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Mountain Ash Limited Partnership Aggregate Operation
NW and SW 31-26-03 W5M, Rocky View County, Alberta

Hydrogeological Assessment Report

MOUNTAIN ASH
LIMITED PARTNERSHIP

January 2020
SLR Project No.: 212.06650.00003

HYDROGEOLOGICAL ASSESSMENT REPORT

MOUNTAIN ASH LIMITED PARTNERSHIP AGGREGATE OPERATION

NW AND SW 31-26-03 W5M

ROCKY VIEW COUNTY, ALBERTA

SLR Project No.: 212.06650.00003

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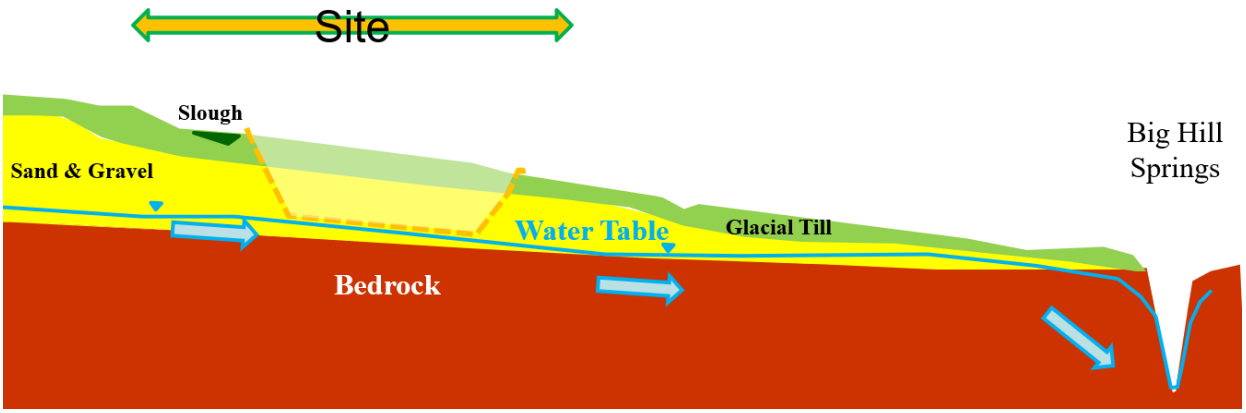
EXECUTIVE SUMMARY

Mountain Ash Limited Partnership (MALP) is proposing to develop an aggregate resource at Section 31, Township 26, Range 3, west of the 5th Meridian in Rocky View County. SLR Consulting (Canada) Ltd. (SLR) was retained to conduct a hydrogeological investigation of this potential aggregate resource development. The objective is to provide a description of baseline hydrogeological conditions in the vicinity of the proposed MALP aggregate resource. We review the potential impacts of the development on groundwater quality and quantity. Based on this we provide mitigation measures to support the development and operation of the aggregate resource being conducted with minimal impact to existing local water users. This includes neighbouring domestic wells, nearby natural heritage features like Big Hill Creek, and the Big Hill Springs Provincial Park. As the ensuing report will identify, it is anticipated that this can be successfully achieved.

The proposed development is an aggregate resource to be worked in six counter-clockwise phases starting in the southeast corner. The sand and gravel will be extracted under dry conditions. No dewatering of the underlying aquifer is planned. In this manner groundwater resources will be protected.

This report creates a picture of the regional setting of the area based on published sources of information such as published geological maps and water well records. Field investigation was undertaken to find local wells, and to drill and install monitoring wells on the site. The soils were scientifically logged for the geologic profile and it was found that the site fit in well with the regional setting. From this, an examination of potential impacts was undertaken and appropriate mitigation was identified. As will be seen in the report, no adverse net impact of the operations on the hydrologic / hydrogeologic setting is predicted.

The two large sloughs in the northwest corner of the site are to be retained on the landscape. A wetland assessment has been undertaken and is covered elsewhere. No streams are located on, or flow from the site, and thus hydrologic impacts are not possible. The following schematic illustrates the hydrogeologic profile found at the site. Given the distances involved, it has been vertically stretched to better show the individual layers and thus is not to scale.



The sloughs are surface water fed and perched on the 4 to 6-metre-thick blanket of dense glacial till which limits the leakage of water into the ground. Beneath the till lies the target sand and gravel deposit which is 11 to 20 metres thick, and generally dry. The water table is close to the bottom

of this deposit and sometimes in the underlying bedrock. This bedrock is the Paskapoo Formation bedrock composed of sandstone, siltstone, mudstone and shale. Although not a very good aquifer, it is permeable enough to provide local water supply and is tapped by the few wells in the area. Groundwater flows to the southeast and eventually discharges in Big Hill Springs at the Provincial Park. The report identifies that this function will not be altered; there may be a slight increase in discharge when the pit is operating, due to the capture of rainfall directly into the sand. It was found that groundwater quality in the sand and gravel and the bedrock is very similar to that in Big Hill Springs.

We have considered the possibility of impacts from manmade sources such as fuels and solvents during the operational phase of the pit. We have also considered natural sources such as suspended solids from reworking of the material on site. These potential effects will be mitigated by using best handling practices as outlined in the *Code of Practice for Pits* (Alberta, 2004), other codes of best practice and adhering to regulatory approval conditions.

Under the current excavation scheme the overall risk of any significant negative impacts on water resources as a result of the development are negligible. This is based on the fact that the aggregate resource will not be mined into the water table and therefore no anticipated changes are possible to the groundwater flow system.

The following mitigation and design measures are recommended to reduce the chance of water quality pollution:

- Develop the site on a phased basis to minimize the working area and allow for progressive site restoration;
- Minimize the size of each working area to reduce the potential for generation of suspended sediment in storm water; and
- Commission settlement ponds and surface infiltration features early in the scheme development and manage all runoff generated during operations onsite; and
- Implement a groundwater monitoring program to monitor the existing groundwater flow system and give early warning of any unanticipated changes.

The effects of the development of an aggregate resource above the water table at this site will be minimal on the surface and groundwater regimes, particularly if the mitigation and design measures discussed above are implemented. **It is predicted that there will be no adverse net impact of development at the site on surface water or groundwater users in the vicinity**.

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1.0 INTRODUCTION

SLR Consulting (Canada) Ltd. (SLR) was retained by Mountain Ash Limited Partnership (MALP) to conduct a hydrogeological assessment of a proposed aggregate resource in Rocky View County, Alberta. The assessment and description of baseline hydrogeological conditions within the vicinity of the site is required to ensure the development and operation of the aggregate resource is conducted with minimal impact to existing local water users and the natural environment. This includes neighbouring domestic wells and the Big Hill Springs Provincial Park.

1.1 Site Description

Mountain Ash Limited Partnership (MALP) wishes to develop a site at the western half of Section 31, Township 26, Range 3, west of the 5th Meridian (Sec 31, Twp 26, Rge 3, W5M) for the purposes of aggregate extraction. The site location is shown on Drawing 1.

The northern part of the proposed site (Northwest quarter of Sec 31, Twp 26, Rge 3, W5M), is currently zoned by the Rocky View County as Natural Resource Industrial District and the southern part (Southwest quarter of Sec 31, Twp 26, Rge 3, W5M) is zoned Ranch and Farm District (Rocky View County, 2019). Its current use is ranch farming by a tenant occupier who lives in a dwelling on the site and ranches cattle, horses and sheep, and uses some of the land as hay pasture. There are two large sloughs in the northwest corner considered as Class II gramminoid marsh wetlands and a number of other, smaller wetlands mainly classified as Class I farmed through wetlands. A detailed description of the wetlands on site is provided in SLR (2020a; 2020b).

1.2 Physiography, Topography and Geomorphology

The Project Site is situated in the Southern Alberta Upland physiographic region of the interior plains division (Pettapiece, 1986). The geomorphological characteristics of this physiographic region are provided by the proximity of bedrock to the surface which causes a varied topography with elevations up to 1,650 metres (m) above sea level (asl) to the west. The site is located at an average elevation of approximately 1,280 masl. The site slopes to the southeast from the topographic high to the north and hosts a low-relief valley feature running northwest to southeast across NW Sec 31, Twp 26, Rge 3, W5M. In SW Sec 31, Twp 26, Rge 3, W5M, the topography slopes steeply southwesterly into the valley running west-northwest to east-southeast which leads to Big Hill Springs Creek. The site is in the Bighill Creek watershed and the study area topography based on LiDAR data is presented on Drawing 2.

The physiographic region coincides with the Foothills natural region which comprises dissected plateaus and rolling uplands with surficial geology comprising glacial till and abundant fluvial deposits. The climate in this natural sub-region is typically characterised by cool summers and cold winters but highly influenced by the periodic warm Chinook winds (Downing and Pettapiece, 2006). Compared to the rest of the country, Alberta has relatively low precipitation in the lee of the mountains and total average annual rainfall in the area is 450 to 500 millimetres (mm) per year (Alberta Agriculture, Food and Rural Development, 2000).

1.3 Proposed Development

The western half of Section 31 covers a total area of approximately 130 hectares (320 acres). The ultimate extraction footprint will be 83.4 ha (206 acres). The property will be operated and

permitted in six phases of uneven size, depending upon setbacks, with operations and permitting commencing initially for the southeast parcel. This is called Phase 1 and comprises about 14.4 ha (35.5 acres) and is expected to take 5 years to extract. It should be noted that the two sloughs in the northwest corner will be retained and Phase 4 will be developed on the lands south and east of them. Each of the subsequent phases is anticipated to take approximately 5 years to extract.

Based on drilling investigations at the site, there is 4 m to 6 m of glacial till overburden overlying approximately 20 m of sand and gravel. The till soils will be stripped and stockpiled for future use in the post-development restoration. The sand and gravel is the target deposit for extraction and lies immediately above the underlying bedrock. Groundwater in assessment boreholes was noted at between 20 m and 24 m below ground surface (m bgs) and above the bedrock. It is anticipated that the site will be worked to 1.0 m above the maximum recorded groundwater level within the gravel deposit and will therefore be worked dry, with no requirement for operational or permanent dewatering. Actual depths will be determined with progressive investigation of water levels as the aggregate resource is developed.

1.4 Objectives

The objectives of this hydrogeological assessment are to provide detailed baseline data which would fulfil the information requirements within the Alberta Code of Practice for Pits (Alberta Government, 2004) and inform the development of the aggregate resource. The report is intended to provide the following:

- A general description of the geological features of the proposed aggregate resource site including the surficial geology and bedrock geology;
- A description of the hydrogeology at the site in context with the local and regional study areas;
- Hydrogeological impact assessment of the quarry development on the surrounding groundwater aquifers (e.g. groundwater draw-down) and provide detail on how the impacts will be avoided or mitigated, to establish net impact; and
- A description of any monitoring programs which will be designed to provide information on effects on groundwater quality and quantity.

In order to achieve these objectives, the results section of this report is split into two main parts, the first of which relates to the geological environment and the second of which relates to the hydrogeology.

2.0 METHODOLOGY

The hydrogeological investigation was divided into two main parts, the first comprising a desktop study and review of available data, with the second comprising a water well field verified survey, several drilling investigations, hydraulic conductivity testing and groundwater monitoring and sampling.

2.1 Desktop Study

A desktop study of existing records was undertaken to obtain regional and local information about the site conditions and site setting. These included:

- Alberta Environment and Parks (AEP) records;
- Historic water well drilling reports;

- Regional and local mapping resources;
- Aerial photographs; and
- Any available operational/environmental documents relating to the site.

This desktop study also included review of existing information that MALP (Formerly Summit Aggregates) collected previously and included aggregate quality analyses (Appendix A) which helped interpret the geologic conditions for the property prior to the SLR and subsequent site investigations. The preliminary desktop review was used to determine:

- the geology and hydrogeology beneath the site;
- locations of surface water bodies in the area;
- the local topography and drainage; and
- the locations of potential sensitive receptors (wells, wetlands and springs).

A initial site reconnaissance was conducted on September 18, 2014 to provide ground-truth for observations made in the initial review and to establish some general characteristics concerning the hydrology of the area. The site visit also included an examination of the creek flowing from Big Hill Springs to the highest upstream point accessible within the Provincial Park. Many other site visits (13) have been made by SLR staff since that time for monitoring and assessment purposes.

2.2 Field Investigation

Following the initial desktop study, field assessments were carried out in accordance with SLR's standard field investigation procedures. This included the following items:

- Water well field verified survey;
- Drilling investigations and monitoring well installation;
- Hydraulic conductivity testing; and
- Groundwater monitoring and sampling.

The methodology behind these aspects of the field investigation is outlined in the following sections.

2.2.1 Water Well Field Verified Survey

After the review of historical water well records, a field verified door to door survey to confirm the location of water wells within 500 m of the property boundaries was undertaken. This field verified survey involved filling out a questionnaire with the well owners on well locations, depths, use, history and any other water related information such as drainage or septic disposal practices at available households. Further details are provided in Section 4.1 below.

2.2.2 SLR Drilling Investigation and Monitoring Well Installation

The first round of monitoring well installation was conducted by SLR from September 30 to October 2, 2014, utilizing a truck mounted drill rig equipped with 150 mm diameter Becker Hammer supplied and operated by Great West Drilling of Calgary, Alberta. Three boreholes (MW14-101, MW14-102 and MW14-103) were drilled to depths between 16.5 m bgs and 27.7 m bgs around the perimeter of the NW quarter section, where they were drilled until refusal was achieved in the upper bedrock. Soil samples were collected from the air flush centrifuge at ground surface where the cuttings were logged by a qualified geologist.

A second round of monitoring well installation was undertaken by MALP as part of further aggregate assessment in June 2018 across the NW quarter section, the borehole logs from which are presented in Appendix A. Four monitoring wells were completed as MW18-104, MW18-105, MW18-106 and MW18-107, please reference Drawing 3 for locations.

A third round of monitoring well installation was undertaken by SLR Consulting from June 3 to June 5, 2019 utilizing a track-mounted drill rig equipped with 150 mm diameter ODEX supplied and operated by Ernco Drilling of Red Deer, Alberta. Three boreholes (MW19-108, MW19-109 and MW19-110) were drilled to depths between 15.8 m bgs and 36.6 m bgs in the SW quarter section, where they were drilled down to bedrock or until groundwater was encountered. Soil samples were collected from the air flush at ground surface where the cuttings were logged.

Monitoring wells were installed in ten of the boreholes as indicated above. The monitoring wells were screened either at the base of the sand and gravel unit or across the upper bedrock / sand and gravel interface to ensure the water table could be measured. The wells were installed to characterize groundwater quality and depth to the water table within the sand and gravel and upper bedrock. The wells were constructed of 50 mm diameter schedule 40 polyvinyl chloride (PVC) pipe with threaded joints. The screened portion of the well was comprised of 0.25 mm horizontal slots (10 Slot) and the annulus was backfilled with silica sand from the bottom of the screen to approximately 0.3 m above the top of the screen. A hydrated bentonite chip seal was placed around the annulus of the solid section of stand pipe above the screened section to within approximately 0.5 m of ground surface. A 50 mm diameter slip cap was placed on the bottom of the well and a 50 mm diameter j-plug was placed on the top of the monitoring well. An above ground steel protective cover with a lockable lid was concreted in place above the top of the wells. Borehole geological information and well construction details are provided in the SLR well logs in Appendix B and those by others are provided in Appendix A.

2.2.3 Hydraulic Conductivity Testing

Hydraulic conductivity tests were conducted on MW14-101 and MW14-103 and comprised a series of rising head slug tests on both wells and a short pumping and recovery test on MW14-101. Yield tests on two private wells were undertaken utilizing the existing water distribution systems at both WW2 and WW4; however, the test in WW4 was not usable for analysis due to interference from the domestic water system. To obtain hydraulic conductivity values, the slug tests were analysed using the Bouwer-Rice method and the recovery tests were analysed using the Theis recovery method, both hosted in the AquiferTest (v3.5) software. A copy of the analysis undertaken is presented in Appendix E. Hydraulic conductivity results from the tests are reported in Section 4.2 below.

2.2.4 Groundwater and Surface Water Monitoring and Sampling

Groundwater monitoring events were carried out on 12 occasions in monitoring wells MW14-101, MW14-102 and MW14-103, on eight occasions in two residential wells (WW2 and WW4), three occasions in MW18-104, MW18-105 and MW18-106, and two occasions in MW18-107, MW19-108, MW19-109 and MW19-110. Depth to groundwater was measured using a Solinst water level meter.

Groundwater samples have been collected from the accessible residential wells in the Paskapoo Formation bedrock and the sand and gravel monitoring wells. The furthest publically accessible upstream point of the stream flowing from Big Hill Springs was sampled within the Big Hill Springs Provincial Park. Residential well samples were collected from a point within the household system

before any water quality treatment and after a purge of 15 minutes or until field parameters were deemed to have stabilized. The monitoring wells in the sand and gravel were purged using a submersible pump or bailers until groundwater chemistry parameters including pH, electrical conductivity (EC), dissolved oxygen and temperature were considered to have stabilized. Water samples were placed in appropriate sample containers provided by the laboratory and preservative supplied by the laboratory was added to the samples where required. The samples were submitted to KaizenLAB or Bureau Veritas Laboratories of Calgary for testing, both of which are Canadian Association for Laboratory Accreditation (CALA) accredited laboratories.

The water quality samples from both residential wells and site monitoring wells were analysed for general chemistry and total metals for comparison purposes. Results of the water quality sampling are provided in Tables A1 to A3 (appended) and the laboratory analytical certificates provided in Appendix G. Historical water quality analysis for residential well 360164 was provided by the householder and the report is provided as Appendix H (Baseline Water Resource Inc., June 2013).

3.0 GEOLOGY

Drawing 3 shows the lines of three vertical cross-sections (Drawings 5, 6 and 7) that run northwest to southeast along the direction of groundwater flow to the springs (A-A'), southwest to northeast across the upper valley (B-B') onsite, and southwest to northeast through the site (C-C') further down valley. They have been prepared to illustrate the relationship between the various geological units in the study area and are referred to in the following subsections.

3.1 Surficial Topsoil

Topsoil in the M.D. of Rocky View County has developed on materials of glacial origin and are therefore heavily influenced by the nature of the parent geologic material. The topsoil lying at surface in the vicinity of the project site is comprised of the Dunvargan Series which are formed from moderately fine textured till with less than 20% coarse material. The Dunvargan Series soils are moderately well drained soils with a typical profile being a thick black soil of greater than 15 centimetre (cm) topsoil; however, in the Rocky View County they are associated with less well developed variants with less than 15 cm topsoil thickness (Turchenek and Fawcett, 1994). Based on the onsite drilling, the surficial soils range in thickness from 30 cm to 60 cm.

In summary, the topsoil is relatively thin, fine grained, with significant organic content and tends to temporarily retain water. It is this layer that supports vegetative growth and land use such as range land or cropping, as well as natural ecosystems.

3.2 Surficial Geology

Surficial geology in the vicinity of the Project site has been determined from the published geology maps (Shetsen, 1987). Two primary layers are found. The upper strata are predominantly comprised of Pleistocene-age moraine draped over the underlying sand and gravel. This moraine consists of an unsorted mixture of clay, silt, sand and gravel with local water-sorted material and is called a glacial till. The till in the vicinity of the site is of a relatively consistent thickness with a flat to undulating topography which reflects the topography of underlying deposits which in turn reflect the shape of the bedrock surface below. Underlying the draped moraine at the site is sand and gravel of glaciofluvial origin, which formed on the slopes and base of meltwater channels draining melting ice sheets (Shetsen, 1981).

Borehole logs from aggregate assessment at the site (Almor Testing Services Ltd, 2014; 2017a; 2017b and 2018) and hydrogeological investigations as part of this assessment are included as Appendix A and Appendix B, respectively. The borehole logs indicate that surficial deposits over the majority of the site include approximately 3 m to 6 m of silty, sandy or gravelly clay till and topsoil (this overburden will have to be moved to extract the underlying aggregate deposits). Beneath the clay till is the sand and gravel deposit of interest, which is generally a well graded mixture of sand and gravel containing occasional beds of pure sand or pure gravel up to 2 m thick. Some layers were difficult to drill and are interpreted to be hard, and are potentially calcified bands. Based on the drilling results, the sand and gravel generally vary in thickness between 10 m and 27 m, with an average thickness of approximately 18 m in those areas investigated.

3.3 Bedrock Geology

Consolidated bedrock underlies the unconsolidated soils at a depth of 15 to 28 m, and represents the basement to site operations where not saturated. Structurally, the site is located several kilometres east of the furthest extent of the main Cordilleran Deformation, and as such is relatively flat-lying bedrock with little folding or faulting compared to older bedrock further west in the Disturbed Belt. The bedrock beneath the sand and gravel at the site consists of Tertiary, Palaeocene age (55 to 65 million years old) sedimentary rocks of the Upper Paskapoo Formation. The Paskapoo formation comprises grey to greenish grey, thickly bedded, calcareous sandstone interbedded with siltstone or mudstone and minor conglomerate or thin limestone beds (Alberta Geological Survey, 1999). The test drilling at this site found grey sandstones and siltstones. The bedrock was derived from sediments eroded from the Rocky Mountains during a period of uplift and erosion and carried east by river systems which drained the mountains. The sandstones within the Paskapoo are a complex series of stacked river channel deposits separated by floodplain siltstone and mudstone deposits (Hamblin, 2004).

Outcrops of the Paskapoo Formation sandstone can be seen in the steep slopes of the Big Hill Springs Provincial Park southeast of the site. A number of domestic well records from the immediate vicinity identify sandstone and shale[1] beneath and surrounding the site.

4.0 HYDROGEOLOGY

The hydrogeological regime at the application site and the surrounding area is described in the following sub sections:

- Field verified survey to establish groundwater wells and use;
- Aquifer properties;
- Groundwater levels and flow; and
- Water quality assessment.

The hydrogeological data has been used to develop a conceptual site model that has in turn been used to assess potential impacts associated with the proposed development. The conceptual site model has also been used to determine appropriate mitigation measures.

[1] It is common for drillers to use the term “shale” to describe mudstones and siltstones, as the differences are subtle and they all share a common fine grained appearance to the untrained eye.

4.1 Field Verified Water Well Survey

The objectives of the field verified water well survey were to establish residential well use, baseline water quality conditions and to provide an assessment of the hydraulic parameters within the aquifers utilised by local residences adjacent to the site. Initially, a water well record search was undertaken by obtaining records from the Alberta Water Wells database which are presented in Appendix C (updated in 2019). This was followed by a door-to-door survey (October to December 2014) of residences within a 500 m radius of the site with visits on a number of occasions to those houses where no resident was at home. Where possible the formal well records were correlated with the actual wells in the field. It is considered that the 1,600 m radius required for a Water Act application is not appropriate for this project as no water body is to be disturbed by the development which will be worked dry and much of that greater area is not in the same groundwater flow field. A number of properties were surveyed and sampled and/or yield tested in order to further assess the relevant aquifer units. At each residential well, a questionnaire was completed to determine the type of well, well completion details, water levels and whether the well user has any issues with water quality or quantity. The questionnaires completed at the residential wells are provided in Appendix D.

The majority of local wells (for which there are records) are utilized for domestic or commercial purposes. The Alberta records indicated a total of 17 wells within 500 m of the Project site with two of those decommissioned (391599 and 391600) and one with very little available detail (395793). Drawing 3 presents the locations of the wells identified from the records search and the door-to-door survey for which Table 1 summarizes the information collected. The majority of drilled wells are drilled to between 30 m and 75 m bgs and are screened within the Paskapoo Formation.

Two drilled wells (WW1 and WW4) are on the site at the residences of the current tenants; however, all of the other drilled wells recorded are greater than 100 m from the site boundary. With respect to the WW1 property, there is a well listed in the records for this property (494800); however, the geology recorded in this record is completely different than the rest of the area. It had been concluded that it is an improperly recorded location in the digital records kept by AEP and has not been used in the analysis.

Dug wells identified at location WW5 (four wells in total) are between 6.1 m and 7.6 m deep according to details provided by the householder. This location is in the bottom of the valley at the southeast end of Section 31. No lithological logs are available for the dug wells; however, based on their estimated depth and the lithological details provided in nearby drilled wells to the east, it is inferred that they are completed in the sand and gravel deposits. The well owners reported that the static water level is 3 m bgs. Although this was unconfirmed by direct measurement, it is a reasonable estimate, given the shallow nature of the wells.

Table 1
Water Wells within 500 Metres

Well Interview Number	Alberta Water Well Record Number	No. of Wells	Well Owner	Easting (UTM)	Northing (UTM)	Well Depth (m)	Drilled / Dug	Distance (m) and Direction from Site
WW1	Unknown	1	Waterman	680559[1]	5682875	Unknown	Drilled	On site
WW2	1475699	1	Rawn	680988[1]	5682770	50.9	Drilled	200m E
WW3	1475698	1	Rawn	681173[1]	5682907	36.0	Drilled	400m E
WW4	350194	1	Nugter	680257[1]	5682091	35.1	Drilled	160m S
WW5	N/A	4	Parker	681547[1]	5681568	6.1 – 7.6	Dug	
N/A	391000	1		679932[2]	5683339	39.6	Drilled	
N/A	360164	1	Carroll	680744[1]	5683480	67.1	Drilled	350m N
N/A	1022436	1	Lafarge Canada Inc.	679682[2]	5682526	30.5	Drilled	
N/A	387449	1	Lafarge Canada Inc.	See Note[3]	NE Quarter, S36-T26-R4	33.8	Drilled	
N/A	494773	1	Lafarge Canada Inc.	See Note[3]	NE Quarter, S36-T26-R4	30.5	Drilled	
N/A	2095665	1	Unknown	See Note[3]	SW Quarter, S6-T27-R3	25.6	Drilled	
N/A	390998	1	Unknown	See Note[3]	SE Quarter, S6-T27-R3	65.5	Drilled	
N/A	390999	1	Unknown	See Note[3]	SE Quarter, S6-T27-R3	73.2	Drilled	
N/A	391598	1	Unknown	See Note[3]	NW Quarter, S3-T26-R3	39.6	Drilled	On site
N/A	395786	1	Unknown	See Note[3]	NE Quarter, S31-T26-R3	62.5	Drilled	

Notes:
1. Location based on GPS measurement in the field.
2. Location based on Abacus Datagraphics database.
3. Wells plotted at quarter-section centroid in Abacus Datagraphics database. Not likely actual location.

4.2 Aquifer Properties

A number of different geological units with different hydraulic properties are present in the study area. The distinct units are discussed here in order with depth from surface (and increasing geological age). The testing of two monitoring wells and two residential wells was undertaken and details of the work are provided below.

4.2.1 Surficial Unconsolidated Deposits

Surficial deposits of unconsolidated soils consist of till overlying sand and gravel deposits as described in Section 3.2 above. Groundwater flows in the intergranular pores in these soils, and the rate of flow is proportional to the hydraulic conductivity of the soil. For example, the hydraulic conductivity is low where clay rich material infills these pores, but is significantly higher where clean sand and gravel is present.

Since the upper glacial till that caps the site is not saturated, no groundwater monitors were installed and therefore no field testing for hydraulic conductivity was undertaken. These soils are not typically aquifers, as their hydraulic conductivity is in the range of 10^{-8} to 10^{-7} m/s (Freeze and Cherry, 1979), but they do act as a protective layer for underlying deposits.

As described in Section 2.2.3, a number of slug and pumping and recovery tests were undertaken on monitoring wells MW14-101 and MW14-103 which are screened in the sand and gravel. The slug tests were conducted using bailers with instantaneous head changes in the wells and the pumping and recovery test (MW14-101) was undertaken by pumping for approximately 20 minutes until water levels stabilised. The slug tests determined hydraulic conductivities of approximately 2×10^{-4} m/s to 3×10^{-4} m/s. The pumping and recovery test indicated hydraulic conductivities of 1×10^{-4} m/s. It is considered that the longer pumping and recovery test gives a better idea of the bulk sand and gravel properties due to its larger radius of influence around the wells. These values nonetheless fall in a narrow range and are typical of sand and gravel aquifers.

4.2.2 Paskapoo Formation Bedrock

The Paskapoo Formation is the most significant aquifer formation in western Alberta and potentially the Prairie region, and although of regional importance as a whole, the isolated nature of the main sandstone units can provide variable success for residential wells. Only the sandstone facies of the Paskapoo Formation demonstrate any significant intergranular porosity; however, the pore spaces may be filled with calcareous cement in some areas. Bedding planes, joints and structural fractures contribute to a secondary permeability of the bedrock as well. Based on water well records in the area and the drilling at this site, much of the formation in this area is primarily comprised of fine-grained bedrock such as siltstone, mudstone and shale which demonstrate low intergranular porosity. Secondary fracture porosity is likely to be responsible for the yields obtained from residential wells in the vicinity of the site and generally provides lower yields within wells completed within mudstone and siltstone than sandstone (Geological Survey of Canada, 2007; Ozaray and Barnes, 1977). The majority of residential wells in the area are drilled into the Paskapoo Formation indicating that the aquifer is locally important for groundwater supplies.

An in-situ variable head permeability test has been undertaken in residential well WW2 by undertaking a short term pumping and recovery test. One other residential well (WW4) was tested; however, due to interference by the particular characteristics of the method of operation of the existing water distribution system, very little analysis could be undertaken on the test results. No

other residential wells were available for yield testing. Test results were analysed using the Cooper-Jacob Time Drawdown method as hosted by AquiferTest (v3.5) software to obtain hydraulic conductivity values. A copy of the analysis undertaken is presented in Appendix E. The test results show that the Paskapoo Formation penetrated by WW2 has an approximate hydraulic conductivity of 2×10^{-7} m/s with a transmissivity of 5×10^{-6} m^2/s. The well record corresponding to WW2 is 1475699 (Appendix C), which shows the water bearing layers to be mostly sandstone and shale at a depth of 45 m. The hydraulic conductivity value obtained reflects this fractured bedrock.

Water levels in WW2 and WW4 were measured over a 1-month period at five-minute intervals by a water level transducer and data logger to assess the responses of the wells to their normal use. The first month of data collected is provided in graphical form in Appendix F. Water levels in WW2 respond significantly to normal domestic use with drawdown up to 8 m seen during normal household use. This contrasts with the response of WW4 to normal use as the well shows a maximum drawdown of approximately 0.11 m. The slow aquifer response in WW2 and fast aquifer response in WW4 also were seen during the yield tests where WW2 had drawdown of >7 m at a flow rate of approximately 12 Litres per minute (L/min) and WW4 had drawdown of just 0.09 m at a flow rate of approximately 39 L/min. The contrast between the performances of the two wells demonstrates the variability of the hydraulic properties of the bedrock in the Paskapoo Formation.

4.2.3 Summary

In summary, the hydraulic conductivity values for the various aquifer units may be compared:

- The glacial sand and gravel deposits had an approximate hydraulic conductivity of 1×10^{-4} m/s to 3×10^{-4} m/s; and
- The Paskapoo Formation hydraulic conductivity was 2×10^{-7} m/s, but can vary.

While it is recognized that these measurements do not establish the full range for each unit, they do provide insight into the aquifer characteristics. It is commonly held (Freeze and Cherry, 1979; Fetter 2001) that useable aquifers have a hydraulic conductivity of greater than 10^{-6} m/s. Only low yield wells (such as some residential wells which only periodically draw water at relatively low rates) are possible below that value. The Paskapoo Formation has a value lower than this, which indicates a low yield aquifer in parts; however, the performance of WW4 indicates that higher yield wells can also be achieved. The Specific Capacity of WW2 is 1.85 L/min/m, and that of WW4 is 433 L/min/m. This is a 234 times difference, and assuming the same saturated thickness (and similar length of pumping time) it can be estimated that the conductivity of the Paskapoo Formation at WW4 is potentially two orders of magnitude higher than at WW2.

4.3 Groundwater Levels and Flow

Initially, a total of three groundwater monitoring wells were installed in the sand and gravel at the site in September / October 2014. These monitoring wells were drilled to prove bedrock and then backfilled with bentonite to the base of the sand and gravel. The wells are screened from the base of the sand and gravel to the top of the saturated zone (MW14-101 and MW14-103); however, MW14-102 has remained dry for the period of monitoring included in this report, indicating that the water table is at least seasonally in the bedrock in some areas of the site. Further monitoring wells were installed at the site in 2018 and 2019 as part of site investigations and were screened either at the base of the sand and gravel or across the sand and gravel / bedrock interface to ensure the water table was intersected.

The locations of these monitoring wells and their groundwater elevations (on July 3, 2019) are presented on Drawing 4. The information from these wells has been supplemented with groundwater level information from residential wells WW2 and WW4 also presented in Drawing 4.

The groundwater monitoring points completed at the site have been subject to periodic groundwater elevation monitoring between October 2014 and September 2019. Sand and gravel wells MW14-101 and MW14-103 and residential wells WW2 and WW4 have been recording continuous groundwater levels using data loggers from 29 October 2014. Groundwater hydrographs of monitoring data to date are presented in Appendix F, a review of which shows:

- The highest manual groundwater elevations are recorded in the sand and gravel at MW14-101 (1,274.87 masl) on 20 November 2014;
- The lowest groundwater elevations are recorded in the sand and gravel in the valley at MW19-109 (1,259.46 masl) on 3 July 2019;
- A downward vertical gradient between the sand and gravel deposits and the underlying Paskapoo Formation is likely. Based on the potentiometric surface in the sand and gravel on Drawing 4, the water level is likely about 1,271 masl at WW2, and the approximate static water level in the bedrock at WW2 is around 1,263 masl (the measured level on Drawing 4 is affected by pumping at the well). The higher total head in the overburden than the bedrock dictates a component of downward vertical groundwater flow from the sand and gravel to the bedrock. The amount of downward groundwater flow is probably limited due to the relatively lower hydraulic conductivity of the underlying bedrock, inhibiting drainage to depth;
- Minimal fluctuation in the groundwater levels within the sand and gravel indicates very little or no influence from pumping within residential wells in the area. Groundwater levels within the sand and gravel have been gradually falling over the initial four or five years of monitoring, with a drop of approximately 0.9 to 1.3 m in the period. Levels have rebounded somewhat (0.1 m) in the months between July and September 2019 due to the higher than average rainfall totals in the area in spring and summer 2019; and
- As discussed in Section 4.2.2 above, variable response to the pumping from normal use in residential wells WW2 and WW4 is seen in the hydrographs with large fluctuations in WW2 as compared with WW4. This is indicative of the differing performance of the wells due to variability of the hydraulic conductivity within the Paskapoo Formation.

Using site groundwater observation data, Drawing 4 shows the inferred potentiometric groundwater surface (drawn in blue) in the sand and gravel at site as recorded on 3 July 2019. Drawing 4 shows that the horizontal flow direction in the sand and gravel is towards the south-southeast and the Big Hill Springs valley.

The potentiometric surface within the Paskapoo Formation cannot be drawn based on just two far apart data points (WW2 and WW4). Examination of historical water levels at other wells based on the water well records show that the elevation of the potentiometric surface is between about 1,266 and 1,268 masl in the area of the site, which is near the bedrock surface. If one assumes the bedrock potentiometric surface is near ground level at the Big Hill Springs, which is about 1,240 masl, then there is strong lateral gradient southeast towards the springs at which point groundwater is observed discharging to the surface.

4.3.1 Groundwater / Surface Water Interactions

Two large sloughs located in the northwestern corner of the site have a surface elevation of approximately 1,290 masl and are perched on the 6 m of low permeability fine grained till. The

presence of freestanding water is seasonal based on observations made at the site, with water levels generally decreasing through summer and autumn. Monitoring well MW14-101 located close to one of the sloughs has a groundwater elevation in the sand and gravel of approximately 1,274 masl, which is well below the base of the till (at about 1,284 masl). This demonstrates that the sloughs are not fed by groundwater from the sand and gravel. Thus, it is inferred that the sloughs are fed by rainfall and snowmelt from the local catchment and from the catchment across Highway 567 transported by the culvert located beneath the highway. These sloughs will be retained on the landscape and this small area will not be developed for aggregate extraction.

Since groundwater from beneath this site flows southeasterly towards the Big Hill Springs, and this is a significant feature in the natural heritage of the County, it represents an offsite interaction of groundwater with surface water. Section 5 of this report discusses potential impacts to this feature. For the purpose of this report; no specific investigation of the springs has been undertaken, other than a site visit to identify general features and the sampling of water quality. Bedrock outcrops can be seen on the valley walls surrounding the stream and springs and thus it is inferred that the host valley is incised into the bedrock. Ozaray & and Barnes, 1977, reports that spring flow is in the order of 40 L/s and water temperature is typically less than 5°C.

4.4 Water Quality Assessment

Groundwater samples have been collected from the accessible residential wells in the Paskapoo Formation bedrock, the sand and gravel monitoring wells and the furthest publically accessible upstream discharge point at Big Hill Springs. Sampling methodologies are described in Section 2.2.4, above and Laboratory analysis certificates are provided in Appendix G.

In order to compare groundwater and surface water quality at this site, a Piper plot showing the relationship between the relative abundance of the major cations and anions in the sampled water has been prepared (Figure 1). These plots include all groundwater and chemistry results from all groundwater monitoring wells on site and are typically helpful in understanding any differences between water types.

On all three plots the sand and gravel aquifer, bedrock aquifer and Big Hill Springs water occupies a very small area exhibiting a calcium and magnesium-rich water with little chloride or sulphate and with high alkalinity (expressed as HCO_3+CO_3). This is typical of clean meteoric water and indicates that water in both the aquifers and the springs is heavily influenced by recharge from rainfall. Often on these diagrams there can be a wider spread in the water “fingerprint”; however, the tight grouping here indicates very similar water between the three sources. In addition, the total dissolved solids in these three water sources generally lie in a fairly narrow range of 210 to 360 mg/L (Tables A1, A2 and A3, appended). On this basis, it is concluded that this is the same water type for the sand and gravel, the Paskapoo bedrock, and the discharge from Big Hill Springs. The updated groundwater and spring water chemistry supports the conclusion that the groundwater within the saturated sand and gravel recharges the Paskapoo Formation bedrock and also provides baseflow to the Big Hill Springs.

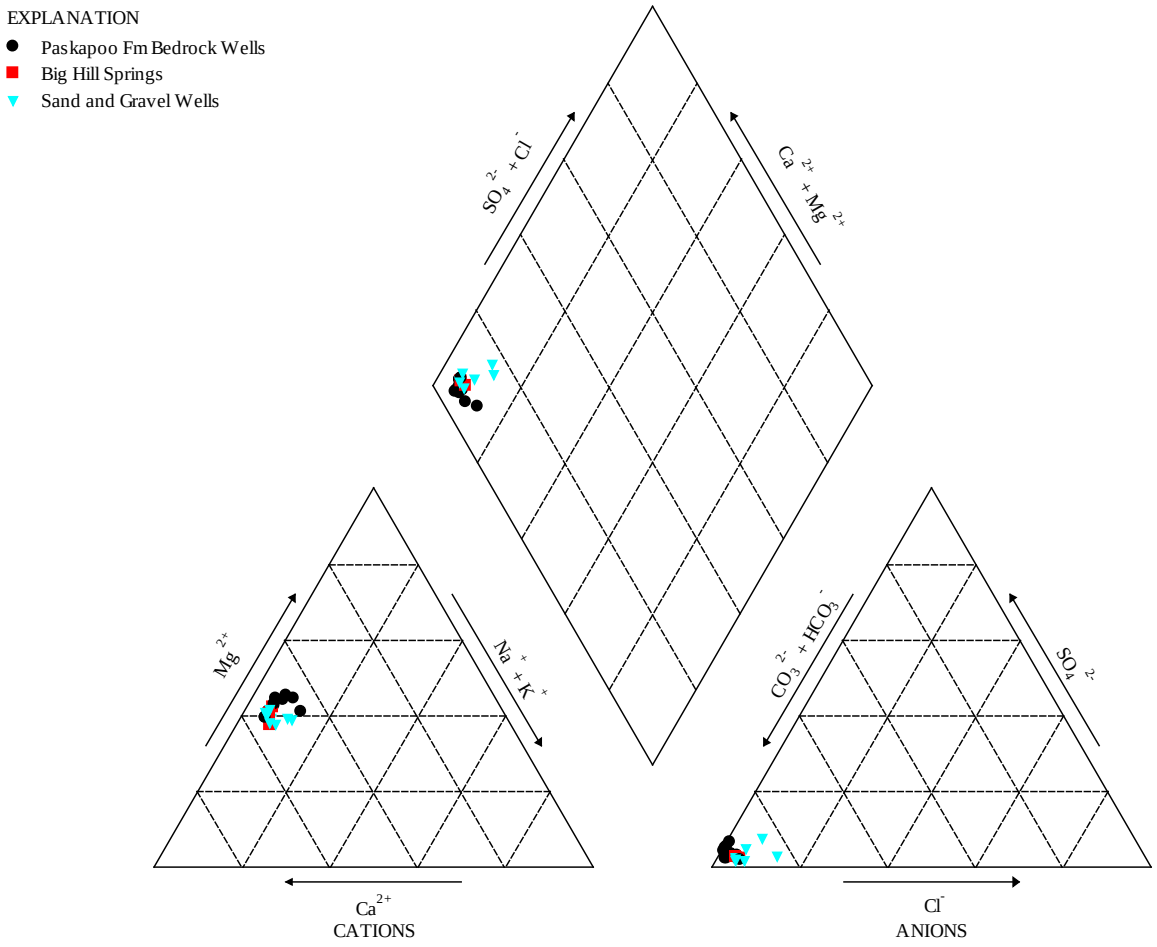

Figure 1
Piper Plot of Groundwater and Surface Water Quality Collected to Date

4.4.1 Surficial Deposits

Table A1 (appended) indicates that groundwater in the sand and gravel deposit is of poor quality for drinking. The Canadian Drinking Water Quality (CDWQ) standards set maximum allowable concentrations (MAC) for 16 parameters for drinking water purposes. A number of these were exceeded in several monitoring wells, including trace metals arsenic, barium, cadmium, chromium, lead, manganese and mercury, and microbiological parameters total coliforms and E. Coli. Other CDWQ guidelines that were exceeded were the aesthetic objective parameters aluminium and iron. Groundwater from a number of the monitoring wells exceeded guidelines for turbidity, which is a parameter that is included because it shows when water is not clear, may contain sediment, and can also mask bacteria counts. The Piper plot in Figure 1 (above) indicates that the sand and gravel samples lie in a zone of Ca-Mg-HCO_3 waters, which indicates an influence from meteoric waters and recharge from rainfall, coupled with the influence of the host soils/bedrock. Of note, the pH was moderately alkaline at 7.8 to 8.2, which is typical of groundwater in these sediments.

The low concentrations of dissolved parameters in the surficial deposits is indicative of recharge from rainfall having a short residence time in the subsurface, where fewer elements have time to

dissolve in the groundwater. Not much of the trace metals are dissolved into the water, but the guidelines are so low that they can be exceeded without contributing significantly to the dissolved load. The high turbidity and total metals in a number of the monitoring wells is potentially artificial and not indicative of the actual water quality. This may have been caused by insufficient development of the monitoring wells before sampling due to the breakdown of the purge pump in both 2014 and 2019, and an undue influence of suspended sediment. The August 2015 sampling in MW14-103 did not experience this problem and sufficient purging and development occurred before the sample was collected on this occasion. The turbidity and concentrations of aluminium, iron and manganese, plus a number of other metals showed a significant reduction from those in November 2014 in the August 2015 sampling.

4.4.2 Paskapoo Formation Bedrock

Table A2 (appended) indicates that groundwater in the Paskapoo Formation is of relatively good quality for drinking, with all parameters meeting the Canadian Drinking Water Quality (CDWQ) guidelines except a single exceedance of total coliforms in WW4. E.Coli was not detected in WW4 which indicates that the coliforms were not related to fecal contamination, however they do indicate that the well could be vulnerable to bacterial contamination, especially with no treatment at that property[2]. pH values were moderately high (7.9 to 8.1) in all samples, indicating slightly more alkaline conditions within the bedrock as compared to the sand and gravel. The Piper plot in Figure 1 indicates that the majority of bedrock samples lie in a zone of Ca-Mg-HCO_3 waters, which again indicates an influence from meteoric waters and recharge from rainfall.

4.4.3 Big Hill Springs

Table A3 (appended) summarizes the water quality results of the water samples taken from the creek downstream from the springs at Big Hill Springs Provincial Park on October 30, 2014, August 4, 2015 and July 10, 2019. Since this groundwater discharge is the source for a surface water stream, and at the point of sampling is within that stream, it is compared to the CWQG Protection for Aquatic Life (PAL) guideline. The PAL has guidelines for 20 parameters of the sampling suite. The sample met 17 of the guidelines for these parameters indicating that water discharging from the spring is generally of good quality. It is noted that total coliforms and E.Coli concentrations exceed the CDWQ drinking water guidelines; however there is no CWQG bacteria guideline for the protection of aquatic life. The high concentrations are consistent with the presence of livestock in the stream catchment and of which evidence was abundant adjacent to the property line at the sampling location. Only aluminium and selenium exceeded the PAL guideline in these natural waters. Of minor note, the laboratory detection limit for mercury (0.001 mg/L) in 2014 and 2015 exceeded the guideline (0.000026 mg/L) and thus the “non-detect” reported in Table A3 may or may not meet the lower guideline. Mercury sources in this geologic setting are not common, nor will the proposed aggregate operation be a source of mercury. Mercury concentrations measured in 2019 fell below the guideline. Since this water is the source for the stream, the downstream biota will be acclimatized to this form of the natural water quality.

The Piper plot in Figure 1 indicates that the Big Hill Spring sample also lies in a zone of Ca-Mg-HCO_3 water, which again indicates an influence from meteoric waters and recharge from rainfall. Due to the similarity between concentrations within the sand and gravel aquifer, bedrock

[2] This well is ultimately scheduled for removal once the aggregate extraction is operational, but is expected to be used in the interim.

aquifer and the spring water, it is clear that the spring water is the same, regardless of which pathway it travelled.

4.5 Water Balance

It is often useful to prepare a water balance for a site in order to understand its hydrogeologic function and against which potential impacts can be compared. This section identifies the basic water balance for the site, where “water in” must equal “water out” within the constraints of the measurements. To do this for this site, we first examine the “water in” which is the precipitation available for groundwater recharge or runoff. This is then calibrated against simple groundwater flow calculations to demonstrate the water balance.

4.5.1 Water Budget

The meteorological station No. 3031093 at the Calgary International Airport has been used to quantify average annual precipitation amounts. This station was selected for its length of record and similarity of terrain. The period of 1981 to 2012 has been used to calculate long term averages which are used in this analysis. Table 2 summarizes the results.

Table 2
Average Annual Water Budget (Calgary YYC)

Month	Ave. Monthly Temperature °C	Precipitation (Snow + Rain) mm	Actual Evapotranspiration mm	Surplus mm	Deficit mm
January	-7.1	9.6	6.5	3.1	
February	-5.5	9.8	8.7	1.1	
March	-1.6	17.9	16.3	1.6	
April	4.5	27.2	35.3		-8.1
May	9.7	58.1	63.8		-5.7
June	13.7	95.2	89.0	6.2	
July	16.6	66.0	101.1		-35.1
August	15.8	57.8	72.2		-14.4
September	11.1	44.0	42.7	1.3	
October	5.2	15.2	18.6		-3.4
November	-2.4	13.0	4.8	8.2	
December	-6.7	10.3	2.9	7.4	
Annual Totals		424.1	461.9	28.9	-66.7
Annual Average	4.5			Net Deficit = -37.8	

Notes:
Weather Station: Elevation: 1,084 masl; Latitude 51°06'50" N; Longitude 114°01'13" W; WMO #71877
Based on a soil moisture storage of 150 mm

At this station, which will have similar results to the Cochrane area, an average annual precipitation of about 424 mm per year occurs. This is typical of the region in the lee of the Rocky Mountains. Examination of this period of record shows that the two wettest years were 1998 and 2005, where upwards of 537 mm fell. The two driest years were 1983 (295 mm) and 2001 (319 mm). Based on Table 5, the wettest months are May to September, with little precipitation over the winter months of December to February (around 10 mm per month on average). The area is known for intensive rainfalls, and the highest month in this period of record was June 2005

when 248 mm fell (almost half the year's precipitation). It should be noted that 386 mm of precipitation has fallen from January 1 to August 31, 2019, which is significantly higher than the same period in an average year (342 mm). The highest monthly rainfall for 2019 fell in June with 135 mm being recorded.

The water budget has been calculated by the method of Thornthwaite and Mather (1957), which uses the monthly average temperatures, latitude, and soil moisture storage to calculate the actual evapotranspiration (AET). The AET is that water that is lost back to the atmosphere by evaporation and plant uptake (transpiration). The calculations indicate there is a net annual deficit of about 38 mm each year. To examine the range of results, a water budget was calculated for the driest and wettest years in the period of record, with the results being presented in Table 3 below.

Table 3
Comparison of Water Budgets in Wet and Dry Years

	Precipitation	Actual Evapotranspiration	Surplus/Deficit
Hottest/driest (1983)	295	384	-89
Average Annual	424	462	-38
Coldest/wettest (1998)	538	488	50

It can be seen that when the precipitation rises, the evapotranspirative uptake increases as well in response to the available water. However, in the wetter years there is still a surplus available for infiltration and runoff.

With reference to the average annual condition shown in Table 6, the months vary as well. The deficits typically occur in the hotter months, despite increased rainfall. Surplus occurs in the cooler months when evaporation is low, and when there is no plant uptake. In these months the soil moisture is replenished, and in the months where there is a deficit, that storage is tapped by the plant rooting systems.

4.5.2 Surplus Partitioning

Section 4.5.1 reports an average annual deficit of about 38 mm. In years when there is a surplus, that surplus water may be partitioned between infiltration and runoff. Using the method of MOEE (1993), which calculates partitioning factors based on topography, soil type and ground cover, an estimate of the annual infiltration and runoff can be derived. Table 4 is reproduced from this manual below, from which the infiltration factors are selected.

Table 4
Infiltration Factors

Description of Area/Development Site		Value of Infiltration Factor
TOPOGRAPHY		
1.	Flat and average slope not exceeding 0.6 m per km	0.30
2.	Rolling land, average slope of 2.8 m to 3.8 m per km	0.20
3.	Hilly land, average slope of 28 m to 47 m per km	0.10
SOIL		
1.	Tight impervious clay	0.10
2.	Medium combinations of clay and loam	0.20
3.	Open sandy loam	0.40
COVER		
1.	Cultivated lands	0.10
2.	Woodlands	0.20

Reproduced from MOEE (1995), Technical Guidelines for the Preparation of Hydrogeological Studies for Land Development Applications.

In this case the fine-grained soils are assigned a factor of 0.2 and the open pasture land cover is given the factor 0.1. The topographic factor is slightly more complex, as there are flat areas sloped down valley, and valley sidewalls with steeper slopes that favor runoff over infiltration. The flat areas have slopes that range from 0.9% to 2%, and are assigned a factor of 0.14. Therefore for the flatter slopes the infiltration factor is 0.2 + 0.1 + 0.14 = 0.44. The steeper slopes range from 2.7% to 23%, and are assigned a factor of 0.1, according to the MOEE (1993) methodology. Therefore, for the steeper slopes the infiltration factor is 0.2 + 0.1 + 0.1 = 0.4. These infiltration factors are multiplied by the surplus in any given year to estimate the rate of groundwater recharge, the remainder being lost to runoff.

4.5.3 Existing Site Water Balance

The final step in the water balance is to judge the contribution of the site to the ground water system. Since the full site is not to be developed, we do not assess those lands that will not change. MALP plan to develop 74 acres (29.83 ha) in the first two phases over ten years. The area of future aggregate extraction is another 132 acres (53.57 ha). To determine volumes available for recharge the maximum surplus (50 mm = 0.05 m) determined above is multiplied by the area. For the full development area (206 acres, or 83.4 hectares) the maximum annual surplus volume of water in a wet year would be 83.4 ha X 10,000 m^2/ha X 0.05 m/yr. = 41,700 m^3/yr.

The flatter areas comprise approximately 55.5 ha and the steeper slopes comprise approximately 27.9 ha, having infiltration factors of 0.44 and 0.40, respectively. The flatter area is 66.5% of the development area, and thus the infiltration in that portion can be calculated by multiplying that volume by the infiltration factor:

41,700 m^3/yr. X 0.665 X 0.44 = 12,201 m^3/yr.

The steeper area is 33.5% of the development area, and thus the infiltration in that portion can be calculated by multiplying that volume by the steep area infiltration factor:

$$41{,}700\ m^3/yr.\ X\ 0.335\ X\ 0.40 = 5{,}587.8\ m^3/yr.$$

Therefore, the total infiltration under existing conditions for the development area (in wet year) is the ensuing sum of 17,789 m^3/yr. The difference between this and the total surplus of 41,700 m^3/yr.; therefore, is lost to run off, that is 23,911 m^3/yr.

It is always wise to independently cross-check this kind of calculation, which is based on meteorological data and estimates of soil, vegetative cover and topography. This can be done by examining the groundwater conditions that receive the water. In this case the Darcy Principle for groundwater flow is used, based on the site geometry and measured range of hydraulic conductivity, and lateral hydraulic gradients. Darcy found that groundwater flow can be quantified in the following manner:

$$Q = K \times dh/dL \times A$$

Where Q is the volumetric flux, K is the horizontal hydraulic conductivity, dh/dL is the horizontal gradient and A is the vertical area (height X breadth) of the sand and gravel available for groundwater flow. In this case the measured range of K for the sand and gravel is 1×10^{-4} to 3×10^{-4} m/s, as reported in Section 4.2.1. The lateral hydraulic gradient (dh/dL) is a minimum of 0.0095 m/m, measured from Drawing 4 where the 2 m (dh) contours are about 210 m (dL) apart. The vertical area, A is not actually known, however it is estimated to be 800 m wide, and the above equation can be used to determine its height. Finally, Q is known because it is necessary to see if the 17,789 m^3/yr can pass through this soil. The flow of 17,789 m^3/yr can be converted to consistent units with the above and is equal to 5.6×10^{-4} m^3/s. Rearranging Darcy's equation:

$$Q = K \times dh/dL \times A$$

$$Q = K \times dh/dL \times (h \times b), \text{ or}$$

$$K \times dh/dL \times (h \times b) = Q, \text{ and rearranging,}$$

$$h = Q / (K \times dh/dL \times b)$$

$$= 5.6 \times 10^{-4}\ m^3/s / (1 \times 10^{-4}\ m/s \times 0.0095 \times 800\ m)$$

$$= 0.74\ m$$

Since the aquifer is many times thicker than this, it is concluded it can easily convey the recharge water generated by this site in a wet year. The reader should be aware that there is groundwater moving onsite from the northwest as well, and this calculation is intended to see if the site water can move in addition to that. Of some interest, the 17,789 m^3/yr. is equivalent to about 0.56 L/s, which is therefore the site's contribution (in a wet year) to the 40 L/s reported coming from the Big Hill Springs, which has a much wider groundwater catchment.

4.6 Conceptual Model Discussion

Using the above findings, a conceptual model has been constructed to aid the reader in understanding the site setting. This conceptual model is further used in Section 5 to conduct an

impact analysis of the proposed aggregate extraction operation. Underlying the site is the Paskapoo Formation bedrock, composed of sandstone, siltstone, mudstone and shale, which serves as the aquifer for most local wells. During deglaciation, this area became a drainage pathway and there is a blanket of outwash sand and gravels lying directly on the bedrock. This deposit has been excavated elsewhere for aggregate, and is the target deposit for MALP's proposed operations. The sand and gravel is 10 to 27 m thick and hosts the water table at depth, but is not a consistent aquifer which has potentially poor water quality, and is only used for domestic purposes in isolated locations (e.g. WW5). Finally, the whole site is blanketed by up to 6 m of fine grained glacial till soils, left when the ice melted. This low permeability blanket restricts the infiltration of precipitation. The site slopes to the southeast from the topographic high to the north and hosts a low-relief valley feature running northwest to southeast across NW Sec 31, Twp 26, Rge 3, W5M. In SW Sec 31, Twp 26, Rge 3, W5M the topography slopes steeply southwesterly into the valley running west-northwest to east-southeast which leads to Big Hill Springs Creek.

The site lies in an area in the lee of the Rocky Mountains and as such is relatively dry. Evapotranspiration on average exceeds precipitation and there is an average annual deficit in the water balance. On the other hand, there is soil moisture storage in the fine-grained soils at surface, so some water is captured in the wet months and helps sustain plants in the drier months. There is a surplus in wetter years. For these reasons the sand and gravel is largely unsaturated and carries groundwater flow along its base above the bedrock. There is also a recharge of the bedrock aquifer from the sand and gravel, so much so that the sand and gravel at test well MW14-102 is dry. Drainage is not complete however, as further downgradient towards the Big Hill Springs Provincial Park some shallow private wells (WW5) in the sand and gravel have enough water in them.

Few residential wells are completed in the sand and gravel deposits due to their limited saturated area, with most residential wells being completed in the bedrock. Water quality in the two aquifers (surficial deposits and bedrock) are very similar to that in Big Hill Springs and are typical of clean meteoric water which indicates that water in both the aquifers and the spring is heavily influenced by recharge from rainfall. It is considered likely, based on the water quality data and the inferred groundwater flow direction in the sand and gravel that a significant contribution to the spring water at Big Hill Springs is provided by groundwater in both aquifers.

The cross-sections run northwest to southeast along the direction of groundwater flow to the springs (A-A'), southwest to northeast across the upper valley (B-B') onsite, and southwest to northeast through the site (C-C') further down valley. They have been prepared to illustrate the relationship between the various geological units in the study area. The likely groundwater flow path shown on Drawing 5 demonstrates the relationship between recharge and discharge areas. The relatively low permeability of the bedrock (even when fractured) is responsible for the perched water table within the sand and gravel. Groundwater recharge occurs in higher areas where overburden is thin or absent and in areas where there are standing water bodies and sloughs perched on top of the low permeability glacial till. Lateral discharge from the aquifers occurs at Big Hill Springs.

5.0 HYDROGEOLOGICAL IMPACT ASSESSMENT

The above sections describe the existing setting where the proposed aggregate resource extraction will be developed. The purpose of impact assessment is to examine how the proposed facility will operate in that setting, and to determine if any adverse effects could be anticipated. The next step is to consider mitigation strategies to ensure the adverse effects are avoided or

corrected. In the ideal case the net effects (the effects of the facility after mitigation) are determined and judged for acceptability within existing practice and regulation.

5.1 Hydrogeological Impact Assessment Criteria

The criteria used here to assess impacts can be expressed simply as “water quantity” and “water quality”. Water quantity refers to potential effects on water levels in wells and wetlands, groundwater flow volumes, and spring discharge volumes. Water quality refers to the potential changes in groundwater quality and/or surface water quality as might be caused by the facility.

5.2 Potential Impacts on Water Quantity

With respect to surface water, there are no streams on or emanating from this site. The presence of the sloughs in the northwest corner is the only surface water feature, and they are seasonal. Examination of the aggregate resource development plan (reproduced on Drawing 3) shows that these lands will be retained in their natural state. Topographically, their catchment area is uphill to the north and west, and thus the development of the aggregate resource downhill to the south will not affect normal overland flow to the sloughs. It can be concluded that there will be no impact to these features.

With respect to groundwater, potential effects include changes to the groundwater levels and/or groundwater flow volumes or directions. It is proposed that the sand and gravel would be worked dry; with the base of the excavation lying 1.0 m above the maximum recorded groundwater level within the deposits, therefore no dewatering is proposed. Based on this, groundwater flow directions will remain the same and there should not be a reduction in groundwater flow volumes, a positive feature as this means no reduction in flow at the Big Hill Springs.

In fact, due to the removal of the lower permeability overburden exposing the more permeable sand and gravel below, recharge to the aquifer is expected to increase. Examination of Table 7 shows that the soil factor increases from 0.2 (for the glacial till) to 0.4 for the sand and gravel. This increases the overall infiltration factor from 0.44 to 0.64 for the flatter areas. The steeper areas will be levelled and will increase from 0.4 to 0.64 as well. Therefore, the calculation for existing conditions shown in Section 4.5.3 can be conducted again with these higher factors. Without listing the details here, the contribution to groundwater (in a wet year) increases from 17,789 m^3/yr to 26,688 m^3/yr due to infiltration. Further to this, there will be no runoff leaving the site due to the management of precipitation falling on the site by infiltration. It is expected that this will be an additional 15,012 m^3/yr, and thus a total of 41,700 m^3/yr of groundwater recharge will occur in a wet year and with the full excavation developed and open. This is conservative, as the site will be progressively restored, returning infiltration conditions to close to their natural state as each phase progresses. With respect to the springs, this amount of water is about 1.3 L/s (an increase of 0.76 L/s) in comparison to the reported Big Hill Springs flow of 40 L/s. It can be concluded that this is a positive impact, but a very minor one. In a drier year there will be no change, other than the momentary capture of any higher intensity storms.

The fine-grained overburden soils removed for sand and gravel extraction would be used to restore the site to an agricultural use. It is anticipated that the final site grade would provide a similar overall average slope to the site as the pre-development state and therefore would have infiltration rates of a similar magnitude. In a dry year or an average year, where there is no surplus, groundwater conditions would remain similar to existing conditions.

5.3 Potential Impacts on Groundwater and Surface Water Quality

During the operational phase of working, the main potential source of water pollution is from manmade sources such as fuels and solvents and natural sources such as suspended solids from reworking of the material on site. These of course are mitigated by best handling practices under the Code of Practice for Pits (Alberta, 2004). The first step in impact assessment is to describe the potential problems to be addressed.

During the aggregate extraction and associated processing (crushing, screening, conveying), there is potential for onsite runoff water to become affected by suspended solids due to surface runoff from working areas, stockpiles and haul roads. In addition, wash water from the crushing plant can convey a heavy suspended sediment load. Without appropriate mitigation measures employed, it is considered that the likelihood of occurrence of this water containing suspended solids loading is high, although with the base of the excavation below ground there is no surface discharge from the site. Thus, the magnitude of impact would be low from a surface water perspective. From a groundwater perspective, the infiltration of these waters into the porous sand and gravel however would mean the capture of the fine sediment in the underlying soils, which may potentially lead to eventual blinding of the near surface. Mitigation measures are proposed as discussed in Section 5.4 below.

During the aggregate extraction and associated works, the use of diesel powered equipment has the potential to cause local impacts should there be any accidental spillage of fuels or lubricants. The specific unmitigated impact of any accidental spillage of raw materials, fuels and lubricants would be on the water quality of the sand and gravel aquifer, since there is no surface water discharge. The implications for unmitigated releases to groundwater are for the down-gradient receptors including the Big Hill Springs approximately 800 m downgradient and nearby groundwater users. It is considered that in the short to medium term the likelihood for contamination of groundwater associated with accidental spillage is low but nevertheless appropriate mitigation measures should be employed. The magnitude of an impact under these conditions could be locally severe, due to the removal of the low permeability glacial till and a significant thickness of unsaturated sand and gravel. It is unlikely that the Environmental Protection and Enhancement Act would be breached offsite unless the spill were directly adjacent to the property boundary. For this reason, the potential overall impact is therefore considered to be of significance to water quality. Therefore, mitigation measures are proposed as discussed in Section 5.4 below.

5.4 Mitigation Measures

Sections 5.2 and 5.3 above identify the potential impacts of the proposed development at the site, and also identify where mitigation measures are required to reduce these potential impacts to acceptable levels. Proposed mitigation measures, over and above those already identified and included in the scheme design, are identified below and for ease of reference are detailed in terms of water quantity and water quality (subdivided further by surface or groundwater). The mitigation measures either reduce the likelihood of an event occurring or reduce the magnitude of the consequences if the event does occur.

It should be noted that several of the mitigation measures proposed below would have a positive effect on more than one potential impact.

The development and restoration of the site would be undertaken using technical guidance including the Code of Practice for Pits (Albert Government, 2004), relevant EPEA rules and other

codes of best practice in order to limit the potential for contamination of both ground and surface waters.

5.4.1 Water Quantity

It is concluded that under the current excavation scheme the overall risk of any significant negative impacts are negligible. This is based on no anticipated changes to the groundwater flow system. However, as an additional safeguard the current groundwater monitoring programmes should continue to be undertaken in order to give an early warning of any potential impacts (either short or long term) on the groundwater resources within the vicinity of the site.

The environmental monitoring programme should include the following:

- Water levels within the perimeter monitoring boreholes and the nearby residential water users at WW2 and WW4 should be monitored regularly by manual measurements and continuously by pressure transducers equipped with data loggers. This will protect both the surrounding water users and the proponent (from frivolous claims);
- Routine inspections to confirm that there are no signs of groundwater entering the excavation and which would indicate that the base of the excavation was below the maximum groundwater level. These should be documented in writing and with photographic confirmation of conditions so found;
- As the base of the excavation is lowered to near the anticipated depth (1.0 m above maximum recorded water level) shallow confirmatory monitoring wells should be installed (on a temporary basis) to refine the actual position of the water table. This information should be surveyed for elevation and location to the site datum to permit revision of any necessary pit design; and
- All monitoring data should be subject to routine review and interpretation to ensure no unanticipated problems exist or go unaddressed.

5.4.2 Groundwater and Surface Water Quality

In order to further reduce the potential risk of impacts to water quality pollution a number of mitigation measures are proposed, and these would be incorporated into the scheme development. The proposed measures include the following:

- The Application site is developed on a phased basis in order to minimise the working area and allow progressive restoration;
- The size of the working areas are minimised in order to reduce the potential for generation of suspended sediment in storm water;
- Settlement ponds and surface infiltration features are commissioned early in the scheme development and all runoff generated at site (including runoff from overburden storage areas and areas of stockpiling) is actively controlled and routed to these ponds as necessary; and
- In addition to the formal settlement ponds and infiltration features, temporary catch basins and sumps are used to collect, gather and manage surface water runoff generated at site within the working areas.

To prevent the discharge of suspended solids from the access road and Plant Site these areas should be developed with appropriate cross-falls to allow immediate drainage to ditches. All drainage would be routed to lined site settlement ponds to ensure no blinding of aquifer soils by sediment occurs.

Given these proposed mitigation measures the risk of unacceptable impacts is low. Nonetheless it is recommended that the following monitoring is undertaken:

- Frequent inspection of the water treatment ponds for erosion or other problems should be undertaken and documented by site operatives to ensure their efficacy; and
- Discharge from the water treatment ponds should only be made in accordance with approval from AEP, i.e. in accordance with the site's EPEA approval.

The threat of accidental spillage of fuels and oils or a vehicular accident occurring on site poses a risk to the groundwater. Standard mitigation measures for training, spill prevention, traffic and handling as per best practices are considered appropriate, along with an effective Emergency Response Plan. Bulk fuel storage would be undertaken in accordance with the *Guide to the Code of Practice for Pits (2004)* and be located in areas where thick clay overburden is still present. Storage would also be in accordance with the *Guidelines for Secondary Containment for Above Ground Storage Tanks (2015).*

The above measures would significantly reduce the likelihood of suspended solids or other pollutants being discharged from the Application site, such that the overall risk is reduced to near zero.

5.5 Net Effects Assessment

After consideration of the mitigation measures detailed in Section 5.4 it may be concluded that the proposed development can be implemented with no adverse net impact to the groundwater or surface water environment. This is based on the fact that the excavation will be operated above the water table, and there is no direct offsite discharge of surface water. No impact is expected on downgradient wells or the Big Hill Spring. A slight benefit will be felt from the additional infiltration of precipitation surplus in that spring flow should increase during wet years.

5.5.1 Cumulative Effects of Multiple Operations

It is noted that several sand and gravel operations are proposed for the immediate surrounding area in addition to the MALP proposal and the currently operating Hillstone Aggregates pit. All are below ground facilities with no surface water discharge.

The same stringent operating procedures will need to be adopted by the other proposed operations to prevent contamination of the underlying aquifers and surface water by fuels, lubricants and sediments. This will include the same high level of preventative mitigation measures and Emergency Response preparations. Based on these factors, the likelihood of a pollution incident is low and therefore the cumulative risk to water quality is negligible from multiple operations in the area.

The water balance indicates that recharge to the underlying aquifers increases when an operation removes the low hydraulic conductivity till material and exposes the sand and gravel to precipitation. As a much larger area will be open at any one time with multiple pits operating together, this will proportionally increase the recharge to the aquifer and therefore the discharge from Big Hill Springs. To illustrate the potential change to groundwater recharge (and discharge at Big Hill Springs) due to multiple pits operating in the same area we have made some simplistic and conservative assumptions below. This is because we do not have details of the proposed phasing and working at the other sites. Assuming conservatively that four additional pits (including the MALP operation) are opened and each has the same total area as used in the

calculations in Section 4.5.3 (83.4 Ha) the total operating recharge in a wet year would be 41,700 m^3/yr x 4 = 166,800 m^3/yr. This compares to the current, undeveloped recharge of 17,789 m^3/yr x 4 = 71,156 m^3/yr, as an increase in recharge to the underlying sand and gravel of 95,644 m^3/yr. This would equate to an increase in flow at Big Hill Springs of approximately 3.0 L/s, which is less than a 10% increase from the 40 L/s quoted in the literature (Ozaray & and Barnes, 1977). This small increase in flow at the Big Hill Springs is overly conservative, as it is known that progressive restoration is planned for the MALP site and is likely to be proposed at the other sites. The real increase will be significantly lower, based on progressive restoration, and therefore the development of multiple sites is likely to provide a small beneficial impact to flow at Big Hill Springs and recharge to the underlying aquifers.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the above physical setting, study results and analyses the following conclusions are offered.

6.1 Conclusions

The site lies in an area of substantive sand and gravel, overlain by a blanket of fine grained soils. In an average meteorological year there is a slight moisture deficit and therefore no groundwater recharge. The water table lies in the bottom of the sand and gravel, moving laterally along the top of and recharging the Paskapoo Formation bedrock. In wetter years a small surplus contributes to the water table at this site, which appears to be maintained by groundwater flow from the northwest. Most local residential wells draw water from the bedrock formation with the exception of some shallow dug wells at location WW5, 1 km southeast of the site. No drawdown of these wells is expected as there will be no dewatering required for extraction of the aggregate. Groundwater from under this site eventually discharges at the Big Hill Springs.

There are no surface water streams or springs on this site, and two sloughs in the northwest corner (fed by storm runoff and perched on the glacial till overburden) will be retained as the site develops. During site development and after site closure, there will be no surface water discharge from the site. When storm water is abundant enough to move on the ground surface it will collect in the lower parts of the site (below existing grade) and ultimately infiltrate into the sand and gravel aquifer. There will be no dewatering of the aquifer because the site sits above the water table, and in fact in wetter years there will be slight augmentation of the groundwater from site infiltration. This will mean a slight increase in spring flow at Big Hill Springs, but probably not at a perceptible level.

Effects of the operation of an aggregate resource development above the water table at this site will be minimal on the ground and surface water, particularly if the mitigation measures discussed in Section 5 of this report are implemented. It is predicted that there will be no adverse net impact of the site.

6.2 Recommendations

Based on the above discussion and conclusions, the following recommendations are provided.

1) The mitigation measures discussed above are implemented as part of the final design;
2) Determination of ultimate excavation depths are based on future monitoring of water table levels beneath the extraction area, through periodic use of temporary shallow groundwater monitoring wells. Monitoring of those wells should include determining their position by survey to the site datum, and documentation of seasonal results to support any re-design thus instigated. The excavation floor should be at least 1.0 m above the maximum recorded water table level;
3) The storm runoff water is directed to sedimentation ponds, designed to ensure clear water discharges. The discharge should be to an unlined infiltration pond for return to the aquifer;
4) Best handling and storage practices for fuels and lubricants are implemented as per the *Guide to the Code of Practice for Pits (2004)* and the *Guidelines for Secondary Containment for Above Ground Storage Tanks (2015)* to minimize the risk of accidental spillage of contaminants at this site; and
5) A monitoring program as described above is implemented to document the lack of effect of the site, and to allow the operators to respond to any unanticipated problems that may occur.

7.0 REFERENCES

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8.0 STATEMENT OF LIMITATIONS

This report has been prepared and the work referred to in this report has been undertaken by SLR Consulting (Canada) Ltd. (SLR) for Mountain Ash Limited Partnership, hereafter referred to as the "Client". The report has been prepared in accordance with the Scope of Work and agreement between SLR and the Client. It is intended for the sole and exclusive use of Mountain Ash Limited Partnership. Other than by the Client and as set out herein, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted without the express written permission of SLR.

This report has been prepared for specific application to this site and site conditions existing at the time work for the report was completed. Any conclusions or recommendations made in this report reflect SLR's professional opinion.

Information contained within this report may have been provided to SLR from third party sources. This information may not have been verified by a third party and/or updated since the date of issuance of the external report and cannot be warranted by SLR. SLR is entitled to rely on the accuracy and completeness of the information provided from third party sources and no obligation to update such information.

Nothing in this report is intended to constitute or provide a legal opinion. SLR makes no representation as to the requirements of compliance with environmental laws, rules, regulations or policies established by federal, provincial or local government bodies. Revisions to the regulatory standards referred to in this report may be expected over time. As a result, modifications to the findings, conclusions and recommendations in this report may be necessary.

The Client may submit this report to Albert Environment and Parks and/or related Alberta environmental regulatory authorities or persons for review and comment purposes.

TABLES

Hydrogeological Assessment Report
Mountain Ash Limited Partnership Aggregate Operation
NW and SW Section 31, Twp 26, Rge 3 W5M
Rocky View County, Alberta
SLR Project No. 212.06650.00003

Table A1
Sand and Gravel Monitoring Well Groundwater Quality Results

Parameter	Guideline (CDWQ)	Units	MW14-101	MW14-103		MW18-104	MW18-105	MW18-106	MW18-107	MW19-108	MW19-109	MW19-110
			20-Nov-14	20-Nov-14	4-Aug-15	4-Jul-19	4-Jul-19	4-Jul-19	4-Jul-19	4-Jul-19	5-Jul-19	10-Jul-19
Total Aluminum[1]	0.1 (OG)	mg/L	**0.164**	**5.57**	**0.109**	**3.7**	**5.4**	**13**	**7**	**15**	**95**	**10**
Total Antimony	0.006 (MAC)	mg/L	<0.00050	<0.00050	<0.00050	0.0049	0.006	0.0048	0.00079	0.0022	0.0034	<0.00060
Total Arsenic	0.01 (MAC)	mg/L	0.00035	0.007858	0.000336	0.0044	0.0056	**0.017**	0.0076	0.0086	**0.071**	0.0084
Total Barium	1 (MAC)	mg/L	0.424	0.7	0.332	0.61	**2.8**	**1.1**	0.79	**1.1**	**7.2**	**2.2**
Bicarbonate (as HCO3)	NV	mg/L	382	380	375	310	320	360	370	390	350	330
Total Boron	5 (MAC)	mg/L	<0.020	<0.020	<0.020	0.025	0.021	<0.020	<0.020	0.029	0.087	<0.020
Total Cadmium	0.005 (MAC)	mg/L	0.000016	0.00029	<0.000005	0.00036	**0.0055**	0.00095	0.00033	0.00095	**0.01**	0.0042
Dissolved Calcium	NV	mg/L	76	75	73	63	69	73	71	74	77	62
Chloride	<250 (AO)	mg/L	10.5	7.8	8.8	29.0	13.0	9.3	10.0	14.0	18	8.4
Total Chromium	0.05 (MAC)	mg/L	<0.0010	0.0076	0.0016	0.018	0.0046	**0.081**	0.025	0.038	**0.19**	0.019
Total Copper	2 (MAC) / 1 (AO)	mg/L	<0.0010	0.0093	0.0013	0.064	0.11	0.11	0.018	0.038	0.29	0.032
Total Iron	<0.3 (AO)	mg/L	0.28	**12**	0.22	**7.6**	**49**	**37**	**17**	**29**	**190**	**10**
Total Lead	0.005 (MAC)	mg/L	0.00031	0.00464	<0.00030	0.0049	**0.025**	**0.019**	**0.0075**	**0.024**	**0.15**	**0.019**
Total Mercury	0.001 (MAC)	mg/L	<0.00010	<0.00010	<0.00020	0.00003	**0.0013**	0.00032	0.000048	0.000067	**0.00208**	0.000002
Dissolved Magnesium	NV	mg/L	33.7	33.4	32.6	30	32	31	32	32	37	30
Total Manganese	0.12 (MAC) / 0.02 (AO)	mg/L	0.02	**0.93**	0.01	**0.62**	**2.90**	**1.90**	**0.60**	**0.74**	**8.9**	**7.3**
Total Molybdenum	NV	mg/L	0.0008	0.00184	0.00086	0.015	0.0014	0.005	0.0021	0.0065	0.023	0.0015
Total Nickel	NV	mg/L	<0.00050	0.01196	0.00051	0.02	0.015	0.036	0.014	0.047	0.41	0.065
Nitrate-N	10 (MAC)	mg/L	1.19	5.22	1.801	0.97	2.6	2.3	2	2.4	1.7	1.9
Nitrite-N	1 (MAC)	mg/L	<0.05	<0.05	<0.005	0.098	<0.010	<0.010	0.034	0.048	0.065	<0.010
Dissolved Potassium	NV	mg/L	4.8	4.3	3.9	4.1	2.9	3.3	3	3.4	6.3	2.7
pH[2]	7.0 -10.5		7.9	7.8	8	7.91	8.05	7.87	7.8	7.91	8.19	7.82
Total Selenium	0.05 (MAC)	mg/L	<0.00060	0.00112	0.00087	0.00049	0.00093	0.0011	0.00094	0.0013	0.00059	0.00096
Total Silver	NV	mg/L	<0.000070	<0.000070	<0.000070	0.00044	<0.00010	0.0017	0.0001	0.0003	0.0025	<0.00010
Dissolved Sodium	<200 (AO)	mg/L	6	8.8	7.9	13	5.7	9	6.6	12	18	6
Sulphate	<500 (AO)	mg/L	8.88	11.9	10.56	9.2	5.8	7.6	6.6	17	26	8.1
Total Thallium	NV	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	0.00023	0.0002	<0.00020	0.00028	0.0026	0.00024
Total Dissolved Solids (calculated)[3]	<500 (AO)	mg/L	337	354	333	310	300	320	320	350	360	290
Turbidity	1 (OG)	NTU	**9.6**	**680**	**8**	**130**	**>4000**	**3100**	**53**	**670**	**>4000**	<0.10
Total Uranium	0.02 (MAC)	mg/L	0.001697	0.002014	0.001563	0.0019	0.012	0.003	0.0027	0.0047	0.016	0.006
Total Zinc	<5 (AO)	mg/L	<0.020	0.033	<0.020	0.072	0.19	0.13	0.037	0.15	1.2	0.14
Total Coliforms	<1 (MAC)	MPN/100 mL	-	-	<1	**>24000**	**<100**	**1100**	**>2400**	**<10**	**120000**	**180**
E.Coli	<1 (MAC)	MPN/100 mL	-	-	<1	**10**	**<100**	**<10**	<1.0	**<10**	**100**	**63**

Notes:
NV = no value
OG = Operational Guidance
AO = Aesthetic Objective
MAC = Maximum Allowable Concentration
Canadian Drinking Water Quality CDWQ Guidelines: September 2019
1. Aluminum Aesthetic Objective (CDWQ - AO): Conventional Treatment Plants <0.1 mg/L (100 ug/L), Other Treatment Systems <0.2 mg/L (200 ug/L)
2. pH Objective (CDWQ): 7.0 - 10.5
3. Calculated result only includes measured parameters. Actual TDS may be higher.
BOLD RED – Exceeds guideline

Table A2
Paskapoo Formation Residential Well Groundwater Quality Results

Parameter	Guideline (CDWQ)	Units	WW1		WW2			WW3		WW4		
			29-Oct-14	4-Aug-15	29-Oct-14	4-Aug-15	10-Jul-19	29-Oct-14	4-Aug-15	30-Oct-14	4-Aug-15	5-Jul-19
Total Aluminum[1]	0.1 (OG)	mg/L	0.0068	0.011	<0.0050	<0.0050	0.006	0.0061	<0.0050	<0.0050	<0.0050	0.0041
Total Antimony	0.006 (MAC)	mg/L	0.00088	<0.00050	0.00059	<0.00050	<0.00060	<0.00050	<0.00050	<0.00050	<0.00050	<0.00060
Total Arsenic	0.01 (MAC)	mg/L	0.000126	0.000132	0.000165	0.000205	<0.00020	0.000143	0.000121	0.000192	0.000194	0.00032
Total Barium	1 (MAC)	mg/L	0.282	0.284	0.128	0.142	0.11	0.221	0.225	0.385	0.391	0.36
Bicarbonate (as HCO3)	NV	mg/L	366.6	359.6	380.6	375.1	350	391.6	377.7	371.8	365.2	340
Total Boron	5 (MAC)	mg/L	0.022	<0.020	0.032	<0.020	0.023	<0.020	<0.020	<0.020	<0.020	<0.020
Total Cadmium	0.005 (MAC)	mg/L	0.000013	<0.000005	0.000016	0.000024	0.000029	0.00004	0.000024	0.000008	<0.000005	<0.000020
Dissolved Calcium	NV	mg/L	70.3	68.2	63.6	63.4	55	73.2	69.7	75.3	72	80
Chloride	<250 (AO)	mg/L	4.29	4.49	1.38	1.93	2	10.31	5.88	10.86	10.95	12
Total Chromium	0.05 (MAC)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012
Total Copper	2 (MAC) / 1 (AO)	mg/L	0.0317	0.013	0.0022	0.0016	0.0045	0.125	0.0057	0.0017	0.0018	0.034
Total Iron	<0.3 (AO)	mg/L	0.015	0.014	0.018	0.04	<0.060	<0.010	<0.010	0.017	0.044	0.3
Total Lead	0.005 (MAC)	mg/L	0.00127	0.00048	<0.00030	<0.00030	0.00054	0.00302	<0.00030	<0.00030	<0.00030	0.011
Total Mercury	0.001 (MAC)	mg/L	<0.00010	<0.00020	<0.00010	<0.00020	<0.0000020	<0.00010	<0.00020	<0.00010	<0.00020	<0.0000020
Dissolved Magnesium	NV	mg/L	35.1	31.8	37.3	35	30	39.9	35.5	35.2	31.5	35
Total Manganese	0.12 (MAC) / 0.02 (AO)	mg/L	<0.0010	<0.0010	0.004	0.0042	0.012	0.0014	<0.0010	<0.0010	<0.0010	<0.0040
Total Molybdenum	NV	mg/L	0.00148	0.00147	0.00222	0.00193	0.0014	0.00113	0.00104	0.00076	0.00066	0.00065
Total Nickel	NV	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	0.0006	0.00174	<0.00050	<0.00050	<0.00050	<0.00050
Nitrate-N	10 (MAC)	mg/L	1.67	1.658	0.78	1.054	0.37	1.87	1.889	3.02	3.314	3.2
Nitrite-N	1 (MAC)	mg/L	<0.05	<0.005	<0.05	<0.005	<0.010	<0.05	<0.005	<0.05	<0.005	<0.010
Dissolved Potassium	NV	mg/L	3.3	3.2	2.8	2.6	2	3.1	3	3.1	2.9	3
pH[2]	7.0 -10.5		8.1	8	8	8.1	7.95	7.9	8	8	8	8.13
Total Selenium	0.05 (MAC)	mg/L	0.00084	<0.00060	0.00112	0.00105	0.00052	0.0007	0.00085	0.0018	0.00096	0.00093
Total Silver	NV	mg/L	<0.000070	<0.00007	<0.00007	<0.00007	<0.00010	<0.00007	<0.00007	<0.00007	<0.00007	0.00012
Dissolved Sodium	<200 (AO)	mg/L	7.2	7	13.8	9.3	17	7.8	7.6	7.1	6.5	7.7
Sulphate	<500 (AO)	mg/L	6.95	7.51	15.82	12.85	20	10.33	11.09	7.66	6.77	5.9
Total Thallium	NV	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Total Dissolved Solids (calculated)[3]	<500 (AO)	mg/L	318	310	328	317	300	349	330	339	328	330
Turbidity	1 (OG)	NTU	0.2	0.31	0.2	1.23	0.31	0.2	0.25	0.6	0.23	0.66
Total Uranium	0.02 (MAC)	mg/L	0.001299	0.001241	0.001023	0.001214	0.00091	0.001744	0.001688	0.001785	0.001672	0.0021
Total Zinc	<5 (AO)	mg/L	<0.020	<0.020	0.024	<0.020	0.046	0.205	<0.020	0.029	0.031	0.99
Total Coliforms	<1 (MAC)	MPN/100 mL	-	<1	-	<1	1	-	<1	-	<1	**11**
E.Coli	<1 (MAC)	MPN/100 mL	-	<1	-	<1	<1	-	<1	-	<1	<1

Notes:

NV = no value

OG = Operational Guidance

AO = Aesthetic Objective

MAC = Maximum Allowable Concentration

Canadian Drinking Water Quality CDWQ Guidelines: September 2019

1. Aluminum Aesthetic Objective (CDWQ - AO): Conventional Treatment Plants <0.1 mg/L (100 ug/L), Other Treatment Systems <0.2 mg/L (200 ug/L)
2. pH Objective (CDWQ): 7.0 - 10.5
3. Calculated result only includes measured parameters. Actual TDS may be higher.

