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**Subject: Castle Mountain Campground & Geotech – Banff National Park  
Geotechnical Site Assessments**

## INTRODUCTION

At the request of Parks Canada Agency (Parks), WSP Canada Inc. (WSP) completed drilling programs at the Castle Mountain Campground, Johnston Canyon Campground, and Johnston Canyon Day Use Area (DUA), Minnewanka DUA, and Cascade Ponds DUA. The purpose of the drilling was two-fold; first to characterize subsurface geology and groundwater conditions, with the intent to use the collected data in wastewater treatment system designs, and second, to install monitoring systems around existing and future wastewater treatment areas. A sample collection program was also conducted at the Peyto Pit to characterize the chemical and physical properties of the material present in the pit.

Data collected at the six Parks sites during the program is presented in Attachments to this letter, compiled by site.

- Attachment A: Castle Mountain Campground
- Attachment B: Johnston Canyon Campground
- Attachment C: Johnston Canyon Day Use Area
- Attachment D: Minnewanka Day Use Area
- Attachment E: Cascade Ponds Day Use Area
- Attachment F: Peyto Pit

## FIELD WORK SUMMARY

WSP field personnel and subcontractor ERNCO Environmental Drilling & Coring Inc. drilled a total of 20 boreholes and installed 13 monitoring wells at the five of the six Parks sites. The boreholes and monitoring wells were completed using a combination of direct push, auger, or ODEX drilling



methods. Test pitting at Peyto Pit was completed using a track hoe to dig the pits and collect samples.

A summary of the field work completed at each of the six Parks sites is presented in the table below:

Location	Boreholes / Monitoring Wells	Monitoring Summary
Castle Mountain Campground	<ul style="list-style-type: none"> <li>Four monitoring wells were installed around the perimeter of the planned septic field area; two of the wells are a nested well pair.</li> </ul>	<ul style="list-style-type: none"> <li>Geotechnical sieve and hydrometer analyses were completed.</li> <li>No monitoring was completed at the wells; no water was identified in the wells after drilling.</li> </ul>
Johnston Canyon Campground	<ul style="list-style-type: none"> <li>Three monitoring wells were installed around the in-construction septic field area.</li> </ul>	<ul style="list-style-type: none"> <li>No monitoring was completed at the wells, but there was water present in the wells after drilling.</li> </ul>
Johnston Canyon DUA	<ul style="list-style-type: none"> <li>Three monitoring wells were installed around the new septic field area. Groundwater was not encountered during drilling, so the wells were installed as deep as possible at each location.</li> <li>Two boreholes were drilled on the southeast and north sides of the parking lot.</li> </ul>	<ul style="list-style-type: none"> <li>No monitoring was completed at the wells; no water was identified in the wells after drilling.</li> </ul>
Minnewanka DUA	<ul style="list-style-type: none"> <li>One monitoring well installed in proposed septic field area.</li> <li>Six boreholes were drilled; 2 were completed in the proposed septic area, and 4 were completed along the roadway.</li> </ul>	<ul style="list-style-type: none"> <li>New monitoring well P19-01 had water after drilling; the well was developed and left to recharge. When WSP returned to sample, there was not enough water to collect a sample.</li> <li>Existing monitoring well S18-03, located across the road from the proposed septic field area, was purged and a water quality sample was collected.</li> </ul>
Cascade Ponds DUA	<ul style="list-style-type: none"> <li>Two monitoring wells were installed around the perimeter of planned septic area.</li> </ul>	<ul style="list-style-type: none"> <li>Geotechnical sieve and hydrometer analyses were completed.</li> <li>Existing monitoring well, P18-01 was purged and the two newly installed monitoring wells were developed. Water quality samples were collected from all three monitoring wells.</li> <li>All three monitoring wells were tested to determine hydraulic conductivity values.</li> </ul>



Peyto Pit	<ul style="list-style-type: none"><li>- Four test pits were dug using a track hoe within the pit.</li><li>- Hand held GPS data was not collected by WSP.</li></ul>	<ul style="list-style-type: none"><li>- Samples were collected off the track hoe bucket.</li><li>- Geotechnical sieve and hydrometer analyses were completed.</li><li>- Chemical analyses were completed. The soil samples were analyzed for inorganic salinity parameters, metals, hydrocarbons, and polyaromatic hydrocarbons (PAHs).</li></ul>
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## RESULTS

### CASTLE MOUNTAIN CAMPGROUND

The drilling program at Castle Mountain Campground was undertaken to further assess the geological material in the area of a planned septic field and to establish a groundwater monitoring network for the area.

Geology encountered during drilling was mainly clayey sand or silty sand interbedded with cobbles and gravel. The finer grained layers of clayey sand or sandy silt appeared to have water present, but this water was being retarded in the finer grained units and was not observed in the coarser, and more dominant, gravel layers. The estimated depth of drilling for all wells was 12 m below ground surface (mbgs) in the planning stages; however, groundwater was not encountered at that depth in some locations. One well was installed at 12 mbgs and the remaining wells were installed close to 15 mbgs. Drilling refusal was encountered at approximately 15 mbgs in the area of the planned septic field and is assumed to be the depth of bedrock.

No water was present in the wells after drilling; therefore, no water quality sampling or hydraulic conductivity testing was conducted.

Sieve and hydrometer analyses were completed on samples from 1, 2, and 3 m depths of the three drill locations. Samples were consistently defined as silty sand with a trace of clay. One sample was described as a sandy silt with a trace of clay.

Maps showing the survey points for the campground, the borehole logs, and the geotechnical sieve/hydrometer analyses data are provided in Attachment A.

### JOHNSTON CANYON CAMPGROUND

The drilling program at Johnston Canyon Campground was undertaken to establish a groundwater monitoring network around the new septic field, which was in construction at the time of drilling.

Geology encountered during drilling was sandy silt interbedded with sand and gravel layers. Groundwater was observed between 9 and 10 mbgs during drilling and a few days after the monitoring wells were installed.



Three monitoring wells were installed to a depth of 10.5 mbgs around the perimeter of the in-construction septic field.

Water was present in the wells after drilling; however, no water quality sampling or hydraulic conductivity testing was conducted as per the scope of work.

A map showing the survey points for the monitoring wells, and the borehole logs are provided in Attachment B.

### JOHNSTON CANYON DAY USE AREA

The drilling program at Johnston Canyon DUA was undertaken to establish a groundwater monitoring network around the newly installed septic field and to assess the depth to bedrock in parts of the parking lot to aid in planning for future projects.

Geology encountered during drilling was sandy silt interbedded with sand and gravel layers. Larger cobbles and boulders or bedrock were encountered on the north/northeastern side of the site, which is the upslope side of the site. Two boreholes drilled on the perimeter of the parking lot were drilled to 7.5 mbgs and did not encounter bedrock; although, a limestone boulder was encountered in 19BH05, which was located next to the washroom building and septic holding tank. Bedrock was encountered at 19BH03, in the southeast corner of the septic field area, at 11 mbgs. Groundwater was not observed to the maximum drilled depth of 16 mbgs.

Three monitoring wells were installed to depths of 11.5, 12, and 16.5 mbgs, as dictated by presumed bedrock depth, around the perimeter of the existing septic field that services the DUA. Groundwater was not encountered during drilling, so the wells were installed as deep as possible at each location.

No water was present in the wells after drilling; therefore, no water quality sampling or hydraulic conductivity testing was conducted.

A map showing the survey points for the boreholes and monitoring wells, and the borehole logs are provided in Attachment C.

### MINNEWANKA DAY USE AREA

The drilling program at Minnewanka DUA was undertaken to assess the geological and groundwater conditions in a proposed septic field area, located down the road southwest of the main DUA. The program also intended to establish a groundwater monitoring network around the proposed septic area. Borehole drilling was also conducted along the roadway to gather information on depth to bedrock, which will be used in future infrastructure projects. There are three existing monitoring wells in the vicinity of the proposed septic field. One is located on the south side of the road, upslope from P19-01, the other two are located north of the road.

Geology encountered during drilling was clayey sand interbedded with gravel and cobble layers. The area assessed is located just off the Minnewanka access road and is within elevated on the valley



wall. Topography suggested that there may be areas of bedrock constraining the unconsolidated surficial materials. Boreholes drilled around the perimeter of the proposed site encountered drilling refusal, most likely bedrock, at depths ranging between 4 and 5.8 mbgs. In one location, 19BH02, bedrock was not encountered and there appears to be a small tributary drainage that would direct flow (both surface water and groundwater) to the larger creek that runs west of the site. Drilling along the roadway encountered bedrock at depths of 2.4, 2.6, and 2.7 mbgs.

One monitoring well was installed during this program, P19-01 was established at 19BH02, to a depth of 9.8 mbgs. Water was observed in the well after drilling and the well was developed and left to recharge for sampling at a later date.

Groundwater sampling was conducted a week after drilling, while there was some water observed in P19-01, it was not enough to collect a sample or test the well for hydraulic conductivity. A sample was collected from monitoring well S18-03 on the north side of the road to obtain some data for the area. The water quality observed at S18-03 was high quality with no parameters of concern.

Maps showing the survey points for the boreholes and monitoring wells, the borehole logs, the geotechnical sieve/hydrometer analyses data, the chemistry data, and the laboratory report are provided in Attachment D.

## CASCADE PONDS DAY USE AREA

The drilling program at Cascade Ponds DUA was undertaken to further assess the geological material in the area of a planned new septic field and to establish a groundwater monitoring network for the area. There is one existing monitoring well at the site in the septic field area, it was installed in 2018.

Geology encountered during drilling was mainly sand and gravel, with some cobbles. Bedrock was not encountered. Sieve and hydrometer testing was conducted on the upper 3 m of geological material, and indicated silty sand was predominant. Groundwater was observed between 4.5 and 4.8 mbgs.

Two monitoring wells were installed to depths of 8.0 and 8.3 mbgs, around the perimeter of the planned septic field that will service the DUA. Water was observed in the wells after drilling and the wells were developed and left to recharge for sampling at a later date.

All three monitoring wells in the septic field area were sampled for water quality analysis and tested to determine hydraulic conductivity of the aquifer. The hydraulic conductivity testing yielded values ranging from 3.18 to  $1.04 \times 10^{-3}$  m/s. The groundwater quality results show no parameters of concern and high-quality groundwater.

A map showing the survey points for the boreholes, monitoring wells and surface water sample points, the borehole logs, the geotechnical sieve/hydrometer analyses data, the hydraulic conductivity analysis, the chemistry data, and the laboratory report are provided in Attachment E.



## PEYTO PIT

Peyto Pit is used by the Parks Canada Agency to store materials, such as soil, from other projects around Banff National Park. Four test pits were dug in the pit to assess the soil material texture and chemistry. Samples were collected from approximately 1.0 to 1.5 m and 2.5 to 3.0 m using a track hoe.

Sieve and hydrometer analyses indicated that soil texture ranged from clayey sandy silt, to silty sand with trace clay.

Samples were analyzed for inorganic salinity parameters, metals, hydrocarbons, and PAHs. The laboratory analytical results were compared to guideline values presented in the *Alberta Tier 1 Soil and Groundwater Remediation Guidelines – Table 1<sup>1</sup>* (AT1) for natural land use. All results were below the AT1 guidelines, with the exception of anthracene in 19TP03 – 2.5 to 3.0 m. Anthracene is used to make dyes, plastics, and pesticides, but is also present naturally the environment. The concentration observed is only slightly above the laboratory method detection limit and is also observed in conjunction with other low concentrations of PAH parameters and F3 and F4 hydrocarbons. F3 and F4 concentrations were observed in all of the samples collected, concentrations were well below the AT1 guidelines for all samples.

The laboratory analytical results confirm that the soil collected from the sampled areas were below AT1 guidelines and the observed compounds of concern are at low enough concentrations that the material could be considered for use elsewhere within the Banff National Park.

The geotechnical sieve/hydrometer analyses data, the chemistry data, and the laboratory report are provided in Attachment F.

## CLOSURE

We trust the above information is suitable for the continued environmental management of the referenced Parks sites. If you have any questions regarding the content of this report, please contact Alyssa Barker by email at [alyssa.barker@wsp.com](mailto:alyssa.barker@wsp.com).

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<sup>1</sup> Alberta Environment and Parks (2019). *Alberta Tier 1 Soil and Groundwater Remediation Guidelines*. Environmental Policy Branch, Environmental Assurance Division, Edmonton, Alberta.



## CERTIFICATION OF WORK

WSP prepared this report solely for the use of the intended recipient, Parks Canada Agency, in accordance with the professional services agreement. The intended recipient is solely responsible for the disclosure of any information contained in this report. The content and opinions contained in the present report are based on the observations and/or information available to WSP at the time of preparation. If a third party makes use of, relies on, or makes decisions in accordance with this report, said third party is solely responsible for such use, reliance or decisions. WSP does not accept responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken by said third party based on this report. This limitations statement is considered an integral part of this report.

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**Attachments:**

Attachment A Castle Mountain Campground  
Attachment B Johnston Canyon Campground  
Attachment C Johnston Canyon Day Use Area  
Attachment D Minnewanka Day Use Area  
Attachment E Cascade Ponds Day Use Area  
Attachment F Peyto Pit



# Attachment A

CASTLE MOUNTAIN CAMPGROUND



## SURVEY DATA



**LEGEND:**

	SEPTIC TANK
	TELUS LINE
	WOOD BOX
	ROAD SHOULDER
	CULVERT
	BUILDING
	CONCRETE
	SURVEYED POINT
	WATER STAND PIPE
	POWER POLE
	GUY ANCHOR
	VALVE
	WELL

**NOTES:**

1. ALL ELEVATIONS AND DIMENSIONS ARE IN METERS AND DECIMALS THEREOF UNLESS SHOWN OTHERWISE.
2. DISTANCES SHOWN ARE BASED UPON NAD83 UTM GRID.
3. NORTH IS SHOWN RELATIVE TO NAD83 UTM SURVEY CONTROL.
4. BEARINGS AND COORDINATES ARE BASED ON THE NAD83 DATUM AND WERE DERIVED FROM GNSS OBSERVATIONS HOLDING PUBLISHED COORDINATE VALUES FOR A.S.C.M 320218.
5. ELEVATIONS ARE GEODETIC AND DERIVED FROM A.S.C.M 320218 (ELEVATION 1400.507)

**WSP REFERENCE DOCUMENTS:**  
 - 19M-01812-G0-000-00-CSTAB001.CSV

THE INFORMATION CONTAINED ON THIS DRAWING, AND ANY DOCUMENTATION PERTAINING TO THIS DRAWING IS CURRENT AS OF DECEMBER 20, 2019, AND AS PER REVISION SHOWN BELOW. ANY FACILITIES UNDER OR ABOVE GROUND INSTALLED AFTER THE AFORE MENTIONED DATE MAY NOT HAVE BEEN CONSIDERED IN THE PREPARATION OF THIS DOCUMENT, OR ITS SUPPORT DOCUMENTS.

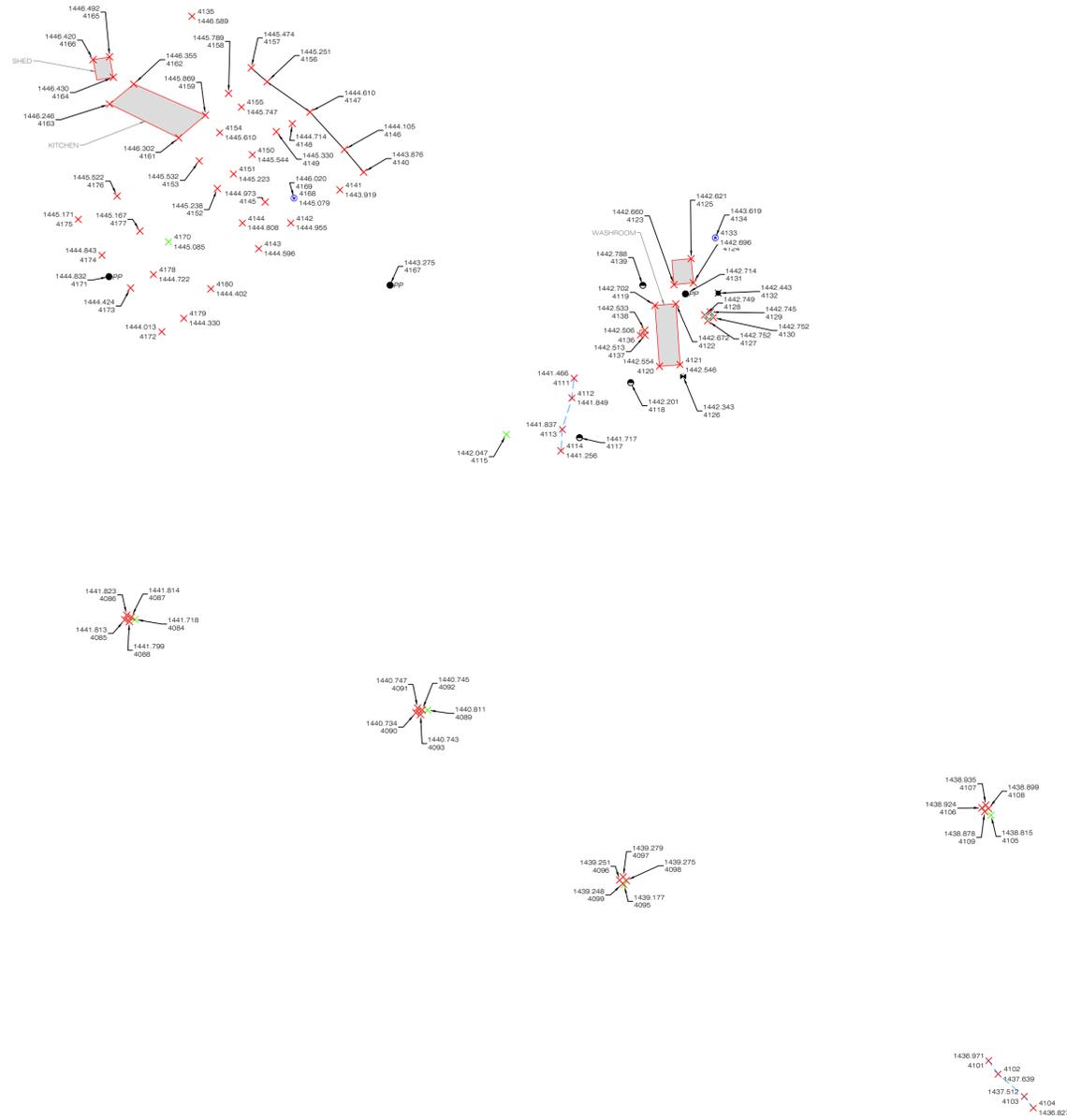
NO	DATE (mm-dd-yy)	REVISION	BY	CHK
00	01-10-20	ORIGINAL ISSUE	PK	KS

**DRAWING TITLE:**  
 BANFF GEOTECHNICAL TOPO SURVEY

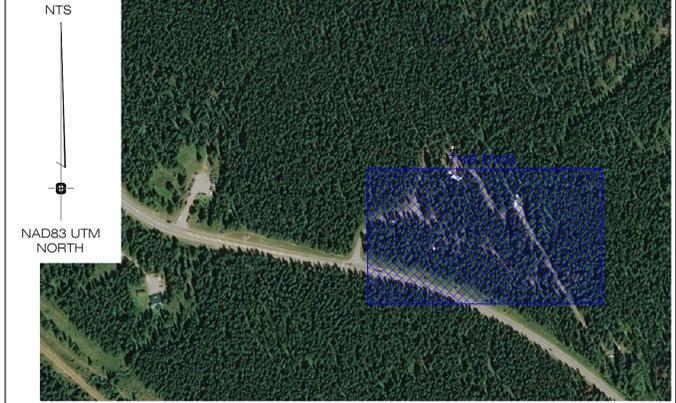
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**SCALE:** 1:500      **DRAWING NUMBER:** 19M-01812-G0-000-00-CSTAB001-Sh1      **REV.** 0

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KEY PLAN



LEGEND:

- SEPTIC TANK
- TELUS LINE
- WOOD BOX
- ROAD SHOULDER
- - - CULVERT
- BUILDING
- CONCRETE
- X SURVEYED POINT
- X WATER STAND PIPE
- PP POWER POLE
- GUY ANCHOR
- VALVE
- WELL

NOTES:

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2. DISTANCES SHOWN ARE BASED UPON NAD83 UTM GRID.
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4. BEARINGS AND COORDINATES ARE BASED ON THE NAD83 DATUM AND WERE DERIVED FROM GNSS OBSERVATIONS HOLDING PUBLISHED COORDINATE VALUES FOR A.S.C.M 320218.
5. ELEVATIONS ARE GEODETIC AND DERIVED FROM A.S.C.M 320218 (ELEVATION 1400.507)

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SCALE: 1:500      DRAWING NUMBER: 19M-01812-G0-000-00-CSTAB001-Sh2      REV. 0

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Survey Data for Drawing Numbers:

