-1964	183.83	16.4592	STEEL	FRESH	Water Supply	Commerical	NULL	17
6601721	16.5	9.4	9.1	Bedrock	29-05-1964	184.02	16.4592	STEEL	FRESH	Water Supply	Commerical	NULL	17
6601727	17.1	15.2	9.1	Bedrock	02-04-1956	179.06	17.0688	OPEN HOLE	FRESH	Water Supply	Commerical	NULL	NULL
6602253	29	26.5	9.1	Bedrock	03-03-1959	112.69	28.956	STEEL	SULPHUR	Water Supply	Commerical	NULL	20
6603308	13.4	0	4	Overburden	12-10-1978	196.88	12.8016	STEEL	FRESH	Water Supply	Commerical	NULL	15
6603499	18	16.2	6.7	Bedrock	10-09-1981	177.77	NULL	STEEL	NULL	Water Supply	Commerical	NULL	10
6603500	18.3	0	5.5	Overburden	15-09-1981	177.08	14.6304	STEEL	FRESH	Water Supply	Commerical	NULL	8
6603813	23.5	20.4	11.6	Bedrock	29-01-1988	181.09	22.86	STEEL	FRESH	Water Supply	Commerical	NULL	8
6603923	16.5	12.8	6.7	Bedrock	12-12-1989	184.65	15.24	STEEL	SULPHUR	Water Supply	Commerical	NULL	15
7170838	27.4	0	12.5	NULL	15-09-2011	196.37	27.12	STEEL	FRESH	Water Supply	Commerical	NULL	22.71
7209819	19.2	0	6.3	NULL	01-10-2013	179.64	18.59	STEEL	Other	Water Supply	Commerical	NULL	6.64
6603166	83.2	10.7	10.1	Bedrock	19-08-1976	193.41	59.436	STEEL	SULPHUR	Water Supply	Cooling And A/C	NULL	30
6603324	33.5	0	10.7	Overburden	31-01-1979	175.61	19.5072	NULL	SULPHUR	Water Supply	Cooling And A/C	Industrial	NULL
6600616	20.4	18.9	8.5	Bedrock	16-11-1960	177.79	20.4216	STEEL	FRESH	Water Supply	Domestic	NULL	10
6600617	24.1	0	3.7	Overburden	29-05-1956	177.26	24.0792	STEEL	SULPHUR	Water Supply	Domestic	NULL	NULL
6600619	31.4	28	5.2	Bedrock	26-08-1960	175.63	30.48	STEEL	SULPHUR	Water Supply	Domestic	NULL	2

Well ID#	Well Depth (m)	Bedrock Depth (m)	Static Water Level (m)	Well Type	Date Completed	Ground Surface Elevation	Water Found Depth (m)	Well Casing Material	Water Description	Well Status	Well Use (1)	Well Use (2)	Recommended Pump Rate (GPM)
6600620	22.6	20.7	5.5	Bedrock	02-03-1956	170.20	21.6408	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	NULL
6600621	21.3	18.6	5.5	Bedrock	22-05-1956	172.77	20.7264	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6600624	20.4	19.8	4	Bedrock	03-05-1954	179.00	20.4216	STEEL	SULPHUR	Water Supply	Domestic	NULL	NULL
6600626	28.3	26.5	4.3	Bedrock	27-08-1956	176.49	28.3464	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	NULL
6600629	31.4	0	3.4	Overburden	02-11-1965	179.17	31.0896	STEEL	FRESH	Water Supply	Domestic	NULL	5
6601226	18.9	18.6	5.5	Bedrock	13-05-1963	175.30	18.8976	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	5
6601227	10.1	8.2	3.4	Bedrock	04-06-1963	191.56	10.0584	STEEL	FRESH	Water Supply	Domestic	NULL	3
6601278	12.2	10.7	3	Bedrock	05-02-1953	192.59	12.192	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601280	18.3	14.3	4.9	Bedrock	16-05-1958	192.18	16.764	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601281	7.6	7.3	1.8	Bedrock	12-05-1961	184.64	7.62	STEEL	FRESH	Water Supply	Domestic	NULL	5
6601282	7.3	6.4	1.2	Bedrock	23-04-1957	182.62	6.096	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601283	8.2	7.6	3.7	Bedrock	31-07-1963	178.75	8.2296	STEEL	FRESH	Water Supply	Domestic	NULL	10
6601285	8.5	7.6	4.6	Bedrock	19-11-1953	184.56	7.9248	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601286	10.4	7.3	2.7	Bedrock	14-10-1955	182.83	9.7536	STEEL	SULPHUR	Water Supply	Domestic	NULL	NULL
6601287	10.4	8.5	1.8	Bedrock	14-10-1956	184.11	10.3632	STEEL	SULPHUR	Water Supply	Domestic	NULL	NULL
6601288	8.5	7.9	1.8	Bedrock	15-10-1956	182.59	8.5344	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601289	7	6.7	1.2	Bedrock	01-03-1957	184.04	6.096	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601290	7.6	7.3	3.7	Bedrock	23-03-1959	184.25	7.3152	STEEL	FRESH	Water Supply	Domestic	NULL	8
6601291	8.2	7.9	3	Bedrock	02-06-1959	184.20	7.9248	STEEL	FRESH	Water Supply	Domestic	NULL	5
6601292	7.9	7.6	2.7	Bedrock	13-07-1959	183.67	7.3152	STEEL	FRESH	Water Supply	Domestic	NULL	5
6601295	10.4	9.4	4.6	Bedrock	06-08-1949	192.27	9.7536	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	15
6601296	10.4	10.1	3.7	Bedrock	29-10-1956	189.61	10.0584	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601297	19.2	0	3	Overburden	03-06-1950	195.01	18.288	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601298	10.7	9.1	4.3	Bedrock	09-08-1956	194.13	10.3632	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	NULL
6601299	9.1	8.8	2.7	Bedrock	24-10-1954	182.95	8.8392	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601300	10.1	7	1.2	Bedrock	15-08-1955	182.59	9.7536	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601301	7.6	0	2.4	Overburden	02-06-1956	182.51	7.62	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601302	9.4	7	3.7	Bedrock	18-09-1958	182.81	8.8392	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601303	10.1	9.8	1.8	Bedrock	02-06-1953	179.70	10.0584	STEEL	SULPHUR	Water Supply	Domestic	NULL	NULL
6601304	9.1	8.5	0.6	Bedrock	02-06-1960	182.54	8.5344	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601306	10.7	10.4	1.8	Bedrock	24-05-1952	185.19	10.0584	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601307	10.1	9.4	0.3	Bedrock	15-06-1953	184.94	9.4488	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601308	10.4	10.1	0.3	Bedrock	02-07-1953	188.41	10.0584	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601309	10.1	9.8	0.6	Bedrock	27-03-1954	185.19	9.7536	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601310	11	9.1	1.5	Bedrock	02-10-1956	186.09	10.668	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601311	11	8.8	1.5	Bedrock	05-10-1956	185.03	10.668	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601312	7.9	7.3	1.8	Bedrock	23-06-1961	184.45	7.9248	STEEL	FRESH	Water Supply	Domestic	NULL	13
6601313	11.3	10.7	2.4	Bedrock	21-03-1949	191.86	10.668	STEEL	FRESH	Water Supply	Domestic	NULL	4
6601316	10.1	9.1	3	Bedrock	01-08-1950	185.50	9.144	STEEL	FRESH	Water Supply	Domestic	NULL	15
6601317	8.2	7.6	1.8	Bedrock	20-07-1951	189.41	8.2296	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601318	11.9	11.3	1.2	Bedrock	26-11-1954	191.28	11.2776	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	NULL
6601319	10.4	10.1	0.6	Bedrock	31-10-1956	193.53	9.7536	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601320	15.8	0	7	Overburden	20-10-1950	196.65	15.24	STEEL	FRESH	Water Supply	Domestic	NULL	20
6601322	9.8	8.5	3	Bedrock	29-04-1950	185.53	9.4488	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601324	11.6	11.3	4.6	Bedrock	30-07-1949	185.84	11.2776	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	20
6601326	9.8	9.4	3.7	Bedrock	31-05-1967	177.79	9.4488	STEEL	FRESH	Water Supply	Domestic	NULL	4
6601327	11.9	10.4	5.2	Bedrock	28-05-1952	179.17	11.5824	STEEL	SULPHUR	Water Supply	Domestic	NULL	NULL
6601328	13.4	10.7	4.3	Bedrock	07-12-1956	177.52	13.1064	STEEL	SULPHUR	Water Supply	Domestic	NULL	NULL
6601330	10.1	8.5	3.7	Bedrock	20-08-1946	196.30	3.6576	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	NULL
6601332	16.8	13.1	3.7	Bedrock	31-07-1950	185.71	16.4592	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601333	8.8	6.7	3	Bedrock	17-11-1967	180.08	8.5344	STEEL	SULPHUR	Water Supply	Domestic	NULL	3
6601334	11.6	10.7	2.7	Bedrock	25-08-1956	181.68	10.9728	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601335	12.5	9.8	1.8	Bedrock	07-02-1957	181.52	12.192	STEEL	SULPHUR	Water Supply	Domestic	NULL	NULL
6601336	13.1	12.2	5.2	Bedrock	07-10-1961	185.06	12.192	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	4
6601337	14.6	14.3	2.4	Bedrock	02-11-1950	186.61	14.6304	OPEN HOLE	SULPHUR	Water Supply	Domestic	NULL	20
6601338	14.3	13.7	2.1	Bedrock	15-06-1951	186.29	14.0208	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601348	11.9	0	3	Overburden	07-07-1950	190.92	11.8872	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601350	9.8	8.8	2.7	Bedrock	25-08-1955	185.11	9.4488	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	NULL
6601351	7.6	5.8	6.1	Bedrock	22-08-1959	178.83	7.3152	STEEL	FRESH	Water Supply	Domestic	NULL	3
6601352	9.1	7	4.6	Bedrock	08-04-1963	180.22	9.144	STEEL	FRESH	Water Supply	Domestic	NULL	4
6601353	9.1	4.9	5.5	Bedrock	10-04-1963	181.83	9.144	STEEL	FRESH	Water Supply	Domestic	NULL	4
6601354	9.1	4.9	4.9	Bedrock	06-04-1963	178.20	9.144	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	4
6601355	12.2	0	4.6	Overburden	25-07-1952	186.88	12.192	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601356	15.5	12.5	4.6	Bedrock	07-07-1954	185.81	15.24	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	NULL
6601357	19.8	15.8	7.6	Bedrock	30-04-1949	187.83	19.2024	STEEL	FRESH	Water Supply	Domestic	NULL	3
6601359	10.1	6.1	3.7	Bedrock	13-10-1951	185.05	10.0584	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	NULL
6601360	12.8	11.3	6.7	Bedrock	06-08-1954	185.01	12.192	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601361	11.3	8.5	2.1	Bedrock	16-05-1955	185.12	10.668	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601362	13.1	11	7	Bedrock	25-08-1958	180.50	12.8016	STEEL	FRESH	Water Supply	Domestic	NULL	NULL

Well ID#	Well Depth (m)	Bedrock Depth (m)	Static Water Level (m)	Well Type	Date Completed	Ground Surface Elevation	Water Found Depth (m)	Well Casing Material	Water Description	Well Status	Well Use (1)	Well Use (2)	Recommended Pump Rate (GPM)
6601363	16.5	10.7	9.4	Bedrock	11-10-1955	186.95	15.8496	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	NULL
6601365	16.5	15.8	10.7	Bedrock	25-08-1961	185.90	16.4592	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	5
6601367	18.9	14.3	10.7	Bedrock	30-09-1961	184.09	18.8976	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	10
6601369	13.4	12.8	4.9	Bedrock	06-03-1948	188.94	13.4112	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601371	15.2	10.7	11.3	Bedrock	17-06-1953	180.72	14.6304	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601372	13.4	11	9.1	Bedrock	27-09-1951	180.22	13.4112	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	NULL
6601374	13.7	9.8	8.8	Bedrock	15-05-1954	180.28	10.0584	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601375	13.1	8.5	8.5	Bedrock	18-05-1954	179.69	9.7536	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601376	14.6	9.8	8.8	Bedrock	26-05-1954	180.03	13.716	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601377	14.9	9.1	8.5	Bedrock	29-05-1954	181.03	14.0208	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601378	12.2	9.8	9.4	Bedrock	12-05-1955	180.18	11.8872	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601379	13.1	9.1	8.5	Bedrock	09-08-1955	180.00	10.0584	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601380	13.4	8.5	9.1	Bedrock	15-10-1955	179.94	12.8016	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601381	17.7	10.4	9.4	Bedrock	14-02-1967	179.95	17.6784	STEEL	FRESH	Water Supply	Domestic	NULL	0
6601382	16.2	14.6	11.3	Bedrock	19-06-1962	183.46	16.1544	STEEL	FRESH	Water Supply	Domestic	NULL	10
6601383	16.8	16.5	5.8	Bedrock	21-11-1963	177.68	16.4592	STEEL	FRESH	Water Supply	Domestic	NULL	5
6601384	13.4	11.9	7.6	Bedrock	28-04-1958	179.16	13.1064	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601387	20.4	20.1	8.5	Bedrock	14-08-1957	181.01	18.288	STEEL	SULPHUR	Water Supply	Domestic	NULL	NULL
6601388	15.8	15.2	6.1	Bedrock	06-05-1954	179.92	15.8496	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601389	17.1	15.2	6.1	Bedrock	20-06-1954	178.92	15.8496	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601390	18.9	15.2	7.3	Bedrock	10-02-1955	179.56	18.288	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601391	17.4	16.8	7	Bedrock	22-09-1956	178.55	16.764	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601392	14.9	13.7	6.1	Bedrock	08-05-1948	176.09	6.096	NULL	FRESH	Water Supply	Domestic	NULL	NULL
6601394	22.6	21.9	1.8	Bedrock	30-06-1960	175.50	21.9456	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601395	18.3	16.8	0.9	Bedrock	05-06-1948	175.89	18.288	STEEL	SULPHUR	Water Supply	Domestic	NULL	NULL
6601398	25.3	24.7	5.5	Bedrock	12-11-1954	174.72	24.9936	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601399	25	23.2	4.9	Bedrock	26-09-1956	172.74	24.384	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601400	21.6	21.3	6.1	Bedrock	23-06-1959	175.01	21.336	STEEL	FRESH	Water Supply	Domestic	NULL	8
6601401	19.2	18.6	4.3	Bedrock	14-07-1959	174.96	13.4112	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	20
6601402	19.8	18.9	3.7	Bedrock	22-03-1960	175.18	19.5072	STEEL	FRESH	Water Supply	Domestic	NULL	24
6601403	23.8	22.9	6.7	Bedrock	06-10-1964	171.82	23.7744	OPEN HOLE	SULPHUR	Water Supply	Domestic	NULL	4
6601404	11.6	4.9	6.7	Bedrock	14-05-1966	173.59	10.9728	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	1
6601625	11.9	9.8	10.1	Bedrock	28-06-1960	181.27	11.8872	STEEL	FRESH	Water Supply	Domestic	NULL	3
6601637	10.7	6.1	3.7	Bedrock	17-10-1951	180.09	10.668	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601639	12.8	10.7	3	Bedrock	20-09-1949	180.07	12.192	OPEN HOLE	SULPHUR	Water Supply	Domestic	NULL	2
6601640	9.8	7.9	6.7	Bedrock	31-03-1966	180.01	9.7536	STEEL	SULPHUR	Water Supply	Domestic	NULL	8
6601650	11.9	10.7	4.6	Bedrock	10-05-1949	177.27	11.5824	OPEN HOLE	SULPHUR	Water Supply	Domestic	NULL	5
6601651	10.1	9.4	3.7	Bedrock	16-09-1954	179.11	9.7536	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	NULL
6601652	11.3	10.7	4.6	Bedrock	28-08-1956	178.24	10.9728	STEEL	SULPHUR	Water Supply	Domestic	NULL	NULL
6601691	9.4	5.2	3.7	Bedrock	17-11-1951	175.64	9.4488	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601692	13.1	8.2	9.8	Bedrock	11-02-1953	181.53	13.1064	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	NULL
6601693	8.2	7.3	3	Bedrock	14-02-1953	185.94	7.62	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601695	16.2	12.2	6.4	Bedrock	23-09-1958	177.13	16.1544	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601714	12.2	11.3	6.1	Bedrock	27-05-1948	184.96	11.8872	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601715	13.1	12.2	7	Bedrock	07-06-1951	185.46	13.1064	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601716	12.2	8.8	5.5	Bedrock	01-10-1953	185.19	11.5824	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	NULL
6601717	18.3	15.8	11.3	Bedrock	22-04-1954	185.48	18.288	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601723	16.8	14.3	8.2	Bedrock	30-01-1959	180.66	16.764	STEEL	FRESH	Water Supply	Domestic	NULL	10
6601724	13.1	8.5	7.9	Bedrock	11-03-1959	181.15	9.144	STEEL	FRESH	Water Supply	Domestic	NULL	8
6601725	21.3	19.5	10.7	Bedrock	30-08-1952	184.41	21.336	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601726	21.3	19.5	10.7	Bedrock	03-09-1952	184.75	21.336	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601729	15.5	14.6	6.1	Bedrock	16-09-1948	181.01	14.9352	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601730	12.5	11.9	5.5	Bedrock	29-10-1948	180.25	12.192	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601732	17.1	15.2	7	Bedrock	25-10-1952	178.84	17.0688	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601733	15.8	14.3	4.6	Bedrock	30-07-1954	176.20	15.24	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601734	16.5	14.6	5.5	Bedrock	17-07-1956	178.99	16.4592	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601735	24.4	21.9	9.1	Bedrock	25-06-1957	184.93	24.384	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601736	20.1	16.5	9.1	Bedrock	20-07-1967	180.25	16.764	STEEL	FRESH	Water Supply	Domestic	NULL	10
6601778	18.3	16.5	5.8	Bedrock	18-08-1956	185.70	18.288	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	NULL
6601779	15.5	15.2	9.1	Bedrock	10-08-1962	180.23	15.24	STEEL	FRESH	Water Supply	Domestic	NULL	10
6601780	16.5	13.4	12.8	Bedrock	10-07-1963	185.20	16.4592	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	8
6601781	17.4	0	7	Overburden	22-07-1963	180.15	17.0688	STEEL	FRESH	Water Supply	Domestic	NULL	10
6601782	15.5	13.7	11.3	Bedrock	03-11-1964	185.07	15.5448	STEEL	FRESH	Water Supply	Domestic	NULL	2
6601783	18	15.8	13.7	Bedrock	04-09-1953	185.72	17.9832	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601784	17.7	16.2	9.1	Bedrock	02-10-1956	186.28	17.6784	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601786	18.3	16.8	12.2	Bedrock	23-06-1961	186.14	18.288	STEEL	FRESH	Water Supply	Domestic	NULL	10
6601787	16.5	15.8	7.3	Bedrock	27-10-1965	183.38	16.4592	STEEL	FRESH	Water Supply	Domestic	NULL	2
6601788	21	19.5	5.5	Bedrock	16-11-1951	183.85	20.7264	STEEL	SULPHUR	Water Supply	Domestic	NULL	NULL
6601789	21.3	17.1	11.6	Bedrock	15-09-1953	185.24	20.7264	STEEL	FRESH	Water Supply	Domestic	NULL	NULL

Well ID#	Well Depth (m)	Bedrock Depth (m)	Static Water Level (m)	Well Type	Date Completed	Ground Surface Elevation	Water Found Depth (m)	Well Casing Material	Water Description	Well Status	Well Use (1)	Well Use (2)	Recommended Pump Rate (GPM)
6601790	12.8	12.2	5.5	Bedrock	10-06-1946	184.94	12.8016	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601792	22.9	20.4	15.2	Bedrock	31-07-1963	182.96	22.86	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	6
6601794	22.9	20.1	10.7	Bedrock	10-07-1957	185.38	22.86	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601795	18.3	16.8	6.7	Bedrock	29-08-1961	185.18	18.288	STEEL	FRESH	Water Supply	Domestic	NULL	10
6601835	20.7	17.7	6.4	Bedrock	20-06-1955	180.45	19.812	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6601848	25.9	25.3	4	Bedrock	19-08-1960	170.01	25.2984	STEEL	FRESH	Water Supply	Domestic	NULL	15
6601849	27.4	0	9.1	Overburden	02-09-1951	174.72	24.384	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6602251	25.3	0	3.7	Overburden	17-05-1966	175.78	25.2984	STEEL	FRESH	Water Supply	Domestic	NULL	2
6602255	8.8	8.5	2.7	Bedrock	04-08-1947	178.66	8.8392	STEEL	MINERIAL	Water Supply	Domestic	NULL	NULL
6602256	7.9	7.3	1.2	Bedrock	05-08-1947	175.22	7.9248	OPEN HOLE	Not stated	Water Supply	Domestic	NULL	NULL
6602257	7.6	7.3	0.9	Bedrock	06-08-1947	178.57	7.62	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	NULL
6602258	9.1	8.5	1.2	Bedrock	08-08-1947	178.72	9.144	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6602259	11.6	10.4	2.4	Bedrock	04-09-1947	178.65	11.5824	STEEL	MINERIAL	Water Supply	Domestic	NULL	NULL
6602264	8.2	0	3	Overburden	25-04-1950	175.02	8.2296	STEEL	SULPHUR	Water Supply	Domestic	NULL	NULL
6602265	22.3	0	3.7	Overburden	25-07-1956	175.81	22.2504	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6602270	11.3	10.4	3	Bedrock	19-09-1959	171.62	10.3632	OPEN HOLE	SULPHUR	Water Supply	Domestic	NULL	4
6602271	16.8	15.8	1.5	Bedrock	04-06-1954	181.05	16.764	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6602283	21.6	21	3	Bedrock	28-06-1965	174.91	21.336	STEEL	FRESH	Water Supply	Domestic	NULL	10
6602289	20.4	20.1	2.7	Bedrock	19-08-1963	176.41	20.1168	STEEL	FRESH	Water Supply	Domestic	NULL	4
6602353	18.6	14.6	13.7	Bedrock	16-08-1968	185.57	18.288	STEEL	FRESH	Water Supply	Domestic	NULL	10
6602354	10.1	9.4	3.7	Bedrock	15-10-1968	180.37	9.7536	STEEL	FRESH	Water Supply	Domestic	NULL	5
6602355	25.9	21	9.1	Bedrock	02-08-1968	180.65	25.2984	STEEL	FRESH	Water Supply	Domestic	NULL	4
6602367	15.8	15.5	7.9	Bedrock	20-07-1968	180.04	15.5448	STEEL	FRESH	Water Supply	Domestic	NULL	5
6602405	22.6	20.4	10.7	Bedrock	08-01-1969	184.98	22.5552	STEEL	FRESH	Water Supply	Domestic	NULL	10
6602454	19.2	14	12.5	Bedrock	13-08-1969	184.49	17.3736	STEEL	FRESH	Water Supply	Domestic	NULL	8
6602455	17.4	13.4	12.8	Bedrock	15-08-1969	183.24	14.9352	STEEL	FRESH	Water Supply	Domestic	NULL	10
6602459	22.3	13.4	14.6	Bedrock	29-08-1969	183.08	21.336	STEEL	FRESH	Water Supply	Domestic	NULL	5
6602492	9.8	6.4	6.1	Bedrock	29-10-1969	185.15	7.62	STEEL	FRESH	Water Supply	Domestic	NULL	5
6602515	26.5	20.4	11.6	Bedrock	16-03-1970	185.10	26.2128	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	5
6602538	19.2	17.1	8.8	Bedrock	08-08-1970	180.63	18.5928	STEEL	FRESH	Water Supply	Domestic	NULL	8
6602554	19.2	10.4	11.3	Bedrock	28-09-1970	180.64	18.5928	STEEL	SULPHUR	Water Supply	Domestic	NULL	8
6602583	23.2	21.6	8.5	Bedrock	23-01-1971	166.91	22.86	STEEL	SULPHUR	Water Supply	Domestic	NULL	8
6602598	17.1	14.6	8.5	Bedrock	07-05-1971	180.93	17.0688	STEEL	FRESH	Water Supply	Domestic	NULL	8
6602600	18	16.5	11	Bedrock	05-07-1971	184.01	17.3736	STEEL	FRESH	Water Supply	Domestic	NULL	8
6602638	27.1	0	14.6	Overburden	13-10-1971	179.03	27.1272	STEEL	FRESH	Water Supply	Domestic	NULL	6
6602673	25	24.1	7	Bedrock	17-07-1972	175.58	24.6888	STEEL	SULPHUR	Water Supply	Domestic	NULL	10
6602724	9.8	5.5	4.6	Bedrock	20-10-1972	185.63	9.144	STEEL	FRESH	Water Supply	Domestic	NULL	4
6602725	10.4	0	5.5	Overburden	19-10-1972	180.18	10.3632	STEEL	FRESH	Water Supply	Domestic	NULL	4
6602739	11.6	8.5	4.3	Bedrock	06-03-1969	179.57	10.668	STEEL	FRESH	Water Supply	Domestic	NULL	10
6602765	24.1	20.7	9.1	Bedrock	18-06-1973	183.62	23.7744	STEEL	FRESH	Water Supply	Domestic	NULL	10
6602792	10.4	6.1	4.9	Bedrock	27-09-1973	185.34	9.7536	STEEL	FRESH	Water Supply	Domestic	NULL	8
6602986	18.3	15.5	6.1	Bedrock	30-08-1974	186.35	17.9832	OPEN HOLE	SULPHUR	Water Supply	Domestic	NULL	6
6603017	12.2	11.6	3.7	Bedrock	28-08-1974	177.98	12.192	STEEL	FRESH	Water Supply	Domestic	NULL	6
6603043	11.9	10.4	2.7	Bedrock	01-09-1974	179.99	11.2776	STEEL	SULPHUR	Water Supply	Domestic	NULL	NULL
6603121	15.2	10.1	8.5	Bedrock	15-04-1976	180.99	13.716	STEEL	MINERIAL	Water Supply	Domestic	NULL	15
6603146	24.1	21	13.7	Bedrock	07-07-1976	185.37	23.1648	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6603168	13.7	9.4	4.9	Bedrock	14-07-1976	185.36	13.1064	STEEL	MINERIAL	Water Supply	Domestic	NULL	3
6603169	13.4	11.3	6.1	Bedrock	12-07-1976	180.24	13.1064	STEEL	MINERIAL	Water Supply	Domestic	NULL	8
6603171	14.6	12.5	7	Bedrock	01-09-1976	180.01	14.3256	STEEL	MINERIAL	Water Supply	Domestic	NULL	8
6603173	26.5	22.9	6.7	Bedrock	06-07-1976	176.22	26.2128	STEEL	MINERIAL	Water Supply	Domestic	NULL	5
6603203	11.6	11	4.6	Bedrock	08-12-1976	179.53	11.2776	STEEL	MINERIAL	Water Supply	Domestic	NULL	10
6603214	18.3	0	4.9	Overburden	08-04-1977	186.08	18.288	NULL	MINERIAL	Water Supply	Domestic	NULL	NULL
6603243	21.3	18.3	11	Bedrock	16-11-1977	184.77	21.0312	STEEL	FRESH	Water Supply	Domestic	NULL	10
6603248	11.3	10.7	6.4	Bedrock	28-09-1977	180.81	10.9728	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6603262	9.8	9.1	4.6	Bedrock	29-03-1978	181.11	9.4488	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	10
6603264	18.3	14.6	12.8	Bedrock	11-05-1978	185.72	17.0688	OPEN HOLE	MINERIAL	Water Supply	Domestic	NULL	10
6603269	24.4	20.1	10.7	Bedrock	19-05-1978	182.96	22.86	STEEL	FRESH	Water Supply	Domestic	NULL	6
6603271	25	24.7	6.7	Bedrock	14-06-1978	182.15	24.6888	STEEL	FRESH	Water Supply	Domestic	NULL	10
6603313	15.2	11	4.3	Bedrock	30-11-1978	183.31	12.192	STEEL	FRESH	Water Supply	Domestic	NULL	0
6603342	14	0	3	Overburden	14-05-1979	184.52	13.4112	NULL	Not stated	Water Supply	Domestic	NULL	6
6603359	22.9	0	2.1	Overburden	06-06-1979	172.06	22.86	STEEL	SULPHUR	Water Supply	Domestic	NULL	8
6603360	15.5	0	0	Overburden	29-05-1979	191.04	15.5448	NULL	FRESH	Water Supply	Domestic	NULL	NULL
6603367	12.8	10.1	7.6	Bedrock	15-11-1979	182.33	12.4968	STEEL	FRESH	Water Supply	Domestic	NULL	12
6603601	18.3	0	4.6	Overburden	15-10-1983	175.70	NULL	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6603646	20.4	19.5	4.9	Bedrock	18-04-1985	181.62	20.4216	STEEL	FRESH	Water Supply	Domestic	NULL	12
6603689	13.4	8.2	0	Bedrock	08-04-1985	181.92	NULL	STEEL	NULL	Water Supply	Domestic	NULL	6
6603728	12.8	11.6	0	Bedrock	16-09-1986	189.80	NULL	STEEL	FRESH	Water Supply	Domestic	NULL	8
6603729	12.2	10.7	3	Bedrock	07-10-1985	175.89	11.5824	STEEL	FRESH	Water Supply	Domestic	NULL	5
6603744	12.2	10.7	5.5	Bedrock	26-05-1986	175.89	11.2776	STEEL	FRESH	Water Supply	Domestic	NULL	8

Well ID#	Well Depth (m)	Bedrock Depth (m)	Static Water Level (m)	Well Type	Date Completed	Ground Surface Elevation	Water Found Depth (m)	Well Casing Material	Water Description	Well Status	Well Use (1)	Well Use (2)	Recommended Pump Rate (GPM)
6603766	27.4	0	8.2	Overburden	24-07-1987	178.24	27.432	STEEL	SULPHUR	Water Supply	Domestic	NULL	12
6603767	22.9	21.9	7.3	Bedrock	08-07-1987	181.09	22.5552	STEEL	FRESH	Water Supply	Domestic	NULL	10
6603830	13.7	12.2	6.4	Bedrock	03-11-1988	185.57	13.4112	OPEN HOLE	MINERIAL	Water Supply	Domestic	NULL	NULL
6603833	13.7	10.4	6.1	Bedrock	12-01-1989	181.21	12.8016	STEEL	SULPHUR	Water Supply	Domestic	NULL	3
6603911	14.9	9.1	7.9	Bedrock	28-08-1989	175.96	14.3256	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6603926	14.9	11.3	4.9	Bedrock	02-02-1990	181.21	14.3256	STEEL	SULPHUR	Water Supply	Domestic	NULL	NULL
6603942	7	3	4.6	Bedrock	22-05-1990	179.51	7.0104	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6603943	21.6	0	6.4	Overburden	20-04-1990	179.91	21.6408	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	NULL
6603953	14.3	13.7	10.4	Bedrock	01-08-1990	182.69	14.3256	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	12
6603984	11.6	10.7	6.1	Bedrock	26-09-1990	183.41	11.2776	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6603998	11.9	0	2.4	Overburden	01-04-1991	181.92	11.8872	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6604002	17.1	0	9.4	Bedrock	14-05-1991	182.69	16.764	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6604066	11.6	8.2	6.7	Bedrock	18-10-1991	179.55	11.2776	NULL	FRESH	Water Supply	Domestic	Livestock	NULL
6604068	16.5	16.5	7	Bedrock	28-11-1991	184.34	14.6304	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6604085	18.3	13.7	5.5	Bedrock	27-05-1992	185.70	16.764	NULL	FRESH	Water Supply	Domestic	NULL	NULL
6604115	13.4	9.1	2.4	Bedrock	08-04-1992	182.86	12.192	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6604116	21.6	20.7	7.3	Bedrock	14-04-1993	181.09	21.0312	STEEL	FRESH	Water Supply	Domestic	NULL	8
6604162	10.1	8.8	4.3	Bedrock	17-11-1993	173.59	9.4488	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6604181	38.7	37.8	2.1	Bedrock	14-11-1994	166.70	38.1	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6604195	21.6	0	6.1	Overburden	29-04-1995	182.39	21.6408	STEEL	Not stated	Water Supply	Domestic	Industrial	12
6604234	39	36.6	9.1	Bedrock	24-02-1996	178.47	36.8808	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6604296	17.4	14.6	9.1	Bedrock	16-06-1998	182.69	17.0688	STEEL	FRESH	Water Supply	Domestic	NULL	0
6604319	18.3	9.1	6.1	Bedrock	01-10-1998	174.96	16.764	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6604320	14.3	7.9	3.7	Bedrock	27-07-1998	173.59	13.1064	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6604420	13.7	9.1	8.5	Bedrock	05-04-1999	173.59	12.192	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6604439	19.2	10.1	4	Bedrock	08-05-2000	179.94	11.5824	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6604452	19.8	9.1	7.6	Bedrock	21-06-2000	179.84	19.2024	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6604508	25.3	21.6	7.6	Bedrock	04-09-2000	178.03	21.6408	STEEL	SULPHUR	Water Supply	Domestic	NULL	5
6604653	13.7	10.4	4.6	Bedrock	08-05-2002	182.39	11.8872	STEEL	Not stated	Water Supply	Domestic	NULL	14
6604658	15.5	5.8	2.4	Bedrock	31-05-2002	183.73	14.6304	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	NULL
6604672	34.1	0	4.6	Overburden	03-09-2002	176.29	33.528	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6604675	16.2	0	6.1	Overburden	31-08-2002	180.37	15.5448	STEEL	FRESH	Water Supply	Domestic	NULL	15
6604678	21.9	14	8.5	Bedrock	14-08-2002	183.47	21.336	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6604682	14	0	7.6	Overburden	04-10-2002	179.31	12.8016	STEEL	FRESH	Water Supply	Domestic	NULL	10
6604702	20.4	18	7.6	Bedrock	08-11-2002	180.44	19.5072	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6604756	32	27.4	6	Bedrock	16-02-2002	179.88	31	OPEN HOLE	FRESH	Water Supply	Domestic	NULL	18
6604804	35.6	0	6.2	Overburden	12-08-2004	175.18	35	STEEL	SULPHUR	Water Supply	Domestic	NULL	NULL
6604805	16.1	6.1	2.3	Bedrock	17-08-2004	187.82	13	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
6604861	25.3	25	6	Bedrock	22-04-2005	181.24	25	STEEL	FRESH	Water Supply	Domestic	NULL	37.85
6604887	16.4	0	11.3	Overburden	25-07-2005	184.96	16	STEEL	FRESH	Water Supply	Domestic	NULL	37.8
6604973	34.4	0	7.3	Overburden	04-09-2006	127.53	34	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
7043858	15.2	14.3	7.4	Bedrock	15-04-2007	187.43	13.7	STEEL	FRESH	Water Supply	Domestic	NULL	NULL
7048238	12.5	0	4.9	NULL	19-07-2007	185.82	12	STEEL	SULPHUR	Water Supply	Domestic	NULL	15.14
7133671	11.9	0	5.3	NULL	17-10-2009	173.31	11.27	STEEL	FRESH	Water Supply	Domestic	NULL	37.85
7153400	13.1	0	8.8	NULL	NULL	179.80	12.4968	STEEL	FRESH	Water Supply	Domestic	NULL	10
7168533	14.3	0	3	NULL	28-08-2011	173.74	13.716	STEEL	NULL	Water Supply	Domestic	NULL	NULL
7168534	15.2	0	3.7	NULL	31-08-2011	175.52	13.716	STEEL	Untested	Water Supply	Domestic	NULL	NULL
7170812	22.9	0	0.3	NULL	02-10-2011	177.70	18.8976	STEEL	Untested	Water Supply	Domestic	NULL	NULL
7170813	14.3	0	3.5	NULL	25-09-2011	175.90	13.4112	STEEL	Untested	Water Supply	Domestic	NULL	NULL
7174754	18.9	0	6.4	NULL	24-11-2011	179.95	17.6784	STEEL	Untested	Water Supply	Domestic	NULL	5
7203341	0	0	1.6	NULL	02-06-2013	180.22	NULL	STEEL	NULL	Water Supply	Domestic	NULL	NULL
7223746	29.6	0	8.3	NULL	10-06-2014	179.87	28	STEEL	FRESH	Water Supply	Domestic	NULL	12.67
7226549	13.4	0	8.4	NULL	18-08-2014	183.94	13	STEEL	FRESH	Water Supply	Domestic	NULL	37.85
7245973	19.8	0	7	NULL	21-07-2015	194.08	14.3256	STEEL	Untested	Water Supply	Domestic	NULL	10
7246553	38.1	0	8.8	NULL	30-07-2015	180.01	32.6136	STEEL	Untested	Water Supply	Domestic	NULL	10
7251281	0	0	4.6	NULL	20-03-2015	184.05	NULL	STEEL	NULL	Water Supply	Domestic	NULL	NULL
7258351	11.9	0	5	NULL	15-02-2016	173.23	11	STEEL	FRESH	Water Supply	Domestic	NULL	37.85
7276178	13.7	0	6.1	NULL	13-11-2016	179.36	10.668	STEEL	Untested	Water Supply	Domestic	NULL	10
7278404	13.1	0	5	NULL	27-09-2016	177.83	12	STEEL	NULL	Water Supply	Domestic	NULL	37.85
7279902	43.6	0	8.1	NULL	17-11-2016	185.23	19.5072	STEEL	Untested	Water Supply	Domestic	NULL	6
6601224	74.7	15.5	2.1	Bedrock	19-06-1942	173.59	21.9456	NULL	FRESH	Water Supply	Industrial	NULL	NULL
6601225	8.5	5.2	6.7	Bedrock	14-12-1959	109.68	6.4008	STEEL	FRESH	Water Supply	Industrial	Domestic	10
6601321	29.3	24.7	11.6	Bedrock	14-08-1952	199.93	24.6888	STEEL	SULPHUR	Water Supply	Industrial	NULL	NULL
6601339	92	12.2	11.6	Bedrock	13-05-1966	190.61	31.6992	STEEL	SULPHUR	Water Supply	Industrial	NULL	102
6601340	82.9	11.6	12.2	Bedrock	28-04-1962	194.68	29.5656	STEEL	SULPHUR	Water Supply	Industrial	NULL	130
6601368	14	10.7	4.6	Bedrock	10-06-1946	180.01	4.572	OPEN HOLE	FRESH	Water Supply	Industrial	NULL	NULL
6601386	45.7	29	13.1	Bedrock	29-08-1961	182.54	32.9184	STEEL	FRESH	Water Supply	Industrial	NULL	24
6602327	27.4	22.6	16.2	Bedrock	08-02-1968	185.57	26.8224	STEEL	FRESH	Water Supply	Industrial	NULL	5
6602456	92	11.3	9.1	Bedrock	26-06-1969	192.02	13.716	OPEN HOLE	FRESH	Water Supply	Industrial	NULL	105

Well ID#	Well Depth (m)	Bedrock Depth (m)	Static Water Level (m)	Well Type	Date Completed	Ground Surface Elevation	Water Found Depth (m)	Well Casing Material	Water Description	Well Status	Well Use (1)	Well Use (2)	Recommended Pump Rate (GPM)
6602457	60	12.2	13.7	Bedrock	05-05-1969	189.98	59.436	OPEN HOLE	SULPHUR	Water Supply	Industrial	NULL	20
6602619	20.1	17.7	12.2	Bedrock	17-04-1970	182.41	19.5072	OPEN HOLE	FRESH	Water Supply	Industrial	NULL	20
6602813	24.4	22.3	9.8	Bedrock	23-11-1973	184.08	23.4696	OPEN HOLE	FRESH	Water Supply	Industrial	NULL	8
6603255	10.4	9.8	6.4	Bedrock	15-07-1977	178.17	10.0584	NULL	FRESH	Water Supply	Industrial	Domestic	NULL
6603315	18.3	17.4	11.3	Bedrock	15-03-1978	183.38	13.1064	STEEL	FRESH	Water Supply	Industrial	NULL	30
6603316	36.3	17.4	11.3	Bedrock	10-04-1978	186.35	20.4216	STEEL	FRESH	Water Supply	Industrial	NULL	35
6603317	58.2	17.1	11.3	Bedrock	01-05-1978	182.69	20.1168	STEEL	FRESH	Water Supply	Industrial	NULL	1
6603318	27.4	21.3	10.7	Bedrock	15-09-1978	184.21	27.432	STEEL	FRESH	Water Supply	Industrial	Domestic	24
6603353	18	0	13.4	Overburden	15-07-1978	185.59	17.9832	STEEL	FRESH	Water Supply	Industrial	NULL	10
6603489	27.4	19.5	11.6	Bedrock	09-04-1981	181.33	21.336	STEEL	SULPHUR	Water Supply	Industrial	NULL	10
6603548	21.9	0	9.8	Overburden	18-01-1982	184.61	21.336	STEEL	FRESH	Water Supply	Industrial	NULL	8
6603647	25	23.5	6.7	Bedrock	09-04-1985	181.34	24.6888	STEEL	SULPHUR	Water Supply	Industrial	NULL	15
6603794	25	24.1	6.7	Bedrock	23-02-1988	181.09	24.9936	STEEL	FRESH	Water Supply	Industrial	NULL	NULL
6603938	22.3	19.5	9.1	Bedrock	22-03-1990	184.82	22.2504	STEEL	FRESH	Water Supply	Industrial	NULL	NULL
6604435	13.7	10.4	0	Bedrock	09-05-2000	176.20	12.4968	STEEL	FRESH	Water Supply	Industrial	NULL	NULL
6604664	29.3	23.5	7.3	Bedrock	13-07-2002	183.16	25.2984	OPEN HOLE	FRESH	Water Supply	Industrial	NULL	NULL
6604868	23.5	20.7	6.7	Bedrock	13-05-2005	185.01	22.2504	STEEL	FRESH	Water Supply	Industrial	NULL	NULL
6603167	18.3	12.5	3.7	Bedrock	19-07-1976	185.92	17.6784	STEEL	SULPHUR	Water Supply	Irrigation	NULL	15
6603343	21.9	0	4.9	Overburden	02-06-1979	185.13	14.6304	STEEL	FRESH	Water Supply	Irrigation	NULL	NULL
6604652	46.6	17.7	19.8	Bedrock	10-04-2002	173.55	24.384	STEEL	FRESH	Water Supply	Irrigation	NULL	NULL
7126688	25	0	0	NULL	13-07-2009	182.74	NULL	STEEL	FRESH	Water Supply	Irrigation	NULL	15
7184710	19.8	0	7	NULL	20-07-2012	185.81	9.144	STEEL	Untested	Water Supply	Irrigation	NULL	15
7248844	19.8	0	6.1	NULL	15-08-2015	177.62	15.24	STEEL	Untested	Water Supply	Irrigation	NULL	10
6600618	21.3	19.8	9.8	Bedrock	22-01-1960	177.68	21.336	STEEL	FRESH	Water Supply	Livestock	Domestic	10
6600625	17.7	14.3	5.8	Bedrock	14-05-1956	178.96	17.0688	STEEL	FRESH	Water Supply	Livestock	Domestic	NULL
6600627	31.4	30.5	7.3	Bedrock	21-04-1960	175.29	31.3944	OPEN HOLE	FRESH	Water Supply	Livestock	Domestic	12
6601279	13.1	11.3	3	Bedrock	01-06-1958	192.67	11.5824	OPEN HOLE	FRESH	Water Supply	Livestock	NULL	NULL
6601284	9.8	7.6	2.4	Bedrock	28-08-1964	180.32	9.7536	STEEL	SULPHUR	Water Supply	Livestock	NULL	2
6601293	10.7	8.8	2.4	Bedrock	16-10-1948	191.69	10.3632	STEEL	FRESH	Water Supply	Livestock	Domestic	NULL
6601294	12.2	8.8	2.4	Bedrock	29-10-1953	193.70	9.4488	STEEL	FRESH	Water Supply	Livestock	Domestic	NULL
6601305	9.1	8.5	3	Bedrock	01-04-1949	182.74	8.8392	STEEL	FRESH	Water Supply	Livestock	Domestic	NULL
6601314	8.8	8.2	1.5	Bedrock	25-04-1949	190.58	8.5344	OPEN HOLE	FRESH	Water Supply	Livestock	Domestic	NULL
6601315	8.8	8.2	3	Bedrock	06-05-1949	190.20	8.2296	STEEL	FRESH	Water Supply	Livestock	Domestic	3
6601323	12.2	8.8	6.4	Bedrock	18-08-1959	185.77	11.5824	STEEL	SULPHUR	Water Supply	Livestock	Domestic	4
6601325	11.3	10.7	6.7	Bedrock	05-08-1949	174.24	10.9728	STEEL	MINERIAL	Water Supply	Livestock	NULL	5
6601331	14.6	10.1	3.7	Bedrock	08-06-1955	194.16	12.8016	OPEN HOLE	FRESH	Water Supply	Livestock	Domestic	NULL
6601341	11.3	0	3	Overburden	12-06-1950	191.64	11.2776	STEEL	FRESH	Water Supply	Livestock	NULL	NULL
6601342	11.6	0	3	Overburden	16-06-1950	191.53	11.5824	STEEL	FRESH	Water Supply	Livestock	NULL	NULL
6601343	10.4	0	3	Overburden	20-06-1950	191.44	10.3632	STEEL	FRESH	Water Supply	Livestock	NULL	NULL
6601344	11	0	3	Overburden	24-06-1950	191.15	10.9728	STEEL	FRESH	Water Supply	Livestock	Domestic	NULL
6601345	11	0	3	Overburden	24-06-1950	191.47	10.9728	STEEL	FRESH	Water Supply	Livestock	NULL	NULL
6601346	10.7	0	3	Overburden	28-06-1950	191.09	10.668	STEEL	FRESH	Water Supply	Livestock	NULL	NULL
6601347	11.3	0	3	Overburden	02-07-1950	190.92	11.2776	STEEL	FRESH	Water Supply	Livestock	NULL	NULL
6601358	9.1	8.2	5.8	Bedrock	07-12-1953	184.52	8.8392	STEEL	FRESH	Water Supply	Livestock	Domestic	NULL
6601364	17.4	10.1	11.6	Bedrock	25-07-1961	185.07	17.3736	OPEN HOLE	SULPHUR	Water Supply	Livestock	Domestic	2
6601366	16.2	14.6	8.5	Bedrock	10-02-1948	184.44	16.1544	STEEL	FRESH	Water Supply	Livestock	Domestic	NULL
6601385	17.1	15.8	6.4	Bedrock	28-03-1962	177.47	17.0688	STEEL	FRESH	Water Supply	Livestock	Domestic	1
6601393	15.8	14.3	7.9	Bedrock	07-02-1958	180.50	15.24	STEEL	FRESH	Water Supply	Livestock	Domestic	NULL
6601397	21.9	0	6.1	Overburden	18-09-1951	175.34	21.9456	STEEL	FRESH	Water Supply	Livestock	Domestic	NULL
6601638	10.7	9.8	6.1	Bedrock	07-12-1964	177.99	10.668	OPEN HOLE	FRESH	Water Supply	Livestock	NULL	10
6601667	21.3	18.3	6.7	Bedrock	15-09-1948	180.52	20.7264	OPEN HOLE	FRESH	Water Supply	Livestock	Domestic	NULL
6601696	12.2	7.6	4.6	Bedrock	02-08-1963	180.13	11.5824	STEEL	FRESH	Water Supply	Livestock	Domestic	10
6601731	21.3	17.7	8.2	Bedrock	08-10-1951	180.25	21.336	STEEL	FRESH	Water Supply	Livestock	Domestic	NULL
6601785	17.4	0	9.1	Overburden	05-08-1960	186.58	16.764	STEEL	FRESH	Water Supply	Livestock	Domestic	17
6601791	19.8	0	6.4	Overburden	14-12-1951	185.41	19.812	STEEL	FRESH	Water Supply	Livestock	Domestic	NULL
6602273	16.5	14	7	Bedrock	23-08-1957	175.65	15.8496	STEEL	SULPHUR	Water Supply	Livestock	Domestic	NULL
6602276	26.2	25.6	8.8	Bedrock	12-07-1963	178.09	25.6032	STEEL	SULPHUR	Water Supply	Livestock	Domestic	10
6602277	24.4	24.1	6.1	Bedrock	22-02-1955	179.05	24.0792	STEEL	SULPHUR	Water Supply	Livestock	Domestic	NULL
6602281	20.4	20.1	3.7	Bedrock	18-10-1956	175.56	19.812	STEEL	FRESH	Water Supply	Livestock	Domestic	NULL
6602282	23.8	23.5	3.7	Bedrock	23-10-1956	175.26	23.1648	STEEL	FRESH	Water Supply	Livestock	Domestic	NULL
6602285	26.8	21.3	6.1	Bedrock	21-03-1947	164.90	26.8224	STEEL	SULPHUR	Water Supply	Livestock	Domestic	25
6602380	30.5	22.9	7.6	Bedrock	20-11-1968	177.49	30.1752	OPEN HOLE	SULPHUR	Water Supply	Livestock	Domestic	5
6602418	22.9	22.6	7.6	Bedrock	08-05-1969	177.70	22.5552	STEEL	SULPHUR	Water Supply	Livestock	Domestic	10
6602446	24.4	22.9	7.9	Bedrock	01-03-1969	174.89	24.384	STEEL	FRESH	Water Supply	Livestock	NULL	12
6602493	37.5	31.1	17.7	Bedrock	22-10-1969	180.25	36.8808	STEEL	FRESH	Water Supply	Livestock	NULL	5
6602513	47.9	34.4	0	Bedrock	29-04-1970	176.70	36.576	STEEL	SULPHUR	Water Supply	Livestock	NULL	5
6602520	9.8	6.4	6.7	Bedrock	09-06-1970	180.09	7.62	STEEL	FRESH	Water Supply	Livestock	NULL	4
6602632	24.4	0	7.3	Overburden	09-09-1971	175.77	24.384	STEEL	SULPHUR	Water Supply	Livestock	NULL	8
6602644	13.4	11.6	4.3	Bedrock	30-11-1971	178.35	12.192	OPEN HOLE	FRESH	Water Supply	Livestock	Domestic	8

TABLE 2A
MECP Water Well Records

Well ID#	Well Depth (m)	Bedrock Depth (m)	Static Water Level (m)	Well Type	Date Completed	Ground Surface Elevation	Water Found Depth (m)	Well Casing Material	Water Description	Well Status	Well Use (1)	Well Use (2)	Recommended Pump Rate (GPM)
6602648	10.1	9.8	3.7	Bedrock	26-10-1971	180.05	10.0584	STEEL	FRESH	Water Supply	Livestock	Domestic	10
6602723	26.8	0	10.4	Overburden	26-09-1972	176.63	26.8224	STEEL	FRESH	Water Supply	Livestock	NULL	10
6603001	32	0	10.7	Overburden	07-10-1974	180.40	31.3944	STEEL	FRESH	Water Supply	Livestock	NULL	NULL
6603240	21.3	17.4	7	Bedrock	30-09-1977	181.05	NULL	STEEL	FRESH	Water Supply	Livestock	Domestic	NULL
6603250	10.7	10.4	3.7	Bedrock	29-10-1977	180.01	10.668	STEEL	FRESH	Water Supply	Livestock	Domestic	5
6603266	12.8	10.1	6.1	Bedrock	10-05-1978	180.92	12.192	STEEL	FRESH	Water Supply	Livestock	Domestic	6
6603268	18	17.7	7.9	Bedrock	31-05-1978	180.27	17.6784	STEEL	FRESH	Water Supply	Livestock	Domestic	NULL
6603273	21.3	18.9	10.7	Bedrock	26-05-1978	184.56	21.0312	OPEN HOLE	FRESH	Water Supply	Livestock	NULL	10
6603302	13.7	0	4.9	Overburden	15-06-1978	176.61	12.8016	STEEL	FRESH	Water Supply	Livestock	NULL	NULL
6603382	17.4	0	7.3	Overburden	01-01-1979	182.05	17.0688	STEEL	FRESH	Water Supply	Livestock	NULL	10
6603989	32.6	4.6	6.1	Bedrock	13-06-1990	179.51	18.288	STEEL	Not stated	Water Supply	Livestock	NULL	NULL
6603286	8.5	7.9	3.4	Bedrock	19-10-1978	177.92	8.2296	OPEN HOLE	SULPHUR	Water Supply	Municipal	NULL	5
6603287	9.8	9.4	4.3	Bedrock	21-10-1978	180.60	9.7536	STEEL	SULPHUR	Water Supply	Municipal	NULL	5
6603388	9.8	9.8	4.3	Bedrock	15-05-1980	180.22	9.7536	STEEL	SULPHUR	Water Supply	Municipal	NULL	10
6602443	16.5	15.2	5.5	Bedrock	22-07-1969	174.87	16.4592	OPEN HOLE	SULPHUR	Water Supply	Not Used	NULL	2
6601722	18.9	14.6	7.6	Bedrock	05-09-1948	184.16	18.5928	STEEL	FRESH	Water Supply	NULL	NULL	25
6603882	20.1	18.6	8.2	Bedrock	09-06-1989	183.41	19.812	STEEL	FRESH	Water Supply	NULL	NULL	16
7209219	19.8	0	3	NULL	10-09-2013	174.52	19.2024	STEEL	Untested	Water Supply	NULL	NULL	30
7282646	137	0	27	NULL	22-02-2017	156.80	33	STEEL	Untested	Water Supply	NULL	NULL	10
7292256	13.7	0	4	NULL	10-07-2017	187.74	11.2776	STEEL	Untested	Water Supply	NULL	NULL	85
6600628	36	30.5	6.4	Bedrock	26-07-1954	179.11	32.9184	STEEL	FRESH	Water Supply	Public	NULL	15
6601349	15.2	11	2.1	Bedrock	15-06-1951	189.81	14.6304	STEEL	FRESH	Water Supply	Public	NULL	NULL
6601370	15.5	9.1	11.3	Bedrock	16-05-1963	183.54	15.5448	STEEL	FRESH	Water Supply	Public	NULL	1
6602252	28	25.9	4.3	Bedrock	31-05-1954	175.44	28.0416	STEEL	FRESH	Water Supply	Public	NULL	NULL
6602286	11.3	11	3.7	Bedrock	04-06-1954	174.18	10.9728	STEEL	SULPHUR	Water Supply	Public	NULL	NULL
6602549	23.2	10.4	13.1	Bedrock	22-08-1970	184.07	19.5072	STEEL	SULPHUR	Water Supply	Public	NULL	5
6604437	14.6	10.4	0	Bedrock	11-05-2000	186.09	13.1064	STEEL	FRESH	Water Supply	Public	NULL	NULL

Data accesssed May 9, 2019

TABLE 2B
MECP Water Well Records
(Abandoned and Test/Monitoring Wells)

Well ID#	Well Depth (m)	Bedrock Depth (m)	Static Water Level (m)	Well Type	Date Completed	Ground Surface Elevation	Water Found Depth (m)	Well Casing Material	Water Description	Well Status	Well Use (1)	Well Use (2)	Recommended Pump Rate (GPM)
7128340	12	0	0	NULL	15-01-2008	173.30	NULL	NULL	NULL	Abandoned Monitoring and Test Hole	NULL	NULL	NULL
7128341	12.5	0	0	NULL	15-01-2008	176.69	NULL	NULL	NULL	Abandoned Monitoring and Test Hole	NULL	NULL	NULL
7128342	11	0	0	NULL	15-01-2008	173.93	NULL	NULL	NULL	Abandoned Monitoring and Test Hole	NULL	NULL	NULL
7128343	12	0	0	NULL	15-01-2008	173.48	NULL	NULL	NULL	Abandoned Monitoring and Test Hole	NULL	NULL	NULL
7128344	12	0	0	NULL	15-01-2008	173.05	NULL	NULL	NULL	Abandoned Monitoring and Test Hole	NULL	NULL	NULL
7259305	0	0	0	NULL	02-03-2015	185.87	NULL	PLASTIC	NULL	Abandoned Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7259308	0	0	0	NULL	02-03-2016	177.25	NULL	PLASTIC	NULL	Abandoned Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7259309	0	0	0	NULL	02-03-2016	177.13	NULL	NULL	NULL	Abandoned Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7259310	0	0	0	NULL	02-03-2016	177.29	NULL	PLASTIC	NULL	Abandoned Monitoring and Test Hole	Municipal	Monitoring	NULL
6604251	74.7	0	0	NULL	18-12-1996	173.59	NULL	NULL	Not stated	Abandoned-Other	Not Used	NULL	NULL
6604636	16.5	0	0	Overburden	07-12-2001	188.02	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
6604659	0	0	0	NULL	12-08-2002	174.69	NULL	NULL	NULL	Abandoned-Other	Not Used	NULL	NULL
6604862	0	0	0	NULL	07-08-2003	184.59	NULL	PLASTIC	NULL	Abandoned-Other	NULL	NULL	NULL
6604863	0	0	0	NULL	06-08-2003	174.42	NULL	PLASTIC	NULL	Abandoned-Other	NULL	NULL	NULL
6604867	0	0	0	NULL	20-05-2005	184.31	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
6604869	0	0	0	NULL	20-05-2005	183.36	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
6604870	0	0	0	NULL	20-05-2005	183.19	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7036641	0	0	0	NULL	18-09-2006	178.53	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7046690	0	0	0	NULL	26-06-2007	206.82	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7052298	0	0	0	NULL	31-10-2007	192.30	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring	NULL	NULL
7100095	0	0	0	NULL	10-05-2007	178.54	NULL	NULL	NULL	Abandoned-Other	Monitoring	NULL	NULL
7109553	0	0	0	NULL	22-08-2008	171.81	NULL	STEEL	NULL	Abandoned-Other	NULL	NULL	NULL
7109715	0	0	0	NULL	07-07-2008	188.26	NULL	STEEL	NULL	Abandoned-Other	Domestic	NULL	NULL
7113174	0	0	0	NULL	01-08-2008	178.51	2	NULL	FRESH	Abandoned-Other	Monitoring	NULL	NULL
7113175	0	0	0	NULL	01-08-2008	177.71	2	NULL	FRESH	Abandoned-Other	Monitoring	NULL	NULL
7113176	0	0	0	NULL	07-08-2008	174.98	NULL	NULL	NULL	Abandoned-Other	Monitoring	NULL	NULL
7113939	0	0	0	NULL	25-09-2008	180.03	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7118141	0	0	0	NULL	NULL	181.96	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7120407	0	0	0	NULL	16-01-2009	181.42	NULL	NULL	NULL	Abandoned-Other	Monitoring	NULL	NULL
7120408	0	0	0	NULL	14-01-2009	182.72	NULL	NULL	NULL	Abandoned-Other	Monitoring	NULL	NULL
7123784	90.8	0	0	NULL	13-04-2009	178.79	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring and Test Hole	NULL	NULL
7123785	110.9	0	0	NULL	06-05-2009	184.54	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring and Test Hole	NULL	NULL
7126689	0	0	2.4	NULL	01-01-2009	184.93	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7131092	0	0	0	NULL	23-06-2009	175.00	4.5	NULL	Not stated	Abandoned-Other	Other	NULL	NULL
7132796	0	0	0	NULL	07-08-2009	191.66	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7139369	0	0	0	NULL	13-12-2009	192.57	NULL	NULL	NULL	Abandoned-Other	Monitoring	NULL	NULL
7147004	0	0	0	NULL	27-05-2010	179.50	NULL	NULL	NULL	Abandoned-Other	Monitoring and Test Hole	NULL	NULL
7147005	0	0	0	NULL	27-05-2010	179.56	NULL	NULL	NULL	Abandoned-Other	Monitoring and Test Hole	NULL	NULL
7147006	0	0	0	NULL	27-05-2010	179.38	NULL	NULL	NULL	Abandoned-Other	Monitoring and Test Hole	NULL	NULL
7147007	0	0	0	NULL	27-05-2010	179.55	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7147834	0	0	0	NULL	01-01-2010	181.16	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7147854	0	0	0	NULL	23-04-2010	178.70	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7147855	0	0	0	NULL	23-04-2010	179.80	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7147856	0	0	0	NULL	23-04-2010	179.77	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7147857	0	0	0	NULL	23-04-2010	178.91	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7151233	0	0	0	NULL	10-09-2010	185.05	5	NULL	FRESH	Abandoned-Other	NULL	NULL	NULL
7151876	0	0	0	NULL	16-09-2010	196.16	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring	NULL	NULL
7151877	0	0	0	NULL	16-09-2010	181.04	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring	NULL	NULL
7151878	0	0	0	NULL	16-09-2010	196.46	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring	NULL	NULL
7151879	0	0	0	NULL	16-09-2010	196.48	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring	NULL	NULL
7151880	0	0	0	NULL	16-09-2010	196.63	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring	NULL	NULL
7151881	0	0	0	NULL	16-09-2010	196.43	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring	NULL	NULL
7151882	0	0	0	NULL	16-09-2010	196.36	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring	NULL	NULL
7151883	0	0	0	NULL	16-09-2010	196.21	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring	NULL	NULL
7151884	0	0	0	NULL	16-09-2010	195.91	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring	NULL	NULL
7154467	0	0	0	NULL	27-05-2010	181.34	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring	NULL	NULL
7171145	0	0	0	NULL	23-09-2011	185.37	3.1	NULL	Not stated	Abandoned-Other	NULL	NULL	NULL
7174665	0	0	0	NULL	20-11-2011	180.01	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring and Test Hole	NULL	NULL
7174666	0	0	0	NULL	24-11-2011	180.03	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring and Test Hole	NULL	NULL
7174667	0	0	0	NULL	24-11-2011	180.03	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring and Test Hole	NULL	NULL
7176419	0	0	0	NULL	20-01-2012	173.48	2.5	NULL	Not stated	Abandoned-Other	NULL	NULL	NULL
7184885	0	0	0	NULL	17-07-2012	183.39	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7216797	0	0	0	NULL	22-01-2014	160.34	1.6	PLASTIC	FRESH	Abandoned-Other	NULL	NULL	NULL
7218047	0	0	0	NULL	14-02-2014	194.62	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7218343	0	0	0	NULL	11-12-2013	185.25	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7230424	0	0	0	NULL	07-08-2014	182.52	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7230425	0	0	0	NULL	07-08-2014	179.00	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7232510	0	0	0	NULL	05-11-2014	178.58	NULL	NULL	NULL	Abandoned-Other	Other	NULL	NULL
7237054	0	0	0	NULL	29-01-2015	178.68	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring	NULL	NULL
7243778	0	0	0	NULL	01-05-2015	200.86	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7243781	0	0	0	NULL	09-04-2015	175.62	2.1336	PLASTIC	NULL	Abandoned-Other	Monitoring	NULL	NULL

TABLE 2B
MECP Water Well Records
(Abandoned and Test/Monitoring Wells)

Well ID#	Well Depth (m)	Bedrock Depth (m)	Static Water Level (m)	Well Type	Date Completed	Ground Surface Elevation	Water Found Depth (m)	Well Casing Material	Water Description	Well Status	Well Use (1)	Well Use (2)	Recommended Pump Rate (GPM)
7252012	0	0	0	NULL	29-07-2015	180.90	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring and Test Hole	NULL	NULL
7256014	0	0	0	NULL	02-04-2015	138.13	5.7912	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7256023	0	0	0	NULL	21-05-2015	182.67	14.0208	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7256026	0	0	0	NULL	20-05-2015	179.35	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7256034	0	0	0	NULL	08-06-2015	198.87	1.524	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7261129	0	0	0	NULL	02-03-2016	176.98	NULL	PLASTIC	NULL	Abandoned-Other	Monitoring and Test Hole	NULL	NULL
7269488	0	0	0	NULL	12-07-2016	169.14	NULL	PLASTIC	NULL	Abandoned-Other	NULL	NULL	NULL
7286129	0	0	0	NULL	24-03-2017	210.64	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7286130	0	0	0	NULL	24-03-2017	215.52	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
7289871	0	0	0	NULL	11-05-2017	200.93	NULL	PLASTIC	NULL	Abandoned-Other	Test Hole	Monitoring	NULL
7289872	0	0	0	NULL	11-05-2017	197.49	NULL	PLASTIC	NULL	Abandoned-Other	Test Hole	Monitoring	NULL
7289873	0	0	0	NULL	11-05-2017	199.49	NULL	PLASTIC	NULL	Abandoned-Other	Test Hole	Monitoring	NULL
7289961	0	0	0	NULL	11-05-2017	197.18	NULL	PLASTIC	NULL	Abandoned-Other	Test Hole	Monitoring	NULL
7290262	0	0	0	NULL	08-05-2017	179.92	NULL	NULL	NULL	Abandoned-Other	NULL	NULL	NULL
6602278	36	0	3	Overburden	08-11-1956	176.01	35.6616	STEEL	SALTY	Abandoned-Quality	Not Used	NULL	NULL
6603314	62.2	36.6	11.6	Bedrock	03-03-1978	184.18	35.052	STEEL	FRESH	Abandoned-Quality	Industrial	NULL	35
6604436	19.2	11	0	Bedrock	09-05-2000	176.20	NULL	NULL	NULL	Abandoned-Quality	Commerical	NULL	NULL
7036854	0	0	0	NULL	03-10-2006	185.20	NULL	NULL	NULL	Abandoned-Quality	Domestic	NULL	NULL
7126686	0	0	6.4	NULL	26-06-2009	181.52	NULL	NULL	NULL	Abandoned-Quality	NULL	NULL	NULL
7147218	0	0	0	NULL	10-06-2010	172.54	NULL	NULL	NULL	Abandoned-Quality	Monitoring	NULL	NULL
7147219	0	0	0	NULL	10-06-2010	172.65	NULL	NULL	NULL	Abandoned-Quality	Monitoring	NULL	NULL
7263837	0	0	0	NULL	02-05-2016	184.61	NULL	STEEL	NULL	Abandoned-Quality	Not Used	NULL	NULL
3804303	0	0	0	NULL	31-08-2005	174.59	NULL	PLASTIC	NULL	Abandoned-Supply	NULL	NULL	NULL
7107922	4.5	0	0	NULL	24-06-2008	187.54	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7107923	4.5	0	0	NULL	24-06-2008	188.16	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7107924	6.1	0	0	NULL	24-06-2008	181.20	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7114868	7.9	0	0	NULL	30-09-2008	181.45	NULL	NULL	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7117538	5.8	0	0	NULL	19-11-2008	183.52	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7117539	5.8	0	0	NULL	19-11-2008	183.52	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7117540	5.8	0	0	NULL	19-11-2008	183.52	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7145251	4.3	0	0	NULL	11-05-2010	195.77	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7145252	8.2	0	0	NULL	11-05-2010	195.77	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7145253	6.1	0	0	NULL	11-05-2010	195.81	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7145254	4.9	0	0	NULL	11-05-2010	195.81	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7150423	4.3	0	0	NULL	03-08-2010	196.34	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7150424	3.4	0	0	NULL	03-08-2010	196.32	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7174200	4.2	0	0	NULL	29-11-2011	189.69	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7174201	4.2	0	0	NULL	29-11-2011	189.88	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7184922	6.1	0	0	NULL	12-06-2012	193.04	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7184939	6.1	0	0	NULL	13-06-2012	193.04	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7194083	0	0	0	NULL	30-11-2012	182.73	NULL	PLASTIC	NULL	Monitoring and Test Hole	Test Hole	NULL	NULL
7194084	0	0	0	NULL	30-11-2012	185.29	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7194085	0	0	0	NULL	30-11-2012	181.25	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7194086	0	0	0	NULL	30-11-2012	182.21	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7206545	6.9	0	0	NULL	08-07-2013	190.03	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7206546	7.6	0	0	NULL	08-07-2013	190.22	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7208723	6.1	0	0	NULL	29-08-2013	193.69	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7208724	0.9	0	0	NULL	29-08-2013	194.25	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7208725	6.1	0	0	NULL	29-08-2013	193.73	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7208911	6.1	0	0	NULL	18-09-2013	187.52	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7208912	6.7	0	0	NULL	18-09-2013	187.52	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7208913	6.1	0	0	NULL	18-09-2013	186.65	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7228348	6.1	0	0	NULL	26-08-2014	204.64	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7228349	6.1	0	0	NULL	26-08-2014	204.79	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7228350	6.1	0	0	NULL	26-08-2014	204.99	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7239386	4.6	0	0	NULL	16-03-2015	177.39	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7239387	3.6	0	0	NULL	16-03-2015	177.15	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7239388	4.6	0	0	NULL	16-03-2015	177.52	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7239389	4.6	0	0	NULL	16-03-2015	177.01	NULL	PLASTIC	Untested	Monitoring and Test Hole	NULL	Monitoring	NULL
7239738	5.1	0	0	NULL	18-03-2015	185.75	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7253348	6.7	0	0	NULL	11-11-2015	168.13	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256213	5.5	0	0	NULL	02-12-2015	176.97	NULL	PLASTIC	Untested	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256214	5.5	0	0	NULL	02-12-2015	172.83	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256218	5.5	0	0	NULL	01-12-2015	177.30	NULL	PLASTIC	Untested	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256219	5.5	0	0	NULL	30-11-2015	176.92	NULL	PLASTIC	Untested	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256220	5.5	0	0	NULL	01-12-2015	177.54	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256221	5.5	0	0	NULL	30-11-2015	177.05	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256223	5.5	0	0	NULL	30-11-2015	177.43	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256224	5.5	0	0	NULL	30-11-2015	176.88	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256225	5.5	0	0	NULL	01-12-2015	177.55	NULL	PLASTIC	Untested	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256516	7.6	0	0	NULL	04-12-2015	193.31	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL

