MARIANNEVILLE DEVELOPMENTS LTD.

HYDROGEOLOGICAL INVESTIGATION REPORT

Estates of Glenway West, Town of Newmarket L09-301





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JANUARY 2020

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January 23, 2020 Our Ref: L09-301

Marianneville Developments Limited Ms. Joanne Barnett 26 Lesmill Road, Unit 3 Toronto, ON M3B 2T5

Dear Ms. Barnett:

Re: Hydrogeological Investigation Report Estates of Glenway, Town of Newmarket, Ontario

Cole Engineering Group Ltd. is pleased to submit the enclosed hydrogeological investigation report for 470 Crossland Gate, Estates of Glenway (West Lands), Marianneville Development Limited, Town of Newmarket, Ontario. The investigation included a review of existing hydrogeological information of the study area, characterization of the geological and hydrogeological setting, and an assessment of potential impacts due to the proposed development. Proposed mitigation measures are also provided.

Should you have any questions or comments, please do not hesitate to contact the undersigned.

Yours truly,

COLE ENGINEERING GROUP LTD.

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Executive Summary

Cole Engineering Group Ltd (COLE) was retained by Marianneville Development Limited (the "Client") to prepare a Hydrogeological Investigation for a proposed mixed use development (the "Site"). The Site is an irregularly shaped lot comprising of approximately 12.54 hectares within the existing Glenway Estate and Country Club Community (West Lands) located in the Town of Newmarket.

The Site is situated in the West Holland Subwatershed and East Holland River Subwatershed (it straddles the boundary) within the Lake Simcoe Watershed, and falls under the jurisdiction of the Lake Simcoe Region Conservation Authority (LSRCA). Regional mapping indicates that the west portion of the Site is located within a significant groundwater recharge area (SGRA). The Site is also located within the Newmarket Wellhead Protection Area WHPA-D and within the York Region WHPA-Q.

The Site is located within the Simcoe Lowlands physiographic region, characterized by sand, silt and clay. In general, the Site is underlain by topsoil and fill to depths ranging from approximately 0.13 mbgs to 1.7 mbgs. Fill was encountered either at the surface or below top soil. It generally consists of silty clay, sandy silt or silty sand mixed with topsoil and rootlets. The topsoil and fill layers are underlain by silty sand to sandy silt till, and silty clay till, interstratified with silty clay, silty sand, and silt layers down to depths ranging from 1.7 mbgs to an investigated depth of 10.1 mbgs.

At a regional scale, groundwater flows generally northerly toward Lake Simcoe. During the monitoring events, shallow groundwater levels at the Site were generally at a higher elevation in the south and central portion of the Site and at a lower elevation in the northeastern portion of the Site. The shallow groundwater flow pattern was interpreted to follow the Site topography and is generally toward the onsite pond and watercourse. Shallow groundwater in the eastern portion of the Site flows northeasterly toward the watercourse while shallow groundwater in the western portion of the Site flows northwesterly toward the onsite pond. The vertical hydraulic gradient at the Site was interpreted to be neutral to downward.

Single-well rising-head tests were conducted in onsite monitoring wells to determine the in-situ hydraulic conductivity (K) of the screened overburden materials. The in-situ K values were estimated to range from 1.2×10^{-8} m/s to 7.0×10^{-7} m/s.

Groundwater samples were collected from three shallow monitoring wells and one deep monitoring well using a manual inertial pump on January 25, 2018. Laboratory groundwater test results were compared to the conservative *Soil and Groundwater Standards – Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition - as amended April 15, 2011* for All Types of Property Use for Coarse-grained materials. The groundwater samples showed no exceedances.

Potential long-term impacts to the groundwater system associated with the proposed development were interpreted to include reduction in infiltration, lowering of the groundwater levels in the overburden, and the potential introduction of preferential pathways for contaminants.

Potential short-term impacts are mostly associated with construction dewatering and are expected to be temporary. Should the need for significant construction dewatering be identified at the detailed design stage (> 50,000 L/day), a Permit to Take Water (PTTW) will be required during installation of site services. The PTTW application package should include a detailed study of the required dewatering rate, estimated zone of influence and mitigation measures required to minimize the dewatering impact. An environmental management plan (EMP) will need to be developed to identify and mitigate potential



short-term impacts during construction. The EMP may include a domestic well interference response protocol and dewatering discharge management measures.

As the proposed development falls within a wellhead protection area of the Newmarket municipal wells, a SWIAMP report is required and will be submitted separately to support the development.

Various best management practices could be incorporated into the proposed development, including promoting infiltration through LID practices to mitigate recharge reductions. A water balance analysis will be required to identify how groundwater resources will be maintained in the post-construction scenario.



Table of Contents

Transmittal Letter Executive Summary Table of Contents

1.0	Intro	duction		1		
	1.1	Proposed Development				
	1.2 Objectives of the Hydrogeological Investigation					
		121	Characterization of the Existing Geological and Hydrogeological Setting	1		
		1.2.2	Identification of Nearby Potential Groundwater Receptors			
		1.2.3	Assessment of Potential Impacts of the Proposed Development	2		
		1.2.4	Recommended Mitigation Measures	2		
2.0	Relev	vant Pol	icies and Regulations	2		
3.0	Exist	ing Site	Conditions	4		
	3.1	Topog	raphy and Drainage	4		
	3.2	Physio	y y y y y y y y y y y y y y y y y y y	4		
	3.3	Regior	al Geology and Hydrogeology			
	3.0	Monit	oring Network	6		
	J. 4	2/11	Rorehole Investigation and Monitoring Well Installation			
	35	Jocal (Seology and Hydrogeology			
	5.5	2 5 1	Groundwater Levels	,		
		3.5.1	Groundwater Flow	8		
		3.5.3	Hydraulic Conductivity			
		3.5.4	Groundwater Quality	9		
4.0	Wate	er Balan	ce			
5.0	Ident	tificatio	n of Potential Receptors	10		
	5.1	Enviro	nmental Features			
		5.1.1	Surface Water Features	10		
		5.1.2	Natural Ecosystem Features	10		
	5.2	Surrou	Inding Groundwater Users	10		
		5.2.1	Ministry of Environment and Climate Change Well Records	11		
		5.2.2	Permitted Water Users	11		
		5.2.3	Private Water Well Survey	11		
6.0	Pote	ntial Im	pact and Proposed Mitigation	12		
	6.1	Identif	fication and Mitigation of Long-Term Impacts			
		6.1.1	Potential Long-Term Impacts to the Groundwater System	12		
		6.1.2	Potential Long-Term Impacts to the Natural Features	12		
		6.1.3	Potential Long-Term Impacts to Groundwater Users			
		6.1.4	Mitigation of Long-Term Impacts	13		
	6.2	Identif	fication and Mitigation of Short-Term Impacts	13		
		6.2.1	Potential Short-Term Impacts to the Groundwater System	13		
		6.2.2	Potential Short-Term Impacts to the Natural Features	14		
		672	Potential Short-Term Impacts to the Other Groundwater Users	14		
		0.2.3		····· ··· ··· ··· ··· ··· ··· ··· ···		



7.0	Summary	14
8.0	Recommendations	15
9.0	References	17

List of Tables

Table 3-1	Monitoring Well Details
Table 3-2	Estimated Hydraulic Conductivities
Table 5-1	Summary of MOECC Well Usage for a 1 km Radius around the Site
Table 5-2	Permitted Water Takers within 1 km of the Site
Table 7	MOE Well Record Details
Table 8	Municipal Groundwater Well Details
Table 9	Permitted Water Takers
Table 10	Water Well Survey Laboratory Sample Results

List of Figures

- Figure 1 Site Location
- Figure 2 Regional Topography
- Figure 3 Site Topography
- Figure 4 Physiography
- Figure 5 Regional Cross Section
- Figure 6 Quaternary Geology
- Figure 7 Bedrock Geology
- Figure 8 Monitoring Well Locations
- Figure 9A Cross-Section A-A'
- Figure 9B Cross-Section B-B'
- Figure 10 Shallow Groundwater Flow Patterns
- Figure 11 Environmental Features
- Figure 12 MOEC Well Records

List of Appendices

- Appendix A Site Plan
- Appendix B Borehole Logs
- Appendix C Hydrographs of Monitoring Wells
- Appendix D Hydraulic Conductivity Analyses
- Appendix E Certificate of Analysis



1.0 Introduction

Cole Engineering Group Ltd ("COLE") was retained by Marianneville Development Limited (the "Client") to prepare a Hydrogeological Investigation for a proposed residential development (the "Site") located within the existing Glenway Estate and Country Club Community (West Lands) in the Town of Newmarket, Regional Municipality of York (Region). The Site is irregular in shape with an approximate area of 12.54 hectares. The Site is located within the western half of the Glenway Community, bordered by Alex Doner Drive and Sykes Road to the north, Crossland Gate to the east, and Bathurst Street to the west. The location of the Site is shown on **Figure 1**.

1.1 **Proposed Development**

The proposed development involves converting an existing golf course land into 75 proposed residential lots and stormwater management ("SWM") facilities. A network of watermain, storm sewer and sanitary sewer is also proposed to be installed within the proposed development. The proposed development plan is shown in **Appendix A**.

1.2 Objectives of the Hydrogeological Investigation

This hydrogeological investigation was undertaken in order to:

- Characterize the existing geological and hydrogeological setting;
- Assess potential groundwater-surface interactions;
- Identify nearby potential groundwater receptors;
- Assess potential impacts to the natural environment and nearby groundwater well users as a result of the development; and,
- Provide recommendations on management measures to mitigate potential impacts.

1.2.1 Characterization of the Existing Geological and Hydrogeological Setting

A conceptual understanding of the geological and hydrogeological system was developed through review of existing reports and available geological information, including:

- East Holland River Subwatershed Plan, Lake Simcoe Region Conservation Authority, (2010);
- West Holland River Subwatershed Plan, Lake Simcoe Region Conservation Authority, (2010);
- Town of Newmarket Official Plan;
- York Region Official Plan (2010);
- Soil Engineers Ltd. (2018). Geotechnical Investigation Preliminary Report, Proposed Residential Development, Glenway West, Alex Doner Drive, Town of Newmarket;
- Geological and hydrogeological information from the Ministry of Natural Resources and Forestry (MNRF);
- Geological and hydrogeological information from Ontario Geological Survey;
- Mapping and reports by Toronto and Region Conservation Authority; and,
- Ministry of the Environment and Climate Change (MOECC) Well Records Database.

A drilling program was conducted at the Site by Soil Engineers Ltd. in January 2017 to characterize local geological and hydrogeological conditions. A total of 15 boreholes were drilled to depths ranging from 6.2 metres below ground surface (mbgs) to 10.1 mbgs. Twelve of the boreholes were instrumented with monitoring wells. Nine shallow monitoring wells were screened to depths ranging from 4.5 mbgs to 6.2 mbgs and three deep monitoring wells were screened to depths ranging from 8.5 mbgs to 10.1 mbgs.



1.2.2 Identification of Nearby Potential Groundwater Receptors

A desktop review was conducted to identify potential groundwater-dependent natural ecosystem features on or near the Site. Information relating to these features was obtained from the following sources:

- East Holland River Subwatershed Plan, Lake Simcoe Region Conservation Authority, (2010);
- West Holland River Subwatershed Plan, Lake Simcoe Region Conservation Authority, (2010);
- York Region Official Plan (2010); and,
- Town of Newmarket Official Plan;

An understanding of typical groundwater usage in the area was obtained by:

- Querying the MOECC water well record database for a 1 km radius around the Site;
- Identifying permitted water takers within a 1 km radius of the Site; and,
- Conducting a door-to-door private water well survey within a 500 m radius of the Site.

1.2.3 Assessment of Potential Impacts of the Proposed Development

Potential short-term and long-term impacts on the groundwater system due to the proposed development were assessed as part of the investigation. This included an evaluation of the potential implications of the development to the hydrologic form and function of groundwater-dependent features and ecosystem features, and of the potential impacts of dewatering activities on nearby groundwater receptors.

1.2.4 Recommended Mitigation Measures

Mitigation measures were recommended to manage and mitigate potential short-term and long-term impacts associated with the proposed development.

2.0 Relevant Policies and Regulations

Environmental regulations and policies that may be relevant for this hydrogeological investigation are listed and discussed briefly below:

- York Region Official Plan (2010);
- Permit to Take Water, Section 34 of the Ontario Water Resources Act (1990);
- Lake Simcoe and Region Conservation Authority ("LSRCA") Policies and Regulations (*Ontario Regulation (O. Reg.) 179/06*);
- The Endangered Species Act (2007);
- The Federal Fisheries Act (1985); and
- The Clean Water Act (2006).

O. Reg. 140/02 – Oak Ridges Moraine Conservation Plan (ORMCP)

The Oak Ridges Moraine Conservation Plan ("ORMCP"), established under the *Oak Ridges Moraine Conservation Act, 2001*, provides land use and resource management direction for the protection of the ecological and hydrological features and functions of the Oak Ridges Moraine. Municipal plans are required to be brought into conformity with this Plan. Among the requirements mandated under O. Reg. 140/02 are those for adherence to minimum vegetation protection zones around key natural heritage



and hydrologically sensitive features, as well as planning, design and construction practices specific to the protection of landform conservation areas.

The western portion of the Site is located in the Oak Ridges Moraine Conservation Plan Area. The area of proposed development is designated as a Settlement Area. As part of this hydrogeological investigation, a desktop search of hydrologically sensitive features was conducted for a 1 km radius around the Site. As detailed in **Section 5.1**, no hydrologically sensitive features were identified within the Site boundaries. Based on a review of Landform Conservation Areas of the Oak Ridges Moraine Map No. 2, the Site is also not located within a landform conservation area.

York Region Official Plan

York Region adopted the current *York Regional Official Plan 2010* (*YROP-2010*) in 2009 which was approved by the Municipal Affairs and Housing in 2010. The York Region Official Plan is an overall planning document that guides economic, environmental and community building decisions to manage growth in York Region.

According to the *York Region Official Plan*, there are no environmentally significant areas or areas of natural and scientific interest within or adjacent to the Site. Furthermore, no key hydrologic features are shown within the Site limits. Western Creek is located approximately 950 m southeast of the Site and Ansnorveldt Creek is located approximately 280 m north of the Site. Wetlands are also shown as being situated approximately 400 m east of the Site. A Provincially Significant Earth Science ANSI known as the Glenville Hills Kames is also located approximately 300 m west of the Site.

O. Reg. 179/06 – Lake Simcoe Region Conservation Authority (LSRCA)

Under Section 28 of the *Conservation Authorities Act*, the local conservation authorities are mandated to protect the health and integrity of the regional greenspace system and to maintain or improve the hydrological and ecological functions performed by valley and stream corridors. The LSRCA enforces this Act through O. Reg. 179/06: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses.

The Site does not lie within any of the LSRCA regulated areas and there are no natural surface water features traversing the Site. Therefore, no application under O.Reg. 179/06 is required for this project.

The Clean Water Act (2006)

The MOECC mandates the protection of existing and future sources of drinking water under the *Clean Water Act*, 2006 ("CWA"). Initiatives undertaken under the *CWA* include the delineation of Wellhead Protection Areas ("WHPAs"), Significant Groundwater Recharge Areas ("SGRAs") and areas of Highly Vulnerable Aquifer ("HVA") as well as the assessment of drinking water quality and quantity threats within Source Protection Regions. Source Protection Plans are developed under the *CWA* which include the restriction and prohibition of certain types of activities and land uses within WHPAs.

Based on regional-scale source protection mapping, the Site is not located within a highly vulnerable aquifer area. However, the Site is located within the Newmarket WHPA-D area and partially overlying a SGRA.

Additionally, the Site is situated in the WHPA-Q area, which is a vulnerable area delineated for the management of activities that may reduce recharge to an aquifer. As per the *Approved South Georgian Bay Lake Simcoe Source Protection Plan* (2015), a water balance analysis is required to demonstrate that the pre-development water balance can be maintained post-development through the implementation



of appropriate mitigation measures. COLE will be completed a water balance for the Site as part of the Functional Servicing Report.

The Endangered Species Act, 2007 – Ontario Ministry of Natural Resources and Forestry

The MNRF has jurisdiction to administer the *Endangered Species Act* (2007) to protect species at risk (SAR) and their habitat. Where works may occur in or near a protected habitat, SAR are on or near the site, and/or the works may harm/harass the species or damage/destroy the protected habitat, a confirmation of notice of activity, a permit or a Letter of Authorization or Advice will be required from the MNRF.

COLE is currently undertaking an Environmental Impact Study ("EIS") for the Site. The results of the EIS will be documented under a separate cover and will identify any MNRF approval requirements under the *Endangered Species Act*.

The Federal Fisheries Act, R.S.C. 1985

Fisheries Ocean Canada (DFO) is the implementing agency of the Federal Fisheries Act. The Act prohibits "serious harm to fish", which is defined as the "death of fish or any permanent alteration to, or destruction of, fish habitat". In cases where serious harm to fish cannot be avoided, an authorization under Section 35(2) of the Act will need to be obtained from the DFO.

Based on the results of the EIS, a determination will be made as to whether a DFO review or authorization will be required for the proposed works.

3.0 Existing Site Conditions

3.1 Topography and Drainage

The Site is located to the south of Holland's Landing, just northeast of the Oak Ridges Moraine (ORM), and falls within the jurisdiction of LSRCA. The west portion of the Site is in the West Holland River Subwatershed and the east portion of the Site is in the East Holland River Subwatershed. There are no natural watercourses traversing the Site. The regional topography slopes northeasterly toward Lake Simcoe. A regional topographic map is presented as **Figure 2**.

Ground elevations at the Site range from about 300 metres above sea level (masl) in the southern portion of the Site to approximately 275 masl along the onsite pond in the northeastern portion of the Site. Overland flow drainage at the Site generally follows the existing topography, with the southern portion of the Site draining toward the watercourse located southeast of the Site and the onsite ponds. A detailed topographic survey for the Site is presented on **Figure 3**.

3.2 Physiography

The Site is located within the Simcoe Lowlands physiographic region (Figure 4). The Simcoe Lowlands physiographic region is characterized by lower elevations and flat-floored valley features that generally correspond to current river systems (Sharpe *et al.*, 1999). The floor materials in the lowlands consist of sand, silt and clay, as a result of flooding from glacial Lake Algonquin (Chapman and Putnam, 1984). The Holland Marsh is located 3 km west of the Site and has been one of the most intensively cultivated areas of the Province since the early 1900s.



3.3 Regional Geology and Hydrogeology

The current understanding of the geologic and hydrogeologic environment was based on scientific work conducted by the Geological Survey of Canada ("GSC"), Conservation Authorities Moraine Coalition ("CAMC") and the LSRCA. The regional geology and hydrogeology discussed in this report builds on information obtained from the above noted studies.

The regional geology in this area consists of Paleozoic sedimentary bedrock overlain by Pleistocene unconsolidated sedimentary materials that have been deposited and modified by glacial, fluvial and lacustrine processes over the last 135,000 years (Kassenaar & Wexler, 2006). **Figure 5** shows the regional cross section obtained from the Approved Assessment Report: Lake Simcoe and Couchiching-Black River Source Protection Area (LSRCA, NVCA & SSEA, 2011). **Figure 6** shows quaternary geology mapping for the region.

The depth of the bedrock in this area is expected to be at 150 m (approximately 130 masl). The different stratigraphic units that overlie the bedrock from the top include:

- A. Recent Deposits;
- B. Halton Till / Kettleby Till;
- C. Oak Ridges Moraine;
- D. Newmarket Till;
- E. Channel Sediments;
- F. Thorncliffe Formation;
- G. Sunnybrook Drift;
- H. Scarborough Formation; and
- I. Bedrock.

Recent Deposits – The Recent Deposits are sediments deposited since the final retreat of the Pleistocene Glaciers. These are mostly glaciolacustrine silts and clays.

Halton Till/Kettleby Till – The Halton Till was deposited approximately 13,000 years before present (B.P.), due to the last glacial advance in the area. The thickness of Halton Till is typically 3 m to 6 m; however, it can locally exceed 15 m in thickness. The Halton Till consists of silt to silty clay with occasional gravel. This till acts as an aquitard of regional extent.

Oak Ridges Moraine – The Oak Ridges Moraine is an extensive stratified sediment complex, 160 km long and 5 km to 20 km wide, located to the south of the site. The deposits consist mainly of sand and gravel. The ORM Complex is a major groundwater recharge area. The sediments in this area are around 100 m thick beneath the crest of the moraine but thins out rapidly towards its margins. The unit is water bearing and occurs at elevations between 230 masl and 260 masl.

The ORM is a regionally significant recharge area. It is known to be unconfined near the crest of the moraine, while it is confined by the till units both to the north and south of the highland. This unit serves as the main source of water for creeks as nearly 90% of the recharge via the ORM sediments discharges to the stream networks flowing north and south from the regional topographic divide. The ORM complex forms a regional aquifer and is commonly used for water supply.

Newmarket Till – The Newmarket Till is regionally extensive and is typically a massive, frequently overconsolidated, stony and dense silty sand diamicton deposited approximately 18,000 to 20,000 years B.P., when the Laurentide ice sheet was at its maximum extent. It acts as a regional aquitard separating the ORM Aquifer from the underlying Thorncliffe Aquifer. The thickness of Newmarket till typically varies between 20 m to 30 m but locally can exceed 60 m in thickness.



Channel Sediments – Sections of Newmarket Till were subject to erosional processes by glacial meltwater which occurred beneath glacial ice. The eroded channels were infilled with higher hydraulic conductivity material including sand and silt. This phenomenon created the potential for hydraulic connections between the shallow ORM Aquifer and deeper Thorncliffe Aquifer. Mapping from Earthfx Inc. (2006) show that the Site does not directly overlie the eroded channel. The location of eroded channel is presented in **Figure 6**.

Thorncliffe Formation – The Thorncliffe Formation was deposited approximately 45,000 years B.P. and is made up of glaciofluvial and lacustrine deposits containing sand, silt, and clay. The Thorncliffe Formation shows a considerable variation in grain size and thickness regionally, and locally can vary between 10 m to 30 m in thickness. It acts as an aquifer of regional extent.

Sunnybrook Drift – The Sunnybrook Drift is a clast-poor silt to silty clay unit and is a regionally extensive aquitard. The thickness of the Sunnybrook Drift is generally less than 10 m to 20 m, although locally it can reach a thickness of 30 m. It was deposited in close proximity to an ice sheet as it finally reached the West Holland River Subwatershed approximately 45,000 B.P. (Earthfx & Gerber, 2008).

Scarborough Formation – The Scarborough Formation marks the beginning of the Wisconsin glaciation, approximately 100,000 years B.P. It is composed of graduated materials that vary from fine silts and clays to sand in a deltaic sequence. However, within the East and West Holland Subwatersheds, the Scarborough Formation is mainly comprised of sand. This unit is mostly found within bedrock valleys and thins laterally away from the valleys (Earthfx & Gerber, 2008). It acts as an aquifer of regional extent.

Bedrock – Underlying the unconsolidated sedimentary material at depths of over 150 m are regional scale, limestone and shale bedrock. These bedrock units were deposited on the Canadian Shield over a period of 200 million years, beginning approximately 550 million years B.P. (Kassenaar & Wexler, 2006). The bedrock underlying the majority of the site is known as the Georgian Bay Formation and Blue Mountain Formation, although the Simcoe Group underlies the north portion of the site (Earthfx, 2009). The Georgian Bay and Blue Mountain Formations were formed in the Upper Ordovician age approximately 455 to 460 million years B.P., and the Simcoe Group and was formed during the Middle Ordovician age, approximately 450 million years B.P. **Figure 7** illustrates the bedrock geology underlying the Site.

3.4 Monitoring Network

3.4.1 Borehole Investigation and Monitoring Well Installation

A total of 15 boreholes were drilled from January 15- 17, 2018, across the Site under the supervision of Soil Engineers Ltd. Boreholes were drilled to depths ranging from 6.2 mbgs to 10.1 mbgs. Twelve of the boreholes were instrumented with monitoring wells. Nine shallow monitoring wells were screened to depths ranging from 3.2 mbgs to 6.2 mbgs and three deep monitoring wells were screened to depths ranging from 8.6 mbgs to 10.1 mbgs. Associated borehole logs are included in **Appendix B**. A map illustrating the location of the boreholes and monitoring wells is provided as **Figure 8**.

Each monitoring well was constructed with a 5 cm (2 inch) diameter polyvinyl chloride (PVC) casing, and instrumented with a 1.5 m or 3 m long screen. All monitoring wells were enclosed in lockable protective casings. Following installation, the wells were developed by purging three well volumes. Monitoring well details are summarized in **Table 3-1**.



		Coord	linates	Ground	Well	Top of Bisor	Well	Screen	Screened
Monitoring Well ID	Well Type	Easting	Northing	Elevation (masl)	Depth (mbgs)	above Grade (m)	Diameter (mm)	Length (m)	Geological Unit
BH1	Shallow	619860.3	4877993	283.0	6.6	0.77	50	3.0	Silty Clay Till/Silty Sand Till
BH2-S	Shallow	619959.4	4878026	283.0	7.03	0.76	50	3.0	Silty Clay Till
BH2-D	Deep	619958.4	4878027	282.9	11.3	0.90	50	1.5	Silty Sand Till
BH4	Shallow	619865	4877781	287.3	7.1	0.87	50	3.0	Silty Clay Till/ Silty Sand Till
BH6	Shallow	620052.8	4878137	284.0	6.9	0.86	50	3.0	Sandy Silt Till
BH7	Shallow	620177	4878238	279.2	5.5	0.89	50	3.0	Silty Clay Till/ Silty Sand Till
BH8-S	Shallow	620377.9	4877938	291.4	6.9	0.74	50	1.5	Silty Sand Till
BH8-D	Deep	620376.7	4877939	291.4	11.1	0.87	50	3.0	Silty Sand Till
BH10	Shallow	620243.7	4878137	290.9	6.9	0.83	50	3.0	Silty Sand Till
BH11	Shallow	620293.4	4878326	279.3	6.8	0.91	50	3.0	Silty Clay Till/Sandy Silt Till
BH12-S	Shallow	620367.6	4878392	277.2	6.9	0.88	50	3.0	Silty Sand Till
BH12-D	Deep	620368.3	4878392	277.1	11.03	0.89	50	1.5	Silty Sand

Table 3-1Monitoring Well Details

Notes: masl – metres above sea level

mbgs – metres below ground surface

3.5 Local Geology and Hydrogeology

Borehole logs from the drilling program were reviewed and used to construct geologic cross-sections across the Site (Figures 9A and 9B). Locations of the cross-sections are shown on Figure 8. The interpreted geologic cross-sections were used to develop the conceptual understanding of the Site stratigraphy and hydrogeological conditions. It should be noted that the cross-sections do not define the limits of the various hydrostratigraphic units but rather focus on grouping materials of similar composition.

In general, the Site is underlain by topsoil and fill to depths ranging from approximately 0.13 mbgs to 1.7 mbgs. Fill was encountered either at the surface or below top soil. It generally consists of silty clay,



sandy silt or silty sand mixed with topsoil and rootlets. The topsoil and fill layers are underlain by silty sand o silty clay till, interstratified with silty clay, silty sand, and silt layers down to depths ranging from 1.7 mbgs to an investigated depth of 10.1 mbgs.

In the northern portion of the Site, discontinuous silty clay deposits were encountered within sandy silt layers at depths ranging from 1 mbgs to 7 mbgs with approximate thickness between 1.3 m and 3 m. The silt and clay deposits are interpreted to correspond to the glaciolacustrine unit mapped at the Site, whereas the silt and clay till deposits may correspond to isolated occurrences of Kettleby/Halton Till or the upper Newmarket Till. The sandy silt and silty sand deposits encountered primarily in the western and southern areas of the Site likely correspond to coarse-grained facies of the glaciolacustrine deposits, or recent alluvial deposits.

3.5.1 Groundwater Levels

Groundwater levels at onsite monitoring wells were measured manually between January 26, 2018 and January 09, 2020. Additionally, data loggers were installed in three monitoring wells (BH1, BH12S, and BH12D) to record hourly groundwater levels and capture the range of water level fluctuations at these locations in greater detail. **Appendix C** shows hydrographs generated for the monitoring wells.

Throughout the monitoring period, water levels were observed to fluctuate on a seasonal basis, with water levels generally lower in the fall and higher in the spring. The highest groundwater level (291.02 masl) was measured in BH-8S near the southeastern corner of the Site on May 27, 2019. The lowest water level (274.71 masl) was measured in BH11 in the northeastern portion of the Site on January 31, 2018. The water level monitoring data are summarized in **Appendix C**.

Water level elevations in the shallow monitoring wells (screened to depths ranging from 3.1 mbgs to 6.3 mbgs) ranged from 274.71 masl (4.64 mbgs) in BH11 to 291.02 masl (0.48 mbgs) in BH-8S. For the deeper wells (screened to depths ranging from 8.6 mbgs to 10.1 mbgs), the water level elevations ranged from 275.17 masl (2.13 mbgs) in BH12D to 289.95 masl (1.55 mbgs) in BH-8D.

3.5.2 Groundwater Flow

At a regional scale, groundwater flows generally northerly toward Lake Simcoe. The groundwater flow pattern across the Site was interpreted from the shallow onsite wells collected on January 26, 2018. Local groundwater flow is anticipated towards the northeast, the topographic low. Based on the shallow groundwater contours, illustrated on **Figure 10**, the local shallow lateral groundwater flow generally follows the Site topography and is toward the onsite surface water features. Shallow groundwater in the eastern portion of the Site flows northeasterly toward the watercourse while shallow groundwater in the western portion of the Site flows northwesterly toward the onsite pond.