BOLD RED – Exceeds guideline

Table A3
Big Hill Springs Water Quality Results

Parameter	Guideline (CWQG PAL Freshwater)	Units	BHS1		
			30-Oct-14	4-Aug-15	10-Jul-19
Hardness (as CaCO3)	NV	mg/L	336	317	200
Total Aluminum[1]	0.1	mg/L	0.0182	0.0144	**0.3**
Total Antimony	NV	mg/L	<0.00050	<0.00050	<0.00060
Total Arsenic	0.005	mg/L	0.000153	0.000146	0.00061
Total Barium	NV	mg/L	0.304	0.313	0.21
Bicarbonate (as HCO3)	NV	mg/L	376.1	371	240
Total Boron[2]	1.5	mg/L	0.024	<0.020	<0.020
Total Cadmium[3]	0.00009	mg/L	0.000032	0.000008	0.000034
Dissolved Calcium	NV	mg/L	74.1	72	48
Chloride[4]	120	mg/L	9.6	10.12	8.2
Total Chromium[5]	0.001	mg/L	<0.0010	<0.0010	0.001
Total Copper[6]	0.004	mg/L	<0.0010	0.001	0.0013
Total Iron	0.3	mg/L	0.027	0.019	0.25
Total Lead[7]	0.007	mg/L	<0.00030	<0.00030	<0.00020
Total Mercury	0.000026	mg/L	**<0.00010**	**<0.00020**	0.0000025
Dissolved Magnesium	NV	mg/L	36.7	33.3	20
Total Manganese	NV	mg/L	0.0019	0.0012	<0.0040
Total Molybdenum	0.073	mg/L	0.00141	0.00089	0.00038
Total Nickel[8]	0.15	mg/L	<0.00050	<0.00050	0.00088
Nitrate-N[9]	2.9	mg/L	2.83	**3.037**	1.4
Nitrite-N	0.06	mg/L	<0.05	<0.005	<0.010
Dissolved Potassium	NV	mg/L	3.4	3.3	4.8
pH	6.5-9		8.2	8.2	8.07
Total Selenium	0.001	mg/L	**0.00218**	**0.0013**	0.00068
Total Silver	0.00025	mg/L	<0.000070	<0.000070	<0.00010
Dissolved Sodium	NV	mg/L	7.8	7.5	5
Sulphate	NV	mg/L	9.36	8.36	4.7
Total Thallium	0.0008	mg/L	<0.00020	<0.00020	<0.00020
Total Dissolved Solids (calculated)[10]	NV	mg/L	342	334	210
Turbidity	NV	NTU	0.8	1.07	5.1
Total Uranium[11]	0.015	mg/L	0.001953	0.001875	0.0013
Total Zinc	0.007	mg/L	**<0.020**	**<0.020**	<0.0030
Total Coliforms	NV	MPN	-	2420	>2400
E.Coli	NV	MPN	-	1733	1600

Notes:

NV = no value

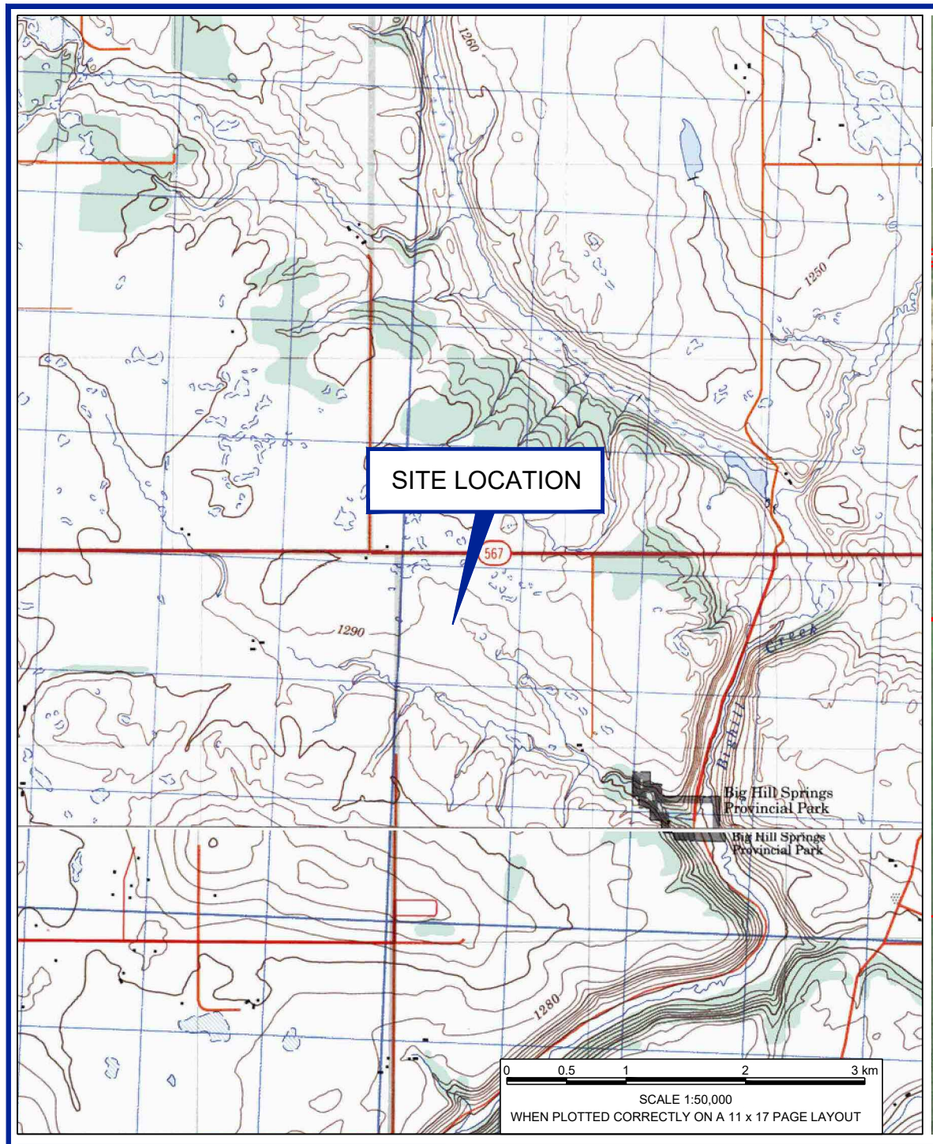
Canadian Water Quality Guidelines (CWQG) Protection for Aquatic Life (PAL) Freshwater Guidelines Updated to September 2019

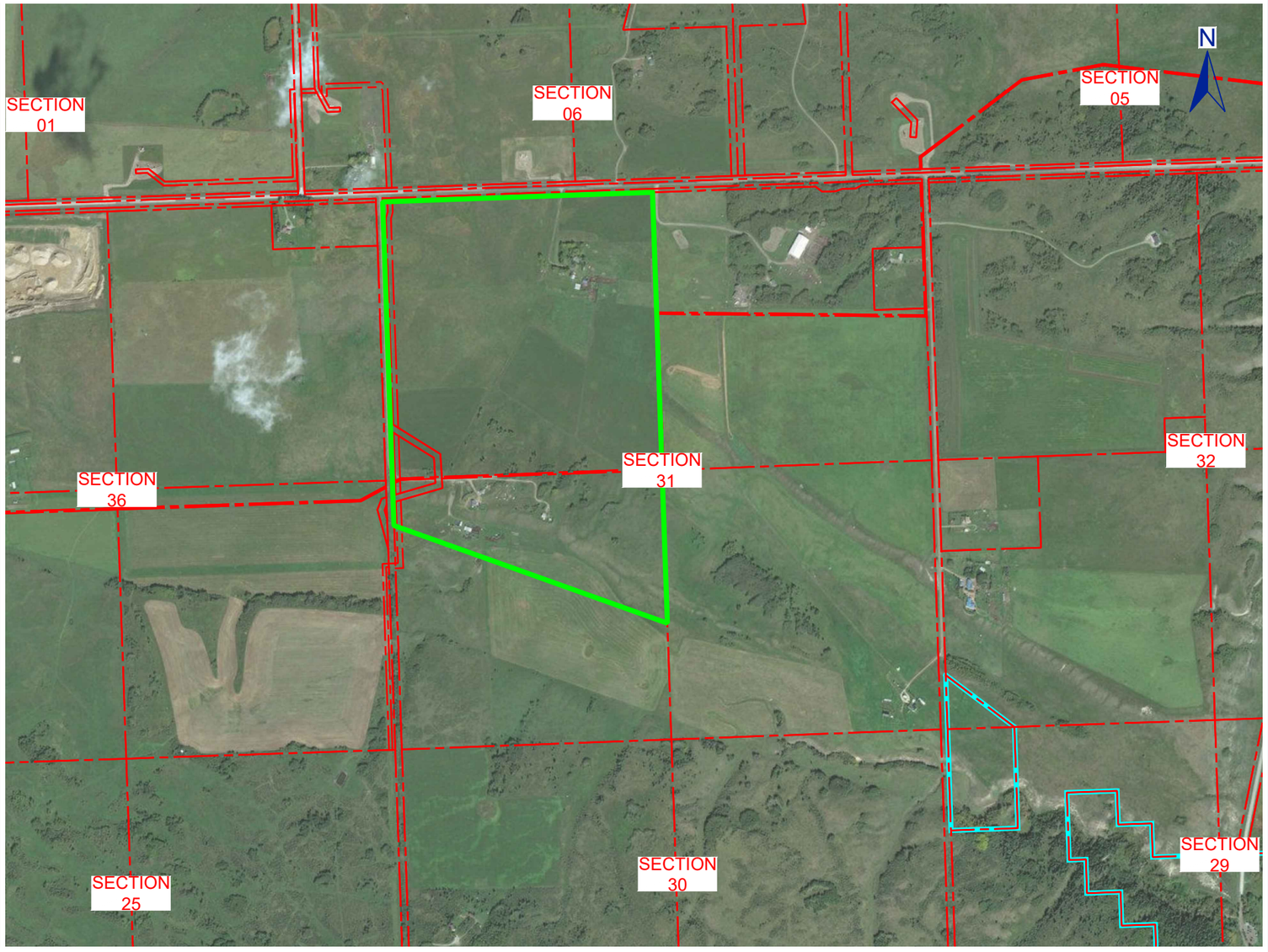
1. Aluminum Guideline (CWQG Aquatic Life - Freshwater): if pH < 6.5 then 0.005 mg/L (5 ug/L), else if pH >= 6.5 then 0.1 mg/L (100 ug/L)
2. Boron Guideline value is for long term exposure. Short term exposure value is 29 mg/L
3. Cadmium Guideline value is for long term exposure. Short term exposure value is 0.001 mg/L
4. Chloride Guideline value is for long term exposure. Short term exposure value is 640 mg/L
5. Chromium Guideline value is for hexavalent chromium as conservative value. Trivalent chromium guideline is 0.0089 mg/L.
6. Copper Guideline (CWQG Aquatic Life - Freshwater): if hardness (as $CaCO_3$) < 82 mg/L then 0.002 mg/L (2 ug/L), if CaCO3 = 83-180 mg/L then is calculated using an equation, if CaCO3 >180 mg/L then 0.004 mg/L (4 ug/L),
7. Lead Guideline (CWQG Aquatic Life - Freshwater): if hardness (as CaCO3) < 60 mg/L then 0.001 mg/L (1 ug/L), if CaCO3 = 60-180 mg/L then is calculated using an equation, if CaCO3 = >180 mg/L then 0.007 mg/L (7 ug/L)
8. Nickel Guideline (CWQG Aquatic Life - Freshwater): if hardness (as CaCO3) < 60 mg/L then 0.025 mg/L (25 ug/L), if CaCO3 = 60-180 mg/L then is calculated using an equation, if CaCO3 > 180 mg/L then 0.150 mg/L (150 ug/L),
9. Nitrate Canadian Water Quality Guidelines (CWQG) for Aquatic Life represents lower value for "Long Term Exposure". Short Term exposure value is 124 for Freshwater
10. Calculated result only includes measured parameters. Actual TDS may be higher.
11. Uranium Guideline value is for long term exposure. Short term exposure value is 0.033 mg/L

BOLD RED – Indicates Exceeds guideline

DRAWINGS

Hydrogeological Assessment Report
Mountain Ash Limited Partnership Aggregate Operation
NW and SW Section 31, Twp 26, Rge 3 W5M
Rocky View County, Alberta
SLR Project No. 212.06650.00003





NOTES:
DRAWING COMPILED FROM LIDAR DATA, PROPERTY LINE DATA AND AIR PHOTOS AS PROVIDED BY THE CLIENT, NTS MAP 82 O/01 TITLED "CALGARY" AND 82 O/08 TITLED "CROSSFIELD" AND SITE RECONNAISSANCE INFORMATION.

LEGAL DESCRIPTION:
W 1/2 SEC 31 TWP 026 RGE 03 W5M
ROCKY VIEW COUNTY, ALBERTA

IMAGERY SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY. IMAGERY DATE: SEPTEMBER 9, 2016.

LEGEND:
- PROPERTY BOUNDARY
- SUBJECT BOUNDARY
- BIG HILL SPRINGS PROVINCIAL PARK

0 100 200 400 600 800 m
SCALE 1:12,500
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM ZONE 11N

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

MOUNTAIN ASH LIMITED PARTNERSHIP
AGGREGATE OPERATION
NW & SW 31-26-03-W5M
ROCKY VIEW COUNTY, ALBERTA

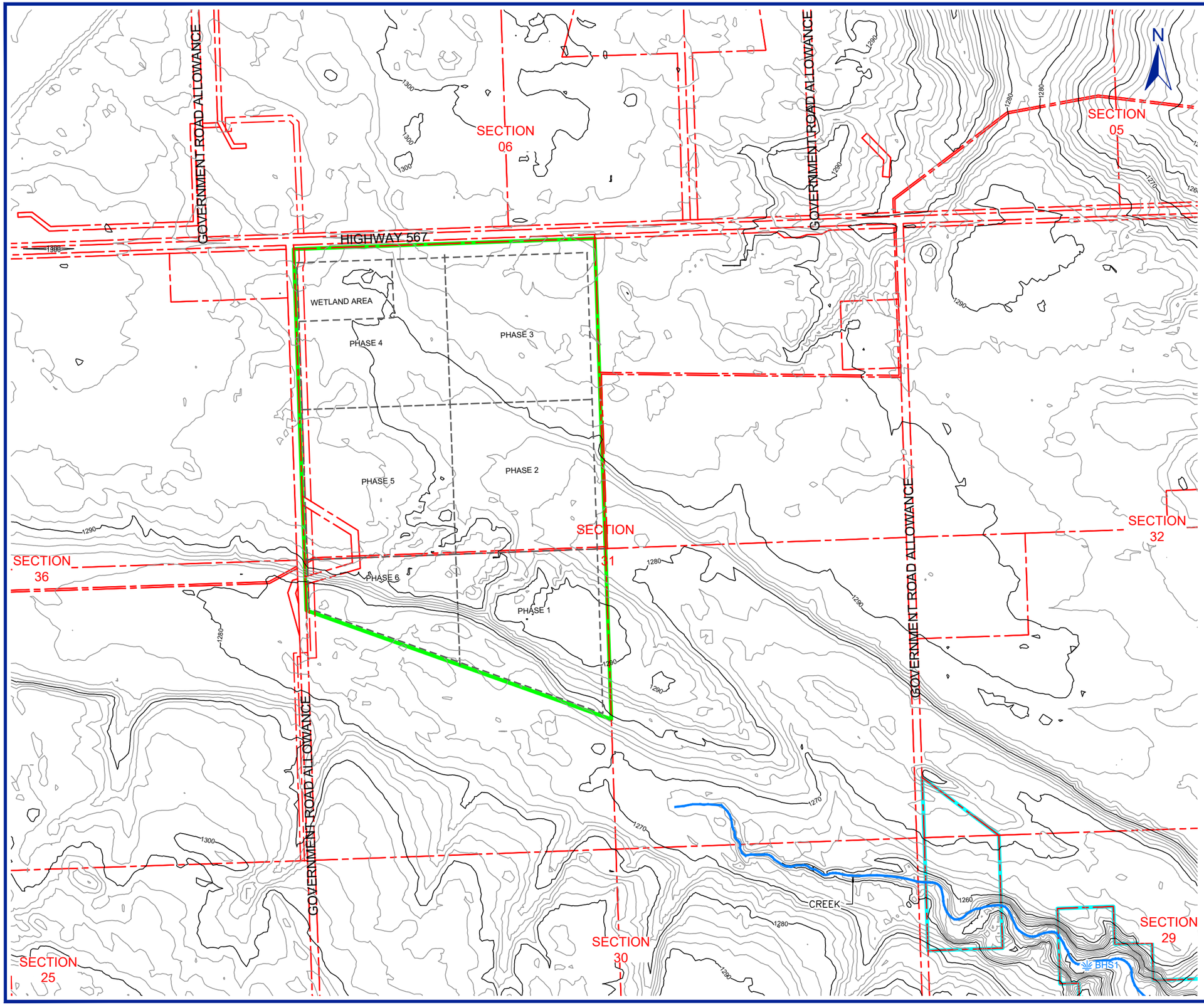
HYDROGEOLOGICAL ASSESSMENT

SITE LOCATION & STUDY AREA

Date: January 14, 2020
Project No. 212.06650.00003
Drawing No. 1

SLR global environmental solutions

Cadfile name: S_212-06650-00003-A6.dwg



NOTES:
DRAWING COMPILED FROM LIDAR DATA, PROPERTY LINE DATA AND AIR PHOTOS AS PROVIDED BY THE CLIENT, NTS MAP 82 O/01 TITLED "CALGARY" AND 82 O/08 TITLED "CROSSFIELD" AND SITE RECONNAISSANCE INFORMATION.

LEGAL DESCRIPTION:
W 1/2 SEC 31 TWP 026 RGE 03 W5M
ROCKY VIEW COUNTY, ALBERTA

LEGEND:

- PROPERTY BOUNDARY
- SITE LOCATION
- BIG HILL SPRINGS PROVINCIAL PARK BOUNDARY
- EXTRACTION PHASE BOUNDARIES
- 1250 — MAJOR CONTOUR INTERVALS - GROUND SURFACE 10 m INVERVALS FROM LIDAR DATA
- MINOR CONTOUR INTERVALS - GROUND SURFACE 2 m INTERVALS FROM LIDAR DATA

0 100 200 400 600 m

SCALE 1:10,000
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM ZONE 11N

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MOUNTAIN ASH LIMITED PARTNERSHIP
AGGREGATE OPERATION
NW & SW 31-26-03-W5M
ROCKY VIEW COUNTY, ALBERTA

HYDROGEOLOGICAL ASSESSMENT

STUDY AREA TOPOGRAPHY

Date: January 14, 2020
Project No. 212.06650.00003

Drawing No. 2

SLR global environmental solutions

Cadfile name: S_212-06650-00003-A6.dwg

NOTES:
DRAWING COMPILED FROM LIDAR DATA, PROPERTY LINE DATA AND AIR PHOTOS AS PROVIDED BY THE CLIENT, NTS MAP 82 O/01 TITLED "CALGARY" AND 82 O/08 TITLED "CROSSFIELD" AND SITE RECONNAISSANCE INFORMATION.

LEGAL DESCRIPTION:
W 1/2 SEC 31 TWP 026 RGE 03 W5M
ROCKY VIEW COUNTY, ALBERTA

IMAGERY SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY. IMAGERY DATE: SEPTEMBER 9, 2016.

LEGEND:

- PROPERTY BOUNDARY
- SITE LOCATION
- BIG HILL SPRINGS PROVINCIAL PARK BOUNDARY
- EXTRACTION PHASE BOUNDARIES
- 500 m RADIUS FROM SITE
- ID — BOREHOLE (OTHERS)
- ID — BOREHOLE COMPLETED AS A MONITORING WELL
- ID — BOREHOLE COMPLETED AS A MONITORING WELL (OTHERS)
- ID — WATER WELL
- ID — WATER WELL (WELL PLOTTED AT QUARTER SECTION CENTROID BASED ON DATABASE. EXACT LOCATION WITHIN QUARTER SECTION IS UNKNOWN)
- ID-D — WATER WELL (DECOMMISSIONED)
- SURFACE WATER MONITORING POINT
- A A' — STRATIGRAPHIC CROSS SECTION LINE
- LINE OF STRATIGRAPHIC PROJECTION

STATION ID	NORTHING	EASTING
MW14-101	5682867.5	680067.9
MW14-102	5682278.7	680793.2
MW14-103	5683099.2	680740.6
MW18-104	5682648.9	680080.8
MW18-105	5682280.0	680070.2
MW18-106	5682664.2	680394.2
MW18-107	5682625.1	680726.1
MW19-108	5682179.2	680387.3
MW19-109	5681802.5	680679.1
MW19-110	5682057.8	680788.1
WW2/1475699	5682770.4	680988.2
WW4/350194	5682091.3	680256.7

0 100 200 400 600 m

SCALE 1:10,000
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM ZONE 11N

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MOUNTAIN ASH LIMITED PARTNERSHIP
AGGREGATE OPERATION
NW & SW 31-26-03-W5M
ROCKY VIEW COUNTY, ALBERTA

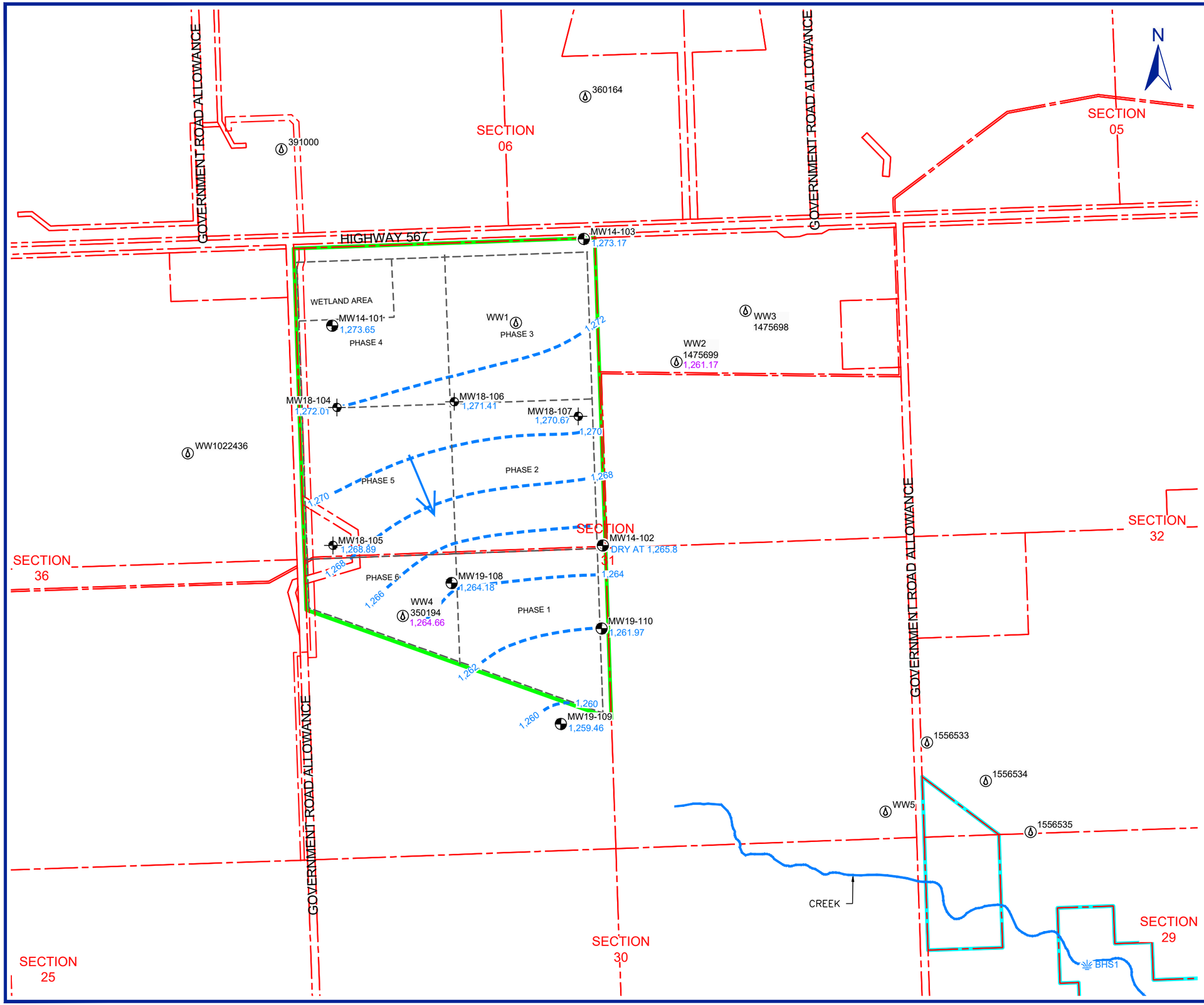
HYDROGEOLOGICAL ASSESSMENT

BOREHOLE, MONITORING WELL AND WATER WELL LOCATION PLAN

Date: January 14, 2020
Project No. 212.06650.00003
Drawing No. 3

SLR global environmental solutions

Cadfile name: S_212-06650-00003-A6.dwg



NOTES:
DRAWING COMPILED FROM LIDAR DATA, PROPERTY LINE DATA AND AIR PHOTOS AS PROVIDED BY THE CLIENT, NTS MAP 82 O/01 TITLED "CALGARY" AND 82 O/08 TITLED "CROSSFIELD" AND SITE RECONNAISSANCE INFORMATION.

LEGAL DESCRIPTION:
W 1/2 SEC 31 TWP 026 RGE 03 W5M
ROCKY VIEW COUNTY, ALBERTA

LEGEND:

- PROPERTY BOUNDARY
- SITE LOCATION
- BIG HILL SPRINGS PROVINCIAL PARK BOUNDARY
- EXTRACTION PHASE BOUNDARIES
- ID — BOREHOLE (OTHERS)
- ID — BOREHOLE COMPLETED AS A MONITORING WELL
- ID — BOREHOLE COMPLETED AS A MONITORING WELL (OTHERS)
- ID — WATER WELL
- SURFACE WATER MONITORING POINT

GROUNDWATER MONITORING RESULTS

- 1,260.73 — GROUNDWATER ELEVATION IN SAND AND GRAVEL (mASL)
- 1,260 — INFERRED GROUNDWATER ELEVATION CONTOUR IN SAND AND GRAVEL (INTERVAL 2.0 m)
- INFERRED GROUNDWATER FLOW DIRECTION IN SAND AND GRAVEL
- 1,260.73 — GROUNDWATER POTENTIOMETRIC ELEVATION IN PASKAPOO FORMATION BEDROCK (mASL)

WATER WELLS WITH EXACT LOCATIONS UNKNOWN ARE LISTED BELOW WITH THE LOCATIONS AVAILABLE FROM ALBERTA WELL RECORDS WHICH INDICATE LOCATIONS AT THE CENTROID OF THE 1/4 SECTIONS. THESE WATER WELLS ARE NOT SHOWN ON THE DRAWINGS.

ALBERTA WATER WELL RECORD NUMBER	LEGAL LAND LOCATION
2095665	SW 6-27-3 W5M
390998	SE 6-27-3 W5M
390999	SE 6-27-3 W5M
387449	NE 36-26-4 W5M
494773	NE 36-26-4 W5M
391598	NW 31-26-3 W5M
395786	NE 31-26-3 W5M

0 100 200 400 600 m

SCALE 1:10,000
WHEN PLOTTED CORRECTLY ON A 11 x 17 PAGE LAYOUT
NAD 1983 UTM ZONE 11N

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MOUNTAIN ASH LIMITED PARTNERSHIP
AGGREGATE OPERATION
NW & SW 31-26-03-W5M
ROCKY VIEW COUNTY, ALBERTA

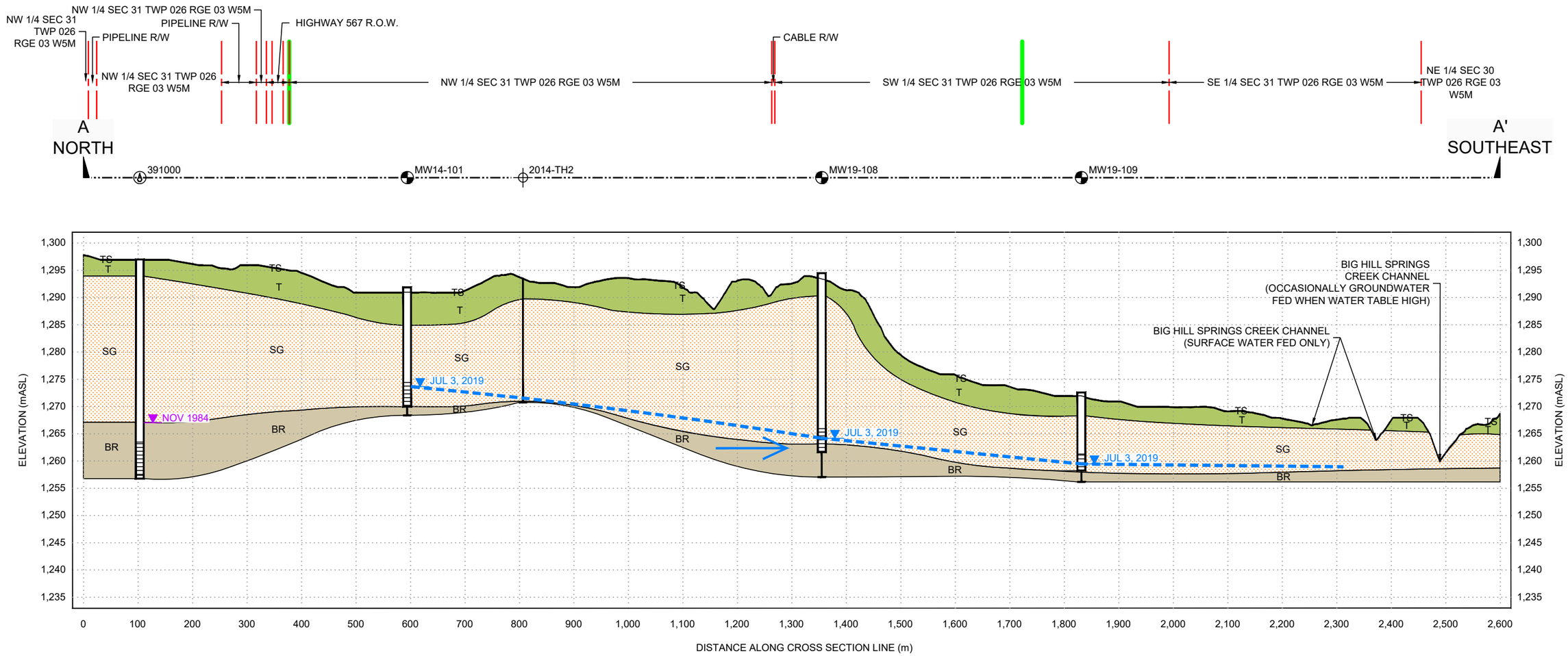
HYDROGEOLOGICAL ASSESSMENT

GROUNDWATER ELEVATIONS (JULY 3, 2019)

Date: January 14, 2020
Project No. 212.06650.00003
Drawing No. 4

SLR global environmental solutions

Cadfile name: S_212-06650-00003-A6.dwg



NOTES:
DRAWING COMPILED FROM LIDAR DATA, PROPERTY LINE DATA AND AIR PHOTOS AS PROVIDED BY THE CLIENT, NTS MAP 82 O/01 TITLED "CALGARY" AND 82 O/08 TITLED "CROSSFIELD" AND SITE RECONNAISSANCE INFORMATION.

LEGAL DESCRIPTION:
W 1/2 SEC 31 TWP 026 RGE 03 W5M
ROCKY VIEW COUNTY, ALBERTA

LEGEND:
- PROPERTY BOUNDARY
- SITE LOCATION
- ID — BOREHOLE (OTHERS)
- ID — BOREHOLE COMPLETED AS A MONITORING WELL
- ID — WATER WELL
- GROUNDWATER ELEVATION IN SAND AND GRAVEL
- GROUNDWATER POTENTIOMETRIC ELEVATION IN PASKAPOO FORMATION BEDROCK
- INFERRED GROUNDWATER LEVEL
- INFERRED GROUNDWATER FLOW DIRECTION

LEGEND:
- A — A' — STRATIGRAPHIC CROSS SECTION A - A'
- TS — TOPSOIL
- T — TILL
- SG — SAND AND GRAVEL
- BR — BEDROCK
- WELL
- SCREENED INTERVAL
- BOREHOLE OR TESTPIT
- END OF HOLE

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

MOUNTAIN ASH LIMITED PARTNERSHIP
AGGREGATE OPERATION
NW & SW 31-26-03-W5M
ROCKY VIEW COUNTY, ALBERTA

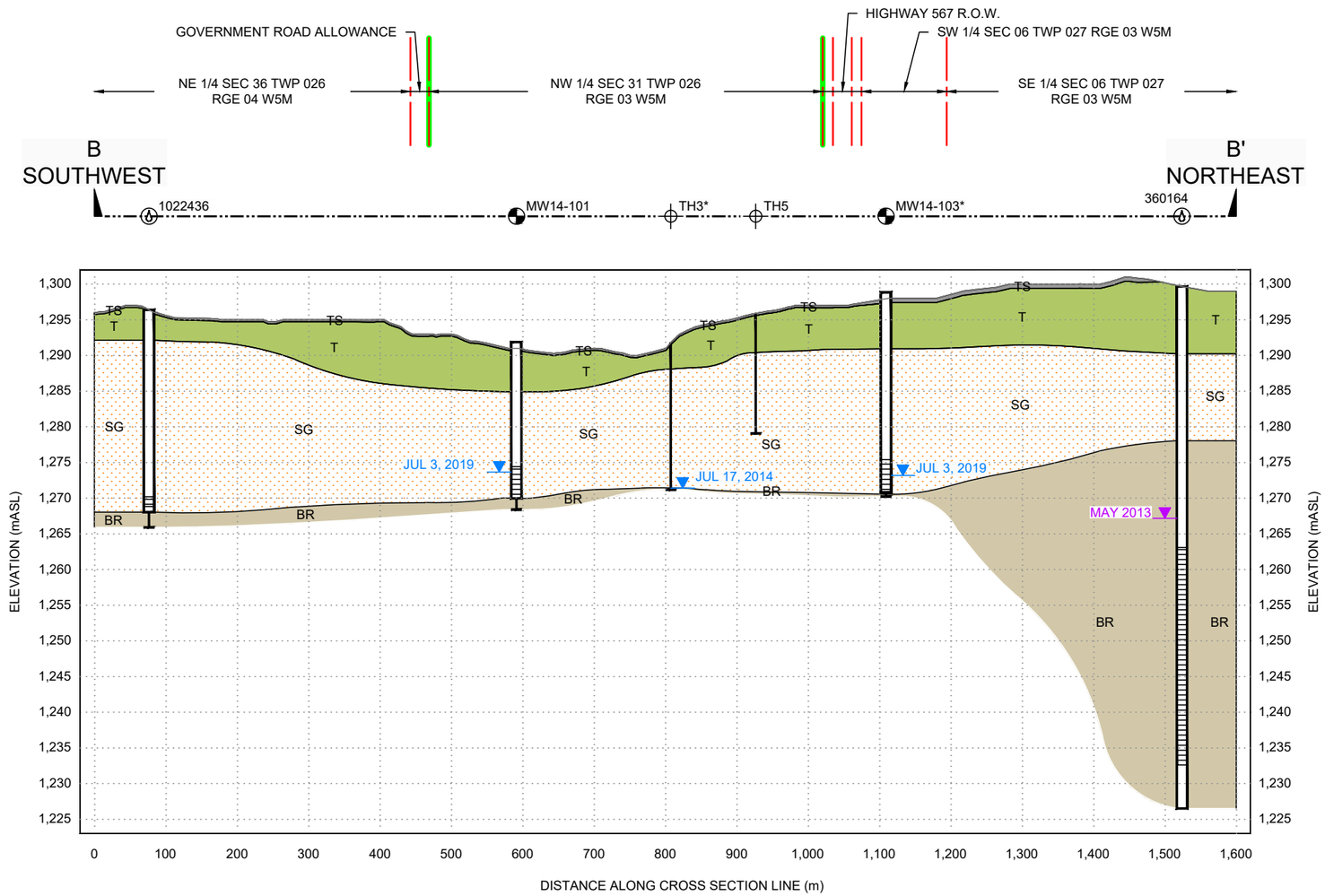
HYDROGEOLOGICAL ASSESSMENT

SCHEMATIC GEOLOGICAL SECTION A - A'

Date: January 14, 2020
Project No. 212.06650.00003
Drawing No. 5

SLR global environmental solutions

Cadfile name: S_212-06650-00003-A6.dwg



NOTES:

DRAWING COMPILED FROM LIDAR DATA, PROPERTY LINE DATA AND AIR PHOTOS AS PROVIDED BY THE CLIENT, NTS MAP 82 O/01 TITLED "CALGARY" AND 82 O/08 TITLED "CROSSFIELD" AND SITE RECONNAISSANCE INFORMATION.

LEGAL DESCRIPTION:
W 1/2 SEC 31 TWP 026 RGE 03 W5M
ROCKY VIEW COUNTY, ALBERTA

LEGEND:

- PROPERTY BOUNDARY
- SITE LOCATION
- ID — BOREHOLE (OTHERS)
- ID — BOREHOLE COMPLETED AS A MONITORING WELL
- ID — WATER WELL
- GROUNDWATER ELEVATION IN SAND AND GRAVEL
- GROUNDWATER POTENTIOMETRIC ELEVATION IN PASKAPOO FORMATION BEDROCK
- B — B' — STATIGRAPHIC CROSS SECTION B - B'

LEGEND:

- TS — TOPSOIL
- T — TILL
- SG — SAND AND GRAVEL
- BR — BEDROCK
- WELL
- SCREENED INTERVAL
- BOREHOLE OR TESTPIT
- END OF HOLE

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

MOUNTAIN ASH LIMITED PARTNERSHIP
AGGREGATE OPERATION
NW & SW 31-26-03-W5M
ROCKY VIEW COUNTY, ALBERTA

HYDROGEOLOGICAL ASSESSMENT

SCHEMATIC GEOLOGICAL SECTION B - B'

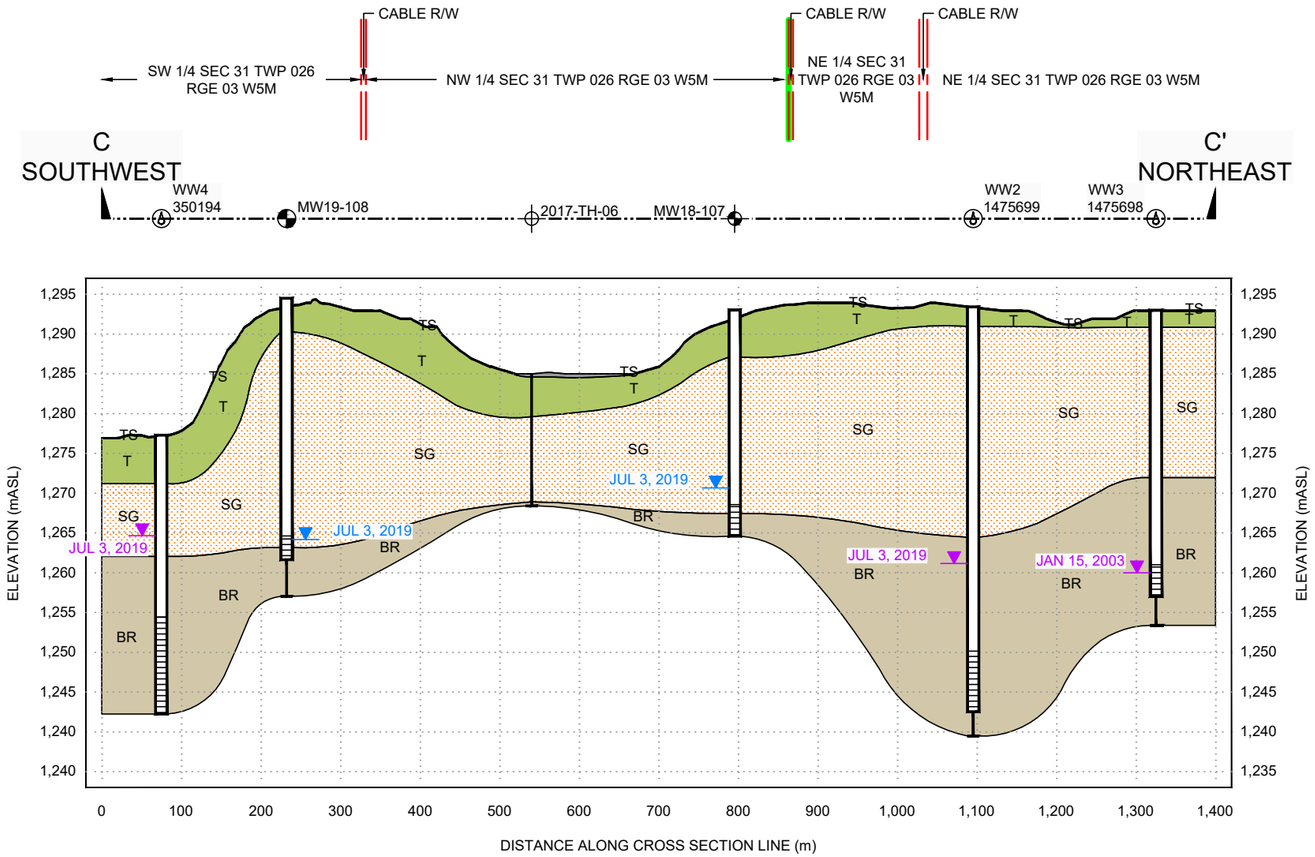
Date: January 14, 2020

Drawing No. 6

Project No. 212.06650.00003

SLR global environmental solutions

Cadfile name: S_212-06650-00003-A6.dwg



NOTES:

DRAWING COMPILED FROM LIDAR DATA, PROPERTY LINE DATA AND AIR PHOTOS AS PROVIDED BY THE CLIENT, NTS MAP 82 O/01 TITLED "CALGARY" AND 82 O/08 TITLED "CROSSFIELD" AND SITE RECONNAISSANCE INFORMATION.

LEGAL DESCRIPTION:
W 1/2 SEC 31 TWP 026 RGE 03 W5M
ROCKY VIEW COUNTY, ALBERTA

LEGEND:

- PROPERTY BOUNDARY
- SITE LOCATION
- ID — BOREHOLE (OTHERS)
- ID — BOREHOLE COMPLETED AS A MONITORING WELL
- ID — BOREHOLE COMPLETED AS A MONITORING WELL (OTHERS)
- ID — WATER WELL
- DATE — GROUNDWATER ELEVATION IN SAND AND GRAVEL
- DATE — GROUNDWATER POTENTIOMETRIC ELEVATION IN PASKAPOO FORMATION BEDROCK

LEGEND:

- C — C' — STRATIGRAPHIC CROSS SECTION C - C'
- TS — TOPSOIL
- T — TILL
- SG — SAND AND GRAVEL
- BR — BEDROCK
- WELL
- SCREENED INTERVAL
- BOREHOLE OR TESTPIT
- END OF HOLE

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

MOUNTAIN ASH LIMITED PARTNERSHIP
AGGREGATE OPERATION
NW & SW 31-26-03-W5M
ROCKY VIEW COUNTY, ALBERTA

HYDROGEOLOGICAL ASSESSMENT

SCHEMATIC GEOLOGICAL SECTION C - C'

Date: January 14, 2020
Project No. 212.06650.00003
Drawing No. 7

SLR global environmental solutions

Cadfile name: S_212-06650-00003-A6.dwg

APPENDIX A
Site Gravel Investigation Results and Logs

Hydrogeological Assessment Report
Mountain Ash Limited Partnership Aggregate Operation
NW and SW Section 31, Twp 26, Rge 3 W5M
Rocky View County, Alberta
SLR Project No. 212.06650.00003

ALMOR TESTING SERVICES LTD.

7505 - 40 STREET S.E., CALGARY, AB T2C 2H5 PHONE (403) 236-8880 • FAX (403) 236-1707

2014 08 27 099-89-14

Summit Aggregates
10919 - 84 Street SE
Calgary, Alberta
T2C 5A6

Attention: Mr. Tige Brady, C.E.T.

Re: Waterman Pit Gravel Investigation
Highway 567, RR 40

We were retained to observe the advancement of test holes, within the proposed Waterman gravel borrow pit, located south of Highway 567 and east of Range Road 40, on July 18 and 19, 2014.

At that time, five (5) test holes, designated as TH1 to TH5, were advanced at the approximate locations shown on the attached Site Plan. The test holes were advanced using a diesel hammer rig operated by Great West Drilling, of Calgary, Alberta. The total depth of the test holes ranged from 16.8m to 22.8m, below existing ground surface. Gravel samples were obtained at regular intervals and returned to our laboratory for further classification and analysis. Groundwater was observed in four (4) test holes (TH1 to TH4) at completion of drilling, perched on top of the bedrock.

Enclosed are five (5) Test Hole Logs, recorded during drilling and four (4) Aggregate Gradation Analyses conducted on representative samples from TH1, TH2, TH3 and TH5. Also enclosed are the results of LA Abrasion testing conducted on representative samples from TH1, TH3, TH4 and TH5, by Curtis Engineering Ltd.

We trust this meets with your present requirements.

Respectfully submitted,
ALMOR TESTING SERVICES LTD.

Abdul Alemi, E.I.T.
AA:ms:A04665

Attachments

PROJECT: WATERMAN GRAVEL PIT ASSESSMENT
SH 567 & RR40

CLIENT: SUMMIT AGGREGATES

PROJECT NO.

HOLE NO. TH1

DRILL TYPE BECKER HAMMER

GEODETIC ELEVATION (m)

DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)
0	**TOPSOIL/ORGANICS**	0
1	**Silty CLAY (TILL)** brown, trace sand, trace to some gravel, stiff, moist	2
2		4
3		6
4		8
5		10
6		12
7		14
8		16
9		18
10	**Sandy GRAVEL** brown, silty, compact, fine to coarse grained, poorly graded, damp	20
11		22
12		24
13		26
14		28
15	- compact to dense below 8.5m	30
16	- some cobble below 9.4m	32
17	- sand layer approx. 0.6m thick	34
18		36
19		38
20		40
21		42
22		44
23	- sand layer approx. 0.6m thick	46
24		48
25		50
26		52
27		54
28		56
29	- sand layer approx. 0.6m thick	58
30		60
31		62
32		64
33		66
34	**CLAYSHALE (BEDROCK)**	68
35	**END OF TEST HOLE AT 20.4m**	70
36	- groundwater level 17.4m at completion	72
37	- test hole backfilled with soil cuttings	74
38		76
39		78
40		80

SAMPLE TYPE

MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT — LIQUID LIMIT
20 40 60

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

Gravel 65.1 %
Sand 31.8 %
Silt and Clay 3.1 %
▼ At completion

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■
20 40 60
□ SPT ◪ Case
■ Cone ◪ BT Pen

GROUNDWATER
▼ Date Measured

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

COMPLETION DEPTH 20.4 m

DATE DRILLED July 18, 2014

LOGGED BY Abdul Alemi

PLATE NO. 1

PROJECT: WATERMAN GRAVEL PIT ASSESSMENT
SH 567 & RR40

CLIENT: SUMMIT AGGREGATES

PROJECT NO.

HOLE NO. TH2

DRILL TYPE BECKER HAMMER

GEODETIC ELEVATION (m)

DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)
0	**TOPSOIL/ORGANICS**	0
1	**Silty CLAY (TILL)** brown, trace sand, trace gravel, stiff, moist	2
2		4
3		6
4		8
4	**Sandy GRAVEL** brown, silty, compact, fine to coarse grained, poorly graded, damp	10
5		12
5	- occasional cobble below 5.2m	14
6		16
7		18
8		20
9		22
10		24
10	- some cobble below 10.1m	26
11	- sand layer approx. 0.6m thick	28
12		30
12	- highly oxidized below 11.9m	32
13		34
14		36
15		38
15	- sand layer approx. 0.6m thick	40
16		42
17		44
18		46
19		48
19	- sand layer approx. 0.6m thick	50
20		52
21		54
21	- saturated sand layer at 21.0m	56
22		58
23		60
23	**SANDSTONE (BEDROCK)**	62
24	**END OF TEST HOLE AT 22.8m**	64
	- groundwater level 21.0m at completion	66
	- test hole backfilled with soil cuttings	68
		70
		72
		74
		76
		78
		80

SAMPLE TYPE

MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT — LIQUID LIMIT
20 40 60

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

Gravel 57.6 %
Sand 31.2 %
Silt and Clay 11.2 %

▼ At completion

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■
20 40 60
□ SPT ◪ Case
■ Cone ◹ BT Pen

GROUNDWATER
▼ Date Measured

COMPLETION DEPTH 22.8 m

DATE DRILLED July 18, 2014

LOGGED BY Abdul Alemi

PLATE NO. 2

PROJECT: WATERMAN GRAVEL PIT ASSESSMENT
SH 567 & RR40

CLIENT: SUMMIT AGGREGATES

PROJECT NO.

HOLE NO. TH3

DRILL TYPE BECKER HAMMER

GEODETIC ELEVATION (m)

DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE
	TOPSOIL/ORGANICS		
1	**Silty CLAY (TILL)** brown, trace sand, trace to some gravel, stiff, moist	2	
2		4	
3		6	
		8	
		10	
		12	
4	**Sandy GRAVEL** brown, trace clay, silty, compact, fine to coarse grained, poorly graded, damp	14	B
5		16	B
		18	
6	- highly oxidized below 6.1m	20	B
7	- occasional cobble below 6.7m	22	
		24	
8		26	
	- occasional fine grained sand layer below 8.5m	28	
9		30	
		32	
10		34	
11	- sand layer approx. 0.6m thick	36	B
		38	
12		40	
		42	
13		44	
14	- some cobble below 13.7m	46	B
		48	
15	- becoming compact to dense	50	
16		52	
		54	
17	- sand layer approx. 0.6m thick	56	
		58	B
18		60	
19		62	
		64	
20	- coarse grained sand layer approx. 0.6m thick	66	B
	SANDSTONE (BEDROCK)	68	
21	**END OF TEST HOLE AT 20.6m**	70	
	- groundwater level 20.4m at completion		
22	- test hole backfilled with soil cuttings	72	
		74	
23		76	
		78	
24		80	

MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT — LIQUID LIMIT
20 40 60

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

Gravel 60.7 %
Sand 28.0 %
Silt and Clay 11.3 %

Gravel 59.8 %
Sand 29.8 %
Silt and Clay 10.4 %

Gravel 62.1 %
Sand 29.6 %
Silt and Clay 8.3 %

▼ At completion

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■
20 40 60
□ SPT ◪ Case
■ Cone ◪ BT Pen

GROUNDWATER
▼ Date Measured

COMPLETION DEPTH 20.6 m

DATE DRILLED July 17, 2014

LOGGED BY Abdul Alemi

PLATE NO. 3

PROJECT: WATERMAN GRAVEL PIT ASSESSMENT
SH 567 & RR40

CLIENT: SUMMIT AGGREGATES

PROJECT NO.

HOLE NO. TH4

DRILL TYPE BECKER HAMMER

GEODETIC ELEVATION (m)

DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)
0	**TOPSOIL/ORGANICS**	0
1	**Silty CLAY (TILL)** brown, trace sand, trace gravel, stiff, low to medium plastic, moist	2
2		4
3		6
4		8
5		10
		12
		14
		16
		18
6	**Sandy GRAVEL** brown, trace clay, silty, compact, fine to coarse grained, poorly graded, damp	20
7		22
		24
8		26
9		28
		30
	- sand layer approx. 0.6m thick	32
10	- occasional cobble below 10.1m	34
11		36
		38
12	- some cobble below 12.2m	40
13		42
		44
14		46
		48
15	- sand layer approx. 0.6m thick	50
16		52
		54
17		56
	- coarse grained sand layer approx. 0.6m thick	58
18		60
		62
19	- saturated below 18.9m	64
20		66
		68
21		70
		72
22	**SANDSTONE (BEDROCK)**	74
	END OF TEST HOLE AT 21.9m	76
23	- groundwater level 18.9m at completion	78
	- test hole backfilled with soil cuttings	80
24		

SAMPLE TYPE

MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT — LIQUID LIMIT
20 40 60

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

▼ At completion

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■
20 40 60
□ SPT ◪ Case
■ Cone ◪ BT Pen

GROUNDWATER
▼ Date Measured

COMPLETION DEPTH 21.9 m

DATE DRILLED July 17, 2014

LOGGED BY Abdul Alemi

PLATE NO. 4

PROJECT: WATERMAN GRAVEL PIT ASSESSMENT
SH 567 & RR40

CLIENT: SUMMIT AGGREGATES

PROJECT NO.

HOLE NO. TH5

DRILL TYPE BECKER HAMMER

GEODETIC ELEVATION (m)

DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE	OTHER TESTS
	TOPSOIL/ORGANICS			
1	**Silty CLAY (TILL)** brown, trace sand, trace gravel, stiff, low to medium plastic, moist	2		
		4		
2		6		
		8		
3		10		
		12		
4		14		
		16		
5		18		
	Sandy GRAVEL brown, trace clay, silty, compact, fine to coarse grained, poorly graded, damp			
6		20		
		22		
7		24	B	
	- occasional cobble below 7.6m			
8		26		
		28		
9	- sand layer approx. 0.3m thick	30		
		32		
10		34		
		36		Gravel 68.4 %
11		38	B	Sand 27.8 %
				Silt and Clay 3.8 %
12		40	B	
		42		
13	- some cobble below 12.8m	44		
		46		
14		48		
		50		
15	- becoming compact to dense	52	B	Gravel 71.2 %
				Sand 22.8 %
16		54		Silt and Clay 6.0 %
	- becoming dense			
17	**END OF TEST HOLE AT16.8m**	56		
	- test hole dry at completion	58		
18	- test hole backfilled with soil cuttings	60		
		62		
19		64		

MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT — LIQUID LIMIT
20 40 60

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

20 40 60
PENETRATION RESISTANCE ■
□ SPT ◪ Case
■ Cone ◺ BT Pen

GROUNDWATER
Date Measured

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

COMPLETION DEPTH 16.8 m

DATE DRILLED July 18, 2014

LOGGED BY Abdul Alemi

PLATE NO. 5

7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Summit Aggregates

Attention Tige Brady

Project Gravel Pit Investigation
Waterman Pit, Hwy567 & RR40

Job No.

Date Sampled	July 18/14	**By**	AA
Date Received	July 18/14	**By**	AA
Date Tested	July 22/14	**By**	JC,KW

Aggregate Type Sandy GRAVEL
Aggregate Source Existing Material

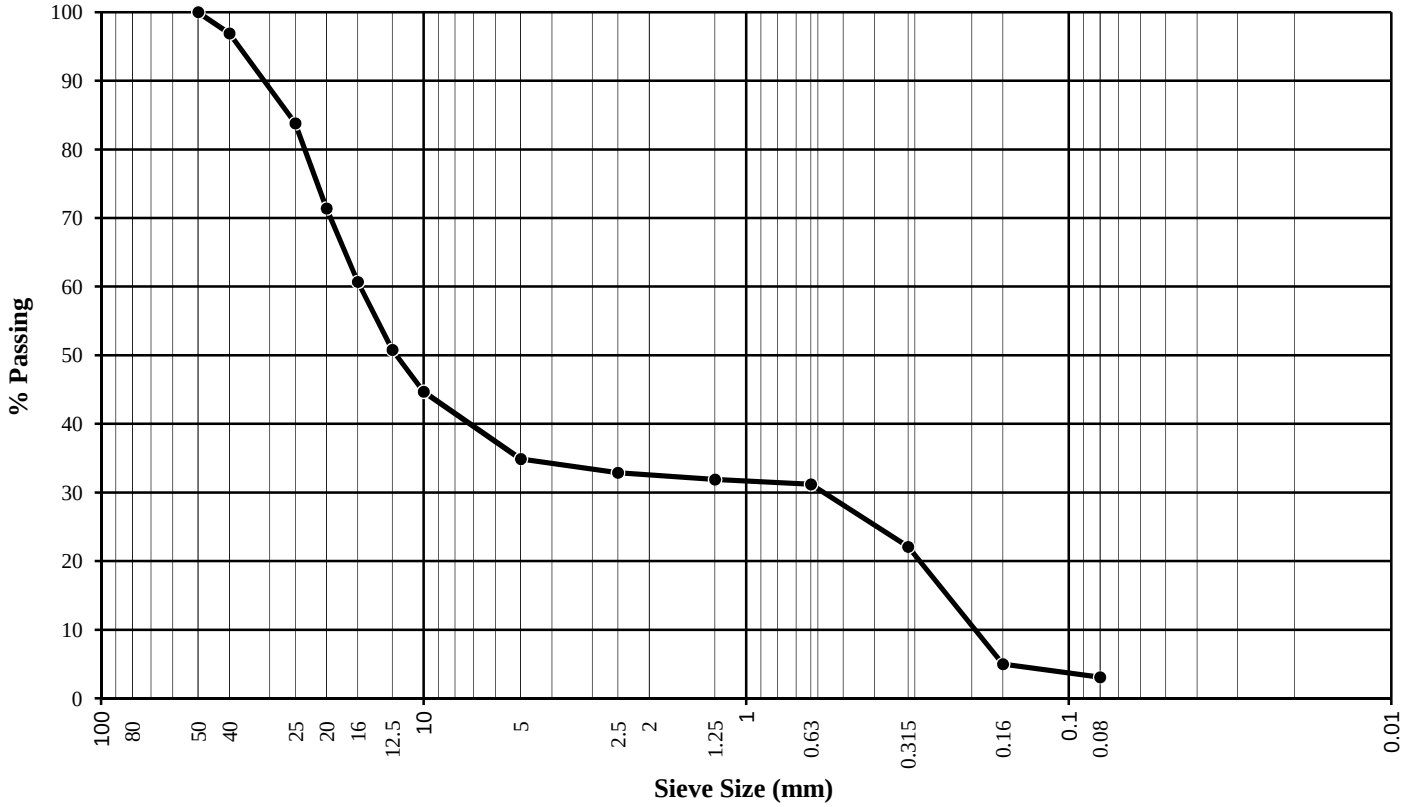
Classification GP
C_C= 0.1
C_U= 76.8

Specification

Comments

TH # 1 @ 55-57ft.
Moisture Content = 7.0%

Sieve Size (mm)	Percent Passing by Weight	Min.	Max.
200			
150			
100			
80			
50	100.0		
40	96.9		
25	83.8		
20	71.4		
16	60.7		
12.5	50.8		
10	44.7		
5	34.9		
2.5	32.9		
1.25	31.9		
0.63	31.2		
0.315	22.1		
0.16	5.0		
0.08	3.1		



7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Summit Aggregates

Attention Tige Brady

Project Gravel Pit Investigation
Waterman Pit, Hwy567 & RR40

Job No.

Date Sampled	July 18/14	**By**	AA
Date Received	July 18/14	**By**	AA
Date Tested	July 22/14	**By**	JC,KW

Aggregate Type Silty, Sandy GRAVEL
Aggregate Source Existing Material

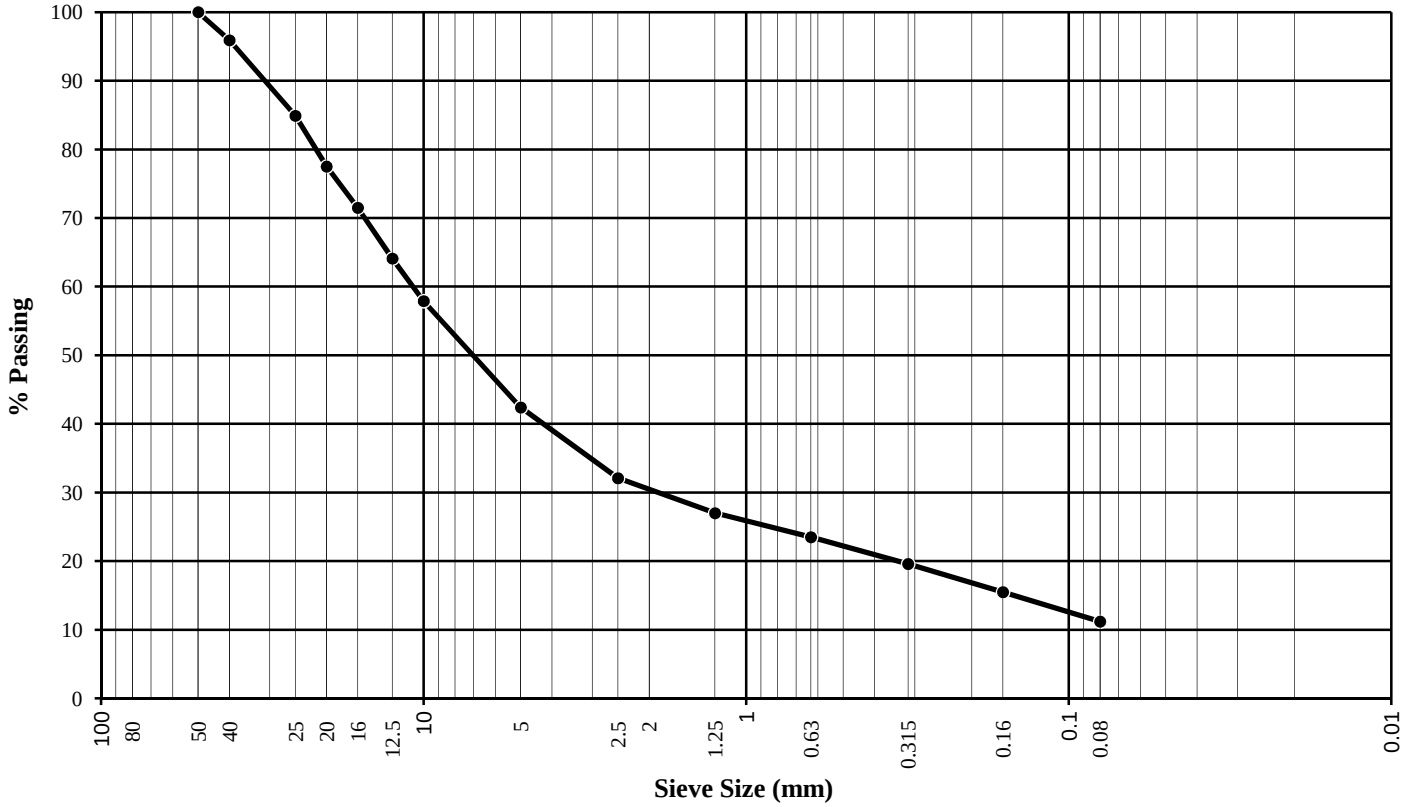
Classification GP-GM
C_C= 3.3
C_U= 135.6

Specification

Comments

TH # 2 @ 39-40ft.
Moisture Content = 4.2%

Sieve Size (mm)	Percent Passing by Weight	Min.	Max.
200			
150			
100			
80			
50	100.0		
40	95.9		
25	84.9		
20	77.5		
16	71.5		
12.5	64.1		
10	57.9		
5	42.4		
2.5	32.1		
1.25	27.0		
0.63	23.5		
0.315	19.6		
0.16	15.5		
0.08	11.2		



7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Summit Aggregates

Attention Tige Brady

Project Gravel Pit Investigation
Waterman Pit, Hwy567 & RR40

Job No.

Date Sampled	July 17/14	**By**	AA
Date Received	July 18/14	**By**	AA
Date Tested	July 22/14	**By**	JC,KW

Aggregate Type Silty, Sandy GRAVEL
Aggregate Source Existing Material

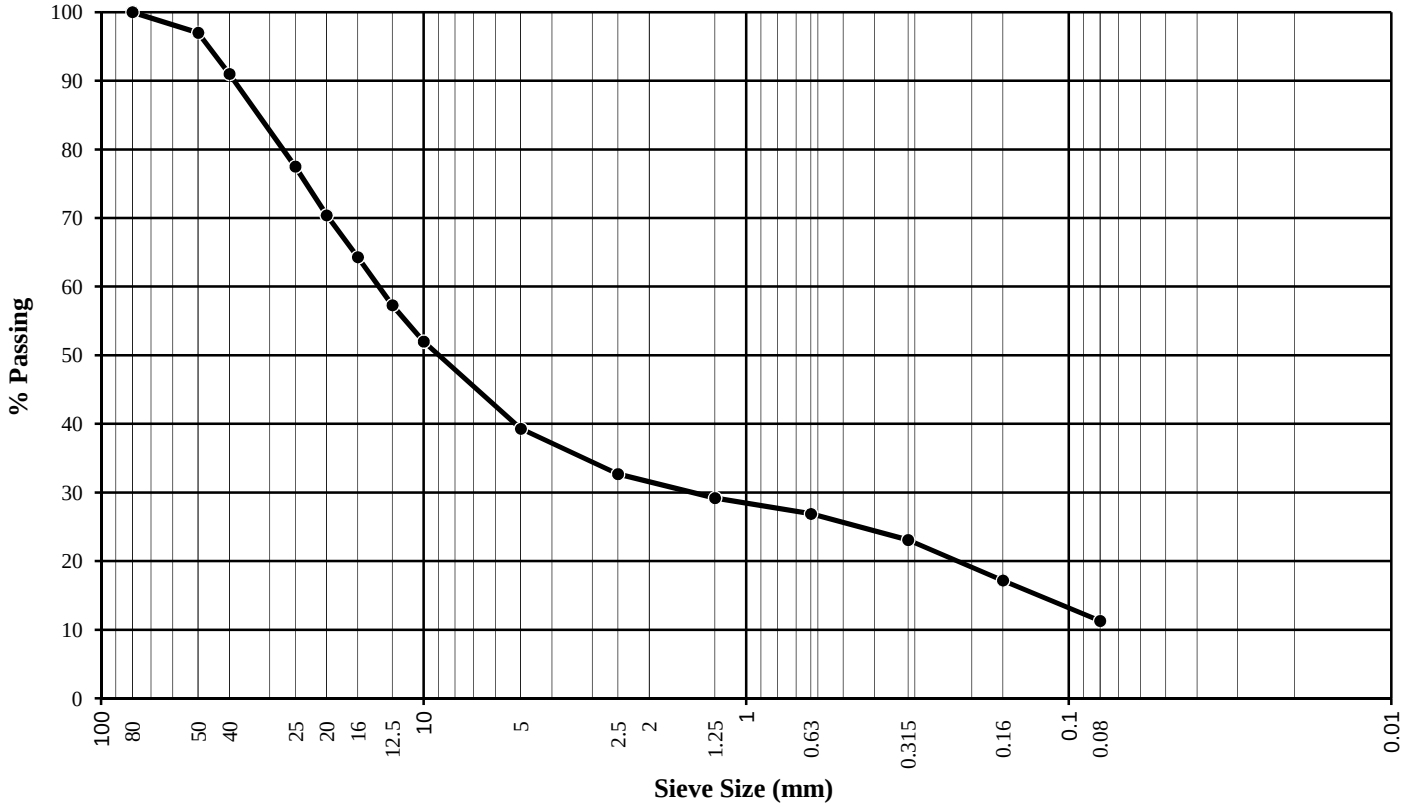
Classification GW-GM
C_C= 1.8
C_U= 173.0

Specification

Comments

TH # 3 @ 20-25ft.
Moisture Content = 2.5%

Sieve Size	Percent Passing by Weight		
(mm)		Min.	Max.
200			
150			
100			
80	100.0		
50	97.0		
40	91.0		
25	77.5		
20	70.4		
16	64.3		
12.5	57.3		
10	52.0		
5	39.3		
2.5	32.7		
1.25	29.2		
0.63	26.9		
0.315	23.1		
0.16	17.2		
0.08	11.3		



7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Summit Aggregates

Attention Tige Brady

Project Gravel Pit Investigation
Waterman Pit, Hwy567 & RR40

Job No.

Date Sampled	July 18/14	**By**	AA
Date Received	July 18/14	**By**	AA
Date Tested	July 24/14	**By**	AA,KC

Aggregate Type Silty, Sandy GRAVEL
Aggregate Source Existing Material

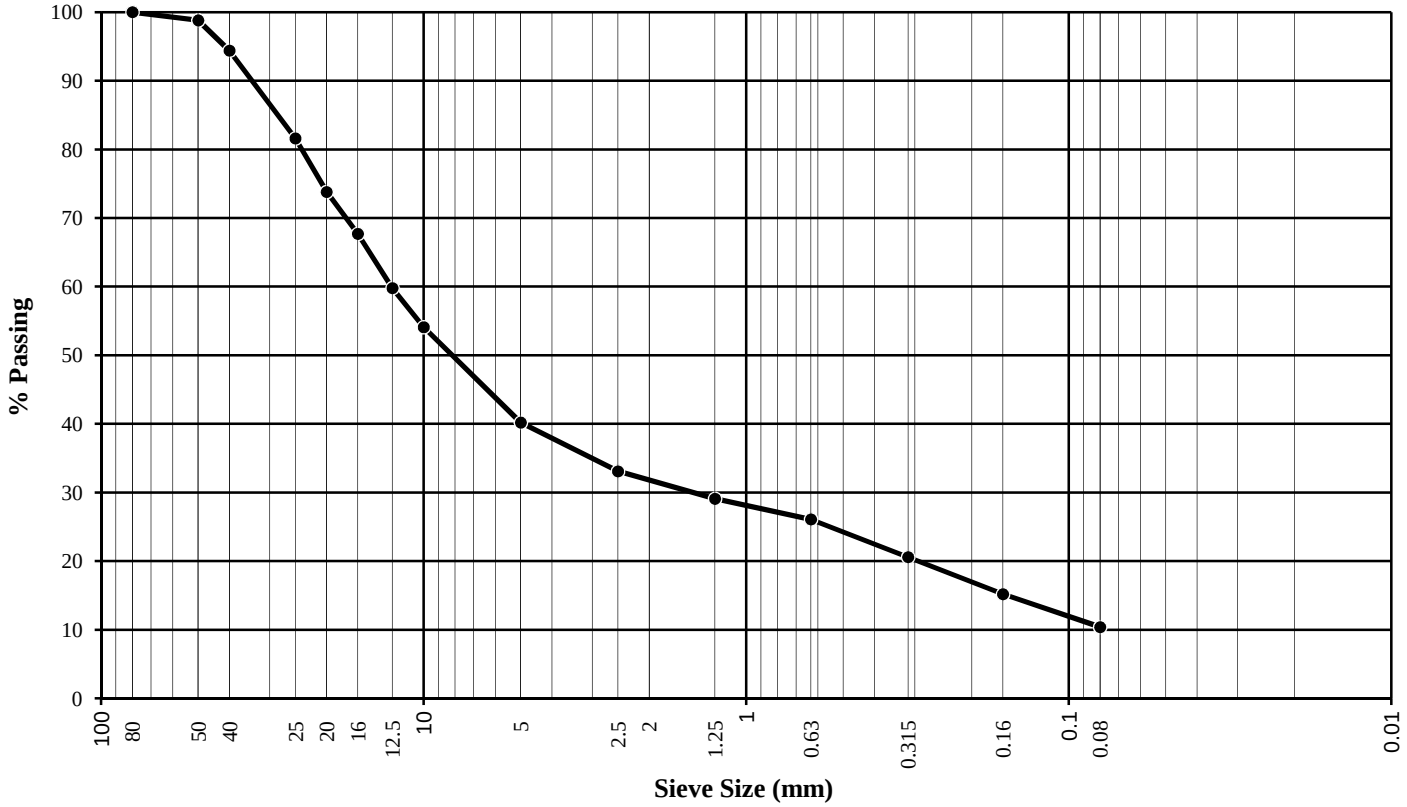
Classification GW-GM
C_C= 2.0
C_U= 157.4

Specification

Comments

TH # 3 @ 46-49ft.
Moisture Content = 2.3%
(L A Abrasion Sample # 2)

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80	100.0		
50	98.8		
40	94.4		
25	81.6		
20	73.8		
16	67.7		
12.5	59.8		
10	54.1		
5	40.2		
2.5	33.1		
1.25	29.1		
0.63	26.1		
0.315	20.6		
0.16	15.2		
0.08	10.4		



7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Summit Aggregates

Attention Tige Brady

Project Gravel Pit Investigation
Waterman Pit, Hwy567 & RR40

Job No.

Date Sampled	July 17/14	**By**	AA
Date Received	July 18/14	**By**	AA
Date Tested	July 22/14	**By**	JC,KW

Aggregate Type Sandy GRAVEL
Aggregate Source Existing Material

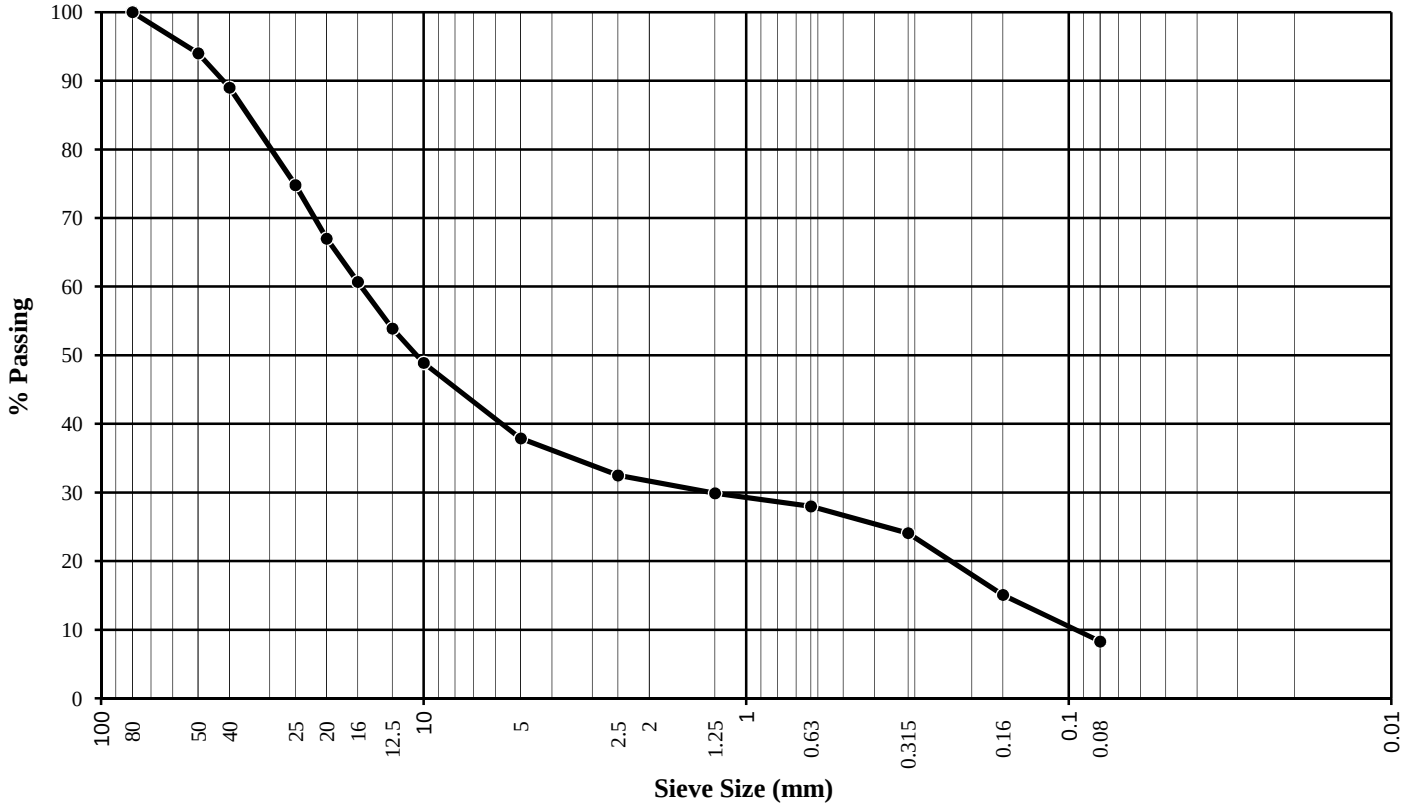
Classification GW-GM
C_C= 1.1
C_U= 156.1

Specification

Comments

TH # 3 @ 57-59ft.
Moisture Content = 0.9%

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80	100.0		
50	94.0		
40	89.0		
25	74.8		
20	67.0		
16	60.7		
12.5	53.9		
10	48.9		
5	37.9		
2.5	32.5		
1.25	29.9		
0.63	28.0		
0.315	24.1		
0.16	15.1		
0.08	8.3		



7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Summit Aggregates

Attention Tige Brady

Project Gravel Pit Investigation
Waterman Pit, Hwy567 & RR40

Job No.

Date Sampled	July 18/14	**By**	AA
Date Received	July 18/14	**By**	AA
Date Tested	July 22/14	**By**	JC,KW

Aggregate Type Sandy GRAVEL
Aggregate Source Existing Material

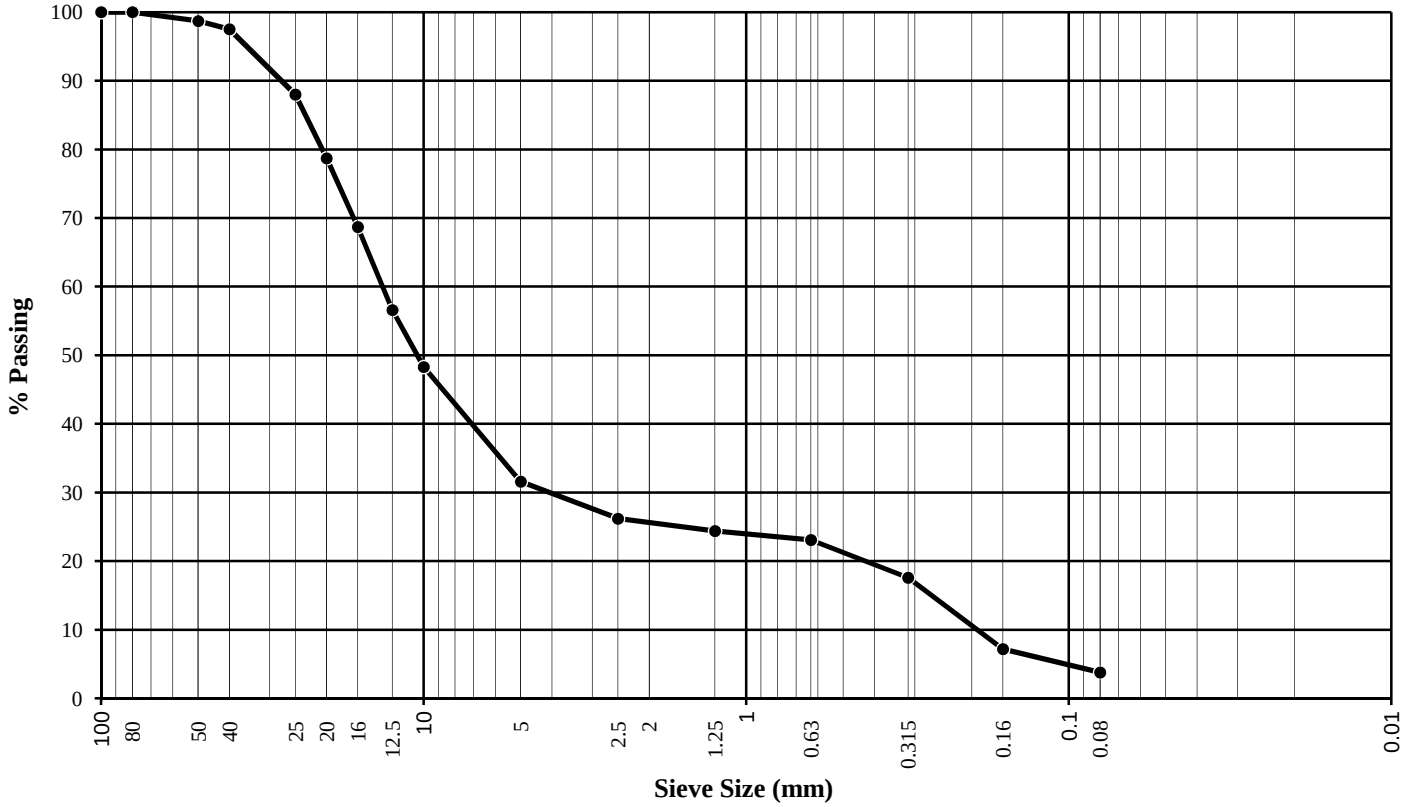
Classification GP
C_C= 6.3
C_U= 67.0

Specification

Comments

TH # 5 @ 36-38ft.
Moisture Content = 3.3%

Sieve Size (mm)	Percent Passing by Weight	Min.	Max.
200			
150			
100			
80	100.0		
50	98.7		
40	97.5		
25	88.0		
20	78.7		
16	68.7		
12.5	56.6		
10	48.3		
5	31.6		
2.5	26.2		
1.25	24.4		
0.63	23.1		
0.315	17.6		
0.16	7.2		
0.08	3.8		



7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Summit Aggregates

Attention Tige Brady

Project Gravel Pit Investigation
Waterman Pit, Hwy567 & RR40

Job No.

Date Sampled	July 18/14	**By**	AA
Date Received	July 18/14	**By**	AA
Date Tested	July 22/14	**By**	JC,KW

Aggregate Type Sandy GRAVEL
Aggregate Source Existing Material

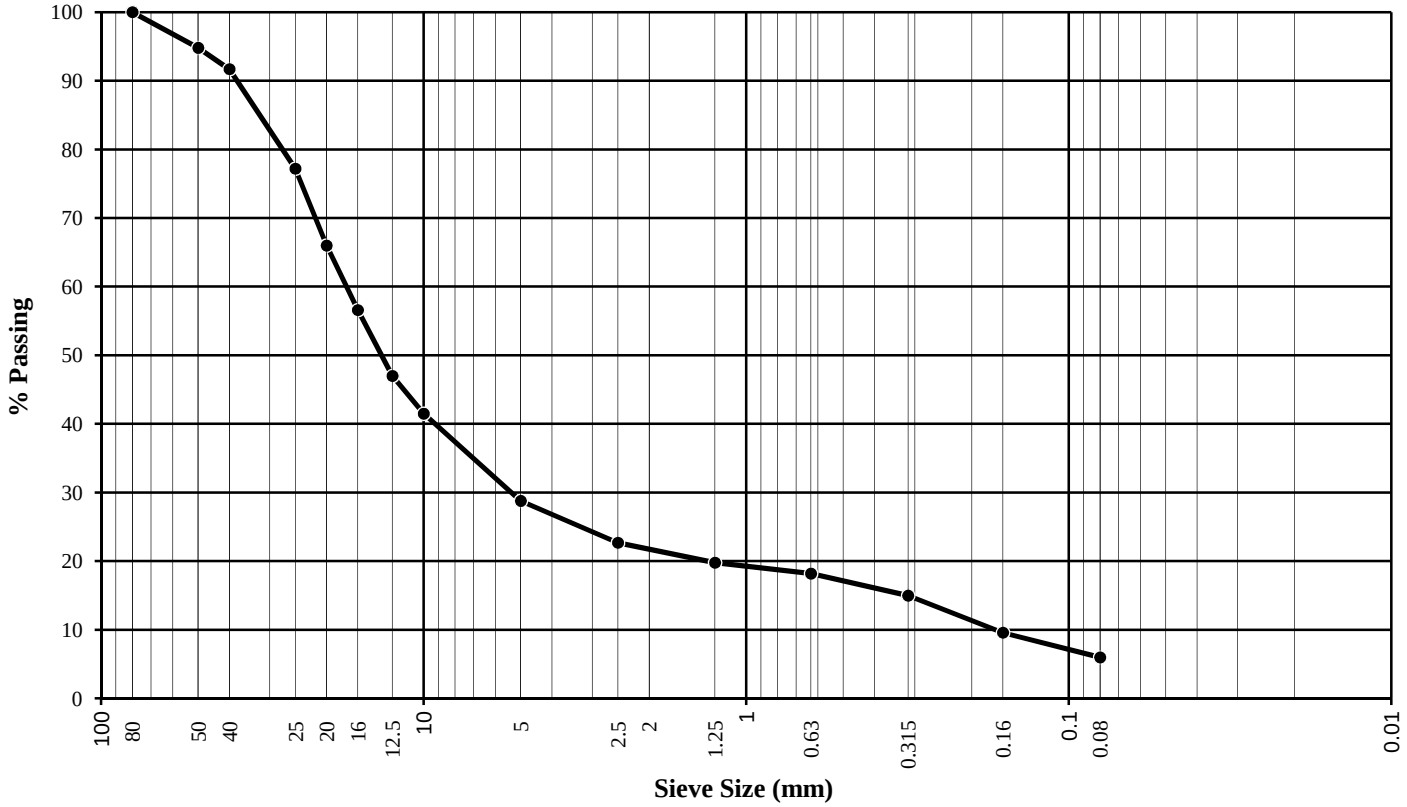
Classification GP
C_C= 10.0
C_U= 101.2

Specification

Comments

TH # 5 @ 51-53ft.
Moisture Content = 2.3%

Sieve Size (mm)	Percent Passing by Weight	Min.	Max.
200			
150			
100			
80	100.0		
50	94.8		
40	91.7		
25	77.2		
20	66.0		
16	56.6		
12.5	47.0		
10	41.5		
5	28.8		
2.5	22.7		
1.25	19.8		
0.63	18.2		
0.315	15.0		
0.16	9.6		
0.08	6.0		



CURTIS ENGINEERING ASSOCIATES LTD.
CALGARY CANMORE

1A, 820 – 28 Street NE
Calgary, Alberta T2A 6K1
Ph: 403-273-5868
Fax: 403-273-5957
geotechnical@curtisengineering.ca

August 1, 2014
File: 313-Misc.

Almor Testing Service
7505 40 Street SE
Calgary, AB T2C 2H5

Email: general@almor.com

Attention: Barry Martin

RE: LA Abrasion Testing (ASTM C131, ASTM C-535)

Curtis Engineering Associates Ltd. ran ASTM C-131 Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine on two (2) samples. Additionally two (2) samples were tested in accordance with ASTM C-535 Standard Test Method for resistance to degradation of large-size coarse aggregate by apbrasion and impact in the Los Angeles machine. The samples delivered to our office washed, split, and dried. The sample was then run through the test process and the results are tabulated below.

Sample ID	Gradin	Mass Prior To Test (g)	Mass After Test (g)	Mass Loss Due to Test (g)	Percent Loss (%)
1	A	4999.3	3580.9	1418.4	28.4
2	A	4998.6	3657.6	1341.0	26.8
3	2	10061.5	8033.8	2027.7	20.2
4	2	9975.5	8219.9	1755.6	17.6

We trust that the above is sufficient for your requirements. Should you need further information, please call.

Yours very truly,

Curtis Engineering Associates Ltd.

Michael Staple, B.Sc., P.Eng.
Geotechnical Engineer

MS/rwc

PLAN SHOWING
DRILL HOLE LOCATION
WATERMAN AGGREGATE
RESOURCE
NW $\frac{1}{4}$ SECTION 31 TWP 26 RGE 3 W5M
UTM, NAD83 Z11
MD OF ROCKY VIEW COUNTY

LEGEND

PROPERTY LINE

X PROPOSED TESTHOLE LOCATION

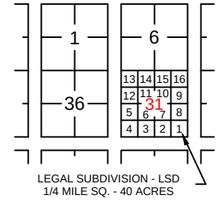
N

SUMMIT AGGREGATES LTD.

1111 Auburn Bay SE
Calgary, Alberta T3M

LEGAL LAND DESCRIPTION

NW 1/4 SECTION 31 TWP 26 RGE 3 W5M



LEGAL SUBDIVISION - LSD
1/4 MILE SQ. - 40 ACRES

DATE: June 23, 2014	DRAWN BY: T BRADY
SCALE: 5,500	DRAWING: FIGURE 3
DATE REVISED: July 20, 2014	REVISED BY: T BRADY-

FILE: 2014 Waterman Aggregates Resource (COP).dwg

AIR PHOTO TAKEN : JULY 04, 2012

DATE PRINTED: June 23, 2014

ALMOR TESTING SERVICES LTD.

7505 - 40 STREET S.E., CALGARY, AB T2C 2H5 PHONE (403) 236-8880 • FAX (403) 236-1707

2017 11 20 099-86-17

Mountain Ash Limited Partnership

Attention: Mr. Tige Brady, C.E.T.
tige.brady@telus.net

Re: Gravel Pit Investigation
Summit Pit Phase 2
Highway 567 and Range Road 40
Rockyview County, Alberta

Almor Testing Services Ltd. observed and obtained gravel samples, during the advancement of ten (10) test holes, at the subject site from July 31 to August 5, 2017. Test holes designated as TH1 through TH10 were advanced in the triangular area of the northeast to southwest portion of the quarter of Section 31, Township Road 26, Range Road 3, W5M. The test holes were advanced using a Becker Hammer drill rig, operated by Great West Drilling of Calgary, Alberta. Refer to Figure 1 in Appendix 'A' for the approximate test hole locations.

Test hole depths ranged from a minimum of 14.1m (TH5) to a maximum of 27.6m (TH10). The thickness of the granular deposit in the test holes ranged from a minimum 9.3m (TH5) to a maximum 23.0m (TH9). The mean average thickness of the granular deposit encountered is 17.5m and ground water elevation ranged between 13.5m (TH5) to 25.5m (TH8).

Samples were obtained for gradation analysis, representative of the granular deposit encountered below the silty clay overburden. Eighteen (18) Gradation Analyses and one (1) Hydrometer Test were performed on samples from Test Hole No.'s 1 through 10. The Test Hole logs and the results of the Gradation Analyses are attached in Appendix 'B'. The Gradation Analyses of the samples indicated fines contents (material passing the 80 µm sieve size) in the range of 5.9% to 19.5%.

The fines content of the gravel samples obtained using a Becker Hammer drill rig is typically higher due to the crushing or fracture of the rocks during pounding of the hammer casing into gravels by the drill rig. A fines content to a maximum of 10% is generally considered desirable for gravels used for structural purposes (roads construction, foundation base, etc.). Aggregates for use in the manufacture of concrete and asphalt products typically have more stringent fines content requirements. In order to estimate the insitu fine content of gravel at the site, three (3) test pits were advanced in close proximity of Test Hole No.'s 2, 5 and 8 and gravel samples were obtained. The Test Pit logs and the results of the Gradation Analyses of the test pit samples are attached in Appendix 'B'. Table 1 compares the fine content of gravel samples obtained using Becker Hammer drill rig and from the test pits.

.../2

TABLE 1
Fine Content Comparison of Gravel Samples
Becker Hammer Drilling vs Test Pits

TP/TH No.	Depth (m)	Fines Content (%)
TP1	5.0 - 6.0	3.1
TH5	5.0 - 6.0	7.8
TP2	5.0 - 6.0	3.1
TH8	5.0 - 6.0	12.1
TP3	5.0 - 6.0	4.0
TH8	5.0 - 6.0	12.1

Table 1 indicates the fines content of the samples obtained using Becker Hammer drill rig is almost 2 to 3 times higher than those obtained from test pits. It is anticipated that the granular material recovered during a commercial mining operation would yield lower fines contents than what is indicated by the samples recovered during this investigation using a hammer rig.

A cursory examination of the coarse aggregate was completed on representative samples and is presented in Table 2. The examination was done by visual means only. This examination is not meant to replace a proper petrographic analysis, which is recommended after crushing operations have commenced.

TABLE 2

Type of Aggregate	Category	Quantity (%)
Quartzite	Good	40.0
Carbonite	Good & Fair	25.0
Sandstone	Good & Fair	30.0
Chert	Fair	4.0
Iron Concretion	Poor & Deleterious	1.0

Los Angeles Abrasion testing of a representative sample was conducted by Curtis Engineering of Calgary, Alberta and is attached in Appendix 'C', with a value of 32.3%. The City of Calgary specification for granular base and granular subbase is an L.A. Abrasion loss of maximum of 45%.

Overall, the aggregates and gradation of the gravels at the test hole locations are suitable for producing aggregates required in the construction industry, with some sorting and blending sand seams.

The volume of the gravel has been estimated based on the limited bore holes advanced and is presented in Appendix 'D'.

.../3

The overburden in the subject areas consisted of topsoil/browns overlying silty clay till.

The topsoil/browns were encountered in all test hole locations and ranged from100 to 300mm in thickness. A Grain Size Distribution test conducted on a topsoil/browns indicated a Gravel content of 0.2%, Sand content of 11.8%, Silt of 67.3%, Clay 20.7% and an Organic Content of 12.6%.

Below topsoil/browns, silty clay till was encountered in all test hole locations. The thickness of silty clay overburden ranged from 4000mm to 9000mm, resulting in an average thickness of 5100mm. The silty clay till overburden had a Moisture Content of approximately 7.7%. An Atterberg Limit test conducted on silty clay till soil indicated a Liquid Limit of 36, a Plastic Limit of 12, resulting in a Plasticity Index of 24. This classifieds the soil as a medium plastic clay (CI).

The attached Appendix 'E' details tests performed on the overburden soils.

The silty clay and topsoil overburden can be utilized for grading during the pit rehabilitation stages of the gravel pit.