TABLE 2B
MECP Water Well Records
(Abandoned and Test/Monitoring Wells)

Well ID#	Well Depth (m)	Bedrock Depth (m)	Static Water Level (m)	Well Type	Date Completed	Ground Surface Elevation	Water Found Depth (m)	Well Casing Material	Water Description	Well Status	Well Use (1)	Well Use (2)	Recommended Pump Rate (GPM)
7256517	7.6	0	0	NULL	04-12-2015	193.25	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256518	7.6	0	0	NULL	04-12-2015	193.33	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256519	7.6	0	0	NULL	04-12-2015	193.42	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256610	7.6	0	0	NULL	27-11-2015	180.22	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256611	7.6	0	0	NULL	27-11-2015	179.81	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256612	7.6	0	0	NULL	27-11-2015	179.80	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256614	7.6	0	0	NULL	30-11-2015	179.80	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256615	10.7	0	0	NULL	30-11-2015	179.98	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7256616	10.7	0	0	NULL	30-11-2015	180.01	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7259306	8.4	0	0	NULL	03-03-2016	186.00	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7259311	7.2	0	0	NULL	03-03-2016	177.66	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7259312	8.2	0	0	NULL	03-03-2016	176.11	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7259313	4	0	0	NULL	03-03-2016	175.78	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7262928	6.1	0	0	NULL	05-04-2016	179.55	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7262929	2.4	0	0	NULL	05-04-2016	177.13	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7263815	6.1	0	0	NULL	28-04-2016	182.68	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7263816	6.1	0	0	NULL	28-04-2016	182.25	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7263817	6.1	0	0	NULL	26-04-2016	183.12	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7264949	6.1	0	0	NULL	18-05-2016	199.69	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7266319	6.1	0	0	NULL	05-04-2016	178.84	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7269179	6.1	0	0	NULL	05-07-2016	177.67	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7269180	6.1	0	0	NULL	05-07-2016	179.16	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7270307	9.1	0	0	NULL	04-07-2016	203.50	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7270308	9.1	0	0	NULL	10-05-2016	205.27	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7270309	9.1	0	0	NULL	11-05-2016	204.12	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7270310	9.1	0	0	NULL	10-05-2016	203.85	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7270311	9.1	0	0	NULL	11-05-2016	204.24	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7270312	9.1	0	0	NULL	11-05-2016	204.28	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7270313	9.1	0	0	NULL	11-05-2016	204.62	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7270314	9.1	0	0	NULL	11-05-2016	204.47	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7273362	3.7	0	0	NULL	01-04-2016	189.49	NULL	OTHER	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7273363	3.7	0	0	NULL	01-09-2016	189.34	NULL	OTHER	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7273364	3.7	0	0	NULL	01-09-2016	189.75	NULL	OTHER	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7275240	6.1	0	0	NULL	24-10-2016	181.67	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7275241	6.1	0	0	NULL	24-10-2016	181.31	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7275242	6.1	0	0	NULL	24-10-2016	181.80	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring	NULL	NULL
7275276	9.1	0	0	NULL	25-10-2016	184.01	NULL	PLASTIC	NULL	Monitoring and Test Hole	Monitoring and Test Hole	NULL	NULL
7281352	6.1	0	0	NULL	17-01-2017	170.63	NULL	PLASTIC	NULL	Monitoring and Test Hole	Test Hole	Monitoring	NULL
7292959	6.1	0	0	NULL	21-07-2017	186.64	NULL	PLASTIC	NULL	Monitoring and Test Hole	Test Hole	Monitoring	NULL
7292960	6.1	0	0	NULL	21-07-2017	187.57	NULL	PLASTIC	NULL	Monitoring and Test Hole	Test Hole	Monitoring	NULL
7292978	7.6	0	0	NULL	27-07-2017	185.69	NULL	PLASTIC	NULL	Monitoring and Test Hole	Test Hole	Monitoring	NULL
6604749	8.5	0	0	Overburden	01-12-2003	180.29	2.5	PLASTIC	FRESH	Not A Well	Not Used	NULL	NULL
3804251	29.3	0	0	Overburden	25-05-2005	176.27	NULL	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
3804304	0	0	0	NULL	25-08-2005	194.56	NULL	PLASTIC	NULL	Observation Wells	Not Used	NULL	NULL
6603872	89.3	0	0	Overburden	16-02-1989	170.34	NULL	STEEL	NULL	Observation Wells	Not Used	NULL	NULL
6604559	2.7	0	0	Overburden	27-08-2001	183.60	1.8288	NULL	FRESH	Observation Wells	NULL	NULL	NULL
6604560	4.3	0	0	Overburden	27-08-2001	177.88	2.1336	NULL	FRESH	Observation Wells	NULL	NULL	NULL
6604561	5.5	0	0	Overburden	28-08-2001	178.31	3.9624	NULL	FRESH	Observation Wells	NULL	NULL	NULL
6604562	4	0	0	Overburden	27-08-2001	177.53	1.8288	NULL	FRESH	Observation Wells	NULL	NULL	NULL
6604755	12.2	0	0	Overburden	19-01-2004	170.62	NULL	STEEL	NULL	Observation Wells	Industrial	NULL	NULL
6604760	6	0	0	Overburden	19-03-2003	174.92	NULL	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
6604775	9.1	0	0	Overburden	05-03-2004	178.80	NULL	PLASTIC	NULL	Observation Wells	Not Used	NULL	NULL
6604806	7.5	0	0	Overburden	27-08-2004	192.10	3.5	PLASTIC	FRESH	Observation Wells	NULL	NULL	NULL
6604817	6.1	0	0	Overburden	19-08-2004	183.53	NULL	PLASTIC	NULL	Observation Wells	Not Used	NULL	NULL
6604820	0	0	0	NULL	22-10-2004	177.95	NULL	PLASTIC	NULL	Observation Wells	Not Used	NULL	NULL
6604821	0	0	0	NULL	22-10-2004	176.47	NULL	PLASTIC	NULL	Observation Wells	Not Used	NULL	NULL
6604822	0	0	0	NULL	22-10-2004	176.20	NULL	PLASTIC	NULL	Observation Wells	Not Used	NULL	NULL
6604849	3	0	0	Overburden	08-12-2004	177.43	0	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
6604878	15.4	13.7	0	Bedrock	25-05-2005	181.07	NULL	PLASTIC	NULL	Observation Wells	Not Used	NULL	NULL
6604879	4.6	0	0	Overburden	16-11-2004	179.08	NULL	NULL	NULL	Observation Wells	Not Used	NULL	NULL
6604899	6.9	0	0	Overburden	10-02-2005	178.42	NULL	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
6604901	6.5	0	0	Overburden	07-02-2005	191.77	2.6	PLASTIC	FRESH	Observation Wells	NULL	NULL	NULL
6604904	10.5	0	0	Overburden	31-08-2005	180.17	6	PLASTIC	FRESH	Observation Wells	NULL	NULL	NULL
6604957	10.7	0	0	Overburden	02-05-2006	175.08	NULL	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
6604962	6	0	0	Overburden	24-07-2006	178.46	4.5	PLASTIC	FRESH	Observation Wells	Not Used	NULL	NULL
6604963	10.6	0	0	Overburden	05-05-2006	188.85	9.1	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
6604964	6.2	0	0	Overburden	17-07-2006	173.96	NULL	PLASTIC	NULL	Observation Wells	Not Used	NULL	NULL
6604966	10.1	0	0	Overburden	27-07-2006	192.23	7.6	PLASTIC	FRESH	Observation Wells	Not Used	NULL	NULL
6604967	14.4	10.7	0	Bedrock	02-08-2006	196.33	NULL	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
6604974	9.7	0	0	Overburden	06-08-2006	192.84	6	PLASTIC	FRESH	Observation Wells	NULL	NULL	NULL
6604978	26.6	0	0	Overburden	07-09-2006	174.79	NULL	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL

TABLE 2B
MECP Water Well Records
(Abandoned and Test/Monitoring Wells)

Well ID#	Well Depth (m)	Bedrock Depth (m)	Static Water Level (m)	Well Type	Date Completed	Ground Surface Elevation	Water Found Depth (m)	Well Casing Material	Water Description	Well Status	Well Use (1)	Well Use (2)	Recommended Pump Rate (GPM)
6604982	14.4	10.7	0	Bedrock	28-08-2006	197.89	9.1	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
7038433	6.2	0	0	Overburden	10-11-2006	178.82	NULL	PLASTIC	NULL	Observation Wells	Not Used	NULL	NULL
7040666	20.4	0	0	Overburden	04-12-2006	207.73	NULL	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
7040786	0	0	0	NULL	04-01-2006	184.81	NULL	PLASTIC	NULL	Observation Wells	Not Used	NULL	NULL
7041807	128.6	16.2	0	Bedrock	07-02-2007	182.01	NULL	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
7041873	6.1	0	0	Overburden	12-02-2007	185.13	1.5	PLASTIC	FRESH	Observation Wells	Not Used	NULL	NULL
7041943	7.3	0	0	Overburden	05-02-2007	180.14	NULL	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
7042004	6.1	0	0	Overburden	04-01-2007	178.25	NULL	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
7042006	25	0	0	Overburden	06-03-2006	179.22	25	PLASTIC	FRESH	Observation Wells	NULL	NULL	NULL
7042011	10.7	0	0	Overburden	06-08-2006	177.25	NULL	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
7044274	9.1	0	0	Overburden	27-04-2007	179.74	4	PLASTIC	NULL	Observation Wells	Not Used	NULL	NULL
7046191	6.1	0	0	NULL	15-06-2006	178.19	4.3	PLASTIC	FRESH	Observation Wells	Monitoring	NULL	NULL
7046192	6.1	0	0	NULL	14-06-2007	193.90	4.3	PLASTIC	FRESH	Observation Wells	Other	NULL	NULL
7049355	7.5	0	0	NULL	24-07-2007	188.29	NULL	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
7050624	6	0	0	NULL	12-09-2007	176.75	NULL	PLASTIC	NULL	Observation Wells	Not Used	NULL	NULL
7050956	21	0	0	NULL	07-09-2007	205.33	19	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
7051403	21.4	0	0	NULL	04-10-2007	183.33	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7053473	6	0	0	NULL	14-11-2007	185.01	NULL	NULL	NULL	Observation Wells	NULL	NULL	NULL
7053477	6	0	0	NULL	27-11-2007	180.02	NULL	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
7053512	0	0	0	NULL	24-08-2007	195.65	NULL	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
7054435	0	0	0	NULL	07-12-2007	185.40	NULL	PLASTIC	NULL	Observation Wells	Other	NULL	NULL
7100743	10.5	0	0	NULL	12-10-2007	191.66	0	PLASTIC	FRESH	Observation Wells	Monitoring	NULL	NULL
7101528	12	0	0	NULL	02-01-2007	173.30	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7101529	12.5	0	0	NULL	02-01-2007	173.83	2	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7101530	11	0	0	NULL	02-01-2007	173.93	1.5	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7101531	12	0	0	NULL	02-01-2007	173.48	1	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
7101532	12	0	0	NULL	02-01-2007	173.05	1	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7104066	9.1	0	0	NULL	13-03-2008	177.28	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7104070	0	0	0	NULL	23-08-2007	178.34	NULL	NULL	NULL	Observation Wells	Not Used	NULL	NULL
7104700	16.6	0	0	NULL	15-12-2007	181.07	NULL	PLASTIC	NULL	Observation Wells	Not Used	NULL	NULL
7108585	8.1	0	0	NULL	12-03-2008	180.10	2.8	PLASTIC	FRESH	Observation Wells	Monitoring	NULL	NULL
7115455	7.5	0	0	NULL	NULL	179.12	2.5	PLASTIC	Untested	Observation Wells	Monitoring	NULL	NULL
7115457	8.5	0	0	NULL	NULL	176.31	1.5	PLASTIC	Untested	Observation Wells	Monitoring	NULL	NULL
7138572	0	0	0	NULL	18-12-2009	191.66	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7147216	3.4	0	0	NULL	10-06-2010	172.54	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7147217	3.2	0	0	NULL	10-06-2010	172.65	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7152850	3.7	0	0	NULL	07-06-2010	181.24	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7157903	28	0	0	NULL	06-12-2010	169.31	NULL	PLASTIC	NULL	Observation Wells	Test Hole	NULL	NULL
7157904	28	0	0	NULL	07-12-2010	169.35	NULL	PLASTIC	NULL	Observation Wells	Test Hole	NULL	NULL
7157905	28	0	0	NULL	08-12-2010	169.33	NULL	PLASTIC	NULL	Observation Wells	Test Hole	NULL	NULL
7157906	28	0	0	NULL	10-12-2010	169.73	NULL	PLASTIC	NULL	Observation Wells	Test Hole	NULL	NULL
7157907	28	0	0	NULL	16-12-2010	169.73	NULL	NULL	NULL	Observation Wells	Test Hole	NULL	NULL
7157908	28	0	0	NULL	22-12-2010	174.50	NULL	PLASTIC	NULL	Observation Wells	Test Hole	NULL	NULL
7157911	28	0	0	NULL	01-12-2010	169.15	NULL	NULL	NULL	Observation Wells	Test Hole	NULL	NULL
7157912	28	0	0	NULL	02-12-2010	169.40	NULL	PLASTIC	NULL	Observation Wells	Test Hole	NULL	NULL
7157913	28	0	0	NULL	03-12-2010	168.99	NULL	PLASTIC	NULL	Observation Wells	Test Hole	NULL	NULL
7158551	0	0	0	NULL	02-12-2010	192.14	NULL	NULL	NULL	Observation Wells	Monitoring	NULL	NULL
7158552	0	0	0	NULL	02-12-2010	191.42	NULL	NULL	NULL	Observation Wells	Monitoring	NULL	NULL
7158553	0	0	0	NULL	02-12-2010	191.46	NULL	NULL	NULL	Observation Wells	Monitoring	NULL	NULL
7158554	0	0	0	NULL	02-12-2010	185.32	NULL	NULL	NULL	Observation Wells	Monitoring	NULL	NULL
7158555	0	0	0	NULL	02-12-2010	191.95	NULL	NULL	NULL	Observation Wells	Monitoring	NULL	NULL
7163417	7.6	0	0	NULL	17-05-2011	173.52	6.096	PLASTIC	Untested	Observation Wells	Monitoring	NULL	NULL
7165533	6	0	0	NULL	10-02-2011	191.91	1.08	PLASTIC	FRESH	Observation Wells	Monitoring	NULL	NULL
7170337	6.1	0	0	NULL	08-08-2011	180.82	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7173446	4.6	0	0	NULL	22-11-2011	175.28	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7173447	7.6	0	0	NULL	23-11-2011	175.64	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7173979	4	0	0	NULL	09-12-2011	175.31	1.5	NULL	FRESH	Observation Wells	Monitoring	NULL	NULL
7174086	3.7	0	0	NULL	08-12-2011	190.42	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7174087	3.7	0	0	NULL	08-12-2011	190.36	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7174095	2.7	0	0	NULL	08-12-2011	190.16	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7174096	3.7	0	0	NULL	08-12-2011	190.42	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7174097	3.1	0	0	NULL	08-12-2011	190.24	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7182936	9.1	0	0	NULL	09-05-2012	116.16	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7184886	15.2	0	0	NULL	09-07-2012	194.59	NULL	PLASTIC	NULL	Observation Wells	Monitoring	Other	NULL
7184890	6.1	0	0	NULL	15-06-2012	175.86	5.7912	PLASTIC	NULL	Observation Wells	Monitoring	Other	NULL
7184940	6.1	0	0	NULL	13-06-2012	193.04	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7185575	6.1	0	0	NULL	17-07-2012	182.01	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7187223	0	0	0	NULL	NULL	170.92	NULL	PLASTIC	NULL	Observation Wells	NULL	NULL	NULL
7187227	5.5	0	0	NULL	26-04-2012	187.21	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7189900	0	0	0	NULL	07-09-2012	186.57	NULL	PLASTIC	NULL	Observation Wells	Monitoring and Test Hole	NULL	NULL
7189901	0	0	0	NULL	07-09-2012	186.35	NULL	PLASTIC	NULL	Observation Wells	Monitoring and Test Hole	NULL	NULL

TABLE 2B
MECP Water Well Records
(Abandoned and Test/Monitoring Wells)

Well ID#	Well Depth (m)	Bedrock Depth (m)	Static Water Level (m)	Well Type	Date Completed	Ground Surface Elevation	Water Found Depth (m)	Well Casing Material	Water Description	Well Status	Well Use (1)	Well Use (2)	Recommended Pump Rate (GPM)
7191623	15.2	0	0	NULL	07-06-2012	176.97	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7191624	15.2	0	0	NULL	07-06-2012	177.90	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7196453	0	0	0	NULL	10-11-2012	191.88	5.7912	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7198982	6	0	0	NULL	31-01-2013	172.83	NULL	PLASTIC	FRESH	Observation Wells	Monitoring	NULL	NULL
7198983	6	0	0	NULL	31-01-2013	174.00	NULL	PLASTIC	FRESH	Observation Wells	Monitoring	NULL	NULL
7198991	6	0	0	NULL	31-01-2013	171.15	NULL	PLASTIC	FRESH	Observation Wells	Monitoring	NULL	NULL
7198992	1.8	0	0	NULL	31-01-2013	172.27	NULL	PLASTIC	FRESH	Observation Wells	Monitoring	NULL	NULL
7200505	9.1	0	0	NULL	22-01-2013	181.42	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7205630	12.6	0	0	NULL	17-09-2012	160.34	3	PLASTIC	FRESH	Observation Wells	NULL	Monitoring	NULL
7207279	3	0	0	NULL	21-08-2013	174.98	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7208213	6.1	0	0	NULL	11-09-2013	175.64	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7208214	6.1	0	0	NULL	12-09-2013	174.55	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7208215	6.1	0	0	NULL	11-09-2013	175.12	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7208216	6.1	0	0	NULL	11-09-2013	175.57	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7213160	12.2	0	0	NULL	29-08-2013	169.34	9.144	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7215425	4.9	0	0	NULL	03-09-2013	171.56	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7216601	21.3	0	0	NULL	21-03-2013	208.67	19.8	PLASTIC	FRESH	Observation Wells	NULL	NULL	NULL
7218046	5.5	0	0	NULL	19-02-2014	177.62	5.1816	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7220120	9.2	0	0	NULL	10-04-2014	182.52	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7220121	9.7	0	0	NULL	10-04-2014	179.00	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7220833	12.2	0	0	NULL	17-04-2014	177.77	7.62	PLASTIC	Untested	Observation Wells	Monitoring	NULL	NULL
7220843	8.2	0	0	NULL	03-04-2014	178.89	3.6576	PLASTIC	Untested	Observation Wells	Monitoring	NULL	NULL
7224734	7.6	0	0	NULL	28-04-2014	186.11	6.7056	PLASTIC	NULL	Observation Wells	Monitoring	Other	NULL
7224735	4.6	0	0	NULL	22-04-2014	193.25	NULL	PLASTIC	NULL	Observation Wells	Monitoring	Other	NULL
7224736	4.6	0	0	NULL	22-04-2014	191.64	NULL	PLASTIC	NULL	Observation Wells	Monitoring	Other	NULL
7224741	7	0	0	NULL	29-05-2014	185.04	7.0104	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7224744	7.6	0	0	NULL	28-04-2014	187.12	7.3152	PLASTIC	NULL	Observation Wells	Monitoring	Other	NULL
7227142	7.6	0	0	NULL	02-05-2014	179.94	7.3152	PLASTIC	NULL	Observation Wells	Other	NULL	NULL
7227144	4.6	0	0	NULL	02-05-2014	179.77	NULL	PLASTIC	NULL	Observation Wells	Other	NULL	NULL
7227154	6.1	0	0	NULL	09-06-2014	177.74	4.8768	PLASTIC	Untested	Observation Wells	Monitoring	NULL	NULL
7227158	6.1	0	0	NULL	11-07-2014	190.59	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7231244	28.9	0	0	NULL	03-10-2014	176.76	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7231684	0	0	0	NULL	22-10-2013	174.90	NULL	NULL	Untested	Observation Wells	Monitoring	NULL	NULL
7231686	0	0	0	NULL	23-10-2013	171.93	NULL	NULL	Untested	Observation Wells	Monitoring	NULL	NULL
7232284	9.1	0	0	NULL	14-10-2014	188.51	6.4008	PLASTIC	Untested	Observation Wells	Monitoring	NULL	NULL
7237038	9.1	0	0	NULL	26-11-2014	180.15	8.5344	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7237047	16.8	0	0	NULL	06-11-2014	193.92	15.24	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7241167	23.8	0	0	NULL	02-04-2015	193.46	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7244960	6.1	0	0	NULL	03-06-2015	191.22	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7244971	10.7	0	0	NULL	27-04-2015	174.93	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7246435	6.1	0	0	NULL	23-07-2015	184.59	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7246437	6.1	0	0	NULL	23-07-2015	182.44	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7246438	6.1	0	0	NULL	24-07-2015	183.83	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7246439	6.1	0	0	NULL	24-07-2015	184.27	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7249838	7.6	0	0	NULL	09-07-2015	193.11	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7249839	10.6	0	0	NULL	09-07-2015	190.64	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7249840	4.5	0	0	NULL	10-07-2015	193.30	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7251752	6.1	0	0	NULL	09-07-2015	184.90	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7251870	7.6	0	0	NULL	30-09-2015	179.51	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7256120	9.1	0	0	NULL	08-12-2015	175.01	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7258857	9.1	0	0	NULL	29-09-2015	186.04	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7264456	7.6	0	0	NULL	26-04-2016	184.93	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7264459	4.6	0	0	NULL	30-03-2016	183.68	1.2192	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7269489	7.6	0	0	NULL	19-07-2016	186.25	6.096	PLASTIC	Untested	Observation Wells	Monitoring	NULL	NULL
7270476	6.1	0	0	NULL	26-07-2016	153.57	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7272870	7.6	0	0	NULL	18-07-2016	184.02	6.096	OTHER	Untested	Observation Wells	Monitoring	NULL	NULL
7275238	9.8	0	0	NULL	25-10-2016	182.99	NULL	PLASTIC	NULL	Observation Wells	Monitoring and Test Hole	NULL	NULL
7275239	9.1	0	0	NULL	26-10-2016	182.74	NULL	PLASTIC	NULL	Observation Wells	Monitoring and Test Hole	NULL	NULL
7275277	4.9	0	0	NULL	25-10-2016	178.79	NULL	PLASTIC	NULL	Observation Wells	Monitoring and Test Hole	NULL	NULL
7280335	30.5	0	0	NULL	07-10-2016	193.21	25.908	PLASTIC	NULL	Observation Wells	NULL	Monitoring	NULL
7283699	6.1	0	0	NULL	01-02-2017	185.82	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7286128	7.6	0	0	NULL	23-03-2017	179.81	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7287721	7.6	0	0	NULL	03-04-2017	170.98	NULL	PLASTIC	Untested	Observation Wells	Monitoring	NULL	NULL
7287722	7.6	0	0	NULL	03-04-2017	165.94	NULL	PLASTIC	Untested	Observation Wells	Monitoring	NULL	NULL
7287723	7.6	0	0	NULL	03-04-2017	169.19	NULL	PLASTIC	Untested	Observation Wells	Monitoring	NULL	NULL
7288588	6.7	0	0	NULL	18-05-2017	177.05	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7288589	4	0	1.5	NULL	18-05-2017	176.70	1.524	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7288590	7.6	0	0	NULL	16-05-2017	176.81	7.3152	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7294079	13.7	0	12.5	NULL	27-07-2017	202.30	12.4968	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7294080	15.2	0	12.5	NULL	27-07-2017	200.89	12.4968	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7294081	15.2	0	12.5	NULL	27-07-2017	202.39	12.4968	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL

TABLE 2B
MECP Water Well Records
(Abandoned and Test/Monitoring Wells)

Well ID#	Well Depth (m)	Bedrock Depth (m)	Static Water Level (m)	Well Type	Date Completed	Ground Surface Elevation	Water Found Depth (m)	Well Casing Material	Water Description	Well Status	Well Use (1)	Well Use (2)	Recommended Pump Rate (GPM)
7295005	6.1	0	0	NULL	17-02-2017	177.80	NULL	PLASTIC	NULL	Observation Wells	Monitoring	NULL	NULL
7295051	6.7	0	0	NULL	22-08-2017	181.08	4.5	PLASTIC	Untested	Observation Wells	Monitoring	NULL	NULL
7122583	15.2	0	0	NULL	04-11-2008	192.57	NULL	NULL	NULL	Other Status	Monitoring	NULL	NULL
6600612	24.7	24.4	2.4	Bedrock	22-06-1960	177.35	16.764	STEEL	FRESH	Test Hole	Not Used	NULL	NULL
6600613	16.8	0	0	Overburden	24-06-1960	177.43	NULL	NULL	NULL	Test Hole	Not Used	NULL	NULL
6600614	28.7	28.3	4.3	Bedrock	04-07-1960	178.33	22.86	STEEL	FRESH	Test Hole	Not Used	NULL	NULL
6600615	25.6	25.3	3	Bedrock	08-07-1960	162.61	22.86	STEEL	FRESH	Test Hole	Not Used	NULL	NULL
6603260	35.1	31.1	9.8	Bedrock	18-10-1977	179.45	32.6136	STEEL	FRESH	Test Hole	Domestic	NULL	30
6603261	30.5	22.3	6.7	Bedrock	27-10-1977	179.92	24.384	STEEL	SULPHUR	Test Hole	Domestic	NULL	30
6603732	9.1	0	0	Overburden	27-02-1987	173.59	NULL	OPEN HOLE	NULL	Test Hole	Municipal	NULL	NULL
6603875	153.9	21.3	3	Bedrock	02-12-1986	176.61	3.048	STEEL	SULPHUR	Test Hole	Not Used	NULL	NULL
6604648	3.7	0	0	Overburden	21-01-2002	173.55	NULL	PLASTIC	NULL	Test Hole	NULL	NULL	NULL
6604782	20	2.1	0	Bedrock	29-04-2004	119.80	NULL	NULL	NULL	Test Hole	NULL	NULL	NULL
6604787	18	0	0	Overburden	09-07-2004	179.06	NULL	NULL	NULL	Test Hole	Not Used	NULL	NULL
6604853	4.6	0	0	Overburden	11-03-2005	132.64	NULL	PLASTIC	NULL	Test Hole	NULL	NULL	NULL
7036632	18.3	0.3	0	Bedrock	22-09-2006	161.33	NULL	PLASTIC	NULL	Test Hole	NULL	NULL	NULL
7105003	0	0	7.3	NULL	08-02-2008	180.32	NULL	PLASTIC	NULL	Test Hole	Test Hole	NULL	NULL
7108580	4.5	0	0	NULL	19-03-2008	176.45	NULL	PLASTIC	NULL	Test Hole	Not Used	NULL	NULL
7109551	5	0	0	NULL	23-07-2008	174.58	NULL	PLASTIC	NULL	Test Hole	Monitoring and Test Hole	NULL	NULL
7112533	5.3	0	0	NULL	21-08-2008	191.57	3	PLASTIC	FRESH	Test Hole	Monitoring	NULL	NULL
7114548	23	0	18.5	NULL	18-08-2008	205.38	18.5	PLASTIC	FRESH	Test Hole	Monitoring	NULL	NULL
7115827	6	0	0	NULL	07-10-2008	189.84	NULL	PLASTIC	NULL	Test Hole	Test Hole	NULL	NULL
7116506	6.1	0	0	NULL	25-11-2008	179.13	NULL	PLASTIC	NULL	Test Hole	Monitoring	NULL	NULL
7116989	9.1	0	0	NULL	12-11-2008	187.27	NULL	PLASTIC	NULL	Test Hole	Test Hole	NULL	NULL
7120640	20.7	0	19.6	NULL	04-02-2009	205.20	19.7	PLASTIC	Not stated	Test Hole	Monitoring	NULL	NULL
7122360	45	0	0	NULL	20-02-2009	193.47	NULL	STEEL	NULL	Test Hole	Monitoring and Test Hole	NULL	NULL
7130897	29	0	0	NULL	31-08-2009	205.32	18.3	PLASTIC	FRESH	Test Hole	Monitoring	NULL	NULL
7135082	8.2	0	0	NULL	06-10-2009	194.42	NULL	PLASTIC	NULL	Test Hole	Monitoring	NULL	NULL
7135500	6.1	0	5.1	NULL	10-08-2009	191.12	5.1	PLASTIC	Not stated	Test Hole	Monitoring	NULL	NULL
7136718	3.7	0	0	NULL	01-12-2009	179.50	NULL	PLASTIC	NULL	Test Hole	Test Hole	NULL	NULL
7140751	9.1	0	0	NULL	02-11-2009	173.90	NULL	PLASTIC	NULL	Test Hole	Monitoring and Test Hole	NULL	NULL
7141989	4.6	0	0	NULL	11-08-2009	177.38	NULL	PLASTIC	NULL	Test Hole	Test Hole	NULL	NULL
7141996	5.8	0	0	NULL	12-08-2009	176.03	NULL	PLASTIC	NULL	Test Hole	Test Hole	NULL	NULL
7143432	6	0	0	NULL	23-03-2010	181.37	NULL	PLASTIC	NULL	Test Hole	Monitoring	NULL	NULL
7144409	6.1	0	0	NULL	23-03-2010	191.26	NULL	PLASTIC	NULL	Test Hole	Test Hole	NULL	NULL
7146057	5.5	0	0	NULL	22-04-2010	186.21	NULL	NULL	NULL	Test Hole	Test Hole	NULL	NULL
7153267	5.5	0	0	NULL	19-04-2010	182.95	NULL	PLASTIC	NULL	Test Hole	Test Hole	NULL	NULL
7156221	6.1	0	0	NULL	26-10-2010	185.09	NULL	PLASTIC	NULL	Test Hole	Test Hole	NULL	NULL
7159568	4.6	0	0	NULL	04-02-2011	180.29	NULL	PLASTIC	NULL	Test Hole	Test Hole	NULL	NULL
7159601	4.6	0	0	NULL	24-09-2010	173.84	NULL	NULL	NULL	Test Hole	Test Hole	NULL	NULL
7166973	6.1	0	0	NULL	29-06-2011	185.83	NULL	PLASTIC	NULL	Test Hole	Test Hole	NULL	NULL
7178698	6.1	0	0	NULL	14-01-2011	174.33	NULL	PLASTIC	NULL	Test Hole	Test Hole	NULL	NULL
7183418	4.6	0	0	NULL	01-03-2012	187.53	NULL	PLASTIC	NULL	Test Hole	Monitoring and Test Hole	NULL	NULL
7200894	6.1	0	0	NULL	26-02-2013	177.24	NULL	PLASTIC	NULL	Test Hole	Monitoring	NULL	NULL
7209169	11.3	0	0	NULL	06-09-2013	158.40	4.6	PLASTIC	Untested	Test Hole	Test Hole	NULL	NULL
7215872	6.1	0	0	NULL	24-10-2013	177.02	NULL	PLASTIC	NULL	Test Hole	Not Used	NULL	NULL
7239868	5.8	0	0	NULL	18-03-2015	185.69	NULL	PLASTIC	NULL	Test Hole	Monitoring and Test Hole	NULL	NULL
7239869	6.1	0	0	NULL	18-03-2015	185.64	NULL	PLASTIC	NULL	Test Hole	Monitoring and Test Hole	NULL	NULL
7243514	6.1	0	0	NULL	28-05-2015	177.47	NULL	PLASTIC	NULL	Test Hole	Monitoring and Test Hole	NULL	NULL
7252219	5.8	0	0	NULL	03-10-2015	186.27	NULL	PLASTIC	NULL	Test Hole	Monitoring and Test Hole	NULL	NULL
7252220	5.2	0	0	NULL	03-10-2015	185.88	NULL	PLASTIC	NULL	Test Hole	Monitoring and Test Hole	NULL	NULL
7252221	5.8	0	0	NULL	03-10-2015	185.61	NULL	PLASTIC	NULL	Test Hole	Monitoring and Test Hole	NULL	NULL
7277452	45.4	0	8.9	NULL	26-10-2016	185.44	10.668	STEEL	Untested	Test Hole	Commerical	NULL	40
7281296	8.9	0	0	NULL	15-08-2016	180.62	7.3	PLASTIC	Untested	Test Hole	Test Hole	NULL	NULL
7281297	8.5	0	0	NULL	15-08-2016	179.61	7.3	PLASTIC	Untested	Test Hole	Test Hole	NULL	NULL
7281298	8.5	0	0	NULL	15-08-2016	181.75	7.3	PLASTIC	Untested	Test Hole	Test Hole	NULL	NULL
7281299	8.5	0	0	NULL	15-08-2016	181.05	2.3	PLASTIC	Untested	Test Hole	Test Hole	NULL	NULL
7289637	22.5	0	0	NULL	22-06-2017	197.93	NULL	PLASTIC	Untested	Test Hole	Test Hole	NULL	NULL
7291283	7.6	0	0	NULL	10-04-2017	166.58	NULL	PLASTIC	NULL	Test Hole	Test Hole	Monitoring	NULL
7291285	7.6	0	0	NULL	10-04-2017	164.28	NULL	PLASTIC	NULL	Test Hole	Monitoring	Test Hole	NULL
7294149	6.1	0	0	NULL	06-07-2017	175.61	NULL	PLASTIC	NULL	Test Hole	NULL	NULL	NULL
7130895	4.6	0	0	NULL	31-07-2009	205.41	NULL	PLASTIC	NULL	NULL	Monitoring	NULL	NULL
7130896	28.7	0	0	NULL	31-07-2009	205.25	18.5	PLASTIC	FRESH	NULL	Monitoring	NULL	NULL
7161307	8.8	0	0	NULL	29-03-2011	179.79	NULL	PLASTIC	NULL	NULL	Monitoring	NULL	NULL
7161308	9.1	0	0	NULL	29-03-2011	179.79	NULL	PLASTIC	NULL	NULL	Monitoring	NULL	NULL
7161309	9.1	0	0	NULL	29-03-2011	179.79	NULL	PLASTIC	NULL	NULL	Monitoring	NULL	NULL
7161310	9.1	0	0	NULL	29-03-2011	179.79	NULL	PLASTIC	NULL	NULL	Monitoring	NULL	NULL
7173963	9.1	0	0	NULL	NULL	175.62	NULL	PLASTIC	NULL	NULL	Monitoring	NULL	NULL
7181666	7.6	0	0	NULL	30-04-2012	176.80	NULL	PLASTIC	NULL	NULL	Monitoring	NULL	NULL
7213109	9.8	0	0	NULL	07-08-2013	176.43	NULL	PLASTIC	NULL	NULL	Monitoring	NULL	NULL
7220603	9.1	0	0	NULL	01-05-2014	177.60	NULL	PLASTIC	NULL	NULL	Monitoring	NULL	NULL

TABLE 2B
MECP Water Well Records
(Abandoned and Test/Monitoring Wells)

Well ID#	Well Depth (m)	Bedrock Depth (m)	Static Water Level (m)	Well Type	Date Completed	Ground Surface Elevation	Water Found Depth (m)	Well Casing Material	Water Description	Well Status	Well Use (1)	Well Use (2)	Recommended Pump Rate (GPM)
7224612	6.1	0	0	NULL	08-07-2014	180.18	NULL	PLASTIC	NULL	NULL	Monitoring	NULL	NULL
7227448	9.1	0	0	NULL	17-07-2014	209.75	NULL	PLASTIC	NULL	NULL	Monitoring	NULL	NULL
7228676	6.7	0	0	NULL	01-05-2014	193.69	NULL	PLASTIC	NULL	NULL	Monitoring	NULL	NULL
7231685	0	0	0	NULL	22-10-2013	174.91	NULL	NULL	Untested	NULL	Monitoring	NULL	NULL
7232056	7.6	0	0	NULL	30-10-2014	192.05	NULL	PLASTIC	NULL	NULL	Monitoring	NULL	NULL
7234468	4.6	0	0	NULL	25-11-2014	201.95	NULL	PLASTIC	NULL	NULL	Monitoring	NULL	NULL
7235985	16.8	0	0	NULL	15-12-2014	192.64	NULL	PLASTIC	NULL	NULL	Monitoring	NULL	NULL
7239667	7.6	0	0	NULL	24-03-2015	183.35	NULL	PLASTIC	NULL	NULL	Monitoring	NULL	NULL
7246436	6.1	0	0	NULL	23-07-2015	181.60	NULL	PLASTIC	NULL	NULL	Monitoring	NULL	NULL
7256955	10.7	0	0	NULL	15-12-2015	181.27	3.048	PLASTIC	Untested	NULL	Monitoring	NULL	NULL
7280346	7.6	0	0	NULL	19-10-2016	190.60	6.096	PLASTIC	NULL	NULL	Monitoring	NULL	NULL
7183414	4.6	0	0	NULL	01-03-2012	186.25	NULL	PLASTIC	NULL	NULL	Monitoring and Test Hole	NULL	NULL
7228877	30.3	0	0	NULL	02-09-2014	175.97	19.812	PLASTIC	Untested	NULL	Monitoring and Test Hole	NULL	NULL
7256215	5.5	0	0	NULL	02-12-2015	180.04	NULL	PLASTIC	NULL	NULL	Monitoring and Test Hole	NULL	NULL
7256216	5.5	0	0	NULL	02-12-2015	180.34	NULL	PLASTIC	NULL	NULL	Monitoring and Test Hole	NULL	NULL
7256217	5.5	0	0	NULL	02-12-2015	179.50	NULL	PLASTIC	Untested	NULL	Monitoring and Test Hole	NULL	NULL
7256222	5.5	0	0	NULL	30-11-2015	177.51	NULL	PLASTIC	NULL	NULL	Monitoring and Test Hole	NULL	NULL
7256520	7.6	0	0	NULL	04-12-2015	193.48	NULL	PLASTIC	NULL	NULL	Monitoring and Test Hole	NULL	NULL
7256613	9.1	0	0	NULL	27-11-2015	179.82	NULL	PLASTIC	NULL	NULL	Monitoring and Test Hole	NULL	NULL
7269173	6.1	0	0	NULL	05-07-2016	176.49	NULL	PLASTIC	NULL	NULL	Monitoring and Test Hole	NULL	NULL
7269174	6.1	0	0	NULL	05-07-2016	175.61	NULL	PLASTIC	NULL	NULL	Monitoring and Test Hole	NULL	NULL
7269175	6.1	0	0	NULL	05-07-2016	175.55	NULL	PLASTIC	NULL	NULL	Monitoring and Test Hole	NULL	NULL
7269176	6.1	0	0	NULL	05-07-2016	176.02	NULL	PLASTIC	NULL	NULL	Monitoring and Test Hole	NULL	NULL
7269177	6.1	0	0	NULL	05-07-2016	177.57	NULL	PLASTIC	NULL	NULL	Monitoring and Test Hole	NULL	NULL
7269178	6.1	0	0	NULL	05-07-2016	177.60	NULL	PLASTIC	NULL	NULL	Monitoring and Test Hole	NULL	NULL
7291284	7.6	0	0	NULL	10-04-2017	165.32	NULL	PLASTIC	NULL	NULL	Test Hole	Monitoring	NULL

Data accesssed May 9, 2019

TABLE 3
MECP Permits to Take Water

Permit #	Permit Holder	Purpose (1)	Purpose (2)	Permit Expires	Permit Issued	Water Source	Source ID	UTM Easting	UTM Northing	UTM Zone	Max Taking (L/day)	Taking days/year	Taking hrs/day	Max Taking L/min
0007-AT4PJV	The Niagara Parks Commission	Recreational	Other - Recreational	31-12-2027	14-11-2017	Surface Water	Niagara River	656377	4770946	17	4906000	200	16	5110
0318-AB8RWR	General Motors of Canada Company	Industrial	Cooling Water	31-08-2021	27-06-2016	Surface Water	Welland Canal, Lock 7 Intake(Primary)	646882	4775881	17	158976000	365	24	110400
0833-9QBR8H	Saint-Gobain Ceramic Materials Canada Inc.	Industrial	Cooling Water	31-08-2025	06-11-2014	Surface Water	Welland River	658283	4769032	17	5000000	365	24	3472
2351-7XFM28	The Regional Municipality of Niagara	Water Supply	Municipal	31-03-2019	17-11-2009	Surface Water	Chippawa Creek	658588	4769324	17	145475000	365	24	144444
2624-9VYHB4	The Niagara Parks Commission	Commercial	Golf Course Irrigation	28-02-2025	03-06-2015	Surface Water	Irrigation Pond	659699	4768042	17	10888800	240	20	9074
2701-9NBLH8	Cytec Canada Inc.	Industrial	Cooling Water	31-08-2024	25-08-2014	Surface Water	Welland River	650468	4767414	17	50400000	365	24	35000
4050-A7LLXS	Benadir Holdings Inc.	Commercial	Golf Course Irrigation	28-02-2026	03-03-2016	Surface Water	Beaverdams Creek	648799	4773989	17	3930000	150	16	4090
4330-AT6LVR	Resolute FP Canada Inc.	Industrial	Cooling Water	31-08-2027	30-11-2017	Surface Water	Welland Ship Canal	646547	4774415	17	75000000	365	24	54000
5175-AK4LPG	Willodell Golf Club of Niagara Ltd.	Commercial	Golf Course Irrigation	31-01-2022	13-03-2017	Surface Water	Lyons Creek	653690	4765026	17	1473000	210	20	2200
5415-9TFJ69	Fallsview Golf Inc.	Commercial	Golf Course Irrigation	30-04-2025	04-03-2015	Surface and Ground Water	Chippawa Power Canal	653423	4767880	17	1817000	80	20	1514
5415-9TFJ69	Fallsview Golf Inc.	Commercial	Golf Course Irrigation	30-04-2025	04-03-2015	Surface and Ground Water	Pond A	655299	4769373	17	1817000	80	8	3785
6133-98BMFV	2285045 Ontario Inc.	Commercial	Golf Course Irrigation	28-02-2023	07-06-2013	Surface and Ground Water	Welland River	651420	4767260	17	2192000	214	24	3105
6133-98BMFV	2285045 Ontario Inc.	Commercial	Golf Course Irrigation	28-02-2023	07-06-2013	Surface and Ground Water	Irrigation Pond	651364	4766647	17	3818400	214	24	7855
6133-98BMFV	2285045 Ontario Inc.	Commercial	Golf Course Irrigation	28-02-2023	07-06-2013	Surface and Ground Water	Pond 1	651861	4767458	17	2160000	214	24	1500
6133-98BMFV	2285045 Ontario Inc.	Commercial	Golf Course Irrigation	28-02-2023	07-06-2013	Surface and Ground Water	Pond 2	651909	4766173	17	2160000	214	24	1500
6133-98BMFV	2285045 Ontario Inc.	Commercial	Golf Course Irrigation	28-02-2023	07-06-2013	Surface and Ground Water	Pond 3	652543	4766634	17	2160000	214	24	1500
6133-98BMFV	2285045 Ontario Inc.	Commercial	Golf Course Irrigation	28-02-2023	07-06-2013	Surface and Ground Water	Pond 4	652437	4766905	17	2160000	214	24	1500
6133-98BMFV	2285045 Ontario Inc.	Commercial	Golf Course Irrigation	28-02-2023	07-06-2013	Surface and Ground Water	Pond 5	652297	4767391	17	2160000	214	24	1500
7278-ANRLM4	Thorold Cogen L.P.	Industrial	Other - Industrial	31-08-2027	28-06-2017	Surface Water	Welland Canal	646513	4774302	17	5784000	365	24	4017
7278-ANRLM4	Thorold Cogen L.P.	Industrial	Cooling Water	31-08-2027	28-06-2017	Surface Water	Welland Canal	646513	4774302	17	492928000	365	24	342311
7537-9P3Q22	Oxy Vinyls Canada Co.	Industrial	Manufacturing	31-08-2024	18-09-2014	Surface Water	Welland River	648677	4767217	17	5700000	365	24	3960
8173-ACPHB3	Mark Steven Shumlick	Commercial	Other - Commercial	30-09-2021	10-08-2016	Surface and Ground Water	Drilled Well	647967	4765303	17	523700	180	24	363.7
8173-ACPHB3	Mark Steven Shumlick	Commercial	Other - Commercial	30-09-2021	10-08-2016	Surface and Ground Water	Irrigation Pond	647967	4765303	17	1091040	180	8	2273
8361-A9GM4M	CRH Canada Group Inc.	Dewatering Construction	Construction	30-04-2018	29-04-2016	Surface and Ground Water	QEWNB/Lyons-Nabut	653903	4766018	17	510000	240	24	354
8361-A9GM4M	CRH Canada Group Inc.	Dewatering Construction	Construction	30-04-2018	29-04-2016	Surface and Ground Water	QEWNB/Lyons-Sabut	653907	4765989	17	510000	240	24	354
8361-A9GM4M	CRH Canada Group Inc.	Dewatering Construction	Construction	30-04-2018	29-04-2016	Surface and Ground Water	QEWNB/Lyons-Nabut	653911	4766008	17	510000	240	24	354
8361-A9GM4M	CRH Canada Group Inc.	Dewatering Construction	Construction	30-04-2018	29-04-2016	Surface and Ground Water	QEWNB/Lyons-Sabut	653907	4765989	17	510000	240	24	354
8361-A9GM4M	CRH Canada Group Inc.	Dewatering Construction	Construction	30-04-2018	29-04-2016	Surface and Ground Water	QEWNB/Tee-Nabut	654112	4765811	17	510000	240	24	354
8361-A9GM4M	CRH Canada Group Inc.	Dewatering Construction	Construction	30-04-2018	29-04-2016	Surface and Ground Water	QEWNB/Tee-Sabut	654127	4765795	17	510000	240	24	354
8470-9ZXR6N	His Star Inc.	Commercial	Golf Course Irrigation	28-02-2025	02-09-2015	Ground Water	Well No. 1	650608	4771798	17	327000	275	24	227
8470-9ZXR6N	His Star Inc.	Commercial	Golf Course Irrigation	28-02-2025	02-09-2015	Ground Water	Well No. 2	650529	4771832	17	589000	275	24	409
8470-9ZXR6N	His Star Inc.	Commercial	Golf Course Irrigation	28-02-2025	02-09-2015	Ground Water	Dugout Pond	650163	4771655	17	2520000	275	12	3500

Data accesssed May 10, 2019

TABLE 4
NPCA Groundwater Quality Results

Well ID	Units	YoungMatthews	BadenPowell	OakHall	OakHall_duplicate	YoungMatthews	BadenPowell	OakHall	YoungMatthews	BadenPowell	OakHall
Easting_17_NAD83	-	649479.3	652903	656818.3	656818.3	649479.3	652903	656818.3	649479.3	652903	656818.3
Northing_17_NAD83	-	4763858.1	4767379.8	4770080.1	4770080.1	4763858.1	4767379.8	4770080.1	4763858.1	4767379.8	4770080.1
Surface Elevation	mASL	182.2	176.4	179.4	179.4	182.2	176.4	179.4	182.2	176.4	179.4
Bedrock Elevation	mASL	151	145	145	145	151	145	145	151	145	145
Subcropping unit	-	Salina	Salina	Guelph	Guelph	Salina	Salina	Guelph	Salina	Salina	Guelph
MECP well ID No	-	7226394	7231244	7228877	7228877	7226394	7231244	7228877	7226394	7231244	7228877
Sample Date	-	28-07-2015	25-08-2015	25-08-2015	25-08-2015	23-09-2016	26-09-2016	14-10-2016	21-09-2017	25-09-2017	16-10-2017
Sample Odour	-	H2S	H2S	H2S	H2S	H2S	H2S	H2S	H2S	H2S	H2S
Alkalinity	mg/L	147	103	253	260	150	116	287	142	106	273
Temperature	°C	12.96	11.12	12.27	-	10.99	11.18	11.84	11.13	11.24	12
DO	%sat	0	0	0	-	-	-	-	0	0	0
Conductivity	µS/cm	2543	4506	4595	-	2811	4444	4345	2398.1	3493.3	3520.5
pH	pH	7.57	7.23	6.98	-	6.8	7.11	6.91	7.06	7.28	6.98
ORP	mV	<190.8	<268.2	<11.8	-	<288	<395	<84	-	-	-
H2S	(mg/L S2)	2.5	33.75	<0.01	<0.01	6.25	34	0.05	2	4	0.34
Ca	ppm	519.56	557.30	278.83	278.06	526.74	528.27	270.09	452.20	452.10	231.47
Mg	ppm	107.75	204.80	205.87	203.05	99.49	178.37	182.43	92.84	165.38	165.89
Na	ppm	4.23	11.01	12.47	12.39	77.18	293.45	420.11	70.21	252.59	355.75
HCO3	mg/L	179	126	308	317	183	141	350	173	129	333
SO4	mg/L	1746.45	2198.37	845.28	840.31	1621.83	1837.30	703.22	1593.72	1992.51	740.12
Cl	G	20.43	584.62	1099.53	1093.89	21.38	541.27	1041.62	19	531	990
NO3	mg/L(N)	<0.006	<0.006	<0.006	<0.006	<0.003	<0.003	<0.03	<0.02	<0.02	<0.1
NO2	S	<0.003	<0.003	<0.003	<0.003	<0.006	<0.006	<0.006	<0.01	<0.01	<0.05
NH3+NH4	mg/L(N)	0.18	0.87	1.07	1.17	0.16	0.98	1.05	0.21	0.851	1.15
TKN	mg/L(N)	0.24	1.4	1.9	1.75	0.13	2.8	3.3	0.24	1	1.06
Organic N	N	0.06	0.53	0.83	0.58	<0.05	1.82	2.23	<0.15	<0.15	<0.15
Br	mg/L	0.25	6.11	9	9.14	57.43	5.91	9.19	0.25	0.6	9
F	mg/L	0.97	1.53	0.83	0.82	0.50	0.73	0.33	0.6	0.13	0.29
Iodide	ppb	67	239	124	124	132	606	247	32	908	117
PO4	mg/L	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
DIC	mg/L C	69.1	31.6	100	71.7	29.26	17.6	59.11	-	-	-
DOC	mg/L C	1.1	<1	2.1	2.2	<1.14	<1.14	1.69	-	-	-
Si	ppb	8641	8609	14680	14478	8153.2	7777.0	13608.0	8020	7711	13579.5
CH4	sat%_est	10.87	0.42	0.00	0.00	2.71	0.61	0.62	2.17	0.65	0.00
CO2	sat%_est	0.16	0.00	0.74	0.64	0.22	0.01	0.73	0.26	0.05	1.13
Ag	ppb	0.018	0.019	0.009	0.008	0.009	0.0075	0.006	0.01	0.0066	0.0081
Al	ppb	<5	<5	<5	<5	4.4325	<0.56	10.6894	<5	<5	<5
As	ppb	0.907	2.142	8.9025	8.973	0.77	0.246	7.206	0.322	1.888	7.805
Au	ppb	-	-	-	-	<0.004	<0.004	<0.004	<0.0007	<0.0007	<0.0007
B	ppb	466	938	670	652	498.67	892.91	648.09	470	880	645
Ba	ppb	8.731	5.312	12.656	12.41	11.37	5.487	14.185	6.96	4.199	12.196
Be	ppb	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.007	0.004	0.01
Bi	ppb	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.001	<0.001	<0.001
Cd	ppb	<0.01	<0.01	0.01	0.012	<0.01	<0.01	<0.01	0.0064	0.0051	0.0081
Ce	ppb	0.0126	0.01	0.00935	0.0077	0.0062	0.0152	0.0034	0.0056	0.0162	0.001
Co	ppb	<0.005	<0.005	0.0085	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cr	ppb	0.084	0.088	0.19	0.975	0.25	0.187	0.307	0.067	0.151	0.072
Cs	ppb	0.0093	0.0331	0.0163	0.018	0.0074	0.0364	0.0177	0.007	0.029	0.0174
Cu	ppb	2.49	2.47	1.115	1.03	2.18	2.595	1.22	2.56	3.13	1.4
Dy	ppb	0.002	0.002	0.0014	0.0015	0.0016	0.0026	<0.001	0.00155	0.00163	0.00054
Er	ppb	0.0016	0.0022	0.002	<0.001	0.0017	0.0028	<0.001	0.00062	0.00065	0.00069
Eu	ppb	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0002	<0.0002	<0.0002
Fe	ppb	685	<15	1415	1415	482.1	3.5	1131.1	536.2	5.6	763.9

TABLE 4
NPCA Groundwater Quality Results

Well ID	Units	YoungMatthews	BadenPowell	OakHall	OakHall_duplicate	YoungMatthews	BadenPowell	OakHall	YoungMatthews	BadenPowell	OakHall
Easting_17_NAD83	-	649479.3	652903	656818.3	656818.3	649479.3	652903	656818.3	649479.3	652903	656818.3
Northing_17_NAD83	-	4763858.1	4767379.8	4770080.1	4770080.1	4763858.1	4767379.8	4770080.1	4763858.1	4767379.8	4770080.1
Surface Elevation	mASL	182.2	176.4	179.4	179.4	182.2	176.4	179.4	182.2	176.4	179.4
Bedrock Elevation	mASL	151	145	145	145	151	145	145	151	145	145
Subcropping unit	-	Salina	Salina	Guelph	Guelph	Salina	Salina	Guelph	Salina	Salina	Guelph
MECP well ID No	-	7226394	7231244	7228877	7228877	7226394	7231244	7228877	7226394	7231244	7228877
Sample Date	-	28-07-2015	25-08-2015	25-08-2015	25-08-2015	23-09-2016	26-09-2016	14-10-2016	21-09-2017	25-09-2017	16-10-2017
Ga	ppb	0.0049	0.008	0.0093	0.007	0.0096	0.0116	0.0098	0.0041	0.0106	0.0102
Gd	ppb	0.0039	0.0025	0.0018	0.0016	<0.001	0.0029	<0.001	0.0017	0.0022	<0.0006
Hf	ppb	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.0008	<0.0008	<0.0008
Hg	ppt	3.9	1.5	25.9	8.6	-	-	-	<1.5	<1.5	<1.5
Ho	ppb	0.00034	0.00037	0.000195	0.00019	0.00021	0.00057	0.00026	0.00029	0.00011	<0.0001
K	ppm	80.49	273.71	393.26	414.73	3.81	10.18	11.99	3.45	9.17	9.92
La	ppb	0.0089	0.0066	0.00435	0.0034	0.0048	0.0096	0.0025	0.0031	0.0151	0.0018
Li	ppb	31.8	203.2	343.5	321	43.9	217.2	296.2	45.11	196.05	277.79
Lu	ppb	0.00035	0.0003	0.00016	0.00026	0.00028	0.00028	0.00012	0.00024	0.00018	0.00015
Mn	ppb	50	106	39	37	43.31	81.85	28.17	35.38	62.94	25.12
Mo	ppb	1.155	0.156	3.508	3.686	0.686	0.2175	3.417	0.63	0.208	3.227
Nb	ppb	0.0089	0.0106	0.01265	0.0111	0.0162	0.0153	0.0112	0.0061	0.0105	0.0039
Nd	ppb	0.0101	0.0101	0.0102	0.0067	0.0081	0.0163	0.0142	0.0072	0.0154	0.0094
Ni	ppb	<0.1	0.39	0.985	1.28	1.03	2.16	3.16	2.85	1.87	2.04
Pb	ppb	0.0043	<0.002	0.00865	0.0064	0.0137	0.0294	0.099	<0.02	<0.02	<0.02
Pr	ppb	0.0021	0.0011	0.0009	0.0008	0.0011	0.0022	0.0007	0.00094	0.00213	0.00058
Rb	ppb	2.695	6.89	4.052	4.245	2.535	6.58	4.114	2.405	5.809	3.494
Sb	ppb	<0.01	<0.01	0.015	<0.01	0.012	<0.01	0.013	<0.005	0.009	0.01
Sc	ppb	0.11	0.26	<0.1	<0.1	0.27	0.24	<0.1	0.3	0.39	<0.1
Se	ppb	1.01	18.14	26.54	27.44	1.01	15.885	24.26	1.22	20.94	32.2
Sm	ppb	<0.001	0.0016	0.0017	<0.001	0.0026	0.0027	0.0016	<0.002	0.0025	<0.002
Sn	ppb	0.05	<0.01	0.035	<0.01	0.034	0.075	0.033	0.029	0.021	0.017
Sr	ppb	11290	10972	7300	7289	11659	11241	6763	9514	9132	6268
Ta	ppb	<0.0003	0.00042	0.0005	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Tb	ppb	0.00017	0.00056	0.00023	<0.0001	0.00017	0.00037	<0.0001	<0.0002	0.00048	<0.0002
Th	ppb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0011	<0.001	<0.001
Ti	ppb	<0.1	0.5	<0.1	<0.1	0.42	0.64	<0.1	<0.4	0.8	0.5
Tl	ppb	<0.001	<0.001	<0.001	<0.001	0.0026	<0.001	<0.001	0.00046	0.001	0.00034
Tm	ppb	0.00027	0.00041	0.00015	0.00013	0.00024	0.00031	<0.0001	<0.0003	0.00032	<0.0003
U	ppb	0.375	0.10249	0.6055	0.504	0.12855	0.07397	0.374	0.1555	0.1934	0.3386
V	ppb	0.0299	0.0128	0.02645	0.0326	0.0417	0.0225	0.0312	0.0218	0.0182	0.0263
W	ppb	0.304	0.1	0.1295	0.127	0.242	0.103	0.101	0.1682	0.1407	0.0451
Y	ppb	0.0586	0.0716	0.04365	0.0432	0.0858	0.0835	0.0443	0.071	0.0757	0.0405
Yb	ppb	0.001	0.0015	<0.001	<0.001	0.0013	0.0017	<0.001	0.00062	0.00175	<0.0003
Zn	ppb	3.9	2.6	2.35	<1	3	3.4	1.8	3.7	3.9	1.7
Zr	ppb	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.026	0.015	0.015

Note: Data provided by Niagara Peninsula Conservation Authority (NPCA)

FIGURES

650000

660000

470000

LEGEND

- WATERCOURSE
- WATERBODY
- WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- SITES OF INTEREST
- REGIONAL STUDY AREA

SURFICIAL GEOLOGY

- 3: PALEOZOIC BEDROCK
- 5D: GLACIOLACUSTRINE-DERIVED SILTY TO CLAYEY TILL
- 8A MASSIVE TO WELL LAMINATED - FINE-TEXTURED GLACIOLACUSTRINE DEPOSITS: SILT AND CLAY, MINOR SAND AND GRAVEL
- 9: COARSE-TEXTURED GLACIOLACUSTRINE DEPOSITS
- 9B: LITTORAL-FORESHORE DEPOSITS
- 12: OLDER ALLUVIAL DEPOSITS
- 19: MODERN ALLUVIAL DEPOSITS
- 21: MAN-MADE DEPOSITS

KEY MAP

0 1 2 3

1:60,000 KILOMETRES

REFERENCE(S)

1. BASE DATA - MNRF LIO, OBTAINED 2019
2. PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES AND FORESTRY, © QUEENS PRINTER 2019
3. IMAGERY: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
4. SURFICIAL GEOLOGY - MINISTRY OF NORTHERN DEVELOPMENT AND MINES, 1:250 000 SCALE SURFICIAL GEOLOGY OF ONTARIO; ONTARIO GEOLOGICAL SURVEY
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
REGIONAL MUNICIPALITY OF NIAGARA

PROJECT
SOUTH NIAGARA FALLS WASTEWATER SOLUTIONS
SCHEDULE C CLASS ENVIRONMENTAL ASSESSMENT

TITLE
SURFICIAL GEOLOGY

CONSULTANT
GOLDER

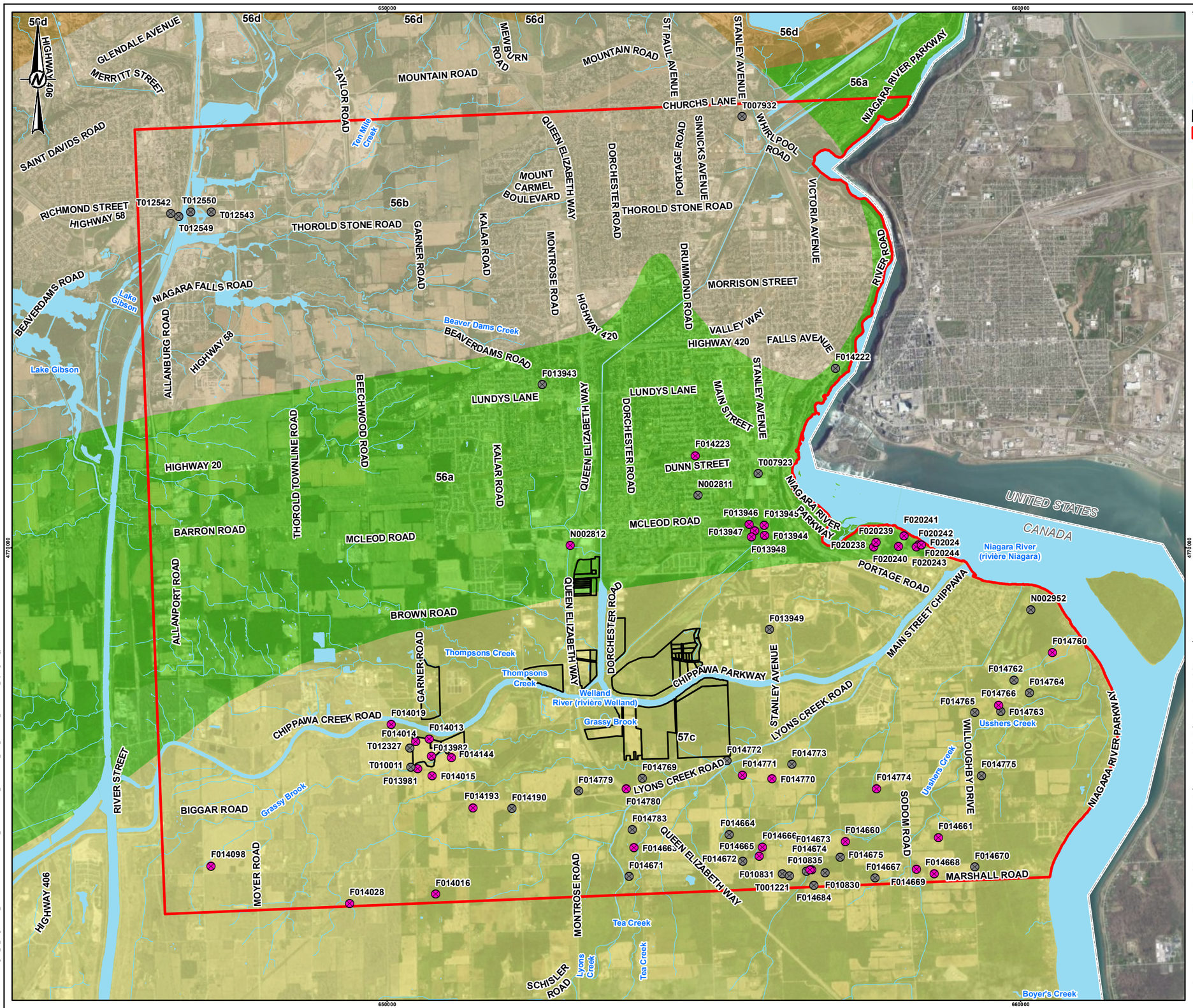
YYYY-MM-DD	2020-04-28
DESIGNED	PR
PREPARED	PR
REVIEWED	MB
APPROVED	SM

PROJECT NO.	CONTROL	REV.	FIGURE
18104462	0001	0.0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

PATH: S:\Client\Region_of_Niagara\New_WasteWaterTreatmentPlant\99_PRO\18104462_GMBluePlan_SNF_WWTP\40_PROD\0001_Hydrogeology\18104462-0001-CH-0001.mxd PRINTED ON: 2020-04-28 AT: 12:09:48 PM



LEGEND

- OIL AND GAS WELL RECORD LOCATIONS
- OIL AND GAS WELL RECORD LOCATIONS (ABANDONED OR NOT DRILLED)
- WATERCOURSE
- WATERBODY
- SITES OF INTEREST
- REGIONAL STUDY AREA

BEDROCK GEOLOGY

- 57C SALINA FM.
- 56A GUELPH FM.
- 56B LOCKPORT FM.
- 56D CLINTON GP.; CATARACT GP.