The vertical hydraulic gradients were also estimated at the monitoring well nests (BH2, BH8, and BH12) to characterize the general vertical groundwater flow at the Site. **Appendix C** summarizes the calculated vertical hydraulic gradient at the well nest for the water level monitoring events conducted on between January 26, 2018 and January 09, 2020.

The hydraulic gradient across the Site is generally neutral to downward across the majority of the Site. The magnitude of vertical hydraulic gradients observed at BH2-D/S and BH12-D/S were estimated to be relatively small (<0.05 m/m) and can be considered as near neutral gradient.



3.5.3 Hydraulic Conductivity

Single-well hydraulic tests were conducted by COLE between January 26, 2017 and January 27, 2017 on selected onsite monitoring wells. These tests were carried out to estimate the in-situ hydraulic conductivity (K) of the screened overburden materials.

A known volume of water was removed from the well and the recovery was measured either manually or using a data logger until a minimum of 80% recovery was achieved. Hydraulic conductivity estimates were obtained using the Hvorslev method (1951). Estimated K values are presented in **Table 3-2**. Details of the Hvorslev method and a summary of Hvorslev calculations are presented in **Appendix D**.

Monitoring Well ID	Screen Length (m)	Estimated K (m/s)	Tested Deposits	
BH1	3	6.5 x 10 ⁻⁸	Silty Clay Till/Silty Sand Till	
BH2-S	3	7.0 x 10 ⁻⁷	Silty Clay Till	
BH2-D	1.5	4.7 x 10 ⁻⁸	Silty Sand Till	
BH4	3	1.5 x 10 ⁻⁷	Silty Clay Till/ Silty Sand Till	
BH7	3	6.3 x 10 ⁻⁷	Silty Clay Till/ Silty Sand Till	
BH8-S	3	7.0 x 10 ⁻⁸	Silty Sand Till	
BH8-D	1.5	9.9 x 10 ⁻⁸	Silty Sand Till	
BH10	3	5.2 x 10 ⁻⁸	Silty Sand Till	
BH12-D	1.5	1.2 x 10 ⁻⁸	Silty Sand Till	

 Table 3-2
 Estimated Hydraulic Conductivities

The in-situ K values were estimated to range from 1.2×10^{-8} m/s to 7.0×10^{-7} m/s. Overall, the estimated horizontal hydraulic conductivities are within the published range for the types of materials within which the monitoring wells were screened (Freeze and Cherry, 1979).

3.5.4 Groundwater Quality

Groundwater samples were collected from three shallow monitoring wells (BH1, BH7, BH8S) and one deep monitoring well (BH8D) using a manual inertial pump on January 25, 2018. Prior to collecting the samples, the monitoring wells were purged by pumping three (3) well volumes from each well or pumping the well dry three times. The purging process removes stagnant water from the well, thereby ensuring the groundwater samples are representative of the groundwater in the formation adjacent to the screen.

The collected groundwater samples were sent to Maxxam Analytics Inc. in Mississauga for laboratory analysis of general inorganics and metals to characterize the baseline groundwater quality at the Site. Laboratory groundwater test results were compared to the conservative *Soil and Groundwater Standards* – *Table 2 Potable Groundwater - as amended April 15, 2011* for All Types of Property Use for Coarse-grained materials. The groundwater samples showed no exceedances.

A summary of the analytical results and laboratory certificate of analysis are provided in **Appendix E**.



4.0 Water Balance

The LSRCA Watershed Development Policies states that every feasible effort to maintain the predevelopment infiltration and evapotranspiration rates must be maintained. As the Site is located in the WHPA-Q for York Region, a water balance analysis will be required to demonstrate that recharge will be maintained. A water balance was calculated using the drainage area plan developed by COLE in the Functional Servicing Report (COLE, 2020).

5.0 Identification of Potential Receptors

As part of this study, potential groundwater receptors including natural ecosystem features and domestic or permitted water supply were identified. The following sections summarize findings related to groundwater-dependent natural ecosystem features and groundwater users.

5.1 Environmental Features

The development is located within the jurisdiction of the LSRCA. The western portion of the Site is located within the West Holland River Subwatershed and the eastern portion of the Site is situated within the East Holland River Subwatershed.

Relevant information on the surface water features were obtained from MNRF mapping, the Natural Heritage Information Centre ("NHIC"), the West Holland River Subwatershed Management Plan, and the East Holland River Subwatershed Management Plan, both prepared by LSRCA in 2010. Key findings from these reports are summarized in the following sections. The nearby areas of natural significance are illustrated on **Figure 11**.

5.1.1 Surface Water Features

There are no natural surface water features traversing the Site. There are two man-made storm management ponds on the Site. The ponds are connected with a pump and piping system that transfers water from pond-to-pond in conjunction with the gravity-fed storm sewer system. Ansnorveldt Creek is located approximately 280 m north of the Site. Western Creek is located approximately 950 m southeast of the Site. Both creeks are classified as warm water watercourses, and thus are unlikely to be groundwater-dependent.

5.1.2 Natural Ecosystem Features

A search on the MNRF mapping revealed that the western portion of the Site is located in the ORMCP Area and the Greenbelt Protected Country Side. A Provincially Significant Earth Science ANSI is also located approximately 300 m west of the Site.

The eastern portion of the Site is predominantly zoned as Parks and Open Space and as Stable Residential land use in Schedule A of the Town of Newmarket Official Plan. Schedule A also designates a natural heritage system approximately 50 m west of the proposed development, and one associated with Ansnorveldt Creek within 280 m north of the Site. There is a floodplain bounding Ansnorveldt Creek within approximately 280 m of the Site.

5.2 Surrounding Groundwater Users

As part of this study, an understanding of the typical groundwater usage in the area was obtained by:



- Querying MOECC water well records within a 1 km radius of the Site;
- Identifying permitted groundwater takers within a 1 km radius of the Site; and
- Conducting a door-to-door private water well survey within a 500 m radius of the Site.

5.2.1 Ministry of Environment and Climate Change Well Records

A search of the MOECC well records database conducted for a 1 km radius around the Site returned a total of 47 records (Figure 12). Based on the well records, the majority (27.6%) of the wells are used for water supply, while 9% of the wells are used for monitoring purposes. The well usage data are summarized in Table 4-1.

Table 4-1 S	ummary of MOECC Well Usage for a 1 km Radius around the Site
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Well Usage	Number of Wells	Percentage of Total Number of Wells
Water Supply	13	27.6%
Observation Well/Test Hole	9	19.1%
Abandoned	15	31.9%
Unspecified	10	21.2%

5.2.2 Permitted Water Users

A search of permitted groundwater users within 1 km of the Site was conducted in January 2018. The MOECC PTTW database identified one active permitted water taker within the area. **Table 4-2** summarizes details of the permit and **Figure 12** illustrates the location of the identified permitted water taker.

Table 4-2Permitted Water Takers within 1 km of the Site

Permit Number	Permit Holder Name	Purpose	Surface Water / Groundwater	Maximum Permitted Water Taking Rate (L/day)
8370-9Y9P2Z Marianneville Developments Limite		Dewatering Construction	Groundwater	1,211,400

5.2.3 Private Water Well Survey

A notice was provided on January 31, 2018 to inform the property owners of the water well survey. Participation was requested from the residents on a voluntary basis.

A door-to-door water well survey was conducted by COLE staff to gain a better understanding of the usage of the local aquifer system and to establish baseline conditions for nearby wells. The water well survey was conducted between February 5, 2017 and February 7, 2017 for properties likely to rely on private wells within a 500 m radius of the Site. Only four properties (17450, 17422, 17390, and 17340 Bathurst Street) were found within a 500 m radius of the Site where the potential presence of potable water well use was identified. The residents were not present during the water well survey, however, a



copy of the survey and a self-addressed stamped envelope was left at the property to provide the resident with the opportunity to complete the questionnaire on their own and participate in the baseline water well survey. At the time of this report, no reply has been received.

6.0 Potential Impact and Proposed Mitigation

The key potential groundwater receptors identified in the previous sections include:

- Natural features (watercourses, ponds, wetlands); and,
- Other groundwater users.

Potential impacts associated with the proposed development can manifest in the short term as a result of construction-related activities or in the long term if changes that occur during the Site development alter the natural form or function of the hydrologic system.

6.1 Identification and Mitigation of Long-Term Impacts

Long-term impacts of the proposed development include impacts to the groundwater system, to natural features and to other groundwater users.

6.1.1 Potential Long-Term Impacts to the Groundwater System

The proposed development will increase the impermeable cover and, as a result, reduce the amount of infiltration to the underlying aquifer units while increasing surface water run-off. Long-term impacts to the regional groundwater system may result from the reduced amount of groundwater infiltration to the aquifers. However, results of hydraulic testing on Site indicate that the surficial soils generally have low permeability and these areas are not expected to contribute significantly to groundwater recharge. LID measures will be proposed and designed at the detailed design stage to address the infiltration deficit and match pre-development infiltration. These areas are important to the recharge of the regional groundwater system.

The western portion of the Site is located within the ORMCP Area and situated within a significant groundwater recharge area. A water balance analysis is required to compare pre-development and post-development recharge conditions to evaluate predicted changes in recharge and run-off volumes due to the proposed development. However, the low-permeability till that covers most of the Site is interpreted to limit the amount of infiltration this Site can contribute.

Additionally, the introduction of overburden material with different hydraulic properties or alterations to the local topography during construction can affect the existing groundwater system. Installation of Site services could also potentially introduce preferential pathways for contaminants to the groundwater and alter the natural groundwater levels and pathways. Moreover, local groundwater quality may be affected by the future application of road salt along the roadways.

6.1.2 Potential Long-Term Impacts to the Natural Features

There are no natural surface water features or wetlands on the Site. No wetlands were identified within 1 km of the Site. Ansnorveldt Creek is located approximately 280 m north of the Site and Western Creek is located approximately 950 m southeast of the Site. Both creeks are classified as warm water watercourses, and thus are unlikely groundwater-dependent. The potential of reduced on-site infiltration is unlikely to have an impact on the hydrological and ecologic function of the natural features since they are not likely groundwater dependent.



6.1.3 Potential Long-Term Impacts to Groundwater Users

Alteration of Site grading and the introduction of preferential pathways through Site servicing could potentially reduce the quantity and quality of groundwater available to nearby groundwater users, particularly those dependent on shallow well systems. Based on the results of the door-to-door private well survey, nearby groundwater users are mostly located to the west of the Site. For the properties identified during the well survey that may be serviced with the water supply wells, records indicate that the wells were approximately from 15 mbgs to 35 mbgs and they are likely screened in the ORM aquifer.

The impacts from the development are expected to be small as the Site is already used as a golf course with underground piping systems. No stress is expected in the deeper aquifer due to the thickness of the Newmarket Till.

6.1.4 Mitigation of Long-Term Impacts

Various best management practices ("BMPs") could be incorporated into the proposed development, including promoting infiltration through LID practices to mitigate recharge reductions. The need for LID measures should be confirmed through water balance analysis. LID measures will be proposed and designed at the detailed design stage to promote infiltration and decrease runoff in order to address the infiltration deficit and help preserve the existing groundwater flow regime, maintain groundwater contributions to nearby groundwater-dependent features as well as minimize channel erosion and sediment loading into downstream surface water features. Combined with various BMPs, the SWM ponds will help mitigate the impact to nearby watercourses.

The use of collars or other methods to restrict the preferential movement of groundwater along the subsurface infrastructure corridors should also be considered. Additionally, road salt application at the proposed development should be managed to minimize sodium and/or chloride loading to the shallow groundwater system.

6.2 Identification and Mitigation of Short-Term Impacts

Site grading activities would affect the site topography and site drainage. Due to the relatively shallow water table observed across the Site, dewatering activities may be required to control water levels for the nominal depth sanitary services and SWM ponds in the shallow overburden.

While the overall dewatering requirements are currently unknown, based on the significantly low dewatering requirements associated with the adjacent Site (Glenway East), it is anticipated that the construction dewatering at Glenway West will be relatively low.

Based on recent regulatory changes, a Permit To Take Water ("PTTW") is required under Section 34 of the *Ontario Water Resources Act* ("OWRA") for construction water takings greater than 400,000 L/day. Otherwise construction water takings require an Environmental Activity and Sector Registration ("EASR") for takings between 50,000 L/day and 400,000 L/day. During the detailed design stage, it will be necessary to refine the hydrogeological analysis in locations along the proposed service alignments to determine if an EASR or PTTW is required.

6.2.1 Potential Short-Term Impacts to the Groundwater System

Construction dewatering may result in a lowering of the groundwater levels in the aquifer, thereby reducing the available groundwater for nearby groundwater takers. However, such impacts would be temporary and recovery of the groundwater system would occur following the completion of dewatering activities.



6.2.2 Potential Short-Term Impacts to the Natural Features

The lowering of the water levels in the shallow perched systems or in underlying confined aquifer units could potentially reduce the groundwater input into nearby natural ecosystem features; however, no groundwater-dependent features were identified within 1 km of the Site.

Dewatering discharge that may be directed to nearby watercourses could potentially alter the physical, chemical, and thermal regime of the receiving watercourses. Erosion control and water retention measures such as rock check dams, discharge via ponds, and silt controls should be considered in designing discharge plans to minimize the impacts.

6.2.3 Potential Short-Term Impacts to the Other Groundwater Users

Dewatering may result in a reduction of available groundwater supply in the private well. An Environmental Management Plan ("EMP") needs to be developed to respond to potential well interference complaints and to provide mitigation during dewatering operations.

6.2.4 Mitigation of Short-Term Impacts

The zone of influence due to dewatering is expected to be localized and limited to the shallow depth due to the low hydraulic conductivity of the shallow till, and the shallow depth of the servicing. However, the dewatering volume and zone of influence could increase significantly if the deeper servicing connections intercept the ORM Aquifer. A review of final design grades will be conducted to confirm the potential need for dewatering in areas where high water levels were observed. If dewatering is required during installation of site servicing, a PTTW will be required. The PTTW application package should include detailed study of the required dewatering rate, estimated zone of influence and mitigation measures required to minimize the dewatering impact.

The nearby surface water features are unlikely groundwater-dependent. Therefore, no impact is anticipated at these reaches of the tributaries due to lowering of groundwater table from dewatering. They can still be impacted by dewatering discharge quality. To minimize potential impacts to these creeks due to dewatering discharge, if possible, dewatering should be conducted during the warm water timing window for construction (July 1st to March 31st), Prior to construction, it will be necessary to prepare a dewatering discharge plan that assesses the quantity and quality of dewatering discharge, as well as the assimilative capacity of the receiving water bodies depending on the discharge route.

To mitigate potential impacts of construction dewatering on nearby groundwater users, a monitoring plan should be prepared as part of an EMP and implemented during dewatering (if required) to track the zone of influence. Furthermore, a protocol in the event of well interference complaints should be developed and included in the EMP to allow for timely response and mitigation in case of well interference during construction.

7.0 Summary

A summary of the hydrogeological investigation is provided below:

- 1. The Site straddles the East Holland River Subwatershed and the West Holland River Subwatershed, and falls under the jurisdiction of the LSRCA.
- 2. The Site is within the Simcoe Lowlands physiographic region. The South Slope of Simcoe Lowlands region is characterized by lower elevations and flat-floored valley features consisting of sand, silt, and clay deposits.



- 3. The bedrock in the regional area is interpreted to be at approximately 130 masl and is overlain by alternating aquifers and aquitards.
- 4. Fifteen boreholes were drilled from January 15 to January 17, 2018 to depths ranging from 6.2 m to 10.1 m. Twelve of the boreholes were instrumented with monitoring wells at screened depths ranging from 3.2 m to 10.1 m.
- 5. Fill, composed mainly of silty clay, was also encountered in several boreholes during the subsurface investigation to a maximum depth of 3.0 m. The topsoil and fill layers are underlain by silty sand o silty clay till, interstratified with silty clay, silty sand, and silt layers down to depths ranging from 1.7 mbgs to an investigated depth of 10.1 mbgs.
- 6. The ORM was not encountered in any of the boreholes drilled on-site and thus it is expected to be locally discontinuous. The Thorncliffe Aquifer is therefore expected to be the main aquifer underlying the Site. Regional mapping indicates that the Thorncliffe Aquifer is locally deeper than 30 mbgs.
- 7. At a regional scale, groundwater flows generally northerly toward Lake Simcoe. During the monitoring program, shallow groundwater levels at the Site were generally at a higher elevation in the south and central portion of the Site and at a lower elevation in the northeastern portion of the Site. Shallow groundwater in the eastern portion of the Site flows northeasterly toward the watercourse while shallow groundwater in the western portion of the Site flows northwesterly toward the onsite pond. The hydraulic gradient across the Site is generally neutral to downward.
- 8. A search of the MOECC well records database conducted for a 1 km radius around the Site returned a total of 161 records, the majority (27.6%) of which are used for water supply or abandoned. Based on a door-to-door water well survey conducted for properties likely to rely on private wells within 500 m of the Site, the majority of private wells near the Site are located to the west of the Site.
- 9. The Site is located within the Newmarket WHPA-D area and within a WHPA-Q area.
- 10. Potential long-term impacts to the groundwater system associated with the development include: reduction in infiltration, introduction of preferential pathways for contaminants such as road salt, and reduction of quantity of groundwater available to nearby shallow well systems. Existing shallow water table and proposed site grading could also influence groundwater seepage into the basements in the proposed development.
- 11. The following mitigation measures are recommended to mitigate the long-term impacts to the groundwater system: implementation of BMPs to promote infiltration and decrease runoff, use of SWM ponds to capture the storm runoff and provide water quality treatment, possible use of collars or other methods to restrict the preferential movement of groundwater in bedding.
- 12. Potential short-term impacts are mostly associated with the construction dewatering. These impacts are expected to be localized and the groundwater system is expected to recover after the completion of the dewatering activities.

8.0 Recommendations

1. It is estimated that the proposed servicing alignment and SWM ponds will be constructed below the groundwater table. During the detailed design stage, it will be necessary to refine the analysis of the hydrogeological conditions along the servicing alignments to estimate dewatering rates. The



anticipated zone of influence and dewatering rates as a result of construction-related dewatering will be estimated. While the overall dewatering requirements are currently unknown, based on the significantly low dewatering requirements associated with the adjacent Site (Glenway East), it is anticipated that the construction dewatering at Glenway West will be relatively low.

- 2. Long-term impacts will need to be addressed through the implementation of BMPs to help increase the amount of infiltration to the aquifer system, and minimize the environmental impacts of the development.
- 3. As the Site is in the WHPA-D for the municipal supply wells, a SWIAMP report will be required to support the development.



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Figures













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Appendix A Site Plan



Appendix B Borehole Logs



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LOG OF BOREHOLE NO.: 8

JOB NO.: 1712-S086

FIGURE NO.: 8











JOB NO.: 1712-5086 LOG OF BOREHOLE NO.: 12



Appendix C

Hydrographs of Monitoring Wells

Well ID	Ground Level (masl)	26-Jan-18	31-Jan-18	29-Mar-18	24-May-18	25-Jul-18	27-Sep-18	29-Nov-18	29-Jan-19	29-Mar-19	27-May-19	30-Jul-19	1-Oct-19	9-Jan-20
BH-1	283.0	282.27	282.11	281.60	281.94	281.05	280.97	282.42	281.70	281.73	282.12	281.18	280.54	282.11
BH-2S	282.8	281.39	281.45	281.05	281.41	280.72	280.66	281.72	281.11	281.14	281.52	280.81	280.22	281.45
BH-2D	282.8	281.52	281.41	281.08	281.48	280.87	280.77	281.79	281.15	281.14	281.52	280.93	280.39	281.44
BH-4	287.4	283.62	283.52	283.06	284.11	282.65	282.54	283.97	283.48	282.86	284.39	283.01	282.16	283.44
BH-6	283.9	283.11	282.65	281.97	282.52	280.83	281.14	283.22	281.98	281.22	282.79	281.15	279.70	282.86
BH-7	279.2	278.93	278.48	278.37	279.02	278.49	277.91	279.06	NM	278.60	279.05	278.25	277.59	278.81
BH-8S	291.5	288.78	289.36	289.76	290.84	287.93	287.14	288.97	289.34	288.33	291.02	288.38	286.10	288.85
BH-8D	291.5	287.88	287.91	288.20	289.60	287.27	286.56	288.15	288.45	287.66	289.95	287.74	285.74	288.09
BH-10	291.8	289.36	289.17	289.15	290.36	288.68	287.89	288.66	289.34	288.60	290.41	288.88	287.25	288.60
BH-11	279.3	274.93	274.71	274.90	275.20	275.04	275.03	275.05	274.96	274.91	275.27	275.15	274.93	275.12
BH-12S	277.3	275.63	275.59	275.51	275.78	275.72	275.27	275.87	275.43	275.51	275.75	275.35	275.25	275.57
BH-12D	277.3	275.84	275.54	275.57	276.00	275.54	275.30	276.00	275.58	275.65	276.00	275.44	275.17	275.71

Table 1 - Groundwater Levels (masl) at On-site Monitoring Wells (January 26, 2018 - January 09, 2020)

Notes:

NM: Not Measured due to freezing period

masl: meter above sea level

Well ID	Ground Level (masl)	26-Jan-18	31-Jan-18	29-Mar-18	24-May-18	25-Jul-18	27-Sep-18	29-Nov-18	29-Jan-19	29-Mar-19	27-May-19	30-Jul-19	1-Oct-19	9-Jan-20
BH-1	283.0	0.69	0.85	1.36	1.02	1.90	1.98	0.54	1.26	1.23	0.84	1.78	2.41	0.85
BH-2S	282.8	1.41	1.35	1.75	1.39	2.08	2.14	1.08	1.69	1.66	1.28	1.99	2.58	1.35
BH-2D	282.8	1.28	1.39	1.72	1.32	1.93	2.03	1.01	1.65	1.66	1.28	1.87	2.41	1.36
BH-4	287.4	3.78	3.88	4.34	3.29	4.75	4.86	3.43	3.92	4.54	3.02	4.39	5.24	3.96
BH-6	283.9	0.79	1.25	1.93	1.38	3.07	2.76	0.68	1.92	2.68	1.11	2.75	4.20	1.04
BH-7	279.2	0.27	0.72	0.84	0.18	0.71	1.29	0.14	NM	0.60	0.15	0.95	1.61	0.39
BH-8S	291.5	2.72	2.14	1.74	0.66	3.57	4.36	2.53	2.16	3.17	0.48	3.12	5.40	2.65
BH-8D	291.5	3.62	3.59	3.30	1.90	4.23	4.94	3.35	3.05	3.84	1.55	3.76	5.76	3.41
BH-10	291.8	2.44	2.63	2.65	1.44	3.12	3.91	3.14	2.46	3.20	1.39	2.92	4.55	3.20
BH-11	279.3	4.41	4.64	4.45	4.15	4.30	4.32	4.29	4.39	4.44	4.07	4.20	4.42	4.23
BH-12S	277.3	1.67	1.71	1.79	1.52	1.58	2.03	1.43	1.87	1.79	1.55	1.95	2.05	1.73
BH-12D	277.3	1.46	1.76	1.73	1.30	1.76	2.00	1.30	1.72	1.65	1.30	1.86	2.13	1.59

Table 2 - Groundwater Levels (mbgs) at On-site Monitoring Wells (January 26, 2018 - January 09, 2020)

Notes:

NM: Not Measured due to freezing period

mbgs: meter below ground surface

Table 3 - Estimated Vertical Hydraulic Gradient at On-site Monitorong Wells

Well ID	26-Jan-18	31-Jan-18	29-Mar-18	24-May-18	25-Jul-18	27-Sep-18	29-Nov-18	29-Jan-19	29-Mar-19	27-May-19	30-Jul-19	1-Oct-19	9-Jan-20
BH2 D/S	-0.03	0.01	-0.01	-0.02	-0.03	-0.02	-0.02	-0.01	0.00	0.00	-0.02	-0.03	0.00
BH8 D/S	0.19	0.30	0.32	0.25	0.14	0.12	0.17	0.18	0.14	0.22	0.13	0.08	0.16
BH12 D/S	-0.04	0.01	-0.01	-0.05	0.04	-0.01	-0.03	-0.03	-0.03	-0.05	-0.02	0.02	-0.03

Notes:

Negative values indicate an upward gradient; positive values indicate a downward gradient







Hydrograph of BH2D/S























Hydrograph of BH8D/S




Hydrograph of BH12D/S



Appendix D

Hydraulic Conductivity Analyses

Glenwey West In-Situ Hydraulic Conductivity Analyses - BH1

Date:

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Conducted By:	AS-A	0	To(early):	8500	S
Well Depth:	6.61	mbtor	K(early):	4.48E-08	m/s
Screened Unit:			To(late):	4000	S
Initial Water Level:	1.455	mbtor	K(late):	9.52E-08	m/s
Available Drawdown (H):	5.16	m	K(average)	6.5E-08	m/s
Head at Time = 0 (Ho):	6.8	m	Recovery:	89.6%	%
Screen Length (L):	3	m			
Borehole Radius (R):	0.0775	m			
Monitoring Well Radius (r):	0.025	m			
Stick Up		m			
Elapsed Time (s)	Water Le	evel (mtor)	H-h	H-Ho	(H-h)/(H-Ho)
0	6.	780	5.325	5.325	1.000
10	6.	776	5.321	5.325	0.999
20	6.	770	5.315	5.325	0.998
30	6.	761	5.306	5.325	0.996
40	6.	751	5.296	5.325	0.995
50	6.	740	5.285	5.325	0.992
60	6.	730	5.275	5.325	0.991
75	6.	719	5.264	5.325	0.989
90	6.	703	5.248	5.325	0.986
105	6.	688	5.233	5.325	0.983
120	6.	664	5.209	5.325	0.978
150	6.	632	5.177	5.325	0.972
180	6.	603	5.148	5.325	0.967
210	6.	572	5.117	5.325	0.961
240	6.	542	5.087	5.325	0.955
270	6.	518	5.063	5.325	0.951
300	6.	490	5.035	5.325	0.946
360	6.	448	4.993	5.325	0.938
420	6.	398	4.943	5.325	0.928
480	6.	340	4.885	5.325	0.917
540	6.	290	4.835	5.325	0.908
600	6.	232	4.777	5.325	0.897
900	6.	015	4.560	5.325	0.856
1200	5.	894	4.439	5.325	0.834
1260	5.	865	4.410	5.325	0.828
1320	5.	838	4.383	5.325	0.823
1380	5.	810	4.355	5.325	0.818
1440	5.	783	4.328	5.325	0.813
1500	5.	758	4.303	5.325	0.808
1560	5.	731	4.276	5.325	0.803
1620	5.	705	4.250	5.325	0.798
1680	5.	678	4.223	5.325	0.793
1740	5.	653	4.198	5.325	0.788
1800	5.	628	4.173	5.325	0.784
1860	5.	603	4.148	5.325	0.779
1920	5.	577	4.122	5.325	0.774





In-Situ Hydraulic Conductivity Analyses - BH1

Glenwey West In-Situ Hydraulic Conductivity Analyses - BH2D

Date:

Well Depth: 11.28 mbtor Screened Unit: 11.28 mbtor Initial Water Level: 2.182 mbtor Available Drawdown (H): 9.10 m Head at Time = 0 (Ho): 10.8 m Screen Length (L): 1.5 m Borehole Radius (R): 0.00775 m Monitoring Well Radius (r): 0.025 m Stick Up m m Elapsed Time (s) Water Level (mtor) H-h H-Ho (H-h)/(H-Ho) 0 10.845 8.663 8.663 0.995 20 10.828 8.663 8.663 0.995 40 10.805 8.623 8.663 0.995 60 10.795 8.613 8.663 0.993 105 10.773 8.591 8.663 0.992 120 10.760 8.578 8.663 0.988 180 10.725 8.543 8.663 0.982 270 10.670 8.564	Conducted By:	AS-A	0	To(early):	14000	S
Screened Unit: 12500 s Initial Water Level: 2.182 mbtor Available Drawdown (H): 9.10 m Screen Length (L): 1.5 m Borehole Radius (R): 0.0775 m Monitoring Well Radius (R): 0.025 m Stick Up m m Elapsed Time (s) Water Level (mtor) H-h H-H-H (H-h)/(H-H0) 0 10.845 8.663 8.663 0.998 20 10.828 8.646 8.663 0.995 40 10.805 8.623 8.663 0.995 50 10.800 8.618 8.663 0.995 60 10.795 8.613 8.663 0.993 105 10.773 8.599 8.663 0.993 105 10.773 8.591 8.663 0.992 120 10.760 8.784 8.663 0.988 180 10.725 8.543 8.663 0.986 2	Well Depth:	11.28	mbtor	K(early):	4.41E-08	m/s
Initial Water Level: 2.182 mbtor Available Drawdown (H): 9.10 m Head at Time = 0 (Ho): 10.8 m Screen Length (L): 1.5 m Borehole Radius (R): 0.0775 m Monitoring Well Radius (I): 0.025 m 10 10.828 8.646 8.663 0.998 20 10.820 8.638 8.663 0.995 40 10.805 8.623 8.663 0.995 50 10.805 8.623 8.663 0.995 60 10.795 8.613 8.663 0.993 90 10.781 8.599 8.663 0.993 105 10.773 8.591 8.663 0.992 120 10.760 8.578 8.663 0.988 180 10.725 8.543 8.663 0.984 240 10.691 8.509 8.663 0.984 240 10.708 8.526 8.663 0.9	Screened Unit:			To(late):	12500	S
Available Drawdown (H): 9.10 m Head at Time = 0 (Ho): 10.8 m Screen Length (L): 1.5 m Borehole Radius (R): 0.0775 m Monitoring Well Radius (r): 0.025 m Stick Up m m Elapsed Time (s) Water Level (mtor) H-h H-H-HO (H-h)/(H-HO) 0 10.845 8.663 8.663 0.998 20 10.828 8.646 8.663 0.995 40 10.805 8.623 8.663 0.995 50 10.800 8.618 8.663 0.993 90 10.784 8.606 8.663 0.993 90 10.773 8.591 8.663 0.992 120 10.760 8.578 8.663 0.992 120 10.760 8.578 8.663 0.986 210 10.760 8.488 8.663 0.986 210 10.670 8.448 8.663	Initial Water Level:	2.182	mbtor	K(late):	4.94E-08	m/s
Head at Time = 0 (H0): 10.8 m Screen Length (L): 1.5 m Borehole Radius (R): 0.0775 m Monitoring Well Radius (r): 0.025 m Stick Up m m Elapsed Time (s) Water Level (mtor) H-h H-H0 (H+h)/(H-H0) 0 10.828 8.664 8.663 0.998 20 10.820 8.638 8.663 0.997 30 10.805 8.623 8.663 0.995 40 10.805 8.623 8.663 0.995 50 10.800 8.613 8.663 0.994 75 10.788 8.606 8.663 0.992 120 10.773 8.591 8.663 0.992 120 10.773 8.591 8.663 0.986 210 10.760 8.578 8.663 0.986 210 10.773 8.591 8.663 0.986 210 10.760 8.484 <td>Available Drawdown (H):</td> <td>9.10</td> <td>m</td> <td>K(average)</td> <td>4.7E-08</td> <td>m/s</td>	Available Drawdown (H):	9.10	m	K(average)	4.7E-08	m/s
Screen Length (L): 1.5 m Borehole Radius (R): 0.0775 m Stick Up m Elapsed Time (s) Water Level (mtor) H-h H-Ho (H-h)/(H-Ho) 0 10.845 8.663 8.663 0.998 20 10.820 8.638 8.663 0.997 30 10.805 8.623 8.663 0.995 40 10.805 8.623 8.663 0.995 50 10.800 8.618 8.663 0.995 60 10.795 8.613 8.663 0.993 105 10.773 8.591 8.663 0.992 120 10.760 8.578 8.663 0.993 105 10.773 8.591 8.663 0.986 210 10.760 8.486 3.0986 210 210 10.708 8.526 8.663 0.984 240 10.651 8.471 8.663 0.976 360	Head at Time = 0 (Ho):	10.8	m	Recovery:	90.5%	%
Borehole Radius (R): 0.0775 m Monitoring Well Radius (r): 0.025 m Elapsed Time (s) Water Level (mtor) H-h H-Ho (H-h)/(H-Ho) 0 10.845 8.663 8.663 0.998 20 10.820 8.638 8.663 0.997 30 10.805 8.623 8.663 0.995 40 10.805 8.623 8.663 0.995 50 10.800 8.618 8.663 0.995 60 10.795 8.613 8.663 0.993 90 10.781 8.599 8.663 0.993 105 10.773 8.591 8.663 0.993 105 10.773 8.591 8.663 0.992 120 10.760 8.578 8.663 0.993 105 10.743 8.561 8.663 0.986 210 10.760 8.578 8.663 0.986 210 10.670 8.488 <td< td=""><td>Screen Length (L):</td><td>1.5</td><td>m</td><td></td><td></td><td></td></td<>	Screen Length (L):	1.5	m			
Monitoring Well Radius (r): 0.025 m Stick Up m Elapsed Time (s) Water Level (mtor) H-h H-Ho (H-h)/(H-Ho) 0 10.845 8.663 8.663 1.000 10 10.822 8.648 8.663 0.998 20 10.820 8.638 8.663 0.995 40 10.805 8.623 8.663 0.995 50 10.800 8.618 8.663 0.995 60 10.795 8.613 8.663 0.993 90 10.781 8.599 8.663 0.992 120 10.760 8.578 8.663 0.992 120 10.760 8.578 8.663 0.996 150 10.743 8.561 8.663 0.984 240 10.691 8.509 8.663 0.986 210 10.760 8.488 8.663 0.973 360 10.612 8.433 8.663 0.976	Borehole Radius (R):	0.0775	m			
Stick Up m Elapsed Time (s) Water Level (mtor) H-h H-Ho (H-h)/(H-Ho) 0 10.845 8.663 8.663 0.998 20 10.820 8.638 8.663 0.997 30 10.805 8.623 8.663 0.995 40 10.805 8.623 8.663 0.995 50 10.800 8.618 8.663 0.995 60 10.795 8.613 8.663 0.993 90 10.781 8.599 8.663 0.993 105 10.773 8.591 8.663 0.992 120 10.760 8.578 8.663 0.996 210 10.708 8.526 8.663 0.986 180 10.725 8.543 8.663 0.986 210 10.708 8.526 8.663 0.986 210 10.570 8.488 8.663 0.973 300 10.653 8.471 8.663 <td>Monitoring Well Radius (r):</td> <td>0.025</td> <td>m</td> <td></td> <td></td> <td></td>	Monitoring Well Radius (r):	0.025	m			
Elapsed Time (s) Water Level (mtor) H-h H-Ho (H-h)/(H-Ho) 0 10.845 8.663 8.663 1.000 10 10.820 8.638 8.663 0.998 20 10.820 8.638 8.663 0.995 30 10.805 8.623 8.663 0.995 40 10.805 8.623 8.663 0.995 60 10.795 8.613 8.663 0.993 60 10.784 8.606 8.663 0.993 90 10.761 8.599 8.663 0.992 120 10.760 8.578 8.663 0.992 120 10.760 8.578 8.663 0.996 150 10.743 8.561 8.663 0.986 210 10.708 8.526 8.663 0.986 210 10.670 8.488 8.663 0.976 360 10.612 8.430 8.663 0.977 420	Stick Up		m			
Elapsed Time (s) Water Level (mtor) H-h H-ho (H-h)(H-Ho) 0 10.845 8.663 8.663 0.998 20 10.820 8.638 8.663 0.997 30 10.805 8.623 8.663 0.995 40 10.805 8.623 8.663 0.995 50 10.800 8.613 8.663 0.993 60 10.755 8.613 8.663 0.993 90 10.781 8.591 8.663 0.993 105 10.773 8.591 8.663 0.992 120 10.760 8.578 8.663 0.993 150 10.773 8.561 8.663 0.986 210 10.760 8.457 8.663 0.986 210 10.670 8.488 8.663 0.986 210 10.670 8.488 8.663 0.970 360 10.612 8.430 8.663 0.970 480						
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Elapsed Time (s)	Water Le	evel (mtor)	H-h	H-Ho	(H-h)/(H-Ho)
10 10.828 8.646 8.663 0.998 20 10.820 8.638 8.663 0.997 30 10.805 8.623 8.663 0.995 40 10.805 8.623 8.663 0.995 50 10.800 8.618 8.663 0.994 75 10.788 8.606 8.663 0.993 90 10.781 8.599 8.663 0.993 105 10.773 8.591 8.663 0.992 120 10.760 8.578 8.663 0.990 150 10.743 8.561 8.663 0.986 100 10.725 8.543 8.663 0.986 210 10.760 8.578 8.663 0.986 210 10.708 8.526 8.663 0.984 240 10.691 8.509 8.663 0.982 270 10.670 8.488 8.663 0.973 360 10.612 8.430 8.663 0.973 420 10.550 8.368 8.663 0.976 480 10.550 8.368 8.663 0.992 500 10.440 7.958 8.663 0.993 1200 10.140 7.958 8.663 0.993 1500 9.975 7.793 8.663 0.861 2200 9.545 7.363 8.663 0.855 2220 9.545 7.333 8.663 0.863 2400 9.485 7.303 8.663	0	10	.845	8.663	8.663	1.000
20 10.820 8.638 8.663 0.997 30 10.805 8.623 8.663 0.995 40 10.805 8.623 8.663 0.995 50 10.800 8.618 8.663 0.995 60 10.795 8.613 8.663 0.993 90 10.781 8.599 8.663 0.993 90 10.773 8.591 8.663 0.993 105 10.773 8.591 8.663 0.992 120 10.760 8.578 8.663 0.988 180 10.725 8.543 8.663 0.986 210 10.708 8.526 8.663 0.986 210 10.661 8.509 8.663 0.982 300 10.653 8.471 8.663 0.982 270 10.670 8.488 8.663 0.980 300 10.653 8.471 8.663 0.973 420 10.585	10	10	.828	8.646	8.663	0.998
30 10.805 8.623 8.663 0.995 40 10.805 8.623 8.663 0.995 50 10.800 8.618 8.663 0.995 60 10.795 8.613 8.663 0.993 90 10.781 8.599 8.663 0.993 90 10.781 8.599 8.663 0.992 120 10.760 8.578 8.663 0.992 120 10.760 8.578 8.663 0.990 150 10.743 8.561 8.663 0.988 180 10.725 8.543 8.663 0.984 240 10.691 8.509 8.663 0.984 240 10.691 8.509 8.663 0.982 270 10.670 8.488 8.663 0.980 300 10.653 8.471 8.663 0.973 420 10.585 8.403 8.663 0.973 420 10.512 8.330 8.663 0.966 540 10.512 8.330 8.663 0.939 1200 10.140 7.958 8.663 0.939 1200 9.975 7.793 8.663 0.855 2280 9.515 7.363 8.663 0.846 2340 9.485 7.303 8.663 0.846 2400 9.485 7.273 8.663 0.846 2400 9.485 7.213 8.663 0.846 2400 <td>20</td> <td>10</td> <td>.820</td> <td>8.638</td> <td>8.663</td> <td>0.997</td>	20	10	.820	8.638	8.663	0.997
40 10.805 8.623 8.663 0.995 50 10.800 8.618 8.663 0.994 50 10.795 8.613 8.663 0.993 90 10.781 8.599 8.663 0.993 90 10.773 8.591 8.663 0.992 120 10.760 8.578 8.663 0.992 120 10.760 8.578 8.663 0.992 120 10.760 8.578 8.663 0.986 210 10.773 8.561 8.663 0.986 210 10.708 8.526 8.663 0.986 210 10.670 8.488 8.663 0.982 270 10.670 8.488 8.663 0.980 300 10.653 8.471 8.663 0.973 360 10.612 8.430 8.663 0.973 420 10.550 8.368 8.663 0.962 600 10.480 8.298 8.663 0.939 1200 10.140 7.958 8.663 0.939 1200 9.975 7.793 8.663 0.855 2220 9.545 7.363 8.663 0.855 2280 9.515 7.333 8.663 0.843 2400 9.485 7.303 8.663 0.846 2440 9.485 7.303 8.663 0.846 2440 9.395 7.213 8.663 0.829 2580 <td>30</td> <td>10</td> <td>.805</td> <td>8.623</td> <td>8.663</td> <td>0.995</td>	30	10	.805	8.623	8.663	0.995
50 10.800 8.618 8.663 0.995 60 10.795 8.613 8.663 0.993 75 10.788 8.606 8.663 0.993 90 10.781 8.599 8.663 0.992 105 10.773 8.591 8.663 0.992 120 10.760 8.578 8.663 0.990 150 10.743 8.561 8.663 0.986 210 10.705 8.543 8.663 0.986 210 10.708 8.526 8.663 0.986 210 10.670 8.488 8.663 0.980 210 10.670 8.448 8.663 0.980 300 10.653 8.471 8.663 0.978 360 10.612 8.430 8.663 0.973 420 10.585 8.403 8.663 0.966 540 10.512 8.330 8.663 0.966 540 10.512 8.330 8.663 0.958 900 10.313 8.131 8.663 0.939 1200 10.140 7.958 8.663 0.939 1200 9.975 7.793 8.663 0.855 2220 9.545 7.363 8.663 0.855 2220 9.545 7.363 8.663 0.846 2400 9.485 7.303 8.663 0.846 2400 9.485 7.303 8.663 0.846 2400 </td <td>40</td> <td>10</td> <td>.805</td> <td>8.623</td> <td>8.663</td> <td>0.995</td>	40	10	.805	8.623	8.663	0.995
60 10.795 8.613 8.663 0.994 75 10.788 8.606 8.663 0.993 90 10.771 8.599 8.663 0.992 105 10.773 8.591 8.663 0.992 120 10.760 8.578 8.663 0.990 150 10.743 8.561 8.663 0.988 180 10.725 8.543 8.663 0.986 210 10.708 8.526 8.663 0.982 270 10.670 8.488 8.663 0.982 270 10.670 8.488 8.663 0.973 300 10.653 8.471 8.663 0.973 300 10.653 8.471 8.663 0.973 420 10.550 8.368 8.663 0.962 600 10.480 8.298 8.663 0.962 600 10.480 8.298 8.663 0.958 900 10.313 8.131 8.663 0.939 1200 10.140 7.958 8.663 0.919 1500 9.975 7.793 8.663 0.855 2220 9.545 7.363 8.663 0.840 2400 9.485 7.273 8.663 0.846 2400 9.485 7.243 8.663 0.846 2400 9.485 7.243 8.663 0.826 220 9.395 7.213 8.663 0.829 2440 </td <td>50</td> <td>10</td> <td>.800</td> <td>8.618</td> <td>8.663</td> <td>0.995</td>	50	10	.800	8.618	8.663	0.995
7510.7888.6068.6630.9939010.7818.5998.6630.99310510.7738.5918.6630.99212010.7608.5788.6630.99015010.7438.5618.6630.98818010.7258.5438.6630.98621010.7088.5268.6630.98227010.6708.4888.6630.98230010.6538.4718.6630.97336010.6128.4308.6630.97342010.5858.4038.6630.96260010.5128.3308.6630.96260010.4808.2988.6630.95890010.3138.1318.6630.939120010.1407.9588.6630.9589009.9757.7938.6630.88121009.6207.4388.6630.85921609.5937.4118.6630.85522209.5457.3638.6630.84624009.4857.3038.6630.84624009.4857.3038.6630.84624009.4857.2738.6630.84624009.4857.2738.6630.83625209.3957.2138.6630.83625209.3957.2138.6630.82926409.3387.1568.6630.826<	60	10	.795	8.613	8.663	0.994
90 10.781 8.599 8.663 0.993 105 10.773 8.591 8.663 0.992 120 10.760 8.578 8.663 0.990 150 10.743 8.561 8.663 0.988 180 10.725 8.543 8.663 0.986 210 10.708 8.526 8.663 0.984 240 10.691 8.509 8.663 0.982 270 10.670 8.488 8.663 0.980 300 10.653 8.471 8.663 0.973 360 10.612 8.430 8.663 0.970 480 10.550 8.368 8.663 0.966 540 10.512 8.330 8.663 0.962 600 10.480 8.298 8.663 0.939 1200 10.140 7.958 8.663 0.939 1200 10.140 7.958 8.663 0.851 2160 9.593 7.411 8.663 0.855 2220 9.545 7.303 8.663 0.840 2460 9.425 7.273 8.663 0.840 2460 9.425 7.243 8.663 0.833 2580 9.365 7.183 8.663 0.829 2640 9.338 7.156 8.663 0.826	75	10	.788	8.606	8.663	0.993
105 10.773 8.591 8.663 0.992 120 10.760 8.578 8.663 0.990 150 10.743 8.561 8.663 0.988 180 10.725 8.543 8.663 0.986 210 10.708 8.526 8.663 0.984 240 10.691 8.509 8.663 0.982 270 10.670 8.488 8.663 0.980 300 10.653 8.471 8.663 0.973 420 10.585 8.403 8.663 0.970 480 10.550 8.368 8.663 0.966 540 10.512 8.330 8.663 0.966 540 10.512 8.330 8.663 0.958 900 10.313 8.131 8.663 0.939 1200 10.140 7.958 8.663 0.939 1200 9.975 7.793 8.663 0.900 1800 9.810 7.628 8.663 0.855 2220 9.545 7.363 8.663 0.855 2220 9.545 7.333 8.663 0.840 2460 9.425 7.273 8.663 0.840 2460 9.425 7.213 8.663 0.836 2280 9.365 7.183 8.663 0.826	90	10	.781	8.599	8.663	0.993
120 10.760 8.578 8.663 0.990 150 10.743 8.561 8.663 0.988 180 10.725 8.543 8.663 0.986 210 10.708 8.526 8.663 0.984 240 10.691 8.509 8.663 0.982 270 10.670 8.488 8.663 0.980 300 10.653 8.471 8.663 0.973 360 10.612 8.430 8.663 0.973 420 10.585 8.403 8.663 0.970 480 10.550 8.368 8.663 0.962 600 10.480 8.298 8.663 0.958 900 10.313 8.131 8.663 0.939 1200 10.140 7.958 8.663 0.939 1200 9.975 7.793 8.663 0.861 1800 9.810 7.628 8.663 0.855 2220 9.545 7.363 8.663 0.855 2220 9.545 7.333 8.663 0.846 2340 9.485 7.303 8.663 0.846 2400 9.455 7.273 8.663 0.843 2400 9.425 7.243 8.663 0.836 2280 9.365 7.183 8.663 0.829 2400 9.338 7.156 8.663 0.829	105	10	.773	8.591	8.663	0.992
150 10.743 8.561 8.663 0.988 180 10.725 8.543 8.663 0.986 210 10.708 8.526 8.663 0.984 240 10.691 8.509 8.663 0.982 270 10.670 8.488 8.663 0.980 300 10.653 8.471 8.663 0.973 360 10.612 8.430 8.663 0.973 420 10.585 8.403 8.663 0.970 480 10.550 8.368 8.663 0.966 540 10.512 8.330 8.663 0.958 900 10.480 8.298 8.663 0.958 900 10.140 7.958 8.663 0.919 1500 9.975 7.793 8.663 0.900 1800 9.810 7.628 8.663 0.851 2100 9.593 7.411 8.663 0.855 2220 9.545 7.363 8.663 0.846 2340 9.485 7.303 8.663 0.846 2340 9.485 7.303 8.663 0.843 2400 9.425 7.243 8.663 0.833 2520 9.395 7.213 8.663 0.826 2640 9.338 7.156 8.663 0.826	120	10	.760	8.578	8.663	0.990
180 10.725 8.543 8.663 0.986 210 10.708 8.526 8.663 0.984 240 10.691 8.509 8.663 0.982 270 10.670 8.488 8.663 0.980 300 10.653 8.471 8.663 0.978 360 10.612 8.430 8.663 0.973 420 10.585 8.403 8.663 0.976 480 10.550 8.368 8.663 0.966 540 10.512 8.330 8.663 0.958 900 10.313 8.131 8.663 0.939 1200 10.140 7.958 8.663 0.919 1500 9.975 7.793 8.663 0.861 2100 9.620 7.438 8.663 0.855 2220 9.545 7.363 8.663 0.850 2280 9.515 7.333 8.663 0.846 2340 9.485 7.303 8.663 0.846 2340 9.485 7.303 8.663 0.846 2460 9.425 7.243 8.663 0.833 2580 9.365 7.183 8.663 0.826 2640 9.338 7.156 8.663 0.826	150	10	.743	8.561	8.663	0.988
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	180	10	.725	8.543	8.663	0.986
240 10.691 8.509 8.663 0.982 270 10.670 8.488 8.663 0.980 300 10.653 8.471 8.663 0.973 360 10.612 8.430 8.663 0.973 420 10.585 8.403 8.663 0.970 480 10.550 8.368 8.663 0.966 540 10.512 8.330 8.663 0.962 600 10.480 8.298 8.663 0.958 900 10.313 8.131 8.663 0.939 1200 10.140 7.958 8.663 0.919 1500 9.975 7.793 8.663 0.990 1800 9.810 7.628 8.663 0.851 2100 9.620 7.438 8.663 0.855 2220 9.545 7.363 8.663 0.855 2280 9.515 7.333 8.663 0.846 2340 9.485 7.303 8.663 0.843 2400 9.455 7.273 8.663 0.843 2400 9.425 7.243 8.663 0.833 2580 9.365 7.183 8.663 0.829 2640 9.338 7.156 8.663 0.826	210	10	.708	8.526	8.663	0.984
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	240	10	.691	8.509	8.663	0.982
300 10.653 8.471 8.663 0.978 360 10.612 8.430 8.663 0.973 420 10.585 8.403 8.663 0.970 480 10.550 8.368 8.663 0.966 540 10.512 8.330 8.663 0.962 600 10.480 8.298 8.663 0.958 900 10.313 8.131 8.663 0.939 1200 10.140 7.958 8.663 0.919 1500 9.975 7.793 8.663 0.900 1800 9.810 7.628 8.663 0.881 2100 9.620 7.438 8.663 0.855 2220 9.545 7.363 8.663 0.855 2220 9.545 7.303 8.663 0.846 2340 9.485 7.303 8.663 0.846 2340 9.485 7.273 8.663 0.843 2400 9.425 7.273 8.663 0.843 2400 9.425 7.243 8.663 0.836 2520 9.395 7.213 8.663 0.829 2640 9.338 7.156 8.663 0.826	270	10	.670	8.488	8.663	0.980
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	300	10	.653	8.471	8.663	0.978
420 10.585 8.403 8.663 0.970 480 10.550 8.368 8.663 0.966 540 10.512 8.330 8.663 0.962 600 10.480 8.298 8.663 0.958 900 10.313 8.131 8.663 0.939 1200 10.140 7.958 8.663 0.919 1500 9.975 7.793 8.663 0.900 1800 9.810 7.628 8.663 0.881 2100 9.620 7.438 8.663 0.859 2160 9.593 7.411 8.663 0.855 2220 9.545 7.363 8.663 0.846 2340 9.485 7.303 8.663 0.843 2400 9.455 7.273 8.663 0.843 2400 9.455 7.243 8.663 0.836 2520 9.395 7.213 8.663 0.833 2580 9.365 7.183 8.663 0.826 2640 9.338 7.156 8.663 0.826	360	10	.612	8.430	8.663	0.973
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	420	10	.585	8.403	8.663	0.970
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$\begin{array}{cccccccccccccccccccccccccccccccccccc$	540	10	.512	8.330	8.663	0.962
900 10.313 8.131 8.663 0.939 1200 10.140 7.958 8.663 0.919 1500 9.975 7.793 8.663 0.900 1800 9.810 7.628 8.663 0.881 2100 9.620 7.438 8.663 0.859 2160 9.593 7.411 8.663 0.855 2220 9.545 7.363 8.663 0.850 2280 9.515 7.333 8.663 0.846 2340 9.485 7.303 8.663 0.843 2400 9.455 7.273 8.663 0.840 2460 9.425 7.243 8.663 0.836 2520 9.395 7.213 8.663 0.833 2580 9.365 7.183 8.663 0.829 2640 9.338 7.156 8.663 0.826	600	10	.480	8.298	8.663	0.958
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	900	10	.313	8.131	8.663	0.939
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18009.8107.6288.6630.88121009.6207.4388.6630.85921609.5937.4118.6630.85522209.5457.3638.6630.85022809.5157.3338.6630.84623409.4857.3038.6630.84324009.4557.2738.6630.84024609.4257.2438.6630.83625209.3957.2138.6630.83325809.3657.1838.6630.82926409.3387.1568.6630.826	1500	9.	975	7.793	8.663	0.900
21009.6207.4388.6630.85921609.5937.4118.6630.85522209.5457.3638.6630.85022809.5157.3338.6630.84623409.4857.3038.6630.84324009.4557.2738.6630.84024609.4257.2438.6630.83625209.3957.2138.6630.83325809.3657.1838.6630.82926409.3387.1568.6630.826	1800	9.	810	7.628	8.663	0.881
21609.5937.4118.6630.85522209.5457.3638.6630.85022809.5157.3338.6630.84623409.4857.3038.6630.84324009.4557.2738.6630.84024609.4257.2438.6630.83625209.3957.2138.6630.83325809.3657.1838.6630.82926409.3387.1568.6630.826	2100	9.	620	7.438	8.663	0.859
2220 9.545 7.363 8.663 0.850 2280 9.515 7.333 8.663 0.846 2340 9.485 7.303 8.663 0.843 2400 9.455 7.273 8.663 0.840 2460 9.425 7.243 8.663 0.836 2520 9.395 7.213 8.663 0.833 2580 9.365 7.183 8.663 0.829 2640 9.338 7.156 8.663 0.826	2160	9.	593	7.411	8.663	0.855
2280 9.515 7.333 8.663 0.846 2340 9.485 7.303 8.663 0.843 2400 9.455 7.273 8.663 0.840 2460 9.425 7.243 8.663 0.836 2520 9.395 7.213 8.663 0.833 2580 9.365 7.183 8.663 0.829 2640 9.338 7.156 8.663 0.826	2220	9.	545	7.363	8.663	0.850
2340 9.485 7.303 8.663 0.843 2400 9.455 7.273 8.663 0.840 2460 9.425 7.243 8.663 0.836 2520 9.395 7.213 8.663 0.833 2580 9.365 7.183 8.663 0.829 2640 9.338 7.156 8.663 0.826	2280	9.	515	7.333	8.663	0.846
2400 9.455 7.273 8.663 0.840 2460 9.425 7.243 8.663 0.836 2520 9.395 7.213 8.663 0.833 2580 9.365 7.183 8.663 0.829 2640 9.338 7.156 8.663 0.826	2340	9.	485	7.303	8.663	0.843
2460 9.425 7.243 8.663 0.836 2520 9.395 7.213 8.663 0.833 2580 9.365 7.183 8.663 0.829 2640 9.338 7.156 8.663 0.826	2400	9.	455	7.273	8.663	0.840
2520 9.395 7.213 8.663 0.833 2580 9.365 7.183 8.663 0.829 2640 9.338 7.156 8.663 0.826	2400	9.	425	7.243	8.663	0.836
2580 9.365 7.183 8.663 0.829 2640 9.338 7.156 8.663 0.826	2520	9.	395	7.213	8.663	0.833
2040 9.338 7.156 8.663 0.826	2580	9.	305	7.183	8.663	0.829
	2040	9.	JJØ	7.150	0.00J	0.826





In-Situ Hydraulic Conductivity Analyses - BH2D

Glenwey West In-Situ Hydraulic Conductivity Analyses - BH2S

Date:

Conducted By:	AS-A	0	To(early):	500	S
Well Depth:	7.03	mbtor	K(early):	7.62E-07	m/s
Screened Unit:			To(late):	600	S
Initial Water Level:	2.17	mbtor	K(late):	6.35E-07	m/s
Available Drawdown (H):	4.86	m	K(average)	7.0E-07	m/s
Head at Time = 0 (Ho):	6.4	m	Recovery:	86.9%	%
Screen Length (L):	3	m			
Borehole Radius (R):	0.0775	m			
Monitoring Well Radius (r):	0.025	m			
Stick Up		m			
Elapsed Time (s)	Water Le	evel (mtor)	H-h	H-Ho	(H-h)/(H-Ho)
0	6.4	400	4.230	4.230	1.000
10	6.2	290	4.120	4.230	0.974
20	6.2	220	4.050	4.230	0.957
30	6.	132	3.962	4.230	0.937
40	6.0	045	3.875	4.230	0.916
50	5.9	975	3.805	4.230	0.900
60	5.9	900	3.730	4.230	0.882
75	5.8	812	3.642	4.230	0.861
90	5.0	690	3.520	4.230	0.832
105	5.	576	3.406	4.230	0.805
120	5.4	485	3.315	4.230	0.784
150	5.3	335	3.165	4.230	0.748
180	5.2	206	3.036	4.230	0.718
210	5.	105	2.935	4.230	0.694
240	5.0	023	2.853	4.230	0.674
270	4.9	932	2.762	4.230	0.653
300	4.8	834	2.664	4.230	0.630
360	4.0	664	2.494	4.230	0.590
420	4.	500	2.330	4.230	0.551
480	4.3	355	2.185	4.230	0.517
540	4.2	213	2.043	4.230	0.483
600	4.1	180	2.010	4.230	0.475
900	3.2	250	1.080	4.230	0.255
1200	2.8	806	0.636	4.230	0.150





In-Situ Hydraulic Conductivity Analyses - BH2S

Glenwey West In-Situ Hydraulic Conductivity Analyses - BH4

Date:

Conducted Bv:	AS-K	S	To(early):	2700	S
Well Depth:	7.14	mbtor	K(early):	1.41E-07	m/s
Screened Unit:			To(late):	2250	S
Initial Water Level:	4.65	mbtor	K(late):	1.69E-07	m/s
Available Drawdown (H):	2.49	m	K(average)	1.5E-07	m/s
Head at Time = 0 (Ho):	6.8	 m	Recovery:	91.3%	%
Screen Length (L):	3		1.0001019.	011070	,.
Borehole Radius (R):	0.0775				
Monitoring Well Radius (r):	0.025				
Stick Up	0.020				
Elapsed Time (s)	Water Lo	evel (mtor)	H-h	H-Ho	(H-h)/(H-Ho)
0	6.	805	2.155	2.155	1.000
10	6.	772	2.122	2.155	0.985
20	6.	760	2.110	2.155	0.979
30	6.	750	2.100	2.155	0.974
40	6.	740	2.090	2.155	0.970
50	6	734	2 084	2 155	0.967
60	6.	725	2.075	2.155	0.963
75	6	713	2 063	2 155	0.957
90	6	700	2 050	2 155	0.951
105	6	686	2.000	2 155	0.945
120	6	674	2.000	2.100	0.040
150	6	650	2 000	2 155	0.928
180	6	630	1 980	2 155	0.919
210	6	604	1 954	2 155	0.907
240	6	592	1 942	2 155	0.901
270	6	563	1 913	2 155	0.888
300	6	545	1 895	2 155	0.879
360	6	512	1 862	2 155	0.864
420	6	474	1 824	2 155	0.846
480	6	440	1 790	2 155	0.831
540	6	402	1 752	2 155	0.813
600	6	368	1 718	2 155	0 797
660	6	335	1 685	2 155	0 782
720	6.	299	1.649	2.155	0.765
780	6	494	1 844	2 155	0.856
840	6.	869	2.219	2.155	1.030
900	6	170	1 520	2 155	0 705
960	6.	134	1.484	2.155	0.689
1020	6	095	1 445	2 155	0.671
1080	6	059	1 409	2 155	0.654
1140	6	023	1 373	2 155	0.637
1200	5.	987	1.337	2 155	0.620
1260	5	951	1.301	2.155	0.604
1320	5.	921	1 271	2 155	0.590
1380	5.	891	1 241	2 155	0.576
1440	5	858	1 208	2 155	0.561
	0.		1.200	2.100	0.001