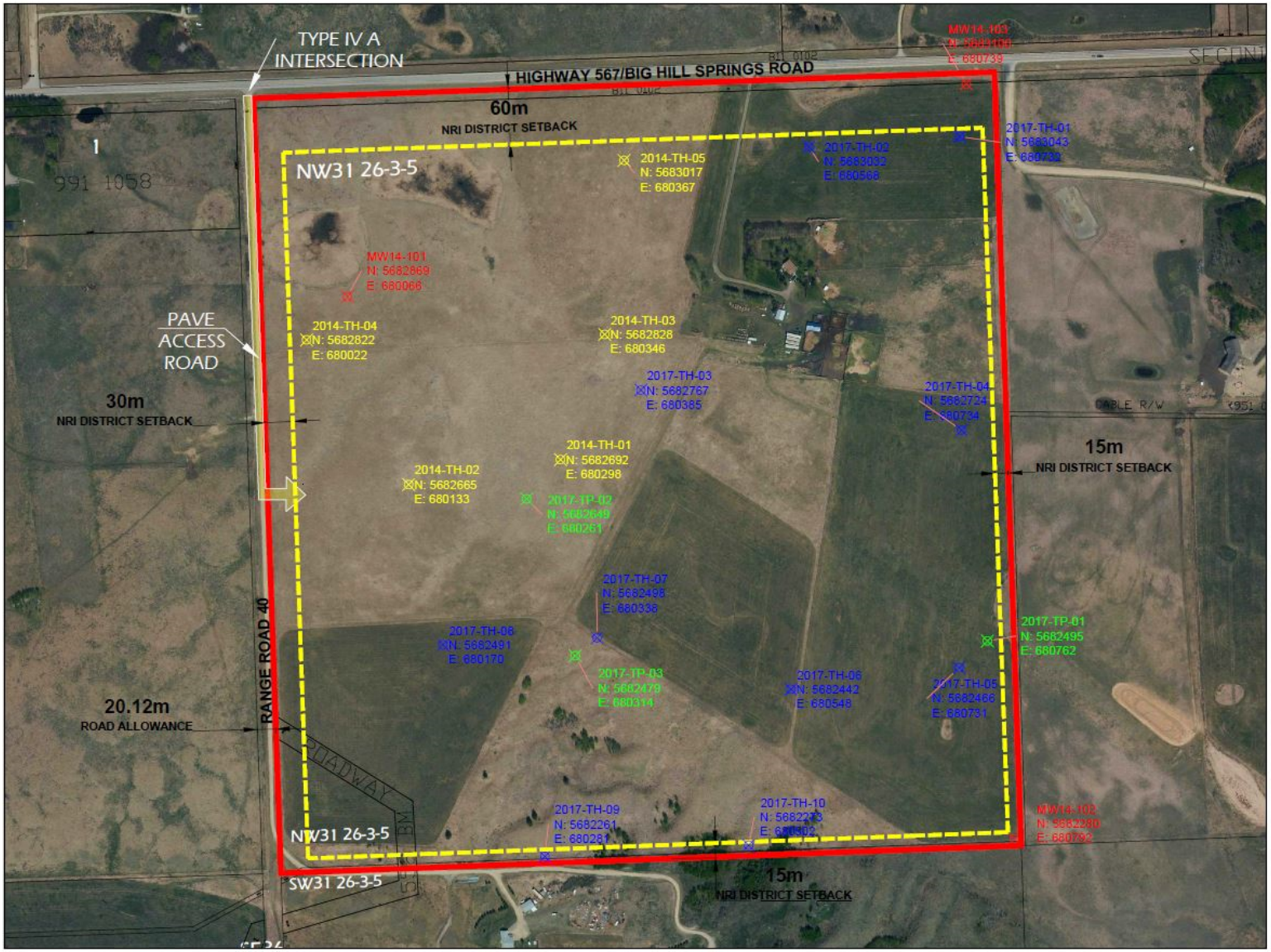
We trust this meets with your present requirements.

Respectfully submitted,
ALMOR TESTING SERVICES LTD.

J.B. Montgomery, P.Eng.
AA: rn:A06227

* APEGA Permit to Practice #P2260

APPENDIX A



PLAN SHOWING
SITE PLAN AND TESTHOLE LOCATION
SUMMIT PIT
NW ¼ SECTION 31 TWP 26 RGE 3 W5M
UTM, NAD83 Z11
ROCKY VIEW COUNTY

LEGEND

- PROPERTY LINES
- LIMIT OF DISTURBANCE
- CURRENT MINING PHASING
- 2017 TEST HOLE WITH BECKER HAMMER RIG
- 2014 GROUND WATER MONITORING WELLS
- 2014 TESTHOLE WITH BECKER HAMMER
- 2017 EXCAVATOR TEST PIT

TACT GROUP INC

SITE 9 BOX 39 RR 1
COchrane, Alberta T4C 1A1

LEGAL LAND DESCRIPTION
NW 1/4 SECTION 31 TWP 26 RGE 3 W5M

DATE: October 02, 2017	DRAWN BY: T BRADY
SCALE: 1:4,000	DRAWING: 1 OF 1
DATE REVISED:	REVISED BY:

FILE: 2017 Project/ 2017 Summit Pit.dwg

AIR PHOTO TAKEN : JULY 04, 2012

DATE PRINTED: October 18, 2017

APPENDIX B

PROJECT: GRAVEL PIT ASSESSMENT
SUMMIT PIT PHASE TWO

CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP

PROJECT NO.

HOLE NO. TH1

DRILL TYPE DIESEL HAMMER RIG

GEODETIC ELEVATION (m) | DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)
1	**Silty CLAY** stiff to very stiff, medium plastic, trace to some sand, mottled olive, damp to moist	2
2		4
		6
	Silty CLAY (TILL) stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist	8
3		10
4		12
		14
5		16
		18
6		20
		22
7		24
		26
8		28
9	- becoming sandy, trace cobble	30
	Silty GRAVEL compact to dense, trace clay, some sand, fine to coarse grained, poorly graded, brown, damp	32
10		34
		36
11	- cleaner below 11.0 m	38
12		40
		42
13	- becoming damp to moist	44
		46
14	- trace to some cobble below 14.0 m	48
15		50
		52
16		54
17		56
		58
18		60
		62
19	- occasional fine grained sand lens below 18.5 m	64
		66
20		68
		70
21		72
22		74
		76
23		78
		80
24		82
25	- becoming wet to saturated below 25.0 m	84
		86
26		88
27		90
	SILTSTONE (BEDROCK)	92
28	**END OF TEST HOLE AT 27.5m**	94
	- no standpipe installed	96
29	- test hole dry at completion	98
30	- test hole backfilled with soil cuttings	

SAMPLE TYPE | MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT | LIQUID LIMIT
20 40 60

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

Gravel 20.8 %
Sand 22.3 %
Silt 31.2 %
Clay 25.7 %

Gravel 53.1 %
Sand 33.9 %
Silt 10.5 %
Clay 2.5 %

Gravel 61.9 %
Sand 29.7 %
Silt & Clay 8.4 %

Gravel 18.6 %
Sand 72.6 %
Silt & Clay 8.8 %

Gravel 65.0 %
Sand 29.1 %
Silt & Clay 5.9 %

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

20 40 60
PENETRATION RESISTANCE ■
□ SPT ◪ Case
■ Cone ◹ BT Pen

GROUNDWATER
Date Measured

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

COMPLETION DEPTH 28 m | DATE DRILLED July 31, 2017 | LOGGED BY Abdul Alemi | PLATE NO. 1

PROJECT: GRAVEL PIT ASSESSMENT
SUMMIT PIT PHASE TWO

CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP

PROJECT NO.

HOLE NO. TH2

DRILL TYPE DIESEL HAMMER RIG

GEODETIC ELEVATION (m) | DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE	MOD UNIFIED SOIL CLASS	WATER CONTENT (%) ● PLASTIC LIMIT / LIQUID LIMIT (20 40 60)	COMPRESSIVE STRENGTH Unconfined ▲ Pocket Pen △ TSF 2 3 4 5 / KPa 200 300 400	OTHER TESTS
1	**Silty CLAY (TILL)** stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist	2					
2		4					
3		6					
4		8					
5		10					
6	- becoming sandy, low plastic, olive/yellow	12					
7	**Sandy SILT** compact to dense, non to low plastic, some gravel to gravelly, brown, damp	14					
8	**Silty GRAVEL** compact to dense, some sand to sandy, fine to coarse grained, poorly graded, brown, damp	16					
9	- occasional fine grained sand/silt lens below 8.0 m	18					
10		20					
11		22					
12		24					
13		26					
14		28					
15		30					
16		32					
17		34					
18	- becoming fine to medium grained	36					
19	- trace cobble below 19.2 m	38					
20	- becoming moist to wet	40					Gravel 58.3 % Sand 31.7 % Silt & Clay 10.0 %
21		42					
22	**END OF TEST HOLE AT 21.2m** (Hammer Refusal) - no standpipe installed - test hole dry at completion - test hole backfilled with soil cuttings	44					
23		46					
24		48					
		50					
		52					
		54					
		56					
		58					
		60					
		62					
		64					
		66					Gravel 64.4 % Sand 16.1 % Silt & Clay 19.5 %
		68					
		70					
		72					
		74					
		76					
		78					
		80					

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

KN/m³ 16 18 20 22 / PCF 100 120 140 — WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■ 20 40 60
□ SPT ◪ Case
■ Cone ◹ BT Pen

GROUNDWATER
Date Measured

COMPLETION DEPTH	21.2 m	DATE DRILLED	July 31, 2017	LOGGED BY	Abdul Alemi	PLATE NO.	2

PROJECT: GRAVEL PIT ASSESSMENT
SUMMIT PIT PHASE TWO

CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP

PROJECT NO.

HOLE NO. TH3

DRILL TYPE DIESEL HAMMER RIG

GEODETIC ELEVATION (m)

DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE	MOD UNIFIED SOIL CLASS	WATER CONTENT (%) ● PLASTIC LIMIT / LIQUID LIMIT (20 40 60)	COMPRESSIVE STRENGTH Unconfined ▲ Pocket Pen △ TSF 2 3 4 5 / KPa 200 300 400	OTHER TESTS
1	**Silty CLAY (TILL)**	2					Gravel 0.2 % Sand 11.8 % Silt 67.3 % Clay 20.7 %
2		4					
	Sandy SILT compact, non to low plastic, some gravel to gravelly, brown, damp	6					
3		8					
		10					
4		12					Gravel 48.8 % Sand 33.6 % Silt & Clay 17.6 %
	Silty GRAVEL compact, some sand to sandy, fine to coarse grained, poorly graded, brown, damp	14					
5		16					
		18					
6		20					
		22					
7		24					
		26					
8	- trace cobble below 8. m	28					
		30					
9		32					
10	- trace to some cobble below 10.0 m	34					
		36					
11		38					
		40					
12		42					
		44					
13		46					
		48					
14		50					
	Silty SAND compact, some gravel, fine to coarse grained, poorly graded, brown, damp	52					Gravel 27.2 % Sand 54.3 % Silt & Clay 18.5 %
15	**Silty GRAVEL** compact, some sand to sandy, fine to coarse grained, poorly graded, brown, damp	54					
		56					
16		58					
		60					
17	**SILTSTONE (BEDROCK)**	62					
		64					Gravel 71 % Sand 20.3 % Silt & Clay 8.7 %
18		66					
		68					
19		70					
		72					
20		74					
	END OF TEST HOLE AT 22.5m	76					
21	(Hammer Refusal)	78					
	- no standpipe installed	80					
22	- test hole dry at completion						
	- test hole backfilled with soil cuttings						
23							
24							

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

KN/m³ 16 18 20 22 / PCF 100 120 140

WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■ (20 40 60)

□ SPT ◪ Case

■ Cone ◹ BT Pen

GROUNDWATER

Date Measured

COMPLETION DEPTH 22.5 m

DATE DRILLED August 1, 2017

LOGGED BY Abdul Alemi

PLATE NO. 3

PROJECT: GRAVEL PIT ASSESSMENT
SUMMIT PIT PHASE TWO

CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP

PROJECT NO.

HOLE NO. TH4

DRILL TYPE DIESEL HAMMER RIG

GEODETIC ELEVATION (m)

DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)
0	**TOPSOIL**	0
1	**Silty CLAY** stiff to very stiff, medium plastic, trace to some sand, olive, damp to moist	2
2	**Silty CLAY (TILL)** stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist	4
3		6
4		8
5		10
6	**Silty GRAVEL** compact, some sand to sandy, fine to coarse grained, poorly graded, brown, damp	12
7		14
8		16
9		18
10	- trace cobble below 10.0 m	20
11		22
12		24
13		26
14		28
15	- occasional fine grained sand lens below 14.5 m	30
16		32
17		34
18		36
19		38
20		40
21	**CLAY** very stiff to hard, high plastic, trace to some silt, trace sand, olive/yellow, moist	42
22	**Silty SAND** compact, trace gravel, fine to coarse grained, poorly graded, brown, damp	44
23	**Sandy GRAVEL** dense, trace to some silt, fine to coarse grained, poorly graded, brown, damp	46
24		48
25		50
26		52
27	**SILTSTONE (BEDROCK)**	54
28	**END OF TEST HOLE AT 26.5m**	56
29	- no standpipe installed	58
	- groundwater level 23.0m at completion	60
	- test hole backfilled with soil cuttings	62
		64
		66
		68
		70
		72
		74
		76
		78
		80
		82
		84
		86
		88
		90
		92
		94
		96

SAMPLE TYPE

MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT — LIQUID LIMIT
20 40 60

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

Gravel 52.1 %
Sand 32.1 %
Silt & Clay 15.8 %

Gravel 31.2 %
Sand 55.5 %
Silt & Clay 13.3 %

Gravel 64.2 %
Sand 28.2 %
Silt & Clay 7.6 %

▼ At completion

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■
20 40 60
□ SPT ◪ Case
■ Cone ◹ BT Pen

GROUNDWATER
▼ Date Measured

COMPLETION DEPTH 27 m

DATE DRILLED August 2, 2017

LOGGED BY Abdul Alemi

PLATE NO. 4

PROJECT: GRAVEL PIT ASSESSMENT
SUMMIT PIT PHASE TWO

CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP

PROJECT NO.

HOLE NO. TH5

DRILL TYPE DIESEL HAMMER RIG

GEODETIC ELEVATION (m)

DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)
0	**TOPSOIL**	0
1	**Silty CLAY (TILL)** stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist	2
2		4
3		6
4		8
5		10
6		12
7		14
8	**Silty GRAVEL** compact, some sand to sandy, trace cobble, fine to coarse grained, poorly graded, brown, damp	16
9		18
10		20
11		22
12		24
13		26
14		28
15	**SANDSTONE (BEDROCK)**	30
16	**MUDSTONE (BEDROCK)**	32
17	**END OF TEST HOLE AT 15.6m** - no standpipe installed - groundwater level 13.5m at completion - test hole backfilled with soil cuttings	34
18		36
19		38
		40
		42
		44
		46
		48
		50
		52
		54
		56
		58
		60
		62
		64

SAMPLE TYPE

MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT — LIQUID LIMIT
20 40 60

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

Gravel 59.6 %
Sand 32.6 %
Silt & Clay 7.8 %

▼ At completion

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■
20 40 60
□ SPT ◪ Case
■ Cone ◹ BT Pen

GROUNDWATER
▼ Date Measured

COMPLETION DEPTH 15.6 m

DATE DRILLED August 2, 2017

LOGGED BY Abdul Alemi

PLATE NO. 5

PROJECT: GRAVEL PIT ASSESSMENT
SUMMIT PIT PHASE TWO

CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP

PROJECT NO.

HOLE NO. TH6

DRILL TYPE DIESEL HAMMER RIG

GEODETIC ELEVATION (m)

DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)
	PREDRILLED	
6	**Sandy GRAVEL** compact, some silt, fine to coarse grained, poorly graded, brown, damp	20
8	- trace cobble below 8.5 m	26
11	**Silty SAND** compact to dense, trace gravel, fine to coarse grained, poorly graded, brown, damp	36
12	**Sandy GRAVEL** compact to dense, some silt, fine to coarse grained, poorly graded, brown, damp	38
13	- trace cobble below 13.4 m	44
16	- becoming wet to saturated	52
16	**SANDSTONE (BEDROCK)**	54
17	**END OF TEST HOLE AT 16.2m** - no standpipe installed - groundwater level 15.8m at completion - test hole backfilled with soil cuttings	56

SAMPLE TYPE

MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT 20 40 60 LIQUID LIMIT

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

Gravel 23.3 %
Sand 58.7 %
Silt & Clay 18.0 %

▼ At completion

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■
20 40 60
□ SPT ◪ Case
■ Cone ◹ BT Pen

GROUNDWATER
▼ Date Measured

COMPLETION DEPTH 16.8 m

DATE DRILLED August 3, 2017

LOGGED BY Abdul Alemi

PLATE NO. 6

PROJECT: GRAVEL PIT ASSESSMENT
SUMMIT PIT PHASE TWO

CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP

PROJECT NO.

HOLE NO. TH7

DRILL TYPE DIESEL HAMMER RIG

GEODETIC ELEVATION (m) | DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)
0	**PREDRILLED**	0
1		2
		4
2	**Silty CLAY (TILL)** stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist	6
		8
3	**Silty GRAVEL** compact, trace to some sand, fine to coarse grained, poorly graded, olive, damp	10
		12
4		14
5		16
	- trace cobble below 5.3 m	18
6		20
		22
7		24
8		26
		28
9		30
		32
10		34
		36
11		38
		40
12		42
		44
13		46
		48
14		50
		52
15		54
		56
16		58
		60
17		62
	- becomiing moist to wet	64
18		66
	- saturated below 19.8 m	68
19		70
	SANDSTONE (BEDROCK)	72
20	**END OF TEST HOLE AT 21.6m**	74
	- no standpipe installed	76
21	- groundwater level 19.8m at completion	78
	- test hole backfilled with soil cuttings	80
22		
23		
24		

SAMPLE TYPE | MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT | LIQUID LIMIT
20 40 60

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

▼ At completion

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■
20 40 60
□ SPT ◪ Case
■ Cone ◹ BT Pen

GROUNDWATER
▼ Date Measured

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

COMPLETION DEPTH	22.1 m	DATE DRILLED	August 3, 2017	LOGGED BY	Abdul Alemi	PLATE NO.	7

PROJECT: GRAVEL PIT ASSESSMENT
SUMMIT PIT PHASE TWO

CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP

PROJECT NO.

HOLE NO. TH8

DRILL TYPE DIESEL HAMMER RIG

GEODETIC ELEVATION (m)

DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)
0	**Silty CLAY (TILL)** stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist	0
4	**Silty GRAVEL** compact, trace to some sand, fine to coarse grained, poorly graded, olive, damp	14
9	- occasional coarse grained sand lens below 9.0 m	30
13	**Silty SAND** compact to dense, trace gravel, fine to coarse grained, poorly graded, brown, damp	42
14	**Sandy GRAVEL** compact to dense, some silt, fine to coarse grained, poorly graded, brown, damp	46
23	- moist below 23.5 m	76
24	- becoming wet	78
25	- saturated below 25.5 m	82
26	**SANDSTONE (BEDROCK)**	86
27	**END OF TEST HOLE AT 26.6m**	88
28	- no standpipe installed	92
29	- groundwater level 25.5m at completion - test hole backfilled with soil cuttings	96

SAMPLE TYPE

MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT — LIQUID LIMIT
20 40 60

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

Gravel 58.5 %
Sand 29.4 %
Silt & Clay 12.1 %

Gravel 56.2 %
Sand 36.9 %
Silt & Clay 6.9 %

▼ At completion

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■
20 40 60
□ SPT ◪ Case
■ Cone ◹ BT Pen

GROUNDWATER
▼ Date Measured

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

COMPLETION DEPTH 27.1 m

DATE DRILLED August 4, 2017

LOGGED BY Jeremy Crawford

PLATE NO. 8

PROJECT: GRAVEL PIT ASSESSMENT
SUMMIT PIT PHASE TWO

CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP

PROJECT NO.

HOLE NO. TH9

DRILL TYPE DIESEL HAMMER RIG

GEODETIC ELEVATION (m)

DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)
0	**TOPSOIL**	0
1	**Silty CLAY (TILL)** stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist	2
2		4
3		6
4		8
5	**Sandy GRAVEL** compact, some silt to silty, fine to coarse grained, poorly graded, olive, damp	10
6		12
7		14
8	- fine to medium grained below 8.0 m	16
9		18
10		20
11		22
12		24
13		26
14		28
15		30
16	- some silt below 16.0 m	32
17		34
18		36
19		38
20		40
21		42
22		44
23		46
24		48
25		50
26		52
27		54
28	**MUDSTONE (BEDROCK)**	56
29	**END OF TEST HOLE AT 28.3m** - no standpipe installed - test hole dry at completion - test hole backfilled with soil cuttings	58
30		60
		62
		64
		66
		68
		70
		72
		74
		76
		78
		80
		82
		84
		86
		88
		90
		92
		94
		96
		98

SAMPLE TYPE

MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT — LIQUID LIMIT
20 40 60

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

Gravel 56.9 %
Sand 33.7 %
Silt & Clay 9.4 %

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■
20 40 60
□ SPT ◪ Case
■ Cone ◹ BT Pen

GROUNDWATER
Date Measured

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

COMPLETION DEPTH 28.3 m

DATE DRILLED August 5, 2017

LOGGED BY Abdul Alemi

PLATE NO. 9

PROJECT: GRAVEL PIT ASSESSMENT
SUMMIT PIT PHASE TWO

CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP

PROJECT NO.

HOLE NO. TH10

DRILL TYPE DIESEL HAMMER RIG

GEODETIC ELEVATION (m)

DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)
0	**TOPSOIL**	0
1	**Silty CLAY (TILL)** stiff to very stiff, low to medium plastic, trace to some sand, trace to some gravel, grey, damp to moist	2
2		4
3		6
4		8
5		10
6	**Silty GRAVEL** compact, some sand to sandy, fine to coarse grained, poorly graded, olive, damp	12
7		14
8		16
9	- occasional high plastic clay lens below 8.5 m	18
10	- becoming fine grained	20
11		22
12		24
13		26
14		28
15	- occasional fine grained sand lens below 15.0 m	30
16		32
17		34
18		36
19		38
20		40
21		42
22		44
23		46
24		48
25		50
26		52
27		54
28	**MUDSTONE (BEDROCK)**	56
29	**END OF TEST HOLE AT 27.6m**	58
30	- no standpipe installed	60
	- test hole dry at completion	62
	- test hole backfilled with soil cuttings	64
		66
		68
		70
		72
		74
		76
		78
		80
		82
		84
		86
		88
		90
		92
		94
		96
		98

SAMPLE TYPE

MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT — LIQUID LIMIT
20 40 60

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

Gravel 69.0 %
Sand 23.4 %
Silt & Clay 7.6 %

Gravel 12.6 %
Sand 66.2 %
Silt & Clay 21.2 %

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TEST HOLE LOG

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■
20 40 60
□ SPT ◪ Case
■ Cone ◹ BT Pen

GROUNDWATER
Date Measured

COMPLETION DEPTH 28 m

DATE DRILLED August 5, 2017

LOGGED BY Abdul Alemi

PLATE NO. 10

EXPLANATION OF SOIL DESCRIPTIONS AND SYMBOLS SHOWN ON TEST HOLE LOGS

The test hole logs summarize the results of field investigations and, if applicable, also laboratory test data. It should be appreciated that conditions established at a test hole location may not be representative of subsurface conditions across the investigated site. Transitions of the soil stratigraphy, either classified or graphically shown, are gradual, rather than the distinct unit boundaries presented.

SOIL DESCRIPTION AND CLASSIFICATION

Soils are described according to their appearance, lithological composition and probable mode of deposition (genetic type). Expected engineering properties and behaviour of the materials are interpreted relative to the soil type and laboratory test results.

I) DEFINITION OF SOIL TYPES

Material	Grain Size
Boulders	Larger than 300mm
Cobbles	75mm - 300mm
Gravel - Coarse	19mm - 75mm
- Fine	5mm - 19mm
Sand - Coarse	2mm - 5mm
- Medium	425um - 2mm
- Fine	75um - 425um
Silt and Clay	Smaller than 75um

II) COMPOSITION OF SOIL

2.1 Principal Component - Major soil type representing at least 50% by weight of material.

2.2 Minor Component - Minor soil types identified by the following terms with respect to their percentages by weight of material:

"Trace"	:	1% - 10%	"Some"	:	10% - 20%
Modifier "Y"	:	20% - 30%	Connector "and"	:	30% - 50%

III) CONSISTENCY OR STRENGTH OF SOIL

3.1 Coarse Grained Soils - (Principal Component larger than 75um). The following terms are used relative to the Standard Penetration Test (SPT), ASTM D1586:

Description	No. of Blows per Foot
Very Loose	Less than 4
Loose	4 - 10
Compact	10 - 30
Dense	30 - 50
Very Dense	Over 50

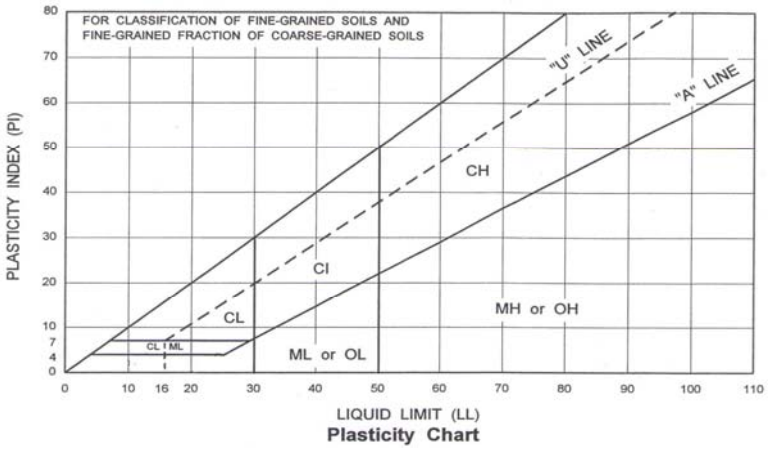
3.2 Fine Grained Soils - (Principal Component smaller than 75um). The following terms are used relative to the unconfined strength and Standard Penetration Test (SPT), ASTM D1586:

	Unconfined Compressive	
Description	Strength kPa (tsf)	No. Blows per Foot
Very Soft	Less than - 24 (0.25)	Less than 2
Soft	24 - 48 (0.25 - 0.5)	2 - 4
Firm	48 - 96 (0.5 - 1.0)	4 - 8
Stiff	96 - 190 (1.0 - 2.0)	8 - 15
Very Stiff	190 - 380 (2.0 - 4.0)	15 - 30
Hard	> 380 (4.0)	Over 30

SOIL CLASSIFICATION SYSTEM (MODIFIED U.S.C.)

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
HIGHLY ORGANIC SOILS			**PT**	PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOR OR ODOR AND OFTEN FIBROUS TEXTURE	
COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE SIZE)	GRAVELS (MORE THAN HALF COARSE FRACTION LARGER THAN NO. 4 SIEVE)	CLEAN GRAVELS	**GW**	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES. <5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 4$; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES. <5% FINES	NOT MEETING ALL ABOVE REQUIREMENTS	
		DIRTY GRAVELS	**GM**	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES. >12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR $I_p < 4$	
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES. >12% FINES	ATTERBERG LIMITS ABOVE "A" LINE OR $I_p > 7$	
	SANDS (MORE THAN HALF COARSE FRACTION LARGER THAN NO. 4 SIEVE SIZE)	CLEAN SANDS	**SW**	WELL-GRADED SANDS, GRAVELLY SANDS. <5% FINES	$C_u = \frac{D_{60}}{D_{10}} > 6$; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1 \text{ to } 3$	
			SP	POORLY-GRADED SANDS, OR GRAVELLY SANDS. <5% FINES	NOT MEETING ALL ABOVE REQUIREMENTS	
		DIRTY SANDS	**SM**	SILTY SANDS, SAND-SILT MIXTURES. >12% FINES	ATTERBERG LIMITS BELOW "A" LINE OR Ip < 4	
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES. >12% FINES	ATTERBERG LIMITS ABOVE '"A" LINE OR Ip > 7	
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES NO. 200 SIEVE SIZE)	SILTS BELOW "A" LINE ON PLASTICITY CHART; NEGLIGIBLE ORGANIC CONTENT		**ML**	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY	$W_L < 50$	SEE PLASTICITY CHART BELOW
			MH	INORGANIC SILTS, MICACEOUS OR DIATO-MACEOUS, FINE SANDY OR SILTY SOILS	$W_L > 50$	
	CLAYS ABOVE "A" LINE ON PLASTICITY CHART; NEGLIGIBLE ORGANIC CONTENT		**CL**	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS, LEAN CLAYS	$W_L < 30$	
			CI	INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	$W_L > 30, < 50$	
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	$W_L > 50$	
	ORGANIC SILTS AND CLAYS BELOW "A" LINE ON PLASTICITY CHART		**OL**	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	$W_L < 50$	
			OH	ORGANIC CLAYS OF HIGH PLASTICITY	$W_L > 50$	

1. All sieve sizes mentioned on this chart are U.S. Standard, ASTM E11.
2. Boundary classifications possessing characteristics of two groups are given combined group symbols, eg. GW-GC is a well graded gravel sand mixture with clay binder between 5% and 12%.
3. Soil fractions and limiting textural boundaries are in accordance with the United Soil Classification System, except that an inorganic clay of medium plasticity (C) is recognized.



Plasticity Chart

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ROCK CLASSIFICATION AND DESCRIPTION

The following factors are usually incorporated in a test hole log for adequate engineering geotechnical description:

Rock Name. Established names for igneous, metamorphic and sedimentary rocks are used. This could include established local names rather than the actual rock name. It is believed that for engineering purposes classification by mechanical properties is more significant than classified by mineralogy and texture.

Alteration and Weathering State. The following grades are used: fresh, slightly weathered, moderately weathered, highly weathered and decomposed. In some cases of decomposed rocks the material may exhibit plasticity and soil mechanics classification could be used.

Structure and Discontinuities. This includes comments on discontinuities (bedding planes or separation along foliation planes and fissures in igneous or sedimentary rocks) and veins in relation to their type, orientation, frequency, infilling and surface structures. RQD percentage of core fractions that are 100mm (4 in.) or greater in length, relative to length of solid core recovered (defined by Deere et al. as the Rock Quality Designation) is indicative of the fractured state.

Assessment of Strength. The field assessment of rock strength can be aided by simple tests such as the use of a hammer or penknife and supplemented by laboratory testing. Any rock with a strength significantly less than 1 MPa (145 psi) could be described with reference to soil mechanics practice.

Ancillary Geological Information. This might include dip, identification of infill, etc.

TEST DATA AND SAMPLE TYPES

Data obtained from laboratory and field testing are shown in appropriate columns on the test hole logs and at the corresponding depth interval. Abbreviations and graphic symbols are as follows:

w	moisture content	*pp*	pocket penetrometer test
W_P or PL	plastic limit (ASTM D 424)	*Y*	unit weight of soil or rock
W_L or LL	liquid limit (ASTM D 423)	*Y*d	dry unit weight
Ip or PI	Plastic index (LL-PL)	q_u	unconfined compressive strength
☐	undisturbed shelby tube sample or rock core	RQD	rock quality designation
☐	disturbed SPT sample		
B	disturbed bag sample		

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Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	July 31/17	**By**	AA
Date Received	July 31/17	**By**	AA
Date Tested	Aug 2/17	**By**	BM

Aggregate Type Sandy Gravel, trace silt/clay
Aggregate Source

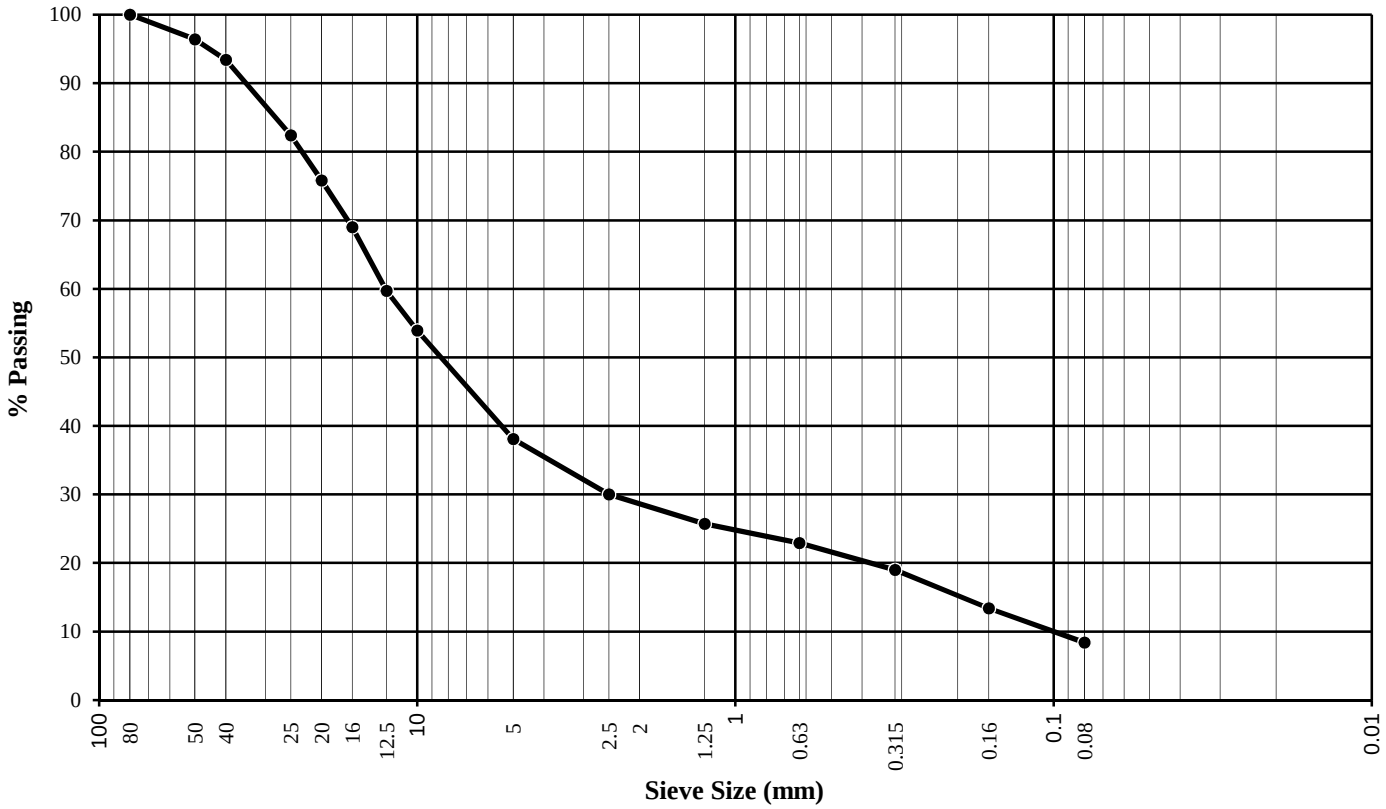
Classification GP-GM
C_C= 3.1
C_U= 119.8

Specification

Comments
Gavel 61.9 %
Sand 29.7 %
Silt/Clay 8.4 %

TH 1
Depth 16 - 17m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80	100.0		
50	96.4		
40	93.4		
25	82.4		
20	75.8		
16	69.0		
12.5	59.7		
10	53.9		
5	38.1		
2.5	30.0		
1.25	25.7		
0.63	22.9		
0.315	19.0		
0.16	13.4		
0.08	8.4		



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Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	Aug 1/17	**By**	AA
Date Received	Aug 1/17	**By**	AA
Date Tested	Aug 2/17	**By**	BM

Aggregate Type Sand, some gravel, trace silt/clay
Aggregate Source

Classification SP-SM
C_C= 1.5
C_U= 5.1

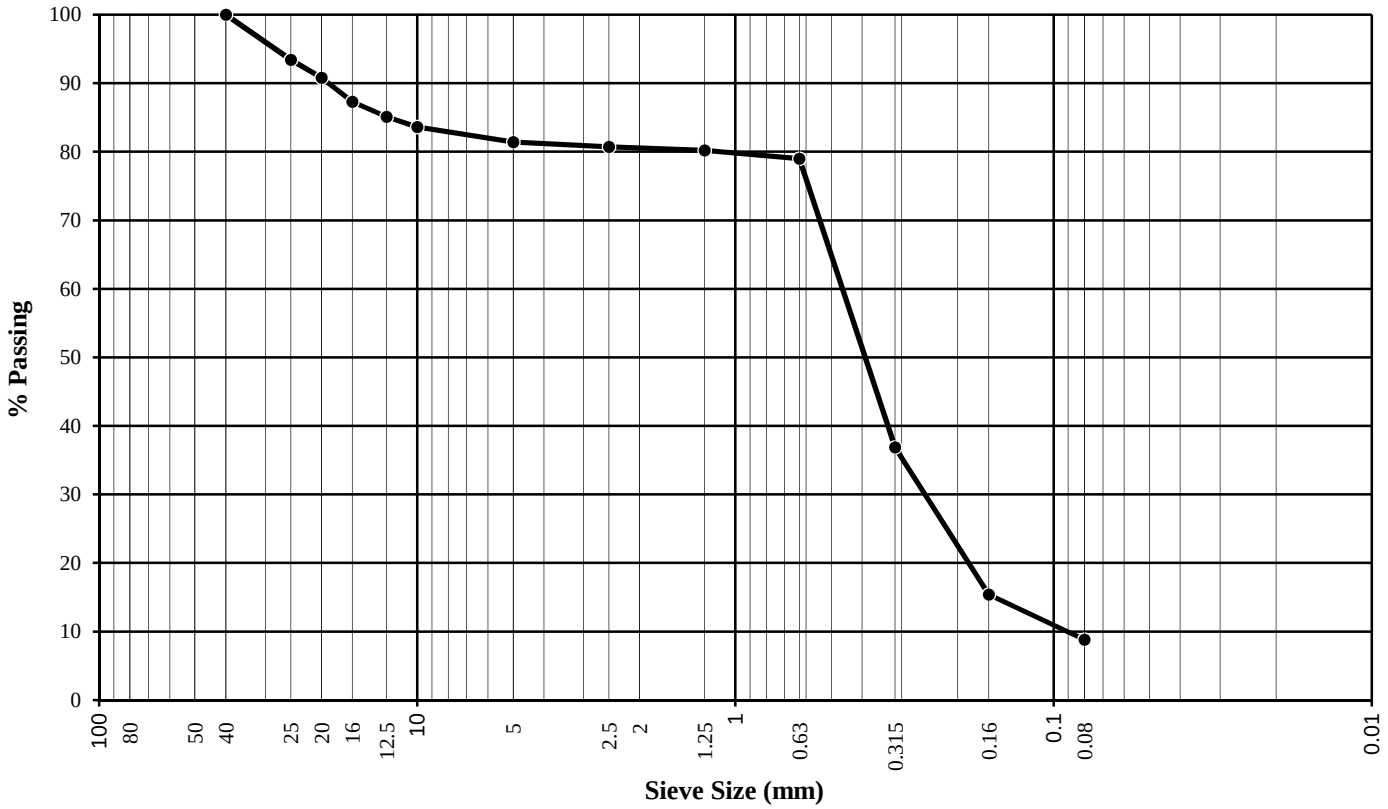
Specification

Comments

Gavel	18.6 %
Sand	72.6 %
Silt/Clay	8.8 %

TH 1
Depth 22.2 - 22.6m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80			
50			
40	100.0		
25	93.4		
20	90.8		
16	87.3		
12.5	85.1		
10	83.6		
5	81.4		
2.5	80.7		
1.25	80.2		
0.63	79.0		
0.315	36.9		
0.16	15.4		
0.08	8.8		



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Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	Aug 1/17	**By**	AA
Date Received	Aug 1/17	**By**	AA
Date Tested	Aug 5/17	**By**	DK

Aggregate Type Sandy Gravel, trace silt/clay

Aggregate Source

Classification GP
C_C= 3.8
C_U= 91.7

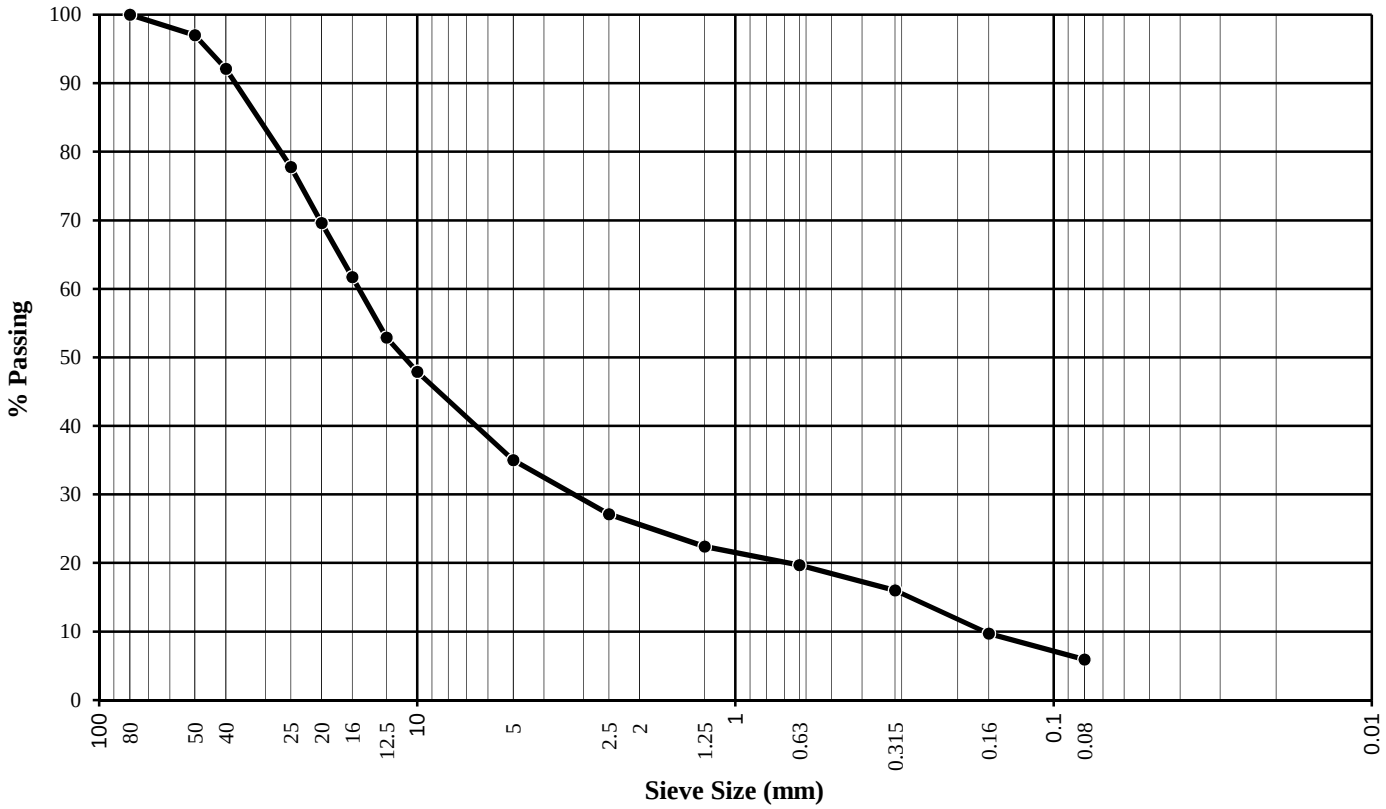
Specification

Comments

Gavel	65.0 %
Sand	29.1 %
Silt/Clay	5.9 %

TH 1
Depth 26 - 27m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80	100.0		
50	97.0		
40	92.1		
25	77.8		
20	69.6		
16	61.7		
12.5	52.9		
10	47.9		
5	35.0		
2.5	27.1		
1.25	22.4		
0.63	19.7		
0.315	16.0		
0.16	9.7		
0.08	5.9		



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Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	July 31/17	**By**	AA
Date Received	July 31/17	**By**	AA
Date Tested	Aug 14/17	**By**	MTS

Aggregate Type Sandy Gravel, trace silt/clay
Aggregate Source

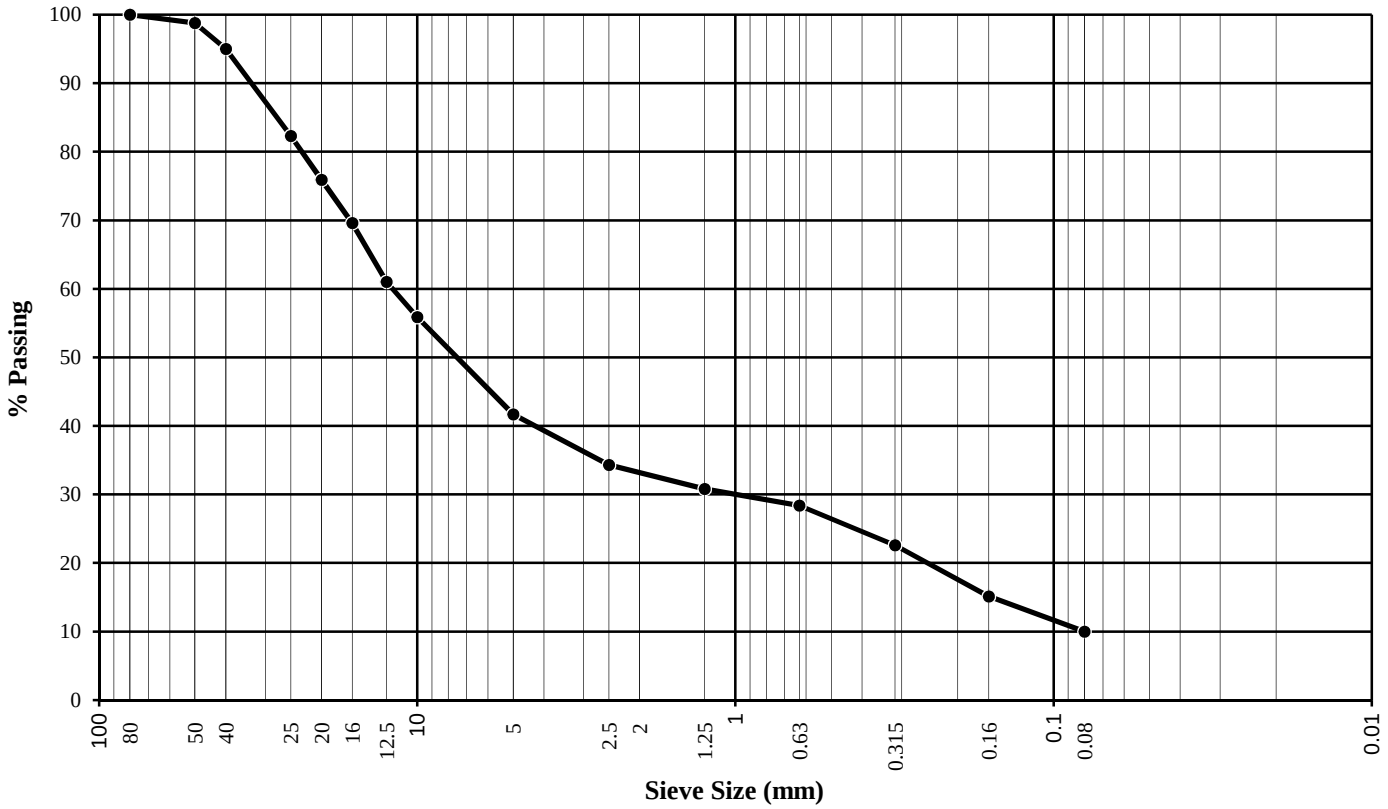
Classification GW-GM
C_C= 1.1
C_U= 150.1

Specification

Comments

Gavel	58.3 %
Sand	31.7 %
Silt/Clay	10.0 %
TH	2
Depth	12 - 13m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80	100.0		
50	98.8		
40	95.0		
25	82.3		
20	75.9		
16	69.6		
12.5	61.0		
10	55.9		
5	41.7		
2.5	34.3		
1.25	30.8		
0.63	28.4		
0.315	22.6		
0.16	15.1		
0.08	10.0		



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Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	Aug 1/17	**By**	AA
Date Received	Aug 1/17	**By**	AA
Date Tested	Aug 4/17	**By**	DK

Aggregate Type Gravel, some sand, some silt/clay
Aggregate Source

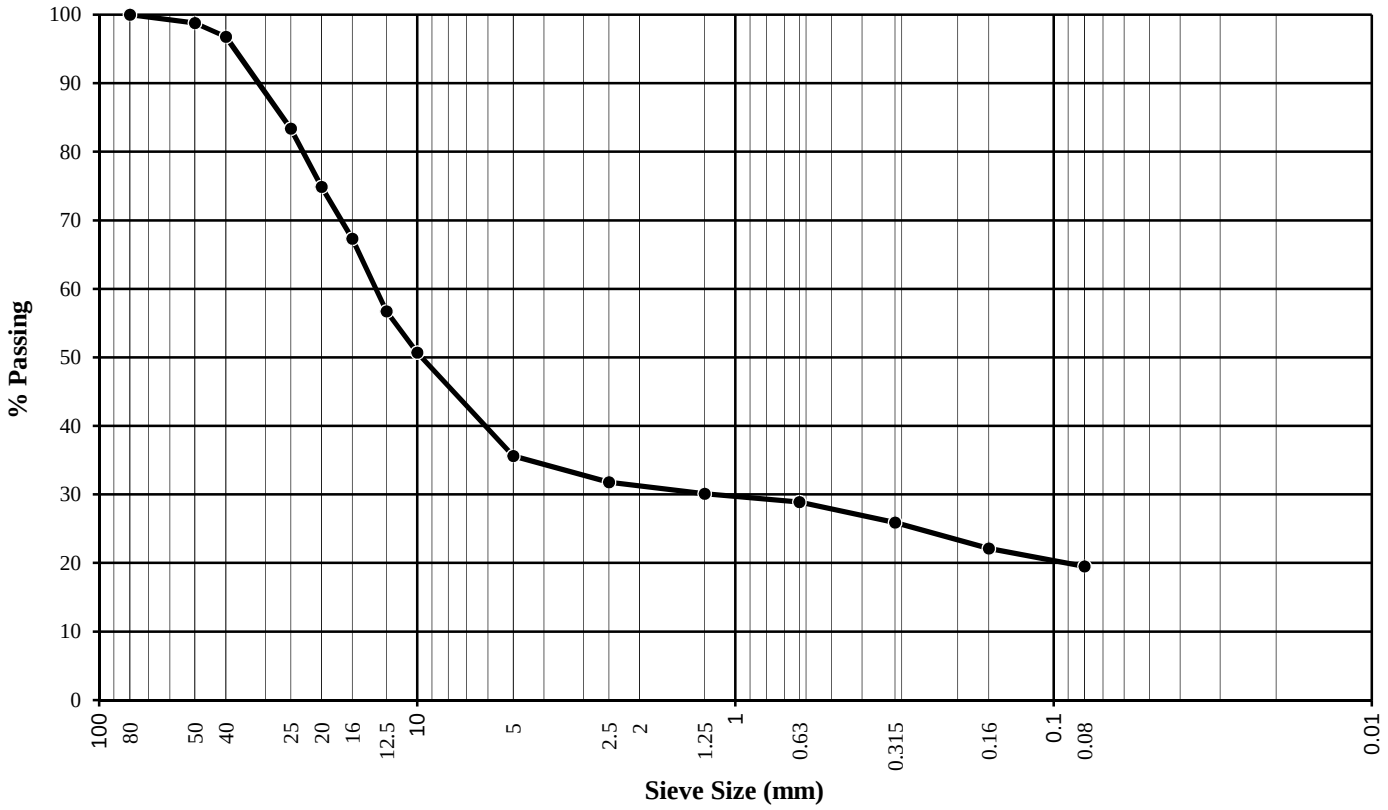
Classification GM or GC
C_C= 1.4
C_U= 170.0

Specification

Comments

Gavel	64.4 %
Sand	16.1 %
Silt/Clay	19.5 %
TH	2
Depth	20 - 21m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80	100.0		
50	98.8		
40	96.8		
25	83.4		
20	74.9		
16	67.3		
12.5	56.7		
10	50.7		
5	35.6		
2.5	31.8		
1.25	30.1		
0.63	28.9		
0.315	25.9		
0.16	22.1		
0.08	19.5		



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Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	Aug 1/17	**By**	AA
Date Received	Aug 1/17	**By**	AA
Date Tested	Aug 14/17	**By**	DK

Aggregate Type Sandy Gravel, some silt/clay
Aggregate Source

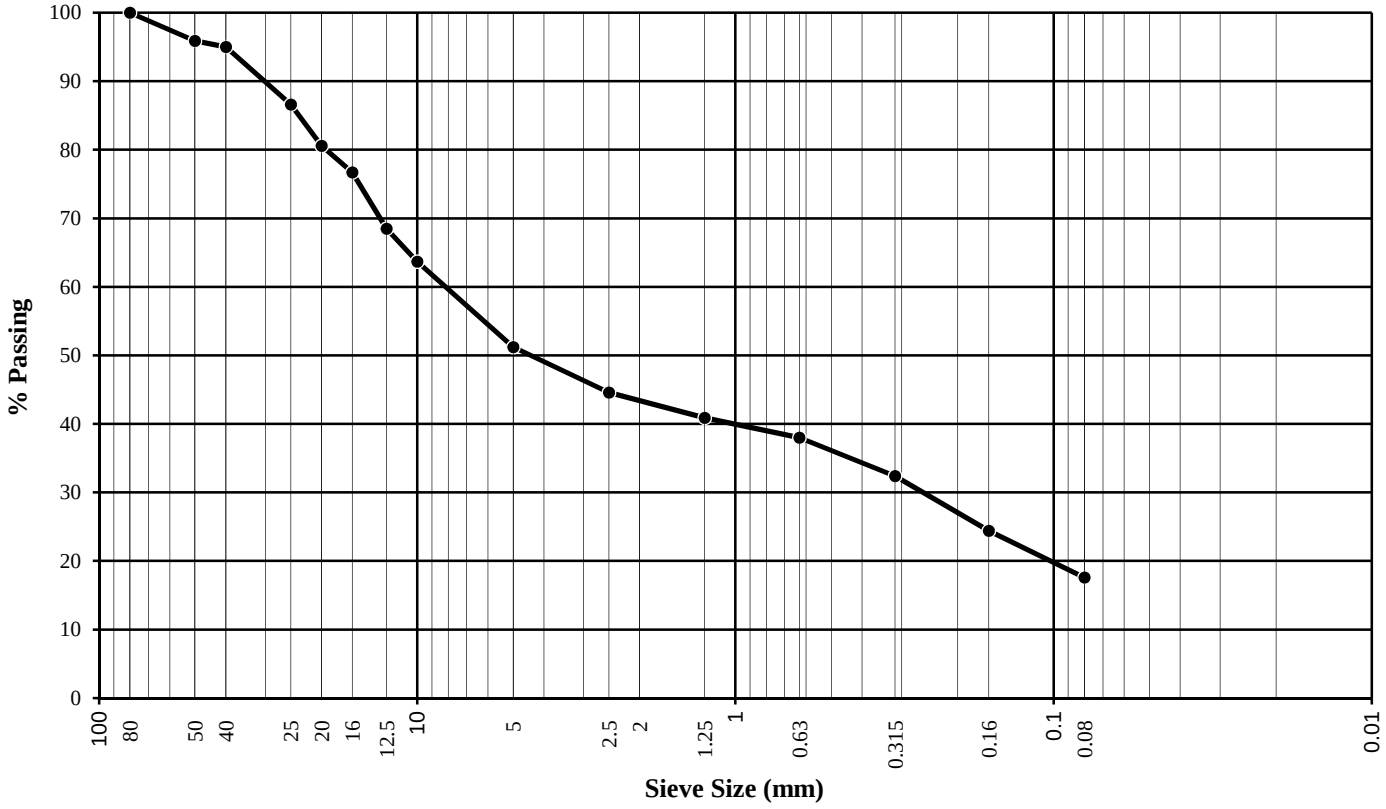
Classification GM or GC
C_C= 0.1
C_U= 106.7

Specification

Comments

Gavel	48.8 %
Sand	33.6 %
Silt/Clay	17.6 %
TH	3
Depth	3 - 4m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80	100.0		
50	95.9		
40	95.0		
25	86.6		
20	80.6		
16	76.7		
12.5	68.5		
10	63.7		
5	51.2		
2.5	44.6		
1.25	40.9		
0.63	38.0		
0.315	32.4		
0.16	24.4		
0.08	17.6		



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Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	Aug 1/17	**By**	AA
Date Received	Aug 1/17	**By**	AA
Date Tested	Aug 2/17	**By**	JKC

Aggregate Type Gravelly Sand, some silt/clay
Aggregate Source

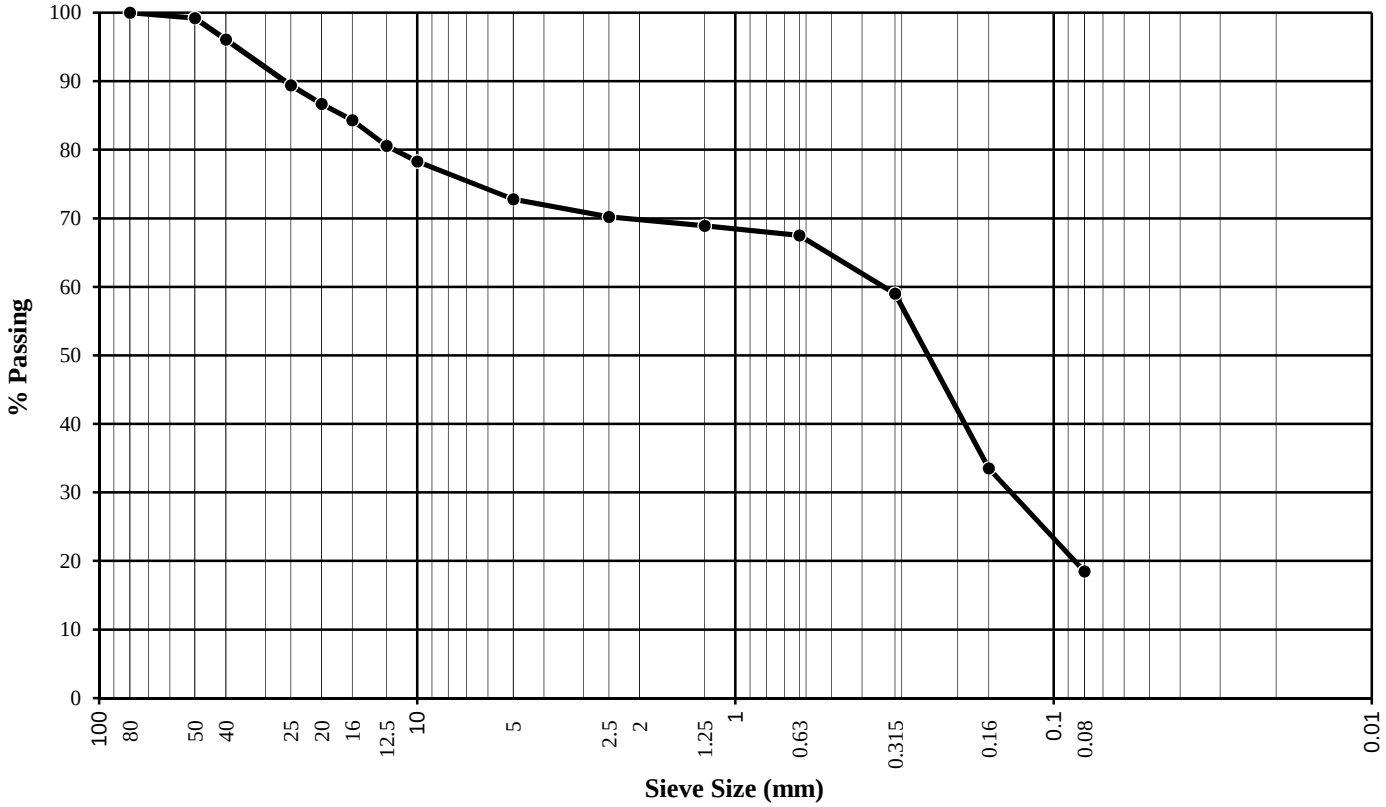
Classification SM or SC
C_C= 0.7
C_U= 4.4

Specification

Comments

Gavel	27.2 %
Sand	54.3 %
Silt/Clay	18.5 %
TH	3
Depth	15 - 16m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80	100.0		
50	99.2		
40	96.1		
25	89.4		
20	86.7		
16	84.3		
12.5	80.6		
10	78.3		
5	72.8		
2.5	70.2		
1.25	68.9		
0.63	67.5		
0.315	59.0		
0.16	33.5		
0.08	18.5		



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Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	Aug 1/17	**By**	AA
Date Received	Aug 1/17	**By**	AA
Date Tested	Aug 2/17	**By**	PS

Aggregate Type Sandy Gravel, trace silt/clay
Aggregate Source

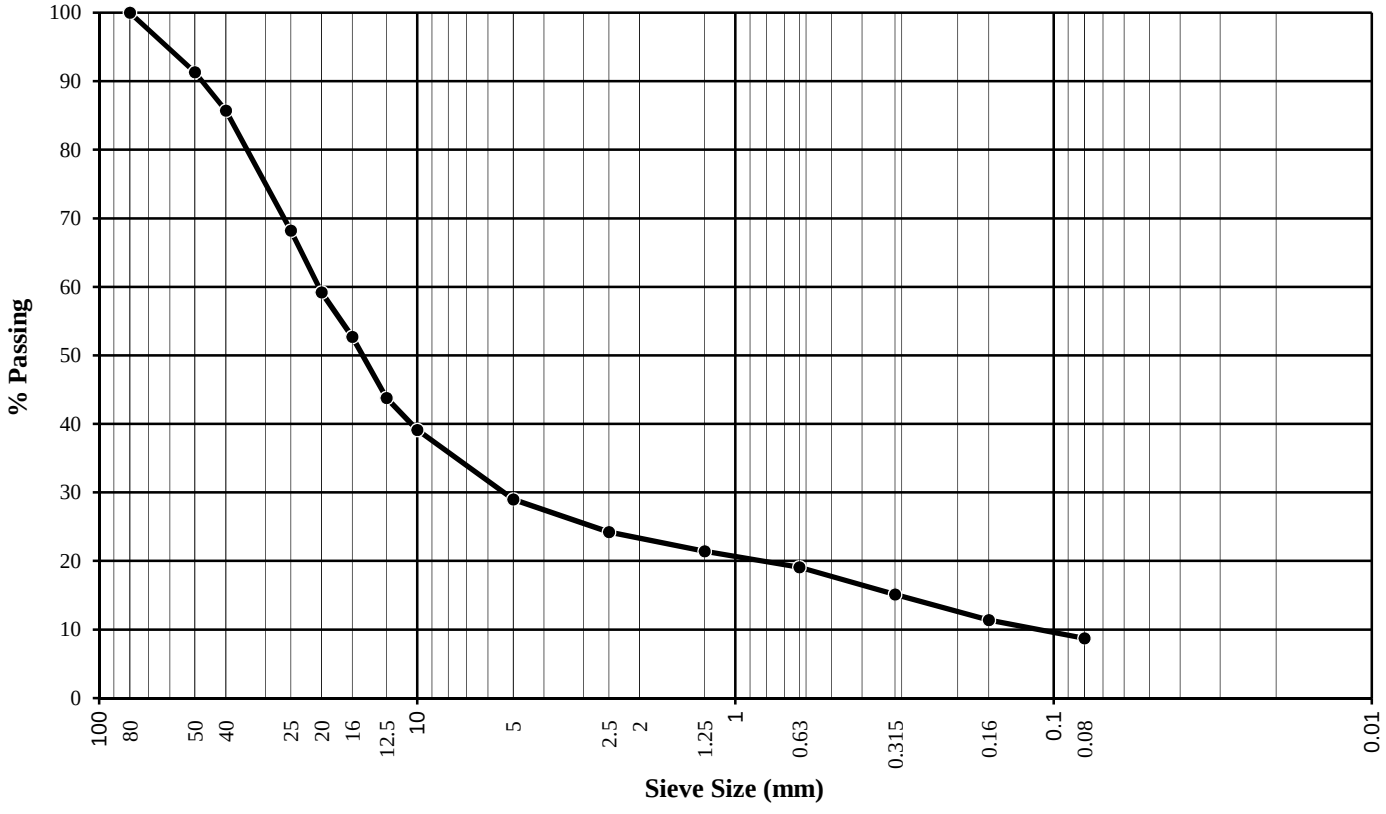
Classification GP-GM
C_C= 12.6
C_U= 173.9

Specification

Comments

Gavel	71.0 %
Sand	20.3 %
Silt/Clay	8.7 %
TH	3
Depth	19.5m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80	100.0		
50	91.3		
40	85.7		
25	68.2		
20	59.2		
16	52.7		
12.5	43.8		
10	39.1		
5	29.0		
2.5	24.2		
1.25	21.4		
0.63	19.1		
0.315	15.1		
0.16	11.4		
0.08	8.7		



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Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	Aug 2/17	**By**	AA
Date Received	Aug 2/17	**By**	AA
Date Tested	Aug 14/17	**By**	BM

Aggregate Type Sandy Gravel, some silt/clay
Aggregate Source

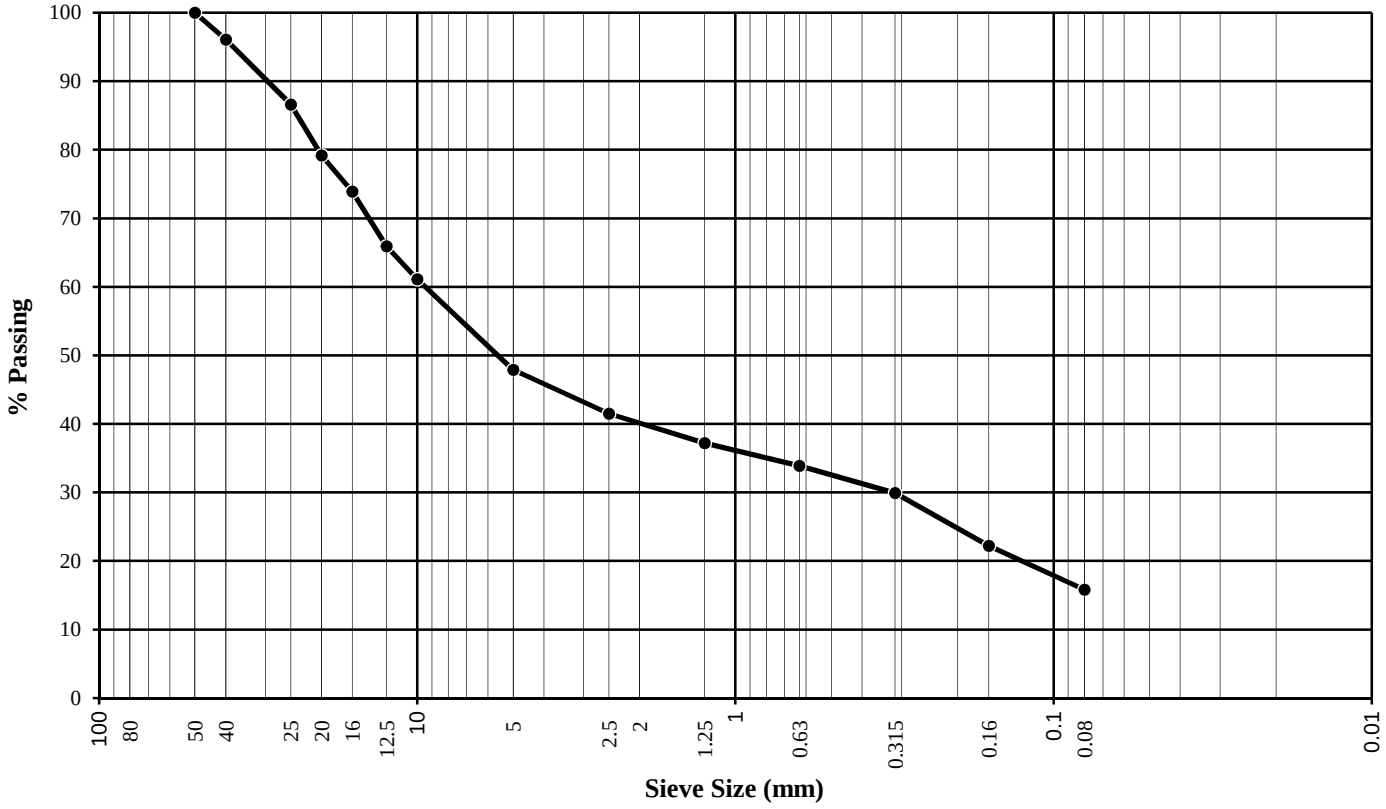
Classification GM or GC
C_C= 0.1
C_U= 120.0

Specification

Comments

Gavel	52.1 %
Sand	32.1 %
Silt/Clay	15.8 %
TH	4
Depth	6 - 7m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80			
50	100.0		
40	96.1		
25	86.6		
20	79.2		
16	73.9		
12.5	65.9		
10	61.1		
5	47.9		
2.5	41.5		
1.25	37.2		
0.63	33.9		
0.315	29.9		
0.16	22.2		
0.08	15.8		



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Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No. 099-86-17
Date Sampled Aug 2/17 **By** AA
Date Received Aug 2/17 **By** AA
Date Tested Aug 6/17 **By** DK

Aggregate Type Gravelly Sand, some silt/clay
Aggregate Source

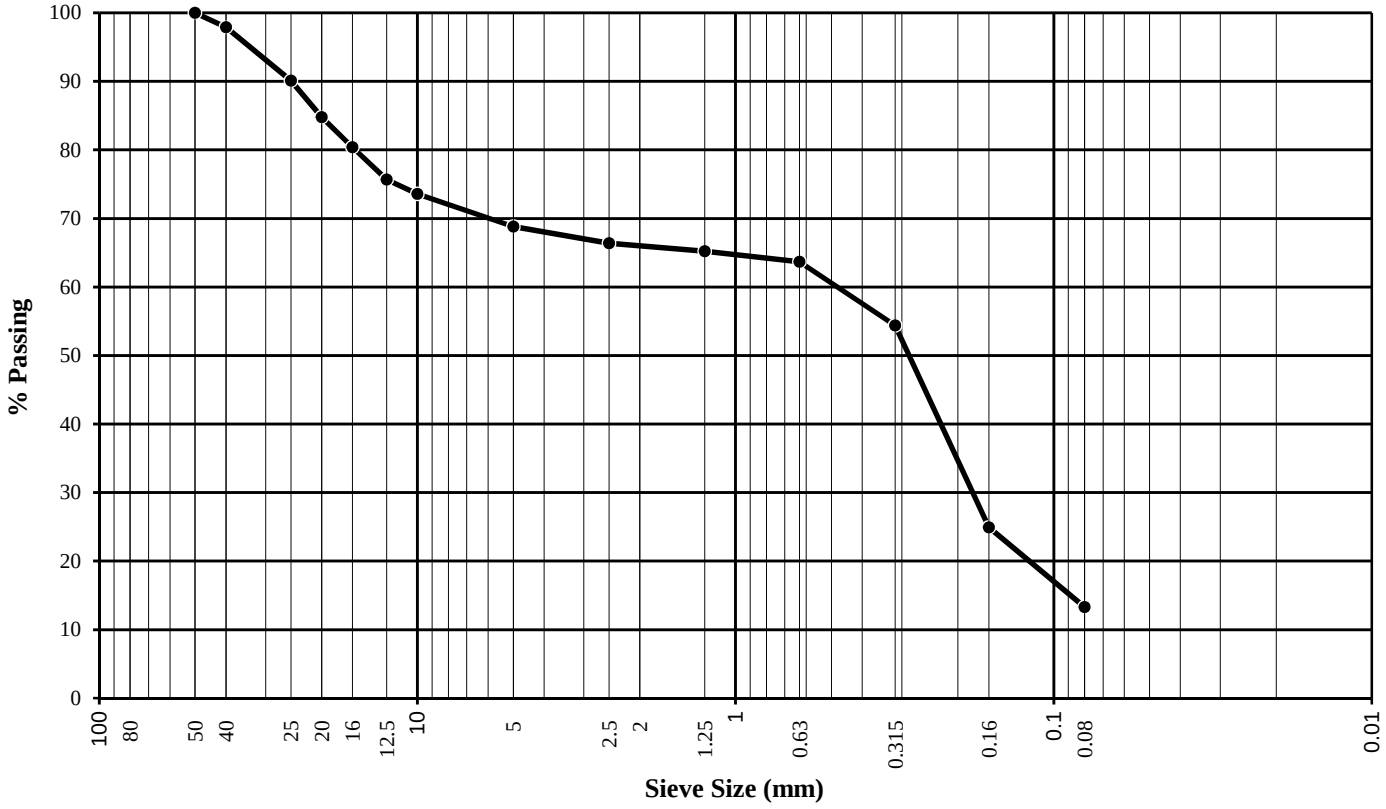
Classification SM or SC
C_C= 0.9
C_U= 6.3

Specification

Comments
Gavel 31.2 %
Sand 55.5 %
Silt/Clay 13.3 %

TH 4
Depth 7 - 7.5m

Sieve Size	Percent Passing by Weight		
(mm)		Min.	Max.
200			
150			
100			
80			
50	100.0		
40	97.9		
25	90.1		
20	84.8		
16	80.4		
12.5	75.7		
10	73.6		
5	68.8		
2.5	66.4		
1.25	65.2		
0.63	63.7		
0.315	54.4		
0.16	24.9		
0.08	13.3		



7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	Aug 2/17	**By**	AA
Date Received	Aug 2/17	**By**	AA
Date Tested	Aug 15/17	**By**	BM

Aggregate Type Sandy Gravel, trace silt/clay
Aggregate Source

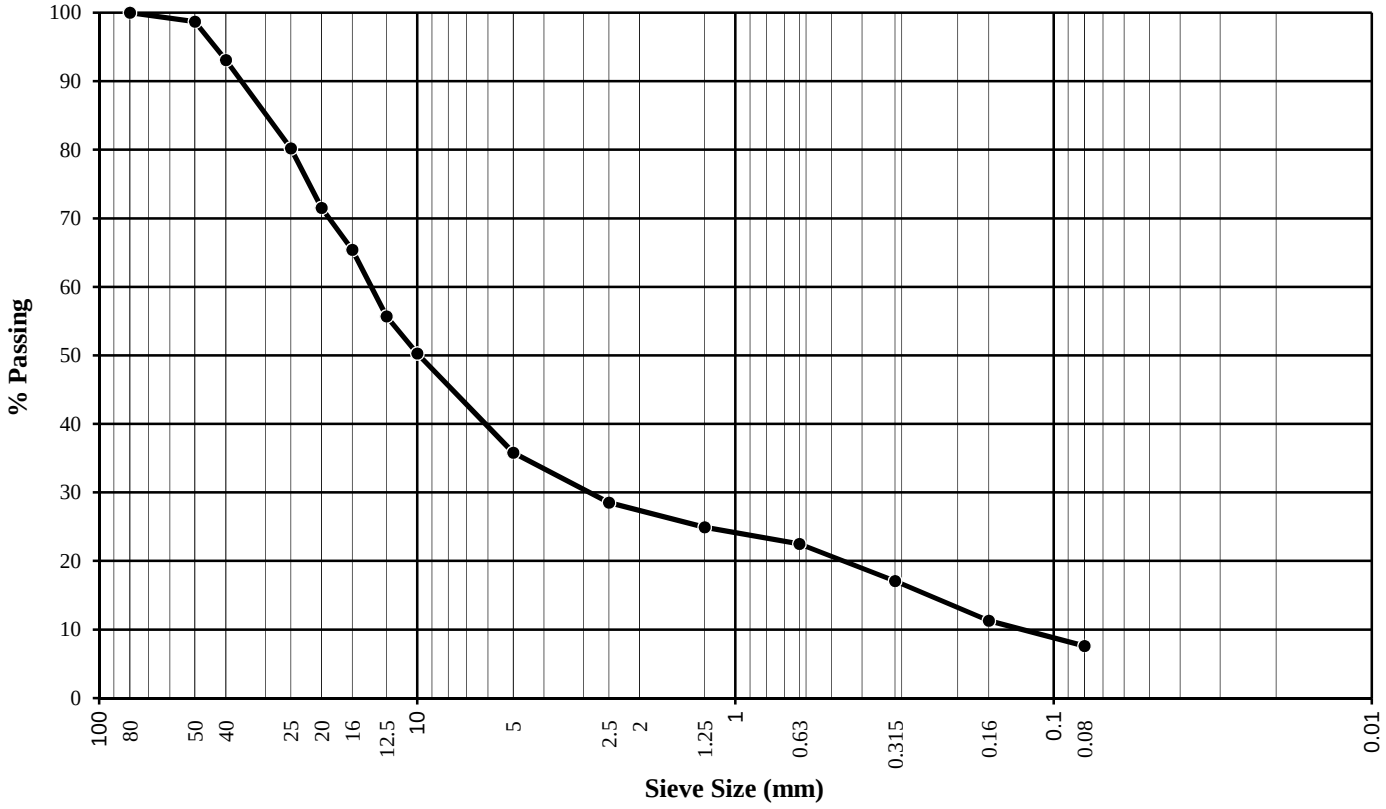
Classification GP
C_C= 3.7
C_U= 107.0

Specification

Comments

Gavel	64.2 %
Sand	28.2 %
Silt/Clay	7.6 %
TH	4
Depth	20 - 20.5m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80	100.0		
50	98.7		
40	93.1		
25	80.2		
20	71.5		
16	65.4		
12.5	55.7		
10	50.3		
5	35.8		
2.5	28.5		
1.25	24.9		
0.63	22.5		
0.315	17.1		
0.16	11.3		
0.08	7.6		



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Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	Aug 2/17	**By**	AA
Date Received	Aug 2/17	**By**	AA
Date Tested	Aug 12/17	**By**	DK

Aggregate Type Sandy Gravel, trace silt/clay
Aggregate Source

Classification GW
C_C= 2.1
C_U= 89.4

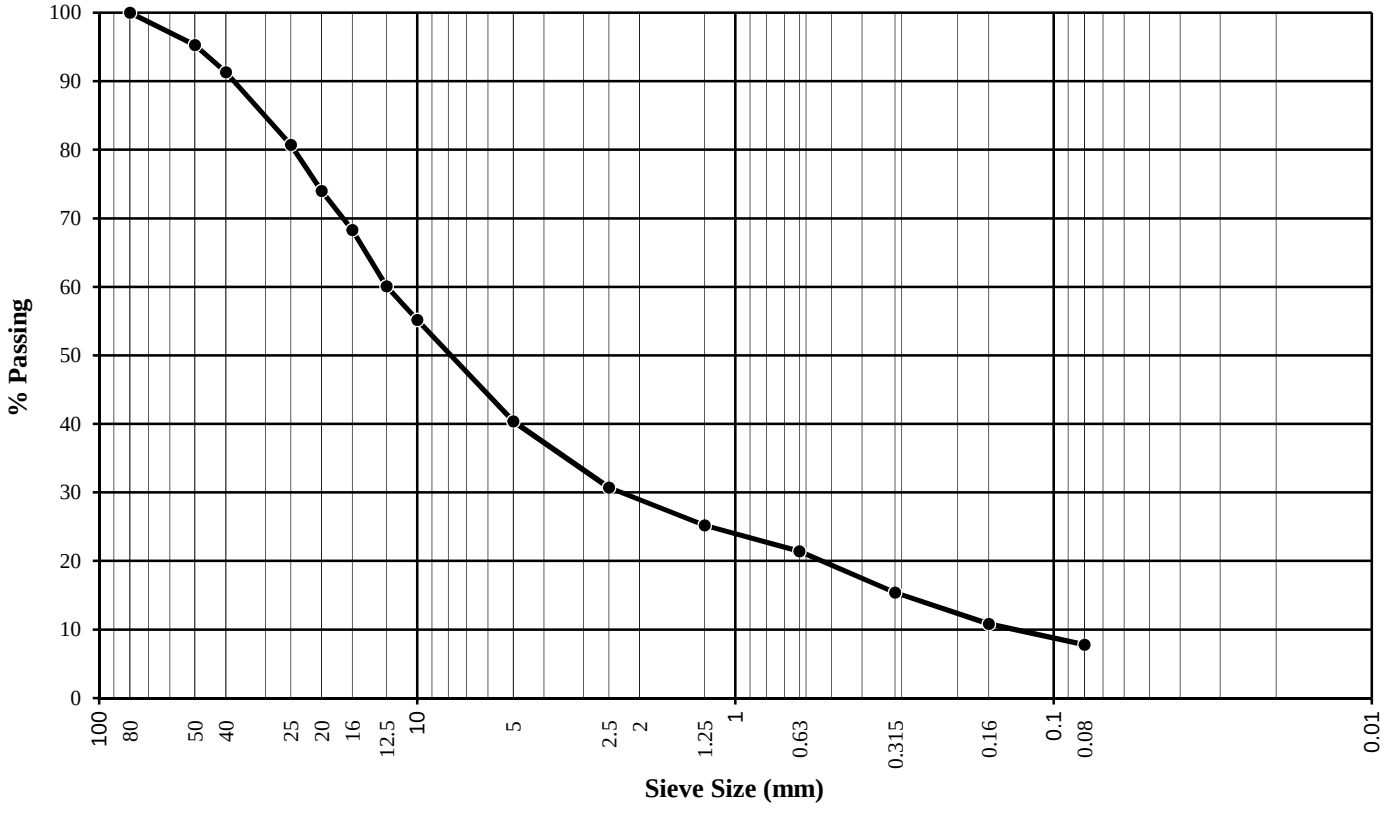
Specification

Comments

Gavel	59.6 %
Sand	32.6 %
Silt/Clay	7.8 %

TH 5
Depth 5 - 6m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80	100.0		
50	95.3		
40	91.3		
25	80.7		
20	74.0		
16	68.3		
12.5	60.1		
10	55.2		
5	40.4		
2.5	30.7		
1.25	25.2		
0.63	21.4		
0.315	15.4		
0.16	10.8		
0.08	7.8		



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Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	Aug 3/17	**By**	AA
Date Received	Aug 3/17	**By**	AA
Date Tested	Aug 5/17	**By**	DK

Aggregate Type Gravelly Sand, some silt/clay
Aggregate Source

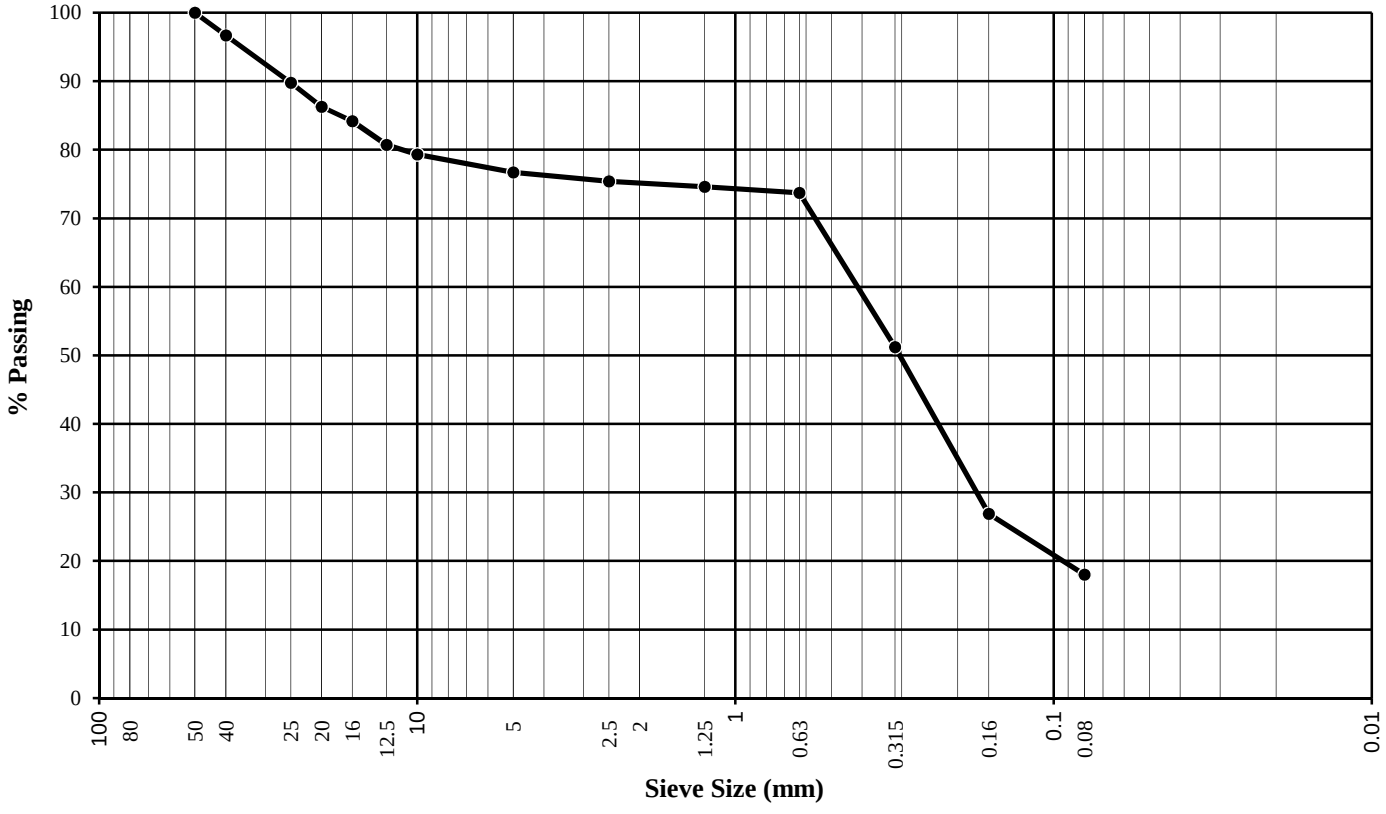
Classification SM or SC
C_C= 0.9
C_U= 5.5

Specification

Comments

Gavel	23.3 %
Sand	58.7 %
Silt/Clay	18.0 %
TH	6
Depth	11 - 11.5m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80			
50	100.0		
40	96.7		
25	89.8		
20	86.3		
16	84.2		
12.5	80.7		
10	79.3		
5	76.7		
2.5	75.4		
1.25	74.6		
0.63	73.7		
0.315	51.2		
0.16	26.9		
0.08	18.0		



7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No. 099-86-17
Date Sampled Aug 4/17 **By** JC
Date Received Aug 4/17 **By** JC
Date Tested Aug 6/17 **By** DK

Aggregate Type Sandy Gravel, some silt/clay
Aggregate Source

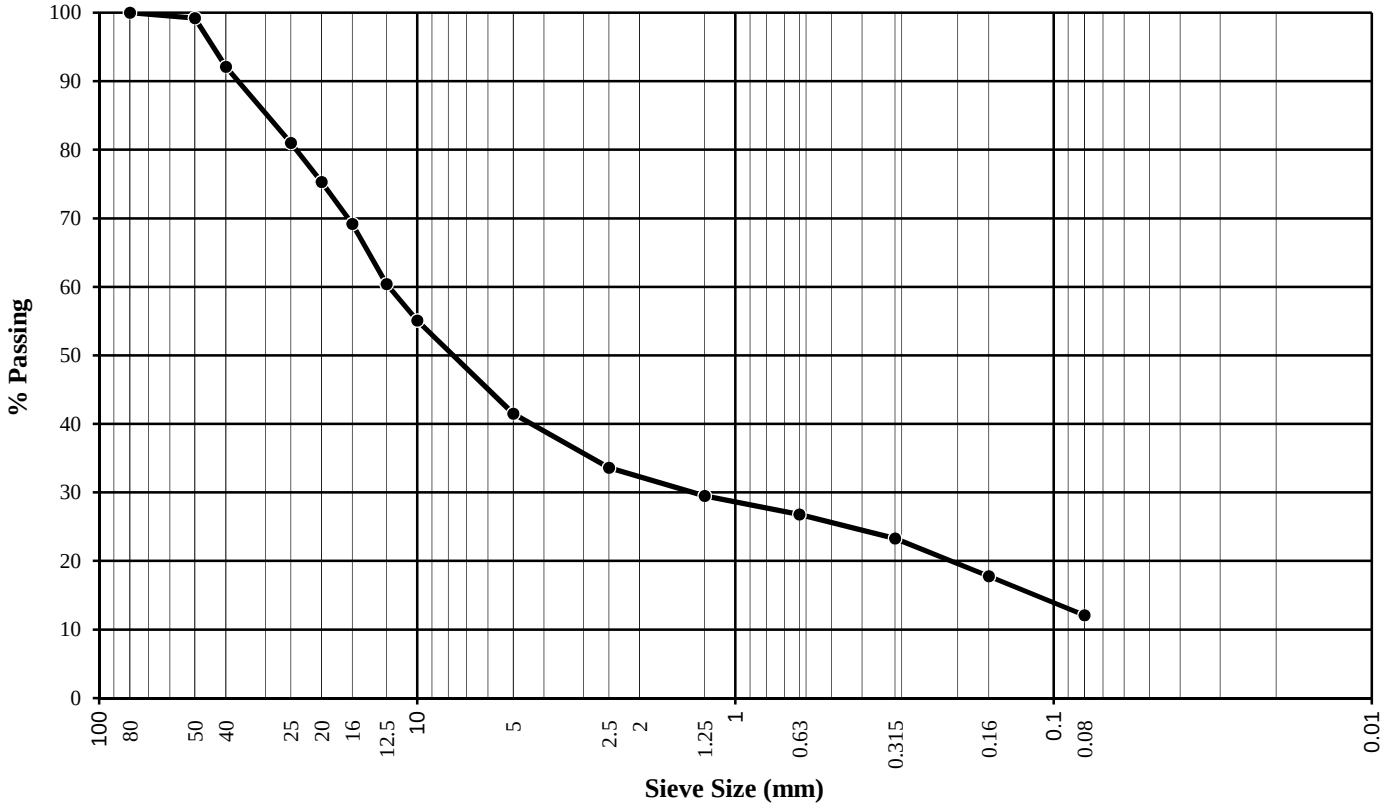
Classification GM or GC
C_C= 1.8
C_U= 154.0

Specification

Comments
Gavel 58.5 %
Sand 29.4 %
Silt/Clay 12.1 %

TH 8
Depth 5 - 6m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80	100.0		
50	99.2		
40	92.1		
25	81.0		
20	75.3		
16	69.2		
12.5	60.4		
10	55.1		
5	41.5		
2.5	33.6		
1.25	29.5		
0.63	26.8		
0.315	23.3		
0.16	17.8		
0.08	12.1		



7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No. 099-86-17
Date Sampled Aug 4/17 **By** JC
Date Received Aug 4/17 **By** JC
Date Tested Aug 6/17 **By** CS