19M-01812-G0-000-00-CSTAB001-Sh1

19M-01812-G0-000-00-CSTAB001-Sh2

Point #	Northing	Easting	Elevation	Description
4020	5680171.371	575849.754	1440.353	TELUSNSHDRBVP
4021	5680173.749	575838.2608	1440.274	TELUSEAPPRCASTLE
4022	5680176.645	575819.966	1440.187	TELUSWAPPRCASTLE
4023	5680178.678	575806.6039	1440.049	TELUSNSHDRBVP
4024	5680184.913	575773.1597	1439.820	TELUSNSHDRBVP
4025	5680190.709	575744.6966	1439.702	TELUSNSHDRBVP
4026	5680197.57	575708.4778	1439.540	TELUSNSHDRBVP
4027	5680201.804	575686.7858	1439.448	TELUSNSHDRBVP
4028	5680206.927	575660.3442	1439.289	TELUSNSHDRBVP
4029	5680212.308	575634.0044	1439.053	TELUSNSHDRBVP
4030	5680217.884	575613.6132	1438.844	TELUSEAPPRROCKBOUND
4031	5680224.219	575592.0021	1438.621	TELUSWAPPRROCKBOUND
4032	5680228.684	575579.0958	1438.512	TELUSNSHDRBVP
4033	5680267.731	575650.4816	1441.705	FORTISPP+TRANSFORMER
4034	5680271.986	575651.6549	1441.924	FORTISPOLEANCH
4035	5680183.564	575624.95	1437.892	FORTISPP
4036	5680192.213	575636.7829	1437.852	TOPW0.9DIAMCULV
4037	5680191.442	575638.4611	1437.802	TOPE0.9DIAMCULV
4038	5680197.542	575639.6541	1439.409	WCULVSSHDRBVP
4039	5680196.873	575641.5891	1439.386	ECULVSSHDRBVP
4040	5680208.81	575649.9917	1439.159	WCULVNSHLDRBVP
4041	5680208.185	575651.4633	1439.223	ECULVNSHLDRBVP
4042	5680212.651	575653.3578	1438.538	TOPW0.9DIAMCULV
4043	5680211.468	575654.4337	1440.436	TOPE0.9DIAMCULV
4068	5680239.534	575879.0663	1443.085	ELELPOLE
4069	5680258.963	575900.362	1444.664	ELELPOLE
4070	5680226.753	575875.7119	1443.069	REGKIOSKCONCPAD
4071	5680227.234	575878.6941	1443.065	REGKIOSKCONCPAD
4072	5680225.163	575879.0085	1443.057	REGKIOSKCONCPAD
4073	5680260.736	575849.4721	1443.747	ELECPOLE
4074	5680212.078	575857.8826	1441.893	GRNDP19-01MW
4075	5680212.191	575857.9065	1442.878	TOPPVCPPIPEP19-01MW
4076	5680213.498	575857.614	1441.968	GRNDP19-04MW
4077	5680213.549	575857.6391	1442.941	TOPPVCPPIPEP19-04MW
4078	5680200.714	575901.667	1442.082	GRNDP19-02MW
4079	5680200.751	575901.7159	1443.101	TOPPVCPPIPEP19-02MW
4080	5680174.037	575887.7117	1440.868	GRNDP19-03MW
4081	5680174.014	575887.6923	1441.640	TOPPVCPPIPEP19-03MW
4082	5680189.992	575883.522	1441.475	GROUNDP18-04MW
4083	5680190.029	575883.5359	1442.292	TOPPVCPPIPEP18-04MW
4084	5680205.789	575955.5295	1441.718	WATERSTANDPIPE1
4085	5680205.737	575953.9994	1441.813	WATERWOODBOX1



Survey Data for Drawing Numbers:

19M-01812-G0-000-00-CSTAB001-Sh1

19M-01812-G0-000-00-CSTAB001-Sh2

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4086	5680206.447	575954.2882	1441.823	WATERWOODBOX1
4087	5680206.166	575954.9876	1441.814	WATERWOODBOX1
4088	5680205.455	575954.6931	1441.799	WATERWOODBOX1
4089	5680192.092	575999.804	1440.811	WATERSTANDPIPE2
4090	5680191.683	575998.0433	1440.734	WATERWOODBOX2
4091	5680192.402	575998.3123	1440.747	WATERWOODBOX2
4092	5680192.136	575999.0109	1440.745	WATERWOODBOX2
4093	5680191.419	575998.7505	1440.743	WATERWOODBOX2
4095	5680165.69	576029.5781	1439.177	WATERSTANDPIPE3
4096	5680166.4	576028.8835	1439.251	WATERWOODBOX3
4097	5680166.87	576029.4306	1439.279	WATERWOODBOX3
4098	5680166.331	576029.8836	1439.275	WATERWOODBOX3
4099	5680165.86	576029.334	1439.248	WATERWOODBOX3
4101	5680139.081	576084.7373	1436.971	TOPNEND900mmCULVERT
4102	5680137.068	576086.195	1437.639	NSHLDRABOVE900mmCULVERT
4103	5680133.685	576090.1226	1437.512	SSHLDRABOVE900mmCULVERT
4104	5680131.942	576091.5145	1436.827	TOPSEND900mmCULVERT
4105	5680176.203	576085.0951	1438.815	WATERSTANDPIPE4
4106	5680177.315	576083.7342	1438.924	WATERWOODBOX4
4107	5680177.743	576084.3192	1438.935	WATERWOODBOX4
4108	5680177.194	576084.7321	1438.899	WATERWOODBOX4
4109	5680176.75	576084.144	1438.878	WATERWOODBOX4
4111	5680242.251	576021.9828	1441.466	TOPNEND750mmCULVERT
4112	5680239.268	576021.6727	1441.849	NSHLDROVER750mmCULVERT
4113	5680234.529	576020.1859	1441.837	SSHLDROVER750mmCULVERT
4114	5680231.286	576020.0056	1441.256	TOPSEND750mmCULVERT
4115	5680233.752	576011.7457	1442.047	WATERSTANDPIPE5
4117	5680233.268	576022.7972	1441.717	WATERMANHOLE
4118	5680241.582	576030.5554	1442.201	WATERMANHOLE
4119	5680253.261	576034.2334	1442.702	WASHROOMBLDGCOR
4120	5680244.065	576034.9041	1442.554	WASHROOMBLDGCOR
4121	5680244.298	576038.0563	1442.546	WASHROOMBLDGCOR
4122	5680253.491	576037.4091	1442.672	WASHROOMBLDGCOR
4123	5680256.408	576037.113	1442.660	BLDGCOR
4124	5680256.693	576040.0435	1442.625	BLDGCOR
4125	5680260.339	576039.7188	1442.621	BLDGCOR
4126	5680242.512	576038.5078	1442.343	VALVECOVER
4127	5680250.951	576042.2038	1442.752	SEPTICTANKWOODHATCH
4128	5680251.811	576041.7635	1442.749	SEPTICTANKWOODHATCH
4129	5680252.268	576042.6277	1442.745	SEPTICTANKWOODHATCH
4130	5680251.41	576043.0728	1442.752	SEPTICTANKWOODHATCH
4131	5680254.995	576038.8417	1442.714	ELECPOLE



Survey Data for Drawing Numbers:

19M-01812-G0-000-00-CSTAB001-Sh1

19M-01812-G0-000-00-CSTAB001-Sh2

Point #	Northing	Easting	Elevation	Description
4132	5680255.116	576043.8083	1442.443	POLEANCHOR
4133	5680263.502	576043.3709	1442.696	GRNDP18-01MW
4134	5680263.467	576043.3668	1443.619	TOPPVCPIPEP18-01MW
4135	5680296.974	575964.1749	1446.589	PLCPNAIL
4136	5680248.765	576032.0023	1442.506	WATERWOODBOX
4137	5680248.772	576032.7333	1442.513	WATERWOODBOX
4138	5680249.536	576032.705	1442.533	WATERWOODBOX
4139	5680256.3	576032.3858	1442.788	WATERWOODMANHOLE
4140	5680273.395	575990.1432	1443.876	5MGRIDSWSHLDR
4141	5680270.714	575986.5575	1443.919	5MGRID
4142	5680265.726	575979.131	1444.955	5MGRID
4143	5680261.842	575974.2934	1444.596	5MGRID
4144	5680265.722	575971.814	1444.808	5MGRID
4145	5680268.887	575975.2453	1444.973	5MGRID
4146	5680276.831	575987.2327	1444.105	5MGRIDSWSHLDR
4147	5680282.5	575982.0201	1444.610	5MGRIDSWSHLDR
4148	5680280.74	575979.3557	1444.714	5MGRIDTOE
4149	5680279.522	575976.9213	1445.330	5MGRID
4150	5680276.04	575973.3052	1445.544	5MGRID
4151	5680273.126	575970.4584	1445.223	5MGRID
4152	5680270.926	575967.9988	1445.238	5MGRID
4153	5680275.098	575965.2596	1445.532	5MGRID
4154	5680279.388	575968.3776	1445.610	5MGRID
4155	5680283.239	575971.6528	1445.747	5MGRID
4156	5680287.069	575975.5246	1445.251	5MGRIDSWSHLDR
4157	5680289.171	575973.1319	1445.474	5MGRIDSWSHLDR
4158	5680285.318	575969.6854	1445.789	5MGRID
4159	5680282.016	575966.1853	1445.869	5MGRID
4161	5680278.596	575962.1459	1446.302	KITCHENSHELTERCOR
4162	5680286.728	575955.3508	1446.355	KITCHENSHELTERCOR
4163	5680283.703	575951.6864	1446.246	KITCHENSHELTERCOR
4164	5680287.755	575952.2568	1446.430	SHEDCOR
4165	5680290.843	575951.686	1446.492	SHEDCOR
4166	5680290.422	575949.187	1446.420	SHEDCOR
4167	5680256.317	575994.1226	1443.275	ELECPOLE
4168	5680269.469	575979.6003	1445.079	GRNDMW
4169	5680269.481	575979.6159	1446.020	TOPLIDMW
4170	5680262.88	575960.6364	1445.085	WATERSTANDPIPE
4171	5680257.61	575951.591	1444.832	ELECPOLE
4172	5680249.274	575959.5697	1444.013	5M
4173	5680255.896	575954.8671	1444.424	5M
4174	5680260.86	575950.5148	1444.843	5M



Survey Data for Drawing Numbers:  
19M-01812-G0-000-00-CSTAB001-Sh1  
19M-01812-G0-000-00-CSTAB001-Sh2

<b>Point #</b>	<b>Northing</b>	<b>Easting</b>	<b>Elevation</b>	<b>Description</b>
4175	5680266.263	575946.9165	1445.171	5M
4176	5680269.8	575952.8306	1445.522	5M
4177	5680264.512	575956.2847	1445.167	5M
4178	5680257.941	575958.3473	1444.722	5M
4179	5680251.313	575962.9456	1444.330	5M
4180	5680255.779	575967.0322	1444.402	5M



## BOREHOLE LOGS

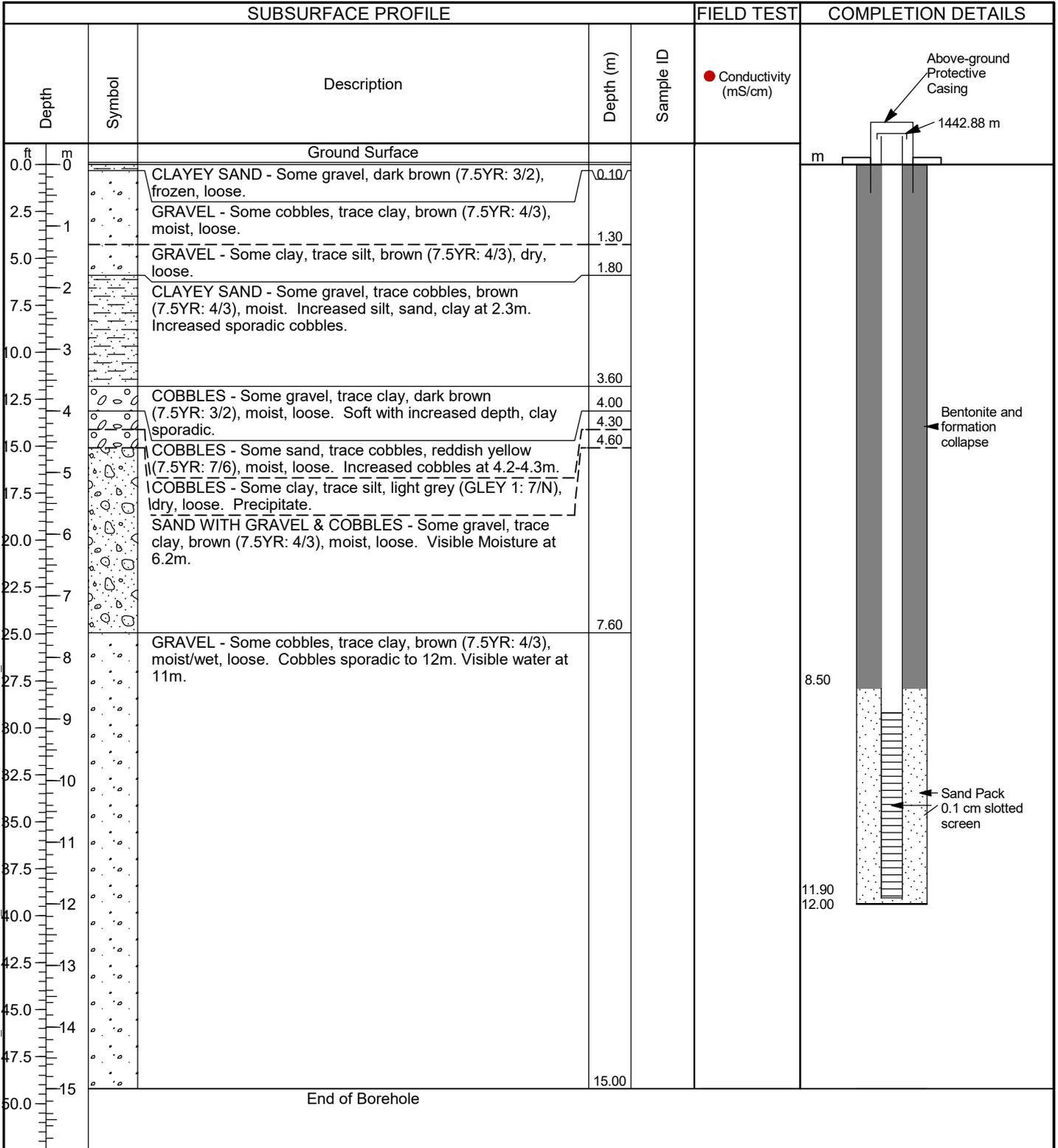


**Client:** Parks Canada  
**Project:** Castle Mountain Campground  
**Location:** NE-32-026-14 W5M

**Well ID:** P19-01  
**Borehole:** 19BH01

Drill Date: 2019 December 9      Drilled by: ERNCO Environmental      Datum: NAD83UTM (Zone 11) Total Depth: 15.00 m  
 Drill Method: Direct Push      Logged by: PL      Accuracy +/-:      Ground Elevation: 1440.868 m  
 Boring Diameter: 10.16 cm (4")      Compiled by: Steven Minckler      Northing: 5680212      Casing Elevation: 1442.878 m  
 Well Diameter: 5.08 cm (2")      Soil Classification System: USCS      Easting: 575857.9      Surface Completion: Above-ground

T:\ENV\RO\CLIENTS\PROJECTS\_2014\W\LOCATION\_PROJECTS\PARKS CANADA\19M-01812-00 CASTLE MTN BOREHOLE LOGS\CASTLE MOUNTAIN DUJ.GPJ 20-2-27



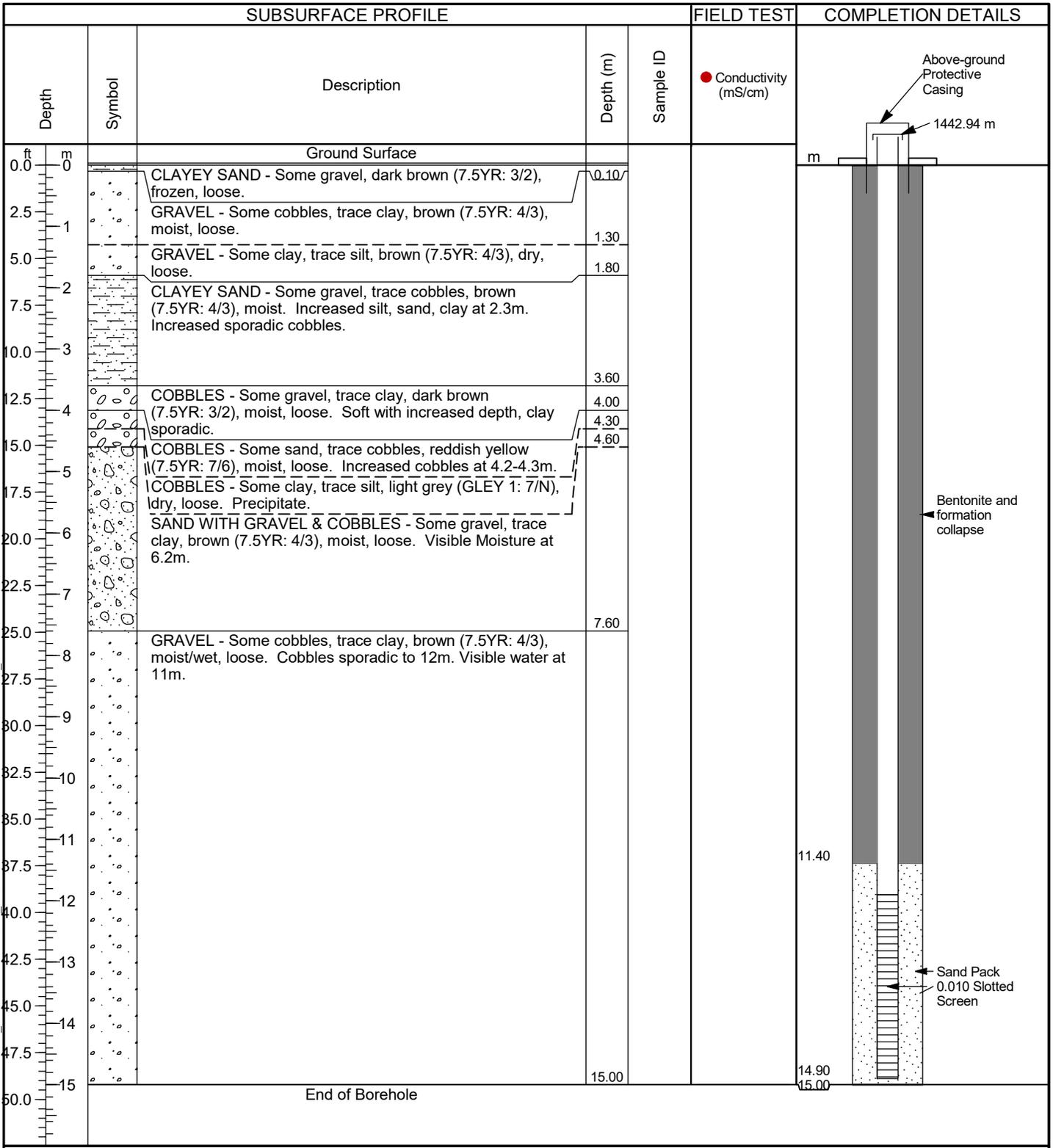


**Client:** Parks Canada  
**Project:** Castle Mountain Campground  
**Location:** NE-32-026-14 W5M

**Well ID:** P19-01D  
**Borehole:** 19BH01D

Drill Date: 2019 December 9      Drilled by: ERNCO Environmental      Datum: NAD83UTM (Zone 11) Total Depth: 15.00 m  
 Drill Method: Direct Push      Logged by: PL      Accuracy +/-:      Ground Elevation: 1440.868 m  
 Boring Diameter: 10.16 cm (4")      Compiled by: Steven Minckler      Northing: 5680213      Casing Elevation: 1442.941 m  
 Well Diameter: 5.08 cm (2")      Soil Classification System: USCS      Easting: 575857.6      Surface Completion: Above-ground

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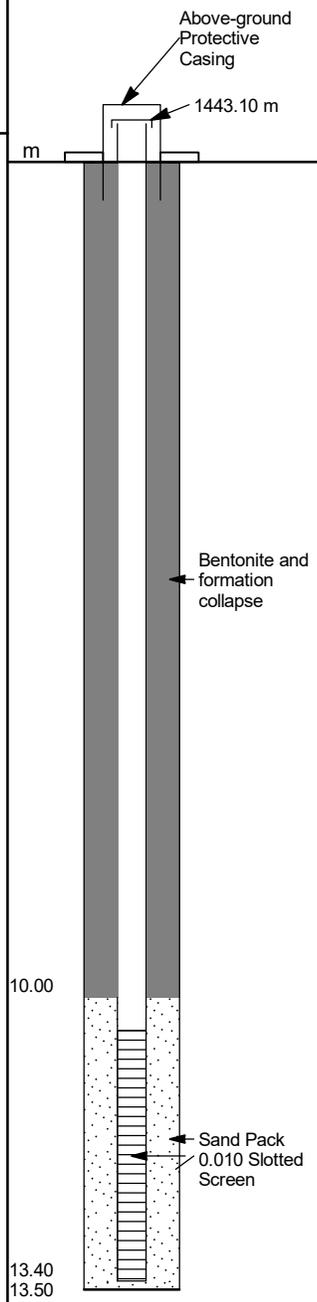
**Client:** Parks Canada  
**Project:** Castle Mountain Campground  
**Location:** NE-32-026-14 W5M

**Well ID:** P19-02  
**Borehole:** 19BH02

Drill Date: 2019 December 9      Drilled by: ERNCO Environmental      Datum: NAD83UTM (Zone 11) Total Depth: 14.50 m  
 Drill Method: Direct Push      Logged by: PL      Accuracy +/-:      Ground Elevation: 1441.475 m  
 Boring Diameter: 10.16 cm (4")      Compiled by: Steven Minckler      Northing: 5680201      Casing Elevation: 1443.101 m  
 Well Diameter: 5.08 cm (2")      Soil Classification System: USCS      Easting: 575901.7      Surface Completion: Above-ground

T:\ENV\ROCLIENTS\PROJECTS\_2014\W\LOCATION\_PROJECTS\PARKS CANADA\19M-01812-00 CASTLE MTN BOREHOLE LOGS\CASTLE MOUNTAIN DUJ.GPJ 20-2-27

SUBSURFACE PROFILE					FIELD TEST	COMPLETION DETAILS
Depth	Symbol	Description	Depth (m)	Sample ID	Conductivity (mS/cm)	
0.0		Ground Surface	0.06/0.50			
0.0 - 0.5		CLAYEY SAND - Some gravel, dark brown (7.5YR: 3/2), frozen, frozen.	0.06/0.50			
0.5 - 2.8		GRAVEL - Some silt, trace clay, brown (7.5YR: 4/3), moist, loose.	2.80			
2.8 - 3.1		GRAVEL - Some cobbles, trace clay, light brown (7.5YR: 6/3), dry, loose.	3.10			
3.1 - 3.4		GRAVEL AND COBBLES - Some sand, trace clay, brown (7.5YR: 4/3), dry, loose.	3.40			
3.4 - 3.5		CLAYEY SAND - Some silt, trace gravel, dark brown (7.5YR: 3/2), moist, soft.	3.50			
3.5 - 4.4		SANDY CLAY - Some silt, brown (7.5YR: 4/3), wet, soft.	4.40			
4.4 - 6.6		SANDY CLAY - Some silt, trace gravel, reddish yellow (7.5YR: 6/6), wet, soft.	6.60			
6.6 - 7.8		COBBLES - Some gravel, trace clay, light grey (GLEYS 1: 7/N), dry, soft.	7.80			
7.8 - 11.5		GRAVEL - Some cobbles, trace clay, dark brown (7.5YR: 3/2), wet, firm.	11.50			
11.5 - 13.4		COBBLES - Some sand, trace clay, brown (7.5YR: 4/3), moist, hard. Visible water at 10.0-10.2 still moist below.	13.40			
13.4 - 14.5		SANDY SILT - Some gravel, brown (7.5YR: 4/3), wet, very hard. Visible moisture. Some increased gravel and cobble at 13.0m.	14.50			
14.5 - 15.0		End of Borehole				