In-Situ Hydraulic Conductivity Analyses - BH4

Glenwey West In-Situ Hydraulic Conductivity Analyses - BH7

Date:

Conducted By:	AS-A	0	To(early):	870	S
Well Depth:	5.52	mbtor	K(early):	4.38E-07	m/s
Screened Unit:			To(late):	420	S
Initial Water Level:	1.162	mbtor	K(late):	9.07E-07	m/s
Available Drawdown (H):	4.36	m	K(average)	6.3E-07	m/s
Head at Time = 0 (Ho):	6.7	m	Recovery:	92.7%	%
Screen Length (L):	3	m			
Borehole Radius (R):	0.0775	m			
Monitoring Well Radius (r):	0.025	m			
Stick Up		m			
Elapsed Time (s)	Water Le	evel (mtor)	H-h	H-Ho	(H-h)/(H-Ho)
0	6.	710	5.548	5.548	1.000
10	6.0	635	5.473	5.548	0.986
20	6.	594	5.432	5.548	0.979
30	6.	542	5.380	5.548	0.970
40	6.4	498	5.336	5.548	0.962
50	6.4	438	5.276	5.548	0.951
60	6.3	379	5.217	5.548	0.940
75	6.3	302	5.140	5.548	0.926
90	6.2	215	5.053	5.548	0.911
105	6.	122	4.960	5.548	0.894
120	6.0	022	4.860	5.548	0.876
150	5.8	854	4.692	5.548	0.846
180	5.0	695	4.533	5.548	0.817
210	5.	543	4.381	5.548	0.790
240	5.3	364	4.202	5.548	0.757
270	5.	195	4.033	5.548	0.727
300	5.0	024	3.862	5.548	0.696
360	4.0	602	3.440	5.548	0.620
420	4.1	188	3.026	5.548	0.545
480	3.8	892	2.730	5.548	0.492
540	3.	578	2.416	5.548	0.435
600	3.	170	2.008	5.548	0.362
900	2.	142	0.980	5.548	0.177
1200	1.4	480	0.318	5.548	0.057





In-Situ Hydraulic Conductivity Analyses - BH7

Glenwey West In-Situ Hydraulic Conductivity Analyses - BH8D

Date:

Conducted By:	AS-AO		To(early):	5550	S
Well Depth:	11.12	mbtor	K(early):	1.11E-07	m/s
Screened Unit:			To(late):	6950	S
Initial Water Level:	4.5	mbtor	K(late):	8.88E-08	m/s
Available Drawdown (H):	6.62	m	K(average)	9.9E-08	m/s
Head at Time = 0 (Ho):	10.6	m	Recovery:	91.1%	%
Screen Length (L):	1.5	m			
Borehole Radius (R):	0.0775	m			
Monitoring Well Radius (r):	0.025	m			
Stick Up		m			
Elansed Time (s)	Mator Le	wel (mtor)	Цb	Н Но	(H b)/(H Ho)
	10	620	6 120	6 120	(11-1)/(11-110)
10	10.	610	6 110	6 120	0.008
20	10.	010	0.110	0.120	0.990
20	10	505	6 005	6 1 2 0	0.006
40	10.	595	0.095	6 120	0.990
40	10.	576	6.076	6 120	0.994
50 60	10.	570	6.070	6 120	0.993
75	10.	570	6.058	6 120	0.992
75	10.	543	6.043	6 120	0.990
105	10.	524	6.034	6 120	0.907
100	10.	520	6.020	6 120	0.900
120	10.	520	6.020	6 120	0.904
190	10.	474	5.000	6 120	0.900
210	10.	474	5.974	6 120	0.970
210	10.	402	5.952	6 120	0.973
240	10.	403	5.951	6 120	0.909
300	10.	385	5.885	6 120	0.903
360	10.	336	5.836	6 120	0.902
420	10.	255	5 755	6 120	0.954
420	10.	105	5.605	6 120	0.940
540	10.	160	5.660	6 120	0.931
600	10.	108	5 608	6 120	0.925
900	10. Q 9	857	5 357	6 120	0.875
960	9.0	809	5 309	6 120	0.867
1020	0.0 0	761	5 261	6 120	0.860
1080	g /	548	5 048	6 120	0.825
1140	9.4	482	4 982	6 120	0.814
1200	9.4	419	4.002	6 120	0.804
1260	9.1	356	4 856	6 120	0.004
1320	9 (293	4 793	6 120	0.783
1380	0.2 Q 2	230	4 730	6 120	0.703
1440	Q /	170	4 670	6 120	0 763
1500	0. Q	113	4 613	6 120	0 754
1560	0. Q (156	4 556	6 120	0.704
1600	9.0 Q (005	4 505	6 120	0.744
1620	9.0 2 (954	4 4 5 4	6 120	0.700
1000	0.3			0.120	0.720





In-Situ Hydraulic Conductivity Analyses - BH8D

Glenwey West In-Situ Hydraulic Conductivity Analyses - BH8S

Date:

Conducted By:	AS-A	0	To(early):	4000	S
Well Depth:	6.95	mbtor	K(early):	9.52E-08	m/s
Screened Unit:			To(late):	7400	S
Initial Water Level:	3.46	mbtor	K(late):	5.15E-08	m/s
Available Drawdown (H):	3.49	m	K(average)	7.0E-08	m/s
Head at Time = 0 (Ho):	6.8	m	Recovery:	90.4%	%
Screen Length (L):	3	m			
Borehole Radius (R):	0.0775	m			
Monitoring Well Radius (r):	0.025	m			
Stick Up		m			
Elapsed Time (s) 0	Water Le	evel (mtor)	H-h	H-Ho	(H-h)/(H-Ho)
10					
20	6.8	800	3.340	3.340	1.000
30	6.0	665	3.205	3.340	0.960
40	6.4	464	3.004	3.340	0.899
50	6.3	300	2.840	3.340	0.850
60	6.0	618	3.158	3.340	0.946
75	6.0	602	3.142	3.340	0.941
90	6.	580	3.120	3.340	0.934
105	6.	563	3.103	3.340	0.929
120	6.	544	3.084	3.340	0.923
150	6.	504	3.044	3.340	0.911
180	6.4	464	3.004	3.340	0.899
210	6.4	435	2.975	3.340	0.891
240	6.4	415	2.955	3.340	0.885
270	6.3	390	2.930	3.340	0.877
300	6.3	371	2.911	3.340	0.872
360	6.3	337	2.877	3.340	0.861
420	6.3	305	2.845	3.340	0.852
480	6.2	270	2.810	3.340	0.841
540	6.2	240	2.780	3.340	0.832
600	6.2	210	2.750	3.340	0.823
900	6.	108	2.648	3.340	0.793
960	6.0	090	2.630	3.340	0.787
1020	6.0	069	2.609	3.340	0.781
1080	6.0	051	2.591	3.340	0.776
1140	6.0	033	2.573	3.340	0.770
1200	6.0	015	2.555	3.340	0.765
1260	5.9	994	2.534	3.340	0.759
1320	5.9	976	2.516	3.340	0.753
1380	5.9	958	2.498	3.340	0.748
1440	5.9	940	2.480	3.340	0.743
1500	5.9	922	2.462	3.340	0.737
1560	5.9	904	2.444	3.340	0.732
1620	5.8	886	2.426	3.340	0.726
1680	5.8	865	2.405	3.340	0.720





In-Situ Hydraulic Conductivity Analyses - BH8S

Glenwey West In-Situ Hydraulic Conductivity Analyses - BH10

Date:

Well Depth: 6.90 mbtor Screened Unit: 1 To(late): 7700 s Initial Water Level: 3.275 mbtor K[atel:: 4.95E-08 m/s Available Drawdown (H): 3.63 m K[atel:: 4.95E-08 m/s Borehole Radius (R): 0.00775 m Monitoring Well Radius (r): 0.025 m Stick Up m m m m m m Stick Up m m m m m m Elapsed Time (s) Water Level (mtor) H-h H-Ho (H-h)/(H-Ho) 0 6.741 3.466 3.495 0.992 20 6.732 3.417 3.495 0.981 50 6.692 3.417 3.495 0.981 50 6.692 3.417 3.495 0.969 90 6.644 3.369 3.495 0.961 120 6.633 3.334 3.495 0.914	Conducted By:	AS-K	S	To(early):	7000	S	
Tor(late): 7700 s Initial Water Level: 3 275 mbtor K(late): 4.96E-08 m's Kaverage 5.2E-08 m's Screen Length (L): 3 m Borehole Radius (R): 0.0775 m Stick Up M H-H-H H-H Elapsed Time (s) Water Level (mtor) H-H H-H H-H 0 6.770 3.495 3.495 0.992 20 6.771 3.442 3.495 0.992 20 6.703 3.442 3.495 0.9085 40 6.661 3.366 3.495 0.9064 120 6.661 3.366 <th col<="" td=""><td>Well Depth:</td><td>6.90</td><td>mbtor</td><td>K(early):</td><td>5.44E-08</td><td>m/s</td></th>	<td>Well Depth:</td> <td>6.90</td> <td>mbtor</td> <td>K(early):</td> <td>5.44E-08</td> <td>m/s</td>	Well Depth:	6.90	mbtor	K(early):	5.44E-08	m/s
Initial Water Level: 3.275 mbtor Available Drawdown (H): 3.63 m (Kaverage) $4.95E-08$ m/s (Kaverage)m/s (Kaverage) $5.2E-08$ m/sHead at Time = 0 (Ho): 6.8 m Borehole Radius (R): 0.0775 m 0.025 m $Recovery:$ 90.4% $\%$ Borehole Radius (R): 0.0775 m Monitoring Well Radius (r): 0.025 m m $Recovery:$ 90.4% $\%$ Elapsed Time (s)Water Level (mtor) 0 6.770 $H-h$ 1.466 $H-Ho$ 3.495 $(H-h)/(H-Ho)$ 10 6.741 3.466 3.495 0.992 20 6.732 3.477 3.442 3.495 0.988 30 6.717 3.442 3.495 0.981 50 6.692 3.417 3.495 0.978 60 6.681 3.366 3.495 0.969 90 6.6444 3.369 3.495 0.964 105 6.633 3.334 3.495 0.964 105 6.6331 3.356 3.495 0.964 120 6.609 3.334 3.495 0.926 240 6.445 3.210 3.495 0.918 270 6.488 3.113 3.495 0.918 270 6.488 3.113 3.495 0.918 270 6.488 3.113 3.495 0.926 240 6.425 3.210 3.495 0.903 360 6.331 3.056 3.045 0.874 900 6.199 <td>Screened Unit:</td> <td></td> <td></td> <td>To(late):</td> <td>7700</td> <td>S</td>	Screened Unit:			To(late):	7700	S	
Available Drawdown (H): 3.63 m Head at Time = 0 (Ho): 6.8 m Screen Length (L): 3 m Borehole Radius (R): 0.0775 m Monitoring Well Radius (r): 0.025 m Stick Up m m Elapsed Time (s) Water Level (mtor) H-h H-H-HO (H-h)/(H-HO) 0 6.770 3.495 3.495 0.992 20 6.732 3.457 3.495 0.985 40 6.703 3.428 3.495 0.985 40 6.703 3.428 3.495 0.981 50 6.661 3.386 3.495 0.975 75 6.661 3.386 3.495 0.964 105 6.633 3.358 3.495 0.964 105 6.661 3.300 3.495 0.964 105 6.633 3.358 3.495 0.926 240 6.444 3.269 3.495 0.935<	Initial Water Level:	3.275	mbtor	K(late):	4.95E-08	m/s	
Head at Time = 0 (Ho):6.8mScreen Length (L):3mBorehole Radius (R):0.025mStick Upm06.7703.4953.495106.7713.4953.49506.732206.7323.4573.49506.7173.4283.495306.7173.4283.495906.682306.7173.4283.495906.6823.4173.495906.6443.3863.495906.6443.3693.495906.6443.3693.495906.6443.3693.495906.6443.3693.495906.6443.3693.495906.6443.3693.4959156.65753.3003.4959262406.4853.2103.4950.9262406.4853.2103.4959006.4313.1563.4959016.5723.3033.4959026.8883.1133.4959033606.3883.1133.4959006.6363.0303.4959006.6443.6953.0303.606.3883.113 <td< td=""><td>Available Drawdown (H):</td><td>3.63</td><td>m</td><td>K(average)</td><td>5.2E-08</td><td>m/s</td></td<>	Available Drawdown (H):	3.63	m	K(average)	5.2E-08	m/s	
Screen Length (L):3mBorehole Radius (R):0.0775mStick UpmStick Upm06.7703.4953.495106.7713.4953.495106.7413.4663.495206.7323.4573.495306.7173.4423.495406.7033.4283.495506.6623.4173.495506.6623.4173.495606.6813.3663.495906.6443.3693.495906.6443.3693.4951206.6093.3343.495906.6443.2693.4951206.6093.3343.4959106.5123.2373.4959262406.4853.1833006.4313.1563.4959113006.3313.0563006.4313.1563.4959276.5653.0103.4959382.106.5123.23734950.9353.602106.5123.23734950.9033606.3313.0563033.4950.9184206.3563.0814406.3313.1569006.1692.8944406.3313.05634950.8624806.3313.0563495 <td>Head at Time = 0 (Ho):</td> <td>6.8</td> <td>m</td> <td>Recovery:</td> <td>90.4%</td> <td>%</td>	Head at Time = 0 (Ho):	6.8	m	Recovery:	90.4%	%	
Borehole Radius (R): 0.0775 m Moniforing Well Radius (r): 0.025 m Stick Up m Elapsed Time (s) Water Level (mtor) H-h H-Ho (H-h)/(H-Ho) 0 6.770 3.495 3.495 0.992 20 6.732 3.457 3.495 0.989 30 6.717 3.442 3.495 0.985 40 6.703 3.428 3.495 0.981 50 6.682 3.417 3.495 0.978 60 6.681 3.406 3.495 0.978 60 6.681 3.406 3.495 0.964 105 6.633 3.358 3.495 0.964 105 6.633 3.358 3.495 0.964 105 6.633 3.358 3.495 0.964 105 6.575 3.300 3.495 0.944 180 6.544 3.269 3.495 0.913 210 6.512 3.237 <td< td=""><td>Screen Length (L):</td><td>3</td><td>m</td><td></td><td></td><td></td></td<>	Screen Length (L):	3	m				
Monitoring Well Radius (r): 0.025 m Stick Up m Elapsed Time (s) Water Level (mtor) H-h H-ho (H-h)/(H-Ho) 0 6.770 3.495 3.495 0.982 20 6.732 3.457 3.495 0.989 30 6.717 3.442 3.495 0.989 40 6.703 3.428 3.495 0.981 50 6.692 3.417 3.495 0.978 60 6.681 3.406 3.495 0.975 75 6.6661 3.386 3.495 0.969 90 6.644 3.369 3.495 0.964 105 6.633 3.358 3.495 0.964 150 6.575 3.300 3.495 0.935 210 6.512 3.237 3.495 0.935 210 6.458 3.183 3.495 0.911 300 6.431 3.156 3.495 0.903	Borehole Radius (R):	0.0775	m				
Stick Up m Elapsed Time (s) Water Level (mtor) H-h H-Ho (H-h)/(H-Ho) 0 6.770 3.495 3.495 1.000 10 6.741 3.466 3.495 0.982 20 6.732 3.457 3.495 0.985 30 6.717 3.442 3.495 0.985 40 6.703 3.428 3.495 0.985 40 6.703 3.428 3.495 0.985 60 6.661 3.346 3.495 0.975 75 6.661 3.386 3.495 0.969 90 6.644 3.369 3.495 0.964 105 6.633 3.358 3.495 0.984 120 6.609 3.344 3.495 0.984 180 6.575 3.300 3.495 0.984 180 6.544 3.269 3.495 0.918 270 6.458 3.183 3.495 0	Monitoring Well Radius (r):	0.025	m				
Elapsed Time (s) Water Level (mtor) H-h H-Ho (H-h)/(H-Ho) 0 6.770 3.495 3.495 1.000 10 6.741 3.466 3.495 0.992 20 6.732 3.457 3.495 0.988 30 6.717 3.442 3.495 0.985 40 6.703 3.428 3.495 0.985 40 6.692 3.417 3.495 0.975 75 6.661 3.366 3.495 0.964 105 6.633 3.358 3.495 0.964 105 6.675 3.300 3.495 0.964 105 6.575 3.300 3.495 0.944 180 6.544 3.269 3.495 0.935 210 6.512 3.237 3.495 0.926 240 6.485 3.113 3.495 0.911 300 6.431 3.166 3.495 0.882 420	Stick Up		m				
Elapsed Time (s) Water Level (mtor) H-h H-h0 (H-h)/(H-Ho) 0 6.770 3.495 3.495 1.000 10 6.741 3.466 3.495 0.982 20 6.732 3.457 3.495 0.985 40 6.703 3.428 3.495 0.985 40 6.703 3.428 3.495 0.987 60 6.692 3.417 3.495 0.975 75 6.661 3.386 3.495 0.964 105 6.633 3.358 3.495 0.964 105 6.633 3.334 3.495 0.964 105 6.675 3.300 3.495 0.944 180 6.544 3.269 3.495 0.935 210 6.512 3.237 3.495 0.926 240 6.485 3.210 3.495 0.911 300 6.431 3.166 3.495 0.802 240							
0 6.770 3.495 3.495 1.000 10 6.741 3.466 3.495 0.992 20 6.732 3.457 3.495 0.989 30 6.717 3.442 3.495 0.985 40 6.703 3.428 3.495 0.978 50 6.692 3.417 3.495 0.978 60 6.681 3.406 3.495 0.975 75 6.661 3.386 3.495 0.969 90 6.644 3.369 3.495 0.961 120 6.609 3.334 3.495 0.961 120 6.609 3.334 3.495 0.961 120 6.675 3.300 3.495 0.944 180 6.575 3.300 3.495 0.926 240 6.485 3.210 3.495 0.926 240 6.454 3.269 3.495 0.918 270 6.458 3.183 3.495 0.918 270 6.458 3.183 3.495 0.933 360 6.338 3.113 3.495 0.801 420 6.356 3.031 3.495 0.867 600 6.285 3.010 3.495 0.867 600 6.285 3.010 3.495 0.874 540 6.305 3.030 3.495 0.867 600 6.285 3.010 3.495 0.772 1560 5.948 2.673 3.495 0.772 <t< td=""><td>Elapsed Time (s)</td><td>Water Le</td><td>evel (mtor)</td><td>H-h</td><td>H-Ho</td><td>(H-h)/(H-Ho)</td></t<>	Elapsed Time (s)	Water Le	evel (mtor)	H-h	H-Ho	(H-h)/(H-Ho)	
10 6.741 3.466 3.495 0.992 20 6.732 3.457 3.495 0.989 30 6.717 3.442 3.495 0.985 40 6.703 3.428 3.495 0.981 50 6.692 3.417 3.495 0.978 60 6.681 3.406 3.495 0.969 90 6.644 3.369 3.495 0.964 105 6.633 3.388 3.495 0.964 105 6.675 3.300 3.495 0.944 180 6.575 3.200 3.495 0.935 210 6.512 3.237 3.495 0.926 240 6.485 3.210 3.495 0.918 270 6.458 3.183 3.495 0.911 300 6.431 3.156 3.495 0.903 360 6.388 3.113 3.495 0.881 420 6.356 3.081 3.495 0.882 480 6.331 3.056 3.495 0.867 600 6.285 3.010 3.495 0.867 600 6.285 3.010 3.495 0.772 1560 5.972 2.697 3.495 0.772 1560 5.948 2.673 3.495 0.775 1740 5.888 2.613 3.495 0.772 1560 5.946 2.571 3.495 0.772 1560 5.946 2.571 3.495 0.772 <td>0</td> <td>6.</td> <td>770</td> <td>3.495</td> <td>3.495</td> <td>1.000</td>	0	6.	770	3.495	3.495	1.000	
20 6.732 3.457 3.495 0.989 30 6.717 3.442 3.495 0.985 40 6.703 3.428 3.495 0.981 50 6.692 3.417 3.495 0.978 60 6.681 3.406 3.495 0.969 90 6.644 3.369 3.495 0.964 105 6.633 3.358 3.495 0.961 120 6.609 3.334 3.495 0.954 150 6.575 3.300 3.495 0.944 180 6.544 3.269 3.495 0.935 210 6.512 2.237 3.495 0.926 240 6.485 3.210 3.495 0.918 270 6.458 3.183 3.495 0.918 270 6.458 3.183 3.495 0.891 300 6.356 3.081 3.495 0.882 480 6.331 3.056 3.495 0.882 480 6.331 3.056 3.495 0.867 600 6.285 3.010 3.495 0.867 600 6.285 3.010 3.495 0.772 1560 5.972 2.697 3.495 0.759 1620 5.927 2.652 3.495 0.759 180 5.867 2.592 3.495 0.759 180 5.866 2.571 3.495 0.724 1800 5.867	10	6.	741	3.466	3.495	0.992	
30 6.717 3.442 3.495 0.985 40 6.703 3.428 3.495 0.981 50 6.692 3.417 3.495 0.978 60 6.681 3.405 0.975 75 6.661 3.386 3.495 0.969 90 6.644 3.369 3.495 0.961 105 6.633 3.358 3.495 0.961 120 6.609 3.334 3.495 0.944 180 6.575 3.300 3.495 0.944 180 6.544 3.269 3.495 0.935 210 6.512 3.237 3.495 0.926 240 6.485 3.183 3.495 0.918 270 6.458 3.183 3.495 0.911 300 6.431 3.156 3.495 0.903 360 6.388 3.113 3.495 0.882 480 6.331 3.056 3.495 0.874 540 6.305 3.030 3.495 0.861 900 6.169 2.894 3.495 0.723 1560 5.948 2.673 3.495 0.772 1560 5.948 2.673 3.495 0.772 1580 5.867 2.592 3.495 0.772 1680 5.867 2.592 3.495 0.772 1880 5.867 2.592 3.495 0.772 1880 5.867 2.592 <t< td=""><td>20</td><td>6.</td><td>732</td><td>3.457</td><td>3.495</td><td>0.989</td></t<>	20	6.	732	3.457	3.495	0.989	
40 6.703 3.428 3.495 0.981 50 6.692 3.417 3.495 0.978 60 6.681 3.406 3.495 0.969 90 6.644 3.369 3.495 0.964 105 6.633 3.358 3.495 0.964 105 6.633 3.358 3.495 0.964 120 6.609 3.334 3.495 0.944 180 6.544 3.269 3.495 0.935 210 6.512 3.237 3.495 0.926 240 6.485 3.183 3.495 0.918 270 6.458 3.183 3.495 0.933 360 6.388 3.113 3.495 0.891 420 6.356 3.081 3.495 0.882 480 6.331 3.056 3.495 0.874 540 6.305 3.030 3.495 0.867 600 6.285 3.010 3.495 0.861 900 6.169 2.894 3.495 0.862 1200 6.71 2.796 3.495 0.772 1560 5.972 2.697 3.495 0.753 1740 5.888 2.613 3.495 0.753 1740 5.888 2.613 3.495 0.723 1860 5.846 2.571 3.495 0.723 1920 5.822 2.547 3.495 0.723 1920 5.822	30	6.	717	3.442	3.495	0.985	
50 6.692 3.417 3.495 0.978 60 6.681 3.406 3.495 0.969 75 6.661 3.386 3.495 0.964 105 6.633 3.358 3.495 0.964 105 6.633 3.358 3.495 0.964 120 6.609 3.334 3.495 0.954 150 6.575 3.300 3.495 0.944 180 6.544 3.269 3.495 0.926 240 6.485 3.210 3.495 0.926 240 6.485 3.210 3.495 0.918 270 6.458 3.183 3.495 0.911 300 6.311 3.156 3.495 0.903 360 6.388 3.113 3.495 0.891 420 6.356 3.081 3.495 0.882 480 6.331 3.056 3.495 0.867 600 6.285 3.010 3.495 0.861 900 6.169 2.894 3.495 0.828 1200 6.071 2.796 3.495 0.753 1560 5.927 2.652 3.495 0.772 1560 5.948 2.673 3.495 0.753 1740 5.888 2.613 3.495 0.723 1860 5.807 2.592 3.495 0.723 1980 5.801 2.505 3.495 0.723 1980 5.801 <td>40</td> <td>6.</td> <td>703</td> <td>3.428</td> <td>3.495</td> <td>0.981</td>	40	6.	703	3.428	3.495	0.981	
60 6.681 3.406 3.495 0.975 75 6.661 3.386 3.495 0.969 90 6.644 3.369 3.495 0.961 105 6.633 3.358 3.495 0.961 120 6.609 3.334 3.495 0.954 150 6.575 3.300 3.495 0.944 180 6.544 3.269 3.495 0.926 240 6.485 3.210 3.495 0.926 240 6.485 3.110 3.495 0.918 270 6.458 3.183 3.495 0.911 300 6.431 3.156 3.495 0.903 360 6.388 3.113 3.495 0.891 420 6.356 3.081 3.495 0.882 480 6.331 3.056 3.495 0.874 540 6.305 3.030 3.495 0.867 600 6.285 3.010 3.495 0.861 900 6.169 2.894 3.495 0.800 1500 5.972 2.697 3.495 0.772 1560 5.948 2.673 3.495 0.772 1680 5.906 2.631 3.495 0.774 1800 5.867 2.592 3.495 0.723 1740 5.886 2.671 3.495 0.723 1920 5.861 2.505 3.495 0.723 1920 5.861 <td>50</td> <td>6.</td> <td>692</td> <td>3.417</td> <td>3.495</td> <td>0.978</td>	50	6.	692	3.417	3.495	0.978	
75 6.661 3.386 3.495 0.969 90 6.644 3.369 3.495 0.964 105 6.633 3.358 3.495 0.964 120 6.609 3.334 3.495 0.954 150 6.575 3.300 3.495 0.935 210 6.512 3.237 3.495 0.926 240 6.485 3.210 3.495 0.918 270 6.458 3.183 3.495 0.911 300 6.431 3.156 3.495 0.903 360 6.388 3.113 3.495 0.891 420 6.356 3.081 3.495 0.882 480 6.331 3.056 3.495 0.867 600 6.285 3.010 3.495 0.861 900 6.169 2.894 3.495 0.861 900 6.169 2.894 3.495 0.861 900 6.169 2.894 3.495 0.765 160 5.972 2.697 3.495 0.765 1620 5.972 2.697 3.495 0.765 1620 5.927 2.652 3.495 0.765 1620 5.927 2.652 3.495 0.765 1620 5.927 2.652 3.495 0.765 1620 5.927 2.652 3.495 0.723 1740 5.888 2.613 3.495 0.748 1800 5.867 2.592 3.495 0.736	60	6.	681	3.406	3.495	0.975	
90 6.644 3.369 3.495 0.964 105 6.633 3.358 3.495 0.961 120 6.609 3.334 3.495 0.954 150 6.575 3.300 3.495 0.935 210 6.512 3.237 3.495 0.926 240 6.485 3.210 3.495 0.918 270 6.458 3.183 3.495 0.911 300 6.431 3.156 3.495 0.903 360 6.388 3.113 3.495 0.891 420 6.356 3.081 3.495 0.882 480 6.331 3.056 3.495 0.874 540 6.305 3.030 3.495 0.867 600 6.285 3.010 3.495 0.861 900 6.169 2.894 3.495 0.828 1200 6.071 2.796 3.495 0.772 1560 5.972 2.697 3.495 0.772 1560 5.948 2.673 3.495 0.753 1740 5.888 2.613 3.495 0.748 1800 5.867 2.592 3.495 0.742 1860 5.846 2.571 3.495 0.723 1920 5.822 2.547 3.495 0.723 1980 5.801 2.526 3.495 0.723 2040 5.780 2.505 3.495 0.712 1960 5.741 2.466 3.495 0.70	75	6.	661	3.386	3.495	0.969	
105 6.633 3.358 3.495 0.961 120 6.609 3.334 3.495 0.954 150 6.575 3.300 3.495 0.944 180 6.544 3.269 3.495 0.935 210 6.512 3.237 3.495 0.926 240 6.485 3.210 3.495 0.918 270 6.458 3.183 3.495 0.911 300 6.431 3.156 3.495 0.903 360 6.388 3.113 3.495 0.891 420 6.356 3.081 3.495 0.874 480 6.331 3.056 3.495 0.874 540 6.305 3.030 3.495 0.867 600 6.285 3.010 3.495 0.861 900 6.169 2.894 3.495 0.828 1200 6.071 2.796 3.495 0.772 1560 5.972 2.697 3.495 0.772 1560 5.972 2.697 3.495 0.7753 1740 5.888 2.613 3.495 0.7748 1800 5.906 2.631 3.495 0.742 1860 5.867 2.592 3.495 0.723 1740 5.882 2.517 3.495 0.723 1920 5.822 2.547 3.495 0.723 1980 5.801 2.526 3.495 0.712 1980 5	90	6.	644	3.369	3.495	0.964	
120 6.609 3.334 3.495 0.954 150 6.575 3.300 3.495 0.944 180 6.574 3.269 3.495 0.935 210 6.512 3.237 3.495 0.926 240 6.485 3.210 3.495 0.918 270 6.458 3.183 3.495 0.911 300 6.431 3.156 3.495 0.903 360 6.388 3.113 3.495 0.891 420 6.356 3.081 3.495 0.882 480 6.331 3.056 3.495 0.874 540 6.305 3.030 3.495 0.867 600 6.285 3.010 3.495 0.861 900 6.169 2.894 3.495 0.800 1500 5.972 2.697 3.495 0.772 1560 5.948 2.673 3.495 0.772 1680 5.906 2.631 3.495 0.759 1680 5.906 2.631 3.495 0.748 1800 5.867 2.592 3.495 0.723 1920 5.822 2.547 3.495 0.723 1920 5.801 2.505 3.495 0.723 2040 5.780 2.505 3.495 0.712 2160 5.741 2.466 3.495 0.712	105	6.	633	3.358	3.495	0.961	
150 6.575 3.300 3.495 0.944 180 6.544 3.269 3.495 0.935 210 6.512 3.237 3.495 0.926 240 6.485 3.210 3.495 0.918 270 6.458 3.183 3.495 0.911 300 6.431 3.156 3.495 0.903 360 6.388 3.113 3.495 0.891 420 6.356 3.081 3.495 0.882 480 6.331 3.056 3.495 0.874 540 6.305 3.030 3.495 0.867 600 6.285 3.010 3.495 0.861 900 6.169 2.894 3.495 0.828 1200 6.771 2.796 3.495 0.772 1560 5.948 2.673 3.495 0.772 1560 5.996 2.631 3.495 0.753 1740 5.888 2.613 3.495 0.753 1740 5.867 2.592 3.495 0.723 1860 5.846 2.571 3.495 0.723 1920 5.822 2.547 3.495 0.723 2040 5.780 2.505 3.495 0.712 2160 5.741 2.466 3.495 0.712	120	6.	609	3.334	3.495	0.954	
180 6.544 3.269 3.495 0.935 210 6.512 3.237 3.495 0.926 240 6.485 3.210 3.495 0.918 270 6.458 3.183 3.495 0.911 300 6.431 3.156 3.495 0.903 360 6.388 3.113 3.495 0.891 420 6.356 3.081 3.495 0.882 480 6.331 3.056 3.495 0.874 540 6.305 3.030 3.495 0.867 600 6.285 3.010 3.495 0.861 900 6.169 2.894 3.495 0.828 1200 6.071 2.796 3.495 0.772 1560 5.972 2.697 3.495 0.775 1620 5.927 2.652 3.495 0.765 1620 5.927 2.652 3.495 0.765 1620 5.927 2.652 3.495 0.765 1620 5.927 2.652 3.495 0.774 1860 5.867 2.592 3.495 0.774 1860 5.846 2.571 3.495 0.723 1920 5.822 2.547 3.495 0.723 2040 5.780 2.505 3.495 0.712 2160 5.741 2.466 3.495 0.712	150	6.	575	3.300	3.495	0.944	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	180	6.	544	3.269	3.495	0.935	
240 6.485 3.210 3.495 0.918 270 6.458 3.183 3.495 0.901 300 6.431 3.156 3.495 0.903 360 6.388 3.113 3.495 0.891 420 6.356 3.081 3.495 0.882 480 6.331 3.056 3.495 0.874 540 6.305 3.030 3.495 0.867 600 6.285 3.010 3.495 0.861 900 6.169 2.894 3.495 0.828 1200 6.071 2.796 3.495 0.800 1500 5.972 2.697 3.495 0.772 1560 5.948 2.673 3.495 0.7753 1620 5.927 2.652 3.495 0.753 1740 5.888 2.613 3.495 0.7748 1800 5.867 2.592 3.495 0.772 1860 5.846 2.571 3.495 0.723 1920 5.822 2.547 3.495 0.723 1980 5.801 2.526 3.495 0.723 2040 5.780 2.505 3.495 0.712 2160 5.741 2.466 3.495 0.706	210	6.	512	3.237	3.495	0.926	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	240	6.4	485	3.210	3.495	0.918	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	270	6.4	458	3.183	3.495	0.911	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	300	6.4	431	3.156	3.495	0.903	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	360	6.3	388	3.113	3.495	0.891	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	420	6.3	356	3.081	3.495	0.882	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	480	6.3	331	3.056	3.495	0.874	
6006.2853.0103.4950.8619006.1692.8943.4950.82812006.0712.7963.4950.80015005.9722.6973.4950.77215605.9482.6733.4950.76516205.9272.6523.4950.75916805.9062.6313.4950.75317405.8882.6133.4950.74818005.8672.5923.4950.74218605.8462.5713.4950.72919805.8012.5263.4950.72320405.7802.5053.4950.71721005.7622.4873.4950.71221605.7412.4663.4950.706	540	6.3	305	3.030	3.495	0.867	
9006.1692.8943.4950.82812006.0712.7963.4950.80015005.9722.6973.4950.77215605.9482.6733.4950.76516205.9272.6523.4950.75916805.9062.6313.4950.75317405.8882.6133.4950.74818005.8672.5923.4950.74218605.8462.5713.4950.73619205.8222.5473.4950.72919805.8012.5263.4950.72320405.7622.4873.4950.71221605.7412.4663.4950.706	600	6.3	285	3.010	3.495	0.861	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	900	6.	169	2.894	3.495	0.828	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1200	6.	071	2.796	3.495	0.800	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	1500	5.9	972	2.697	3.495	0.772	
16205.9272.6523.4950.75916805.9062.6313.4950.75317405.8882.6133.4950.74818005.8672.5923.4950.74218605.8462.5713.4950.73619205.8222.5473.4950.72919805.8012.5263.4950.72320405.7802.5053.4950.71721005.7622.4873.4950.71221605.7412.4663.4950.706	1560	5.9	948	2.673	3.495	0.765	
16805.9062.6313.4950.75317405.8882.6133.4950.74818005.8672.5923.4950.74218605.8462.5713.4950.73619205.8222.5473.4950.72919805.8012.5263.4950.72320405.7802.5053.4950.71721005.7622.4873.4950.71221605.7412.4663.4950.706	1620	5.9	927	2.652	3.495	0.759	
17405.8882.6133.4950.74818005.8672.5923.4950.74218605.8462.5713.4950.73619205.8222.5473.4950.72919805.8012.5263.4950.72320405.7802.5053.4950.71721005.7622.4873.4950.71221605.7412.4663.4950.706	1680	5.9	906	2.631	3.495	0.753	
18005.8672.5923.4950.74218605.8462.5713.4950.73619205.8222.5473.4950.72919805.8012.5263.4950.72320405.7802.5053.4950.71721005.7622.4873.4950.71221605.7412.4663.4950.706	1740	5.8	888	2.613	3.495	0.748	
18605.8462.5713.4950.73619205.8222.5473.4950.72919805.8012.5263.4950.72320405.7802.5053.4950.71721005.7622.4873.4950.71221605.7412.4663.4950.706	1800	5.8	867	2.592	3.495	0.742	
19205.8222.5473.4950.72919805.8012.5263.4950.72320405.7802.5053.4950.71721005.7622.4873.4950.71221605.7412.4663.4950.706	1860	5.8	846	2.571	3.495	0.736	
19805.8012.5263.4950.72320405.7802.5053.4950.71721005.7622.4873.4950.71221605.7412.4663.4950.706	1920	5.	822	2.547	3.495	0.729	
20405.7802.5053.4950.71721005.7622.4873.4950.71221605.7412.4663.4950.706	1980	5.	801	2.526	3.495	0.723	
21005.7622.4873.4950.71221605.7412.4663.4950.706	2040	5.	780	2.505	3.495	0.717	
2160 5.741 2.466 3.495 0.706	2100	5.	762	2.487	3.495	0.712	
	2160	5.	741	2.466	3.495	0.706	