Aggregate Type Sandy Gravel, trace silt/clay
Aggregate Source

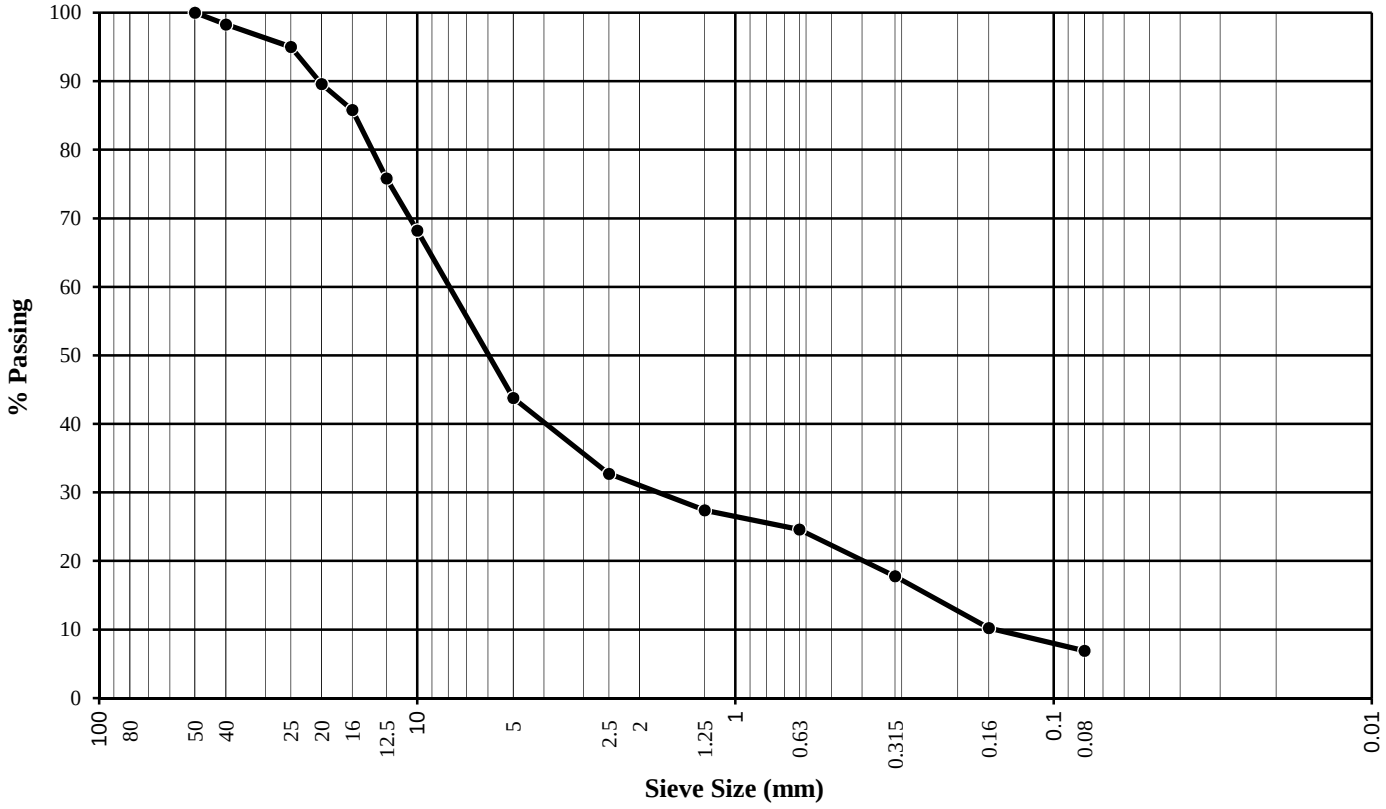
Classification GW
C_C= 2.0
C_U= 53.7

Specification

Comments
Gavel 56.2 %
Sand 36.9 %
Silt/Clay 6.9 %

TH 8
Depth 23 - 23.5m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80			
50	100.0		
40	98.3		
25	95.0		
20	89.6		
16	85.8		
12.5	75.8		
10	68.2		
5	43.8		
2.5	32.7		
1.25	27.4		
0.63	24.6		
0.315	17.8		
0.16	10.2		
0.08	6.9		



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Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	Aug 5/17	**By**	AA
Date Received	Aug 5/17	**By**	AA
Date Tested	Aug 15/17	**By**	BM

Aggregate Type Sandy Gravel, trace silt/clay
Aggregate Source

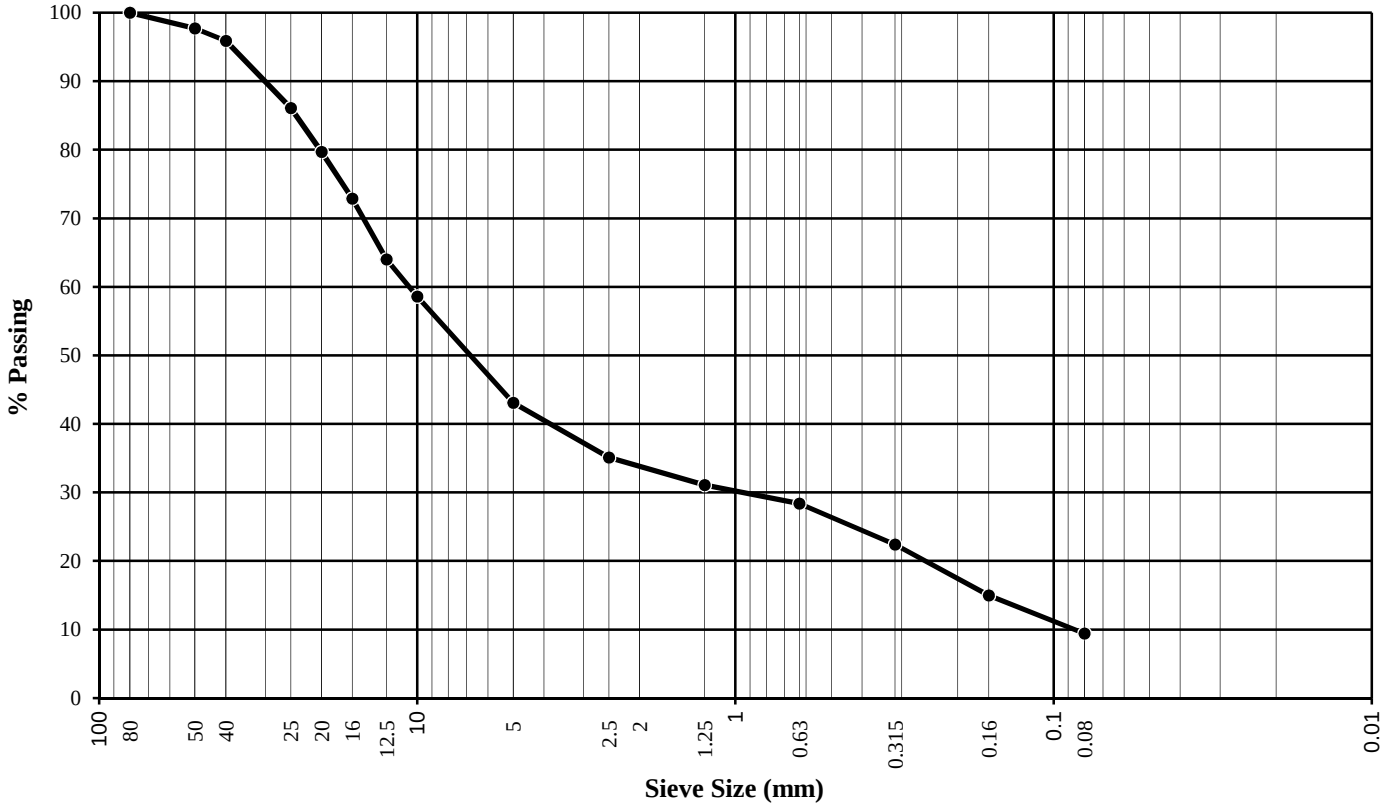
Classification GW-GM
C_C= 1.1
C_U= 120.8

Specification

Comments

Gavel	56.9 %
Sand	33.7 %
Silt/Clay	9.4 %
TH	9
Depth	7 - 7.5m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80	100.0		
50	97.7		
40	95.9		
25	86.1		
20	79.7		
16	72.9		
12.5	64.0		
10	58.6		
5	43.1		
2.5	35.1		
1.25	31.1		
0.63	28.4		
0.315	22.4		
0.16	15.0		
0.08	9.4		



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Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	Aug 5/17	**By**	AA
Date Received	Aug 5/17	**By**	AA
Date Tested	Aug 14/17	**By**	BM

Aggregate Type Sandy Gravel, trace silt/clay
Aggregate Source

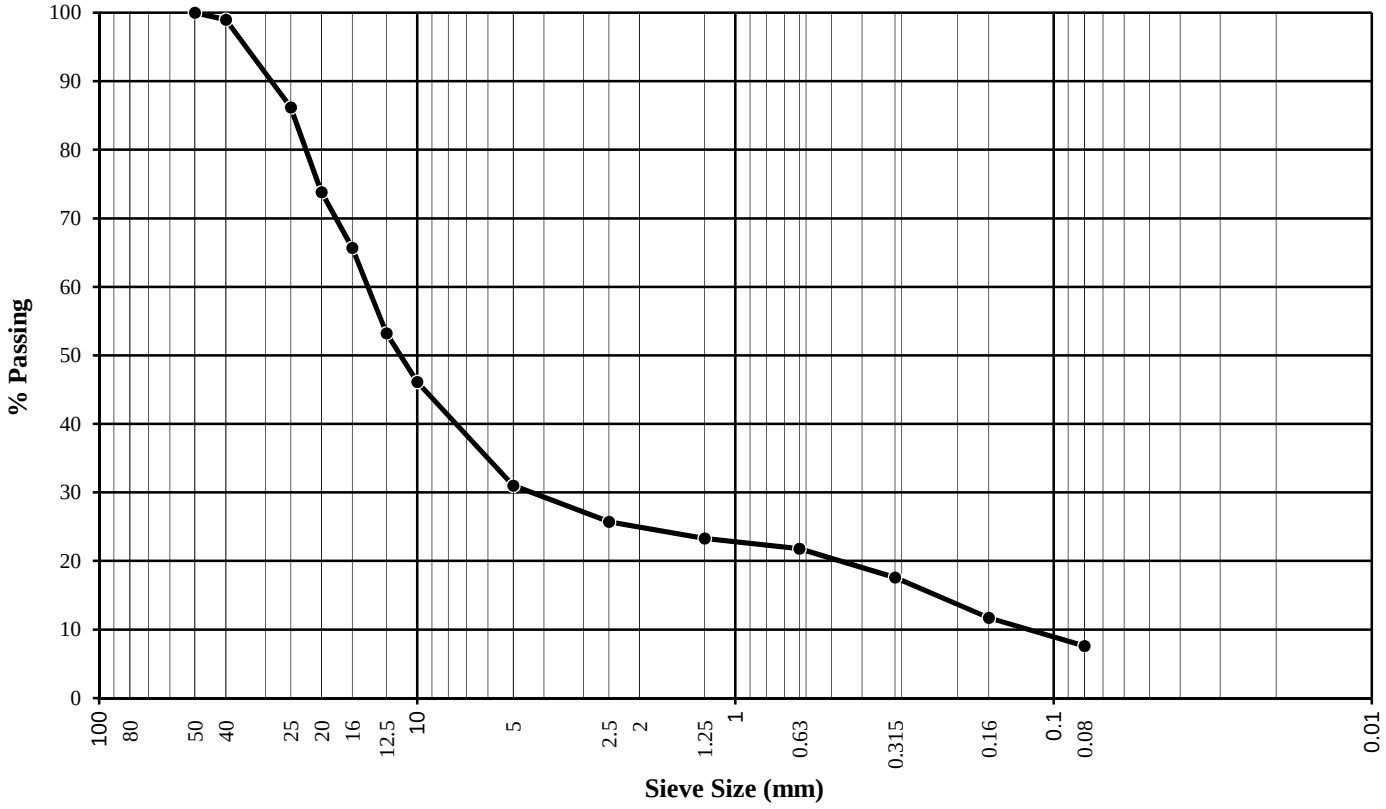
Classification GP
C_C= 10.8
C_U= 113.2

Specification

Comments

Gavel	69.0 %
Sand	23.4 %
Silt/Clay	7.6 %
TH	10
Depth	10 - 10.5m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80			
50	100.0		
40	99.0		
25	86.2		
20	73.8		
16	65.7		
12.5	53.2		
10	46.1		
5	31.0		
2.5	25.7		
1.25	23.3		
0.63	21.8		
0.315	17.6		
0.16	11.7		
0.08	7.6		



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Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	Aug 5/17	**By**	AA
Date Received	Aug 5/17	**By**	AA
Date Tested	Aug 15/17	**By**	BM

Aggregate Type Silty Sand, some gravel/clay
Aggregate Source

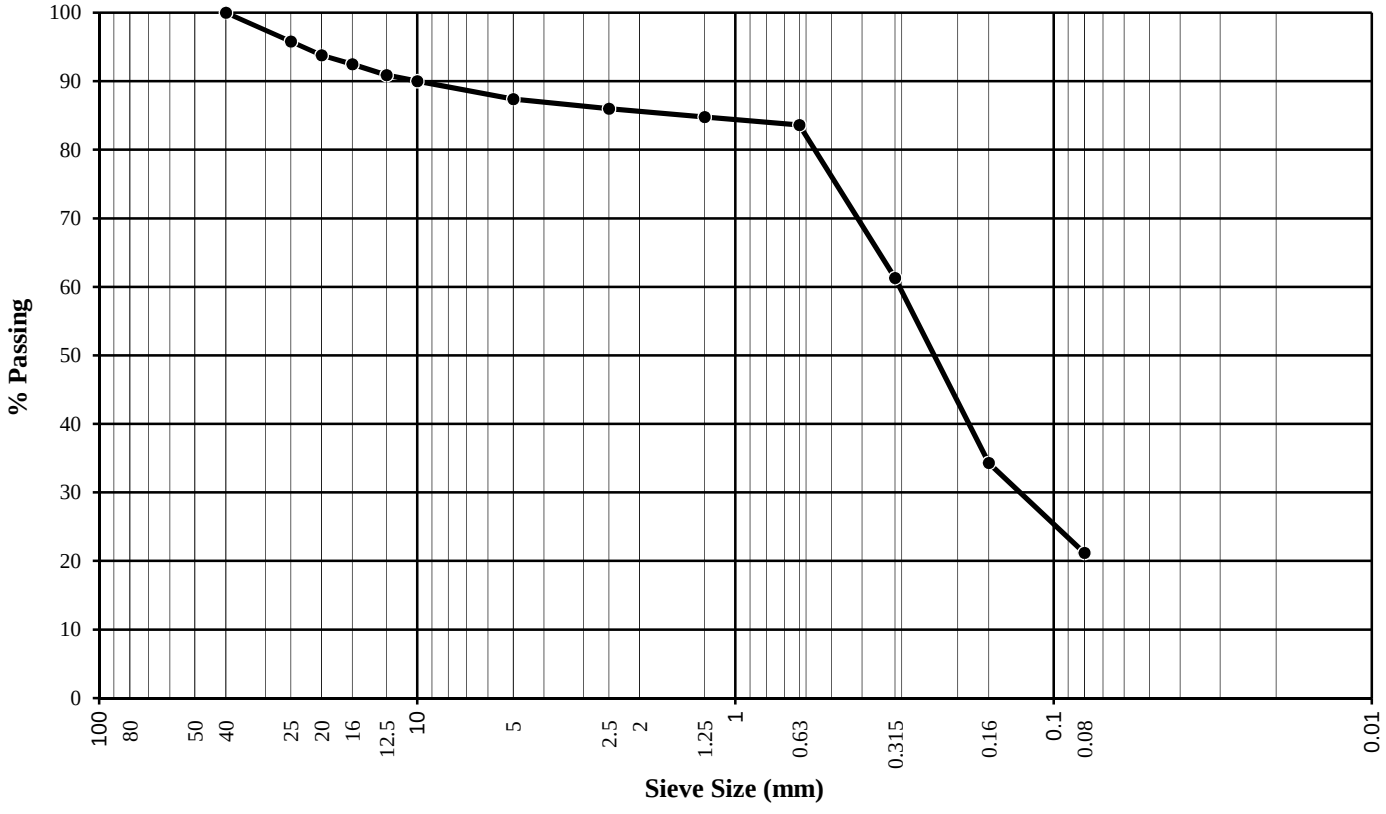
Classification SM or SC
C_C= 0.7
C_U= 3.8

Specification

Comments

Gavel	12.6 %
Sand	66.2 %
Silt/Clay	21.2 %
TH	10
Depth	17.1 - 17.3m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80			
50			
40	100.0		
25	95.8		
20	93.8		
16	92.5		
12.5	90.9		
10	90.0		
5	87.4		
2.5	86.0		
1.25	84.8		
0.63	83.6		
0.315	61.3		
0.16	34.3		
0.08	21.2		



7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Grain Size Distribution

ASTM D-422

Project	Summit Pit Ph 2	**Test Hole #**	TH1
Client	Mountain Ash Limited Partnership	**Depth**	9 - 11m
Almor Job #	099-86-17	**Technician**	JC
Date Recieved	July 31/17		
Date Tested	Aug 7/17		

Sieve Size (mm)	% Passing
150	
100	
80	100.0
50	97.9
40	95.7
25	90.0
20	84.6
10	63.8
5	46.9
2	36.4
0.425	29.6
0.080	13.0
0.005	2.5
0.002	2.5

Soil Classification

Gravel	53.1%
Sand	33.9%
Silt	10.5%
Clay	2.5%

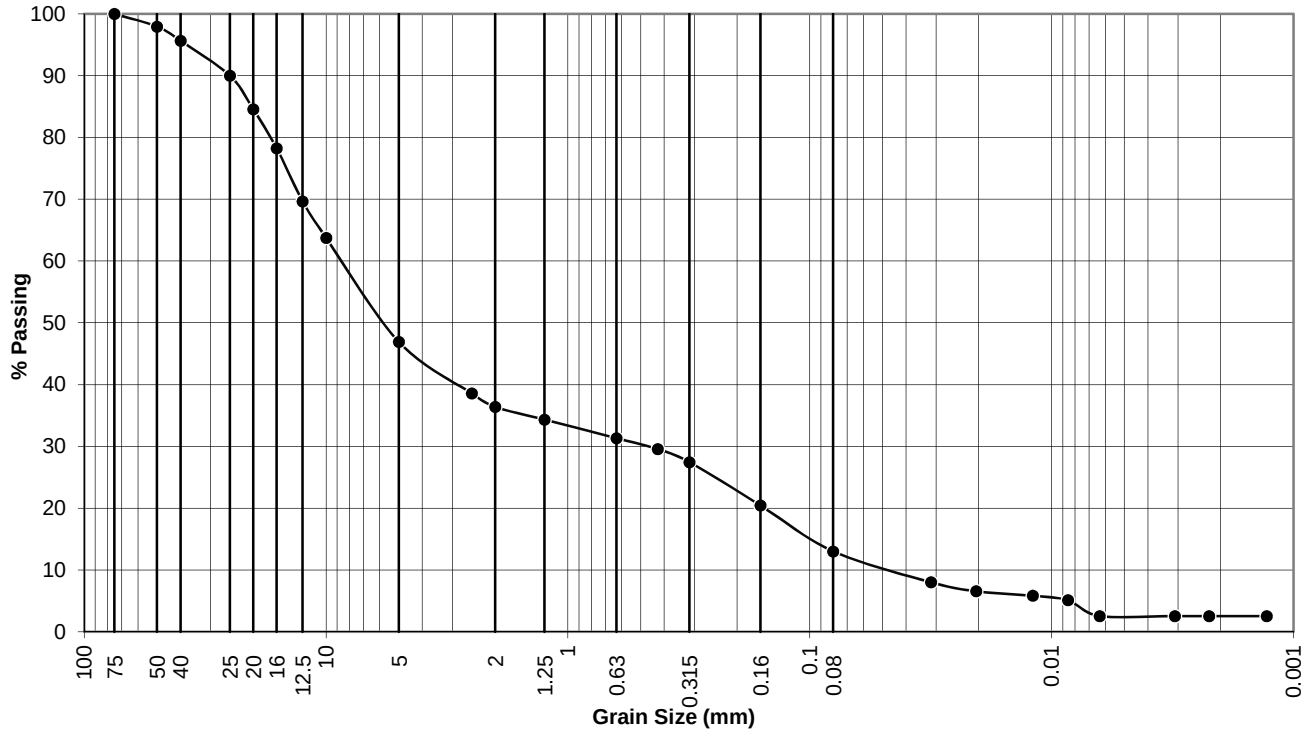
Soil Description Sandy GRAVEL, some silt, trace clay

Soil Properties

Natural Moisture Content	%
Liquid Limit	%
Plastic Limit	%
Plasticity Index	%
Specific Gravity	2.65

Comments

Gravel		Sand			Silt	Clay
Coarse	Fine	Coarse	Medium	Fine		



7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	Aug 2/17	**By**	AA
Date Received	Aug 2/17	**By**	AA
Date Tested	Aug 12/17	**By**	BM

Aggregate Type Gravel, some sand, trace silt
Aggregate Source

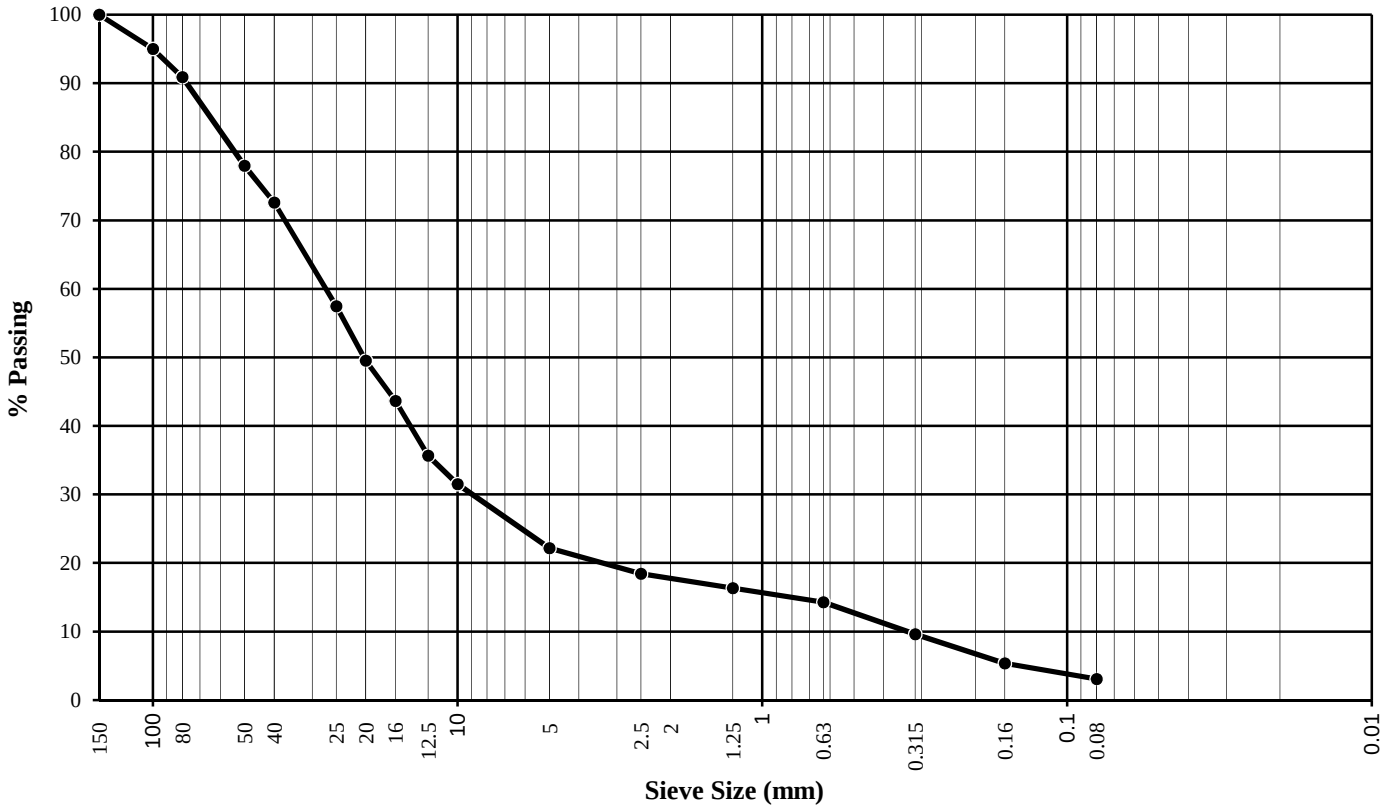
Classification GP
C_C= 9.0
C_U= 80.6

Specification

Comments

Gavel	77.8 %
Sand	19.1 %
Silt/Clay	3.1 %
TP	1
Depth	5 - 6m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150	100.0		
100	95.0		
80	90.9		
50	77.9		
40	72.6		
25	57.5		
20	49.5		
16	43.7		
12.5	35.7		
10	31.5		
5	22.2		
2.5	18.4		
1.25	16.3		
0.63	14.3		
0.315	9.6		
0.16	5.3		
0.08	3.1		



7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	Aug 2/17	**By**	AA
Date Received	Aug 2/17	**By**	AA
Date Tested	Aug 14/17	**By**	MTS

Aggregate Type Gravel, some sand, trace silt
Aggregate Source

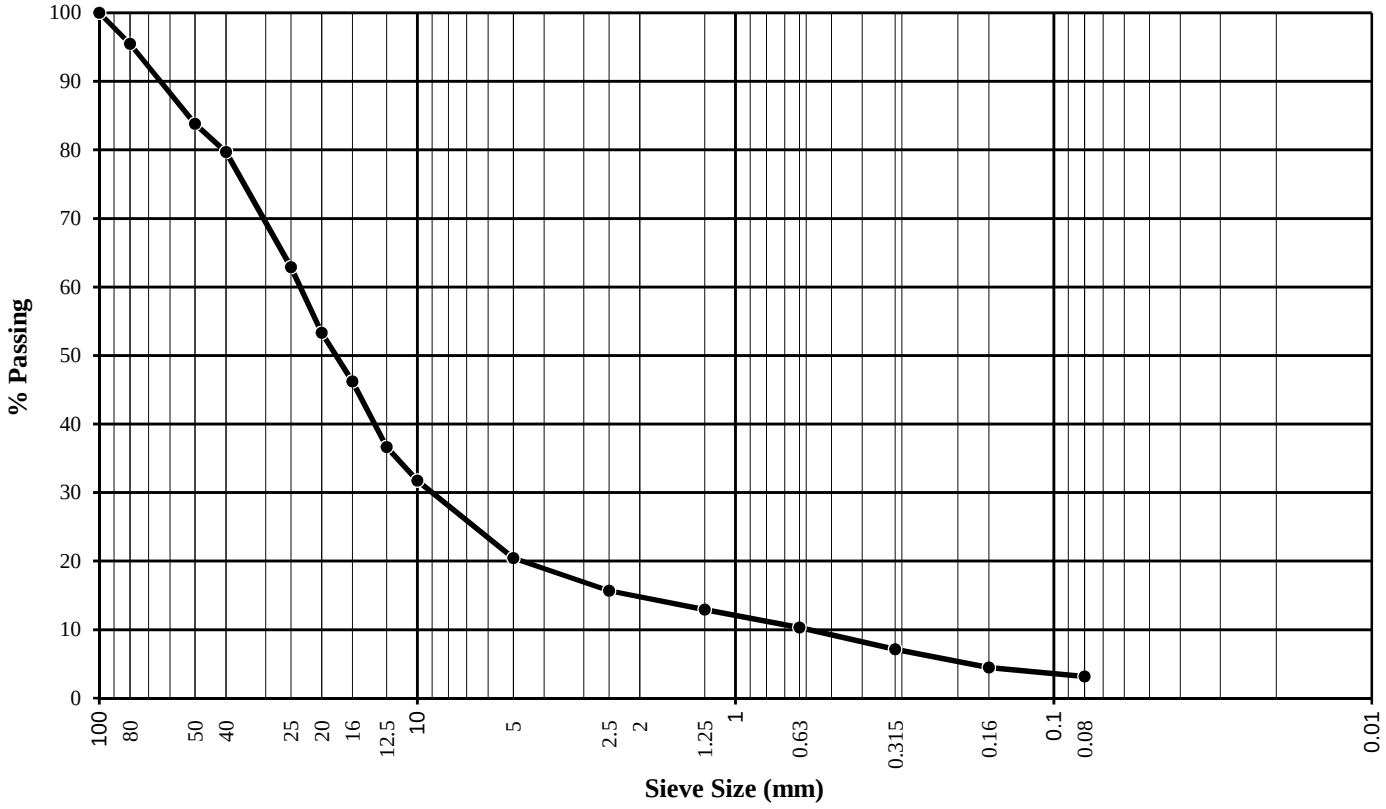
Classification GP
C_C= 6.0
C_U= 39.2

Specification

Comments
Gavel 79.6 %
Sand 17.3 %
Silt/Clay 3.2 %

TP 2
Depth 5 - 6m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100	100.0		
80	95.5		
50	83.8		
40	79.7		
25	62.9		
20	53.3		
16	46.2		
12.5	36.6		
10	31.8		
5	20.4		
2.5	15.7		
1.25	12.9		
0.63	10.3		
0.315	7.1		
0.16	4.5		
0.08	3.2		



7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project Summit Pit Ph 2, Gravel Investigation

Job No.	099-86-17		
Date Sampled	Aug 2/17	**By**	AA
Date Received	Aug 2/17	**By**	AA
Date Tested	Aug 6/17	**By**	DK

Aggregate Type Gravel, some sand, trace silt
Aggregate Source

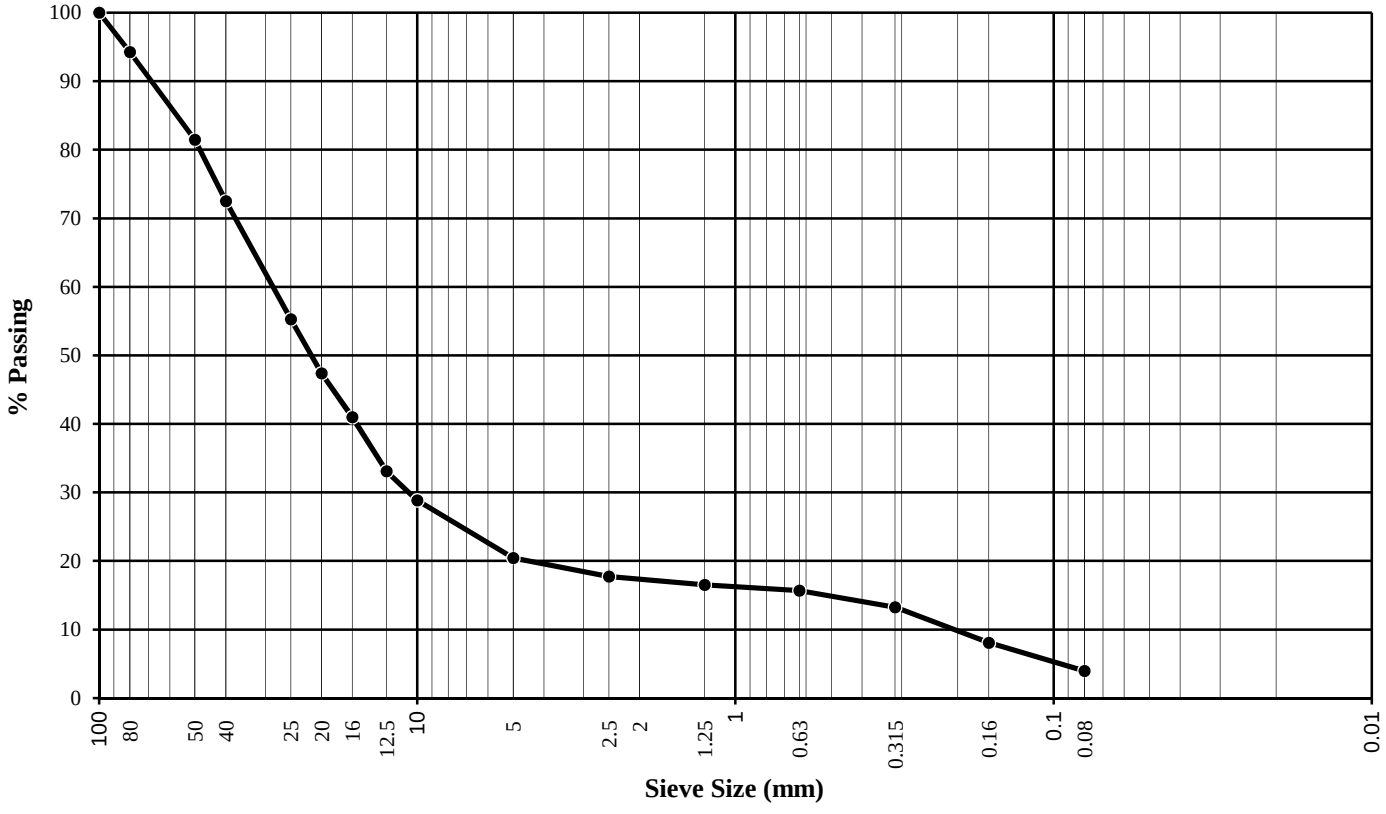
Classification GP
C_C= 18.0
C_U= 133.6

Specification

Comments

Gavel	79.6 %
Sand	16.5 %
Silt/Clay	4.0 %
TP	3
Depth	5.0 - 6.0m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100	100.0		
80	94.3		
50	81.5		
40	72.5		
25	55.3		
20	47.4		
16	41.0		
12.5	33.1		
10	28.8		
5	20.4		
2.5	17.8		
1.25	16.5		
0.63	15.7		
0.315	13.2		
0.16	8.1		
0.08	4.0		



APPENDIX C

Curtis GEO Solutions Inc.

Aug 23, 2017
File: 317-Misc.

Almor Testing Services Ltd.
7505 - 40 Street SE
Calgary, AB T2C 2H5

Email: aalemi@almor.com

Attn: Abdul Alemi

Re: LA Abrasion Testing (ASTM C - 131)

Curtis Geo Solutions Inc. tested one (1) sample in accordance with ASTM C-131 Standard Test Method for resistance to degradation of small-size coarse aggregate by abrasion and impact in the Los Angeles machine. The sample was delivered to our office washed, graded (Gradation A) and dried. The sample was run through the test process and the results are tabulated below.

Sample ID	Mass Prior To Test (g)	Mass After Test (g)	Mass Loss Due to Test (g)	Percent Loss (%)
Summit Pit Ph. 2	5002.7	3385.2	1617.5	32.3

We trust that the above is sufficient for your requirements. Should you need further information, please call.

Yours very truly,

Curtis GEO Solutions Inc.

Michael Staple, B.Sc., P.Eng.
Geotechnical Engineer

MS/bd

Curtis GEO Solutions Inc.

Aug 23, 2017
File: 317-Misc.

Almor Testing Services Ltd.
7505 - 40 Street SE
Calgary, AB T2C 2H5

Email: aalemi@almor.com

Attn: Abdul Alemi

Re: **LA Abrasion Testing (ASTM C - 535)**

Curtis Geo Solutions Inc. tested one (1) sample in accordance with ASTM C-535 Standard Test Method for resistance to degradation of Large-size coarse aggregate by abrasion and impact in the Los Angeles machine. The sample was delivered to our office washed, graded (Gradation 1) and dried. The sample was run through the test process and the results are tabulated below.

Sample ID	Mass Prior To Test (g)	Mass After Test (g)	Mass Loss Due to Test (g)	Percent Loss (%)
Summit Pit Ph. 2	10030.1	7735.6	2294.5	22.9

We trust that the above is sufficient for your requirements. Should you need further information, please call.

Yours very truly,

Curtis GEO Solutions Inc.

Michael Staple, B.Sc., P.Eng.
Geotechnical Engineer

MS/bd

APPENDIX D

Gravel/Sand Volume Calculations

As requested, we submit our gravel/sand calculations based on the limited test holes advanced to the depth of bedrock, with a Diesel Hammer Rig.

Per your request, we have combined the data obtained during the 2014 Waterman Gravel Pit Investigation and the data from the Summit Phase 2 Investigation.

Waterman Pit

Test Hole No.	Depth (m)
1	20.4
2	22.8
3	20.6
4	21.9
5	16.8
Average	20.5

Summit Phase 2

Test Hole No.	Depth (m)
1	18.5
2	14.2
3	14.0
4	21.5
5	9.3
6	10.5
7	19.1
8	22.6
9	23.0
10	22.6
Average	17.5

Combined Average = 18.5m

1 acre = ±4046.89 m^2

160 acres = 160 x 4046.89 m^2 = ±647502.4 m^2

Based on the test hole logs (Waterman Pit and Summit Phase 2), total volume of aggregate:

Total volume = Average Depth x Area
= 18.5 m x 647502.4 m^3
= 11,978,794.4 m^3

APPENDIX E

7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Grain Size Distribution

ASTM D-422

Project	Summit Pit Ph 2	**Test Hole #**	TH3
Client	Mountain Ash Limited Partnership	**Depth**	0.2m
Almor Job #	099-86-17	**Technician**	KC
Date Recieved	Aug 1/17		
Date Tested	Aug 4/17		

Sieve Size (mm)	% Passing
150	
100	
80	
50	
40	
25	
20	
10	100.0
5	99.8
2	99.6
0.425	98.7
0.080	88.0
0.005	31.2
0.002	20.7

Soil Classification

Gravel	0.2%
Sand	11.8%
Silt	67.3%
Clay	20.7%

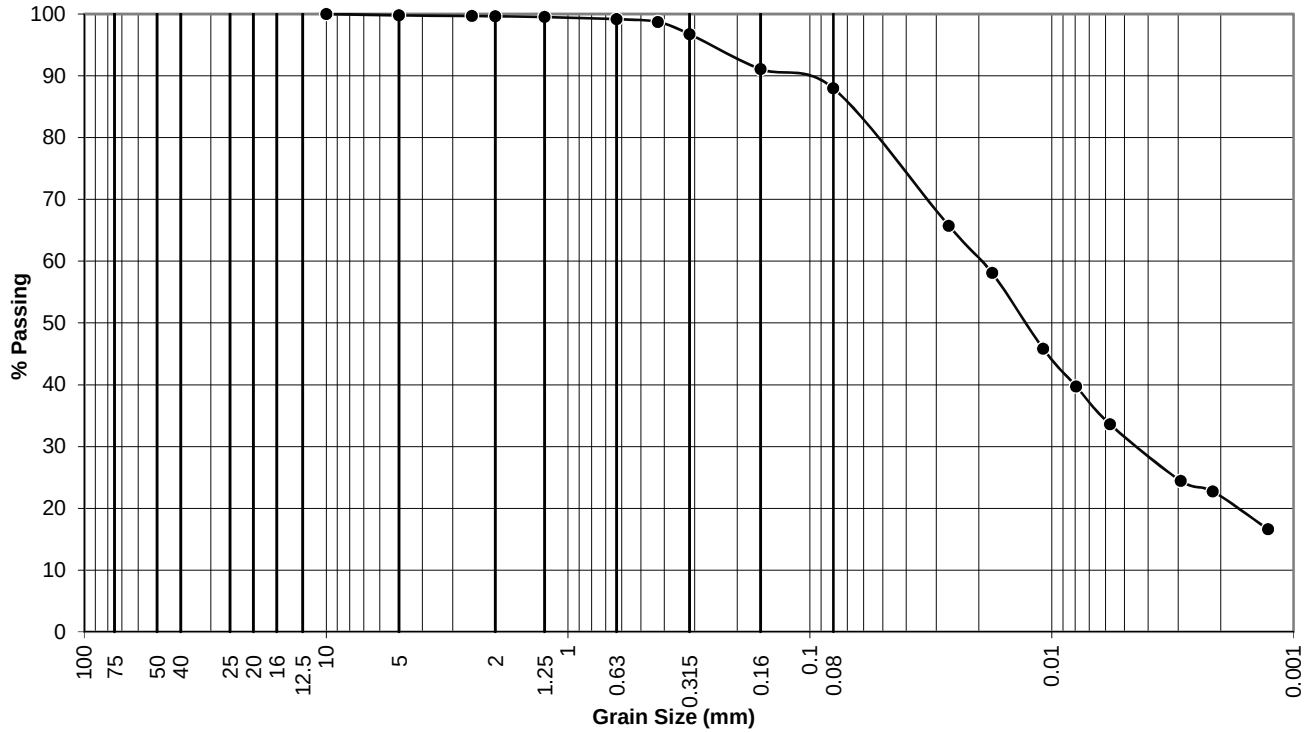
Soil Description Clayey SILT, some Sand, trace Gravel

Soil Properties

Natural Moisture Content	18.7	%
Liquid Limit		%
Plastic Limit		%
Plasticity Index		%
Specific Gravity	2.65	
Organic Content	12.6	%

Comments Topsoil - Grain Size Distribution

Gravel		Sand			Silt	Clay
Coarse	Fine	Coarse	Medium	Fine		



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Calgary, Alberta T2C 2H5
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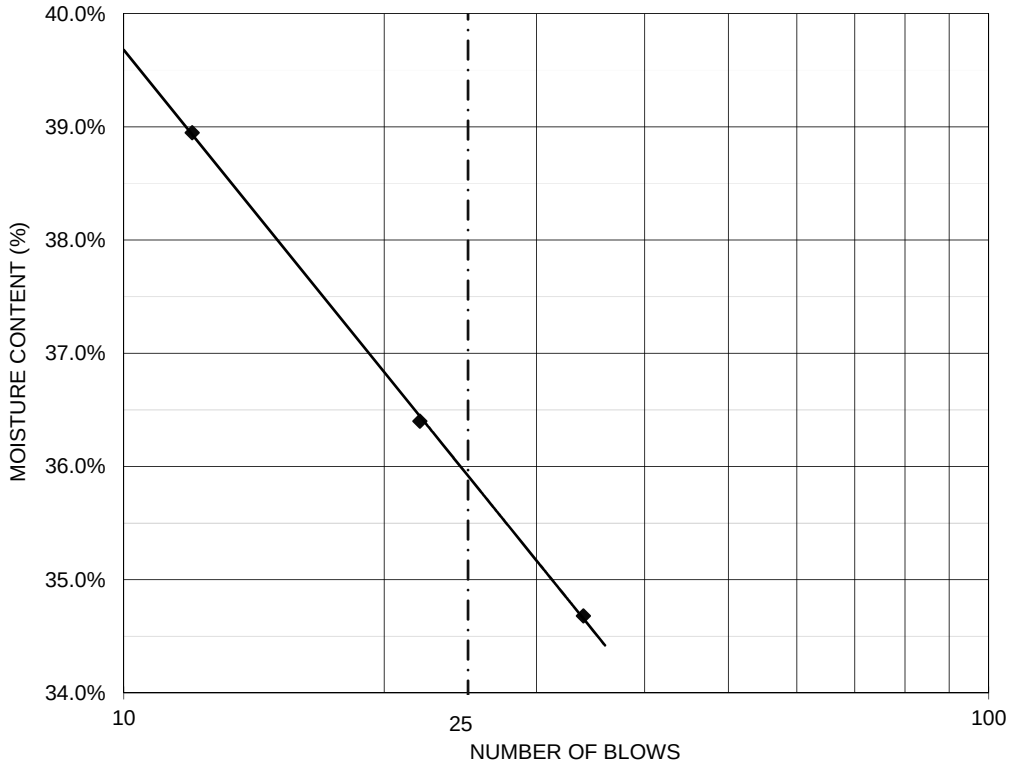
Atterberg Limits Determination

ASTM D4318

CLIENT	Mountain Ash Limited Partnership			DATE	Sept 28/17
PROJECT	Summit Pit Ph 2			JOB #	099-86-17
TESTHOLE	TH1	DEPTH	4.5m	TECH.	JKC
SAMPLE ID				DATE REC'D.	Aug 1/17
SOIL DESCRIPTION					

LIQUID LIMIT					Wn	PLASTIC LIMIT	
Trial No.	1	2	3			1	2
Number of Blows	34	22	12				
Tare Number	AT-41	AT-42	AT-43		MF-96	AT-44	AT-45
Wet + Tare (g)	34.340	41.740	47.312		210.0	37.664	36.373
Dry + Tare (g)	29.370	34.661	38.440		199.8	35.178	34.125
Tare Weight (g)	15.039	15.213	15.661		3.8	15.278	15.669
Weight Dry Soil (g)	14.331	19.448	22.779		196.0	19.900	18.456
Weight Water (g)	4.970	7.079	8.872		10.2	2.486	2.248
Moisture Content (%)	34.7%	36.4%	38.9%		5.2%	12.5%	12.2%

Natural Moisture Content (%) =	5.2
Liquid Limit (L_L) =	36
Plastic Limit (P_L) =	12
Plasticity Index (I_P) =	24
USC Soil Classification =	**CI**



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Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Grain Size Distribution

ASTM D-422

Project	Summit Pit Ph 2	**Test Hole #**	TH1
Client	Mountain Ash Limited Partnership	**Depth**	3.0m
Almor Job #	099-86-17	**Technician**	KC
Date Recieved	Aug 1/17		
Date Tested	Aug 4/17		

Sieve Size (mm)	% Passing
150	
100	
80	
50	
40	100.0
25	90.8
20	88.3
10	83.8
5	79.2
2	74.7
0.425	66.8
0.080	56.9
0.005	34.1
0.002	25.7

Soil Classification

Gravel	20.8%
Sand	22.3%
Silt	31.2%
Clay	25.7%

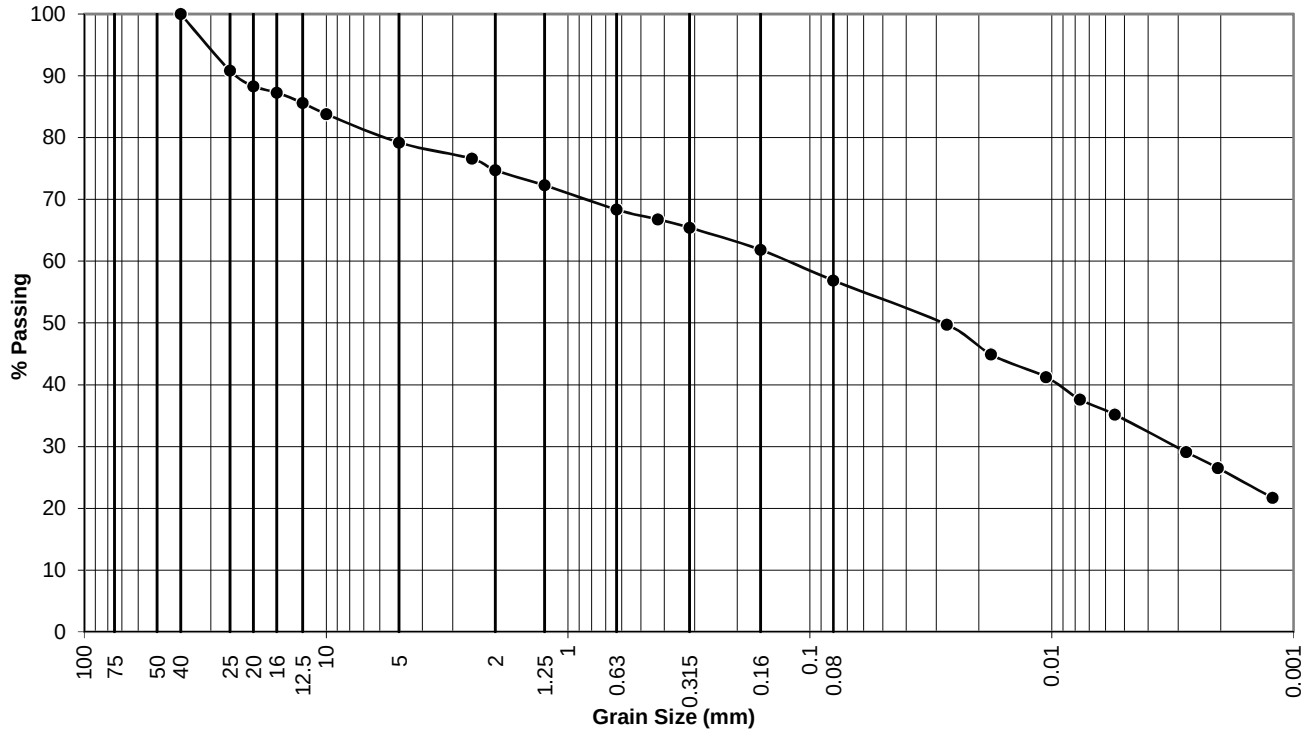
Soil Description Sandy Clayey SILT, some gravel

Soil Properties

Natural Moisture Content	7.7	%
Liquid Limit		%
Plastic Limit		%
Plasticity Index		%
Specific Gravity	2.65	

Comments Silty Clay Till (Overburden) - Grain Size Distribution

Gravel		Sand			Silt	Clay
Coarse	Fine	Coarse	Medium	Fine		



ALMOR TESTING SERVICES LTD.

7505 - 40 STREET S.E., CALGARY, AB T2C 2H5 PHONE (403) 236-8880 • FAX (403) 236-1707

2017 12 28 099-144-17

Mountain Ash Limited Partnership

Attention: Mr. Tige Brady, C.E.T. *(tige.brady@telus.net)*

Re: Gravel Pit Investigation
John Nugter Property
Highway 567 and Range Road 40
Rocky View County, Alberta

Almor Testing Services Ltd. observed and obtained gravel samples, during the advancement of six (6) test holes, at the subject site from August 8 to August 12, 2017. Test holes designated as JN01 through JN06 were advanced mostly to the north and northeast of the SW 1/4, Section 31, Township Road 26, Range Road 3, W5M. The test holes were advanced using a Becker Hammer drill rig, operated by Great West Drilling of Calgary, Alberta. Refer to Figure 1 in Appendix 'A' for the approximate test hole locations.

Test hole depths ranged from a minimum of 7.6m (JN06) to a maximum of 28.6m (JN04). The thickness of the granular deposit in the test holes ranged from a minimum 7.1m (JN03) to a maximum 24.2m (JN04). The mean average thickness of the granular deposit encountered is 20.2m and groundwater seepage was not encountered in the test holes. This value does not include the data from Test Hole JN06, as no gravel was encountered in this test hole.

Samples were obtained for gradation analysis, representative of the granular deposit encountered below the silty clay overburden. Four (4) Gradation Analyses were performed on samples from Test Hole No.'s JN01 through JN04. The Test Hole logs and the results of the Gradation Analyses are attached in Appendix 'B'. The Gradation Analyses of the samples indicated fines contents (material passing the 80 µm sieve size) in the range of 9.8% to 16.4%.

The fines content of the gravel samples obtained using a Becker Hammer drill rig is typically higher, due to the crushing or fracture of the rocks during pounding of the hammer casing into the gravels. A fines content to a maximum of 10% is generally considered desirable for gravels used for structural purposes (roads construction, foundation base, etc.). Aggregates for use in the manufacture of concrete and asphalt products typically have more stringent fines content requirements. In order to estimate the insitu fine content of gravel at the site, two (2) test pits were advanced in close proximity of Test Hole No.'s 2 and 3 and gravel samples were obtained. The Test Pit logs and the results of the Gradation Analyses of the test pit samples are attached in Appendix 'C'. Table 1 compares the fine content of gravel samples obtained using the Becker Hammer drill rig and from the test pits.

.../2

TABLE 1
Fine Content Comparison of Gravel Samples
Becker Hammer Drilling vs Test Pits

TP/TH No.	Depth (m)	Fines Content (%)
TP01	4.5 - 5.25	5.8
JN02	5.5	16.2
TP02	4.5 - 5.25	7.9
JN03	4.9 - 5.5	9.8

Table 1 indicates the fines content of the samples obtained using Becker Hammer drill rig is almost 1.3 to 3 times higher than those obtained from test pits. It is anticipated that the granular material recovered, during a commercial mining operation would yield lower fines contents than what is indicated by the samples recovered, during this investigation using a hammer rig.

Overall, the aggregates and gradation of the gravels at the test hole locations are suitable for producing aggregates required in the construction industry, with some sorting and blending sand seams.

The volume of the gravel has been estimated based on the limited bore holes advanced and is presented in Appendix 'D'.

The overburden in the subject areas consisted of topsoil/browns overlying silty clay till.

The topsoil/browns were encountered in all test hole locations and ranged from 100 to 300mm in thickness.

Below topsoil/browns, silty clay till was encountered in all test hole locations. The thickness of silty clay overburden ranged from 3500mm (JN05) to 7500mm (JN06). The thickness of the overburden at the test hole JN06 location may be more, as drilling was terminated at a depth of 7.5m. The overburden soil was described as silty clay till of low to medium plasticity.

The silty clay and topsoil overburden can be utilized for grading, during the pit rehabilitation stages of the gravel pit.

We trust this meets with your present requirements.

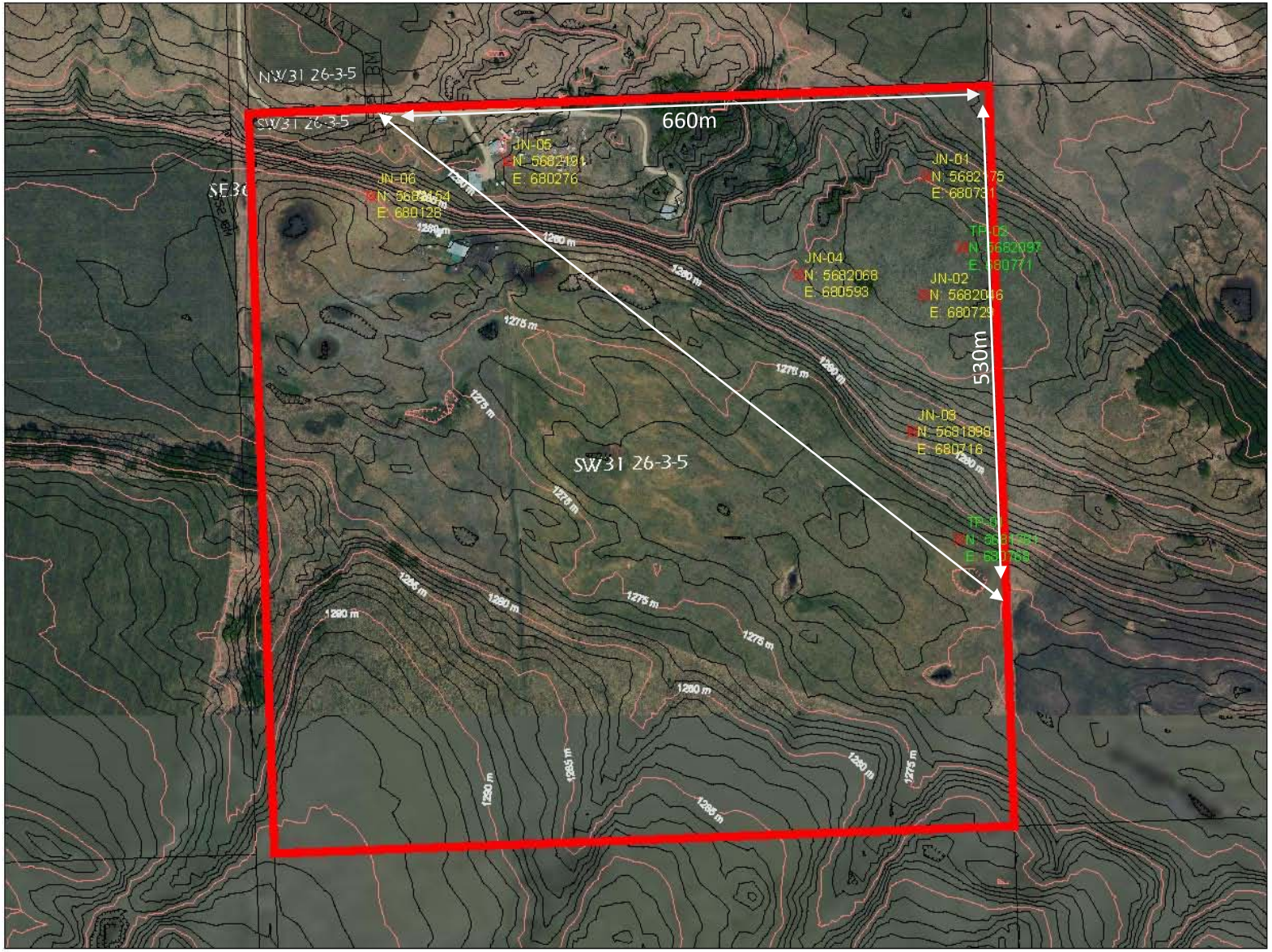
Respectfully submitted,
ALMOR TESTING SERVICES LTD.

* APEGA Permit to Practice #P2260

J.B. Montgomery, P.Eng.
AA:ms:A06268

Attachments

APPENDIX A



PLAN SHOWING
TESTHOLE LOCATION
SUMMIT PIT
SW ¼ SECTION 31 TWP 26 RGE 3 W5M
UTM, NAD83 Z11
ROCKY VIEW COUNTY

LEGEND

PROPERTY LINES
LIMIT OF DISTURBANCE
MAJOR INTERVAL
MINOR INTERVAL
1m TO 5m CONTOUR INTERVAL
TESTHOLE AND TEST PIT

TACT GROUP INC.

SITE 9 BOX 39 RR 1
Cochrane, Alberta T4C 1A1

LEGAL LAND DESCRIPTION
SW 1/4 SECTION 31 TWP 26 RGE 3 W5 M

DATE: November 17, 2017	DRAWN BY: T BRADY
SCALE: 1:4,000	DRAWING: Figure 3
DATE REVISED: ----------	REVISED BY: ----------

FILE: 2017 Projects\2017 Summit Pit.dwg

AIR PHOTO TAKEN: JULY 04, 2012

DATE PRINTED: November 17, 2017

Figure 1

APPENDIX B

PROJECT: GRAVEL PIT ASSESSMENT
JOHN NUGTER PROPERTY

CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP

PROJECT NO.

HOLE NO. JN01

DRILL TYPE DIESEL HAMMER RIG

GEODETIC ELEVATION (m) | DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)
0	**TOPSOIL**	0
1	**Silty CLAY (TILL)** stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist	2
2		4
3		6
4		8
4	**Gravelly SAND** compact, trace to some silt, fine grained, poorly graded, olive, damp	14
5		16
6		18
6		20
7	**Silty GRAVEL** compact to dense, some sand to sandy, fine to coarse grained, poorly graded, brown, damp	22
8		24
9		26
10		28
11		30
12		32
13		34
14		36
15		38
16		40
17		42
18		44
19		46
20		48
21		50
22		52
23		54
24		56
25		58
26		60
27		62
28		64
29		66
30	- occasional medium to high plastic clay lens below 20.0 m	68
31		70
32		72
		74
		76
		78
		80
		82
		84
		86
	SILTSTONE (BEDROCK)	88
	END OF TEST HOLE AT 26.6m	90
	- no standpipe installed	92
	- test hole dry at completion	94
	- test hole backfilled with soil cuttings	96
		98
		100
		102
		104
		106

SAMPLE TYPE

MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT — LIQUID LIMIT
20 40 60

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

Gravel 57.1 %
Sand 26.5 %
Silt & Clay 16.4 %

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■
20 40 60
□ SPT ◪ Case
■ Cone ◹ BT Pen

GROUNDWATER
Date Measured

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

COMPLETION DEPTH	27 m	DATE DRILLED	August 8, 2017	LOGGED BY	Kevin Carter	PLATE NO.	11

PROJECT: GRAVEL PIT ASSESSMENT
JOHN NUGTER PROPERTY

CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP

PROJECT NO.

HOLE NO. JN02

DRILL TYPE DIESEL HAMMER RIG

GEODETIC ELEVATION (m) | DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)
0	**TOPSOIL**	0
1	**Silty CLAY (TILL)** stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist	2
2		4
3		6
4		8
5	**Sandy GRAVEL** compact to dense, trace to some silt, fine to coarse grained, poorly graded, olive, damp	10
6		12
7		14
8		16
9		18
10		20
11		22
12	**Gravelly SAND** compact, trace to some silt, fine grained, poorly graded, olive, damp	24
13		26
14		28
15		30
16		32
17		34
18		36
19		38
20		40
21	- some gravel below 15.0 m	42
22		44
23		46
24		48
25		50
26		52
27		54
28	**Silty GRAVEL** compact to dense, some sand to sandy, fine to coarse grained, poorly graded, brown, damp	56
29		58
30		60
31		62
32		64
		66
		68
	- occasional medium to high plastic clay lens below 20.5 m	70
		72
		74
		76
		78
		80
		82
		84
		86
		88
		90
	SILTSTONE (BEDROCK)	92
	END OF TEST HOLE AT 27.8m	94
	- no standpipe installed	96
	- test hole dry at completion	98
	- test hole backfilled with soil cuttings	100
		102
		104
		106

SAMPLE TYPE

MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT — LIQUID LIMIT
20 40 60

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

Gravel 47.4 %
Sand 36.4 %
Silt & Clay 16.2 %

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

20 40 60
PENETRATION RESISTANCE ■
□ SPT ◪ Case
■ Cone ◹ BT Pen

GROUNDWATER
Date Measured

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

COMPLETION DEPTH	28.5 m	DATE DRILLED	August 8, 2017	LOGGED BY	Kevin Carter	PLATE NO.	12

PROJECT: GRAVEL PIT ASSESSMENT
JOHN NUGTER PROPERTY

CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP

PROJECT NO.

HOLE NO. JN03

DRILL TYPE DIESEL HAMMER RIG

GEODETIC ELEVATION (m) | DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)
0	**TOPSOIL**	0
0	**Silty CLAY (TILL)** stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist	2
1		4
2		6
3		8
4		10
4		12
4		14
5	**Silty GRAVEL** compact to dense, some sand to sandy, fine to coarse grained, poorly graded, brown, damp	16
6	- occasional medium to high plastic clay lens below 6.0 m	18
6		20
7		22
8		24
8		26
9		28
10		30
10		32
11		34
11		36
12	**MUDSTONE (BEDROCK)**	38
12		40
13	**END OF TEST HOLE AT 12.8m** - no standpipe installed - test hole dry at completion - test hole backfilled with soil cuttings	42
13		44
14		46
14		48

SAMPLE TYPE

MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT 20 40 60 LIQUID LIMIT

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

Gravel 58.6 %
Sand 31.6 %
Silt & Clay 9.8 %

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■
20 40 60
□ SPT ◪ Case
■ Cone ◹ BT Pen

GROUNDWATER
Date Measured

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

COMPLETION DEPTH 12.8 m

DATE DRILLED August 10, 2017

LOGGED BY Kevin Carter

PLATE NO. 13

PROJECT: GRAVEL PIT ASSESSMENT
JOHN NUGTER PROPERTY

CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP

PROJECT NO.

HOLE NO. JN04

DRILL TYPE DIESEL HAMMER RIG

GEODETIC ELEVATION (m) | DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)
0	**TOPSOIL**	0
1–3	**Silty CLAY (TILL)** stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist	2–12
4–27	**Sandy GRAVEL** compact to dense, trace to some silt, fine to coarse grained, poorly graded, brown, damp - occasional medium to high plastic clay lens below 24.0 m - becoming silty	14–92
28	**MUDSTONE (BEDROCK)**	94
29	**END OF TEST HOLE AT 28.6m** - no standpipe installed - test hole dry at completion - test hole backfilled with soil cuttings	96–106

SAMPLE TYPE | MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT | LIQUID LIMIT
20 40 60

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

Gravel 56.6 %
Sand 33.2 %
Silt & Clay 10.2 %

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■
20 40 60
□ SPT ◪ Case
■ Cone ◹ BT Pen

GROUNDWATER
Date Measured

COMPLETION DEPTH 28.8 m | DATE DRILLED August 11, 2017 | LOGGED BY Kevin Carter | PLATE NO. 14

PROJECT: GRAVEL PIT ASSESSMENT
JOHN NUGTER PROPERTY

CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP

PROJECT NO.

HOLE NO. JN05

DRILL TYPE DIESEL HAMMER RIG

GEODETIC ELEVATION (m) | DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)
0	**TOPSOIL**	0
1	**Silty CLAY (TILL)** stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist	2
2		4
3		6
4	**Sandy GRAVEL** compact to dense, trace to some silt, fine to coarse grained, poorly graded, brown, damp	8
5		10
6		12
7	- occasional fine to coarse grained sand lens below 6.8 m	14
8	**Gravelly SAND** compact, trace to some silt, fine grained, poorly graded, olive, damp	16
9	- trace to some gravel below 8.5 m	18
10	- some gravel below 9.8 m	20
11	**Sandy GRAVEL** compact to dense, trace to some silt, fine to coarse grained, poorly graded, brown, damp	22
12		24
13		26
14		28
15		30
16		32
17		34
18		36
19		38
20		40
21		42
22		44
23		46
24		48
25		50
26	- occasional medium to high plastic clay lens below 26.0 m	52
27		54
28	**SILTSTONE (BEDROCK)**	56
29	**END OF TEST HOLE AT 28.0m**	58
30	- no standpipe installed	60
31	- test hole dry at completion	62
32	- test hole backfilled with soil cuttings	64
		66
		68
		70
		72
		74
		76
		78
		80
		82
		84
		86
		88
		90
		92
		94
		96
		98
		100
		102
		104
		106

SAMPLE TYPE

MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT — LIQUID LIMIT
20 40 60

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■
20 40 60
□ SPT ◪ Case
■ Cone ◹ BT Pen

GROUNDWATER
Date Measured

COMPLETION DEPTH 28.2 m

DATE DRILLED August 11, 2017

LOGGED BY Kevin Carter

PLATE NO. 15

PROJECT: GRAVEL PIT ASSESSMENT
JOHN NUGTER PROPERTY

CLIENT: MOUNTAIN ASH LIMITED PARTNERSHIP

PROJECT NO.

HOLE NO. JN06

DRILL TYPE DIESEL HAMMER RIG

GEODETIC ELEVATION (m) | DATUM

DEPTH (m)	SOIL DESCRIPTION	DEPTH (ft)
	TOPSOIL	
1	**Silty CLAY (TILL)** stiff to very stiff, low to medium plastic, trace to some sand, trace gravel, olive, damp to moist	2
		4
2		6
		8
3		10
		12
4		14
		16
5		18
		20
6		22
		24
7	**END OF TEST HOLE AT 7.5m** - no standpipe installed - test hole dry at completion - test hole backfilled with soil cuttings	26
8		28
		30
9		32

SAMPLE TYPE

MOD UNIFIED SOIL CLASS

WATER CONTENT (%) ●
PLASTIC LIMIT — LIQUID LIMIT
20 40 60

COMPRESSIVE STRENGTH
Unconfined ▲
Pocket Pen △
TSF 2 3 4 5
KPa 200 300 400

OTHER TESTS

KN/m³ 16 18 20 22
PCF 100 120 140
WET UNIT WEIGHT ○

PENETRATION RESISTANCE ■
20 40 60
□ SPT ◪ Case
■ Cone ◹ BT Pen

GROUNDWATER
Date Measured

ALMOR TESTING SERVICES LTD.

TEST HOLE LOG

COMPLETION DEPTH 7.5 m | DATE DRILLED August 12, 2017 | LOGGED BY Kevin Carter | PLATE NO. 16

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Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project John Nugter Property, Gravel Investigation

Job No.	099-144-17		
Date Sampled	Aug 8/17	**By**	KC
Date Received	Aug 8/17	**By**	KC
Date Tested	Aug 16/17	**By**	BM

Aggregate Type Sandy GRAVEL, some silt/clay
Aggregate Source

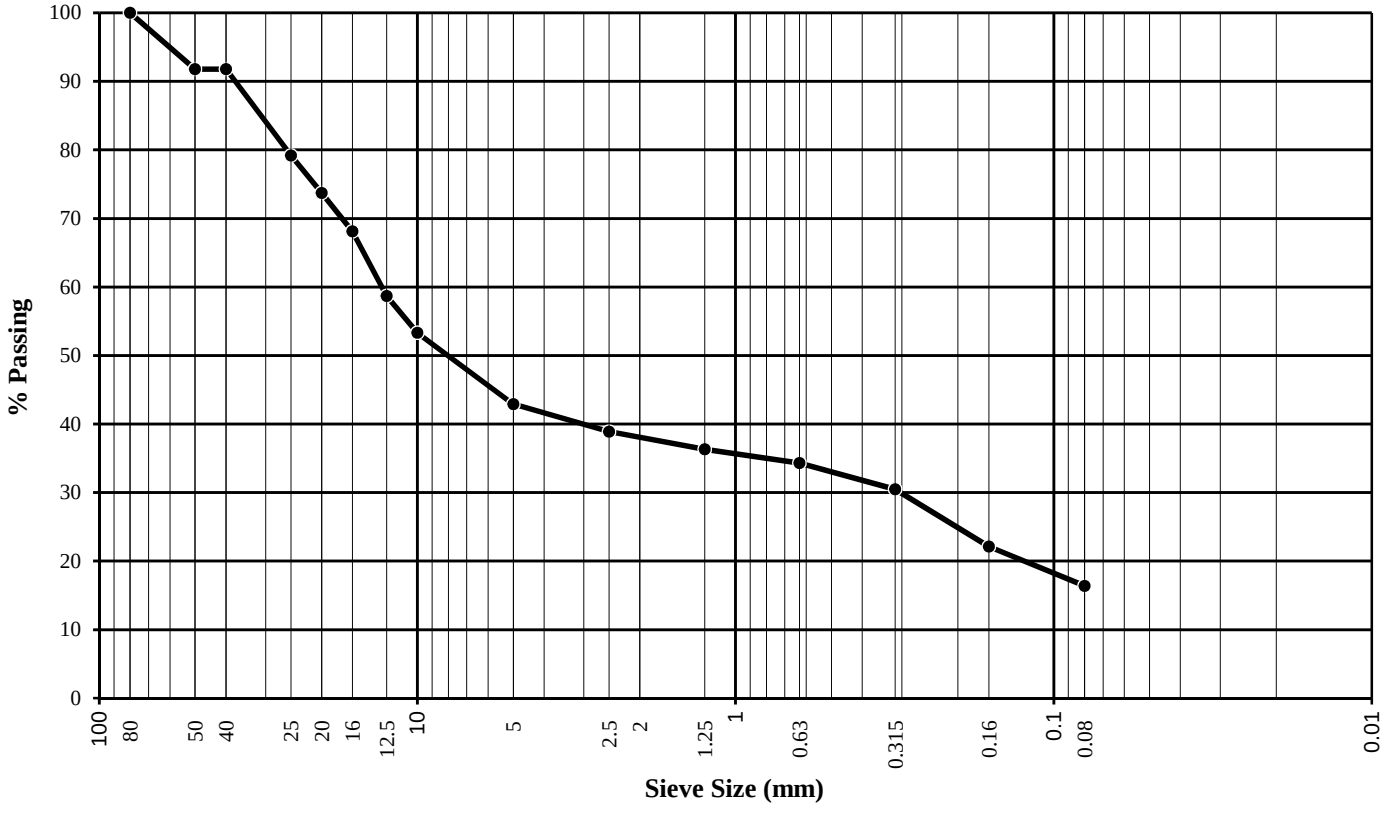
Classification GM or GC
C_C= 0.1
C_U= 162.3

Specification

Comments

Gavel	57.1 %
Sand	26.5 %
Silt/Clay	16.4 %
TH	JN01
Depth	20.5m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80	100.0		
50	91.8		
40	91.8		
25	79.2		
20	73.7		
16	68.1		
12.5	58.7		
10	53.3		
5	42.9		
2.5	38.9		
1.25	36.3		
0.63	34.3		
0.315	30.5		
0.16	22.1		
0.08	16.4		



7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project John Nugter Property, Gravel Investigation

Job No.	099-144-17		
Date Sampled	Aug 8/17	**By**	KC
Date Received	Aug 8/17	**By**	KC
Date Tested	Aug 16/17	**By**	BM

Aggregate Type Sandy GRAVEL, some silt/clay
Aggregate Source

Classification GM or GC
C_C= 0.1
C_U= 101.3

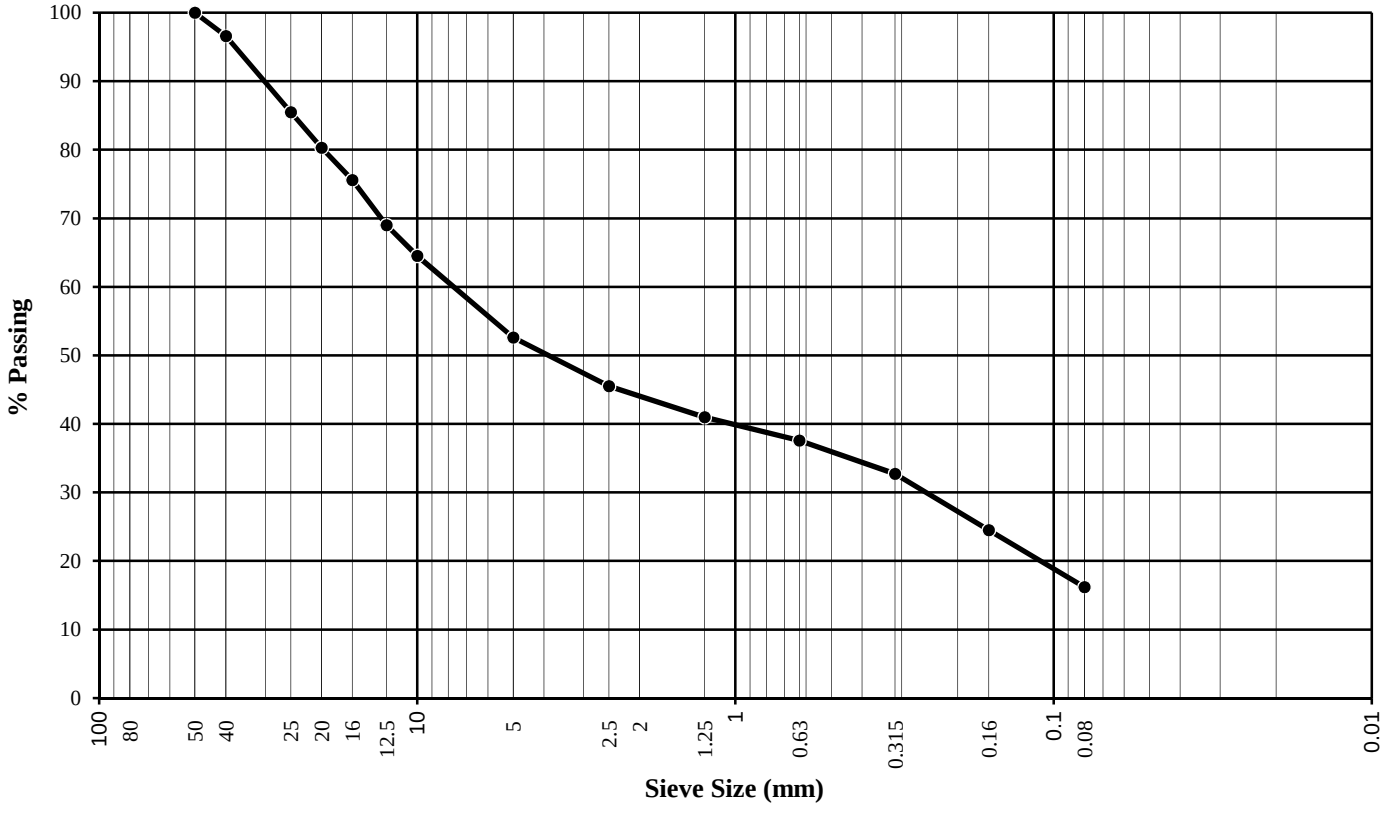
Specification

Comments

Gavel	47.4 %
Sand	36.4 %
Silt/Clay	16.2 %
TH	JN02
Depth	5.5m

Compare to TP Sample

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80			
50	100.0		
40	96.6		
25	85.5		
20	80.3		
16	75.6		
12.5	69.0		
10	64.5		
5	52.6		
2.5	45.5		
1.25	41.0		
0.63	37.6		
0.315	32.7		
0.16	24.5		
0.08	16.2		



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Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project John Nugter Property, Gravel Investigation

Job No. 099-144-17
Date Sampled Aug 10/17 **By** KC
Date Received Aug 10/17 **By** KC
Date Tested Aug 12/17 **By** BM

Aggregate Type Sandy GRAVEL trace silt/clay
Aggregate Source

Classification GW-GM
C_C= 2.3
C_U= 144.6

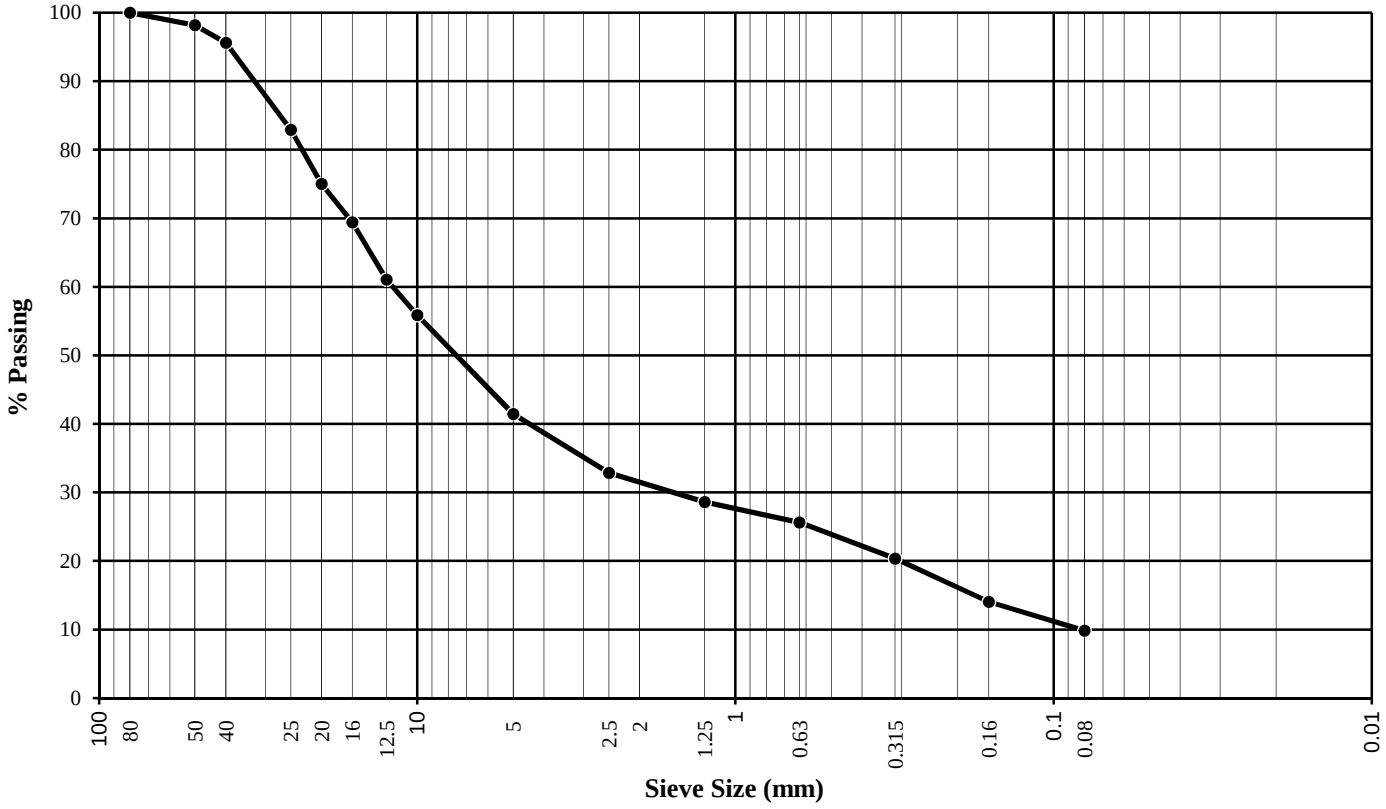
Specification

Comments
Gavel 58.6 %
Sand 31.6 %
Silt/Clay 9.8 %

TH JN03
Depth 4.9 to 5.5m

Compare to TP Sample

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80	100.0		
50	98.2		
40	95.6		
25	82.9		
20	75.0		
16	69.4		
12.5	61.1		
10	55.9		
5	41.4		
2.5	32.8		
1.25	28.6		
0.63	25.6		
0.315	20.4		
0.16	14.0		
0.08	9.8		



7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project John Nugter Property, Gravel Investigation

Job No.	099-144-17		
Date Sampled	Aug 11/17	**By**	KC
Date Received	Aug 11/17	**By**	KC
Date Tested	Aug 12/17	**By**	BM

Aggregate Type Sandy GRAVEL some silt/clay
Aggregate Source

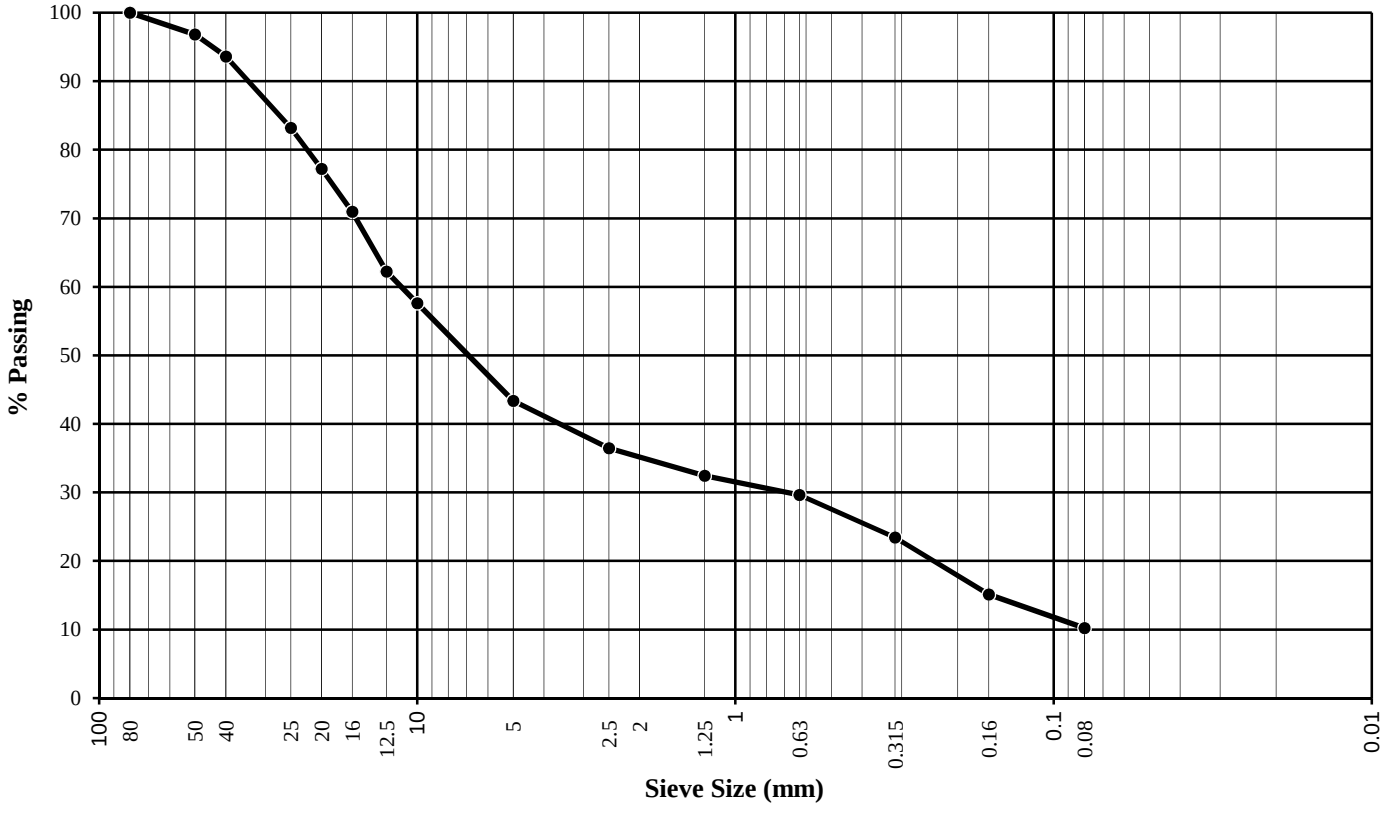
Classification GW-GM
C_C= 0.6
C_U= 141.1

Specification

Comments

Gavel	56.6 %
Sand	33.2 %
Silt/Clay	10.2 %
TH	JN04
Depth	18.0m

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100			
80	100.0		
50	96.8		
40	93.6		
25	83.2		
20	77.2		
16	71.0		
12.5	62.2		
10	57.6		
5	43.4		
2.5	36.5		
1.25	32.4		
0.63	29.6		
0.315	23.4		
0.16	15.1		
0.08	10.2		



APPENDIX C

7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project John Nugter Property, Gravel Investigation

Job No.	099-144-17		
Date Sampled	Aug 6/17	**By**	KC
Date Received	Aug 6/17	**By**	KC
Date Tested	Aug 12/17	**By**	BM

Aggregate Type Sandy GRAVEL trace silt/clay
Aggregate Source

Classification GP
C_C= 10.9
C_U= 185.5

Specification

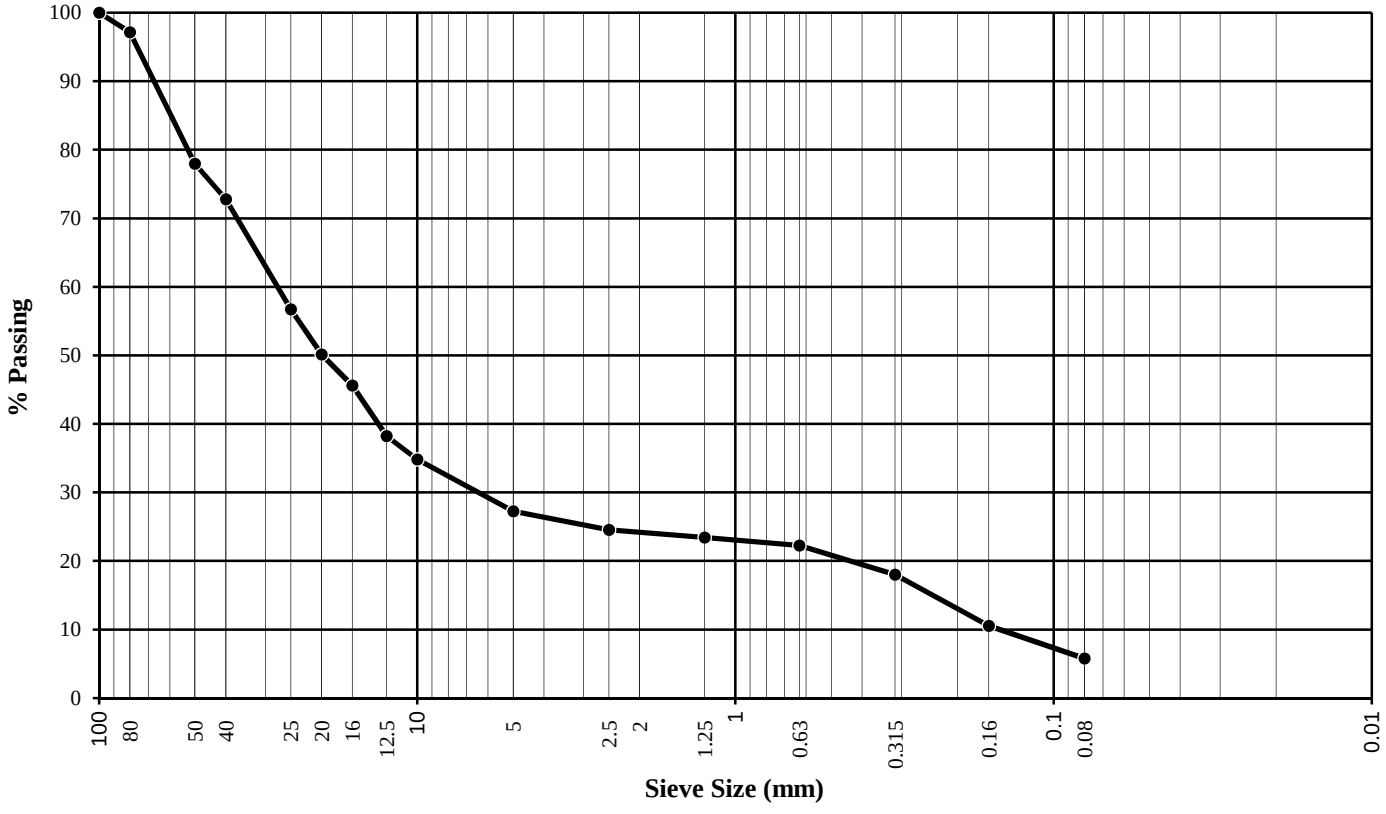
Comments

Gavel	72.7 %
Sand	21.5 %
Silt/Clay	5.8 %

TP adj to JN02
Depth 4.5 to 5.25m

Compare to TH JN02 Sample

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100	100.0		
80	97.2		
50	78.0		
40	72.8		
25	56.7		
20	50.1		
16	45.6		
12.5	38.2		
10	34.8		
5	27.3		
2.5	24.5		
1.25	23.4		
0.63	22.3		
0.315	18.0		
0.16	10.5		
0.08	5.8		



7505 - 40 Street SE
Calgary, Alberta T2C 2H5
Telephone: (403) 236-8880

Aggregate Analysis Report

ASTM C-136

Client Mountain Ash Limited Partnership

Attention Tige Brady

Project John Nugter Property, Gravel Investigation

Job No.	099-144-17		
Date Sampled	Aug 6/17	**By**	KC
Date Received	Aug 6/17	**By**	KC
Date Tested	Aug 12/17	**By**	BM

Aggregate Type Sandy GRAVEL trace silt/clay
Aggregate Source

Classification GP
C_C= 13.4
C_U= 203.9

Specification

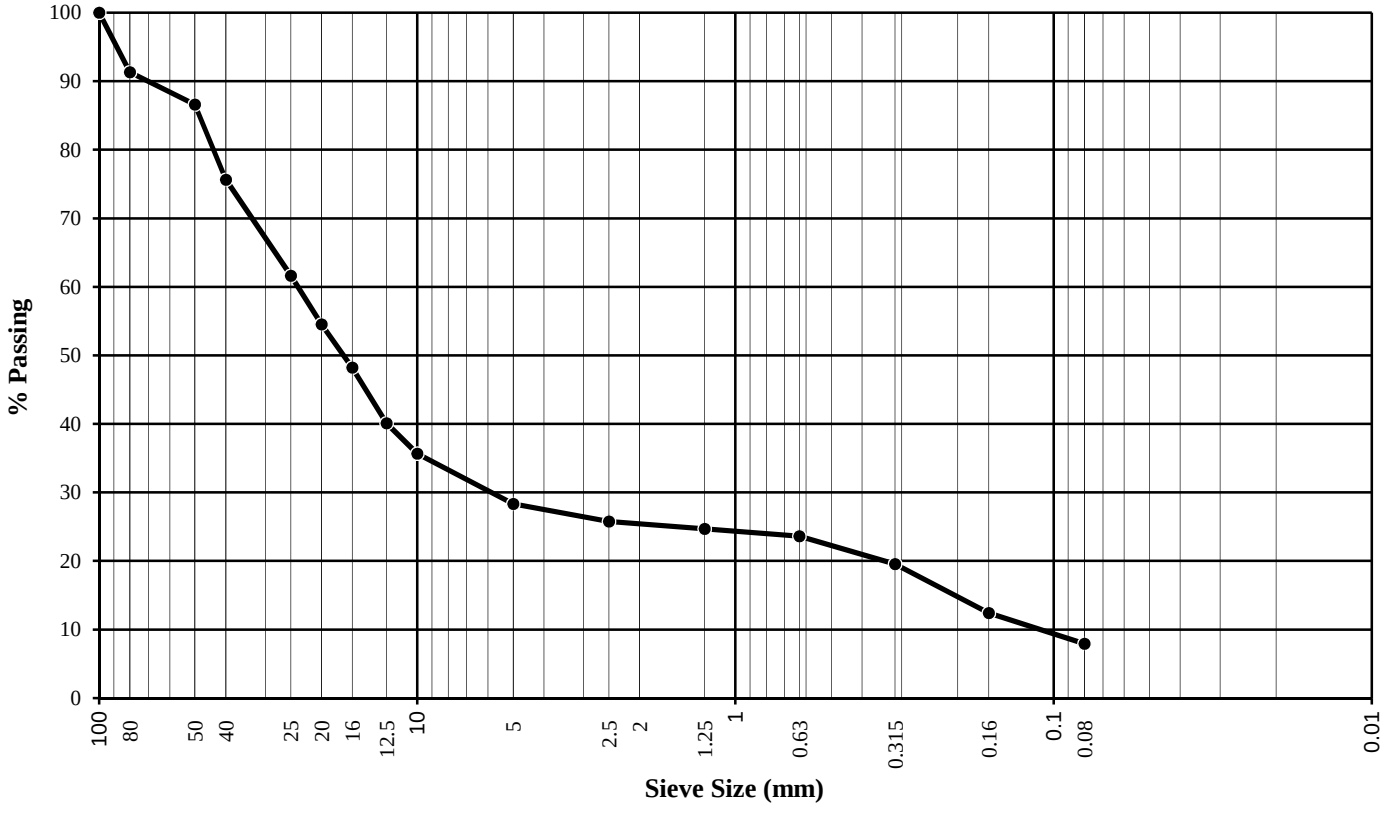
Comments

Gavel	71.6 %
Sand	20.4 %
Silt/Clay	7.9 %

TP adj to JN03
Depth 4.5 to 5.25m

Compare to TH JN03 Sample

Sieve Size (mm)	Percent Passing by Weight		
		Min.	Max.
200			
150			
100	100.0		
80	91.3		
50	86.6		
40	75.7		
25	61.6		
20	54.5		
16	48.2		
12.5	40.1		
10	35.7		
5	28.4		
2.5	25.8		
1.25	24.7		
0.63	23.6		
0.315	19.6		
0.16	12.4		
0.08	7.9		



APPENDIX D

Estimated Sand/Gravel Volumes

As requested, we submit our sand/gravel calculations for the above noted project, based on the limited test holes advanced to the depth of bedrock, with a Diesel Hammer Rig.