0 1 2 3

1:60,000 KILOMETRES

REFERENCE(S)

1. BASE DATA - MNRF LIO, OBTAINED 2019
2. PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES AND FORESTRY, © QUEENS PRINTER 2019
3. IMAGERY: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY
SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
4. BEDROCK GEOLOGY - ONTARIO GEOLOGICAL SURVEY 2011. 1:250 000 SCALE BEDROCK GEOLOGY OF ONTARIO; ONTARIO GEOLOGICAL SURVEY, MISCELLANEOUS RELEASE---DATA 126-REVISION 1.
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
REGIONAL MUNICIPALITY OF NIAGARA

PROJECT
SOUTH NIAGARA FALLS WASTEWATER SOLUTIONS
SCHEDULE C CLASS ENVIRONMENTAL ASSESSMENT

TITLE
BEDROCK GEOLOGY AND GAS WELLS

CONSULTANT
GOLDER

YYYY-MM-DD	2020-04-28
DESIGNED	PR
PREPARED	PR
REVIEWED	MB
APPROVED	SM

PROJECT NO.	CONTROL	REV.	FIGURE
18104462	0001	0.0	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

650000

660000

4770000

0318-AB8RWR

4330-AT6LVR

7278-ANRLM4

7278-ANRLM4

4050-A7LLXS

Ten Mile Creek

Lake Gibson

Lake Gibson

Beaver Dams Creek

8470-9ZXR6N

8470-9ZXR6N

8470-9ZXR6N

0007-AT4PJV

UNITED STATES

CANADA

OakHall

5415-9TFJ69

2351-7XFM28

0833-9QBR8H

2624-9VYHB4

Niagara River (rivière Niagara)

Thompsons Creek

Thompsons Creek

5415-9TFJ69

2701-9NBLH8

6133-98BMFV

7537-9P3Q22

BadenPowell

Welland River (rivière Welland)

Grassy Brook

Usshers Creek

6133-98BMFV

6133-98BMFV

6133-98BMFV

6133-98BMFV

6133-98BMFV

Lyons Creek

8361-A9GM4M

8361-A9GM4M

8361-A9GM4M

8361-A9GM4M

8361-A9GM4M

Grassy Brook

Usshers Creek

8173-ACPHB3

8173-ACPHB3

5175-AK4LPG

YoungMatthews

Tea Creek

Lyons Creek

Tea Creek

Boyer's Creek

650000

660000

4770000

LEGEND

- NPCA MONITORED WELLS
- MECP WATER WELL RECORD LOCATION
- MECP WATER WELL RECORD LOCATION - WELL NOT USED FOR WATER SUPPLY (TEST AND MONITORING WELLS, WELL ABANDONMENT RECORDS ETC.)

PERMIT TO TAKE WATER

- SURFACE WATER
- GROUND WATER
- SURFACE AND GROUND WATER
- WATERCOURSE
- WATERBODY
- SITES OF INTEREST
- REGIONAL STUDY AREA

KEY MAP

0 1 2 3

1:60,000 KILOMETRES

REFERENCE(S)

1. BASE DATA - MNRF LIO, OBTAINED 2019
2. PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES AND FORESTRY, © QUEENS PRINTER 2019
3. IMAGERY: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
4. SUFICIAL GEOLOGY - MINISTRY OF NORTHERN DEVELOPMENT AND MINES, 1:250 000 SCALE SURFICIAL GEOLOGY OF ONTARIO; ONTARIO GEOLOGICAL SURVEY
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
REGIONAL MUNICIPALITY OF NIAGARA

PROJECT
SOUTH NIAGARA FALLS WASTEWATER SOLUTIONS
SCHEDULE C CLASS ENVIRONMENTAL ASSESSMENT

TITLE
WATER WELLS AND WATER TAKING PERMITS

CONSULTANT
GOLDER

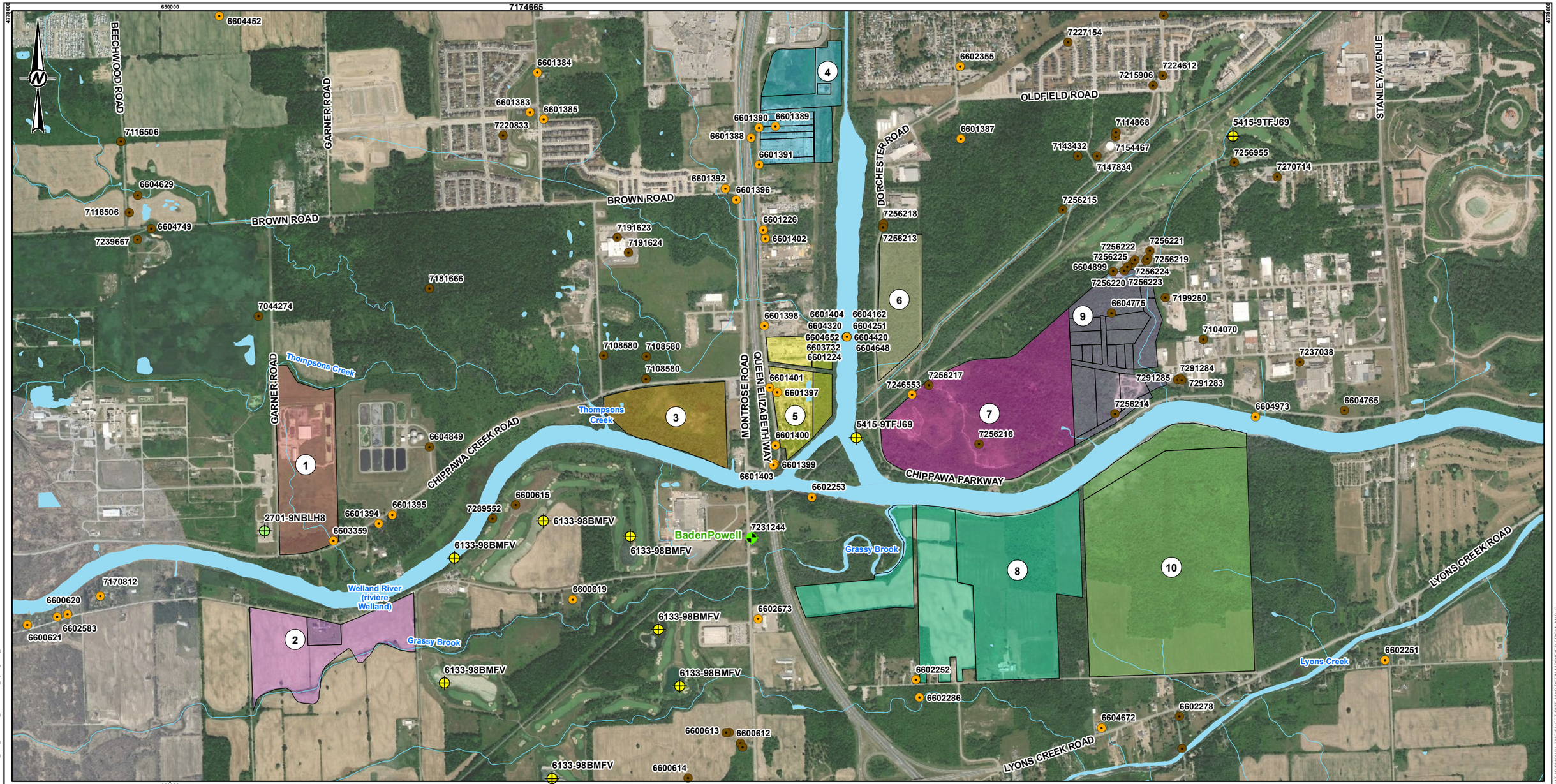
YYYY-MM-DD	2020-04-28
DESIGNED	PR
PREPARED	PR
REVIEWED	MB
APPROVED	SM

PROJECT NO.	CONTROL	REV.	FIGURE
18104462	0001	0.0	3A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

PATH: S:\Clients\Region_of_Niagara\New_WasteWaterTreatmentPlant\99_PROJ\18104462_GMBluePlan_SNF_WWTP40_PROD\0001_Hydrogeology\18104462-0001-CH-0003A.mxd PRINTED ON: 2020-04-28 AT: 12:08:36 PM



LEGEND

- NPCA MONITORED WELLS
- MECP WATER WELL RECORD LOCATION
- MECP WATER WELL RECORD LOCATION - WELL NOT USED FOR WATER SUPPLY (TEST AND MONITORING WELLS, WELL ABANDONMENT RECORDS ETC.)

PERMIT TO TAKE WATER

- SURFACE WATER
- GROUND WATER
- SURFACE AND GROUND

- WATERCOURSE
- WATERBODY
- REGIONAL STUDY
- SITES OF INTEREST
- (1) SITES OF INTEREST ID
- SITE 1
- SITE 2
- SITE 3
- SITE 4
- SITE 5
- SITE 6
- SITE 7
- SITE 8
- SITE 9
- SITE 10

REFERENCE(S)

1. BASE DATA - MNRF LIO, OBTAINED 2019
2. PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES AND FORESTRY, © QUEENS PRINTER 2019
3. IMAGERY: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY
4. SUFICIAL GEOLOGY - MINISTRY OF NORTHERN DEVELOPMENT AND MINES, 1:250 000 SCALE SURFICIAL GEOLOGY OF ONTARIO; ONTARIO GEOLOGICAL SURVEY
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

0 500 1,000
1:19,000 METRES

CLIENT
REGIONAL MUNICIPALITY OF NIAGARA

CONSULTANT
GOLDER

YYYY-MM-DD	2020-04-28
DESIGNED	PR
PREPARED	PR
REVIEWED	MB
APPROVED	SM

PROJECT
SOUTH NIAGARA FALLS WASTEWATER SOLUTIONS
SCHEDULE C CLASS ENVIRONMENTAL ASSESSMENT

TITLE
WATER WELLS AND WATER TAKING PERMITS – SITES OF INTEREST AREA

PROJECT NO.	CONTROL	REV.	FIGURE
18104462	0001	0.0	3B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0

PATH: S:\Clients\Region_of_Niagara\New_WasteWater\Treatment\Plant\99_PRO\18104462_GMBluePlan_SNF_WWTP\40_PROD\0001_Hydrogeology\18104462-0001-CH-0003B.mxd PRINTED ON: 2020-04-28 AT: 12:10:22 PM

650000

660000

4770000

GLENDALE AVENUE
MERRITT STREET
HIGHWAY 406
SAINT DAVIDS ROAD
RICHMOND STREET
HIGHWAY 58
BEAVERDAMS ROAD
NIAGARA FALLS ROAD
ALLANBURG ROAD
HIGHWAY 58
BEAVERDAMS ROAD
HIGHWAY 20
ALLANPORT ROAD
BARRON ROAD
MCLEOD ROAD
BROWN ROAD
RIVER STREET
BIGGAR ROAD
MOYER ROAD
HIGHWAY 406
SCHISLER ROAD
MOUNTAIN ROAD
MEWBURN ROAD
TAYLOR ROAD
MOUNTAIN ROAD
ST PAUL AVENUE
WHIRLPOOL ROAD
NIAGARA RIVER PARKWAY
MOUNT CARMEL BOULEVARD
QUEEN ELIZABETH WAY
DORCHESTER ROAD
PORTAGE ROAD
SINNICKS AVENUE
STANLEY AVENUE
VICTORIA AVENUE
RIVER ROAD
THOROLD STONE ROAD
GARNER ROAD
KALAR ROAD
MONTROSE ROAD
DRUMMOND ROAD
MORRISON STREET
VALLEY WAY
HIGHWAY 420
FALLS AVENUE
LUNDYS LANE
LUNDYS LANE
MAIN STREET
STANLEY AVENUE
NIAGARA RIVER PARKWAY
THOROLD TOWNLINE ROAD
BEECHWOOD ROAD
KALAR ROAD
DORCHESTER ROAD
DUNN STREET
MONTROSE ROAD
DORCHESTER ROAD
STANLEY AVENUE
PORTAGE ROAD
MAIN STREET CHIPPAWA
CHIPPAWA PARKWAY
NIAGARA RIVER PARKWAY
GARNER ROAD
CHIPPAWA CREEK ROAD
RIVER STREET
BIGGAR ROAD
LYONS CREEK ROAD
LYONS CREEK ROAD
SODOM ROAD
WILLOUGHBY DRIVE
MARSHALL ROAD
SCHISLER ROAD

Ten Mile Creek
Beaver Dams Creek
Thompsons Creek
Grassy Brook
Tea Creek
Lyons Creek
Usshers Creek
Boyer's Creek

Firemans Park Wetland Complex
Welland Canal North Turn Basin Wetland Complex
Lake Gibson Moodie Welland Canal Reservoir Wetland Complex
Lake Gibson
Lake Gibson
Warren Creek Wetland Complex
Thompson Creek Wetland Complex
South Allanburg Slough Forest Wetland Complex
Niagara Falls Slough Forest Wetland Complex
Welland River East Wetland Complex
Welland River (rivière Welland)
Lyons Creek Wetland Complex
Lower Grassy Brook Wetland Complex
Upper Grassie Brook Wetland Complex
Lyons Creek North Wetland Complex
Port Robinson Woodlot Wetland Complex
Niagara Street Cataract Road Woodlot Wetland Complex
Welland River Between the Canals Wetland Complex
Tea Creek Wetland Complex
Willoughby Marsh Wetland Complex
Usshers Creek Wetland Complex
Navy Island Wetland Complex

Niagara River (rivière Niagara)
UNITED STATES
CANADA

LEGEND
- WATERCOURSE
- WATERBODY
- WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- SITES OF INTEREST
- REGIONAL STUDY AREA
- SIGNIFICANT GROUNDWATER RECHARGE AREA
- HIGHLY VULNERABLE AQUIFER

KEY MAP

0 1 2 3
1:60,000 KILOMETRES

REFERENCE(S)
1. BASE DATA - MNRF LIO, OBTAINED 2019
2. PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES AND FORESTRY, © QUEENS PRINTER 2019
3. IMAGERY: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
4. SUFICIAL GEOLOGY - MINISTRY OF NORTHERN DEVELOPMENT AND MINES, 1:250 000 SCALE SURFICIAL GEOLOGY OF ONTARIO; ONTARIO GEOLOGICAL SURVEY
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
REGIONAL MUNICIPALITY OF NIAGARA

PROJECT
SOUTH NIAGARA FALLS WASTEWATER SOLUTIONS
SCHEDULE C CLASS ENVIRONMENTAL ASSESSMENT

TITLE
GROUNDWATER RECHARGE AND VULNERABILITY

CONSULTANT
GOLDER

YYYY-MM-DD	2020-04-28
DESIGNED	PR
PREPARED	PR
REVIEWED	MB
APPROVED	SM

PROJECT NO.	CONTROL	REV.	FIGURE
18104462	0001	0.0	4A

650000

4770000

BEECHWOOD ROAD
GARNER ROAD
Warren Creek Wetland Complex
BROWN ROAD
Thompson Creek Wetland Complex
Thompsons Creek
GARNER ROAD
BROWN ROAD
Welland River East Wetland Complex
Thompsons Creek
MONTROSE ROAD
QUEEN ELIZABETH WAY
DORCHESTER ROAD
OLDFIELD ROAD
Niagara Falls Slough Forest Wetland Complex
STANLEY AVENUE
CHIPPAWA PARKWAY
Welland River (rivière Welland)
Lyons Creek Wetland Complex
LYONS CREEK ROAD
CHIPPAWA CREEK ROAD
Grassy Brook
Lower Grassy Brook Wetland Complex
Grassy Brook
QUEEN ELIZABETH WAY
Lyons Creek
LYONS CREEK ROAD
Upper Grassie Brook Wetland Complex
Lyons Creek North Wetland Complex
LYONS CREEK ROAD

1
2
3
4
5
6
7
8
9
10

650000

4770000

LEGEND

- WATERCOURSE
- WATERBODY
- WETLAND
- PROVINCIALLY SIGNIFICANT WETLAND
- (1) SITES OF INTEREST ID
- SITES OF INTEREST
- SITE 1
- SITE 2
- SITE 3
- SITE 4
- SITE 5
- SITE 6
- SITE 7
- SITE 8
- SITE 9
- SITE 10
- SIGNIFICANT GROUNDWATER RECHARGE
- HIGHLY VULNERABLE

0 500 1,000
1:19,500 METRES

REFERENCE(S)

1. BASE DATA - MNRF LIO, OBTAINED 2019
2. PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES AND FORESTRY, © QUEENS PRINTER 2019
3. IMAGERY: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY
4. SUFICIAL GEOLOGY - MINISTRY OF NORTHERN DEVELOPMENT AND MINES, 1:250 000 SCALE SURFICIAL GEOLOGY OF ONTARIO; ONTARIO GEOLOGICAL SURVEY
5. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
REGIONAL MUNICIPALITY OF NIAGARA

CONSULTANT
GOLDER

YYYY-MM-DD	2020-04-28
DESIGNED	PR
PREPARED	PR
REVIEWED	MB
APPROVED	SM

PROJECT
SOUTH NIAGARA FALLS WASTEWATER SOLUTIONS
SCHEDULE C CLASS ENVIRONMENTAL ASSESSMENT

TITLE
GROUNDWATER RECHARGE AND VULNERABILITY - SITES OF INTEREST AREA

PROJECT NO.	CONTROL	REV.	FIGURE
18104462	0001	0.0	4B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

PATH: S:\Clients\Region_of_Niagara\New_WasteWaterTreatmentPlant\69_PRO\18104462_GMBluePlan_SNF_WWTP\40_PRO\0001_Hydrogeology\18104462-0001-GH-0004B.mxd PRINTED ON: 2020-04-28 AT: 12:14:11 PM

V3.10.2

REGIONAL MUNICIPALITY OF NIAGARA
SOUTH NIAGARA FALLS WASTEWATER SOLUTIONS

Hydrogeological Investigation

Preliminary Hydrogeological Investigations – Preferred WWTP Site and Trunk Sewer

REGIONAL MUNICIPALITY OF NIAGARA

SOUTH NIAGARA FALLS WW SOLUTIONS EA, NIAGARA, ON

PRELIMINARY HYDROGEOLOGICAL INVESTIGATION

April 14, 2022

SOUTH NIAGARA FALLS WW SOLUTIONS EA, NIAGARA, ON

PRELIMINARY HYDROGEOLOGICAL INVESTIGATION

REGIONAL MUNICIPALITY OF NIAGARA

FINAL

PROJECT NO.: 201-11602-00
DATE: APRIL 14, 2022

WSP
610 CHARTWELL ROAD
SUITE 300
OAKVILLE, ON, CANADA L6J 4A5

T: +1 905-823-8500
F: +1 905-823-8503
WSP.COM

April 14, 2022

Regional Municipality of Niagara
1815 Sir Isaac Brock Way
Thorold, ON, L2V 4T7

Attention: Ms. Lisa Vespi, P.Eng., PMP

Dear Madam:

WSP Canada Inc. is pleased to present our Preliminary Hydrogeological Investigation report, which has been prepared to support the Schedule C Environmental Assessment (EA) and conceptual design for the South Niagara Falls Waste Water Treatment Plant (WWTP) and associated trunk sewer in Niagara Falls, Ontario.

The report documents relevant background information, results of our field investigations and analyses, and provides our recommendations and conclusions.

The report also provides a discharge plan, which discusses environmental monitoring, environmental controls and a mitigation plan in relation to the dewatering at the site.

Please feel free to contact the undersigned if there are any questions or concerns.

Yours sincerely,

Natalia Codoban, M.Eng., P.Eng.

Senior Hydrogeologist /
Environmental Engineer

610 CHARTWELL ROAD
SUITE 300
OAKVILLE, ON, CANADA L6J 4A5

T: +1 905-823-8500
F: +1 905-823-8503
wsp.com

NC/nc

Cc: Phyllis McCrindle; Valyn Bernard, WSP

WSP ref.: 201-11602-00

REVISION HISTORY

FIRST ISSUE				
April 14, 2022	Draft hydrogeological report			
Prepared by	Reviewed by	Approved by		
Valyn Bernard, B.A.Sc., P.Eng.	Natalia Codoban, M.Eng., P.Eng.	Natalia Codoban, M.Eng., P.Eng.		
REVISION 1				
May 26, 2022	Final hydrogeological report			
Prepared by	Reviewed by	Approved By		
Valyn Bernard, B.A.Sc., P.Eng.	Natalia Codoban, M.Eng., P.Eng.	Natalia Codoban, M.Eng., P.Eng.		
REVISION 2				
<Date>	<Remarks>			
Prepared by	Reviewed by	Approved By		
<preparer, title>	<reviewer, title>	<approver, title>		

SIGNATURES

PREPARED BY

Valyn Bernard, P.Eng.
Project Engineer

May 26, 2022
Date

APPROVED BY

Natalia Codoban, M.Eng., P.Eng.
Senior Hydrogeologist / Environmental Engineer

May 26, 2022
Date

The original of this digital file will be conserved by WSP Canada Inc. for a period of not less than 10 years. As the digital file transmitted to the intended recipient is no longer under the control of WSP Canada Inc, its integrity cannot be assured. As such, WSP Canada Inc. does not guarantee any modifications made to this digital file subsequent to its transmission to the intended recipient.

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1 Introduction

1.1 Project Description and Background

WSP Canada Inc. (WSP) was retained by Regional Municipality of Niagara (the Region) to complete a preliminary hydrogeological investigation to support the Schedule C Environmental Assessment (EA) and conceptual design for the proposed South Niagara Falls Waste Water Treatment Plant (WWTP) and associated sanitary trunk sewer (collectively referred to as 'the Site') in Niagara Falls, Ontario. An evaluation zone of 500 m ('the Study Area') was added around the Site's boundaries to assess hydrogeological conditions for this project. The Site and the Study Area are shown on **Figure 1**.

The 2041 Growth Plan for the Region identified a significant growth in residents and employment within the Region by 2041. The Water and Wastewater Master Servicing Plan (MSP) was updated in 2017 to evaluate the existing and planned water and wastewater infrastructure and its ability to service the Region's existing users and the anticipated growth. The MSP evaluated and developed recommended strategies, and selected a preferred South Niagara Falls servicing strategy to service the anticipated growth, including the construction of a new Wastewater Treatment Plant within South Niagara Falls (Niagara Region, October 2020). The Region retained GM BluePlan Engineering Limited (GMBP) to complete the Municipal Class EA for the Wastewater Treatment Plant.

A Geotechnical Desktop Study Report and a Hydrogeological Baseline Conditions Technical Memorandum were prepared by Golder Associates Ltd. in June 2020 and May 2020, respectively, to support the Municipal Class EA being prepared GMBP. The objective of the Golder's reports were to review available information from regional geology, water well records and geotechnical investigations completed in or in proximity of the project area and to provide a summary of geological and hydrogeological conditions for the proposed new WWTP and associated infrastructure upgrades. The preliminary hydrogeological investigation and geotechnical investigation were carried out to support the EA and conceptual design of the preferred alternatives.

The Site is divided into two main components: Subproject 1 "Trunk Sewer" and Subproject 2 "Wastewater Treatment Plant site", as defined in the Request for Tender (Niagara Region, October 2020). Each project component includes the following proposed works:

Subproject 1 – Trunk Sewer (Sewer Alignment and Construction Shaft Locations)

- 3000 mm dia. construction shaft (Montrose Shaft 01) within the Ontario Power Generation (OPG lands)
- Approximately 470 m long, 1500 mm dia. concrete sanitary sewer between the OPG lands and Montrose Road (between Montrose Shaft 01 and Montrose Shaft 02)
- 3000 mm dia. construction shaft at Montrose Road, west of the OPG lands (Montrose Shaft 02)
- Approximately 485 m long, 1500 mm dia. concrete sanitary sewer along Montrose Road, between Montrose Shaft 02 and Montrose Shaft 03 (Brown Road)
- 3000 mm dia. construction shaft at Montrose Road and Brown Road (Montrose Shaft 03)
- 1800 mm dia. construction shaft at Brown Road and Heartland Forest Road (Brown Shaft 01)
- Approximately 700 m long, 1500 mm dia. concrete sanitary sewer along Brown Road, between Heartland Forest Road and Montrose Road (between Brown Shaft 01 and Montrose Shaft 03)
- Approximately 740 m long, 1800 mm dia. concrete sanitary sewer along Montrose Road between Brown Road and Chippawa Creek Road
- 3000 mm dia. construction shaft at Montrose Road and Chippawa Creek Road (Montrose Shaft 04)
- Approximately 840 m long, 1800 mm dia. concrete sanitary sewer along Montrose Road, between Chippawa Creek Road and Grassy Brook Road
- 3000 mm dia. construction shaft at Montrose Road and Grassy Brook Road (Montrose Shaft 05)
- Approximately 750 m long, 1800 mm dia. concrete sanitary sewer along Montrose Road, between Grassy Brook Road and Reixinger Road
- 3000 mm dia. construction shaft at Montrose Road and Reixinger Road (Montrose Shaft 06)
- Approximately 1,040 m long, 2500 mm dia. concrete sanitary sewer along Reixinger Road, between Montrose Road and Dell Road
- 3000 mm dia. construction shaft at Reixinger Road and Dell Road (Reixinger Shaft 02)
- Approximately 120 m long, 2500 mm dia. concrete sanitary sewer, from Rexinger Road and Dell Road northerly to WWTP site.

Subproject 2 – Wastewater Treatment Plant Site

- The WWTP study area covers approximately 76 ha (760,000 m^2) on the south side of the Welland River, between the River and Reixinger Road, and include parts of Lots 7, 8, 9 and 10 of Broken Front Welland River Concession in Willoughby Township. The WWTP and all associated subsurface works required to construct the WWTP will take place within an area approximately 16.2 ha (162,000 m^2) of the Study Area.

The sections of sanitary sewers from the OPG lands to the WWTP will be installed by trenchless methods using the eight construction shafts listed in the above sections. Based on details provided in March 2022 by CIMA+, the Civil Engineers for the project, Phase 1 of the WWTP and all associated subsurface works will be constructed using open excavation methods. A temporary secant wall is proposed to be installed at the location of a deep pumping station located at the south portion of the WWTP footprint, to support the open excavation and to minimize groundwater infiltration during construction.

The preliminary hydrogeological investigation was completed alongside a preliminary investigation report issued to the Region under a separate cover.

1.2 Project Objectives

The main objectives of this hydrogeological investigation are to:

- Characterize the geology and hydrogeology across the Site and within the Study Area;
- Establish groundwater elevations and hydraulic characteristics of the subsurface materials;
- Provide a preliminary assessment of the construction dewatering flow rates;
- Assess groundwater quality and compare the groundwater results to the Regional Municipality of Niagara Sewer Bylaw and the Ministry of Environment Conservation and Parks (MECP) Provincial Water Quality Objectives (PWQO), for evaluation of general water quality and potential discharge options;
- Identify permitting requirements to support the proposed construction dewatering;
- Assess potential impacts to groundwater quality and quantity related to construction and operation of the WWTP;

- Develop a preliminary construction monitoring and mitigation plan to address potential groundwater impacts during construction and operation of the WWTP; and
- Prepare a Hydrogeological Investigation Report, in accordance with the Ontario Water Resources Act, Ontario Regulation 378/04.

1.3 Scope of Work and Methodology

To achieve the investigation objectives, WSP followed the proposed scope of work outlined in the Region's Request for Tender for the project and carried out the following work, in coordination with WSP's geotechnical investigations:

- Review all existing geological and hydrogeological information provided by the Region and other sources for the 500-m buffer zone around the WWTP and associated sanitary trunk sewer;
- Coordinate drilling with the geotechnical team, for evaluation of hydrogeological conditions in the Study Area;
- Carry out a groundwater level monitoring program for all monitoring wells;
- Complete Single Well Response Tests (SWRTs) at each monitoring wells, for evaluation of hydraulic conductivity values of the strata around each monitoring well;
- Evaluate hydraulic conductivity for water-bearing zones, using grain size analysis results from the geotechnical study;
- Analyze groundwater quality from select monitoring wells for the Region of Niagara sanitary and combined sewer by-law, for evaluation of suitability of groundwater discharge into sewers during dewatering activities;
- Analyze groundwater quality from select monitoring wells for MECP PWQO parameters, for evaluation of general water quality and suitability of groundwater discharge into the natural environment;
- Analyze groundwater quality from select monitoring wells for hydrogen sulphide and methane concentrations, for evaluation of potential subsurface natural gas or hydrogen sulphide entry into excavations during construction;
- Estimate construction dewatering flow rates and zone of influence from dewatering activities; and
- Document findings of the desktop study and fieldwork in a hydrogeological report and provide recommendations on Permit to Take Water (PTTW) or

Environmental Activity and Sector Registry (EASR) requirements to support dewatering during construction.

2 Study Area Conditions

2.1 Physiography

According to Chapman and Putnam (2007), the Site and Study Area lies within the Haldimand Clay Plain physiographic region. The Haldimand Clay Plain consists of a strip of land 50 to 25 km wide between the glacial Lake Iroquois shoreline and the present shoreline of Lake Ontario. The surficial geological materials in this region, including glacial till, silt, clay, sand and gravel deposits, are the result of glacial activity, which occurred during the Late Wisconsinan Substage of the Pleistocene Epoch 23 000 to 10 000 years ago. Glaciolacustrine deposits of clay and silt were deposited in the deep water of proglacial lakes, which covered the area during ice retreats. In some parts of the Plain, localized areas of till are present at the surface. The regional deposits were formed by the inundation of glacial Lake Warren, which existed during the late Pleistocene.

In the vicinity of the proposed trunk sewers and WWTP, clay plains are present at ground surface. The mapped clay plains are consistent with the description of subsurface materials observed in boreholes advanced at the Site (see **Section 2.6.1**).

2.2 Topography and Drainage

The topography at the Site and within the Study Area is generally flat to undulating, sloping gently towards the south towards the Welland River, with approximate ground surface elevations varying from 180 m above sea level (masl) at the north limit of the Site to 175 masl to the south limit of the Site, based on mapping available through the Ministry of Natural Resources and Forestry website (March 2022a).

The Site consists of cultivated and uncultivated areas within the OPG and WWTP lands and asphalt paved roadways along Montrose Road, Brown Road and Reixinger Road. The land use at the Site and within the Study Area is primarily agricultural, with small areas of residential and industrial developments.

Welland River is the main watercourse within the Study Area, bisecting the middle portion of the Site (see **Figure 3**). The southern portion of the Site (south of Welland River) is located within the Grassy Brooks and Lyons Creek sub-watersheds, which are both located within the Lower Welland River and South Niagara Falls watershed (NPCA, 2012). Grassy Brook creek, which intersects Montrose Road south of Grassy Brook Road, flows from the west of Montrose Road easterly and northerly, draining to Welland River. A tributary of Lyons Creek is located west and south of the intersection

of Montrose Road and Reixinger Road and drains easterly towards Lyons creek (see **Figure 3**).

A Provincial Significant Wetland 'Grassy Brook' is present along the Grassy Book creek, west of the Site (MNRF, March 2022b).

2.3 Source Water Protection

The Source Protection Plan (SPP) for the Niagara Peninsula Source Protection Area (SPA) contains policies that apply to vulnerable areas. The Niagara Peninsula Watershed is under the jurisdiction of the Niagara Peninsula Conservation Authority (NPCA). The study boundaries were evaluated to identify any potential drinking water vulnerabilities and threats, including the proximity to any vulnerable areas, including the following:

- Wellhead Protection Areas (WHPA);
- Intake Protection Zones (IPZ);
- Highly Vulnerable Aquifers (HVA);
- Significant Groundwater Recharge Areas (SGRA); and
- Wellhead Protection Area-Q (WHPS-Q, Water Quantity)

The MECP Source Protection Information Atlas indicates that the Site does not fall within vulnerable areas (MECP, 2022a), as highlighted in **Table 2-1.**

TABLE 2-1 - Summary of Vulnerable Areas

Source Protection Area:	Niagara Peninsula
Wellhead Protection Area (WHPA):	No
Wellhead Protection Area Q1 (WHPA-Q1):	No
Wellhead Protection Area Q2 (WHPA-Q2):	No
Wellhead Protection Area E (GUDI):	No
Intake Protection Zone (IPZ):	No
Intake Protection Zone Q (IPZ-Q):	No
Issue Contributing Area:	No
Significant Groundwater Recharge Area (SGRA):	No

Highly Vulnerable Aquifer (HVA):	Yes, score of 6 – several areas within the Study Area (south of Brown Road and west of Montrose Road, south of Grassy Brook Road between Montrose Road and QEW)
Event Based Area:	No

As indicated in **Table 2-1**, there are several areas within the Study Area that are within HVA. Areas designated as HVA were mapped using the Intrinsic Susceptibility Index (or assessment of vulnerability), which uses existing information from the Water Well Information System (WWIS) database and the aquifer vulnerability index. Factors such as transport pathways were also considered in determining the groundwater vulnerability (NPCA, December 2013). Best management practices are recommended to be implemented during construction to minimize any negative impacts to the existing groundwater conditions at the Site.

2.4 Regional Geology

Available geological mapping and MECP water well records (WWRs) were reviewed to evaluate the soils present at the Site and within the Study Area. The soils at the Site and within the majority of the Study Area consist of fine-textured glaciolacustrine deposits, described as silt and clay, with minor inclusions of sand and gravel. Along the central portion of the Study Area, modern alluvial deposits of sand and gravel with inclusions of clay and silt, potentially containing organic remains, are present within the Welland River channel. Man-made deposits are observed along the northeastern portion of the Study Area, and generally consists of fill (OGS, 1990). A surficial geology map of the Site and the surrounding area is presented on **Figure 2**. A map showing available WWRs within the Study Area is presented on **Figure 1** and are provided in **Appendix A**.

Based on the WWR review, clay deposits extend to depths ranging between 0.3 and 32 metres below ground surface (mbgs) in the Study Area. The water well records describe the presence of a sand and gravel layer underlying the clay deposits in select areas, varying at depths ranging between 15 and 34 mbgs (MECP, 2022b).

Bedrock in the Study Area corresponds to sandstone, shale, dolostone and siltstone of the Guelph Formation along the north limit of Site and limestone, dolostone, shale, sandstone, gypsum and salt of the Salina Formation for the remainder of the Study Area (OGS, 1991).

2.5 Regional Hydrogeology

The movement of groundwater through the subsurface is controlled by the hydraulic gradients and the relative distribution of coarse and fine-grained sediments. In general, water will move laterally through coarse-grained sediments (sands and gravels) and vertically through fine-grained sediments (silts and clays). As such, the geologic units are typically grouped into hydrostratigraphic units that reflect the capacity of the geologic units to transmit water. Hydrostratigraphic units are considered to be either aquifers (with good capacity to transmit water) or aquitards (which typically impede transmission of water). Ultimately, the distribution and interconnection of aquifers and aquitards are responsible for observed groundwater movement in the Study Area.

Generally, the glaciolacustrine silt / clay units and till units behave as aquitards. Local coarser-grained layers within these units may provide local sources of groundwater.

The Amabel, Lockport and Guelph Formations constitute a high-capacity aquifer in the Niagara Region and in the area between Hamilton and Owen Sound. The permeability of this aquifer is highly variable due to a fracturing and chemical dissolution of the upper few meters of dolomites. The potential for developing high-capacity wells in the aquifer is good (Singer et. al., 2003).

The Salina Formation is described as a high-capacity, water-supply source north of Kitchener-Waterloo. Substantial fracturing was encountered within this unit indicative of the high permeability of the Salina Formation (Singer et.al., 2003). However, due to the presence of sulphur containing materials, water quality in this aquifer is poor.

2.6 Site-Specific Geology

In December 2020, boreholes were advanced at the Site by WSP to depths set by the Region in the Request for Tender (Niagara Region, October 2020). The geotechnical report was reviewed to assist with the evaluation of onsite specific geological conditions.

The drilling program was completed to provide geotechnical and hydrogeological information at the WWTP site and along the proposed trunk sewer alignment and included the completion of seventeen (17) boreholes BH20-01 through BH20-12S/D and BH-P01 to BH-P03 drilled to depths ranging between 4.6 and 39.6 mbgs. Monitoring wells were installed in thirteen of the borehole locations. The borehole and monitoring well locations are shown on **Figure 3**, and the borehole logs are provided in **Appendix B**.

Prior to drilling operations, all underground utilities were cleared at the borehole locations by the representatives of the public and private utilities locate companies.

Boreholes were advanced with the hollow stem auger equipment by a drilling sub-contractor under the direction and supervision of WSP personnel. Soil samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler. The samples were logged in the field and returned to the WSP laboratory for detailed examination by the project engineer and for laboratory testing. Monitoring wells, 50 mm in diameter, were installed in thirteen borehole locations BH20-01, BH20-03, BH20-06S/D, BH20-07S/D, BH20-08, BH20-10, BH20-11, BH20-12S/D, BH-P01 and BH-P03. The wells were constructed by inserting 10-slot PVC screen and casing assembly into the borehole to the designed depth and then installing a silica sand pack filter around the screened interval. Above the sand pack, a bentonite plugging material was installed to eliminate potential contamination from surface along the annular space. The monitoring wells were completed with flushmount and monument protective casings. The surface elevations at each monitoring well were established by land survey and referenced to the geodetic datum. **Table 2-2** includes a summary of all boreholes advanced during the field investigation, including well construction details.

Table 2-2 - Summary of Boreholes and Monitoring Wells

BH / MW WELL ID	LOCATION	GROUND SURFACE (M ASL)	TOTAL DEPTH (M)	TOP OF SCREEN (M ASL)	BOTTOM OF SCREEN (M ASL)	LITHOLOGY SCREENED
BH20-01	High Lift SPS	180.46	16.8	165.18	163.66	Bedrock (Salina Formation)
BH20-02	Montrose Road	181.20	16.8	NA	NA	NA
BH20-03	Brown Road	178.10	20.1	161.05	158.00	Bedrock (Salina Formation)
BH20-04	Montrose Road	178.90	19.9	NA	NA	NA
BH20-05	Montrose Road	177.80	25.0	NA	NA	NA
BH20-06D	Montrose Road	175.86	30.5	148.41	145.36	Bedrock (Salina Formation)
BH20-06S	Montrose Road	175.78	15.2	163.58	160.58	Silty Clay, trace sand

BH / MW WELL ID	LOCATION	GROUND SURFACE (M ASL)	TOTAL DEPTH (M)	TOP OF SCREEN (M ASL)	BOTTOM OF SCREEN (M ASL)	LITHOLOGY SCREENED
BH20-07D	Montrose Road	177.10	30.7	149.63	146.58	Bedrock (Salina Formation)
BH20-07S	Montrose Road	177.01	19.8	160.26	157.21	Silt, trace to some clay
BH20-08	Reixinger Road	176.90	39.6	140.33	137.28	Bedrock (Salina Formation)
BH20-09	Montrose Road	176.00	29.3	NA	NA	NA
BH20-10	Future WWTP	176.79	9.8	170.04	166.99	Silty Clay, trace sand
BH20-11	Future WWTP	176.51	9.8	169.76	166.71	Silty Clay, trace sand
BH20-12D	Future WWTP	174.94	9.8	168.19	165.14	Silty Clay, trace sand
BH20-12S	Future WWTP	174.95	4.6	173.40	170.35	Silty Clay, trace sand
BH-P01	Montrose Road	180.49	7.6	175.94	172.89	Silty Clay, trace sand
BH-P03	Brown Road	178.16	5.2	176.01	172.96	Silty Clay, trace sand

NA: Not Applicable (i.e., monitoring well was not installed); SPS = Sewage Pumping Station

2.6.1 Site-Specific Soil Conditions

PAVEMENT/TOPSOIL/FILL MATERIAL

Topsoil was encountered in boreholes BH20-10, BH20-11 and BH20-12 S/D and ranged in thickness between 150 mm to 230 mm at the ground surface. These

boreholes were drilled within the proposed WWTP site, which is currently cultivated agricultural land (See **Figure 3**).

During advancement of boreholes BH20-02, BH20-03, BH20-05, BH20-06 S/D and BH20-09, 100 mm to 150 mm thick asphalt at the surface was encountered. Approximately 50 mm and 700 mm granular base material were encountered in boreholes BH20-05 and BH20-09, respectively. Below the asphalt, a 6.4 m thick crushed limestone was encountered in BH20-02; a 1.3 m thick granular fill was encountered in BH20-03, 50 mm granular fill and 0.9 m crusher run limestone were encountered in BH20-05, 1.7 m thick crushed run limestone was encountered in BH20-06D and 0.7 m thick granular fill was encountered in BH20-09. A 0.8 m thick crushed run limestone was also encountered within the silty clay fill in BH20-06D. A 0.1 to 0.8 m thick crushed run limestone was encountered at ground surface in BH20-04 and BH20-07D.

Silty clay fill was encountered in some boreholes to depths varying from 1.1 to 5.7 mbgs. Trace to some inclusions of organics were noted in the fill material.

One (1) selected silty clay fill samples (BH20-3/SS6) was subjected to grain size analysis and the gradation curve presented the following fractions:

Gravel: 0 %

Sand: 1 %

Silt and clay: 99 %

The soil is classified as silt clay to clay according to the Unified Soil Classification System. Results of the grain size analysis is included in **Appendix C**.

SILTY CLAY

A deposit of silty clay was encountered in all boreholes at depths ranging in thickness varying between 1.1 to 6.6 mbgs and extended to depths of 4.6 to 23.2 mbgs. The cohesive deposit was found to be in a very soft to hard consistency with measured SPT ‘N’ value of nil blows to 30 blows per 300 mm of penetration. The water content obtained from the samples revealed from this deposit were 6 to 40%. A layer of organic clay was embedded within the silty clay deposit in borehole BH20-06 at depths of 7.2 to 9.3 mbgs, with measured SPT ‘N’ value of nil to 4 blows per 300 mm of penetration and natural moisture content of 102 to 117%.

A layer of silt was interbedded within the silty clay deposit in borehole BH20-03, BH20-08 and BH20-09 at starting depths of 4.7 to 13.3 mbgs and extending to depths of 5.3 to 15.2 mbgs. The silt deposit was found to be in loose to compact state of compactness with measured SPT ‘N’ value of 8 to 24 blows per 300 mm penetration. The natural moisture content obtained from the sample reveled from silt layer was 24 to 27%.

Seventeen (17) selected silty clay samples were subjected to grain size analysis. Based on the results of the analysis, the soil is classified as low to high plasticity silty clay or clay (CL or CH) according to the Unified Soil Classification System.

CLAYEY SILT TILL

A deposit of clayey silt till deposit was encountered below the silty clay layer in borehole BH20-01 and below silt layer in boreholes BH20-02 and BH20-07 at depths of 10.2 to 24.7 mbgs. The clayey silt till deposit extended to the borehole depths of 11.7 to 26.4 mbgs. Boulders/cobbles within the till deposit were also encountered during the borehole drilling.

A selected clayey silt till sample (BH20-01/SS12) was subjected to grain size analyses and the gradation curve presented the following fractions:

Gravel: 11%

Sand: 32%

Silt: 45%

clay: 12%

SANDY GRAVEL/SAND/SILT AND SAND/SILT

Below the silty clay layer or below clayey silt till deposit in all boreholes, a deposit of cohesionless soils comprised of silt, silt and sand & sandy gravel was encountered at depths of 11.7 to 23.2 mbgs and extended to depths of 14.3 to 27.4 mbgs. The cohesionless deposit was found in very loose to very dense state of compactness with measured SPT 'N' value of 2 to over 50 blows per 300 mm penetration. Water contents ranged from 9% to 27%.

In the vicinity of the Welland River, the sandy gravel and coarse sand deposits were encountered at borehole BH20-6 S/D below the clayey silt deposits, at depths between 17.8 and 27.4 mbgs, and may be associated with the Welland River deposits.

Three (3) selected silt to silty sand samples (BH20-01/SS13, BH20-03/SS17 and BH20-04/SS15) were subjected to grain size analyses and the gradation curve presented the following fractions:

Gravel: 3 to 26%

Sand: 5 to 40%

Silt and clay: 34 to 92%

CLAYEY SILT (RESIDUAL SOIL)

Localized clayey silt (residual soil) clay deposit was encountered at a depth of 19.9 – 20.9 mbgs in borehole BH20-09. The clayey silt matrix containing extensive broken

bedrock slabs and fragments. This stratum was difficult to auger due to the fragmented dolostone content and given its hard condition. The natural moisture content measured in the test sample from these materials was 13%.

This complex is a transitional deposit between bedrock and the overlying soil or may be the completely to highly weathered bedrock. This deposit has characteristics of both the bedrock and soil. The rock slabs found within the soil matrix can be quite large in size (0.5 m to 1 m or more).

BEDROCK

Dolostone of Salina Formation was cored and inferred due to auger/spoon refusal in boreholes BH20-01, BH20-03, BH20-04, BH20-05, BH20-06D, BH20-07D, BH20-08 and BH20-09 at depths ranging from 14.3 to 29.3 mbgs, corresponding to elevation 147.6 to 166.1 masl, as listed in Table 3.1. Bedrock was proven by bedrock coring in these boreholes. Rock core logs are provided on borehole logs appended in **Appendix B**. The rock cores mainly consist of dolostone.

3 Hydrogeological Assessment

3.1 MECP Water Well Records Review

The search of the MECP WWRs database was completed for the Study Area. The locations of the water well records are shown on **Figure 1**; the water well records are included in **Appendix A**.

Based on a review of the MECP WWRs database, there are 37 records within the Study Area. The 37 WWRs were reported to be used for the following purposes: 20 water supply wells (14 domestic, 2 livestock, 2 commercial and 2 public), 14 observation wells/test holes, 1 abandoned well and 2 unknown wells (MECP, 2022b). The records show that water supply wells were installed between 1948 and 1972 with one water supply well advanced in 2002.

Twelve of the domestic wells are located within the northern portion of the Study Area, north of the Welland River, with the remaining two domestic wells are present in the southern portion of the Study Area (see **Figure 1**). The WWRs for the domestic wells indicated that the majority of the wells were installed with 152 mm to 178 mm nominal diameter steel casing from the ground surface to depths ranging between 15 mbgs and 25 mbgs. All of the domestic wells were reported to be bedrock wells, with the exception of WWR 6604672 located southeast of the Site, which was reported to be an overburden well with a steel casing installed from the ground surface to a depth of 32 mbgs. Static water levels at these locations were reported between 3.7 and 7.3 mbgs, corresponding to elevations between 165.1 and 173.8 masl.

The livestock, commercial and public wells were all installed in bedrock southeast of Montrose Road and Chippawa Creek Road, except for WWR 6601397 (livestock well) which was installed within the overburden. Steel casings with nominal diameter of 127 mm to 152 mm were installed in all of the bedrock wells from the ground surface to depths ranging between 11 mbgs and 28 mbgs. A steel casing was installed in the overburden well from ground surface to a depth of 22 mbgs. Static water levels at these locations were reported to range between 3.7 and 9.1 mbgs, corresponding to elevations between 103.5 and 171.2 masl.

The records show consistency in the materials found through the depth of the well, mainly consisting of clay deposits, underlain by sand and gravel seams and bedrock. This is consistent with the regional geology understanding, with silt and clay glaciolacustrine deposits with minor inclusions of sand and gravel.

3.2 Groundwater Conditions

Manual groundwater levels were measured by WSP in the newly installed monitoring wells on December 18 and 23, 2020 and January 13 and 28, 2021. Depth to groundwater ranges from 2.28 and 9.92 mbgs in on-site wells, corresponding to elevations varying between 168.96 and 178.24 masl. A summary of all groundwater elevations at the Site is included in **Table 3-1.**

Table 3-1 - Groundwater Levels In WSP 2021 Monitoring Wells At The Site

	DECEMBER 18, 2020		DECEMBER 23, 2020		JANUARY 13, 2021		JANUARY 28, 2021	
WELL ID	GW LEVEL (M BGS)	GW ELEV. (M ASL)	GW LEVEL (M BGS)	GW ELEV. (M ASL)	GW LEVEL (M BGS)	GW ELEV. (M ASL)	GW LEVEL (M BGS)	GW ELEV. (M ASL)
BH20-01	10.96	169.50	10.81	169.65	-	-	-	-
BH20-03	-	-	-	-	3.50	174.60	-	-
BH20-06D	-	-	-	-	3.51	172.35	-	-
BH20-06S	-	-	-	-	3.94	171.86	-	-
BH20-07D	-	-	-	-	5.33	171.77	-	-
BH20-07S	-	-	-	-	4.56	172.45	-	-
BH20-08	-	-	7.64	169.26	5.75	171.15	5.85	171.05

WELL ID	DECEMBER 18, 2020		DECEMBER 23, 2020		JANUARY 13, 2021		JANUARY 28, 2021	
	GW LEVEL (M BGS)	GW ELEV. (M ASL)	GW LEVEL (M BGS)	GW ELEV. (M ASL)	GW LEVEL (M BGS)	GW ELEV. (M ASL)	GW LEVEL (M BGS)	GW ELEV. (M ASL)
BH20-10	7.30	169.49	6.37	170.42	-	-	-	-
BH20-11	8.21	168.30	7.75	168.76	-	-	-	-
BH20-12D	7.01	167.93	6.88	168.06	-	-	-	-
BH20-12S	5.09	169.86	4.76	170.19	-	-	-	-
BH-P01	3.46	177.03	2.28	178.21	-	-	-	-
BH-P03	-	-	-	-	3.30	174.86	-	-

Based on the local topography and groundwater elevations measured in shallow wells, shallow groundwater direction is inferred to flow towards Welland River.

3.3 Hydraulic Conductivity Testing

Saturated hydraulic conductivity (K) of the overburden was estimated at the Site using two methods. Single Well Response Tests (SWRT) were conducted by WSP staff at four monitoring wells; grain size distribution plots were also analyzed to estimate the hydraulic conductivity based on the Hazen's empirical relationship. The grain size distribution charts are presented in **Appendix C.**

Grain size distribution plots for various locations (outlined in **Table 3-2**) were analyzed based on the Hazen's estimation, which is an empirical relationship where:

$$K = C \times d_{10}^2$$

Where:

C = constant, average value of 1.0, when D is in mm and K is in cm/s;

d_{10} = diameter of the 10th percentile grain size (mm).

In advance of performing SWRT, the monitoring wells were developed to remove the potential presence of fine sediments. The development process involved purging of the monitoring wells to induce the flow of fresh formation water through the screen. The monitoring well water level was permitted to fully recover prior to performing SWRTs.

During the SWRTs, a slug of water was instantaneously removed from the well and the response to the water level was recorded using a datalogger. The hydraulic conductivity values for each of the tested wells were calculated from the SWRT data using Aquifertest Software and the Hvorslev solution (Fetter, 2001). The semi-log plots for normalized drawdown versus time are included in **Appendix D**. It should be noted that SWRTs were attempted at monitoring well BH20-03, however due to the instantaneous response in the monitoring well, the hydraulic conductivity at this location could not be estimated through theattempted in-situ testing.

The summary of hydraulic conductivity (K) values from the SWRTs at BH20-01, BH20-06S, BH20-06D, BH20-07S, BH20-07D, BH20-08, BH20-10, BH20-11 and BH20-12D are provided in **Table 3-2.**

Table 3-2 - Single Well Response Test Results

WELL ID	STRATIGRAPHIC UNIT TESTED	SWRT(M/SEC)
BH20-01	Bedrock (Salina Formation)	1.19E-05
BH20-03	Bedrock (Salina Formation)	K Greater than E-05
BH20-06D	Bedrock (Salina Formation)	9.97E-07
BH20-06S	Silty Clay, trace sand	4.92E-06
BH20-07D	Bedrock (Salina Formation)	3.38E-07
BH20-07S	Silt, trace to some clay	8.25E-07

WELL ID	STRATIGRAPHIC UNIT TESTED	SWRT(M/SEC)
BH20-08	Bedrock (Salina Formation)	1.42E-08
BH20-10	Silty Clay, trace sand	5.06E-09
BH20-11	Silty Clay, trace sand	5.59E-09
BH20-12D	Silty Clay, trace sand	5.23E-09
BH20-12S	Silty Clay, trace sand	NA

Note: NA = Not Analyzed

As can be seen from **Table 3-3**, the estimated hydraulic conductivity for the shallow wells screened in silty clay ranges between 5.1 X 10^{-9} and 4.9 X 10^{-6} m/s; the estimated hydraulic conductivity for the deep wells screened in the bedrock ranges between 1.4 X 10^{-8} m/s and 1.2 X 10^{-5} m/s. There are expected ranges given the geology.

A summary of estimated K values from grain size distribution charts are provided in **Table 3-3.**

Table 3-3 - Grain Size Distribution Results

Well ID	Sample Depth (m BGS)	Sample Elevation (m AMSL)	Sample Description	Effective Grain Size (D10) [mm]	Hazen (K) [m/s]
Subproject 1 - Trunk Sewer					
BH20-01-SS9	6.9-7.5	173.1-173.5	Silty Clay, trace sand	**0.001**	**<1.00E-08**
BH20-01-SS12	10.7-11.3	169.2-169.8	Clayey Silt Till, sandy	0.0013	1.69E-08
BH20-01-SS13	12.2-12.5	168.0-168.3	Silty Sand, gravelly, trace clay	0.0041	1.68E-07
BH20-02-SS11	13.7-14.3	166.9-167.5	Silty Clay, trace sand	**0.001**	**<1.00E-08**
BH20-03-SS15	10.7-11.3	166.8-167.4	Silty Clay, trace sand, occasional gravel	**0.001**	**<1.00E-08**

BH20-04-SS12	10.7-11.3	167.7-168.2	Silty Clay, trace sand	**0.001**	**<1.00E-08**
BH20-04-SS15	15.2-15.9	162.3-163.0	Silt, some sand, trace gravel and trace clay	0.0032	1.02E-07
BH20-05-SS14	13.7-14.0	163.8-164.1	Silty Clay, trace sand	**0.001**	**<1.00E-08**
BH20-07-SS18	18.3-19.0	158.2-158.8	Silt, trace to some clay, trace sand	0.0127	1.61E-06
BH20-09-SS17	18.2-18.9	157.1-157.7	Silty Clay, trace sand and trace gravel	**0.001**	**<1.00E-08**
Subproject 2 - Wastewater Treatment Plant Site					
BH20-08-SS18	19.8-20.4	156.5-157.1	Silty Clay, trace sand	**0.001**	**<1.00E-08**
BH20-10-SS11	9.1-9.8	167.0-167.6	Silty Clay, trace sand	**0.001**	**<1.00E-08**
BH20-11-SS11	9.1-9.8	166.7-167.6	Silty Clay, trace sand	**0.001**	**<1.00E-08**
BH20-12-SS11	9.1-9.8	165.1-165.8	Silty Clay, trace sand	**0.001**	**<1.00E-08**

Note: values shown in bold indicate D10 was not reached and value is outside the recommended range of 0.1 to 3 mm

Estimated K values for silty clay to silt (<1.0 x 10^{-8} m/s to 1.6 x 10^{-6} m/s) shown in **Table 3-3** are comparable to K values estimated during SWRT in wells screened in silty clay to silt (see **Table 3-2**).

3.4 Groundwater Quality

To assess the groundwater quality for discharge options to the natural environment and nearby sewers, unfiltered groundwater samples were collected from monitoring wells BH20-3, BH20-7S, BH20-7D, BH20-8 and BH20-12D on January 13 and 21, and February 2, 2021 for analysis of general chemistry and metals and comparison against the PWQO and the Niagara Sewer Use By-Law, to evaluate suitable groundwater discharge options during dewatering activities for construction at the Site. Additional unfiltered groundwater samples were collected from wells BH20-1, BH20-3, BH20-7D and BH20-8 for analysis of concentrations of hydrogen sulphide and dissolved methane to evaluate if these parameters need to be managed during construction activities.

Prior to collection of the samples, approximately three (3) well volumes of standing groundwater were purged from the wells. The samples were placed into pre-cleaned laboratory-supplied vials and/or bottles provided with analytical test group specific preservatives, as required. Dedicated nitrile gloves were used during sample handling.

The groundwater samples were submitted to an independent laboratory, ALS Canada Ltd. (ALS), in London, Ontario. ALS is a certified laboratory by the Canadian Association for Laboratory Accreditation (CALA) Inc.

A summary of the analytical results is provided in **Table 3-4,** and the laboratory Certificates of Analysis (CofA) are enclosed in **Appendix E.**

Table 3-4 - Groundwater Sampling Results

Parameters	UNIT	Niagara Sewer Use By-Law	PWQO (1) (Hardness > 100ppm)	RDL	BH20-3	BH20-7D	BH20-3	BH20-7S	BH20-1	BH20-12D	BH20-8
Laboratory Report Number					L2548351	L2548351	L2550950	L2550950	L2550950	L2550950	L2554453
Sample Date					13-Jan-21	13-Jan-21	21-Jan-21	21-Jan-21	21-Jan-21	21-Jan-21	02-Feb-21
Physical Tests											
Conductivity	umho/cm	NV	NV	3.0000	NA	NA	5930	2360	NA	676	12400
Hardness (as CaCO3)	mg/L	NV	NV	1.3	NA	NA	1150	799	NA	192	1760
Langelier Index Temperature	C	NV	NV	-50	NA	NA	20	20	NA	20	20
pH	pH units	6.0-11.0	6.5 - 8.5	0.1	NA	NA	8.24	7.95	NA	8.27	8.09
Total Suspended Solids	mg/L	350	NV	3	NA	NA	1450	154	NA	19.6	<6.0
Total Dissolved Solids	mg/L	NV	NV	20.000	NA	NA	3490	1670	NA	409	3710
Anions and Nutrients											
Alkalinity, Bicarbonate (as CaCO3)	mg/L	NV	NV	2.0000	NA	NA	276	77.7	NA	177	214
Alkalinity, Carbonate (as CaCO3)	mg/L	NV	NV	2.0000	NA	NA	<2.0	<2.0	NA	<2.0	<2.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	NV	NV	2.0000	NA	NA	<2.0	<2.0	NA	<2.0	<2.0
Alkalinity (Total as CaCO3)	mg/L	NV	NV	2.0000	NA	NA	276	77.7	NA	177	214
Ammonia, Total (as N)	mg/L	NV	NV	0.0100	NA	NA	0.087	0.512	NA	0.147	4.83
Chloride (Cl)	mg/L	NV	NV	0.5000	NA	NA	1750	291	NA	21.4	4460
Computed Conductivity	uS/cm	NV	NV	NV	NA	NA	5320	2380	NA	667	9430
Conductivity % Difference	%	NV	NV	NV	NA	NA	-11	1	NA	-1	-27
Fluoride (F)	mg/L	10	NV	0.02	NA	NA	0.98	0.67	NA	0.435	0.74
Hardness (as CaCO3)	mg/L	NV	NV	NV	NA	NA	1150	799	NA	192	1760
Ion Balance	%	NV	NV	NV	NA	NA	117	98	NA	113	35
Langelier Index	-	NV	NV	-10	NA	NA	1	0	NA	1	1
Nitrate and Nitrite as N	mg/L	NV	NV	0.0220	NA	NA	<0.22	<0.11	NA	<0.022	<0.45
Nitrate (as N)	mg/L	NV	NV	0.0200	NA	NA	<0.20	<0.10	NA	<0.020	<0.40
Nitrite (as N)	mg/L	NV	NV	0.0100	NA	NA	<0.10	<0.050	NA	<0.010	<0.20
Total Kjeldahl Nitrogen	mg/L	100	NV	0.05	NA	NA	1.04	0.87	NA	0.41	9
Saturation pH	pH	NV	NV	NV	NA	NA	6.87	7.55	NA	7.67	6.8
Orthophosphate (P)	mg/L	NV	NV	0.0030	NA	NA	<0.0030	<0.0030	NA	0.006	0.0125
Phosphorus, Total	mg/L	10	0.010	0.003	NA	NA	0.405	0.0867	NA	0.0523	0.48
TDS (Calculated)	mg/L	NV	NV	NV	NA	NA	3850	1640	NA	418	7760
Sulfate (SO4)	mg/L	1500	NV	0.3	NA	NA	403	817	NA	145	1980
Sulphide (as S)	mg/L	NV	NV	0.0180	0.022	24	0.027	0.021	<0.018	0.019	194
Sulphide (as H2S)	mg/L	1	0.002	0.0190	0.023	25.5 25.5	NA	NA	<0.019	NA	206 206
Anion Sum	me/L	NV	NV	NV	0.023	25.5	62.4	26.5	NA	6.61	171
Cation Sum	me/L	NV	NV	NV	0.023	25.5	72.9	26	NA	7.48	59.7
Cation - Anion Balance	%	NV	NV	NV	0.023	25.5	8	-1	NA	6	-48

Parameters	UNIT	Niagara Sewer Use By-Law	PWQO (1) (Hardness > 100ppm)	RDL	BH20-3	BH20-7D	BH20-3	BH20-7S	BH20-1	BH20-12D	BH20-8
Laboratory Report Number					L2548351	L2548351	L2550950	L2550950	L2550950	L2550950	L2554453
Sample Date					13-Jan-21	13-Jan-21	21-Jan-21	21-Jan-21	21-Jan-21	21-Jan-21	02-Feb-21
Cyanides											
Cyanide, Total	mg/L	1	0.005	0.0020	NA	NA	<0.0020	<0.0020	NA	<0.0020	<0.020
Organic / Inorganic Carbon (Water)											
Total Organic Carbon (TOC)	mg/L	NV	NV	0.5000	NA	NA	45.9	48	NA	4.98	24.1
Total Metals											
Aluminum (Al)-Total	mg/L	NV	0.075	0.005	NA	NA	11.8	1.61	NA	0.499	0.13
Antimony (Sb)-Total	mg/L	5	0.02	0.0001	NA	NA	0.0034	0.0084	NA	0.00103	<0.0010
Arsenic (As)-Total	mg/L	1	0.005	0.0001	NA	NA	0.0067	0.0029	NA	0.00182	0.0164
Barium (Ba)-Total	mg/L	NV	NV	0.0001	NA	NA	0.245	0.0435	NA	0.0535	0.106
Beryllium (Be)-Total	mg/L	NV	1.1	0.0001	NA	NA	<0.0010	<0.0010	NA	<0.00010	<0.0010
Boron (B)-Total	mg/L	NV	0.2	0.01	NA	NA	0.14	0.36	NA	0.356	0.83
Cadmium (Cd)-Total	mg/L	0.7	0.0001	0.00002	NA	NA	0.000392	<0.00010	NA	<0.000020	<0.000050
Calcium (Ca)-Total	mg/L	NV	NV	0.5	NA	NA	263	152	NA	34.6	488
Chromium (Cr)-Total	mg/L	3	NV	0.0005	NA	NA	0.0265	<0.0050	NA	0.0011	<0.0050
Cobalt (Co)-Total	mg/L	5	0.0009	0.0001	NA	NA	0.0079	0.0016	NA	0.00035	<0.0009
Copper (Cu)-Total	mg/L	3	0.005	0.001	NA	NA	0.0277	<0.0050	NA	0.0025	<0.0050
Iron (Fe)-Total	mg/L	NV	0.3	0.01	NA	NA	23.6	4.52	NA	0.594	0.37
Lead (Pb)-Total	mg/L	1	0.005	0.00005	NA	NA	0.0251	0.00685	NA	0.000597	<0.00050
Magnesium (Mg)-Total	mg/L	NV	NV	0.05	NA	NA	119	102	NA	25.7	131
Manganese (Mn)-Total	mg/L	NV	NV	0.0005	NA	NA	0.752	0.183	NA	0.0425	0.535
Mercury (Hg)-Total	mg/L	0.01	0.0002	0.00001	NA	NA	0.0000183	<0.0000050	NA	<0.0000050	<0.0010
Molybdenum (Mo)-Total	mg/L	5	0.04	0.0001	NA	NA	0.0181	0.0558	NA	0.0253	0.00804
Nickel (Ni)-Total	mg/L	2	0.025	0.0005	NA	NA	0.0192	0.0057	NA	0.00083	<0.0050
Potassium (K)-Total	mg/L	NV	NV	0.050	NA	NA	5.56	5.51	NA	2.58	13.8
Selenium (Se)-Total	mg/L	1	0.1	0.000	NA	NA	<0.00050	<0.00050	NA	0.00056	0.0118
Silver (Ag)-Total	mg/L	5	0.0001	0.00005	NA	NA	<0.00050	<0.00050	NA	<0.000050	<0.00010
Sodium (Na)-Total	mg/L	NV	NV	0.05	NA	NA	1150	227	NA	82.1	558
Strontium (Sr)-Total	mg/L	NV	NV	0.001	NA	NA	1.75	4.28	NA	0.901	19.3
Thallium (Tl)-Total	mg/L	NV	0.0003	0.00001	NA	NA	0.00012	<0.00010	NA	0.000026	<0.00010
Tin (Sn)-Total	mg/L	5	NV	0.0001	NA	NA	0.006	0.0049	NA	0.00262	0.006
Titanium (Ti)-Total	mg/L	NV	NV	0.0003	NA	NA	0.259	0.0368	NA	0.00867	<0.0030
Tungsten (W)-Total	mg/L	NV	0.03	0.0001	NA	NA	0.0059	0.0114	NA	<0.00010	0.0102
Uranium (U)-Total	mg/L	NV	0.005	0.00001	NA	NA	0.00427	0.00112	NA	0.00367	0.00204
Vanadium (V)-Total	mg/L	NV	0.006	0.0005	NA	NA	0.024	<0.0050	NA	0.00271	<0.0050
Zinc (Zn)-Total	mg/L	3	0.02	0.003	NA	NA	0.898	0.049	NA	0.0865	0.035

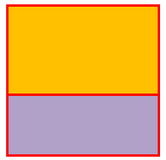
Parameters	UNIT	Niagara Sewer Use By-Law	PWQO (1) (Hardness > 100ppm)	RDL	BH20-3	BH20-7D	BH20-3	BH20-7S	BH20-1	BH20-12D	BH20-8
Laboratory Report Number					L2548351	L2548351	L2550950	L2550950	L2550950	L2550950	L2554453
Sample Date					13-Jan-21	13-Jan-21	21-Jan-21	21-Jan-21	21-Jan-21	21-Jan-21	02-Feb-21
Zirconium (Zr)-Total	mg/L	NV	0.004	0.0003	NA	NA	0.0029	<0.0020	NA	0.00038	<0.0020
Dissolved Metals											
Mercury (Hg)-Dissolved	mg/L	NV	0.0002	0.000005	NA	NA	<0.0000050	<0.0000050		<0.0000050	<0.00050
Aggregate Organics (Water)											
BOD	mg/L	300	NV	3	NA	NA	13	107	NA	<3.0	150
Oil and Grease, Total	mg/L	NV	NV	5.00	NA	NA	7.3	<5.0	NA	<5.0	<5.0
Animal/Veg Oil & Grease	mg/L	150	NV	1.10	NA	NA	4.1	<5.0	NA	<5.0	<5.0
Mineral Oil and Grease	mg/L	15	NV	2.50	NA	NA	3.2	<2.5	NA	<2.5	<2.5
Phenols (4AAP)	mg/L	1.0	0.001	0.001	NA	NA	0.0043	0.0204	NA	0.0011	0.175
Volatile Organic Compounds (Water)											
Benzene	ug/L	10.00	100	0.5	NA	NA	<0.50	<0.50	NA	<0.50	0.53
Chloroform	ug/L	40	NV	1	NA	NA	<1.0	<1.0	NA	<1.0	<1.0
1,2-Dichlorobenzene	ug/L	50	2.5	0.5	NA	NA	<0.50	<0.50	NA	<0.50	<0.50
1,4-Dichlorobenzene	ug/L	80	4.0	0.5	NA	NA	<0.50	<0.50	NA	<0.50	<0.50
Dichloromethane	ug/L	210	100	2	NA	NA	<2.0	<2.0	NA	<2.0	<2.0
Ethylbenzene	ug/L	160	8.0	0.5	NA	NA	<0.50	<0.50	NA	<0.50	0.51
Methane, Dissolved	ug/L	NV	NV	5	106	502	NA	NA	268	NA	22700
1,1,2,2-Tetrachloroethane	ug/L	40	70	1	NA	NA	<0.50	<0.50	NA	<0.50	<0.50
Tetrachloroethylene	ug/L	50	50	0.5	NA	NA	<0.50	<0.50	NA	<0.50	<0.50
Toluene	ug/L	200	0.8	0.5	NA	NA	1.35	<0.50	NA	<0.50	1.74
Trichloroethylene	ug/L	50	20	1	NA	NA	<0.50	<0.50	NA	<0.50	<0.50
o-Xylene	ug/L	520	40.0	0.5	NA	NA	<0.50	<0.50	NA	<0.50	<0.50
4-Bromofluorobenzene	%	NV	NV	NV	NA	NA	95.7	87.8	NA	88.1	97.5
1,4-Difluorobenzene	%	NV	NV	NV	NA	NA	99.3	98.6	NA	98.7	100.8

NOTES

1) The Regional Municipality of Niagara, Sewer Use By-Law No 27-2014 Table 1 - Limits for Sanitary and Combined Sewers

2) PWQO = Provincial Water Quality Objectives for Use Under Part XV.1 of the Environmental Protection Act (July, 1994).