In-Situ Hydraulic Conductivity Analyses - BH10

Glenwey West In-Situ Hydraulic Conductivity Analyses - BH12D

Date:

Conducted By:	AS-K	S	To(early):	44000	S
Well Depth:	11.03	mbtor	K(early):	1.40E-08	m/s
Screened Unit:			To(late):	60000	S
Initial Water Level:	2.359	mbtor	K(late):	1.03E-08	m/s
Available Drawdown (H):	8.67	m	K(average)	1.2E-08	m/s
Head at Time = 0 (Ho):	10.7	m	Recovery:	88.5%	%
Screen Length (L):	1.5	m			
Borehole Radius (R):	0.0775	m			
Monitoring Well Radius (r):	0.025	m			
Stick Up		m			
Elapsed Time (s)	Water Le	evel (mtor)	H-h	H-Ho	(H-h)/(H-Ho)
0	10.	.680	8.321	8.321	1.000
10	10.	.678	8.319	8.321	1.000
20	10.	.675	8.316	8.321	0.999
30	10.	.673	8.314	8.321	0.999
40	10.	.671	8.312	8.321	0.999
50	10.	.670	8.311	8.321	0.999
60	10.	.667	8.308	8.321	0.998
75	10.	.663	8.304	8.321	0.998
90	10.	.661	8.302	8.321	0.998
105	10.	.655	8.296	8.321	0.997
120	10.	.653	8.294	8.321	0.997
150	10.	.646	8.287	8.321	0.996
180	10.	.642	8.283	8.321	0.995
210	10.	.636	8.277	8.321	0.995
240	10.	.630	8.271	8.321	0.994
270	10.	.627	8.268	8.321	0.994
300	10.	.620	8.261	8.321	0.993
360	10.	.613	8.254	8.321	0.992
420	10.	.590	8.231	8.321	0.989
480	10.	.565	8.206	8.321	0.986
540					
600					
900	10.	.513	8.154	8.321	0.980
1200	10.	.457	8.098	8.321	0.973
1500	10	.404	8.045	8.321	0.967
1560	10.	.389	8.030	8.321	0.965
1620	10.	.374	8.015	8.321	0.963
1680	10.	.362	8.003	8.321	0.962
1740	10.	.347	7.988	8.321	0.960
1800	10.	.335	7.976	8.321	0.959
1860	10.	.320	7.961	8.321	0.957
1920	10	.308	7.949	8.321	0.955
1980	10	.299	7.940	8.321	0.954
2040	10	.287	7.928	8.321	0.953
2100	10	.275	7.916	8.321	0.951
2160	10.	.263	7.904	8.321	0.950





In-Situ Hydraulic Conductivity Analyses - BH12D

Appendix E Certificate of Analysis



Your Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT Your C.O.C. #: 647580-01-01

Attention: Arthur Szybalski

Cole Engineering Group Ltd 70 Valleywood Dr Markham, ON CANADA L3R 4T5

> Report Date: 2018/02/06 Report #: R4970846 Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B818943 Received: 2018/01/25, 18:08

Sample Matrix: Water # Samples Received: 1

		Date	Date		
Analyses	Quantity	Extracted	Analyzed	Laboratory Method	Reference
Alkalinity	1	N/A	2018/01/26	CAM SOP-00448	SM 22 2320 B m
Carbonate, Bicarbonate and Hydroxide	1	N/A	2018/01/29	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	1	N/A	2018/01/29	CAM SOP-00463	EPA 325.2 m
Conductivity	1	N/A	2018/01/26	CAM SOP-00414	SM 22 2510 m
Dissolved Organic Carbon (DOC) (1)	1	N/A	2018/01/27	CAM SOP-00446	SM 22 5310 B m
Hardness (calculated as CaCO3)	1	N/A	2018/01/30	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	1	N/A	2018/01/30	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	1	N/A	2018/01/30		
Anion and Cation Sum	1	N/A	2018/01/30		
Total Ammonia-N	1	N/A	2018/02/01	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (2)	1	N/A	2018/01/29	CAM SOP-00440	SM 22 4500-NO3I/NO2B
рН	1	N/A	2018/01/26	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	1	N/A	2018/01/29	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	1	N/A	2018/01/30		
Sat. pH and Langelier Index (@ 4C)	1	N/A	2018/01/30		
Sulphate by Automated Colourimetry	1	N/A	2018/01/29	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	1	N/A	2018/01/30		

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.



Your Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT Your C.O.C. #: 647580-01-01

Attention: Arthur Szybalski

Cole Engineering Group Ltd 70 Valleywood Dr Markham, ON CANADA L3R 4T5

> Report Date: 2018/02/06 Report #: R4970846 Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B818943

Received: 2018/01/25, 18:08

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.

(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager. Jolanta Goralczyk, Project Manager Email: JGoralczyk@maxxam.ca Phone# (905)817-5751

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

Total Cover Pages : 2 Page 2 of 11



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

RCAP - COMPREHENSIVE (WATER)

Maxxam ID					FZD251		
Sampling Date					2018/01/25		
		-			14:10		
COC Number					647580-01-01		
		UNITS	Criteria	Criteria-2	BH8D	RDL	QC Batch
Calculated Parar	neters						
Anion Sum		me/L	-	-	11.7	N/A	5370360
Bicarb. Alkalinity	(calc. as CaCO3)	mg/L	-	-	450	1.0	5369295
Calculated TDS		mg/L	-	-	620	1.0	5369360
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	-	2.2	1.0	5369295
Cation Sum		me/L	-	-	11.1	N/A	5370360
Hardness (CaCO3	3)	mg/L	-	-	470	1.0	5370041
Ion Balance (% D	ifference)	%	-	-	2.80	N/A	5370042
Langelier Index (@ 20C)	N/A	-	-	1.00		5370363
Langelier Index (@ 4C)	N/A	-	-	0.756		5370364
Saturation pH (@	20C)	N/A	-	-	6.72		5370363
Saturation pH (@	9 4C)	N/A	-	-	6.97		5370364
Inorganics							
Total Ammonia-N	N	mg/L	-	-	0.087	0.050	5374412
Conductivity		umho/cm	-	-	1000	1.0	5371394
Dissolved Organi	c Carbon	mg/L	-	-	2.1	0.50	5371736
Orthophosphate	(P)	mg/L	-	-	ND	0.010	5371415
рН		рН	-	-	7.72		5371393
Dissolved Sulpha	te (SO4)	mg/L	-	-	64	1.0	5371416
Alkalinity (Total a	as CaCO3)	mg/L	-	-	450	1.0	5371392
Dissolved Chloric	le (Cl)	mg/L	790	790	28	1.0	5371408
Nitrite (N)		mg/L	-	-	0.079	0.010	5372089
Nitrate (N)		mg/L	-	-	6.98	0.10	5372089
Nitrate + Nitrite	(N)	mg/L	-	-	7.05	0.10	5372089
No Fill	No Exceedance						
Grey	Exceeds 1 criter	ia policy/lev	vel				
Black	Exceeds both cr	iteria/levels					
RDL = Reportable	e Detection Limit						
QC Batch = Quali	ty Control Batch						
Criteria: Ontario Reg. 153/04 (Amended April 15, 2011) Table 1: Full Depth Background Site Condition Standards Ground Water - All Types of Property Uses Criteria-2: Ontario Reg. 153/04 (Amended April 15, 2011)							
Table 2: Full Dep Potable Ground V ND = Not detecte	th Generic Site Co Water- All Types o ed	ndition Star f Property L	ndards in Jses - Coa	a Potable G arse Texture	iround Water Co ed Soil	onditio	n
N/A = Not Applic	able						



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

RCAP - COMPREHENSIVE (WATER)

Maxxam ID				FZD251		
Sampling Date				2018/01/25		
				14:10		
COC Number				647580-01-01		
	UNITS	Criteria	Criteria-2	BH8D	RDL	QC Batch
Dissolved Aluminum (Al)	ug/L	-	-	ND	5.0	5372091
Dissolved Antimony (Sb)	ug/L	1.5	6.0	0.98	0.50	5372091
Dissolved Arsenic (As)	ug/L	13	25	ND	1.0	5372091
Dissolved Barium (Ba)	ug/L	610	1000	95	2.0	5372091
Dissolved Beryllium (Be)	ug/L	0.5	4.0	ND	0.50	5372091
Dissolved Boron (B)	ug/L	1700	5000	60	10	5372091
Dissolved Cadmium (Cd)	ug/L	0.5	2.7	ND	0.10	5372091
Dissolved Calcium (Ca)	ug/L	-	-	130000	200	5372091
Dissolved Chromium (Cr)	ug/L	11	50	ND	5.0	5372091
Dissolved Cobalt (Co)	ug/L	3.8	3.8	ND	0.50	5372091
Dissolved Copper (Cu)	ug/L	5	87	ND	1.0	5372091
Dissolved Iron (Fe)	ug/L	-	-	ND	100	5372091
Dissolved Lead (Pb)	ug/L	1.9	10	ND	0.50	5372091
Dissolved Magnesium (Mg)	ug/L	-	-	34000	50	5372091
Dissolved Manganese (Mn)	ug/L	-	-	47	2.0	5372091
Dissolved Molybdenum (Mo)	ug/L	23	70	2.2	0.50	5372091
Dissolved Nickel (Ni)	ug/L	14	100	2.2	1.0	5372091
Dissolved Phosphorus (P)	ug/L	-	-	ND	100	5372091
Dissolved Potassium (K)	ug/L	-	-	6900	200	5372091
Dissolved Selenium (Se)	ug/L	5	10	ND	2.0	5372091
Dissolved Silicon (Si)	ug/L	-	-	10000	50	5372091
Dissolved Silver (Ag)	ug/L	0.3	1.5	ND	0.10	5372091
Dissolved Sodium (Na)	ug/L	490000	490000	36000	100	5372091
Dissolved Strontium (Sr)	ug/L	-	-	400	1.0	5372091
Dissolved Thallium (Tl)	ug/L	0.5	2.0	ND	0.050	5372091
No Fill No Exceedance						
Grey Exceeds 1 criter	ia policy/lev	vel				
Black Exceeds both cr	iteria/levels	5				
RDL = Reportable Detection Limit						
QC Batch = Quality Control Batch						
Criteria: Ontario Reg. 153/04 (Ame	ended April	15, 2011)				
Table 1: Full Depth Background Site Condition Standards						
Ground Water - All Types of Prope	rty Uses		1)			
Table 2: Full Depth Generic Site Co	ndition Sta	ndards in	⊥) a Potable G	Fround Water C	onditio	n
Potable Ground Water- All Types of	of Property	Uses - Coa	arse Texture	ed Soil		
ND = Not detected						



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

RCAP - COMPREHENSIVE (WATER)

Maxxam ID					FZD251		
Sampling Date					2018/01/25		
Sampling Date					14:10		
COC Number					647580-01-01		
		UNITS	Criteria	Criteria-2	BH8D	RDL	QC Batch
Dissolved Titaniu	um (Ti)	ug/L	-	-	ND	5.0	5372091
Dissolved Uraniu	um (U)	ug/L	8.9	20	0.37	0.10	5372091
Dissolved Vanad	lium (V)	ug/L	3.9	6.2	0.58	0.50	5372091
Dissolved Zinc (Z	ːn)	ug/L	160	1100	5.8	5.0	5372091
No Fill	No Exceedance						
Grey	Exceeds 1 criteri	a policy/lev	/el				
Black	Exceeds both cri	teria/levels	;				
RDL = Reportabl	e Detection Limit						
QC Batch = Qual	ity Control Batch						
Criteria: Ontario Reg. 153/04 (Amended April 15, 2011) Table 1: Full Depth Background Site Condition Standards Ground Water - All Types of Property Uses							
Criteria-2: Ontario Reg. 153/04 (Amended April 15, 2011) Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition Potable Ground Water- All Types of Property Uses - Coarse Textured Soil ND = Not detected							



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

TEST SUMMARY

Maxxam ID:	FZD248	Collected:	2018/01/25
Sample ID:	BH8S	Shipped:	
Matrix:	Water	Received:	2018/01/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5371392	N/A	2018/01/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5369295	N/A	2018/01/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
Conductivity	AT	5371394	N/A	2018/01/26	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
Hardness (calculated as CaCO3)		5370041	N/A	2018/01/30	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
Ion Balance (% Difference)	CALC	5370042	N/A	2018/01/30	Automated Statchk
Anion and Cation Sum	CALC	5370360	N/A	2018/01/30	Automated Statchk
Total Ammonia-N	LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5372089	N/A	2018/01/29	Chandra Nandlal
рН	AT	5371393	N/A	2018/01/26	Surinder Rai
Orthophosphate	KONE	5371415	N/A	2018/01/29	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5370363	N/A	2018/01/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5370364	N/A	2018/01/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5371416	N/A	2018/01/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5369360	N/A	2018/01/30	Automated Statchk

Maxxam ID:	FZD249
Sample ID:	BH7
Matrix:	Water

Collected:	2018/01/25
Shipped:	
Received:	2018/01/25

Instrumentation	Batch	Extracted	Date Analyzed	Analyst
AT	5371392	N/A	2018/01/26	Surinder Rai
CALC	5369295	N/A	2018/01/29	Automated Statchk
KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
AT	5371394	N/A	2018/01/26	Surinder Rai
TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
	5370041	N/A	2018/01/30	Automated Statchk
ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
CALC	5370042	N/A	2018/01/30	Automated Statchk
CALC	5370360	N/A	2018/01/30	Automated Statchk
LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
LACH	5372089	N/A	2018/01/29	Chandra Nandlal
AT	5371393	N/A	2018/01/26	Surinder Rai
KONE	5371415	N/A	2018/01/29	Alina Dobreanu
CALC	5370363	N/A	2018/01/30	Automated Statchk
CALC	5370364	N/A	2018/01/30	Automated Statchk
KONE	5371416	N/A	2018/01/29	Alina Dobreanu
CALC	5369360	N/A	2018/01/30	Automated Statchk
	Instrumentation AT CALC KONE AT TOCV/NDIR ICP/MS CALC CALC CALC LACH/NH4 LACH AT KONE CALC CALC CALC CALC CALC CALC CALC CAL	Instrumentation Batch AT 5371392 CALC 5369295 KONE 5371408 AT 5371394 TOCV/NDIR 5371736 ICP/MS 5370041 ICP/MS 5370042 CALC 5370042 CALC 5370360 LACH/NH4 5372089 AT 5371393 KONE 5371415 CALC 5370363 CALC 5370363 CALC 5370363 CALC 5370364 KONE 5371415 CALC 5370364 KONE 5371416 CALC 5369360	Instrumentation Batch Extracted AT 5371392 N/A CALC 5369295 N/A KONE 5371408 N/A AT 5371394 N/A AT 5371394 N/A AT 5371394 N/A TOCV/NDIR 5371736 N/A ICP/MS 5372091 N/A CALC 5370042 N/A CALC 5370360 N/A CALC 5370360 N/A LACH/NH4 5372089 N/A AT 5371393 N/A KONE 5371415 N/A CALC 5370363 N/A LACH 5371415 N/A KONE 5371415 N/A CALC 5370364 N/A CALC 5370364 N/A CALC 5371416 N/A CALC 5369360 N/A	Instrumentation Batch Extracted Date Analyzed AT 5371392 N/A 2018/01/26 CALC 5369295 N/A 2018/01/29 KONE 5371408 N/A 2018/01/29 AT 5371394 N/A 2018/01/29 AT 5371394 N/A 2018/01/26 TOCV/NDIR 5371736 N/A 2018/01/26 TOCV/NDIR 5370041 N/A 2018/01/30 ICP/MS 5370041 N/A 2018/01/30 CALC 5370042 N/A 2018/01/30 CALC 5370360 N/A 2018/01/30 CALC 537042 N/A 2018/01/30 LACH/NH4 5372089 N/A 2018/01/30 LACH 5372089 N/A 2018/01/29 AT 5371393 N/A 2018/01/29 AT 5371415 N/A 2018/01/29 CALC 5370363 N/A 2018/01/30 CALC 5370364 <t< td=""></t<>



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

TEST SUMMARY

Maxxam ID:	FZD250	Collected:	2018/01/25
Sample ID:	BH1	Shipped:	
Matrix:	Water	Received:	2018/01/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5371392	N/A	2018/01/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5369295	N/A	2018/01/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
Conductivity	AT	5371394	N/A	2018/01/26	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
Hardness (calculated as CaCO3)		5370041	N/A	2018/01/30	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
Ion Balance (% Difference)	CALC	5370042	N/A	2018/01/30	Automated Statchk
Anion and Cation Sum	CALC	5370360	N/A	2018/01/30	Automated Statchk
Total Ammonia-N	LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5372089	N/A	2018/01/29	Chandra Nandlal
рН	AT	5371393	N/A	2018/01/26	Surinder Rai
Orthophosphate	KONE	5371415	N/A	2018/01/29	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5370363	N/A	2018/01/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5370364	N/A	2018/01/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5371416	N/A	2018/01/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5369360	N/A	2018/01/30	Automated Statchk

Maxxam ID:	FZD251
Sample ID:	BH8D
Matrix:	Water

Collected:	2018/01/25
Shipped:	
Received:	2018/01/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5371392	N/A	2018/01/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5369295	N/A	2018/01/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
Conductivity	AT	5371394	N/A	2018/01/26	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
Hardness (calculated as CaCO3)		5370041	N/A	2018/01/30	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
Ion Balance (% Difference)	CALC	5370042	N/A	2018/01/30	Automated Statchk
Anion and Cation Sum	CALC	5370360	N/A	2018/01/30	Automated Statchk
Total Ammonia-N	LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5372089	N/A	2018/01/29	Chandra Nandlal
рН	AT	5371393	N/A	2018/01/26	Surinder Rai
Orthophosphate	KONE	5371415	N/A	2018/01/29	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5370363	N/A	2018/01/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5370364	N/A	2018/01/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5371416	N/A	2018/01/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5369360	N/A	2018/01/30	Automated Statchk



Maxxam Job #: B818943 Report Date: 2018/02/06 Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

GENERAL COMMENTS

Each te	emperature is the	average of up to t	ee cooler temperatures taken at receipt
	Package 1	3.0°C	
Revise	d Report (2018/02	2/06): Criteria limit	have been added as per client's request.
Result	s relate only to th	e items tested.	