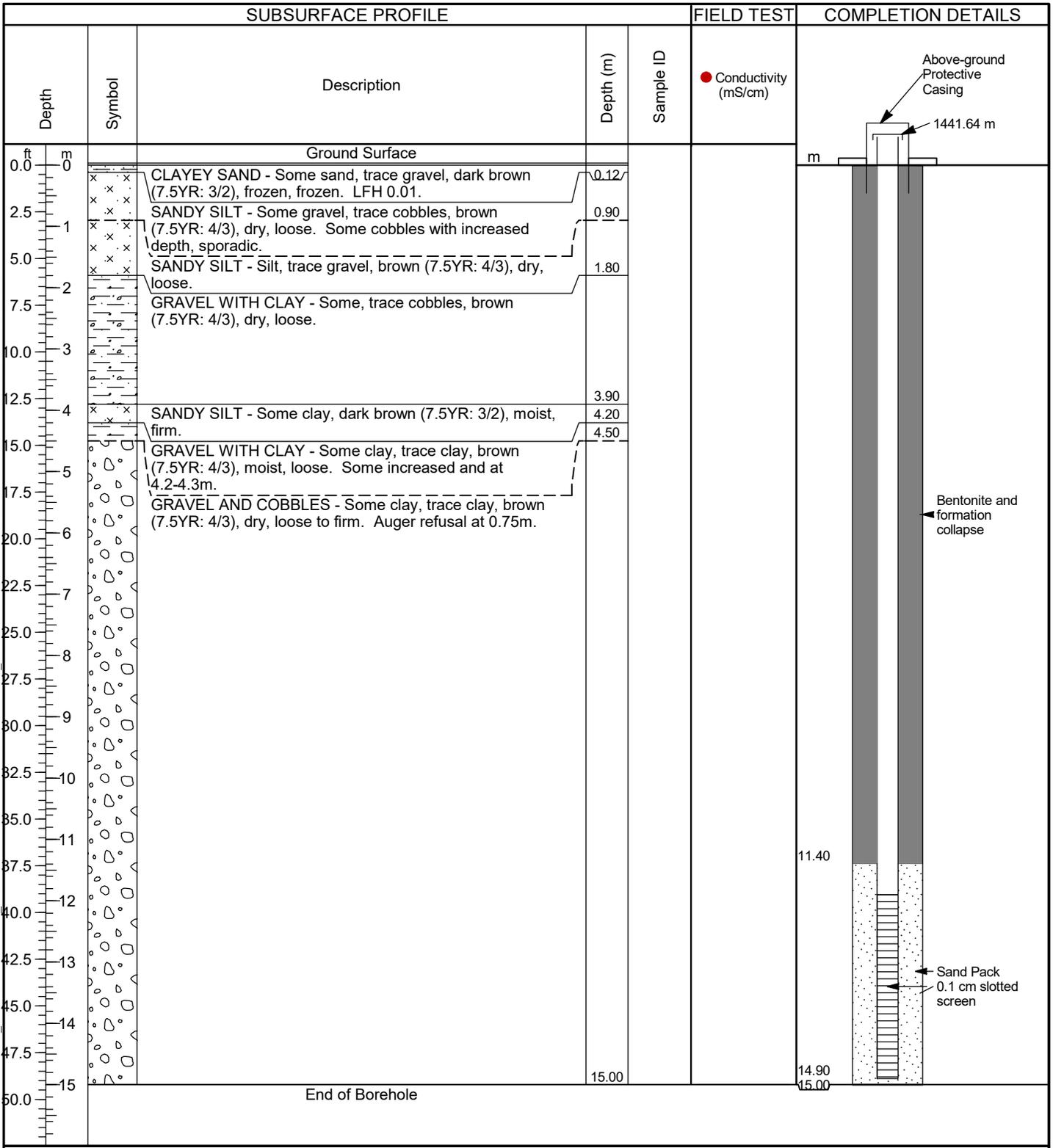


**Client:** Parks Canada  
**Project:** Castle Mountain Campground  
**Location:** NE-32-026-14 W5M

**Well ID:** P19-03  
**Borehole:** 19BH03

Drill Date: 2019 December 11      Drilled by: ERNCO Environmental      Datum: NAD83UTM (Zone 11) Total Depth: 15.00 m  
 Drill Method: Direct Push      Logged by: PL      Accuracy +/-:      Ground Elevation: 1442.082 m  
 Boring Diameter: 10.16 cm (4")      Compiled by: Steven Minckler      Northing: 5680174      Casing Elevation: 1441.640 m  
 Well Diameter: 5.08 cm (2")      Soil Classification System: USCS      Easting: 575887.7      Surface Completion: Above-ground

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## GEO TECHNICAL LAB DATA



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

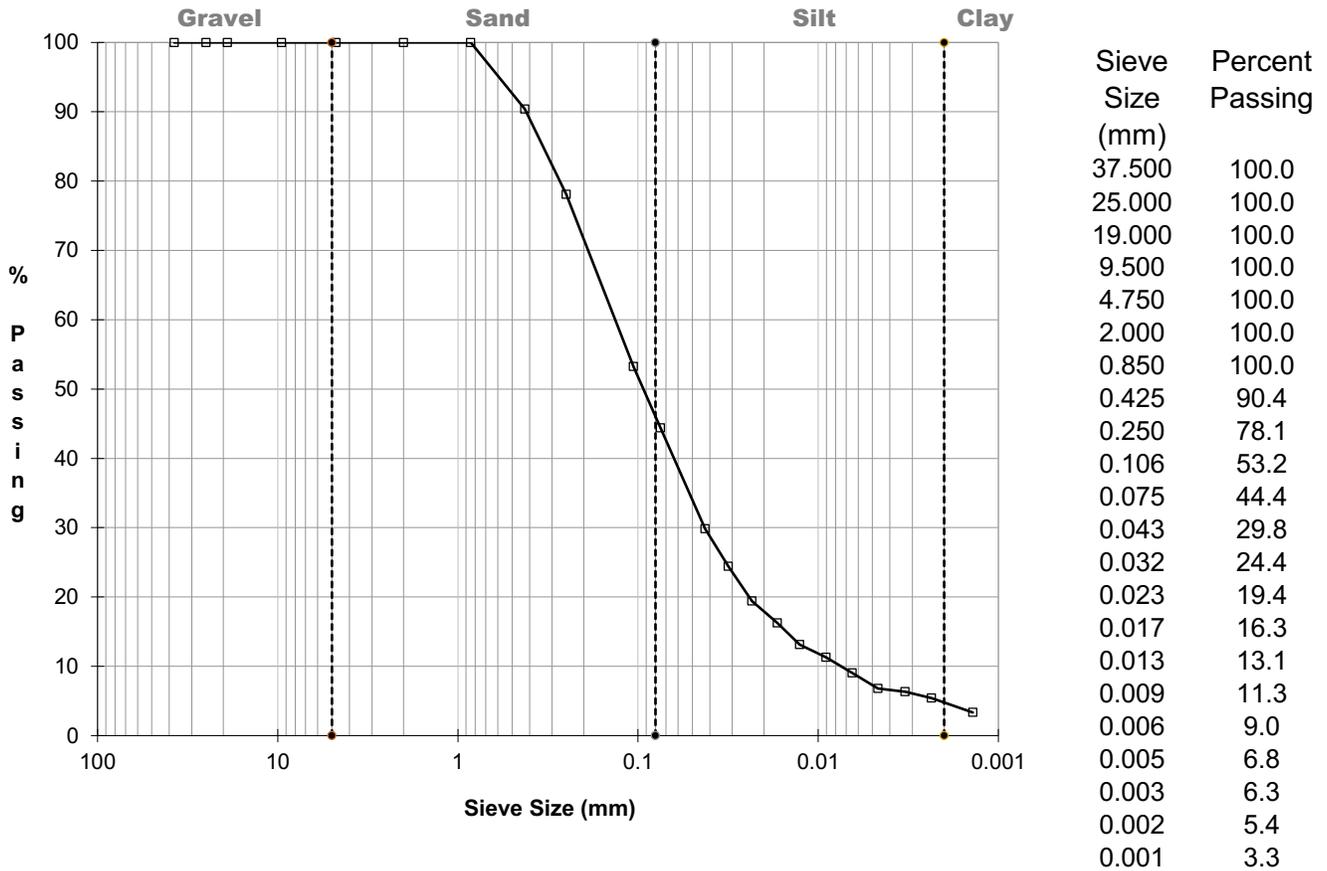
# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-01  
 Sample Depth: 1 m  
 Source: Castle Mountain  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 2, 2020 Date Received: December 18, 2019



Gravel = 0.0 %  
 Sand = 55.6 %  
 Silt = 39.0 %  
 Clay = 5.4 %

Sample Description: Silty SAND trace of clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

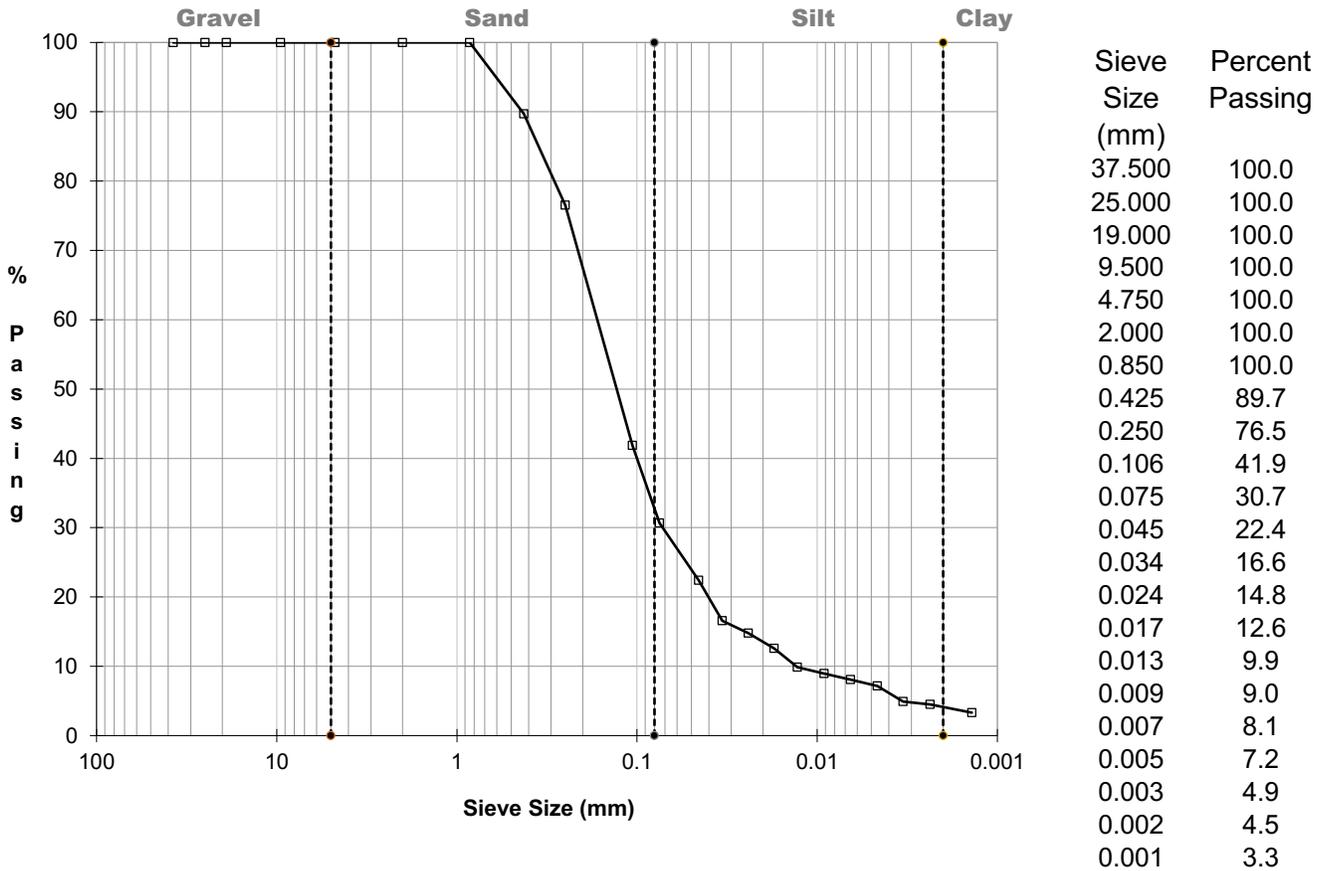
# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-01  
 Sample Depth: 2 m  
 Source: Castle Mountain  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 2, 2020 Date Received: December 18, 2019



Gravel = 0.0 %  
 Sand = 69.3 %  
 Silt = 26.2 %  
 Clay = 4.5 %

Sample Description: Silty SAND trace of clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

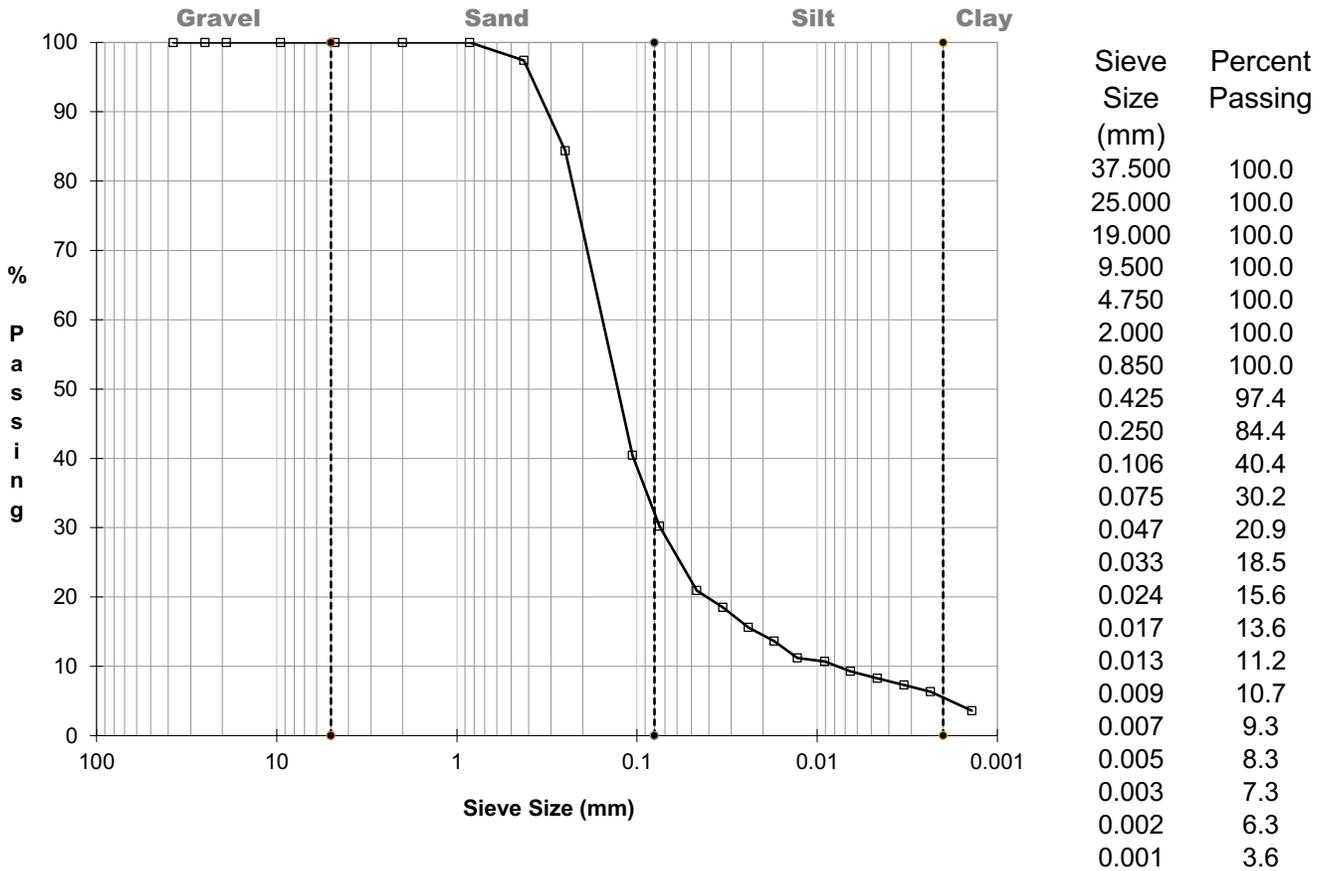
# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-01  
 Sample Depth: 3 m  
 Source: Castle Mountain  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 2, 2020 Date Received: December 18, 2019



Gravel = 0.0 %  
 Sand = 69.8 %  
 Silt = 23.9 %  
 Clay = 6.3 %

Sample Description: Silty SAND trace of clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

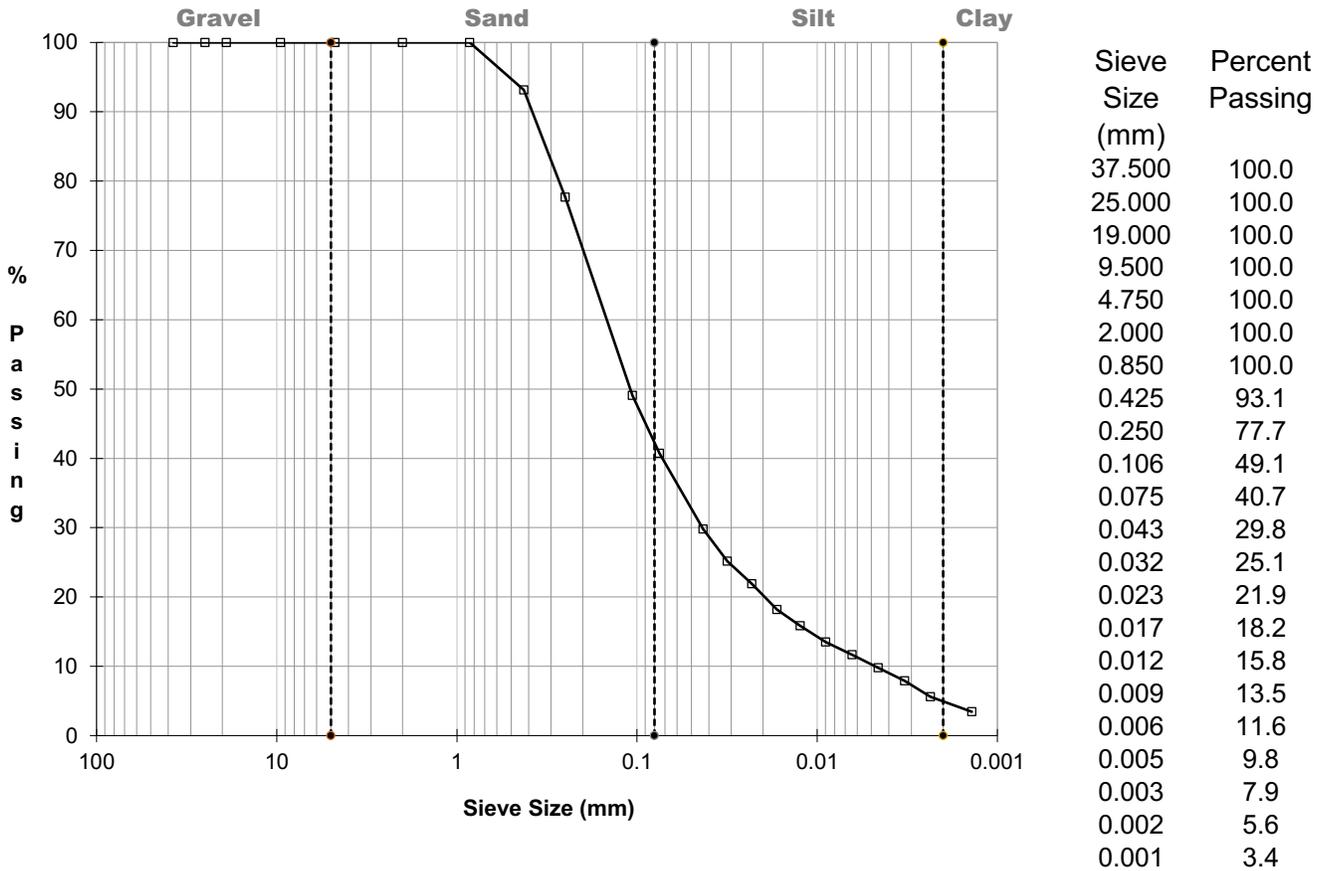
# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-02  
 Sample Depth: 1 m  
 Source: Castle Mountain  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 2, 2020 Date Received: December 18, 2019



Gravel = 0.0 %  
 Sand = 59.3 %  
 Silt = 35.1 %  
 Clay = 5.6 %

Sample Description: Silty SAND trace of clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada

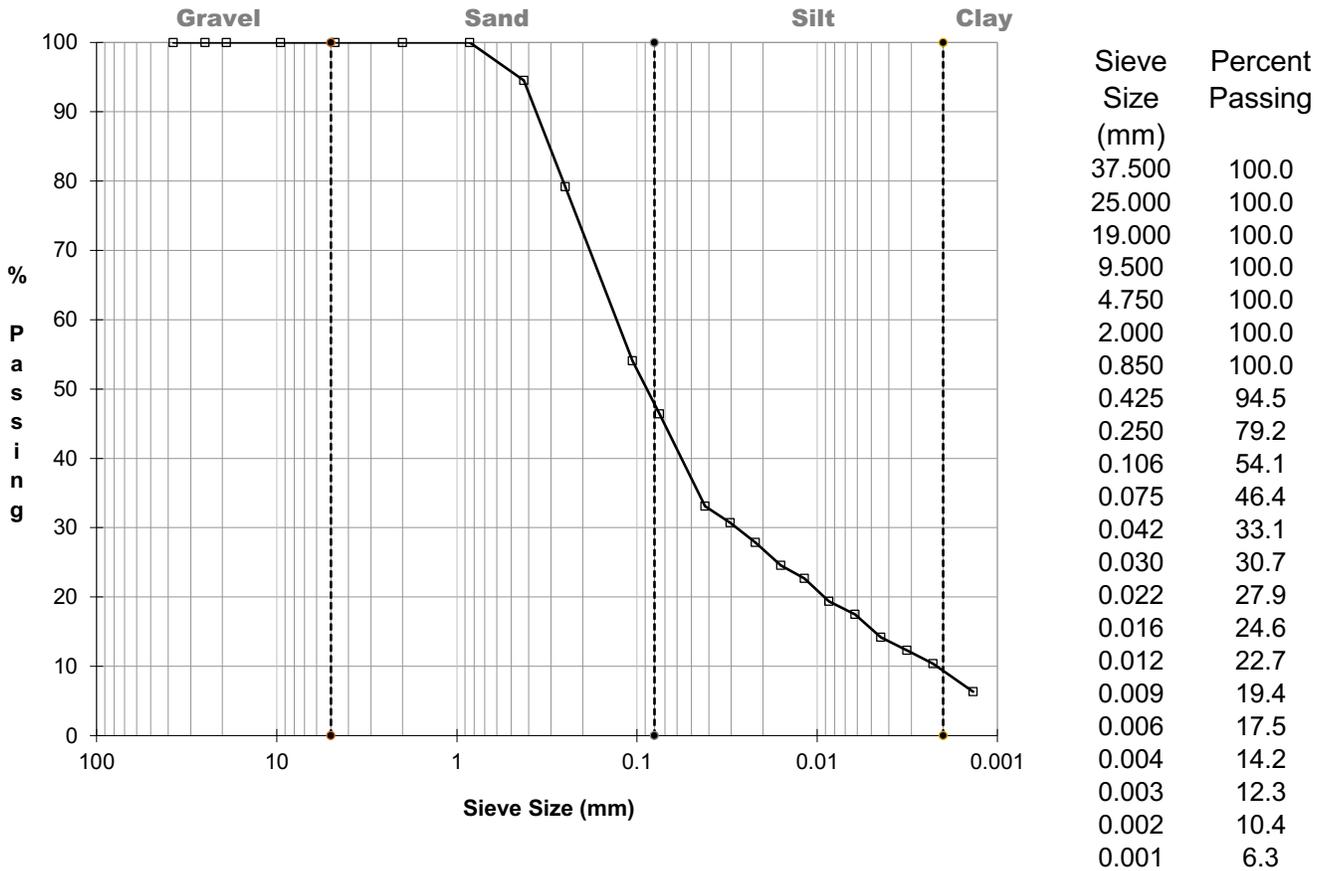
Borehole No.: BH19-02  
 Sample Depth: 2 m  
 Source: Castle Mountain  
 Sampled By: N/A  
 Tested By: PC

Project: Castle Mountain Campground Geotech

n/a

Date Tested: January 2, 2020

Date Received: December 18, 2019



Gravel = 0.0 %  
 Sand = 53.6 %  
 Silt = 36.0 %  
 Clay = 10.4 %

Sample Description: Silty SAND some clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

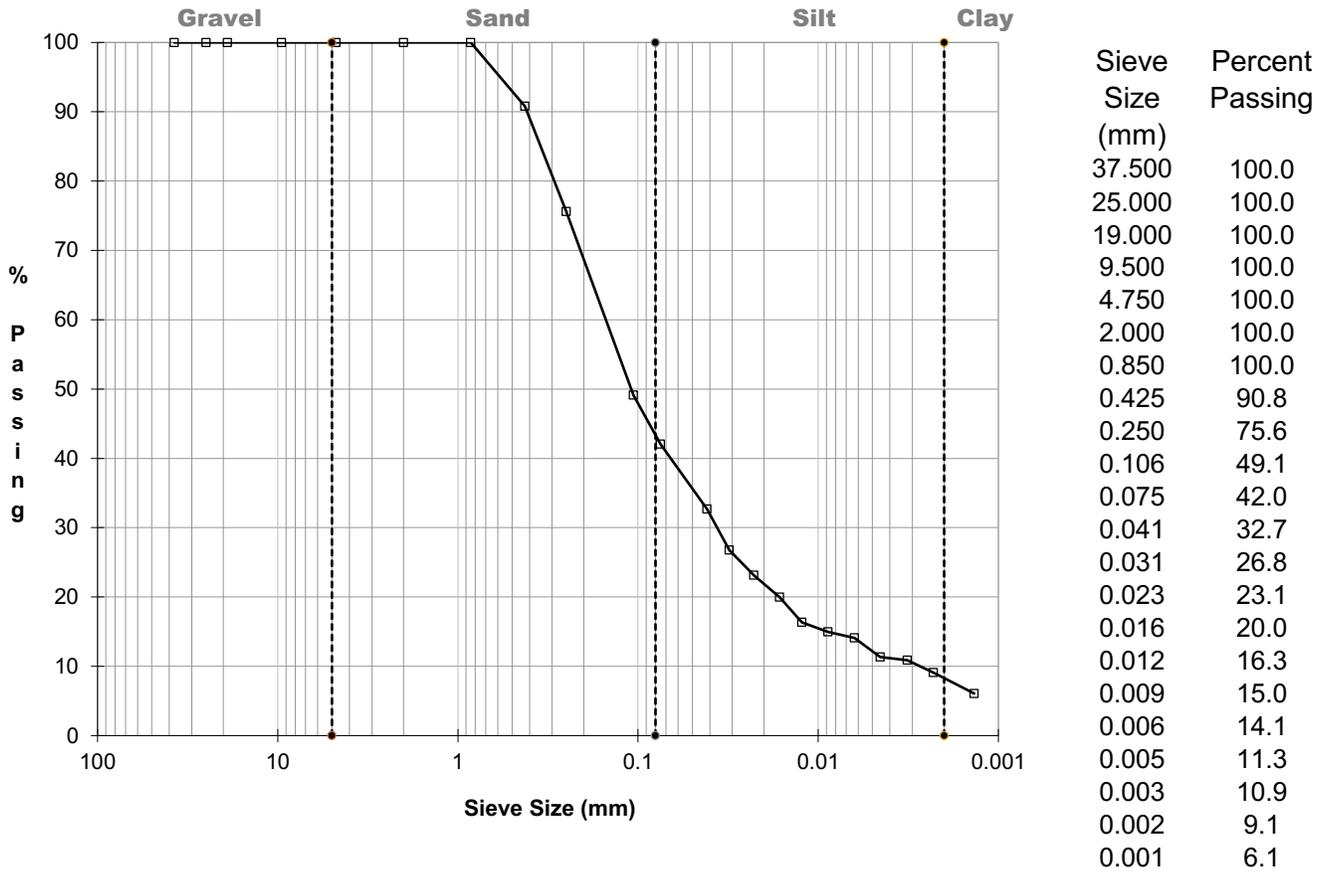
# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-02  
 Sample Depth: 3 m  
 Source: Castle Mountain  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 2, 2020 Date Received: December 18, 2019



Sand = 0.0 %  
 Sand = 58.0 %  
 Silt = 32.9 %  
 Clay = 9.1 %

Sample Description: Silty SAND trace of clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

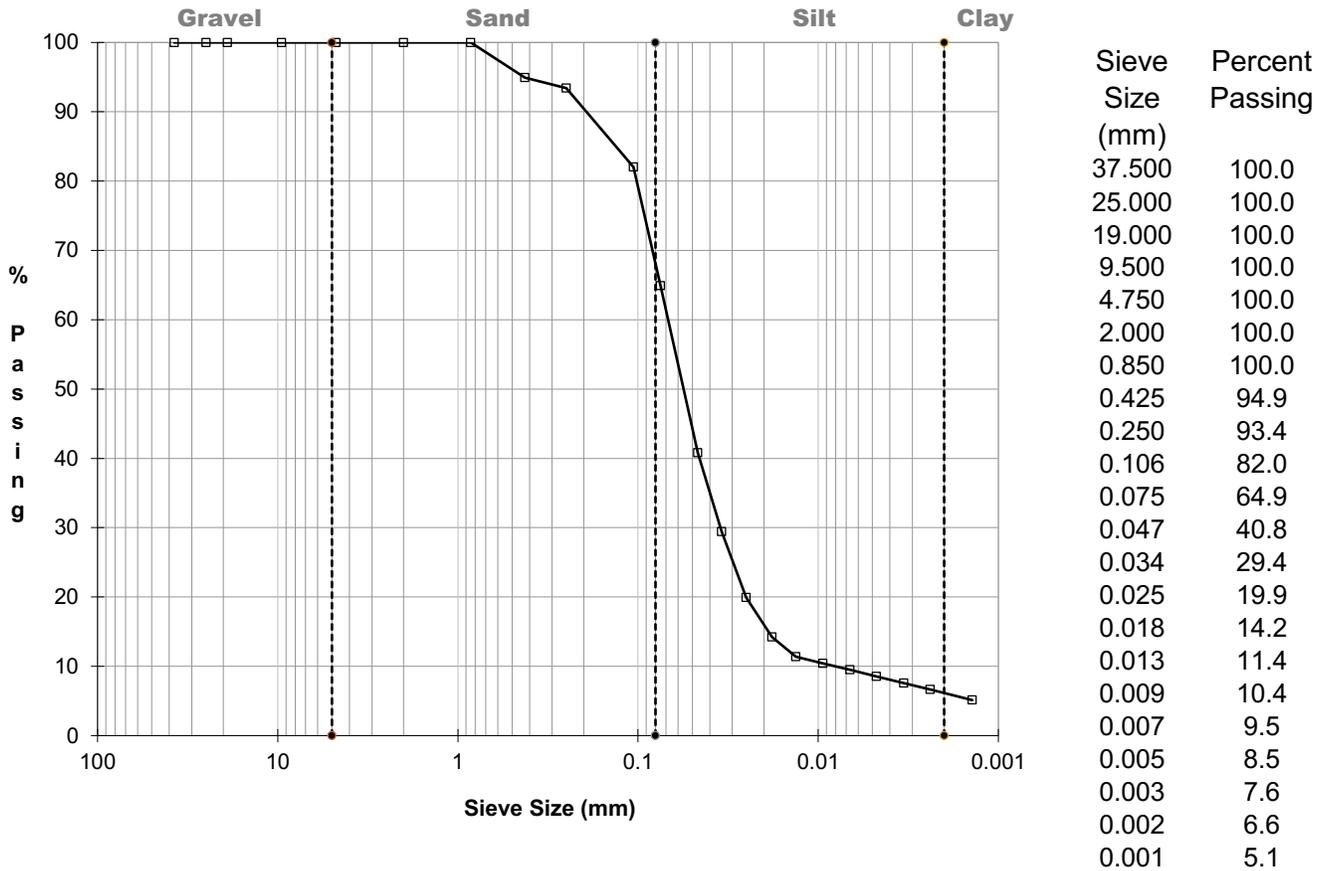
# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-03  
 Sample Depth: 1 m  
 Source: Castle Mountain  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 2, 2020 Date Received: December 18, 2019



Sand = 0.0 %  
 Sand = 35.1 %  
 Silt = 58.3 %  
 Clay = 6.6 %

Sample Description: Sandy SILT trace of clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

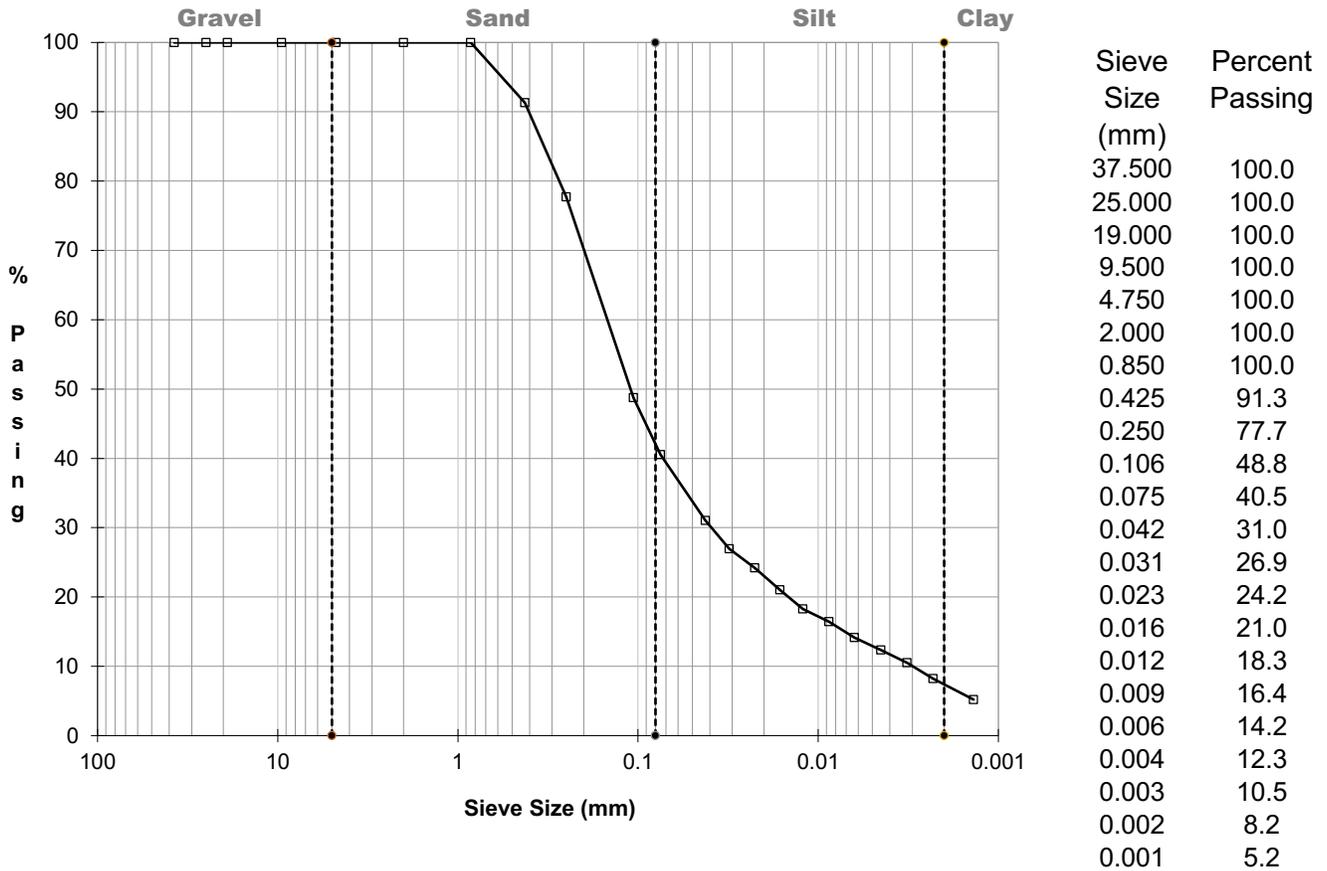
# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-03  
 Sample Depth: 2 m  
 Source: Castle Mountain  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 2, 2020 Date Received: December 18, 2019



Sand = 0.0 %  
 Sand = 59.5 %  
 Silt = 32.3 %  
 Clay = 8.2 %

Sample Description: Silty SAND trace of clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

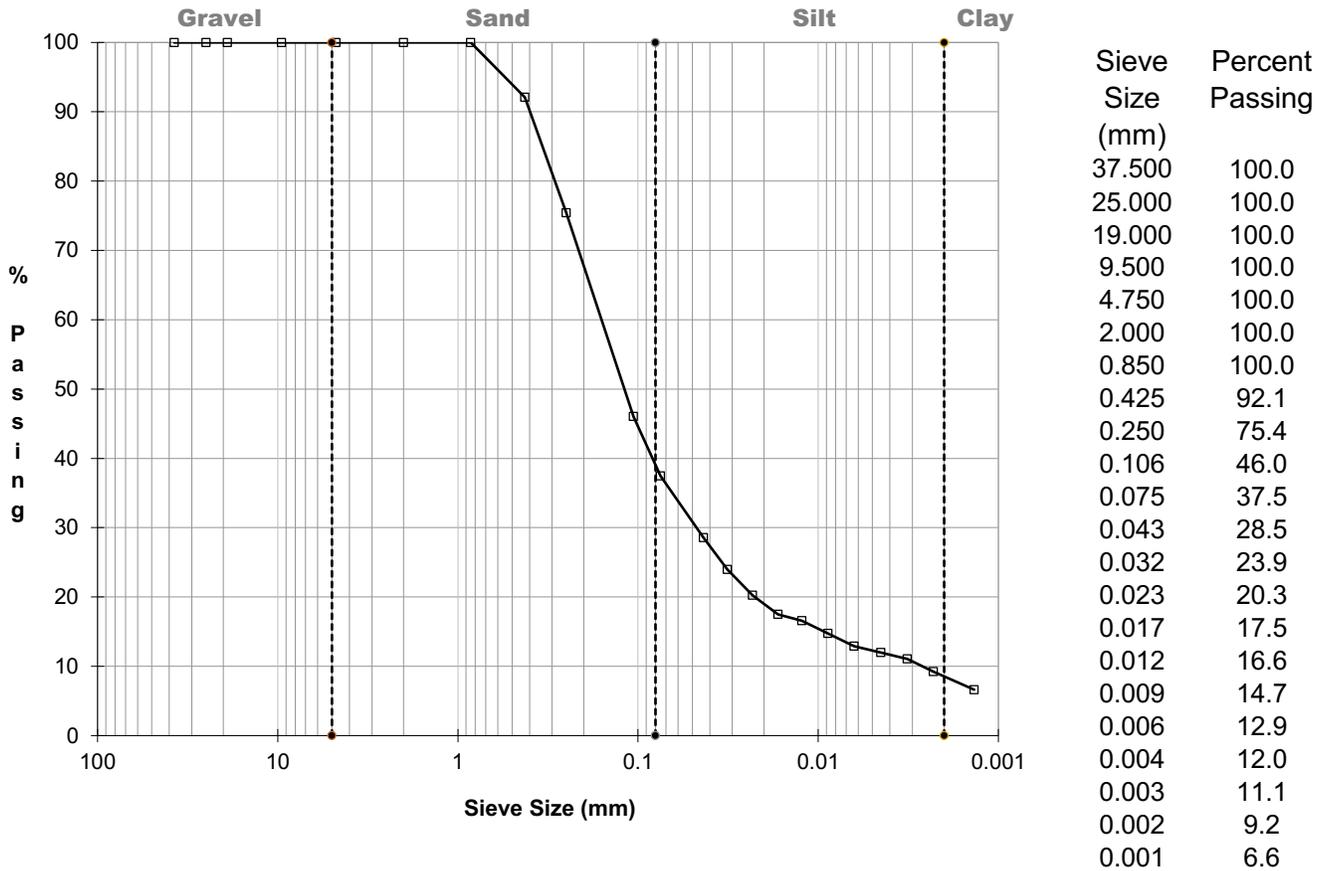
# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-03  
 Sample Depth: 3 m  
 Source: Castle Mountain  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 2, 2020 Date Received: December 18, 2019



Sand = 0.0 %  
 Sand = 62.5 %  
 Silt = 28.3 %  
 Clay = 9.2 %

Sample Description: Silty SAND trace of clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



# Attachment B

JOHNSTON CANYON CAMPGROUND



## SURVEY DATA



BOREHOLE AS-BUILT(M)						
POINT #	DESC.	DATE OF AS-BUILT	NORTHING	EASTING	TOP ELEVATION	GROUND ELEVATION
4058	GROUND19BH01	18-Dec-19	5677411.166	580593.323	-	1421.007
4059	TOPPVC19BH01	18-Dec-19	5677411.149	580593.313	1421.730	-
4060	GROUND19BH02	18-Dec-19	5677351.045	580628.965	-	1421.228
4061	TOPPVC19BH02	18-Dec-19	5677351.003	580629.030	1421.966	-
4062	GROUND19BH-03	18-Dec-19	5677330.657	580595.431	-	1420.763
4063	TOPPVC19BH03	18-Dec-19	5677330.315	580595.386	1421.233	-



LEGEND:

× SURVEYED POINT

NOTES:

1. ALL ELEVATIONS AND DIMENSIONS ARE IN METERS AND DECIMALS THEREOF UNLESS SHOWN OTHERWISE.
2. DISTANCES SHOWN ARE BASED UPON NAD83 UTM GRID.
3. NORTH IS SHOWN RELATIVE TO NAD83 UTM SURVEY CONTROL.
4. BEARINGS AND COORDINATES ARE BASED ON THE NAD83 DATUM AND WERE DERIVED FROM GNSS OBSERVATIONS HOLDING PUBLISHED COORDINATE VALUES FOR A.S.C.M 320218.
5. ELEVATIONS ARE GEODETIC AND DERIVED FROM A.S.C.M 320218 (ELEVATION 1400.507)

THE INFORMATION CONTAINED ON THIS DRAWING, AND ANY DOCUMENTATION PERTAINING TO THIS DRAWING IS CURRENT AS OF December 20, 2019, AND AS PER REVISION SHOWN BELOW. ANY FACILITIES UNDER OR ABOVE GROUND INSTALLED AFTER THE AFORE MENTIONED DATE MAY NOT HAVE BEEN CONSIDERED IN THE PREPARATION OF THIS DOCUMENT, OR ITS SUPPORT DOCUMENTS.