3) Orange shading indicates parameter exceeds Niagara Sewer Use Criteria 27-2014 (Table 1 - Limits for Sanitary and Combined Sewers)
4) Purple shading indicates parameter exceeds PWQO.



Parameters	UNIT	Niagara Sewer Use By-Law	PWQO (1) (Hardness > 100ppm)	RDL	BH20-3	BH20-7D	BH20-3	BH20-7S	BH20-1	BH20-12D	BH20-8
Laboratory Report Number					L2548351	L2548351	L2550950	L2550950	L2550950	L2550950	L2554453
Sample Date					13-Jan-21	13-Jan-21	21-Jan-21	21-Jan-21	21-Jan-21	21-Jan-21	02-Feb-21

5) Yellow shading indicates that results below the Detection Limit but the Detection Limit exceeds the PWQO limit

The results of the unfiltered water quality sampling and analysis indicated the following:

- BH20-01 – the concentration of hydrogen sulphide (H2S) was below the detection limit (<0.019 mg/L) but the detection limit exceeded the PWQO guideline limit of 0.002 mg/L.
- BH20-03 – Concentrations of total aluminium, total arsenic, total cadmium, total cobalt, total iron, total lead, total phosphorous, total vanadium, total zinc and phenols and toluene exceeded the PWQO guideline limits. Concentrations of total suspended solids (TSS) and total silver in the groundwater sample exceeded the Niagara Sewer Use By-Law limit of 350 mg/L. Concentration of hydrogen sulphide exceeded the PWQO criteria and Niagara Sewer Use By-Law limit of 0.002 and 1 mg/L, respectively. Detectable concentrations of dissolved methane were noted in the groundwater sample. Concentration of total silver was below the detection limit (<0.00050 mg/L) but the detection limit exceeded the PWQO guideline of 0.001 mg/L.
- BH20-07S - Concentrations of total aluminium, total boron, total cobalt, total iron, total lead, total molybdenum, total phosphorous, total zinc and phenols exceeded the PWQO guideline limits. Concentration of total silver was below the detection limit (<0.00050 mg/L) but the detection limit exceeded the PWQO guideline of 0.001 mg/L. All parameters analyzed met the Niagara Sewer Use By-Law limits.
- BH20-07D – Concentrations of H2S exceeded the PWQO and Niagara Sewer Use By-Law limits. Detectable concentrations of dissolved methane were noted in the groundwater sample.
- BH20-08 – Concentrations of total aluminium, total arsenic, total boron, total iron, total phosphorous, total zinc, H2S, phenols, and toluene exceeded the PWQO guideline limits. Concentrations of sulfate (SO4) and H2S exceeded the Niagara Sewer Use By-Law limits. Concentrations of cyanide, total mercury and dissolved mercury were below their detection limits but detection limits exceeded the PWQO. Elevated concentrations of dissolved methane were detected in the groundwater sample.
- BH20-12D – Concentrations of total aluminum, total boron, total iron, total phosphorous, total zinc and phenols exceeded the PWQO guideline limits. All parameters analyzed met the Niagara Sewer Use By-Law limits.

Based on the groundwater sampling results, discharge to the natural environment and nearby sewers would require some pre-treatment of groundwater. Treatment options typically include the use of weir tanks for discharge water detention and settlement of suspended solids or filtration. A contaminant specialist is recommended to be contacted to understand exceedances for phenols and toluene in groundwater.

4 Preliminary Dewatering Assessment

It is understood that Site is divided into two main components: Subproject 1 'Trunk Sewer' and Subproject 2 'Wastewater Treatment Plant site'. The sections of sanitary sewers from the OPG lands to the WWTP will be installed through trenchless methods using eight construction shafts, as described in Section 1.1. The proposed WWTP and all associated subsurface works will be constructed using open excavation methods. A temporary secant wall is proposed to be installed at the location of a deep pumping station located at the south portion of the WWTP footprint, to support the open excavation and to minimize groundwater infiltration.

The location and depths of the proposed construction shafts are shown on **Figures 4-1** to **4-10.** A conceptual site plan showing details of the proposed WWTP and associated buildings was provided by Region in November 2021, to WSP to assist with the preliminary hydrogeological evaluation. A copy of the conceptual site plan is provided in **Appendix F**. As discussed in Section 1.1, CIMA+ provided additional engineering details related to construction for Subproject 2 in March 2022.

For the dewatering assessment, the estimated lowest excavation elevation is assumed to be at the base of the construction shafts and at the bearing elevation of the proposed building structures within the WWTP footprint based on available design drawings and guidance from CIMA+. **It should be noted that the current drilling program may not provide adequate coverage and depths over all the areas within the WWTP footprint. Additional drilling should be considered once designs are finalized to target the footprint of each proposed building and the dewatering assessment updated during the detail design stage.**

4.1 Short-Term Dewatering Requirements

The interpreted static groundwater levels at the Site are higher than the maximum excavation depths and, therefore, groundwater control will be required during excavation. To maintain a stable and relatively dry excavation, water levels should be lowered to at least 1.0 m below the lowest excavation depth. Based on guidance from WSP's geotechnical team, open excavations will require safe slopping to provide safe working conditions during construction. In consultation with the geotechnical team, a ratio of 1 to 2 should be applied to excavation slopes (i.e., for every 1 m of vertical excavation from the ground surface, the walls should be sloped to a length of 2 m from the bottom of the excavation). WSP hydrogeological team has taken this into consideration when assuming the lateral extent of the open excavations.

For a conservative dewatering assessment, the highest measured water level and available hydraulic conductivity estimated in different areas of the Site were used in the calculations. It should be noted that groundwater levels can vary and are subject to seasonal fluctuations and may respond to major weather events.

A complete list of assumptions used in the construction dewatering calculations for the construction shafts, based on the design drawings and available water level and hydraulic conductivity estimates, is included in **Table F-1 (Appendix F)**.

Several building components within the WWTP footprint will be constructed above grade and will not require open excavations during construction, as shown on the conceptual site model in **Appendix F**. These buildings include a disinfection building, maintenance building, administrative building, headworks building and primary clarifiers.

A complete list of buildings requiring open excavations, along with assumptions used in the construction dewatering calculations for the WWTP building components, based on the conceptual site plan and guidance from CIMA+ engineers and the geotechnical team at WSP, are provided in **Table 4-1.**

Table 4-1 - Construction Dewatering Inputs - Wwtp Footprint (Phase 1)

INPUT	DIMENSIONS	NOTES
Groundwater Elevation in Overburden	4.26 mbgs	Highest Water Level 4.76 mbgs (BH20-12S) + 0.5 m for seasonal fluctuation
Hydraulic Conductivity of the Overburden	1.0 x 10^{-8} m/s	Conservative value, based on low hydraulic conductivities estimated using single well response tests (10^{-9} m/s) in BH20-10, BH20-11 and BH20-12
Digestor Tanks (2)		
Approximate Depth to Groundwater		Based on
Approximate Excavation Depth	3.65 mbgs	Tanks will be installed partially below grade
Target Pumping Level	4.65 mbgs	Assumed to be 1.0 m below excavation depth
Dimensions of Excavation for 1 Digestor Tank (2 tanks in total)	40 m diameter, Assume 40 m length x 40 m width	Provided by CIMA+, as shown on the Conceptual Site Plan
Dimensions of Excavation for 1 Digestor Tank with safe sloping (2 tanks in total)	Assume (40 + 7.3 m) length x (40 + 7.3 m) width	Assumes V:H ratio for sloping of 1:2
Mechanical Building		
Approximate Depth to Groundwater		Based on
Approximate Excavation Depth	3.65 mbgs	Building will be installed partially below grade
Target Pumping Level	4.65 mbgs	Assumed to be 1.0 m below excavation depth
Dimensions of Excavation for Mechanical Building	26 m length x 26 m width	Provided by CIMA+, as shown on the Conceptual Site Plan
Dimensions of Excavation for Mechanical Building with safe sloping	Assume (26 + 7.3 m) length x (26 + 7.3 m) width	Assumes V:H ratio for sloping of 1:2
Chlorine Contact Tank		
Approximate Depth to Groundwater		Based on
Approximate Excavation Depth	3.00 mbgs	Tanks will be installed below grade
Target Pumping Level	4.00 mbgs	Assumed to be 1.0 m below excavation depth
Dimensions of Excavation for Chlorine Contact Tank	40 m length x 20 m width	Provided by CIMA+, as shown on the Conceptual Site Plan
Dimensions of Excavation for Chlorine Contact Tank with safe sloping	Assume (40 + 6 m) length x (20 + 6 m) width	Assumes V:H ratio for sloping of 1:2
Secondary Clarifiers (2)		
Approximate Depth to Groundwater		Based on
Approximate Excavation Depth	6.0 mbgs	Clarifiers will be installed below grade
Target Pumping Level	7.0 mbgs	Assumed to be 1.0 m below excavation depth
Dimensions of Excavation for 1 Secondary Clarifier (2 in total)	43 m diameter, Assume 43 m length x 43 m width	Provided by CIMA+, as shown on the Conceptual Site Plan
Dimensions of Excavation for 1 Secondary Clarifier with safe sloping (2 in total)	Assume (43 + 12 m) length x (43 + 12 m) width	Assumes V:H ratio for sloping of 1:2
Aeration Tank		
		Based on
Approximate Excavation Depth	7.00 mbgs	Tank will be installed below grade
Target Pumping Level	8.00 mbgs	Assumed to be 1.0 m below excavation depth
Dimensions of Excavation for Aeration Tank	40 m length x 27 m width	Provided by CIMA+, as shown on the Conceptual Site Plan
Dimensions of Excavation for Aeration Tank with safe sloping	(40 + 14 m) length x (27 + 14 m) width	Assumes V:H ratio for sloping of 1:2
Deep Pump Station		
Approximate Depth to Groundwater		
Approximate Excavation Depth	39.0 mbgs	Tank will be installed below grade
Target Pumping Level	40.0 mbgs	Assumed to be 1.0 m below excavation depth
Dimensions of Excavation for Deep Pump Station	25 m	Supported by secant wall, 1.2m thick

Notes:

- Based on input from CIMA and guidance from the geotechnical team, the secant wall proposed to be installed at the deep pump station will restrict groundwater infiltration to the open excavation during construction

- The water bearing zones are uniform, continuous and of infinite extent
- The water bearing zone will not be depleted by initial drainage
- Water seepage across the base of the excavation is assumed to be negligible
- The dewatering estimate provided in this report is based on the information by the client and their civil design team, as outlined in these general assumptions. Detailed design drawings were not available at the time of preparing this report. WSP should be given the opportunity to revise the dewatering calculations once detailed designs are available.

4.1.1 Construction Dewatering Flow Equations

The dewatering flow estimate for the proposed shafts and WWTP components were calculated using the Dupuit-Thiem Approximation for a Single Well (Cashman, 2013), which is expressed as follows:

$$Q_w = \pi \times K \times \frac{(H^2 - h^2)}{2.3 \times \log {}^{Ro}/_{r_e}}$$

Where:

Qw = Rate of pumping (m³/sec);

K = Hydraulic conductivity (m/sec);

H = Head beyond the influence of pumping (static groundwater elevation) (m);

h = Head above base of aquifer at the excavation (m);

R = Radius of Influence (m);

re = Effective radius of excavation (m) = √(a*b)/π

a = excavation length

b = excavation width

For proposed works where the ratio of excavation length (a) vs. excavation width (b) is greater than 1.5, the dewatering flow estimates were calculated using the Dupuit approach (Dupuit, 1863), which is expressed as follows:

$$Q = \frac{2\ x\ (L + W)\ x\ K\ x(H^2 - h^2)}{Ro}$$

Where:

K = Hydraulic conductivity (m/sec);

H = Static Saturated Head in m;

h = Dynamic Saturated Head in m;

L =Length of excavation in m;

W =Width of excavation in m;

Ro = Radius of Influence (m).

It is expected that the initial dewatering rate will be higher in order to remove groundwater from within the overburden formation. The dewatering rates are expected to decrease once the target water level is achieved in the excavation footprint, as

groundwater will have been removed from ‘storage’ within the overburden soils, resulting in lower seepage rates into the excavation.

4.1.2 Zone Of Influence

The zone of influence (ZOI) for construction dewatering is based on the empirical Sichardt’s Equation and represents the theoretical distance from the center of dewatering where the lowering of groundwater becomes insignificant. The equation is empirical and was developed to provide representative flow rates using the steady state flow dewatering equations, as discussed above.

It is noted that in steady state conditions, the radius (or zone) of influence of pumping will extend until boundary flow conditions are reached, and sufficient water inputs are equal to the discharge rate due to pumping. As a result, the distance of influence calculated using the Sichardt’s equation is used to provide a representative flow rate calculation, but it is not accurate in determining the actual radius influenced by pumping. The ZOI from dewatering for linear flow is calculated based on the following empirical relationship:

$$R_0 = C(H - h)\sqrt{K}$$

Where:

K = Hydraulic conductivity (m/sec);

H = Static Saturated Head in m;

h = Dynamic Saturated Head in m;

C = Coefficient based on geometry and source of dewatering (2000 for single line well points, 3000 for wells).

4.1.3 Preliminary Dewatering Flow Estimates for Trunk Sewer Shafts

Dewatering rates for steady-state conditions are presented in **Table F1**. The Plan and Profile drawings showing the location of the proposed construction shafts and sanitary trunk sewers were reviewed to determine potential groundwater control requirements during construction. The Plan and Profile drawings are shown in **Figures 4-1** through to **4-10**.

As described in Section 1.1, 1500 mm and 1800 mm diameter concrete trunk sewers will be installed as part of the South Niagara Falls Wastewater Solution project using trenchless methods. Shafts along the alignment will be constructed by open-cut method.

For the purposes of the calculating dewatering flow estimates by trenchless method, it is assumed that the construction shafts shown on **Figures 4-1** to **4-10** will be circular in shape. An additional 1 m was added to the proposed shaft diameters to account for installation of equipment during trenchless installation activities. Hydraulic conductivity of 1.0 x 10^{-4} m/s was used for dewatering calculations for shaft 'Montrose Shaft 04', associated with presence of sand and gravel in BH20-05 at elevations of 159.4-161.5 masl and presence of sandy gravel in BH20-06S/D at elevations of 156.5-158.0 masl. It is interpreted that deposits of sand and gravel to sandy gravel may be associated with the Welland River deposits. Due to the proximity of this shaft location to the Welland River, there is a potential for a hydraulic connection between the observed groundwater in BH20-06S/D and the adjacent Welland River. The bottom elevation of this shaft was estimated to be 160 masl.

As shown in **Table F1 (Appendix F**) and summarized in **Table 4-2**, dewatering volumes to support construction of eight construction shafts are estimated to range from 94 L/day to 166,652 L/day, with a safety factor of "2". The safety factor has been applied to account for seasonal fluctuations in the groundwater table and variation in hydrogeological properties beyond those encountered during the course of this study. This peak dewatering flow rate also provides additional capacity for the dewatering contractors.

Table 4-2 - Dewatering Estimates for Installation of Trunk Sewer Construction Shafts

Shaft Number	Shaft Location	Shaft Diam. (m)	ZOI (m)	Estimate (L/Day)	Estimate with S.F. (L/Day)	Precipitation Estimate (L)
Montrose Shaft 01	Ontario Power Generation Lands	4.0	4.4	1,107	2,214	160
Montrose Shaft 02	Montrose Road, west of the OPG lands	4.0	0.9	47	94	160
Montrose Shaft 03	Montrose Road and Brown Road	4.0	2.9	181	363	160

Brown Shaft 01	Brown Road and Heartland Forest Road	2.8	1.7	206	416	78
Montrose Shaft 04	Montrose Road and Chippawa Creek Road	4.0	414.0	83,326	166,652	160
Montrose Shaft 05	Montrose Road and Grassy Brook Road	4.0	21.4	1,530	3,061	160
Montrose Shaft 06	Montrose Road and Grassy Brook Road	4.0	2.5	360	720	160
Reixinger Shaft 02	Reixinger Road and Dell Road	4.0	2.7	136	273	160

Notes: S.F. = Safety Factor

This assessment does not represent an engineering design of a dewatering operation, but a preliminary hydrogeological analysis for assessment of dewatering volumes based on the engineering dimensions available at this time. These dimensions should be verified at the next stage of the project.

4.1.4 Preliminary Dewatering Flow Estimates for WWTP Components

Based on the assumptions provided in this report, the results of the preliminary dewatering rate estimates for building components within the footprint of the WWTP can be summarized as follows:

Table 4-3 - Dewatering Estimates for Construction of WWTP Components

Building Component	ZOI (M)	Total Flow (L/Day)*	Total Flow with Factor Of Safety Of 2 * (L/Day)	Precipitation Estimate (L)
Digestor Tank (2 tanks in total)	26.8	5,100	10,100	22,400
Mechanical Building	18.9	3,600	7,100	11,100
Chlorine Contact Tank	19.5	0 (i.e., dry conditions)	0 (i.e., dry conditions)	12,000
Secondary Clarifier (2 in total)	31.9	5,300	10,500	30,300
Aeration Tank	27.7	4,300	8,600	22,100
Deep Pump Station [(a)]	37.4	18,800	37,500	4,900

*The dewatering flow rates are rounded to the nearest hundred for permit considerations

[(a)] The hydraulic conductivity for soils inside the caisson wall were assumed to be 5 x 10^{-8} m/s, to account for potential groundwater infiltration in the bedrock at the bottom of the excavation

The complete dewatering flow rate estimates for the WWTP components are provided in **Appendix F**, **Tables F-2 to F-6.**

The construction dewatering flow rates includes a factor of safety of “2”, to account for seasonal fluctuations in the groundwater table and variation in hydrogeological properties beyond those encountered during the course of this study. This peak dewatering flow rate also provides additional capacity for the dewatering contractors.

Please note that it is the responsibility of the contractor to ensure dry conditions are maintained within the excavation at all times. Additional pumping capacity may be

required to maintain dry conditions within the excavation during and following significant precipitation events. Additionally, the presence of near-surface fill material could hold groundwater volumes. Additional investigations in the detail design stage can confirm the extent of near surface material within the footprint of the proposed treatment plant components.

This assessment does not represent an engineering design of a dewatering operation, but a preliminary hydrogeological analysis for assessment of dewatering volumes based on the engineering dimensions available at this time. These dimensions should be verified at the next stage of the project.

4.1.5 Precipitation Contribution

Rain and snow that accumulates in the excavation area will need to be handled during construction. In order to predict the effects of precipitation, a simple estimate was calculated based on the geometry of the planned excavation areas and a 10-mm rain event. The results are included in **Tables F1 through Table F6** (**Appendix F**) and are summarized in **Table 4-2 and Table 4-3**. It is recommended that additional capacity be included for the handling of large precipitation events in order to keep the excavation area relatively dry and stable.

4.2 Permitting For Construction Dewatering

The short-term construction dewatering flow rate volumes associated with the proposed development are required to evaluate permitting requirements as follows:

- Temporary groundwater takings at dewatering rates greater than 50,000 L/day, but less than 400,000 L/day at any one time for the project will require a registration with the Environmental Activity and Sector Registry (EASR);
- Temporary groundwater takings at dewatering rates greater than 400,000 L/day at any one time for the project will require a Category 3 Permit to Take Water (PTTW); or
- Groundwater takings less than 50,000 L/day at any one time do not require an EASR nor a PTTW.

It should be noted that cumulative site-wide daily construction dewatering volumes may be authorized through an EASR, so long as dewatering rates at any given source location do not exceed 400,000 L/day for groundwater control, and the zone of influence (ZOI) of construction dewatering at multiple active dewatering source locations do not overlap.

Construction dewatering to remove accumulated water from precipitation or runoff is not counted towards this total of 400,000 L/day per source location, so long as water takings attributed to stormwater management can be discerned from groundwater takings.

If construction methodologies are used to limit construction dewatering at each individual source location to less than 400,000 L/day with appropriate water quality, then all of the construction dewatering potentially required for the project site could be authorized through an EASR, instead of a PTTW, provided that the calculated ZOI of each of the separate source locations do not overlap one another.

The expected daily groundwater taking rate will depend largely on the construction plan/schedule and will need to take into consideration the number and size of excavations being dewatered at a given time. Based on the estimated dewatering rates for each construction shafts and the proposed WWTP components, it is anticipated that daily dewatering rates will exceed 50,000 L/day. As a result, it is likely that a registration on the EASR or a Category 3 PTTW will need to be obtained for the project during short-term construction activities. This conclusion should be verified through installation of additional monitoring wells and reviewed an updated design.

4.3 Dewatering Area of Influence

Using the results of the well testing and assuming an open-cut excavation at the construction shaft locations and the proposed WWTP components, the maximum predicted theoretical radius of influence from the edges of the excavations could be as large as 414 m at Montrose Shaft 04 and 37.4 m at the proposed deep Pump Station within the Subproject 2 “Wastewater Treatment Plant site”. It should be noted that dewatering associated with the above ZOIs are for expected pumping rates and will consist of short-term pumping. Actual ZOIs may not reach stabilized conditions and maybe smaller.

5 Preliminary Evaluation of Groundwater Impacts

5.1 Water Supply Wells

Based on a review of the MECP WWRs, there are 20 water supply wells within the Study Area, with 18 of the water supply wells installed within the bedrock, with casings installed from the ground surface to depths ranging between 11 mbgs and 28 mbgs or elevations varying between 86 and 166 masl. One domestic well (WWR 6604672) and one livestock well (WWR 6601397) were installed within the overburden and were installed with casings from the ground surface to depths of 32 mbgs and 22 mbgs, respectively. A review of available aerial imagery identified evidence of municipal water supply available along the Montrose Road and Oakwood Drive right of way, suggesting that domestic and commercial water supply is provided through watermains in the area.

A review of available profile drawings (**Figures 4-1** to **4-10**) indicates that the construction shafts will be excavated in overburden and the proposed dewatering will be within the depths of the construction shafts. Based on the proposed depths and the anticipated ZOIs during the construction of the shafts, impacts to bedrock water supply wells in the vicinity of the proposed shafts resulting from short-term removal of groundwater to support the installation of the sewers is expected to be minimal due to the depth of casing installations as shown in the available water well records (**Appendix A**).

Due to dewatering at Montrose Shaft 04 in sand and gravel and livestock well WWR 6601397 (see **Figure 1** and **Figure 2**, screened in gravel (i.e., the same aquifer), WSP recommends confirming reliance on this well for water supply purposes through the completion of a water well survey in this area.

Two domestic wells WWR 6602252 and WWR 6602286 were installed along Reixinger Road (see **Figure 1** and **Figure 2**) in 1954, in proximity to proposed Reixinger Shaft 02 and deep Pump Station within the “Wastewater Treatment Plant site”. Both wells are screened in the bedrock (see **Appendix A)**. Due to an estimated ZOI of 27.5 m for dewatering activities to take place in the bedrock for the deep Pump Station, it is also recommended to complete a water well survey in the area to confirm reliance on these wells for water supply purposes.

5.2 Ground Settlement

During the course of dewatering activities and some time after, settlement can occur in saturated unconsolidated soils within a ZOI. Based on the dewatering assessment, the maximum ZOI is anticipated to be approximately 414 m from the excavation boundaries. A detailed assessment of potential groundwater assessment is recommended to be completed at the detail design stage to identify potential impacts to nearby existing structures and utilities.

5.3 Contaminant Movement

Groundwater quality samples collected at the locations of the proposed construction shafts along Montrose Road and Brown Road indicated exceedances of the PWQO guideline for total aluminium, total arsenic, total boron, total cadmium, total cobalt, total copper, total iron, total lead, total molybdenum, total phosphorous, total zinc, total vanadium, phenols, toluene and sulphide (as H2S). Groundwater quality samples collected in the vicinity of the proposed WWTP footprint indicated exceedances of the PWQO guideline for total aluminium, total arsenic, total boron, total iron, total phosphorous, total zinc, H2S, phenols and toluene. Prior to discharge to nearby the natural environment, pre-treatment of groundwater will be required to meet the PWQO. Filtration, aeration and chemical treatment of the groundwater prior to discharge into the natural environment expected to reduce the concentration of metals and sulphide. Discharge of groundwater would need to use treatment systems that conventionally use iron or calcium-based coagulants that bind to the phosphorus molecules and catalyze the precipitation of phosphorus. This will reduce the phosphorus concentration in the water.

As discussed in Section 3.4, groundwater quality sample collected at BH20-03 indicated concentrations of TSS exceeding the Niagara Sewer Use By-Law limit of 350 mg/L. Groundwater quality samples collected at BH20-07D and BH20-08 identified concentrations of H2S exceeding the Niagara Sewer Use By-Law limits of 1 mg/L. Additionally, the groundwater quality sample collected at BH20-08 identified concentrations of sulfate exceeding the Niagara Sewer Use By-Law limits of 1500 mg/L.

Prior to discharge to the nearby sewers, pre-treatment of groundwater discharge will be required. Treatment options typically include the use of weir tanks for discharge water detention and settlement of suspended solids or filtration. WSP recommends an additional filtered groundwater sample be collected from monitoring well BH20-03 to confirm that the elevated concentrations of TSS are reduced in a filtered sample and to

confirm the effectiveness of the settlement tanks and filtration prior to discharge to the nearby sewers.

A program to monitor water quality during construction conditions is included in Section 6.1.

5.4 Well Decommissioning

Following the completion of construction activities, all dewatering wells, well points, eductors and monitoring wells installed at various stages of this project must be decommissioned. The installation and eventual decommissioning of the wells and dewatering system must be carried out by a licensed water well contractor in accordance with Ontario Regulation 903 of the Ontario Water Resources Act. Those monitoring wells that are in the construction footprint, shall be decommissioned in advance of construction activities.

5.5 Impact On Natural Features

The Welland River and tributaries of Lyons Creek and Grassy Brook is the nearest natural receptor to the proposed construction activities, with the Welland River traversing the trunk sewer alignment in the middle portion of the Site, and Grassy Brook and tributaries of Lyons Creeks intersecting the trunk sewer alignment at Montrose Road and Reixinger Road within the south portion of the Site. Minimal impact to the natural environment is anticipated from the dewatering activities to support open-cut works for the construction shafts, based on estimated ZOIs for Montrose Shaft 05.

To assess dewatering impacts associated with construction of Montrose Shaft 04, it is recommended to install additional monitoring wells close to the Welland River. To evaluate impacts associated with construction of Reixinger Shaft 02 and deep Pump Station within the “Wastewater Treatment Plant site” to the natural environment, WSP recommends installation of monitoring wells and carrying out additional dewatering calculations for this area. Once the design progresses / further refined at next stage of the project, WSP recommends evaluating impacts of dewatering activities in vicinity of Montrose Shaft 04 and Reixinger Shaft 02 to natural resources. For Montrose Shaft 04, this should include an impact assessment for construction the tunnel and associated shaft in proximity to the Welland River.

Mitigation and monitoring measures during dewatering activities (filtration, monitoring of run off to the natural environment) will need to be implemented to minimize impacts to the environment. Quality of groundwater will need to be confirmed through sampling

and treatment to meet the appropriate criteria prior to the groundwater discharge into the natural environment (i.e,, PWQO).

Mitigation measures to manage and contain impacts of dewatering are provided in **Section 6.**

6 Conclusion and Recommendations

Based on the results of the hydrogeological investigation, the following conclusions and recommendations are presented:

CONCLUSIONS

- Watercourses within the Study Area include Welland River (intersecting Montrose Road along the middle portion of the Site), Grassy Brook (intersecting Montrose Road, south of Grassy Brook Road) and a tributary of Lyons Creek (is located west and south of the intersection of Montrose Road and Reixinger Road). The inferred direction of shallow groundwater across the Site is from the north to south towards Welland River.
- The Study Area is within Highly Vulnerable Aquifer. Due to shallow and short-duration of construction and given that best management practices are followed during construction, it is not anticipated that the construction works would have a negative impact to the existing groundwater conditions at the Site.
- Based on the review of the MECP WWRs, there are 37 well records within the Study Area, with 20 wells registered as water supply wells. The remaining records are for abandoned wells, observation and monitoring wells, test holes or records with no details. Based on the proposed depths and anticipated ZOIs during the construction of shafts, minimal impacts are anticipated to majority of water supply wells as a result of the dewatering activities during construction in most areas.
- WWRs, borehole logs and test pit logs show consistency in the materials found within the Study Area, mainly consisting of clayey silt to silty clay deposits, interbedded with layers of sand and gravel. Within the Site, surficial fill was observed at the surface, underlain by deposits silty clay and clayey silt till deposits, interbedded with layers of sandy gravel, sand, silt and silt. Welland River deposits were observed in wells BH20-6D and BH20-7D.
- Groundwater was measured to be at elevations of between 168.96 and 178.24 m ASL in on-site wells in December and January 2021. These values fluctuate at the Site depending on climactic conditions (i.e., precipitation, atmospheric pressure and air temperature).
- The estimated hydraulic conductivity for the shallow wells screened in silty clay ranges between 5.4 X 10^{-9} and 4.9 X 10^{-6} m/s; the estimated hydraulic conductivity for the deep wells screened in the bedrock ranges between 1.4 X 10^{-8} m/s and 1.2 X 10^{-5} m/s.

- Dewatering volumes during construction of eight construction shafts to install the truck sewers are estimated to range between 4 and 88,795 L/day, with a contingency factor of “2”.
- Dewatering to support construction of WWTP components are estimated to be between 0 L/day (dry conditions) and 37,500 L/day, with a contingency factor of “2”.
- It was estimated that additional 32 to 90 L of precipitation water for a single construction shaft will be required to be managed during dewatering; it was estimated that precipitation contributions requiring management during dewatering at the WWTP will range between 4,900 to 30,300 L of precipitation water for various construction tasks in this.

RECOMMENDATIONS

- To confirm seasonally high groundwater levels within the proposed sewer alignment, construction shaft locations and the wastewater treatment plant site, WPS recommends completion of groundwater measurements within the on-site monitoring wells in the spring months (March through May).
- Due to dewatering in sand and gravel at Montrose Shaft 04 and dewatering in the bedrock in proximity to proposed Reixinger Shaft 02 and deep Pump Station, WSP recommends completing a water well survey to confirm reliance on private wells for water supply purposes in these areas.
- WSP recommends installing additional monitoring wells in proximity of the Welland River and Reixinger Shaft 02 and carrying out additional dewatering calculations for these areas and assessing impacts of dewatering activities to the natural environment.
- WSP recommends evaluating impacts of dewatering activities in vicinity of Montrose Shaft 04 and Reixinger Shaft 02 to natural resources, at the next design stage. For Montrose Shaft 04, this would include impact assessment to the tunnel and associated shaft in proximity to the Welland River.
- Pre-treatment of groundwater during dewatering is recommended for concentrations of:
    - total metals, phenols, toluene and sulphide for discharge of groundwater to the natural environment along Montrose Road.
    - total metals, H2S, phenols and toluene for discharge of groundwater to the natural environment within the footprint of the proposed WWTP.
    - TSS, H2S and sulfate for discharge of groundwater to nearby sewers.

- It is recommended that an ecological assessment be conducted during the detail design to identify and confirm potential ecological sensitivities related to dewatering activities, including locations for discharge of groundwater and the best management practices required to protect these natural features (i.e. watercourses).
- Once detailed design plans are available, the dewatering calculations and impact assessment are recommended to be updated to include final details for the construction shafts, the trenchless sections and buildings within the WWTP footprint.
- A detailed assessment of potential groundwater assessment is recommended to be completed at the detail design stage to identify potential impacts to nearby existing structures and utilities.
- In conformance with Regulation 903 of the Ontario Water Resources Act, the installation and eventual decommissioning of any dewatering system wells or monitoring wells shall be carried out by a licensed contractor, under the supervision of a licensed water well technician.

7 Standards and Limitations

WSP Canada Inc. prepared this report solely for the use of the intended recipient, Regional Municipality of Niagara, in accordance with the professional services agreement between the parties. In the event a contract has not been executed, the parties agree that the WSP General Terms for Consultant shall govern their business relationship which was provided to you prior to the preparation of this report.

The report is intended to be used in its entirety. No excerpts may be taken to be representative of the findings in the assessment.

The conclusions presented in this report are based on work performed by trained, professional and technical staff, in accordance with their reasonable interpretation of current and accepted engineering and scientific practices at the time the work was performed.

The content and opinions contained in the present report are based on the observations and/or information available to WSP at the time of preparation, using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by WSP and other engineering/scientific practitioners working under similar conditions, and subject to the same time, financial and physical constraints applicable to this project.

WSP disclaims any obligation to update this report if, after the date of this report, any conditions appear to differ significantly from those presented in this report; however, WSP reserves the right to amend or supplement this report based on additional information, documentation or evidence.

WSP makes no other representations whatsoever concerning the legal significance of its findings.

The intended recipient is solely responsible for the disclosure of any information contained in this report. If a third party makes use of, relies on, or makes decisions in accordance with this report, said third party is solely responsible for such use, reliance or decisions. WSP does not accept responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken by said third party based on this report.

WSP has provided services to the intended recipient in accordance with the professional services agreement between the parties and in a manner consistent with that degree of care, skill and diligence normally provided by members of the same profession performing the same or comparable services in respect of projects of a similar nature in similar circumstances. It is understood and agreed by WSP and the

recipient of this report that WSP provides no warranty, express or implied, of any kind. Without limiting the generality of the foregoing, it is agreed and understood by WSP and the recipient of this report that WSP makes no representation or warranty whatsoever as to the sufficiency of its scope of work for the purpose sought by the recipient of this report.

In preparing this report, WSP has relied in good faith on information provided by others, as noted in the report. WSP has reasonably assumed that the information provided is correct and WSP is not responsible for the accuracy or completeness of such information.

Benchmark and elevations used in this report are primarily to establish relative elevation differences between the specific testing and/or sampling locations and should not be used for other purposes, such as grading, excavating, construction, planning, development, etc.

WSP disclaims any responsibility for consequential financial effects on transactions or property values, or requirements for follow-up actions /or costs.

Design recommendations given in this report are applicable only to the project and areas as described in the text and then only if constructed in accordance with the details stated in this report. The comments made in this report on potential construction issues and possible methods are intended only for the guidance of the designer. The number of testing and/or sampling locations may not be sufficient to determine all the factors that may affect construction methods and costs. We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

Overall conditions can only be extrapolated to an undefined limited area around these testing and sampling locations. The conditions that WSP interprets to exist between testing and sampling points may differ from those that actually exist. The accuracy of any extrapolation and interpretation beyond the sampling locations will depend on natural conditions, the history of Site development and changes through construction and other activities. In addition, analysis has been carried out for the identified chemical and physical parameters only, and it should not be inferred that other chemical species or physical conditions are not present. WSP cannot warrant against undiscovered environmental liabilities or adverse impacts off-Site.

The original of this digital file will be kept by WSP for a period of not less than 10 years. As the digital file transmitted to the intended recipient is no longer under the control of WSP, its integrity cannot be assured. As such, WSP does not guarantee any

modifications made to this digital file subsequent to its transmission to the intended recipient.

This limitations statement is considered an integral part of this report.

8 References

- Cashman, P. M. (2013). Groundwater Lowering in Construction: A Practical Guide to Dewatering (Second Ed.).
- Chapman, L.J. and Putnam, D.F. (2007). The Physiography of Southern Ontario, Ontario Geological Survey, Special Volume 2.
- Dupuit, L. (1863). Etudes théoriques et pratiqués sur le mouvement des eaux dans les canaux découverts et a travers les terrains perméables, 2nd Edition: Dunot, Paris.
- Fetter, C.W. (2001). Applied Hydrogeology Fourth Edition. Upper Saddle River, New Jersey: Prentice Hall.
- Golder Associates Ltd, June 19, 2020. Geotechnical Desktop Study Report, South Niagara Falls Wastewater Solutions Schedule C Class Environmental Assessment.
- Golder Associates Ltd, May 4, 2020. Hydrogeological Baseline Conditions – South Niagara Falls Wastewater Solutions Schedule C Class Environmental Assessment, Niagara Falls, Ontario.
- Ministry of Natural Resources and Forestry, March 2022a. Make A Topographic Map. Retrieved from: https://www.lioapplications.lrc.gov.on.ca/MakeATopographicMap/index.html?viewer=Make_A_Topographic_Map.MATM&locale=en-CA.
- Ministry of Natural Resources and Forestry, March 2022b. Make a Map: Natural Heritage Areas. Retrieved from: https://www.lioapplications.lrc.gov.on.ca/Natural_Heritage/index.html?viewer=Natural_Heritage.Natural_Heritage&locale=en-CA
- Niagara Peninsula Conservation Authority, 2012. Lower Welland River and South Niagara Falls, 2012 Watershed Report Card.
- Niagara Peninsula Conservation Authority, December 2013. Source Protection Plan for the Niagara Peninsula Source Protection Area.
- Niagara Peninsula Conservation Authority, November 28, 2013. Updated Assessment Report, Niagara Peninsula Source Protection Area.
- Ontario Geological Survey (1990). Quaternary Geology: Toronto and Surrounding Area. Ontario Geological Survey Map P. 2204, Scale 1: 100,000.
- Ontario Geological Survey (1991). Bedrock Geology of Ontario, Southern Sheet; Ontario Geological Survey, Map 2544, scale 1: 1,000,000.
- Ontario Ministry of Environment, Conservation, and Parks (2022a). The Source Water Protection Information Atlas. Retrieved in March from:

https://www.lioapplications.lrc.gov.on.ca/SourceWaterProtection/index.html?viewer=SourceWaterProtection.SWPViewer&locale=en-CA

- Ontario Ministry of the Environment, Conservation, and Parks (2022b). Map: Well records. Retrieved in March 2022 from: https://www.ontario.ca/environment-and-energy/map-well-record
- Regional Municipality of Niagara, October 14, 2020. Request for Tender for South Niagara Falls WW Solutions EA – Geotechnical and Hydro-geological Investigations.
- Singer, S.M., Cheng, C.K. and Scafe, M.G. (2003). Hydrogeology of Southern Ontario, Second Edition. Environmental Monitoring and Reporting Branch, Ontario Ministry of the Environment.
- WSP Canada Inc, February 26, 2021. Preliminary Geotechnical Investigation Report for Proposed South Niagara Falls Wastewater Treatment Plant and Associated Trunk Sewer, Township of Willoughby, Region of Niagara.

APPENDIX

A MECP WATER WELL RECORDS

MECP Water Well Records

Well Record #

6600612 Lot 001 Conc NIAGARA FALLS CITY (CROWLAND) / NIAGARA (WELLAND)

Date 6/22/1960 (DD/MM/YYYY) Elev 177.4 (masl) Easting 652792 Northing 4766407
/ Not Used Test Hole UTM RC 5 margin of error : 100 m - 300 m
Water Found 16.8 (mbgs) 160.6 (masl) FRESH
Casing Diameter 5 inch Casing Material: STEEL
Top of Screen 15.5 (mbgs) Bottom of Screen 18.6 (mbgs)
Screen Interval 3.0 (m)

Flowing? N
SWL 2.4 (mbgs) 174.9 (masl)
Pumping WL 3.0 (mbgs) 174.3 (masl)
Pump Rate 36.4 (LPM) 8 / 0
Spec. Cap. 59.66 (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	177.4		
0.3	177.0		TOPSOIL / /
4.6	172.8	RED	CLAY / /
11.9	165.5	GREY	CLAY / /
15.2	162.1	BLUE	CLAY / GRAVEL / BOULDERS
16.8	160.6		CLAY / SILT /
19.2	158.1		SILT / FINE SAND / MEDIUM SAND
23.5	153.9		CLAY / SILT /
24.4	153.0		CLAY / GRAVEL / BOULDERS
24.7	152.7		LIMESTONE / /

6600613 Lot 001 Conc NIAGARA FALLS CITY (CROWLAND) / NIAGARA (WELLAND)

Date 6/24/1960 (DD/MM/YYYY) Elev 177.4 (masl) Easting 652777 Northing 4766405
/ Not Used Test Hole UTM RC 5 margin of error : 100 m - 300 m
Water Found (mbgs) (masl)
Casing Diameter 5 inch Casing Material:
Top of Screen (mbgs) Bottom of Screen (mbgs)
Screen Interval (m)

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	177.4		
0.3	177.1		TOPSOIL / /
4.6	172.9	RED	CLAY / /
11.9	165.5	GREY	CLAY / /
15.2	162.2	BLUE	CLAY / GRAVEL / BOULDERS
16.8	160.7		CLAY / SILT /

6601226 Lot Conc NIAGARA FALLS CITY / NIAGARA (WELLAND)

Date 5/13/1963 (DD/MM/YYYY) Elev 175.3 (masl) Easting 652962 Northing 4768916
/ Domestic Water Supply UTM RC 5 margin of error : 100 m - 300 m
Water Found 18.9 (mbgs) 156.4 (masl) FRESH
Casing Diameter 7 inch Casing Material: STEEL
Top of Screen (mbgs) Bottom of Screen (mbgs)
Screen Interval (m)

Flowing? N
SWL 5.5 (mbgs) 169.8 (masl)
Pumping WL 13.7 (mbgs) 161.6 (masl)
Pump Rate 77.3 (LPM) 2 / 0
Spec. Cap. 9.39 (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	175.3		
12.8	162.5	BROWN	CLAY / /
18.6	156.7	RED	CLAY / /
18.9	156.4		LIMESTONE / /

6601385 Lot 186 Conc NIAGARA FALLS CITY / NIAGARA (WELLAND)

Date 3/28/1962 (DD/MM/YYYY) Elev 177.5 (masl) Easting 651865 Northing 4769469
Domestic / Livestock Water Supply UTM RC 5 margin of error : 100 m - 300 m
Water Found 17.1 (mbgs) 160.4 (masl) FRESH
Casing Diameter 6 inch Casing Material: STEEL
Top of Screen (mbgs) Bottom of Screen (mbgs)
Screen Interval (m)

Flowing? N
SWL 6.4 (mbgs) 171.1 (masl)
Pumping WL 11.0 (mbgs) 166.5 (masl)
Pump Rate 4.5 (LPM) 2 / 0
Spec. Cap. 0.99 (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	177.5		

Well Record #

3.0	174.4	BROWN	CLAY /		/
13.7	163.8	BLUE	CLAY /		/
15.8	161.6		STONES /	GRAVEL	/
17.1	160.4		LIMESTONE /		/

6601388 — Lot 197 Conc — NIAGARA FALLS CITY / NIAGARA (WELLAND)

Date 5/6/1954 (DD/MM/YYYY) — Elev 179.9 (masl) — Easting 652901 — Northing 4769376 — / Domestic — Water Supply — UTM RC 9 unknown UTM

Water Found 15.8 (mbgs) 164.1 (masl) FRESH

Casing Diameter 6 inch — Casing Material: STEEL

Top of Screen (mbgs) — Bottom of Screen (mbgs)

Screen Interval (m)

Flowing? N

SWL	6.1	(mbgs)	173.8	(masl)
Pumping WL	7.6	(mbgs)	172.3	(masl)
Pump Rate	45.5	(LPM)	2	/ 0
Spec. Cap.	29.83	(LPM/m)	Hour	/ Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions		
0.0	179.9				
3.0	176.9		CLAY /		/
13.7	166.2	BLUE	CLAY /		/
15.2	164.7		FINE SAND /		/
15.8	164.1		GRAVEL /	LIMESTONE	/

6601389 — Lot 197 Conc — NIAGARA FALLS CITY / NIAGARA (WELLAND)

Date 6/20/1954 (DD/MM/YYYY) — Elev 178.9 (masl) — Easting 653023 — Northing 4769432 — / Domestic — Water Supply — UTM RC 9 unknown UTM

Water Found 15.8 (mbgs) 163.1 (masl) FRESH

Casing Diameter 6 inch — Casing Material: STEEL

Top of Screen (mbgs) — Bottom of Screen (mbgs)

Screen Interval (m)

Flowing? N

SWL	6.1	(mbgs)	172.8	(masl)
Pumping WL	13.7	(mbgs)	165.2	(masl)
Pump Rate	13.6	(LPM)	3	/ 0
Spec. Cap.	1.79	(LPM/m)	Hour	/ Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions		
0.0	178.9				
3.0	175.9		CLAY /		/
13.7	165.2	BLUE	CLAY /		/
15.2	163.7		FINE SAND /		/
17.1	161.8		LIMESTONE /		/

6601390 — Lot 197 Conc — NIAGARA FALLS CITY / NIAGARA (WELLAND)

Date 2/10/1955 (DD/MM/YYYY) — Elev 179.6 (masl) — Easting 652941 — Northing 4769426 — / Domestic — Water Supply — UTM RC 9 unknown UTM

Water Found 18.3 (mbgs) 161.3 (masl) FRESH

Casing Diameter 6 inch — Casing Material: STEEL

Top of Screen (mbgs) — Bottom of Screen (mbgs)

Screen Interval (m)

Flowing? N

SWL	7.3	(mbgs)	172.2	(masl)
Pumping WL	9.1	(mbgs)	170.4	(masl)
Pump Rate	27.3	(LPM)	0	/ 30
Spec. Cap.	14.91	(LPM/m)	Hour	/ Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions		
0.0	179.6				
0.6	178.9		FILL /		/
5.5	174.1	BROWN	CLAY /		/
11.3	168.3	BLUE	CLAY /		/
12.8	166.8	GREY	CLAY /		/
15.2	164.3		CLAY /	STONES	/
18.9	160.7		LIMESTONE /		/

6601391 — Lot 197 Conc — NIAGARA FALLS CITY / NIAGARA (WELLAND)

Date 9/22/1956 (DD/MM/YYYY) — Elev 178.6 (masl) — Easting 652940 — Northing 4769241 — / Domestic — Water Supply — UTM RC 9 unknown UTM

Water Found 16.8 (mbgs) 161.8 (masl) FRESH

Casing Diameter 6 inch — Casing Material: STEEL

Top of Screen (mbgs) — Bottom of Screen (mbgs)

Screen Interval (m)

Flowing? N

SWL	7.0	(mbgs)	171.5	(masl)
Pumping WL	8.5	(mbgs)	170.0	(masl)
Pump Rate	36.4	(LPM)	0	/ 30
Spec. Cap.	23.86	(LPM/m)	Hour	/ Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	178.6		

Well Record #

1.2	177.3		FILL /		/	
4.6	174.0	BROWN	CLAY /		/	
9.4	169.1	BLUE	CLAY /		/	
14.0	164.5	GREY	MUCK /		/	
16.8	161.8		GRAVEL /		/	
17.4	161.2		LIMESTONE /		/	

6601392 **Lot 198 Conc** **NIAGARA FALLS CITY / NIAGARA (WELLAND)**

Flowing? N

Date 5/8/1948 (DD/MM/YYYY)
Elev 176.1 (masl) Easting 652773 Northing 4769122
/ Domestic Water Supply UTM RC 9 unknown UTM
Water Found 6.1 (mbgs) 170.0 (masl) FRESH
Casing Diameter 6 inch Casing Material:
Top of Screen (mbgs) Bottom of Screen (mbgs)
Screen Interval (m)

SWL 6.1 (mbgs) 170.0 (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions	
0.0	176.1			
13.7	162.4		TOPSOIL / CLAY	/
14.9	161.2		SHALE /	/

6601396 **Lot 210 Conc** **NIAGARA FALLS CITY / NIAGARA (WELLAND)**

Flowing? N

Date 4/10/1964 (DD/MM/YYYY)
Elev 176.0 (masl) Easting 652826 Northing 4769065
/ Commerical Water Supply UTM RC 5 margin of error : 100 m - 300 m
Water Found 23.8 (mbgs) 152.2 (masl) SULPHUR
Casing Diameter 6 inch Casing Material: STEEL
Top of Screen (mbgs) Bottom of Screen (mbgs)
Screen Interval (m)

SWL 5.2 (mbgs) 170.8 (masl)
Pumping WL 22.9 (mbgs) 153.1 (masl)
Pump Rate 90.9 (LPM) 2 / 0
Spec. Cap. 5.14 (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions	
0.0	176.0			
1.2	174.7	BROWN	CLAY /	/
19.8	156.1	BLUE	CLAY /	/
23.5	152.5	BROWN	CLAY /	/
23.8	152.2		GRAVEL /	/
24.1	151.9		LIMESTONE /	/

6601397 **Lot 211 Conc** **NIAGARA FALLS CITY / NIAGARA (WELLAND)**

Flowing? N

Date 9/18/1951 (DD/MM/YYYY)
Elev 175.3 (masl) Easting 653033 Northing 4768105
Domestic / Livestock Water Supply UTM RC 9 unknown UTM
Water Found 21.9 (mbgs) 153.4 (masl) FRESH
Casing Diameter 6 inch Casing Material: STEEL
Top of Screen (mbgs) Bottom of Screen (mbgs)
Screen Interval (m)

SWL 6.1 (mbgs) 169.2 (masl)
Pumping WL 15.2 (mbgs) 160.1 (masl)
Pump Rate 68.2 (LPM) 1 / 0
Spec. Cap. 7.46 (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions	
0.0	175.3			
3.0	172.3		CLAY /	/
21.3	154.0	BLUE	CLAY /	/
21.9	153.4		GRAVEL /	/

6601398 **Lot 211 Conc** **NIAGARA FALLS CITY / NIAGARA (WELLAND)**

Flowing? N

Date 11/12/1954 (DD/MM/YYYY)
Elev 174.7 (masl) Easting 652968 Northing 4768438
/ Domestic Water Supply UTM RC 9 unknown UTM
Water Found 25.0 (mbgs) 149.7 (masl) FRESH
Casing Diameter 6 inch Casing Material: STEEL
Top of Screen (mbgs) Bottom of Screen (mbgs)
Screen Interval (m)

SWL 5.5 (mbgs) 169.2 (masl)
Pumping WL 5.5 (mbgs) 169.2 (masl)
Pump Rate 68.2 (LPM) 0 / 30
Spec. Cap. 9,999.99 (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions	
0.0	174.7			
1.5	173.2		FILL / CLAY	/
6.7	168.0	BROWN	CLAY /	/

Well Record #

17.1	157.7	BLUE	CLAY /	/
20.7	154.0		MEDIUM SAND /	/
24.7	150.0		GRAVEL /	/
25.3	149.4		LIMESTONE /	/

6601399 — **Lot 211 Conc** — **NIAGARA FALLS CITY / NIAGARA (WELLAND)**

Flowing? N

Date 9/26/1956 (DD/MM/YYYY)

Elev 172.7 (masl) Easting 653018 Northing 4767747

/ Domestic Water Supply UTM RC 9 unknown UTM

Water Found 24.4 (mbgs) 148.4 (masl) FRESH

Casing Diameter 6 inch Casing Material: STEEL

Top of Screen (mbgs) Bottom of Screen (mbgs)

Screen Interval (m)

SWL 4.9 (mbgs) 167.9 (masl)

Pumping WL 6.4 (mbgs) 166.3 (masl)

Pump Rate 36.4 (LPM) 0 / 30

Spec. Cap. 23.86 (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions	
0.0	172.7			
0.3	172.4		TOPSOIL /	/
4.3	168.5	BROWN	CLAY /	/
12.2	160.6	BLUE	CLAY /	/
21.3	151.4		MEDIUM SAND /	/
23.2	149.6		GRAVEL /	/
25.0	147.8	BROWN	LIMESTONE /	/

6601400 — **Lot 211 Conc** — **NIAGARA FALLS CITY / NIAGARA (WELLAND)**

Flowing? N

Date 6/23/1959 (DD/MM/YYYY)

Elev 175.0 (masl) Easting 653022 Northing 4767840

/ Domestic Water Supply UTM RC 5 margin of error : 100 m - 300 m

Water Found 21.3 (mbgs) 153.7 (masl) FRESH

Casing Diameter 7 inch Casing Material: STEEL

Top of Screen (mbgs) Bottom of Screen (mbgs)

Screen Interval (m)

SWL 6.1 (mbgs) 168.9 (masl)

Pumping WL 13.7 (mbgs) 161.3 (masl)

Pump Rate 36.4 (LPM) 3 / 0

Spec. Cap. 4.77 (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions	
0.0	175.0			
3.0	172.0	BROWN	CLAY /	/
15.2	159.8	BLUE	CLAY /	/
16.8	158.2	RED	MEDIUM SAND /	/
18.3	156.7	BLUE	CLAY /	/
21.0	154.0	RED	MEDIUM SAND /	/
21.3	153.7		GRAVEL /	/
21.6	153.4		LIMESTONE /	/

6601401 — **Lot 211 Conc** — **NIAGARA FALLS CITY / NIAGARA (WELLAND)**

Flowing? N

Date 7/14/1959 (DD/MM/YYYY)

Elev 175.0 (masl) Easting 652993 Northing 4768127

/ Domestic Water Supply UTM RC 5 margin of error : 100 m - 300 m

Water Found 13.4 (mbgs) 161.6 (masl) FRESH

Casing Diameter 6 inch Casing Material: STEEL

Top of Screen (mbgs) Bottom of Screen (mbgs)

Screen Interval (m)

SWL 4.3 (mbgs) 170.7 (masl)

Pumping WL 19.2 (mbgs) 155.8 (masl)

Pump Rate 90.9 (LPM) 5 / 0

Spec. Cap. 6.09 (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions		
0.0	175.0				
5.5	169.5		CLAY /		/
13.4	161.6		CLAY /	MEDIUM SAND	/
18.6	156.4		FINE SAND /		/
19.2	155.8		LIMESTONE /		/

Well Record #

6601402 Lot 211 Conc NIAGARA FALLS CITY / NIAGARA (WELLAND)

Date 3/22/1960 DD/MM/YYYY

Elev 175.2 (masl) Easting 652972 Northing 4768873

/ Domestic Water Supply UTM RC 5 margin of error : 100 m - 300 m

Water Found 19.5 (mbgs) 155.7 (masl) FRESH

Casing Diameter 6 inch Casing Material: STEEL

Top of Screen (mbgs) Bottom of Screen (mbgs)

Screen Interval (m)

Flowing? N

SWL	3.7	(mbgs)	171.5	(masl)
Pumping WL	7.6	(mbgs)	167.6	(masl)
Pump Rate	100.0	(LPM)	5 / 0	
Spec. Cap.	25.24	(LPM/m)	Hour / Minute	

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	175.2		
14.6	160.5		CLAY / /
18.9	156.3		CLAY / MEDIUM SAND /
19.5	155.7		SHALE / /
19.8	155.4		LIMESTONE / /

6601403 Lot Conc NIAGARA FALLS CITY / NIAGARA (WELLAND)

Date 10/6/1964 DD/MM/YYYY

Elev 171.8 (masl) Easting 653013 Northing 4767742

/ Domestic Water Supply UTM RC 5 margin of error : 100 m - 300 m

Water Found 23.8 (mbgs) 148.0 (masl) SULPHUR

Casing Diameter 6 inch Casing Material: STEEL

Top of Screen (mbgs) Bottom of Screen (mbgs)

Screen Interval (m)

Flowing? N

SWL	6.7	(mbgs)	165.1	(masl)
Pumping WL	22.9	(mbgs)	149.0	(masl)
Pump Rate	36.4	(LPM)	2 / 0	
Spec. Cap.	2.25	(LPM/m)	Hour / Minute	

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	171.8		
20.7	151.1	BROWN	CLAY / /
22.9	149.0		HARDPAN / GRAVEL /
23.8	148.0		LIMESTONE / /

6602252 Lot 009 Conc NIAGARA FALLS CITY (WILLOUGHBY) / NIAGARA (WELLAND)

Date 5/31/1954 DD/MM/YYYY

Elev 175.4 (masl) Easting 653724 Northing 4766671

/ Public Water Supply UTM RC 9 unknown UTM

Water Found 28.0 (mbgs) 147.4 (masl) FRESH

Casing Diameter 6 inch Casing Material: STEEL

Top of Screen (mbgs) Bottom of Screen (mbgs)

Screen Interval (m)

Flowing? N

SWL	4.3	(mbgs)	171.2	(masl)
Pumping WL	10.7	(mbgs)	164.8	(masl)
Pump Rate	45.5	(LPM)	4 / 0	
Spec. Cap.	7.10	(LPM/m)	Hour / Minute	

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	175.4		
3.0	172.4		CLAY / /
24.4	151.1	BLUE	CLAY / /
25.3	150.1		STONES / /
25.9	149.5		FINE SAND / /
28.0	147.4		LIMESTONE / /

6602253 Lot 010 Conc NIAGARA FALLS CITY (WILLOUGHBY) / NIAGARA (WELLAND)

Date 3/3/1959 DD/MM/YYYY

Elev 112.7 (masl) Easting 653204 Northing 4767581

/ Commerical Water Supply UTM RC 5 margin of error : 100 m - 300 m

Water Found 29.0 (mbgs) 83.7 (masl) SULPHUR

Casing Diameter 5 inch Casing Material: STEEL

Top of Screen (mbgs) Bottom of Screen (mbgs)

Screen Interval (m)

Flowing? N

SWL	9.1	(mbgs)	103.5	(masl)
Pumping WL	11.6	(mbgs)	101.1	(masl)
Pump Rate	90.9	(LPM)	0 / 30	
Spec. Cap.	37.29	(LPM/m)	Hour / Minute	

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	112.7		
5.5	107.2	RED	CLAY / /
15.5	97.1	BLUE	CLAY / /
24.4	88.3		MEDIUM SAND / /
26.5	86.2		GRAVEL / /
29.0	83.7		SHALE / /

Well Record #

6602286 — **Lot 016 Conc 07 NIAGARA FALLS CITY (WILLOUGHBY) / NIAGARA (WELLAND)**

Date 6/4/1954 (DD/MM/YYYY)
Elev 174.2 (masl) Easting 653742 Northing 4766581
/ Public Water Supply UTM RC 9 unknown UTM
Water Found 11.0 (mbgs) 163.2 (masl) SULPHUR
Casing Diameter 6 inch Casing Material: STEEL
Top of Screen (mbgs) Bottom of Screen (mbgs)
Screen Interval (m)

Flowing? N
SWL 3.7 (mbgs) 170.5 (masl)
Pumping WL 6.1 (mbgs) 168.1 (masl)
Pump Rate 36.4 (LPM) 2 / 0
Spec. Cap. 14.91 (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	174.2		
4.6	169.6		CLAY / /
10.1	164.1	BLUE	CLAY / /
10.4	163.8		MEDIUM SAND / GRAVEL /
11.0	163.2		GRAVEL / /
11.3	162.9		LIMESTONE / /

6602673 — **Lot 010 Conc NIAGARA FALLS CITY (WILLOUGHBY) / NIAGARA (WELLAND)**

Date 7/17/1972 (DD/MM/YYYY)
Elev 175.6 (masl) Easting 652935 Northing 4766973
/ Domestic Water Supply UTM RC 4 margin of error : 30 m - 100 m
Water Found 24.7 (mbgs) 150.9 (masl) SULPHUR
Casing Diameter 6 inch Casing Material: STEEL
Top of Screen (mbgs) Bottom of Screen (mbgs)
Screen Interval (m)

Flowing? N
SWL 7.0 (mbgs) 168.6 (masl)
Pumping WL 13.7 (mbgs) 161.9 (masl)
Pump Rate 45.5 (LPM) 2 / 0
Spec. Cap. 6.78 (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	175.6		
4.6	171.0	BROWN	CLAY / /
23.5	152.1	RED	CLAY / SILT /
24.1	151.5	GREY	CLAY / GRAVEL /
25.0	150.6	GREY	LIMESTONE / /

6604672 — **Lot 016 Conc 06 NIAGARA FALLS CITY (WILLOUGHBY) / NIAGARA (WELLAND)**

Date 9/3/2002 (DD/MM/YYYY)
Elev 176.3 (masl) Easting 654651 Northing 4766430
/ Domestic Water Supply UTM RC 5 margin of error : 100 m - 300 m
Water Found 33.5 (mbgs) 142.8 (masl) FRESH
Casing Diameter 6 inch Casing Material: STEEL
Top of Screen (mbgs) Bottom of Screen (mbgs)
Screen Interval (m)

Flowing? N
SWL 4.6 (mbgs) 171.7 (masl)
Pumping WL (mbgs) (masl)
Pump Rate 181.8 (LPM) 1 / 0
Spec. Cap. (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	176.3		
5.5	170.8	BROWN	CLAY / TOPSOIL /
11.9	164.4	RED	CLAY / /
32.3	144.0	RED	CLAY / BOULDERS /
34.1	142.1	GREY	GRAVEL / BOULDERS /

6604962 — **Lot 003 Conc NIAGARA FALLS CITY / NIAGARA (WELLAND)**

Date 7/24/2006 (DD/MM/YYYY)
Elev 178.5 (masl) Easting 653232 Northing 4770049
/ Not Used Observation Wells UTM RC 3 margin of error : 10 - 30 m
Water Found 4.5 (mbgs) 174.0 (masl) FRESH
Casing Diameter 5.1 cm Casing Material: PLASTIC
Top of Screen 1.5 (mbgs) Bottom of Screen 6.0 (mbgs)
Screen Interval 4.5 (m)

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	178.5		
6.0	172.5	RED	SAND / SILTY / CLAY

Well Record #

7191623 Lot Conc NIAGARA FALLS CITY / NIAGARA (WELLAND)

Date 6/7/2012 DD/MM/YYYY | Elev 177.0 (masl) | Easting 652232 | Northing 4768877 | / Monitoring | Observation Wells | UTM RC 4 | margin of error : 30 m - 100 m

Water Found (mbgs) (masl)

Casing Diameter 5.2 cm | Casing Material: PLASTIC

Top of Screen 12.2 (mbgs) | Bottom of Screen 15.2 (mbgs)

Screen Interval 3.0 (m)

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	177.0		
0.3	176.7	BLACK	TOPSOIL / /
3.3	173.7	BROWN	CLAY / SILT / LIGHT-COLOURED
15.2	161.8	GREY	CLAY / / SOFT

7191624 Lot Conc NIAGARA FALLS CITY / NIAGARA (WELLAND)

Date 6/7/2012 DD/MM/YYYY | Elev 177.9 (masl) | Easting 652288 | Northing 4768803 | / Monitoring | Observation Wells | UTM RC 4 | margin of error : 30 m - 100 m

Water Found (mbgs) (masl)

Casing Diameter 5.2 cm | Casing Material: PLASTIC

Top of Screen 12.2 (mbgs) | Bottom of Screen 15.2 (mbgs)

Screen Interval 3.0 (m)

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	177.9		
0.3	177.6	BLACK	TOPSOIL / /
3.3	174.6	BROWN	CLAY / SILT / LIGHT-COLOURED
15.2	162.7	GREY	CLAY / /

7200894 Lot Conc NIAGARA FALLS CITY (CROWLAND) / NIAGARA (WELLAND)

Date 2/26/2013 DD/MM/YYYY | Elev 177.2 (masl) | Easting 652849 | Northing 4766352 | / Monitoring | Test Hole | UTM RC 4 | margin of error : 30 m - 100 m

Water Found (mbgs) (masl)

Casing Diameter 5 cm | Casing Material: PLASTIC

Top of Screen 3.0 (mbgs) | Bottom of Screen 6.1 (mbgs)

Screen Interval 3.0 (m)

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	177.2		
2.4	174.8	BROWN	CLAY / SILT / SILTY
6.1	171.1	BROWN	CLAY / /

7231244 Lot Conc NIAGARA FALLS CITY (WILLOUGHBY) / NIAGARA (WELLAND)

Date 10/3/2014 DD/MM/YYYY | Elev 176.8 (masl) | Easting 652902 | Northing 4767380 | / Monitoring | Observation Wells | UTM RC 4 | margin of error : 30 m - 100 m

Water Found (mbgs) (masl)

Casing Diameter 2.5 inch | Casing Material: PLASTIC

Top of Screen 27.4 (mbgs) | Bottom of Screen (mbgs)

Screen Interval (m)

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	176.8		
0.3	176.5	BLACK	SILT / CLAY / TOPSOIL
1.2	175.5	BROWN	SAND / GRAVEL / GRAVEL
3.0	173.7	BROWN	CLAY / SILT / CLAY
9.1	167.6	GREY	CLAY / SILT / SILT
15.8	160.9	RED	CLAY / SILT / SILT
17.4	159.4	RED	SILT / CLAY / CLAY
22.9	153.9	RED	CLAY / SILT / CLAY
26.8	149.9	GREY	SILT / GRAVEL / SILT
28.9	147.9	GREY	LIMESTONE / / LIMESTONE

Well Record #

7256214 | Lot | Conc | NIAGARA FALLS CITY / NIAGARA (WELLAND)

Date 12/2/2015 (DD/MM/YYYY) | Elev 172.8 (masl) | Easting 654718 | Northing 4767998 | UTM RC 4 | margin of error : 30 m - 100 m

/ Monitoring and Te | Monitoring and Test Hole

Water Found (mbgs) (masl)

Casing Diameter 1.3 inch | Casing Material: PLASTIC

Top of Screen 2.4 (mbgs) | Bottom of Screen 5.5 (mbgs)

Screen Interval 3.0 (m)

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	172.8		
4.6	168.3	BROWN	CLAY / SILT / PACKED
5.5	167.3	GREY	CLAY / SILT /

7256216 | Lot | Conc | NIAGARA FALLS CITY / NIAGARA (WELLAND)

Date 12/2/2015 (DD/MM/YYYY) | Elev 180.3 (masl) | Easting 654039 | Northing 4767847 | UTM RC 4 | margin of error : 30 m - 100 m

/ Monitoring and Te

Water Found (mbgs) (masl)

Casing Diameter 1.3 inch | Casing Material: PLASTIC

Top of Screen 2.4 (mbgs) | Bottom of Screen 5.5 (mbgs)

Screen Interval 3.0 (m)

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	180.3		
0.6	179.7	BROWN	TOPSOIL / / LOOSE
5.5	174.9	BROWN	CLAY / SILT / PACKED

7265625 | Lot | Conc | NIAGARA FALLS CITY (CROWLAND) / NIAGARA (WELLAND)

Date 3/2/2016 (DD/MM/YYYY) | Elev 177.3 (masl) | Easting 652859 | Northing 4766334 | UTM RC 4 | margin of error : 30 m - 100 m

/

Water Found (mbgs) (masl)

Casing Diameter | Casing Material:

Top of Screen (mbgs) | Bottom of Screen (mbgs)

Screen Interval (m)

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0	177.3		

/ /

7305848 | Lot | Conc | NIAGARA FALLS CITY (CROWLAND) / NIAGARA (WELLAND)

Date 12/21/2017 (DD/MM/YYYY) | Elev (masl) | Easting 652826 | Northing 4767454 | UTM RC 4 | margin of error : 30 m - 100 m

Monitoring / Test Hole | Abandoned-Other

Water Found (mbgs) (masl)

Casing Diameter | Casing Material:

Top of Screen (mbgs) | Bottom of Screen (mbgs)

Screen Interval (m)

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0			

/ /

7322038 | Lot | Conc | NIAGARA FALLS CITY / NIAGARA (WELLAND)

Date 9/12/2018 (DD/MM/YYYY) | Elev (masl) | Easting 653971 | Northing 4767892 | UTM RC 4 | margin of error : 30 m - 100 m

/ Monitoring | Observation Wells

Water Found (mbgs) (masl)

Casing Diameter 2 inch | Casing Material: PLASTIC

Top of Screen 4.6 (mbgs) | Bottom of Screen 7.6 (mbgs)

Screen Interval 3.0 (m)

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0			
4.6		BROWN	CLAY / SILT / OTHER
7.6		GREY	CLAY / SILT / SOFT

Well Record #

7323779 Lot Conc NIAGARA FALLS CITY / NIAGARA (WELLAND)

Date 11/13/2018 DD/MM/YYYY | Elev (masl) | Easting 652393 | Northing 4769711 | / Monitoring | Observation Wells | UTM RC 4 | margin of error : 30 m - 100 m

Water Found 6.1 (mbgs) (masl)

Casing Diameter 2 Inch | Casing Material: PLASTIC

Top of Screen 4.6 (mbgs) | Bottom of Screen 7.6 (mbgs)

Screen Interval 3.0 (m)

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0			
0.3			TOPSOIL / /
4.6		BROWN	CLAY / SILTY / DENSE
7.6		RED	CLAY / / SOFT

7323780 Lot Conc NIAGARA FALLS CITY / NIAGARA (WELLAND)

Date 11/13/2018 DD/MM/YYYY | Elev (masl) | Easting 652402 | Northing 4769711 | / Monitoring | Observation Wells | UTM RC 4 | margin of error : 30 m - 100 m

Water Found 6.1 (mbgs) (masl) Untested

Casing Diameter 2 Inch | Casing Material: PLASTIC

Top of Screen 4.6 (mbgs) | Bottom of Screen 7.6 (mbgs)

Screen Interval 3.0 (m)

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0			
0.3			TOPSOIL / /
4.6		BROWN	CLAY / SILTY / DENSE
7.6		RED	CLAY / / SOFT

7323787 Lot Conc NIAGARA FALLS CITY / NIAGARA (WELLAND)

Date 11/13/2018 DD/MM/YYYY | Elev (masl) | Easting 652550 | Northing 4769673 | / Monitoring | Observation Wells | UTM RC 4 | margin of error : 30 m - 100 m

Water Found (mbgs) (masl)

Casing Diameter 2 inch | Casing Material: PLASTIC

Top of Screen 1.5 (mbgs) | Bottom of Screen 3.0 (mbgs)

Screen Interval 1.5 (m)

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0			
1.5		BLACK	SILT / CLAY /
3.5		BROWN	SILT / CLAY / STONES

7323789 Lot Conc NIAGARA FALLS CITY / NIAGARA (WELLAND)

Date 11/6/2018 DD/MM/YYYY | Elev (masl) | Easting 652485 | Northing 4769940 | / Monitoring | Observation Wells | UTM RC 4 | margin of error : 30 m - 100 m

Water Found 6.1 (mbgs) (masl) Untested

Casing Diameter 2 inch | Casing Material: PLASTIC

Top of Screen 9.3 (mbgs) | Bottom of Screen 12.3 (mbgs)

Screen Interval 3.0 (m)

Flowing?
SWL (mbgs) (masl)
Pumping WL (mbgs) (masl)
Pump Rate (LPM) /
Spec. Cap. (LPM/m) Hour / Minute

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0			
1.5			FILL / /
4.6		BROWN	SILT / CLAY / SAND
11.3		GREY	SILT / STONES / SAND
12.3		BROWN	SILT / STONES / SAND

Well Record #

7338633 **Lot 010 Conc NIAGARA FALLS CITY (WILLOUGHBY) / NIAGARA (WELLAND)**

Flowing?