Maxxam Job #: B818943 Report Date: 2018/02/06

QUALITY ASSURANCE REPORT

Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

			Matrix	Spike	SPIKED	BLANK	Method E	Method Blank		D
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5371392	Alkalinity (Total as CaCO3)	2018/01/26			98	85 - 115	ND, RDL=1.0	mg/L	0.79	20
5371393	pH	2018/01/26			101	98 - 103			0.31	N/A
5371394	Conductivity	2018/01/26			99	85 - 115	ND, RDL=1.0	umho/cm	0.48	25
5371408	Dissolved Chloride (Cl)	2018/01/29	NC	80 - 120	105	80 - 120	ND, RDL=1.0	mg/L	0.067	20
5371415	Orthophosphate (P)	2018/01/29	107	75 - 125	100	80 - 120	ND, RDL=0.010	mg/L	NC	25
5371416	Dissolved Sulphate (SO4)	2018/01/29	NC	75 - 125	100	80 - 120	ND, RDL=1.0	mg/L	0.82	20
5371736	Dissolved Organic Carbon	2018/01/27	92	80 - 120	94	80 - 120	ND, RDL=0.50	mg/L	0.37	20
5372089	Nitrate (N)	2018/01/29	96	80 - 120	107	80 - 120	ND, RDL=0.10	mg/L	0.20	20
5372089	Nitrite (N)	2018/01/29	100	80 - 120	98	80 - 120	ND, RDL=0.010	mg/L	4.6	20
5372091	Dissolved Aluminum (Al)	2018/01/30	97	80 - 120	98	80 - 120	ND, RDL=5.0	ug/L	NC	20
5372091	Dissolved Antimony (Sb)	2018/01/30	100	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Arsenic (As)	2018/01/30	97	80 - 120	98	80 - 120	ND, RDL=1.0	ug/L	NC	20
5372091	Dissolved Barium (Ba)	2018/01/30	96	80 - 120	97	80 - 120	ND, RDL=2.0	ug/L	5.8	20
5372091	Dissolved Beryllium (Be)	2018/01/30	97	80 - 120	99	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Boron (B)	2018/01/30	98	80 - 120	100	80 - 120	ND, RDL=10	ug/L	NC	20
5372091	Dissolved Cadmium (Cd)	2018/01/30	97	80 - 120	98	80 - 120	ND, RDL=0.10	ug/L	NC	20
5372091	Dissolved Calcium (Ca)	2018/01/30	NC	80 - 120	98	80 - 120	ND, RDL=200	ug/L	3.3	20
5372091	Dissolved Chromium (Cr)	2018/01/30	96	80 - 120	98	80 - 120	ND, RDL=5.0	ug/L	NC	20
5372091	Dissolved Cobalt (Co)	2018/01/30	93	80 - 120	96	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Copper (Cu)	2018/01/30	96	80 - 120	100	80 - 120	ND, RDL=1.0	ug/L	NC	20
5372091	Dissolved Iron (Fe)	2018/01/30	96	80 - 120	99	80 - 120	ND, RDL=100	ug/L	NC	20
5372091	Dissolved Lead (Pb)	2018/01/30	92	80 - 120	95	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Magnesium (Mg)	2018/01/30	96	80 - 120	99	80 - 120	ND, RDL=50	ug/L	1.1	20
5372091	Dissolved Manganese (Mn)	2018/01/30	94	80 - 120	95	80 - 120	ND, RDL=2.0	ug/L	NC	20
5372091	Dissolved Molybdenum (Mo)	2018/01/30	98	80 - 120	98	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Nickel (Ni)	2018/01/30	93	80 - 120	96	80 - 120	ND, RDL=1.0	ug/L	NC	20
5372091	Dissolved Phosphorus (P)	2018/01/30	101	80 - 120	107	80 - 120	ND, RDL=100	ug/L	NC	20
5372091	Dissolved Potassium (K)	2018/01/30	98	80 - 120	101	80 - 120	ND, RDL=200	ug/L	2.3	20
5372091	Dissolved Selenium (Se)	2018/01/30	96	80 - 120	97	80 - 120	ND, RDL=2.0	ug/L	NC	20
5372091	Dissolved Silicon (Si)	2018/01/30	98	80 - 120	98	80 - 120	ND, RDL=50	ug/L	3.7	20
5372091	Dissolved Silver (Ag)	2018/01/30	94	80 - 120	96	80 - 120	ND, RDL=0.10	ug/L	NC	20



Maxxam Job #: B818943 Report Date: 2018/02/06

QUALITY ASSURANCE REPORT(CONT'D)

Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

			Matrix Spike		SPIKED BLANK		Method Blank		RPI)
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5372091	Dissolved Sodium (Na)	2018/01/30	97	80 - 120	100	80 - 120	ND, RDL=100	ug/L	0.69	20
5372091	Dissolved Strontium (Sr)	2018/01/30	94	80 - 120	96	80 - 120	ND, RDL=1.0	ug/L	1.1	20
5372091	Dissolved Thallium (TI)	2018/01/30	92	80 - 120	95	80 - 120	ND, RDL=0.050	ug/L	NC	20
5372091	Dissolved Titanium (Ti)	2018/01/30	97	80 - 120	99	80 - 120	ND, RDL=5.0	ug/L	NC	20
5372091	Dissolved Uranium (U)	2018/01/30	92	80 - 120	93	80 - 120	ND, RDL=0.10	ug/L	0.22	20
5372091	Dissolved Vanadium (V)	2018/01/30	95	80 - 120	96	80 - 120	ND, RDL=0.50	ug/L	12	20
5372091	Dissolved Zinc (Zn)	2018/01/30	87	80 - 120	89	80 - 120	ND, RDL=5.0	ug/L	NC	20
5374412	Total Ammonia-N	2018/02/01	100	75 - 125	98	80 - 120	ND, RDL=0.050	mg/L	13	20

N/A = Not Applicable

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

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

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

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

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

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

VALIDATION SIGNATURE PAGE

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

Eve Risberge Eva Pran

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

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



Your Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT Your C.O.C. #: 647580-01-01

Attention: Arthur Szybalski

Cole Engineering Group Ltd 70 Valleywood Dr Markham, ON CANADA L3R 4T5

> Report Date: 2018/02/06 Report #: R4970846 Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B818943 Received: 2018/01/25, 18:08

Sample Matrix: Water # Samples Received: 4

		Date	Date		
Analyses	Quantity	Extracted	Analyzed	Laboratory Method	Reference
Alkalinity	4	N/A	2018/01/26	CAM SOP-00448	SM 22 2320 B m
Carbonate, Bicarbonate and Hydroxide	4	N/A	2018/01/29	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	4	N/A	2018/01/29	CAM SOP-00463	EPA 325.2 m
Conductivity	4	N/A	2018/01/26	CAM SOP-00414	SM 22 2510 m
Dissolved Organic Carbon (DOC) (1)	4	N/A	2018/01/27	CAM SOP-00446	SM 22 5310 B m
Hardness (calculated as CaCO3)	4	N/A	2018/01/30	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	4	N/A	2018/01/30	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	4	N/A	2018/01/30		
Anion and Cation Sum	4	N/A	2018/01/30		
Total Ammonia-N	4	N/A	2018/02/01	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (2)	4	N/A	2018/01/29	CAM SOP-00440	SM 22 4500-NO3I/NO2B
рН	4	N/A	2018/01/26	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	4	N/A	2018/01/29	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	4	N/A	2018/01/30		
Sat. pH and Langelier Index (@ 4C)	4	N/A	2018/01/30		
Sulphate by Automated Colourimetry	4	N/A	2018/01/29	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	4	N/A	2018/01/30		

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.



Your Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT Your C.O.C. #: 647580-01-01

Attention: Arthur Szybalski

Cole Engineering Group Ltd 70 Valleywood Dr Markham, ON CANADA L3R 4T5

> Report Date: 2018/02/06 Report #: R4970846 Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B818943

Received: 2018/01/25, 18:08

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.

(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager. Jolanta Goralczyk, Project Manager Email: JGoralczyk@maxxam.ca Phone# (905)817-5751

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

Total Cover Pages : 2 Page 2 of 11



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

RCAP - COMPREHENSIVE (WATER)

Maxxam ID				FZD248	FZD249	FZD250	FZD251		
Compling Date				2018/01/25	2018/01/25	2018/01/25	2018/01/25		
Samping Date				14:10	14:50	13:40	14:10		
COC Number				647580-01-01	647580-01-01	647580-01-01	647580-01-01		
	UNITS	Criteria	Criteria-2	BH8S	BH7	BH1	BH8D	RDL	QC Batch
Calculated Parameters									
Anion Sum	me/L	-	-	9.37	11.3	11.9	11.7	N/A	5370360
Bicarb. Alkalinity (calc. as CaCO3) mg/L	-		400	330	470	450	1.0	5369295
Calculated TDS	mg/L		-	500	610	620	620	1.0	5369360
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	-	2.7	1.9	2.6	2.2	1.0	5369295
Cation Sum	me/L	-		8.72	10.5	11.2	11.1	N/A	5370360
Hardness (CaCO3)	mg/L	-	-	310	390	510	470	1.0	5370041
Ion Balance (% Difference)	%	-	-	3.55	3.46	3.17	2.80	N/A	5370042
Langelier Index (@ 20C)	N/A	-	-	1.01	0.910	1.18	1.00		5370363
Langelier Index (@ 4C)	N/A	-		0.761	0.663	0.928	0.756		5370364
Saturation pH (@ 20C)	N/A	-	-	6.86	6.87	6.59	6.72		5370363
Saturation pH (@ 4C)	N/A	-	-	7.10	7.12	6.84	6.97		5370364
Inorganics									
Total Ammonia-N	mg/L	-	-	0.11	0.39	0.24	0.087	0.050	5374412
Conductivity	umho/cm	<u> </u>		800	1100	1000	1000	1.0	5371394
Dissolved Organic Carbon	mg/L	-	-	1.7	6.4	6.6	2.1	0.50	5371736
Orthophosphate (P)	mg/L	-		ND	ND	ND	ND	0.010	5371415
рН	рН	-	-	7.86	7.78	7.77	7.72		5371393
Dissolved Sulphate (SO4)	mg/L		-	31	55	80	64	1.0	5371416
Alkalinity (Total as CaCO3)	mg/L	-	-	400	330	470	450	1.0	5371392
Dissolved Chloride (Cl)	mg/L	790	790	14	130	27	28	1.0	5371408
Nitrite (N)	mg/L		-	ND	ND	0.081	0.079	0.010	5372089
Nitrate (N)	mg/L	-	-	4.63	ND	0.50	6.98	0.10	5372089
Nitrate + Nitrite (N)	mg/L	-	-	4.63	ND	0.58	7.05	0.10	5372089
No Fill No Ex	eedance								

Grey Black Exceeds 1 criteria policy/level

Exceeds both criteria/levels

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

Criteria: Ontario Reg. 153/04 (Amended April 15, 2011)

Table 1: Full Depth Background Site Condition Standards

Ground Water - All Types of Property Uses

Criteria-2: Ontario Reg. 153/04 (Amended April 15, 2011)

Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition

Potable Ground Water- All Types of Property Uses - Coarse Textured Soil

N/A = Not Applicable

ND = Not detected



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

RCAP - COMPREHENSIVE (WATER)

Maxxam ID					FZD248	FZD249	FZD250	FZD251		
Sampling Date					2018/01/25	2018/01/25	2018/01/25	2018/01/25		
					14:10	14:50	13:40	14:10	<u> </u>	
COC Number					647580-01-01	647580-01-01	647580-01-01	647580-01-01		
	U	NITS	Criteria	Criteria-2	BH8S	BH7	BH1	BH8D	RDL	QC Batch
Metals										
Dissolved Aluminum (Al)		ıg/L	-	-	ND	ND	ND	ND	5.0	5372091
Dissolved Antimony (Sb)	U	ıg/L	1.5	6.0	ND	ND	0.61	0.98	0.50	5372091
Dissolved Arsenic (As)	u	ıg/L	13	25	ND	1.8	ND	ND	1.0	5372091
Dissolved Barium (Ba)	u	ıg/L	610	1000	53	76	130	95	2.0	5372091
Dissolved Beryllium (Be)	u	ıg/L	0.5	4.0	ND	ND	ND	ND	0.50	5372091
Dissolved Boron (B)	u	ıg/L	1700	5000	34	20	56	60	10	5372091
Dissolved Cadmium (Cd)	U	ıg/L	0.5	2.7	ND	ND	ND	ND	0.10	5372091
Dissolved Calcium (Ca)	u	ıg/L	-	-	100000	120000	170000	130000	200	5372091
Dissolved Chromium (Cr)	u	ıg/L	11	50	ND	ND	ND	ND	5.0	5372091
Dissolved Cobalt (Co)	u	ıg/L	3.8	3.8	ND	1.6	2.8	ND	0.50	5372091
Dissolved Copper (Cu)	U	ıg/L	5	87	1.2	6.3	4.7	ND	1.0	5372091
Dissolved Iron (Fe)	u	ıg/L	-	-	ND	1600	ND	ND	100	5372091
Dissolved Lead (Pb)	U	ıg/L	1.9	10	ND	ND	ND	ND	0.50	5372091
Dissolved Magnesium (Mg)		ıg/L	-	-	12000	19000	23000	34000	50	5372091
Dissolved Manganese (Mn)		ıg/L	-	-	45	1300	1700	47	2.0	5372091
Dissolved Molybdenum (Mo)	U	ıg/L	23	70	1.2	0.95	2.6	2.2	0.50	5372091
Dissolved Nickel (Ni)		ıg/L	14	100	1.4	2.0	4.1	2.2	1.0	5372091
Dissolved Phosphorus (P)	u	ıg/L	-	-	ND	ND	ND	ND	100	5372091
Dissolved Potassium (K)	u	ıg/L	-	-	3600	2400	3700	6900	200	5372091
Dissolved Selenium (Se)	u	ıg/L	5	10	ND	ND	ND	ND	2.0	5372091
Dissolved Silicon (Si)	u	ıg/L	-	-	7800	7500	7300	10000	50	5372091
Dissolved Silver (Ag)	u	ıg/L	0.3	1.5	ND	ND	ND	ND	0.10	5372091
Dissolved Sodium (Na)	u	ıg/L	490000	490000	57000	61000	19000	36000	100	5372091
Dissolved Strontium (Sr)	u	ıg/L	-	-	260	320	440	400	1.0	5372091
Dissolved Thallium (TI)	u	ıg/L	0.5	2.0	ND	ND	ND	ND	0.050	5372091
Dissolved Titanium (Ti)	u	ıg/L	-	-	ND	ND	ND	ND	5.0	5372091
No Fill No	Exceedan	ce								
Grey Exc	Grey Exceeds 1 criteria policy/level									
Black Exceeds both criteria/levels										
RDL = Reportable Detection Limit										
QC Batch = Quality Control Ba	QC Batch = Quality Control Batch									
Criteria: Ontario Reg. 153/04 (Amended April 15, 2011) Table 1: Full Depth Background Site Condition Standards Ground Water - All Types of Property Uses										
Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition Potable Ground Water- All Types of Property Uses - Coarse Textured Soil										

ND = Not detected


Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID					FZD248	FZD249	FZD250	FZD251		
Sampling Date					2018/01/25 14:10	2018/01/25 14:50	2018/01/25 13:40	2018/01/25 14:10		
COC Number					647580-01-01	647580-01-01	647580-01-01	647580-01-01		
		UNITS	Criteria	Criteria-2	BH8S	BH7	BH1	BH8D	RDL	QC Batch
Dissolved Uranium (U)		ug/L	8.9	20	0.40	0.40	2.3	0.37	0.10	5372091
Dissolved Vanadium (V)		ug/L	3.9	6.2	ND	ND	0.58	0.58	0.50	5372091
Dissolved Zinc (Zn)		ug/L	160	1100	ND	ND	7.0	5.8	5.0	5372091
No Fill	No Exce	edance								
Grey	Exceeds	1 criteria p	olicy/leve	el						
Black	Exceeds	both criteri	a/levels							
RDL = Reportable Detect	ion Limit									
QC Batch = Quality Cont	rol Batch									
Criteria: Ontario Reg. 153/04 (Amended April 15, 2011) Table 1: Full Depth Background Site Condition Standards Ground Water - All Types of Property Uses										
Criteria-2: Ontario Reg. 153/04 (Amended April 15, 2011) Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition Potable Ground Water- All Types of Property Uses - Coarse Textured Soil ND = Not detected										



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID:	FZD248	Collected:	2018/01/25
Sample ID:	BH8S	Shipped:	
Matrix:	Water	Received:	2018/01/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5371392	N/A	2018/01/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5369295	N/A	2018/01/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
Conductivity	AT	5371394	N/A	2018/01/26	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
Hardness (calculated as CaCO3)		5370041	N/A	2018/01/30	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
Ion Balance (% Difference)	CALC	5370042	N/A	2018/01/30	Automated Statchk
Anion and Cation Sum	CALC	5370360	N/A	2018/01/30	Automated Statchk
Total Ammonia-N	LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5372089	N/A	2018/01/29	Chandra Nandlal
рН	AT	5371393	N/A	2018/01/26	Surinder Rai
Orthophosphate	KONE	5371415	N/A	2018/01/29	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5370363	N/A	2018/01/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5370364	N/A	2018/01/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5371416	N/A	2018/01/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5369360	N/A	2018/01/30	Automated Statchk

Maxxam ID:	FZD249
Sample ID:	BH7
Matrix:	Water

Collected:	2018/01/25
Shipped:	
Received:	2018/01/25

Instrumentation	Batch	Extracted	Date Analyzed	Analyst
AT	5371392	N/A	2018/01/26	Surinder Rai
CALC	5369295	N/A	2018/01/29	Automated Statchk
KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
AT	5371394	N/A	2018/01/26	Surinder Rai
TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
	5370041	N/A	2018/01/30	Automated Statchk
ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
CALC	5370042	N/A	2018/01/30	Automated Statchk
CALC	5370360	N/A	2018/01/30	Automated Statchk
LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
LACH	5372089	N/A	2018/01/29	Chandra Nandlal
AT	5371393	N/A	2018/01/26	Surinder Rai
KONE	5371415	N/A	2018/01/29	Alina Dobreanu
CALC	5370363	N/A	2018/01/30	Automated Statchk
CALC	5370364	N/A	2018/01/30	Automated Statchk
KONE	5371416	N/A	2018/01/29	Alina Dobreanu
CALC	5369360	N/A	2018/01/30	Automated Statchk
	Instrumentation AT CALC KONE AT TOCV/NDIR ICP/MS CALC CALC CALC LACH/NH4 LACH AT KONE CALC CALC CALC CALC CALC CALC CALC CAL	Instrumentation Batch AT 5371392 CALC 5369295 KONE 5371408 AT 5371394 TOCV/NDIR 5371736 ICP/MS 5370041 ICP/MS 5370042 CALC 5370042 CALC 5370360 LACH/NH4 5372089 AT 5371393 KONE 5371415 CALC 5370363 CALC 5370363 CALC 5370363 CALC 5370364 KONE 5371415 CALC 5370364 KONE 5371416 CALC 5369360	Instrumentation Batch Extracted AT 5371392 N/A CALC 5369295 N/A KONE 5371408 N/A AT 5371394 N/A AT 5371394 N/A AT 5371394 N/A TOCV/NDIR 5371736 N/A ICP/MS 5372091 N/A CALC 5370042 N/A CALC 5370360 N/A CALC 5370360 N/A LACH/NH4 5372089 N/A AT 5371393 N/A KONE 5371415 N/A CALC 5370363 N/A LACH 5371415 N/A KONE 5371415 N/A CALC 5370364 N/A CALC 5370364 N/A CALC 5371416 N/A CALC 5369360 N/A	Instrumentation Batch Extracted Date Analyzed AT 5371392 N/A 2018/01/26 CALC 5369295 N/A 2018/01/29 KONE 5371408 N/A 2018/01/29 AT 5371394 N/A 2018/01/29 AT 5371394 N/A 2018/01/26 TOCV/NDIR 5371736 N/A 2018/01/26 TOCV/NDIR 5370041 N/A 2018/01/30 ICP/MS 5370041 N/A 2018/01/30 CALC 5370042 N/A 2018/01/30 CALC 5370360 N/A 2018/01/30 CALC 5370360 N/A 2018/01/30 LACH/NH4 5372089 N/A 2018/01/29 AT 5371393 N/A 2018/01/29 AT 5370363 N/A 2018/01/29 CALC 5370363 N/A 2018/01/30 CALC 5370364 N/A 2018/01/30 CALC 5371416 <



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID:	FZD250	Collected:	2018/01/25
Sample ID:	BH1	Shipped:	
Matrix:	Water	Received:	2018/01/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5371392	N/A	2018/01/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5369295	N/A	2018/01/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
Conductivity	AT	5371394	N/A	2018/01/26	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
Hardness (calculated as CaCO3)		5370041	N/A	2018/01/30	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
Ion Balance (% Difference)	CALC	5370042	N/A	2018/01/30	Automated Statchk
Anion and Cation Sum	CALC	5370360	N/A	2018/01/30	Automated Statchk
Total Ammonia-N	LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5372089	N/A	2018/01/29	Chandra Nandlal
рН	AT	5371393	N/A	2018/01/26	Surinder Rai
Orthophosphate	KONE	5371415	N/A	2018/01/29	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5370363	N/A	2018/01/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5370364	N/A	2018/01/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5371416	N/A	2018/01/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5369360	N/A	2018/01/30	Automated Statchk

Maxxam ID:	FZD251
Sample ID:	BH8D
Matrix:	Water

Collected:	2018/01/25
Shipped:	
Received:	2018/01/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5371392	N/A	2018/01/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5369295	N/A	2018/01/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
Conductivity	AT	5371394	N/A	2018/01/26	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
Hardness (calculated as CaCO3)		5370041	N/A	2018/01/30	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
Ion Balance (% Difference)	CALC	5370042	N/A	2018/01/30	Automated Statchk
Anion and Cation Sum	CALC	5370360	N/A	2018/01/30	Automated Statchk
Total Ammonia-N	LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5372089	N/A	2018/01/29	Chandra Nandlal
рН	AT	5371393	N/A	2018/01/26	Surinder Rai
Orthophosphate	KONE	5371415	N/A	2018/01/29	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5370363	N/A	2018/01/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5370364	N/A	2018/01/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5371416	N/A	2018/01/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5369360	N/A	2018/01/30	Automated Statchk



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

GENERAL COMMENTS

Each te	emperature is the	average of up to t	ee cooler temperatures taken at receipt
	Package 1	3.0°C	
Revise	d Report (2018/02	2/06): Criteria limit	have been added as per client's request.
Result	s relate only to th	e items tested.	



QUALITY ASSURANCE REPORT

Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

			Matrix	Matrix Spike SPIKED BLANK		Method Blank		RPD		
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5371392	Alkalinity (Total as CaCO3)	2018/01/26			98	85 - 115	ND, RDL=1.0	mg/L	0.79	20
5371393	рН	2018/01/26			101	98 - 103			0.31	N/A
5371394	Conductivity	2018/01/26			99	85 - 115	ND, RDL=1.0	umho/cm	0.48	25
5371408	Dissolved Chloride (Cl)	2018/01/29	NC	80 - 120	105	80 - 120	ND, RDL=1.0	mg/L	0.067	20
5371415	Orthophosphate (P)	2018/01/29	107	75 - 125	100	80 - 120	ND, RDL=0.010	mg/L	NC	25
5371416	Dissolved Sulphate (SO4)	2018/01/29	NC	75 - 125	100	80 - 120	ND, RDL=1.0	mg/L	0.82	20
5371736	Dissolved Organic Carbon	2018/01/27	92	80 - 120	94	80 - 120	ND, RDL=0.50	mg/L	0.37	20
5372089	Nitrate (N)	2018/01/29	96	80 - 120	107	80 - 120	ND, RDL=0.10	mg/L	0.20	20
5372089	Nitrite (N)	2018/01/29	100	80 - 120	98	80 - 120	ND, RDL=0.010	mg/L	4.6	20
5372091	Dissolved Aluminum (Al)	2018/01/30	97	80 - 120	98	80 - 120	ND, RDL=5.0	ug/L	NC	20
5372091	Dissolved Antimony (Sb)	2018/01/30	100	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Arsenic (As)	2018/01/30	97	80 - 120	98	80 - 120	ND, RDL=1.0	ug/L	NC	20
5372091	Dissolved Barium (Ba)	2018/01/30	96	80 - 120	97	80 - 120	ND, RDL=2.0	ug/L	5.8	20
5372091	Dissolved Beryllium (Be)	2018/01/30	97	80 - 120	99	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Boron (B)	2018/01/30	98	80 - 120	100	80 - 120	ND, RDL=10	ug/L	NC	20
5372091	Dissolved Cadmium (Cd)	2018/01/30	97	80 - 120	98	80 - 120	ND, RDL=0.10	ug/L	NC	20
5372091	Dissolved Calcium (Ca)	2018/01/30	NC	80 - 120	98	80 - 120	ND, RDL=200	ug/L	3.3	20
5372091	Dissolved Chromium (Cr)	2018/01/30	96	80 - 120	98	80 - 120	ND, RDL=5.0	ug/L	NC	20
5372091	Dissolved Cobalt (Co)	2018/01/30	93	80 - 120	96	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Copper (Cu)	2018/01/30	96	80 - 120	100	80 - 120	ND, RDL=1.0	ug/L	NC	20
5372091	Dissolved Iron (Fe)	2018/01/30	96	80 - 120	99	80 - 120	ND, RDL=100	ug/L	NC	20
5372091	Dissolved Lead (Pb)	2018/01/30	92	80 - 120	95	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Magnesium (Mg)	2018/01/30	96	80 - 120	99	80 - 120	ND, RDL=50	ug/L	1.1	20
5372091	Dissolved Manganese (Mn)	2018/01/30	94	80 - 120	95	80 - 120	ND, RDL=2.0	ug/L	NC	20
5372091	Dissolved Molybdenum (Mo)	2018/01/30	98	80 - 120	98	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Nickel (Ni)	2018/01/30	93	80 - 120	96	80 - 120	ND, RDL=1.0	ug/L	NC	20
5372091	Dissolved Phosphorus (P)	2018/01/30	101	80 - 120	107	80 - 120	ND, RDL=100	ug/L	NC	20
5372091	Dissolved Potassium (K)	2018/01/30	98	80 - 120	101	80 - 120	ND, RDL=200	ug/L	2.3	20
5372091	Dissolved Selenium (Se)	2018/01/30	96	80 - 120	97	80 - 120	ND, RDL=2.0	ug/L	NC	20
5372091	Dissolved Silicon (Si)	2018/01/30	98	80 - 120	98	80 - 120	ND, RDL=50	ug/L	3.7	20
5372091	Dissolved Silver (Ag)	2018/01/30	94	80 - 120	96	80 - 120	ND, RDL=0.10	ug/L	NC	20



QUALITY ASSURANCE REPORT(CONT'D)

Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

			Matrix	Matrix Spike SPIKED BLANK		Method Blank		RPD		
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5372091	Dissolved Sodium (Na)	2018/01/30	97	80 - 120	100	80 - 120	ND, RDL=100	ug/L	0.69	20
5372091	Dissolved Strontium (Sr)	2018/01/30	94	80 - 120	96	80 - 120	ND, RDL=1.0	ug/L	1.1	20
5372091	Dissolved Thallium (TI)	2018/01/30	92	80 - 120	95	80 - 120	ND, RDL=0.050	ug/L	NC	20
5372091	Dissolved Titanium (Ti)	2018/01/30	97	80 - 120	99	80 - 120	ND, RDL=5.0	ug/L	NC	20
5372091	Dissolved Uranium (U)	2018/01/30	92	80 - 120	93	80 - 120	ND, RDL=0.10	ug/L	0.22	20
5372091	Dissolved Vanadium (V)	2018/01/30	95	80 - 120	96	80 - 120	ND, RDL=0.50	ug/L	12	20
5372091	Dissolved Zinc (Zn)	2018/01/30	87	80 - 120	89	80 - 120	ND, RDL=5.0	ug/L	NC	20
5374412	Total Ammonia-N	2018/02/01	100	75 - 125	98	80 - 120	ND, RDL=0.050	mg/L	13	20

N/A = Not Applicable

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

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

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

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

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

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

VALIDATION SIGNATURE PAGE

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

Eve Risberge Eva Pran

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

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



Your Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT Your C.O.C. #: 647580-01-01

Attention: Arthur Szybalski

Cole Engineering Group Ltd 70 Valleywood Dr Markham, ON CANADA L3R 4T5

> Report Date: 2018/02/06 Report #: R4970846 Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B818943 Received: 2018/01/25, 18:08

Sample Matrix: Water # Samples Received: 1

		Date	Date		
Analyses	Quantity	Extracted	Analyzed	Laboratory Method	Reference
Alkalinity	1	N/A	2018/01/26	CAM SOP-00448	SM 22 2320 B m
Carbonate, Bicarbonate and Hydroxide	1	N/A	2018/01/29	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	1	N/A	2018/01/29	CAM SOP-00463	EPA 325.2 m
Conductivity	1	N/A	2018/01/26	CAM SOP-00414	SM 22 2510 m
Dissolved Organic Carbon (DOC) (1)	1	N/A	2018/01/27	CAM SOP-00446	SM 22 5310 B m
Hardness (calculated as CaCO3)	1	N/A	2018/01/30	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	1	N/A	2018/01/30	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	1	N/A	2018/01/30		
Anion and Cation Sum	1	N/A	2018/01/30		
Total Ammonia-N	1	N/A	2018/02/01	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (2)	1	N/A	2018/01/29	CAM SOP-00440	SM 22 4500-NO3I/NO2B
рН	1	N/A	2018/01/26	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	1	N/A	2018/01/29	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	1	N/A	2018/01/30		
Sat. pH and Langelier Index (@ 4C)	1	N/A	2018/01/30		
Sulphate by Automated Colourimetry	1	N/A	2018/01/29	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	1	N/A	2018/01/30		

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.



Your Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT Your C.O.C. #: 647580-01-01

Attention: Arthur Szybalski

Cole Engineering Group Ltd 70 Valleywood Dr Markham, ON CANADA L3R 4T5

> Report Date: 2018/02/06 Report #: R4970846 Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B818943

Received: 2018/01/25, 18:08

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.