Please refer to the site plan indicating the triangular shaped area used for the sand/gravel volume calculations.

Based on the logs, the thickness of sand/gravel in the test holes are as follows:

JN01 - 22.1m
JN02 - 23.8m
JN03 - 7.1m
JN04 - 24.2m
JN05 - 24.0m

The average depth of sand/gravel is 20.2m

The area of triangle is :

Base of triangle = 660m
Height of triangle = 530m
Total area of triangle = ½ x Base x Height
= ½ x 800m x 490m
= 174,900 m^2

The estimated volume of aggregate is:

Average Depth x Area = Total Volume (m^3)
20.2m x 174,900 m^2 = 353,2980 m^3

SAND & GRAVEL EXPLORATION LOG

PROPERTY:
PLANT: CALGARY
COUNTY: ROCKY VIEW
PROVINCE: ALBERTA
LOCATION: MOUNTAIN ASH
LOGGED BY: D.B.

BORING ID: MA-18-06
COORD. SYS: WGS84 - UTM ZONE 11N
RIG: B.L. - Track Mounted
NORTHING: 5,682,650.0
EASTING: 680,079.0
ELEVATION: 1,294.0
TOTAL DEPTH: 27.4m

DRILL METHOD: SONIC
DATE STARTED: 06-26-18
DATE COMPLETED: 06-26-18
TYPE SAMPLE: 4.0" CORE
CASED TO: 27.4
EST. WL (m): 21.9m

Depth (m)	Lithology	Thickness (m)	MATERIAL DESCRIPTION	Gravel %	Oversize	Sample Run	Picture #	Depth (m)
0		0.3	topsoil					0
		0.9	silty till			1	1	
		1.8	clay till, stiff			2	2	
		3.0	sandy gravel, medium to fine sand thin clayey seam @ 5.6m	28.5	16.9	3	3	
5						4	4	5
		1.8	sandy gravel, medium to fine sand	31.6	22	5	5	
		0.3	clay seam, moist	25.5	18.4			
		0.9	silty gravel, fine sand, dry	31.9	12.5	6	6	
		1.2	gravel, clay, fine sand, moist	28.1	24.7	7	7	
10								10
		0.3	clay seam					
		2.1	gravel, fine to medium sand, silty, poorly graded consolidated thin silt seams.	30.6	19.1	8	8	

SAND & GRAVEL EXPLORATION LOG

PROPERTY:
PLANT: CALGARY
COUNTY: ROCKY VIEW
PROVINCE: ALBERTA
LOCATION: MOUNTAIN ASH
LOGGED BY: D.B.

BORING ID: MA-18-06
COORD. SYS: WGS84 - UTM ZONE 11N
RIG: B.L. - Track Mounted
NORTHING: 5,682,650.0
EASTING: 680,079.0
ELEVATION: 1,294.0
TOTAL DEPTH: 27.4m

DRILL METHOD: SONIC
DATE STARTED: 06-26-18
DATE COMPLETED: 06-26-18
TYPE SAMPLE: 4.0" CORE
CASED TO: 27.4
EST. WL (m): 21.9m

Depth (m)	Lithology	Thickness (m)	MATERIAL DESCRIPTION	Gravel %	Oversize	Sample Run	Picture #	Depth (m)
		1.8	gravel, fine to medium sand, silty, poorly graded consolidated thin silt seams. 	29.7	17.5	9	9	
						10	10	
15		0.6	gravel, clay, fine sand, moist	33.7	11.4			15
		0.9	lost core, wet, likely saturated			11	11	
		0.6	clay, gravel	21.7	11.7			
		1.5	gravel, silt, fine sand, cobbles, poorly graded dry	24.3	19.8	12	12	
		1.2	gravel, silt/clay, fine sand, wet	22.4	19.5	13	13	
20		1.8	gravel, silt, fine sand, cobbles, poorly graded dry	18.5	25.8	14	14	20
		3.7	clay with sand and gravel, wet	25.8	17.6	15	15	
						16	16	

SAND & GRAVEL EXPLORATION LOG

PROPERTY:
PLANT: CALGARY
COUNTY: ROCKY VIEW
PROVINCE: ALBERTA
LOCATION: MOUNTAIN ASH
LOGGED BY: D.B.

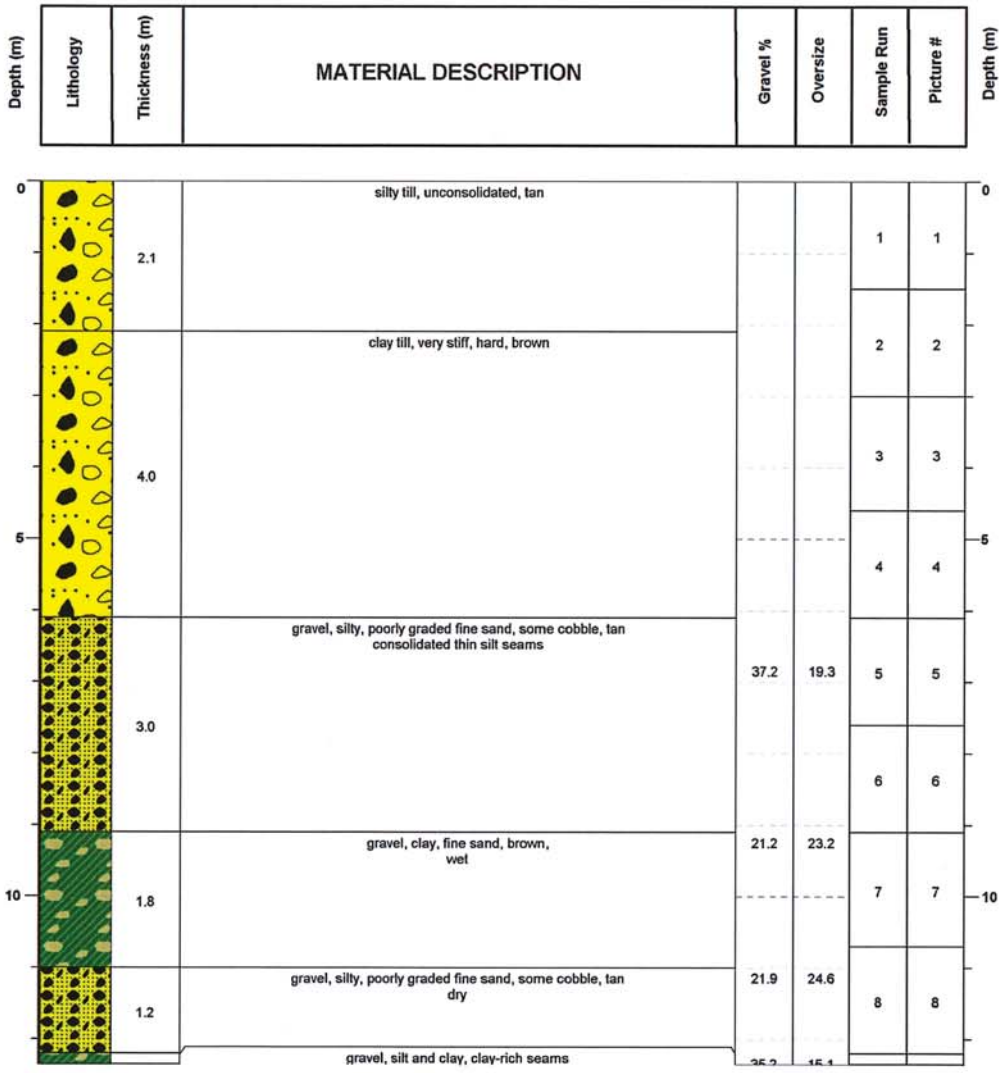
BORING ID: MA-18-06
COORD. SYS: WGS84 - UTM ZONE 11N
RIG: B.L. - Track Mounted
NORTHING: 5,682,650.0
EASTING: 680,079.0
ELEVATION: 1,294.0
TOTAL DEPTH: 27.4m

DRILL METHOD: SONIC
DATE STARTED: 06-26-18
DATE COMPLETED: 06-26-18
TYPE SAMPLE: 4.0" CORE
CASED TO: 27.4
EST. WL (m): 21.9m

Depth (m)	Lithology	Thickness (m)	MATERIAL DESCRIPTION	Gravel %	Oversize	Sample Run	Picture #	Depth (m)
25		2.4	siltstone			17	17	25
						18	18	

SAND & GRAVEL EXPLORATION LOG

PROPERTY:		BORING ID:	MA-18-07		
PLANT:	CALGARY	COORD. SYS:	WGS84 - UTM ZONE 11N	DRILL METHOD:	SONIC
COUNTY:	ROCKY VIEW	RIG:	B.L. - Track Mounted	DATE STARTED:	06-26-18
PROVINCE:	ALBERTA	NORTHING:	5,682,664.0	DATE COMPLETED:	06-26-18
LOCATION:	MOUNTAIN ASH	EASTING:	680,393.0	TYPE SAMPLE:	4.0" CORE
LOGGED BY:	D.B.	ELEVATION:	1,287.8	CASED TO:	19.8m
		TOTAL DEPTH:	19.8m	EST. WL (m):	15.2m



SAND & GRAVEL EXPLORATION LOG

PROPERTY:
PLANT: *CALGARY*
COUNTY: *ROCKY VIEW*
PROVINCE: *ALBERTA*
LOCATION: *MOUNTAIN ASH*
LOGGED BY: *D.B.*

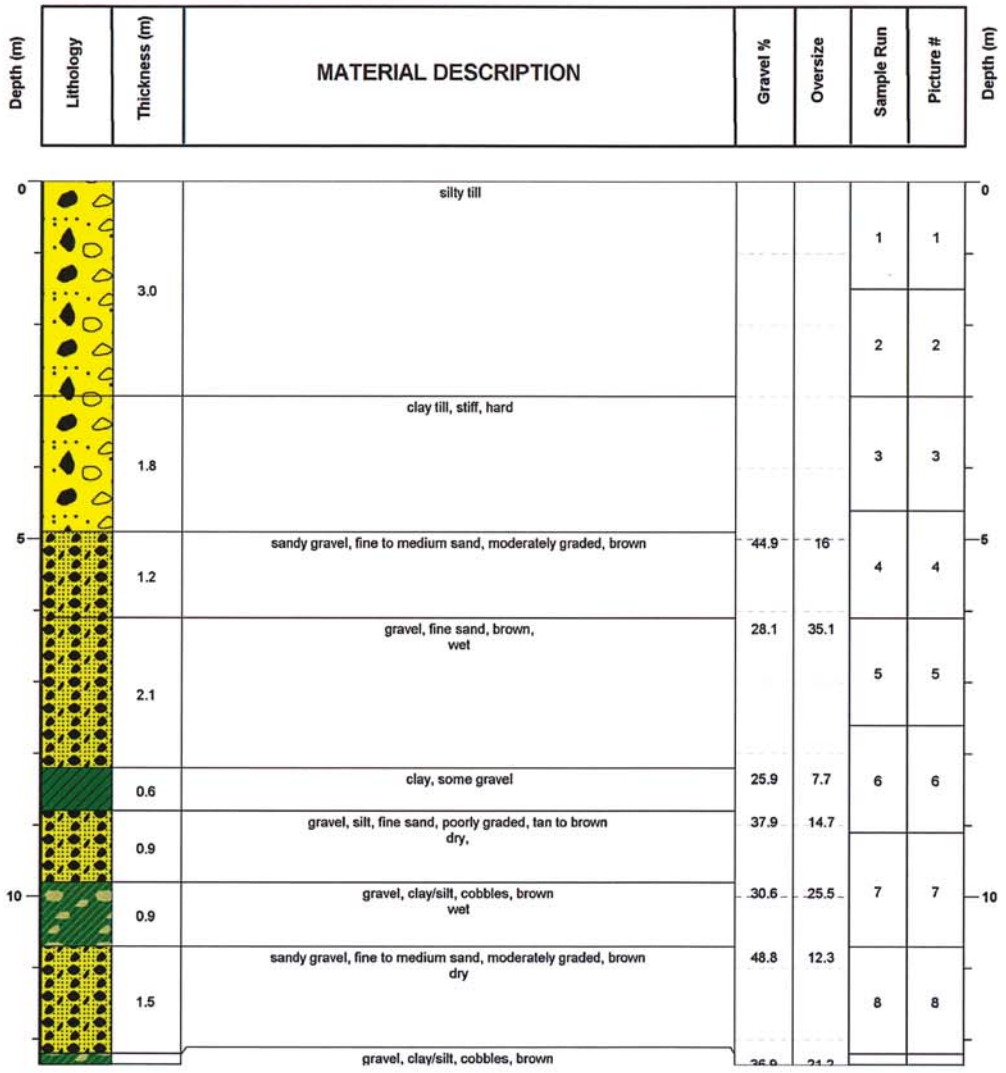
BORING ID: *MA-18-07*
COORD. SYS: *WGS84 - UTM ZONE 11N*
RIG: *B.L. - Track Mounted*
NORTHING: 5,682,664.0
EASTING: 680,393.0
ELEVATION: 1,287.8
TOTAL DEPTH: *19.8m*

DRILL METHOD: *SONIC*
DATE STARTED: *06-26-18*
DATE COMPLETED: *06-26-18*
TYPE SAMPLE: *4.0" CORE*
CASED TO: *19.8m*
EST. WL (m): *15.2m*

Depth (m)	Lithology	Thickness (m)	MATERIAL DESCRIPTION	Gravel %	Oversize	Sample Run	Picture #	Depth (m)
		1.5	gravel, silt and clay, clay-rich seams wet			9	9	
		1.5	gravel, silty, poorly graded fine sand, some cobble - increasing with depth, tan dry, getting wet near the bottom of run	30.3	24.1	10	10	
15								15
		3.0	gravel, silt and clay, fine sand, medium sand seam (>150mm) @ 16.5m wet	11.7	47.3	11	11	
						12	12	
		0.6	siltstone					
		0.6	sand and gravel, wet			13	13	
		0.3	siltstone / claystone					

SAND & GRAVEL EXPLORATION LOG

PROPERTY:		BORING ID:	MA-18-08		
PLANT:	CALGARY	COORD. SYS:	WGS84 - UTM ZONE 11N	DRILL METHOD:	SONIC
COUNTY:	ROCKY VIEW	RIG:	B.L. - Track Mounted	DATE STARTED:	06-28-18
PROVINCE:	ALBERTA	NORTHING:	5,682,628.0	DATE COMPLETED:	06-28-18
LOCATION:	MOUNTAIN ASH	EASTING:	680,724.0	TYPE SAMPLE:	4.0" CORE
LOGGED BY:	D.B.	ELEVATION:	1,292.1	CASED TO:	27.4m
		TOTAL DEPTH:	27.4m	EST. WL (m):	21.3m



Depth (m)	Thickness (m)	MATERIAL DESCRIPTION	Gravel %	Oversize	Sample Run	Picture #	Depth (m)
0	3.0	silty till			1	1	0
					2	2	
	1.8	clay till, stiff, hard			3	3	
5	1.2	sandy gravel, fine to medium sand, moderately graded, brown	44.9	16	4	4	5
	2.1	gravel, fine sand, brown, wet	28.1	35.1	5	5	
	0.6	clay, some gravel	25.9	7.7	6	6	
	0.9	gravel, silt, fine sand, poorly graded, tan to brown dry,	37.9	14.7			
10	0.9	gravel, clay/silt, cobbles, brown wet	30.6	25.5	7	7	10
	1.5	sandy gravel, fine to medium sand, moderately graded, brown dry	48.8	12.3	8	8	
		gravel, clay/silt, cobbles, brown					

SAND & GRAVEL EXPLORATION LOG

PROPERTY:
PLANT: CALGARY
COUNTY: ROCKY VIEW
PROVINCE: ALBERTA
LOCATION: MOUNTAIN ASH
LOGGED BY: D.B.

BORING ID: MA-18-08
COORD. SYS: WGS84 - UTM ZONE 11N
RIG: B.L. - Track Mounted
NORTHING: 5,682,628.0
EASTING: 680,724.0
ELEVATION: 1,292.1
TOTAL DEPTH: 27.4m

DRILL METHOD: SONIC
DATE STARTED: 06-28-18
DATE COMPLETED: 06-28-18
TYPE SAMPLE: 4.0" CORE
CASED TO: 27.4m
EST. WL (m): 21.3m

Depth (m)	Lithology	Thickness (m)	MATERIAL DESCRIPTION	Gravel %	Oversize	Sample Run	Picture #	Depth (m)
		1.2	gravel, clay/silt, cobbles, brown wet			9	9	
		1.8	gravel, silt, fine sand, consolidated, dry	31	15.5	10	10	
15		1.8	gravel, fine sand, clay, some cobble wet to saturated	27.7	24.6	11	11	15
		1.2	gravel, silt, fine sand, poorly graded dry	31.6	19.6	12	12	
		1.2	clayey sand and gravel, cobbles, wet	20.8	23.2	13	13	
20		1.8	gravel, silt, fine sand, some cobble, consolidated, damp	35	23.8	14	14	20
		3.4	gravel, silty, fine sand, saturated	26.4	39.9	15	15	
						16	16	

SAND & GRAVEL EXPLORATION LOG

PROPERTY:
PLANT: CALGARY
COUNTY: ROCKY VIEW
PROVINCE: ALBERTA
LOCATION: MOUNTAIN ASH
LOGGED BY: D.B.

BORING ID: MA-18-08
COORD. SYS: WGS84 - UTM ZONE 11N
RIG: B.L. - Track Mounted
NORTHING: 5,682,628.0
EASTING: 680,724.0
ELEVATION: 1,292.1
TOTAL DEPTH: 27.4m

DRILL METHOD: SONIC
DATE STARTED: 06-28-18
DATE COMPLETED: 06-28-18
TYPE SAMPLE: 4.0" CORE
CASED TO: 27.4m
EST. WL (m): 21.3m

Depth (m)	Lithology	Thickness (m)	MATERIAL DESCRIPTION	Gravel %	Oversize	Sample Run	Picture #	Depth (m)
25		2.7	claystone			17	17	25
						18	18	

SAND & GRAVEL EXPLORATION LOG

PROPERTY:
PLANT: CALGARY
COUNTY: ROCKY VIEW
PROVINCE: ALBERTA
LOCATION: MOUNTAIN ASH
LOGGED BY: D.B.

BORING ID: MA-18-11
COORD. SYS: WGS84 - UTM ZONE 11N
RIG: B.L. - Track Mounted
NORTHING: 5,682,281.0
EASTING: 680,070.0
ELEVATION: 1,294.0
TOTAL DEPTH: 27.4m

DRILL METHOD: SONIC
DATE STARTED: 06-25-18
DATE COMPLETED: 06-25-18
TYPE SAMPLE: 4.0" CORE
CASED TO: 27.4m
EST. WL (m): 24.4m

Depth (m)	Lithology	Thickness (m)	MATERIAL DESCRIPTION	Gravel %	Oversize	Sample Run	Picture #	Depth (m)
0		1.5	dry silt, becoming hard and consolidated			1	1	0
		2.4	clay till, hard, stiff			2	2	
						3	3	
5		2.1	sandy gravel, moderately to poorly graded sand / silt dry	34.1	23.2	4	4	5
		1.5	gravel, fine sand and silt, cobbles saturated from 6.7m to 7.6m, thin (<100mm) clay lense at bottom	28.2	24.9	5	5	
		2.4	sandy gravel, moderately graded, some coarse sand dry	27.6	14.2	6	6	
10		0.6	sand, fine to medium, with silt, trace gravel consolidated, dry	1	0	7	7	10
		0.9	gravel ,silt, clay seam at 11.6m saturated	42.6	20	8	8	
		0.6	sandy gravel, moderately graded, some coarse sand damp, use 25-33' as reference sample					
			clay, with sand and gravel. sticky	35.2	16.1			

SAND & GRAVEL EXPLORATION LOG

PROPERTY:
PLANT: CALGARY
COUNTY: ROCKY VIEW
PROVINCE: ALBERTA
LOCATION: MOUNTAIN ASH
LOGGED BY: D.B.

BORING ID: MA-18-11
COORD. SYS: WGS84 - UTM ZONE 11N
RIG: B.L. - Track Mounted
NORTHING: 5,682,281.0
EASTING: 680,070.0
ELEVATION: 1,294.0
TOTAL DEPTH: 27.4m

DRILL METHOD: SONIC
DATE STARTED: 06-25-18
DATE COMPLETED: 06-25-18
TYPE SAMPLE: 4.0" CORE
CASED TO: 27.4m
EST. WL (m): 24.4m

Depth (m)	Lithology	Thickness (m)	MATERIAL DESCRIPTION	Gravel %	Oversize	Sample Run	Picture #	Depth (m)
		1.5	clay, with sand and gravel. sticky			9	9	
		1.5	gravel, silty to sandy, damp at bottom	34.4	18	10	10	
15		1.8	gravel, higher clay content, damp	27.6	17.6	11	11	15
		3.0	gravel, sand, silt consolidated	23.3	24.4	12	12	
						13	13	
20		1.2	gravel, silt, sand, clay seams (<100mm thick)	25.2	17.6	14	14	20
		3.0	coarse gravel, some sand, silt, poorly graded consolidated, dry	20.3	22.3	15	15	
						16	16	
			gravel, clay, sand	28.6	26.5			

SAND & GRAVEL EXPLORATION LOG

PROPERTY:
PLANT: CALGARY
COUNTY: ROCKY VIEW
PROVINCE: ALBERTA
LOCATION: MOUNTAIN ASH
LOGGED BY: D.B.

BORING ID: MA-18-11
COORD. SYS: WGS84 - UTM ZONE 11N
RIG: B.L. - Track Mounted
NORTHING: 5,682,281.0
EASTING: 680,070.0
ELEVATION: 1,294.0
TOTAL DEPTH: 27.4m

DRILL METHOD: SONIC
DATE STARTED: 06-25-18
DATE COMPLETED: 06-25-18
TYPE SAMPLE: 4.0" CORE
CASED TO: 27.4m
EST. WL (m): 24.4m

Depth (m)	Lithology	Thickness (m)	MATERIAL DESCRIPTION	Gravel %	Oversize	Sample Run	Picture #	Depth (m)
25		1.2	wet			17	17	25
		1.8	siltstone			18	18	

APPENDIX B
SLR Consulting Ltd – Monitoring Well Construction Logs

Hydrogeological Assessment Report
Mountain Ash Limited Partnership Aggregate Operation
NW and SW Section 31, Twp 26, Rge 3 W5M
Rocky View County, Alberta
SLR Project No. 212.06650.00003

SLR CONSULTING (CANADA) LTD.

CLIENT: **Summit Aggregates Resource**
PROJECT: **Hydrogeological Assessment**
NW 31-026-3 W5M Alberta
PROJECT No. **203.50065.00001**

BOREHOLE LOG

BOREHOLE NO: MW14-101
SURFACE ELEVATION: 1293.53 m
UTM COORDINATES 5682869 N 680066.4 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DESCRIPTION	TEST DATA (■SPT Count ◆% Moisture)	WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
-1									stickup, above ground steel protector	1294
0					Ground Surface					
					TOPSOIL Clay, some silt, occasional gravel, rootlets, brown, moist, soft to firm 0.3					
1		WP1			**CLAY TILL** Sandy, gravelly (fine to coarse grained) clay, light brown, dry, very hard				backfilled with drill cuttings	1293
2										1292
3										1291
4										1290
5										1289
6		WP2			**SAND AND GRAVEL** 6.1 Fine to medium grained sand, fine to coarse grained gravel, well graded, light brown to orangey brown, dry, compact with occasional hard, calcified bands					1288
7										1287
8										1286
9									hydrated bentonite chips	1285
10										1284
11										1283
12										1282
										1281

DRILLING METHOD: Becker Hammer

DRILL DATE: 30 September 2014 LOGGED BY: RT

Notes: ■ GRAB SAMPLE

SLR CONSULTING (CANADA) LTD.

CLIENT: **Summit Aggregates Resource**
PROJECT: **Hydrogeological Assessment**
NW 31-026-3 W5M Alberta
PROJECT No. **203.50065.00001**

BOREHOLE LOG

BOREHOLE NO: MW14-101
SURFACE ELEVATION: 1293.53 m
UTM COORDINATES 5682869 N 680066.4 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DESCRIPTION	TEST DATA (■SPT Count ◆% Moisture)	WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
13										1280
14										1279
15		WP3			**GRAVEL** 14.63 Medium to coarse grained, sandy, light brown, moist, compact with occasional hard bands Below 15.2 m: Occasional cobbles				50 mm solid PVC pipe	1278
16								▼	GW = 16.40 mbg (2Oct2014)	1277
17					Below 16.8 m: Wet					1276
18										1275
19									50 mm 010 slot PVC pipe	1274
20		WP4			**SAND** 19.5 Medium to coarse grained, grey brown, wet, very loose					1273
21		WP5			**SANDSTONE** 21.03 Fine grained, brown, grey, wet, weak					1272
22		WP6			Below 21.6 m: Weathered, clayey, silty, soft				bentonite chips	
					End of borehole at 22.3 m 22.3 Well Completion Details: Screened interval from 16.5 m to 21.0 m below surface Elevation at top of pipe (TOP) = 1294.240 m Groundwater Information: Depth to groundwater from TOP = 17.11 m (2Oct2014)					

DRILLING METHOD: Becker Hammer

DRILL DATE: 30 September 2014 LOGGED BY: RT

Notes: ■ GRAB SAMPLE

SLR CONSULTING (CANADA) LTD.

CLIENT: **Summit Aggregates Resource**
PROJECT: **Hydrogeological Assessment**
NW 31-026-3 W5M Alberta
PROJECT No. **203.50065.00001**

BOREHOLE LOG

BOREHOLE NO: MW14-102
SURFACE ELEVATION: 1283.26 m
UTM COORDINATES 5682280 N 680791.6 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DESCRIPTION	TEST DATA (■SPT Count ◆% Moisture)	WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
-1									stickup, above ground steel protector	1284
0					Ground Surface					
					TOPSOIL Sandy, occasional gravel, dark brown, rootlets, moist 0.3				silica sand	1283
1					**CLAY TILL** Silty, sandy clay, some gravel, brown, moist, very hard					1282
2		WP7							hydrated bentonite chips	1281
3										1280
4		WP8			**SAND** 3.96 Medium to coarse grained, well graded, gravelly (fine to coarse, rounded), occasional cobble, brown, moist					1279
					GRAVEL AND SAND 4.57 Well graded, fine to coarse gravel and well graded, fine to coarse sand, occasional cobble, rounded, moist					
5		WP9								1278
6										1277
					SAND AND GRAVEL 6.4 Fine grained, trace medium, trace coarse sand. Fine to coarse, rounded gravel, red, moist				backfilled with drill cuttings	
7		WP10								1276
8					From 7.6 to 7.9 m: Rounded, medium to coarse gravel, sandy, dry					1275
9										1274
									hydrated bentonite chips	
10									50 mm solid PVC pipe	1273
11		WP11			**GRAVEL** 10.7 Poorly graded, medium, rounded, sandy, trace silt, trace clay coating on gravel, black and dark brown staining Below 11.3 m: Fine to coarse grained gravel, rounded, sandy, fine, dark brown, moist					1272
12		WP12								1271
									50 mm 010 slot PVC pipe	

DRILLING METHOD: Becker Hammer

DRILL DATE: 1 October 2014 LOGGED BY: MH

Notes: ■ GRAB SAMPLE

SLR CONSULTING (CANADA) LTD.

CLIENT: **Summit Aggregates Resource**
PROJECT: **Hydrogeological Assessment**
NW 31-026-3 W5M Alberta
PROJECT No. **203.50065.00001**

BOREHOLE LOG

BOREHOLE NO: MW14-102
SURFACE ELEVATION: 1283.26 m
UTM COORDINATES 5682280 N 680791.6 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DESCRIPTION	TEST DATA (■SPT Count ◆% Moisture)	WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
13					**GRAVEL AND SAND** 12.8 Fine to medium, trace coarse, rounded gravel. Fine, trace medium, trace coarse sand, occasional cobble, dry Below 13.7 m: Increasing cobble					1270
14										1269
15		WP13			**SANDSTONE** 14.93 Weak, fine grained, silty, dry From 15.5 to 15.8 m: Higher clay and silt				silica sand	1268
16		WP14 WP15			Becoming more competent below 15.8 m				bentonite chips	1267
					End of borehole at 16.5 m 16.5 Well Completion Details: Screened interval from 10.4 m to 14.9 m below surface Elevation at top of pipe (TOP) = 1284.060 m					

DRILLING METHOD: Becker Hammer

DRILL DATE: 1 October 2014 LOGGED BY: MH

Notes: ■ GRAB SAMPLE

SLR CONSULTING (CANADA) LTD.

CLIENT: **Summit Aggregates Resource**
PROJECT: **Hydrogeological Assessment**
NW 31-026-3 W5M Alberta
PROJECT No. **203.50065.00001**

BOREHOLE LOG

BOREHOLE NO: **MW14-103**
SURFACE ELEVATION: 1299.81 m
UTM COORDINATES 5683100 N 680739 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DESCRIPTION	TEST DATA (■SPT Count ◆% Moisture)	WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
-1									stickup, above ground steel protector	
0					Ground Surface					1300
					TOPSOIL Silty and clay, trace sand, rootlets, dark brown, moist				silica sand	
1					**CLAY TILL** 0.61 Silty, sandy clay, trace rounded gravel, grey, moist, very hard, softer below 2.4 m					1299
2										1298
3		WP16							hydrated bentonite chips	1297
4										1296
5										1295
6					Below 6.4 m: Brown					1294
7					**SAND AND GRAVEL** 7.01 Very fine, trace coarse sand. Medium to coarse grained, rounded gravel. Some silt, red/brown, dry					1293
8										1292
9					**GRAVEL AND SAND** 8.53 Fine to medium, (trace coarse) gravel. Poorly graded, very fine sand, brown, moist					1291
10		WP17								1290
11					Below 10.7 m: Increasing gravel					1289
12										1288
										1287

DRILLING METHOD: Becker Hammer

DRILL DATE: 1 October 2014 LOGGED BY: MH

Notes: ■ GRAB SAMPLE

SLR CONSULTING (CANADA) LTD.

CLIENT: **Summit Aggregates Resource**
PROJECT: **Hydrogeological Assessment**
NW 31-026-3 W5M Alberta
PROJECT No. **203.50065.00001**

BOREHOLE LOG

BOREHOLE NO: MW14-103
SURFACE ELEVATION: 1299.81 m
UTM COORDINATES 5683100 N 680739 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DESCRIPTION	TEST DATA ■SPT Count ◆% Moisture	WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
13					Below 12.8 m: Increasing gravel, some cobble				50 mm solid PVC pipe	
14					Below 14.0 m: Decreasing gravel, no cobble					1286
15										1285
16										1284
17					Below 16.8 m: Decreasing gravel					1283
18										1282
19		WP18			**SAND AND GRAVEL** 19.2 Poorly graded, very fine sand. Medium with trace fine and trace coarse gravel. Occasional cobble, red/brown, moist					1281
20										1280
21					Below 21.3 m: Increasing gravel					1279
22										1278
23					Below 23.2 m: 0.08 m clay lens			▼	GW = 23.49 mbg (2Oct2014)	1277
24										1276
25									50 mm 010 slot PVC pipe	1275
26		WP19			Below 25.3 m: Wet gravel, very angular					1274
										1273

DRILLING METHOD: Becker Hammer

DRILL DATE: 1 October 2014 LOGGED BY: MH

Notes: ■ GRAB SAMPLE

SLR CONSULTING (CANADA) LTD.

CLIENT: **Summit Aggregates Resource**
PROJECT: **Hydrogeological Assessment**
NW 31-026-3 W5M Alberta
PROJECT No. **203.50065.00001**

BOREHOLE LOG

BOREHOLE NO: MW14-103
SURFACE ELEVATION: 1299.81 m
UTM COORDINATES 5683100 N 680739 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DESCRIPTION	TEST DATA (■SPT Count ◆% Moisture)	WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
27										
		WP20 WP21			**WEATHERED SILTSTONE** 27.4 Clay and silt, some sand, grey with red striations, moist Below 27.7 m: Siltstone, grey, dry 27.7 End of borehole at 27.7 m Well Completion Details: Screened interval from 22.6 m to 27.1 m below surface Elevation at top of pipe (TOP) = 1300.720 m Groundwater Information: Depth to groundwater from TOP = 24.40 m (2Oct2014)				silica sand hydrated bentonite chips	

DRILLING METHOD: Becker Hammer
DRILL DATE: 1 October 2014 LOGGED BY: MH

Notes: ■ GRAB SAMPLE

SLR CONSULTING (CANADA) LTD.

CLIENT: **Mountain Ash Limited Partnership**
PROJECT: **Proposed Summit Pit**
NW 31-026-03 W5M Cochrane, AB
PROJECT No. **212.06650.00003**

BOREHOLE LOG

BOREHOLE NO: MW19-108
SURFACE ELEVATION: 1293.64 m
UTM COORDINATES 680386 N 5682182 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DESCRIPTION	TEST DATA (■ SPT Count, ◆ % Moisture)	WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
					Ground Surface				above ground steel protector	1294
0					**CLAY TILL** Fine trace gravel, dark grey brown, minor sample recovery, dry					
1					@ 1.5 m: Some fine to coarse gravel				hydrated bentonite chips	1293
2										1292
3										1291
					SAND AND GRAVEL 3.35 Fine to coarse sand and gravel, brown, dry					1290
4										
5					**SANDY GRAVEL** 4.57 Medium to coarse gravel, coarse sand, brown, dry					1289
6										1288
7										1287
8										1286
9										1285

DRILLING METHOD: Sonic/Odex

DRILL DATE: June 3, 2019 LOGGED BY: NY

Notes: ■ GRAB SAMPLE

SLR CONSULTING (CANADA) LTD.

CLIENT: **Mountain Ash Limited Partnership**
PROJECT: **Proposed Summit Pit**
NW 31-026-03 W5M Cochrane, AB
PROJECT No. **212.06650.00003**

BOREHOLE LOG

BOREHOLE NO: MW19-108
SURFACE ELEVATION: 1293.64 m
UTM COORDINATES 680386 N 5682182 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DESCRIPTION	TEST DATA (■ SPT Count, ◆ % Moisture)	WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
0					**GRAVELLY SAND** 9.14 Fine to coarse sand and gravel, yellow brown, dry					1284
10										1283
11										1282
12										1281
13										1280
14										1279
15										1278
16									slough and backfill	1277
17										1276
18										1275
19										

DRILLING METHOD: Sonic/Odex

DRILL DATE: June 3, 2019 LOGGED BY: NY

Notes: ■ GRAB SAMPLE

SLR CONSULTING (CANADA) LTD.

CLIENT: **Mountain Ash Limited Partnership**
PROJECT: **Proposed Summit Pit**
NW 31-026-03 W5M Cochrane, AB
PROJECT No. **212.06650.00003**

BOREHOLE LOG

BOREHOLE NO: MW19-108
SURFACE ELEVATION: 1293.64 m
UTM COORDINATES 680386 N 5682182 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DESCRIPTION	TEST DATA (■ SPT Count, ◆ % Moisture)	WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
					@ 19.2 m: Trace silt present to 20.7 m					
20										1274
21										1273
22										1272
23										1271
24										1270
25										1269
26										1268
27					**SAND** 26.8 Some gravel, brown, fine to coarse sand and gravel, dry					1267
28										1266
29										1265

DRILLING METHOD: Sonic/Odex

DRILL DATE: June 3, 2019 LOGGED BY: NY

Notes: ■ GRAB SAMPLE

SLR CONSULTING (CANADA) LTD.

CLIENT: **Mountain Ash Limited Partnership**
PROJECT: **Proposed Summit Pit**
NW 31-026-03 W5M Cochrane, AB
PROJECT No. **212.06650.00003**

BOREHOLE LOG

BOREHOLE NO: MW19-108
SURFACE ELEVATION: 1293.64 m
UTM COORDINATES 680386 N 5682182 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DESCRIPTION	TEST DATA (■ SPT Count, ◆ % Moisture)	WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
30								▽	GW = 1263.34 m (5June2019)	1264
									filter pack sand	
31					**BEDROCK** 30.48 Siltstone, grey, dry					1263
32										1262
33										1261
34										1260
									bentonite pellets	
35										1259
36										1258
					End of borehole at 36.6 m 36.6					

DRILLING METHOD: Sonic/Odex

DRILL DATE: June 3, 2019 LOGGED BY: NY

Notes: ■ GRAB SAMPLE

SLR CONSULTING (CANADA) LTD.

CLIENT: **Mountain Ash Limited Partnership**
PROJECT: **Proposed Summit Pit**
NW 31-026-03 W5M Cochrane, AB
PROJECT No. **212.06650.00003**

BOREHOLE LOG

BOREHOLE NO: MW19-109
SURFACE ELEVATION: 1271.68 m
UTM COORDINATES 5681803 N 680679 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DESCRIPTION	TEST DATA (■ SPT Count, ◆ % Moisture)	WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
					Ground Surface				above ground steel protector	1272
0					**CLAY TILL** Trace fine gravel, dark brown, moist					
1					@ 1.5 m: Some fine gravel				hydrated bentonite chips	1271
2										1270
3										1269
4					**SAND AND GRAVEL** 3.66 Coarse sand, fine to coarse gravel, grey brown, dry					1268
5										1267
6					**GRAVELLY SAND** 5.49 Fine to coarse gravel and sand, grey brown, dry					1266
7									slough and backfill	1265
8										1264
9										1263

DRILLING METHOD: ODEX Air Rotary Drilling

DRILL DATE: June 4, 2019 LOGGED BY: NY

Notes:

SLR CONSULTING (CANADA) LTD.

CLIENT: **Mountain Ash Limited Partnership**
PROJECT: **Proposed Summit Pit**
NW 31-026-03 W5M Cochrane, AB
PROJECT No. **212.06650.00003**

BOREHOLE LOG

BOREHOLE NO: MW19-109
SURFACE ELEVATION: 1271.68 m
UTM COORDINATES 5681803 N 680679 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DESCRIPTION	TEST DATA (■ SPT Count, ◆ % Moisture)	WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
10										1262
11										1261
					SANDY GRAVEL 11.58 Fine to coarse gravel and sand, grey brown, dry					1260
12								▽	filter pack sand GW = 1259.36 m (5June2019)	1259
13										1258
14					**BEDROCK** 14.02 Could not determine lithology with minimal returns					1257
15									bentonite pellets	1256
					End of borehole at 15.8 m 15.8 Groundwater Information: Depth to groundwater from TOP = 12.32 m (5June2019)					

DRILLING METHOD: ODEX Air Rotary Drilling

DRILL DATE: June 4, 2019 LOGGED BY: NY

Notes:

SLR CONSULTING (CANADA) LTD.

CLIENT: **Mountain Ash Limited Partnership**
PROJECT: **Proposed Summit Pit**
NW 31-026-03 W5M Cochrane, AB
PROJECT No. **212.06650.00003**

BOREHOLE LOG

BOREHOLE NO: MW19-110
SURFACE ELEVATION: 1291.14 m
UTM COORDINATES 5682058 N 680788 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DESCRIPTION	TEST DATA (■ SPT Count, ◆ % Moisture)	WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
					Ground Surface				above ground steel protector	
0					**CLAY TILL** Trace gravel, dark brown, moist					1291
1										1290
2										1289
3										1288
					SAND AND GRAVEL 3.35 Fine to coarse sand and gravel, yellow brown, dry					
4										1287
					GRAVELLY SAND 4.57 Fine to coarse sand and gravel, reddish brown, dry					
5										1286
					@ 5.5 m: Yellow brown to 11.6 m				hydrated bentonite chips	
6										1285
7										1284
8										1283
9										

DRILLING METHOD: ODEX Air Rotary Drilling

DRILL DATE: June 4, 2019 LOGGED BY: NY

Notes: ■ GRAB SAMPLE

SLR CONSULTING (CANADA) LTD.

CLIENT: **Mountain Ash Limited Partnership**
PROJECT: **Proposed Summit Pit**
NW 31-026-03 W5M Cochrane, AB
PROJECT No. **212.06650.00003**

BOREHOLE LOG

BOREHOLE NO: MW19-110
SURFACE ELEVATION: 1291.14 m
UTM COORDINATES 5682058 N 680788 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DESCRIPTION	TEST DATA (■ SPT Count, ◆ % Moisture)	WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
10					@ 9.1 m: Clay layer, dark brown, moist to 10.1 m					1281
11										1280
12					**GRAVEL AND SAND** 11.58 Fine to coarse sand and gravel, yellow brown, dry					1279
13										1278
14										1277
15										1276
16										1275
17										1274
18										1273
19										

DRILLING METHOD: ODEX Air Rotary Drilling

DRILL DATE: June 4, 2019 LOGGED BY: NY

Notes: ■ GRAB SAMPLE

SLR CONSULTING (CANADA) LTD.

CLIENT: **Mountain Ash Limited Partnership**
PROJECT: **Proposed Summit Pit**
NW 31-026-03 W5M Cochrane, AB
PROJECT No. **212.06650.00003**

BOREHOLE LOG

BOREHOLE NO: MW19-110
SURFACE ELEVATION: 1291.14 m
UTM COORDINATES 5682058 N 680788 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DESCRIPTION	TEST DATA (■ SPT Count, ◆ % Moisture)	WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
20					@ 20.7 m: Grey - brown to 29.3 m				slough and backfill	1271
21										1270
22										1269
23										1268
24										1267
25										1266
26										1265
27										1264
28										1263
29								▽	GW = 1262.29 m (5June2019)	

DRILLING METHOD: ODEX Air Rotary Drilling

Notes: ■ GRAB SAMPLE

DRILL DATE: June 4, 2019 LOGGED BY: NY

SLR CONSULTING (CANADA) LTD.

CLIENT: **Mountain Ash Limited Partnership**
PROJECT: **Proposed Summit Pit**
NW 31-026-03 W5M Cochrane, AB
PROJECT No. **212.06650.00003**

BOREHOLE LOG

BOREHOLE NO: MW19-110
SURFACE ELEVATION: 1291.14 m
UTM COORDINATES 5682058 N 680788 E

DEPTH (m)	SAMPLE TYPE	SAMPLE ID	% Recovery	SOIL TYPE	SOIL DESCRIPTION	TEST DATA (■ SPT Count, ◆ % Moisture)	WELL COMPLETION	WATER LEVEL	WELL COMPLETION NOTES	ELEVATION (m)
30					**BEDROCK** 29.3 Siltstone, grey, dry				filter pack sand	1261
31										1260
32										1259
33									bentonite pellets	1258
					End of borehole at 33.2 m 33.2 Groundwater Information: Depth to groundwater from TOP = 28.85 m (5June2019)					

DRILLING METHOD: ODEX Air Rotary Drilling

DRILL DATE: June 4, 2019 LOGGED BY: NY

Notes: ■ GRAB SAMPLE

APPENDIX C
Alberta Water Well Records

Hydrogeological Assessment Report
Mountain Ash Limited Partnership Aggregate Operation
NW and SW Section 31, Twp 26, Rge 3 W5M
Rocky View County, Alberta
SLR Project No. 212.06650.00003

Reconnaissance Report

View in Imperial

Export to Excel

Groundwater Wells

Please click the water Well ID to generate the Water Well Drilling Report.

GIC Well ID	LSD	SEC	TWP	RGE	M	DRILLING COMPANY	DATE COMPLETED	DEPTH (m)	TYPE OF WORK	USE	CHM	LT	PT	WELL OWNER	STATIC LEVEL (m)	TEST RATE (L/min)	SC_DIA (cm)
350194	SW	31	26	3	5	LOU'S WATER WELL DRILLING	1990-03-09	35.05	New Well	Domestic		9		DAVIDSON, D.W.	15.24	54.55	14.12
360164	SE	6	27	3	5	AERO DRILLING & CONSULTING LTD.	1991-10-08	73.15	New Well	Domestic		10		BARGETZI, ERNIE	33.53	136.38	14.12
387449	NE	36	26	4	5	PARSONS DRLG	1962-08-10	33.83	New Well	Unknown		9		BRISTOW, C.R.	21.95	72.74	0.00
390998	SE	6	27	3	5	ALBERTA SOUTHERN EXPLORATION DRILLING LTD.	1987-02-11	65.53	New Well	Domestic & Stock		11		STRANGE, R.	45.72	36.37	16.84
390999	SE	6	27	3	5	ALBERTA SOUTHERN EXPLORATION DRILLING LTD.	1987-11-19	73.15	New Well	Stock		15		STRANGE, R.	39.62	45.46	16.84
391000	4	6	27	3	5	DIVERSIFIED DRILLING & EXPLORATION CO.	1984-11-07	40.23	New Well	Domestic & Stock	1	7		CIRCLE J RANCHES	28.96	68.19	13.97
391598	NW	31	26	3	5	PARSONS DRILLING		39.62	New Well	Domestic & Stock				MURRAY, R.J.			17.78
391599	NE	31	26	3	5	KRIEGER DRILLING LTD.		49.38	New Well-Decommissioned	Investigation		14		PARKER, G.L.	0.00		0.00
391600	NE	31	26	3	5	KRIEGER DRILLING LTD.	1981-10-14	27.43	New Well-Decommissioned	Domestic		9		PARKER, G.L.			0.00
395786	NE	31	26	3	5	PARSONS DRILLING	1981-11-19	62.48	New Well	Domestic & Stock		21		PARKER, G.L.	48.77	68.19	17.78
395793	NE	31	26	3	5	UNKNOWN DRILLER		62.48	Chemistry	Domestic				KIRK, S.			0.00
494773	NE	36	26	4	5	ALKEN BASIN DRILLING LTD.	1999-11-16	30.48	New Well	Stock		4	9	GOETJEN, MORRIE	22.25	63.65	13.97
498400	NW	31	26	3	5	MEDICINE VALLEY WATER WELLS	2001-05-14	74.68	New Well	Domestic		14	24	GIBBS, DAVE	10.82	9.09	13.97
1022436	9	36	26	4	5	AARON DRILLING INC.	2014-05-05	30.48	New Well	Investigation		6		LAFARGE CANADA INC			16.81
1475698	16	31	26	3	5	M&M DRILLING CO. LTD.	2003-01-14	39.62	New Well	Domestic		10	24	QUICK WAY FARMS LTD	32.00	45.46	14.13
1475699	15	31	26	3	5	M&M DRILLING CO. LTD.	2003-01-17	53.95	New Well	Domestic		10	24	QUICK WAY FARMS LTD	32.64	24.55	14.13
2095665	SW	6	27	3	5	UNKNOWNDRILLINGCOMP11		25.60	Well Inventory	Domestic & Stock		1		CIRCLE J RANCHES LTD			

Government of Alberta

Water Well Drilling Report

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

View in Imperial | Export to Excel

GIC Well ID 350194
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1990/03/16

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
DAVIDSON, D.W.	P.O. BOX 970 COCHRANE				T0L 0W0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SW	31	026	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.259801 Longitude -114.414277
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Drilling Information

Method of Drilling: Cable Tool

Proposed Well Use: Domestic

Type of Work: New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
6.10		Boulders
10.67		Sand & Gravel
12.19		Sand
15.24		Gravel
18.29		Gray Shale
22.86		Light Green Shale
28.96		Green Shale
32.00		Green Shale
35.05		Green Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 0.00 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1990/03/09	54.55	15.24

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
35.05 m		1990/03/02	1990/03/09

Borehole

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

Surface Casing (if applicable)
Steel
Size OD : 14.12 cm
Wall Thickness : 0.478 cm
Bottom at : 15.24 m

Well Casing/Liner
Steel
Size OD : 11.43 cm
Wall Thickness : 0.318 cm
Top at : 13.72 m
Bottom at : 35.05 m

Perforations

From (m)	To (m)	Diameter or Slot Width(cm)	Slot Length(cm)	Hole or Slot Interval(cm)
22.86	35.05	0.318		25.40

Perforated by: Torch

Annular Seal: Driven
Placed from 0.00 m to 15.24 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : 0.00 cm

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

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount 0.00

Contractor Certification

Name of Journeyman responsible for drilling/construction of well: UNKNOWN NA DRILLER
Certification No: 1
Company Name: LOU'S WATER WELL DRILLING
Copy of Well report provided to owner
Date approval holder signed

Government of Alberta

Water Well Drilling Report

View in Imperial | Export to Excel

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

GIC Well ID 350194
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1990/03/16

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
DAVIDSON, D.W.	P.O. BOX 970 COCHRANE				T0L 0W0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SW	31	026	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.259801 Longitude -114.414277
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

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

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

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

Additional Comments on Well

Yield Test

Taken From Ground Level
Measurement in Metric

Test Date	Start Time	Static Water Level
1990/03/09	12:00 AM	15.24 m

Depth to water level

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

Method of Water Removal

Type Bailer
Removal Rate 54.55 L/min
Depth Withdrawn From 0.00 m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

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

Certification No
1

Company Name
LOU'S WATER WELL DRILLING

Copy of Well report provided to owner

Date approval holder signed

Government of Alberta

Water Well Drilling Report

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

View in Imperial | Export to Excel

GIC Well ID 360164
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1991/10/24

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
BARGETZI, ERNIE	233 RATCLIFF PLACE SE, CALGARY				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SE	06	027	03	5		2	9110979	

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.274744 Longitude -114.405998
How Location Obtained
Not Verified

Elevation m
How Elevation Obtained
Not Obtained

Drilling Information

Method of Drilling
Rotary

Proposed Well Use
Domestic

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
9.45		Till & Clay
21.64		Gravel
25.30		Brown Shale
34.75		Gray Shale
39.62		Gray Sandstone
44.20		Gray Shale
51.82		Gray Sandstone
59.74		Gray Shale
66.75		Gray Sandstone
73.15		Gray Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 136.38 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1991/10/08	136.38	33.53

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
73.15 m		1991/10/08	1991/10/08

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	73.15

Surface Casing (if applicable)
Steel
Size OD : 14.12 cm
Wall Thickness : 0.620 cm
Bottom at : 24.99 m

Well Casing/Liner
Steel
Size OD : 11.43 cm
Wall Thickness : 0.396 cm
Top at : 18.29 m
Bottom at : 73.15 m

Perforations

From (m)	To (m)	Diameter or Slot Width(cm)	Slot Length(cm)	Hole or Slot Interval(cm)
36.58	67.06	0.157		15.24

Perforated by Torch

Annular Seal Drive Shoe
Placed from 0.00 m to 24.99 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : 0.00 cm

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

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount 0.00

Contractor Certification

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

Certification No
1

Company Name
AERO DRILLING & CONSULTING LTD.

Copy of Well report provided to owner
Date approval holder signed

Government of Alberta

Water Well Drilling Report

View in Imperial | Export to Excel

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

GIC Well ID 360164
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1991/10/24

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
BARGETZI, ERNIE	233 RATCLIFF PLACE SE, CALGARY				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SE	06	027	03	5		2	9110979	

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.274744 Longitude -114.405998
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

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

Recommended Pump Rate 136.38 L/min
Recommended Pump Intake Depth (From TOC) 0.00 m
Pump Installed
Type
Depth m
Make
H.P.
Model (Output Rating)

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

Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well

Yield Test

Taken From Ground Level | Measurement in Metric

Test Date	Start Time	Static Water Level
1991/10/08	12:00 AM	33.53 m

Depth to water level

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

Method of Water Removal

Type Air
Removal Rate 136.38 L/min
Depth Withdrawn From 39.62 m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

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

Certification No
1

Company Name
AERO DRILLING & CONSULTING LTD.

Copy of Well report provided to owner

Date approval holder signed

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 387449
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
BRISTOW, C.R.	COCHRANE				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NE	36	026	04	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267032 Longitude -114.426119
How Location Obtained
Map

Elevation 1292.35 m
How Elevation Obtained
Estimated

Drilling Information

Method of Drilling
Cable Tool

Proposed Well Use
Unknown

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
4.88		Yellow Clay
21.03		Gravel
23.77		Fine Grained Sand
25.91		Yellow Clay
26.82		Blue Clay
27.13		Hard Shale
28.04		Sand
32.00		Blue Shale & Sandstone Ledges
33.83		Gray Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 0.00 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1962/08/10	72.74	21.95

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
33.83 m			1962/08/10

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	33.83

Surface Casing (if applicable)

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

Well Casing/Liner

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

Perforations

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

Perforated by

Annular Seal

Placed from 0.00 m to 0.00 m
Amount

Other Seals

Type	At (m)

Screen Type

Size OD : 0.00 cm

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

Attachment
Top Fittings
Bottom Fittings

Pack

Type
Grain Size
Amount

Contractor Certification

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

Certification No
1

Company Name
PARSONS DRLG

Copy of Well report provided to owner
Date approval holder signed

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 387449
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
BRISTOW, C.R.	COCHRANE				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NE	36	026	04	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267032 Longitude -114.426119
How Location Obtained: Map

Elevation 1292.35 m
How Elevation Obtained: Estimated

Additional Information

Measurement in Metric

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

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

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

Sample Collected for Potability:
Submitted to ESRD:

Additional Comments on Well

Yield Test

Taken From Ground Level
Measurement in Metric

Test Date	Start Time	Static Water Level
1962/08/10	12:00 AM	21.95 m

Depth to water level

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

Method of Water Removal

Type: Bailer
Removal Rate: 72.74 L/min
Depth Withdrawn From: 0.00 m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well: UNKNOWN NA DRILLER
Certification No: 1
Company Name: PARSONS DRLG
Copy of Well report provided to owner
Date approval holder signed

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 390998
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1987/03/05

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
STRANGE, R.	P.O. BOX 981 COCHRANE				T0L 0W0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SE	06	027	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.274744 Longitude -114.405998
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Drilling Information

Method of Drilling: Rotary

Proposed Well Use: Domestic & Stock

Type of Work: New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
7.62		Till
10.36		Gravel
11.58		Silty Clay
17.68		Weathered Shale
27.43		Shale
39.62		Sandstone
48.77		Shale
60.96		Sandstone
62.48		Shale
63.70		Sandstone
65.53		Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 27.28 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1987/02/11	36.37	45.72

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
65.53 m		1987/02/10	1987/02/11

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	65.53

Surface Casing (if applicable)
Steel
Size OD : 16.84 cm
Wall Thickness : 0.478 cm
Bottom at : 18.29 m

Well Casing/Liner
Plastic
Size OD : 12.70 cm
Wall Thickness : 0.630 cm
Top at : 16.76 m
Bottom at : 65.53 m

Perforations

From (m)	To (m)	Diameter or Slot Width(cm)	Slot Length(cm)	Hole or Slot Interval(cm)
47.24	59.44	0.000		0.10

Perforated by: Machine

Annular Seal: Driven
Placed from 0.00 m to 11.58 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : 0.00 cm

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

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well: UNKNOWN NA DRILLER
Certification No: 1
Company Name: ALBERTA SOUTHERN EXPLORATION DRILLING LTD.
Copy of Well report provided to owner
Date approval holder signed

Government of Alberta

Water Well Drilling Report

View in Imperial | Export to Excel

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

GIC Well ID 390998
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1987/03/05

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
STRANGE, R.	P.O. BOX 981 COCHRANE				T0L 0W0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SE	06	027	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.274744 Longitude -114.405998
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

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

Recommended Pump Rate 27.28 L/min
Recommended Pump Intake Depth (From TOC) 62.48 m
Pump Installed
Depth m
Type
Make
H.P.
Model (Output Rating)

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

Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well

Yield Test

Taken From Ground Level | Measurement in Metric

Test Date	Start Time	Static Water Level
1987/02/11	12:00 AM	45.72 m

Depth to water level

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

Method of Water Removal

Type Air
Removal Rate 36.37 L/min
Depth Withdrawn From 0.00 m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

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

Certification No
1

Company Name
ALBERTA SOUTHERN EXPLORATION DRILLING LTD.

Copy of Well report provided to owner

Date approval holder signed

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 390999
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1987/12/02

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
STRANGE, R.	P.O. BOX 981 COCHRANE				T0L 0W0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SE	06	027	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.274744 Longitude -114.405998
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Drilling Information

Method of Drilling: Rotary

Proposed Well Use: Stock

Type of Work: New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
5.79		Till
8.84		Gravel
9.75		Till
16.76		Yellow Sandstone
20.12		Gray Sandstone
30.48		Shale
36.88		Sandstone
39.62		Shale
40.23		Moist Sandstone
50.29		Shale
51.82		Sandstone
58.22		Shale
64.01		Shale
71.32	Yes	Water Bearing Sandstone
73.15		Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 31.82 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1987/11/19	45.46	39.62

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
73.15 m		1987/11/18	1987/11/19

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	73.15

Surface Casing (if applicable)
Steel
Size OD : 16.84 cm
Wall Thickness : 0.478 cm
Bottom at : 11.89 m

Well Casing/Liner
Plastic
Size OD : 12.70 cm
Wall Thickness : 0.630 cm
Top at : 9.14 m
Bottom at : 73.15 m

Perforations

From (m)	To (m)	Diameter or Slot Width(cm)	Slot Length(cm)	Hole or Slot Interval(cm)
39.62	73.15	0.157		15.24

Perforated by: Other

Annular Seal: Driven
Placed from 0.00 m to 9.75 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : 0.00 cm

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

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well: UNKNOWN NA DRILLER
Certification No: 1
Company Name: ALBERTA SOUTHERN EXPLORATION DRILLING LTD.
Copy of Well report provided to owner
Date approval holder signed

Government of Alberta

Water Well Drilling Report

View in Imperial | Export to Excel

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GIC Well ID 390999
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1987/12/02

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
STRANGE, R.	P.O. BOX 981 COCHRANE				T0L 0W0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SE	06	027	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.274744 Longitude -114.405998
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

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

Recommended Pump Rate 31.82 L/min
Recommended Pump Intake Depth (From TOC) 60.96 m
Pump Installed
Depth m
Type
Make
H.P.
Model (Output Rating)

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

Additional Comments on Well
WATER OCCURES AT 130-132' @ 1 GPM, 210-234' @ 8-10 GPM.

Yield Test

Taken From Ground Level
Measurement in Metric

Test Date	Start Time	Static Water Level
1987/11/19	12:00 AM	39.62 m

Depth to water level

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

Method of Water Removal
Type Air
Removal Rate 45.46 L/min
Depth Withdrawn From 0.00 m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

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

Certification No
1

Company Name
ALBERTA SOUTHERN EXPLORATION DRILLING LTD.

Copy of Well report provided to owner
Date approval holder signed

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 391000
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1984/12/05

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
CIRCLE J RANCHES	RR2, COCHRANE				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	04	06	027	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.272936 Longitude -114.420414
How Location Obtained
Map

Elevation m
How Elevation Obtained
Not Obtained

Drilling Information

Method of Drilling
Cable Tool

Proposed Well Use
Domestic & Stock

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
3.05		Yellow Clay
7.32		Cemented Gravel
19.51		Gravel
20.12		Cemented Gravel
29.87		Gravel & Boulders
32.92		Brown Shale & Sandstone
40.23	Yes	Brown Water Bearing Sandstone

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 0.00 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1984/11/07	68.19	28.96

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
40.23 m		1984/10/15	1984/11/07

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	40.23

Surface Casing (if applicable)
Steel
Size OD : 13.97 cm
Wall Thickness : 0.620 cm
Bottom at : 31.09 m

Well Casing/Liner
Steel
Size OD : 11.43 cm
Wall Thickness : 0.318 cm
Top at : 0.00 m
Bottom at : 40.23 m

Perforations

From (m)	To (m)	Diameter or Slot Width(cm)	Slot Length(cm)	Hole or Slot Interval(cm)
33.53	39.62	0.396		25.40

Perforated by Torch

Annular Seal Driven
Placed from 0.00 m to 1.22 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : 0.00 cm

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

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

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

Certification No
1

Company Name
DIVERSIFIED DRILLING & EXPLORATION CO.

Copy of Well report provided to owner
Date approval holder signed

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 391000
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1984/12/05

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
CIRCLE J RANCHES	RR2, COCHRANE				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	04	06	027	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.272936 Longitude -114.420414
How Location Obtained: Map

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

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

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

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

Sample Collected for Potability
Submitted to ESRD Yes

Additional Comments on Well

Yield Test

Taken From Ground Level
Measurement in Metric

Test Date	Start Time	Static Water Level
1984/11/07	12:00 AM	28.96 m

Depth to water level

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

Method of Water Removal

Type Bailer
Removal Rate 68.19 L/min
Depth Withdrawn From 32.00 m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

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

Certification No
1

Company Name
DIVERSIFIED DRILLING & EXPLORATION CO.

Copy of Well report provided to owner

Date approval holder signed

Government of Alberta

Water Well Drilling Report

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

View in Imperial | Export to Excel

GIC Well ID 391598
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
MURRAY, R.J.	511 19ST NW, CALGARY				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NW	31	026	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267033 Longitude -114.414280
How Location Obtained
Map

Elevation 1290.83 m
How Elevation Obtained
Estimated

Drilling Information

Method of Drilling
Cable Tool

Proposed Well Use
Domestic & Stock

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description

Yield Test Summary

Measurement in Metric

Recommended Pump Rate L/min

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

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
39.62 m			

Borehole

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

Surface Casing (if applicable)
Steel
Size OD : 17.78 cm
Wall Thickness : 0.000 cm
Bottom at : 26.82 m

Well Casing/Liner
Steel
Size OD : 12.70 cm
Wall Thickness : 0.000 cm
Top at : 0.00 m
Bottom at : 39.62 m

Perforations

From (m)	To (m)	Diameter or Slot Width(cm)	Slot Length(cm)	Hole or Slot Interval(cm)
31.09	38.10	0.000		0.00

Perforated by

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

Other Seals

Type	At (m)

Screen Type
Size OD : 0.00 cm

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

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

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

Certification No
1

Company Name
PARSONS DRILLING

Copy of Well report provided to owner
Date approval holder signed

Government of Alberta

Water Well Drilling Report

View in Imperial | Export to Excel

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GIC Well ID 391598
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
MURRAY, R.J.	511 19ST NW, CALGARY				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NW	31	026	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267033 Longitude -114.414280
How Location Obtained: Map

Elevation 1290.83 m
How Elevation Obtained: Estimated

Additional Information

Measurement in Metric

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

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

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

Sample Collected for Potability ____ Submitted to ESRD ____

Additional Comments on Well

Yield Test

Taken From Ground Level | Measurement in Metric

Test Date	Start Time	Static Water Level
		m

Method of Water Removal

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

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

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

Certification No
1

Company Name
PARSONS DRILLING

Copy of Well report provided to owner

Date approval holder signed

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 391599
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
PARKER, G.L.	P.O. BOX 123 COCHRANE				T0L 0W0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NE	31	026	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267033 Longitude -114.402748
How Location Obtained: Map

Elevation 1295.40 m
How Elevation Obtained: Estimated

Drilling Information

Method of Drilling
Rotary

Proposed Well Use
Investigation

Type of Work
New Well-Abandoned

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
0.30		Topsoil
1.22		Gray Clay
4.27		Brown Clay
6.71		Brown Sandy Clay
11.89		Sandy Gravel
17.07		Medium Grained Gravel
18.90		Fine Grained Gravel
19.20		Sandstone
24.69		Fine Grained Sand
32.92		Fine Grained Gravel
36.27		Shale
36.58		Dark Shale
43.59		Clay & Shale
49.38		Unknown

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 0.00 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1981/10/10		0.00

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
49.38 m			

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	49.38

Surface Casing (if applicable)
Size OD : 0.00 cm
Wall Thickness : 0.000 cm
Bottom at : 0.00 m

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

Perforations

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

Perforated by

Annular Seal Driven
Placed from 0.00 m to 0.00 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : 0.00 cm

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

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

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

Certification No
1

Company Name
KRIEGER DRILLING LTD.

Copy of Well report provided to owner

Date approval holder signed

Government of Alberta

Water Well Drilling Report

View in Imperial | Export to Excel

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GIC Well ID 391599
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
PARKER, G.L.	P.O. BOX 123 COCHRANE				T0L 0W0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NE	31	026	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267033 Longitude -114.402748
How Location Obtained: Map

Elevation 1295.40 m
How Elevation Obtained: Estimated

Additional Information

Measurement in Metric

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

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

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

Additional Comments on Well
DRILLER REPORTS MED HARD WATER, NO SPECS FOR SURFACE CASING

Yield Test

Taken From Ground Level
Measurement in Metric

Test Date	Start Time	Static Water Level
1981/10/10	12:00 AM	0.00 m

Depth to water level

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

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

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

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

Certification No
1

Company Name
KRIEGER DRILLING LTD.

Copy of Well report provided to owner

Date approval holder signed

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 391600
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1981/11/25

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
PARKER, G.L.	P.O. BOX 123 COCHRANE				T0L 0W0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NE	31	026	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267033 Longitude -114.402748
How Location Obtained: Map

Elevation 1295.40 m
How Elevation Obtained: Estimated

Drilling Information

Method of Drilling: Rotary

Proposed Well Use: Domestic

Type of Work: New Well-Abandoned

Plugged 1981/10/14
Plugged with Unknown
Amount

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
0.30		Topsoil
10.06		Sandy Till
17.68		Clay & Shale
20.12		Clay & Gravel
21.03		Shale
22.86		Clay & Silt
24.08		Gray Clay
26.82		Clay & Gravel
27.43		Lost Circulation

Yield Test Summary

Measurement in Metric

Recommended Pump Rate L/min

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

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
27.43 m		1981/10/11	1981/10/14

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	27.43

Surface Casing (if applicable)

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

Well Casing/Liner

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

Perforations

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

Perforated by

Annular Seal

Placed from 0.00 m to 0.00 m
Amount

Other Seals

Type	At (m)

Screen Type

Size OD : 0.00 cm

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

Attachment
Top Fittings
Bottom Fittings

Pack

Type
Grain Size
Amount

Contractor Certification

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

Certification No: 1

Company Name: KRIEGER DRILLING LTD.

Copy of Well report provided to owner

Date approval holder signed

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 391600
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1981/11/25

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
PARKER, G.L.	P.O. BOX 123 COCHRANE				T0L 0W0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NE	31	026	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267033 Longitude -114.402748
How Location Obtained: Map

Elevation 1295.40 m
How Elevation Obtained: Estimated

Additional Information

Measurement in Metric

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

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

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

Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well

Yield Test

Taken From Ground Level | Measurement in Metric

Test Date	Start Time	Static Water Level
		m

Method of Water Removal

Type
Removal Rate L/min
Depth Withdrawn From m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

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

Certification No
1

Company Name
KRIEGER DRILLING LTD.

Copy of Well report provided to owner

Date approval holder signed

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 395786
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1982/02/02

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
PARKER, G.L.	P.O. BOX 123 COCHRANE				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NE	31	026	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267033 Longitude -114.402748
How Location Obtained: Map

Elevation m
How Elevation Obtained: Not Obtained

Drilling Information

Method of Drilling: Cable Tool

Proposed Well Use: Domestic & Stock

Type of Work: New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
1.83		Brown Clay & Boulders
3.35		Gray Clay & Boulders
3.96		Boulders
10.97		Brown Clay & Gravel
13.72		Gravel
15.54		Brown Shale
21.64		Gray Hard Shale
23.16		Gray Hard Sandstone
25.30		Gray Shale
26.82		Gray Sandstone
27.74		Gray Shale
28.65		Gray Sandstone
29.26		Gray Soft Sandstone
30.78		Gray Hard Sandstone
34.75		Gray Firm Shale
36.88		Gray Hard Sandstone
43.89		Gray Firm Shale
45.11		Gray Hard Sandstone
54.86		Gray Shale
56.39	Yes	Gray Water Bearing Sandstone
62.48		Gray Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 0.00 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1981/11/19	68.19	48.77

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
62.48 m		1981/11/05	1981/11/19

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	62.48

Surface Casing (if applicable)
Steel
Size OD : 17.78 cm
Wall Thickness : 0.587 cm
Bottom at : 13.72 m

Well Casing/Liner
Steel
Size OD : 12.70 cm
Wall Thickness : 0.556 cm
Top at : 0.00 m
Bottom at : 62.48 m

Perforations

From (m)	To (m)	Diameter or Slot Width(cm)	Slot Length(cm)	Hole or Slot Interval(cm)
48.16	61.87	0.953		40.64

Perforated by: Torch

Annular Seal: Drive Shoe
Placed from 0.00 m to 13.72 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : 0.00 cm

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

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount 0.00

Contractor Certification

Name of Journeyman responsible for drilling/construction of well: UNKNOWN NA DRILLER
Certification No: 1
Company Name: PARSONS DRILLING
Copy of Well report provided to owner
Date approval holder signed

Government of Alberta

Water Well Drilling Report

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

View in Imperial | Export to Excel

GIC Well ID 395786
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1982/02/02

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
PARKER, G.L.	P.O. BOX 123 COCHRANE				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NE	31	026	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267033 Longitude -114.402748
How Location Obtained: Map

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

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

Recommended Pump Rate 0.00 L/min
Recommended Pump Intake Depth (From TOC) 60.96 m
Pump Installed
Depth m
Type
Make
H.P.
Model (Output Rating)

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

Additional Comments on Well
DRILLER REPORTS WATER QUALITY AS TURBID

Yield Test

Taken From Ground Level
Measurement in Metric

Test Date	Start Time	Static Water Level
1981/11/19	12:00 AM	48.77 m

Depth to water level

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

Method of Water Removal

Type Bailer
Removal Rate 68.19 L/min
Depth Withdrawn From 48.77 m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

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

Certification No
1

Company Name
PARSONS DRILLING

Copy of Well report provided to owner

Date approval holder signed

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 395793
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
KIRK, S.	P.O. BOX 1295 COCHRANE				T0L 0W0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NE	31	026	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267033 Longitude -114.402748
How Location Obtained
Not Verified

Elevation m
How Elevation Obtained
Not Obtained

Drilling Information

Method of Drilling
Unknown

Proposed Well Use
Domestic

Type of Work
Chemistry

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description

Yield Test Summary

Measurement in Metric

Recommended Pump Rate L/min

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

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
62.48 m			

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	62.48

Surface Casing (if applicable)

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

Well Casing/Liner

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

Perforations

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

Perforated by

Annular Seal

Placed from 0.00 m to 0.00 m
Amount

Other Seals

Type	At (m)

Screen Type

Size OD : 0.00 cm

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

Attachment
Top Fittings
Bottom Fittings

Pack

Type
Grain Size
Amount

Contractor Certification

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

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner

Date approval holder signed

Government of Alberta

Water Well Drilling Report

View in Imperial | Export to Excel

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

GIC Well ID 395793
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
KIRK, S.	P.O. BOX 1295 COCHRANE				T0L 0W0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NE	31	026	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267033 Longitude -114.402748
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

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

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

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

Sample Collected for Potability
Submitted to ESRD

Additional Comments on Well

Yield Test

Taken From Ground Level | Measurement in Metric

Test Date	Start Time	Static Water Level
		m

Method of Water Removal

Type
Removal Rate L/min
Depth Withdrawn From m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

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

Certification No
1

Company Name
UNKNOWN DRILLER

Copy of Well report provided to owner

Date approval holder signed

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 494773
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1999/11/25

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
GOETJEN, MORRIE	RR1, AIRDRIE			CANADA	T4B 2A3

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NE	36	26	4	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267032 Longitude -114.426119
How Location Obtained
Not Verified

Elevation m
How Elevation Obtained
Not Obtained

Drilling Information

Method of Drilling
Rotary

Proposed Well Use
Stock

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
3.05		Brown Clay
23.16		Coarse Grained Gravel
29.26	Yes	Water Bearing Gravel
30.48		Brown Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 36.37 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
1999/11/16	63.65	22.25

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
30.48 m		1999/11/15	1999/11/16

Borehole

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

Surface Casing (if applicable)
Steel
Size OD : 13.97 cm
Wall Thickness : 0.620 cm
Bottom at : 28.04 m

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

Perforations

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

Perforated by

Annular Seal Driven & Bentonite
Placed from 0.00 m to 28.04 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : 0.00 cm

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

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

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

Certification No
1

Company Name
ALKEN BASIN DRILLING LTD.

Copy of Well report provided to owner

Date approval holder signed

Government of Alberta

Water Well Drilling Report

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

View in Imperial | Export to Excel

GIC Well ID 494773
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1999/11/25

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
GOETJEN, MORRIE	RR1, AIRDRIE			CANADA	T4B 2A3

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NE	36	26	4	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267032 Longitude -114.426119
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

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

Recommended Pump Rate 36.37 L/min
Recommended Pump Intake Depth (From TOC) 27.43 m
Pump Installed
Depth m
Type
Make
H.P.
Model (Output Rating)

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

Additional Comments on Well

DRILLER REPORTS DISTANCE FROM TOP OF CASING TO GROUND LEVEL: 2'.

Yield Test

Taken From Ground Level
Measurement in Metric

Test Date	Start Time	Static Water Level
1999/11/16	12:00 AM	22.25 m

Method of Water Removal

Type Air
Removal Rate 63.65 L/min
Depth Withdrawn From 30.48 m

If water removal period was < 2 hours, explain why

Depth to water level

Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)
	1:00	26.82
	2:00	24.38
	3:00	23.16
	4:00	22.71
	5:00	22.56
	6:00	22.40
	7:00	22.25
	8:00	22.25
	10:00	22.25

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

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

Certification No
1

Company Name
ALKEN BASIN DRILLING LTD.

Copy of Well report provided to owner

Date approval holder signed

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 498400
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2001/06/22

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
GIBBS, DAVE	P.O. BOX 1773 SPRUCE VIEW				T0M 1V0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NW	31	026	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267033 Longitude -114.414280
How Location Obtained
Not Verified

Elevation m
How Elevation Obtained
Not Obtained

Drilling Information

Method of Drilling
Cable Tool

Proposed Well Use
Domestic

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
4.57		Brown Clay & Rocks
8.23		Gray Sandstone
13.72		Gray Shale
19.51		Gray Sandy Shale
22.86		Gray Shale
24.08		Gray Sandstone
29.87		Gray Shale
30.78		Blue Shale
34.14		Gray Silty Shale
54.56		Gray Shale
57.30		Gray Sandstone
67.67		Gray Shale
71.63		Gray Sandy Shale
74.68		Gray Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 9.09 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
2001/05/14	9.09	10.82

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
74.68 m		2001/05/07	2001/05/14

Borehole

Diameter (cm)	From (m)	To (m)
0.00	0.00	74.68

Surface Casing (if applicable)
Steel
Size OD : 13.97 cm
Wall Thickness : 0.620 cm
Bottom at : 24.69 m

Well Casing/Liner
Plastic
Size OD : 11.43 cm
Wall Thickness : 0.602 cm
Top at : 19.81 m
Bottom at : 74.68 m

Perforations

From (m)	To (m)	Diameter or Slot Width(cm)	Slot Length(cm)	Hole or Slot Interval(cm)
24.69	74.68	0.635		20.32

Perforated by Saw

Annular Seal Driven
Placed from 0.00 m to 24.69 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : 0.00 cm

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

Attachment
Top Fittings Bottom Fittings

Pack
Type Grain Size
Amount

Contractor Certification

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

Certification No
1

Company Name
MEDICINE VALLEY WATER WELLS

Copy of Well report provided to owner Date approval holder signed

Government of Alberta

Water Well Drilling Report

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

View in Imperial | Export to Excel

GIC Well ID 498400
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2001/06/22

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
GIBBS, DAVE	P.O. BOX 1773 SPRUCE VIEW				T0M 1V0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	NW	31	026	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267033 Longitude -114.414280
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

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

Recommended Pump Rate 9.09 L/min
Recommended Pump Intake Depth (From TOC) 71.63 m
Pump Installed
Depth m
Type
Make
H.P.
Model (Output Rating)

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

Additional Comments on Well

DRILLER REPORTS DISTANCE FROM TOP OF CASING TO GROUND LEVEL: 1'.

Yield Test

Taken From Ground Level
Depth to water level

Measurement in Metric

Test Date	Start Time	Static Water Level
2001/05/14	12:00 AM	10.82 m

Method of Water Removal

Type Bailer
Removal Rate 9.09 L/min
Depth Withdrawn From 0.00 m

If water removal period was < 2 hours, explain why

Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)
	1:00	54.32
	2:00	53.77
	3:00	53.28
	4:00	52.88
	5:00	52.40
	6:00	52.09
	7:00	51.82
	8:00	51.58
	9:00	51.19
	10:00	50.81
	12:00	50.38
	14:00	50.05
	16:00	49.50
	20:00	48.05
	25:00	46.09
	30:00	44.84
	35:00	43.08
	40:00	41.53
	50:00	39.01
	60:00	36.32
	75:00	33.19
	90:00	30.57
	105:00	28.79
	120:00	26.93

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

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

Certification No
1

Company Name
MEDICINE VALLEY WATER WELLS

Copy of Well report provided to owner

Date approval holder signed

Government of Alberta

Water Well Drilling Report

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

View in Imperial | Export to Excel

GIC Well ID 1022436
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2014/09/24

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
LAFARGE CANADA INC	115 QUARRY PARK BLVD	CALGARY	ALBERTA	CANADA	T2C 5G9

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	9	36	26	4	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.265686 Longitude -114.424418
How Location Obtained
Hand held autonomous GPS 20-30m

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

Drilling Information

Method of Drilling
Rotary - Air

Proposed Well Use
Investigation

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
0.30		Topsoil
4.27		Brown Moist Clay
25.30		Gravel
28.35		Moist Gravel
29.26		Sandstone
30.48		Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate L/min

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

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
30.48 m	28.35 m	2014/05/01	2014/05/05

Borehole

Diameter (cm)	From (m)	To (m)
20.02	0.00	25.60
15.56	25.60	30.48

Surface Casing (if applicable)
Steel
Size OD : 16.81 cm
Wall Thickness : 0.478 cm
Bottom at : 25.60 m

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

Perforations

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

Perforated by

Annular Seal Cement/Grout
Placed from 0.00 m to 25.60 m
Amount 150.00 Gallons

Other Seals

Type	At (m)
Driven	25.60

Screen Type Stainless Steel
Size OD : 14.12 cm

From (m)	To (m)	Slot Size (cm)
26.21	27.43	0.025

Attachment Telescoped
Top Fittings Packer
Bottom Fittings Tail Pipe

Pack
Type Natural
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
CHRIS QUINLAN

Certification No
48135A

Company Name
AARON DRILLING INC.

Copy of Well report provided to owner
Yes

Date approval holder signed
2014/09/24

Government of Alberta

Water Well Drilling Report

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

View in Imperial | Export to Excel

GIC Well ID 1022436
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2014/09/24

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
LAFARGE CANADA INC	115 QUARRY PARK BLVD	CALGARY	ALBERTA	CANADA	T2C 5G9

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	9	36	26	4	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.265686 Longitude -114.424418
How Location Obtained
Hand held autonomous GPS 20-30m

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

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level 91.44 cm
Is Artesian Flow
Rate L/min
Is Flow Control Installed
Describe

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

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

Additional Comments on Well
PUMP TEST PERFORMED BY WATERLINE RESOURCES

Yield Test

Taken From Ground Level | Measurement in Metric

Test Date	Start Time	Static Water Level
		m

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

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken		Diversion Date & Time
CITY OF CALGARY	9092.18	L	2014/04/29 8:00 AM

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
CHRIS QUINLAN

Certification No
48135A

Company Name
AARON DRILLING INC.

Copy of Well report provided to owner
Yes

Date approval holder signed
2014/09/24

Government of Alberta

Water Well Drilling Report

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

View in Imperial | Export to Excel

GIC Well ID 1475698
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
QUICK WAY FARMS LTD	P.O. BOX 1719	BROOKS	AB	CA	T1R 1C5

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	16	31	026	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267444 Longitude -114.400639
How Location Obtained: Hand held autonomous GPS 20-30m

Elevation m
How Elevation Obtained: Not Obtained

Drilling Information

Method of Drilling: Rotary

Proposed Well Use: Domestic

Type of Work: New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
2.13		Clay
21.03		Clay & Gravel
23.16		Clay
26.82		Gray Shale
28.65		Gray Sandy Shale
31.39		Gray Shale
31.70		Sandstone
33.53		Shale
35.97		Sandstone
39.62		Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 36.37 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
2003/01/15	45.46	32.00

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
39.62 m		2003/01/10	2003/01/14

Borehole

Diameter (cm)	From (m)	To (m)
22.23	0.00	39.62

Surface Casing (if applicable): Steel
Size OD : 14.13 cm
Wall Thickness : 0.478 cm
Bottom at : 35.97 m

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

Perforations

From (m)	To (m)	Diameter or Slot Width(cm)	Slot Length(cm)	Hole or Slot Interval(cm)
32.00	35.97	0.318		25.40

Perforated by: Torch

Annular Seal: Driven & Bentonite
Placed from 0.00 m to 31.39 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : cm

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

Attachment
Top Fittings
Bottom Fittings

Pack
Type Unknown
Grain Size
Amount Unknown

Contractor Certification

Name of Journeyman responsible for drilling/construction of well: WILLIAM PENROD
Certification No: A000187
Company Name: M&M DRILLING CO. LTD.
Copy of Well report provided to owner
Date approval holder signed

Government of Alberta

Water Well Drilling Report

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

View in Imperial | Export to Excel

GIC Well ID 1475698
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
QUICK WAY FARMS LTD	P.O. BOX 1719	BROOKS	AB	CA	T1R 1C5

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	16	31	026	03	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267444 Longitude -114.400639
How Location Obtained: Hand held autonomous GPS 20-30m

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

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

Recommended Pump Rate 36.37 L/min
Recommended Pump Intake Depth (From TOC) 35.05 m
Pump Installed
Type
Depth m
Make
H.P.
Model (Output Rating)

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

Additional Comments on Well

FIELD TEST HARD WATER TDS 250, GPS # 51.2671333, N-51-16.0-2.8, W-114-24-2.3, -114.40038333, BOREHOLE DIAMETER 8.75" TO 103' & 6.25" TO 130'

Yield Test

Taken From Ground Level
Measurement in Metric

Test Date	Start Time	Static Water Level
2003/01/15	12:00 AM	32.00 m

Method of Water Removal

Type Pump
Removal Rate 45.46 L/min
Depth Withdrawn From 35.05 m

If water removal period was < 2 hours, explain why

Depth to water level

Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)
32.39	1:00	32.81
32.59	2:00	32.69
32.69	3:00	32.65
32.75	4:00	32.61
32.83	5:00	32.60
32.85	6:00	32.56
32.89	7:00	32.51
32.90	8:00	32.49
32.92	9:00	32.47
32.94	10:00	32.45
32.99	12:00	32.40
33.02	14:00	32.37
33.05	16:00	32.34
33.08	20:00	32.32
33.13	25:00	32.28
33.06	30:00	32.26
33.19	35:00	32.23
33.24	40:00	32.21
33.27	50:00	32.20
33.28	60:00	32.16
33.31	75:00	32.12
33.32	90:00	32.10
33.34	105:00	32.09
33.35	120:00	32.06

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well: WILLIAM PENROD
Certification No: A000187
Company Name: M&M DRILLING CO. LTD.
Copy of Well report provided to owner
Date approval holder signed

Government of Alberta

Water Well Drilling Report

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

View in Imperial | Export to Excel

GIC Well ID 1475699
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
QUICK WAY FARMS LTD	P.O. BOX 1719	BROOKS	AB	CA	T1R 1C5

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	15	31	026	03	5				STOCK WELL

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267556 Longitude -114.405667
How Location Obtained: Hand held autonomous GPS 20-30m

Elevation m
How Elevation Obtained: Not Obtained

Drilling Information

Method of Drilling
Rotary

Proposed Well Use
Domestic

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
2.44		Clay & Rocks
27.43		Lost Circulation Gravel
28.96		Shattered Shale
32.92		Brown Sandstone
34.75		Gray Sandstone
45.72		Shale & Sandstone Ledges
47.24	Yes	Water Bearing Sandstone
50.29	Yes	Water Bearing Shale
50.90	Yes	Water Bearing Sandstone
53.95		Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 27.28 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
2003/01/20	24.55	32.64

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
53.95 m		2003/01/15	2003/01/17

Borehole

Diameter (cm)	From (m)	To (m)
22.23	0.00	53.95

Surface Casing (if applicable)
Steel
Size OD : 14.13 cm
Wall Thickness : 0.478 cm
Bottom at : 30.18 m

Well Casing/Liner
Plastic
Size OD : 11.43 cm
Wall Thickness : 0.544 cm
Top at : 23.47 m
Bottom at : 53.95 m

Perforations

From (m)	To (m)	Diameter or Slot Width(cm)	Slot Length(cm)	Hole or Slot Interval(cm)
43.28	50.90	0.635		25.40

Perforated by Saw

Annular Seal Driven & Bentonite
Placed from 0.00 m to 30.18 m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : cm

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

Attachment
Top Fittings Bottom Fittings

Pack
Type Unknown Grain Size
Amount Unknown

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
WILLIAM PENROD

Certification No
A000187

Company Name
M&M DRILLING CO. LTD.