Date 3/16/2018 DD/MM/YYYY

Elev (masl) Easting 652978 Northing 4767551

UTM RC 4 margin of error : 30 m - 100 m

SWL (mbgs) (masl)

Pumping WL (mbgs) (masl)

Pump Rate (LPM) /

Spec. Cap. (LPM/m) Hour / Minute

/

Water Found (mbgs) (masl)

Casing Diameter Casing Material:

Top of Screen (mbgs) Bottom of Screen (mbgs)

Screen Interval (m)

Depth (m)	Elev (masl)	Color	Soil Descriptions
0.0			

/ /

APPENDIX

B BOREHOLE LOGS

Explanation of Terms Used in the Record of Borehole

Sample Type

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Dimension type sample
FS	Foil sample
NR	No recovery
RC	Rock core
SC	Soil core
SS	Spoon sample
SH	Shelby tube sample
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

Penetration Resistance

Standard Penetration Resistance (SPT), N:
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) required to drive a 50 mm (2 in) drive open sampler for a distance of 300 mm (12 in).

WH – Samples sinks under "weight of hammer"

Dynamic Cone Penetration Resistance, N_d:
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) to drive uncased a 50 mm (2 in) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in).

Textural Classification of Soils (ASTM D2487-10)

Classification	Particle Size
Boulders	> 300 mm
Cobbles	75 mm - 300 mm
Gravel	4.75 mm - 75 mm
Sand	0.075 mm - 4.75 mm
Silt	0.002 mm - 0.075 mm
Clay	<0.002 mm(*)

(*) Canadian Foundation Engineering Manual (4th Edition)

Coarse Grain Soil Description (50% greater than 0.075 mm)

Terminology	Proportion
Trace	0-10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. sand and gravel)	> 35%

Soil Description

a) Cohesive Soils(*)

Consistency	Undrained Shear Strength (kPa)	SPT "N" Value
Very soft	<12	0-2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very stiff	100-200	15-30
Hard	>200	>30

(*) Hierarchy of Shear Strength prediction
1. Lab triaxial test
2. Field vane shear test
3. Lab. vane shear test
4. SPT "N" value
5. Pocket penetrometer

b) Cohesionless Soils

Density Index (Relative Density)	SPT "N" Value
Very loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

Soil Tests

w	Water content
w_P	Plastic limit
w_l	Liquid limit
C	Consolidation (oedometer) test
CID	Consolidated isotropically drained triaxial test
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement
D_R	Relative density (specific gravity, Gs)
DS	Direct shear test
ENV	Environmental/ chemical analysis
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified proctor compaction test
SPC	Standard proctor compaction test
OC	Organic content test
U	Unconsolidated Undrained Triaxial Test
V	Field vane (LV-laboratory vane test)
γ	Unit weight

Explanation of Terms Used in the Bedrock Core Log

Strength (ISRM)

Term	Grade	Description	Unconfined Compressive Strength (MPa)	(psi)
Extremely weak rock	RO	Indented by thumbnail	0.25-1.0	36-145
Very weak	R1	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	1.0-5.0	145-725
Weak rock	R2	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	5.0-25	725-3625
Medium Strong	R3	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	25-50	3625-7250
Strong rock	R4	Specimen require more than one blow of geological hammer to fracture it	50-100	7250-14500
Very strong rock	R5	Specimen requires many blows of geological hammer to fracture it	100-250	14500-36250
Extremely strong rock	R6	Specimen can only be chipped with geological hammer	>250	>36250

Bedding (Geological Society Eng. Group Working Party, 1970. Q.J. of Eng. Geol. Vol. 3)

Term	Bed Thickness	
Very thickly bedded	>2 m	>6.5 ft
Thickly bedded	600 mm-2 m	2.00-6.50 ft
Medium bedded	200 mm-600 mm	0.65-2.00 ft
Thinly bedded	60 mm-200 mm	0.20-0.65 ft
Very thinly bedded	20 mm-60 mm	0.06-0.20 ft
Laminated	6 mm-20 mm	0.02-0.06 ft
Thinly laminated	<6 mm	<0.02 ft

TCR (Total Core Recovery)

Sum of lengths of rock core recovered from a core run, divided by the length of the core run and expressed as a percentage.

SCR (Solid Core Rocovery)

Sum length of solid, full diameter drill core recovered expressed as a percentage of the total length of the core run.

RQD (Rock Quality Designation, after Deere, 1968)

Sum of lengths of pieces of rock core measured along centreline of core equal to or greater than 100 mm from a core run, divided by the length of the core run and expressed as a percentage. Core fractured by drilling is considered intact. RQD normally quoted for N-size or H-size core.

RQD(%)	Rock Quality
90-100	Excellent
75-90	Good
50-75	Fair
25-50	Poor
0-25	Very poor

Weathering (ISRM)

Term	Grade	Description
Fresh	W1	No visible sign of rock material weathering
Slightly weathered	W2	Discolouration indicates weathering of rock material and discontinuity surface. All the rock material may be discoloured by weathering and may be somewhat weaker than in its fresh condition
Moderately weathered	W3	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a either as a continuous framework or as corestones
Highly weathered	W4	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a continuous framework or as corestones
Completely weathered	W5	All rock material is decomposed and/or disintegrated to a soil. The original mass structure is still largely intact
Residual soil	W6	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported

(FI) Fracture Index

Expressed as the number of discontinuities per 300mm (1 ft). Excludes drill-induced fractures and fragmented zones. Reported as ">25" if frequency exceeds 25 fractures/0.3m.

Broken Zone

Zone of full diameter core of very low RQD which may include some drill-induced fractures.

Fragmented Zone

Zone where core is less than full diameter and RQD = 0.

Discontinuity Spacing (ISRM)

Term	Average Spacing	
Extremely widely spaced	>6 m	>20.00 ft
Very widely spaced	2 m-6 m	6.50-20.00 ft
Widely spaced	600 mm-2 m	2.00-6.50 ft
Moderately spaced	200 mm-600 mm	0.65-2.00 ft
Closely spaced	60 mm-200 mm	0.20-0.65 ft
Very closely spaced	20 mm-60 mm	0.06-0.20 ft
Extremely closely spaced	<20 mm	>0.06 ft

Note: Excludes drill-induced fractures and fragmented rock.

Discontinuity Orientation

Discontinuity, fracture and bedding plane orientations are cited as the acute angle measured with respect to the core axis. Fractures perpendicular to the core axis are at 90° and those parallel to the core axis are at 0°.

LOG OF BOREHOLE BH20-01

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 1D
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-09-2020 to Dec-09-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4769584.2 E 653265.365
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
180.5	Ground Surface											
0.0	**FILL:** silty clay, some sand to sandy, trace gravel, trace organics, trace rootlet, brownish grey, moist, stiff to very stiff.		1	SS	11		Concrete					
							Sand					
			2	SS	15		180					
178.9												
1.5	**SILTY CLAY:** trace sand, contains silt seams, brown, moist, very stiff to very soft.		3	SS	23		179					
			4	SS	13		178					
			5	SS	7		177		51		8.4	0 1 (99)
	brownish grey		6	SS	4		176					
			1	Vane				3.3 +35				
	125mm reddish brown silt layer		8	SS	4		175					
	grey, wet		1	TW			174					
			9	SS	4		173					0 1 55 44
			10	SS	1		Holeplug					
							172					
			2	Vane			171	1.3 +28				
						▽	W. L. 170.7 m					

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-01

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 1D
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-09-2020 to Dec-09-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4769584.2 E 653265.365
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
170.3							W. L. 170.5 m Dec 18, 2020					
10.2	**CLAYEY SILT TILL:** sandy, trace gravel, reddish brown, moist to wet, firm.						170					
11			12	SS	7				○			11 32 45 12
168.7							169					
11.7	**SILTY SAND:** gravelly, trace clay, contains silty clay pockets, reddish brown, wet, dense to very dense.											
12			13	SS	48				○			26 40 27 7
13							168					
	75mm silty clay layer						167					
14			14	SS	50/ 150mm				○			
166.1							166					
14.3	**BEDROCK:**											
15	Coring began at 14.02m Refer to Rock Core Log		1	RC			Sand					
							165					
16			2	RC			Screen					
							164					
163.7												
16.8	**END OF BOREHOLE**											

Note:
1) TW denotes thin wall shelby tube sample.
2) 50 mm monitoring well was installed upon completion, screened between 15.24m and 16.76m.

Water Level measured in monitoring well:

Date	W.L.Depth (m)
Dec. 18, 2020	10.96
Dec. 23, 2020	9.77

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF ROCK CORE BH20-01

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 1D
LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-09-2020 to Dec-09-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4769584.2 E 653265.365
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE NUMBER	CORE SAMPLE SIZE	TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm^3) E (GPa)
166.1	Rock Surface															
14.3	**SALINA FORMATION:** Bedding almost horizontal (θ=90°)								0	Fragmented zone: 14.67m-14.72m						
15			1	HQ	100	95		95	5		W2 to W1					
165.1									0							
15.4									0	Fracture: 15.88m-15.90m, θ=0° and 15°, two sets			108	40		
16			2	HQ	100	93		80	4	16.34m-16.35m, θ=80°	W2 to W1					
									4	Soft layer 16.17m ~ 16.2m (W5)			66	68		
163.7									1							
16.8	**END OF BOREHOLE** Note: 1) 50 mm monitoring well was installed upon completion, screened between 15.24m and 16.76m. Water Level measured in monitoring well: Date W.L.Depth (m) Dec. 18, 2020 10.96 Dec. 23, 2020 9.92								5	16.69m ~ 16.74m (W5)						

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered θ = angle to the core axis

E = Modulus of Elasticity
*: UCS [Mpa] ≈ 24 $I_{S(50)}$

LOG OF BOREHOLE BH20-02

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers
ENCL NO.: 2
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm
ORIGINATED BY AKJ
DATUM: Geodetic
Date: Dec-14-2020 to Dec-14-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4769568.12 E 652816.68
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
181.2	Ground Surface						
181.0 0.2	**ASPHALT:** 150mm						
	FILL: crusher run limestone mix with silty clay pockets, grey, moist, compact.		1	SS	16		181
			2	SS	15		180
178.9 2.3	**FILL:** crusher run limestone, grey, moist, compact to loose.		3	SS	16		179
			4	SS	8		178
			5	SS	20		177
			6	SS	14		176
			7	SS	8		175
174.7 6.6	**SILTY CLAY:** trace sand, contains silt seams, reddish brown, moist, firm to very soft.		8	SS	6		174
			9	SS	2		173
			1	Vane			172

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)
REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

+ 2.7 28

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-02

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers
ENCL NO.: 2
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm
ORIGINATED BY AKJ
DATUM: Geodetic
Date: Dec-14-2020 to Dec-14-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4769568.12 E 652816.68
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued							
	SILTY CLAY: trace sand, contains silt seams, reddish brown, moist, firm to very soft.(Continued)						171	
	grey, wet		10	SS	3			
							170	
			1	TW			169	
							168	
	contains dilatant reddish brown silt layers		11	SS	3			0 0 63 37
166.4							167	
14.8	**SILT:** some clay to clayey, trace sand, dilatant, reddish brown, wet, compact.							
165.7			12	SS	15		166	
15.5	**CLAYEY SILT TILL:** sandy, trace gravel, contains shale/limestone fragments, reddish brown, moist, stiff to hard.							
			13	SS	>50/ Initial50mm		165	
164.4								
16.8								

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH (kPa) 20 40 60 80 100
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) 10 20 30

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-03

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 3
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-02-2020 to Dec-03-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4769057.248 E 652136.143
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa)	WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
178.1	Ground Surface											
178.0	**ASPHALT:** 150mm						178					
0.2	**GRANULAR FILL:** sand and gravel, trace silt, trace clay, grey, moist, very dense to dense,		1	SS	58							
			2	SS	35		177					
176.6												
1.5	**FILL:** silty clay, trace sand, trace gravel, trace organics, brown, moist, firm.		3	SS	7		176					
	reddish brown		4	SS	5							
175.0			1	Vane			175					
3.1	**SILTY CLAY:** trace sand, occasional gravel, reddish brown, moist, firm.		6	SS	6	▽						0 1 (99)
			1	TW		W. L. 174.6 m Jan 13, 2020	174					
173.5												
4.6	**SILT:** trace to some clay, trace sand, dilatant, reddish brown, wet, compact.		8	SS	26		173					
172.8												
5.3	**SILTY CLAY:** trace sand, occasional gravel, contains dilatant silt seams/layers,reddish brown, wet, firm to soft		9	SS	4							
			2	Vane			172	3.0 +42				
			11	SS	4							
			2	TW			171					
			13	SS	6		170					
			3	Vane			169	2.3 +24				

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-03

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 3
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-02-2020 to Dec-03-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4769057.248 E 652136.143
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS "N" 0.3 m	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued					
	SILTY CLAY: trace sand, occasional gravel, contains dilatant silt seams/layers,reddish brown, wet, firm to soft(Continued)				168	
11		15	SS	3	167	0 0 67 33
12		3	TW		166	
13					165	
164.8						
13.3	**SILT:** trace to some clay, trace sand, dilatant, reddish brown, wet to saturated, very loose.					
14		17	SS	2	164	3 5 (92)
15					163	spoon got hard
162.9						
15.2	**BEDROCK:**					
	Coring began at 15.24m Refer to Rock Core Log	1	RC			
16		2	RC		162	
17					161	
18		3	RC		160	
19		4	RC		159	
20						

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100
SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100
PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%) 10 20 30
[Non-Plastic]
POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ε=3% Strain at Failure

LOG OF BOREHOLE BH20-03

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 3
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-02-2020 to Dec-03-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4769057.248 E 652136.143
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	SOIL PROFILE: DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
158.0							158					
20.1	**END OF BOREHOLE** Note: 1) TW denotes thin wall shelby tube sample. 2) 50 mm monitoring well was installed upon completion, screened between 4.50m and 7.60m. Water Level measured in monitoring well: Date W.L.Depth (m) Jan. 13, 2021 3.5											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF ROCK CORE BH20-03

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 3
LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-02-2020 to Dec-03-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4769057.248 E 652136.143
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE NUMBER	CORE SAMPLE SIZE	TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm³) E (GPa)
162.9	Rock Surface															
15.2	**SALINA FORMATION:** Bedding almost horizontal (θ=90°)		1	HQ	100	23		18	>25 10 10	Fragmented zone:15.24m-15.57m 15.81m-15.95m Fracture: 15.57m-15.61m, θ=45° 15.57m-15.65m, θ=10° 15.65m-15.67m, θ=65° 15.75m-15.81m, θ=20° Lost zone: 15.95m-16.33m(inferred)	W2					
162.2																
16.0			2	HQ	64	38		17	>25 >25 3 4	Fragmented zone:16.33m-16.54m Fracture: 16.74m-16.80m, θ=40° 16.83m-16.87m, θ=70° 16.92m-16.94m, θ=50° 16.93m-16.97m, θ=60° 16.97m-17.02m, θ=45°	W4 to W1					
161.1																
17.0			3	HQ	100	97		65	7 6 3 0 1	Fragmented zone: 17.02m-17.04m Fracture: 17.46m-17.48m, θ=80° 17.61m-17.67m, θ=40° 18.42m-18.44m, θ=70°	W2 to W1		189	87	215.1	2.71
159.6																
18.5			4	HQ	95	92		81	0 7 1 0 0	Fracture: 18.85m-18.90m, θ=0° and 5°, two sets 18.94m-18.96m, θ=80° 18.98m-19.01m, θ=65°	W4 to W1		40	26		
158.0																
20.1	**END OF BOREHOLE** Note: 1) 50 mm monitoring well was installed upon completion, screened between 4.50m and 7.60m. Water Level measured in monitoring well: Date W.L.Depth (m) Jan. 13, 2021 3.5															

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered

θ = angle to the core axis

E = Modulus of Elasticity

*: UCS [Mpa] ≈ 24 $I_{S(50)}$

LOG OF BOREHOLE BH20-04

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 4
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-07-2020 to Dec-08-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4769091.167 E 652847.816
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
178.9	Ground Surface					
0.0	**FILL:** crusher run limestone, contains silty sand pockets, brownish grey, moist, compact.	1	SS	26		
178.2						
0.8	**FILL:** silty clay, trace sand, trace gravel, trace organics, trace rootlet, brownish grey, moist, stiff.	2	SS	9		178
177.9 1.1	**SILTY CLAY:** trace sand, contains silt seams, brown, moist, very stiff to very soft.	3	SS	20		177
		4	SS	16		
	reddish brown	5	SS	12		176
		6	SS	9		175
		7	SS	7		174
		8	SS	7		
		9	SS	8		173
	grey, wet	10	SS	2		172
		1	Vane			171
						170
						169

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH (kPa) 20 40 60 80 100
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
2.5
+35

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
0	4	(96)	

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-04

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 4
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-07-2020 to Dec-08-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4769091.167 E 652847.816
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued										
	SILTY CLAY: trace sand, contains silt seams, brown, moist, very stiff to very soft.(Continued)										
11			12	SS	2		168				0 0 68 32
12							167				
			1	TW							
13							166				
14			14	SS	6		165				0 0 70 30
164.3											
14.6	**SILT:** some sand, trace gravel, trace clay, contains clayey silt layers/pockets, dilatant, reddish brown, wet, loose.										
15	trace gravel, contains shale fragments		15	SS	6		164		[Non-Plastic]		8 20 64 8
16							163				
162.5											
16.5	**BEDROCK:**		1	RC			162				
17	Coring began at 16.31m Refer to Rock Core Log										
18			2	RC			161				
19			3	RC			160				
159.0											

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-04

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 4
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-07-2020 to Dec-08-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4769091.167 E 652847.816
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

SOIL PROFILE			SAMPLES						DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION						GR SA SI CL
	Continued												
19.9	**END OF BOREHOLE** Note: 1) TW denotes thin wall shelby tube sample.												

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF ROCK CORE BH20-04

PROJECT: Geotechnical Investigation | REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara | Method: Hollow Stem Augers/HQ Core | ENCL NO.: 4
LOCATION: Niagara Region Sanitary Sewer | Diameter: 203 mm/63mm | ORIGINATED BY SL
DATUM: Geodetic | Date: Dec-07-2020 to Dec-08-2020 | COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4769091.167 E 652847.816 | Equipment: Pontil Drilling CME 75 (Truck) | CHECKED BY MK

(m) ELEV DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE NUMBER	CORE SAMPLE SIZE	TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm³) E (GPa)
162.5	Rock Surface															
16.5 / 161.8	**SALINA FORMATION:** Bedding almost horizontal (θ=90°)		1	HQ	100	44		44	>25, 6	Fragmented zone: 16.46m-16.81m; Fracture: 16.81m-16.82m, θ=0° to 50°	W2					
17.1 / 160.3			2	HQ	100	100		97	0, 0, 0, 2, 0	Joint: 17.09m-17.25m, θ=0°; 17.42m-17.50m, θ=0°	W2 to W1				100	2.61
18.6 / 159.0			3	HQ	100	100		100	0, 0, 0, 0	Joint: 18.69m-18.71m, θ=65°; 18.75m-18.77m, θ=70°	W2 to W1		48	24		
19.9	**END OF BOREHOLE** Note:															

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered θ = angle to the core axis

E = Modulus of Elasticity
*: UCS [Mpa] ≈ 24 $I_{S(50)}$

LOG OF BOREHOLE BH20-05

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 5
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-04-2020 to Dec-04-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4768160.887 E 652873.207
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
177.8	Ground Surface											
177.7 / 0.0	**ASPHALT:** 150mm											
177.6 / 0.2	**GRANULAR FILL:** 50mm		1	SS	50/ initial125mm							
	FILL: crusher run limestone, contains silty sand pockets, brownish grey, moist, very dense to compact.											
176.8 / 1.1	**FILL:** silty clay, trace sand, trace gravel, trace organics, trace rootlet, brownish grey, moist, stiff.		2	SS	13		177					
176.0 / 1.8	**SILTY CLAY:** trace sand, contains silt seams, brown, moist, very stiff to very soft.		3	SS	14		176					
			4	SS	19		175					
			5	SS	18							
	---------- brown to reddish brown		6	SS	6		174					
			1	Vane			173	+ 3.0				
			8	SS	11		172					
	contains grey silt seams		9	SS	10							0 2 (98)
							171					
			10	SS	9		170					
							169					
			11	SS	9						8.4	
							168					

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-05

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 5
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-04-2020 to Dec-04-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4768160.887 E 652873.207
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS "N" 0.3 m	ELEVATION
	Continued				
	SILTY CLAY: trace sand, contains silt seams, brown, moist, very stiff to very soft.(Continued)				
	grey, wet	12	SS	2	167
		2	Vane		166
		14	SS	2	164
		1	TW		163
161.5					162
16.3	**SAND AND GRAVEL:** trace silt, trace clay, reddish brown, wet, compact to loose.	16	SS	15	161
159.4					160
18.4	**SILTY CLAY:** trace sand, trace gravel, trace shale fragments, reddish brown, wet, stiff to firm.	17	SS	8	159
					158

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE
DYNAMIC CONE PENETRATION RESISTANCE PLOT
WATER CONTENT (%): PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L

REMARKS AND GRAIN SIZE DISTRIBUTION (%)	GR	SA	SI	CL
	0	5		(95)

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-05

PROJECT: Geotechnical Investigation		REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara	Method: Hollow Stem Augers/HQ Core	ENCL NO.: 5
PROJECT LOCATION: Niagara Region Sanitary Sewer	Diameter: 203 mm/63mm	ORIGINATED BY SL
DATUM: Geodetic	Date: Dec-04-2020 to Dec-04-2020	COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4768160.887 E 652873.207	Equipment: Pontil Drilling CME 75 (Truck)	CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION (Continued)	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa)	WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	SILTY CLAY: trace sand, trace gravel, trace shale fragments, reddish brown, wet, stiff to firm.(Continued)		18	SS	5				○ (approx. 26)			
21							157					
			3	Vane				+ 59 (Sensitivity 2.4)				
22							156					
23							155					
154.1 / 23.8	**BEDROCK:** Coring began at 23.77m. Refer to Rock Core Log						154					
24			1	RC								
152.9 / 25.0	**END OF BOREHOLE** Notes: 1) Borehole was sealed with bentonite and cement grouting. 2) TW denotes thin wall shelby tube sample.						153					

Legend: DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH (kPa): ○ UNCONFINED, + FIELD VANE & Sensitivity, ● QUICK TRIAXIAL, × LAB VANE, 20 40 60 80 100; PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: + 3, × 3 : Numbers refer to Sensitivity; ○ 8 =3% Strain at Failure

LOG OF ROCK CORE BH20-05

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 5
LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-04-2020 to Dec-04-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4768160.887 E 652873.207
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE NUMBER	CORE SAMPLE SIZE	TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm^3) E (GPa)
154.1	Rock Surface															
23.8 24	**SALINA FORMATION:** Bedding almost horizontal (θ=90°)		1	HQ	100	71		48	17 5 3 3	Fragmented zone: 23.91m-24.09m Fracture: 24.42m-24.47m, θ=0° 24.83m-24.99m, θ=10° 24.84m-24.94m, θ=30°	W2 to W1					
152.9																
25.0	**END OF BOREHOLE** Note:															

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered

θ = angle to the core axis

E = Modulus of Elasticity

*: UCS [Mpa] ≈ 24 $I_{S(50)}$

LOG OF BOREHOLE BH20-06D

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/Mud Rotory
ENCL NO.: 6D
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm
ORIGINATED BY AKJ
DATUM: Geodetic
Date: Dec-15-2020 to Dec-16-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4767709.7 E 652872.7
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
175.8	Ground Surface						
175.8 / 0.0	**ASPHALT:** 100mm						
175.7 / 0.1	**FILL:** crusher run limestone, grey, moist, very dense to compact.		1	SS	70/200mm		
	contains silty sand pockets,		2	SS	35		175
174.0			3	SS	10		174
1.8	**FILL:** silty clay, some sand, trace gravel, trace organics, greyish brown, moist, stiff to firm.		4	SS	7		
			5	SS	8	▽	173
172.0							
3.8	**FILL:** crusher run limestone, grey, wet, very loose to loose.		6	SS	4		
171.2							
4.6	**FILL:** clayey silt, sandy, trace gravel, trace organics, brown, moist to wet, firm to soft.		7	SS	4		171
170.1	75mm crushed stone layer		8	SS	3		
5.7	**SILTY CLAY:** some sand, trace gravel, trace organics, trace peat, grey, moist, soft (Alluvial Deposit).		1	Vane			170
168.6							169
7.2	**ORGANIC CLAYEY SILT:** interval with peat seams and layer, sandy, trace rootlets, dark brown, moist, soft to firm.		10	SS	4		168
166.5							167
9.3	**SILTY CLAY:** trace sand, contains reddish brown silt layers, grey, wet, very soft to hard.		11	SS	0		166

W. L. 172.3 m
Jan 13, 2020

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-06D

PROJECT: Geotechnical Investigation
CLIENT: Regional Municipality of Niagara
PROJECT LOCATION: Niagara Region Sanitary Sewer
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4767709.7 E 652872.7

Method: Hollow Stem Augers/Mud Rotory
Diameter: 203 mm
Date: Dec-15-2020 to Dec-16-2020
Equipment: Pontil Drilling CME 75 (Truck)

REF. NO.: 201-11602-00
ENCL NO.: 6D
ORIGINATED BY AKJ
COMPILED BY BW
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
	SILTY CLAY: trace sand, contains reddish brown silt layers, grey, wet, very soft to hard.(Continued)											
			2	Vane			165	1.0 +28				
	reddish grey		13	SS	1		164		○			
			1	TW			163					
	150mm wet grey sandy silt layer		15	SS	16		162		○			
	contains reddish brown silt seams		16	SS	31		161		○			4 3 51 42
158.0							160					
17.8	**SANDY GRAVEL:** trace silt, trace clay, reddish grey, wet, dense.		17	SS	48		159		○			
156.5							158					
19.4	**COARSE SAND:** trace to some gravel, trace silt, trace clay, grey, wet, compact to very dense.						157		○			
							156					

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-06D

PROJECT: Geotechnical Investigation
CLIENT: Regional Municipality of Niagara
PROJECT LOCATION: Niagara Region Sanitary Sewer
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4767709.7 E 652872.7

Method: Hollow Stem Augers/Mud Rotory
Diameter: 203 mm
Date: Dec-15-2020 to Dec-16-2020
Equipment: Pontil Drilling CME 75 (Truck)

REF. NO.: 201-11602-00
ENCL NO.: 6D
ORIGINATED BY AKJ
COMPILED BY BW
CHECKED BY MK

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS "N" 0.3 m	ELEVATION
	Continued				
	COARSE SAND: trace to some gravel, trace silt, trace clay, grey, wet, compact to very dense.(Continued)	18	SS	28	
	150mm dilatant reddish brown sandy silt layer, trace cobbles/boulders	19	SS	92/ 300mm	
153.4					
22.4	**SANDY GRAVEL:** trace silt, trace clay, trace cobbles, grey, wet, very dense.	20	SS	50/ 100	
148.4					
27.4	**BEDROCK:**	21	SS/NR	50/ initial0mm	
		22	SS	50/ initial25mm	

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-06D

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/Mud Rotory
ENCL NO.: 6D
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm
ORIGINATED BY AKJ
DATUM: Geodetic
Date: Dec-15-2020 to Dec-16-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4767709.7 E 652872.7
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
145.3	**BEDROCK:**(Continued)											
30.5	**END OF BOREHOLE** Note: 1) TW denotes thin wall shelby tube sample. 2) 50 mm monitoring well was installed upon completion, screened between 28.35m and 30.48m. Water Level measured in monitoring well: Date W.L.Depth (m) Jan. 13, 2021 3.5		23	SS	50/ initial25mm							

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-06S

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers
ENCL NO.: 6S
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm
DATUM: Geodetic
Date: Dec-17-2020
BH LOCATION: See Borehole Location Plan N 4767710.5 E 652872.6
Equipment: Pontil Drilling CME 75 (Truck)

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
175.8	Ground Surface											
175.7 / 0.1	Direct Drilling to Depth of 15.24 Without Sampling Lithology Inferred from BH-06 (Deep)											
174.0 / 1.8												
172.0 / 3.8						W. L. 171.9 m Jan 13, 2020						
171.2 / 4.6												
170.1 / 5.7												
168.6 / 7.2												
166.5 / 9.3												

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-06S

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers
ENCL NO.: 6S
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm
DATUM: Geodetic
Date: Dec-17-2020
BH LOCATION: See Borehole Location Plan N 4767710.5 E 652872.6
Equipment: Pontil Drilling CME 75 (Truck)

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
11							165					
12							164					
13							163					
14							162					
15							161					
160.6												
15.2	Note: 1) Borehole was sealed with bentonite. 2) 50 mm monitoring well was installed upon completion, screened between 12.19m and 15.24m. Water Level measured in monitoring well: Date W.L.Depth (m) Jan. 13, 2021 3.9											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-07D

PROJECT: Geotechnical Investigation
CLIENT: Regional Municipality of Niagara
PROJECT LOCATION: Niagara Region Sanitary Sewer
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4767374.6 E 652880.1

Method: Hollow Stem Augers//Mud Rotory/HQ Core
Diameter: 203 mm/63mm
Date: Dec-21-2020 to Dec-22-2020
Equipment: Pontil Drilling CME 75 (Truck)

REF. NO.: 201-11602-00
ENCL NO.: 7D
ORIGINATED BY SL
COMPILED BY BW
CHECKED BY MK

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS "N" 0.3 m
177.1	Ground Surface			
177.0 / 0.1	**GRANULAR FILL:** crusher run limestone, grey, moist, compact.	1	SS	19
	FILL: silty clay, trace sand, trace gravel, trace organics, grey, moist, very stiff to stiff.	2	SS	9
175.4 / 1.7	**SILTY CLAY:** trace sand, contains reddish brown silt seams, brown, moist, very stiff to very soft.	3	SS	18
		4	SS	17
		5	SS	14
		6	SS	7
		7	SS	8
	grey	8	SS	7
		9	SS	4
		1	Vane	2.0 +35
	contains dilatant silt layers	11	SS	2

GROUND WATER CONDITIONS: W. L. 171.8 m Jan 13, 2020

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)
REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-07D

PROJECT: Geotechnical Investigation
CLIENT: Regional Municipality of Niagara
PROJECT LOCATION: Niagara Region Sanitary Sewer
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4767374.6 E 652880.1

Method: Hollow Stem Augers//Mud Rotory/HQ Core
Diameter: 203 mm/63mm
Date: Dec-21-2020 to Dec-22-2020
Equipment: Pontil Drilling CME 75 (Truck)

REF. NO.: 201-11602-00
ENCL NO.: 7D
ORIGINATED BY SL
COMPILED BY BW
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
	SILTY CLAY: trace sand, contains reddish brown silt seams, brown, moist, very stiff to very soft.(Continued)						167					
11			1	TW			166					
12							165					
			13	SS	1			○				
13							164					
14			2	Vane			163	+2.0 28				
162.3												
14.8	**SILT:** trace to some clay, trace sand, dilatant, reddish brown, wet, loose to very dense.											
15			15	SS	8		162		○			
16							161					
17	some sand to sandy between 16.8m to 20.4m		17	SS	50		160					
18							159					
			18	SS	58				○			0 15 81 4
19							158					
20												

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-07D

PROJECT: Geotechnical Investigation
CLIENT: Regional Municipality of Niagara
PROJECT LOCATION: Niagara Region Sanitary Sewer
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4767374.6 E 652880.1

Method: Hollow Stem Augers//Mud Rotory/HQ Core
Diameter: 203 mm/63mm
Date: Dec-21-2020 to Dec-22-2020
Equipment: Pontil Drilling CME 75 (Truck)

REF. NO.: 201-11602-00
ENCL NO.: 7D
ORIGINATED BY SL
COMPILED BY BW
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
	SILT: trace to some clay, trace sand, dilatant, reddish brown, wet, loose to very dense.(Continued)		19	SS	55		157					
							156					
			20	SS	56		155					
							154					
152.4							153					
24.7	**CLAYEY SILT TILL:** sandy, trace to some gravel, grey, moist to wet, stiff.		21	SS	13		152					
150.7							151					
26.4	**BEDROCK:** Coring began at 27.13m Refer to Rock Core Log		1	RC			150					
			2	RC			149					
			3	RC			148					

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-07D

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers//Mud Rotory/HQ Core
ENCL NO.: 7D
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-21-2020 to Dec-22-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4767374.6 E 652880.1
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
	BEDROCK:						147					
	Coring began at 27.13m Refer to Rock Core Log(Continued)											
146.4												
30.7	**END OF BOREHOLE**											
	Note: 1) TW denotes thin wall shelby tube sample. 2) 50 mm monitoring well was installed upon completion, screened between 27.43m and 30.48m.											
	Water Level measured in monitoring well: Date W.L.Depth (m) Jan. 13, 2021 5.3											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF ROCK CORE BH20-07D

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers//Mud Rotory/HQ Core
ENCL NO.: 7D
LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-21-2020 to Dec-22-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4767374.6 E 652880.1
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE NUMBER	CORE SAMPLE SIZE	TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm^3) E (GPa)
150.0	Rock Surface															
27.1 149.3	**SALINA FORMATION:** Bedding almost horizontal (θ=90°) *(continued)*		1	HQ	100	84		34	15 5	Fragmented zone:27.37m-27.42m 27.51m-27.55m Fracture: 27.13m-27.23m, θ=10° 27.27m-27.31m, θ=15° to 0°	W2				223.5	2.75
27.8 28 29 147.9			2	HQ	100	95		75	3 3 6 0 4	Fragmented zone: 27.87m-27.88m;28.65m-28.68m Fracture: 28.15m-28.16m, θ=70° 28.33m-28.36m, θ=60° to 65° 29.07m-29.10m, θ=0° and 0°,two sets Joint: 28.18m-28.19m, θ=75° 28.27m-28.28m, θ=80°	W2 to W1					
29.2 30 146.4			3	HQ	100	93		70	6 4 2 1 2	Soft layer 29.29m ~ 29.31m (W5) Fracture: 29.16m-29.21m, θ=0° and 5°,two sets 29.74m-29.76m, θ=75°	W2 to W1					
30.7	**END OF BOREHOLE** Note: 1) 50 mm monitoring well was installed upon completion, screened between 27.43m and 30.48m. Water Level measured in monitoring well: Date W.L.Depth (m) Jan. 13, 2021 5.3															

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered θ = angle to the core axis

E = Modulus of Elasticity
*: UCS [Mpa] ≈ 24 $I_{S(50)}$

LOG OF BOREHOLE BH20-07S

PROJECT: Geotechnical Investigation
CLIENT: Regional Municipality of Niagara
PROJECT LOCATION: Niagara Region Sanitary Sewer
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4767373.8 E 652880.3

Method: Hollow Stem Augers
Diameter: 203 mm
Date: Dec-23-2020
Equipment: Pontil Drilling CME 75 (Truck)

REF. NO.: 201-11602-00
ENCL NO.: 7S
ORIGINATED BY AKJ
COMPILED BY BW
CHECKED BY MK

SOIL PROFILE: (m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH (kPa): ○ UNCONFINED, + FIELD VANE & Sensitivity, ● QUICK TRIAXIAL, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
177.0	Ground Surface											
176.9 / 0.1	Direct Drilling to Depth of 19.81 Without Sampling Lithology Inferred from BH-07 (Deep)						176					
175.3 / 1.7							175, 174, 173					
						W. L. 172.4 m Jan 13, 2020	172, 171, 170, 169, 168					

Depth scale (m): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ 8=3% Strain at Failure

LOG OF BOREHOLE BH20-07S

PROJECT: Geotechnical Investigation
CLIENT: Regional Municipality of Niagara
PROJECT LOCATION: Niagara Region Sanitary Sewer
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4767373.8 E 652880.3

Method: Hollow Stem Augers
Diameter: 203 mm
Date: Dec-23-2020
Equipment: Pontil Drilling CME 75 (Truck)

REF. NO.: 201-11602-00
ENCL NO.: 7S
ORIGINATED BY AKJ
COMPILED BY BW
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
11							166					
12							165					
13							164					
14							163					
162.2 14.8												
15							162					
16							161					
17							160					
18							159					
19							158					
157.2 19.8	**END OF BOREHOLE**											

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-07S

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers
ENCL NO.: 7S
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm
ORIGINATED BY AKJ
DATUM: Geodetic
Date: Dec-23-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4767373.8 E 652880.3
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT w_P w w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m						GR SA SI CL
	Continued										
	Note: 1) 50 mm monitoring well was installed upon completion, screened between 16.76m and 19.81m. Water Level measured in monitoring well: Date W.L.Depth (m) Jan. 13, 2021 4.6										

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-08

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 8
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-18-2020 to Dec-18-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4766690.054 E 654312.344
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"
176.9	Ground Surface			
0.0	**FILL:** topsoil with silty clay pockets, trace sand, trace gravel, greyish brown, moist, firm.	1	SS	5
176.1				
0.8	**FILL:** silty clay, trace sand, trace gravel, trace organics, greyish brown, stiff.	2	SS	11
175.4				
1.5	**SILTY CLAY:** trace sand, brown, moist, very stiff to very soft.	3	SS	17
	---------- contains reddish brown silt seams	4	SS	13
		5	SS	9
		6	SS	9
	---------- grey	7	SS	6
		8	SS	6
	---------- reddish grey, wet	9	SS	4
		1	Vane	
		11	SS	3

GROUND WATER CONDITIONS: Concrete; Sand; W. L. 171.1 m Jan 13, 2020 Jan 28, 2021; W. L. 170.4 m Dec 23, 2020

ELEVATION: 176, 175, 174, 173, 172, 170, 169, 168, 167

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) (10 20 30)

2.0
+28

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-08

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 8
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-18-2020 to Dec-18-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4766690.054 E 654312.344
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
	SILTY CLAY: trace sand, brown, moist, very stiff to very soft.(Continued)											
			1	TW			166					0 4 48 48
							165					
			13	SS	0		164					
163.6												
13.3	**SILT:** trace to some clay, trace sand, dilatant, reddish brown, wet, compact.											
			14	SS	18		163					
162.1												
14.8	**SILTY CLAY:** trace sand, contains dilatant silt seams, grey, wet, very soft to stiff.						162					
			15	SS	0		161					
			2	Vane			160	2.0 +31				
							159					
			17	SS	5		Holeplug					
							158					
	trace gravel, trace limestone						157					

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-08

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 8
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-18-2020 to Dec-18-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4766690.054 E 654312.344
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
	fragments, contains dilatant silt layers **SILTY CLAY:** trace sand, contains dilatant silt seams, grey, wet, very soft to stiff.(Continued)		18	SS	7							1 5 59 35
			19	SS	12		156					
							155					
153.7							154					
23.2	**SILT:** trace to some clay, trace sand, trace gravel, dilatant, reddish brown, wet, compact.		20	SS	26		153					
							152					
							151					
							150					
	some gravel, trace shale fragments		21	SS	14		149					
147.6							148					
29.3	**BEDROCK:** Coring began at 29.26m Refer to Rock Core Log		1	RC			147					

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-08

PROJECT: Geotechnical Investigation
CLIENT: Regional Municipality of Niagara
PROJECT LOCATION: Niagara Region Sanitary Sewer
DATUM: Geodetic
BH LOCATION: See Borehole Location Plan N 4766690.054 E 654312.344

Method: Hollow Stem Augers/HQ Core
Diameter: 203 mm/63mm
Date: Dec-18-2020 to Dec-18-2020
Equipment: Pontil Drilling CME 75 (Truck)

REF. NO.: 201-11602-00
ENCL NO.: 8
ORIGINATED BY SL
COMPILED BY BW
CHECKED BY MK

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS "N" 0.3 m	ELEVATION
	Continued				
	BEDROCK:				
	Coring began at 29.26m Refer to Rock Core Log(Continued)	2	RC		
31		3	RC		146
32		4	RC		145
33		5	RC		144
34					143
35		6	RC		142
36					141
					Sand
37		7	RC		140
38					139
					Screen
39		8	RC		138
137.3					
39.6	**END OF THE BOREHOLE** Note: 1) 50 mm monitoring well was				

Continued Next Page

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100
PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%): 10 20 30
POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)
REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-08

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 8
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-18-2020 to Dec-18-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4766690.054 E 654312.344
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m							GR SA SI CL
	Continued installed upon completion, screened between 36.55m and 39.60m. Water Level measured in monitoring well: Date W.L.Depth (m) Dec. 23, 2020 6.50 Jan. 13, 2021 4.61 Jan. 28, 2021 4.71							DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH (kPa) ○ UNCONFINED + FIELD VANE & Sensitivity ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30			

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ε=3% Strain at Failure

LOG OF ROCK CORE BH20-08

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 8
LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-18-2020 to Dec-18-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4766690.054 E 654312.344
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE NUMBER	CORE SAMPLE SIZE	TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm^3) E (GPa)
147.6	Rock Surface															
29.3	**SALINA FORMATION:** Bedding almost horizontal (θ=90°)								20	Fragmented zone:29.26m-29.43m Gysum:30.12m-30.13m Fracture:						
30			1	HQ	100	78		36	7	29.51m-29.63m, θ=5° 29.63m-29.67m, θ=0° and 0°,two sets	W2					
146.7									3	29.83m-29.92m, θ=5°					149.4	2.72
30.2			2	HQ	58	58		58	13	Lost zone:30.38m-30.51m(inferred) Joint:31.28m-31.29m, θ=75°	W2 to W4					
146.4																
30.5									0							
31									2	Gysum: 31.23m-31.24m 31.28m-31.29m 31.67m-31.69m						
			3	HQ	100	98		98	1		W2 to W1					
									1							
32									0							
144.9																
32.0									1	Gysum: 32.03m-32.04m;32.51m-32.53m						
									1	32.91m-32.92m;32.96m-32.97m 33.05m-33.06m;33.10m-33.11m						
			4	HQ	100	100		100	1	33.13m-33.14m;33.19m-33.20m 33.29m-33.30m;33.31m-33.32m	W2 to W1					
33									1	33.34m-33.35m;33.39m-33.41m 33.47m-33.48m Joint:						
									1	32.04m-32.51m, θ=75° 32.75m-32.92m, θ=75°						
143.4																
33.5									4	Fragmented zone: 33.53m-33.55m						
34									2	Gysum: 33.57m-33.58m;33.62m-33.63m						
			5	HQ	100	97		90	2	33.67m-33.68m;33.80m-33.81m 34.06m-34.07m;34.42m-34.44m	W2 to W1					
									2	34.54m-34.55m						
35									1							
141.9																
35.0									1	Gysum: 35.32m-35.33m;35.84m-35.85m						
									0	35.92m-35.93m;36.02m-36.03m 36.04m-36.05m;36.13m-36.14m						
			6	HQ	100	98		78	3	36.25m-36.26m;36.35m-36.36m 36.40m-36.41m;36.46m-36.47m	W2 to W1					
36									1	Fracture: 35.65m-35.67m, θ=55°						
									5	36.25m-36.26m, θ=80°						
140.3																
36.6									3							
37									0	Fracture: 37.55m-37.57m, θ=0°						
			7	HQ	100	100		87	0	Joint: 37.57m-37.62m, θ=0°	W2 to W1					
									1							
38									0							
138.8																
38.1									1	Gysum: 38.48m-38.49m;38.55m-38.56m					160.4	2.78
									4	38.62m-38.63m;38.95m-38.96m 39.27m-39.28m;39.38m-39.39m						
39			8	HQ	100	100		85	2	39.45m-39.46m;39.54m-39.55m 39.59m-39.60m	W2 to W1					
									2	Fracture: 38.95m-38.96m, θ=0°						

Continued Next Page

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered θ = angle to the core axis

E = Modulus of Elasticity

*: UCS [Mpa] ≈ 24 $I_{S(50)}$

LOG OF ROCK CORE BH20-08

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 8
LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-18-2020 to Dec-18-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4766690.054 E 654312.344
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE NUMBER	CORE SAMPLE SIZE	TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm^3) E (GPa)
	Continued															
137.3	**SALINA FORMATION:** Bedding almost horizontal (θ=90°) *(continued)*								1							
39.6	**END OF THE BOREHOLE** Note: 1) 50 mm monitoring well was installed upon completion, screened between 36.55m and 39.60m. Water Level measured in monitoring well: Date W.L.Depth (m) Dec. 23, 2020 6.50 Jan. 13, 2021 4.61 Jan. 28, 2021 4.71															

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered θ = angle to the core axis

E = Modulus of Elasticity
*: UCS [Mpa] ≈ 24 $I_{S(50)}$

LOG OF BOREHOLE BH20-09

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 9
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-09-2020 to Dec-10-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4766605.863 E 652916.408
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
176.0	Ground Surface						
175.9 / 0.1	**ASPHALT:** 100mm						
	GRANULAR FILL: sand and gravel, trace silt, trace clay, grey, moist, compact to dense,		1	SS	30		
175.2 / 0.8	**FILL:** crusher run limestone, contains silty sand pockets, grey, moist, compact to loose.		2	SS	19		175
			3	SS	8		174
			4	SS	10		
			5	SS	18		173
			6	SS	8		172
171.2 / 4.7	**SILTY CLAY:** trace sand, contains silt seams, grey, moist, very soft to stiff.		7	SS	4		171
			8	SS	1		
			1	Vane			170
	---------- reddish brown,wet		10	SS	4		169
			1	TW			168
							167

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

+49 1.8

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)
REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-09

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 9
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-09-2020 to Dec-10-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4766605.863 E 652916.408
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa) / WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued										
	SILTY CLAY: trace sand, contains silt seams, grey, moist, very soft to stiff.(Continued)										
11			12	SS	10		165				0 5 (95)
164.2											
11.7 12	**SILT:** trace clay, trace sand, dilatant, reddish brown, wet, firm to stiff.						164				
			13	SS	8						
13 162.7							163				
13.3	**SILTY CLAY:** trace sand, trace gravel, contains dilatant silt seams and shale fragments, reddish brown, wet, stiff to firm.										
14			14	SS	10		162				
15							161				
			15	SS	4						5 8 (87)
16							160				
17			2	Vane			159	2.3 +56			
18							158				
			17	SS	8						0 4 58 38
19							157				
156.1 20 19.9											

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-09

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 9
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-09-2020 to Dec-10-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4766605.863 E 652916.408
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued											
	CLAYEY SILT TILL (RESIDUAL SOIL): sandy, trace gravel, contains dolostone/limestone fragments, grey, wet, hard.(Continued)		18	SS	54				○			
155.1												
21 20.9	**BEDROCK:** Coring began at 21.34m Refer to Rock Core Log		1	RC			155					
22			2	RC			154					
23							153					
24			3	RC			152					
25			4	RC			151					
26							150					
27			5	RC			149					
28			6	RC			148					
29							147					
146.7												
29.3	**END OF BOREHOLE** Notes: 1) Borehole was sealed with bentonite and cement grouting. 2) TW denotes thin wall shelby tube											

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-09

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 9
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-09-2020 to Dec-10-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4766605.863 E 652916.408
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

SOIL PROFILE			SAMPLES						DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT w_P w w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100					GR SA SI CL
	Continued sample.												

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF ROCK CORE BH20-09

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers/HQ Core
ENCL NO.: 9
LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm/63mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-09-2020 to Dec-10-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4766605.863 E 652916.408
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE NUMBER	CORE SAMPLE SIZE	TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm^3) E (GPa)
155.8	Rock Surface															
20.1	**SALINA FORMATION:** Bedding almost horizontal (θ=90°)															
21																
154.6																
21.3			1	HQ	100	80		0	19	Fragmented zone:21.34m-21.39m 21.48m-21.49m Gysum:21.64m-21.65m	W2					
154.2																
21.7									23	21.70m-21.71m Fracture:	W2 to W1					
22									17	21.46m-21.48m, θ=0° and 0°, two sets 21.49m-21.64m, θ=10°						
			2	HQ	100	67		31	3	Fragmented zone:21.74m-21.91m 22.06m-22.16m;22.71m-22.73m						
									9	22.89m-22.97m;23.15m-23.19m Fracture:					180.3	2.72
23									13	21.93m-21.98m, θ=5° 22.00m-22.03m, θ=45°						
152.8																
23.2									11	22.03m-22.06m, θ=0° and 20°, two sets	W2 to W1					
									4	22.25m-22.30m, θ=35° and 65°, two sets						
24			3	HQ	100	85		50	6	22.30m-22.35m, θ=0° 22.40m-22.42m, θ=70°			106	96		
									5	22.45m-22.48m, θ=65° 22.86m-22.89m, θ=20°						
									16	22.97m-23.00m, θ=0° 23.11m-23.13m, θ=75° Soft layer Joint: 24.57m ~ 24.65m (W5 to W4)						
151.1										22.24m-22.27m, θ=75°						
24.8									2	22.52m-22.59m, θ=0° Fragmented zone:	W4 to W1					
25									17	23.28m-23.34m Gysum:						
			4	HQ	95	79		44	5	24.37m-24.48m Fracture:						
									16	23.25m-23.28m, θ=0° 23.58m-23.62m, θ=0°						
26									4	24.08m-24.09m, θ=15° Joint:						
149.7										22.34m-22.39m, θ=5°						
26.3									6	Fragmented zone:25.15m-25.22m	W4 to W1					
									1	25.41m-25.46m;25.57m-25.60m 25.78m-25.82m;25.98m-26.04m						
27			5	HQ	98	95		77	2	Gysum:25.91m-25.92m Fracture: 25.22m-25.25m, θ=0°						
									2	25.25m-25.34m, θ=0° 25.34m-25.36m, θ=50°						
									8	25.87m-25.88m, θ=10° 26.04m-26.21m, θ=0°						
148.2										Gysum:27.25m-27.27m						
27.8									11	27.62m-27.63m;27.65m-27.66m 27.69m-27.70m;27.71m-27.72m	W2 to W1					
28									4	27.74m-27.75m Fracture:						
			6	HQ	100	96		77	3	26.29m-26.33m, θ=5° 26.38m-26.41m, θ=0°						
									0	Fragmented zone:27.81m-27.86m Gysum:28.02m-28.03m						
29									0	28.13m-28.14m;28.16m-28.17m 28.21m-28.22m;28.34m-28.35m						
146.7										~~28.45m-28.46m;28.49m-28.50m~~						
29.3	**END OF BOREHOLE** Note:									28.68m-28.69m Fracture: 27.88m-27.90m, θ=0°						

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered θ = angle to the core axis E = Modulus of Elasticity

*: UCS [Mpa] ≈ 24 $I_{S(50)}$

LOG OF BOREHOLE BH20-10

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers
ENCL NO.: 10
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm
ORIGINATED BY AKJ
DATUM: Geodetic
Date: Dec-11-2020 to Dec-11-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4766859.246 E 654268.177
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
176.7	Ground Surface							
0.0 / 176.5	**TOPSOIL:** 200mm						Concrete	
0.2	**FILL:** silty clay, trace sand, trace gravel, trace organics, greyish brown, moist, firm to very stiff.		1	SS	6		Sand	
			2	SS	14		176	
175.1								
1.7	**SILTY CLAY:** trace sand, contains silt seams, brown, moist, very stiff to firm.		3	SS	21		175	
	---------- reddish brown		4	SS	19		174	
			5	SS	13		Holeplug	
			6	SS	11		173	
	brownish grey		7	SS	9		172	
	---------- grey, wet		8	SS	6		W. L. 171.5 m Dec 23, 2020	
			9	SS	5		171 W. L. 170.6 m Dec 18, 2020	
							Sand 170	
			1	Vane			169 +1.0 28	
							Screen 168	
	contains reddish brown silt layers		11	SS	6			1 5 54 40
167.0							167	
9.8	**END OF THE BOREHOLE**							

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%) 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-10

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers
ENCL NO.: 10
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm
ORIGINATED BY AKJ
DATUM: Geodetic
Date: Dec-11-2020 to Dec-11-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4766859.246 E 654268.177
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m							GR SA SI CL
	Continued											
	Note: 1) 50 mm monitoring well was installed upon completion, screened between 6.71m and 9.75m. Water Level measured in monitoring well: Date W.L.Depth (m) Dec. 18, 2020 6.16 Dec. 23, 2020 5.23											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-11

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers
ENCL NO.: 11
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm
ORIGINATED BY AKJ
DATUM: Geodetic
Date: Dec-11-2020 to Dec-11-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4766986.744 E 654318.837
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
176.5	Ground Surface							
176.3	**TOPSOIL:** 150mm						Concrete	
0.2	**FILL:** silty clay, trace sand, trace gravel, trace organics, brown, moist, firm to very stiff.		1	SS	7		Sand	
			2	SS	27		175	
174.6			3	SS	19			
1.8	**SILTY CLAY:** trace sand, contains silt seams, brown, moist, very stiff to very soft.							
	reddish brown		4	SS	14		174	
			5	SS	8		Holeplug	
			6	SS	8		172	
			7	SS	10			
	grey		8	SS	6		171	
	wet		9	SS	2		170 Sand	
						▽	W. L. 169.8 m Dec 23, 2020	
						▽	W. L. 169.3 m Dec 18, 2020	
							169	
			1	Vane			+24 1.0	
							Screen	
							168	
			11	SS	4		167	0 4 49 47
166.7								
9.8	**END OF THE BOREHOLE**							

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100
SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100
PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%) 10 20 30
POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-11

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers
ENCL NO.: 11
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm
ORIGINATED BY AKJ
DATUM: Geodetic
Date: Dec-11-2020 to Dec-11-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4766986.744 E 654318.837
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa)	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20 40 60 80 100	10 20 30			GR SA SI CL
	Continued											
	Note: 1) 50 mm monitoring well was installed upon completion, screened between 6.71m and 9.75m. Water Level measured in monitoring well: Date W.L.Depth (m) Dec. 18, 2020 7.12 Dec. 23, 2020 6.66											

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

LOG OF BOREHOLE BH20-12D

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers
ENCL NO.: 12A
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm
ORIGINATED BY AKJ
DATUM: Geodetic
Date: Dec-10-2020 to Dec-10-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4767290.374 E 654078.539
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
174.9	Ground Surface						
0.0 / 174.7	**TOPSOIL:** 230mm					Concrete	
0.2	**FILL:** silty clay, trace sand, trace gravel, trace organics, greyish brown, moist, stiff.	1	SS	9		Sand	
	100mm silty sand layers	2	SS	11		174	
173.4							
1.5	**SILTY CLAY:** trace sand, contains silt seams, reddish brown, moist, very stiff to very soft.	3	SS	19		173	
	reddish brown to grey	4	SS	10		172	
	grey	5	SS	8		Holeplug	
	wet	6	SS	5		171	
		1	Vane			170	
	contains dilatant silt layers	8	SS	1	▽	W. L. 169.1 m W. L. 169.0 m Dec 18, 2020	
		1	TW			Sand	
						168	
		10	SS	3		167	
						Screen	
						166	
	trace shale fragments	11	SS	2			1 6 55 38
165.1							
9.8	**END OF THE BOREHOLE**						

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100
PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%): 10 20 30
POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)
1.4 / 24

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; ○ε=3% Strain at Failure

LOG OF BOREHOLE BH20-12D

PROJECT: Geotechnical Investigation		REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara	Method: Hollow Stem Augers	ENCL NO.: 12A
PROJECT LOCATION: Niagara Region Sanitary Sewer	Diameter: 203 mm	ORIGINATED BY AKJ
DATUM: Geodetic	Date: Dec-10-2020 to Dec-10-2020	COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4767290.374 E 654078.539	Equipment: Pontil Drilling CME 75 (Truck)	CHECKED BY MK

SOIL PROFILE			SAMPLES					DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH (kPa): ○ UNCONFINED, + FIELD VANE & Sensitivity, ● QUICK TRIAXIAL, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L; WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m^3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION Continued	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION					
	Note: 1) 50 mm monitoring well was installed upon completion, screened between 6.71m and 9.75m. Water Level measured in monitoring well: Date W.L.Depth (m) Dec. 18, 2020 5.93 Dec. 23, 2020 5.80											

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ 8=3% Strain at Failure

LOG OF BOREHOLE BH20-12S

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers
ENCL NO.: 12B
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm
ORIGINATED BY AKJ
DATUM: Geodetic
Date: Dec-10-2020 to Dec-10-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4767289.917 E 654080.153
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
174.9	Ground Surface											
174.8 0.0	**TOPSOIL:** 150mm						Concrete					
0.2	**FILL:** silty clay, trace sand, trace gravel, trace organics, brownish grey, moist, stiff to very stiff.		1	SS	11		Sand					
1	300mm silty sand layers		2	SS	17		Holeplug					
173.6							Sand					
1.3	**SILTY CLAY:** trace sand, contains silt seams, reddish brown, moist, very stiff to firm.		3	SS	17		173					
2			4	SS	13							
3	grey		5	SS	6		172 Screen					
						▽	W. L. 171.3 m Dec 23, 2020					
4	wet		6	SS	6	▽	W. L. 170.9 m Dec 18, 2020					
170.4												
4.6	**END OF THE BOREHOLE**											

Note:
1) 50 mm monitoring well was installed upon completion, screened between 1.52m and 4.57m.

Water Level measured in monitoring well:

Date	W.L.Depth (m)
Dec. 18, 2020	4.01
Dec. 23, 2020	3.67

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

LOG OF BOREHOLE BH-P01

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers
ENCL NO.: 1S
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm
ORIGINATED BY SL
DATUM: Geodetic
Date: Dec-09-2020 to Dec-09-2020
COMPILED BY BW
BH LOCATION: See Borehole Location Plan N 4769629.776 E 653228.046
Equipment: Pontil Drilling CME 75 (Truck)
CHECKED BY MK

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION
180.5	Ground Surface						
0.0	Direct Drilling to Depth of 7.62 Without Sampling Lithology Inferred from BH-06 (Deep)						Concrete Sand 180
179.0							179
1.5						W. L. 178.2 m Dec 23, 2020	
						W. L. 177.1 m Dec 18, 2020	
							Sand 176
							175
							Screen 174
172.9							173
7.6	**END OF BOREHOLE** Note: 1) 50 mm monitoring well was installed upon completion, screened between 4.57m and 7.62m. Water Level measured in monitoring well: Date W.L.Depth (m) Dec. 18, 2020 3.5 Dec. 23, 2020 2.3						

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+3, ×3: Numbers refer to Sensitivity
○ε=3% Strain at Failure

LOG OF BOREHOLE BH-P03

PROJECT: Geotechnical Investigation
REF. NO.: 201-11602-00
CLIENT: Regional Municipality of Niagara
Method: Hollow Stem Augers
ENCL NO.: 3S
PROJECT LOCATION: Niagara Region Sanitary Sewer
Diameter: 203 mm
DATUM: Geodetic
Date: Dec-11-2020
BH LOCATION: See Borehole Location Plan N 652135.207 E 4769057.188
Equipment: Pontil Drilling CME 75 (Truck)

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION
178.1	Ground Surface						
0.0 / 177.9	**FILL:** granular sand and gravel, brown, moist, compact		1	SS	10		Concrete
0.3	**SILTY CLAY:** trace sand, occasional gravel, reddish brown, moist, firm.						Sand
1			2	SS	18		177
			3	SS	17		Holeplug
2							176
			4	SS	13		
3							Sand
			5	SS	11		175 W. L. 174.8 m Jan 13, 2020
4			6	SS	12		
							Screen
5			7	SS	7		
172.9							173
5.2	**END OF BOREHOLE**						

Note:
1) 50 mm monitoring well was installed upon completion, screened between 3.70m and 5.20m.