(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager. Jolanta Goralczyk, Project Manager Email: JGoralczyk@maxxam.ca Phone# (905)817-5751

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Total Cover Pages : 2 Page 2 of 11



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID FZD248							
Sampling Date					2018/01/25		
		_			14:10		
COC Number					647580-01-01		
		UNITS	Criteria	Criteria-2	BH8S	RDL	QC Batch
Calculated Parar	neters						
Anion Sum		me/L	-	-	9.37	N/A	5370360
Bicarb. Alkalinity	(calc. as CaCO3)	mg/L	-	-	400	1.0	5369295
Calculated TDS		mg/L	-	-	500	1.0	5369360
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	-	2.7	1.0	5369295
Cation Sum		me/L	-	-	8.72	N/A	5370360
Hardness (CaCO	3)	mg/L	-	-	310	1.0	5370041
Ion Balance (% D	ifference)	%	-	-	3.55	N/A	5370042
Langelier Index (@ 20C)	N/A	-	-	1.01		5370363
Langelier Index (@ 4C)	N/A	-	-	0.761		5370364
Saturation pH (@	20C)	N/A	-	-	6.86		5370363
Saturation pH (@	N/A	-	-	7.10		5370364	
Inorganics							
Total Ammonia-I	mg/L	-	-	0.11	0.050	5374412	
Conductivity		umho/cm	-	-	800	1.0	5371394
Dissolved Organic Carbon		mg/L	-	-	1.7	0.50	5371736
Orthophosphate (P)		mg/L	-	-	ND	0.010	5371415
рН		рН	-	-	7.86		5371393
Dissolved Sulpha	te (SO4)	mg/L	-	-	31	1.0	5371416
Alkalinity (Total a	as CaCO3)	mg/L	-	-	400	1.0	5371392
Dissolved Chloric	le (Cl)	mg/L	790	790	14	1.0	5371408
Nitrite (N)		mg/L	-	-	ND	0.010	5372089
Nitrate (N)		mg/L	-	-	4.63	0.10	5372089
Nitrate + Nitrite	(N)	mg/L	-	-	4.63	0.10	5372089
No Fill	No Exceedance						
Grey	Exceeds 1 criter	ia policy/lev	vel				
Black	Exceeds both cr	iteria/levels					
RDL = Reportable	e Detection Limit						
QC Batch = Quali	ty Control Batch						
Criteria: Ontario Reg. 153/04 (Amended April 15, 2011) Table 1: Full Depth Background Site Condition Standards Ground Water - All Types of Property Uses Criteria-2: Ontario Reg. 153/04 (Amended April 15, 2011) Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition Potable Ground Water- All Types of Property Uses - Coarse Textured Soil							
N/A = Not Applic	ahle						
NA – NOLAPPIC	avie						



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID				FZD248		
Sampling Date				2018/01/25		
				14:10		
COC Number				647580-01-01		
	UNITS	Criteria	Criteria-2	BH8S	RDL	QC Batch
Dissolved Aluminum (Al)	ug/L	-	-	ND	5.0	5372091
Dissolved Antimony (Sb)	ug/L	1.5	6.0	ND	0.50	5372091
Dissolved Arsenic (As)	ug/L	13	25	ND	1.0	5372091
Dissolved Barium (Ba)	ug/L	610	1000	53	2.0	5372091
Dissolved Beryllium (Be)	ug/L	0.5	4.0	ND	0.50	5372091
Dissolved Boron (B)	ug/L	1700	5000	34	10	5372091
Dissolved Cadmium (Cd)	ug/L	0.5	2.7	ND	0.10	5372091
Dissolved Calcium (Ca)	ug/L	-	-	100000	200	5372091
Dissolved Chromium (Cr)	ug/L	11	50	ND	5.0	5372091
Dissolved Cobalt (Co)	ug/L	3.8	3.8	ND	0.50	5372091
Dissolved Copper (Cu)	ug/L	5	87	1.2	1.0	5372091
Dissolved Iron (Fe)	ug/L	-	-	ND	100	5372091
Dissolved Lead (Pb)	ug/L	1.9	10	ND	0.50	5372091
Dissolved Magnesium (Mg)	ug/L	-	-	12000	50	5372091
Dissolved Manganese (Mn)	ug/L	-	-	45	2.0	5372091
Dissolved Molybdenum (Mo)	ug/L	23	70	1.2	0.50	5372091
Dissolved Nickel (Ni)	ug/L	14	100	1.4	1.0	5372091
Dissolved Phosphorus (P)	ug/L	-	-	ND	100	5372091
Dissolved Potassium (K)	ug/L	-	-	3600	200	5372091
Dissolved Selenium (Se)	ug/L	5	10	ND	2.0	5372091
Dissolved Silicon (Si)	ug/L	-	-	7800	50	5372091
Dissolved Silver (Ag)	ug/L	0.3	1.5	ND	0.10	5372091
Dissolved Sodium (Na)	ug/L	490000	490000	57000	100	5372091
Dissolved Strontium (Sr)	ug/L	-	-	260	1.0	5372091
Dissolved Thallium (Tl)	ug/L	0.5	2.0	ND	0.050	5372091
No Fill No Exceedance						
Grey Exceeds 1 criter	ia policy/lev	vel				
Black Exceeds both cr	iteria/levels	5				
RDL = Reportable Detection Limit						
QC Batch = Quality Control Batch						
Criteria: Ontario Reg. 153/04 (Ame	ended April	15, 2011)				
Table 1: Full Depth Background Site Condition Standards						
Ground Water - All Types of Prope	Ground Water - All Types of Property Uses					
Table 2: Full Depth Generic Site Co	ndition Sta	ndards in	⊥) a Potable G	Fround Water C	onditio	n
Potable Ground Water- All Types of	of Property	Uses - Coa	arse Texture	ed Soil		
ND = Not detected						



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID					FZD248			
Sampling Date					2018/01/25			
Sumpling Date					14:10			
COC Number	OC Number				647580-01-01			
		UNITS	Criteria	Criteria-2	BH8S	RDL	QC Batch	
Dissolved Titaniu	um (Ti)	ug/L	-	-	ND	5.0	5372091	
Dissolved Uraniu	ım (U)	ug/L	8.9	20	0.40	0.10	5372091	
Dissolved Vanad	ium (V)	ug/L	3.9	6.2	ND	0.50	5372091	
Dissolved Zinc (Z	ːn)	ug/L	160	1100	ND	5.0	5372091	
No Fill	No Exceedance		-					
Grey	Exceeds 1 criteria policy/level							
Black	Exceeds both cri	teria/levels	;					
RDL = Reportable	e Detection Limit							
QC Batch = Qual	ity Control Batch							
Criteria: Ontario Table 1: Full De Ground Water -	Criteria: Ontario Reg. 153/04 (Amended April 15, 2011) Table 1: Full Depth Background Site Condition Standards Ground Water - All Types of Property Uses							
Criteria-2: Ontar Table 2: Full Dep Potable Ground ND = Not detect	Criteria-2: Ontario Reg. 153/04 (Amended April 15, 2011) Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition Potable Ground Water- All Types of Property Uses - Coarse Textured Soil ND = Not detected							



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID:	FZD248	Collected:	2018/01/25
Sample ID:	BH8S	Shipped:	
Matrix:	Water	Received:	2018/01/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5371392	N/A	2018/01/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5369295	N/A	2018/01/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
Conductivity	AT	5371394	N/A	2018/01/26	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
Hardness (calculated as CaCO3)		5370041	N/A	2018/01/30	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
Ion Balance (% Difference)	CALC	5370042	N/A	2018/01/30	Automated Statchk
Anion and Cation Sum	CALC	5370360	N/A	2018/01/30	Automated Statchk
Total Ammonia-N	LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5372089	N/A	2018/01/29	Chandra Nandlal
рН	AT	5371393	N/A	2018/01/26	Surinder Rai
Orthophosphate	KONE	5371415	N/A	2018/01/29	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5370363	N/A	2018/01/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5370364	N/A	2018/01/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5371416	N/A	2018/01/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5369360	N/A	2018/01/30	Automated Statchk

Maxxam ID:	FZD249
Sample ID:	BH7
Matrix:	Water

Collected:	2018/01/25
Shipped:	
Received:	2018/01/25

Instrumentation	Batch	Extracted	Date Analyzed	Analyst
AT	5371392	N/A	2018/01/26	Surinder Rai
CALC	5369295	N/A	2018/01/29	Automated Statchk
KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
AT	5371394	N/A	2018/01/26	Surinder Rai
TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
	5370041	N/A	2018/01/30	Automated Statchk
ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
CALC	5370042	N/A	2018/01/30	Automated Statchk
CALC	5370360	N/A	2018/01/30	Automated Statchk
LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
LACH	5372089	N/A	2018/01/29	Chandra Nandlal
AT	5371393	N/A	2018/01/26	Surinder Rai
KONE	5371415	N/A	2018/01/29	Alina Dobreanu
CALC	5370363	N/A	2018/01/30	Automated Statchk
CALC	5370364	N/A	2018/01/30	Automated Statchk
KONE	5371416	N/A	2018/01/29	Alina Dobreanu
CALC	5369360	N/A	2018/01/30	Automated Statchk
	Instrumentation AT CALC KONE AT TOCV/NDIR ICP/MS CALC CALC CALC LACH/NH4 LACH AT KONE CALC CALC CALC CALC CALC CALC CALC CAL	Instrumentation Batch AT 5371392 CALC 5369295 KONE 5371408 AT 5371394 TOCV/NDIR 5371736 ICP/MS 5370041 ICP/MS 5370042 CALC 5370042 CALC 5370360 LACH/NH4 5372089 AT 5371393 KONE 5371415 CALC 5370363 CALC 5370363 CALC 5370363 CALC 5370364 KONE 5371415 CALC 5370364 KONE 5371416 CALC 5369360	Instrumentation Batch Extracted AT 5371392 N/A CALC 5369295 N/A KONE 5371408 N/A AT 5371394 N/A AT 5371394 N/A AT 5371394 N/A TOCV/NDIR 5371736 N/A ICP/MS 5372091 N/A CALC 5370042 N/A CALC 5370360 N/A CALC 5370360 N/A LACH/NH4 5372089 N/A AT 5371393 N/A KONE 5371415 N/A CALC 5370363 N/A LACH 5371415 N/A KONE 5371415 N/A CALC 5370364 N/A CALC 5370364 N/A CALC 5371416 N/A CALC 5369360 N/A	Instrumentation Batch Extracted Date Analyzed AT 5371392 N/A 2018/01/26 CALC 5369295 N/A 2018/01/29 KONE 5371408 N/A 2018/01/29 AT 5371394 N/A 2018/01/29 AT 5371394 N/A 2018/01/26 TOCV/NDIR 5371736 N/A 2018/01/26 TOCV/NDIR 5370041 N/A 2018/01/30 ICP/MS 5370041 N/A 2018/01/30 CALC 5370042 N/A 2018/01/30 CALC 5370360 N/A 2018/01/30 CALC 5370360 N/A 2018/01/30 LACH/NH4 5372089 N/A 2018/01/29 AT 5371393 N/A 2018/01/29 AT 5370363 N/A 2018/01/29 CALC 5370363 N/A 2018/01/30 CALC 5370364 N/A 2018/01/30 CALC 5371416 <



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID:	FZD250	Collected:	2018/01/25
Sample ID:	BH1	Shipped:	
Matrix:	Water	Received:	2018/01/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5371392	N/A	2018/01/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5369295	N/A	2018/01/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
Conductivity	AT	5371394	N/A	2018/01/26	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
Hardness (calculated as CaCO3)		5370041	N/A	2018/01/30	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
Ion Balance (% Difference)	CALC	5370042	N/A	2018/01/30	Automated Statchk
Anion and Cation Sum	CALC	5370360	N/A	2018/01/30	Automated Statchk
Total Ammonia-N	LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5372089	N/A	2018/01/29	Chandra Nandlal
рН	AT	5371393	N/A	2018/01/26	Surinder Rai
Orthophosphate	KONE	5371415	N/A	2018/01/29	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5370363	N/A	2018/01/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5370364	N/A	2018/01/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5371416	N/A	2018/01/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5369360	N/A	2018/01/30	Automated Statchk

Maxxam ID:	FZD251
Sample ID:	BH8D
Matrix:	Water

Collected:	2018/01/25
Shipped:	
Received:	2018/01/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5371392	N/A	2018/01/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5369295	N/A	2018/01/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
Conductivity	AT	5371394	N/A	2018/01/26	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
Hardness (calculated as CaCO3)		5370041	N/A	2018/01/30	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
Ion Balance (% Difference)	CALC	5370042	N/A	2018/01/30	Automated Statchk
Anion and Cation Sum	CALC	5370360	N/A	2018/01/30	Automated Statchk
Total Ammonia-N	LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5372089	N/A	2018/01/29	Chandra Nandlal
рН	AT	5371393	N/A	2018/01/26	Surinder Rai
Orthophosphate	KONE	5371415	N/A	2018/01/29	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5370363	N/A	2018/01/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5370364	N/A	2018/01/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5371416	N/A	2018/01/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5369360	N/A	2018/01/30	Automated Statchk



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

GENERAL COMMENTS

Each te	emperature is the	average of up to t	ee cooler temperatures taken at receipt
	Package 1	3.0°C	
Revise	d Report (2018/02	2/06): Criteria limit	have been added as per client's request.
Result	s relate only to th	e items tested.	



QUALITY ASSURANCE REPORT

Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

			Matrix Spike		SPIKED	SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	
5371392	Alkalinity (Total as CaCO3)	2018/01/26			98	85 - 115	ND, RDL=1.0	mg/L	0.79	20	
5371393	рН	2018/01/26			101	98 - 103			0.31	N/A	
5371394	Conductivity	2018/01/26			99	85 - 115	ND, RDL=1.0	umho/cm	0.48	25	
5371408	Dissolved Chloride (Cl)	2018/01/29	NC	80 - 120	105	80 - 120	ND, RDL=1.0	mg/L	0.067	20	
5371415	Orthophosphate (P)	2018/01/29	107	75 - 125	100	80 - 120	ND, RDL=0.010	mg/L	NC	25	
5371416	Dissolved Sulphate (SO4)	2018/01/29	NC	75 - 125	100	80 - 120	ND, RDL=1.0	mg/L	0.82	20	
5371736	Dissolved Organic Carbon	2018/01/27	92	80 - 120	94	80 - 120	ND, RDL=0.50	mg/L	0.37	20	
5372089	Nitrate (N)	2018/01/29	96	80 - 120	107	80 - 120	ND, RDL=0.10	mg/L	0.20	20	
5372089	Nitrite (N)	2018/01/29	100	80 - 120	98	80 - 120	ND, RDL=0.010	mg/L	4.6	20	
5372091	Dissolved Aluminum (Al)	2018/01/30	97	80 - 120	98	80 - 120	ND, RDL=5.0	ug/L	NC	20	
5372091	Dissolved Antimony (Sb)	2018/01/30	100	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L	NC	20	
5372091	Dissolved Arsenic (As)	2018/01/30	97	80 - 120	98	80 - 120	ND, RDL=1.0	ug/L	NC	20	
5372091	Dissolved Barium (Ba)	2018/01/30	96	80 - 120	97	80 - 120	ND, RDL=2.0	ug/L	5.8	20	
5372091	Dissolved Beryllium (Be)	2018/01/30	97	80 - 120	99	80 - 120	ND, RDL=0.50	ug/L	NC	20	
5372091	Dissolved Boron (B)	2018/01/30	98	80 - 120	100	80 - 120	ND, RDL=10	ug/L	NC	20	
5372091	Dissolved Cadmium (Cd)	2018/01/30	97	80 - 120	98	80 - 120	ND, RDL=0.10	ug/L	NC	20	
5372091	Dissolved Calcium (Ca)	2018/01/30	NC	80 - 120	98	80 - 120	ND, RDL=200	ug/L	3.3	20	
5372091	Dissolved Chromium (Cr)	2018/01/30	96	80 - 120	98	80 - 120	ND, RDL=5.0	ug/L	NC	20	
5372091	Dissolved Cobalt (Co)	2018/01/30	93	80 - 120	96	80 - 120	ND, RDL=0.50	ug/L	NC	20	
5372091	Dissolved Copper (Cu)	2018/01/30	96	80 - 120	100	80 - 120	ND, RDL=1.0	ug/L	NC	20	
5372091	Dissolved Iron (Fe)	2018/01/30	96	80 - 120	99	80 - 120	ND, RDL=100	ug/L	NC	20	
5372091	Dissolved Lead (Pb)	2018/01/30	92	80 - 120	95	80 - 120	ND, RDL=0.50	ug/L	NC	20	
5372091	Dissolved Magnesium (Mg)	2018/01/30	96	80 - 120	99	80 - 120	ND, RDL=50	ug/L	1.1	20	
5372091	Dissolved Manganese (Mn)	2018/01/30	94	80 - 120	95	80 - 120	ND, RDL=2.0	ug/L	NC	20	
5372091	Dissolved Molybdenum (Mo)	2018/01/30	98	80 - 120	98	80 - 120	ND, RDL=0.50	ug/L	NC	20	
5372091	Dissolved Nickel (Ni)	2018/01/30	93	80 - 120	96	80 - 120	ND, RDL=1.0	ug/L	NC	20	
5372091	Dissolved Phosphorus (P)	2018/01/30	101	80 - 120	107	80 - 120	ND, RDL=100	ug/L	NC	20	
5372091	Dissolved Potassium (K)	2018/01/30	98	80 - 120	101	80 - 120	ND, RDL=200	ug/L	2.3	20	
5372091	Dissolved Selenium (Se)	2018/01/30	96	80 - 120	97	80 - 120	ND, RDL=2.0	ug/L	NC	20	
5372091	Dissolved Silicon (Si)	2018/01/30	98	80 - 120	98	80 - 120	ND, RDL=50	ug/L	3.7	20	
5372091	Dissolved Silver (Ag)	2018/01/30	94	80 - 120	96	80 - 120	ND, RDL=0.10	ug/L	NC	20	



QUALITY ASSURANCE REPORT(CONT'D)

Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

			Matrix	Spike	SPIKED	BLANK	Method B	lank	RPI)
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5372091	Dissolved Sodium (Na)	2018/01/30	97	80 - 120	100	80 - 120	ND, RDL=100	ug/L	0.69	20
5372091	Dissolved Strontium (Sr)	2018/01/30	94	80 - 120	96	80 - 120	ND, RDL=1.0	ug/L	1.1	20
5372091	Dissolved Thallium (TI)	2018/01/30	92	80 - 120	95	80 - 120	ND, RDL=0.050	ug/L	NC	20
5372091	Dissolved Titanium (Ti)	2018/01/30	97	80 - 120	99	80 - 120	ND, RDL=5.0	ug/L	NC	20
5372091	Dissolved Uranium (U)	2018/01/30	92	80 - 120	93	80 - 120	ND, RDL=0.10	ug/L	0.22	20
5372091	Dissolved Vanadium (V)	2018/01/30	95	80 - 120	96	80 - 120	ND, RDL=0.50	ug/L	12	20
5372091	Dissolved Zinc (Zn)	2018/01/30	87	80 - 120	89	80 - 120	ND, RDL=5.0	ug/L	NC	20
5374412	Total Ammonia-N	2018/02/01	100	75 - 125	98	80 - 120	ND, RDL=0.050	mg/L	13	20

N/A = Not Applicable

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

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

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

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

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

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

VALIDATION SIGNATURE PAGE

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

Eve Risberge Eva Pran

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

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



Your Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT Your C.O.C. #: 647580-01-01

Attention: Arthur Szybalski

Cole Engineering Group Ltd 70 Valleywood Dr Markham, ON CANADA L3R 4T5

> Report Date: 2018/02/06 Report #: R4970846 Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B818943 Received: 2018/01/25, 18:08

Sample Matrix: Water # Samples Received: 1

		Date	Date		
Analyses	Quantity	Extracted	Analyzed	Laboratory Method	Reference
Alkalinity	1	N/A	2018/01/26	CAM SOP-00448	SM 22 2320 B m
Carbonate, Bicarbonate and Hydroxide	1	N/A	2018/01/29	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	1	N/A	2018/01/29	CAM SOP-00463	EPA 325.2 m
Conductivity	1	N/A	2018/01/26	CAM SOP-00414	SM 22 2510 m
Dissolved Organic Carbon (DOC) (1)	1	N/A	2018/01/27	CAM SOP-00446	SM 22 5310 B m
Hardness (calculated as CaCO3)	1	N/A	2018/01/30	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	1	N/A	2018/01/30	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	1	N/A	2018/01/30		
Anion and Cation Sum	1	N/A	2018/01/30		
Total Ammonia-N	1	N/A	2018/02/01	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (2)	1	N/A	2018/01/29	CAM SOP-00440	SM 22 4500-NO3I/NO2B
рН	1	N/A	2018/01/26	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	1	N/A	2018/01/29	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	1	N/A	2018/01/30		
Sat. pH and Langelier Index (@ 4C)	1	N/A	2018/01/30		
Sulphate by Automated Colourimetry	1	N/A	2018/01/29	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	1	N/A	2018/01/30		

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.



Your Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT Your C.O.C. #: 647580-01-01

Attention: Arthur Szybalski

Cole Engineering Group Ltd 70 Valleywood Dr Markham, ON CANADA L3R 4T5

> Report Date: 2018/02/06 Report #: R4970846 Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B818943

Received: 2018/01/25, 18:08

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.

(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager. Jolanta Goralczyk, Project Manager Email: JGoralczyk@maxxam.ca Phone# (905)817-5751

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

Total Cover Pages : 2 Page 2 of 11



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID FZD249						
Sampling Date				2018/01/25		
				14:50		
COC Number				647580-01-01		
	UNITS	Criteria	Criteria-2	BH7	RDL	QC Batch
Calculated Parameters	-					
Anion Sum	me/L	-	-	11.3	N/A	5370360
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	-	-	330	1.0	5369295
Calculated TDS	mg/L	-	-	610	1.0	5369360
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	-	1.9	1.0	5369295
Cation Sum	me/L	-	-	10.5	N/A	5370360
Hardness (CaCO3)	mg/L	-	-	390	1.0	5370041
Ion Balance (% Difference)	%	-	-	3.46	N/A	5370042
Langelier Index (@ 20C)	N/A	-	-	0.910		5370363
Langelier Index (@ 4C)	N/A	-	-	0.663		5370364
Saturation pH (@ 20C)	N/A	-	-	6.87		5370363
Saturation pH (@ 4C)	N/A	-	-	7.12		5370364
Inorganics	-					
Total Ammonia-N	mg/L	-	-	0.39	0.050	5374412
Conductivity	umho/cm	-	-	1100	1.0	5371394
Dissolved Organic Carbon	mg/L	-	-	6.4	0.50	5371736
Orthophosphate (P)	mg/L	-	-	ND	0.010	5371415
рН	рН	-	-	7.78		5371393
Dissolved Sulphate (SO4)	mg/L	-	-	55	1.0	5371416
Alkalinity (Total as CaCO3)	mg/L	-	-	330	1.0	5371392
Dissolved Chloride (Cl)	mg/L	790	790	130	1.0	5371408
Nitrite (N)	mg/L	-	-	ND	0.010	5372089
Nitrate (N)	mg/L	-	-	ND	0.10	5372089
Nitrate + Nitrite (N)	mg/L	-	-	ND	0.10	5372089
No Fill No Exceedance						
Grey Exceeds 1 criter	ia policy/lev	el				
Black Exceeds both cr	iteria/levels					
RDL = Reportable Detection Limit						
QC Batch = Quality Control Batch						
Criteria: Ontario Reg. 153/04 (Amended April 15, 2011) Table 1: Full Depth Background Site Condition Standards Ground Water - All Types of Property Uses Criteria-2: Ontario Reg. 153/04 (Amended April 15, 2011) Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition Potable Ground Water- All Types of Property Uses - Coarse Textured Soil						
N/A = Not Applicable						



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID				FZD249		
Sampling Date				2018/01/25		
				14:50		
		a ·· ·	<u></u>	64/580-01-01		
	UNITS	Criteria	Criteria-2	BH7	RDL	QC Batch
Dissolved Aluminum (Al)	ug/L	-	-	ND	5.0	5372091
Dissolved Antimony (Sb)	ug/L	1.5	6.0	ND	0.50	5372091
Dissolved Arsenic (As)	ug/L	13	25	1.8	1.0	5372091
Dissolved Barium (Ba)	ug/L	610	1000	76	2.0	5372091
Dissolved Beryllium (Be)	ug/L	0.5	4.0	ND	0.50	5372091
Dissolved Boron (B)	ug/L	1700	5000	20	10	5372091
Dissolved Cadmium (Cd)	ug/L	0.5	2.7	ND	0.10	5372091
Dissolved Calcium (Ca)	ug/L	-	-	120000	200	5372091
Dissolved Chromium (Cr)	ug/L	11	50	ND	5.0	5372091
Dissolved Cobalt (Co)	ug/L	3.8	3.8	1.6	0.50	5372091
Dissolved Copper (Cu)	ug/L	5	87	6.3	1.0	5372091
Dissolved Iron (Fe)	ug/L	-	-	1600	100	5372091
Dissolved Lead (Pb)	ug/L	1.9	10	ND	0.50	5372091
Dissolved Magnesium (Mg)	ug/L	-	-	19000	50	5372091
Dissolved Manganese (Mn)	ug/L	-	-	1300	2.0	5372091
Dissolved Molybdenum (Mo)	ug/L	23	70	0.95	0.50	5372091
Dissolved Nickel (Ni)	ug/L	14	100	2.0	1.0	5372091
Dissolved Phosphorus (P)	ug/L	-	-	ND	100	5372091
Dissolved Potassium (K)	ug/L	-	-	2400	200	5372091
Dissolved Selenium (Se)	ug/L	5	10	ND	2.0	5372091
Dissolved Silicon (Si)	ug/L	-	-	7500	50	5372091
Dissolved Silver (Ag)	ug/L	0.3	1.5	ND	0.10	5372091
Dissolved Sodium (Na)	ug/L	490000	490000	61000	100	5372091
Dissolved Strontium (Sr)	ug/L	-	-	320	1.0	5372091
Dissolved Thallium (Tl)	ug/L	0.5	2.0	ND	0.050	5372091
No Fill No Exceedance						
Grey Exceeds 1 criter	ia policy/lev	vel				
Black Exceeds both cr	iteria/levels	5				
RDL = Reportable Detection Limit						
QC Batch = Quality Control Batch						
Criteria: Ontario Reg. 153/04 (Ame	nded April	15, 2011)				
Table 1: Full Depth Background Site Condition Standards						
Ground Water - All Types of Prope	rty Uses		4)			
Table 2: Eull Denth Generic Site Co	ndition Star	ndards in	⊥) a Potable G	Ground Water C	onditio	n
Potable Ground Water- All Types o	f Property	Uses - Coa	arse Texture	ed Soil	chartio	
ND = Not detected						



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID					FZD249			
Sampling Date					2018/01/25			
oumping bate					14:50			
COC Number					647580-01-01			
		UNITS	Criteria	Criteria-2	BH7	RDL	QC Batch	
Dissolved Titaniu	um (Ti)	ug/L	-	-	ND	5.0	5372091	
Dissolved Uraniu	ım (U)	ug/L	8.9	20	0.40	0.10	5372091	
Dissolved Vanad	ium (V)	ug/L	3.9	6.2	ND	0.50	5372091	
Dissolved Zinc (Z	'n)	ug/L	160	1100	ND	5.0	5372091	
No Fill	No Exceedance							
Grey	Exceeds 1 criteri	a policy/lev	vel					
Black	Exceeds both cri	teria/levels	5					
RDL = Reportable	e Detection Limit							
QC Batch = Qual	ity Control Batch							
Criteria: Ontario Reg. 153/04 (Amended April 15, 2011) Table 1: Full Depth Background Site Condition Standards Ground Water - All Types of Property Uses								
Criteria-2: Ontario Reg. 153/04 (Amended April 15, 2011) Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition Potable Ground Water- All Types of Property Uses - Coarse Textured Soil ND = Not detected								



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID:	FZD248	Collected:	2018/01/25
Sample ID:	BH8S	Shipped:	
Matrix:	Water	Received:	2018/01/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5371392	N/A	2018/01/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5369295	N/A	2018/01/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
Conductivity	AT	5371394	N/A	2018/01/26	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
Hardness (calculated as CaCO3)		5370041	N/A	2018/01/30	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
Ion Balance (% Difference)	CALC	5370042	N/A	2018/01/30	Automated Statchk
Anion and Cation Sum	CALC	5370360	N/A	2018/01/30	Automated Statchk
Total Ammonia-N	LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5372089	N/A	2018/01/29	Chandra Nandlal
рН	AT	5371393	N/A	2018/01/26	Surinder Rai
Orthophosphate	KONE	5371415	N/A	2018/01/29	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5370363	N/A	2018/01/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5370364	N/A	2018/01/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5371416	N/A	2018/01/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5369360	N/A	2018/01/30	Automated Statchk

Maxxam ID:	FZD249
Sample ID:	BH7
Matrix:	Water

Collected:	2018/01/25
Shipped:	
Received:	2018/01/25

Instrumentation	Batch	Extracted	Date Analyzed	Analyst
AT	5371392	N/A	2018/01/26	Surinder Rai
CALC	5369295	N/A	2018/01/29	Automated Statchk
KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
AT	5371394	N/A	2018/01/26	Surinder Rai
TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
	5370041	N/A	2018/01/30	Automated Statchk
ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
CALC	5370042	N/A	2018/01/30	Automated Statchk
CALC	5370360	N/A	2018/01/30	Automated Statchk
LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
LACH	5372089	N/A	2018/01/29	Chandra Nandlal
AT	5371393	N/A	2018/01/26	Surinder Rai
KONE	5371415	N/A	2018/01/29	Alina Dobreanu
CALC	5370363	N/A	2018/01/30	Automated Statchk
CALC	5370364	N/A	2018/01/30	Automated Statchk
KONE	5371416	N/A	2018/01/29	Alina Dobreanu
CALC	5369360	N/A	2018/01/30	Automated Statchk
	Instrumentation AT CALC KONE AT TOCV/NDIR ICP/MS CALC CALC CALC LACH/NH4 LACH AT KONE CALC CALC CALC CALC CALC CALC CALC CAL	Instrumentation Batch AT 5371392 CALC 5369295 KONE 5371408 AT 5371394 TOCV/NDIR 5371736 ICP/MS 5370041 ICP/MS 5370042 CALC 5370042 CALC 5370360 LACH/NH4 5372089 AT 5371393 KONE 5371415 CALC 5370363 CALC 5370363 CALC 5370363 CALC 5370364 KONE 5371415 CALC 5370364 KONE 5371416 CALC 5369360	Instrumentation Batch Extracted AT 5371392 N/A CALC 5369295 N/A KONE 5371408 N/A AT 5371394 N/A AT 5371394 N/A AT 5371394 N/A TOCV/NDIR 5371736 N/A ICP/MS 5372091 N/A CALC 5370042 N/A CALC 5370360 N/A CALC 5370360 N/A LACH/NH4 5372089 N/A AT 5371393 N/A KONE 5371415 N/A CALC 5370363 N/A LACH 5371415 N/A KONE 5371415 N/A CALC 5370364 N/A CALC 5370364 N/A CALC 5371416 N/A CALC 5369360 N/A	Instrumentation Batch Extracted Date Analyzed AT 5371392 N/A 2018/01/26 CALC 5369295 N/A 2018/01/29 KONE 5371408 N/A 2018/01/29 AT 5371394 N/A 2018/01/29 AT 5371394 N/A 2018/01/26 TOCV/NDIR 5371736 N/A 2018/01/26 TOCV/NDIR 5370041 N/A 2018/01/30 ICP/MS 5370041 N/A 2018/01/30 CALC 5370042 N/A 2018/01/30 CALC 5370360 N/A 2018/01/30 CALC 5370360 N/A 2018/01/30 LACH/NH4 5372089 N/A 2018/01/29 AT 5371393 N/A 2018/01/29 AT 5370363 N/A 2018/01/29 CALC 5370363 N/A 2018/01/30 CALC 5370364 N/A 2018/01/30 CALC 5371416 <



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID:	FZD250	Collected:	2018/01/25
Sample ID:	BH1	Shipped:	
Matrix:	Water	Received:	2018/01/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5371392	N/A	2018/01/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5369295	N/A	2018/01/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
Conductivity	AT	5371394	N/A	2018/01/26	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
Hardness (calculated as CaCO3)		5370041	N/A	2018/01/30	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
Ion Balance (% Difference)	CALC	5370042	N/A	2018/01/30	Automated Statchk
Anion and Cation Sum	CALC	5370360	N/A	2018/01/30	Automated Statchk
Total Ammonia-N	LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5372089	N/A	2018/01/29	Chandra Nandlal
рН	AT	5371393	N/A	2018/01/26	Surinder Rai
Orthophosphate	KONE	5371415	N/A	2018/01/29	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5370363	N/A	2018/01/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5370364	N/A	2018/01/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5371416	N/A	2018/01/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5369360	N/A	2018/01/30	Automated Statchk

Maxxam ID:	FZD251
Sample ID:	BH8D
Matrix:	Water

Collected:	2018/01/25
Shipped:	
Received:	2018/01/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5371392	N/A	2018/01/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5369295	N/A	2018/01/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
Conductivity	AT	5371394	N/A	2018/01/26	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
Hardness (calculated as CaCO3)		5370041	N/A	2018/01/30	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
Ion Balance (% Difference)	CALC	5370042	N/A	2018/01/30	Automated Statchk
Anion and Cation Sum	CALC	5370360	N/A	2018/01/30	Automated Statchk
Total Ammonia-N	LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5372089	N/A	2018/01/29	Chandra Nandlal
рН	AT	5371393	N/A	2018/01/26	Surinder Rai
Orthophosphate	KONE	5371415	N/A	2018/01/29	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5370363	N/A	2018/01/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5370364	N/A	2018/01/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5371416	N/A	2018/01/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5369360	N/A	2018/01/30	Automated Statchk



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

GENERAL COMMENTS

Each te	emperature is the	average of up to t	ee cooler temperatures taken at receipt				
	Package 1	3.0°C					
Revise	Revised Report (2018/02/06): Criteria limits have been added as per client's request.						
Result	s relate only to th	e items tested.					