Copy of Well report provided to owner Date approval holder signed

Government of Alberta

Water Well Drilling Report

View in Imperial | Export to Excel

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GIC Well ID 1475699
GoA Well Tag No.
Drilling Company Well ID
Date Report Received

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
QUICK WAY FARMS LTD	P.O. BOX 1719	BROOKS	AB	CA	T1R 1C5

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	15	31	026	03	5				STOCK WELL

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.267556 Longitude -114.405667
How Location Obtained: Hand held autonomous GPS 20-30m

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

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

Recommended Pump Rate 27.28 L/min
Recommended Pump Intake Depth (From TOC) 42.67 m
Pump Installed
Depth m
Type
Make
H.P.
Model (Output Rating)

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

Additional Comments on Well

FIELD TEST 300 TDS MOD HARD BAILED @ 7 IGM, GPS # 51-16-03.2, W-114-24-20.4, -114.4034, BOREHOLE DIAMETER 8.75" TO 99' & 5.125" 177', 90' - 95' SHATTERED SHALE (LOSS CIRCULATION),

Yield Test

Taken From Ground Level
Measurement in Metric

Test Date	Start Time	Static Water Level
2003/01/20	12:00 AM	32.64 m

Method of Water Removal

Type Pump
Removal Rate 24.55 L/min
Depth Withdrawn From 53.34 m

If water removal period was < 2 hours, explain why

Depth to water level

Drawdown (m)	Elapsed Time Minutes:Sec	Recovery (m)
35.07	1:00	36.99
35.73	2:00	36.20
35.83	3:00	36.12
36.01	4:00	36.02
36.22	5:00	35.91
36.37	6:00	35.79
36.49	7:00	35.72
36.62	8:00	35.61
31.24	9:00	35.45
36.86	10:00	35.41
36.96	12:00	35.29
37.11	14:00	35.16
36.91	16:00	35.05
37.40	20:00	34.88
37.58	25:00	34.75
37.76	30:00	34.59
37.90	35:00	34.50
38.01	40:00	34.40
38.28	50:00	34.27
38.43	60:00	34.14
38.71	75:00	34.03
38.91	90:00	33.91
39.09	105:00	33.83
39.24	120:00	33.74

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well: WILLIAM PENROD
Certification No: A000187
Company Name: M&M DRILLING CO. LTD.
Copy of Well report provided to owner
Date approval holder signed

Government of Alberta

Water Well Drilling Report

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

View in Imperial | Export to Excel

GIC Well ID 1556533
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2014/06/04

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
SOUTH ROCK LTD	P.O. BOX 460	MEDICINE HAT	ALBERTA	CANADA	T1A 7G2

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	4	32	26	3	5				OBSERVATION HOLE #5

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.258118 Longitude -114.396505
How Location Obtained
Differential corrected handheld GPS 5-10m

Elevation 1270.00 m
How Elevation Obtained
Differential corrected handheld GPS 5-10m

Drilling Information

Method of Drilling
Rotary - Mud

Proposed Well Use
Monitoring

Type of Work
Other

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
0.30		Black Topsoil
6.40		Brown Clay
11.89		Gray Gravel
13.72		Gray Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate L/min

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

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
13.72 m	13.72 m	2014/05/08	2014/05/08

Borehole

Diameter (cm)	From (m)	To (m)
14.29	0.00	13.72

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

Well Casing/Liner
Plastic
Size OD : 6.35 cm
Wall Thickness : 0.516 cm
Top at : -0.91 m
Bottom at : 13.72 m

Perforations

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

Perforated by

Annular Seal Bentonite Chips/Tablets
Placed from 0.91 m to 9.75 m
Amount 300.00 Pounds

Other Seals

Type	At (m)

Screen Type Slotted PVC
Size OD : 6.35 cm

From (m)	To (m)	Slot Size (cm)
10.67	13.72	0.254

Attachment Attached To Casing
Top Fittings Riser Pipe
Bottom Fittings Plug

Pack
Type Sand
Grain Size 10-20
Amount 200.00 Pounds

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
CHAD NIEMANS

Certification No
46340A

Company Name
NIEMANS DRILLING (1980) LTD.

Copy of Well report provided to owner
Yes

Date approval holder signed
2014/06/04

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 1556533
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2014/06/04

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
SOUTH ROCK LTD	P.O. BOX 460	MEDICINE HAT	ALBERTA	CANADA	T1A 7G2

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	4	32	26	3	5				OBSERVATION HOLE #5

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.258118 Longitude -114.396505
How Location Obtained
Differential corrected handheld GPS 5-10m

Elevation 1270.00 m
How Elevation Obtained
Differential corrected handheld GPS 5-10m

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level 91.44 cm
Is Artesian Flow
Rate L/min
Is Flow Control Installed
Describe

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

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

Additional Comments on Well
LOCKABLE PROTECTOR PIPE INSTALLED AND CONCRETED INTO THE GROUND.

Yield Test

Taken From Ground Level | Measurement in Metric

Test Date	Start Time	Static Water Level
		m

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

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken		Diversion Date & Time
TOWN OF OKOTOKS	1818.44	L	2014/05/08 7:00 AM

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
CHAD NIEMANS

Certification No
46340A

Company Name
NIEMANS DRILLING (1980) LTD.

Copy of Well report provided to owner
Yes

Date approval holder signed
2014/06/04

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 1556534
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2014/06/04

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
SOUTH ROCK LTD	P.O. BOX 460	MEDICINE HAT	ALBERTA	CANADA	T1A 7G2

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	4	32	26	3	5				OBSERVATION WELL #6

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.257155 Longitude -114.394328
How Location Obtained
Differential corrected handheld GPS 5-10m

Elevation 1277.00 m
How Elevation Obtained
Differential corrected handheld GPS 5-10m

Drilling Information

Method of Drilling
Rotary - Mud

Proposed Well Use
Monitoring

Type of Work
Other

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
5.79		Brown Sandy Clay & Rocks
8.84		Gray Gravel
10.97		Gray Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate L/min

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

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
10.97 m	10.97 m	2014/05/12	2014/05/12

Borehole

Diameter (cm)	From (m)	To (m)
14.29	0.00	10.97

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

Well Casing/Liner
Plastic
Size OD : 6.35 cm
Wall Thickness : 0.518 cm
Top at : -0.91 m
Bottom at : 10.97 m

Perforations

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

Perforated by

Annular Seal Bentonite Chips/Tablets
Placed from 0.91 m to 7.01 m
Amount 200.00 Pounds

Other Seals

Type	At (m)

Screen Type Slotted PVC
Size OD : 6.35 cm

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

Attachment Attached To Casing
Top Fittings Riser Pipe
Bottom Fittings Plug

Pack
Type Sand
Grain Size 10-20
Amount 200.00 Pounds

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
CHAD NIEMANS

Certification No
46340A

Company Name
NIEMANS DRILLING (1980) LTD.

Copy of Well report provided to owner
Yes

Date approval holder signed
2014/06/04

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 1556534
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2014/06/04

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
SOUTH ROCK LTD	P.O. BOX 460	MEDICINE HAT	ALBERTA	CANADA	T1A 7G2

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	4	32	26	3	5				OBSERVATION WELL #6

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.257155 Longitude -114.394328
How Location Obtained
Differential corrected handheld GPS 5-10m

Elevation 1277.00 m
How Elevation Obtained
Differential corrected handheld GPS 5-10m

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level 91.44 cm
Is Artesian Flow
Rate L/min
Is Flow Control Installed
Describe

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

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

Additional Comments on Well
INSTALLED LOCKABLE PROTECTOR CASING AND CONCRETED INTO THE GROUND.

Yield Test

Taken From Ground Level | Measurement in Metric

Test Date	Start Time	Static Water Level
		m

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

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken		Diversion Date & Time
TOWN OF OKOTOKS	2727.66	L	2014/05/12 7:00 AM

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
CHAD NIEMANS

Certification No
46340A

Company Name
NIEMANS DRILLING (1980) LTD.

Copy of Well report provided to owner
Yes

Date approval holder signed
2014/06/04

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 1556535
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2014/06/04

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
SOUTH ROCK LTD	P.O. BOX 460	MEDICINE HAT	ALBERTA	CANADA	T1A 7G2

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	4	32	26	3	5				OBSERVATION WELL #7

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.255906 Longitude -114.392635
How Location Obtained
Differential corrected handheld GPS 5-10m

Elevation 1273.00 m
How Elevation Obtained
Differential corrected handheld GPS 5-10m

Drilling Information

Method of Drilling
Rotary - Mud

Proposed Well Use
Monitoring

Type of Work
Other

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
3.66		Brown Clay & Rocks
11.28		Gray Gravel
12.19		Gray Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate L/min

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

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
12.19 m	12.19 m	2014/05/13	2014/05/13

Borehole

Diameter (cm)	From (m)	To (m)

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

Well Casing/Liner
Plastic
Size OD : 6.35 cm
Wall Thickness : 0.518 cm
Top at : -0.91 m
Bottom at : 12.19 m

Perforations

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

Perforated by

Annular Seal Bentonite Chips/Tablets
Placed from 0.91 m to 8.23 m
Amount 250.00 Pounds

Other Seals

Type	At (m)

Screen Type Plastic
Size OD : 6.35 cm

From (m)	To (m)	Slot Size (cm)
9.14	12.19	0.000

Attachment Attached To Casing
Top Fittings Riser Pipe
Bottom Fittings Plug

Pack
Type Sand
Grain Size 10-20
Amount 200.00 Pounds

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
CHAD NIEMANS

Certification No
46340A

Company Name
NIEMANS DRILLING (1980) LTD.

Copy of Well report provided to owner
Yes

Date approval holder signed
2014/06/04

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 1556535
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2014/06/04

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
SOUTH ROCK LTD	P.O. BOX 460	MEDICINE HAT	ALBERTA	CANADA	T1A 7G2

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	4	32	26	3	5				OBSERVATION WELL #7

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.255906 Longitude -114.392635
How Location Obtained
Differential corrected handheld GPS 5-10m

Elevation 1273.00 m
How Elevation Obtained
Differential corrected handheld GPS 5-10m

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level 91.44 cm
Is Artesian Flow
Rate L/min
Is Flow Control Installed
Describe

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

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

Additional Comments on Well
INSTALLED LOCKABLE PROTECTOR CASING AND CONCRETED INTO THE GROUND.

Yield Test

Taken From Ground Level | Measurement in Metric

Test Date	Start Time	Static Water Level
		m

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

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken		Diversion Date & Time
TOWN OF OKOTOKS	1818.44	L	2014/05/12 7:00 AM

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
CHAD NIEMANS

Certification No
46340A

Company Name
NIEMANS DRILLING (1980) LTD.

Copy of Well report provided to owner
Yes

Date approval holder signed
2014/06/04

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 2095665
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2014/12/04

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
CIRCLE J RANCHES LTD	RR 2	COCHRANE	ALBERTA	CANADA	T0L 0W0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SW	6	27	3	5				M. GILES

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.274608 Longitude -114.417737
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Drilling Information

Method of Drilling
Unknown

Proposed Well Use
Domestic & Stock

Type of Work
Well Inventory

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
25.60		Old Well

Yield Test Summary

Measurement in Metric

Recommended Pump Rate L/min

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

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
25.60 m		1934/06/30	

Borehole

Diameter (cm)	From (m)	To (m)

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

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

Perforations

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

Perforated by

Annular Seal
Placed from m to m
Amount

Other Seals

Type	At (m)

Screen Type
Size OD : cm

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

Attachment
Top Fittings Bottom Fittings

Pack
Type Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN DRILLER11

Certification No
11

Company Name
UNKNOWNDRILLINGCOMP11

Copy of Well report provided to owner | Date approval holder signed

Government of Alberta

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 2095665
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2014/12/04

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
CIRCLE J RANCHES LTD	RR 2	COCHRANE	ALBERTA	CANADA	T0L 0W0

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SW	6	27	3	5				M. GILES

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.274608 Longitude -114.417737
How Location Obtained: Not Verified

Elevation m
How Elevation Obtained: Not Obtained

Additional Information

Measurement in Metric

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

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

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

Additional Comments on Well

ORIGINAL WELL REPORT NOT IN GIC. THE FOLLOWING INFORMATION WAS TAKEN FROM DROUGHT EMERGENCY GROUNDWATER TESTING PROGRAM APPLICATION RECEIVED ON DECEMBER 04, 1984. OWNER REPORTS THIS WELL WAS BAILED OUT TO 4 FEET OF WATER, TOOK 1 DAY TO RECOVER, WERE GETTING 1 GPM CONSISTENTLY. OWNER REPORTS THAT WELL WAS CONSTRUCTED IN APPROXIMATELY 1934 AND IS APPROXIMATELY 84 FEET DEEP. ALREADY DRILLED ANOTHER WELL 391000.

Yield Test

Taken From Ground Level | Measurement in Metric

Test Date	Start Time	Static Water Level
		m

Method of Water Removal

Type
Removal Rate L/min
Depth Withdrawn From m

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	L	

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN DRILLER11

Certification No
11

Company Name
UNKNOWNDRILLINGCOMP11

Copy of Well report provided to owner

Date approval holder signed

APPENDIX D
Residential Well Assessment Questionnaires

Hydrogeological Assessment Report
Mountain Ash Limited Partnership Aggregate Operation
NW and SW Section 31, Twp 26, Rge 3 W5M
Rocky View County, Alberta
SLR Project No. 212.06650.00003

Water Well Reconnaissance Survey

SLR

SITE RECONNAISSANCE CHECKLIST

Project Name: WATERMAN AGGREGATE RESOURCE

Project Number: 203.50065.00001 **SLR Staff:** R. Till

Street Address: [redacted] - NW 31-26-3 W5M - 35181 BIG HILL SPRINGS ROAD

Property Type: Private Residence ☑ Commerical/Industrial ☐ Other _____

Person/Resident Interviewed: JULIE THORESON, BRUCE WATERMAN

Date of Visit: 29 OCT 2014 **Time:** 10:15

1. Well Owner Information

Name: BRUCE WATERMAN

Street Address: _____

Contact Number: Home: _____ Business: _____ Cell: _____

Email Address: _____

2. Well User/Occupant of the Residence Using the Well

Same as Well Owner ☐

If different from well owner please fill out details below:

Name: JULIE THORESON

Street Address: _____

Contact Number: Home: _____ Business: _____ Cell: _____

Email Address: _____

3. Well Details

Well Location Lot: NW 31-26-3 W5M Concession: _____ Township: _____

3A. Well Use

Water Use: (NO DRINKING, USES BOTTLED WATER)

Domestic:	☑	No. of people using water from the well:	1
Livestock:	☑	No. of livestock using water from the well:	7 HORSES + SHEEP + GOAT
Lawn Watering:	☐	Acres/area covered: _____	Approximate Amount: _____
Irrigation:	☐	Acres/area covered: _____	Approximate Amount: _____

3A. Well Use Continued

Additional Equipment: Pool: ☐ Jacuzzi/Hot Tub: ☐ Landscape water feature/fountain: ☐

Other: _____

Private waste and water disposal: Type (ex. Septic tank): SEPTIC TANK

System description: 1000 GAL TANK

Distance to Well: 75 ft Direction from well (N, S, E, or W): W

Well is: Uphill ☐ Downhill ☐ Same Grade ☑ as the waste water system

3B. Well Construction Details

Construction/Installation Date: UNKNOWN PRE-1960 Contractor: _____

Type of Installation: Drilled ☑ Dug ☐ Other: _____

Diameter: 6/8 INCH Well Depth (m): ~ 400 ft

Screen? UNKNOWN YES ☐ NO ☐

Screen length (m) _____

Depth to top of screen (m) _____

MOE Record Number: _____

Confirmed ☐ Inferred ☐

Is the well accesible for sampling? YES ☐ NO ☑

If no provide details: WELL HEAD APPROXIMATELY ~~6FT~~ 2m BELOW GROUND LEVEL IN A PIT

Location of measurement (top of pipe (TOP), ground surface): —

SLR staff member collecting the measurement: —

Date of original measurement: — Original/initial water level depth (m)

Subsequent water level measurements

Date						
Depth (m)						
Staff						

3C. Pumping Equipment

Pump Type: Suction-lift ☐ Pumping Capacity _____

Positive-submergence ☐ Age _____

How is the pump lubricated? _____

Depth of intake setting: Original (m) _____ Present (m) 100+ ft Pumping Rate (L/s) _____

Storage Tank: Type: CISTERN Capacity: 1000 GAL

Additional Features: Chlorinator ☐ Water softener ☐ Water filter ☐ Filter type: _____

NO TREATMENT

SLR

4. Well History

How long have you owned, operated or lived on this property? 7 YEARS

Have you ever experienced any previous problems with your well? SAND IN WELL

If so, when? ON GOING

What was the cause of the previous problem:

Drought		Pump Failure	
Plugging		Increased usage	
Interference		Contamination	✓

If the problem was contamination, what water quality changes were apparent? (Note any differences in taste, odour, colour or clarity)

SAND IN CISTERN, PIPES ETC

What action was taken to overcome this problem? FLUSHING + CHLORINATED

What were the effects of this action? CLEARED PROBLEM BUT PROBLEM CAME BACK

Did you ever have your well?

deepend,	YES ☐	NO ☑		
cleaned,	YES ☑	NO ☐	SHOCKED	
or a new well	YES ☐	NO ☑		

If so why?

Outline briefly any previous repairs or changes in pumping equipment, and dates

5. Sample Details – TAKEN FROM KITCHEN TAP – (NO TREATMENT ON SITE)

Date: 29/10/14 Sample Collected? YES ☑ NO ☐

Sample Name/Number: WW1 Number of Bottles: 2

Field Analysis Harness ____ Iron ____ Conductivity ____

pH ____ Temperature ____ Other ____

6. Contact Details

Permission for future monitoring? YES ☑ NO ☐

Well Aware Booklet:

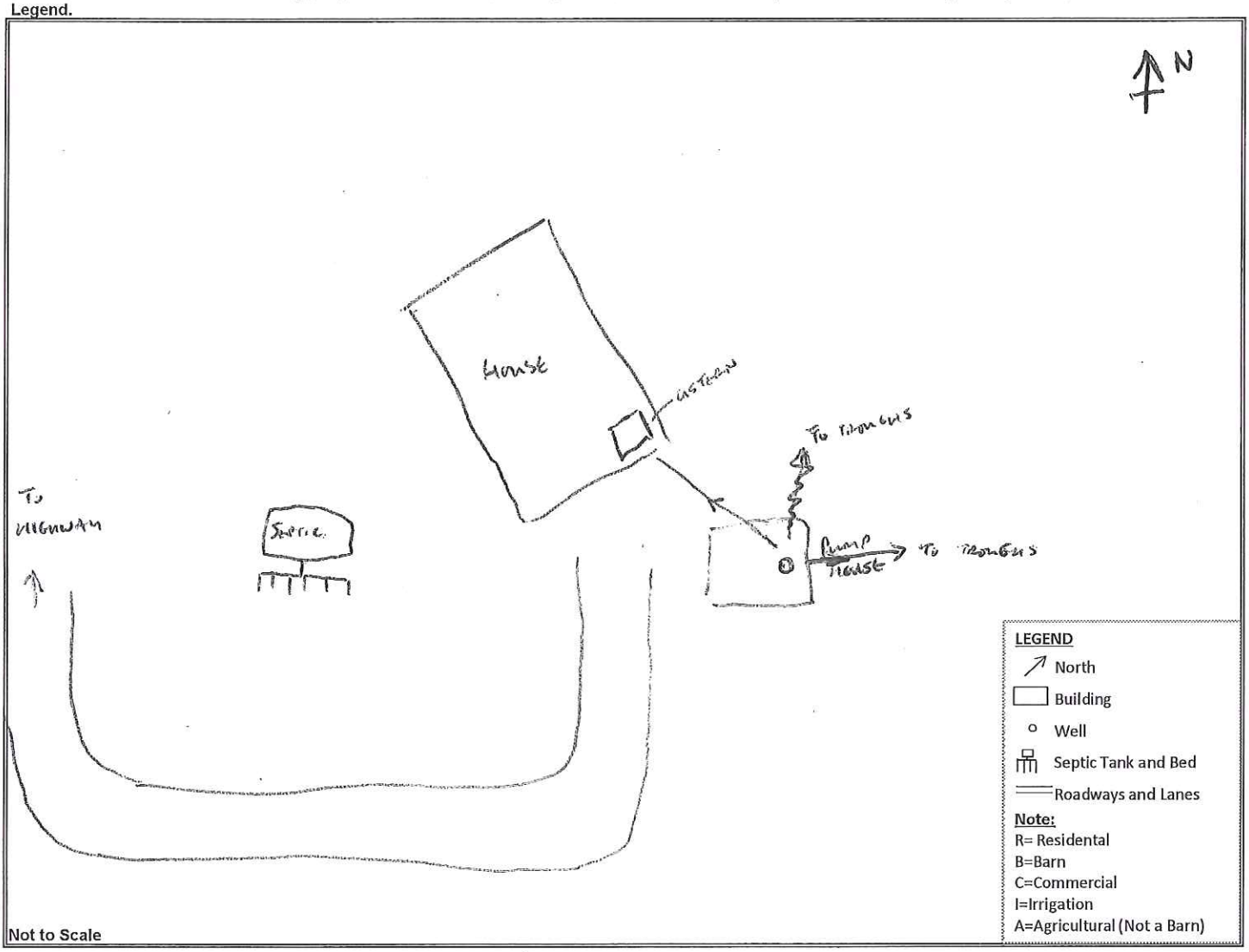
Perferred contact time/method: call/contact ahead ☑ site visit ☐

Contact by: email ☐ phone ☑ perferred contact number: ____

preferred contact time (evening, weekday, morning, etc.): ANY TIME DURING DAY

7. Well Location Sketch

Notes: shown location of water well(s), septic tanks and beds, laneways/roads, fences, site buildings, north arrow, and any distinguishing site features. Include Legend.



Well GPS _____ , _____

8. Site Photograph Log

Number of Photos Taken: _____

Photograph Number/Name	Description

Water Well Reconnaissance Survey

SLR

SITE RECONNAISSANCE CHECKLIST

Project Name: WATERMAN AGGREGATE RESOURCE

Project Number: 203.50065.00001 **SLR Staff:** R. TILL

Street Address: SE 31-26-3 WSM

Property Type: Private Residence ☑ Commerical/Industrial ☐ Other _____

Person/Resident Interviewed: MRS PARKER

Date of Visit: PHONE CALL 10 DEC 2014 **Time:** 16:30

1. Well Owner Information

Name: MRS PARKER

Street Address: Box 123 SE 31 26 3 WSM

Contact Number: Home: _____ Business: _____ Cell: _____

Email Address: _____

2. Well User/Occupant of the Residence Using the Well

Same as Well Owner ☑

If different from well owner please fill out details below:

Name: _____

Street Address: _____

Contact Number: Home: _____ Business: _____ Cell: _____

Email Address: _____

3. Well Details

Well Location Lot: IN HOUSE Concession: SE 31-26-3 WSM Township: _____

3A. Well Use

4 WELLS

Water Use:

Domestic:	☑	No. of people using water from the well:	2
Livestock:	☑	No. of livestock using water from the well:	100 HEAD CATTLE
Lawn Watering:	☐	Acres/area covered: _____	Approximate Amount: _____
Irrigation:	☐	Acres/area covered: _____	Approximate Amount: _____

3 ARTESIAN WELLS

3A. Well Use Continued

Additional Equipment: Pool: ☐ Jacuzzi/Hot Tub: ☐ Landscape water feature/fountain: ☐

Other: _____

Private waste and water disposal: Type (ex. Spectic tank): SEPTIC TANK

System description: _____

Distance to Well: 100 ft Direction from well (N, S, E, or W): $ DEPENDS ON WELL

Well is: Uphill ☑ Downhill ☐ Same Grade ☐ as the waste water system

3B. Well Construction Details

Construction/Installation Date: 1920's Contractor: OWNER

Type of Installation: Drilled ☐ Dug ☑ Other: _____

Diameter: 6" OR 8" Well Depth (m): 20 - 25 FEET

Screen? YES ☑ NO ☐

Screen length (m) _____

Depth to top of screen (m) _____

MOE Record Number: _____

Confirmed ☐ Inferred ☐

Is the well accesible for sampling? YES ☐ NO ☑

If no provide details: IN THE HOUSE

Location of measurement (top of pipe (TOP), ground surface): _____

SLR staff member collecting the measurement: _____

Date of original measurement: _____ Original/initial water level depth (m) 3 ARTESIAN - 10 ft Below Ground

Subsequent water level measurements

Date						
Depth (m)						
Staff						

3C. Pumping Equipment

Pump Type: Suction-lift ☐ SUBMERSIBLE Pumping Capacity _____

Positive-submergence ☐ Age _____

How is the pump lubricated? _____

Depth of intake setting: Original (m) _____ Present (m) _____ Pumping Rate (L/s) _____

Storage Tank: NO Type: _____ Capacity: _____

Additional Features: NO TREATMENT Chlorinator ☐ Water softener ☐ Water filter ☐ Filter type: _____

SLR

4. Well History

How long have you owned, operated or lived on this property? 1955

Have you ever experienced any previous problems with your well? NO

If so, when? _____

What was the cause of the previous problem:

Drought	✓	Pump Failure	✓
Plugging	✓	Increased usage	✓
Interference	✓	Contamination	✓

If the problem was contamination, what water quality changes were apparent? (Note any differences in taste, odour, colour or clarity)

_____

What action was taken to overcome this problem? _____

_____

What were the effects of this action? _____

Did you ever have your well?

deepend,	YES ☐	NO ☑
cleaned,	YES ☐	NO ☑
or a new well	YES ☐	NO ☑

If so why? _____

_____

Outline briefly any previous repairs or changes in pumping equipment, and dates 1966/67 PUMPS

_____

5. Sample Details

Date: _____ Sample Collected? YES ☐ NO ☐

Sample Name/Number: _____ Number of Bottles: _____

Field Analysis Harness _____ Iron _____ Conductivity _____

pH _____ Temperature _____ Other _____

6. Contact Details

Permission for future monitoring? YES ☐ NO ☑ – NOT UNTIL AFTER XMAS

Well Aware Booklet: _____

Perferred contact time/method: call/contact ahead ☐ site visit ☐

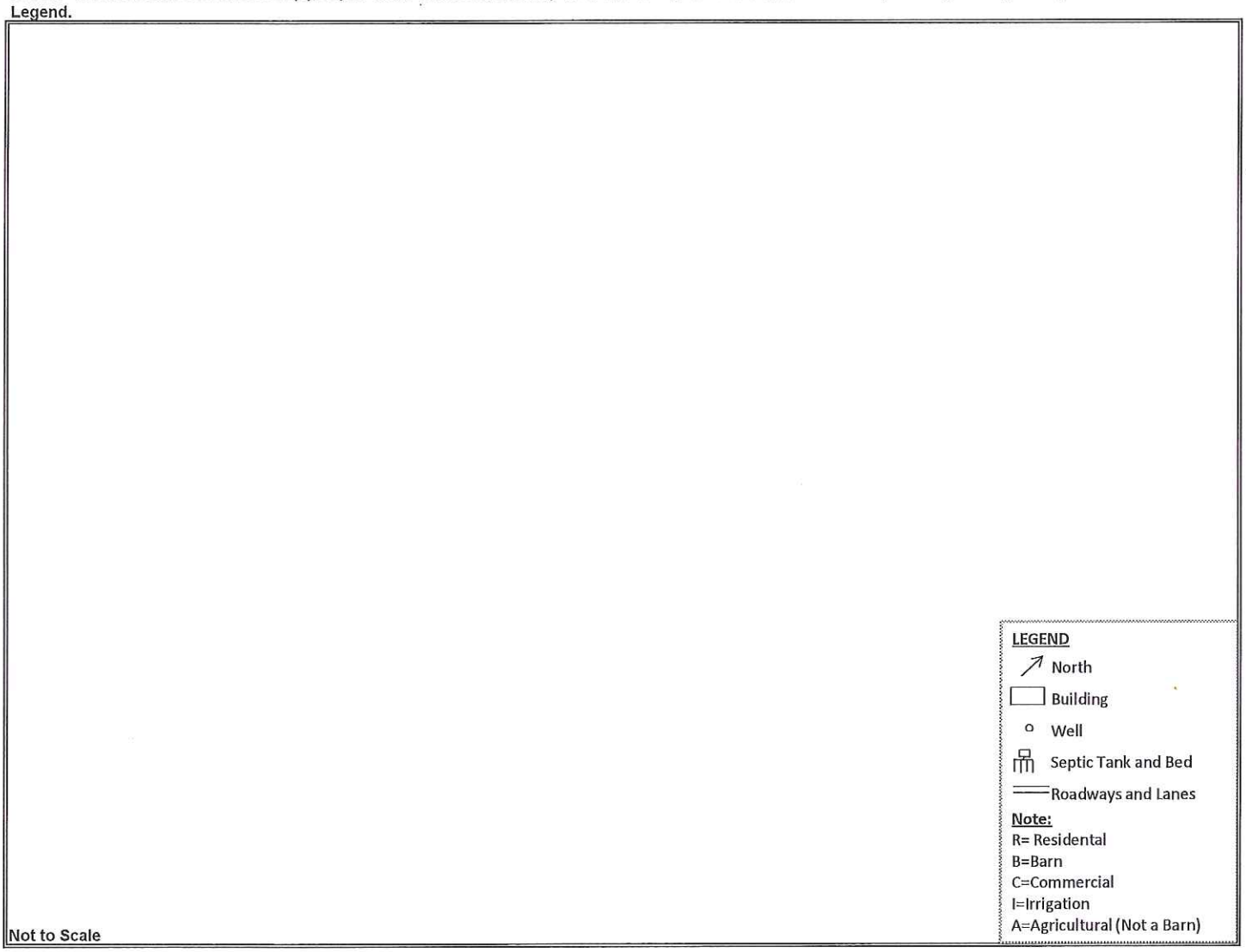
Contact by: email ☐ phone ☐ perferred contact number: _____

preferred contact time (evening, weekday, morning, etc.): _____

_____

7. Well Location Sketch

Notes: shown location of water well(s), septic tanks and beds, laneways/roads, fences, site buildings, north arrow, and any distinguishing site features. Include Legend.



Not to Scale

Well GPS _____

8. Site Photograph Log

Number of Photos Taken: _____

Photograph Number/Name	Description

Water Well Reconnaissance Survey

SLR

SITE RECONNAISSANCE CHECKLIST

Project Name: WATERMAN AGGREGATE RESOURCE

Project Number: 203.50065.00001 SLR Staff: R. TILL

Street Address: NE 31-26-3-WSM

Property Type: Private Residence ☑ Commerical/Industrial ☐ Other

Person/Resident Interviewed: CALVIN & [redacted] RAWN

Date of Visit: 29 OCT 2014 Time: 12:00

1. Well Owner Information

Name: CALVIN RAWN

Street Address: AS ABOVE

Contact Number: Home: Business: Cell: [redacted]

Email Address: [redacted]

2. Well User/Occupant of the Residence Using the Well

Same as Well Owner ☑

If different from well owner please fill out details below:

Name:

Street Address:

Contact Number: Home: Business: Cell:

Email Address:

3. Well Details

Well Location Lot: NE 31-26-3 WSM Concession: Township:

3A. Well Use

2 WELLS

Water Use:

Domestic: ☑ No. of people using water from the well: 5 (WW2)

Livestock: ☑ No. of livestock using water from the well: 40 HORSES (WW3)

Lawn Watering: ☐ Acres/area covered: Approximate Amount:

Irrigation: ☐ Acres/area covered: Approximate Amount:

3A. Well Use Continued

Additional Equipment: Pool: ☐ Jacuzzi/Hot Tub: ☐ Landscape water feature/fountain: ☐

Other: _____

Private waste and water disposal: Type (ex. Spectic tank): SEPTIC TANK

System description: _____

Distance to Well 2-300 ft Direction from well (N, S, E, or W) EAST

Well is Uphill ☐ Downhill ☐ Same Grade ☑ as the waste water system

3B. Well Construction Details

Construction/Installation Date: _____ Contractor: _____

Type of Installation: Drilled ☑ Dug ☐ Other: _____

Diameter: 6 INCH Well Depth (m): HOUSE 177 + BARN 135 ft

Screen? YES ☐ NO ☐

Screen length (m) _____

Depth to top of screen (m) _____

MOE Record Number: _____

Confirmed ☐ Inferred ☐

Is the well accesible for sampling? YES ☑ (WW2) NO ☑ (WW3)

If no provide details: WW3 BLOCKED @ 27.5m bTOP

Location of measurement (top of pipe (TOP), ground surface): TOP

SLR staff member collecting the measurement: ROBERT TILL

Date of original measurement: 29/OCT/2014 Original/initial water level depth (m) 29.65 m bTOP (WW2)

Subsequent water level measurements – WW2 – LOGGER INSTALLED

Date						
Depth (m)						
Staff						

3C. Pumping Equipment

Pump Type: Suction-lift ☐ SUBMERSIBLE Pumping Capacity —

Positive-submergence ☐ Age 10 YRS + 5 YRS

How is the pump lubricated? _____

Depth of intake setting: Original (m) _____ Present (m) WW2 160 ft + WW3 125 ft Pumping Rate (L/s) _____

Storage Tank: Type: CISTERN Capacity: WW2 400 GAL (HOUSE) + WW3 750 GAL

Additional Features: Chlorinator ☐ Water softener ☑ HOUSE Water filter ☑ HOUSE Filter type: PARTICULATE

SLR

4. Well History

How long have you owned, operated or lived on this property? 10 YRS

Have you ever experienced any previous problems with your well? NO

If so, when? _____

What was the cause of the previous problem:

Drought		Pump Failure	
Plugging		Increased usage	
Interference		Contamination	

If the problem was contamination, what water quality changes were apparent? (Note any differences in taste, odour, colour or clarity)

N/A

What action was taken to overcome this problem? N/A

What were the effects of this action? N/A

Did you ever have your well?

deepend,	YES	☐	NO	☑
cleaned,	YES	☐	NO	☑
or a new well	YES	☐	NO	☑

If so why? _____

Outline briefly any previous repairs or changes in pumping equipment, and dates REPLACED HOUSE PUMP

5. Sample Details

WW2 - STANDPIPE AT BACK OF PUMP HOUSE, WW3 - HOSE IN STABLES (NO TREATMENT)

Date: 29 OCT 2014 Sample Collected? YES ☑ NO ☐

Sample Name/Number: WW2 + WW3 Number of Bottles: 2 EACH

Field Analysis Harness _____ Iron _____ Conductivity 577 µS/cm

pH 7.62 Temperature 6.4°C Other _____

6. Contact Details

Permission for future monitoring? YES ☑ NO ☐

Well Aware Booklet: _____

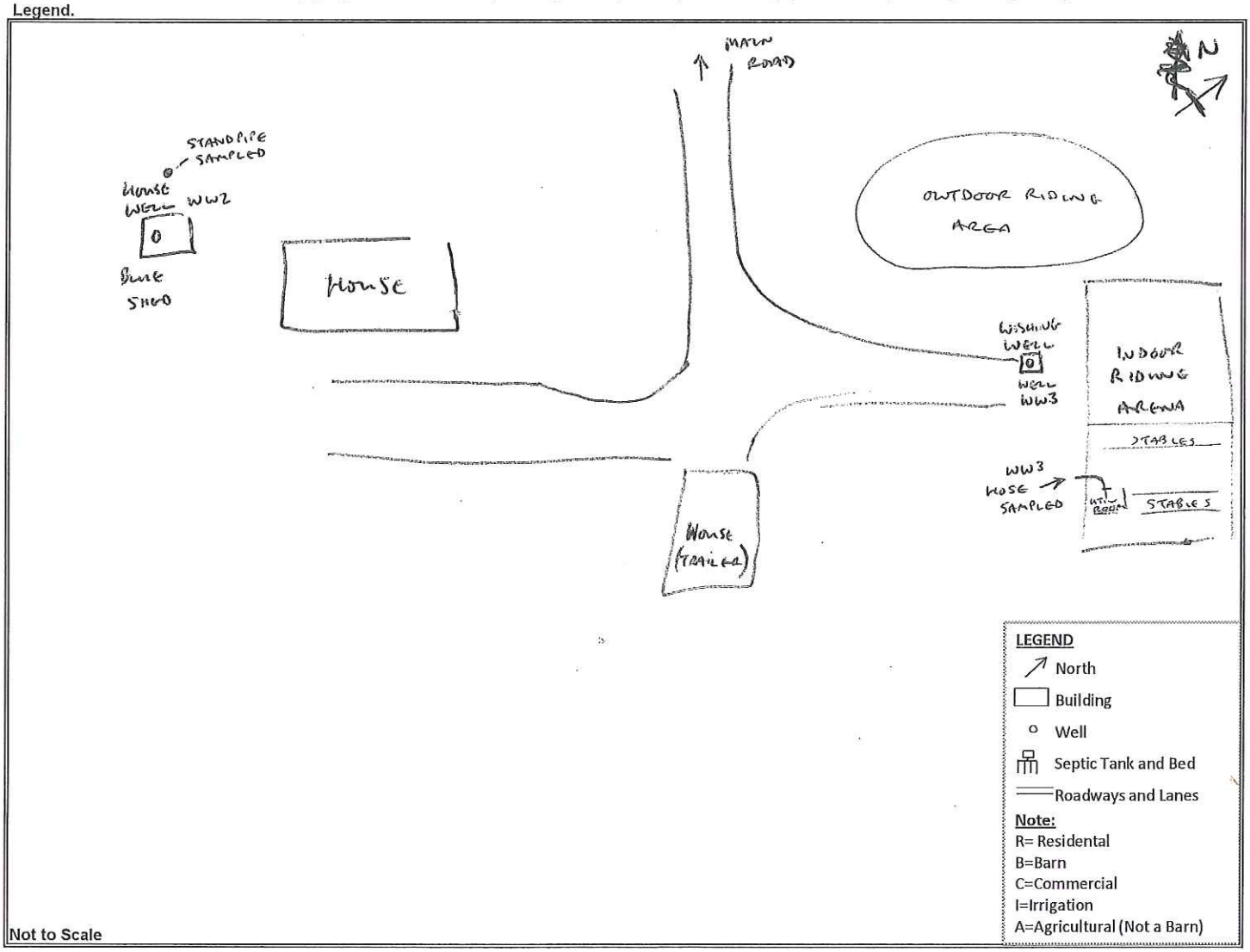
Perferred contact time/method: call/contact ahead ☑ site visit ☐

Contact by: email ☐ phone ☐ perferred contact number: _____

preferred contact time (evening, weekday, morning, etc.): DURING DAY - ANY REASONABLE HOUR

7. Well Location Sketch

Notes: shown location of water well(s), septic tanks and beds, laneways/roads, fences, site buildings, north arrow, and any distinguishing site features. Include Legend.



Well GPS WW2 - 0680992 m , 5682772 m WW3 - 0681169 m , 5682906 m

8. Site Photograph Log

Number of Photos Taken: _____

Photograph Number/Name	Description

Water Well Reconnaissance Survey

SLR

SITE RECONNAISSANCE CHECKLIST

Project Name: WATERMAN AGGREGATE RESOURCE

Project Number: 203.50065.00001 SLR Staff: R. TILL

Street Address: SW 31-26-03 W5M

Property Type: Private Residence ☑ Commerical/Industrial ☐ Other _____

Person/Resident Interviewed: JOHN NUGTER

Date of Visit: 30 OCTOBER 2014 Time: 11:20

1. Well Owner Information

Name: JOHN NUGTER

Street Address: AS ABOVE

Contact Number: Home: _____ Business: _____ Cell: [redacted]

Email Address: _____

2. Well User/Occupant of the Residence Using the Well

Same as Well Owner ☑

If different from well owner please fill out details below:

Name: _____

Street Address: _____

Contact Number: Home: _____ Business: _____ Cell: _____

Email Address: _____

3. Well Details

Well Location Lot: SW 31-26-03 W5M Concession: _____ Township: _____

3A. Well Use

Water Use:

Domestic:	☑	No. of people using water from the well:	3	
Livestock:	☑	No. of livestock using water from the well:	25 CATTLE, 5 HORSES	
Lawn Watering:	☐	Acres/area covered: _____	Approximate Amount:	_____
Irrigation:	☐	Acres/area covered: _____	Approximate Amount:	_____

3A. Well Use Continued

Additional Equipment: Pool: ☐ Jacuzzi/Hot Tub: ☐ Landscape water feature/fountain: ☐

Other: _____

Private waste and water disposal: Type (ex. Spectic tank): SEPTIC TANKS (2 TANKS)

System description: 1 TANK FOR HOUSE + 1 FOR RENTAL HOUSE

Distance to Well _____ Direction from well (N, S, E, or W) _____

Well is Uphill ☐ Downhill ☐ Same Grade ☐ as the waste water system

3B. Well Construction Details

Construction/Installation Date: 1990 Contractor: LOU'S WATER WELL DRILLING

Type of Installation: Drilled ☑ Dug ☐ Other: _____

Diameter: _____ Well Depth (m): 115 ft

Screen? YES ☑ NO ☐

Screen length (m) _____

Depth to top of screen (m) _____

MOE Record Number: 350194

Is the well accesible for sampling? YES ☑ NO ☐

Confirmed ☑ Inferred ☐

If no provide details: _____

Location of measurement (top of pipe (TOP), ground surface): TOP

SLR staff member collecting the measurement: ROBERT TILL

Date of original measurement: 30 OCTOBER 2014 Original/initial water level depth (m) 11.734 mbToC

Subsequent water level measurements

Date						
Depth (m)						
Staff						

3C. Pumping Equipment

Pump Type: Suction-lift ☐ SUBMERSIBLE Pumping Capacity 30 GAL/MIN

Positive-submergence ☐ Age 2006

How is the pump lubricated? _____

Depth of intake setting: Original (m) _____ Present (m) 100 ft ? Pumping Rate (L/s) _____

Storage Tank: Type: N/A Capacity: _____

Additional Features: Chlorinator ☐ Water softener ☐ Water filter ☐ Filter type: _____

NO TREATMENT

SLR

4. Well History

How long have you owned, operated or lived on this property? 17 YEARS

Have you ever experienced any previous problems with your well? NO

If so, when? _____

What was the cause of the previous problem:

Drought		Pump Failure	
Plugging		Increased usage	
Interference		Contamination	

If the problem was contamination, what water quality changes were apparent? (Note any differences in taste, odour, colour or clarity)

What action was taken to overcome this problem? _____

What were the effects of this action? _____

Did you ever have your well?

deepend,	YES	☐	NO	☑
cleaned,	YES	☐	NO	☑
or a new well	YES	☐	NO	☑

If so why? _____

Outline briefly any previous repairs or changes in pumping equipment, and dates CHANGED PUMP 2006

5. Sample Details

Date: 30 OCT 2014 Sample Collected? YES ☑ NO ☐

Sample Name/Number: WW4 Number of Bottles: 2

Field Analysis Harness _____ Iron _____ Conductivity 606 µS/cm

pH 5.44 ? Temperature 5.1°C Other _____

6. Contact Details

Permission for future monitoring? YES ☑ NO ☐

Well Aware Booklet: _____

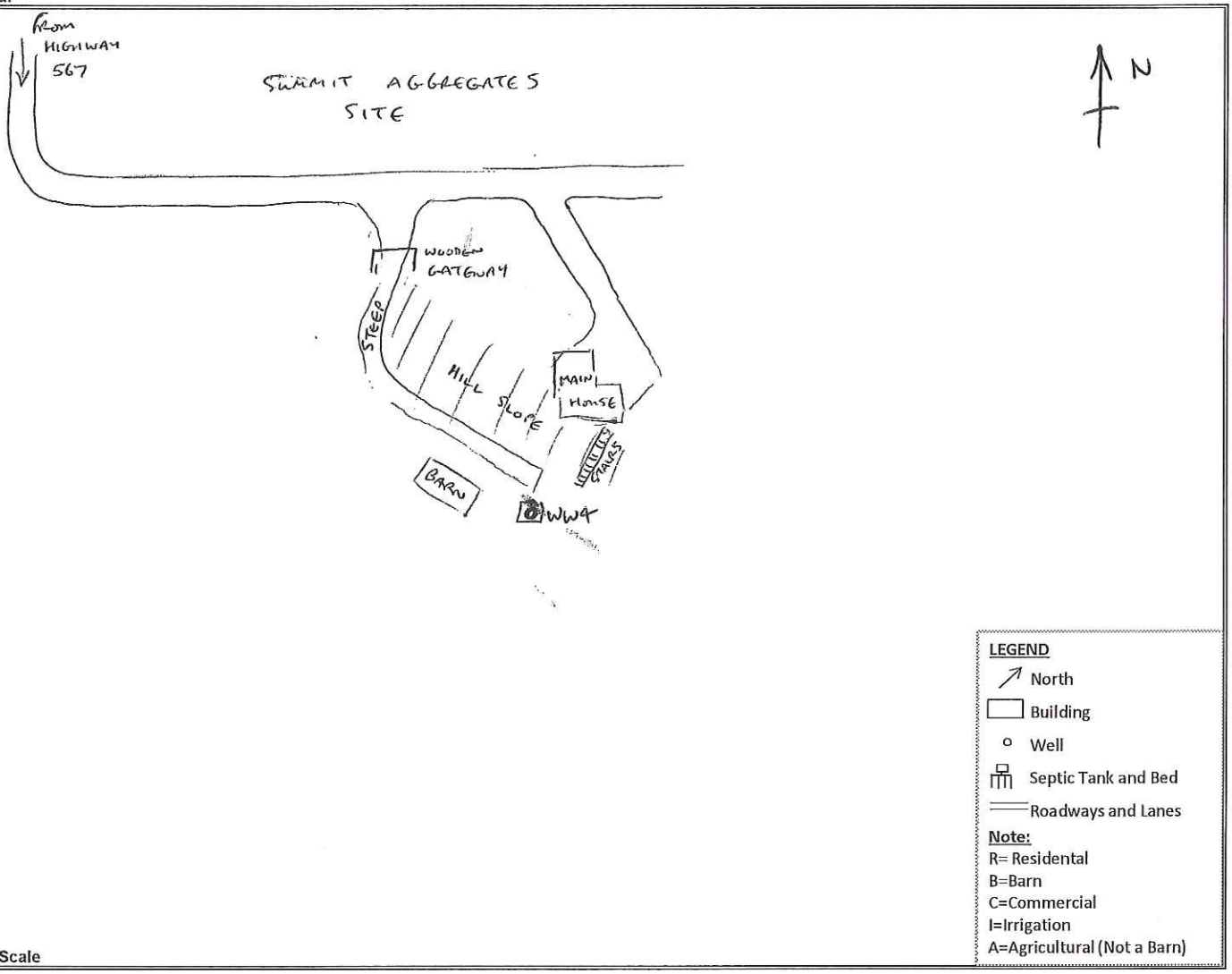
Perferred contact time/method: call/contact ahead ☑ site visit ☐

Contact by: email ☐ phone ☑ perferred contact number:

preferred contact time (evening, weekday, morning, etc.): _____

7. Well Location Sketch

Notes: shown location of water well(s), septic tanks and beds, laneways/roads, fences, site buildings, north arrow, and any distinguishing site features. Include Legend.



Not to Scale

Well GPS 0680258 . 5682090 .

8. Site Photograph Log

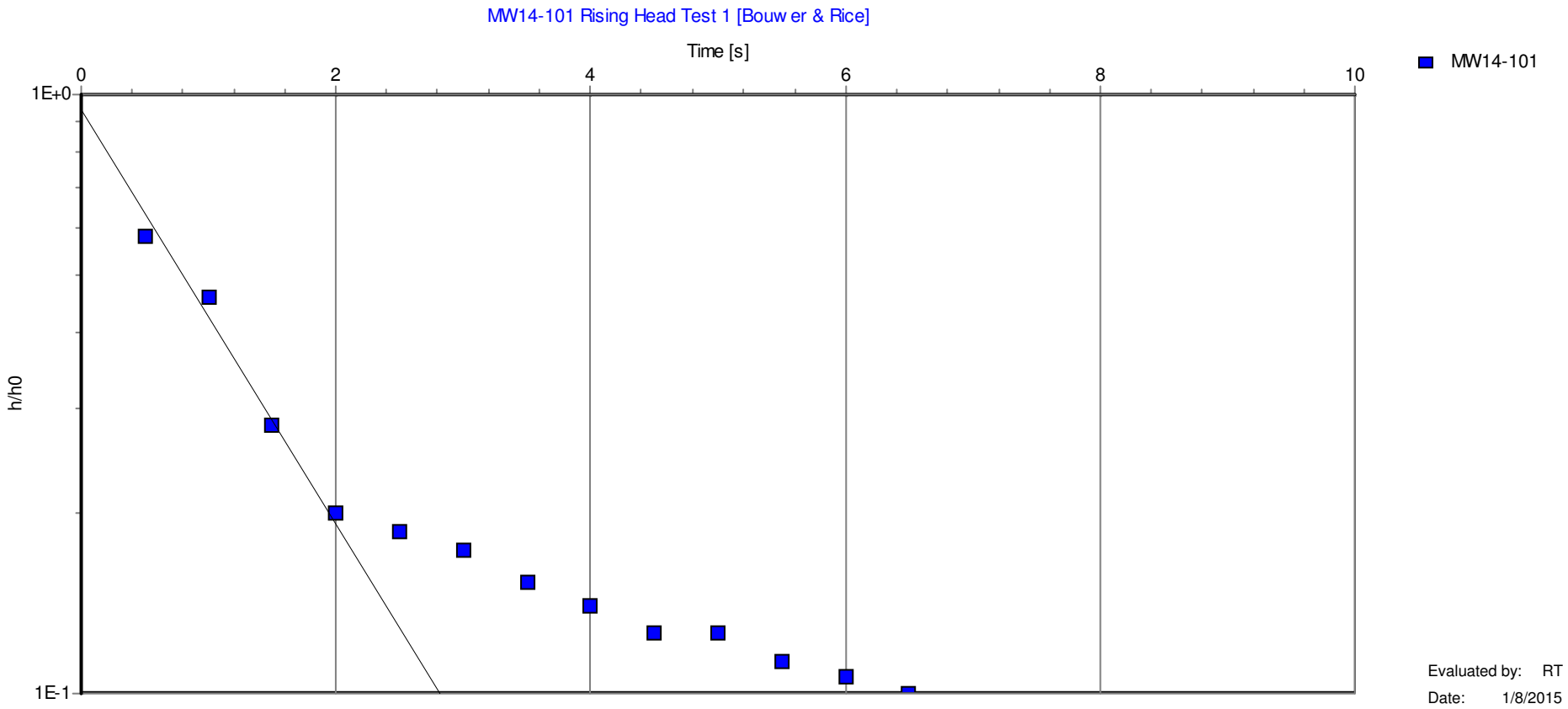
Number of Photos Taken: _____

Photograph Number/Name	Description

APPENDIX E
Hydraulic Conductivity Test Analysis

Hydrogeological Assessment Report
Mountain Ash Limited Partnership Aggregate Operation
NW and SW Section 31, Twp 26, Rge 3 W5M
Rocky View County, Alberta
SLR Project No. 212.06650.00003

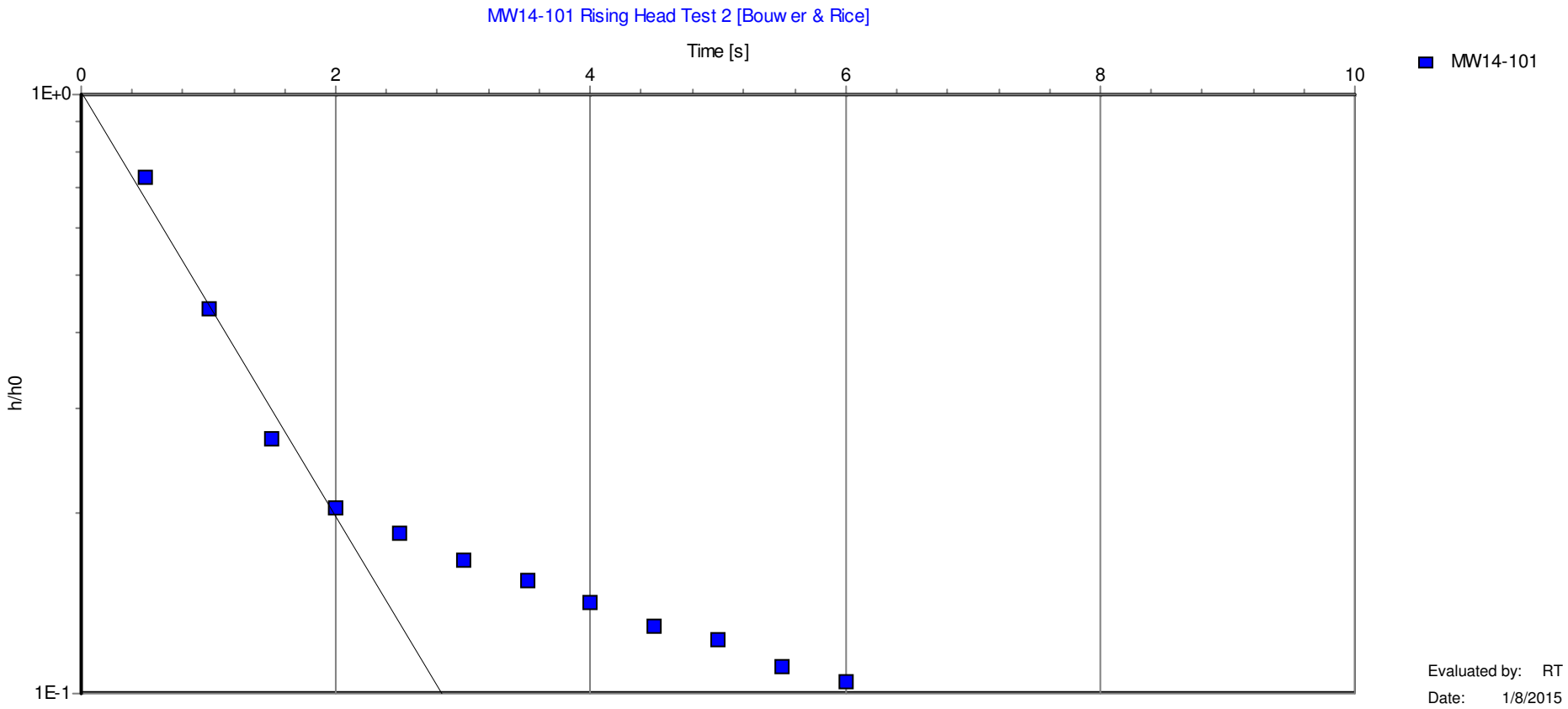
SLR	**Analysis Report**	**Slug Test:** **MW14-101 Rising Head Test 1**
	Project: Summit Aggregate Resource	**Analysis Method:** **Bouwer & Rice**
	Number: 203.50065.00001	Comments:
	Client: Summit Aggregates	Saturated screen length = 4.5 [m] Max. Head Change = 0.45 [m] R (eff) not used in analysis



Analysis results: Conductivity: 1.85E-4 [m/s]

Test parameters:				
	Test Well:	MW14-101	r(eff):	0.044 [m]
	Screen radius:	0.0254 [m]	Aquifer thickness:	5.325 [m]
	Screen length:	4.5 [m]	Boring radius:	0.0762 [m]

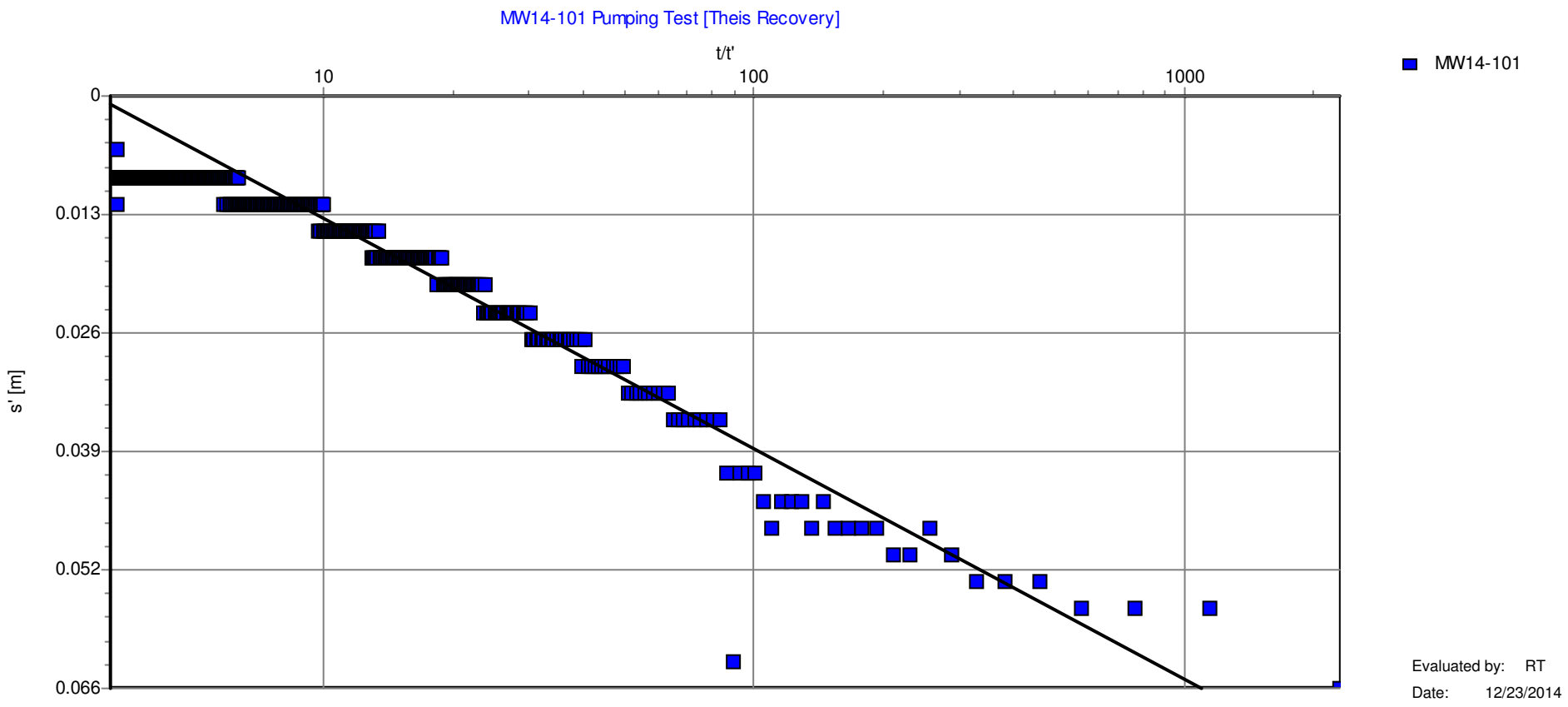
SLR	**Analysis Report**	**Slug Test:** **MW14-101 Rising Head Test 2**
	Project: Summit Aggregate Resource	**Analysis Method:** **Bouwer & Rice**
	Number: 203.50065.00001	Comments:
	Client: Summit Aggregates	Saturated screen length = 4.5 [m] Max. Head Change = 0.49 [m] R (eff) not used in analysis



Analysis results: Conductivity: 1.91E-4 [m/s]

Test parameters:				
	Test Well:	MW14-101	r(eff):	0.044 [m]
	Screen radius:	0.0254 [m]	Aquifer thickness:	5.325 [m]
	Screen length:	4.5 [m]	Boring radius:	0.0762 [m]

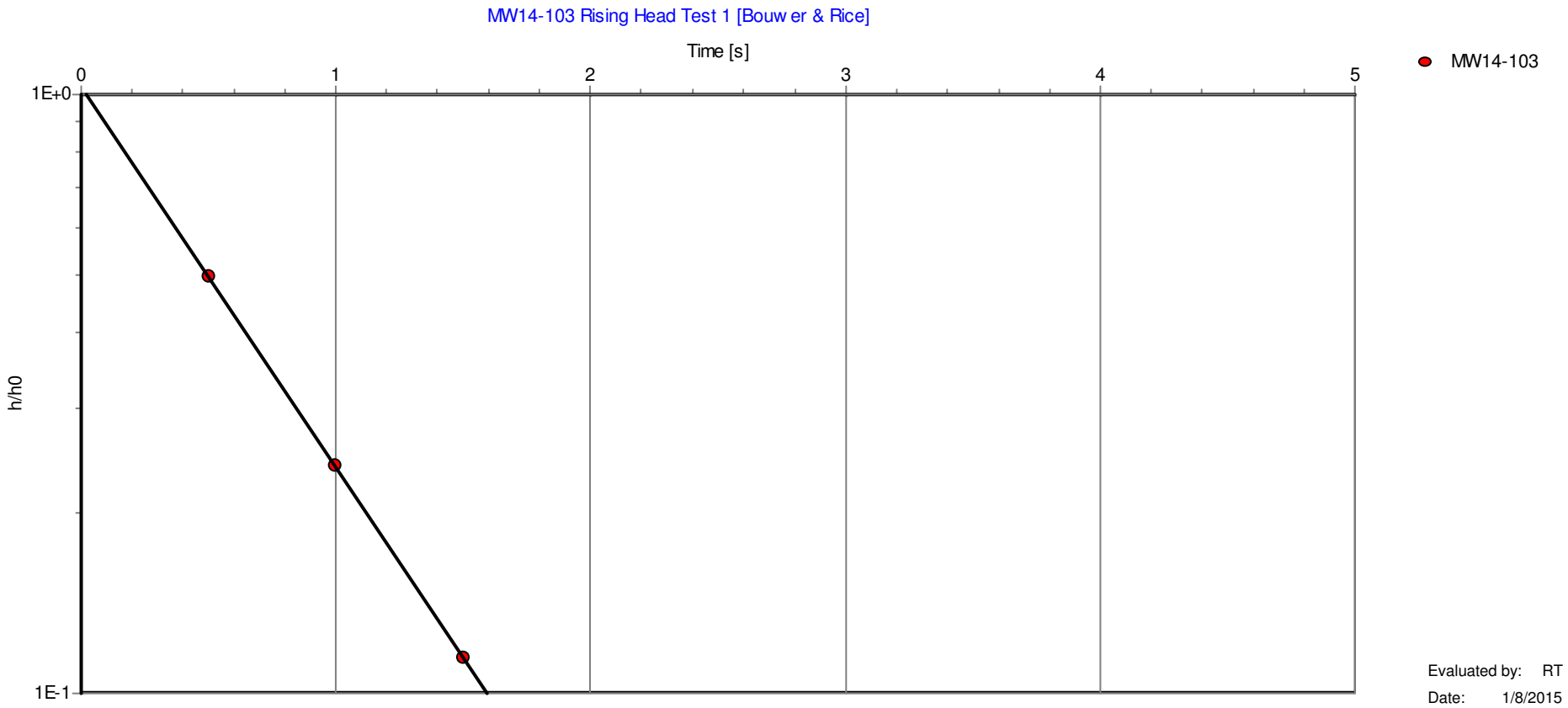
SLR	**Analysis Report**	**Pumping Test:** **MW14-101 Yield Test**
	Project: Summit Aggregate Resource	**Analysis Method:** **Theis Recovery**
	Number: 203.50065.00001	Comments:
	Client: Summit Aggregates	Saturated screen length = 4.50 [m] Max. Head Change = 0.09 [m] R (eff) not used in analysis



Analysis results:	Transmissivity:	5.75E-4 [m²/s]	Conductivity:	1.08E-4 [m/s]

Test parameters:	Pumping Well:	MW14-101	Pumping Time	1148 [s]
	Screen radius:	0.0254 [m]	Aquifer thickness:	5.325 [m]
	Screen length:	4.5 [m]	Boring radius:	0.0762 [m]
			Discharge Rate:	8E-5 [m³/s]

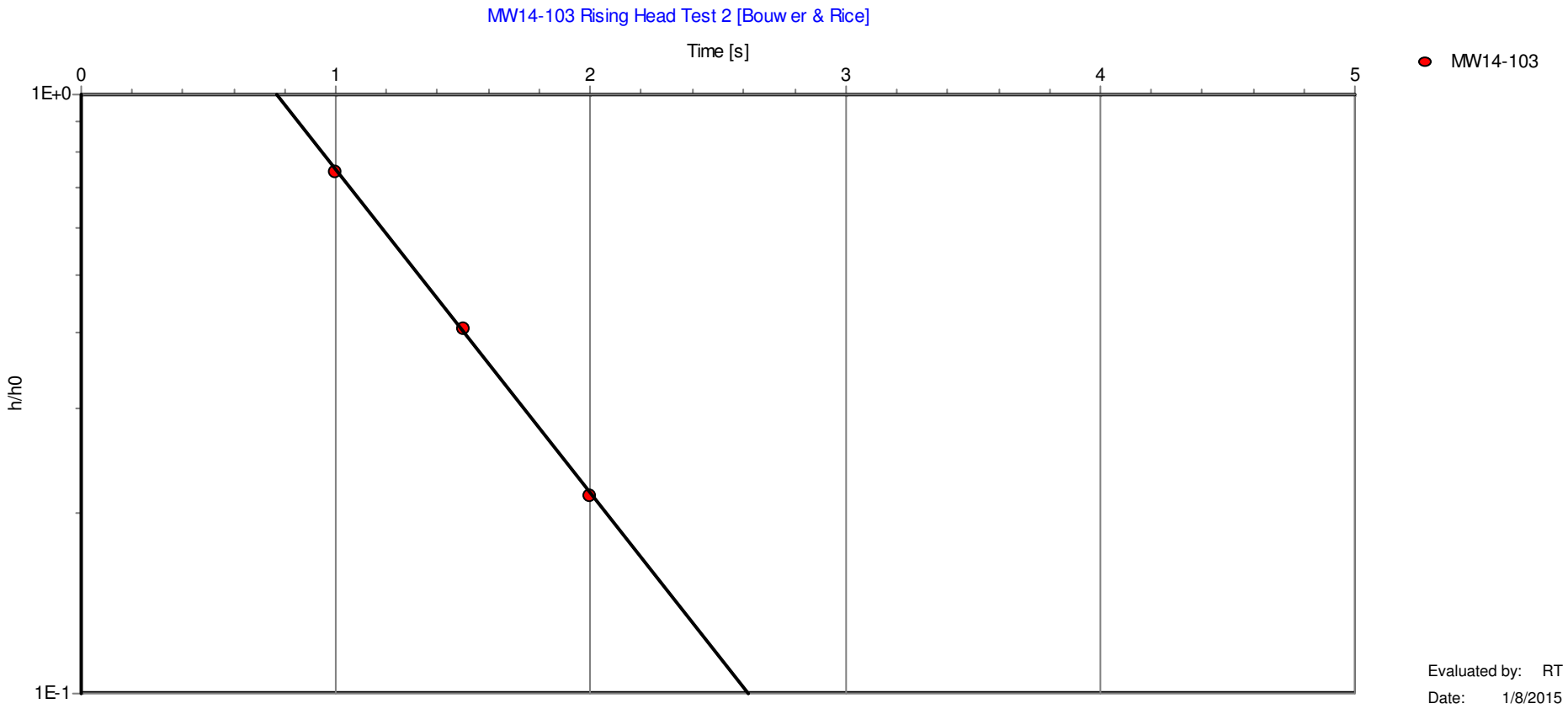
	Analysis Report	**Slug Test:** **MW14-103 Rising Head Test 1**
	Project: Summit Aggregate Resource	**Analysis Method:** **Bouwer & Rice**
	Number: 203.50065.00001	Comments:
	Client: Summit Aggregates	Saturated screen length = 4.36 [m] Max. Head Change = 0.58 [m] R (eff) not used in analysis



Analysis results: Conductivity: 3.28E-4 [m/s]

Test parameters:				
	Test Well:	MW14-103	r(eff):	0.044 [m]
	Screen radius:	0.0254 [m]	Aquifer thickness:	4.357 [m]
	Screen length:	4.5 [m]	Boring radius:	0.0762 [m]

	Analysis Report	**Slug Test:** **MW14-103 Rising Head Test 2**
	Project: Summit Aggregate Resource	**Analysis Method:** **Bouwer & Rice**
	Number: 203.50065.00001	Comments:
	Client: Summit Aggregates	Saturated screen length = 4.36 [m] Max. Head Change = 0.65 [m] R (eff) not used in analysis



Analysis results: Conductivity: 2.79E-4 [m/s]

Test parameters:				
	Test Well:	MW14-103	r(eff):	0.044 [m]
	Screen radius:	0.0254 [m]	Aquifer thickness:	4.357 [m]
	Screen length:	4.5 [m]	Boring radius:	0.0762 [m]

Analysis Report	Pumping Test: WW2 Yield Test
Project: Summit Aggregate Resource	**Analysis Method: Cooper-Jacob Time-Drawdown**
Number: 203.50065.00001	Comments:
Client: Summit Aggregates	Saturated screen length = 7.62 [m] Max. Head Change = >7 [m] R (eff) not used in analysis

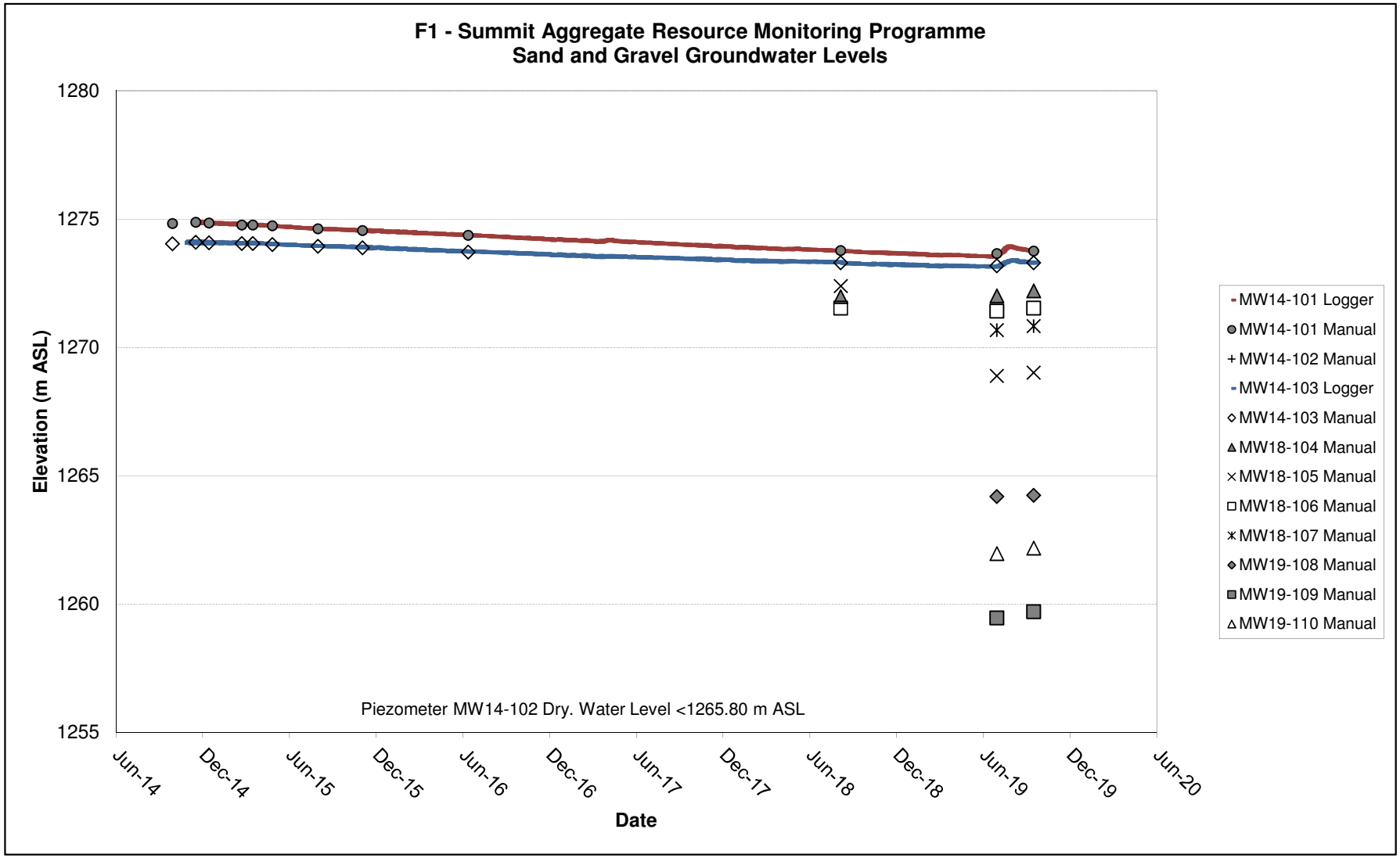
Analysis results: Transmissivity: 4.63E-6 [m²/s] Conductivity: 2.18E-7 [m/s]

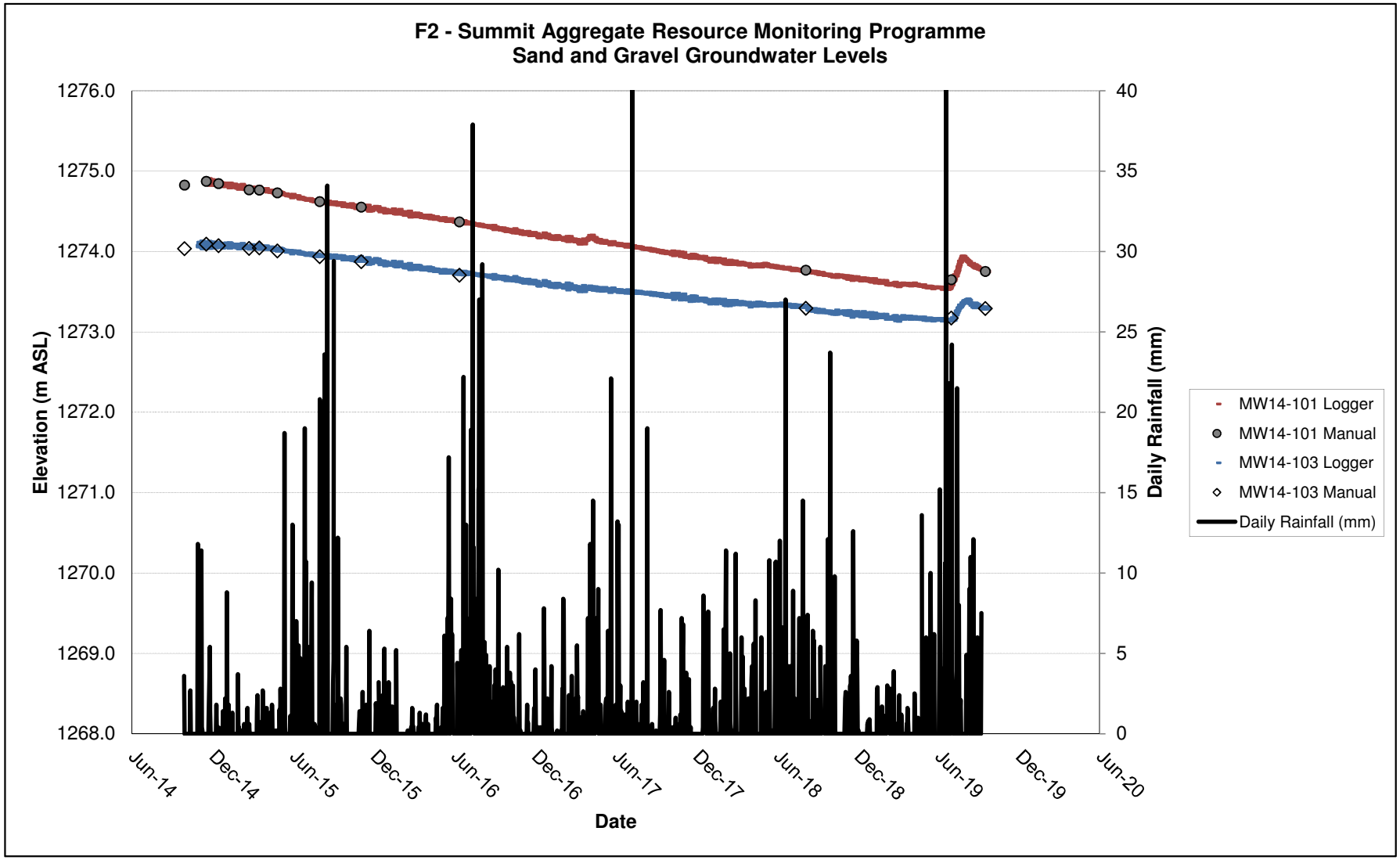
Test parameters:

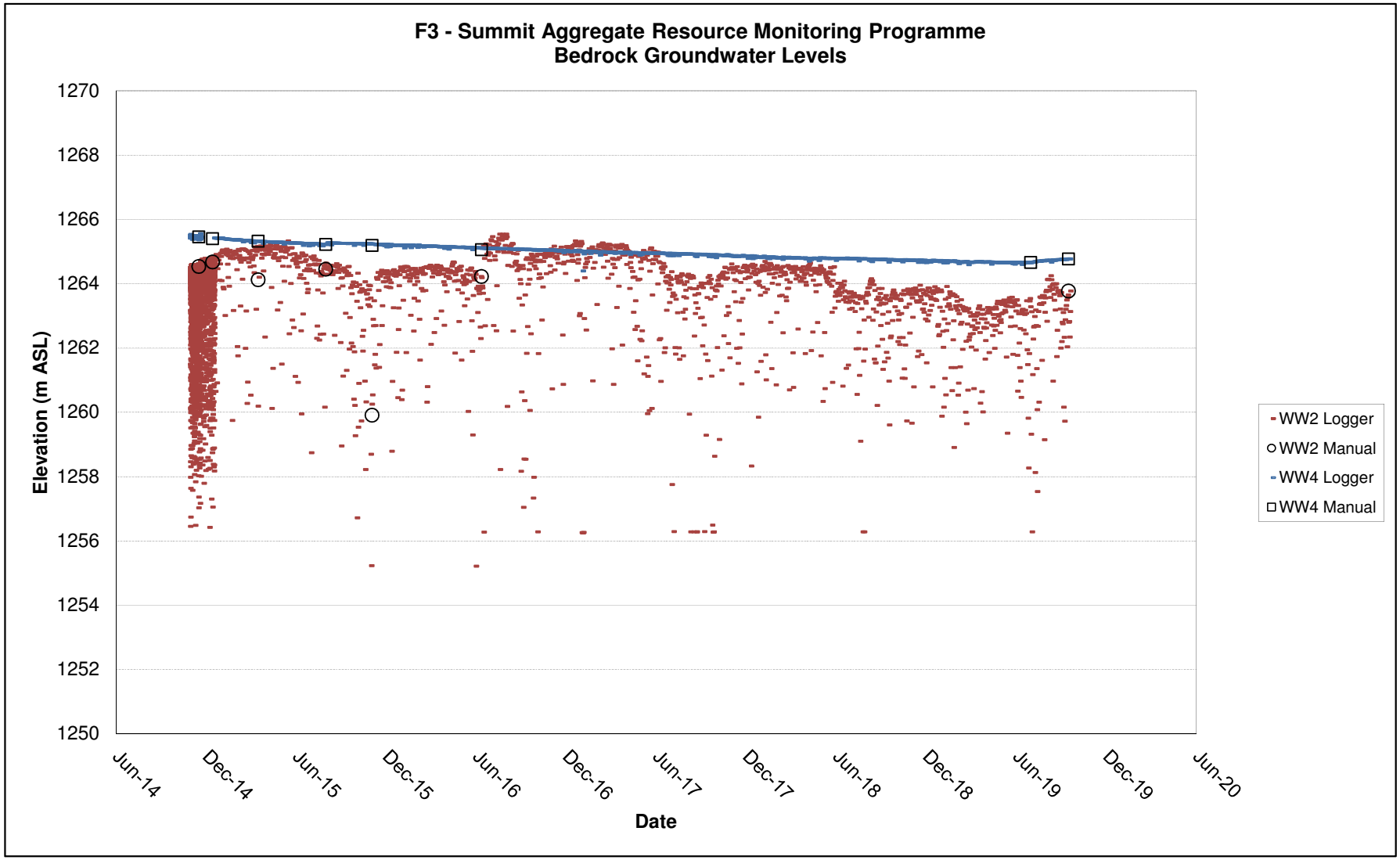
Pumping Well:	WW2		
Screen radius:	0.051 [m]	Aquifer thickness:	21.25 [m]
Screen length:	7.62 [m]	Boring radius:	0.111 [m]
		Discharge Rate:	0.000196 [m³/s]

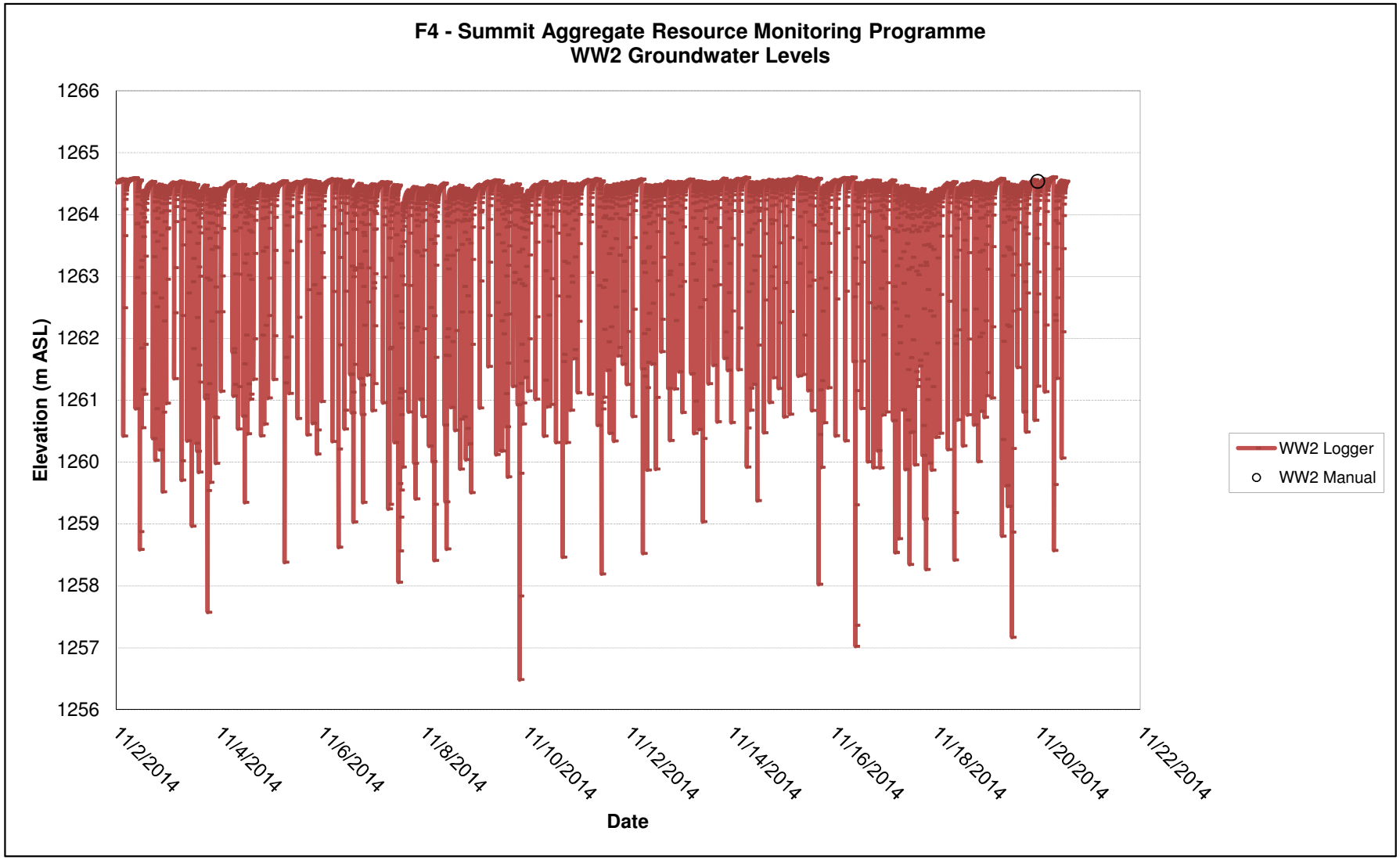
APPENDIX F
Groundwater Elevation Data

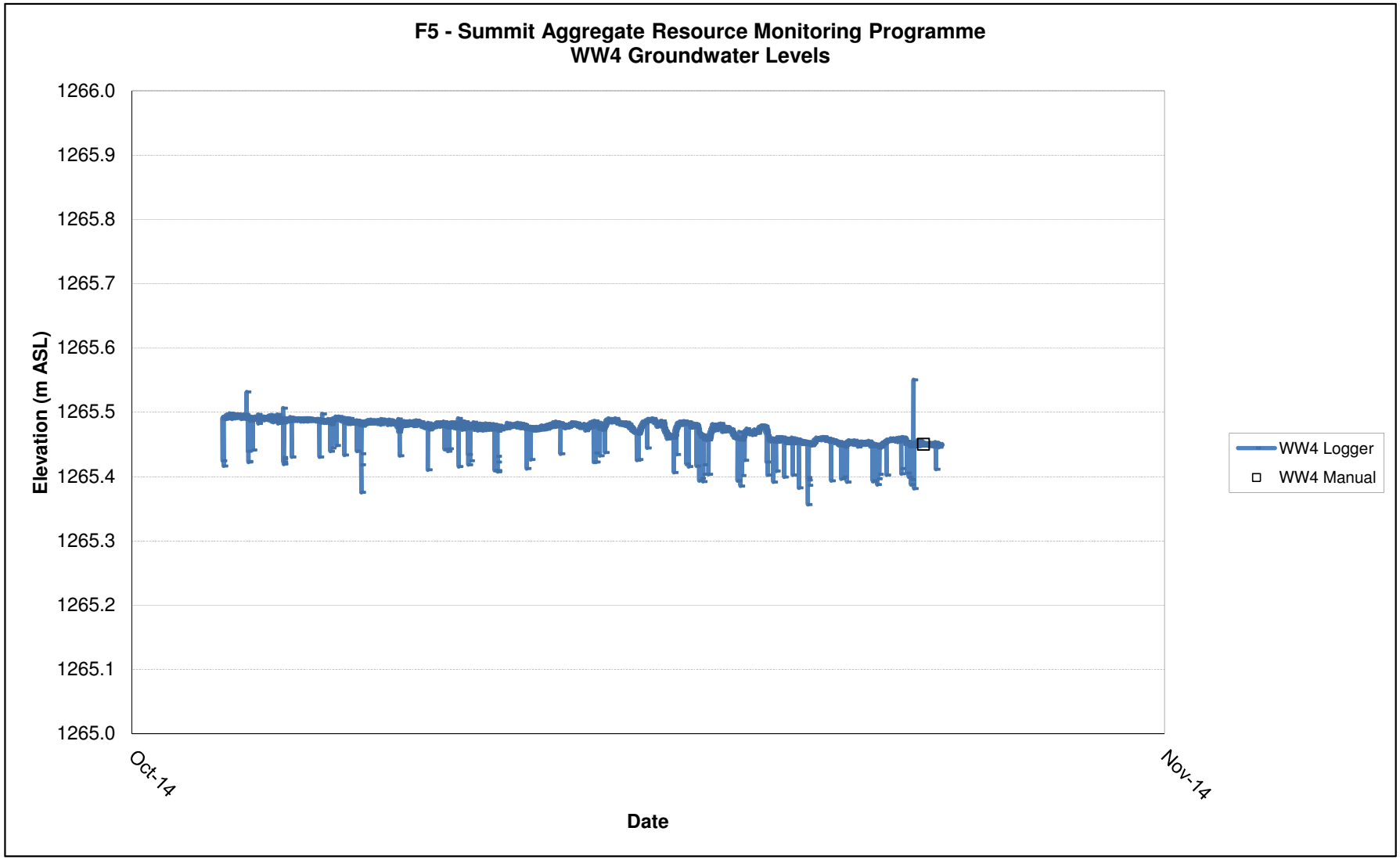
Hydrogeological Assessment Report
Mountain Ash Limited Partnership Aggregate Operation
NW and SW Section 31, Twp 26, Rge 3 W5M
Rocky View County, Alberta
SLR Project No. 212.06650.00003


F1 - Summit Aggregate Resource Monitoring Programme
Sand and Gravel Groundwater Levels
Elevation (m ASL)
1280
1275
1270
1265
1260
1255
Jun-14
Dec-14
Jun-15
Dec-15
Jun-16
Dec-16
Jun-17
Dec-17
Jun-18
Dec-18
Jun-19
Dec-19
Jun-20
Date
Piezometer MW14-102 Dry. Water Level <1265.80 m ASL
MW14-101 Logger
MW14-101 Manual
MW14-102 Manual
MW14-103 Logger
MW14-103 Manual
MW18-104 Manual
MW18-105 Manual
MW18-106 Manual
MW18-107 Manual
MW19-108 Manual
MW19-109 Manual
MW19-110 Manual


F2 - Summit Aggregate Resource Monitoring Programme
Sand and Gravel Groundwater Levels
Elevation (m ASL)
Daily Rainfall (mm)
Date
1276.0
1275.0
1274.0
1273.0
1272.0
1271.0
1270.0
1269.0
1268.0
40
35
30
25
20
15
10
5
0
Jun-14
Dec-14
Jun-15
Dec-15
Jun-16
Dec-16
Jun-17
Dec-17
Jun-18
Dec-18
Jun-19
Dec-19
Jun-20
MW14-101 Logger
MW14-101 Manual
MW14-103 Logger
MW14-103 Manual
Daily Rainfall (mm)


F3 - Summit Aggregate Resource Monitoring Programme
Bedrock Groundwater Levels
Elevation (m ASL)
1270
1268
1266
1264
1262
1260
1258
1256
1254
1252
1250
Jun-14
Dec-14
Jun-15
Dec-15
Jun-16
Dec-16
Jun-17
Dec-17
Jun-18
Dec-18
Jun-19
Dec-19
Jun-20
Date
WW2 Logger
WW2 Manual
WW4 Logger
WW4 Manual


F4 - Summit Aggregate Resource Monitoring Programme
WW2 Groundwater Levels
Elevation (m ASL)
1266
1265
1264
1263
1262
1261
1260
1259
1258
1257
1256
11/2/2014
11/4/2014
11/6/2014
11/8/2014
11/10/2014
11/12/2014
11/14/2014
11/16/2014
11/18/2014
11/20/2014
11/22/2014
Date
WW2 Logger
WW2 Manual


F5 - Summit Aggregate Resource Monitoring Programme
WW4 Groundwater Levels
1266.0
1265.9
1265.8
1265.7
1265.6
1265.5
1265.4
1265.3
1265.2
1265.1
1265.0
Elevation (m ASL)
Oct-14
Nov-14
Date
WW4 Logger
WW4 Manual

APPENDIX G
Laboratory Analytical Reports

Hydrogeological Assessment Report
Mountain Ash Limited Partnership Aggregate Operation
NW and SW Section 31, Twp 26, Rge 3 W5M
Rocky View County, Alberta
SLR Project No. 212.06650.00003

333 50th Ave. S.E.
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KaizenLAB