REVISION TABLE

NO.	DATE (mm-dd-yy)	DESCRIPTION	BY	CHK
00	01-10-20	ORIGINAL ISSUE	PK	KS

DRAWING TITLE:  
 BANFF GEOTECHNICAL TOPO SURVEY  
 BOREHOLE AS-BUILT  
 JOHNSON CANYON CAMPGROUND

CLIENT:



SCALE: 1:1000	DRAWING NUMBER: 19M-01812-G0-000-00-CSTAB002 - Sh1	REV. 0
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237 4th Ave SW, Suite 3200  
 Calgary, Alberta  
 T2P 4K3  
 PH:(403)-266-2800



## BOREHOLE LOGS



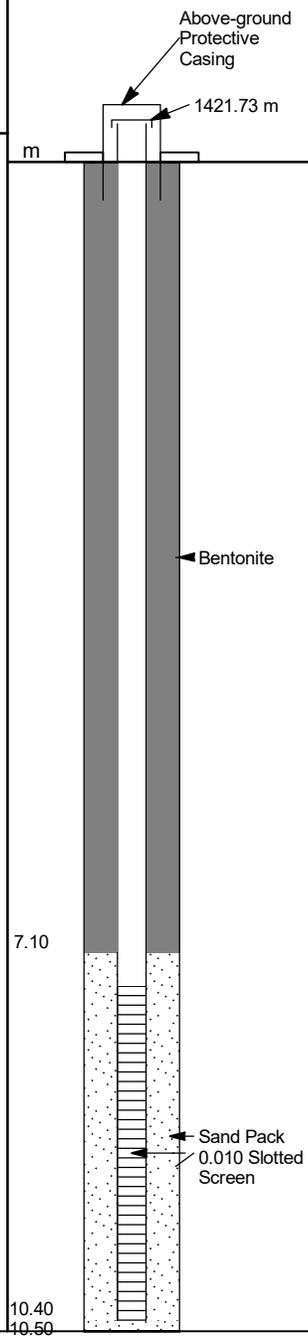
**Client:** Parks Canada  
**Project:** Johnston Canyon Campground  
**Location:** NE-23-026-14 W5M

**Well ID:** P19-01  
**Borehole:** 19BH01

Drill Date: 2019 December 15      Drilled by: ERNCO Environmental      Datum: NAD83UTM (Zone 11) Total Depth: 10.50 m  
 Drill Method: ODEX      Logged by: AB      Accuracy +/-:      Ground Elevation: 1421.007 m  
 Boring Diameter: 15.24 cm (6")      Compiled by: Steven Minckler      Northing: 5677411.166      Casing Elevation: 1421.730 m  
 Well Diameter: 5.08 cm (2")      Soil Classification System: USCS      Easting: 580593.323      Surface Completion: Above-ground

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SUBSURFACE PROFILE					FIELD TEST	COMPLETION DETAILS
Depth	Symbol	Description	Depth (m)	Sample ID	Conductivity (mS/cm)	
0.0		Ground Surface				
0.0 - 1.5	x x x x	SANDY SILT - Some clay, trace gravel, brown (7.5YR: 4/3), dry.	1.50			
1.5 - 3.0	o o o o	GRAVEL AND COBBLES - Some sand, trace silt, brown (7.5YR: 4/3), dry. Increased cobble at 1.8-2.5m then moves to sand, silt.	3.00			
3.0 - 4.5	x x x x	SANDY SILT - Some gravel, brown (7.5YR: 4/3), dry.	4.50			
4.5 - 6.0	x x x x	SANDY SILT - Trace gravel, brown (7.5YR: 4/3), moist. Increased moisture with depth.	6.00			
6.0 - 7.5	x x x x	SANDY SILT - Trace gravel, brown (7.5YR: 4/3), moist.	7.50			
7.5 - 9.0	x x x x	SANDY SILT - Some gravel, brown (7.5YR: 4/3), moist. Increased gravel with depth.	9.00			
9.0 - 10.5	o o o o	GRAVEL WITH CLAY - Some silt, brown (7.5YR: 4/3), moist/wet.	10.50			
10.50		End of Borehole				









# Attachment C

JOHNSTON CANYON DAY USE AREA



## SURVEY DATA



BOREHOLE AS-BUILT(M)						
POINT #	DESC.	DATE OF AS-BUILT	NORTHING	EASTING	TOP ELEVATION	GROUND ELEVATION
4050	GRND19BH-01	18-Dec-19	5677673.296	581031.646	-	1429.259
4051	TOPPVCPIPE	18-Dec-19	5677673.342	581031.654	1430.072	-
4052	GRND19BH-02	18-Dec-19	5677642.454	581063.709	-	1428.653
4053	TOPPVCPIPE19-02	18-Dec-19	5677642.450	581063.670	1429.532	-
4054	GRND19BH-03	18-Dec-19	5677661.992	581089.958	-	1428.711
4055	TOPPVCPIPE19-03	18-Dec-19	5677661.981	581089.961	1429.420	-
4056	BH19- <del>06</del> -05	18-Dec-19	5677789.158	580989.815	-	1431.844
4057	BH19- <del>05</del> -04	18-Dec-19	5677708.547	581020.167	-	1429.997



LEGEND:

× SURVEYED POINT

NOTES:

1. ALL ELEVATIONS AND DIMENSIONS ARE IN METERS AND DECIMALS THEREOF UNLESS SHOWN OTHERWISE.
2. DISTANCES SHOWN ARE BASED UPON NAD83 UTM GRID.
3. NORTH IS SHOWN RELATIVE TO NAD83 UTM SURVEY CONTROL.
4. BEARINGS AND COORDINATES ARE BASED ON THE NAD83 DATUM AND WERE DERIVED FROM GNSS OBSERVATIONS HOLDING PUBLISHED COORDINATE VALUES FOR A.S.C.M 320218.
5. ELEVATIONS ARE GEODETIC AND DERIVED FROM A.S.C.M 320218 (ELEVATION 1400.507)

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REVISION TABLE

NO.	DATE	DESCRIPTION	BY	CHK
00	01-10-20	ORIGINAL ISSUE	PK	KS

DRAWING TITLE:  
 BANFF GEOTECHNICAL TOPO SURVEY  
 BOREHOLE AS-BUILT  
 JOHNSON CANYON DUA

CLIENT:



SCALE: 1:1250	DRAWING NUMBER: 19M-01812-G0-000-00-CSTAB002 - Sh1	REV. 0
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237 4th Ave SW, Suite 3200  
 Calgary, Alberta  
 T2P 4K3  
 PH:(403)-266-2800



## BOREHOLE LOGS





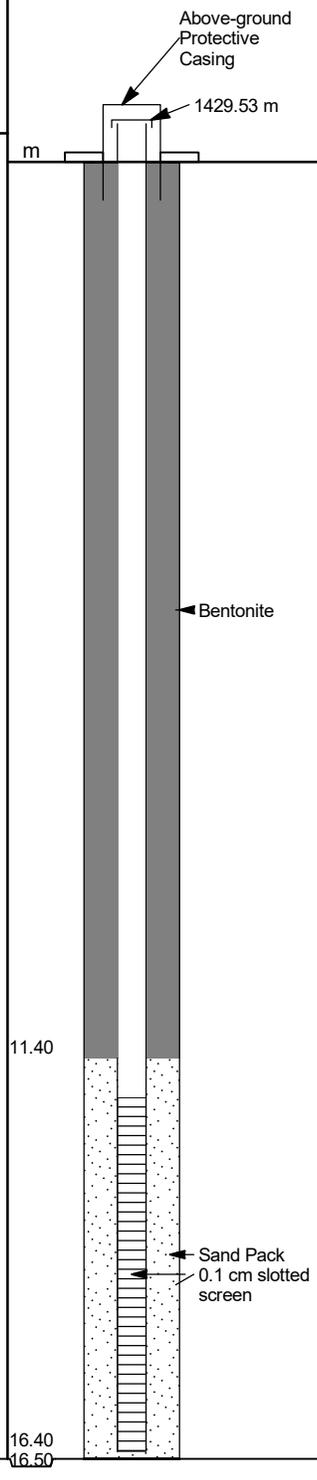
**Client:** Parks Canada  
**Project:** Johnston Canyon Day Use Area  
**Location:** SW-25-026-13 W5M

**Well ID:** P19-02  
**Borehole:** 19BH02

Drill Date: 2019 December 15      Drilled by: ERNCO Environmental      Datum: NAD83UTM (Zone 11) Total Depth: 16.50 m  
 Drill Method: ODEX      Logged by: AB      Accuracy +/-:      Ground Elevation: 1428.653 m  
 Boring Diameter: 15.24 cm (6")      Compiled by: Steven Minckler      Northing: 5677642.454      Casing Elevation: 1429.532 m  
 Well Diameter: 5.08 cm (2")      Soil Classification System: USCS      Easting: 581063.709      Surface Completion: Above-ground

T:\ENV\ROCLIENTS\PROJECTS\_2014\NOLOCATION\_PROJECTS\PARKS CANADA\19M-018\12-00\_CASTLE MT\BOREHOLE LOGS\JOHNSTON CANYON DIA.GPJ 20-2-27

SUBSURFACE PROFILE					FIELD TEST	COMPLETION DETAILS
Depth	Symbol	Description	Depth (m)	Sample ID	Conductivity (mS/cm)	
0.0		Ground Surface				
0.0 - 1.50	x x x x	SANDY SILT - Some gravel, brown (7.5YR: 4/3), dry.	1.50			
1.50 - 3.00	o o o o	GRAVEL - Some silt, trace cobbles, brown (7.5YR: 4/3), dry. Cobbles increase with depth.	3.00			
3.00 - 4.50	o o o o	GRAVEL - Some cobbles, trace silt, brown (7.5YR: 4/3), dry. Cobbles increase and hard to 4.0m.	4.50			
4.50 - 7.50	x x x x	SANDY SILT - Some gravel, trace cobbles, brown (7.5YR: 4/3), moist. Increased sand and silt at 7.0m.	7.50			
7.50 - 9.00	x x x x	SANDY SILT - Some gravel, trace cobbles, brown (7.5YR: 4/3), dry.	9.00			
9.00 - 12.00	x x x x	SANDY SILT - Some gravel, brown (7.5YR: 4/3), moist. Increased moisture at 11-12m.	12.00			
12.00 - 14.80	x x x x	SANDY SILT - Some sand, brown (7.5YR: 4/3), moist.	14.80			
14.80 - 16.50	o o o o	GRAVEL - Some silt, trace cobbles, brown (7.5YR: 4/3), dry.	16.50			
End of Borehole						



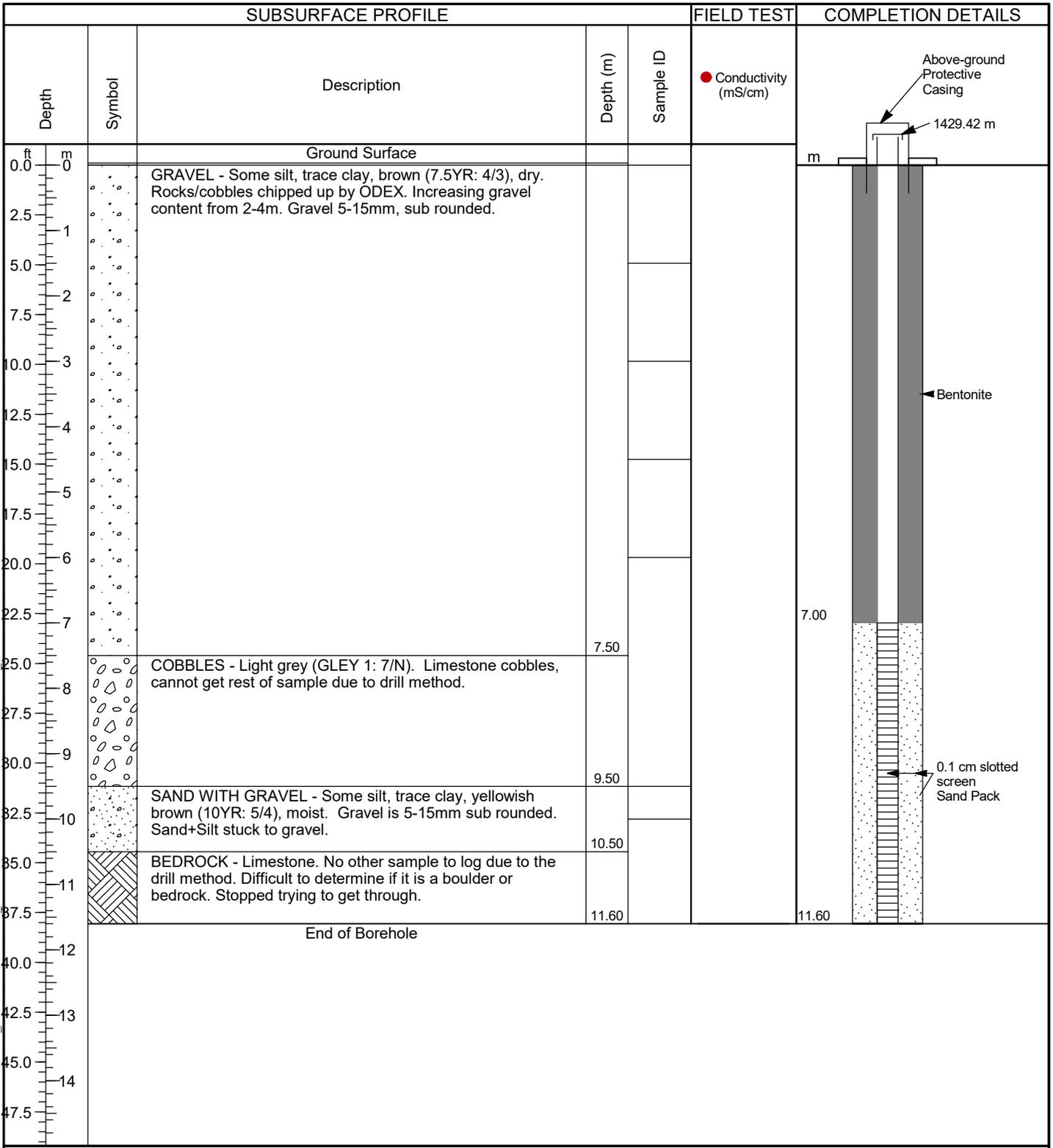


**Client:** Parks Canada  
**Project:** Johnston Canyon Day Use Area  
**Location:** SW-25-026-13 W5M

**Well ID:** P19-03  
**Borehole:** 19BH03

Drill Date: 2019 December 17      Drilled by: ERNCO Environmental      Datum: NAD83UTM (Zone 11) Total Depth: 11.60 m  
 Drill Method: ODEX      Logged by: AB      Accuracy +/-:      Ground Elevation: 1428.711 m  
 Boring Diameter: 15.24 cm (6")      Compiled by: Steven Minckler      Northing: 5677661.992      Casing Elevation: 1429.420 m  
 Well Diameter: 5.08 cm (2")      Soil Classification System: USCS      Easting: 581089.958      Surface Completion: Above-ground

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**Client:** Parks Canada  
**Project:** Johnston Canyon Day Use Area  
**Location:** SW-25-026-13 W5M

**Borehole: 19BH05**

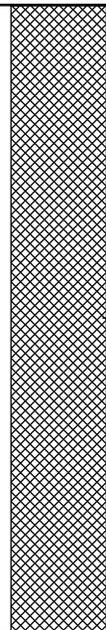
Drill Date: 2019 December 17  
 Drill Method: ODEX  
 Boring Diameter: 15.24 cm (6")  
 Total Depth: 7.50 m

Drilled by: ERNCO Environmental  
 Logged by: AB  
 Compiled by: STEVEN Minckler  
 Soil Classification System: USCS

Datum: NAD83UTM (Zone 11) / Accuracy +/-:  
 Northing: 5677708.547  
 Easting: 581020.167  
 Ground Elevation: 1429.997 m

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SUBSURFACE PROFILE					FIELD TEST	COMPLETION DETAILS
Depth	Symbol	Description	Depth (m)	Sample ID	● Conductivity (mS/cm)	
Ground Surface						
0.0						m
2.5		GRAVEL & COBBLES WITH CLAY - Very dark grey (7.5YR: 3/1), dry. Cobble and fill material. ODEX crushed most of the material.	1.00			
5.0		GRAVEL - Some silt, trace clay, brown (7.5YR: 4/3), moist. Sand and gravel, some chips from ODEX crushing gravel. Gravel roughly 5-10 mm sub rounded. Increasing sand content at 3-4m and trace clay from 4-7.5m. Boulder between 5.5-6.0m, then back to gravelly sand with some silt and trace clay.				
7.5			7.50			7.50
End of Borehole						
10.0						
12.5						
15.0						
17.5						
20.0						
22.5						
25.0						
27.5						
30.0						
32.5						
35.0						
37.5						
40.0						
42.5						
45.0						
47.5						
50.0						



Formation Collapse

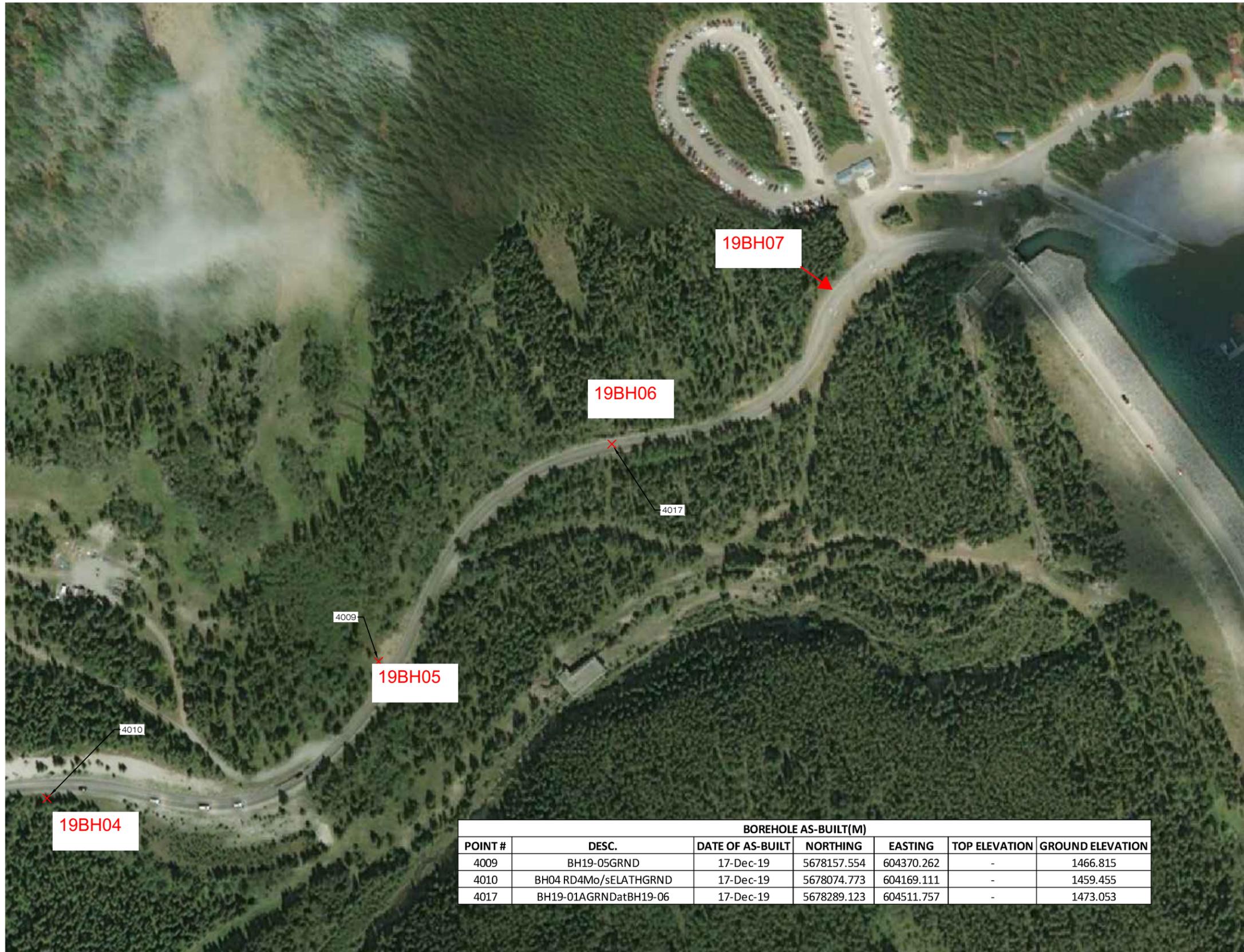


# Attachment D

MINNEWANKA DAY USE AREA



## SURVEY DATA



LEGEND:

× SURVEYED POINT

NOTES:

1. ALL ELEVATIONS AND DIMENSIONS ARE IN METERS AND DECIMALS THEREOF UNLESS SHOWN OTHERWISE.
2. DISTANCES SHOWN ARE BASED UPON NAD83 UTM GRID.
3. NORTH IS SHOWN RELATIVE TO NAD83 UTM SURVEY CONTROL.
4. BEARINGS AND COORDINATES ARE BASED ON THE NAD83 DATUM AND WERE DERIVED FROM GNSS OBSERVATIONS HOLDING PUBLISHED COORDINATE VALUES FOR A.S.C.M 320218.
5. ELEVATIONS ARE GEODETIC AND DERIVED FROM A.S.C.M 320218 (ELEVATION 1400.507)

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REVISION TABLE

NO.	DATE	DESCRIPTION	BY	CHK
00	01-08-20	ORIGINAL ISSUE	PK	KS

DRAWING TITLE:  
 BANFF GEOTECHNICAL TOPO SURVEY  
 BOREHOLE AS-BUILT  
 LAKE MINNEWANKA DUA

CLIENT:



SCALE: 1:2500	DRAWING NUMBER: 19M-01812-G0-000-00-CSTAB002 - Sh4	REV. 0
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BOREHOLE AS-BUILT(M)						
POINT #	DESC.	DATE OF AS-BUILT	NORTHING	EASTING	TOP ELEVATION	GROUND ELEVATION
4009	BH19-05GRND	17-Dec-19	5678157.554	604370.262	-	1466.815
4010	BH04 RD4Mo/sELATHGRND	17-Dec-19	5678074.773	604169.111	-	1459.455
4017	BH19-01AGRNDatBH19-06	17-Dec-19	5678289.123	604511.757	-	1473.053

BOREHOLE AS-BUILT(M)						
POINT #	DESC.	DATE OF AS-BUILT	NORTHING	EASTING	TOP ELEVATION	GROUND ELEVATION
4011	GRND19MYS	17-Dec-19	5678040.439	604067.726	-	1458.824
4012	CAP19MYS	17-Dec-19	5678040.414	604067.729	1459.903	-
4013	GRND19BH03	17-Dec-19	5677980.106	604118.447	-	1461.541
4014	GRND19BH02	17-Dec-19	5677994.689	604062.314	-	1458.694
4015	CAP19BH02	17-Dec-19	5677994.721	604062.264	1459.718	-
4016	GRNDBH19-02B	17-Dec-19	5677975.966	604079.387	-	1457.737
4194	GRND-MW	20-Dec-19	5678097.274	604043.788	-	1459.118
4195	TOPLID-MW	20-Dec-19	5678097.280	604043.814	1460.167	-
4196	GRNDS18-02-MW	20-Dec-19	5678155.803	603922.622	-	1464.149
4197	TOPPVCPIPES18-02-MW	20-Dec-19	5678155.808	603922.581	1465.022	-