QUALITY ASSURANCE REPORT

Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

		Matrix Spike		Spike	SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5371392	Alkalinity (Total as CaCO3)	2018/01/26			98	85 - 115	ND, RDL=1.0	mg/L	0.79	20
5371393	рН	2018/01/26			101	98 - 103			0.31	N/A
5371394	Conductivity	2018/01/26			99	85 - 115	ND, RDL=1.0	umho/cm	0.48	25
5371408	Dissolved Chloride (Cl)	2018/01/29	NC	80 - 120	105	80 - 120	ND, RDL=1.0	mg/L	0.067	20
5371415	Orthophosphate (P)	2018/01/29	107	75 - 125	100	80 - 120	ND, RDL=0.010	mg/L	NC	25
5371416	Dissolved Sulphate (SO4)	2018/01/29	NC	75 - 125	100	80 - 120	ND, RDL=1.0	mg/L	0.82	20
5371736	Dissolved Organic Carbon	2018/01/27	92	80 - 120	94	80 - 120	ND, RDL=0.50	mg/L	0.37	20
5372089	Nitrate (N)	2018/01/29	96	80 - 120	107	80 - 120	ND, RDL=0.10	mg/L	0.20	20
5372089	Nitrite (N)	2018/01/29	100	80 - 120	98	80 - 120	ND, RDL=0.010	mg/L	4.6	20
5372091	Dissolved Aluminum (Al)	2018/01/30	97	80 - 120	98	80 - 120	ND, RDL=5.0	ug/L	NC	20
5372091	Dissolved Antimony (Sb)	2018/01/30	100	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Arsenic (As)	2018/01/30	97	80 - 120	98	80 - 120	ND, RDL=1.0	ug/L	NC	20
5372091	Dissolved Barium (Ba)	2018/01/30	96	80 - 120	97	80 - 120	ND, RDL=2.0	ug/L	5.8	20
5372091	Dissolved Beryllium (Be)	2018/01/30	97	80 - 120	99	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Boron (B)	2018/01/30	98	80 - 120	100	80 - 120	ND, RDL=10	ug/L	NC	20
5372091	Dissolved Cadmium (Cd)	2018/01/30	97	80 - 120	98	80 - 120	ND, RDL=0.10	ug/L	NC	20
5372091	Dissolved Calcium (Ca)	2018/01/30	NC	80 - 120	98	80 - 120	ND, RDL=200	ug/L	3.3	20
5372091	Dissolved Chromium (Cr)	2018/01/30	96	80 - 120	98	80 - 120	ND, RDL=5.0	ug/L	NC	20
5372091	Dissolved Cobalt (Co)	2018/01/30	93	80 - 120	96	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Copper (Cu)	2018/01/30	96	80 - 120	100	80 - 120	ND, RDL=1.0	ug/L	NC	20
5372091	Dissolved Iron (Fe)	2018/01/30	96	80 - 120	99	80 - 120	ND, RDL=100	ug/L	NC	20
5372091	Dissolved Lead (Pb)	2018/01/30	92	80 - 120	95	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Magnesium (Mg)	2018/01/30	96	80 - 120	99	80 - 120	ND, RDL=50	ug/L	1.1	20
5372091	Dissolved Manganese (Mn)	2018/01/30	94	80 - 120	95	80 - 120	ND, RDL=2.0	ug/L	NC	20
5372091	Dissolved Molybdenum (Mo)	2018/01/30	98	80 - 120	98	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Nickel (Ni)	2018/01/30	93	80 - 120	96	80 - 120	ND, RDL=1.0	ug/L	NC	20
5372091	Dissolved Phosphorus (P)	2018/01/30	101	80 - 120	107	80 - 120	ND, RDL=100	ug/L	NC	20
5372091	Dissolved Potassium (K)	2018/01/30	98	80 - 120	101	80 - 120	ND, RDL=200	ug/L	2.3	20
5372091	Dissolved Selenium (Se)	2018/01/30	96	80 - 120	97	80 - 120	ND, RDL=2.0	ug/L	NC	20
5372091	Dissolved Silicon (Si)	2018/01/30	98	80 - 120	98	80 - 120	ND, RDL=50	ug/L	3.7	20
5372091	Dissolved Silver (Ag)	2018/01/30	94	80 - 120	96	80 - 120	ND, RDL=0.10	ug/L	NC	20



QUALITY ASSURANCE REPORT(CONT'D)

Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

			Matrix Spike		SPIKED BLANK		Method Blank		RPI)
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5372091	Dissolved Sodium (Na)	2018/01/30	97	80 - 120	100	80 - 120	ND, RDL=100	ug/L	0.69	20
5372091	Dissolved Strontium (Sr)	2018/01/30	94	80 - 120	96	80 - 120	ND, RDL=1.0	ug/L	1.1	20
5372091	Dissolved Thallium (TI)	2018/01/30	92	80 - 120	95	80 - 120	ND, RDL=0.050	ug/L	NC	20
5372091	Dissolved Titanium (Ti)	2018/01/30	97	80 - 120	99	80 - 120	ND, RDL=5.0	ug/L	NC	20
5372091	Dissolved Uranium (U)	2018/01/30	92	80 - 120	93	80 - 120	ND, RDL=0.10	ug/L	0.22	20
5372091	Dissolved Vanadium (V)	2018/01/30	95	80 - 120	96	80 - 120	ND, RDL=0.50	ug/L	12	20
5372091	Dissolved Zinc (Zn)	2018/01/30	87	80 - 120	89	80 - 120	ND, RDL=5.0	ug/L	NC	20
5374412	Total Ammonia-N	2018/02/01	100	75 - 125	98	80 - 120	ND, RDL=0.050	mg/L	13	20

N/A = Not Applicable

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

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

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

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

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

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

VALIDATION SIGNATURE PAGE

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

Eve Risberge Eva Pran

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

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



Your Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT Your C.O.C. #: 647580-01-01

Attention: Arthur Szybalski

Cole Engineering Group Ltd 70 Valleywood Dr Markham, ON CANADA L3R 4T5

> Report Date: 2018/02/06 Report #: R4970846 Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B818943 Received: 2018/01/25, 18:08

Sample Matrix: Water # Samples Received: 1

		Date	Date		
Analyses	Quantity	Extracted	Analyzed	Laboratory Method	Reference
Alkalinity	1	N/A	2018/01/26	CAM SOP-00448	SM 22 2320 B m
Carbonate, Bicarbonate and Hydroxide	1	N/A	2018/01/29	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	1	N/A	2018/01/29	CAM SOP-00463	EPA 325.2 m
Conductivity	1	N/A	2018/01/26	CAM SOP-00414	SM 22 2510 m
Dissolved Organic Carbon (DOC) (1)	1	N/A	2018/01/27	CAM SOP-00446	SM 22 5310 B m
Hardness (calculated as CaCO3)	1	N/A	2018/01/30	CAM SOP 00102/00408/00447	SM 2340 B
Dissolved Metals by ICPMS	1	N/A	2018/01/30	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	1	N/A	2018/01/30		
Anion and Cation Sum	1	N/A	2018/01/30		
Total Ammonia-N	1	N/A	2018/02/01	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (2)	1	N/A	2018/01/29	CAM SOP-00440	SM 22 4500-NO3I/NO2B
рН	1	N/A	2018/01/26	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	1	N/A	2018/01/29	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	1	N/A	2018/01/30		
Sat. pH and Langelier Index (@ 4C)	1	N/A	2018/01/30		
Sulphate by Automated Colourimetry	1	N/A	2018/01/29	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	1	N/A	2018/01/30		

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.



Your Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT Your C.O.C. #: 647580-01-01

Attention: Arthur Szybalski

Cole Engineering Group Ltd 70 Valleywood Dr Markham, ON CANADA L3R 4T5

> Report Date: 2018/02/06 Report #: R4970846 Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B818943

Received: 2018/01/25, 18:08

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.

Results relate to samples tested.

This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.

(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager. Jolanta Goralczyk, Project Manager Email: JGoralczyk@maxxam.ca Phone# (905)817-5751

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Total Cover Pages : 2 Page 2 of 11



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID					FZD250		
Sampling Date					2018/01/25		
					13:40		
COC Number					647580-01-01		
		UNITS	Criteria	Criteria-2	BH1	RDL	QC Batch
Calculated Parar	neters						
Anion Sum		me/L	-	-	11.9	N/A	5370360
Bicarb. Alkalinity	(calc. as CaCO3)	mg/L	-	-	470	1.0	5369295
Calculated TDS		mg/L	-	-	620	1.0	5369360
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	-	2.6	1.0	5369295
Cation Sum		me/L	-	-	11.2	N/A	5370360
Hardness (CaCO	3)	mg/L	-	-	510	1.0	5370041
Ion Balance (% D	ifference)	%	-	-	3.17	N/A	5370042
Langelier Index (@ 20C)	N/A	-	-	1.18		5370363
Langelier Index (@ 4C)	N/A	-	-	0.928		5370364
Saturation pH (@	20C)	N/A	-	-	6.59		5370363
Saturation pH (@	9 4C)	N/A	-	-	6.84		5370364
Inorganics							
Total Ammonia-N	mg/L	-	-	0.24	0.050	5374412	
Conductivity		umho/cm	-	-	1000	1.0	5371394
Dissolved Organic Carbon		mg/L	-	-	6.6	0.50	5371736
Orthophosphate (P)		mg/L	-	-	ND	0.010	5371415
рН		рН	-	-	7.77		5371393
Dissolved Sulpha	te (SO4)	mg/L	-	-	80	1.0	5371416
Alkalinity (Total a	as CaCO3)	mg/L	-	-	470	1.0	5371392
Dissolved Chloric	le (Cl)	mg/L	790	790	27	1.0	5371408
Nitrite (N)		mg/L	-	-	0.081	0.010	5372089
Nitrate (N)		mg/L	-	-	0.50	0.10	5372089
Nitrate + Nitrite	(N)	mg/L	-	-	0.58	0.10	5372089
No Fill	No Exceedance						
Grey	Exceeds 1 criter	ia policy/lev	vel				
Black	Exceeds both cr	iteria/levels					
RDL = Reportable	e Detection Limit						
QC Batch = Quality Control Batch							
Criteria: Ontario Reg. 153/04 (Amended April 15, 2011) Table 1: Full Depth Background Site Condition Standards Ground Water - All Types of Property Uses Criteria-2: Ontario Reg. 153/04 (Amended April 15, 2011)							
Potable 2: Full Dep Potable Ground V ND = Not detecte	th Generic Site Co Water- All Types o ed	f Property l	Jses - Coa	a Potable G arse Texture	ed Soil	onaitioi	n
N/A = Not Applicable							



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID					FZD250	
Sampling Date				2018/01/25		
				13:40		
COC Number				647580-01-01		
	UNITS	Criteria	Criteria-2	BH1	RDL	QC Batch
Dissolved Aluminum (Al)	ug/L	-	-	ND	5.0	5372091
Dissolved Antimony (Sb)	ug/L	1.5	6.0	0.61	0.50	5372091
Dissolved Arsenic (As)	ug/L	13	25	ND	1.0	5372091
Dissolved Barium (Ba)	ug/L	610	1000	130	2.0	5372091
Dissolved Beryllium (Be)	ug/L	0.5	4.0	ND	0.50	5372091
Dissolved Boron (B)	ug/L	1700	5000	56	10	5372091
Dissolved Cadmium (Cd)	ug/L	0.5	2.7	ND	0.10	5372091
Dissolved Calcium (Ca)	ug/L	-	-	170000	200	5372091
Dissolved Chromium (Cr)	ug/L	11	50	ND	5.0	5372091
Dissolved Cobalt (Co)	ug/L	3.8	3.8	2.8	0.50	5372091
Dissolved Copper (Cu)	ug/L	5	87	4.7	1.0	5372091
Dissolved Iron (Fe)	ug/L	-	-	ND	100	5372091
Dissolved Lead (Pb)	ug/L	1.9	10	ND	0.50	5372091
Dissolved Magnesium (Mg)	ug/L	-	-	23000	50	5372091
Dissolved Manganese (Mn)	ug/L	-	-	1700	2.0	5372091
Dissolved Molybdenum (Mo) ug/L 23 70 2.6 0.5				0.50	5372091	
Dissolved Nickel (Ni)	ug/L	14	100	4.1	1.0	5372091
Dissolved Phosphorus (P) ug/L			-	ND	100	5372091
Dissolved Potassium (K)	ug/L	-	-	3700	200	5372091
Dissolved Selenium (Se)	ug/L	5	10	ND	2.0	5372091
Dissolved Silicon (Si)	ug/L	-	-	7300	50	5372091
Dissolved Silver (Ag)	ug/L	0.3	1.5	ND	0.10	5372091
Dissolved Sodium (Na)	ug/L	490000	490000	19000	100	5372091
Dissolved Strontium (Sr)	ug/L	-	-	440	1.0	5372091
Dissolved Thallium (TI)	ug/L	0.5	2.0	ND	0.050	5372091
No Fill No Exceedance						
Grey Exceeds 1 criter	ia policy/lev	/el				
Black Exceeds both cr	Black Exceeds both criteria/levels					
RDL = Reportable Detection Limit						
QC Batch = Quality Control Batch						
Criteria: Ontario Reg. 153/04 (Amended April 15, 2011)						
Table 1: Full Depth Background Site Condition Standards						
Ground Water - All Types of Property Uses						
Table 2: Full Depth Generic Site Co	nenueu Apr	ndards in	⊥) a Potable G	Fround Water C	onditio	n
Potable Ground Water- All Types of	of Property	Uses - Coa	arse Texture	ed Soil		-
ND = Not detected						



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID					FZD250		
Sampling Date					2018/01/25		
Sampling Date					13:40		
COC Number					647580-01-01		
		UNITS	Criteria	Criteria-2	BH1	RDL	QC Batch
Dissolved Titaniu	um (Ti)	ug/L	-	-	ND	5.0	5372091
Dissolved Uraniu	ım (U)	ug/L	8.9	20	2.3	0.10	5372091
Dissolved Vanad	ium (V)	ug/L	3.9	6.2	0.58	0.50	5372091
Dissolved Zinc (Z	ːn)	ug/L	160	1100	7.0	5.0	5372091
No Fill	No Exceedance	-					
Grey	Exceeds 1 criteri	a policy/lev	/el				
Black	Exceeds both cri	teria/levels	;				
RDL = Reportable	e Detection Limit						
QC Batch = Qual	ity Control Batch						
Criteria: Ontario Reg. 153/04 (Amended April 15, 2011) Table 1: Full Depth Background Site Condition Standards Ground Water - All Types of Property Uses							
Criteria-2: Ontario Reg. 153/04 (Amended April 15, 2011) Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition Potable Ground Water- All Types of Property Uses - Coarse Textured Soil ND = Not detected							



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID:	FZD248	Collected:	2018/01/25
Sample ID:	BH8S	Shipped:	
Matrix:	Water	Received:	2018/01/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5371392	N/A	2018/01/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5369295	N/A	2018/01/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
Conductivity	AT	5371394	N/A	2018/01/26	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
Hardness (calculated as CaCO3)		5370041	N/A	2018/01/30	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
Ion Balance (% Difference)	CALC	5370042	N/A	2018/01/30	Automated Statchk
Anion and Cation Sum	CALC	5370360	N/A	2018/01/30	Automated Statchk
Total Ammonia-N	LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5372089	N/A	2018/01/29	Chandra Nandlal
рН	AT	5371393	N/A	2018/01/26	Surinder Rai
Orthophosphate	KONE	5371415	N/A	2018/01/29	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5370363	N/A	2018/01/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5370364	N/A	2018/01/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5371416	N/A	2018/01/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5369360	N/A	2018/01/30	Automated Statchk

Maxxam ID:	FZD249
Sample ID:	BH7
Matrix:	Water

Collected:	2018/01/25
Shipped:	
Received:	2018/01/25

Instrumentation	Batch	Extracted	Date Analyzed	Analyst
AT	5371392	N/A	2018/01/26	Surinder Rai
CALC	5369295	N/A	2018/01/29	Automated Statchk
KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
AT	5371394	N/A	2018/01/26	Surinder Rai
TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
	5370041	N/A	2018/01/30	Automated Statchk
ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
CALC	5370042	N/A	2018/01/30	Automated Statchk
CALC	5370360	N/A	2018/01/30	Automated Statchk
LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
LACH	5372089	N/A	2018/01/29	Chandra Nandlal
AT	5371393	N/A	2018/01/26	Surinder Rai
KONE	5371415	N/A	2018/01/29	Alina Dobreanu
CALC	5370363	N/A	2018/01/30	Automated Statchk
CALC	5370364	N/A	2018/01/30	Automated Statchk
KONE	5371416	N/A	2018/01/29	Alina Dobreanu
CALC	5369360	N/A	2018/01/30	Automated Statchk
	Instrumentation AT CALC KONE AT TOCV/NDIR ICP/MS CALC CALC CALC LACH/NH4 LACH AT KONE CALC CALC CALC CALC CALC CALC CALC CAL	Instrumentation Batch AT 5371392 CALC 5369295 KONE 5371408 AT 5371394 TOCV/NDIR 5371736 ICP/MS 5370041 ICP/MS 5370042 CALC 5370042 CALC 5370360 LACH/NH4 5372089 AT 5371393 KONE 5371415 CALC 5370363 CALC 5370363 CALC 5370363 CALC 5370364 KONE 5371415 CALC 5370364 KONE 5371416 CALC 5369360	Instrumentation Batch Extracted AT 5371392 N/A CALC 5369295 N/A KONE 5371408 N/A AT 5371394 N/A AT 5371394 N/A AT 5371394 N/A TOCV/NDIR 5371736 N/A ICP/MS 5372091 N/A CALC 5370042 N/A CALC 5370360 N/A CALC 5370360 N/A LACH/NH4 5372089 N/A AT 5371393 N/A KONE 5371415 N/A CALC 5370363 N/A LACH 5371415 N/A KONE 5371415 N/A CALC 5370364 N/A CALC 5370364 N/A CALC 5371416 N/A CALC 5369360 N/A	Instrumentation Batch Extracted Date Analyzed AT 5371392 N/A 2018/01/26 CALC 5369295 N/A 2018/01/29 KONE 5371408 N/A 2018/01/29 AT 5371394 N/A 2018/01/29 AT 5371394 N/A 2018/01/26 TOCV/NDIR 5371736 N/A 2018/01/26 TOCV/NDIR 5370041 N/A 2018/01/30 ICP/MS 5370041 N/A 2018/01/30 CALC 5370042 N/A 2018/01/30 CALC 5370360 N/A 2018/01/30 CALC 5370360 N/A 2018/01/30 LACH/NH4 5372089 N/A 2018/01/29 AT 5371393 N/A 2018/01/29 AT 5370363 N/A 2018/01/29 CALC 5370363 N/A 2018/01/30 CALC 5370364 N/A 2018/01/30 CALC 5371416 <



Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

Maxxam ID:	FZD250	Collected:	2018/01/25
Sample ID:	BH1	Shipped:	
Matrix:	Water	Received:	2018/01/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5371392	N/A	2018/01/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5369295	N/A	2018/01/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
Conductivity	AT	5371394	N/A	2018/01/26	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
Hardness (calculated as CaCO3)		5370041	N/A	2018/01/30	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
Ion Balance (% Difference)	CALC	5370042	N/A	2018/01/30	Automated Statchk
Anion and Cation Sum	CALC	5370360	N/A	2018/01/30	Automated Statchk
Total Ammonia-N	LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5372089	N/A	2018/01/29	Chandra Nandlal
рН	AT	5371393	N/A	2018/01/26	Surinder Rai
Orthophosphate	KONE	5371415	N/A	2018/01/29	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5370363	N/A	2018/01/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5370364	N/A	2018/01/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5371416	N/A	2018/01/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5369360	N/A	2018/01/30	Automated Statchk

Maxxam ID:	FZD251
Sample ID:	BH8D
Matrix:	Water

Collected:	2018/01/25
Shipped:	
Received:	2018/01/25

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	5371392	N/A	2018/01/26	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	5369295	N/A	2018/01/29	Automated Statchk
Chloride by Automated Colourimetry	KONE	5371408	N/A	2018/01/29	Deonarine Ramnarine
Conductivity	AT	5371394	N/A	2018/01/26	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	5371736	N/A	2018/01/27	Nimarta Singh
Hardness (calculated as CaCO3)		5370041	N/A	2018/01/30	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	5372091	N/A	2018/01/30	Thao Nguyen
Ion Balance (% Difference)	CALC	5370042	N/A	2018/01/30	Automated Statchk
Anion and Cation Sum	CALC	5370360	N/A	2018/01/30	Automated Statchk
Total Ammonia-N	LACH/NH4	5374412	N/A	2018/02/01	Charles Opoku-Ware
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	5372089	N/A	2018/01/29	Chandra Nandlal
рН	AT	5371393	N/A	2018/01/26	Surinder Rai
Orthophosphate	KONE	5371415	N/A	2018/01/29	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	5370363	N/A	2018/01/30	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	5370364	N/A	2018/01/30	Automated Statchk
Sulphate by Automated Colourimetry	KONE	5371416	N/A	2018/01/29	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	5369360	N/A	2018/01/30	Automated Statchk


Maxxam Job #: B818943 Report Date: 2018/02/06 Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

GENERAL COMMENTS

Each te	emperature is the	average of up to t	ee cooler temperatures taken at receipt						
	Package 1	3.0°C							
Revised Report (2018/02/06): Criteria limits have been added as per client's request.									
Result	s relate only to th	e items tested.							



Maxxam Job #: B818943 Report Date: 2018/02/06

QUALITY ASSURANCE REPORT

Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5371392	Alkalinity (Total as CaCO3)	2018/01/26			98	85 - 115	ND, RDL=1.0	mg/L	0.79	20
5371393	pH	2018/01/26			101	98 - 103			0.31	N/A
5371394	Conductivity	2018/01/26			99	85 - 115	ND, RDL=1.0	umho/cm	0.48	25
5371408	Dissolved Chloride (Cl)	2018/01/29	NC	80 - 120	105	80 - 120	ND, RDL=1.0	mg/L	0.067	20
5371415	Orthophosphate (P)	2018/01/29	107	75 - 125	100	80 - 120	ND, RDL=0.010	mg/L	NC	25
5371416	Dissolved Sulphate (SO4)	2018/01/29	NC	75 - 125	100	80 - 120	ND, RDL=1.0	mg/L	0.82	20
5371736	Dissolved Organic Carbon	2018/01/27	92	80 - 120	94	80 - 120	ND, RDL=0.50	mg/L	0.37	20
5372089	Nitrate (N)	2018/01/29	96	80 - 120	107	80 - 120	ND, RDL=0.10	mg/L	0.20	20
5372089	Nitrite (N)	2018/01/29	100	80 - 120	98	80 - 120	ND, RDL=0.010	mg/L	4.6	20
5372091	Dissolved Aluminum (Al)	2018/01/30	97	80 - 120	98	80 - 120	ND, RDL=5.0	ug/L	NC	20
5372091	Dissolved Antimony (Sb)	2018/01/30	100	80 - 120	100	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Arsenic (As)	2018/01/30	97	80 - 120	98	80 - 120	ND, RDL=1.0	ug/L	NC	20
5372091	Dissolved Barium (Ba)	2018/01/30	96	80 - 120	97	80 - 120	ND, RDL=2.0	ug/L	5.8	20
5372091	Dissolved Beryllium (Be)	2018/01/30	97	80 - 120	99	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Boron (B)	2018/01/30	98	80 - 120	100	80 - 120	ND, RDL=10	ug/L	NC	20
5372091	Dissolved Cadmium (Cd)	2018/01/30	97	80 - 120	98	80 - 120	ND, RDL=0.10	ug/L	NC	20
5372091	Dissolved Calcium (Ca)	2018/01/30	NC	80 - 120	98	80 - 120	ND, RDL=200	ug/L	3.3	20
5372091	Dissolved Chromium (Cr)	2018/01/30	96	80 - 120	98	80 - 120	ND, RDL=5.0	ug/L	NC	20
5372091	Dissolved Cobalt (Co)	2018/01/30	93	80 - 120	96	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Copper (Cu)	2018/01/30	96	80 - 120	100	80 - 120	ND, RDL=1.0	ug/L	NC	20
5372091	Dissolved Iron (Fe)	2018/01/30	96	80 - 120	99	80 - 120	ND, RDL=100	ug/L	NC	20
5372091	Dissolved Lead (Pb)	2018/01/30	92	80 - 120	95	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Magnesium (Mg)	2018/01/30	96	80 - 120	99	80 - 120	ND, RDL=50	ug/L	1.1	20
5372091	Dissolved Manganese (Mn)	2018/01/30	94	80 - 120	95	80 - 120	ND, RDL=2.0	ug/L	NC	20
5372091	Dissolved Molybdenum (Mo)	2018/01/30	98	80 - 120	98	80 - 120	ND, RDL=0.50	ug/L	NC	20
5372091	Dissolved Nickel (Ni)	2018/01/30	93	80 - 120	96	80 - 120	ND, RDL=1.0	ug/L	NC	20
5372091	Dissolved Phosphorus (P)	2018/01/30	101	80 - 120	107	80 - 120	ND, RDL=100	ug/L	NC	20
5372091	Dissolved Potassium (K)	2018/01/30	98	80 - 120	101	80 - 120	ND, RDL=200	ug/L	2.3	20
5372091	Dissolved Selenium (Se)	2018/01/30	96	80 - 120	97	80 - 120	ND, RDL=2.0	ug/L	NC	20
5372091	Dissolved Silicon (Si)	2018/01/30	98	80 - 120	98	80 - 120	ND, RDL=50	ug/L	3.7	20
5372091	Dissolved Silver (Ag)	2018/01/30	94	80 - 120	96	80 - 120	ND, RDL=0.10	ug/L	NC	20



Maxxam Job #: B818943 Report Date: 2018/02/06

QUALITY ASSURANCE REPORT(CONT'D)

Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

			Matrix Spike SPIKED BLANK		Method Blank		RPD			
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
5372091	Dissolved Sodium (Na)	2018/01/30	97	80 - 120	100	80 - 120	ND, RDL=100	ug/L	0.69	20
5372091	Dissolved Strontium (Sr)	2018/01/30	94	80 - 120	96	80 - 120	ND, RDL=1.0	ug/L	1.1	20
5372091	Dissolved Thallium (TI)	2018/01/30	92	80 - 120	95	80 - 120	ND, RDL=0.050	ug/L	NC	20
5372091	Dissolved Titanium (Ti)	2018/01/30	97	80 - 120	99	80 - 120	ND, RDL=5.0	ug/L	NC	20
5372091	Dissolved Uranium (U)	2018/01/30	92	80 - 120	93	80 - 120	ND, RDL=0.10	ug/L	0.22	20
5372091	Dissolved Vanadium (V)	2018/01/30	95	80 - 120	96	80 - 120	ND, RDL=0.50	ug/L	12	20
5372091	Dissolved Zinc (Zn)	2018/01/30	87	80 - 120	89	80 - 120	ND, RDL=5.0	ug/L	NC	20
5374412	Total Ammonia-N	2018/02/01	100	75 - 125	98	80 - 120	ND, RDL=0.050	mg/L	13	20

N/A = Not Applicable

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

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

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

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

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

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).



Report Date: 2018/02/06

Cole Engineering Group Ltd Client Project #: L09-301 Site Location: MARIANNEVILLE DEVELOPMENT

VALIDATION SIGNATURE PAGE

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

Eve Risberge Eva Pran

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

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