ANALYTICAL REPORT

Client: SLR Consulting (Canada) Ltd.
6940 Roper Rd NW
Edmonton, AB T6B 3H9

Attention: Robert Till

KaizenLAB JOB #:	**167115**
DATE RECEIVED:	30-Oct-2014
DATE REPORTED:	05-Nov-2014
PROJECT ID:	203.50065.00001
LOCATION:	Summit Aggregates

KaizenLAB Sample # 167115_001 **Sample ID:** WW1
Date Sampled 29-Oct-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Routine Water Potability Analysis (Potability pkg #2)				
Electrical Conductivity (EC)	uS/cm	552		
pH		8.1	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	318	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	0.2	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	<0.00040	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	300.7		
Bicarbonate (as HCO3)	mg/L	366.6		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	70.3		
Dissolved Magnesium	mg/L	35.1		
Dissolved Potassium	mg/L	3.3		
Dissolved Sodium	mg/L	7.2	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	320.3		
Anions in Water				
Chloride	mg/L	4.29	250.00 (AO)	Acceptable
Fluoride	mg/L	0.12	1.50 (MAC)	Pass
Nitrate-N	mg/L	1.67	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.05	1.00 (AO)	Acceptable
Nitrite-N + Nitrate-N	mg/L	1.67		

*CDWQG = Canadian Drinking Water Quality Guidelines, Health Canada 2008: MAC = Maximum Acceptable Concentration (affects health), AO = Aesthetic Objective (does not affect health but affects color, taste, etc.), OG = Operational Guidance

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KaizenLAB Sample # 167115_001 **Sample ID:** WW1

Date Sampled 29-Oct-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Phosphate	mg/L	<0.10		
Sulphate	mg/L	6.95	500.00 (AO)	Acceptable
Total Metals including Mercury				
Total Mercury	mg/L	<0.00010		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	0.0068	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	0.00088	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000126	0.0100 (MAC)	Pass
Total Barium	mg/L	0.282	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	0.022	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000013	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.0317	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.015	0.30 (AO)	Acceptable
Total Lead	mg/L	0.00127	0.0100 (MAC)	Pass
Total Manganese	mg/L	<0.0010	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00148		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	0.00084	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.433		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.106		
Total Uranium	mg/L	0.001299	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	<0.020	5.000 (AO)	Acceptable

Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L
- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

*CDWQG = Canadian Drinking Water Quality Guidelines, Health Canada 2008: MAC = Maximum Acceptable Concentration (affects health), AO = Aesthetic Objective (does not affect health but affects color, taste, etc.), OG = Operational Guidance

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KaizenLAB

KaizenLAB Sample # 167115_002 **Sample ID:** WW2

Date Sampled 29-Oct-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Routine Water Potability Analysis (Potability pkg #2)				
Electrical Conductivity (EC)	uS/cm	566		
pH		8.0	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	328	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	0.2	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	0.00300	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	312.2		
Bicarbonate (as HCO3)	mg/L	380.6		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	63.6		
Dissolved Magnesium	mg/L	37.3		
Dissolved Potassium	mg/L	2.8		
Dissolved Sodium	mg/L	13.8	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	312.2		
Anions in Water				
Chloride	mg/L	1.38	250.00 (AO)	Acceptable
Fluoride	mg/L	0.14	1.50 (MAC)	Pass
Nitrate-N	mg/L	0.78	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.05	1.00 (AO)	Acceptable
Nitrite-N + Nitrate-N	mg/L	0.78		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	15.82	500.00 (AO)	Acceptable

*CDWQG = Canadian Drinking Water Quality Guidelines, Health Canada 2008: MAC = Maximum Acceptable Concentration (affects health), AO = Aesthetic Objective (does not affect health but affects color, taste, etc.), OG = Operational Guidance

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KaizenLAB

KaizenLAB Sample # 167115_002 **Sample ID:** WW2

Date Sampled 29-Oct-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Total Metals including Mercury				
Total Mercury	mg/L	<0.00010		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	<0.0050	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	0.00059	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000165	0.0100 (MAC)	Pass
Total Barium	mg/L	0.128	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	0.032	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000016	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.0022	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.018	0.30 (AO)	Acceptable
Total Lead	mg/L	<0.00030	0.0100 (MAC)	Pass
Total Manganese	mg/L	0.0040	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00222		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	0.00112	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.488		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.0971		
Total Uranium	mg/L	0.001023	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	0.024	5.000 (AO)	Acceptable

Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L
- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

*CDWQG = Canadian Drinking Water Quality Guidelines, Health Canada 2008: MAC = Maximum Acceptable Concentration (affects health), AO = Aesthetic Objective (does not affect health but affects color, taste, etc.), OG = Operational Guidance

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KaizenLAB

KaizenLAB Sample # 167115_003 **Sample ID:** WW3

Date Sampled 29-Oct-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Routine Water Potability Analysis (Potability pkg #2)				
Electrical Conductivity (EC)	uS/cm	607		
pH		7.9	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	349	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	0.2	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	<0.00040	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	321.2		
Bicarbonate (as HCO3)	mg/L	391.6		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	73.2		
Dissolved Magnesium	mg/L	39.9		
Dissolved Potassium	mg/L	3.1		
Dissolved Sodium	mg/L	7.8	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	346.9		
Anions in Water				
Chloride	mg/L	10.31	250.00 (AO)	Acceptable
Fluoride	mg/L	0.14	1.50 (MAC)	Pass
Nitrate-N	mg/L	1.87	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.05	1.00 (AO)	Acceptable
Nitrite-N + Nitrate-N	mg/L	1.87		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	10.33	500.00 (AO)	Acceptable

*CDWQG = Canadian Drinking Water Quality Guidelines, Health Canada 2008: MAC = Maximum Acceptable Concentration (affects health), AO = Aesthetic Objective (does not affect health but affects color, taste, etc.), OG = Operational Guidance

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KaizenLAB

KaizenLAB Sample # 167115_003 **Sample ID:** WW3

Date Sampled 29-Oct-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Total Metals including Mercury				
Total Mercury	mg/L	<0.00010		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	0.0061	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000143	0.0100 (MAC)	Pass
Total Barium	mg/L	0.221	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000040	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.125	1.0000 (AO)	Acceptable
Total Iron	mg/L	<0.010	0.30 (AO)	Acceptable
Total Lead	mg/L	0.00302	0.0100 (MAC)	Pass
Total Manganese	mg/L	0.0014	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00113		
Total Nickel	mg/L	0.00174		
Total Selenium	mg/L	0.00070	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.421		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.109		
Total Uranium	mg/L	0.001744	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	0.205	5.000 (AO)	Acceptable

Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L
- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

*CDWQG = Canadian Drinking Water Quality Guidelines, Health Canada 2008: MAC = Maximum Acceptable Concentration (affects health), AO = Aesthetic Objective (does not affect health but affects color, taste, etc.), OG = Operational Guidance

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KaizenLAB Sample # 167115_004 **Sample ID:** WW4

Date Sampled 30-Oct-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Routine Water Potability Analysis (Potability pkg #2)				
Electrical Conductivity (EC)	uS/cm	596		
pH		8.0	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	339	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	0.6	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	<0.00040	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	304.9		
Bicarbonate (as HCO3)	mg/L	371.8		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	75.3		
Dissolved Magnesium	mg/L	35.2		
Dissolved Potassium	mg/L	3.1		
Dissolved Sodium	mg/L	7.1	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	333.1		
Anions in Water				
Chloride	mg/L	10.86	250.00 (AO)	Acceptable
Fluoride	mg/L	0.15	1.50 (MAC)	Pass
Nitrate-N	mg/L	3.02	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.05	1.00 (AO)	Acceptable
Nitrite-N + Nitrate-N	mg/L	3.02		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	7.66	500.00 (AO)	Acceptable

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KaizenLAB

KaizenLAB Sample # 167115_004 **Sample ID:** WW4

Date Sampled 30-Oct-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Total Metals including Mercury				
Total Mercury	mg/L	<0.00010		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	<0.0050	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000192	0.0100 (MAC)	Pass
Total Barium	mg/L	0.385	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000008	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.0017	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.017	0.30 (AO)	Acceptable
Total Lead	mg/L	<0.00030	0.0100 (MAC)	Pass
Total Manganese	mg/L	<0.0010	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00076		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	0.00180	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.425		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.114		
Total Uranium	mg/L	0.001785	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	0.029	5.000 (AO)	Acceptable

Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L
- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

*CDWQG = Canadian Drinking Water Quality Guidelines, Health Canada 2008: MAC = Maximum Acceptable Concentration (affects health), AO = Aesthetic Objective (does not affect health but affects color, taste, etc.), OG = Operational Guidance

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KaizenLAB

KaizenLAB Sample # 167115_005 **Sample ID:** BHS1
Date Sampled 30-Oct-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Routine Water Potability Analysis (Potability pkg #2)				
Electrical Conductivity (EC)	uS/cm	588		
pH		8.2	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	342	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	0.8	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	<0.00040	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	308.5		
Bicarbonate (as HCO3)	mg/L	376.1		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	74.1		
Dissolved Magnesium	mg/L	36.7		
Dissolved Potassium	mg/L	3.4		
Dissolved Sodium	mg/L	7.8	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	336.0		
Anions in Water				
Chloride	mg/L	9.60	250.00 (AO)	Acceptable
Fluoride	mg/L	0.14	1.50 (MAC)	Pass
Nitrate-N	mg/L	2.83	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.05	1.00 (AO)	Acceptable
Nitrite-N + Nitrate-N	mg/L	2.83		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	9.36	500.00 (AO)	Acceptable

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KaizenLAB Sample # 167115_005 **Sample ID:** BHS1

Date Sampled 30-Oct-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Total Metals including Mercury				
Total Mercury	mg/L	<0.00010		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	0.0182	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000153	0.0100 (MAC)	Pass
Total Barium	mg/L	0.304	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	0.024	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000032	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	<0.0010	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.027	0.30 (AO)	Acceptable
Total Lead	mg/L	<0.00030	0.0100 (MAC)	Pass
Total Manganese	mg/L	0.0019	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00141		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	0.00218	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.443		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	0.0083		
Total Titanium	mg/L	0.115		
Total Uranium	mg/L	0.001953	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	<0.020	5.000 (AO)	Acceptable

Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L
- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

*CDWQG = Canadian Drinking Water Quality Guidelines, Health Canada 2008: MAC = Maximum Acceptable Concentration (affects health), AO = Aesthetic Objective (does not affect health but affects color, taste, etc.), OG = Operational Guidance

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Test Methodologies

Alkalinity in Water: Modified from APHA 2320B
Anions in Water: Modified from APHA 4110B
Cations in Water: Modified from APHA 3030B and APHA 3120B
Dissolved Metals in Water: Modified from APHA 3030B and APHA 3125B
Electrical Conductivity in Water: Modified from APHA 2510B
pH in Water: Modified from APHA 4500-H+ B
Total Dissolved Solids (calculated): Modified from APHA 1030E
Total Mercury in Water: Modified from EPA 200.2 and EPA 1631
Total Metals in Water: Modified from EPA 200.2 and APHA 3125B
True Colour in Water: Modified from APHA 2120C
Turbidity in Water: Modified from APHA 2130B

Final Review by:

Natalia Klink
Client Service Representative / Project Coordinator

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KaizenLAB

ANALYTICAL REPORT

Client: SLR Consulting (Canada) Ltd.
6940 Roper Rd NW
Edmonton, AB T6B 3H9

Attention: Robert Till

KaizenLAB JOB #:	**167823**
DATE RECEIVED:	21-Nov-2014
DATE REPORTED:	27-Nov-2014
PROJECT ID:	203,50065,00001
LOCATION:	Summit Aggregates

KaizenLAB Sample # 167823_001 **Sample ID:** MW 14-101
Date Sampled 20-Nov-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Routine Water Potability Analysis (Potability pkg #2)				
Electrical Conductivity (EC)	uS/cm	596		
pH		7.9	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	337	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	9.6	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0400	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	<0.00400	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	313.6		
Bicarbonate (as HCO3)	mg/L	382.3		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	76.1		
Dissolved Magnesium	mg/L	33.7		
Dissolved Potassium	mg/L	4.8		
Dissolved Sodium	mg/L	6.0	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	328.6		
Anions in Water				
Chloride	mg/L	10.54	250.00 (AO)	Acceptable
Fluoride	mg/L	0.13	1.50 (MAC)	Pass
Nitrate-N	mg/L	1.19	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.05	1.00 (AO)	Acceptable
Nitrite-N + Nitrate-N	mg/L	1.19		

*CDWQG = Canadian Drinking Water Quality Guidelines, Health Canada 2008: MAC = Maximum Acceptable Concentration (affects health), AO = Aesthetic Objective (does not affect health but affects color, taste, etc.), OG = Operational Guidance

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KaizenLAB Sample # 167823_001 **Sample ID:** MW 14-101

Date Sampled 20-Nov-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Phosphate	mg/L	<0.10		
Sulphate	mg/L	8.88	500.00 (AO)	Acceptable
Total Metals including Mercury				
Total Mercury	mg/L	<0.00010		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	0.164	0.10 (OG) see notes	Unacceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000350	0.0100 (MAC)	Pass
Total Barium	mg/L	0.424	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000016	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	<0.0010	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.28	0.30 (AO)	Acceptable
Total Lead	mg/L	0.00031	0.0100 (MAC)	Pass
Total Manganese	mg/L	0.0164	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00080		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	<0.00060	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.384		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	0.0182		
Total Titanium	mg/L	0.122		
Total Uranium	mg/L	0.001697	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	<0.020	5.000 (AO)	Acceptable

Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L
- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

*CDWQG = Canadian Drinking Water Quality Guidelines, Health Canada 2008: MAC = Maximum Acceptable Concentration (affects health), AO = Aesthetic Objective (does not affect health but affects color, taste, etc.), OG = Operational Guidance

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KaizenLAB

KaizenLAB Sample # 167823_002 **Sample ID:** MW 14-103

Date Sampled 20-Nov-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Routine Water Potability Analysis (Potability pkg #2)				
Electrical Conductivity (EC)	uS/cm	610		
pH		7.8	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	354	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	680	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0400	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	<0.00400	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	311.5		
Bicarbonate (as HCO3)	mg/L	379.8		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	74.7		
Dissolved Magnesium	mg/L	33.4		
Dissolved Potassium	mg/L	4.3		
Dissolved Sodium	mg/L	8.8	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	324.1		
Anions in Water				
Chloride	mg/L	7.83	250.00 (AO)	Acceptable
Fluoride	mg/L	0.13	1.50 (MAC)	Pass
Nitrate-N	mg/L	5.22	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.05	1.00 (AO)	Acceptable
Nitrite-N + Nitrate-N	mg/L	5.22		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	11.90	500.00 (AO)	Acceptable

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KaizenLAB

KaizenLAB Sample # 167823_002 **Sample ID:** MW 14-103

Date Sampled 20-Nov-2014

Parameter Description	Units	Result	Guideline Limits*	Comment
Total Metals including Mercury				
Total Mercury	mg/L	<0.00010		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	5.57	0.10 (OG) see notes	Unacceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.007858	0.0100 (MAC)	Pass
Total Barium	mg/L	0.700	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000290	0.0050 (MAC)	Pass
Total Chromium	mg/L	0.0076	0.050 (MAC)	Pass
Total Cobalt	mg/L	0.00445		
Total Copper	mg/L	0.0093	1.0000 (AO)	Acceptable
Total Iron	mg/L	12	0.30 (AO)	Unacceptable
Total Lead	mg/L	0.00464	0.0100 (MAC)	Pass
Total Manganese	mg/L	0.928	0.0500 (AO)	Unacceptable
Total Molybdenum	mg/L	0.00184		
Total Nickel	mg/L	0.01196		
Total Selenium	mg/L	0.00112	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.423		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.236		
Total Uranium	mg/L	0.002014	0.020000 (MAC)	Pass
Total Vanadium	mg/L	0.01145		
Total Zinc	mg/L	0.033	5.000 (AO)	Acceptable

Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L
- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

*CDWQG = Canadian Drinking Water Quality Guidelines, Health Canada 2008: MAC = Maximum Acceptable Concentration (affects health), AO = Aesthetic Objective (does not affect health but affects color, taste, etc.), OG = Operational Guidance

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KaizenLAB

Test Methodologies

Alkalinity in Water: Modified from APHA 2320B
Anions in Water: Modified from APHA 4110B
Cations in Water: Modified from APHA 3030B and APHA 3120B
Dissolved Metals in Water: Modified from APHA 3030B and APHA 3125B
Electrical Conductivity in Water: Modified from APHA 2510B
pH in Water: Modified from APHA 4500-H+ B
Total Dissolved Solids (calculated): Modified from APHA 1030E
Total Mercury in Water: Modified from EPA 200.2 and EPA 1631
Total Metals in Water: Modified from EPA 200.2 and APHA 3125B
True Colour in Water: Modified from APHA 2120C
Turbidity in Water: Modified from APHA 2130B

Final Review by:

Joel Sababan
Client Services Administrator

Note: The results in this report relate only to the items tested. Information is available for any items in 5.10.2 of ISO/IEC 17025 that cannot be put on a test report.

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KaizenLAB

ANALYTICAL REPORT

Client: SLR Consulting (Canada) Ltd.
6940 Roper Rd NW
Edmonton, AB T6B 3H9

Attention: Robert Till

KaizenLAB JOB #:	**173114**
DATE RECEIVED:	04-Aug-2015
DATE REPORTED:	06-Aug-2015
PROJECT ID:	203-50065-00003
LOCATION:	Summit

KaizenLAB Sample # 173114_001 **Sample ID:** MW14-103
Date Sampled 4-Aug-2015

Parameter Description	Units	Result	Guideline Limits*	Comment
Routine Water Potability Analysis (Potability pkg #2)				
Electrical Conductivity (EC)	uS/cm	611		
pH		8.0	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	333	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	8.00	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	0.00069	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	307.7		
Bicarbonate (as HCO3)	mg/L	375.1		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	73.3		
Dissolved Magnesium	mg/L	32.6		
Dissolved Potassium	mg/L	3.9		
Dissolved Sodium	mg/L	7.9	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	317.0		
Anions in Water				
Chloride	mg/L	8.81	250.00 (AO)	Acceptable
Fluoride	mg/L	0.14	1.50 (MAC)	Pass
Nitrate-N	mg/L	1.801	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.005	1.00 (MAC)	Pass
Nitrite-N + Nitrate-N	mg/L	1.801		

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KaizenLAB Sample # 173114_001 **Sample ID:** MW14-103

Date Sampled 4-Aug-2015

Parameter Description	Units	Result	Guideline Limits*	Comment
Phosphate	mg/L	<0.10		
Sulphate	mg/L	10.56	500.00 (AO)	Acceptable
Total Metals including Mercury				
Total Mercury	mg/L	<0.00020		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	0.109	0.10 (OG) see notes	Unacceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000336	0.0100 (MAC)	Pass
Total Barium	mg/L	0.332	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	<0.000005	0.0050 (MAC)	Pass
Total Chromium	mg/L	0.0016	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.0013	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.22	0.30 (AO)	Acceptable
Total Lead	mg/L	<0.00030	0.0100 (MAC)	Pass
Total Manganese	mg/L	0.0144	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00086		
Total Nickel	mg/L	0.00051		
Total Selenium	mg/L	0.00087	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.377		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.118		
Total Uranium	mg/L	0.001563	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	<0.020	5.000 (AO)	Acceptable
Total Coliforms and E. coli				
E. Coli	MPN/100mL	<1	0 (MAC)	Pass
Total Coliforms	MPN/100mL	<1	0 (MAC)	Pass

Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L
- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

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KaizenLAB Sample # 173114_002 **Sample ID:** WW1

Date Sampled 4-Aug-2015

Parameter Description	Units	Result	Guideline Limits*	Comment
Routine Water Potability Analysis (Potability pkg #2)				
Electrical Conductivity (EC)	uS/cm	570		
pH		8.0	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	310	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	0.31	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	<0.00040	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	294.9		
Bicarbonate (as HCO3)	mg/L	359.6		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	68.2		
Dissolved Magnesium	mg/L	31.8		
Dissolved Potassium	mg/L	3.2		
Dissolved Sodium	mg/L	7.0	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	301.4		
Anions in Water				
Chloride	mg/L	4.49	250.00 (AO)	Acceptable
Fluoride	mg/L	0.14	1.50 (MAC)	Pass
Nitrate-N	mg/L	1.658	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.005	1.00 (MAC)	Pass
Nitrite-N + Nitrate-N	mg/L	1.658		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	7.51	500.00 (AO)	Acceptable

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KaizenLAB Sample # 173114_002 **Sample ID:** WW1

Date Sampled 4-Aug-2015

Parameter Description	Units	Result	Guideline Limits*	Comment
Total Metals including Mercury				
Total Mercury	mg/L	<0.00020		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	0.0110	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000132	0.0100 (MAC)	Pass
Total Barium	mg/L	0.284	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	<0.000005	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.0130	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.014	0.30 (AO)	Acceptable
Total Lead	mg/L	0.00048	0.0100 (MAC)	Pass
Total Manganese	mg/L	<0.0010	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00147		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	<0.00060	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.450		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.105		
Total Uranium	mg/L	0.001241	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	<0.020	5.000 (AO)	Acceptable
Total Coliforms and E. coli				
E. Coli	MPN/100mL	<1	0 (MAC)	Pass
Total Coliforms	MPN/100mL	<1	0 (MAC)	Pass

Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L
- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

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KaizenLAB Sample # 173114_003 **Sample ID:** WW2

Date Sampled 4-Aug-2015

Parameter Description	Units	Result	Guideline Limits*	Comment
Routine Water Potability Analysis (Potability pkg #2)				
Electrical Conductivity (EC)	uS/cm	585		
pH		8.1	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	317	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	1.23	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	0.00275	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	307.6		
Bicarbonate (as HCO3)	mg/L	375.1		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	63.4		
Dissolved Magnesium	mg/L	35.0		
Dissolved Potassium	mg/L	2.6		
Dissolved Sodium	mg/L	9.3	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	302.4		
Anions in Water				
Chloride	mg/L	1.93	250.00 (AO)	Acceptable
Fluoride	mg/L	0.15	1.50 (MAC)	Pass
Nitrate-N	mg/L	1.054	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.005	1.00 (MAC)	Pass
Nitrite-N + Nitrate-N	mg/L	1.054		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	12.85	500.00 (AO)	Acceptable

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KaizenLAB Sample # 173114_003 **Sample ID:** WW2

Date Sampled 4-Aug-2015

Parameter Description	Units	Result	Guideline Limits*	Comment
Total Metals including Mercury				
Total Mercury	mg/L	<0.00020		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	<0.0050	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000205	0.0100 (MAC)	Pass
Total Barium	mg/L	0.142	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000024	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.0016	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.040	0.30 (AO)	Acceptable
Total Lead	mg/L	<0.00030	0.0100 (MAC)	Pass
Total Manganese	mg/L	0.0042	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00193		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	0.00105	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.454		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.103		
Total Uranium	mg/L	0.001214	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	<0.020	5.000 (AO)	Acceptable
Total Coliforms and E. coli				
E. Coli	MPN/100mL	<1	0 (MAC)	Pass
Total Coliforms	MPN/100mL	<1	0 (MAC)	Pass

Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L
- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

*CDWQG = Canadian Drinking Water Quality Guidelines, Health Canada 2008: MAC = Maximum Acceptable Concentration (affects health), AO = Aesthetic Objective (does not affect health but affects color, taste, etc.), OG = Operational Guidance

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Phone (403) 297-0868
Fax: (403) 297-0869

KaizenLAB Sample # 173114_004 **Sample ID:** WW3

Date Sampled 4-Aug-2015

Parameter Description	Units	Result	Guideline Limits*	Comment
Routine Water Potability Analysis (Potability pkg #2)				
Electrical Conductivity (EC)	uS/cm	604		
pH		8.0	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	330	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	0.25	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	<0.00040	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	309.8		
Bicarbonate (as HCO3)	mg/L	377.7		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	69.7		
Dissolved Magnesium	mg/L	35.5		
Dissolved Potassium	mg/L	3.0		
Dissolved Sodium	mg/L	7.6	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	320.4		
Anions in Water				
Chloride	mg/L	5.88	250.00 (AO)	Acceptable
Fluoride	mg/L	0.14	1.50 (MAC)	Pass
Nitrate-N	mg/L	1.889	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.005	1.00 (MAC)	Pass
Nitrite-N + Nitrate-N	mg/L	1.889		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	11.09	500.00 (AO)	Acceptable

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KaizenLAB Sample # 173114_004 **Sample ID:** WW3

Date Sampled 4-Aug-2015

Parameter Description	Units	Result	Guideline Limits*	Comment
Total Metals including Mercury				
Total Mercury	mg/L	<0.00020		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	<0.0050	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000121	0.0100 (MAC)	Pass
Total Barium	mg/L	0.225	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000024	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.0057	1.0000 (AO)	Acceptable
Total Iron	mg/L	<0.010	0.30 (AO)	Acceptable
Total Lead	mg/L	<0.00030	0.0100 (MAC)	Pass
Total Manganese	mg/L	<0.0010	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00104		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	0.00085	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.418		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.111		
Total Uranium	mg/L	0.001688	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	<0.020	5.000 (AO)	Acceptable
Total Coliforms and E. coli				
E. Coli	MPN/100mL	<1	0 (MAC)	Pass
Total Coliforms	MPN/100mL	<1	0 (MAC)	Pass

Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L
- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

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KaizenLAB Sample # 173114_005 **Sample ID:** WW4

Date Sampled 4-Aug-2015

Parameter Description	Units	Result	Guideline Limits*	Comment
Routine Water Potability Analysis (Potability pkg #2)				
Electrical Conductivity (EC)	uS/cm	608		
pH		8.0	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	328	500 (AO)	Acceptable
True Colour	TCU	<3	15 (AO)	Acceptable
Turbidity	NTU	0.23	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	<0.00040	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	299.6		
Bicarbonate (as HCO3)	mg/L	365.2		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	72.0		
Dissolved Magnesium	mg/L	31.5		
Dissolved Potassium	mg/L	2.9		
Dissolved Sodium	mg/L	6.5	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	309.4		
Anions in Water				
Chloride	mg/L	10.95	250.00 (AO)	Acceptable
Fluoride	mg/L	0.14	1.50 (MAC)	Pass
Nitrate-N	mg/L	3.314	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.005	1.00 (MAC)	Pass
Nitrite-N + Nitrate-N	mg/L	3.314		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	6.77	500.00 (AO)	Acceptable

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KaizenLAB Sample # 173114_005 **Sample ID:** WW4

Date Sampled 4-Aug-2015

Parameter Description	Units	Result	Guideline Limits*	Comment
Total Metals including Mercury				
Total Mercury	mg/L	<0.00020		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	<0.0050	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000194	0.0100 (MAC)	Pass
Total Barium	mg/L	0.391	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	<0.000005	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.0018	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.044	0.30 (AO)	Acceptable
Total Lead	mg/L	<0.00030	0.0100 (MAC)	Pass
Total Manganese	mg/L	<0.0010	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00066		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	0.00096	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.421		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.114		
Total Uranium	mg/L	0.001672	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	0.031	5.000 (AO)	Acceptable
Total Coliforms and E. coli				
E. Coli	MPN/100mL	<1	0 (MAC)	Pass
Total Coliforms	MPN/100mL	<1	0 (MAC)	Pass

Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L
- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

*CDWQG = Canadian Drinking Water Quality Guidelines, Health Canada 2008: MAC = Maximum Acceptable Concentration (affects health), AO = Aesthetic Objective (does not affect health but affects color, taste, etc.), OG = Operational Guidance

333 50th Ave. S.E.
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Phone (403) 297-0868
Fax: (403) 297-0869

KaizenLAB Sample # 173114_006 **Sample ID:** BHS1

Date Sampled 4-Aug-2015

Parameter Description	Units	Result	Guideline Limits*	Comment
Routine Water Potability Analysis (Potability pkg #2)				
Electrical Conductivity (EC)	uS/cm	606		
pH		8.2	6.5-8.5 (AO)	Acceptable
Total Dissolved Solids (calculated)	mg/L	334	500 (AO)	Acceptable
True Colour	TCU	3	15 (AO)	Acceptable
Turbidity	NTU	1.07	0.1/0.3/1.0 see notes	See notes
Dissolved Metals in Water by ICP-MS				
Dissolved Iron	mg/L	<0.0040	0.3000 (AO)	Acceptable
Dissolved Manganese	mg/L	0.00069	0.0500 (AO)	Acceptable
Alkalinity parameters of water				
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0		
Alkalinity (total, as CaCO3)	mg/L	304.3		
Bicarbonate (as HCO3)	mg/L	371.0		
Carbonate (as CO3)	mg/L	<1.5		
Hydroxide (as OH)	mg/L	<0.5		
Cations in Water				
Dissolved Calcium	mg/L	72.0		
Dissolved Magnesium	mg/L	33.3		
Dissolved Potassium	mg/L	3.3		
Dissolved Sodium	mg/L	7.5	200.00 (AO)	Acceptable
Hardness (calculated, as CaCO3)	mg/L	317.0		
Anions in Water				
Chloride	mg/L	10.12	250.00 (AO)	Acceptable
Fluoride	mg/L	0.15	1.50 (MAC)	Pass
Nitrate-N	mg/L	3.037	10.00 (MAC)	Pass
Nitrite-N	mg/L	<0.005	1.00 (MAC)	Pass
Nitrite-N + Nitrate-N	mg/L	3.037		
Phosphate	mg/L	<0.10		
Sulphate	mg/L	8.36	500.00 (AO)	Acceptable

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333 50th Ave. S.E.
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KaizenLAB Sample # 173114_006 **Sample ID:** BHS1

Date Sampled 4-Aug-2015

Parameter Description	Units	Result	Guideline Limits*	Comment
Total Metals including Mercury				
Total Mercury	mg/L	<0.00020		
Total Metals in Water by ICP-MS				
Total Aluminum	mg/L	0.0144	0.10 (OG) see notes	Acceptable
Total Antimony	mg/L	<0.00050	0.0060 (MAC)	Pass
Total Arsenic	mg/L	0.000146	0.0100 (MAC)	Pass
Total Barium	mg/L	0.313	1.0000 (MAC)	Pass
Total Beryllium	mg/L	<0.0010		
Total Boron	mg/L	<0.020	5.00 (MAC)	Pass
Total Cadmium	mg/L	0.000008	0.0050 (MAC)	Pass
Total Chromium	mg/L	<0.0010	0.050 (MAC)	Pass
Total Cobalt	mg/L	<0.00020		
Total Copper	mg/L	0.0010	1.0000 (AO)	Acceptable
Total Iron	mg/L	0.019	0.30 (AO)	Acceptable
Total Lead	mg/L	<0.00030	0.0100 (MAC)	Pass
Total Manganese	mg/L	0.0012	0.0500 (AO)	Acceptable
Total Molybdenum	mg/L	0.00089		
Total Nickel	mg/L	<0.00050		
Total Selenium	mg/L	0.00130	0.0100 (MAC)	Pass
Total Silver	mg/L	<0.000070		
Total Strontium	mg/L	0.450		
Total Thallium	mg/L	<0.00020		
Total Tin	mg/L	<0.0070		
Total Titanium	mg/L	0.117		
Total Uranium	mg/L	0.001875	0.020000 (MAC)	Pass
Total Vanadium	mg/L	<0.00060		
Total Zinc	mg/L	<0.020	5.000 (AO)	Acceptable
Total Coliforms and E. coli				
E. Coli	MPN/100mL	1733	0 (MAC)	Fail
Total Coliforms	MPN/100mL	2420	0 (MAC)	Fail

Notes:

- Aluminum: This Operational Guideline applies only to drinking water treatment plants using aluminum-based coagulants: conventional systems - 0.1 mg/L, other systems - 0.2 mg/L
- Turbidity: Based on slow sand or diatomaceous earth filtration (0.1 NTU) / membrane filtration (0.3 NTU) / conventional treatment (1.0 NTU). No limits apply for well water not under the influence of surface water. For further details and additional guidance restriction, see Guidelines for Canadian Drinking Water Quality (GCDWQ 2008).

*CDWQG = Canadian Drinking Water Quality Guidelines, Health Canada 2008: MAC = Maximum Acceptable Concentration (affects health), AO = Aesthetic Objective (does not affect health but affects color, taste, etc.), OG = Operational Guidance

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Phone (403) 297-0868
Fax: (403) 297-0869

Test Methodologies

Alkalinity in Water: Modified from APHA 2320B
Anions in Water: Modified from APHA 4110B
Cations in Water: Modified from APHA 3030B and APHA 3120B
Dissolved Metals in Water: Modified from APHA 3030B and APHA 3125B
E. coli in Water: Modified from Method 9223 B. Enzyme Substrate Test. Standard Methods for the Examination of Water and Wastewater, 22nd ed. 2012
Electrical Conductivity in Water: Modified from APHA 2510B
pH of Water: Modified from APHA 4500-H+ B
Total Coliforms in Water: Modified from Method 9223 B. Enzyme Substrate Test. Standard Methods for the Examination of Water and Wastewater, 22nd
Total Dissolved Solids (calculated): Modified from APHA 1030E
Total Mercury in Water: Modified from EPA 200.2 and EPA 1631
Total Metals in Water: Modified from EPA 200.2 and APHA 3125B
True Colour in Water: Modified from APHA 2120C
Turbidity in Water: Modified from APHA 2130B

Final Review by:

Enyo Sewordor
Client Service Representative / Project Coordinator

Note: The results in this report relate only to the items tested. Information is available for any items in 5.10.2 of ISO/IEC 17025 that cannot be put on a test report.

Your P.O. #: EDM4886
Your Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your C.O.C. #: M083946

Attention: ROBERT TILL

SLR CONSULTING (CANADA) LTD
6940 ROPER ROAD
EDMONTON, AB
CANADA T6B 3H9

Report Date: 2019/07/25
Report #: R2757540
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: B953759
Received: 2019/07/05, 07:00

Sample Matrix: Water
Samples Received: 5

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH	4	N/A	2019/07/08	AB SOP-00005	SM 23 2320 B m
Alkalinity @25C (pp, total), CO3,HCO3,OH	1	N/A	2019/07/10	AB SOP-00005	SM 23 2320 B m
Cadmium - low level CCME - Dissolved	5	N/A	2019/07/24		Auto Calc
Cadmium - low level CCME (Total)	5	N/A	2019/07/11		Auto Calc
Chloride by Automated Colourimetry	5	N/A	2019/07/10	AB SOP-00020	SM 23-4500-Cl-E m
Total Coliforms and E.Coli	5	2019/07/05	2019/07/06	AB SOP-00089	SM 23 9223 A,B m
Conductivity @25C	4	N/A	2019/07/08	AB SOP-00005	SM 23 2510 B m
Conductivity @25C	1	N/A	2019/07/10	AB SOP-00005	SM 23 2510 B m
Hardness	5	N/A	2019/07/10		Auto Calc
Mercury - Low Level (Total)	1	2019/07/11	2019/07/11	CAL SOP-00007	EPA 1631 RE 20460 m
Mercury - Low Level (Total)	4	2019/07/11	2019/07/12	CAL SOP-00007	EPA 1631 RE 20460 m
Elements by ICP-Dissolved-Lab Filtered (1)	5	N/A	2019/07/09	AB SOP-00042	EPA 6010d R5 m
Elements by ICP - Total	5	2019/07/10	2019/07/10	AB SOP-00014 / AB SOP-00042	EPA 6010d R4 m
Elements by ICPMS-Dissolved-Lab Filtered (2)	3	N/A	2019/07/23	AB SOP-00043	EPA 6020b R2 m
Elements by ICPMS-Dissolved-Lab Filtered (2)	2	N/A	2019/07/24	AB SOP-00043	EPA 6020b R2 m
Elements by ICPMS - Total	4	2019/07/10	2019/07/10	AB SOP-00014 / AB SOP-00043	EPA 6020b R2 m
Elements by ICPMS - Total	1	2019/07/10	2019/07/11	AB SOP-00014 / AB SOP-00043	EPA 6020b R2 m
Ion Balance	5	N/A	2019/07/06		Auto Calc
Sum of cations, anions	5	N/A	2019/07/10		Auto Calc
Nitrate and Nitrite	5	N/A	2019/07/11		Auto Calc
Nitrate + Nitrite-N (calculated)	5	N/A	2019/07/11		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	5	N/A	2019/07/07	AB SOP-00023	SM 23 4110 B m
pH @25°C (3)	4	N/A	2019/07/08	AB SOP-00005	SM 23 4500-H+B m
pH @25°C (3)	1	N/A	2019/07/10	AB SOP-00005	SM 23 4500-H+B m
Sulphate by Automated Colourimetry	5	N/A	2019/07/10	AB SOP-00018	SM 23 4500-SO4 E m
Total Dissolved Solids (Calculated)	5	N/A	2019/07/10		Auto Calc
Turbidity	5	N/A	2019/07/06	CAL SOP-00081	SM 23 2130 B m

Remarks:

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Your P.O. #: EDM4886
Your Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your C.O.C. #: M083946

Attention: ROBERT TILL

SLR CONSULTING (CANADA) LTD
6940 ROPER ROAD
EDMONTON, AB
CANADA T6B 3H9

Report Date: 2019/07/25
Report #: R2757540
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: B953759
Received: 2019/07/05, 07:00

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs 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 BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs 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 BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

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 > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(2) Samples were filtered and preserved at the lab. Values may not reflect concentrations at the time of sampling. Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(3) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Bureau Veritas Laboratories endeavours to analyze samples as soon as possible after receipt.

Encryption Key

Jenelle Feller
Key Account Specialist
25 Jul 2019 16:32:26

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Jenelle Feller, Key Account Specialist
Email: JFeller@bvlabs.com
Phone# (403)735-2264

==========

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: B953759
Report Date: 2019/07/25

SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

ROUTINE WATER -LAB FILTERED (WATER)

BV Labs ID		WA5520		WA5521		WA5522		WA5523		
Sampling Date		2019/07/04 09:55		2019/07/04 10:55		2019/07/04 11:55		2019/07/04 13:55		
COC Number		M083946		M083946		M083946		M083946		
	UNITS	MW18-105	QC Batch	MW19-108	RDL	MW18-104	RDL	MW18-106	RDL	QC Batch
Calculated Parameters										
Anion Sum	meq/L	5.9	9493590	7.3	N/A	6.2	N/A	6.6	N/A	9493590
Cation Sum	meq/L	6.4	9493590	7.0	N/A	6.3	N/A	6.7	N/A	9493590
Hardness (CaCO3)	mg/L	300	9493521	320	0.50	280	0.50	310	0.50	9493521
Ion Balance (% Difference)	%	4.0	9493527	2.3	N/A	0.59	N/A	0.98	N/A	9493527
Dissolved Nitrate (NO3)	mg/L	12	9493534	11	0.044	4.3	0.044	10	0.044	9493534
Nitrate plus Nitrite (N)	mg/L	2.6	9493540	2.5	0.014	1.1	0.014	2.3	0.014	9493540
Dissolved Nitrite (NO2)	mg/L	<0.033	9493534	0.16	0.033	0.32	0.033	<0.033	0.033	9493534
Calculated Total Dissolved Solids	mg/L	300	9493550	350	1.0	310	1.7	320	1.0	9493550
Misc. Inorganics										
Conductivity	uS/cm	560	9498908	610	2.0	570	2.0	590	2.0	9497188
pH	pH	8.05	9498906	7.91	N/A	7.91	N/A	7.87	N/A	9497187
Anions										
Alkalinity (PP as CaCO3)	mg/L	<1.0	9498897	<1.0	1.0	<1.0	1.0	<1.0	1.0	9497185
Alkalinity (Total as CaCO3)	mg/L	260	9498897	320	1.0	260	1.0	300	1.0	9497185
Bicarbonate (HCO3)	mg/L	320	9498897	390	1.0	310	1.0	360	1.0	9497185
Carbonate (CO3)	mg/L	<1.0	9498897	<1.0	1.0	<1.0	1.0	<1.0	1.0	9497185
Hydroxide (OH)	mg/L	<1.0	9498897	<1.0	1.0	<1.0	1.0	<1.0	1.0	9497185
Dissolved Sulphate (SO4)	mg/L	5.8	9501390	17	1.0	9.2	1.0	7.6	1.0	9501390
Dissolved Chloride (Cl)	mg/L	13	9501388	14	1.0	29	1.0	9.3	1.0	9501388
Nutrients										
Dissolved Nitrite (N)	mg/L	<0.010	9495539	0.048	0.010	0.098	0.010	<0.010	0.010	9495539
Dissolved Nitrate (N)	mg/L	2.6	9495539	2.4	0.010	0.97	0.010	2.3	0.010	9495539
Lab Filtered Elements										
Dissolved Aluminum (Al)	mg/L	<0.040	9497648	<0.040	0.040	<0.040	0.040	<0.040	0.040	9497648
Dissolved Barium (Ba)	mg/L	0.34	9497648	0.24	0.010	0.45	0.010	0.32	0.010	9497648
Dissolved Boron (B)	mg/L	<0.020	9497648	<0.020	0.020	0.031	0.020	<0.020	0.020	9497648
Dissolved Calcium (Ca)	mg/L	69	9497648	74	0.30	63	0.30	73	0.30	9497648
Dissolved Chromium (Cr)	mg/L	<0.010	9497648	<0.010	0.010	<0.010	0.010	<0.010	0.010	9497648
Dissolved Iron (Fe)	mg/L	0.16	9497648	0.16	0.060	0.18	0.060	0.16	0.060	9497648
Dissolved Lithium (Li)	mg/L	<0.020	9497648	<0.020	0.020	<0.020	0.020	<0.020	0.020	9497648

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: B953759
Report Date: 2019/07/25

SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

ROUTINE WATER -LAB FILTERED (WATER)

BV Labs ID		WA5520		WA5521		WA5522		WA5523		
Sampling Date		2019/07/04 09:55		2019/07/04 10:55		2019/07/04 11:55		2019/07/04 13:55		
COC Number		M083946		M083946		M083946		M083946		
	UNITS	MW18-105	QC Batch	MW19-108	RDL	MW18-104	RDL	MW18-106	RDL	QC Batch
Dissolved Magnesium (Mg)	mg/L	32	9497648	32	0.20	30	0.20	31	0.20	9497648
Dissolved Manganese (Mn)	mg/L	<0.0040	9497648	0.064	0.0040	0.40	0.0040	0.018	0.0040	9497648
Dissolved Phosphorus (P)	mg/L	<0.10	9497648	<0.10	0.10	0.21	0.10	<0.10	0.10	9497648
Dissolved Potassium (K)	mg/L	2.9	9497648	3.4	0.30	4.1	0.30	3.3	0.30	9497648
Dissolved Silicon (Si)	mg/L	4.7	9497648	4.8	0.10	3.8	0.10	4.6	0.10	9497648
Dissolved Sodium (Na)	mg/L	5.7	9497648	12	0.50	13	0.50	9.0	0.50	9497648
Dissolved Strontium (Sr)	mg/L	0.44	9497648	0.46	0.020	0.41	0.020	0.44	0.020	9497648
Dissolved Sulphur (S)	mg/L	1.6	9497648	4.5	0.20	2.6	0.20	2.1	0.20	9497648
RDL = Reportable Detection Limit										

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BV Labs Job #: B953759
Report Date: 2019/07/25

SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

ROUTINE WATER -LAB FILTERED (WATER)

BV Labs ID		WA5524		
Sampling Date		2019/07/04 14:55		
COC Number		M083946		
	UNITS	MW18-107	RDL	QC Batch
Calculated Parameters				
Anion Sum	meq/L	6.6	N/A	9493590
Cation Sum	meq/L	6.5	N/A	9493590
Hardness (CaCO3)	mg/L	310	0.50	9493521
Ion Balance (% Difference)	%	0.68	N/A	9493527
Dissolved Nitrate (NO3)	mg/L	8.9	0.044	9493534
Nitrate plus Nitrite (N)	mg/L	2.1	0.014	9493540
Dissolved Nitrite (NO2)	mg/L	0.11	0.033	9493534
Calculated Total Dissolved Solids	mg/L	320	1.0	9493550
Misc. Inorganics				
Conductivity	uS/cm	580	2.0	9497188
pH	pH	7.80	N/A	9497187
Anions				
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	9497185
Alkalinity (Total as CaCO3)	mg/L	300	1.0	9497185
Bicarbonate (HCO3)	mg/L	370	1.0	9497185
Carbonate (CO3)	mg/L	<1.0	1.0	9497185
Hydroxide (OH)	mg/L	<1.0	1.0	9497185
Dissolved Sulphate (SO4)	mg/L	6.6	1.0	9501390
Dissolved Chloride (Cl)	mg/L	10	1.0	9501388
Nutrients				
Dissolved Nitrite (N)	mg/L	0.034	0.010	9495539
Dissolved Nitrate (N)	mg/L	2.0	0.010	9495539
Lab Filtered Elements				
Dissolved Aluminum (Al)	mg/L	<0.040	0.040	9497648
Dissolved Barium (Ba)	mg/L	0.34	0.010	9497648
Dissolved Boron (B)	mg/L	0.029	0.020	9497648
Dissolved Calcium (Ca)	mg/L	71	0.30	9497648
Dissolved Chromium (Cr)	mg/L	<0.010	0.010	9497648
Dissolved Iron (Fe)	mg/L	0.15	0.060	9497648
Dissolved Lithium (Li)	mg/L	<0.020	0.020	9497648

RDL = Reportable Detection Limit
N/A = Not Applicable

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BV Labs Job #: B953759
Report Date: 2019/07/25

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Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

ROUTINE WATER -LAB FILTERED (WATER)

BV Labs ID		WA5524		
Sampling Date		2019/07/04 14:55		
COC Number		M083946		
	UNITS	MW18-107	RDL	QC Batch
Dissolved Magnesium (Mg)	mg/L	32	0.20	9497648
Dissolved Manganese (Mn)	mg/L	0.039	0.0040	9497648
Dissolved Phosphorus (P)	mg/L	<0.10	0.10	9497648
Dissolved Potassium (K)	mg/L	3.0	0.30	9497648
Dissolved Silicon (Si)	mg/L	4.8	0.10	9497648
Dissolved Sodium (Na)	mg/L	6.6	0.50	9497648
Dissolved Strontium (Sr)	mg/L	0.46	0.020	9497648
Dissolved Sulphur (S)	mg/L	2.0	0.20	9497648
RDL = Reportable Detection Limit				

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BV Labs Job #: B953759
Report Date: 2019/07/25

SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

REG. METALS (CCME/AT1) – DISS. LAB FILT.

BV Labs ID		WA5520	WA5521	WA5522	WA5523		WA5524		
Sampling Date		2019/07/04 09:55	2019/07/04 10:55	2019/07/04 11:55	2019/07/04 13:55		2019/07/04 14:55		
COC Number		M083946	M083946	M083946	M083946		M083946		
	UNITS	MW18-105	MW19-108	MW18-104	MW18-106	QC Batch	MW18-107	RDL	QC Batch
Low Level Elements									
Dissolved Cadmium (Cd)	ug/L	<0.020	<0.020	0.039	<0.020	9512961	<0.020	0.020	9513604
Lab Filtered Elements									
Dissolved Aluminum (Al)	mg/L	<0.0030	0.0051	0.0051	0.0034	9519537	0.0033	0.0030	9519537
Dissolved Antimony (Sb)	mg/L	<0.00060	<0.00060	0.0013	<0.00060	9519537	<0.00060	0.00060	9519537
Dissolved Arsenic (As)	mg/L	<0.00020	0.00022	0.00080	<0.00020	9519537	0.00023	0.00020	9519537
Dissolved Beryllium (Be)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	9519537	<0.0010	0.0010	9519537
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	9519537	<0.0010	0.0010	9519537
Dissolved Cobalt (Co)	mg/L	<0.00030	0.00039	0.0012	<0.00030	9519537	<0.00030	0.00030	9519537
Dissolved Copper (Cu)	mg/L	0.00030	<0.00020	0.0025	0.00072	9519537	<0.00020	0.00020	9519537
Dissolved Lead (Pb)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	9519537	<0.00020	0.00020	9519537
Dissolved Molybdenum (Mo)	mg/L	0.00096	0.0029	0.012	0.0012	9519537	0.00095	0.00020	9519537
Dissolved Nickel (Ni)	mg/L	<0.00050	0.0023	0.0024	<0.00050	9519537	<0.00050	0.00050	9519537
Dissolved Selenium (Se)	mg/L	0.00043	0.00074	0.00024	0.00067	9519537	0.00081	0.00020	9519537
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	9519537	<0.00010	0.00010	9519537
Dissolved Thallium (Tl)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	9519537	<0.00020	0.00020	9519537
Dissolved Tin (Sn)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	9519537	0.0012	0.0010	9519537
Dissolved Titanium (Ti)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	9519537	<0.0010	0.0010	9519537
Dissolved Uranium (U)	mg/L	0.0018	0.0027	0.0015	0.0020	9519537	0.0017	0.00010	9519537
Dissolved Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	9519537	<0.0010	0.0010	9519537
Dissolved Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	9519537	<0.0030	0.0030	9519537
RDL = Reportable Detection Limit									

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SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

REG. METALS (CCME/AT1) – DISS. LAB FILT.

BV Labs ID		WA5524		
Sampling Date		2019/07/04 14:55		
COC Number		M083946		
	UNITS	MW18-107 Lab-Dup	RDL	QC Batch
Lab Filtered Elements				
Dissolved Aluminum (Al)	mg/L	0.0036	0.0030	9519537
Dissolved Antimony (Sb)	mg/L	<0.00060	0.00060	9519537
Dissolved Arsenic (As)	mg/L	<0.00020	0.00020	9519537
Dissolved Beryllium (Be)	mg/L	<0.0010	0.0010	9519537
Dissolved Chromium (Cr)	mg/L	<0.0010	0.0010	9519537
Dissolved Cobalt (Co)	mg/L	<0.00030	0.00030	9519537
Dissolved Copper (Cu)	mg/L	<0.00020	0.00020	9519537
Dissolved Lead (Pb)	mg/L	<0.00020	0.00020	9519537
Dissolved Molybdenum (Mo)	mg/L	0.00090	0.00020	9519537
Dissolved Nickel (Ni)	mg/L	<0.00050	0.00050	9519537
Dissolved Selenium (Se)	mg/L	0.00079	0.00020	9519537
Dissolved Silver (Ag)	mg/L	<0.00010	0.00010	9519537
Dissolved Thallium (Tl)	mg/L	<0.00020	0.00020	9519537
Dissolved Tin (Sn)	mg/L	<0.0010	0.0010	9519537
Dissolved Titanium (Ti)	mg/L	<0.0010	0.0010	9519537
Dissolved Uranium (U)	mg/L	0.0018	0.00010	9519537
Dissolved Vanadium (V)	mg/L	<0.0010	0.0010	9519537
Dissolved Zinc (Zn)	mg/L	<0.0030	0.0030	9519537

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

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BV Labs Job #: B953759
Report Date: 2019/07/25

SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

REGULATED METALS (CCME/AT1) - TOTAL

BV Labs ID		WA5520		WA5521	WA5522	WA5523	WA5524		
Sampling Date		2019/07/04 09:55		2019/07/04 10:55	2019/07/04 11:55	2019/07/04 13:55	2019/07/04 14:55		
COC Number		M083946		M083946	M083946	M083946	M083946		
	UNITS	MW18-105	RDL	MW19-108	MW18-104	MW18-106	MW18-107	RDL	QC Batch
Low Level Elements									
Total Cadmium (Cd)	ug/L	5.5	0.020	0.95	0.36	0.95	0.33	0.020	9493589
Elements									
Total Aluminum (Al)	mg/L	5.4	0.0030	15	3.7	13	7.0	0.0030	9500624
Total Antimony (Sb)	mg/L	0.0060	0.00060	0.0022	0.0049	0.0048	0.00079	0.00060	9500624
Total Arsenic (As)	mg/L	0.0056	0.00020	0.0086	0.0044	0.017	0.0076	0.00020	9500624
Total Barium (Ba)	mg/L	2.8	0.010	1.1	0.61	1.1	0.79	0.010	9500611
Total Beryllium (Be)	mg/L	0.0014	0.0010	0.0012	<0.0010	<0.0010	<0.0010	0.0010	9500624
Total Boron (B)	mg/L	0.021	0.020	0.029	0.025	<0.020	<0.020	0.020	9500611
Total Calcium (Ca)	mg/L	720 (1)	1.5	170	90	350	170	0.30	9500611
Total Chromium (Cr)	mg/L	0.0046	0.0010	0.038	0.018	0.081	0.025	0.0010	9500624
Total Cobalt (Co)	mg/L	0.035	0.00030	0.011	0.0071	0.015	0.0051	0.00030	9500624
Total Copper (Cu)	mg/L	0.11	0.00020	0.038	0.064	0.11	0.018	0.00020	9500624
Total Iron (Fe)	mg/L	49	0.060	29	7.6	37	17	0.060	9500611
Total Lead (Pb)	mg/L	0.025	0.00020	0.024	0.0049	0.019	0.0075	0.00020	9500624
Total Lithium (Li)	mg/L	0.033	0.020	0.025	<0.020	0.021	<0.020	0.020	9500611
Total Magnesium (Mg)	mg/L	77	0.20	50	35	78	58	0.20	9500611
Total Manganese (Mn)	mg/L	2.9	0.0040	0.74	0.62	1.9	0.60	0.0040	9500611
Total Molybdenum (Mo)	mg/L	0.0014	0.00020	0.0065	0.015	0.0050	0.0021	0.00020	9500624
Total Nickel (Ni)	mg/L	0.015	0.00050	0.047	0.020	0.036	0.014	0.00050	9500624
Total Phosphorus (P)	mg/L	1.6	0.10	1.0	0.76	1.2	0.61	0.10	9500611
Total Potassium (K)	mg/L	6.6	0.30	5.6	4.6	5.0	3.6	0.30	9500611
Total Selenium (Se)	mg/L	0.00093	0.00020	0.0013	0.00049	0.0011	0.00094	0.00020	9500624
Total Silicon (Si)	mg/L	41	0.10	27	9.9	23	12	0.10	9500611
Total Silver (Ag)	mg/L	<0.00010	0.00010	0.00030	0.00044	0.0017	0.00010	0.00010	9500624
Total Sodium (Na)	mg/L	5.6	0.50	12	12	8.1	6.1	0.50	9500611
Total Strontium (Sr)	mg/L	1.4	0.020	0.57	0.41	0.58	0.51	0.020	9500611
Total Sulphur (S)	mg/L	2.3	0.20	5.7	3.2	2.5	2.2	0.20	9500611
Total Thallium (Tl)	mg/L	0.00023	0.00020	0.00028	<0.00020	0.00020	<0.00020	0.00020	9500624
Total Tin (Sn)	mg/L	<0.0010	0.0010	0.0037	0.0052	0.0014	<0.0010	0.0010	9500624
Total Titanium (Ti)	mg/L	0.0092	0.0010	0.098	0.030	0.092	0.13	0.0010	9500624

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

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BV Labs Job #: B953759
Report Date: 2019/07/25

SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

REGULATED METALS (CCME/AT1) - TOTAL

BV Labs ID		WA5520		WA5521	WA5522	WA5523	WA5524		
Sampling Date		2019/07/04 09:55		2019/07/04 10:55	2019/07/04 11:55	2019/07/04 13:55	2019/07/04 14:55		
COC Number		M083946		M083946	M083946	M083946	M083946		
	UNITS	MW18-105	RDL	MW19-108	MW18-104	MW18-106	MW18-107	RDL	QC Batch
Total Uranium (U)	mg/L	0.012	0.00010	0.0047	0.0019	0.0030	0.0027	0.00010	9500624
Total Vanadium (V)	mg/L	0.0053	0.0010	0.036	0.011	0.033	0.018	0.0010	9500624
Total Zinc (Zn)	mg/L	0.19	0.0030	0.15	0.072	0.13	0.037	0.0030	9500624
RDL = Reportable Detection Limit									

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BV Labs Job #: B953759
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Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WA5520		WA5521	WA5522	WA5523		WA5524		
Sampling Date		2019/07/04 09:55		2019/07/04 10:55	2019/07/04 11:55	2019/07/04 13:55		2019/07/04 14:55		
COC Number		M083946		M083946	M083946	M083946		M083946		
	UNITS	MW18-105	RDL	MW19-108	MW18-104	MW18-106	RDL	MW18-107	RDL	QC Batch
Microbiological Param.										
E.Coli DST	MPN/100mL	<100 (1)	100	<10 (1)	10 (1)	<10 (1)	10	<1.0	1.0	9493707
Total Coliforms DST	MPN/100mL	<100 (1)	100	<10 (1)	>24000 (1)	1100 (1)	10	>2400	1.0	9493707
Physical Properties										
Turbidity	NTU	>4000 (2)	0.10	670	130	3100	0.10	53	0.10	9495349

RDL = Reportable Detection Limit
(1) Detection limit raised due to matrix interference.
(2) Sample contained sediment

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BV Labs Job #: B953759
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Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

BV Labs ID		WA5520		WA5521		WA5522		WA5523		WA5524		
Sampling Date		2019/07/04 09:55		2019/07/04 10:55		2019/07/04 11:55		2019/07/04 13:55		2019/07/04 14:55		
COC Number		M083946		M083946		M083946		M083946		M083946		
	UNITS	MW18-105	RDL	MW19-108	RDL	MW18-104	RDL	MW18-106	RDL	MW18-107	RDL	QC Batch
Low Level Elements												
Total Mercury (Hg)	ug/L	1.3 (1)	0.20	0.067 (1)	0.020	0.030 (1)	0.0060	0.32 (1)	0.20	0.048 (1)	0.0060	9502664

RDL = Reportable Detection Limit
(1) Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly.

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BV Labs Job #: B953759
Report Date: 2019/07/25

SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

GENERAL COMMENTS

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

Package 1	3.7°C

Results relate only to the items tested.

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BV Labs Job #: B953759
Report Date: 2019/07/25

SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9493707	GK1	Method Blank	E.Coli DST	2019/07/06	<1.0		mpn/100mL	
			Total Coliforms DST	2019/07/06	<1.0		mpn/100mL	
9493707	GK1	RPD	E.Coli DST	2019/07/06	170		%	N/A
			Total Coliforms DST	2019/07/06	33		%	N/A
9495349	EH2	Spiked Blank	Turbidity	2019/07/06		100	%	80 - 120
9495349	EH2	Method Blank	Turbidity	2019/07/06	<0.10		NTU	
9495349	EH2	RPD	Turbidity	2019/07/06	3.9		%	20
9495539	KD9	Matrix Spike	Dissolved Nitrite (N)	2019/07/07		100	%	80 - 120
			Dissolved Nitrate (N)	2019/07/07		99	%	80 - 120
9495539	KD9	Spiked Blank	Dissolved Nitrite (N)	2019/07/07		100	%	80 - 120
			Dissolved Nitrate (N)	2019/07/07		100	%	80 - 120
9495539	KD9	Method Blank	Dissolved Nitrite (N)	2019/07/07	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/07/07	<0.010		mg/L	
9495539	KD9	RPD	Dissolved Nitrite (N)	2019/07/07	NC		%	20
			Dissolved Nitrate (N)	2019/07/07	0.63		%	20
9497185	IK0	Spiked Blank	Alkalinity (Total as CaCO3)	2019/07/08		105	%	80 - 120
9497185	IK0	Method Blank	Alkalinity (PP as CaCO3)	2019/07/08	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2019/07/08	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/07/08	0.0.0, RDL=1.0		mg/L	
			Carbonate (CO3)	2019/07/08	<1.0		mg/L	
			Hydroxide (OH)	2019/07/08	<1.0		mg/L	
9497185	IK0	RPD	Alkalinity (PP as CaCO3)	2019/07/08	NC		%	20
			Alkalinity (Total as CaCO3)	2019/07/08	1.7		%	20
			Bicarbonate (HCO3)	2019/07/08	1.7		%	20
			Carbonate (CO3)	2019/07/08	NC		%	20
			Hydroxide (OH)	2019/07/08	NC		%	20
9497187	IK0	Spiked Blank	pH	2019/07/08		100	%	97 - 103
9497187	IK0	RPD	pH	2019/07/08	0.052		%	N/A
9497188	IK0	Spiked Blank	Conductivity	2019/07/08		99	%	90 - 110
9497188	IK0	Method Blank	Conductivity	2019/07/08	<2.0		uS/cm	
9497188	IK0	RPD	Conductivity	2019/07/08	0.31		%	10
9497648	MAP	Matrix Spike	Dissolved Aluminum (Al)	2019/07/09		93	%	80 - 120
			Dissolved Barium (Ba)	2019/07/09		92	%	80 - 120
			Dissolved Boron (B)	2019/07/09		94	%	80 - 120
			Dissolved Calcium (Ca)	2019/07/09		NC	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/09		92	%	80 - 120
			Dissolved Iron (Fe)	2019/07/09		94	%	80 - 120
			Dissolved Lithium (Li)	2019/07/09		94	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/09		87	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/09		94	%	80 - 120
			Dissolved Phosphorus (P)	2019/07/09		96	%	80 - 120
			Dissolved Potassium (K)	2019/07/09		91	%	80 - 120
			Dissolved Silicon (Si)	2019/07/09		92	%	80 - 120
			Dissolved Sodium (Na)	2019/07/09		80	%	80 - 120
			Dissolved Strontium (Sr)	2019/07/09		86	%	80 - 120
			Dissolved Sulphur (S)	2019/07/09		102	%	80 - 120
9497648	MAP	Spiked Blank	Dissolved Aluminum (Al)	2019/07/09		96	%	80 - 120
			Dissolved Barium (Ba)	2019/07/09		97	%	80 - 120
			Dissolved Boron (B)	2019/07/09		97	%	80 - 120
			Dissolved Calcium (Ca)	2019/07/09		98	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/09		98	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Iron (Fe)	2019/07/09		105	%	80 - 120
			Dissolved Lithium (Li)	2019/07/09		96	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/09		96	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/09		100	%	80 - 120
			Dissolved Phosphorus (P)	2019/07/09		95	%	80 - 120
			Dissolved Potassium (K)	2019/07/09		93	%	80 - 120
			Dissolved Silicon (Si)	2019/07/09		98	%	80 - 120
			Dissolved Sodium (Na)	2019/07/09		96	%	80 - 120
			Dissolved Strontium (Sr)	2019/07/09		98	%	80 - 120
			Dissolved Sulphur (S)	2019/07/09		97	%	80 - 120
9497648	MAP	Method Blank	Dissolved Aluminum (Al)	2019/07/09	<0.040		mg/L	
			Dissolved Barium (Ba)	2019/07/09	<0.010		mg/L	
			Dissolved Boron (B)	2019/07/09	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/07/09	<0.30		mg/L	
			Dissolved Chromium (Cr)	2019/07/09	<0.010		mg/L	
			Dissolved Iron (Fe)	2019/07/09	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/07/09	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/07/09	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/07/09	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2019/07/09	<0.10		mg/L	
			Dissolved Potassium (K)	2019/07/09	<0.30		mg/L	
			Dissolved Silicon (Si)	2019/07/09	<0.10		mg/L	
			Dissolved Sodium (Na)	2019/07/09	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/07/09	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/07/09	<0.20		mg/L	
9497648	MAP	RPD	Dissolved Calcium (Ca)	2019/07/09	0.75		%	20
			Dissolved Iron (Fe)	2019/07/09	NC		%	20
			Dissolved Magnesium (Mg)	2019/07/09	0.57		%	20
			Dissolved Manganese (Mn)	2019/07/09	NC		%	20
			Dissolved Potassium (K)	2019/07/09	1.1		%	20
			Dissolved Sodium (Na)	2019/07/09	0.69		%	20
9498897	IK0	Spiked Blank	Alkalinity (Total as CaCO3)	2019/07/09		92	%	80 - 120
9498897	IK0	Method Blank	Alkalinity (PP as CaCO3)	2019/07/09	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2019/07/09	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/07/09	<1.0		mg/L	
			Carbonate (CO3)	2019/07/09	<1.0		mg/L	
			Hydroxide (OH)	2019/07/09	<1.0		mg/L	
9498897	IK0	RPD	Alkalinity (PP as CaCO3)	2019/07/09	NC		%	20
			Alkalinity (Total as CaCO3)	2019/07/09	2.2		%	20
			Bicarbonate (HCO3)	2019/07/09	2.2		%	20
			Carbonate (CO3)	2019/07/09	NC		%	20
			Hydroxide (OH)	2019/07/09	NC		%	20
9498906	IK0	Spiked Blank	pH	2019/07/09		101	%	97 - 103
9498906	IK0	RPD	pH	2019/07/09	0.053		%	N/A
9498908	IK0	Spiked Blank	Conductivity	2019/07/09		102	%	90 - 110
9498908	IK0	Method Blank	Conductivity	2019/07/09	<2.0		uS/cm	
9498908	IK0	RPD	Conductivity	2019/07/09	1.1		%	10
9500611	ALX	Matrix Spike	Total Barium (Ba)	2019/07/10		96	%	80 - 120
			Total Boron (B)	2019/07/10		97	%	80 - 120
			Total Calcium (Ca)	2019/07/10		NC	%	80 - 120
			Total Iron (Fe)	2019/07/10		101	%	80 - 120
			Total Lithium (Li)	2019/07/10		95	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Magnesium (Mg)	2019/07/10		95	%	80 - 120
			Total Manganese (Mn)	2019/07/10		94	%	80 - 120
			Total Phosphorus (P)	2019/07/10		95	%	80 - 120
			Total Potassium (K)	2019/07/10		94	%	80 - 120
			Total Silicon (Si)	2019/07/10		99	%	80 - 120
			Total Sodium (Na)	2019/07/10		NC	%	80 - 120
			Total Strontium (Sr)	2019/07/10		94	%	80 - 120
			Total Sulphur (S)	2019/07/10		95	%	80 - 120
9500611	ALX	Spiked Blank	Total Barium (Ba)	2019/07/10		96	%	80 - 120
			Total Boron (B)	2019/07/10		96	%	80 - 120
			Total Calcium (Ca)	2019/07/10		95	%	80 - 120
			Total Iron (Fe)	2019/07/10		103	%	80 - 120
			Total Lithium (Li)	2019/07/10		94	%	80 - 120
			Total Magnesium (Mg)	2019/07/10		96	%	80 - 120
			Total Manganese (Mn)	2019/07/10		97	%	80 - 120
			Total Phosphorus (P)	2019/07/10		94	%	80 - 120
			Total Potassium (K)	2019/07/10		92	%	80 - 120
			Total Silicon (Si)	2019/07/10		98	%	80 - 120
			Total Sodium (Na)	2019/07/10		95	%	80 - 120
			Total Strontium (Sr)	2019/07/10		95	%	80 - 120
			Total Sulphur (S)	2019/07/10		96	%	80 - 120
9500611	ALX	Method Blank	Total Barium (Ba)	2019/07/10	<0.010		mg/L	
			Total Boron (B)	2019/07/10	<0.020		mg/L	
			Total Calcium (Ca)	2019/07/10	<0.30		mg/L	
			Total Iron (Fe)	2019/07/10	<0.060		mg/L	
			Total Lithium (Li)	2019/07/10	<0.020		mg/L	
			Total Magnesium (Mg)	2019/07/10	<0.20		mg/L	
			Total Manganese (Mn)	2019/07/10	<0.0040		mg/L	
			Total Phosphorus (P)	2019/07/10	<0.10		mg/L	
			Total Potassium (K)	2019/07/10	<0.30		mg/L	
			Total Silicon (Si)	2019/07/10	<0.10		mg/L	
			Total Sodium (Na)	2019/07/10	<0.50		mg/L	
			Total Strontium (Sr)	2019/07/10	<0.020		mg/L	
			Total Sulphur (S)	2019/07/10	<0.20		mg/L	
9500611	ALX	RPD	Total Barium (Ba)	2019/07/10	0.68		%	20
			Total Boron (B)	2019/07/10	1.0		%	20
			Total Calcium (Ca)	2019/07/10	0.17		%	20
			Total Iron (Fe)	2019/07/10	3.0		%	20
			Total Lithium (Li)	2019/07/10	0		%	20
			Total Magnesium (Mg)	2019/07/10	0.46		%	20
			Total Manganese (Mn)	2019/07/10	NC		%	20
			Total Phosphorus (P)	2019/07/10	NC		%	20
			Total Potassium (K)	2019/07/10	0.63		%	20
			Total Silicon (Si)	2019/07/10	0.92		%	20
			Total Sodium (Na)	2019/07/10	0.55		%	20
			Total Strontium (Sr)	2019/07/10	0.38		%	20
			Total Sulphur (S)	2019/07/10	0.37		%	20
9500624	LQ1	Matrix Spike	Total Aluminum (Al)	2019/07/10		97	%	80 - 120
			Total Antimony (Sb)	2019/07/10		105	%	80 - 120
			Total Arsenic (As)	2019/07/10		94	%	80 - 120
			Total Beryllium (Be)	2019/07/10		97	%	80 - 120
			Total Chromium (Cr)	2019/07/10		99	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Cobalt (Co)	2019/07/10		97	%	80 - 120
			Total Copper (Cu)	2019/07/10		109	%	80 - 120
			Total Lead (Pb)	2019/07/10		102	%	80 - 120
			Total Molybdenum (Mo)	2019/07/10		104	%	80 - 120
			Total Nickel (Ni)	2019/07/10		96	%	80 - 120
			Total Selenium (Se)	2019/07/10		97	%	80 - 120
			Total Silver (Ag)	2019/07/10		100	%	80 - 120
			Total Thallium (Tl)	2019/07/10		99	%	80 - 120
			Total Tin (Sn)	2019/07/10		99	%	80 - 120
			Total Titanium (Ti)	2019/07/10		101	%	80 - 120
			Total Uranium (U)	2019/07/10		98	%	80 - 120
			Total Vanadium (V)	2019/07/10		99	%	80 - 120
			Total Zinc (Zn)	2019/07/10		NC	%	80 - 120
9500624	LQ1	Spiked Blank	Total Aluminum (Al)	2019/07/10		99	%	80 - 120
			Total Antimony (Sb)	2019/07/10		105	%	80 - 120
			Total Arsenic (As)	2019/07/10		95	%	80 - 120
			Total Beryllium (Be)	2019/07/10		94	%	80 - 120
			Total Chromium (Cr)	2019/07/10		100	%	80 - 120
			Total Cobalt (Co)	2019/07/10		98	%	80 - 120
			Total Copper (Cu)	2019/07/10		98	%	80 - 120
			Total Lead (Pb)	2019/07/10		97	%	80 - 120
			Total Molybdenum (Mo)	2019/07/10		100	%	80 - 120
			Total Nickel (Ni)	2019/07/10		97	%	80 - 120
			Total Selenium (Se)	2019/07/10		95	%	80 - 120
			Total Silver (Ag)	2019/07/10		100	%	80 - 120
			Total Thallium (Tl)	2019/07/10		100	%	80 - 120
			Total Tin (Sn)	2019/07/10		98	%	80 - 120
			Total Titanium (Ti)	2019/07/10		99	%	80 - 120
			Total Uranium (U)	2019/07/10		93	%	80 - 120
			Total Vanadium (V)	2019/07/10		99	%	80 - 120
			Total Zinc (Zn)	2019/07/10		96	%	80 - 120
9500624	LQ1	Method Blank	Total Aluminum (Al)	2019/07/10	<0.0030		mg/L	
			Total Antimony (Sb)	2019/07/10	<0.00060		mg/L	
			Total Arsenic (As)	2019/07/10	<0.00020		mg/L	
			Total Beryllium (Be)	2019/07/10	<0.0010		mg/L	
			Total Chromium (Cr)	2019/07/10	<0.0010		mg/L	
			Total Cobalt (Co)	2019/07/10	<0.00030		mg/L	
			Total Copper (Cu)	2019/07/10	<0.00020		mg/L	
			Total Lead (Pb)	2019/07/10	<0.00020		mg/L	
			Total Molybdenum (Mo)	2019/07/10	<0.00020		mg/L	
			Total Nickel (Ni)	2019/07/10	<0.00050		mg/L	
			Total Selenium (Se)	2019/07/10	<0.00020		mg/L	
			Total Silver (Ag)	2019/07/10	<0.00010		mg/L	
			Total Thallium (Tl)	2019/07/10	<0.00020		mg/L	
			Total Tin (Sn)	2019/07/10	<0.0010		mg/L	
			Total Titanium (Ti)	2019/07/10	<0.0010		mg/L	
			Total Uranium (U)	2019/07/10	<0.00010		mg/L	
			Total Vanadium (V)	2019/07/10	<0.0010		mg/L	
			Total Zinc (Zn)	2019/07/10	<0.0030		mg/L	
9500624	LQ1	RPD	Total Aluminum (Al)	2019/07/10	5.2		%	20
			Total Antimony (Sb)	2019/07/10	NC		%	20
			Total Arsenic (As)	2019/07/10	NC		%	20

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Beryllium (Be)	2019/07/10	NC		%	20
			Total Chromium (Cr)	2019/07/10	7.9		%	20
			Total Cobalt (Co)	2019/07/10	NC		%	20
			Total Copper (Cu)	2019/07/10	7.8		%	20
			Total Lead (Pb)	2019/07/10	NC		%	20
			Total Molybdenum (Mo)	2019/07/10	1.8		%	20
			Total Nickel (Ni)	2019/07/10	12		%	20
			Total Selenium (Se)	2019/07/10	1.9		%	20
			Total Silver (Ag)	2019/07/10	NC		%	20
			Total Thallium (Tl)	2019/07/10	NC		%	20
			Total Tin (Sn)	2019/07/10	NC		%	20
			Total Titanium (Ti)	2019/07/10	NC		%	20
			Total Uranium (U)	2019/07/10	4.8		%	20
			Total Vanadium (V)	2019/07/10	NC		%	20
			Total Zinc (Zn)	2019/07/10	NC		%	20
9501388	ZI	Matrix Spike	Dissolved Chloride (Cl)	2019/07/10		NC	%	80 - 120
9501388	ZI	Spiked Blank	Dissolved Chloride (Cl)	2019/07/10		106	%	80 - 120
9501388	ZI	Method Blank	Dissolved Chloride (Cl)	2019/07/10	<1.0		mg/L	
9501388	ZI	RPD	Dissolved Chloride (Cl)	2019/07/10	1.2		%	20
9501390	ZI	Matrix Spike	Dissolved Sulphate (SO4)	2019/07/10		NC	%	80 - 120
9501390	ZI	Spiked Blank	Dissolved Sulphate (SO4)	2019/07/10		103	%	80 - 120
9501390	ZI	Method Blank	Dissolved Sulphate (SO4)	2019/07/10	<1.0		mg/L	
9501390	ZI	RPD	Dissolved Sulphate (SO4)	2019/07/10	0.13		%	20
9502664	RK3	Matrix Spike	Total Mercury (Hg)	2019/07/11		95	%	80 - 120
9502664	RK3	Spiked Blank	Total Mercury (Hg)	2019/07/11		91	%	80 - 120
9502664	RK3	Method Blank	Total Mercury (Hg)	2019/07/11	<0.0020		ug/L	
9502664	RK3	RPD	Total Mercury (Hg)	2019/07/11	NC		%	20
9519537	ANE	Matrix Spike [WA5524-01]	Dissolved Aluminum (Al)	2019/07/23		110	%	80 - 120
			Dissolved Antimony (Sb)	2019/07/23		99	%	80 - 120
			Dissolved Arsenic (As)	2019/07/23		98	%	80 - 120
			Dissolved Beryllium (Be)	2019/07/23		102	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/23		95	%	80 - 120
			Dissolved Cobalt (Co)	2019/07/23		94	%	80 - 120
			Dissolved Copper (Cu)	2019/07/23		93	%	80 - 120
			Dissolved Lead (Pb)	2019/07/23		92	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/07/23		98	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/23		94	%	80 - 120
			Dissolved Selenium (Se)	2019/07/23		108	%	80 - 120
			Dissolved Silver (Ag)	2019/07/23		94	%	80 - 120
			Dissolved Thallium (Tl)	2019/07/23		96	%	80 - 120
			Dissolved Tin (Sn)	2019/07/23		75 (1)	%	80 - 120
			Dissolved Titanium (Ti)	2019/07/23		84	%	80 - 120
			Dissolved Uranium (U)	2019/07/23		104	%	80 - 120
			Dissolved Vanadium (V)	2019/07/23		98	%	80 - 120
			Dissolved Zinc (Zn)	2019/07/23		94	%	80 - 120
9519537	ANE	Spiked Blank	Dissolved Aluminum (Al)	2019/07/23		106	%	80 - 120
			Dissolved Antimony (Sb)	2019/07/23		100	%	80 - 120
			Dissolved Arsenic (As)	2019/07/23		99	%	80 - 120
			Dissolved Beryllium (Be)	2019/07/23		100	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/23		98	%	80 - 120
			Dissolved Cobalt (Co)	2019/07/23		97	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Copper (Cu)	2019/07/23		99	%	80 - 120
			Dissolved Lead (Pb)	2019/07/23		94	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/07/23		96	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/23		97	%	80 - 120
			Dissolved Selenium (Se)	2019/07/23		107	%	80 - 120
			Dissolved Silver (Ag)	2019/07/23		94	%	80 - 120
			Dissolved Thallium (Tl)	2019/07/23		97	%	80 - 120
			Dissolved Tin (Sn)	2019/07/23		81	%	80 - 120
			Dissolved Titanium (Ti)	2019/07/23		88	%	80 - 120
			Dissolved Uranium (U)	2019/07/23		100	%	80 - 120
			Dissolved Vanadium (V)	2019/07/23		99	%	80 - 120
			Dissolved Zinc (Zn)	2019/07/23		94	%	80 - 120
9519537	ANE	Method Blank	Dissolved Aluminum (Al)	2019/07/23	<0.0030		mg/L	
			Dissolved Antimony (Sb)	2019/07/23	<0.00060		mg/L	
			Dissolved Arsenic (As)	2019/07/23	<0.00020		mg/L	
			Dissolved Beryllium (Be)	2019/07/23	<0.0010		mg/L	
			Dissolved Chromium (Cr)	2019/07/23	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/07/23	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/07/23	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/07/23	<0.00020		mg/L	
			Dissolved Molybdenum (Mo)	2019/07/23	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/07/23	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/07/23	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/07/23	<0.00010		mg/L	
			Dissolved Thallium (Tl)	2019/07/23	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/07/23	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/07/23	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/07/23	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/07/23	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/07/23	<0.0030		mg/L	
9519537	ANE	RPD [WA5524-01]	Dissolved Aluminum (Al)	2019/07/23	9.8		%	20
			Dissolved Antimony (Sb)	2019/07/23	NC		%	20
			Dissolved Arsenic (As)	2019/07/23	12		%	20
			Dissolved Beryllium (Be)	2019/07/23	NC		%	20
			Dissolved Chromium (Cr)	2019/07/23	NC		%	20
			Dissolved Cobalt (Co)	2019/07/23	NC		%	20
			Dissolved Copper (Cu)	2019/07/23	NC		%	20
			Dissolved Lead (Pb)	2019/07/23	NC		%	20
			Dissolved Molybdenum (Mo)	2019/07/23	5.2		%	20
			Dissolved Nickel (Ni)	2019/07/23	NC		%	20
			Dissolved Selenium (Se)	2019/07/23	2.0		%	20
			Dissolved Silver (Ag)	2019/07/23	NC		%	20
			Dissolved Thallium (Tl)	2019/07/23	NC		%	20
			Dissolved Tin (Sn)	2019/07/23	16		%	20
			Dissolved Titanium (Ti)	2019/07/23	NC		%	20
			Dissolved Uranium (U)	2019/07/23	4.6		%	20
			Dissolved Vanadium (V)	2019/07/23	NC		%	20

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Zinc (Zn)	2019/07/23	NC		%	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).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: B953759
Report Date: 2019/07/25

SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

VALIDATION SIGNATURE PAGE

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

Ghayasuddin Khan, M.Sc., P.Chem., QP, Scientific Specialist, Inorganics

Harry (Peng) Liang, Senior Analyst

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

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Maxxam
A Bureau Veritas Group Company

Calgary: 4000 19th St. NE, T2E 6P8. Toll Free (800) 386-7247
Edmonton: 9331-48 St. T6B 2R4. Toll Free (800) 386-7247
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CHAIN OF CUSTODY RECORD

M 083946

Page 1 of 1

Invoice Information	Report Information (if differs from invoice)	Project Information	Turnaround Time (TAT) Required
Company: SLR Consulting Ltd.	Company: Summit Aggregates	Quotation #:	[X] 5 - 7 Days Regular (Most analyses)
Contact Name: Robert Till	Contact Name:	P.O. #/ AFE#: ~~EDM4886~~ EDM4886	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 16946 Roper Road, Edmonton AB, T6B 3H9	Address:	Project #: 212-06550-00003	Rush TAT (Surcharges will be applied)
Phone:	Phone:	Site Location: Mountain Ash	[ ] Same Day [ ] 2 Days [ ] 1 Day [ ] 3-4 Days
Email: rtill@slrconsulting.com	Email: rtill@slrconsulting.com	Site #:	Date Required:
Copies: ~~nyari@slrconsulting.com~~ nyari@slrconsulting.com	Copies: nyari@slrconsulting.com	Sampled By: Noushin Yari	Rush Confirmation #:

Laboratory Use Only

Depot Reception

	YES	NO	Cooler ID	Temp
Seal Present	✓			
Seal Intact	✓			
Cooling Media	—			
			Cooler ID	Temp
Seal Present				
Seal Intact				
Cooling Media				
			Cooler ID	Temp
Seal Present				
Seal Intact				
Cooling Media				

3 0 8

Analysis Requested

	Sample Identification	Depth (Unit)	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	# of containers	BTEX F1	VOC	BTEX F1-F2	BTEX F1-F4	Routine Water	Regulated Metals	Tot	Diss	Mercury	Total	Dissolved	Salinity 4	Sieve (75 micron)	Texture (% Sand, Silt, Clay)	Basic Class II Landfill	Turbidity	Total Coliforms & E. Coli	HOLD - DO NOT ANALYZE
1	MW18-105		2019/07/04	9:55 AM	Ground water	6					X	X			X							X		X
2	MW19-108		↓	10:55 AM		6					X	X			X							X		X
3	MW18-104			11:55 AM		6					X	X			X							X		X
4	MW18-106			1:55 pm		6					X	X			X							X		X
5	MW18-107			2:55 PM	↓	6					X	X			X							X		X
6																								
7																								
8																								
9																								
10																								

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

Regulatory Criteria

- [X] AT1
- [ ] CCME
- [ ] Drinking Water
- [ ] D50 (Drilling Waste)
- [ ] Saskatchewan
- [ ] Other:

Special Instructions

→ silty
→ silty
→ silty

Metals preserved not field filtered. Too wet in field and could not label bottles w/ marker or Pen. Labels on bags.

Relinquished by: (Signature/ Print)	DATE (YYYY/MM/DD)	Time (HH:MM)	Received by: (Signature/ Print)	DATE (YYYY/MM/DD)	Time (HH:MM)
[signature] / Noushin Yari	2019/07/05	06:45 AM	[signature]	2019/07/05	07:00

05-Jul-19 07:00
Jenelle Feller
B953759
JEM INS-0239

AB FCD-00331/7

Your P.O. #: EDM4886
Your Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
PO # EDM3288
Your C.O.C. #: M083948

Attention: ROBERT TILL

SLR CONSULTING (CANADA) LTD
6940 ROPER ROAD
EDMONTON, AB
CANADA T6B 3H9

Report Date: 2019/07/12
Report #: R2751511
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B953951
Received: 2019/07/05, 12:20

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH	2	N/A	2019/07/10	AB SOP-00005	SM 23 2320 B m
Cadmium - low level CCME (Total)	2	N/A	2019/07/11		Auto Calc
Chloride by Automated Colourimetry	2	N/A	2019/07/10	AB SOP-00020	SM 23-4500-Cl-E m
Total Coliforms and E.Coli	2	2019/07/05	2019/07/06	AB SOP-00089	SM 23 9223 A,B m
Conductivity @25C	2	N/A	2019/07/10	AB SOP-00005	SM 23 2510 B m
Hardness	2	N/A	2019/07/11		Auto Calc
Mercury (Total) by CV	1	2019/07/10	2019/07/10	CAL SOP-00007	EPA 1631 RE 20460 m
Mercury (Total) by CV	1	2019/07/10	2019/07/11	CAL SOP-00007	EPA 1631 RE 20460 m
Elements by ICP-Dissolved-Lab Filtered (1)	2	N/A	2019/07/09	AB SOP-00042	EPA 6010d R5 m
Elements by ICP - Total	2	2019/07/10	2019/07/10	AB SOP-00014 / AB SOP-00042	EPA 6010d R4 m
Elements by ICPMS - Total	2	2019/07/10	2019/07/10	AB SOP-00014 / AB SOP-00043	EPA 6020b R2 m
Ion Balance	2	N/A	2019/07/06		Auto Calc
Sum of cations, anions	2	N/A	2019/07/11		Auto Calc
Nitrate and Nitrite	2	N/A	2019/07/10		Auto Calc
Nitrate + Nitrite-N (calculated)	2	N/A	2019/07/10		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	2	N/A	2019/07/07	AB SOP-00023	SM 23 4110 B m
pH @25°C (2)	2	N/A	2019/07/10	AB SOP-00005	SM 23 4500-H+B m
Sulphate by Automated Colourimetry	2	N/A	2019/07/10	AB SOP-00018	SM 23 4500-SO4 E m
Total Dissolved Solids (Calculated)	2	N/A	2019/07/11		Auto Calc
Turbidity	2	N/A	2019/07/06	CAL SOP-00081	SM 23 2130 B m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs 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 BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs 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. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Your P.O. #: EDM4886
Your Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
PO # EDM3288
Your C.O.C. #: M083948

Attention: ROBERT TILL

SLR CONSULTING (CANADA) LTD
6940 ROPER ROAD
EDMONTON, AB
CANADA T6B 3H9

Report Date: 2019/07/12
Report #: R2751511
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B953951
Received: 2019/07/05, 12:20

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs 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 BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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. When sampling is not conducted by BV Labs, results relate to the supplied 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 > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(2) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Bureau Veritas Laboratories endeavours to analyze samples as soon as possible after receipt.