LEGEND:

X SURVEYED POINT

NOTES:

1. ALL ELEVATIONS AND DIMENSIONS ARE IN METERS AND DECIMALS THEREOF UNLESS SHOWN OTHERWISE.
2. DISTANCES SHOWN ARE BASED UPON NAD83 UTM GRID.
3. NORTH IS SHOWN RELATIVE TO NAD83 UTM SURVEY CONTROL.
4. BEARINGS AND COORDINATES ARE BASED ON THE NAD83 DATUM AND WERE DERIVED FROM GNSS OBSERVATIONS HOLDING PUBLISHED COORDINATE VALUES FOR A.S.C.M 320218.
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REVISION TABLE

NO.	DATE (mm-dd-yy)	DESCRIPTION	BY	CHK
00	01-08-20	ORIGINAL ISSUE	PK	KS

DRAWING TITLE:  
BANFF GEOTECHNICAL TOPO SURVEY  
BOREHOLE AS-BUILT  
LAKE MINNEWANKA DUA

CLIENT:



SCALE: 1:2500	DRAWING NUMBER: 19M-01812-G0-000-00-CSTAB002 - Sh5	REV. 0
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PH:(403)-266-2800



## BOREHOLE LOGS



**Client:** Parks Canada  
**Project:** Minnewanka Day Use Area  
**Location:** SW-29-026-11 W5M

**Borehole: 19BH01**

Drill Date: 2019 December 4  
 Drill Method: Direct Push  
 Boring Diameter: 10.16 cm (4")  
 Total Depth: 4.50 m

Drilled by: ERNCO Environmental  
 Logged by: PL  
 Compiled by: STEVEN MINCKLER  
 Soil Classification System: USCS

Datum: NAD83UTM (Zone 11) / Accuracy +/-:  
 Northing: 5678289.123  
 Easting: 604511.757  
 Ground Elevation: 1473.053 m

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SUBSURFACE PROFILE					FIELD TEST	COMPLETION DETAILS
Depth	Symbol	Description	Depth (m)	Sample ID	● Conductivity (mS/cm)	
0.0		Ground Surface				m
0.0 - 0.20		SANDY CLAY - Some gravel, dark brown (7.5YR: 3/2), frozen, firm. Rooting visible.	0.20			
0.20 - 0.80		SANDY CLAY - Some gravel, trace silt, brown (7.5YR: 4/3), moist, firm. Gravel 25-45mm, small stones <10mm.	0.80			
0.80 - 1.60		CLAYEY SAND - Brown (7.5YR: 4/3), moist, loose. Some visible water, minimal, sporadic.	1.60			
1.60 - 3.10		GRAVEL & COBBLES WITH SAND - Some gravel, trace clay, brown (7.5YR: 4/3), moist, loose.	3.10			
3.10 - 3.80		GRAVEL & COBBLES WITH SAND - Some sand, trace clay, dark brown (7.5YR: 3/2), wet, loose. Water visible at 3.5 meters.	3.80			
3.80 - 4.50		GRAVEL & COBBLES WITH SAND - Some sand, trace clay, brown (7.5YR: 4/3), moist, loose. Bed rock at 4.3 meters.	4.50			
4.50		End of Borehole				4.50
						Formation Collapse

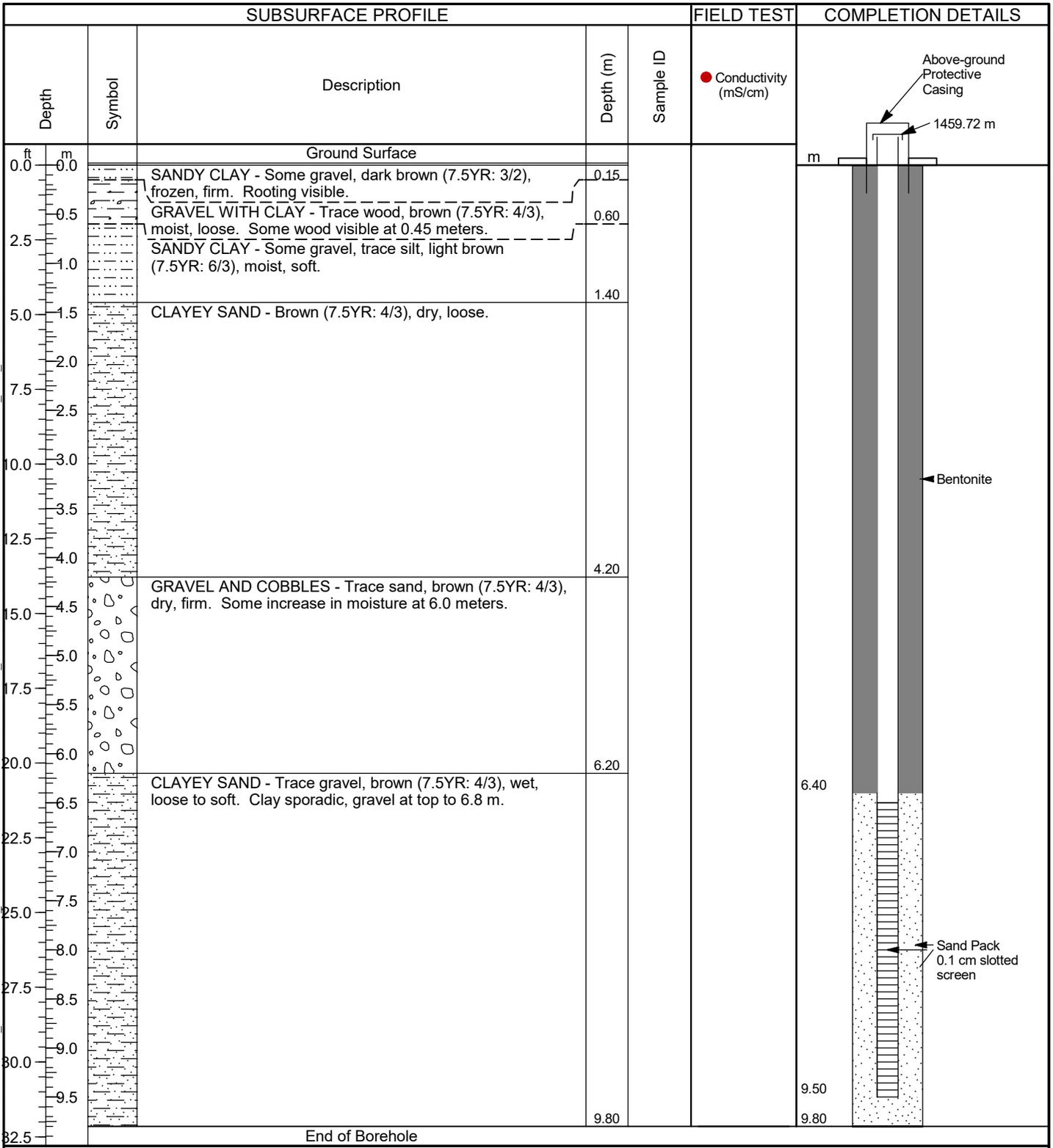


**Client:** Parks Canada  
**Project:** Minnewanka Day Use Area  
**Location:** SW-29-026-11 W5M

**Well ID:** P19-01  
**Borehole:** 19BH02

Drill Date: 2019 December 4      Drilled by: ERNCO Environmental      Datum: NAD83UTM (Zone 11) Total Depth: 9.80 m  
 Drill Method: Direct Push      Logged by: PL      Accuracy +/-:      Ground Elevation: 1458.694 m  
 Boring Diameter: 10.16 cm (4")      Compiled by: Steven Minckler      Northing: 5677994.689      Casing Elevation: 1459.718 m  
 Well Diameter: 5.08 cm (2")      Soil Classification System: USCS      Easting: 604062.314      Surface Completion: Above-ground

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**Client:** Parks Canada  
**Project:** Minnewanka Day Use Area  
**Location:** SW-29-026-11 W5M

**Borehole: 19BH03**

Drill Date: 2019 December 5  
 Drill Method: Direct Push  
 Boring Diameter: 10.16 cm (4")  
 Total Depth: 5.80 m

Drilled by: ERNCO Environmental  
 Logged by: PL  
 Compiled by: STEVEN MINCKLER  
 Soil Classification System: USCS

Datum: NAD83UTM (Zone 11) / Accuracy +/-:  
 Northing: 5677980.106  
 Easting: 604118.447  
 Ground Elevation: 1461.541 m

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SUBSURFACE PROFILE					FIELD TEST	COMPLETION DETAILS
Depth	Symbol	Description	Depth (m)	Sample ID	● Conductivity (mS/cm)	
0.0		Ground Surface				m
0.0		SANDY CLAY - Some gravel, dark brown (7.5YR: 3/2), frozen, firm. LFH 1 cm.	0.15			
0.5		COBBLES - Some sand, dark brown (7.5YR: 3/2), frozen, firm. Rocks, gravel <50mm.				
1.2		CLAYEY SAND - Light brown (7.5YR: 6/3), moist, soft.	1.20			
2.8		CLAYEY SAND - Some gravel, dark brown (7.5YR: 3/2), moist, soft to loose.	2.80			
3.8		GRAVEL AND COBBLES - Some sand, brown (7.5YR: 4/3), moist, loose. Moist to 4.3.	3.80			
5.8		End of Borehole	5.80			5.80

Formation Collapse



**Client:** Parks Canada  
**Project:** Minnewanka Day Use Area  
**Location:** SW-29-026-11 W5M

**Borehole: 19BH04**

Drill Date: 2019 December 5  
 Drill Method: Direct Push  
 Boring Diameter: 10.16 cm (4")  
 Total Depth: 4.00 m

Drilled by: ERNCO Environmental  
 Logged by: PL  
 Compiled by: STEVEN MINCKLER  
 Soil Classification System: USCS

Datum: NAD83UTM (Zone 11) / Accuracy +/-:  
 Northing: 5678074.773  
 Easting: 604169.111  
 Ground Elevation: 1459.455 m

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SUBSURFACE PROFILE					FIELD TEST	COMPLETION DETAILS
Depth	Symbol	Description	Depth (m)	Sample ID	Conductivity (mS/cm)	
0.0		Ground Surface				m
0.0 - 0.40		COARSE SAND - Trace clay, black (7.5YR: 2.5/1), dry, loose.	0.40			
0.40 - 1.00		GRAVEL WITH CLAY - Trace clay, light greenish grey (GLEY 1: 7/1 10Y), dry, loose.	1.00			
1.00 - 2.30		CLAYEY SAND - Some gravel, trace rock, brown (7.5YR: 4/3), moist, loose. Rocks 30-45 mm, moist at 1.8-1.9 m.	2.30			
2.30 - 4.00		GRAVEL WITH CLAY - Sand rock, trace clay, brown (7.5YR: 4/3), dry, loose. Rocks 40-55 mm, some moisture at 3.7-3.8 m.	4.00			
End of Borehole						



**Client:** Parks Canada  
**Project:** Minnewanka Day Use Area  
**Location:** SW-29-026-11 W5M

**Borehole: 19BH05**

Drill Date: 2019 December 5  
 Drill Method: Direct Push  
 Boring Diameter: 10.16 cm (4")  
 Total Depth: 2.40 m

Drilled by: ERNCO Environmental  
 Logged by: PL  
 Compiled by: STEVEN MINCKLER  
 Soil Classification System: USCS

Datum: NAD83UTM (Zone 11) / Accuracy +/-:  
 Northing: 5678157.554  
 Easting: 604370.262  
 Ground Elevation: 1466.815 m

**SUBSURFACE PROFILE**

**FIELD TEST**

**COMPLETION DETAILS**

Depth	Symbol	Description	Depth (m)	Sample ID	Conductivity (mS/cm)	Completion Details
0.0		Ground Surface				
0.0 - 0.40		SAND WITH GRAVEL - Trace clay, black (7.5YR: 2.5/1), dry, loose.	0.40			
0.40 - 1.10		GRAVEL - Some clay, very dark grey (7.5YR: 3/1), dry, hard. Very hard 0.4-0.9 m. Increased sand at 0.9 m.	1.10			
1.10 - 2.40		CLAYEY SAND - Trace gravel, brown (7.5YR: 4/3), dry, loose. Increased gravel at 1.7-1.9 m. Auger refusal at 2.4 m.	2.40			Formation Collapse
2.40		End of Borehole				

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**Client:** Parks Canada  
**Project:** Minnewanka Day Use Area  
**Location:** SW-29-026-11 W5M

**Borehole: 19BH06**

Drill Date: 2019 December 5  
 Drill Method: Direct Push  
 Boring Diameter: 10.16 cm (4")  
 Total Depth: 2.60 m

Drilled by: ERNCO Environmental  
 Logged by: PL  
 Compiled by: STEVEN MINCKLER  
 Soil Classification System: USCS

Datum: NAD83UTM (Zone 11) / Accuracy +/-:  
 Northing: 5678289.123  
 Easting: 604511.757  
 Ground Elevation: 1473.053 m

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SUBSURFACE PROFILE					FIELD TEST	COMPLETION DETAILS
Depth	Symbol	Description	Depth (m)	Sample ID	● Conductivity (mS/cm)	
0.0		Ground Surface				m
0.0 - 0.40		SAND WITH GRAVEL - Trace clay, black (7.5YR: 2.5/1), dry, loose. Grey after 0.06 cobble, oil and asphalt smell at 0.28 to 0.35 m.	0.40			<p>Formation Collapse</p>
0.40 - 1.00		GRAVEL - Dark brown (7.5YR: 3/2), dry, loose to firm.	1.00			
1.00 - 1.20		CLAYEY SAND - Light brown (7.5YR: 6/3), moist, loose.	1.20			
1.20 - 1.80		CLAYEY SAND - Brown (7.5YR: 4/3), moist, firm.	1.80			
1.80 - 2.60		GRAVEL - Light brown (7.5YR: 6/3). Increased gravel.	2.60			
2.60		End of Borehole	2.60		2.60	



**Client:** Parks Canada  
**Project:** Minnewanka Day Use Area  
**Location:** SW-29-026-11 W5M

**Borehole: 19BH07**

Drill Date: 2019 December 6  
 Drill Method: Direct Push  
 Boring Diameter: 10.16 cm (4")  
 Total Depth: 2.70 m

Drilled by: ERNCO Environmental  
 Logged by: PL  
 Compiled by: STEVEN MINCKLER  
 Soil Classification System: USCS

Datum: NAD83UTM (Zone 11) / Accuracy +/-:  
 Northing: 5678040.439  
 Easting: 604067.726  
 Ground Elevation: 1458.824 m

**SUBSURFACE PROFILE**

**FIELD TEST**

**COMPLETION DETAILS**

Depth		Symbol	Description	Depth (m)	Sample ID	Conductivity (mS/cm)	COMPLETION DETAILS	
ft	m		Ground Surface				m	
0.0	0.0	●●●●●●	COARSE SAND - Trace clay, black (7.5YR: 2.5/1), frozen, loose.	0.40			<p>Formation Collapse</p>	
	0.5	□□□□□□	GRAVEL WITH CLAY - Light grey (7.5YR: 7/1), dry, loose. Increased gravel at depth.	1.00				
2.5	1.0	●●●●●●	COARSE SAND - Light grey (7.5YR: 7/1), dry, loose.	1.30				
	1.5	□□□□□□	GRAVEL WITH CLAY - Brown (7.5YR: 4/3), moist, firm.	1.70				
5.0	2.0	●●●●●●	SAND - Light brown (7.5YR: 6/3), moist, loose. Firm to loose, but breaks up loose.	2.70				
7.5	2.5		End of Borehole					
10.0	3.0							
	3.5							
12.5	4.0							
	4.5							
15.0	5.0							
	5.5							
17.5	6.0							
	6.5							
20.0								
22.5								

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## GEOTECHNICAL LAB DATA



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

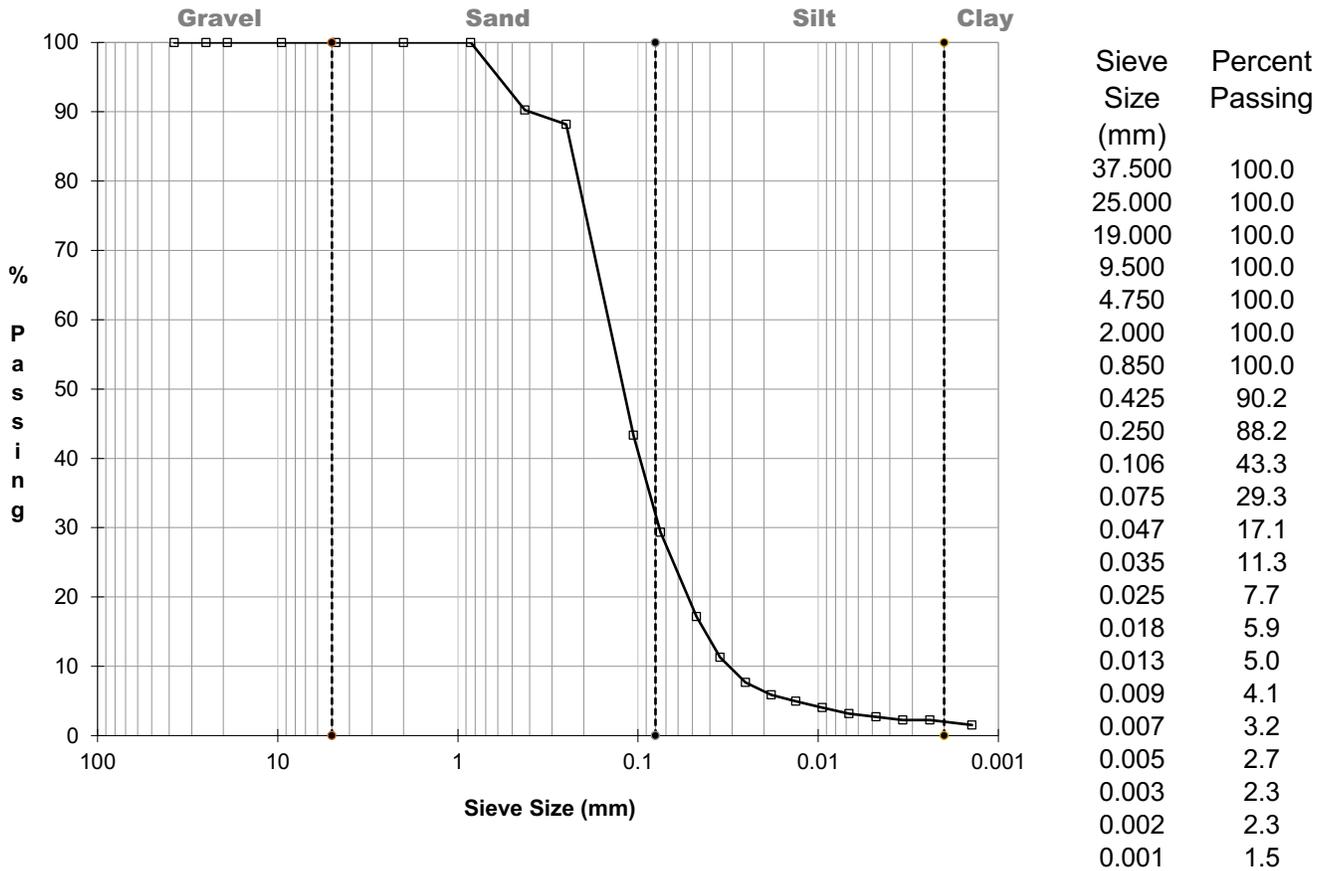
# Sieve Analysis

Report Date: January 13, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-01  
 Sample Depth: 1m  
 Source: Lake Minnewanka  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 6, 2020 Date Received: December 18, 2019



Sand = 0.0 %  
 Sand = 70.7 %  
 Silt = 27.0 %  
 Clay = 2.3 %

Sample Description: Silty SAND trace clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

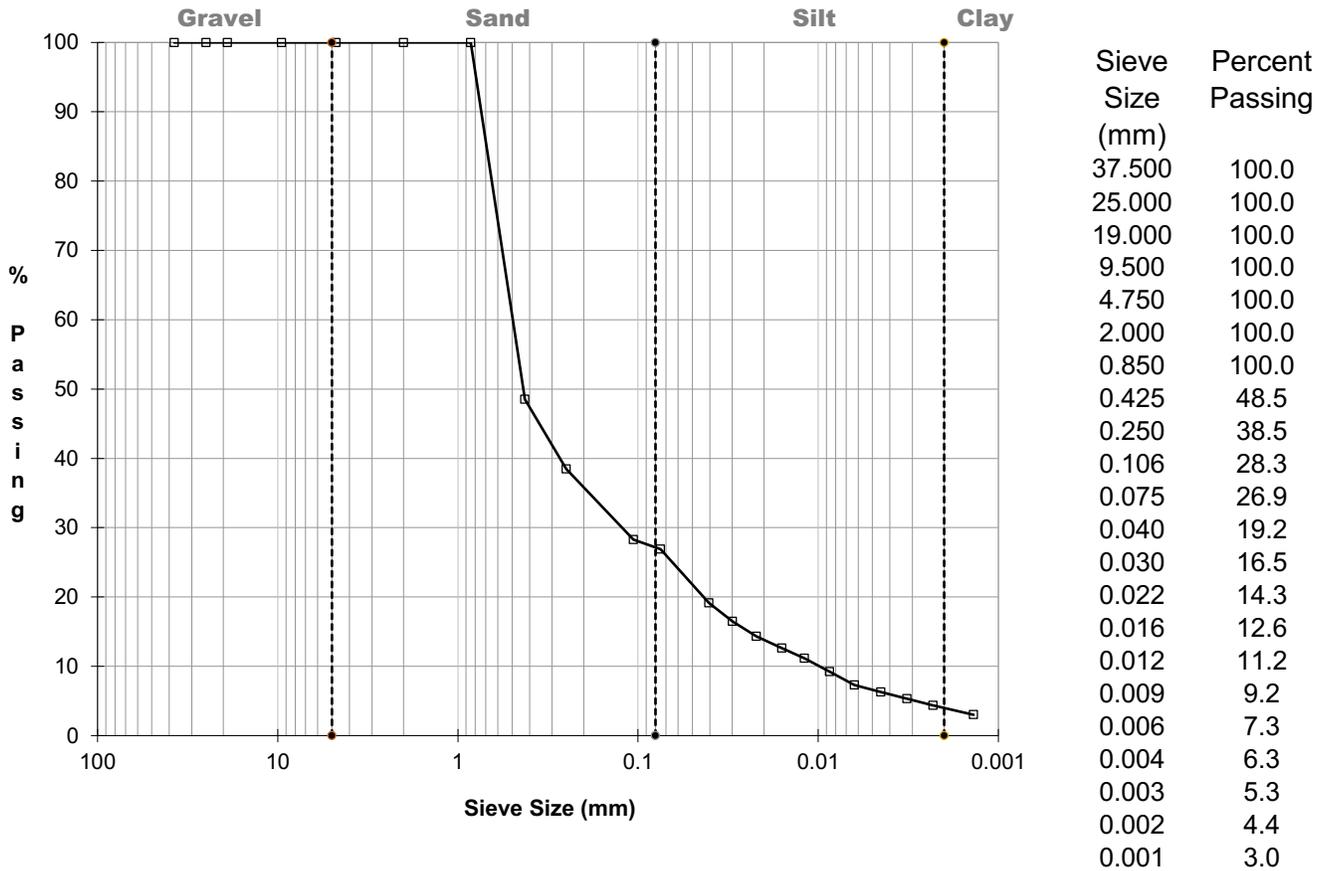
# Sieve Analysis

Report Date: January 13, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-01  
 Sample Depth: 2m  
 Source: Lake Minnewanka  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 8, 2020 Date Received: December 18, 2019