Water Level measured in monitoring well:

Date	W.L.Depth (m)
Jan. 13, 2021	3.3

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)
REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ ε=3% Strain at Failure

APPENDIX

C GRAIN SIZE DISTRIBUTION PLOTS

Particle Size Distribution Report

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	11	7	8	17	45	12

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
16.00	100		
13.20	99		
9.50	96		
4.75	89		
2.00	82		
0.85	78		
0.425	74		
0.25	70		
0.15	66		
0.106	62		
0.075	57		
0.0426 mm.	47		
0.0311 mm.	41		
0.0203 mm.	33		
0.0121 mm.	26		
0.0087 mm.	22		
0.0062 mm.	19		
0.0031 mm.	14		
0.0013 mm.	9.9		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 5.4155 D_{85}= 2.9294 D_{60}= 0.0895
D_{50}= 0.0495 D_{30}= 0.0165 D_{15}= 0.0037
D_{10}= 0.0013 C_u= 66.54 C_c= 2.27

Classification

USCS= AASHTO=

Remarks

Sample Number: 20-01_SS12

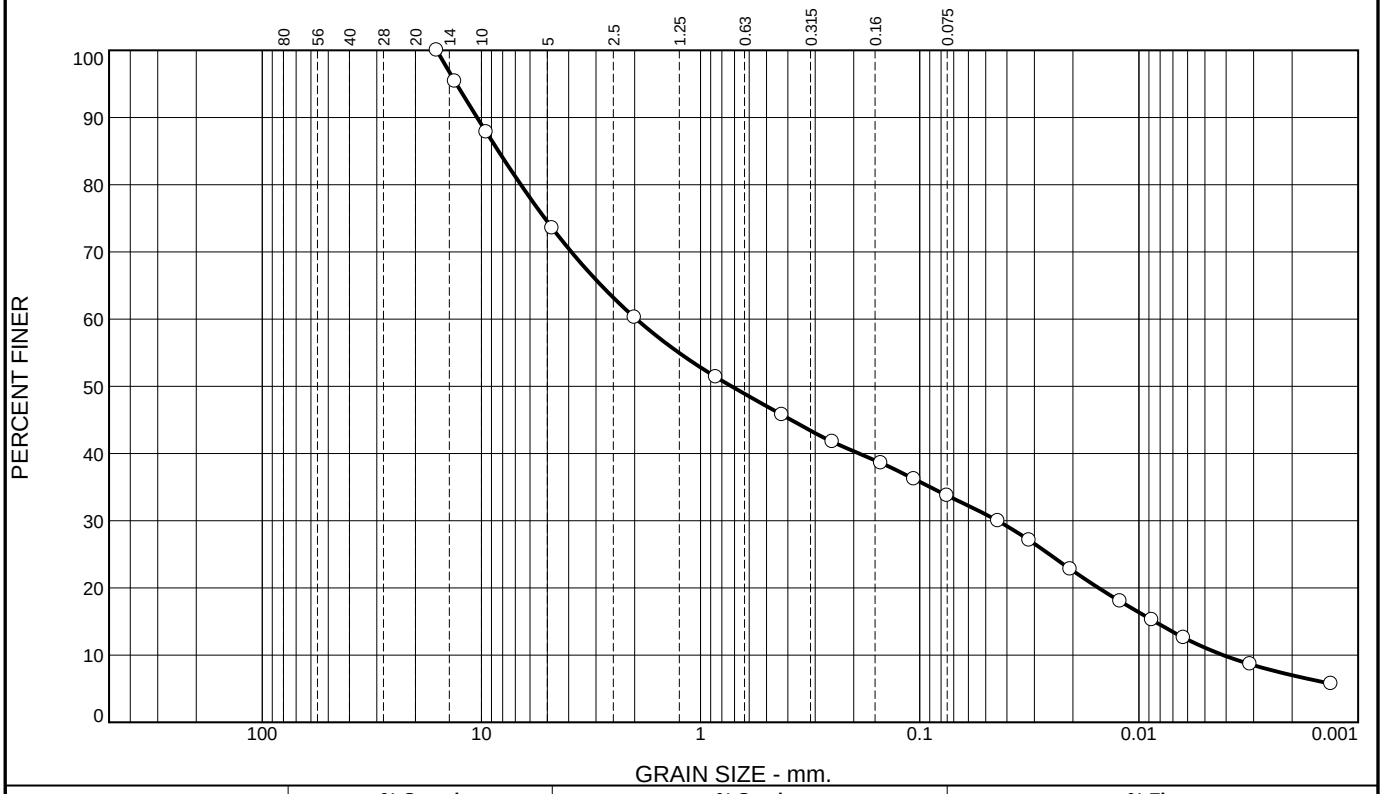
Date: Jan. 11, 2021

Client: Niagara Region
Project: Niagara Region Sanitary-Geotechnical

Project No: 201-11602-00 **Figure** R1598-H-1

Tested By: Bruce Shan/Bonnie Wang

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	26	14	14	12	27	7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
16.00	100		
13.20	95		
9.50	88		
4.75	74		
2.00	60		
0.85	51		
0.425	46		
0.25	42		
0.15	39		
0.106	36		
0.075	34		
0.0439 mm.	30		
0.0316 mm.	27		
0.0205 mm.	23		
0.0122 mm.	18		
0.0087 mm.	15		
0.0062 mm.	13		
0.0031 mm.	8.6		
0.0013 mm.	5.7		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 10.4714 D_{85}= 8.3624 D_{60}= 1.9635
D_{50}= 0.7232 D_{30}= 0.0442 D_{15}= 0.0085
D_{10}= 0.0041 C_u= 475.76 C_c= 0.24

Classification

USCS= AASHTO=

Remarks

Sample Number: 20-01_SS13

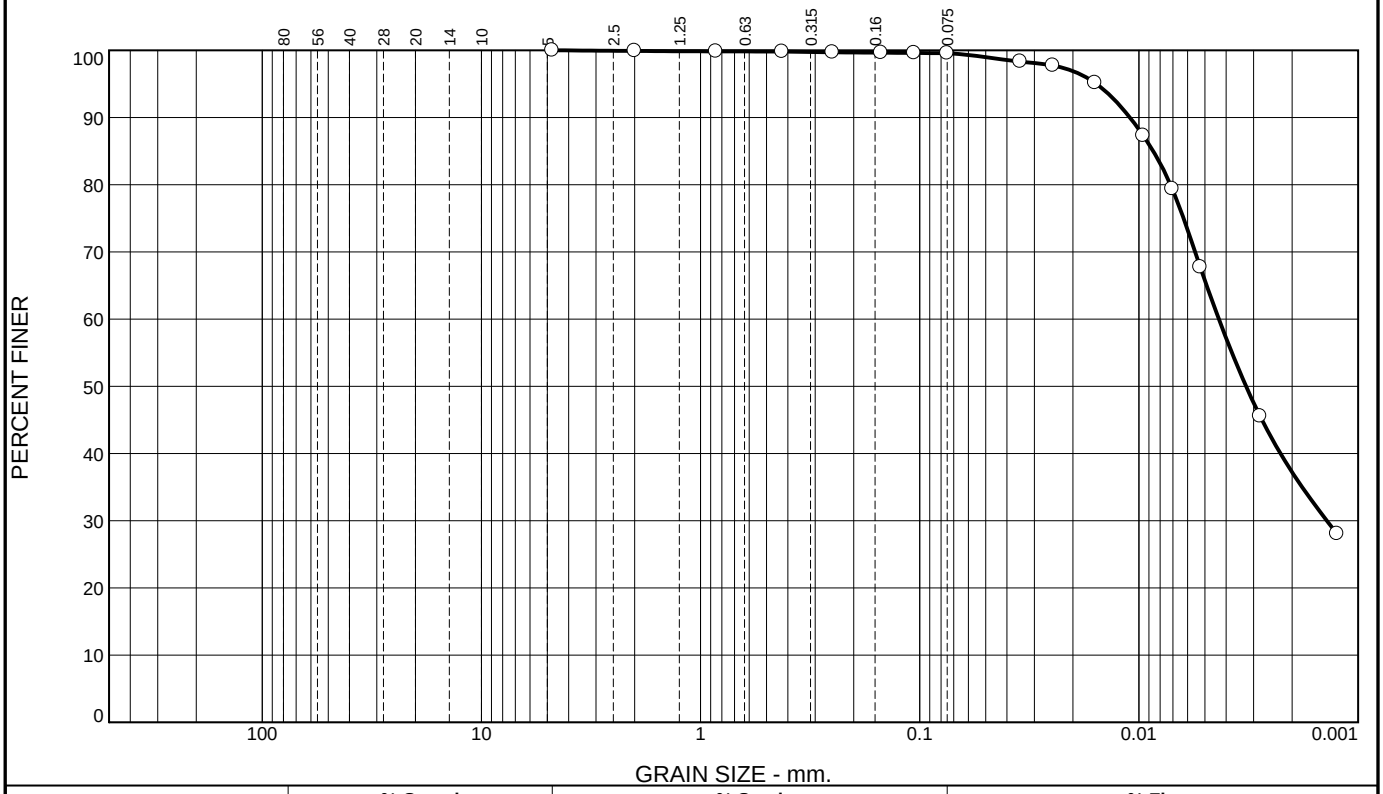
Date: Jan. 07, 2021

Client: Niagara Region
Project: Niagara Region Sanitary-Geotechnical

Project No: 201-11602-00 **Figure** R1598-H-2

Tested By: Bruce Shan/Bonnie Wang

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	0	63	37

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4.75	100		
2.00	100		
0.85	100		
0.425	100		
0.25	100		
0.15	100		
0.106	100		
0.075	100		
0.0348 mm.	98		
0.0247 mm.	98		
0.0159 mm.	95		
0.0096 mm.	87		
0.0070 mm.	79		
0.0052 mm.	68		
0.0028 mm.	46		
0.0012 mm.	28		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.0110 D_{85}= 0.0086 D_{60}= 0.0043
D_{50}= 0.0032 D_{30}= 0.0014 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: 20-02_SS11

Date: Jan. 11, 2021

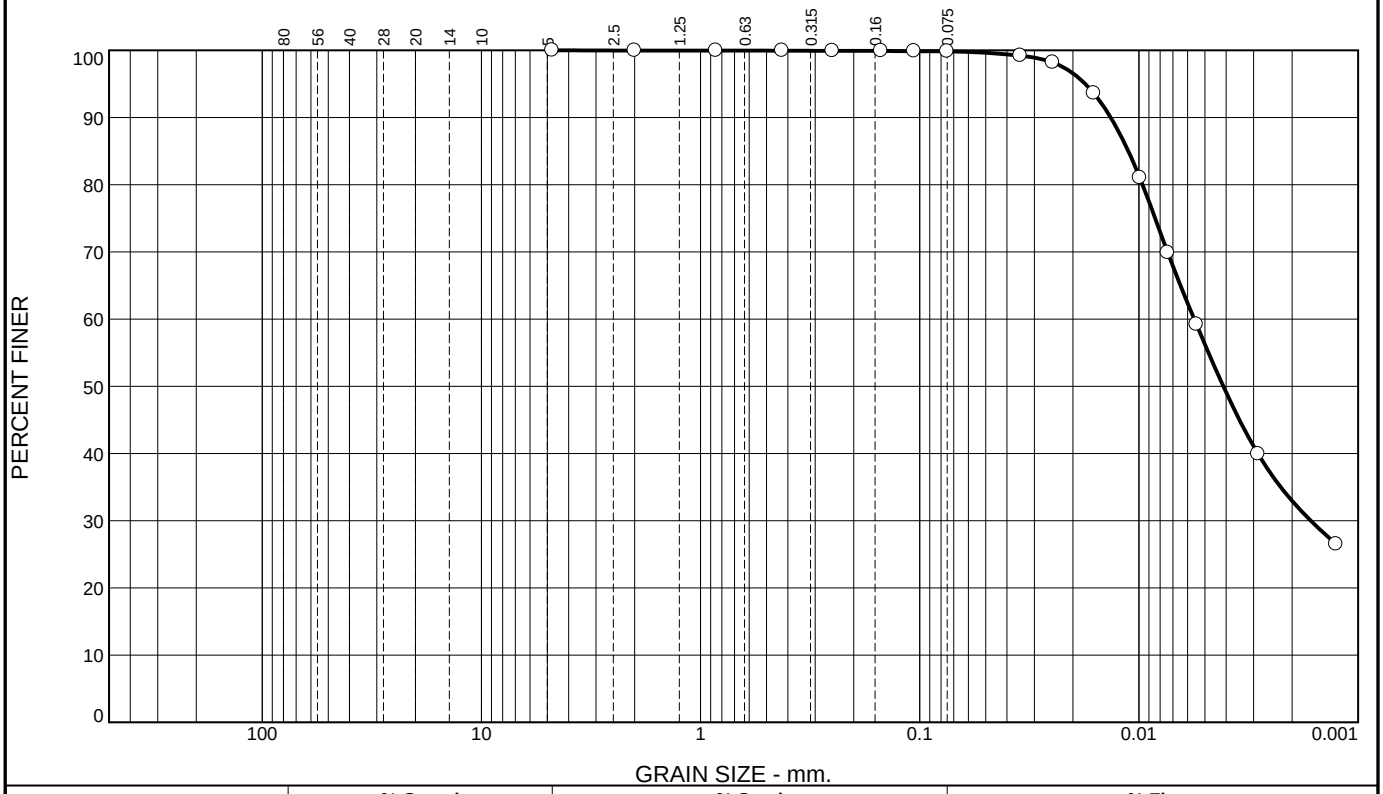
Client: Niagara Region

Project: Niagara Region Sanitary-Geotechnical

Project No: 201-11602-00 **Figure** R1598-H-3

Tested By: Bruce Shan/Bonnie Wang

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	0	67	33

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4.75	100		
2.00	100		
0.85	100		
0.425	100		
0.25	100		
0.15	100		
0.106	100		
0.075	100		
0.0347 mm.	99		
0.0247 mm.	98		
0.0161 mm.	94		
0.0099 mm.	81		
0.0074 mm.	70		
0.0055 mm.	59		
0.0029 mm.	40		
0.0013 mm.	26		

* (no specification provided)

Soil Description

Silty Clay

Atterberg Limits

PL= 17 LL= 31 PI= 14

Coefficients

D_{90}= 0.0135 D_{85}= 0.0112 D_{60}= 0.0056
D_{50}= 0.0041 D_{30}= 0.0016 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(13)

Remarks

Sample Number: 20-03_SS15

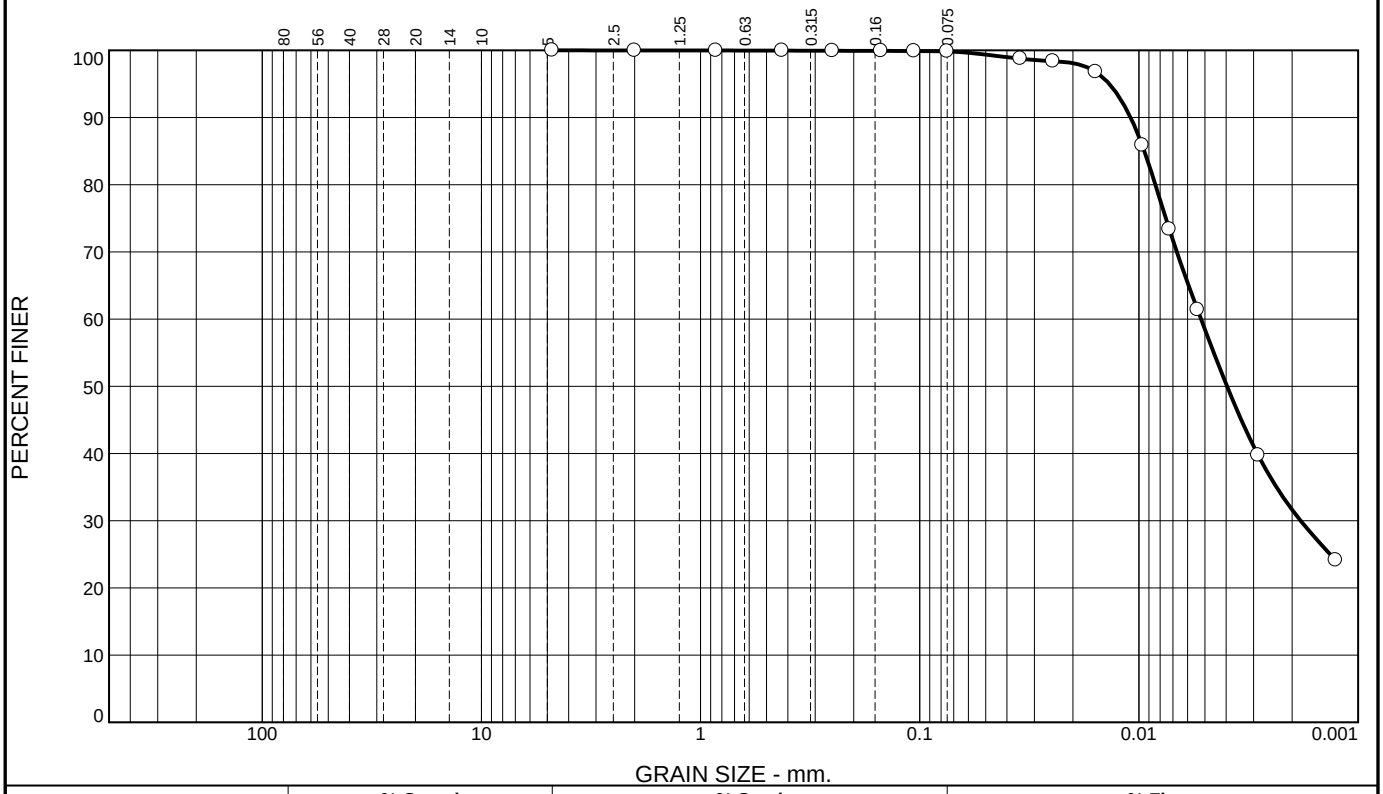
Date: Jan. 07, 2021

Client: Niagara Region
Project: Niagara Region Sanitary-Geotechnical

Project No: 201-11602-00 **Figure** R1598-H-4

Tested By: Bruce Shan/Bonnie Wang

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	0	68	32

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4.75	100		
2.00	100		
0.85	100		
0.425	100		
0.25	100		
0.15	100		
0.106	100		
0.075	100		
0.0347 mm.	99		
0.0246 mm.	98		
0.0157 mm.	97		
0.0097 mm.	86		
0.0073 mm.	73		
0.0054 mm.	61		
0.0029 mm.	40		
0.0013 mm.	24		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.0109 D_{85}= 0.0094 D_{60}= 0.0052
D_{50}= 0.0040 D_{30}= 0.0018 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: 20-04_SS12

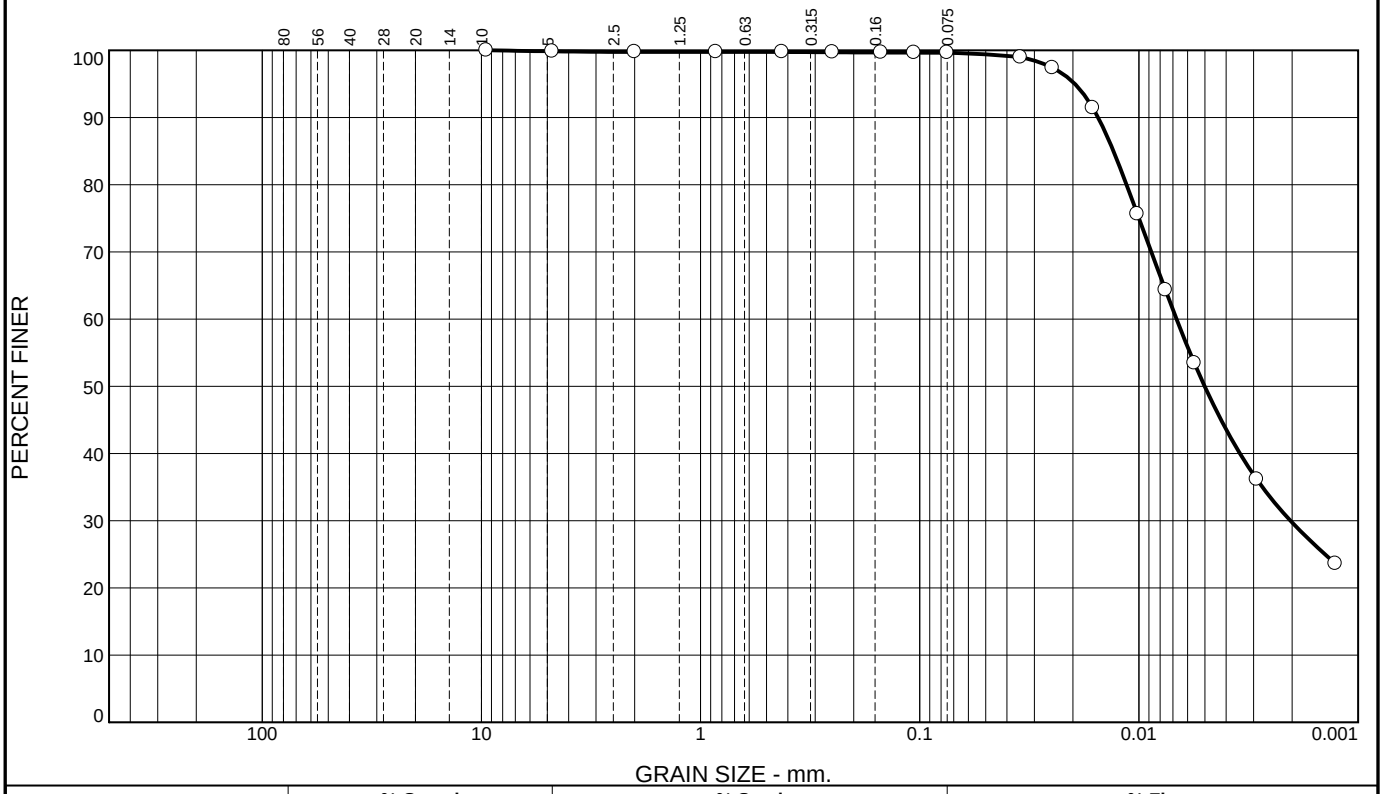
Date: Jan. 11, 2021

Client: Niagara Region
Project: Niagara Region Sanitary-Geotechnical

Project No: 201-11602-00 **Figure** R1598-H-5

Tested By: Bruce Shan/Bonnie Wang

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	0	70	30

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
9.50	100		
4.75	100		
2.00	100		
0.85	100		
0.425	100		
0.25	100		
0.15	100		
0.106	100		
0.075	100		
0.0347 mm.	99		
0.0248 mm.	97		
0.0162 mm.	91		
0.0102 mm.	76		
0.0076 mm.	64		
0.0056 mm.	53		
0.0029 mm.	36		
0.0013 mm.	24		

* (no specification provided)

Soil Description

Silt Clay

Atterberg Limits

PL= 17 LL= 26 PI= 9

Coefficients

D_{90}= 0.0153 D_{85}= 0.0131 D_{60}= 0.0067
D_{50}= 0.0050 D_{30}= 0.0020 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-4(8)

Remarks

Sample Number: 20-05_SS14

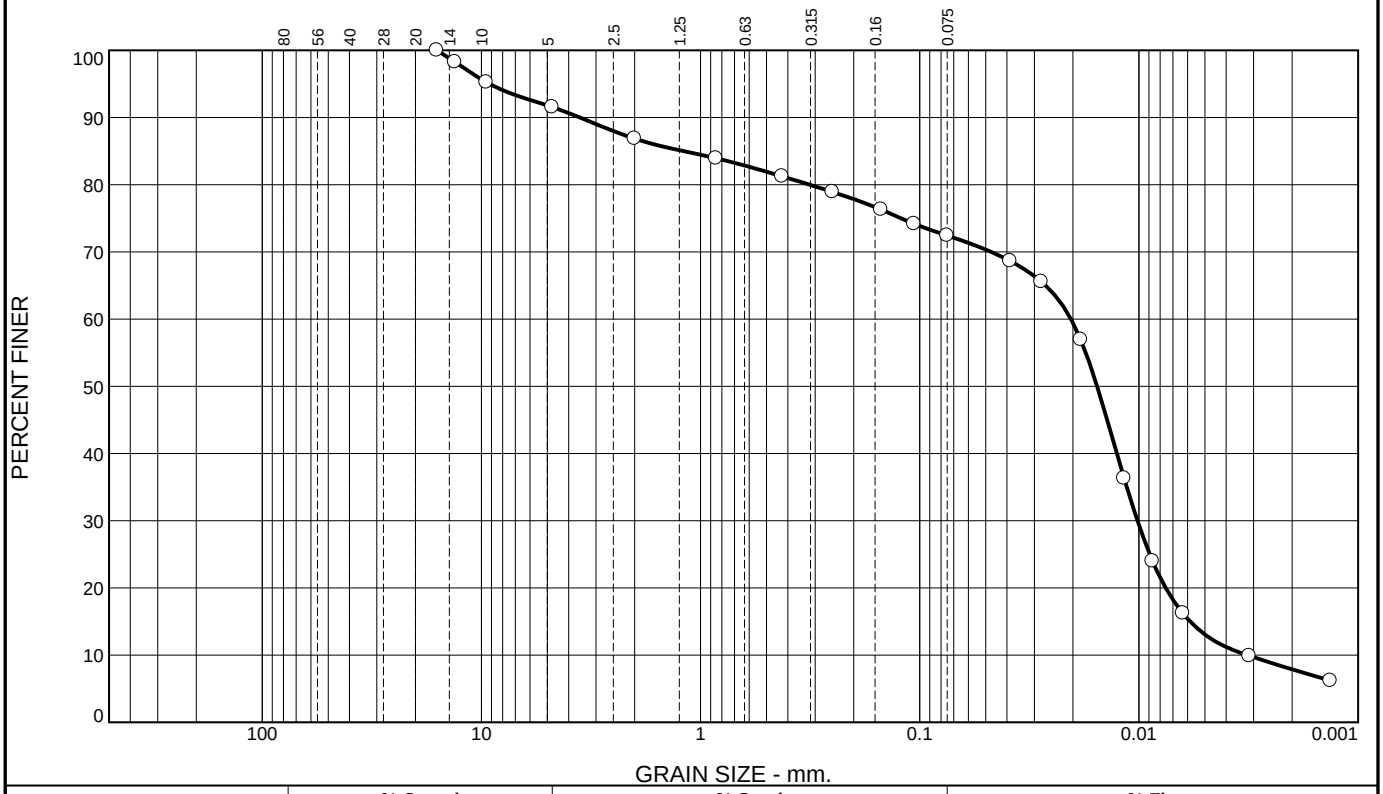
Date: Jan. 07, 2021

Client: Niagara Region
Project: Niagara Region Sanitary-Geotechnical

Project No: 201-11602-00 **Figure** R1598-H-7

Tested By: Bruce Shan/Bonnie Wang

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	8	5	6	9	64	8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
16.00	100		
13.20	98		
9.50	95		
4.75	92		
2.00	87		
0.85	84		
0.425	81		
0.25	79		
0.15	76		
0.106	74		
0.075	72		
0.0387 mm.	69		
0.0279 mm.	66		
0.0184 mm.	57		
0.0117 mm.	36		
0.0087 mm.	24		
0.0063 mm.	16		
0.0031 mm.	9.9		
0.0013 mm.	6.2		

* (no specification provided)

Soil Description

Silt with Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{90}= 3.5565 D_{85}= 1.1996 D_{60}= 0.0204
D_{50}= 0.0155 D_{30}= 0.0102 D_{15}= 0.0058
D_{10}= 0.0032 C_u= 6.37 C_c= 1.58

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Sample Number: 20-04_SS15

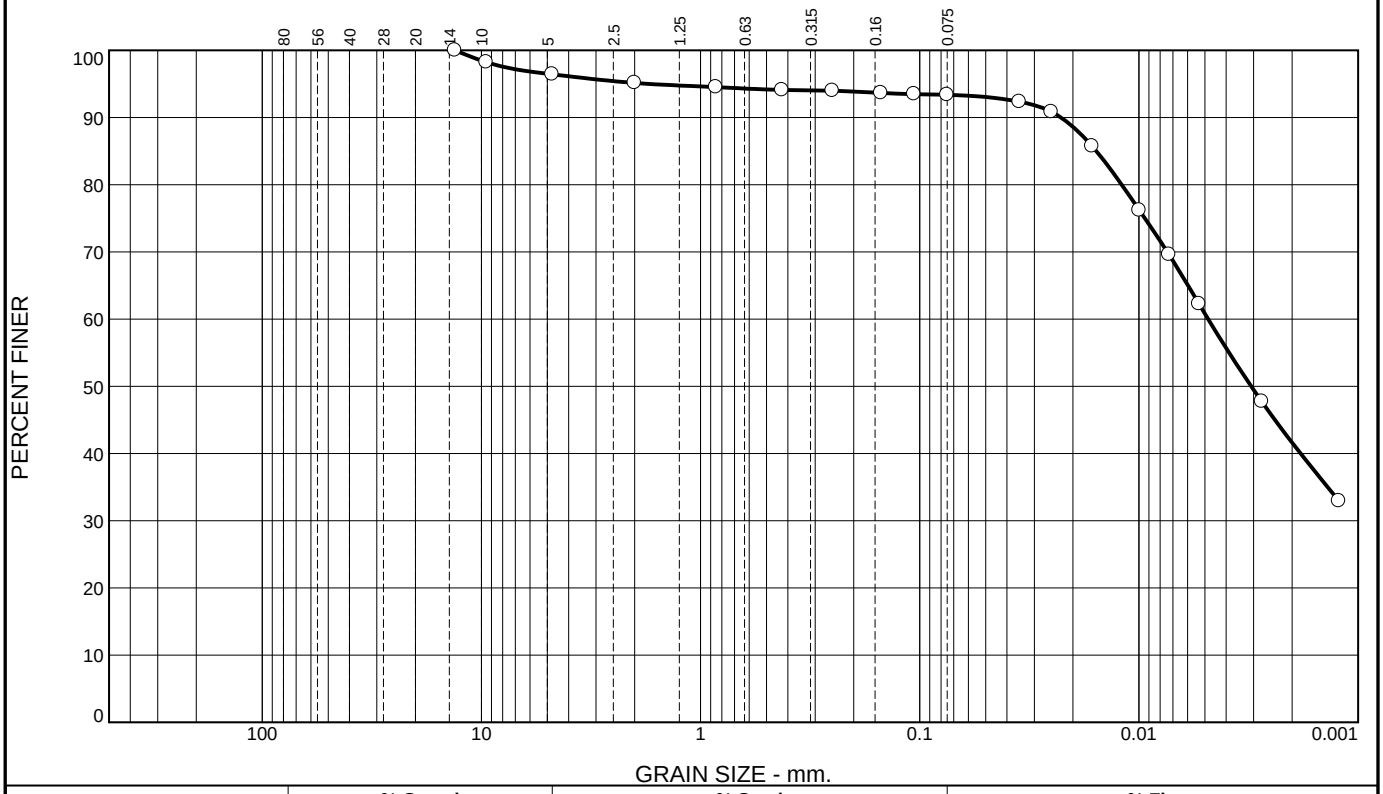
Date: Jan. 07, 2021

Client: Niagara Region
Project: Niagara Region Sanitary-Geotechnical

Project No: 201-11602-00 **Figure** R1598-H-6

Tested By: Bruce Shan/Bonnie Wang

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	4	1	1	1	51	42

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
13.20	100		
9.50	98		
4.75	96		
2.00	95		
0.85	95		
0.425	94		
0.25	94		
0.15	94		
0.106	93		
0.075	93		
0.0351 mm.	92		
0.0251 mm.	91		
0.0164 mm.	86		
0.0100 mm.	76		
0.0073 mm.	70		
0.0053 mm.	62		
0.0028 mm.	48		
0.0012 mm.	33		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.0227 D_{85}= 0.0156 D_{60}= 0.0048
D_{50}= 0.0031 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: 20-06_SS16

Date: Jan. 11, 2021

Client: Niagara Region
Project: Niagara Region Sanitary-Geotechnical

Project No: 201-11602-00 **Figure** R1598-H-8

Tested By: Bruce Shan/Bonnie Wang

Particle Size Distribution Report

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	15	81	4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
4.75	100		
2.00	100		
0.85	100		
0.425	100		
0.25	100		
0.15	99		
0.106	96		
0.075	85		
0.0363 mm.	45		
0.0290 mm.	33		
0.0205 mm.	18		
0.0125 mm.	9.9		
0.0090 mm.	7.4		
0.0064 mm.	6.0		
0.0032 mm.	4.2		
0.0013 mm.	3.1		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.0862 D_{85}= 0.0756 D_{60}= 0.0468
D_{50}= 0.0395 D_{30}= 0.0275 D_{15}= 0.0183
D_{10}= 0.0127 C_u= 3.68 C_c= 1.27

Classification

USCS= AASHTO=

Remarks

Sample Number: 20-07_SS18

Date: Jan. 11, 2021

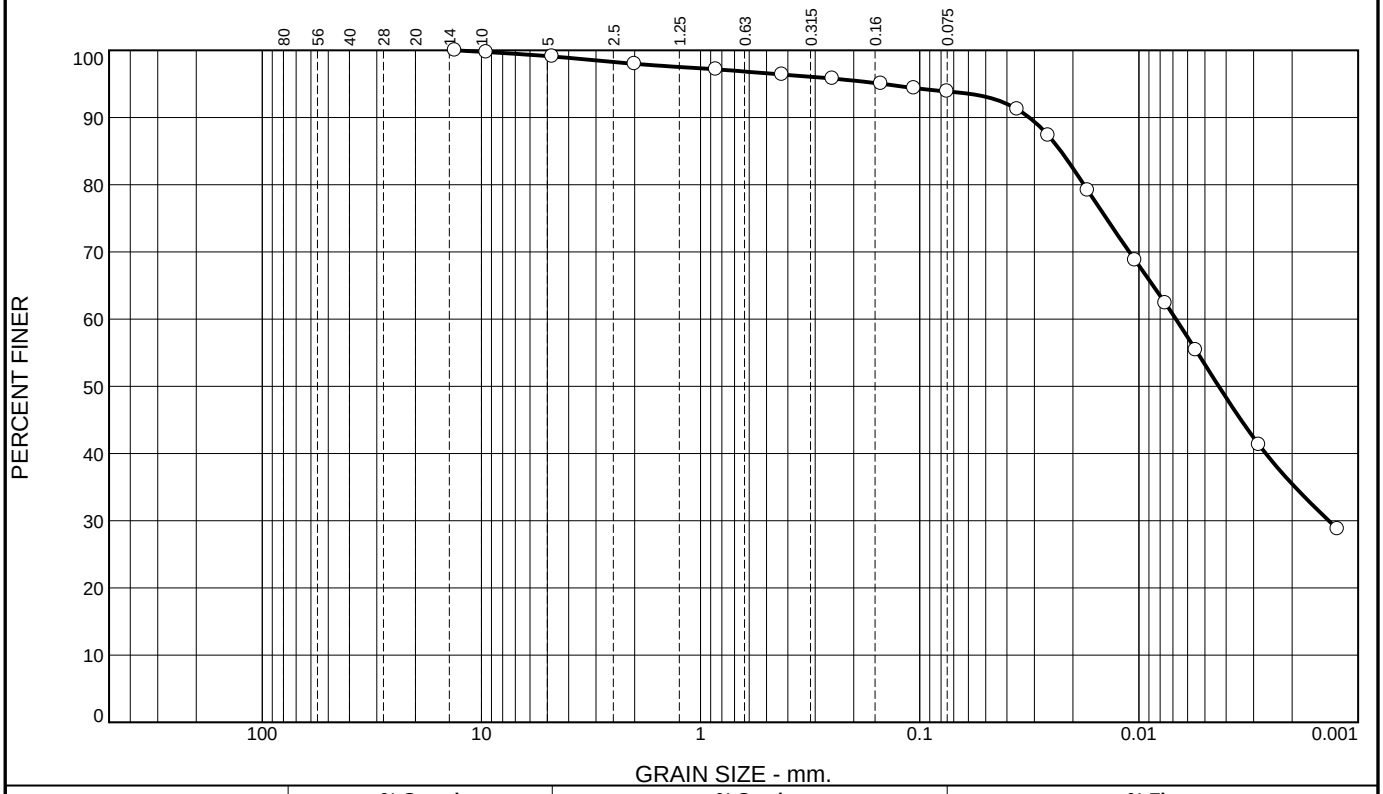
Client: Niagara Region

Project: Niagara Region Sanitary-Geotechnical

Project No: 201-11602-00 **Figure** R1598-H-9

Tested By: Bruce Shan/Bonnie Wang

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	1	1	2	2	59	35

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
13.20	100		
9.50	100		
4.75	99		
2.00	98		
0.85	97		
0.425	96		
0.25	96		
0.15	95		
0.106	94		
0.075	94		
0.0359 mm.	91		
0.0259 mm.	87		
0.0171 mm.	79		
0.0104 mm.	69		
0.0076 mm.	62		
0.0055 mm.	55		
0.0028 mm.	41		
0.0012 mm.	29		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.0316 D_{85}= 0.0227 D_{60}= 0.0068
D_{50}= 0.0043 D_{30}= 0.0014 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: 20-08_SS18

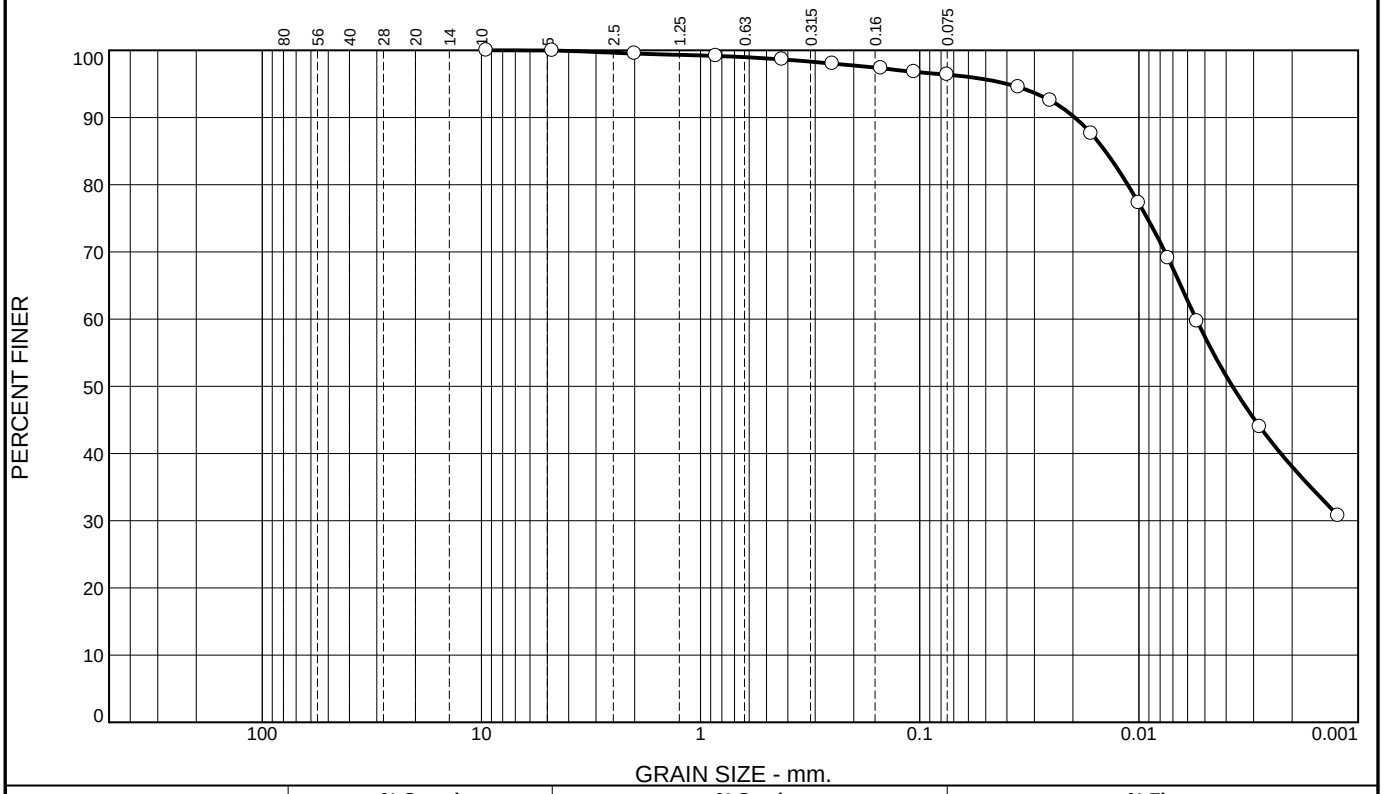
Date: Jan. 11, 2021

Client: Niagara Region
Project: Niagara Region Sanitary-Geotechnical

Project No: 201-11602-00 **Figure** R1598-H-10

Tested By: Bruce Shan/Bonnie Wang

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	1	3	58	38

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
9.50	100		
4.75	100		
2.00	100		
0.85	99		
0.425	99		
0.25	98		
0.15	97		
0.106	97		
0.075	96		
0.0355 mm.	95		
0.0254 mm.	93		
0.0165 mm.	88		
0.0100 mm.	77		
0.0074 mm.	69		
0.0054 mm.	60		
0.0028 mm.	44		
0.0012 mm.	31		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.0196 D_{85}= 0.0142 D_{60}= 0.0055
D_{50}= 0.0037 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: 20-09_SS17

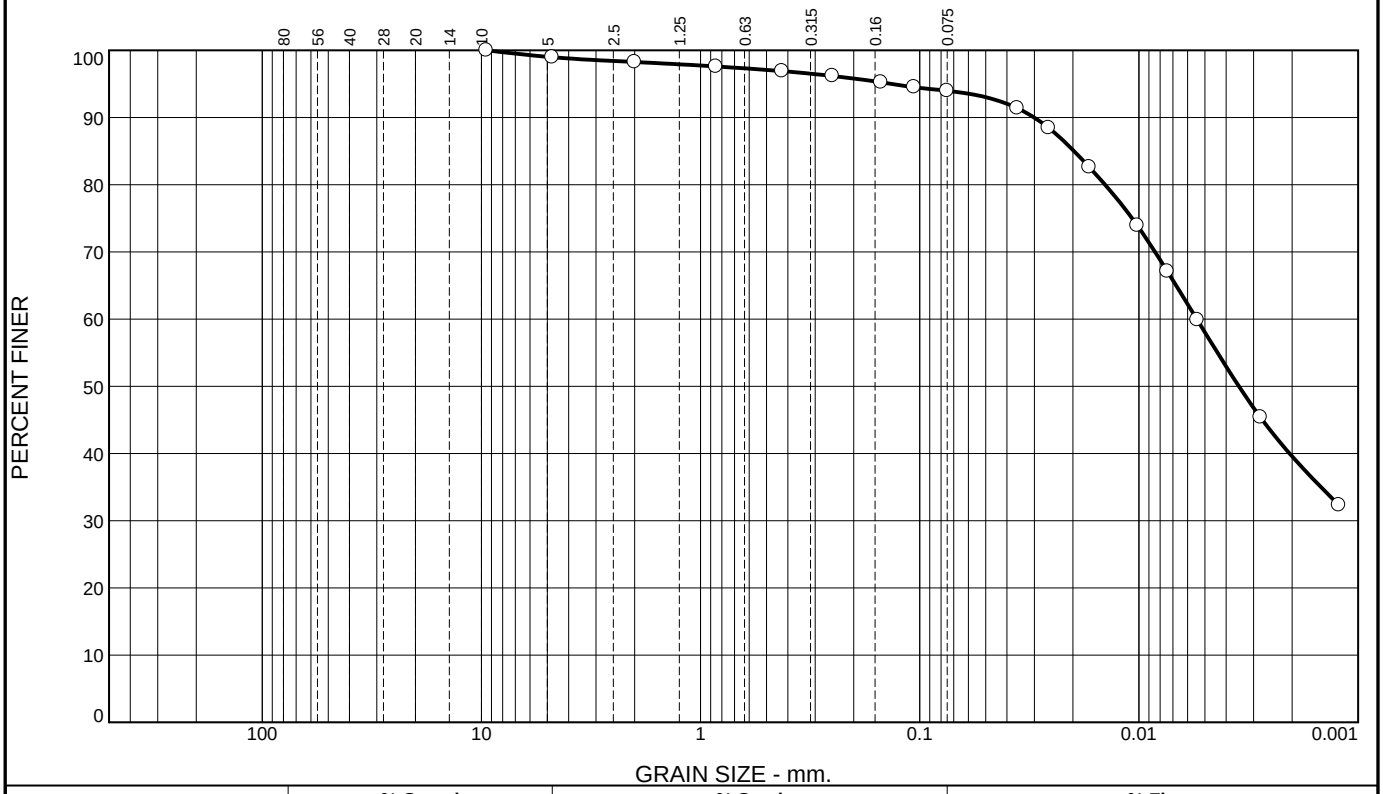
Date: Jan. 11, 2021

Client: Niagara Region
Project: Niagara Region Sanitary-Geotechnical

Project No: 201-11602-00 **Figure** R1598-H-11

Tested By: Bruce Shan/Bonnie Wang

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	1	1	1	3	54	40

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
9.50	100		
4.75	99		
2.00	98		
0.85	98		
0.425	97		
0.25	96		
0.15	95		
0.106	95		
0.075	94		
0.0359 mm.	91		
0.0258 mm.	88		
0.0169 mm.	83		
0.0102 mm.	74		
0.0074 mm.	67		
0.0054 mm.	60		
0.0028 mm.	45		
0.0012 mm.	32		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.0301 D_{85}= 0.0198 D_{60}= 0.0054
D_{50}= 0.0035 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: 20-10_SS11

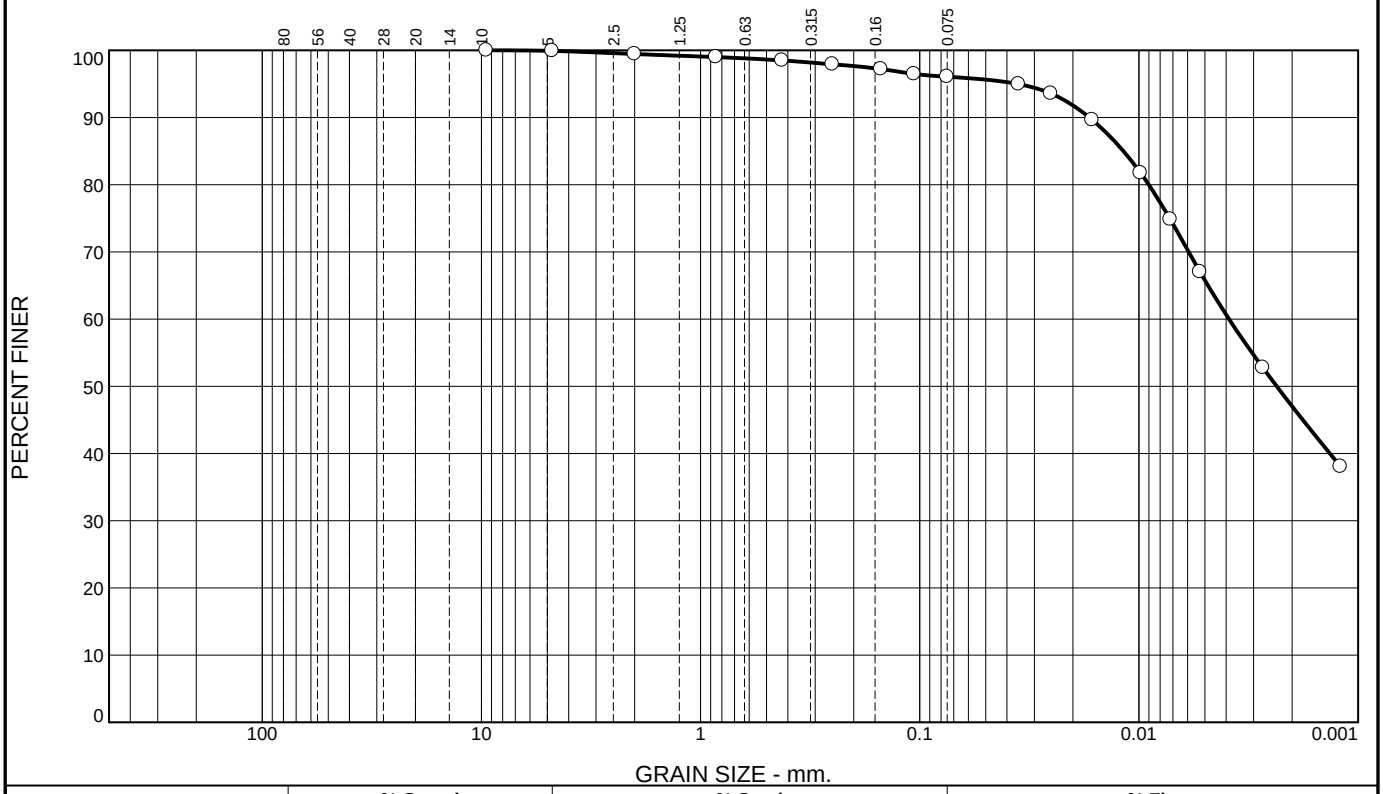
Date: Jan. 11, 2021

Client: Niagara Region
Project: Niagara Region Sanitary-Geotechnical

Project No: 201-11602-00 **Figure** R1598-H-12

Tested By: Bruce Shan/Bonnie Wang

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	1	1	2	49	47

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
9.50	100		
4.75	100		
2.00	99		
0.85	99		
0.425	98		
0.25	98		
0.15	97		
0.106	96		
0.075	96		
0.0354 mm.	95		
0.0252 mm.	94		
0.0163 mm.	90		
0.0098 mm.	82		
0.0072 mm.	75		
0.0053 mm.	67		
0.0027 mm.	53		
0.0012 mm.	38		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.0168 D_{85}= 0.0118 D_{60}= 0.0039
D_{50}= 0.0024 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: 20-11_SS11

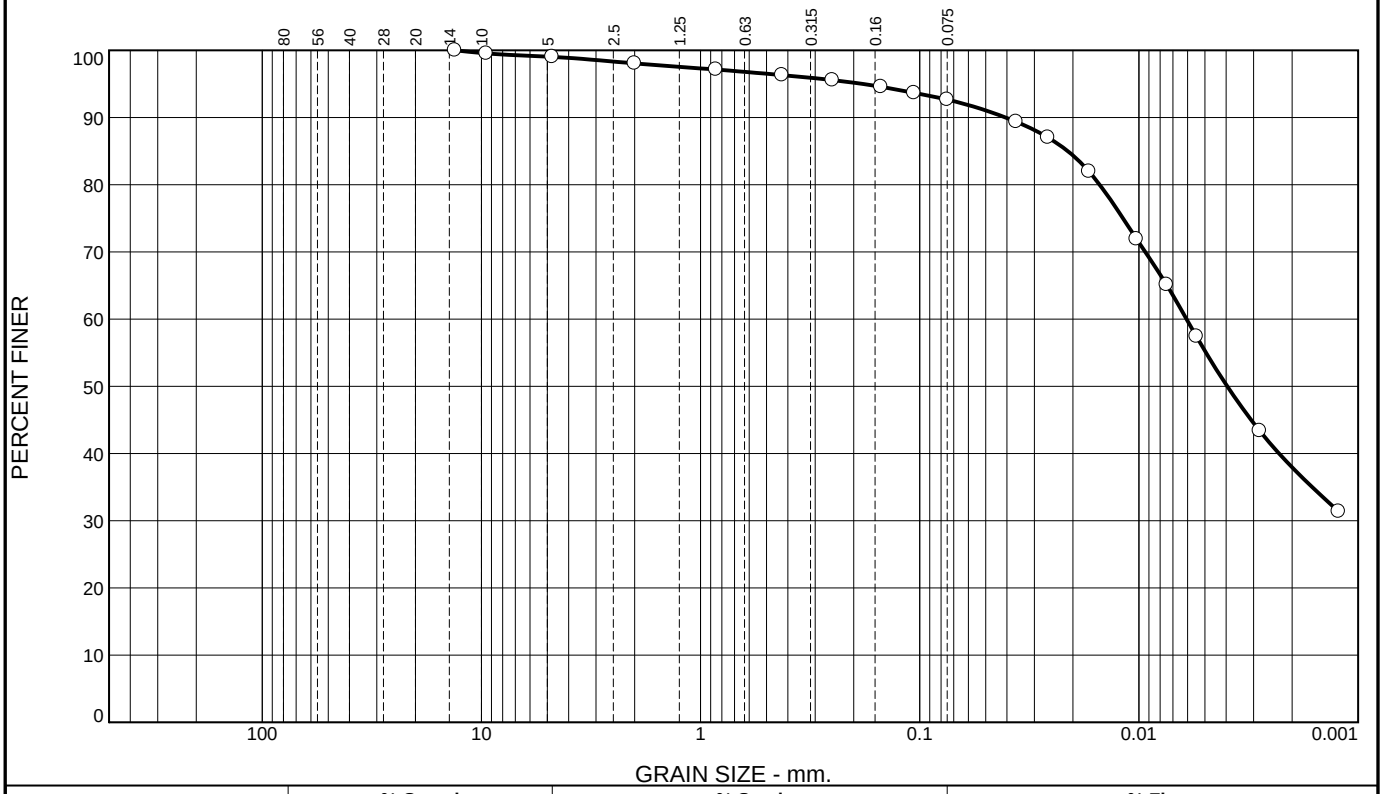
Date: Jan. 11, 2021

Client: Niagara Region
Project: Niagara Region Sanitary-Geotechnical

Project No: 201-11602-00 **Figure** R1598-H-13

Tested By: Bruce Shan/Bonnie Wang

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	1	1	2	3	55	38

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
13.2	100		
9.50	100		
4.75	99		
2.00	98		
0.85	97		
0.425	96		
0.25	96		
0.15	95		
0.106	94		
0.075	93		
0.0363 mm.	89		
0.0260 mm.	87		
0.0169 mm.	82		
0.0102 mm.	72		
0.0075 mm.	65		
0.0055 mm.	57		
0.0028 mm.	43		
0.0012 mm.	31		

* (no specification provided)

Soil Description

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.0406 D_{85}= 0.0211 D_{60}= 0.0061
D_{50}= 0.0040 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sample Number: 20-12_SS11

Date: Jan. 11, 2021

Client: Niagara Region
Project: Niagara Region Sanitary-Geotechnical

Project No: 201-11602-00 **Figure** R1598-H-14

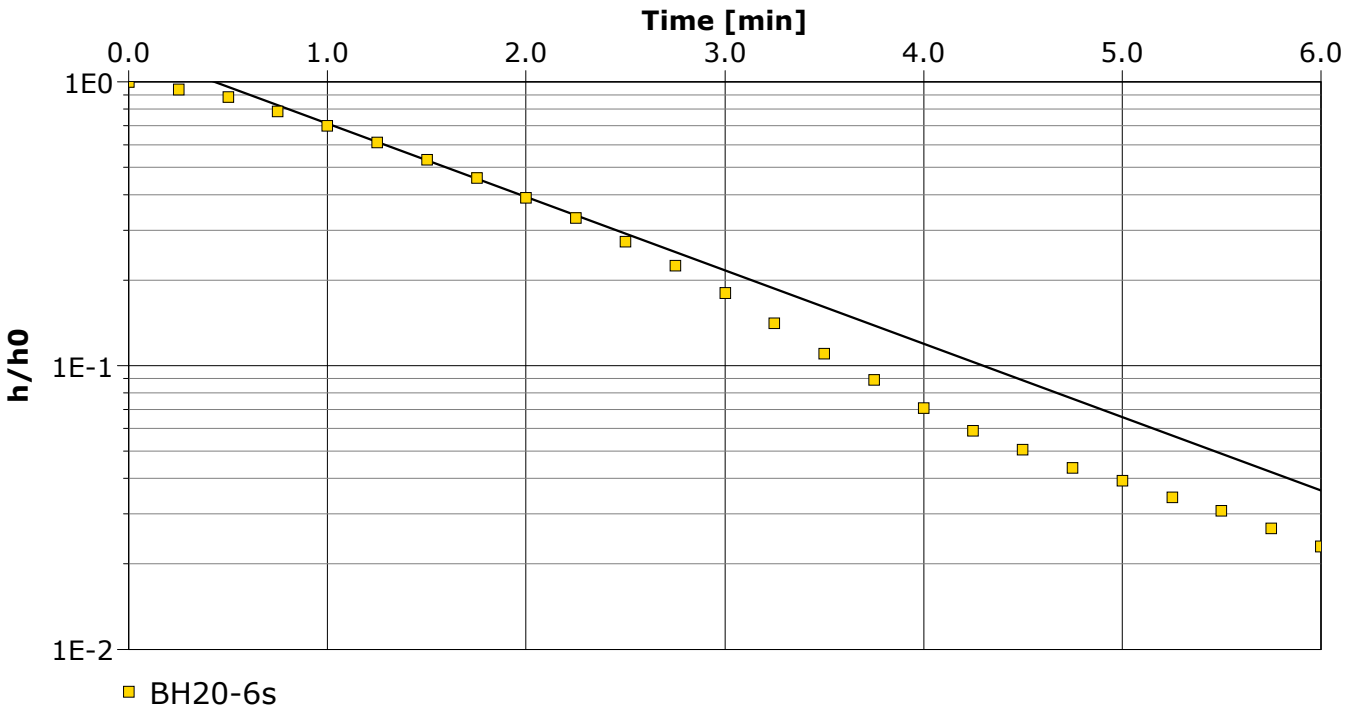
Tested By: Bruce Shan/Bonnie Wang

APPENDIX

D SINGLE WELL RESPONSE TEST RESULTS

	Slug Test Analysis Report
	Project: South Niagara WW Solutions
	Number: 201-11602-00
	Client: Niagara Region

Location: Niagara Falls	Slug Test: BH20-6s K-Test	Test Well: BH20-6s
Test Conducted by: CS		Test Date: 2021-01-22
Analysis Performed by: HS	BH20-6s	Analysis Date: 2021-01-22
Aquifer Thickness: 3.30 m		



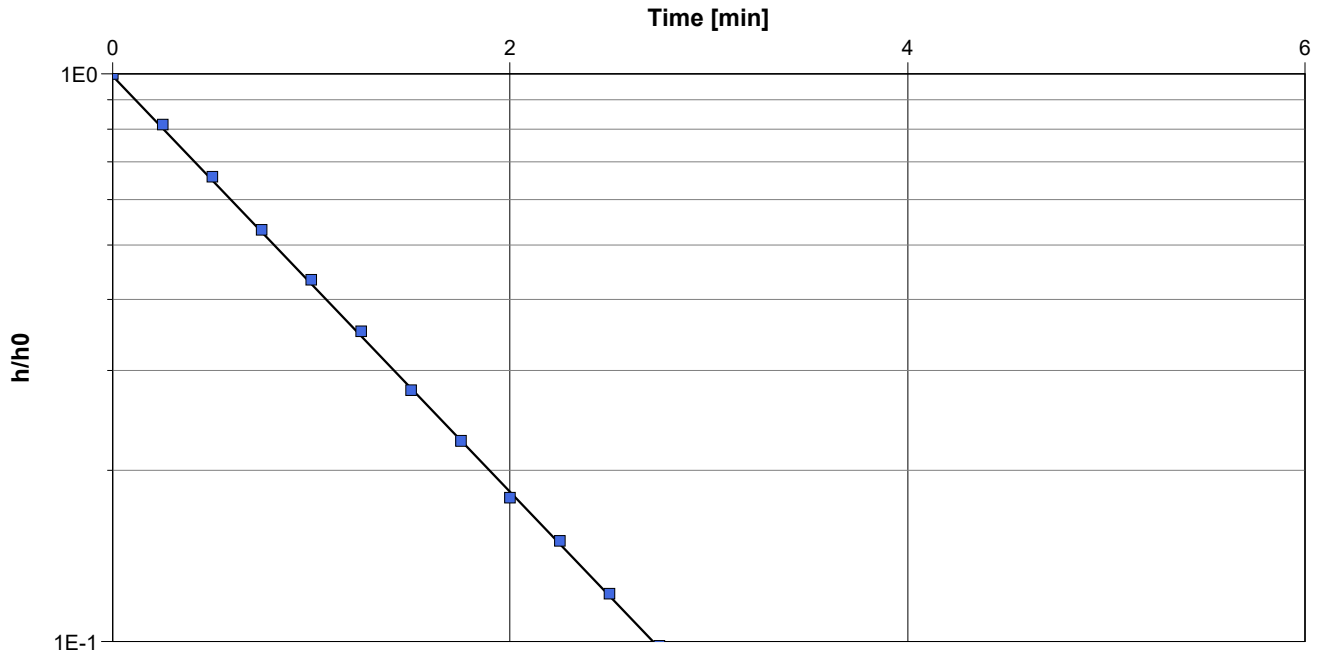
Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH20-6s	4.92×10^{-6}	

1. Well screen: 15.24 to 12.19 m below ground surface
2. Screen size 0.05 m
3. Screen length: 3.05 m
4. Borehole diameter: 203 mm = 8 inches
5. Water level before start of test: 4.9 mbgs
6. Annular fill: Sand from 15.2 to 11.9 m, bentonite above sand pack up to 0.6 mbgs, concrete above up to surface
7. Dominant lithology: Silty clay, trace sand
8. Type of test: rising head

	Slug Test Analysis Report
	Project: South Niagara WW Solutions
	Number: 201-11602-00
	Client: Niagara Region

Location: Niagara Falls	Slug Test: BH20-1 K-Test	Test Well: BH20-1
Test Conducted by: CS		Test Date: 2020-12-18
Analysis Performed by: HS	BH20-1 K-Test Analysis	Analysis Date: 2021-01-12
Aquifer Thickness: 1.82 m		



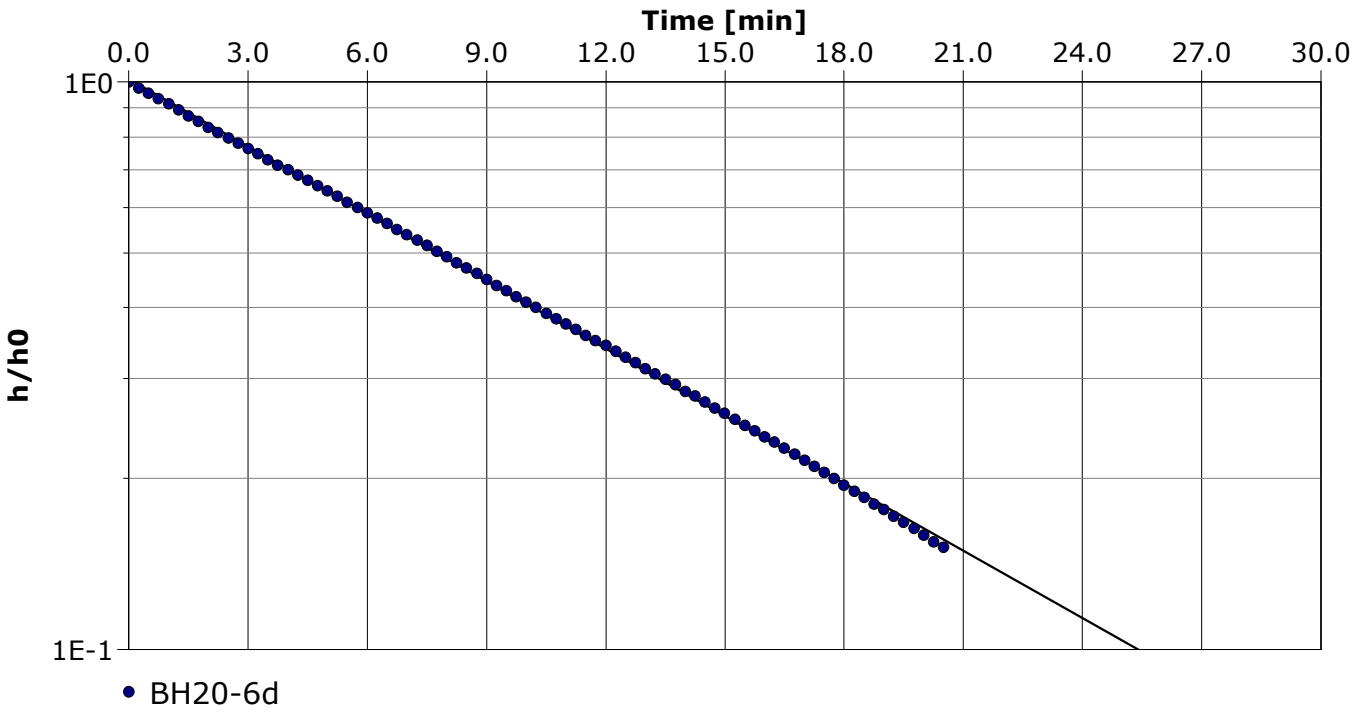
Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH20-1	1.19×10^{-5}	

1. Well screen: 15.24 to16.76 m below ground surface
2. Screen size 0.05 m
3. Screen length: 1.52 m
4. Borehole diameter: 203 mm = 8 inches
5. Water level before start of test: 9.8 mbgs
6. Annular fill: Sand from 16.76 to 14.94 m, bentonite above sand pack up to 0.6 mbgs, concrete above up to surface
7. Dominant lithology: Bedrock
8. Type of test: rising head

	Slug Test Analysis Report
	Project: South Niagara WW Solutions
	Number: 201-11602-00
	Client: Niagara Region

Location: Niagara Falls	Slug Test: BH20-6d K-Test	Test Well: BH20-6d
Test Conducted by: CS		Test Date: 2021-01-22
Analysis Performed by: HS	BH20-6d K-Test Analysis	Analysis Date: 2021-01-22
Aquifer Thickness: 2.30 m		



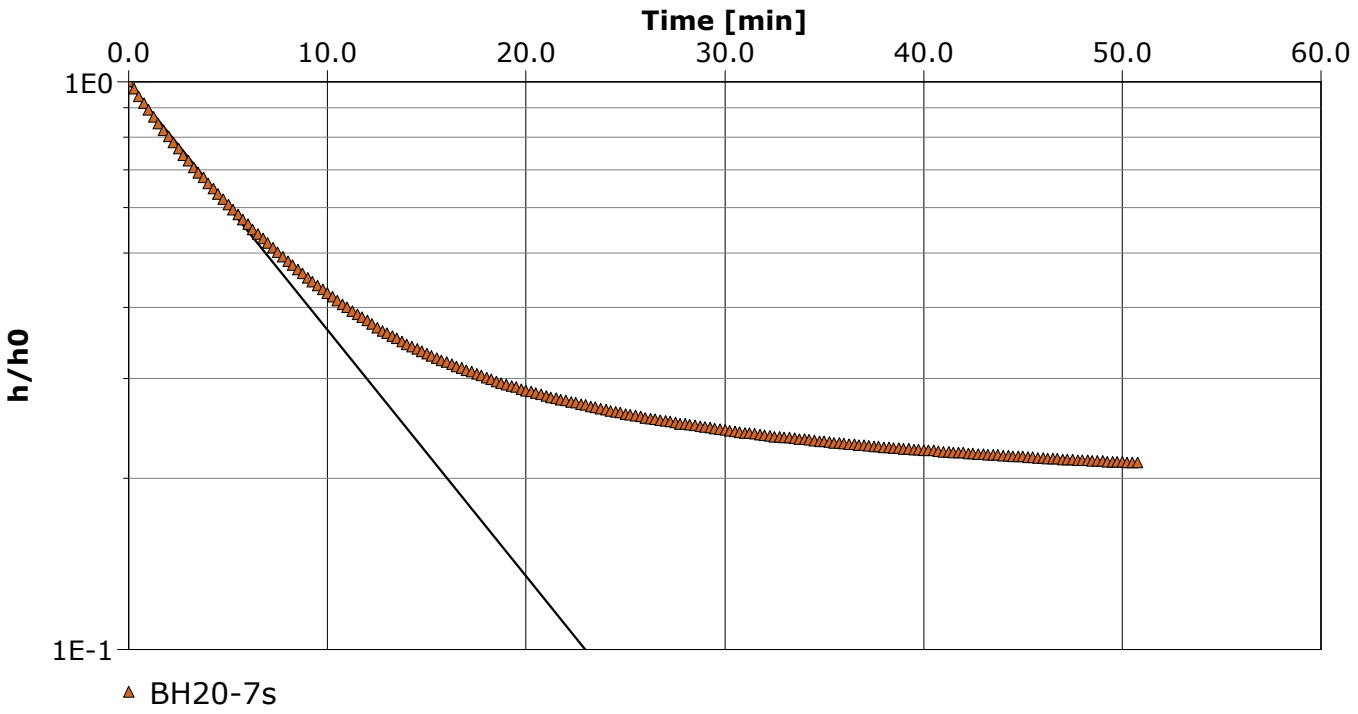
Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH20-6d	9.97×10^{-7}	

1. Well screen: 30.48 to 28.35 m below ground surface
2. Screen size 0.05 m
3. Screen length: 2.13 m
4. Borehole diameter: 203 mm = 8 inches
5. Water level before start of test: 3.55 mbgs
6. Annular fill: Sand from 30.5 to 28.2 m, bentonite above sand pack up to 0.6 mbgs, concrete above up to surface
7. Dominant lithology: Bedrock
8. Type of test: rising head

	Slug Test Analysis Report
	Project: South Niagara WW Solutions
	Number: 201-11602-00
	Client: Niagara Region

Location: Niagara Falls	Slug Test: BH20-7s K-Test	Test Well: BH20-7s
Test Conducted by: SK/CS		Test Date: 2021-01-22
Analysis Performed by: HS	BH20-7s K-Test	Analysis Date: 2021-01-22
Aquifer Thickness: 3.30 m		



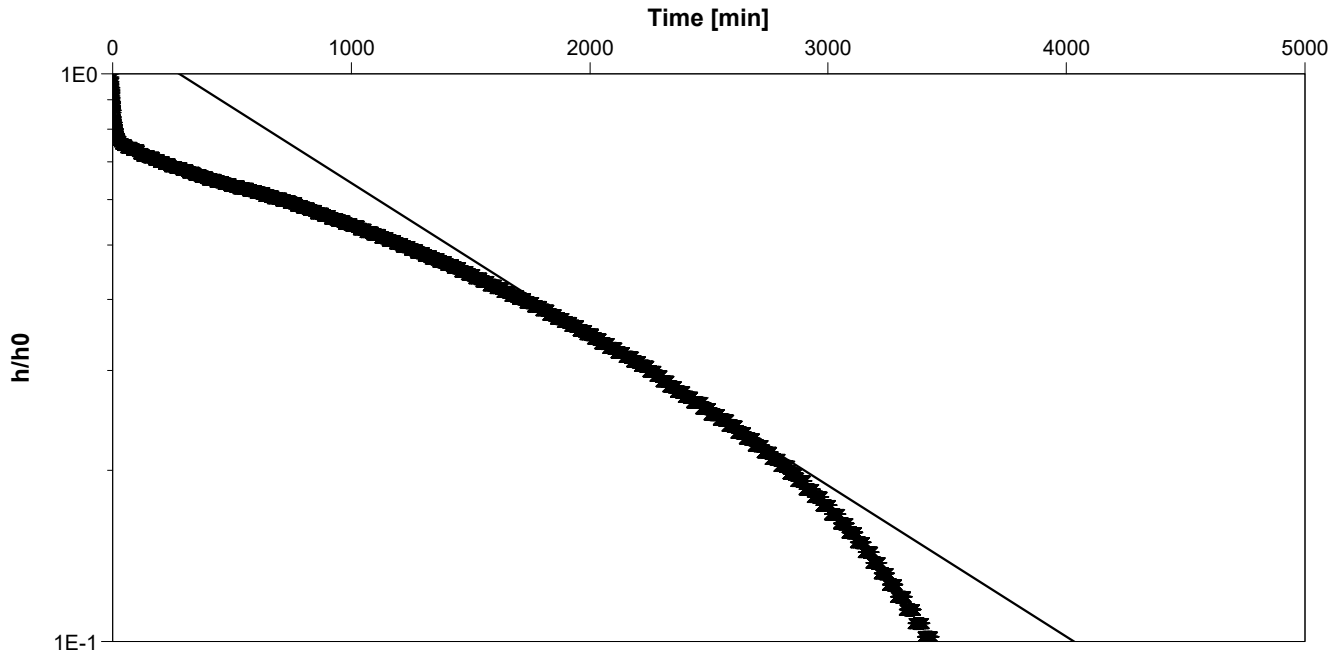
Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH20-7s	8.25×10^{-7}	