Encryption Key

Jenelle Feller
Key Account Specialist
12 Jul 2019 17:52:06

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Jenelle Feller, Key Account Specialist
Email: JFeller@bvlabs.com
Phone# (403)735-2264

==========

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Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: B953951
Report Date: 2019/07/12

SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

ROUTINE WATER -LAB FILTERED (WATER)

BV Labs ID		WA6549	WA6550		
Sampling Date		2019/07/05	2019/07/05		
COC Number		M083948	M083948		
	UNITS	MW19-109	WW4	RDL	QC Batch
Calculated Parameters					
Anion Sum	meq/L	6.9	6.3	N/A	9493590
Cation Sum	meq/L	7.9	7.3	N/A	9493590
Hardness (CaCO3)	mg/L	350	340	0.50	9494037
Ion Balance (% Difference)	%	6.2	7.6	N/A	9493527
Dissolved Nitrate (NO3)	mg/L	7.4	14	0.044	9493534
Nitrate plus Nitrite (N)	mg/L	1.7	3.2	0.014	9493540
Dissolved Nitrite (NO2)	mg/L	0.22	<0.033	0.033	9493534
Calculated Total Dissolved Solids	mg/L	360	330	1.0	9493550
Misc. Inorganics					
Conductivity	uS/cm	660	600	2.0	9498940
pH	pH	8.19	8.13	N/A	9498939
Anions					
Alkalinity (PP as CaCO3)	mg/L	<1.0	<1.0	1.0	9498938
Alkalinity (Total as CaCO3)	mg/L	290	280	1.0	9498938
Bicarbonate (HCO3)	mg/L	350	340	1.0	9498938
Carbonate (CO3)	mg/L	<1.0	<1.0	1.0	9498938
Hydroxide (OH)	mg/L	<1.0	<1.0	1.0	9498938
Dissolved Sulphate (SO4)	mg/L	26	5.9	1.0	9501583
Dissolved Chloride (Cl)	mg/L	18	12	1.0	9501576
Nutrients					
Dissolved Nitrite (N)	mg/L	0.065	<0.010	0.010	9495902
Dissolved Nitrate (N)	mg/L	1.7	3.2	0.010	9495902
Lab Filtered Elements					
Dissolved Calcium (Ca)	mg/L	77	80	0.30	9499250
Dissolved Iron (Fe)	mg/L	0.15	0.16	0.060	9499250
Dissolved Magnesium (Mg)	mg/L	37	35	0.20	9499250
Dissolved Manganese (Mn)	mg/L	0.42	<0.0040	0.0040	9499250
Dissolved Potassium (K)	mg/L	6.3	3.0	0.30	9499250
Dissolved Sodium (Na)	mg/L	18	7.7	0.50	9499250

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: B953951
Report Date: 2019/07/12

SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

REGULATED METALS (CCME/AT1) - TOTAL

BV Labs ID		WA6549		WA6550		
Sampling Date		2019/07/05		2019/07/05		
COC Number		M083948		M083948		
	UNITS	MW19-109	RDL	WW4	RDL	QC Batch
Low Level Elements						
Total Cadmium (Cd)	ug/L	10	0.020	<0.020	0.020	9494032
Elements						
Total Aluminum (Al)	mg/L	95	0.0030	0.0041	0.0030	9500624
Total Antimony (Sb)	mg/L	0.0034	0.00060	<0.00060	0.00060	9500624
Total Arsenic (As)	mg/L	0.071	0.00020	0.00032	0.00020	9500624
Total Barium (Ba)	mg/L	7.2 (1)	0.050	0.36	0.010	9500611
Total Beryllium (Be)	mg/L	0.0083	0.0010	<0.0010	0.0010	9500624
Total Boron (B)	mg/L	0.087	0.020	<0.020	0.020	9500611
Total Calcium (Ca)	mg/L	1500 (1)	1.5	68	0.30	9500611
Total Chromium (Cr)	mg/L	0.19	0.0010	0.0012	0.0010	9500624
Total Cobalt (Co)	mg/L	0.12	0.00030	<0.00030	0.00030	9500624
Total Copper (Cu)	mg/L	0.29	0.00020	0.034	0.00020	9500624
Total Iron (Fe)	mg/L	190	0.060	0.30	0.060	9500611
Total Lead (Pb)	mg/L	0.15	0.00020	0.011	0.00020	9500624
Total Lithium (Li)	mg/L	0.18	0.020	<0.020	0.020	9500611
Total Magnesium (Mg)	mg/L	210	0.20	30	0.20	9500611
Total Manganese (Mn)	mg/L	8.9	0.0040	<0.0040	0.0040	9500611
Total Molybdenum (Mo)	mg/L	0.023	0.00020	0.00065	0.00020	9500624
Total Nickel (Ni)	mg/L	0.41	0.00050	<0.00050	0.00050	9500624
Total Phosphorus (P)	mg/L	8.1	0.10	<0.10	0.10	9500611
Total Potassium (K)	mg/L	20	0.30	2.3	0.30	9500611
Total Selenium (Se)	mg/L	0.00059	0.00020	0.00093	0.00020	9500624
Total Silicon (Si)	mg/L	110 (1)	0.50	4.7	0.10	9500611
Total Silver (Ag)	mg/L	0.0025	0.00010	0.00012	0.00010	9500624
Total Sodium (Na)	mg/L	18	0.50	5.7	0.50	9500611
Total Strontium (Sr)	mg/L	2.4	0.020	0.39	0.020	9500611
Total Sulphur (S)	mg/L	11	0.20	1.7	0.20	9500611
Total Thallium (Tl)	mg/L	0.0026	0.00020	<0.00020	0.00020	9500624
Total Tin (Sn)	mg/L	0.0047	0.0010	<0.0010	0.0010	9500624
Total Titanium (Ti)	mg/L	0.23	0.0010	<0.0010	0.0010	9500624

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

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: B953951
Report Date: 2019/07/12

SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

REGULATED METALS (CCME/AT1) - TOTAL

BV Labs ID		WA6549		WA6550		
Sampling Date		2019/07/05		2019/07/05		
COC Number		M083948		M083948		
	UNITS	MW19-109	RDL	WW4	RDL	QC Batch
Total Uranium (U)	mg/L	0.016	0.00010	0.0021	0.00010	9500624
Total Vanadium (V)	mg/L	0.22	0.0010	<0.0010	0.0010	9500624
Total Zinc (Zn)	mg/L	1.2	0.0030	0.99	0.0030	9500624
RDL = Reportable Detection Limit						

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: B953951
Report Date: 2019/07/12

SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WA6549		WA6550		
Sampling Date		2019/07/05		2019/07/05		
COC Number		M083948		M083948		
	UNITS	MW19-109	RDL	WW4	RDL	QC Batch
Microbiological Param.						
E.Coli DST	MPN/100mL	100	100	<1.0	1.0	9494183
Total Coliforms DST	MPN/100mL	120000	100	11	1.0	9494183
Physical Properties						
Turbidity	NTU	>4000 (1)	0.10	0.66	0.10	9495457

RDL = Reportable Detection Limit
(1) Sample contained sediment

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: B953951
Report Date: 2019/07/12

SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

MERCURY BY COLD VAPOR (WATER)

BV Labs ID		WA6549		WA6550		
Sampling Date		2019/07/05		2019/07/05		
COC Number		M083948		M083948		
	UNITS	MW19-109	RDL	WW4	RDL	QC Batch
Elements						
Total Mercury (Hg)	ug/L	2.08 (1)	0.20	<0.0020	0.0020	9500789

RDL = Reportable Detection Limit
(1) Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: B953951
Report Date: 2019/07/12

SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

GENERAL COMMENTS

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

Package 1	7.0°C

Results relate only to the items tested.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: B953951
Report Date: 2019/07/12

SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9494183	GK1	Method Blank	E.Coli DST	2019/07/06	<1.0		mpn/100mL	
			Total Coliforms DST	2019/07/06	<1.0		mpn/100mL	
9494183	GK1	RPD	E.Coli DST	2019/07/06	NC		%	N/A
			Total Coliforms DST	2019/07/06	NC		%	N/A
9495457	EH2	Spiked Blank	Turbidity	2019/07/06		100	%	80 - 120
9495457	EH2	Method Blank	Turbidity	2019/07/06	<0.10		NTU	
9495457	EH2	RPD [WA6550-02]	Turbidity	2019/07/06	5.9		%	20
9495902	KD9	Matrix Spike	Dissolved Nitrite (N)	2019/07/07		99	%	80 - 120
			Dissolved Nitrate (N)	2019/07/07		100	%	80 - 120
9495902	KD9	Spiked Blank	Dissolved Nitrite (N)	2019/07/07		99	%	80 - 120
			Dissolved Nitrate (N)	2019/07/07		100	%	80 - 120
9495902	KD9	Method Blank	Dissolved Nitrite (N)	2019/07/07	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/07/07	<0.010		mg/L	
9495902	KD9	RPD	Dissolved Nitrite (N)	2019/07/07	NC		%	20
			Dissolved Nitrate (N)	2019/07/07	NC		%	20
9498938	IK0	Spiked Blank	Alkalinity (Total as CaCO3)	2019/07/10		92	%	80 - 120
9498938	IK0	Method Blank	Alkalinity (PP as CaCO3)	2019/07/10	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2019/07/10	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/07/10	<1.0		mg/L	
			Carbonate (CO3)	2019/07/10	<1.0		mg/L	
			Hydroxide (OH)	2019/07/10	<1.0		mg/L	
9498938	IK0	RPD	Alkalinity (PP as CaCO3)	2019/07/10	NC		%	20
			Alkalinity (Total as CaCO3)	2019/07/10	1.7		%	20
			Bicarbonate (HCO3)	2019/07/10	1.7		%	20
			Carbonate (CO3)	2019/07/10	NC		%	20
			Hydroxide (OH)	2019/07/10	NC		%	20
9498939	IK0	Spiked Blank	pH	2019/07/10		101	%	97 - 103
9498939	IK0	RPD	pH	2019/07/10	0.36		%	N/A
9498940	IK0	Spiked Blank	Conductivity	2019/07/10		102	%	90 - 110
9498940	IK0	Method Blank	Conductivity	2019/07/10	<2.0		uS/cm	
9498940	IK0	RPD	Conductivity	2019/07/10	0.61		%	10
9499250	ALX	Matrix Spike	Dissolved Calcium (Ca)	2019/07/09		97	%	80 - 120
			Dissolved Iron (Fe)	2019/07/09		101	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/09		98	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/09		101	%	80 - 120
			Dissolved Potassium (K)	2019/07/09		102	%	80 - 120
			Dissolved Sodium (Na)	2019/07/09		NC	%	80 - 120
9499250	ALX	Spiked Blank	Dissolved Calcium (Ca)	2019/07/09		100	%	80 - 120
			Dissolved Iron (Fe)	2019/07/09		105	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/09		104	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/09		102	%	80 - 120
			Dissolved Potassium (K)	2019/07/09		103	%	80 - 120
			Dissolved Sodium (Na)	2019/07/09		105	%	80 - 120
9499250	ALX	Method Blank	Dissolved Calcium (Ca)	2019/07/09	<0.30		mg/L	
			Dissolved Iron (Fe)	2019/07/09	<0.060		mg/L	
			Dissolved Magnesium (Mg)	2019/07/09	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/07/09	<0.0040		mg/L	
			Dissolved Potassium (K)	2019/07/09	<0.30		mg/L	
			Dissolved Sodium (Na)	2019/07/09	0.77, RDL=0.50 (1)		mg/L	
9499250	ALX	RPD	Dissolved Calcium (Ca)	2019/07/09	2.2		%	20
			Dissolved Iron (Fe)	2019/07/09	0.079		%	20

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Magnesium (Mg)	2019/07/09	2.2		%	20
			Dissolved Manganese (Mn)	2019/07/09	NC		%	20
			Dissolved Potassium (K)	2019/07/09	0.075		%	20
			Dissolved Sodium (Na)	2019/07/09	1.6		%	20
9500611	ALX	Matrix Spike	Total Barium (Ba)	2019/07/10		96	%	80 - 120
			Total Boron (B)	2019/07/10		97	%	80 - 120
			Total Calcium (Ca)	2019/07/10		NC	%	80 - 120
			Total Iron (Fe)	2019/07/10		101	%	80 - 120
			Total Lithium (Li)	2019/07/10		95	%	80 - 120
			Total Magnesium (Mg)	2019/07/10		95	%	80 - 120
			Total Manganese (Mn)	2019/07/10		94	%	80 - 120
			Total Phosphorus (P)	2019/07/10		95	%	80 - 120
			Total Potassium (K)	2019/07/10		94	%	80 - 120
			Total Silicon (Si)	2019/07/10		99	%	80 - 120
			Total Sodium (Na)	2019/07/10		NC	%	80 - 120
			Total Strontium (Sr)	2019/07/10		94	%	80 - 120
			Total Sulphur (S)	2019/07/10		95	%	80 - 120
9500611	ALX	Spiked Blank	Total Barium (Ba)	2019/07/10		96	%	80 - 120
			Total Boron (B)	2019/07/10		96	%	80 - 120
			Total Calcium (Ca)	2019/07/10		95	%	80 - 120
			Total Iron (Fe)	2019/07/10		103	%	80 - 120
			Total Lithium (Li)	2019/07/10		94	%	80 - 120
			Total Magnesium (Mg)	2019/07/10		96	%	80 - 120
			Total Manganese (Mn)	2019/07/10		97	%	80 - 120
			Total Phosphorus (P)	2019/07/10		94	%	80 - 120
			Total Potassium (K)	2019/07/10		92	%	80 - 120
			Total Silicon (Si)	2019/07/10		98	%	80 - 120
			Total Sodium (Na)	2019/07/10		95	%	80 - 120
			Total Strontium (Sr)	2019/07/10		95	%	80 - 120
			Total Sulphur (S)	2019/07/10		96	%	80 - 120
9500611	ALX	Method Blank	Total Barium (Ba)	2019/07/10	<0.010		mg/L	
			Total Boron (B)	2019/07/10	<0.020		mg/L	
			Total Calcium (Ca)	2019/07/10	<0.30		mg/L	
			Total Iron (Fe)	2019/07/10	<0.060		mg/L	
			Total Lithium (Li)	2019/07/10	<0.020		mg/L	
			Total Magnesium (Mg)	2019/07/10	<0.20		mg/L	
			Total Manganese (Mn)	2019/07/10	<0.0040		mg/L	
			Total Phosphorus (P)	2019/07/10	<0.10		mg/L	
			Total Potassium (K)	2019/07/10	<0.30		mg/L	
			Total Silicon (Si)	2019/07/10	<0.10		mg/L	
			Total Sodium (Na)	2019/07/10	<0.50		mg/L	
			Total Strontium (Sr)	2019/07/10	<0.020		mg/L	
			Total Sulphur (S)	2019/07/10	<0.20		mg/L	
9500611	ALX	RPD	Total Barium (Ba)	2019/07/10	0.68		%	20
			Total Boron (B)	2019/07/10	1.0		%	20
			Total Calcium (Ca)	2019/07/10	0.17		%	20
			Total Iron (Fe)	2019/07/10	3.0		%	20
			Total Lithium (Li)	2019/07/10	0		%	20
			Total Magnesium (Mg)	2019/07/10	0.46		%	20
			Total Manganese (Mn)	2019/07/10	NC		%	20
			Total Phosphorus (P)	2019/07/10	NC		%	20
			Total Potassium (K)	2019/07/10	0.63		%	20

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Silicon (Si)	2019/07/10	0.92		%	20
			Total Sodium (Na)	2019/07/10	0.55		%	20
			Total Strontium (Sr)	2019/07/10	0.38		%	20
			Total Sulphur (S)	2019/07/10	0.37		%	20
9500624	LQ1	Matrix Spike [WA6550-04]	Total Aluminum (Al)	2019/07/10		97	%	80 - 120
			Total Antimony (Sb)	2019/07/10		105	%	80 - 120
			Total Arsenic (As)	2019/07/10		94	%	80 - 120
			Total Beryllium (Be)	2019/07/10		97	%	80 - 120
			Total Chromium (Cr)	2019/07/10		99	%	80 - 120
			Total Cobalt (Co)	2019/07/10		97	%	80 - 120
			Total Copper (Cu)	2019/07/10		109	%	80 - 120
			Total Lead (Pb)	2019/07/10		102	%	80 - 120
			Total Molybdenum (Mo)	2019/07/10		104	%	80 - 120
			Total Nickel (Ni)	2019/07/10		96	%	80 - 120
			Total Selenium (Se)	2019/07/10		97	%	80 - 120
			Total Silver (Ag)	2019/07/10		100	%	80 - 120
			Total Thallium (Tl)	2019/07/10		99	%	80 - 120
			Total Tin (Sn)	2019/07/10		99	%	80 - 120
			Total Titanium (Ti)	2019/07/10		101	%	80 - 120
			Total Uranium (U)	2019/07/10		98	%	80 - 120
			Total Vanadium (V)	2019/07/10		99	%	80 - 120
			Total Zinc (Zn)	2019/07/10		NC	%	80 - 120
9500624	LQ1	Spiked Blank	Total Aluminum (Al)	2019/07/10		99	%	80 - 120
			Total Antimony (Sb)	2019/07/10		105	%	80 - 120
			Total Arsenic (As)	2019/07/10		95	%	80 - 120
			Total Beryllium (Be)	2019/07/10		94	%	80 - 120
			Total Chromium (Cr)	2019/07/10		100	%	80 - 120
			Total Cobalt (Co)	2019/07/10		98	%	80 - 120
			Total Copper (Cu)	2019/07/10		98	%	80 - 120
			Total Lead (Pb)	2019/07/10		97	%	80 - 120
			Total Molybdenum (Mo)	2019/07/10		100	%	80 - 120
			Total Nickel (Ni)	2019/07/10		97	%	80 - 120
			Total Selenium (Se)	2019/07/10		95	%	80 - 120
			Total Silver (Ag)	2019/07/10		100	%	80 - 120
			Total Thallium (Tl)	2019/07/10		100	%	80 - 120
			Total Tin (Sn)	2019/07/10		98	%	80 - 120
			Total Titanium (Ti)	2019/07/10		99	%	80 - 120
			Total Uranium (U)	2019/07/10		93	%	80 - 120
			Total Vanadium (V)	2019/07/10		99	%	80 - 120
			Total Zinc (Zn)	2019/07/10		96	%	80 - 120
9500624	LQ1	Method Blank	Total Aluminum (Al)	2019/07/10	<0.0030		mg/L	
			Total Antimony (Sb)	2019/07/10	<0.00060		mg/L	
			Total Arsenic (As)	2019/07/10	<0.00020		mg/L	
			Total Beryllium (Be)	2019/07/10	<0.0010		mg/L	
			Total Chromium (Cr)	2019/07/10	<0.0010		mg/L	
			Total Cobalt (Co)	2019/07/10	<0.00030		mg/L	
			Total Copper (Cu)	2019/07/10	<0.00020		mg/L	
			Total Lead (Pb)	2019/07/10	<0.00020		mg/L	
			Total Molybdenum (Mo)	2019/07/10	<0.00020		mg/L	
			Total Nickel (Ni)	2019/07/10	<0.00050		mg/L	
			Total Selenium (Se)	2019/07/10	<0.00020		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Silver (Ag)	2019/07/10	<0.00010		mg/L	
			Total Thallium (Tl)	2019/07/10	<0.00020		mg/L	
			Total Tin (Sn)	2019/07/10	<0.0010		mg/L	
			Total Titanium (Ti)	2019/07/10	<0.0010		mg/L	
			Total Uranium (U)	2019/07/10	<0.00010		mg/L	
			Total Vanadium (V)	2019/07/10	<0.0010		mg/L	
			Total Zinc (Zn)	2019/07/10	<0.0030		mg/L	
9500624	LQ1	RPD	Total Aluminum (Al)	2019/07/10	5.2		%	20
			Total Antimony (Sb)	2019/07/10	NC		%	20
			Total Arsenic (As)	2019/07/10	NC		%	20
			Total Beryllium (Be)	2019/07/10	NC		%	20
			Total Chromium (Cr)	2019/07/10	7.9		%	20
			Total Cobalt (Co)	2019/07/10	NC		%	20
			Total Copper (Cu)	2019/07/10	7.8		%	20
			Total Lead (Pb)	2019/07/10	NC		%	20
			Total Molybdenum (Mo)	2019/07/10	1.8		%	20
			Total Nickel (Ni)	2019/07/10	12		%	20
			Total Selenium (Se)	2019/07/10	1.9		%	20
			Total Silver (Ag)	2019/07/10	NC		%	20
			Total Thallium (Tl)	2019/07/10	NC		%	20
			Total Tin (Sn)	2019/07/10	NC		%	20
			Total Titanium (Ti)	2019/07/10	NC		%	20
			Total Uranium (U)	2019/07/10	4.8		%	20
			Total Vanadium (V)	2019/07/10	NC		%	20
			Total Zinc (Zn)	2019/07/10	NC		%	20
9500789	RK3	Matrix Spike	Total Mercury (Hg)	2019/07/10		101	%	80 - 120
9500789	RK3	Spiked Blank	Total Mercury (Hg)	2019/07/10		113	%	80 - 120
9500789	RK3	Method Blank	Total Mercury (Hg)	2019/07/10	<0.0020		ug/L	
9500789	RK3	RPD	Total Mercury (Hg)	2019/07/10	NC		%	20
9501576	STI	Matrix Spike	Dissolved Chloride (Cl)	2019/07/10		NC	%	80 - 120
9501576	STI	Spiked Blank	Dissolved Chloride (Cl)	2019/07/10		106	%	80 - 120
9501576	STI	Method Blank	Dissolved Chloride (Cl)	2019/07/10	<1.0		mg/L	
9501576	STI	RPD	Dissolved Chloride (Cl)	2019/07/10	0.52		%	20
9501583	STI	Matrix Spike	Dissolved Sulphate (SO4)	2019/07/10		NC	%	80 - 120
9501583	STI	Spiked Blank	Dissolved Sulphate (SO4)	2019/07/10		102	%	80 - 120
9501583	STI	Method Blank	Dissolved Sulphate (SO4)	2019/07/10	<1.0		mg/L	
9501583	STI	RPD	Dissolved Sulphate (SO4)	2019/07/10	1.4		%	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).

(1) Method blank above criteria. Data inspected. All data < RDL or greater than 10x Method Blank.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

BV Labs Job #: B953951
Report Date: 2019/07/12

SLR CONSULTING (CANADA) LTD
Client Project #: 212.06550.00003
Site Location: MOUNTAIN ASH
Your P.O. #: EDM4886
Sampler Initials: NY

VALIDATION SIGNATURE PAGE

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

Ghayasuddin Khan, M.Sc., P.Chem., QP, Scientific Specialist, Inorganics

Harry (Peng) Liang, Senior Analyst

BV Labs 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.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Maxxam
A Bureau Veritas Group Company

Calgary: 4000 19th St. NE, T2E 6P8. Toll Free (800) 386-7247
Edmonton: 9331-48 St. T6B 2R4. Toll Free (800) 386-7247
maxxam.ca

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CHAIN OF CUSTODY RECORD

M 083948

Page 1 of 1

Invoice Information		Report Information (if differs from invoice)		Project Information	
Company:	SLR Consulting Ltd.	Company:	Summit Aggregates	Quotation #:	
Contact Name:	Robert Till	Contact Name:		P.O. #/ AFE#:	EDM4886
Address:	6940 Roper Road, Edmonton, T6B 3H9	Address:		Project #:	212.06550.00003
Phone:		Phone:		Site Location:	Mantain Ash
Email:	rtill@slrconsulting.com	Email:	rtill@slrconsulting.com	Site #:	
Copies:	nyari@slrconsulting.com	Copies:	nyari@slrconsulting.com	Sampled By:	NY

Turnaround Time (TAT) Required

☒ 5 - 7 Days Regular (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

☐ Same Day ☐ 2 Days ☐ 1 Day ☐ 3-4 Days

Date Required:

Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID			
Seal Present	✓					
Seal Intact	✓		Temp	6	9	6
Cooling Media	✓					
Seal Present						
Seal Intact			Temp			
Cooling Media						
Seal Present						
Seal Intact			Temp			
Cooling Media						

Depot Reception

Regulatory Criteria

☒ AT1
☐ CCME
☐ Drinking Water
☐ D50 (Drilling Waste)
☐ Saskatchewan
☐ Other:

Analysis Requested

#	Sample Identification	Depth (Unit)	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	# of containers	BTEX F1 ☐ VOC	BTEX F1-F2	BTEX F1-F4	Routine Water	Regulated Metals Tot ☒ Diss	Mercury Total ☒ Dissolved	Salinity 4	Sieve (75 micron)	Texture (% Sand, Silt, Clay)	Basic Class II Landfill	Turbidity	~~Total Metals~~	Total Coliforms + E. Coli	HOLD - DO NOT ANALYZE
1	~~MW19-110~~		~~2019/07/05~~		~~Ground water~~	~~6~~				~~X~~	~~X~~	~~X~~					~~X~~		~~X~~	
2	MW19-109		↓		↓	6				X	X	X					X		X	
3	WW4		↓		↓	6				X	X	X					X		X	
4	~~WW2~~		↓		↓	~~6~~				~~X~~	~~X~~	~~X~~					~~X~~		~~X~~	
5	~~BHS1~~		↓		Stream water	6				X	X	X					X		X	
6																				
7																				
8																				
9																				
10																				

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

Special Instructions

→ silty

Metals preserved not filtered.

Rainy conditions could not write on labels. Paper in each bag indicate samples

Relinquished by: (Signature/ Print)	DATE (YYYY/MM/DD)	Time (HH:MM)	Received by: (Signature/ Print)	DATE (YYYY/MM/DD)	Time (HH:MM)	Maxxam Job #
[signature] / Noushin Yari	2019/07/05		[signature] JENINE MCINTYRE	2019/07/05	12:20	05-Jul-19 12:20 Jenelle Feller B953951

AB FCD-00331/7

KK7 INS-0170

Your P.O. #: EDM4886
PO # EDM3288
Your C.O.C. #: M083881

Attention: ROBERT TILL

SLR CONSULTING (CANADA) LTD
6940 ROPER ROAD
EDMONTON, AB
CANADA T6B 3H9

Report Date: 2019/07/18
Report #: R2753966
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B955649
Received: 2019/07/10, 20:35

Sample Matrix: Water
Samples Received: 3

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH	3	N/A	2019/07/16	AB SOP-00005	SM 23 2320 B m
Cadmium - low level CCME - Dissolved	3	N/A	2019/07/12		Auto Calc
Cadmium - low level CCME (Total)	3	N/A	2019/07/15		Auto Calc
Chloride/Sulphate by Auto Colourimetry	3	N/A	2019/07/16	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO4-E m
Total Coliforms and E.Coli	3	2019/07/11	2019/07/12	AB SOP-00089	SM 23 9223 A,B m
Conductivity @25C	3	N/A	2019/07/16	AB SOP-00005	SM 23 2510 B m
Hardness	3	N/A	2019/07/12		Auto Calc
Mercury (Total) by CV	2	2019/07/16	2019/07/16	CAL SOP-00007	EPA 1631 RE 20460 m
Mercury (Total) by CV	1	2019/07/16	2019/07/17	CAL SOP-00007	EPA 1631 RE 20460 m
Elements by ICP-Dissolved-Lab Filtered (1)	3	N/A	2019/07/12	AB SOP-00042	EPA 6010d R5 m
Elements by ICP - Total	3	2019/07/13	2019/07/16	AB SOP-00014 / AB SOP-00042	EPA 6010d R4 m
Elements by ICPMS-Dissolved-Lab Filtered (2)	3	N/A	2019/07/12	AB SOP-00043	EPA 6020b R2 m
Elements by ICPMS - Total	3	2019/07/13	2019/07/14	AB SOP-00014 / AB SOP-00043	EPA 6020b R2 m
Ion Balance	3	N/A	2019/07/12		Auto Calc
Sum of cations, anions	3	N/A	2019/07/12		Auto Calc
Nitrate and Nitrite	3	N/A	2019/07/12		Auto Calc
Nitrate + Nitrite-N (calculated)	3	N/A	2019/07/12		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	2	N/A	2019/07/11	AB SOP-00023	SM 23 4110 B m
Nitrogen (Nitrite - Nitrate) by IC	1	N/A	2019/07/12	AB SOP-00023	SM 23 4110 B m
pH @25°C (3)	3	N/A	2019/07/16	AB SOP-00005	SM 23 4500-H+B m
Total Dissolved Solids (Calculated)	3	N/A	2019/07/17		Auto Calc
Turbidity	3	N/A	2019/07/13	CAL SOP-00081	SM 23 2130 B m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs 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 BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs 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

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Your P.O. #: EDM4886
PO # EDM3288
Your C.O.C. #: M083881

Attention: ROBERT TILL

SLR CONSULTING (CANADA) LTD
6940 ROPER ROAD
EDMONTON, AB
CANADA T6B 3H9

Report Date: 2019/07/18
Report #: R2753966
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B955649
Received: 2019/07/10, 20:35

indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs 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 BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

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. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.

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 > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(2) Samples were filtered and preserved at the lab. Values may not reflect concentrations at the time of sampling. Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(3) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Bureau Veritas Laboratories endeavours to analyze samples as soon as possible after receipt.

Encryption Key

Jenelle Feller
Key Account Specialist
18 Jul 2019 17:04:14

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Jenelle Feller, Key Account Specialist
Email: JFeller@bvlabs.com
Phone# (403)735-2264
==========
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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ROUTINE + DISS. REG. METALS – LAB FILT (WATER)

BV Labs ID		WB5701		WB5702	WB5703		
Sampling Date		2019/07/10 13:45		2019/07/10 14:52	2019/07/10 16:48		
COC Number		M083881		M083881	M083881		
	UNITS	BHS1	QC Batch	WW2	MW19-110	RDL	QC Batch
Calculated Parameters							
Anion Sum	meq/L	4.3	9502278	6.2	6.0	N/A	9502278
Cation Sum	meq/L	4.4	9502278	6.1	5.9	N/A	9502278
Hardness (CaCO3)	mg/L	200	9502270	260	280	0.50	9502270
Ion Balance (% Difference)	%	0.87	9502276	1.3	0.91	N/A	9502276
Dissolved Nitrate (NO3)	mg/L	6.3	9502284	1.6	8.6	0.044	9502284
Nitrate plus Nitrite (N)	mg/L	1.4	9502287	0.37	1.9	0.014	9502287
Dissolved Nitrite (NO2)	mg/L	<0.033	9502284	<0.033	<0.033	0.033	9502284
Calculated Total Dissolved Solids	mg/L	210	9502288	300	290	1.0	9502288
Misc. Inorganics							
Conductivity	uS/cm	420	9508468	580	560	2.0	9508468
pH	pH	8.07	9508466	7.95	7.82	N/A	9508466
Low Level Elements							
Dissolved Cadmium (Cd)	ug/L	0.025	9502398	0.036	0.032	0.020	9502398
Anions							
Alkalinity (PP as CaCO3)	mg/L	<1.0	9508465	<1.0	<1.0	1.0	9508465
Alkalinity (Total as CaCO3)	mg/L	190	9508465	290	270	1.0	9508465
Bicarbonate (HCO3)	mg/L	240	9508465	350	330	1.0	9508465
Carbonate (CO3)	mg/L	<1.0	9508465	<1.0	<1.0	1.0	9508465
Hydroxide (OH)	mg/L	<1.0	9508465	<1.0	<1.0	1.0	9508465
Dissolved Chloride (Cl)	mg/L	8.2	9509749	2.0	8.4	1.0	9509749
Dissolved Sulphate (SO4)	mg/L	4.7	9509749	20	8.1	1.0	9509749
Nutrients							
Dissolved Nitrite (N)	mg/L	<0.010	9503263	<0.010	<0.010	0.010	9503263
Dissolved Nitrate (N)	mg/L	1.4	9503263	0.37	1.9	0.010	9503263
Lab Filtered Elements							
Dissolved Aluminum (Al)	mg/L	0.12	9504202	<0.0030	0.0078	0.0030	9504202
Dissolved Antimony (Sb)	mg/L	<0.00060	9504202	<0.00060	<0.00060	0.00060	9504202
Dissolved Arsenic (As)	mg/L	0.00044	9504202	<0.00020	0.00023	0.00020	9504202
Dissolved Barium (Ba)	mg/L	0.19	9503452	0.097	0.25	0.010	9503452
Dissolved Beryllium (Be)	mg/L	<0.0010	9504202	<0.0010	<0.0010	0.0010	9504202
Dissolved Boron (B)	mg/L	<0.020	9503452	0.023	<0.020	0.020	9503452
Dissolved Calcium (Ca)	mg/L	48	9503452	55	62	0.30	9503452

RDL = Reportable Detection Limit
N/A = Not Applicable

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ROUTINE + DISS. REG. METALS – LAB FILT (WATER)

BV Labs ID		WB5701		WB5702	WB5703		
Sampling Date		2019/07/10 13:45		2019/07/10 14:52	2019/07/10 16:48		
COC Number		M083881		M083881	M083881		
	UNITS	BHS1	QC Batch	WW2	MW19-110	RDL	QC Batch
Dissolved Chromium (Cr)	mg/L	<0.0010	9504202	<0.0010	<0.0010	0.0010	9504202
Dissolved Cobalt (Co)	mg/L	<0.00030	9504202	<0.00030	<0.00030	0.00030	9504202
Dissolved Copper (Cu)	mg/L	0.00095	9504202	0.0026	0.00032	0.00020	9504202
Dissolved Iron (Fe)	mg/L	0.10	9503452	<0.060	<0.060	0.060	9503452
Dissolved Lead (Pb)	mg/L	<0.00020	9504202	<0.00020	<0.00020	0.00020	9504202
Dissolved Lithium (Li)	mg/L	<0.020	9503452	<0.020	<0.020	0.020	9503452
Dissolved Magnesium (Mg)	mg/L	20	9503452	30	30	0.20	9503452
Dissolved Manganese (Mn)	mg/L	<0.0040	9503452	0.0096	0.042	0.0040	9503452
Dissolved Molybdenum (Mo)	mg/L	0.00098	9507484	0.0020	0.0021	0.00020	9504202
Dissolved Nickel (Ni)	mg/L	0.00085	9504202	0.00054	0.0015	0.00050	9504202
Dissolved Phosphorus (P)	mg/L	<0.10	9503452	<0.10	<0.10	0.10	9503452
Dissolved Potassium (K)	mg/L	4.8	9503452	2.0	2.7	0.30	9503452
Dissolved Selenium (Se)	mg/L	0.00058	9504202	0.00045	0.00067	0.00020	9504202
Dissolved Silicon (Si)	mg/L	6.4	9503452	4.0	4.4	0.10	9503452
Dissolved Silver (Ag)	mg/L	<0.00010	9504202	<0.00010	<0.00010	0.00010	9504202
Dissolved Sodium (Na)	mg/L	5.0	9503452	17	6.0	0.50	9503452
Dissolved Strontium (Sr)	mg/L	0.27	9503452	0.56	0.41	0.020	9503452
Dissolved Sulphur (S)	mg/L	1.8	9503452	5.3	2.2	0.20	9503452
Dissolved Thallium (Tl)	mg/L	<0.00020	9504202	<0.00020	<0.00020	0.00020	9504202
Dissolved Tin (Sn)	mg/L	<0.0010	9504202	<0.0010	<0.0010	0.0010	9504202
Dissolved Titanium (Ti)	mg/L	0.0038	9504202	<0.0010	0.0012	0.0010	9504202
Dissolved Uranium (U)	mg/L	0.0011	9504202	0.00081	0.0024	0.00010	9504202
Dissolved Vanadium (V)	mg/L	<0.0010	9504202	<0.0010	<0.0010	0.0010	9504202
Dissolved Zinc (Zn)	mg/L	<0.0030	9504202	0.043	0.0032	0.0030	9504202

RDL = Reportable Detection Limit

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REGULATED METALS (CCME/AT1) - TOTAL

BV Labs ID		WB5701	WB5702		WB5703		
Sampling Date		2019/07/10 13:45	2019/07/10 14:52		2019/07/10 16:48		
COC Number		M083881	M083881		M083881		
	UNITS	BHS1	WW2	RDL	MW19-110	RDL	QC Batch
Low Level Elements							
Total Cadmium (Cd)	ug/L	0.034	0.029	0.020	4.2	0.020	9502399
Elements							
Total Aluminum (Al)	mg/L	0.30	0.0060	0.0030	10	0.0030	9505482
Total Antimony (Sb)	mg/L	<0.00060	<0.00060	0.00060	<0.00060	0.00060	9505482
Total Arsenic (As)	mg/L	0.00061	<0.00020	0.00020	0.0084	0.00020	9505482
Total Barium (Ba)	mg/L	0.21	0.11	0.010	2.2	0.010	9505479
Total Beryllium (Be)	mg/L	<0.0010	<0.0010	0.0010	0.0019	0.0010	9505482
Total Boron (B)	mg/L	<0.020	0.023	0.020	<0.020	0.020	9505479
Total Calcium (Ca)	mg/L	50	59	0.30	600 (1)	1.5	9505479
Total Chromium (Cr)	mg/L	0.0010	<0.0010	0.0010	0.019	0.0010	9505482
Total Cobalt (Co)	mg/L	<0.00030	<0.00030	0.00030	0.030	0.00030	9505482
Total Copper (Cu)	mg/L	0.0013	0.0045	0.00020	0.032	0.00020	9505482
Total Iron (Fe)	mg/L	0.25	<0.060	0.060	10	0.060	9505479
Total Lead (Pb)	mg/L	<0.00020	0.00054	0.00020	0.019	0.00020	9505482
Total Lithium (Li)	mg/L	<0.020	0.023	0.020	<0.020	0.020	9505479
Total Magnesium (Mg)	mg/L	21	33	0.20	130	0.20	9505479
Total Manganese (Mn)	mg/L	<0.0040	0.012	0.0040	7.3	0.0040	9505479
Total Molybdenum (Mo)	mg/L	0.00038	0.0014	0.00020	0.0015	0.00020	9505482
Total Nickel (Ni)	mg/L	0.00088	0.00060	0.00050	0.065	0.00050	9505482
Total Phosphorus (P)	mg/L	<0.10	<0.10	0.10	2.5	0.10	9505479
Total Potassium (K)	mg/L	5.4	2.3	0.30	4.7	0.30	9505479
Total Selenium (Se)	mg/L	0.00068	0.00052	0.00020	0.00096	0.00020	9505482
Total Silicon (Si)	mg/L	7.5	4.6	0.10	15	0.10	9505479
Total Silver (Ag)	mg/L	<0.00010	<0.00010	0.00010	<0.00010	0.00010	9505482
Total Sodium (Na)	mg/L	5.3	20	0.50	6.9	0.50	9505479
Total Strontium (Sr)	mg/L	0.27	0.58	0.020	1.1	0.020	9505479
Total Sulphur (S)	mg/L	1.8	6.1	0.20	2.5	0.20	9505479
Total Thallium (Tl)	mg/L	<0.00020	<0.00020	0.00020	0.00024	0.00020	9505482
Total Tin (Sn)	mg/L	<0.0010	<0.0010	0.0010	<0.0010	0.0010	9505482
Total Titanium (Ti)	mg/L	0.0068	<0.0010	0.0010	0.17	0.0010	9505482
Total Uranium (U)	mg/L	0.0013	0.00091	0.00010	0.0060	0.00010	9505482
Total Vanadium (V)	mg/L	0.0015	<0.0010	0.0010	0.025	0.0010	9505482

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

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REGULATED METALS (CCME/AT1) - TOTAL

BV Labs ID		WB5701	WB5702		WB5703		
Sampling Date		2019/07/10 13:45	2019/07/10 14:52		2019/07/10 16:48		
COC Number		M083881	M083881		M083881		
	UNITS	BHS1	WW2	RDL	MW19-110	RDL	QC Batch
Total Zinc (Zn)	mg/L	<0.0030	0.046	0.0030	0.14	0.0030	9505482
RDL = Reportable Detection Limit							

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RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WB5701	WB5702		WB5703		
Sampling Date		2019/07/10 13:45	2019/07/10 14:52		2019/07/10 16:48		
COC Number		M083881	M083881		M083881		
	UNITS	**BHS1**	**WW2**	**RDL**	**MW19-110**	**RDL**	**QC Batch**
Microbiological Param.							
E.Coli DST	MPN/100mL	1600	<1.0	1.0	63 (1)	10	9502759
Total Coliforms DST	MPN/100mL	>2400	1.0	1.0	180 (1)	10	9502759
Physical Properties							
Turbidity	NTU	5.1	0.31	0.10	<0.10	0.10	9505873

RDL = Reportable Detection Limit
(1) Detection limit raised due to matrix interference.

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MERCURY BY COLD VAPOR (WATER)

BV Labs ID		WB5701	WB5702		WB5703		
Sampling Date		2019/07/10 13:45	2019/07/10 14:52		2019/07/10 16:48		
COC Number		M083881	M083881		M083881		
	UNITS	**BHS1**	**WW2**	**RDL**	**MW19-110**	**RDL**	**QC Batch**
Elements							
Total Mercury (Hg)	ug/L	0.0025	<0.0020	0.0020	0.257 (1)	0.020	9509199

RDL = Reportable Detection Limit
(1) Due to the sample matrix, sample required dilution. Detection limit was adjusted accordingly.

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GENERAL COMMENTS

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

Package 1	5.0°C

RESULTS OF CHEMICAL ANALYSES OF WATER Comments

Method Blank Total Coliforms and E.Coli: Method Blank exceeds normal acceptance limits due to possible lab contamination.

Sample WB5701, Elements by ICPMS-Dissolved-Lab Filtered: Test repeated.

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9502759	AP1	Method Blank	E.Coli DST	2019/07/12	1.0, RDL=1.0		mpn/100mL	
			Total Coliforms DST	2019/07/12	1.0, RDL=1.0		mpn/100mL	
9502759	AP1	RPD [WB5702-03]	E.Coli DST	2019/07/12	NC		%	N/A
			Total Coliforms DST	2019/07/12	0		%	N/A
9503263	PR6	Matrix Spike [WB5701-01]	Dissolved Nitrite (N)	2019/07/11		104	%	80 - 120
			Dissolved Nitrate (N)	2019/07/11		103	%	80 - 120
9503263	PR6	Spiked Blank	Dissolved Nitrite (N)	2019/07/11		102	%	80 - 120
			Dissolved Nitrate (N)	2019/07/11		103	%	80 - 120
9503263	PR6	Method Blank	Dissolved Nitrite (N)	2019/07/11	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/07/11	<0.010		mg/L	
9503263	PR6	RPD [WB5701-01]	Dissolved Nitrite (N)	2019/07/11	NC		%	20
			Dissolved Nitrate (N)	2019/07/11	0.16		%	20
9503452	MAP	Matrix Spike	Dissolved Barium (Ba)	2019/07/12		95	%	80 - 120
			Dissolved Boron (B)	2019/07/12		102	%	80 - 120
			Dissolved Calcium (Ca)	2019/07/12		104	%	80 - 120
			Dissolved Iron (Fe)	2019/07/12		99	%	80 - 120
			Dissolved Lithium (Li)	2019/07/12		93	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/12		103	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/12		107	%	80 - 120
			Dissolved Phosphorus (P)	2019/07/12		104	%	80 - 120
			Dissolved Potassium (K)	2019/07/12		98	%	80 - 120
			Dissolved Silicon (Si)	2019/07/12		99	%	80 - 120
			Dissolved Sodium (Na)	2019/07/12		99	%	80 - 120
			Dissolved Strontium (Sr)	2019/07/12		100	%	80 - 120
			Dissolved Sulphur (S)	2019/07/12		102	%	80 - 120
9503452	MAP	Spiked Blank	Dissolved Barium (Ba)	2019/07/12		89	%	80 - 120
			Dissolved Boron (B)	2019/07/12		95	%	80 - 120
			Dissolved Calcium (Ca)	2019/07/12		94	%	80 - 120
			Dissolved Iron (Fe)	2019/07/12		94	%	80 - 120
			Dissolved Lithium (Li)	2019/07/12		86	%	80 - 120
			Dissolved Magnesium (Mg)	2019/07/12		97	%	80 - 120
			Dissolved Manganese (Mn)	2019/07/12		99	%	80 - 120
			Dissolved Phosphorus (P)	2019/07/12		93	%	80 - 120
			Dissolved Potassium (K)	2019/07/12		90	%	80 - 120
			Dissolved Silicon (Si)	2019/07/12		91	%	80 - 120
			Dissolved Sodium (Na)	2019/07/12		92	%	80 - 120
			Dissolved Strontium (Sr)	2019/07/12		94	%	80 - 120
			Dissolved Sulphur (S)	2019/07/12		94	%	80 - 120
9503452	MAP	Method Blank	Dissolved Barium (Ba)	2019/07/12	<0.010		mg/L	
			Dissolved Boron (B)	2019/07/12	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/07/12	<0.30		mg/L	
			Dissolved Iron (Fe)	2019/07/12	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/07/12	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/07/12	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/07/12	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2019/07/12	<0.10		mg/L	
			Dissolved Potassium (K)	2019/07/12	<0.30		mg/L	
			Dissolved Silicon (Si)	2019/07/12	<0.10		mg/L	
			Dissolved Sodium (Na)	2019/07/12	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/07/12	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/07/12	<0.20		mg/L	
9503452	MAP	RPD	Dissolved Barium (Ba)	2019/07/12	0.76		%	20

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Boron (B)	2019/07/12	2.7		%	20
			Dissolved Calcium (Ca)	2019/07/12	0.72		%	20
			Dissolved Iron (Fe)	2019/07/12	20		%	20
			Dissolved Lithium (Li)	2019/07/12	NC		%	20
			Dissolved Magnesium (Mg)	2019/07/12	0.45		%	20
			Dissolved Manganese (Mn)	2019/07/12	NC		%	20
			Dissolved Phosphorus (P)	2019/07/12	NC		%	20
			Dissolved Potassium (K)	2019/07/12	5.0		%	20
			Dissolved Silicon (Si)	2019/07/12	0.94		%	20
			Dissolved Sodium (Na)	2019/07/12	0.29		%	20
			Dissolved Strontium (Sr)	2019/07/12	0.46		%	20
			Dissolved Sulphur (S)	2019/07/12	0.089		%	20
9504202	HC7	Matrix Spike	Dissolved Aluminum (Al)	2019/07/12		90	%	80 - 120
			Dissolved Antimony (Sb)	2019/07/12		97	%	80 - 120
			Dissolved Arsenic (As)	2019/07/12		94	%	80 - 120
			Dissolved Beryllium (Be)	2019/07/12		90	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/12		97	%	80 - 120
			Dissolved Cobalt (Co)	2019/07/12		95	%	80 - 120
			Dissolved Copper (Cu)	2019/07/12		96	%	80 - 120
			Dissolved Lead (Pb)	2019/07/12		90	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/07/12		98	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/12		93	%	80 - 120
			Dissolved Selenium (Se)	2019/07/12		99	%	80 - 120
			Dissolved Silver (Ag)	2019/07/12		89	%	80 - 120
			Dissolved Thallium (Tl)	2019/07/12		90	%	80 - 120
			Dissolved Tin (Sn)	2019/07/12		94	%	80 - 120
			Dissolved Titanium (Ti)	2019/07/12		98	%	80 - 120
			Dissolved Uranium (U)	2019/07/12		97	%	80 - 120
			Dissolved Vanadium (V)	2019/07/12		97	%	80 - 120
			Dissolved Zinc (Zn)	2019/07/12		104	%	80 - 120
9504202	HC7	Spiked Blank	Dissolved Aluminum (Al)	2019/07/12		99	%	80 - 120
			Dissolved Antimony (Sb)	2019/07/12		105	%	80 - 120
			Dissolved Arsenic (As)	2019/07/12		100	%	80 - 120
			Dissolved Beryllium (Be)	2019/07/12		95	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/12		99	%	80 - 120
			Dissolved Cobalt (Co)	2019/07/12		101	%	80 - 120
			Dissolved Copper (Cu)	2019/07/12		102	%	80 - 120
			Dissolved Lead (Pb)	2019/07/12		97	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/07/12		101	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/12		101	%	80 - 120
			Dissolved Selenium (Se)	2019/07/12		99	%	80 - 120
			Dissolved Silver (Ag)	2019/07/12		98	%	80 - 120
			Dissolved Thallium (Tl)	2019/07/12		99	%	80 - 120
			Dissolved Tin (Sn)	2019/07/12		96	%	80 - 120
			Dissolved Titanium (Ti)	2019/07/12		102	%	80 - 120
			Dissolved Uranium (U)	2019/07/12		101	%	80 - 120
			Dissolved Vanadium (V)	2019/07/12		103	%	80 - 120
			Dissolved Zinc (Zn)	2019/07/12		104	%	80 - 120
9504202	HC7	Method Blank	Dissolved Aluminum (Al)	2019/07/12	<0.0030		mg/L	
			Dissolved Antimony (Sb)	2019/07/12	<0.00060		mg/L	
			Dissolved Arsenic (As)	2019/07/12	<0.00020		mg/L	
			Dissolved Beryllium (Be)	2019/07/12	<0.0010		mg/L	
			Dissolved Chromium (Cr)	2019/07/12	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/07/12	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/07/12	<0.00020		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Lead (Pb)	2019/07/12	<0.00020		mg/L	
			Dissolved Molybdenum (Mo)	2019/07/12	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/07/12	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/07/12	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/07/12	<0.00010		mg/L	
			Dissolved Thallium (Tl)	2019/07/12	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/07/12	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/07/12	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/07/12	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/07/12	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/07/12	<0.0030		mg/L	
9504202	HC7	RPD	Dissolved Aluminum (Al)	2019/07/12	NC		%	20
			Dissolved Antimony (Sb)	2019/07/12	NC		%	20
			Dissolved Arsenic (As)	2019/07/12	NC		%	20
			Dissolved Beryllium (Be)	2019/07/12	NC		%	20
			Dissolved Chromium (Cr)	2019/07/12	NC		%	20
			Dissolved Cobalt (Co)	2019/07/12	4.5		%	20
			Dissolved Copper (Cu)	2019/07/12	4.7		%	20
			Dissolved Lead (Pb)	2019/07/12	NC		%	20
			Dissolved Molybdenum (Mo)	2019/07/12	8.3		%	20
			Dissolved Nickel (Ni)	2019/07/12	0.86		%	20
			Dissolved Selenium (Se)	2019/07/12	11		%	20
			Dissolved Silver (Ag)	2019/07/12	NC		%	20
			Dissolved Thallium (Tl)	2019/07/12	NC		%	20
			Dissolved Tin (Sn)	2019/07/12	NC		%	20
			Dissolved Titanium (Ti)	2019/07/12	NC		%	20
			Dissolved Uranium (U)	2019/07/12	4.8		%	20
			Dissolved Vanadium (V)	2019/07/12	NC		%	20
			Dissolved Zinc (Zn)	2019/07/12	6.3		%	20
9505479	FM0	Matrix Spike	Total Barium (Ba)	2019/07/16		99	%	80 - 120
			Total Boron (B)	2019/07/16		99	%	80 - 120
			Total Calcium (Ca)	2019/07/16		96	%	80 - 120
			Total Iron (Fe)	2019/07/16		105	%	80 - 120
			Total Lithium (Li)	2019/07/16		99	%	80 - 120
			Total Magnesium (Mg)	2019/07/16		99	%	80 - 120
			Total Manganese (Mn)	2019/07/16		99	%	80 - 120
			Total Phosphorus (P)	2019/07/16		97	%	80 - 120
			Total Potassium (K)	2019/07/16		96	%	80 - 120
			Total Silicon (Si)	2019/07/16		100	%	80 - 120
			Total Sodium (Na)	2019/07/16		100	%	80 - 120
			Total Strontium (Sr)	2019/07/16		98	%	80 - 120
			Total Sulphur (S)	2019/07/16		98	%	80 - 120
9505479	FM0	Spiked Blank	Total Barium (Ba)	2019/07/16		98	%	80 - 120
			Total Boron (B)	2019/07/16		98	%	80 - 120
			Total Calcium (Ca)	2019/07/16		95	%	80 - 120
			Total Iron (Fe)	2019/07/16		103	%	80 - 120
			Total Lithium (Li)	2019/07/16		97	%	80 - 120
			Total Magnesium (Mg)	2019/07/16		98	%	80 - 120
			Total Manganese (Mn)	2019/07/16		98	%	80 - 120
			Total Phosphorus (P)	2019/07/16		95	%	80 - 120
			Total Potassium (K)	2019/07/16		94	%	80 - 120
			Total Silicon (Si)	2019/07/16		98	%	80 - 120
			Total Sodium (Na)	2019/07/16		98	%	80 - 120
			Total Strontium (Sr)	2019/07/16		96	%	80 - 120
			Total Sulphur (S)	2019/07/16		99	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9505479	FM0	Method Blank	Total Barium (Ba)	2019/07/16	<0.010		mg/L	
			Total Boron (B)	2019/07/16	<0.020		mg/L	
			Total Calcium (Ca)	2019/07/16	<0.30		mg/L	
			Total Iron (Fe)	2019/07/16	<0.060		mg/L	
			Total Lithium (Li)	2019/07/16	<0.020		mg/L	
			Total Magnesium (Mg)	2019/07/16	<0.20		mg/L	
			Total Manganese (Mn)	2019/07/16	<0.0040		mg/L	
			Total Phosphorus (P)	2019/07/16	<0.10		mg/L	
			Total Potassium (K)	2019/07/16	<0.30		mg/L	
			Total Silicon (Si)	2019/07/16	<0.10		mg/L	
			Total Sodium (Na)	2019/07/16	<0.50		mg/L	
			Total Strontium (Sr)	2019/07/16	<0.020		mg/L	
			Total Sulphur (S)	2019/07/16	<0.20		mg/L	
9505479	FM0	RPD	Total Iron (Fe)	2019/07/16	NC		%	20
9505482	LQ1	Matrix Spike	Total Aluminum (Al)	2019/07/14		NC	%	80 - 120
			Total Antimony (Sb)	2019/07/14		108	%	80 - 120
			Total Arsenic (As)	2019/07/14		97	%	80 - 120
			Total Beryllium (Be)	2019/07/14		101	%	80 - 120
			Total Chromium (Cr)	2019/07/14		94	%	80 - 120
			Total Cobalt (Co)	2019/07/14		93	%	80 - 120
			Total Copper (Cu)	2019/07/14		90	%	80 - 120
			Total Lead (Pb)	2019/07/14		95	%	80 - 120
			Total Molybdenum (Mo)	2019/07/14		104	%	80 - 120
			Total Nickel (Ni)	2019/07/14		93	%	80 - 120
			Total Selenium (Se)	2019/07/14		101	%	80 - 120
			Total Silver (Ag)	2019/07/14		106	%	80 - 120
			Total Thallium (Tl)	2019/07/14		105	%	80 - 120
			Total Tin (Sn)	2019/07/14		119	%	80 - 120
			Total Titanium (Ti)	2019/07/14		94	%	80 - 120
			Total Uranium (U)	2019/07/14		115	%	80 - 120
			Total Vanadium (V)	2019/07/14		97	%	80 - 120
			Total Zinc (Zn)	2019/07/14		NC	%	80 - 120
9505482	LQ1	Spiked Blank	Total Aluminum (Al)	2019/07/14		92	%	80 - 120
			Total Antimony (Sb)	2019/07/14		109	%	80 - 120
			Total Arsenic (As)	2019/07/14		97	%	80 - 120
			Total Beryllium (Be)	2019/07/14		99	%	80 - 120
			Total Chromium (Cr)	2019/07/14		94	%	80 - 120
			Total Cobalt (Co)	2019/07/14		93	%	80 - 120
			Total Copper (Cu)	2019/07/14		93	%	80 - 120
			Total Lead (Pb)	2019/07/14		99	%	80 - 120
			Total Molybdenum (Mo)	2019/07/14		101	%	80 - 120
			Total Nickel (Ni)	2019/07/14		94	%	80 - 120
			Total Selenium (Se)	2019/07/14		100	%	80 - 120
			Total Silver (Ag)	2019/07/14		109	%	80 - 120
			Total Thallium (Tl)	2019/07/14		107	%	80 - 120
			Total Tin (Sn)	2019/07/14		110	%	80 - 120
			Total Titanium (Ti)	2019/07/14		92	%	80 - 120
			Total Uranium (U)	2019/07/14		97	%	80 - 120
			Total Vanadium (V)	2019/07/14		96	%	80 - 120
			Total Zinc (Zn)	2019/07/14		92	%	80 - 120
9505482	LQ1	Method Blank	Total Aluminum (Al)	2019/07/14	<0.0030		mg/L	
			Total Antimony (Sb)	2019/07/14	<0.00060		mg/L	
			Total Arsenic (As)	2019/07/14	<0.00020		mg/L	
			Total Beryllium (Be)	2019/07/14	<0.0010		mg/L	
			Total Chromium (Cr)	2019/07/14	<0.0010		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Cobalt (Co)	2019/07/14	<0.00030		mg/L	
			Total Copper (Cu)	2019/07/14	<0.00020		mg/L	
			Total Lead (Pb)	2019/07/14	<0.00020		mg/L	
			Total Molybdenum (Mo)	2019/07/14	<0.00020		mg/L	
			Total Nickel (Ni)	2019/07/14	<0.00050		mg/L	
			Total Selenium (Se)	2019/07/14	<0.00020		mg/L	
			Total Silver (Ag)	2019/07/14	<0.00010		mg/L	
			Total Thallium (Tl)	2019/07/14	<0.00020		mg/L	
			Total Tin (Sn)	2019/07/14	<0.0010		mg/L	
			Total Titanium (Ti)	2019/07/14	<0.0010		mg/L	
			Total Uranium (U)	2019/07/14	<0.00010		mg/L	
			Total Vanadium (V)	2019/07/14	<0.0010		mg/L	
			Total Zinc (Zn)	2019/07/14	<0.0030		mg/L	
9505482	LQ1	RPD	Total Aluminum (Al)	2019/07/14	NC		%	20
			Total Lead (Pb)	2019/07/14	NC		%	20
9505873	EH2	Spiked Blank	Turbidity	2019/07/13		96	%	80 - 120
9505873	EH2	Method Blank	Turbidity	2019/07/13	<0.10		NTU	
9505873	EH2	RPD	Turbidity	2019/07/13	2.1		%	20
9507484	LQ1	Matrix Spike	Dissolved Molybdenum (Mo)	2019/07/15		96	%	80 - 120
9507484	LQ1	Spiked Blank	Dissolved Molybdenum (Mo)	2019/07/15		94	%	80 - 120
9507484	LQ1	Method Blank	Dissolved Molybdenum (Mo)	2019/07/15	<0.00020		mg/L	
9507484	LQ1	RPD	Dissolved Molybdenum (Mo)	2019/07/15	NC		%	20
9508465	IK0	Spiked Blank	Alkalinity (Total as CaCO3)	2019/07/16		92	%	80 - 120
9508465	IK0	Method Blank	Alkalinity (PP as CaCO3)	2019/07/16	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2019/07/16	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/07/16	<1.0		mg/L	
			Carbonate (CO3)	2019/07/16	<1.0		mg/L	
			Hydroxide (OH)	2019/07/16	<1.0		mg/L	
9508465	IK0	RPD [WB5703-01]	Alkalinity (PP as CaCO3)	2019/07/16	NC		%	20
			Alkalinity (Total as CaCO3)	2019/07/16	1.5		%	20
			Bicarbonate (HCO3)	2019/07/16	1.5		%	20
			Carbonate (CO3)	2019/07/16	NC		%	20
			Hydroxide (OH)	2019/07/16	NC		%	20
9508466	IK0	Spiked Blank	pH	2019/07/16		100	%	97 - 103
9508466	IK0	RPD [WB5703-01]	pH	2019/07/16	0.39		%	N/A
9508468	IK0	Spiked Blank	Conductivity	2019/07/16		100	%	90 - 110
9508468	IK0	Method Blank	Conductivity	2019/07/16	<2.0		uS/cm	
9508468	IK0	RPD [WB5703-01]	Conductivity	2019/07/16	2.7		%	10
9509199	RK3	Matrix Spike	Total Mercury (Hg)	2019/07/16		81	%	80 - 120
9509199	RK3	Spiked Blank	Total Mercury (Hg)	2019/07/16		90	%	80 - 120
9509199	RK3	Method Blank	Total Mercury (Hg)	2019/07/16	<0.0020		ug/L	
9509199	RK3	RPD	Total Mercury (Hg)	2019/07/16	NC		%	20
9509749	STI	Matrix Spike	Dissolved Chloride (Cl)	2019/07/16		NC	%	80 - 120
			Dissolved Sulphate (SO4)	2019/07/16		NC	%	80 - 120
9509749	STI	Spiked Blank	Dissolved Chloride (Cl)	2019/07/16		108	%	80 - 120
			Dissolved Sulphate (SO4)	2019/07/16		108	%	80 - 120
9509749	STI	Method Blank	Dissolved Chloride (Cl)	2019/07/16	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/07/16	<1.0		mg/L	
9509749	STI	RPD	Dissolved Chloride (Cl)	2019/07/16	1.5		%	20

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Sulphate (SO4)	2019/07/16	0.63		%	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).

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VALIDATION SIGNATURE PAGE

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

Ghayasuddin Khan, M.Sc., P.Chem., QP, Scientific Specialist, Inorganics

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports.
For Service Group specific validation please refer to the Validation Signature Page.

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Maxxam
A Bureau Veritas Group Company

Calgary: 4000 19th St. NE, T2E 6P8. Toll Free (800) 386-7247
Edmonton: 9331-48 St. T6B 2R4. Toll Free (800) 386-7247
maxxam.ca

CHAIN OF CUSTODY RECORD

M 083881

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Invoice Information	Report Information (if differs from invoice)	Project Information	Turnaround Time (TAT) Required
Company: SLR Consulting (Canada) Ltd.	Company: Summit Aggregates c/o SLR Consulting	Quotation #:	[X] 5 - 7 Days Regular (Most analyses)
Contact Name: Robert Till	Contact Name: Robert Till	P.O. #/ AFE#: EDM4886	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 6940 Roper Road. Edmonton, AB	Address:	Project #:	Rush TAT (Surcharges will be applied)
Phone: 780-490-7893	Phone:	Site Location:	[ ] Same Day [ ] 2 Days [ ] 1 Day [ ] 3-4 Days
Email: rtill@slrconsulting.com	Email: rtill@slrconsulting.com	Site #:	Date Required:
Copies: nyari@slrconsulting.com	Copies: nyari@slrconsulting.com	Sampled By:	Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID			
Seal Present	✓		Temp	5	5.5	
Seal Intact	✓					
Cooling Media	✓					
	YES	NO	Cooler ID			
Seal Present			Temp			
Seal Intact						
Cooling Media						
	YES	NO	Cooler ID			
Seal Present			Temp			
Seal Intact						
Cooling Media						

Depot Reception

Regulatory Criteria

[X] AT1
[ ] CCME
[ ] Drinking Water
[ ] D50 (Drilling Waste)
[ ] Saskatchewan
[ ] Other:

Special Instructions

Metals preserved not filtered.

	Sample Identification	Depth (Unit)	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	# of containers	BTEX F1 [ ] VOC [ ]	BTEX F1-F2	BTEX F1-F4	Routine Water	Regulated Metals [x] Diss Tot	Mercury [x] Dissolved Total	Salinity 4	Sieve (75 micron)	Texture (% Sand, Silt, Clay)	Basic Class II Landfill	Turbidity	Total Coliforms + E. coli	HOLD - DO NOT ANALYZE
1	BHS1		2019/07/10	1:45 PM	Water	6				X	X	X					X	X	
2	WW2		↓	2:52 PM		6				X	X	X					X	X	
3	MW19-110		↓	4:48 PM	↓	6				X	X	X					X	X	
4																			
5																			
6																			
7																			
8																			
9																			
10																			

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

Relinquished by: (Signature/ Print)	DATE (YYYY/MM/DD)	Time (HH:MM)	Received by: (Signature/ Print)	DATE (YYYY/MM/DD)	Time (HH:MM)
Naushin Yari	2019/07/10	19:00	Jenelle Kingsbury	2019/07/10	2035

10-Jul-19 20:35
Jenelle Feller
B955649
CCQ INS-0170

AB FCD-00331/7

APPENDIX H
Baseline Water Resources – Water Well Testing Results Letter Report

Hydrogeological Assessment Report
Mountain Ash Limited Partnership Aggregate Operation
NW and SW Section 31, Twp 26, Rge 3 W5M
Rocky View County, Alberta
SLR Project No. 212.06650.00003

BASELINE WATER RESOURCE INC

Mr. K. Carroll
103 Dalcastle Mews NW
Calgary, Alberta
T3A 2N8

June 7, 2013

RE: Water Well Testing Results: SE 06-027-03 W5M
PENGROWTH ENERGY CORPORATION: 03-06-027-03 W5M
BASELINE WATER RESOURCE INC.: Project # 13-4007

INTRODUCTION

Baseline Water Resource Inc. (BWRI) was retained by Pengrowth Energy Corporation (Pengrowth) to conduct a baseline water well assessment (1 well) for Mr. Kevin Carroll in SE 06-027-03 W5M on May 7, 2013. Pengrowth plans to develop from a surface location within 03-06-027-03 W5M.

The table below displays the water well location, UTM co-ordinates and where available the corresponding Alberta Environment and Sustainable Resource Development (ESRD) Drilling Report GIC ID number (ESRD, 2013).

Water Well Name	Legal Land Location	NAD 83, UTM Zone 11	ESRD Well GIC ID
House Well	SE 06-027-03 W5M	5683479 m, 0680742 m	0360164

RESULTS

HOUSE WELL

Procedure

Testing was completed by discharging water from a hose bib off east side of the residence. Water was flowed through ¾" lines and discharged approximately 5 m east of the residence. Photographs of the well casing, discharge connection/sample area, and the Flow Through Cell at discharge follow this report.

Water Quantity

The water level at the start of the test was 35.100 m from the top of the well casing (TOC). The well was pumped at a constant flow rate of 24.0 L/min (5.28 IGPM) for 60 minutes. The water level at the end of the test was 35.270 m

from the TOC (0.170 m total drawdown). The water level in the well recovered to 35.115 m in 60 minutes (90% Recovery). Yield test data is presented in Table 1.

Water Quality

Water quality samples were collected and submitted to ALS Laboratory Group Ltd (ALS) in Calgary, Alberta for routine potability, total metals, benzene, toluene, ethyl benzene and xylenes (BTEX) and petroleum hydrocarbon fractions (F1-F2) and bacteriological analysis (total coliforms and E. coli). A copy of the laboratory analytical report is attached.

Field parameters including electrical conductivity (EC), pH and temperature were measured prior to water sample collection. Field parameter results are included in the table below.

Water Well Name	Time	EC (µS/cm)	pH	Temp (°C)
House Well	1520 h	534	7.28	5.7

Water quality analytical results were compared to the "Guideline for Canadian Drinking Water Quality" (GCDWQ) standard (Health Canada, 2012). Guidelines are either health-based (Maximum Acceptable Concentration (MAC)) or Aesthetic Objectives (AO). Aesthetic Objectives are based on considerations such as taste, odour and colour, and do not constitute a health hazard. Water quality exceedances are summarized in the table below.

Parameter	Concentration	MAC	AO
Iron (Fe)-Total	0.927 mg/L	-	0.3 mg/L
Turbidity	6.70 NTU	1 NTU	-

The turbidity value (6.70 NTU) exceeded the MAC guidelines. It should be noted that this is an operational guideline intended for water treatment facilities and therefore is not directly related to private water wells.

In cases where a MAC has been exceeded, the landowner is encouraged to contact the local health unit.

BTEX and Petroleum Hydrocarbon Analysis

None of the analyzed parameters were detected above the laboratory's minimum reportable detection limits.

BASELINE WATER RESOURCE INC

Free Gas Analysis

Water was directed through a Flow Through Cell (FTC) at a constant rate of 3.0 L/min for 60 minutes (180 L total). No free gas was observed during the sampling event

INTERPRETATION OF ANALYTICAL RESULTS

For assistance with the interpretation of your water sample analytical results, please find the attached interpretation guides provided by Alberta Health Services.

Any parameter exceedance relating to groundwater quality can be discussed with your local Health Office. For further information call the Health Link line at 1-866-408-LINK (5465) or go to the following website link:

http://www.healthlinkalberta.ca/default.htm

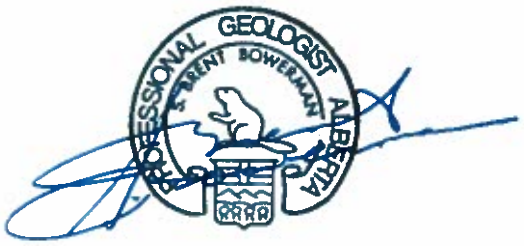
FOLLOW UP CONTACT FOR WATER WELL CONCERNS

Any concerns regarding baseline water well quality or performance should be directed to Alberta Environment and Sustainable Resources (ESRD). To reach a water well specialist at ESRD, the contact number is 1-800-222-6514.

CLOSURE

Baseline Water Resource Inc. is pleased to submit this report as fulfillment of Pengrowths' requirements for baseline water well testing.

Sincerely,



S. Brent Bowerman, P.Geol.
President
Baseline Water Resource Inc.

BASELINE WATER RESOURCE INC

DISCLAIMER

Baseline Water Resource Inc. has used proficient skill and diligence conducting the water well assessment and preparation of this report. This report is a representation of the conditions and information present and available at the time of the assessment. Information received from all other sources is considered to be accurate but cannot be guaranteed. Baseline Water Resource Inc. is not responsible for any individual interpretation of this material nor any decisions based upon findings in this report.

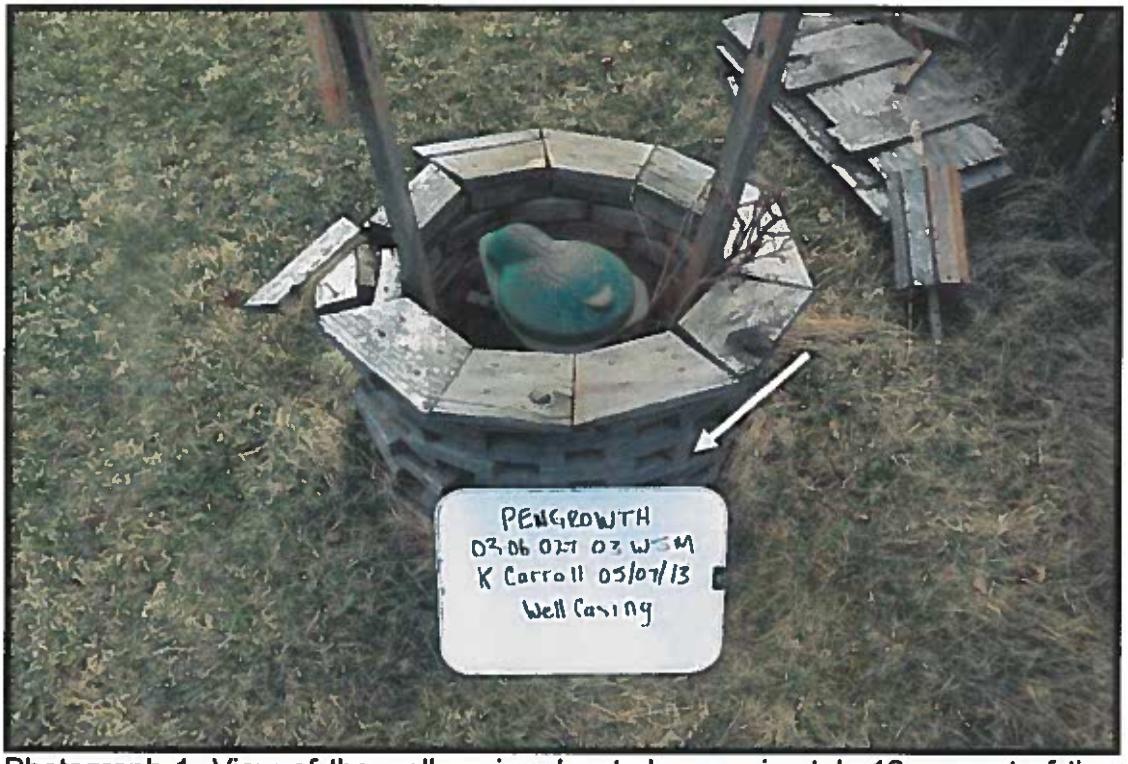
REFERENCES

Alberta Environment and Sustainable Resource Development (ESRD), 2013. "Groundwater Information Centre Map". http://www.envinfo.gov.ab.ca/GroundWater/. Last accessed May 7, 2013.

Alberta Health Services, Environmental Health, 2009. Guide to Interpreting Your Drinking Water Chemical Test Results, June, 2009.

Alberta Health Services, Environmental Health, 2009. Interpretation of Bacteriological Results, June 2009.

Health Canada, 2012. "Guidelines for Canadian Drinking Water Quality Summary Table (Prepared by the Federal-Provincial-Territorial Committee on Drinking Water)".



Photograph 1. View of the well casing, located approximately 12 m west of the residence.

Photograph 2. View of the discharge connection and sample area located on the east side of the residence.

Photograph 3. View of the FTC at discharge, located approximately 5 m east of the residence.

TABLE 1. YIELD TEST DATA (House Well)

Total Drawdown: 0.170 m **90% Recovery: 35.117 m**

Drawdown		Recovery	
Time (minutes)	Depth to Water (m b.t.c.[1])	Time (minutes)	Depth to Water (m b.t.c.)
0	35.100	0	35.270
1	35.100	1	35.125
2	35.100	2	35.120
3	35.100	3	35.120
4	35.100	4	35.120
5	35.100	5	35.120
6	35.100	6	35.120
7	35.105	7	35.120
8	35.105	8	35.120
9	35.105	9	35.115
10	35.105	10	35.115 [2]
15	-		
20	35.230		
25	35.115		
30	35.140		
35	35.260		
40	35.135		
50	35.120		
60	35.270		

NOTES:

1. b.t.c. denotes "below top of well casing".
2. Denotes 90% Recovery achieved.
3. The constant pumping rate was 24.0 L/min (5.28 lgpm).
4. The distance between ground level and the top of the well casing 0.33 m.
5. All water level measurements were taken from the top of the well casing.
6. A water level tape was used to collect water level measurements.

BASELINE WATER RESOURCE INC.
ATTN: CLINT GANES
#7, 3800-19 STREET NE
CALGARY AB T2E 6V2

Date Received: 08-MAY-13
Report Date: 14-MAY-13 17:07 (MT)
Version: FINAL

Client Phone: 403-282-3999

Certificate of Analysis

Lab Work Order #: L1298547
Project P.O. #: 2013LC0027
Job Reference: 13-4007
C of C Numbers:
Legal Site Desc: 03-06-027-03 W5M

Other Information: INV COMMENTS: 13-4007

Brent Whitehead
Senior Scientist

Sample Details / Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	Guideline Limits #2
L1298547-1 K. CARROLL							
Sampled By: GF on 07-MAY-13 @ 15:20							
Matrix: WATER							
Physical Tests							
Turbidity	6.70		0.10	NTU	10-MAY-13		
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	334		5.0	mg/L	08-MAY-13		
Bicarbonate (HCO3)	407		5.0	mg/L	08-MAY-13		
Carbonate (CO3)	<5.0		5.0	mg/L	08-MAY-13		
Chloride (Cl)	1.79		0.10	mg/L	08-MAY-13	250	
Conductivity (EC)	626		3.0	uS/cm	08-MAY-13		
Fluoride (F)	0.13		0.10	mg/L	08-MAY-13		1.5
Hardness (as CaCO3)	337			mg/L	11-MAY-13		
Hydroxide (OH)	<5.0		5.0	mg/L	08-MAY-13		
Ion Balance	101			%	11-MAY-13		
Nitrate and Nitrite (as N)	0.704		0.071	mg/L	10-MAY-13		10
Nitrate (as N)	0.633		0.050	mg/L	08-MAY-13		10
Nitrite (as N)	0.072		0.050	mg/L	08-MAY-13		1
pH	7.65		0.10	pH	08-MAY-13	6.5-8.5	
TDS (Calculated)	345			mg/L	11-MAY-13	500	
Sulfate (SO4)	18.7		0.50	mg/L	08-MAY-13	500	
Bacteriological Tests							
MPN - E. coli	<1		1	MPN/100mL	08-MAY-13		**0
MPN - Total Coliforms	<1		1	MPN/100mL	08-MAY-13		**0
Total Metals							
Aluminum (Al)-Total	<0.0050		0.0050	mg/L	10-MAY-13	0.1	
Antimony (Sb)-Total	<0.00010		0.00010	mg/L	10-MAY-13		0.006
Arsenic (As)-Total	0.00011		0.00010	mg/L	10-MAY-13		0.01
Barium (Ba)-Total	0.108		0.000050	mg/L	10-MAY-13		1
Beryllium (Be)-Total	<0.00050		0.00050	mg/L	10-MAY-13		
Boron (B)-Total	0.016		0.010	mg/L	10-MAY-13		5
Cadmium (Cd)-Total	<0.000050		0.000050	mg/L	10-MAY-13		0.005
Calcium (Ca)-Total	66.3		0.10	mg/L	10-MAY-13		
Chromium (Cr)-Total	<0.00050		0.00050	mg/L	10-MAY-13		0.05
Cobalt (Co)-Total	<0.00010		0.00010	mg/L	10-MAY-13		
Copper (Cu)-Total	0.00183		0.00010	mg/L	10-MAY-13	1	
Iron (Fe)-Total	0.927		0.030	mg/L	10-MAY-13	*0.3	
Lead (Pb)-Total	0.00022		0.00010	mg/L	10-MAY-13		0.01
Lithium (Li)-Total	0.0100		0.0050	mg/L	10-MAY-13		
Magnesium (Mg)-Total	38.8		0.10	mg/L	10-MAY-13		
Manganese (Mn)-Total	0.0092		0.0050	mg/L	10-MAY-13	0.05	
Mercury (Hg)-Total	<0.000050		0.000050	mg/L	10-MAY-13		0.001
Molybdenum (Mo)-Total	0.00101		0.000050	mg/L	10-MAY-13		
Nickel (Ni)-Total	0.00055		0.00050	mg/L	10-MAY-13		
Potassium (K)-Total	2.27		0.50	mg/L	10-MAY-13		
Selenium (Se)-Total	0.0016		0.0010	mg/L	10-MAY-13		0.01
Silver (Ag)-Total	<0.000010		0.000010	mg/L	10-MAY-13		

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Federal Guidelines for Canadian Drinking Water Quality (AUG, 2012) = [Suite] - CA_CDWQ MAC and AO (includes "interim" MACs)

#1: GCDWQ - Aesthetic Objective

#2: GCDWQ - Maximum Acceptable Concentrations (MACs)

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	Guideline Limits #2
L1298547-1 K. CARROLL Sampled By: GF on 07-MAY-13 @ 15:20 Matrix: WATER							
Total Metals							
Sodium (Na)-Total	11.0		1.0	mg/L	10-MAY-13	200	
Thallium (Tl)-Total	<0.00010		0.00010	mg/L	10-MAY-13		
Tin (Sn)-Total	<0.00010		0.00010	mg/L	10-MAY-13		
Titanium (Ti)-Total	<0.0010		0.0010	mg/L	10-MAY-13		
Uranium (U)-Total	0.00168		0.000010	mg/L	10-MAY-13		0.02
Vanadium (V)-Total	<0.0010		0.0010	mg/L	10-MAY-13		
Zinc (Zn)-Total	<0.0050		0.0050	mg/L	10-MAY-13	5	
Volatile Organic Compounds							
Benzene	<0.00050		0.00050	mg/L	10-MAY-13		0.005
Ethylbenzene	<0.00050		0.00050	mg/L	10-MAY-13	0.0024	
Toluene	<0.00050		0.00050	mg/L	10-MAY-13	0.024	
o-xylene	<0.00050		0.00050	mg/L	10-MAY-13		
m+p-Xylene	<0.00050		0.00050	mg/L	10-MAY-13		
Xylenes	<0.00050		0.00050	mg/L	10-MAY-13	0.3	
F1(C6-C10)	<0.10		0.10	mg/L	10-MAY-13		
F1-BTEX	<0.10		0.10	mg/L	10-MAY-13		
Hydrocarbons							
F2 (C10-C16)	<0.25		0.25	mg/L	10-MAY-13		

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Federal Guidelines for Canadian Drinking Water Quality (AUG, 2012) = [Suite] - CA_CDWQ MAC and AO (includes "interim" MACs)

#1: GCDWQ - Aesthetic Objective

#2: GCDWQ - Maximum Acceptable Concentrations (MACs)

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference***
BTX,F1-CL	Water	BTEX and F1 (C6-C10)	EPA 5030/8015& 8260-P&T GC-MS/FID
CL-CL	Water	Chloride (Cl)	APHA 4110 B-Ion Chromatography
Inorganic Anions by ion chromatography (IC) in water and aqueaous extracts of soils.			
F-IC-CL	Water	Fluoride	APHA 4110 B-Ion Chromatography
F2-CL	Water	F2	EPA 3510/8000-GC-FID
HG-TOT-CVAFS-CL	Water	Total Mercury in Water by CVAFS	EPA 1631E
This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).			
IONBALANCE-CL	Water	Ion Balance Calculation	APHA 1030E
MET-DIS-ICP-CL	Water	Dissolved Metals by ICPOES	EPA SW-846 3005A/6010B
This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).			
MET-TOT-ICP-CL	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B
This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion using a hotblock (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).			
MET-TOT-LOW-MS-CL	Water	Total Metals in Water by ICPMS	EPA SW-846 3005A/6020A
N2N3-CALC-CL	Water	Nitrate+Nitrite	CALCULATION
NO2-CL	Water	Nitrite-N	APHA 4110 B-Ion Chromatography
NO3-IC-CL	Water	Nitrate-N	APHA 4110 B-Ion Chromatography
PH/EC/ALK-CL	Water	pH, Conductivity and Total Alkalinity	APHA 4500H,2510,2320
All samples analyzed by this method for pH will have exceeded the 15 minute recommended hold time from time of sampling (field analysis is recommended for pH where highly accurate results are needed) pH measurement is determined from the activity of the hydrogen ions using a hydrogen electrode and a reference electrode. Alkalinity measurement is based on the sample's capacity to neutralize acid Conductivity measurement is based on the sample's capacity to convey an electric current			
SO4-CL	Water	Sulfate (SO4)	APHA 4110 B-Ion Chromatography
TC-EC-MPN-CL	Water	Total Coliforms and E. Coli by MPN	APHA METHOD 9223
This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture hydrolyzable substrates and then sealed in a multi-well packet. The packet is incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.			
TURBIDITY-CL	Water	Turbidity	APHA 2130 B-Nephelometer
A strong light beam is sent through a transparent tube containing the sample. Light that is reflected at 90 degrees to the axis by suspended particles is detected by the photocell. The electrical response is proportional to the sample turbidity.			

*** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA		

Additional Information:

INV COMMENTS	13-4007

Reference Information

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information.

L1298547-COFC

JSTODY / ANALYTICAL REQUEST FORM

CANADA TOLL FREE 1-800-668-9878

WWW.ALSENVIRO.COM

DATE: 05/08/2013

LAB WORK ORDER #

REPORT TO:

COMPANY: Baseline Water Resource Inc.

CONTACT: Clint Ganes

ADDRESS: #7, 3800 - 19 Street NE

Calgary, AB T2E 6V2

PHONE: 403-282-3999 FAX:

CELL PHONE: 403-869-2592

REPORT DISTRIBUTION:

EMAIL ✓ FAX

FINAL RESULTS BY EMAIL ONLY

EMAIL 1: clintg@baselinewater.com

EMAIL 2: gregf@baselinewater.com

EMAIL 3:

SELECT: pdf x digital both

SERVICE REQUESTED

x REGULAR SERVICE (DEFAULT)

PRIORITY SERVICE (50% SURCHARGE)

EMERGENCY SERVICE (100% SURCHARGE)

INVOICE TO: SAME AS ABOVE: NO

COMPANY: Pengrowth Energy Corp.

CONTACT:

ADDRESS:

PHONE: (403) FAX:

BWRI PROJECT # 13-4007

JOB#

AFE: 2013LC0027

LSD: 03-06-027-03 W5M

QUOTE:

ANALYSIS REQUESTED

INDICATE BOTTLES: FILTERED/PRESERVED (F/P) → F P

Lab Sample Number	SAMPLE ID	SAMPLING LOCATION	SAMPLED BY / DATE / TIME	SAMPLE TYPE	ROUTINE POTABILITY	METALS TOTAL CCME	TC-EC	BTEX	F1 & F2	Gas Comp	HAZARDOUS ? Y/N	HIGHLY CONTAMINATED ? Y/N	NUMBER OF CONTAINERS
1													
2	K. Carroll	[illegible]. hose bib off residence.	CF 05/07/13 @ 1[illegible]H	H_2O	X	X	X	X	X			2	7
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													

GUIDELINES / REGULATIONS

GCDWQ (Guidelines for Canadian Drinking Water Quality)

SPECIAL INSTRUCTIONS / NATURE OF HAZARDOUS MATERIAL

If Gas Compositional Analysis identifies the presence of methane gas, the PM must report directly to Clint Ganes (clintg@baselinewater.com) to determine if Gas Isotopic Analysis is required.

SAMPLE CONDITION

FROZEN COLD AMBIENT

MEAN TEMPERATURE 9

Failure to complete all portions of this form may delay analysis. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the reverse of the white report copy.

RELINQUISHED BY:	DATE & TIME:	RECEIVED BY:	DATE & TIME:	SAMPLE CONDITION ACCEPTABLE UPON RECEIPT ? (Y/N)
C. Farrell G. Fell	05/08/13 @ 0920H		May 8 9:20am	
RELINQUISHED BY:	DATE & TIME:	RECEIVED BY:	DATE & TIME:	

Alberta Health Services

Environmental Health

GUIDE TO INTERPRETING YOUR DRINKING WATER CHEMICAL TEST RESULTS

The laboratory report on the chemical quality of your drinking water sample is attached.

The *Guidelines for Canadian Drinking Water Quality* provide maximum limits for substances in drinking water that can be harmful to your health, such as sodium, fluoride, nitrate and nitrite. For your protection, the maximum limits are set below the levels at which any harmful health effects have actually been observed.

The other chemical quality limits provided below (e.g. total hardness, sulphate and iron) are not significant to health, but describe water quality conditions that are best for various household uses and for aesthetic reasons such as the water's taste, smell, and appearance.

The amount of a substance in your water sample is described as milligrams per Litre (mg/L), which is equivalent to parts per million (ppm).

The test results for Conductivity, Cation/Anion Sum, Ion Balance, % Difference are for laboratory work purposes only.

PARAMETER (limit)	DESCRIPTION
pH (6.5 – 8.5)	A pH above 8.5 may lead to problems with scale formation (mineral deposits) on cookware, plumbing and appliance parts. Corrosion (rusting or eating away) of plumbing and appliance parts may be a problem below pH 6.5.
Sodium (200 mg/L)	Sodium in drinking water should not exceed 20 mg/L for people on sodium-reduced diet (if your doctor told you to cut down on salt). If in doubt consult your doctor. Over 200 mg/L will give water a salty taste, but poses no significant risk to people in good health.
Potassium (No guideline)	Potassium at levels of 50 to 100 mg/L may add to corrosion and scaling problems.
Calcium (No guideline)	Calcium adds to water hardness and is essential for human health.
Magnesium (No guideline)	Magnesium adds to water hardness and is essential for human health. High levels of magnesium can cause a laxative effect (loose stools) in new users.
Total Hardness (80 to 100 mg/L)	Water hardness results from the calcium, magnesium, and other minerals that water collects as it moves through the ground. Water hardness is described as follows: soft = 0 to <60 mg/L; medium hard = 60 to <120 mg/L; hard = 120 to <180 mg/L; and very hard = 180 mg/L or more. Soft water can increase corrosion while hard water increases scaling on pipes, water heaters and appliances. Hard water also requires more soap during washing. Water softeners will lower hardness to acceptable levels, but will increase sodium levels (see sodium).
Iron (0.3 mg/L)	At levels above 0.3 mg/L, iron can leave a reddish-brown stain on laundry and plumbing fixtures and produce unpleasant tastes in beverages. High iron levels also cause growth of iron bacteria on parts of the well, water system, and plumbing. Shock chlorination is used to control iron bacteria (shocking your well may have to be repeated every year). In really bad cases, an iron filter may be needed.
Total Dissolved Solids (TDS) (500 mg/L)	TDS is a measure of minerals in the water. High TDS can cause scaling and affect water's taste and smell. Low TDS can give water a flat taste.

PARAMETER (limit)	DESCRIPTION
Carbonate, Bicarbonate & Hydroxide (No guideline)	Carbonates, bicarbonates and hydroxides are related to water's alkalinity, salinity, and the amount of total dissolved solids. Higher levels of bicarbonates can cause more scale formation.
Total Alkalinity (No guideline)	Alkalinity is formed by bicarbonate, carbonate and hydroxide. Lower levels of alkalinity can cause corrosion problems while higher levels can cause more scale formation.
Fluoride (1.5 mg/L)	Fluoride levels over 1.5 mg/L may increase the risk of dental fluorosis (e.g. white spots on tooth enamel) in children with developing teeth (newborns to age thirteen). Contact your family dentist for information on the correct use of fluoride supplements for children in low-fluoride areas (less than 0.7 mg/L). Fluoride can be removed from drinking water by point-of-use devices such as reverse osmosis or distillation.
Nitrate (10 mg/L) **Nitrite** (1.0 mg/L)	Nitrate and nitrite levels above the limits can cause methemoglobinemia (often referred to as blue baby syndrome) in sensitive people, including pregnant women and infants less than 6 months of age. Nitrates and nitrites decrease the ability of the blood to carry oxygen, which can be life-threatening. Infants and sensitive people should not drink water or eat foods prepared with water that contains levels of nitrates or nitrites above the limit. Agricultural wastes (nitrates are a part of fertilizers) and malfunctioning or poorly designed onsite septic systems are common sources of nitrate and nitrite contamination of water wells. Nitrates and nitrites can be removed by point-of-use devices such as distillation and reverse osmosis.
Sulphate (500 mg/L)	Sulphates can occur naturally in water, or result from the decomposition of plants, animals and organic wastes. Ground water that naturally contains sulphates may also contain sulphate-reducing bacteria which change sulphates to hydrogen sulphide (a gas with a "rotten egg" odour). Sulphate-reducing bacteria can also cause corrosion problems. Aeration or chlorination followed by filtration will reduce hydrogen sulphide in well water. High levels of sulphate may have a laxative effect (loose stools) on new users. Regular users tend to become accustomed to high sulphate levels.
Chloride (250 mg/L)	Chloride over 250 mg/L may affect the taste of water and beverages. High levels of chloride may also cause either corrosion or scale formation, depending upon what else is in the water. A sudden increase in chloride levels may indicate pollution of your water supply (e.g. from road salt, irrigation drainage).

For more information contact

- www.albertahealthservices.ca/eph.asp
- HEALTH Link Alberta at 403-943-LINK or 1-866-408-LINK
- or your local health centre at one of the locations listed below.

Airdrie Airdrie Public Health Centre 604 Main Street South Airdrie, AB T4B 3K7 Phone: 403-912-8400 Fax: 403-912-8410	**Banff** Banff Health Centre 303 Lynx Street PO Box 1266 Banff, AB T1L 1B3 Phone: 403-762-2990 Fax: 403-762-5570	**Calgary/Mountain View/Rocky View** Calgary and Area 10101 Southport Rd SW Calgary, AB T2G 2E6 Phone: 403-943-2288 Fax: 403-943-8056	**Canmore** Canmore Public Health #104, 800 Railway Avenue Canmore, AB T1W 1P1 Phone: 403-678-5656 Fax: 403-678-5068
Claresholm Claresholm Public Health 5221 2nd Street W PO Box 1391 Claresholm, AB T0L 0T0 Phone: 403-625-4061 Fax: 403-625-4062	**Didsbury** Didsbury Health Unit PO Bag 130 1210 -20th Avenue Didsbury, AB T0M 0W0 Phone: 403-335-7292 Fax: 403-335-7610	**Okotoks** Okotoks Public Health Centre 11 Cimarron Commons Okotoks, AB T1S 2E9 Phone: 403-995-2600 Fax: 403-995-2639	**Strathmore** Public Health Building 650 Westchester Road Strathmore, AB T1P 1H8 Phone: 403-361-7200 Fax: 403-934-7244

Alberta Health Services

Environmental Health

Interpretation of Bacteriological Results

The Provincial Laboratory of Public Health performs laboratory tests on well water samples. Initially the laboratory looks for whether bacteria are present or absent in a sample. The presence of certain types of bacteria such as *E-coli* or Total Coliforms indicates that your water may be unsafe to drink. Private laboratories often test for fecal coliforms instead of *E-coli*.

If your well water sample result shows the presence of *E-coli* or Total Coliforms, you will be contacted by a Health Inspector to discuss these results and what further actions should be taken.

The following definitions will help you interpret your report:

DEFINITIONS

Absent: Indicates bacteria were **not** identified in the well water sample tested.

Present: Indicates bacteria **were** identified in the well water sample tested.

E-coli:

The presence of *E-coli* in a private water supply indicates that the water supply has recently been impacted by fecal contamination and **should not be considered safe to drink.** This situation should be discussed with the Health Inspector who can make recommendations about boiling your water or other treatment methods.

Total Coliforms:

The presence of Total Coliforms in a private water supply indicates the possible surface contamination of the water supply. Total Coliforms may also indicate inadequate water treatment (if treatment used). This situation should be discussed with the Health Inspector who can make recommendations on what further action you should take.

For more information contact:

- www.albertahealthservices.ca/eph.asp
- Health Link Alberta at 403-943-LINK or 1-866-408-LINK
- or your local health centre

SLR

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