Gravel = 0.0 %  
 Sand = 73.1 %  
 Silt = 22.5 %  
 Clay = 4.4 %

Sample Description: Silty SAND trace clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

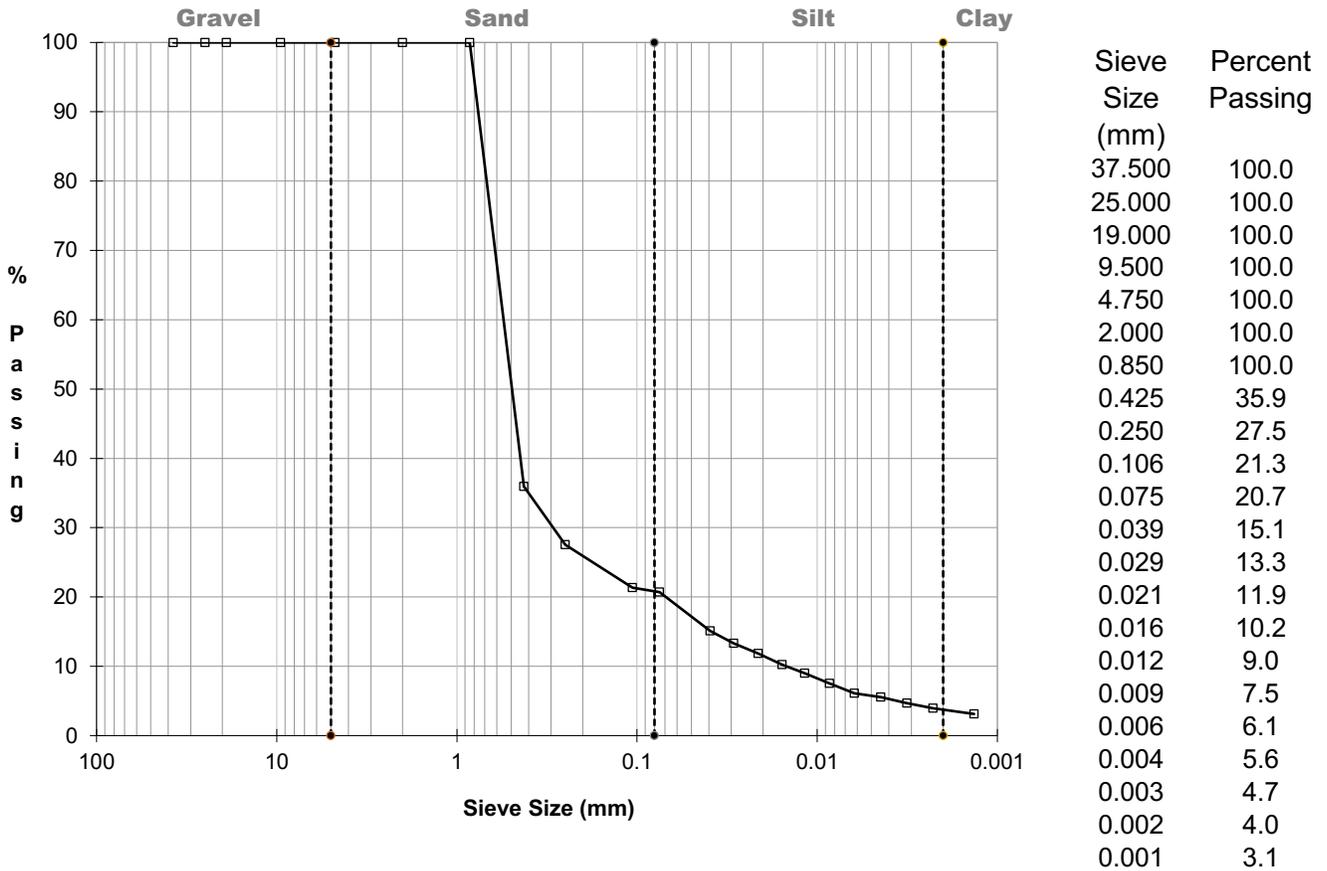
# Sieve Analysis

Report Date: January 13, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-01  
 Sample Depth: 3m  
 Source: Lake Minnewanka  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 8, 2020 Date Received: December 18, 2019



Sand = 0.0 %  
 Sand = 79.3 %  
 Silt = 16.7 %  
 Clay = 4.0 %

Sample Description: Silty SAND trace clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

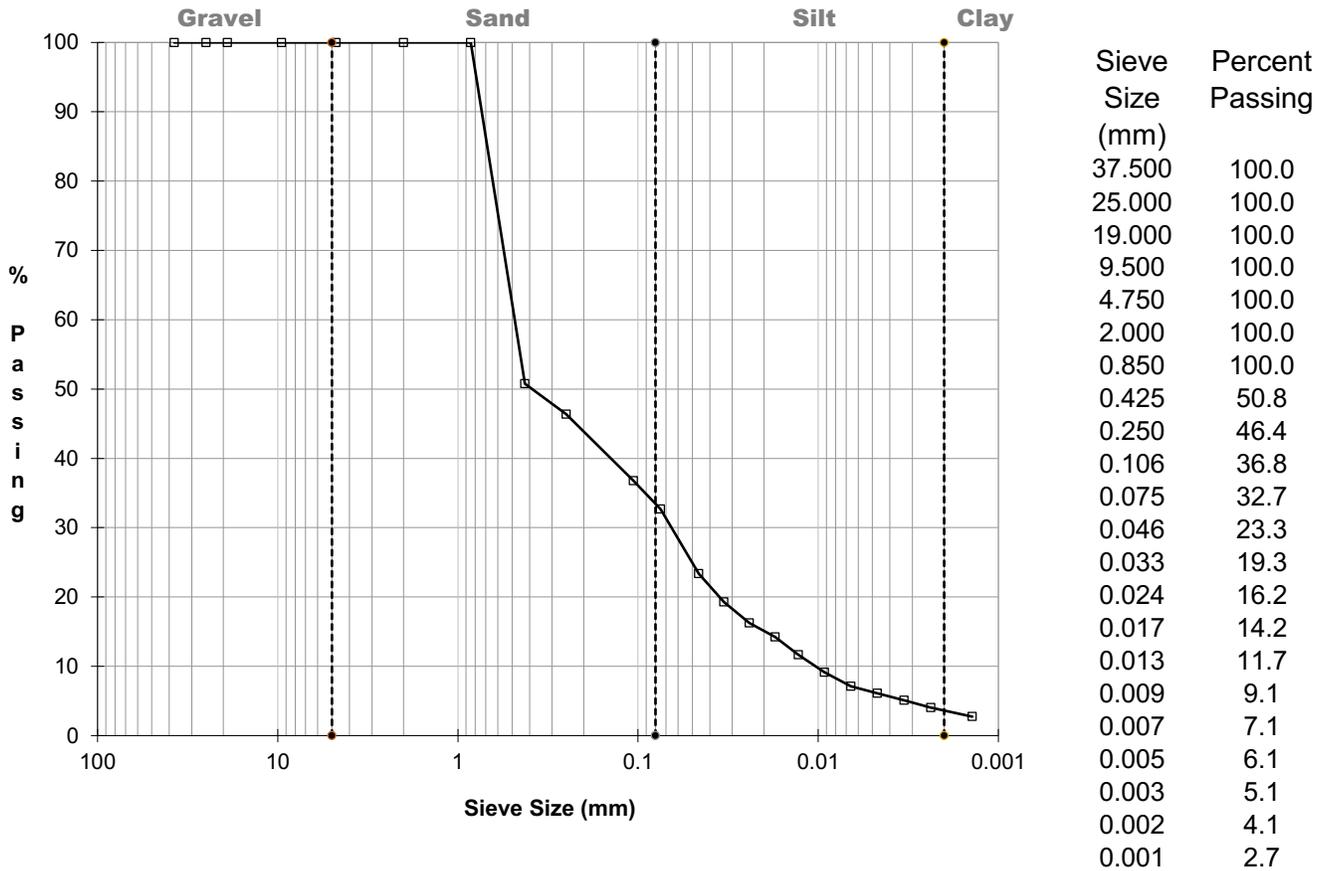
# Sieve Analysis

Report Date: January 13, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-02  
 Sample Depth: 1m  
 Source: Lake Minnewanka  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 8, 2020 Date Received: December 18, 2019



Gravel = 0.0 %  
 Sand = 67.3 %  
 Silt = 28.6 %  
 Clay = 4.1 %

Sample Description: Silty SAND trace clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

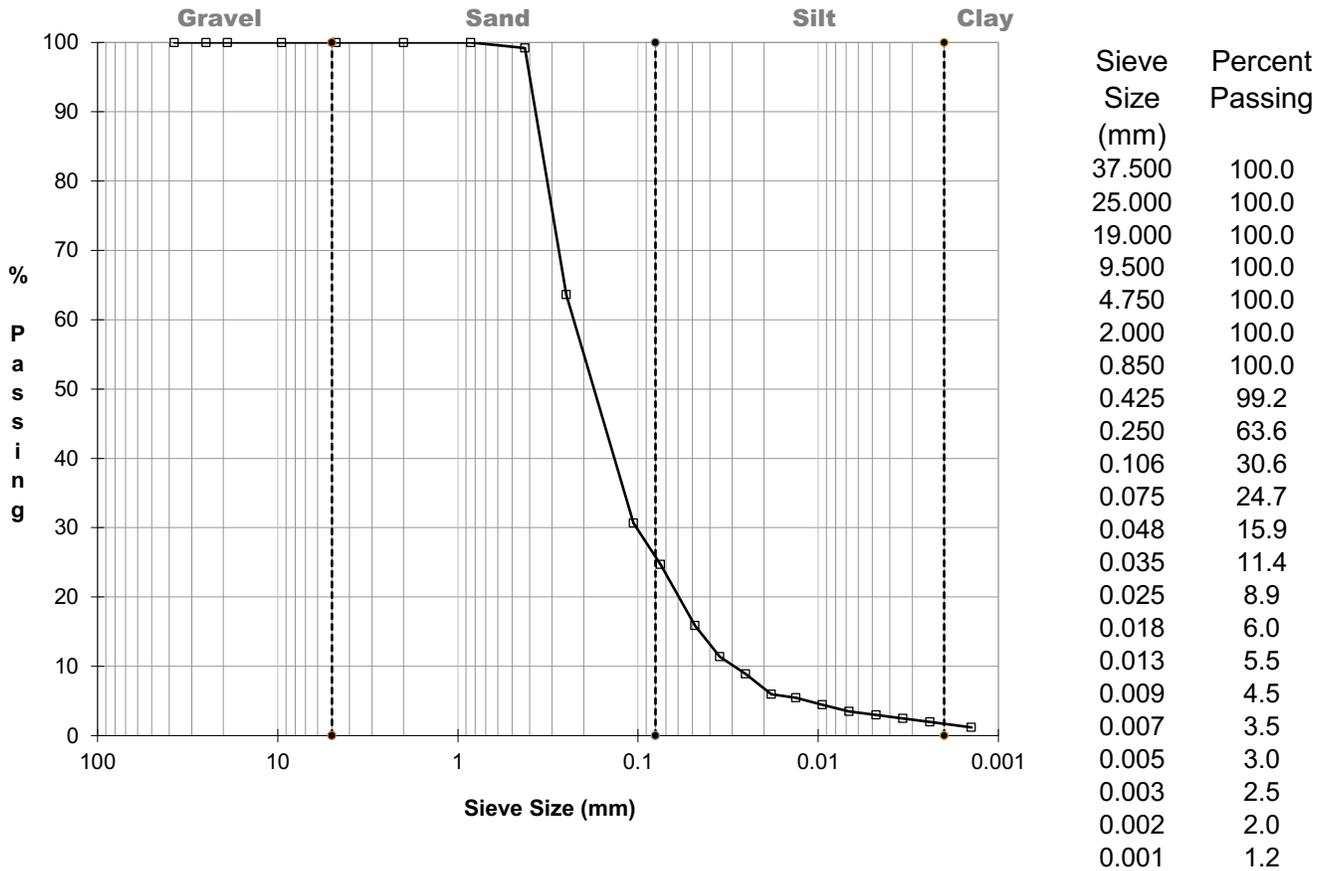
# Sieve Analysis

Report Date: January 13, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-02  
 Sample Depth: 2m  
 Source: Lake Minnewanka  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 8, 2020 Date Received: December 18, 2019



Sand = 0.0 %  
 Sand = 75.3 %  
 Silt = 22.7 %  
 Clay = 2.0 %

Sample Description: Silty SAND trace clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

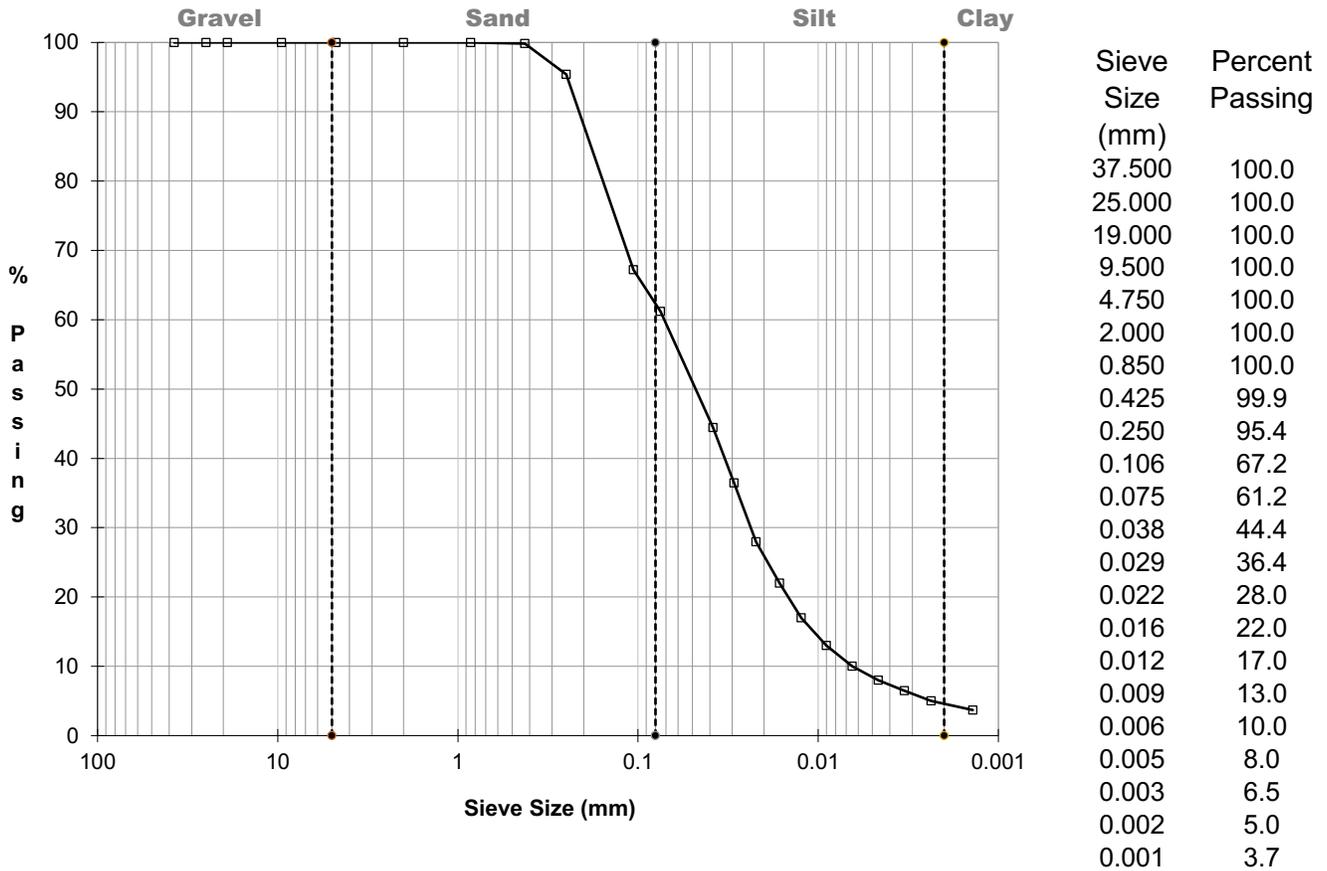
# Sieve Analysis

Report Date: January 13, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-02  
 Sample Depth: 3m  
 Source: Lake Minnewanka  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 8, 2020 Date Received: December 18, 2019



Sand = 0.0 %  
 Sand = 38.8 %  
 Silt = 56.2 %  
 Clay = 5.0 %

Sample Description: Sandy SILT trace of clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

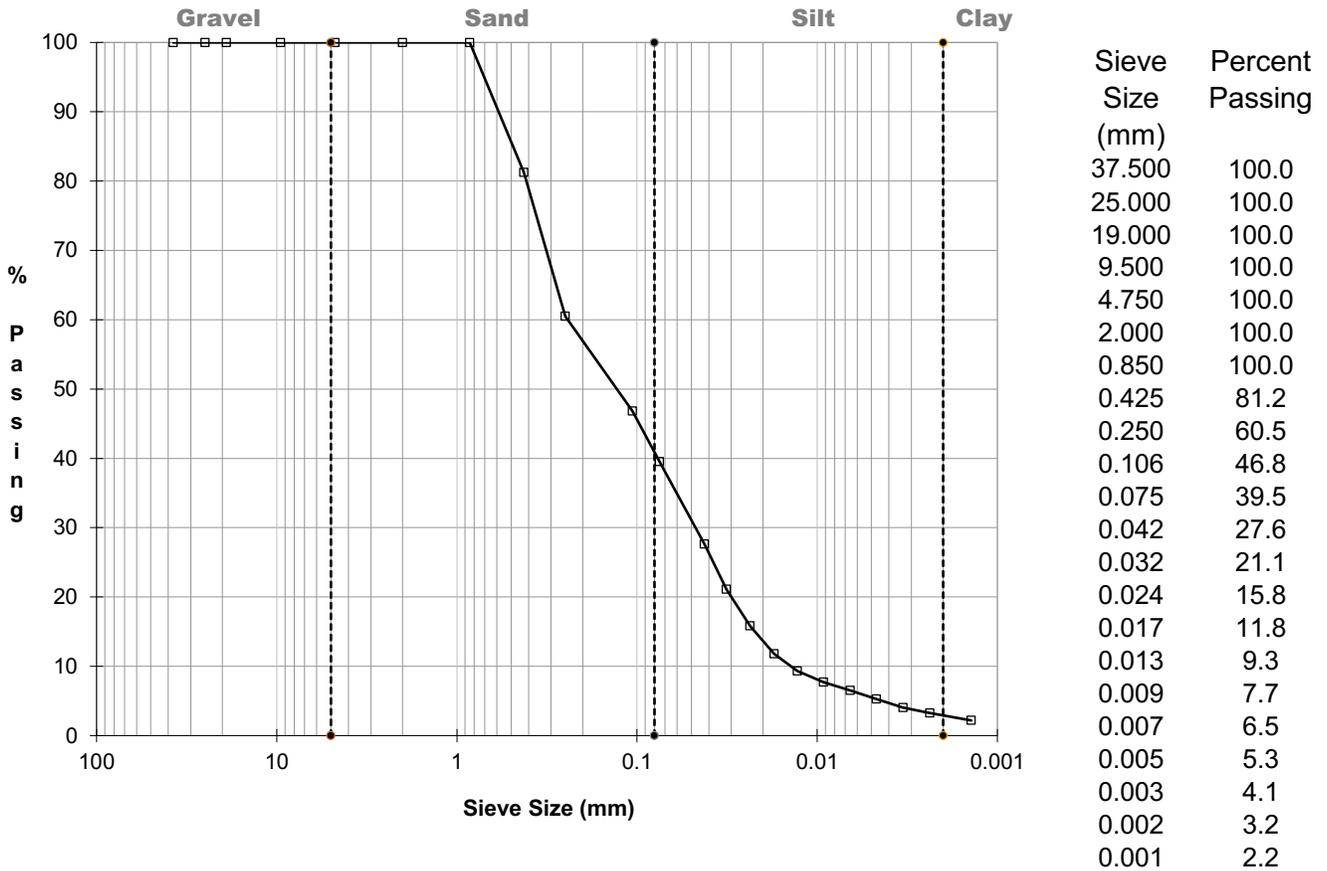
# Sieve Analysis

Report Date: January 13, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-03  
 Sample Depth: 1m  
 Source: Lake Minnewanka  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 8, 2020 Date Received: December 18, 2019



Sand = 0.0 %  
 Sand = 60.5 %  
 Silt = 36.3 %  
 Clay = 3.2 %

Sample Description: Silty SAND trace of clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