1. Well screen: 19.81 to 16.76 m below ground surface
2. Screen size 0.05 m
3. Screen length: 3.05 m
4. Borehole diameter: 203 mm = 8 inches
5. Water level before start of test: 4.6 mbgs
6. Annular fill: Sand from 19.8 to 16.5 m, bentonite above sand pack up to 0.6 mbgs, concrete above up to surface
7. Dominant lithology: Silt, trace to some clay, trace sand
8. Type of test: rising head

	Slug Test Analysis Report
	Project: South Niagara WW Solutions
	Number: 201-11602-00
	Client: Niagara Region

Location: Niagara Falls	Slug Test: BH20-10 K-Test	Test Well: BH20-10
Test Conducted by: CS		Test Date: 2020-12-18
Analysis Performed by: VBernard	BH20-10	Analysis Date: 2021-01-12
Aquifer Thickness: 3.05 m		



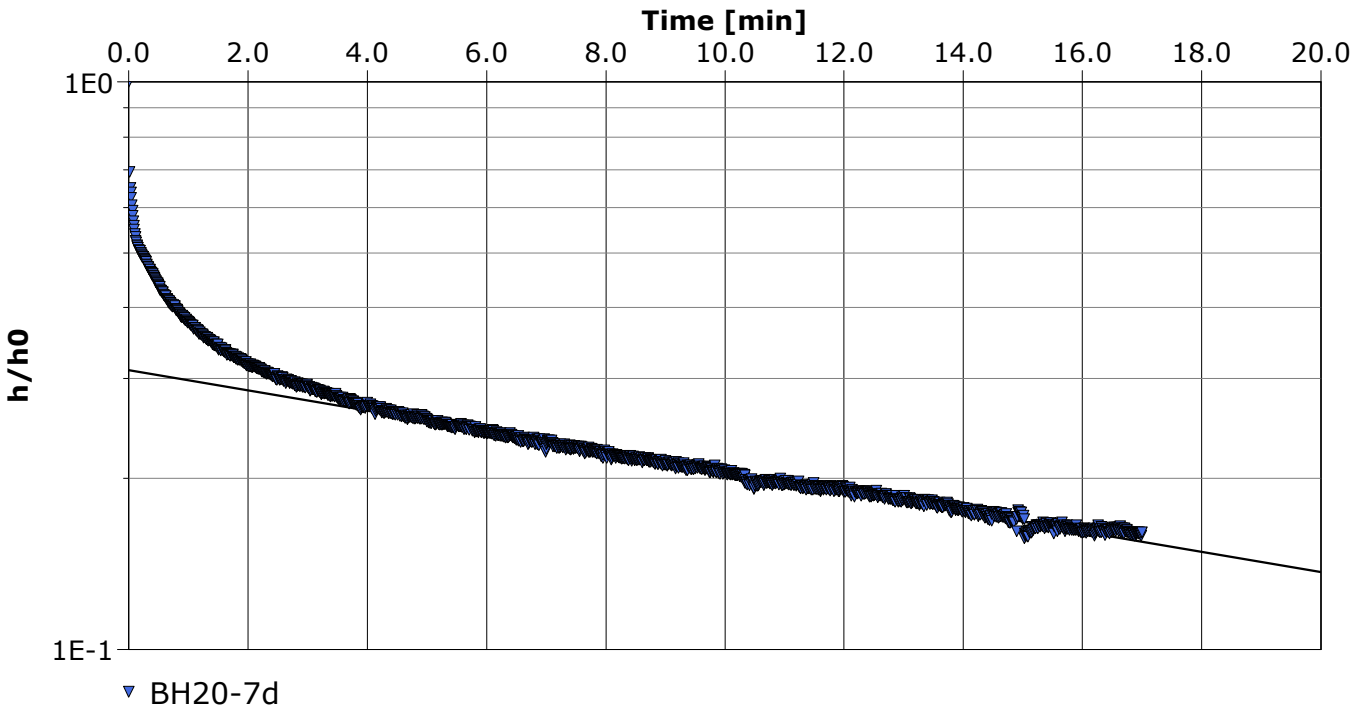
Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH20-10	5.06×10^{-9}	

1. Well screen: 6.71 to 9.75 m below ground surface
2. Screen size 0.05 m
3. Screen length: 3.05 m
4. Borehole diameter: 203 mm = 8 inches
5. Water level before start of test: 7.2 mbgs
6. Annular fill: Sand from 6.5 to 9.75 m, bentonite above sand pack up to 0.6 mbgs, concrete above up to surface
7. Dominant lithology: Silty clay, trace sand
8. Type of test: rising head

	Slug Test Analysis Report
	Project: South Niagara WW Solutions
	Number: 201-11602-00
	Client: Niagara Region

Location: Niagara Falls	Slug Test: BH20-7d K-Test	Test Well: BH20-7d
Test Conducted by: CS/SK		Test Date: 2021-01-22
Analysis Performed by: HS	BH20-7d	Analysis Date: 2021-01-22
Aquifer Thickness: 3.50 m		



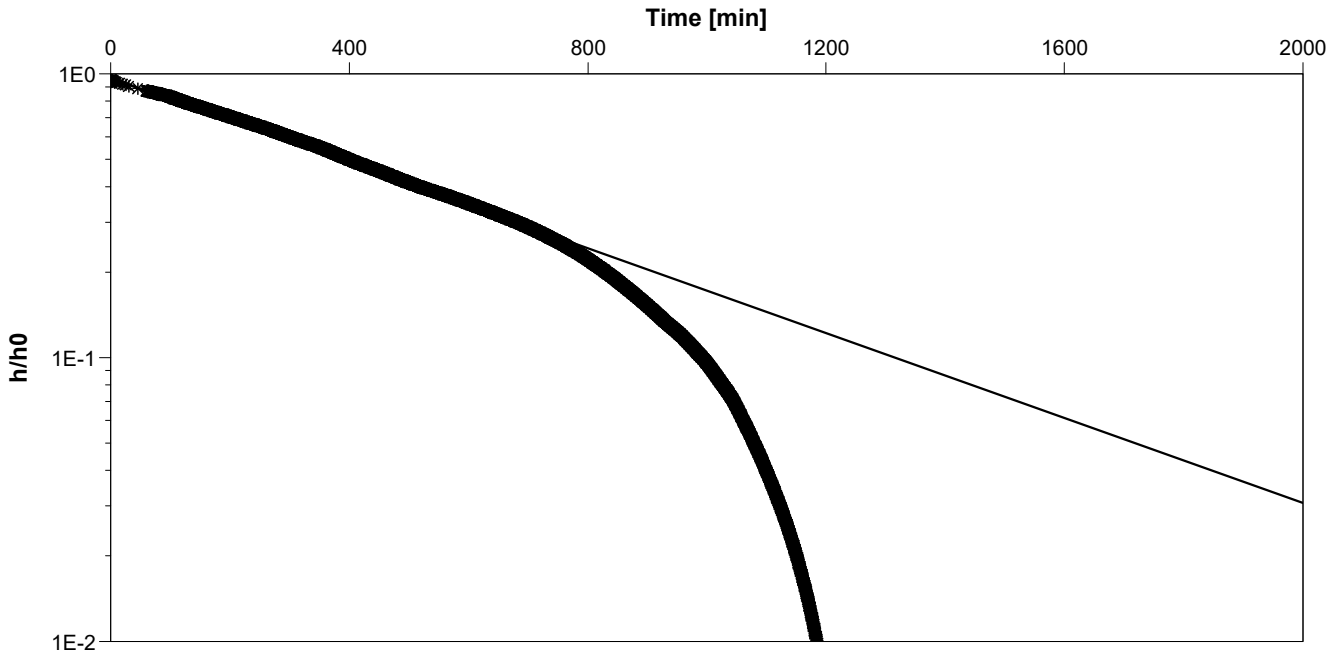
Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH20-7d	3.38×10^{-7}	

1. Well screen: 30.48 to 27.43 m below ground surface
2. Screen size 0.05 m
3. Screen length: 3.05 m
4. Borehole diameter: 203 mm = 8 inches
5. Water level before start of test: 5.37 mbgs
6. Annular fill: Sand from 30.7 to 27.2 m, bentonite above sand pack up to 0.6 mbgs, concrete above up to surface
7. Dominant lithology: Bedrock (Salina formation)
8. Type of test: rising head

	Slug Test Analysis Report
	Project: South Niagara WW Solutions
	Number: 201-11602-00
	Client: Niagara Region

Location: Niagara Falls	Slug Test: BH20-8 K-Test	Test Well: BH20-8
Test Conducted by: SK		Test Date: 2021-01-28
Analysis Performed by: VBernard	BH20-8 K-Test Analysis	Analysis Date: 2021-02-10
Aquifer Thickness: 3.30 m		



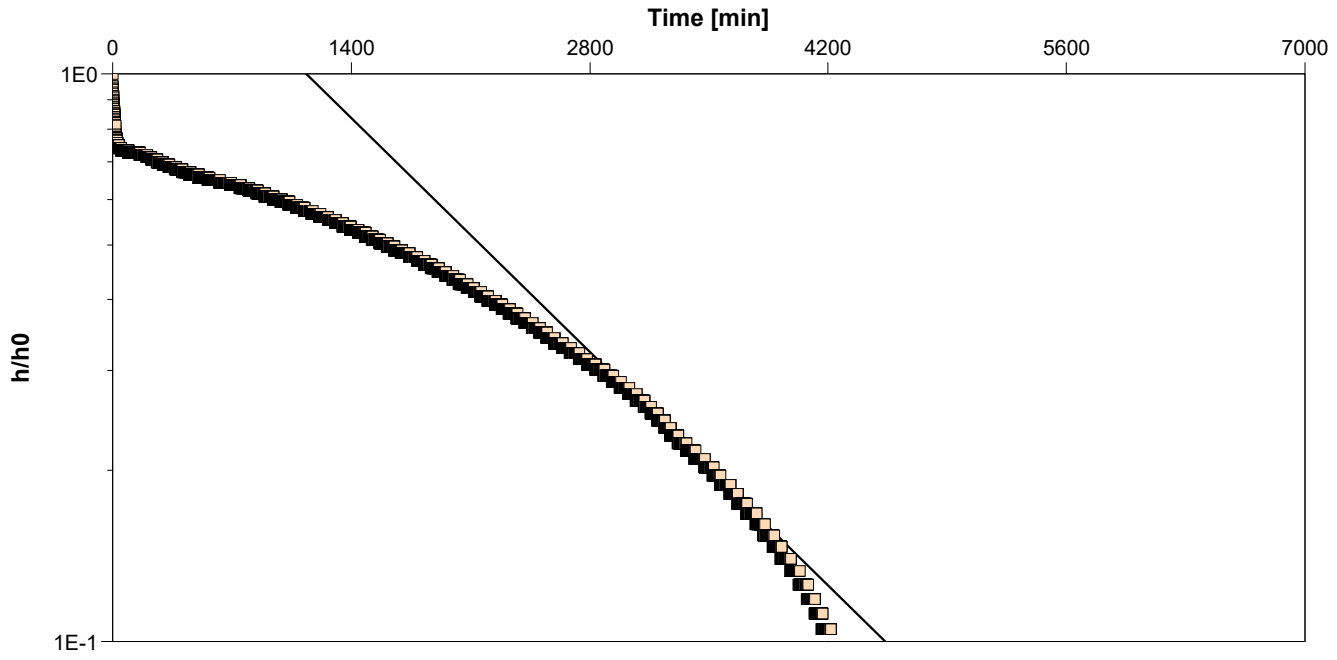
Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH20-8	1.42×10^{-8}	

1. Well screen: 39.60 to 36.55 m below ground surface
2. Screen size 0.05 m
3. Screen length: 3.1 m
4. Borehole diameter: 203 mm = 8 inches
5. Water level before start of test: 5.85 mbgs
6. Annular fill: Sand from 39.6 to 36.3 m, bentonite above sand pack up to 0.6 mbgs, concrete above up to surface
7. Dominant lithology: Bedrock (Salina formation)
8. Type of test: rising head

	Slug Test Analysis Report
	Project: South Niagara WW Solutions
	Number: 201-11602-00
	Client: Niagara Region

Location: Niagara Falls	Slug Test: BH20-11 K-Test	Test Well: BH20-11
Test Conducted by: CS		Test Date: 2020-12-18
Analysis Performed by: VBernard	BH20-11	Analysis Date: 2021-01-12
Aquifer Thickness: 3.05 m		



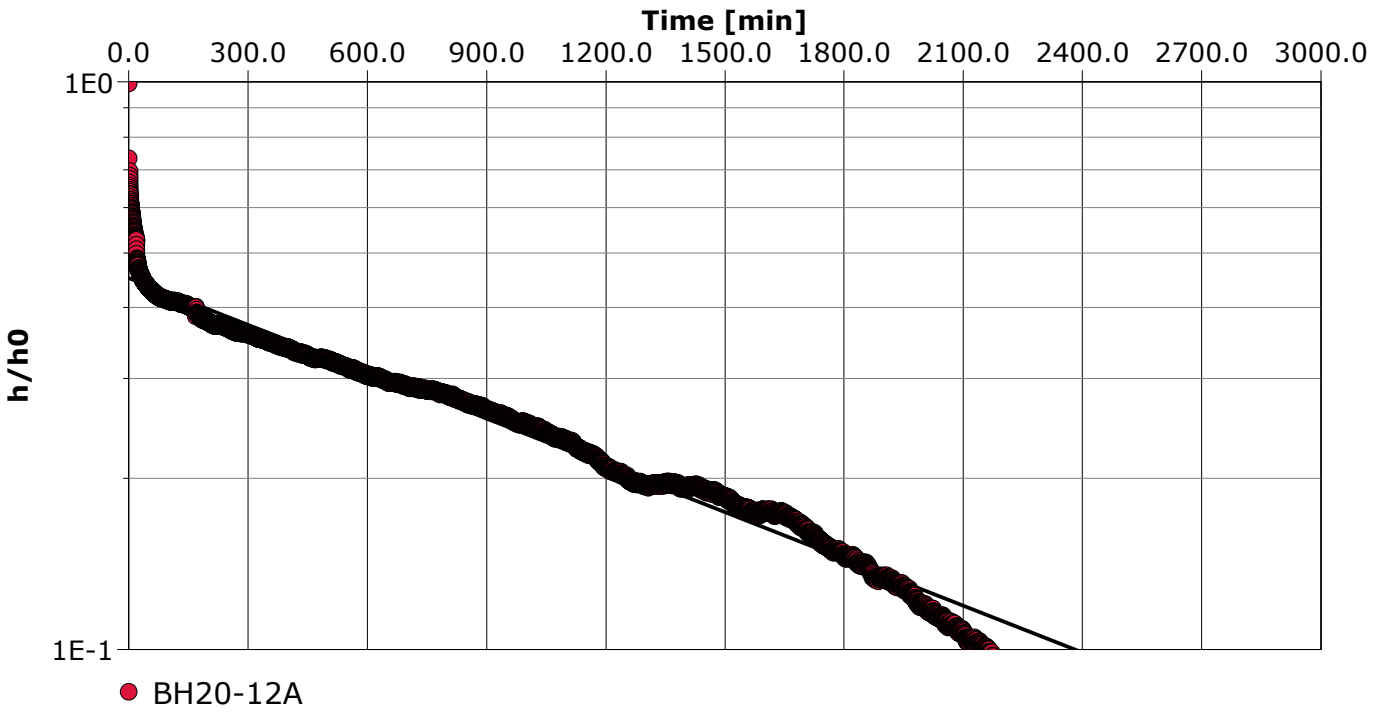
Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH20-11	5.59×10^{-9}	

1. Well screen: 9.75 to 6.71 m below ground surface
2. Screen size 0.05 m
3. Screen length: 3.05 m
4. Borehole diameter: 203 mm = 8 inches
5. Water level before start of test: 7.3 mbgs
6. Annular fill: Sand from 6.70 to 6.40 m, bentonite above sand pack up to 0.6 mbgs, concrete above up to surface
7. Dominant lithology: Silty clay, trace sand
8. Type of test: rising head

	Slug Test Analysis Report
	Project: South Niagara WW Solutions
	Number: 201-11602-00
	Client: Niagara Region

Location: Niagara Falls	Slug Test: BH20-12A K-Test	Test Well: BH20-12A
Test Conducted by: CS		Test Date: 2021-01-13
Analysis Performed by: HS	BH20-12A K-Test Analysis	Analysis Date: 2021-01-13
Aquifer Thickness: 3.35 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH20-12A	5.23×10^{-9}	

1. Well screen: 9.75 to 6.71 m below ground surface
2. Screen size 0.05 m
3. Screen length: 3.05 m
4. Borehole diameter: 203 mm = 8 inches
5. Water level before start of test: 6.73 mbgs
6. Annular fill: Sand from 6.70 to 6.40 m, bentonite above sand pack up to 0.6 mbgs, concrete above up to surface
7. Dominant lithology: Silty clay, trace sand
8. Type of test: rising head

APPENDIX

E CERTIFICATES OF ANALYSIS

WSP CANADA INC.
ATTN: Valyn Bernard
55 King Street, Suite 700
St. Catharines ON L2R 3H5

Date Received: 14-JAN-21
Report Date: 12-FEB-21 13:30 (MT)
Version: FINAL REV. 3

Client Phone: 905-687-1771

Certificate of Analysis

Lab Work Order #: L2548351

Project P.O. #: NOT SUBMITTED
Job Reference: 201-11602-00-100-1004
C of C Numbers:
Legal Site Desc:

Emily Hansen
Account Manager

ANALYTICAL REPORT

WATER - [Combined] - Ontario PWQO and Sanitary Sewer Use By-Laws

			ALS ID	L2548351-1	L2548351-2
			Sampled Date	13-JAN-21	13-JAN-21
			Sampled Time	12:00	12:00
			Sample ID	BH3	BH7D
Grouping	Analyte	Unit			
Anions and Nutrients	Sulphide (as S)	mg/L	0.022	24.0 DLHC	
	Sulphide (as H2S)	mg/L	0.023	25.5	
Volatile Organic Compounds	Methane, Dissolved	ug/L	106	502	

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Summary of Guideline Exceedances: [Combined] - Ontario PWQO and Sanitary Sewer Use By-Laws

ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit
Guideline						
Ontario Niagara Sanitary Sewer By-Law No. 27-2014						
L2548351-2	BH7D	Anions and Nutrients	Sulphide (as H2S)	25.5	1	mg/L
Surface Water PWQO						
L2548351-1	BH3	Anions and Nutrients	Sulphide (as H2S)	0.023	0.002	mg/L
L2548351-2	BH7D	Anions and Nutrients	Sulphide (as H2S)	25.5	0.002	mg/L
Surface Water - PWQO - Hardness>100PPM						
L2548351-1	BH3	Anions and Nutrients	Sulphide (as H2S)	0.023	0.002	mg/L
L2548351-2	BH7D	Anions and Nutrients	Sulphide (as H2S)	25.5	0.002	mg/L

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
METHANE-DIS-WT	Water	Methane, dissolved	EPA REGION 1, NATATTEN.WPD, REV. 1

Water samples are collected in headspace vials containing sodium bisulfate preservative. A volume of water is withdrawn from the un-capped vial. After shaking & equilibration, the vial headspace is analyzed for target gases by GC/FID. The concentration of the gas in water is proportional to the partial pressure of the gas above the liquid & is calculated using Henry's Law.

S2-T>H2S-CALC-WT	Water	Total Sulphide Calculated as H2S	Calculation

This calculation converts Total Sulphide as (S2-) and reports it as Total Sulphide as (H2S). Total Sulphide as (S2-) is determined using procedures adapted from APHA 4500-S2 "Sulphide".

SULPHIDE-WT	Water	Sulphide (as S)	APHA 4500S2D

This analysis is carried out using procedures adapted from APHA Method 4500-S2-D "Methylene Blue Method". Sulphide is determined colourmetrically.

**ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody Numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2548351 Report Date: 12-FEB-21

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
METHANE-DIS-WT	**Water**							
Batch R5352939								
WG3475163-3 DUP		**L2548351-1**						
Methane, Dissolved		106	93.0		ug/L	13	30	19-JAN-21
WG3475163-1 MB								
Methane, Dissolved			<5.0		ug/L		5	19-JAN-21
SULPHIDE-WT	**Water**							
Batch R5352759								
WG3475131-3 DUP		**L2547965-1**						
Sulphide (as S)		10.9	10.2		mg/L	6.9	20	19-JAN-21
WG3475131-2 LCS								
Sulphide (as S)			103.0		%		75-125	19-JAN-21
WG3475131-1 MB								
Sulphide (as S)			<0.018		mg/L		0.018	19-JAN-21
WG3475131-4 MS		**L2547965-1**						
Sulphide (as S)			N/A	MS-B	%		-	19-JAN-21

Quality Control Report

Workorder: L2548351 Report Date: 12-FEB-21

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS www.alsglobal.com

Ch[illegible] Request Form

L2548351-COFC

COC Number: 20 -

Page of

Report To	Contact and company name below will appear on the final report
Company:	WSP Canada Inc.
Contact:	Valyn Bernard
Phone:	289-835-2546
	Company address below will appear on the final report
Street:	55 King St, Suite 200
City/Province:	St. Ca
Postal Code:	
Invoice To	Same as Report To ☐ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Report[s]

Select Report Format: ☐ PDF ☐ EXCEL ☐ EDD (DIGITAL)
Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax Valyn.Bernard@wsp.com
Email 2
Email 3

Invoice Recipients

Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax payables.ontario@wsp.com
Email 2

Turnaround Time (TAT) Requested

☐ Routine [R] if received by 3pm M-F - no surcharges apply
☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum
☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum
☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum
☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum
☐ Same day [E2] if received by 10am M-S - 200% rush surcharge. Additional fees may apply to rush resuests on weekends, statutory holidays and non-routine tests

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm am/pm

For tests that can not be performed according to the TAT requested, you will be contacted.

Project Information

ALS Account # / Quote #: Q83429
Job #: 201-11602-00-100-1004
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#
Major/Minor Code: | Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only): 2548351

ALS Contact: | Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	METHANE-DIS-WT	Sulphide (Hydrogen)	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	BH3	13-01-21	12:00	GW		X	X			
	BH7D	13-01-21	13:00	GW		X	X			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☒ NO

Are samples for human consumption/ use? ☐ YES ☒ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

SAMPLE RECEIPT DETAILS (lab use only)

Cooling Method: ☐ NONE ☒ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED
Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO
Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A
INITIAL COOLER TEMPERATURES °C | FINAL COOLER TEMPERATURES °C: 0.4

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: SN CCS	Date: 13 Jan/20	Time: 4pm	Received by:	Date:	Time:	Received by: [signature]	Date: 1/14/21	Time: 15:5

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

WSP CANADA INC.
ATTN: Valyn Bernard
55 King Street, Suite 700
St. Catharines ON L2R 3H5

Date Received: 22-JAN-21
Report Date: 26-FEB-21 13:19 (MT)
Version: FINAL REV. 3

Client Phone: 905-687-1771

Certificate of Analysis

Lab Work Order #: L2550950

Project P.O. #: NOT SUBMITTED
Job Reference: 201-11602-00-100-1004
C of C Numbers:
Legal Site Desc:

Emily Hansen
Account Manager

WATER - [Combined] - Ontario PWQO and Sanitary Sewer Use By-Laws

			ALS ID	L2550950-1	L2550950-2	L2550950-3	L2550950-4
			Sampled Date	21-JAN-21	21-JAN-21	21-JAN-21	21-JAN-21
			Sampled Time	-	-	-	-
			Sample ID	BH3	BH7S	BH-01	BH12A
Grouping	Analyte	Unit					
Physical Tests	Conductivity	umhos/cm		5930	2360		676
	Hardness (as CaCO3)	mg/L		HTC 1150	HTC 799		HTC 192
	Langelier Index Temperature	C		20	20		20
	pH	pH units		8.24	7.95		8.27
	Total Suspended Solids	mg/L		DLHC 1450	154		19.6
	Total Dissolved Solids	mg/L		DLDS 3490	DLDS 1670		DLDS 409
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3)	mg/L		276	77.7		177
	Alkalinity, Carbonate (as CaCO3)	mg/L		<2.0	<2.0		<2.0
	Alkalinity, Hydroxide (as CaCO3)	mg/L		<2.0	<2.0		<2.0
	Alkalinity, Total (as CaCO3)	mg/L		276	77.7		177
	Ammonia, Total (as N)	mg/L		0.087	DLHC 0.512		0.147
	Chloride (Cl)	mg/L		DLDS 1750	DLDS 291		21.4
	Computed Conductivity	uS/cm		5320	2380		667
	Conductivity % Difference	%		-11	1		-1
	Fluoride (F)	mg/L		DLDS 0.98	DLDS 0.67		0.435
	Hardness (as CaCO3)	mg/L		1150	799		192
	Ion Balance	%		117	98		113
	Langelier Index			1	0		1
	Nitrate and Nitrite as N	mg/L		<0.22	<0.11		<0.022
	Nitrate (as N)	mg/L		DLDS <0.20	DLDS <0.10		<0.020
	Nitrite (as N)	mg/L		DLDS <0.10	DLDS <0.050		<0.010
	Total Kjeldahl Nitrogen	mg/L		1.04	0.870		0.410
	Saturation pH	pH		6.87	7.55		7.67
	Orthophosphate-Dissolved (as P)	mg/L		<0.0030	<0.0030		0.0060

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

WATER - [Combined] - Ontario PWQO and Sanitary Sewer Use By-Laws

			ALS ID	L2550950-1	L2550950-2	L2550950-3	L2550950-4
			Sampled Date	21-JAN-21	21-JAN-21	21-JAN-21	21-JAN-21
			Sampled Time	-	-	-	-
			Sample ID	BH3	BH7S	BH-01	BH12A
Grouping	Analyte	Unit					
Anions and Nutrients	Phosphorus, Total	mg/L		0.405	0.0867		0.0523
	TDS (Calculated)	mg/L		3850	1640		418
	Sulfate (SO4)	mg/L		DLDS 403	DLDS 817		145
	Sulphide (as S)	mg/L		0.027	0.021	<0.018	0.019
	Sulphide (as H2S)	mg/L				<0.019	
	Anion Sum	me/L		62.4	26.5		6.61
	Cation Sum	me/L		72.9	26.0		7.48
	Cation - Anion Balance	%		8	-1		6
Cyanides	Cyanide, Total	mg/L		<0.0020	<0.0020		<0.0020
Organic / Inorganic Carbon	Total Organic Carbon	mg/L		DLM 45.9	DLM 48.0		4.98
Total Metals	Aluminum (Al)-Total	mg/L		DLHC 11.8	DLHC 1.61		0.499
	Antimony (Sb)-Total	mg/L		DLHC 0.0034	DLHC 0.0084		0.00103
	Arsenic (As)-Total	mg/L		DLHC 0.0067	DLHC 0.0029		0.00182
	Barium (Ba)-Total	mg/L		DLHC 0.245	DLHC 0.0435		0.0535
	Beryllium (Be)-Total	mg/L		DLHC <0.0010	DLHC <0.0010		<0.00010
	Boron (B)-Total	mg/L		DLHC 0.14	DLHC 0.36		0.356
	Cadmium (Cd)-Total	mg/L		DLHC 0.000392	DLM <0.00010		DLM <0.000020
	Calcium (Ca)-Total	mg/L		DLHC 263	DLHC 152		34.6
	Chromium (Cr)-Total	mg/L		DLHC 0.0265	DLHC <0.0050		0.00110
	Cobalt (Co)-Total	mg/L		DLHC 0.0079	DLHC 0.0016		0.00035
	Copper (Cu)-Total	mg/L		DLHC 0.0277	DLHC <0.0050		0.0025
	Iron (Fe)-Total	mg/L		DLHC 23.6	DLHC 4.52		0.594
	Lead (Pb)-Total	mg/L		DLHC 0.0251	DLHC 0.00685		0.000597
	Magnesium (Mg)-Total	mg/L		DLHC 119	DLHC 102		25.7

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

WATER - [Combined] - Ontario PWQO and Sanitary Sewer Use By-Laws

			ALS ID	L2550950-1	L2550950-2	L2550950-3	L2550950-4
			Sampled Date	21-JAN-21	21-JAN-21	21-JAN-21	21-JAN-21
			Sampled Time	-	-	-	-
			Sample ID	BH3	BH7S	BH-01	BH12A
Grouping	Analyte	Unit					
Total Metals	Manganese (Mn)-Total	mg/L	DLHC 0.752	DLHC 0.183		0.0425
	Mercury (Hg)-Total	mg/L	0.0000183	<0.0000050		<0.0000050
	Molybdenum (Mo)-Total	mg/L	DLHC 0.0181	DLHC 0.0558		0.0253
	Nickel (Ni)-Total	mg/L	DLHC 0.0192	DLHC 0.0057		0.00083
	Potassium (K)-Total	mg/L	DLHC 5.56	DLHC 5.51		2.58
	Selenium (Se)-Total	mg/L	DLHC <0.00050	DLHC <0.00050		0.000560
	Silver (Ag)-Total	mg/L	DLHC <0.00050	DLHC <0.00050		<0.000050
	Sodium (Na)-Total	mg/L	DLHC 1150	DLHC 227		82.1
	Strontium (Sr)-Total	mg/L	DLHC 1.75	DLHC 4.28		0.901
	Thallium (Tl)-Total	mg/L	DLHC 0.00012	DLHC <0.00010		0.000026
	Tin (Sn)-Total	mg/L	DLHC 0.0060	DLHC 0.0049		0.00262
	Titanium (Ti)-Total	mg/L	DLHC 0.259	DLHC 0.0368		0.00867
	Tungsten (W)-Total	mg/L	DLHC 0.0059	DLHC 0.0114		<0.00010
	Uranium (U)-Total	mg/L	DLHC 0.00427	DLHC 0.00112		0.00367
	Vanadium (V)-Total	mg/L	DLHC 0.0240	DLHC <0.0050		0.00271
	Zinc (Zn)-Total	mg/L	DLHC 0.898	DLHC 0.049		0.0865
	Zirconium (Zr)-Total	mg/L	DLHC 0.0029	DLHC <0.0020		0.00038
Dissolved Metals	Dissolved Mercury Filtration Location		LAB	LAB		LAB
	Mercury (Hg)-Dissolved	mg/L	<0.0000050	<0.0000050		<0.0000050
Aggregate Organics	BOD	mg/L	13	HTD 107		BODL <3.0
	Oil and Grease, Total	mg/L	7.3	<5.0		<5.0
	Animal/Veg Oil & Grease	mg/L	4.1	<5.0		<5.0
	Mineral Oil and Grease	mg/L	3.2	<2.5		<2.5
	Phenols (4AAP)	mg/L	0.0043	0.0204		0.0011

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

WATER - [Combined] - Ontario PWQO and Sanitary Sewer Use By-Laws

			ALS ID	L2550950-1	L2550950-2	L2550950-3	L2550950-4
			Sampled Date	21-JAN-21	21-JAN-21	21-JAN-21	21-JAN-21
			Sampled Time	-	-	-	-
			Sample ID	BH3	BH7S	BH-01	BH12A
Grouping	Analyte	Unit					
Volatile Organic Compounds	Benzene	ug/L	OWP <0.50	OWP <0.50		OWP <0.50
	Chloroform	ug/L	OWP <1.0	OWP <1.0		OWP <1.0
	1,2-Dichlorobenzene	ug/L	OWP <0.50	OWP <0.50		OWP <0.50
	1,4-Dichlorobenzene	ug/L	OWP <0.50	OWP <0.50		OWP <0.50
	Dichloromethane	ug/L	OWP <2.0	OWP <2.0		OWP <2.0
	Ethylbenzene	ug/L	OWP <0.50	OWP <0.50		OWP <0.50
	Methane, Dissolved	ug/L			268	
	1,1,2,2-Tetrachloroethane	ug/L	OWP <0.50	OWP <0.50		OWP <0.50
	Tetrachloroethylene	ug/L	OWP <0.50	OWP <0.50		OWP <0.50
	Toluene	ug/L	OWP 1.35	OWP <0.50		OWP <0.50
	Trichloroethylene	ug/L	OWP <0.50	OWP <0.50		OWP <0.50
	o-Xylene	ug/L	OWP <0.50	OWP <0.50		OWP <0.50
	Surrogate: 4-Bromofluorobenzene	%	95.7	87.8		88.1
	Surrogate: 1,4-Difluorobenzene	%	99.3	98.6		98.7

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Summary of Guideline Exceedances: [Combined] - Ontario PWQO and Sanitary Sewer Use By-Laws

Guideline ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit
Ontario Niagara Sanitary Sewer By-Law No. 27-2014						
L2550950-1	BH3	Physical Tests	Total Suspended Solids	1450	350	mg/L
Surface Water PWQO						
L2550950-1	BH3	Anions and Nutrients	Phosphorus, Total	0.405	0.01	mg/L
		Total Metals	Aluminum (Al)-Total	11.8	0.015	mg/L
			Arsenic (As)-Total	0.0067	0.005	mg/L
			Cadmium (Cd)-Total	0.000392	0.0001	mg/L
			Cobalt (Co)-Total	0.0079	0.0009	mg/L
			Copper (Cu)-Total	0.0277	0.001	mg/L
			Iron (Fe)-Total	23.6	0.3	mg/L
			Lead (Pb)-Total	0.0251	0.001	mg/L
			Silver (Ag)-Total	<0.00050	0.0001	mg/L
			Vanadium (V)-Total	0.0240	0.006	mg/L
			Zinc (Zn)-Total	0.898	0.02	mg/L
		Aggregate Organics	Phenols (4AAP)	0.0043	0.001	mg/L
		Volatile Organic Compounds	Toluene	1.35	0.8	ug/L
L2550950-2	BH7S	Anions and Nutrients	Phosphorus, Total	0.0867	0.01	mg/L
		Total Metals	Aluminum (Al)-Total	1.61	0.015	mg/L
			Boron (B)-Total	0.36	0.2	mg/L
			Cobalt (Co)-Total	0.0016	0.0009	mg/L
			Copper (Cu)-Total	<0.0050	0.001	mg/L
			Iron (Fe)-Total	4.52	0.3	mg/L
			Lead (Pb)-Total	0.00685	0.001	mg/L
			Molybdenum (Mo)-Total	0.0558	0.04	mg/L
			Silver (Ag)-Total	<0.00050	0.0001	mg/L
			Zinc (Zn)-Total	0.049	0.02	mg/L
		Aggregate Organics	Phenols (4AAP)	0.0204	0.001	mg/L
L2550950-3	BH-01	Anions and Nutrients	Sulphide (as H2S)	<0.019	0.002	mg/L
L2550950-4	BH12A	Anions and Nutrients	Phosphorus, Total	0.0523	0.01	mg/L
		Total Metals	Aluminum (Al)-Total	0.499	0.015	mg/L
			Boron (B)-Total	0.356	0.2	mg/L
			Copper (Cu)-Total	0.0025	0.001	mg/L
			Iron (Fe)-Total	0.594	0.3	mg/L
			Zinc (Zn)-Total	0.0865	0.02	mg/L
		Aggregate Organics	Phenols (4AAP)	0.0011	0.001	mg/L
Surface Water - PWQO - Hardness>100PPM						
L2550950-1	BH3	Anions and Nutrients	Phosphorus, Total	0.405	0.01	mg/L

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Summary of Guideline Exceedances: [Combined] - Ontario PWQO and Sanitary Sewer Use By-Laws

Guideline ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit
Surface Water - PWQO - Hardness>100PPM						
L2550950-1	BH3	Total Metals	Aluminum (Al)-Total	11.8	0.0750	mg/L
			Arsenic (As)-Total	0.0067	0.005	mg/L
			Cobalt (Co)-Total	0.0079	0.0009	mg/L
			Copper (Cu)-Total	0.0277	0.0050	mg/L
			Iron (Fe)-Total	23.6	0.3	mg/L
			Lead (Pb)-Total	0.0251	0.0050	mg/L
			Silver (Ag)-Total	<0.00050	0.0001	mg/L
			Vanadium (V)-Total	0.0240	0.006	mg/L
			Zinc (Zn)-Total	0.898	0.02	mg/L
		Aggregate Organics	Phenols (4AAP)	0.0043	0.001	mg/L
		Volatile Organic Compounds	Toluene	1.35	0.8	ug/L
L2550950-2	BH7S	Anions and Nutrients	Phosphorus, Total	0.0867	0.01	mg/L
		Total Metals	Aluminum (Al)-Total	1.61	0.0750	mg/L
			Boron (B)-Total	0.36	0.2	mg/L
			Cobalt (Co)-Total	0.0016	0.0009	mg/L
			Iron (Fe)-Total	4.52	0.3	mg/L
			Lead (Pb)-Total	0.00685	0.0050	mg/L
			Molybdenum (Mo)-Total	0.0558	0.04	mg/L
			Silver (Ag)-Total	<0.00050	0.0001	mg/L
			Zinc (Zn)-Total	0.049	0.02	mg/L
		Aggregate Organics	Phenols (4AAP)	0.0204	0.001	mg/L
L2550950-3	BH-01	Anions and Nutrients	Sulphide (as H2S)	<0.019	0.002	mg/L
L2550950-4	BH12A	Anions and Nutrients	Phosphorus, Total	0.0523	0.01	mg/L
		Total Metals	Aluminum (Al)-Total	0.499	0.0750	mg/L
			Boron (B)-Total	0.356	0.2	mg/L
			Iron (Fe)-Total	0.594	0.3	mg/L
			Zinc (Zn)-Total	0.0865	0.02	mg/L
		Aggregate Organics	Phenols (4AAP)	0.0011	0.001	mg/L

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments
L2550950-2	Water	Note: DLM - Cd LOR increased due to potential interference from Mo	
L2550950-4	Water	Note: DLM - Cd LOR increased due to potential interference from Mo	

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
HTD	Hold time exceeded for re-analysis or dilution, but initial testing was conducted within hold time.
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
BODL	Limit of Reporting for BOD was increased to account for the largest volume of sample tested.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
OWP	Organic water sample contained visible sediment (must be included as part of analysis). Measured concentrations of organic substances in water can be biased high due to presence of

Reference Information

sediment.

DLHC Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SPEC-PCT-WT	Water	Automated Speciated Alkalinity	APHA 2320B

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

BOD-WT	Water	BOD	APHA 5210 B

This analysis is carried out using procedures adapted from APHA Method 5210B - "Biochemical Oxygen Demand (BOD)". All forms of biochemical oxygen demand (BOD) are determined by diluting and incubating a sample for a specified time period, and measuring the oxygen depletion using a dissolved oxygen meter. Dissolved BOD (SOLUBLE) is determined by filtering the sample through a glass fibre filter prior to dilution. Carbonaceous BOD (CBOD) is determined by adding a nitrification inhibitor to the diluted sample prior to incubation.

CL-IC-N-WT	Water	Chloride by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

CN-TOT-WT	Water	Cyanide, Total	ISO 14403-2

Total cyanide is determined by the combination of UV digestion and distillation. Cyanide is converted to cyanogen chloride by reacting with chloramine-T, the cyanogen chloride then reacts with a combination of barbituric acid and isonicotinic acid to form a highly colored complex.

When using this method, high levels of thiocyanate in samples can cause false positives at ~1-2% of the thiocyanate concentration. For samples with detectable cyanide analyzed by this method, ALS recommends analysis for thiocyanate to check for this potential interference

EC-SCREEN-WT	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

EC-WT	Water	Conductivity	APHA 2510 B

Water samples can be measured directly by immersing the conductivity cell into the sample.

ETL-N2N3-WT	Water	Calculate from NO2 + NO3	APHA 4110 B
F-IC-N-WT	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-WT	Water	Hardness	APHA 2340 B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-WT	Water	Dissolved Mercury in Water by CVAAS	EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
			Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).
HG-T-CVAA-WT	Water	Total Mercury in Water by CVAAS	EPA 1631E (mod)
			Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.
IONBALANCE-OP03-WT	Water	Detailed Ion Balance Calculation	APHA 1030E, 2330B, 2510A
LANGELIER-CALC-WT	Water	Langelier Index	APHA 2330B
			Langelier Index provides an indication of scale formation potential at a given pH and temperature. Field pH is used where provided. Positive values indicate oversaturation with respect to CaCO3. Negative values indicate undersaturation of CaCO3. Langelier Index is calculated as per APHA 2330B Saturation Index.
MET-T-CCMS-WT	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)
			Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.
			Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
			Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).
METHANE-DIS-WT	Water	Methane, dissolved	EPA REGION 1, NATATTEN.WPD, REV. 1
			Water samples are collected in headspace vials containing sodium bisulfate preservative. A volume of water is withdrawn from the un-capped vial. After shaking & equilibration, the vial headspace is analyzed for target gases by GC/FID. The concentration of the gas in water is proportional to the partial pressure of the gas above the liquid & is calculated using Henry's Law.
NH3-F-WT	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC
			This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.
NO2-IC-WT	Water	Nitrite in Water by IC	EPA 300.1 (mod)
			Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
NO3-IC-WT	Water	Nitrate in Water by IC	EPA 300.1 (mod)
			Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
OGG-SPEC-CALC-WT	Water	Speciated Oil and Grease A/V Calc	CALCULATION
			Sample is extracted with hexane, sample speciation into mineral and animal/vegetable fractions is achieved via silica gel separation and is then determined gravimetrically.
OGG-SPEC-WT	Water	Speciated Oil and Grease-Gravimetric	APHA 5520 B
			The procedure involves an extraction of the entire water sample with hexane. Sample speciation into mineral and animal/vegetable fractions is achieved via silica gel separation and is then determined gravimetrically.
P-T-COL-WT	Water	Total P in Water by Colour	APHA 4500-P PHOSPHORUS

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
		This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is deteremined colourimetrically after persulphate digestion of the sample.	
PH-WT	Water	pH	APHA 4500 H-Electrode
		Water samples are analyzed directly by a calibrated pH meter.	
		Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011). Holdtime for samples under this regulation is 28 days	
PHENOLS-4AAP-WT	Water	Phenol (4AAP)	EPA 9066
		An automated method is used to distill the sample. The distillate is then buffered to pH 9.4 which reacts with 4AAP and potassium ferricyanide to form a red complex which is measured colorimetrically.	
PO4-DO-COL-WT	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P PHOSPHORUS
		This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.	
S2-T>H2S-CALC-WT	Water	Total Sulphide Calculated as H2S	Calculation
		This calculation converts Total Sulphide as (S2-) and reports it as Total Sulphide as (H2S). Total Sulphide as (S2-) is determined using procedures adapted from APHA 4500-S2 "Sulphide".	
SO4-IC-N-WT	Water	Sulfate in Water by IC	EPA 300.1 (mod)
		Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.	
SOLIDS-TDS-WT	Water	Total Dissolved Solids	APHA 2540C
		This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.	
SOLIDS-TSS-WT	Water	Suspended solids	APHA 2540 D-Gravimetric
		A well-mixed sample is filtered through a weighed standard glass fibre filter and the residue retained is dried in an oven at 104–1C for a minimum of four hours or until a constant weight is achieved.	
SULPHIDE-WT	Water	Sulphide (as S)	APHA 4500S2D
		This analysis is carried out using procedures adapted from APHA Method 4500-S2-D "Methylene Blue Method". Sulphide is determined colourmetrically.	
TKN-F-WT	Water	TKN in Water by Fluorescence	J. ENVIRON. MONIT., 2005,7,37-42,RSC
		Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection	
TOC-WT	Water	Total Organic Carbon	APHA 5310B
		Sample is injected into a heated reaction chamber which is packed with an oxidative catalyst. The water is vaporized and the organic cabon is oxidized to carbon dioxide. The carbon dioxide is transported in a carrier gas and is measured by a non-dispersive infrared detector.	
VOC-ROU-HS-WT	Water	Volatile Organic Compounds	SW846 8260
		Aqueous samples are analyzed by headspace-GC/MS.	

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**

**ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody Numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2550950 Report Date: 26-FEB-21

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-SPEC-PCT-WT	**Water**							
Batch R5357315								
WG3477682-4 DUP		**WG3477682-3**						
Alkalinity, Total (as CaCO3)		277	282		mg/L	1.8	20	23-JAN-21
Alkalinity, Bicarbonate (as CaCO3)		277	282		mg/L	1.8	20	23-JAN-21
Alkalinity, Carbonate (as CaCO3)		<2.0	<2.0	RPD-NA	mg/L	N/A	20	23-JAN-21
Alkalinity, Hydroxide (as CaCO3)		<2.0	<2.0	RPD-NA	mg/L	N/A	20	23-JAN-21
WG3477682-2 LCS								
Alkalinity, Total (as CaCO3)			102.3		%		85-115	23-JAN-21
WG3477682-1 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	23-JAN-21
Alkalinity, Bicarbonate (as CaCO3)			<2.0		mg/L		2	23-JAN-21
Alkalinity, Carbonate (as CaCO3)			<2.0		mg/L		2	23-JAN-21
Alkalinity, Hydroxide (as CaCO3)			<2.0		mg/L		2	23-JAN-21
BOD-WT	**Water**							
Batch R5359073								
WG3477841-2 DUP		**L2550730-1**						
BOD		<2.0	<2.0	RPD-NA	mg/L	N/A	30	23-JAN-21
WG3477841-3 LCS								
BOD			97.5		%		85-115	23-JAN-21
WG3477841-1 MB								
BOD			<2.0		mg/L		2	23-JAN-21
Batch R5360962								
WG3480086-2 DUP		**L2552013-2**						
BOD		<3.0	<3.0	RPD-NA	mg/L	N/A	30	28-JAN-21
WG3480086-3 LCS								
BOD			104.0		%		85-115	28-JAN-21
WG3480086-1 MB								
BOD			<2.0		mg/L		2	28-JAN-21
CL-IC-N-WT	**Water**							
Batch R5358043								
WG3478467-4 DUP		**WG3478467-3**						
Chloride (Cl)		21.4	21.4		mg/L	0.1	20	25-JAN-21
WG3478467-2 LCS								
Chloride (Cl)			100.3		%		90-110	25-JAN-21
WG3478467-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	25-JAN-21
WG3478467-5 MS		**WG3478467-3**						
Chloride (Cl)			98.8		%		75-125	25-JAN-21

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CN-TOT-WT	**Water**							
Batch R5358329								
WG3478787-3 DUP		**WG3478787-5**						
Cyanide, Total		0.140	0.155		mg/L	10	20	26-JAN-21
WG3478787-2 LCS								
Cyanide, Total			96.9		%		80-120	26-JAN-21
WG3478787-1 MB								
Cyanide, Total			<0.0020		mg/L		0.002	26-JAN-21
WG3478787-4 MS		**WG3478787-5**						
Cyanide, Total			85		%		70-130	26-JAN-21
EC-WT	**Water**							
Batch R5357315								
WG3477682-4 DUP		**WG3477682-3**						
Conductivity		717	718		umhos/cm	0.1	10	23-JAN-21
WG3477682-2 LCS								
Conductivity			99.6		%		90-110	23-JAN-21
WG3477682-1 MB								
Conductivity			<3.0		umhos/cm		3	23-JAN-21
F-IC-N-WT	**Water**							
Batch R5358043								
WG3478467-4 DUP		**WG3478467-3**						
Fluoride (F)		0.427	0.429		mg/L	0.6	20	25-JAN-21
WG3478467-2 LCS								
Fluoride (F)			101.6		%		90-110	25-JAN-21
WG3478467-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	25-JAN-21
WG3478467-5 MS		**WG3478467-3**						
Fluoride (F)			97.6		%		75-125	25-JAN-21
HG-D-CVAA-WT	**Water**							
Batch R5357400								
WG3478095-8 DUP		**WG3478095-7**						
Mercury (Hg)-Dissolved		<0.0000050	<0.0000050	RPD-NA	mg/L	N/A	20	25-JAN-21
WG3478095-2 LCS								
Mercury (Hg)-Dissolved			89.7		%		80-120	25-JAN-21
WG3478095-1 MB								
Mercury (Hg)-Dissolved			<0.0000050		mg/L		0.000005	25-JAN-21
WG3478095-10 MS		**WG3478095-9**						
Mercury (Hg)-Dissolved			86.5		%		70-130	25-JAN-21
HG-T-CVAA-WT	**Water**							

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-T-CVAA-WT	**Water**							
Batch R5357364								
WG3478093-3 DUP		**L2550335-2**						
Mercury (Hg)-Total		0.0000062	0.0000058		mg/L	6.7	20	25-JAN-21
WG3478093-2 LCS								
Mercury (Hg)-Total			99.6		%		80-120	25-JAN-21
WG3478093-1 MB								
Mercury (Hg)-Total			<0.0000050		mg/L		0.000005	25-JAN-21
WG3478093-4 MS		**L2550716-1**						
Mercury (Hg)-Total			102.9		%		70-130	25-JAN-21
MET-T-CCMS-WT	**Water**							
Batch R5357725								
WG3477986-4 DUP		**WG3477986-3**						
Aluminum (Al)-Total		0.050	0.051		mg/L	0.9	20	25-JAN-21
Antimony (Sb)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	25-JAN-21
Arsenic (As)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	25-JAN-21
Barium (Ba)-Total		0.0635	0.0618		mg/L	2.8	20	25-JAN-21
Beryllium (Be)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	25-JAN-21
Boron (B)-Total		0.34	0.33		mg/L	4.3	20	25-JAN-21
Cadmium (Cd)-Total		0.000064	0.000090	J	mg/L	0.000027	0.0001	25-JAN-21
Calcium (Ca)-Total		288	296		mg/L	2.6	20	25-JAN-21
Chromium (Cr)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	25-JAN-21
Cobalt (Co)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	25-JAN-21
Copper (Cu)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	25-JAN-21
Iron (Fe)-Total		1.08	1.07		mg/L	0.6	20	25-JAN-21
Lead (Pb)-Total		0.00160	0.00163		mg/L	1.7	20	25-JAN-21
Magnesium (Mg)-Total		36.7	37.6		mg/L	2.5	20	25-JAN-21
Manganese (Mn)-Total		0.294	0.288		mg/L	2.1	20	25-JAN-21
Molybdenum (Mo)-Total		0.0147	0.0143		mg/L	2.9	20	25-JAN-21
Nickel (Ni)-Total		0.0061	0.0058		mg/L	5.4	20	25-JAN-21
Potassium (K)-Total		13.3	13.1		mg/L	1.8	20	25-JAN-21
Selenium (Se)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	25-JAN-21
Silver (Ag)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	25-JAN-21
Sodium (Na)-Total		150	148		mg/L	1.1	20	25-JAN-21
Strontium (Sr)-Total		3.17	3.13		mg/L	1.4	20	25-JAN-21
Thallium (Tl)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	25-JAN-21
Tin (Sn)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	25-JAN-21

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5357725								
WG3477986-4 DUP		**WG3477986-3**						
Titanium (Ti)-Total		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	25-JAN-21
Tungsten (W)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	25-JAN-21
Uranium (U)-Total		0.00114	0.00111		mg/L	2.6	20	25-JAN-21
Vanadium (V)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	25-JAN-21
Zinc (Zn)-Total		0.071	0.073		mg/L	2.0	20	25-JAN-21
Zirconium (Zr)-Total		<0.0020	<0.0020	RPD-NA	mg/L	N/A	20	25-JAN-21
WG3477986-2 LCS								
Aluminum (Al)-Total			96.9		%		80-120	25-JAN-21
Antimony (Sb)-Total			100.1		%		80-120	25-JAN-21
Arsenic (As)-Total			95.4		%		80-120	25-JAN-21
Barium (Ba)-Total			98.5		%		80-120	25-JAN-21
Beryllium (Be)-Total			101.0		%		80-120	25-JAN-21
Boron (B)-Total			98.7		%		80-120	25-JAN-21
Cadmium (Cd)-Total			95.9		%		80-120	25-JAN-21
Calcium (Ca)-Total			99.3		%		80-120	25-JAN-21
Chromium (Cr)-Total			93.8		%		80-120	25-JAN-21
Cobalt (Co)-Total			90.8		%		80-120	25-JAN-21
Copper (Cu)-Total			92.8		%		80-120	25-JAN-21
Iron (Fe)-Total			88.2		%		80-120	25-JAN-21
Lead (Pb)-Total			96.4		%		80-120	25-JAN-21
Magnesium (Mg)-Total			102.3		%		80-120	25-JAN-21
Manganese (Mn)-Total			95.9		%		80-120	25-JAN-21
Molybdenum (Mo)-Total			97.0		%		80-120	25-JAN-21
Nickel (Ni)-Total			93.4		%		80-120	25-JAN-21
Potassium (K)-Total			94.5		%		80-120	25-JAN-21
Selenium (Se)-Total			95.1		%		80-120	25-JAN-21
Silver (Ag)-Total			97.8		%		80-120	25-JAN-21
Sodium (Na)-Total			93.3		%		80-120	25-JAN-21
Strontium (Sr)-Total			100.7		%		80-120	25-JAN-21
Thallium (Tl)-Total			99.2		%		80-120	25-JAN-21
Tin (Sn)-Total			96.0		%		80-120	25-JAN-21
Titanium (Ti)-Total			92.8		%		80-120	25-JAN-21
Tungsten (W)-Total			96.5		%		80-120	25-JAN-21

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5357725								
WG3477986-2 LCS								
Uranium (U)-Total			94.0		%		80-120	25-JAN-21
Vanadium (V)-Total			93.6		%		80-120	25-JAN-21
Zinc (Zn)-Total			95.1		%		80-120	25-JAN-21
Zirconium (Zr)-Total			98.3		%		80-120	25-JAN-21
WG3477986-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	25-JAN-21
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	25-JAN-21
Arsenic (As)-Total			<0.00010		mg/L		0.0001	25-JAN-21
Barium (Ba)-Total			<0.00010		mg/L		0.0001	25-JAN-21
Beryllium (Be)-Total			<0.00010		mg/L		0.0001	25-JAN-21
Boron (B)-Total			<0.010		mg/L		0.01	25-JAN-21
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	25-JAN-21
Calcium (Ca)-Total			<0.050		mg/L		0.05	25-JAN-21
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	25-JAN-21
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	25-JAN-21
Copper (Cu)-Total			<0.00050		mg/L		0.0005	25-JAN-21
Iron (Fe)-Total			<0.010		mg/L		0.01	25-JAN-21
Lead (Pb)-Total			<0.000050		mg/L		0.00005	25-JAN-21
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	25-JAN-21
Manganese (Mn)-Total			<0.00050		mg/L		0.0005	25-JAN-21
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	25-JAN-21
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	25-JAN-21
Potassium (K)-Total			<0.050		mg/L		0.05	25-JAN-21
Selenium (Se)-Total			<0.000050		mg/L		0.00005	25-JAN-21
Silver (Ag)-Total			<0.000050		mg/L		0.00005	25-JAN-21
Sodium (Na)-Total			<0.050		mg/L		0.05	25-JAN-21
Strontium (Sr)-Total			<0.0010		mg/L		0.001	25-JAN-21
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	25-JAN-21
Tin (Sn)-Total			<0.00010		mg/L		0.0001	25-JAN-21
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	25-JAN-21
Tungsten (W)-Total			<0.00010		mg/L		0.0001	25-JAN-21
Uranium (U)-Total			<0.000010		mg/L		0.00001	25-JAN-21
Vanadium (V)-Total			<0.00050		mg/L		0.0005	25-JAN-21
Zinc (Zn)-Total			<0.0030		mg/L		0.003	25-JAN-21

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5357725								
WG3477986-1 MB								
Zirconium (Zr)-Total			<0.00020		mg/L		0.0002	25-JAN-21
WG3477986-5 MS		**WG3477986-3**						
Aluminum (Al)-Total			88.2		%		70-130	25-JAN-21
Antimony (Sb)-Total			99.4		%		70-130	25-JAN-21
Arsenic (As)-Total			96.7		%		70-130	25-JAN-21
Barium (Ba)-Total			N/A	MS-B	%		-	25-JAN-21
Beryllium (Be)-Total			93.1		%		70-130	25-JAN-21
Boron (B)-Total			N/A	MS-B	%		-	25-JAN-21
Cadmium (Cd)-Total			88.3		%		70-130	25-JAN-21
Calcium (Ca)-Total			N/A	MS-B	%		-	25-JAN-21
Chromium (Cr)-Total			90.3		%		70-130	25-JAN-21
Cobalt (Co)-Total			86.7		%		70-130	25-JAN-21
Copper (Cu)-Total			80.9		%		70-130	25-JAN-21
Iron (Fe)-Total			N/A	MS-B	%		-	25-JAN-21
Lead (Pb)-Total			89.4		%		70-130	25-JAN-21
Magnesium (Mg)-Total			N/A	MS-B	%		-	25-JAN-21
Manganese (Mn)-Total			N/A	MS-B	%		-	25-JAN-21
Molybdenum (Mo)-Total			N/A	MS-B	%		-	25-JAN-21
Nickel (Ni)-Total			85.0		%		70-130	25-JAN-21
Potassium (K)-Total			N/A	MS-B	%		-	25-JAN-21
Selenium (Se)-Total			99.1		%		70-130	25-JAN-21
Silver (Ag)-Total			89.1		%		70-130	25-JAN-21
Sodium (Na)-Total			N/A	MS-B	%		-	25-JAN-21
Strontium (Sr)-Total			N/A	MS-B	%		-	25-JAN-21
Thallium (Tl)-Total			91.4		%		70-130	25-JAN-21
Tin (Sn)-Total			93.7		%		70-130	25-JAN-21
Titanium (Ti)-Total			90.9		%		70-130	25-JAN-21
Tungsten (W)-Total			94.2		%		70-130	25-JAN-21
Uranium (U)-Total			N/A	MS-B	%		-	25-JAN-21
Vanadium (V)-Total			95.4		%		70-130	25-JAN-21
Zinc (Zn)-Total			N/A	MS-B	%		-	25-JAN-21
Zirconium (Zr)-Total			97.3		%		70-130	25-JAN-21
METHANE-DIS-WT	**Water**							

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
METHANE-DIS-WT	**Water**							
Batch R5358874								
WG3479226-3 DUP		**L2550950-3**						
Methane, Dissolved		268	283		ug/L	5.5	30	28-JAN-21
WG3479226-1 MB								
Methane, Dissolved			<5.0		ug/L		5	28-JAN-21
NH3-F-WT	**Water**							
Batch R5358357								
WG3478437-3 DUP		**WG3478437-5**						
Ammonia, Total (as N)		5.36	5.28		mg/L	1.5	20	27-JAN-21
WG3478437-2 LCS								
Ammonia, Total (as N)			106.2		%		85-115	27-JAN-21
WG3478437-1 MB								
Ammonia, Total (as N)			<0.010		mg/L		0.01	27-JAN-21
WG3478437-4 MS		**WG3478437-5**						
Ammonia, Total (as N)			N/A	MS-B	%		-	27-JAN-21
NO2-IC-WT	**Water**							
Batch R5358043								
WG3478467-4 DUP		**WG3478467-3**						
Nitrite (as N)		<0.010	<0.010	RPD-NA	mg/L	N/A	20	25-JAN-21
WG3478467-2 LCS								
Nitrite (as N)			99.8		%		90-110	25-JAN-21
WG3478467-1 MB								
Nitrite (as N)			<0.010		mg/L		0.01	25-JAN-21
WG3478467-5 MS		**WG3478467-3**						
Nitrite (as N)			99.1		%		75-125	25-JAN-21
NO3-IC-WT	**Water**							
Batch R5358043								
WG3478467-4 DUP		**WG3478467-3**						
Nitrate (as N)		<0.020	<0.020	RPD-NA	mg/L	N/A	20	25-JAN-21
WG3478467-2 LCS								
Nitrate (as N)			99.5		%		90-110	25-JAN-21
WG3478467-1 MB								
Nitrate (as N)			<0.020		mg/L		0.02	25-JAN-21
WG3478467-5 MS		**WG3478467-3**						
Nitrate (as N)			95.8		%		75-125	25-JAN-21
OGG-SPEC-WT	**Water**							

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
OGG-SPEC-WT	**Water**							
Batch R5357383								
WG3477985-2 LCS								
Oil and Grease, Total			88.3		%		70-130	25-JAN-21
Mineral Oil and Grease			85.3		%		70-130	25-JAN-21
WG3477985-1 MB								
Oil and Grease, Total			<5.0		mg/L		5	25-JAN-21
Mineral Oil and Grease			<2.5		mg/L		2.5	25-JAN-21
P-T-COL-WT	**Water**							
Batch R5358547								
WG3478432-3 DUP		**WG3478432-5**						
Phosphorus, Total		0.0048	0.0040		mg/L	18	20	27-JAN-21
WG3478432-2 LCS								
Phosphorus, Total			101.1		%		80-120	27-JAN-21
WG3478432-1 MB								
Phosphorus, Total			<0.0030		mg/L		0.003	27-JAN-21
WG3478432-4 MS		**WG3478432-5**						
Phosphorus, Total			96.8		%		70-130	27-JAN-21
PH-WT	**Water**							
Batch R5357315								
WG3477682-4 DUP		**WG3477682-3**						
pH		8.15	8.13	J	pH units	0.02	0.2	23-JAN-21
WG3477682-2 LCS								
pH			7.02		pH units		6.9-7.1	23-JAN-21
PHENOLS-4AAP-WT	**Water**							
Batch R5358425								
WG3478435-3 DUP		**L2550854-1**						
Phenols (4AAP)		<0.0010	0.0011	RPD-NA	mg/L	N/A	20	26-JAN-21
WG3478435-2 LCS								
Phenols (4AAP)			101.4		%		85-115	26-JAN-21
WG3478435-1 MB								
Phenols (4AAP)			<0.0010		mg/L		0.001	26-JAN-21
WG3478435-4 MS		**L2550854-1**						
Phenols (4AAP)			110.3		%		75-125	26-JAN-21
PO4-DO-COL-WT	**Water**							
Batch R5358432								
WG3479377-3 DUP		**WG3479377-5**						
Orthophosphate-Dissolved (as P)		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	27-JAN-21
WG3479377-2 LCS								

Quality Control Report

Workorder: L2550950 Report Date: 26-FEB-21

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5

Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PO4-DO-COL-WT	**Water**							
Batch R5358432								
WG3479377-2 LCS								
Orthophosphate-Dissolved (as P)			106.5		%		80-120	27-JAN-21
WG3479377-1 MB								
Orthophosphate-Dissolved (as P)			<0.0030		mg/L		0.003	27-JAN-21
WG3479377-4 MS		**WG3479377-5**						
Orthophosphate-Dissolved (as P)			93.5		%		70-130	27-JAN-21
SO4-IC-N-WT	**Water**							
Batch R5358043								
WG3478467-4 DUP		**WG3478467-3**						
Sulfate (SO4)		145	145		mg/L	0.0	20	25-JAN-21
WG3478467-2 LCS								
Sulfate (SO4)			100.6		%		90-110	25-JAN-21
WG3478467-1 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	25-JAN-21
WG3478467-5 MS		**WG3478467-3**						
Sulfate (SO4)			N/A	MS-B	%		-	25-JAN-21
SOLIDS-TDS-WT	**Water**							
Batch R5358675								
WG3478903-3 DUP		**L2550552-1**						
Total Dissolved Solids		773	772		mg/L	0.1	20	26-JAN-21
WG3478903-2 LCS								
Total Dissolved Solids			99.8		%		85-115	26-JAN-21
WG3478903-1 MB								
Total Dissolved Solids			<10		mg/L		10	26-JAN-21
SOLIDS-TSS-WT	**Water**							
Batch R5358288								
WG3478900-3 DUP		**L2550552-1**						
Total Suspended Solids		221	231		mg/L	4.2	20	27-JAN-21
WG3478900-2 LCS								
Total Suspended Solids			102.7		%		85-115	27-JAN-21
WG3478900-1 MB								
Total Suspended Solids			<3.0		mg/L		3	27-JAN-21
SULPHIDE-WT	**Water**							
Batch R5359080								
WG3479853-3 DUP		**L2550909-1**						
Sulphide (as S)		0.54	0.51		mg/L	6.1	20	28-JAN-21
WG3479853-2 LCS								

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SULPHIDE-WT	**Water**							
Batch R5359080								
WG3479853-2 LCS								
Sulphide (as S)			94.0		%		75-125	28-JAN-21
WG3479853-1 MB								
Sulphide (as S)			<0.018		mg/L		0.018	28-JAN-21
WG3479853-4 MS		**L2550909-1**						
Sulphide (as S)			N/A	MS-B	%		-	28-JAN-21
TKN-F-WT	**Water**							
Batch R5358005								
WG3478434-3 DUP		**L2550950-4**						
Total Kjeldahl Nitrogen		0.410	0.400		mg/L	2.5	20	26-JAN-21
WG3478434-2 LCS								
Total Kjeldahl Nitrogen			107.5		%		75-125	26-JAN-21
WG3478434-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	26-JAN-21
WG3478434-4 MS		**L2550950-4**						
Total Kjeldahl Nitrogen			110.0		%		70-130	26-JAN-21
TOC-WT	**Water**							
Batch R5358250								
WG3478438-3 DUP		**L2550950-2**						
Total Organic Carbon		48.0	49.0		mg/L	2.2	20	26-JAN-21
WG3478438-2 LCS								
Total Organic Carbon			109.0		%		80-120	26-JAN-21
WG3478438-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	26-JAN-21
WG3478438-4 MS		**L2550950-2**						
Total Organic Carbon			N/A	MS-B	%		-	26-JAN-21
VOC-ROU-HS-WT	**Water**							
Batch R5357754								
WG3478117-4 DUP		**WG3478117-3**						
1,1,2,2-Tetrachloroethane		<0.50	<0.50	RPD-NA	ug/L	N/A	30	26-JAN-21
1,2-Dichlorobenzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	26-JAN-21
1,4-Dichlorobenzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	26-JAN-21
Benzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	26-JAN-21
Chloroform		<1.0	<1.0	RPD-NA	ug/L	N/A	30	26-JAN-21
Dichloromethane		<2.0	<2.0	RPD-NA	ug/L	N/A	30	26-JAN-21
Ethylbenzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	26-JAN-21

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-HS-WT	**Water**							
Batch R5357754								
WG3478117-4 DUP		**WG3478117-3**						
o-Xylene		<0.30	<0.30	RPD-NA	ug/L	N/A	30	26-JAN-21
Tetrachloroethylene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	26-JAN-21
Toluene		<0.40	<0.40	RPD-NA	ug/L	N/A	30	26-JAN-21
Trichloroethylene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	26-JAN-21
WG3478117-1 LCS								
1,1,2,2-Tetrachloroethane			90.1		%		70-130	26-JAN-21
1,2-Dichlorobenzene			106.3		%		70-130	26-JAN-21
1,4-Dichlorobenzene			106.6		%		70-130	26-JAN-21
Benzene			103.5		%		70-130	26-JAN-21
Chloroform			106.5		%		70-130	26-JAN-21
Dichloromethane			111.8		%		70-130	26-JAN-21
Ethylbenzene			102.9		%		70-130	26-JAN-21
o-Xylene			113.1		%		70-130	26-JAN-21
Tetrachloroethylene			94.7		%		70-130	26-JAN-21
Toluene			107.9		%		70-130	26-JAN-21
Trichloroethylene			99.8		%		70-130	26-JAN-21
WG3478117-2 MB								
1,1,2,2-Tetrachloroethane			<0.50		ug/L		0.5	26-JAN-21
1,2-Dichlorobenzene			<0.50		ug/L		0.5	26-JAN-21
1,4-Dichlorobenzene			<0.50		ug/L		0.5	26-JAN-21
Benzene			<0.50		ug/L		0.5	26-JAN-21
Chloroform			<1.0		ug/L		1	26-JAN-21
Dichloromethane			<2.0		ug/L		2	26-JAN-21
Ethylbenzene			<0.50		ug/L		0.5	26-JAN-21
o-Xylene			<0.30		ug/L		0.3	26-JAN-21
Tetrachloroethylene			<0.50		ug/L		0.5	26-JAN-21
Toluene			<0.40		ug/L		0.4	26-JAN-21
Trichloroethylene			<0.50		ug/L		0.5	26-JAN-21
Surrogate: 1,4-Difluorobenzene			99.0		%		70-130	26-JAN-21
Surrogate: 4-Bromofluorobenzene			91.6		%		70-130	26-JAN-21
WG3478117-5 MS		**WG3478117-3**						
1,1,2,2-Tetrachloroethane			94.1		%		50-150	26-JAN-21
1,2-Dichlorobenzene			105.9		%		50-150	26-JAN-21
1,4-Dichlorobenzene			108.3		%		50-150	26-JAN-21

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-HS-WT	**Water**							
Batch R5357754								
WG3478117-5 MS		**WG3478117-3**						
Benzene			102.4		%		50-150	26-JAN-21
Chloroform			106.9		%		50-150	26-JAN-21
Dichloromethane			109.3		%		50-150	26-JAN-21
Ethylbenzene			100.0		%		50-150	26-JAN-21
o-Xylene			114.1		%		50-150	26-JAN-21
Tetrachloroethylene			90.3		%		50-150	26-JAN-21
Toluene			102.7		%		50-150	26-JAN-21
Trichloroethylene			99.9		%		50-150	26-JAN-21

Quality Control Report

Workorder: L2550950 Report Date: 26-FEB-21

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Workorder: L2550950 Report Date: 26-FEB-21

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Aggregate Organics							
BOD							
	2	21-JAN-21	28-JAN-21 00:00	4	7	days	EHT

Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2550950 were received on 22-JAN-21 15:45.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody

L2550950-COFC

COC Number: 20 -

Page of

www.alsglobal.com

Report To	Contact and company name below will appear on the final report
Company:	WSP Canada Inc.
Contact:	Valyn Bernard
Phone:	289-835-2546
	Company address below will appear on the final report
Street:	610 Chartwell Rd, Oakville
City/Province:	
Postal Code:	
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☑ YES ☐ NO
Company:	WSP Canada Inc
Contact:	Valyn Bernard

Project Information

ALS Account # / Quote #:	Q83429
Job #:	201-11602-00-100-1004
PO / AFE:	
LSD:	
ALS Lab Work Order # (lab use only):	L2550950

Reports / Recipients

Select Report Format:	☐ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Merge QC/QCI Reports with COA	☑ YES ☐ NO ☐ N/A
Compare Results to Criteria on Report - provide details below if box checked	☑
Select Distribution:	☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	Valyn.Bernard@wsp.com
Email 2	
Email 3	

Invoice Recipients

Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax	payables.ontario@wsp.com
Email 2	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Contact: Sampler: CS/SK

Turnaround Time (TAT) Requested

- ☑ Routine [R] if received by 3pm M-F - no surcharges apply
- ☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum
- ☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum
- ☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum
- ☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum
- ☐ Same day [E2] if received by 10am M-S - 200% rush surcharge. Additional fees may apply to rush resuests on weekends, statutory holidays and non-routine tests

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm am/pm

For tests that can not be performed according to the TAT requested, you will be contacted.

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Analysis Request

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	SPEC ALK, CHLORIDE	EC, HARDNESS	TOTAL METALS, DISSOLVED HG	ION BALANCE	LANGLIER INDEX	TSS, TDS, PH, N2N3, PO4	SULPHIDE	NH3, TP	TOC	Methane	Niagara Lagoon Sewer Use	PWQO	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	BH3	Jan 21/21	AM	GW	15											X	X			
	BH7S	↓	↓	↓	15											X	X			
	BH-01				2							X			X					
	BH12A				15											X	X			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human consumption/ use? ☐ YES ☑ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

SAMPLE RECEIPT DETAILS (lab use only)

Cooling Method: ☐ NONE ☑ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				2.4	7.8		

SHIPMENT RELEASE (client use)

Released by:	Date:	Time:
Caitlyn Smael	Jan 21/21	13:00

INITIAL SHIPMENT RECEPTION (lab use only)

Received by:	Date:	Time:

FINAL SHIPMENT RECEPTION (lab use only)

Received by:	Date:	Time:
	1/22/21	15:45

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

AUG 2020 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

WSP CANADA INC.
ATTN: Valyn Bernard
55 King Street, Suite 700
St. Catharines ON L2R 3H5

Date Received: 03-FEB-21
Report Date: 04-MAR-21 14:58 (MT)
Version: FINAL REV. 4

Client Phone: 905-687-1771

Certificate of Analysis

Lab Work Order #: L2554453

Project P.O. #: NOT SUBMITTED
Job Reference: 201-11602-00-100-1004
C of C Numbers:
Legal Site Desc:

Comments: ADDITIONAL 04-MAR-21 14:48

Emily Hansen
Account Manager

ANALYTICAL REPORT

WATER - [Combined] - Ontario PWQO and Sanitary Sewer Use By-Laws

		ALS ID	L2554453-1
		Sampled Date	02-FEB-21
		Sampled Time	16:00
		Sample ID	**BH8**
Grouping	Analyte	Unit	
Physical Tests	Conductivity	umhos/cm	12400
	Hardness (as CaCO3)	mg/L	HTC 1760
	Langelier Index Temperature	C	20
	Langelier Index	none	1.3
	pH	pH units	8.09
	Total Suspended Solids	mg/L	DLHC <6.0
	Total Dissolved Solids	mg/L	3710
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3)	mg/L	214
	Alkalinity, Carbonate (as CaCO3)	mg/L	<2.0
	Alkalinity, Hydroxide (as CaCO3)	mg/L	<2.0
	Alkalinity, Total (as CaCO3)	mg/L	214
	Ammonia, Total (as N)	mg/L	DLHC 4.83
	Chloride (Cl)	mg/L	DLDS 4460
	Computed Conductivity	uS/cm	9430
	Conductivity % Difference	%	-27
	Fluoride (F)	mg/L	DLDS 0.74
	Hardness (as CaCO3)	mg/L	1760
	Ion Balance	%	35
	Langelier Index		1
	Nitrate and Nitrite as N	mg/L	<0.45
	Nitrate (as N)	mg/L	DLDS <0.40
	Nitrite (as N)	mg/L	DLDS <0.20
	Total Kjeldahl Nitrogen	mg/L	DLM 9.0
	Saturation pH	pH	6.80

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

WATER - [Combined] - Ontario PWQO and Sanitary Sewer Use By-Laws

			ALS ID	L2554453-1
			Sampled Date	02-FEB-21
			Sampled Time	16:00
			Sample ID	BH8
Grouping	Analyte	Unit		
Anions and Nutrients	Orthophosphate-Dissolved (as P)	mg/L		0.0125
	Phosphorus, Total	mg/L	DLHC	0.48
	TDS (Calculated)	mg/L		7760
	Sulfate (SO4)	mg/L	DLDS	1980
	Sulphide (as S)	mg/L	DLHC	194
	Sulphide (as H2S)	mg/L		206
	Anion Sum	me/L		171
	Cation Sum	me/L		59.7
	Cation - Anion Balance	%		-48
Cyanides	Cyanide, Total	mg/L	DLM	<0.020
Organic / Inorganic Carbon	Total Organic Carbon	mg/L	DLM	24.1
Total Metals	Aluminum (Al)-Total	mg/L	DLHC	0.130
	Antimony (Sb)-Total	mg/L	DLHC	<0.0010
	Arsenic (As)-Total	mg/L	DLHC	0.0164
	Barium (Ba)-Total	mg/L	DLHC	0.106
	Beryllium (Be)-Total	mg/L	DLHC	<0.0010
	Boron (B)-Total	mg/L	DLHC	0.83
	Cadmium (Cd)-Total	mg/L	DLHC	<0.000050
	Calcium (Ca)-Total	mg/L	DLHC	488
	Chromium (Cr)-Total	mg/L	DLHC	<0.0050
	Cobalt (Co)-Total	mg/L	DLHC	<0.0009
	Copper (Cu)-Total	mg/L	DLHC	<0.0050
	Iron (Fe)-Total	mg/L	DLHC	0.37
	Lead (Pb)-Total	mg/L	DLHC	<0.00050

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

WATER - [Combined] - Ontario PWQO and Sanitary Sewer Use By-Laws

		ALS ID	L2554453-1
		Sampled Date	02-FEB-21
		Sampled Time	16:00
		Sample ID	**BH8**
Grouping	Analyte	Unit	
Total Metals	Magnesium (Mg)-Total	mg/L	DLHC 131
	Manganese (Mn)-Total	mg/L	DLHC 0.535
	Mercury (Hg)-Total	mg/L	<0.0010
	Molybdenum (Mo)-Total	mg/L	DLHC 0.00804
	Nickel (Ni)-Total	mg/L	DLHC <0.0050
	Potassium (K)-Total	mg/L	DLHC 13.8
	Selenium (Se)-Total	mg/L	DLHC 0.0118
	Silver (Ag)-Total	mg/L	DLHC <0.00010
	Sodium (Na)-Total	mg/L	DLHC 558
	Strontium (Sr)-Total	mg/L	DLHC 19.3
	Thallium (Tl)-Total	mg/L	DLHC <0.00010
	Tin (Sn)-Total	mg/L	DLHC 0.0060
	Titanium (Ti)-Total	mg/L	DLHC <0.0030
	Tungsten (W)-Total	mg/L	DLHC 0.0102
	Uranium (U)-Total	mg/L	DLHC 0.00204
	Vanadium (V)-Total	mg/L	DLHC <0.0050
	Zinc (Zn)-Total	mg/L	DLHC 0.035
	Zirconium (Zr)-Total	mg/L	DLHC <0.0020
Dissolved Metals	Dissolved Mercury Filtration Location		FIELD
	Mercury (Hg)-Dissolved	mg/L	DLM <0.00050
Aggregate Organics	BOD	mg/L	150
	Oil and Grease, Total	mg/L	<5.0
	Animal/Veg Oil & Grease	mg/L	<5.0
	Mineral Oil and Grease	mg/L	<2.5

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

WATER - [Combined] - Ontario PWQO and Sanitary Sewer Use By-Laws

		ALS ID	L2554453-1
		Sampled Date	02-FEB-21
		Sampled Time	16:00
		Sample ID	**BH8**
Grouping	Analyte	Unit	
Aggregate Organics	Phenols (4AAP)	mg/L	DLM 0.175
Volatile Organic Compounds	Benzene	ug/L	0.53
	Chloroform	ug/L	<1.0
	1,2-Dichlorobenzene	ug/L	<0.50
	1,4-Dichlorobenzene	ug/L	<0.50
	Dichloromethane	ug/L	<2.0
	Ethylbenzene	ug/L	0.51
	Methane, Dissolved	ug/L	DLHC 22700
	1,1,2,2-Tetrachloroethane	ug/L	<0.50
	Tetrachloroethylene	ug/L	<0.50
	Toluene	ug/L	1.74
	Trichloroethylene	ug/L	<0.50
	o-Xylene	ug/L	<0.50
	Surrogate: 4-Bromofluorobenzene	%	97.5
	Surrogate: 1,4-Difluorobenzene	%	100.8

Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Summary of Guideline Exceedances: [Combined] - Ontario PWQO and Sanitary Sewer Use By-Laws

Guideline ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit
Ontario Niagara Sanitary Sewer By-Law No. 27-2014						
L2554453-1	BH8	Anions and Nutrients	Sulfate (SO4)	1980	1500	mg/L
			Sulphide (as H2S)	206	1	mg/L
Surface Water PWQO						
L2554453-1	BH8	Anions and Nutrients	Phosphorus, Total	0.48	0.01	mg/L
			Sulphide (as H2S)	206	0.002	mg/L
		Cyanides	Cyanide, Total	<0.020	0.0050	mg/L
		Total Metals	Aluminum (Al)-Total	0.130	0.015	mg/L
			Arsenic (As)-Total	0.0164	0.005	mg/L
			Boron (B)-Total	0.83	0.2	mg/L
			Copper (Cu)-Total	<0.0050	0.001	mg/L
			Iron (Fe)-Total	0.37	0.3	mg/L
			Mercury (Hg)-Total	<0.0010	0.0002	mg/L
			Zinc (Zn)-Total	0.035	0.02	mg/L
		Dissolved Metals	Mercury (Hg)-Dissolved	<0.00050	0.0002	mg/L
		Aggregate Organics	Phenols (4AAP)	0.175	0.001	mg/L
		Volatile Organic Compounds	Toluene	1.74	0.8	ug/L
Surface Water - PWQO - Hardness>100PPM						
L2554453-1	BH8	Anions and Nutrients	Phosphorus, Total	0.48	0.01	mg/L
			Sulphide (as H2S)	206	0.002	mg/L
		Cyanides	Cyanide, Total	<0.020	0.0050	mg/L
		Total Metals	Aluminum (Al)-Total	0.130	0.0750	mg/L
			Arsenic (As)-Total	0.0164	0.005	mg/L
			Boron (B)-Total	0.83	0.2	mg/L
			Iron (Fe)-Total	0.37	0.3	mg/L
			Mercury (Hg)-Total	<0.0010	0.0002	mg/L
			Zinc (Zn)-Total	0.035	0.02	mg/L
		Dissolved Metals	Mercury (Hg)-Dissolved	<0.00050	0.0002	mg/L
		Aggregate Organics	Phenols (4AAP)	0.175	0.001	mg/L
		Volatile Organic Compounds	Toluene	1.74	0.8	ug/L

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SPEC-PCT-WT	Water	Automated Speciated Alkalinity	APHA 2320B

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

BOD-WT	Water	BOD	APHA 5210 B

This analysis is carried out using procedures adapted from APHA Method 5210B - "Biochemical Oxygen Demand (BOD)". All forms of biochemical oxygen demand (BOD) are determined by diluting and incubating a sample for a specified time period, and measuring the oxygen depletion using a dissolved oxygen meter. Dissolved BOD (SOLUBLE) is determined by filtering the sample through a glass fibre filter prior to dilution. Carbonaceous BOD (CBOD) is determined by adding a nitrification inhibitor to the diluted sample prior to incubation.

CL-IC-N-WT	Water	Chloride by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

CN-TOT-WT	Water	Cyanide, Total	ISO 14403-2

Total cyanide is determined by the combination of UV digestion and distillation. Cyanide is converted to cyanogen chloride by reacting with chloramine-T, the cyanogen chloride then reacts with a combination of barbituric acid and isonicotinic acid to form a highly colored complex.

When using this method, high levels of thiocyanate in samples can cause false positives at ~1-2% of the thiocyanate concentration. For samples with detectable cyanide analyzed by this method, ALS recommends analysis for thiocyanate to check for this potential interference

EC-SCREEN-WT	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

EC-WT	Water	Conductivity	APHA 2510 B

Water samples can be measured directly by immersing the conductivity cell into the sample.

ETL-N2N3-WT	Water	Calculate from NO2 + NO3	APHA 4110 B
F-IC-N-WT	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-WT	Water	Hardness	APHA 2340 B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

		Dissolved Mercury in Water by CVAAS	EPA 1631E (mod)

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
HG-D-CVAA-WT	Water		

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

HG-T-SLUDGE-CVAA-WT	Water	Total Mercury in Sludge by CVAAS	SW846 7470A

Liquid sample is digested with a heated, strong, mixed acid solution to convert all forms of mercury to divalent mercury. The divalent mercury is then reduced to elemental mercury, sparged from solution and analyzed by CVAAS.

IONBALANCE-OP03-WT	Water	Detailed Ion Balance Calculation	APHA 1030E, 2330B, 2510A
LANGELIER-CALC-WT	Water	Langelier Index	APHA 2330B

Langelier Index provides an indication of scale formation potential at a given pH and temperature. Field pH is used where provided. Positive values indicate oversaturation with respect to CaCO3. Negative values indicate undersaturation of CaCO3. Langelier Index is calculated as per APHA 2330B Saturation Index.

MET-T-CCMS-WT	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

METHANE-DIS-WT	Water	Methane, dissolved	EPA REGION 1, NATATTEN.WPD, REV. 1

Water samples are collected in headspace vials containing sodium bisulfate preservative. A volume of water is withdrawn from the un-capped vial. After shaking & equilibration, the vial headspace is analyzed for target gases by GC/FID. The concentration of the gas in water is proportional to the partial pressure of the gas above the liquid & is calculated using Henry's Law.

NH3-F-WT	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-IC-WT	Water	Nitrite in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-IC-WT	Water	Nitrate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

OGG-SPEC-CALC-WT	Water	Speciated Oil and Grease A/V Calc	CALCULATION

Sample is extracted with hexane, sample speciation into mineral and animal/vegetable fractions is achieved via silica gel separation and is then determined gravimetrically.

OGG-SPEC-WT	Water	Speciated Oil and Grease-Gravimetric	APHA 5520 B

The procedure involves an extraction of the entire water sample with hexane. Sample speciation into mineral and animal/vegetable fractions is achieved via silica gel separation and is then determined gravimetrically.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
P-T-COL-WT	Water	Total P in Water by Colour	APHA 4500-P PHOSPHORUS
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is deteremined colourimetrically after persulphate digestion of the sample.			
PH-WT	Water	pH	APHA 4500 H-Electrode
Water samples are analyzed directly by a calibrated pH meter.			
Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011). Holdtime for samples under this regulation is 28 days			
PHENOLS-4AAP-WT	Water	Phenol (4AAP)	EPA 9066
An automated method is used to distill the sample. The distillate is then buffered to pH 9.4 which reacts with 4AAP and potassium ferricyanide to form a red complex which is measured colorimetrically.			
PO4-DO-COL-WT	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P PHOSPHORUS
This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.			
S2-T>H2S-CALC-WT	Water	Total Sulphide Calculated as H2S	Calculation
This calculation converts Total Sulphide as (S2-) and reports it as Total Sulphide as (H2S). Total Sulphide as (S2-) is determined using procedures adapted from APHA 4500-S2 "Sulphide".			
SO4-IC-N-WT	Water	Sulfate in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
SOLIDS-TDS-WT	Water	Total Dissolved Solids	APHA 2540C
This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.			
SOLIDS-TSS-WT	Water	Suspended solids	APHA 2540 D-Gravimetric
A well-mixed sample is filtered through a weighed standard glass fibre filter and the residue retained is dried in an oven at 104–1 C for a minimum of four hours or until a constant weight is achieved.			
SULPHIDE-WT	Water	Sulphide (as S)	APHA 4500S2D
This analysis is carried out using procedures adapted from APHA Method 4500-S2-D "Methylene Blue Method". Sulphide is determined colourmetrically.			
TKN-F-WT	Water	TKN in Water by Fluorescence	J. ENVIRON. MONIT., 2005,7,37-42,RSC
Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection			
TOC-WT	Water	Total Organic Carbon	APHA 5310B
Sample is injected into a heated reaction chamber which is packed with an oxidative catalyst. The water is vaporized and the organic cabon is oxidized to carbon dioxide. The carbon dioxide is transported in a carrier gas and is measured by a non-dispersive infrared detector.			
VOC-ROU-HS-WT	Water	Volatile Organic Compounds	SW846 8260

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**

Aqueous samples are analyzed by headspace-GC/MS.

**ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody Numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2554453 Report Date: 04-MAR-21

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-SPEC-PCT-WT	**Water**							
Batch R5365005								
WG3483408-4 DUP		**WG3483408-3**						
Alkalinity, Total (as CaCO3)		53.9	48.1		mg/L	11	20	04-FEB-21
Alkalinity, Bicarbonate (as CaCO3)		49.3	42.1		mg/L	16	20	04-FEB-21
Alkalinity, Carbonate (as CaCO3)		4.6	6.0	J	mg/L	1.4	4	04-FEB-21
Alkalinity, Hydroxide (as CaCO3)		<2.0	<2.0	RPD-NA	mg/L	N/A	20	04-FEB-21
WG3483408-2 LCS								
Alkalinity, Total (as CaCO3)			101.5		%		85-115	04-FEB-21
WG3483408-1 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	04-FEB-21
Alkalinity, Bicarbonate (as CaCO3)			<2.0		mg/L		2	04-FEB-21
Alkalinity, Carbonate (as CaCO3)			<2.0		mg/L		2	04-FEB-21
Alkalinity, Hydroxide (as CaCO3)			<2.0		mg/L		2	04-FEB-21
BOD-WT	**Water**							
Batch R5368638								
WG3483554-2 DUP		**L2554504-1**						
BOD		200	190		mg/L	4.8	30	04-FEB-21
WG3483554-3 LCS								
BOD			98.5		%		85-115	04-FEB-21
WG3483554-1 MB								
BOD			<2.0		mg/L		2	04-FEB-21
CL-IC-N-WT	**Water**							
Batch R5364301								
WG3483834-10 DUP		**WG3483834-8**						
Chloride (Cl)		66.2	66.0		mg/L	0.2	20	04-FEB-21
WG3483834-7 LCS								
Chloride (Cl)			101.6		%		90-110	04-FEB-21
WG3483834-6 MB								
Chloride (Cl)			<0.50		mg/L		0.5	04-FEB-21
WG3483834-9 MS		**WG3483834-8**						
Chloride (Cl)			99.4		%		75-125	04-FEB-21
CN-TOT-WT	**Water**							
Batch R5363573								
WG3483647-7 DUP		**WG3483647-9**						
Cyanide, Total		<0.0020	<0.0020	RPD-NA	mg/L	N/A	20	04-FEB-21
WG3483647-6 LCS								
Cyanide, Total			92.5		%		80-120	04-FEB-21
WG3483647-5 MB								

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CN-TOT-WT	**Water**							
Batch R5363573								
WG3483647-5 MB								
Cyanide, Total			<0.0020		mg/L		0.002	04-FEB-21
WG3483647-8 MS		**WG3483647-9**						
Cyanide, Total			92.2		%		70-130	04-FEB-21
EC-WT	**Water**							
Batch R5365005								
WG3483408-4 DUP		**WG3483408-3**						
Conductivity		647	645		umhos/cm	0.3	10	04-FEB-21
WG3483408-2 LCS								
Conductivity			101.2		%		90-110	04-FEB-21
WG3483408-1 MB								
Conductivity			<3.0		umhos/cm		3	04-FEB-21
F-IC-N-WT	**Water**							
Batch R5364301								
WG3483834-10 DUP		**WG3483834-8**						
Fluoride (F)		0.125	0.123		mg/L	1.2	20	04-FEB-21
WG3483834-7 LCS								
Fluoride (F)			102.9		%		90-110	04-FEB-21
WG3483834-6 MB								
Fluoride (F)			<0.020		mg/L		0.02	04-FEB-21
WG3483834-9 MS		**WG3483834-8**						
Fluoride (F)			95.6		%		75-125	04-FEB-21
HG-D-CVAA-WT	**Water**							
Batch R5362208								
WG3483334-4 DUP		**WG3483334-3**						
Mercury (Hg)-Dissolved		<0.0000050	<0.0000050	RPD-NA	mg/L	N/A	20	04-FEB-21
WG3483334-2 LCS								
Mercury (Hg)-Dissolved			105.0		%		80-120	04-FEB-21
WG3483334-1 MB								
Mercury (Hg)-Dissolved			<0.0000050		mg/L		0.000005	04-FEB-21
WG3483334-6 MS		**WG3483334-5**						
Mercury (Hg)-Dissolved			101.4		%		70-130	04-FEB-21
HG-T-SLUDGE-CVAA-WT	**Water**							
Batch R5363943								
WG3483883-2 CRM		**WT-SS-2-SLUDGE**						
Mercury (Hg)-Total			107.8		%		70-130	05-FEB-21
WG3483883-6 DUP		**WG3483883-5**						

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-T-SLUDGE-CVAA-WT	**Water**							
Batch R5363943								
WG3483883-6 DUP		**WG3483883-5**						
Mercury (Hg)-Total		0.0018	0.0020		mg/L	14	40	05-FEB-21
WG3483883-3 LCS								
Mercury (Hg)-Total			104.0		%		70-130	05-FEB-21
WG3483883-1 MB								
Mercury (Hg)-Total			<0.0010		mg/L		0.001	05-FEB-21
MET-T-CCMS-WT	**Water**							
Batch R5362879								
WG3483231-4 DUP		**WG3483231-3**						
Aluminum (Al)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	04-FEB-21
Antimony (Sb)-Total		0.00019	0.00018		mg/L	4.1	20	04-FEB-21
Arsenic (As)-Total		0.00171	0.00167		mg/L	2.6	20	04-FEB-21
Barium (Ba)-Total		0.0372	0.0371		mg/L	0.1	20	04-FEB-21
Beryllium (Be)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	04-FEB-21
Boron (B)-Total		0.050	0.050		mg/L	0.2	20	04-FEB-21
Cadmium (Cd)-Total		<0.0000050	<0.0000050	RPD-NA	mg/L	N/A	20	04-FEB-21
Calcium (Ca)-Total		84.9	84.6		mg/L	0.3	20	04-FEB-21
Chromium (Cr)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	04-FEB-21
Cobalt (Co)-Total		0.00011	0.00011		mg/L	0.9	20	04-FEB-21
Copper (Cu)-Total		0.00245	0.00247		mg/L	0.6	20	04-FEB-21
Iron (Fe)-Total		0.026	0.027		mg/L	1.2	20	04-FEB-21
Lead (Pb)-Total		0.000179	0.000182		mg/L	1.8	20	04-FEB-21
Magnesium (Mg)-Total		44.7	44.0		mg/L	1.5	20	04-FEB-21
Manganese (Mn)-Total		0.00953	0.00942		mg/L	1.1	20	04-FEB-21
Molybdenum (Mo)-Total		0.00206	0.00204		mg/L	0.8	20	04-FEB-21
Nickel (Ni)-Total		0.00364	0.00365		mg/L	0.3	20	04-FEB-21
Potassium (K)-Total		2.83	2.75		mg/L	2.7	20	04-FEB-21
Selenium (Se)-Total		0.000067	0.000069		mg/L	1.6	20	04-FEB-21
Silver (Ag)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	04-FEB-21
Sodium (Na)-Total		28.4	27.9		mg/L	1.8	20	04-FEB-21
Strontium (Sr)-Total		1.51	1.52		mg/L	0.4	20	04-FEB-21
Thallium (Tl)-Total		0.000022	0.000021		mg/L	2.3	20	04-FEB-21
Tin (Sn)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	04-FEB-21
Titanium (Ti)-Total		<0.00030	<0.00030	RPD-NA	mg/L	N/A	20	04-FEB-21

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5362879								
WG3483231-4 DUP		**WG3483231-3**						
Tungsten (W)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	04-FEB-21
Uranium (U)-Total		0.00115	0.00117		mg/L	1.6	20	04-FEB-21
Vanadium (V)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	04-FEB-21
Zinc (Zn)-Total		0.0096	0.0093		mg/L	3.0	20	04-FEB-21
Zirconium (Zr)-Total		<0.00020	<0.00020	RPD-NA	mg/L	N/A	20	04-FEB-21
WG3483231-2 LCS								
Aluminum (Al)-Total			100.7		%		80-120	04-FEB-21
Antimony (Sb)-Total			101.7		%		80-120	04-FEB-21
Arsenic (As)-Total			98.1		%		80-120	04-FEB-21
Barium (Ba)-Total			97.2		%		80-120	04-FEB-21
Beryllium (Be)-Total			106.8		%		80-120	04-FEB-21
Boron (B)-Total			107.9		%		80-120	04-FEB-21
Cadmium (Cd)-Total			99.0		%		80-120	04-FEB-21
Calcium (Ca)-Total			104.8		%		80-120	04-FEB-21
Chromium (Cr)-Total			96.6		%		80-120	04-FEB-21
Cobalt (Co)-Total			98.3		%		80-120	04-FEB-21
Copper (Cu)-Total			95.8		%		80-120	04-FEB-21
Iron (Fe)-Total			100.8		%		80-120	04-FEB-21
Lead (Pb)-Total			100.4		%		80-120	04-FEB-21
Magnesium (Mg)-Total			98.2		%		80-120	04-FEB-21
Manganese (Mn)-Total			98.4		%		80-120	04-FEB-21
Molybdenum (Mo)-Total			105.9		%		80-120	04-FEB-21
Nickel (Ni)-Total			95.5		%		80-120	04-FEB-21
Potassium (K)-Total			95.0		%		80-120	04-FEB-21
Selenium (Se)-Total			96.3		%		80-120	04-FEB-21
Silver (Ag)-Total			99.9		%		80-120	04-FEB-21
Sodium (Na)-Total			94.5		%		80-120	04-FEB-21
Strontium (Sr)-Total			104.7		%		80-120	04-FEB-21
Thallium (Tl)-Total			98.7		%		80-120	04-FEB-21
Tin (Sn)-Total			98.2		%		80-120	04-FEB-21
Titanium (Ti)-Total			93.2		%		80-120	04-FEB-21
Tungsten (W)-Total			97.8		%		80-120	04-FEB-21
Uranium (U)-Total			101.1		%		80-120	04-FEB-21

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5362879								
WG3483231-2 LCS								
Vanadium (V)-Total			97.3		%		80-120	04-FEB-21
Zinc (Zn)-Total			97.3		%		80-120	04-FEB-21
Zirconium (Zr)-Total			98.2		%		80-120	04-FEB-21
WG3483231-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	04-FEB-21
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	04-FEB-21
Arsenic (As)-Total			<0.00010		mg/L		0.0001	04-FEB-21
Barium (Ba)-Total			<0.00010		mg/L		0.0001	04-FEB-21
Beryllium (Be)-Total			<0.00010		mg/L		0.0001	04-FEB-21
Boron (B)-Total			<0.010		mg/L		0.01	04-FEB-21
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	04-FEB-21
Calcium (Ca)-Total			<0.050		mg/L		0.05	04-FEB-21
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	04-FEB-21
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	04-FEB-21
Copper (Cu)-Total			<0.00050		mg/L		0.0005	04-FEB-21
Iron (Fe)-Total			<0.010		mg/L		0.01	04-FEB-21
Lead (Pb)-Total			<0.000050		mg/L		0.00005	04-FEB-21
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	04-FEB-21
Manganese (Mn)-Total			<0.00050		mg/L		0.0005	04-FEB-21
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	04-FEB-21
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	04-FEB-21
Potassium (K)-Total			<0.050		mg/L		0.05	04-FEB-21
Selenium (Se)-Total			<0.000050		mg/L		0.00005	04-FEB-21
Silver (Ag)-Total			<0.000050		mg/L		0.00005	04-FEB-21
Sodium (Na)-Total			<0.050		mg/L		0.05	04-FEB-21
Strontium (Sr)-Total			<0.0010		mg/L		0.001	04-FEB-21
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	04-FEB-21
Tin (Sn)-Total			<0.00010		mg/L		0.0001	04-FEB-21
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	04-FEB-21
Tungsten (W)-Total			<0.00010		mg/L		0.0001	04-FEB-21
Uranium (U)-Total			<0.000010		mg/L		0.00001	04-FEB-21
Vanadium (V)-Total			<0.00050		mg/L		0.0005	04-FEB-21
Zinc (Zn)-Total			<0.0030		mg/L		0.003	04-FEB-21
Zirconium (Zr)-Total			<0.00020		mg/L		0.0002	04-FEB-21

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5362879								
WG3483231-5 MS		**WG3483231-6**						
Aluminum (Al)-Total			96.7		%		70-130	05-FEB-21
Antimony (Sb)-Total			104.6		%		70-130	05-FEB-21
Arsenic (As)-Total			100.3		%		70-130	05-FEB-21
Barium (Ba)-Total			N/A	MS-B	%		-	05-FEB-21
Beryllium (Be)-Total			100.9		%		70-130	05-FEB-21
Boron (B)-Total			98.5		%		70-130	05-FEB-21
Cadmium (Cd)-Total			96.8		%		70-130	05-FEB-21
Calcium (Ca)-Total			N/A	MS-B	%		-	05-FEB-21
Chromium (Cr)-Total			98.4		%		70-130	05-FEB-21
Cobalt (Co)-Total			96.9		%		70-130	05-FEB-21
Copper (Cu)-Total			N/A	MS-B	%		-	05-FEB-21
Iron (Fe)-Total			97.8		%		70-130	05-FEB-21
Lead (Pb)-Total			93.9		%		70-130	05-FEB-21
Magnesium (Mg)-Total			N/A	MS-B	%		-	05-FEB-21
Manganese (Mn)-Total			96.9		%		70-130	05-FEB-21
Molybdenum (Mo)-Total			102.3		%		70-130	05-FEB-21
Nickel (Ni)-Total			95.3		%		70-130	05-FEB-21
Potassium (K)-Total			98.2		%		70-130	05-FEB-21
Selenium (Se)-Total			101.9		%		70-130	05-FEB-21
Silver (Ag)-Total			96.1		%		70-130	05-FEB-21
Sodium (Na)-Total			N/A	MS-B	%		-	05-FEB-21
Strontium (Sr)-Total			N/A	MS-B	%		-	05-FEB-21
Thallium (Tl)-Total			98.4		%		70-130	05-FEB-21
Tin (Sn)-Total			96.3		%		70-130	05-FEB-21
Titanium (Ti)-Total			98.5		%		70-130	05-FEB-21
Tungsten (W)-Total			97.1		%		70-130	05-FEB-21
Uranium (U)-Total			N/A	MS-B	%		-	05-FEB-21
Vanadium (V)-Total			101.6		%		70-130	05-FEB-21
Zinc (Zn)-Total			N/A	MS-B	%		-	05-FEB-21
Zirconium (Zr)-Total			96.1		%		70-130	05-FEB-21
METHANE-DIS-WT	**Water**							

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
METHANE-DIS-WT	**Water**							
Batch R5366019								
WG3484032-3 DUP		**L2554453-1**						
Methane, Dissolved		22700	25400		ug/L	11	30	08-FEB-21
WG3484032-1 MB								
Methane, Dissolved			<5.0		ug/L		5	08-FEB-21
NH3-F-WT	**Water**							
Batch R5366073								
WG3483708-3 DUP		**WG3483708-5**						
Ammonia, Total (as N)		0.106	0.105		mg/L	1.3	20	05-FEB-21
WG3483708-2 LCS								
Ammonia, Total (as N)			104.5		%		85-115	05-FEB-21
WG3483708-1 MB								
Ammonia, Total (as N)			<0.010		mg/L		0.01	05-FEB-21
WG3483708-4 MS		**WG3483708-5**						
Ammonia, Total (as N)			N/A	MS-B	%		-	05-FEB-21
NO2-IC-WT	**Water**							
Batch R5364301								
WG3483834-10 DUP		**WG3483834-8**						
Nitrite (as N)		<0.010	<0.010	RPD-NA	mg/L	N/A	20	04-FEB-21
WG3483834-7 LCS								
Nitrite (as N)			101.4		%		90-110	04-FEB-21
WG3483834-6 MB								
Nitrite (as N)			<0.010		mg/L		0.01	04-FEB-21
WG3483834-9 MS		**WG3483834-8**						
Nitrite (as N)			100.3		%		75-125	04-FEB-21
NO3-IC-WT	**Water**							
Batch R5364301								
WG3483834-10 DUP		**WG3483834-8**						
Nitrate (as N)		0.032	0.029		mg/L	8.4	20	04-FEB-21
WG3483834-7 LCS								
Nitrate (as N)			101.2		%		90-110	04-FEB-21
WG3483834-6 MB								
Nitrate (as N)			<0.020		mg/L		0.02	04-FEB-21
WG3483834-9 MS		**WG3483834-8**						
Nitrate (as N)			98.4		%		75-125	04-FEB-21
OGG-SPEC-WT	**Water**							

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
OGG-SPEC-WT	**Water**							
Batch R5362716								
WG3483244-2 LCS								
Oil and Grease, Total			96.2		%		70-130	04-FEB-21
Mineral Oil and Grease			95.8		%		70-130	04-FEB-21
WG3483244-1 MB								
Oil and Grease, Total			<5.0		mg/L		5	04-FEB-21
Mineral Oil and Grease			<2.5		mg/L		2.5	04-FEB-21
P-T-COL-WT	**Water**							
Batch R5366400								
WG3483742-3 DUP		**WG3483742-5**						
Phosphorus, Total		1.59	1.55		mg/L	2.3	20	08-FEB-21
WG3483742-2 LCS								
Phosphorus, Total			104.0		%		80-120	08-FEB-21
WG3483742-1 MB								
Phosphorus, Total			<0.0030		mg/L		0.003	08-FEB-21
WG3483742-4 MS		**WG3483742-5**						
Phosphorus, Total			N/A	MS-B	%		-	08-FEB-21
PH-WT	**Water**							
Batch R5365005								
WG3483408-4 DUP		**WG3483408-3**						
pH		8.48	8.60	J	pH units	0.12	0.2	04-FEB-21
WG3483408-2 LCS								
pH			7.00		pH units		6.9-7.1	04-FEB-21
PHENOLS-4AAP-WT	**Water**							
Batch R5366564								
WG3483713-3 DUP		**L2554104-1**						
Phenols (4AAP)		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	05-FEB-21
WG3483713-2 LCS								
Phenols (4AAP)			100.3		%		85-115	05-FEB-21
WG3483713-1 MB								
Phenols (4AAP)			<0.0010		mg/L		0.001	05-FEB-21
WG3483713-4 MS		**L2554104-1**						
Phenols (4AAP)			102.6		%		75-125	05-FEB-21
PO4-DO-COL-WT	**Water**							
Batch R5363658								
WG3483960-3 DUP		**L2553200-1**						
Orthophosphate-Dissolved (as P)		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	05-FEB-21
WG3483960-2 LCS								

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PO4-DO-COL-WT	**Water**							
Batch R5363658								
WG3483960-2 LCS								
Orthophosphate-Dissolved (as P)			104.9		%		80-120	05-FEB-21
WG3483960-1 MB								
Orthophosphate-Dissolved (as P)			<0.0030		mg/L		0.003	05-FEB-21
WG3483960-4 MS		**L2553200-1**						
Orthophosphate-Dissolved (as P)			95.5		%		70-130	05-FEB-21
SO4-IC-N-WT	**Water**							
Batch R5364301								
WG3483834-10 DUP		**WG3483834-8**						
Sulfate (SO4)		228	228		mg/L	0.0	20	04-FEB-21
WG3483834-7 LCS								
Sulfate (SO4)			102.4		%		90-110	04-FEB-21
WG3483834-6 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	04-FEB-21
WG3483834-9 MS		**WG3483834-8**						
Sulfate (SO4)			N/A	MS-B	%		-	04-FEB-21
SOLIDS-TDS-WT	**Water**							
Batch R5370029								
WG3485187-3 DUP		**L2554851-1**						
Total Dissolved Solids		719	718		mg/L	0.1	20	09-FEB-21
WG3485187-2 LCS								
Total Dissolved Solids			96.8		%		85-115	09-FEB-21
WG3485187-1 MB								
Total Dissolved Solids			<10		mg/L		10	09-FEB-21
SOLIDS-TSS-WT	**Water**							
Batch R5366563								
WG3484225-3 DUP		**L2554453-1**						
Total Suspended Solids		<6.0	<6.0	RPD-NA	mg/L	N/A	20	06-FEB-21
WG3484225-2 LCS								
Total Suspended Solids			113.3		%		85-115	06-FEB-21
WG3484225-1 MB								
Total Suspended Solids			<3.0		mg/L		3	06-FEB-21
SULPHIDE-WT	**Water**							
Batch R5366405								
WG3484860-3 DUP		**WG3484860-5**						
Sulphide (as S)		0.28	0.26		mg/L	9.6	20	08-FEB-21
WG3484860-2 LCS								

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SULPHIDE-WT	**Water**							
Batch R5366405								
WG3484860-2 LCS								
Sulphide (as S)			114.9		%		75-125	08-FEB-21
WG3484860-1 MB								
Sulphide (as S)			<0.018		mg/L		0.018	08-FEB-21
WG3484860-4 MS		**WG3484860-5**						
Sulphide (as S)			N/A	MS-B	%		-	08-FEB-21
TKN-F-WT	**Water**							
Batch R5366936								
WG3483711-3 DUP		**L2554068-1**						
Total Kjeldahl Nitrogen		0.650	0.570		mg/L	13	20	08-FEB-21
WG3483711-2 LCS								
Total Kjeldahl Nitrogen			118.8		%		75-125	08-FEB-21
WG3483711-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	08-FEB-21
WG3483711-4 MS		**L2554068-1**						
Total Kjeldahl Nitrogen			98.0		%		70-130	08-FEB-21
TOC-WT	**Water**							
Batch R5368027								
WG3483740-3 DUP		**L2554459-1**						
Total Organic Carbon		6.54	6.86		mg/L	4.8	20	08-FEB-21
WG3483740-2 LCS								
Total Organic Carbon			96.8		%		80-120	08-FEB-21
WG3483740-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	08-FEB-21
WG3483740-4 MS		**L2554459-1**						
Total Organic Carbon			108.0		%		70-130	08-FEB-21
VOC-ROU-HS-WT	**Water**							
Batch R5363446								
WG3483271-4 DUP		**WG3483271-3**						
1,1,2,2-Tetrachloroethane		<0.50	<0.50	RPD-NA	ug/L	N/A	30	05-FEB-21
1,2-Dichlorobenzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	05-FEB-21
1,4-Dichlorobenzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	05-FEB-21
Benzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	05-FEB-21
Chloroform		<1.0	<1.0	RPD-NA	ug/L	N/A	30	05-FEB-21
Dichloromethane		<2.0	<2.0	RPD-NA	ug/L	N/A	30	05-FEB-21
Ethylbenzene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	05-FEB-21

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-HS-WT	**Water**							
Batch R5363446								
WG3483271-4 DUP		**WG3483271-3**						
o-Xylene		<0.30	<0.30	RPD-NA	ug/L	N/A	30	05-FEB-21
Tetrachloroethylene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	05-FEB-21
Toluene		0.47	<0.40	RPD-NA	ug/L	N/A	30	05-FEB-21
Trichloroethylene		<0.50	<0.50	RPD-NA	ug/L	N/A	30	05-FEB-21
WG3483271-1 LCS								
1,1,2,2-Tetrachloroethane			57.9	LCS-L	%		70-130	05-FEB-21
1,2-Dichlorobenzene			99.9		%		70-130	05-FEB-21
1,4-Dichlorobenzene			111.6		%		70-130	05-FEB-21
Benzene			99.8		%		70-130	05-FEB-21
Chloroform			99.5		%		70-130	05-FEB-21
Dichloromethane			98.3		%		70-130	05-FEB-21
Ethylbenzene			102.1		%		70-130	05-FEB-21
o-Xylene			110.4		%		70-130	05-FEB-21
Tetrachloroethylene			100.3		%		70-130	05-FEB-21
Toluene			103.6		%		70-130	05-FEB-21
Trichloroethylene			94.0		%		70-130	05-FEB-21
WG3483271-2 MB								
1,1,2,2-Tetrachloroethane			<0.50		ug/L		0.5	05-FEB-21
1,2-Dichlorobenzene			<0.50		ug/L		0.5	05-FEB-21
1,4-Dichlorobenzene			<0.50		ug/L		0.5	05-FEB-21
Benzene			<0.50		ug/L		0.5	05-FEB-21
Chloroform			<1.0		ug/L		1	05-FEB-21
Dichloromethane			<2.0		ug/L		2	05-FEB-21
Ethylbenzene			<0.50		ug/L		0.5	05-FEB-21
o-Xylene			<0.30		ug/L		0.3	05-FEB-21
Tetrachloroethylene			<0.50		ug/L		0.5	05-FEB-21
Toluene			<0.40		ug/L		0.4	05-FEB-21
Trichloroethylene			<0.50		ug/L		0.5	05-FEB-21
Surrogate: 1,4-Difluorobenzene			100.0		%		70-130	05-FEB-21
Surrogate: 4-Bromofluorobenzene			92.2		%		70-130	05-FEB-21
WG3483271-5 MS		**WG3483271-3**						
1,1,2,2-Tetrachloroethane			94.9		%		50-150	05-FEB-21
1,2-Dichlorobenzene			102.4		%		50-150	05-FEB-21
1,4-Dichlorobenzene			105.9		%		50-150	05-FEB-21

Quality Control Report

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-ROU-HS-WT	**Water**							
Batch R5363446								
WG3483271-5 MS		**WG3483271-3**						
Benzene			97.8		%		50-150	05-FEB-21
Chloroform			97.6		%		50-150	05-FEB-21
Dichloromethane			96.5		%		50-150	05-FEB-21
Ethylbenzene			100.2		%		50-150	05-FEB-21
o-Xylene			108.9		%		50-150	05-FEB-21
Tetrachloroethylene			100.7		%		50-150	05-FEB-21
Toluene			101.3		%		50-150	05-FEB-21
Trichloroethylene			94.2		%		50-150	05-FEB-21

Quality Control Report

Workorder: L2554453 Report Date: 04-MAR-21

Client: WSP CANADA INC.
55 King Street, Suite 700
St. Catharines ON L2R 3H5
Contact: Valyn Bernard

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
LCS-L	Lab Control Sample recovery was below ALS DQO. Reference Material and/or Matrix Spike results were acceptable. Non-detected sample results are considered reliable. Other results, if reported, have been qualified.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody

L2554453-COFC

COC Number: 20 -

Page 1 of 1

www.alsglobal.com

Report To	Contact and company name below will appear on the final report
Company:	WSP Canada Inc.
Contact:	Valyn Bernard
Phone:	289-835-2546
	Company address below will appear on the final report
Street:	
City/Province:	
Postal Code:	
Invoice To	Same as Report To ☐ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Reports / Recipients

Select Report Format: ☐ PDF ☑ EXCEL ☐ EDD (DIGITAL)

Merge QC/QCI Reports with COA ☐ YES ☐ NO ☐ N/A

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: Valyn.Bernard@wsp.com

Email 2:

Email 3:

Invoice Recipients

Select Invoice Distribution: ☐ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: payables.ontario@wsp.com

Email 2:

Turnaround Time (TAT) Requested

☐ Routine [R] if received by 3pm M-F - no surcharges apply

☐ 1 day [P4] if received by 3pm M-F - 20% rush surcharge minimum

☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum

☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum

☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum

☐ Same day [E2] if received by 10am M-S - 200% rush surcharge. Additional fees may apply to rush resuests on weekends, statutory holidays and non-routine tests

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm am/pm

For tests that can not be performed according to the TAT requested, you will be contacted.

Project Information

ALS Account # / Quote #:	Q83429
Job #:	201-11602-00-100-1004
PO / AFE:	
LSD:	

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	

ALS Lab Work Order # (lab use only): L2554453

ALS Contact: | Sampler:

Analysis Request

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	ON-SAN-NIAGARA-WT (Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below)	PuRO (P)	Piss, Mather (P)	Hydrogen Sulphide (P)	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	BH8	02/02/21	4pm	GW	22	X	X	X	X			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO

Are samples for human consumption/ use? ☐ YES ☑ NO

Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)

SAMPLE RECEIPT DETAILS (lab use only)

Cooling Method: ☐ NONE ☐ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				2.8			

SHIPMENT RELEASE (client use)

Released by:	Date:	Time:
SK	2 Feb 21	4pm

INITIAL SHIPMENT RECEPTION (lab use only)

Received by:	Date:	Time:

FINAL SHIPMENT RECEPTION (lab use only)

Received by:	Date:	Time:
	3-Feb-21	1500

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

AUG 2020 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

APPENDIX

F DEWATERING CALCULATIONS

Table F1: Dewatering Calculations for Trenchless Construction in the Study Area - Shafts

DUPUIT-THIEM EQUATION

$$Q = \frac{\pi K(H^2 - h^2)}{2.3\ log(\frac{R_0}{r_e})}\ (m^3/day)$$

SICHARDT FORMULA

$$R_{sich} = C(H - h)\sqrt{K}\ (m)$$

EFFECTIVE RADIUS

$$r_e = \sqrt{\frac{a\ x\ b}{\pi}}\ (m)$$

No.	Shaft Number	Shaft Location	Soil Description at Depth of Shaft	Monitoring Well used for Hydraulic Conductivity	Hydraulic Conductivity (m/sec)	Shaft diameter (m)	Borehole / Monitoring Well used for Groundwater Elevation	Inferred Groundwater Elevation (masl)	Bottom Elevation of Shaft (masl)	Target Pumping Water Elevation (m)	Base of Aquifer (m)	H (m)	h (m)	a and b (m)	Effective Radius r_e (m)	Calculated radius of influence R_0 (m)	Q (m^3/sec)	Q (m^3/day)	Q (L/day)	S.F.	Qmax (m^3/day)	Qmax (L/day)	Precipitation (L)
1	Montrose Shaft 01	Ontario Power Generation Lands	Silty Sand	BH20-01	1.68E-07	4.0	BH20-01	169.7	166.1	165.10	165.10	3.6	0.0	4.0	2.3	4.4	1.28E-05	1.11	1,107	2	2.21	2,214	160
2	Montrose Shaft 02	Montrose Road, west of the OPG lands	Silty Clay and Silt	BH20-02	1.00E-08	4.0	BH20-01	169.7	166.7	165.71	165.70	3.0	0.0	4.0	2.3	0.9	5.43E-07	0.05	47	2	0.09	94	160
3	Montrose Shaft 03	Montrose Road and Brown Road	Silty Clay	BH20-04	1.00E-08	4.0	BH-P03	175.6	165.7	164.68	164.30	9.9	0.4	4.0	2.3	2.9	2.10E-06	0.18	181	2	0.36	363	160
4	Brown Shaft 01	Brown Road and Heartland Forest Road	Silty Clay Till	BH20-03	1.00E-08	2.8	BH-P03	174.8	167.5	166.49	164.80	7.3	1.7	2.8	1.6	1.7	2.41E-06	0.21	208	2	0.42	416	78
5	Montrose Shaft 04	Montrose Road and Chippawa Creek Road	Sand and Gravel	BH20-05	1.00E-04	4.0	BH20-06S	173.9	160.0	159.00	158.90	13.9	0.1	4.0	2.3	414.0	9.64E-04	83.33	83,326	2	166.65	166,652	160
6	Montrose Shaft 05	Montrose Road and Grassy Brook Road	Silt	BH20-07S	8.25E-07	4.0	BH20-07S	172.5	159.0	158.00	152.40	13.5	5.6	4.0	2.3	21.4	1.77E-05	1.53	1,530	2	3.06	3,061	160
7	Montrose Shaft 06	Montrose Road and Grassy Brook Road	Silty Clay	BH20-09	1.00E-08	4.0	BH20-09	168.3	158.1	157.08	155.10	10.2	2.0	4.0	2.3	2.5	4.17E-06	0.36	360	2	0.72	720	160
8	Reixinger Shaft 2	Reixinger Road and Dell Road	Silty Clay	BH20-08	1.00E-08	4.0	BH20-08	168.9	157.3	156.26	153.70	11.6	2.6	4.0	2.3	2.7	1.58E-06	0.14	136	2	0.27	273	160
																TOTAL		86.90	86,895.69		173.79	173791	1198

No.	Date	Description	By

STAMPS:

0 25 m 50 m 100 m

SCALE BAR

ARCHITECT:

C2 Architecture

C2 Architecture Inc.
415 Baseline Road West
Bowmanville, ON L1C 5M2
☎ 905.697.4464

CLIENT:

PROJECT NAME:

SOUTH NIAGARA FALLS WWTP CLASS EA AND CONCEPTUAL DESIGN

SHEET TITLE:

PHASE 1 SITE PLAN

DISCIPLINE:

GENERAL

DRAFTER: Author	SCALE: AS NOTED
DESIGNER: Designer	DATE:
APPROVER: Approver	CHECKER: Checker
PROJECT No: T001140A	DRAWING No: G101
SHEET No: of	

CONSTRUCTION DEWATERING ASSUMPTIONS

Hydrogeological Investigation

201-11602-00 South Niagara WW Solutions

Dupuit-Thiem Equation
Overburden

Table F-2: Construction Dewatering Flow Rate - Digestor Tanks

Description	Symbol	Value	Unit	Explanation
Input Data				
Depth to Groundwater		4.26	mbgs	Highest Water Level 4.76 mbgs (BH20-12S) + 0.5 m for seasonal fluctuation
Base of excavation		3.65	mbgs	Bearing elevation, as shown on Conceptual Site Plan provided by CIMA March 18, 2022
Base of Water-Bearing Zone		14.80	mbgs	Base of silt deposit at BH20-08
Hydraulic Conductivity	K	1.0E-08	m/s	Conservative value, based on low hydraulic conductivities estimated using single well response tests (10-9 m/s) in BH20-10, BH20-11 and BH20-12
	K	8.6E-04	m/day	Converted to m/day
Dimensions of Excavation	a	47.3	m	Dimensions of building footprint as per Conceptual Site Plan provided by CIMA March 18, 2022 + V:H (1:2) for safe sloping during excavations
	b	47.3	m	Dimensions of building footprint as per Conceptual Site Plan provided by CIMA March 18, 2022 + V:H (1:2) for safe sloping during excavations
Output				
Target water level		4.65	mbgs	1 m below base of excavation
Head beyond the influence of pumping (static groundwater elevation	H	10.5	m	
Head above base of aquifer at 1 m below base of the excavation (m);	h	10.2	m	if h>H, static groundwater level is estimated to be below the depth of the target water level
Effective radius	r_e	26.7	m	Effective radius of rectangular excavation
Sichardt estimate for radius of influence	R_{sich}	0.12	m	where c = 3000 for well approximation
Radius of influence	R_0	26.8	m	Manipulated value, Re+Rsich
Construction dewatering flow rate	Q	5.8E-05	m^3/sec	Construction flow rate - Dupuit Equation
Construction dewatering flow rate	Q	5.0	m^3/day	Construction flow rate - Dupuit Equation
Safety factor	S.F.	2.00		
Maximum Construction Flow Rate (with applied safety factor)	Q_{max}	10.0	m^3/day	during the initial period
Estimated Construction Dewatering Flow Rate		**5,100**	L/day	
Estimated Maximum Construction Flow Rate with Safety Factor		**10,100**	L/day	

Stormwater Estimate

Location	Assumed Precip Event (mm)	Area (m^2)	Total (L)
Excavation	10	2237	22,400

CONSTRUCTION DEWATERING ASSUMPTIONS

Hydrogeological Investigation

201-11602-00 South Niagara WW Solutions

Dupuit-Thiem Equation
Overburden

Table F-3: Construction Dewatering Flow Rate - Mechanical Building

Description	Symbol	Value	Unit	Explanation
Input Data				
Depth to Groundwater		4.26	mbgs	Highest Water Level 4.76 mbgs (BH20-12S) + 0.5 m for seasonal fluctuation
Base of excavation		3.65	mbgs	Bearing elevation, as shown on Conceptual Site Plan provided by CIMA March 18, 2022
Base of Water-Bearing Zone		14.80	mbgs	Base of silt deposit at BH20-08
Hydraulic Conductivity	K	1.0E-08	m/s	Conservative value, based on low hydraulic conductivities estimated using single well response tests (10-9 m/s) in BH20-10, BH20-11 and BH20-12
	K	8.6E-04	m/day	Converted to m/day
Dimensions of Excavation	a	33.3	m	Dimensions of building footprint as per Conceptual Site Plan provided by CIMA March 18, 2022 + V:H (1:2) for safe sloping during excavations
	b	33.3	m	Dimensions of building footprint as per Conceptual Site Plan provided by CIMA March 18, 2022 + V:H (1:2) for safe sloping during excavations
Output				
Target water level		4.65	mbgs	1 m below base of excavation
Head beyond the influence of pumping (static groundwater elevation	H	10.5	m	
Head above base of aquifer at 1 m below base of the excavation (m);	h	10.2	m	if h>H, static groundwater level is estimated to be below the depth of the target water level
Effective radius	r_e	18.8	m	Effective radius of rectangular excavation
Sichardt estimate for radius of influence	R_{sich}	0.12	m	where c = 3000 for well approximation
Radius of influence	R_0	18.9	m	Manipulated value, Re+Rsich
Construction dewatering flow rate	Q	4.1E-05	m^3/sec	Construction flow rate - Dupuit Equation
Construction dewatering flow rate	Q	3.5	m^3/day	Construction flow rate - Dupuit Equation
Safety factor	S.F.	2.00		
Maximum Construction Flow Rate (with applied safety factor)	Q_{max}	7.1	m^3/day	during the initial period
Estimated Construction Dewatering Flow Rate		**3,600**	L/day	
Estimated Maximum Construction Flow Rate with Safety Factor		**7,100**	L/day	

Stormwater Estimate

Location	Assumed Precip Event (mm)	Area (m^2)	Total (L)
Excavation	10	1109	11,100

CONSTRUCTION DEWATERING ASSUMPTIONS

Hydrogeological Investigation

201-11602-00 South Niagara WW Solutions

Dupuit-Thiem Equation
Overburden

Table F-4: Construction Dewatering Flow Rate - Chlorine Contact Tank

Description	Symbol	Value	Unit	Explanation
Input Data				
Depth to Groundwater		4.26	mbgs	Highest Water Level 4.76 mbgs (BH20-12S) + 0.5 m for seasonal fluctuation
Base of excavation		3.00	mbgs	Bearing elevation, as shown on Conceptual Site Plan provided by CIMA March 18, 2022
Base of Water-Bearing Zone		14.80	mbgs	Base of silt deposit at BH20-08
Hydraulic Conductivity	K	1.0E-08	m/s	Conservative value, based on low hydraulic conductivities estimated using single well response tests (10-9 m/s) in BH20-10, BH20-11 and BH20-12
	K	8.6E-04	m/day	Converted to m/day
Dimensions of Excavation	a	46.0	m	Dimensions of building footprint as per Conceptual Site Plan provided by CIMA March 18, 2022 + V:H (1:2) for safe sloping during excavations
	b	26.0	m	Dimensions of building footprint as per Conceptual Site Plan provided by CIMA March 18, 2022 + V:H (1:2) for safe sloping during excavations
Output				
Target water level		4.00	mbgs	1 m below base of excavation
Head beyond the influence of pumping (static groundwater elevatio	H	10.5	m	
Head above base of aquifer at 1 m below base of the excavation (m);	h	10.8	m	if h>H, static groundwater level is estimated to be below the depth of the target water level
Effective radius	r_e	19.5	m	Effective radius of rectangular excavation
Sichardt estimate for radius of influence	R_{sich}	0.00	m	where c = 3000 for well approximation
Radius of influence	R_0	19.5	m	Manipulated value, Re+Rsich
Construction dewatering flow rate	Q	0.00	m^3/sec	Construction flow rate - Dupuit Equation, long narrow trench
Construction dewatering flow rate	Q	0.00	m^3/day	Construction flow rate - Dupuit Equation, long narrow trench
Safety factor	S.F.	2.00		
Maximum Construction Flow Rate (with applied safety factor)	Q_{max}	0.0	m^3/day	during the initial period
Estimated Construction Dewatering Flow Rate		**0**	L/day	
Estimated Maximum Construction Flow Rate with Safety Factor		**0**	L/day	

Stormwater Estimate

Location	Assumed Precip Event (mm)	Area (m^2)	Total (L)
Excavation	10	1196	12,000

CONSTRUCTION DEWATERING ASSUMPTIONS

Hydrogeological Investigation

201-11602-00 South Niagara WW Solutions

Dupuit-Thiem Equation
Overburden

Table F-5: Construction Dewatering Flow Rate - Secondary Clarifiers

Description	Symbol	Value	Unit	Explanation
Input Data				
Depth to Groundwater		4.26	mbgs	Highest Water Level 4.76 mbgs (BH20-12S) + 0.5 m for seasonal fluctuation
Base of excavation		6.00	mbgs	Bearing elevation, as shown on Conceptual Site Plan provided by CIMA March 18, 2022
Base of Water-Bearing Zone		14.80	mbgs	Base of silt deposit at BH20-08
Hydraulic Conductivity	K	1.0E-08	m/s	Conservative value, based on low hydraulic conductivities estimated using single well response tests (10-9 m/s) in BH20-10, BH20-11 and BH20-12
	K	8.6E-04	m/day	Converted to m/day
Dimensions of Excavation	a	55.0	m	Dimensions of building footprint as per Conceptual Site Plan provided by CIMA March 18, 2022 + V:H (1:2) for safe sloping during excavations
	b	55.0	m	Dimensions of building footprint as per Conceptual Site Plan provided by CIMA March 18, 2022 + V:H (1:2) for safe sloping during excavations
Output				
Target water level		7.00	mbgs	1 m below base of excavation
Head beyond the influence of pumping (static groundwater elevation	H	10.5	m	
Head above base of aquifer at 1 m below base of the excavation (m);	h	7.8	m	if h>H, static groundwater level is estimated to be below the depth of the target water level
Effective radius	r_e	31.0	m	Effective radius of rectangular excavation
Sichardt estimate for radius of influence	R_{sich}	0.82	m	where c = 3000 for well approximation
Radius of influence	R_0	31.9	m	Manipulated value, Re+Rsich
Construction dewatering flow rate	Q	6.0E-05	m^3/sec	Construction flow rate - Dupuit Equation
Construction dewatering flow rate	Q	5.2	m^3/day	Construction flow rate - Dupuit Equation
Safety factor	S.F.	2.00		
Maximum Construction Flow Rate (with applied safety factor)	Q_{max}	10.4	m^3/day	during the initial period
Estimated Construction Dewatering Flow Rate		**5,300**	L/day	
Estimated Maximum Construction Flow Rate with Safety Factor		**10,500**	L/day	

Stormwater Estimate

Location	Assumed Precip Event (mm)	Area (m^2)	Total (L)
Excavation	10	3025	30,300

CONSTRUCTION DEWATERING ASSUMPTIONS

Hydrogeological Investigation

201-11602-00 South Niagara WW Solutions

Dupuit-Thiem Equation
Overburden

Table F-6: Construction Dewatering Flow Rate -Aeration Tank

Description	Symbol	Value	Unit	Explanation
Input Data				
Depth to Groundwater		4.26	mbgs	Highest Water Level 4.76 mbgs (BH20-12S) + 0.5 m for seasonal fluctuation
Base of excavation		7.00	mbgs	Bearing elevation, as shown on Conceptual Site Plan provided by CIMA March 18, 2022
Base of Water-Bearing Zone		14.80	mbgs	Base of silt deposit at BH20-08
Hydraulic Conductivity	K	1.0E-08	m/s	Conservative value, based on low hydraulic conductivities estimated using single well response tests (10-9 m/s) in BH20-10, BH20-11 and BH20-12
	K	8.6E-04	m/day	Converted to m/day
Dimensions of Excavation	a	54.0	m	Dimensions of building footprint as per Conceptual Site Plan provided by CIMA March 18, 2022 + V:H (1:2) for safe sloping during excavations
	b	41.0	m	Dimensions of building footprint as per Conceptual Site Plan provided by CIMA March 18, 2022 + V:H (1:2) for safe sloping during excavations
Output				
Target water level		8.00	mbgs	1 m below base of excavation
Head beyond the influence of pumping (static groundwater elevation	H	10.5	m	
Head above base of aquifer at 1 m below base of the excavation (m);	h	6.8	m	if h>H, static groundwater level is estimated to be below the depth of the target water level
Effective radius	r_e	26.5	m	Effective radius of rectangular excavation
Sichardt estimate for radius of influence	R_{sich}	1.12	m	where c = 3000 for well approximation
Radius of influence	R_0	27.7	m	Manipulated value, Re+Rsich
Construction dewatering flow rate	Q	4.9E-05	m^3/sec	Construction flow rate - Dupuit Equation
Construction dewatering flow rate	Q	4.3	m^3/day	Construction flow rate - Dupuit Equation
Safety factor	S.F.	2.00		
Maximum Construction Flow Rate (with applied safety factor)	Q_{max}	8.5	m^3/day	during the initial period
Estimated Construction Dewatering Flow Rate		**4,300**	L/day	
Estimated Maximum Construction Flow Rate with Safety Factor		**8,600**	L/day	

Stormwater Estimate

Location	Assumed Precip Event (mm)	Area (m^2)	Total (L)
Excavation	10	2214	22,100

CONSTRUCTION DEWATERING ASSUMPTIONS

Hydrogeological Investigation

201-11602-00 South Niagara WW Solutions

Dupuit-Thiem Equation
Overburden

Table F-7: Construction Dewatering Flow Rate - Deep Pumping Station

Description	Symbol	Value	Unit	Explanation
Input Data				
Depth to Groundwater		5.25	mbgs	Highest Water Level 5.75 mbgs (BH20-8) + 0.5 m for seasonal fluctuation
Base of excavation		39.00	mbgs	Bearing elevation, as shown on Conceptual Site Plan provided by CIMA March 18, 2022
Base of Water-Bearing Zone		42.00	mbgs	3 m below the bottom of excavation in bedrock
Hydraulic Conductivity	K	5.0E-08	m/s	Based on proposed secant wall, minimal infiltration is anticipated during excavation
	K	4.3E-03	m/day	Converted to m/day
Dimensions of Excavation	a	25.0	m	Dimensions of footprint as per Conceptual Site Plan provided by CIMA March 18, 2022
	b	25.0	m	Dimensions of footprint as per Conceptual Site Plan provided by CIMA March 18, 2022
Output				
Target water level		40.00	mbgs	1 m below base of excavation
Head beyond the influence of pumping (static groundwater elevation	H	36.8	m	
Head above base of aquifer at 1 m below base of the excavation (m);	h	2.0	m	if h>H, static groundwater level is estimated to be below the depth of the target water level
Effective radius	r_e	14.1	m	Effective radius of rectangular excavation
Sichardt estimate for radius of influence	R_{sich}	23.31	m	where c = 3000 for well approximation
Radius of influence	R_0	37.4	m	Manipulated value, Re+Rsich
Construction dewatering flow rate	Q	2.2E-04	m^3/sec	Construction flow rate - Dupuit Equation
Construction dewatering flow rate	Q	18.7	m^3/day	Construction flow rate - Dupuit Equation
Safety factor	S.F.	2.00		
Maximum Construction Flow Rate (with applied safety factor)	Q_{max}	37.5	m^3/day	during the initial period
Estimated Construction Dewatering Flow Rate		**18,800**	L/day	
Estimated Maximum Construction Flow Rate with Safety Factor		**37,500**	L/day	

Stormwater Estimate

Location	Assumed Precip Event (mm)	Area (m^2)	Total (L)
Excavation	10	491	4,900