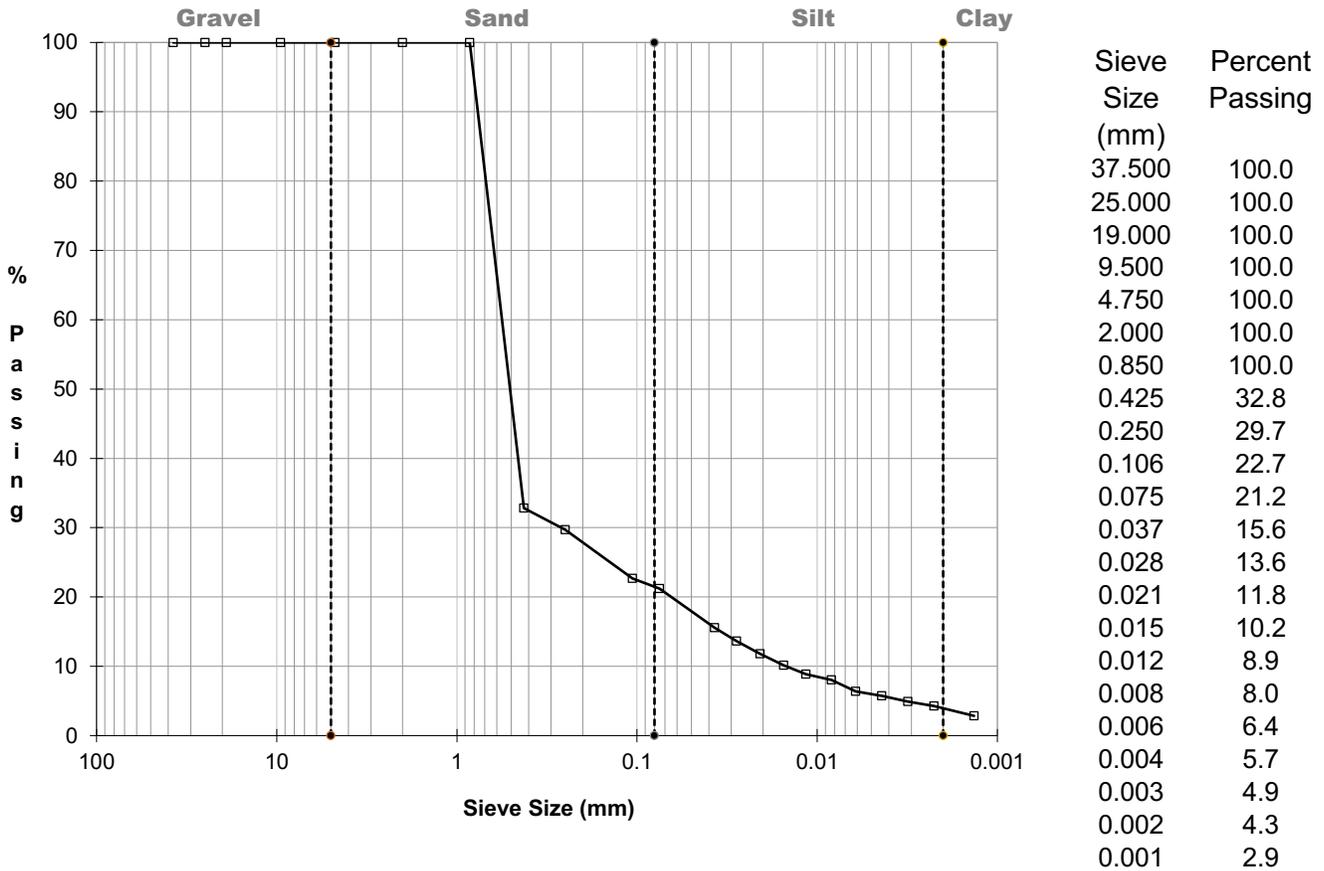
# Sieve Analysis

Report Date: January 13, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-03  
 Sample Depth: 2m  
 Source: Lake Minnewanka  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 8, 2020 Date Received: December 18, 2019



Sand = 0.0 %  
 Sand = 78.8 %  
 Silt = 16.9 %  
 Clay = 4.3 %

Sample Description: Silty SAND trace of clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

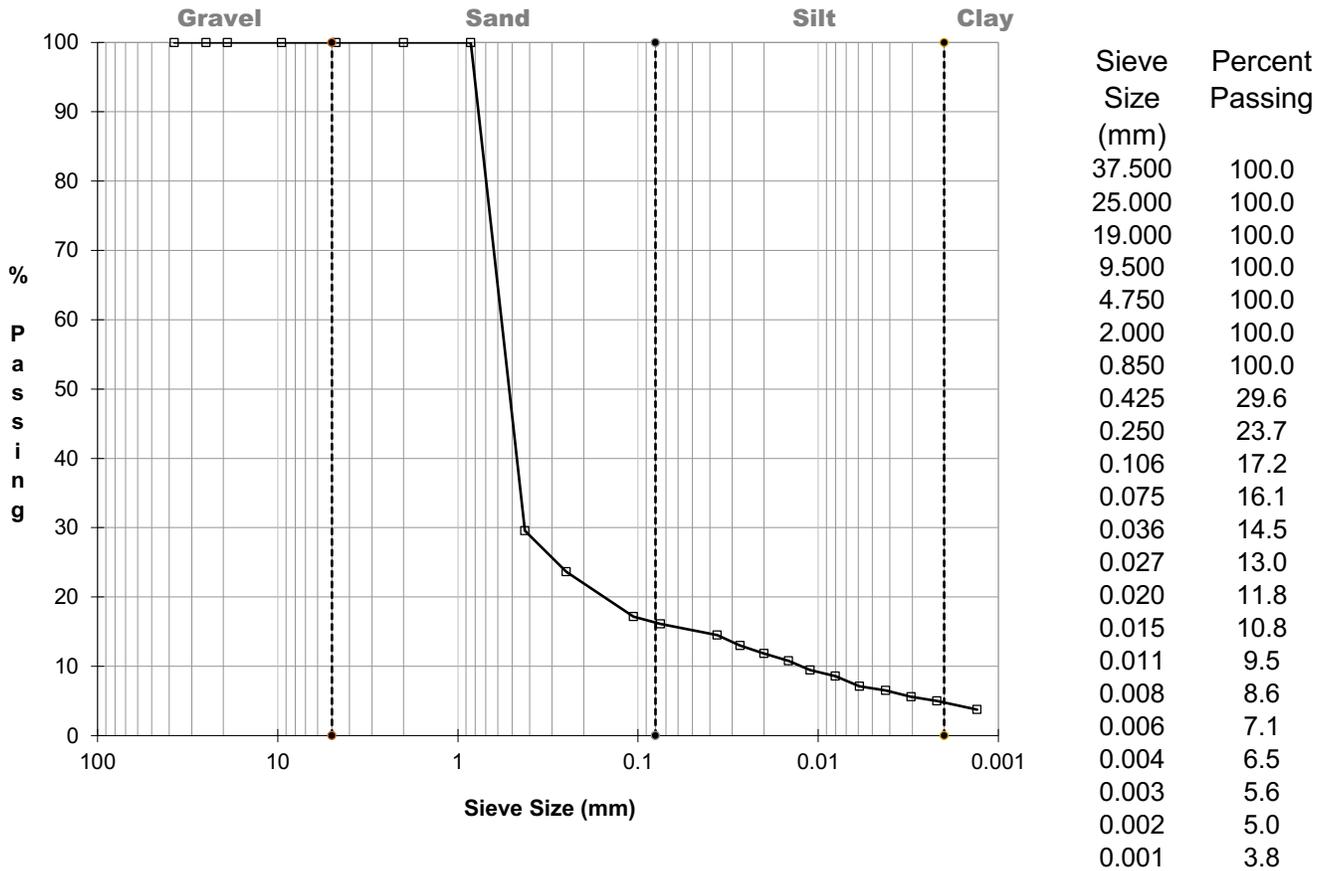
# Sieve Analysis

Report Date: January 13, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-03  
 Sample Depth: 3m  
 Source: Lake Minnewanka  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 8, 2020 Date Received: December 18, 2019



Sand = 0.0 %  
 Sand = 83.9 %  
 Silt = 11.1 %  
 Clay = 5.0 %

Sample Description: Silty SAND trace of clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



## MONITORING DATA

**TABLE 1. WATER QUALITY RESULTS - ROUTINE AND INDICATOR ANALYSIS**  
**Parks Canada - Banff National Park - Lake Minnewanka Day Use Area**

Monitoring Well	Sample Date	Electrical Conductivity (EC) ( $\mu\text{S/cm}$ )	Sodium Adsorption Ratio (SAR)	pH	Total Dissolved Solids (TDS) (mg/L)	Ion Balance (%)	Alkalinity (Total as $\text{CaCO}_3$ ) (mg/L)	Hardness ( $\text{CaCO}_3$ ) (mg/L)	Bicarbonate ( $\text{HCO}_3$ ) (mg/L)	Carbonate ( $\text{CO}_3$ ) (mg/L)	Hydroxide ( $\text{OH}$ ) (mg/L)	Chloride (Cl) (mg/L)	Fluoride (F) (mg/L)	Sulphate ( $\text{SO}_4$ ) (mg/L)	Nitrate+Nitrite-N ( $\text{NO}_3\text{-N}+\text{NO}_2\text{-N}$ ) (mg/L)	Nitrate-N ( $\text{NO}_3\text{-N}$ ) (mg/L)	Nitrite-N ( $\text{NO}_2\text{-N}$ ) (mg/L)	Phosphorous (P) (mg/L)	Calcium (Ca) (mg/L)	Magnesium (Mg) (mg/L)	Potassium (K) (mg/L)	Sodium (Na) (mg/L)	Iron (Fe) (mg/L)	Manganese (Mn) (mg/L)	Fecal Coliforms (MPN) (MPN/100 mL)	Total Coliforms (MPN) (MPN/100 mL)	Ammonia, Total (as N) (mg/L)	Total Organic Carbon (mg/L)	Total Kjeldahl Nitrogen (mg/L)
AT1 - Natural Area (coarse-grained)	13-Dec-19	533	0.10	8.04	282	105	214	279	261	<5	<5	<1	0.16	58	0.05	0.05	<0.01	0.37	58.9	32.1	0.8	4.0	<0.1	0.036	<1	<1	<0.20	3	0.1

Note: "-" - Not Analyzed

"<" - Below laboratory detection limits, detection limits are less than the applied guideline

NS - No Standards

AT1 - Alberta Tier 1 Soil and Groundwater Remediation Guidelines - Coarse-Grained (AEP, 2019)

SWQG - Surface Water Quality Guidelines (SWQG) for the Protection of Freshwater Aquatic Life - Environmental Quality Guidelines for Alberta Surface Waters (Government of Alberta, 2018)

<sup>1</sup> SWQG Table 1.7 - Guideline varies with hardness at each sample location. Range represents site-specific minimum and maximum guideline values (Government of Alberta, 2018)

<sup>2</sup> SWQG Table 1.4 - Guideline varies with chloride at each sample location (Government of Alberta, 2018)

Shading indicates values above the applicable guidelines



# LABORATORY REPORT



CLIENT NAME: WSP CANADA INC.  
10909 JASPER AVE, SUITE 1200  
EDMONTON, AB T5J 3L9  
(780) 435-4477

ATTENTION TO: Alyssa Barker

PROJECT: 19M-01812-00 / Lake Minewanka

AGAT WORK ORDER: 19C555977

WATER ANALYSIS REVIEWED BY: Yu Zhang, Senior Analyst

DATE REPORTED: Dec 21, 2019

PAGES (INCLUDING COVER): 11

VERSION\*: 1

Should you require any information regarding this analysis please contact your client services representative at (403) 735-2005

\*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.



## Certificate of Analysis

AGAT WORK ORDER: 19C555977

PROJECT: 19M-01812-00 / Lake Minewanka

2910 12TH STREET NE  
CALGARY, ALBERTA  
CANADA T2E 7P7  
TEL (403)735-2005  
FAX (403)735-2771  
<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY:

### Microbial Analysis

DATE RECEIVED: 2019-12-14

DATE REPORTED: 2019-12-15

SAMPLE DESCRIPTION: S18-03  
SAMPLE TYPE: Water  
DATE SAMPLED: 2019-12-13  
13:26  
800098

Parameter	Unit	G / S	RDL	800098
Total Coliforms (MPN)	MPN/100 mL		1	<1
Fecal Coliforms (MPN)	MPN/100 mL		1	<1

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Calgary (unless marked by \*)

Certified By:



## Certificate of Analysis

AGAT WORK ORDER: 19C555977

PROJECT: 19M-01812-00 / Lake Minewanka

2910 12TH STREET NE  
 CALGARY, ALBERTA  
 CANADA T2E 7P7  
 TEL (403)735-2005  
 FAX (403)735-2771  
<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY:

### Routine Chemistry Water Analysis (WSP)

DATE RECEIVED: 2019-12-14

DATE REPORTED: 2019-12-17

SAMPLE DESCRIPTION: S18-03  
 SAMPLE TYPE: Water  
 DATE SAMPLED: 2019-12-13  
 13:26  
 800098

Parameter	Unit	G / S	RDL	800098
pH	pH Units	7.0-10.5	N/A	8.04
p - Alkalinity (as CaCO <sub>3</sub> )	mg/L		5	<5
T - Alkalinity (as CaCO <sub>3</sub> )	mg/L		5	214
Bicarbonate	mg/L		5	261
Carbonate	mg/L		5	<5
Hydroxide	mg/L		5	<5
Electrical Conductivity	uS/cm		5	533
Electrical Conductivity	dS/m		0.05	0.53
Chloride	mg/L	(250)	1	<1
Fluoride	mg/L	1.5	0.01	0.16
Nitrate	mg/L	45	0.1	0.2
Nitrate-N	mg/L	10	0.02	0.05
Nitrite	mg/L	3	0.05	<0.05
Nitrite-N	mg/L	1	0.01	<0.01
Nitrate+Nitrite - Nitrogen	mg/L		0.02	0.05
Sulfate	mg/L	(500)	1	58
Dissolved Calcium	mg/L		0.3	58.9
Dissolved Magnesium	mg/L		0.2	32.1
Dissolved Sodium	mg/L	(200)	0.6	4.0
Dissolved Potassium	mg/L		0.6	0.8
Dissolved Iron	mg/L	(0.3)	0.1	<0.1
Dissolved Manganese	mg/L	0.12 (0.02)	0.005	0.036
Calculated TDS	mg/L		0.6	282
Sodium Adsorption Ratio	N/A			0.10
Hardness	mg CaCO <sub>3</sub> /L		1	279
Ion Balance	%		1	105

Certified By:



**AGAT** Laboratories

# Certificate of Analysis

AGAT WORK ORDER: 19C555977

PROJECT: 19M-01812-00 / Lake Minewanka

2910 12TH STREET NE  
CALGARY, ALBERTA  
CANADA T2E 7P7  
TEL (403)735-2005  
FAX (403)735-2771  
<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY:

## Routine Chemistry Water Analysis (WSP)

DATE RECEIVED: 2019-12-14

DATE REPORTED: 2019-12-17

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to 2019 Canadian Drinking Water Quality MAC (AO)  
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

800098 < - Values refer to Report Detection Limits.

If sodium results in mg/L are less than detection, SAR is non-calculable and is reported as 0.

Analysis performed at AGAT Calgary (unless marked by \*)

Certified By:



## Certificate of Analysis

AGAT WORK ORDER: 19C555977

PROJECT: 19M-01812-00 / Lake Minewanka

2910 12TH STREET NE  
CALGARY, ALBERTA  
CANADA T2E 7P7  
TEL (403)735-2005  
FAX (403)735-2771  
<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY:

### Water Analysis - NH3, TOC, T-P

DATE RECEIVED: 2019-12-14

DATE REPORTED: 2019-12-19

SAMPLE DESCRIPTION: S18-03  
SAMPLE TYPE: Water  
DATE SAMPLED: 2019-12-13  
13:26  
800098

Parameter	Unit	G / S	RDL	800098
Ammonia, Total (as N)	mg/L		0.20	<0.20
Total Organic Carbon	mg/L		1	3
Total Phosphorus	mg/L		0.08	0.37

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard  
Analysis performed at AGAT Calgary (unless marked by \*)

Certified By:



## Certificate of Analysis

AGAT WORK ORDER: 19C555977

PROJECT: 19M-01812-00 / Lake Minewanka

2910 12TH STREET NE  
CALGARY, ALBERTA  
CANADA T2E 7P7  
TEL (403)735-2005  
FAX (403)735-2771  
<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY:

### Water Analysis - TKN

DATE RECEIVED: 2019-12-14

DATE REPORTED: 2019-12-17

SAMPLE DESCRIPTION: S18-03  
SAMPLE TYPE: Water  
DATE SAMPLED: 2019-12-13  
13:26

Parameter	Unit	G / S	RDL	800098
Total Kjeldahl Nitrogen	mg/L		0.1	0.1

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Edmonton (unless marked by \*)

Certified By:

## Quality Assurance

CLIENT NAME: WSP CANADA INC.  
PROJECT: 19M-01812-00 / Lake Minewanka  
SAMPLING SITE:

AGAT WORK ORDER: 19C555977  
ATTENTION TO: Alyssa Barker  
SAMPLED BY:

Water Analysis																
RPT Date:			DUPLICATE				Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Measured Value		Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits		
								Lower	Upper		Lower	Upper		Lower	Upper	

**Routine Chemistry Water Analysis (WSP)**

pH	791389		8.14	8.07	0.9%	N/A	100%	90%	110%						
T - Alkalinity (as CaCO3)	791389		114	114	0.0%	< 5	109%	80%	120%						
Electrical Conductivity	791389		376	379	0.8%	< 5	107%	80%	120%						
Chloride	800096		336	336	0.1%	< 1	98%	80%	120%	96%	80%	120%	NA	80%	120%
Fluoride	800096		<0.1	<0.1	NA	< 0.01	97%	80%	120%	85%	80%	120%	93%	80%	120%
Nitrate	800096		1	<1	NA	< 0.1	101%	80%	120%	101%	80%	120%	96%	80%	120%
Nitrite	800096		<0.40	<0.40	NA	< 0.05	98%	80%	120%	97%	80%	120%	93%	80%	120%
Sulfate	800096		107	109	1.1%	< 1	99%	80%	120%	100%	80%	120%	NA	80%	120%
Dissolved Calcium	800098	800098	58.9	57.2	2.9%	< 0.3	108%	80%	120%	100%	80%	120%	NA	80%	120%
Dissolved Magnesium	800098	800098	32.1	31.4	2.1%	< 0.2	104%	80%	120%	96%	80%	120%	NA	80%	120%
Dissolved Sodium	800098	800098	4.0	4.0	1.4%	< 0.6	103%	80%	120%	94%	80%	120%	96%	80%	120%
Dissolved Potassium	800098	800098	0.8	0.9	NA	< 0.6	106%	80%	120%	92%	80%	120%	97%	80%	120%
Dissolved Iron	800098	800098	<0.1	<0.1	NA	< 0.1	100%	80%	120%	99%	80%	120%	94%	80%	120%
Dissolved Manganese	800098	800098	0.036	0.035	1.6%	< 0.005	99%	80%	120%	93%	80%	120%	84%	80%	120%

Comments: If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution.  
If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

pH has been analyzed past the recommended holding time of 15 minutes from sampling (field measurement ideal if more accurate data required)

Nitrate and Nitrite: The regulatory hold time for the analysis of nitrate and/or nitrite in water is 72 hours.

**Microbial Analysis**

Total Coliforms (MPN)	2705	136	<1	<1	NA	< 1
Fecal Coliforms (MPN)	2705	136	<1	<1	NA	< 1

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

**Water Analysis - NH3, TOC, T-P**

Ammonia, Total (as N)	811925		<0.05	<0.05	NA	< 0.05	101%	80%	120%	103%	80%	120%	91%	80%	120%
Total Organic Carbon	800100		11	11	0.0%	< 1	96%	80%	120%	119%	80%	120%	NA	80%	120%
Total Phosphorus	787293		0.18	0.20	NA	< 0.08	95%	80%	120%	91%	80%	120%	96%	80%	120%

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

**Water Analysis - TKN**

Total Kjeldahl Nitrogen	351	800136	< 0.1	< 0.1	NA	< 0.1	97%	80%	120%
-------------------------	-----	--------	-------	-------	----	-------	-----	-----	------

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.



## Quality Assurance

CLIENT NAME: WSP CANADA INC.

AGAT WORK ORDER: 19C555977

PROJECT: 19M-01812-00 / Lake Minewanka

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY:

### Water Analysis (Continued)

RPT Date:		DUPLICATE				Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE		MATRIX SPIKE	
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper

Certified By: \_\_\_\_\_

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*Results relate only to the items tested. Results apply to samples as received.*

## Method Summary

CLIENT NAME: WSP CANADA INC.

AGAT WORK ORDER: 19C555977

PROJECT: 19M-01812-00 / Lake Minewanka

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Total Coliforms (MPN)	MIC 0205	SM 9223	INCUBATOR
Fecal Coliforms (MPN)	MIC-0205	SM 9223	INCUBATOR
pH	INST 0101, INST 0104	SM 4500 H+	PH METER
p - Alkalinity (as CaCO <sub>3</sub> )	INST 0101	SM 2320 B	TITRATION
T - Alkalinity (as CaCO <sub>3</sub> )	INST 0101	SM 2320 B	TITRATION
Bicarbonate	INST 0101	SM 2320 B	PC TITRATE
Carbonate	INST 0101	SM 2320 B	PC TITRATE
Hydroxide	WAT 0310	SM 2320 B	TITRATION
Electrical Conductivity	INST 0101, INST 0120	SM 2510 B	CONDUCTIVITY METER
Chloride	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Fluoride	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Nitrate	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Nitrate-N	INST 0150	SM 4110 B	CALCULATION
Nitrite	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Nitrite-N	INST 0150	SM 4110 B	CALCULATION
Nitrate+Nitrite - Nitrogen	INST 0150	SM 4110 B	CALCULATION
Sulfate	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Dissolved Calcium	INST 0140	SM 3120 B DW -R	ICP/OES
Dissolved Magnesium	INST 0140	SM 3120 B DW -R	ICP/OES
Dissolved Sodium	INST 0140	SM 3120 B DW -R	ICP/OES
Dissolved Potassium	INST 0140	SM 3120 B DW -R	ICP/OES
Dissolved Iron	INST 0140	SM 3120 B DW -R	ICP/OES
Dissolved Manganese	INST 0140	SM 3120 B DW -R	ICP/OES
Calculated TDS		SM 1030E	CALCULATION
Sodium Adsorption Ratio		CARTER & GREGORICH 2007	CALCULATION
Hardness		SM 2340 B	CALCULATION
Ion Balance		SM 1030E	CALCULATION
Ammonia, Total (as N)	INST-0420	SM 4500-NH <sub>3</sub> G	DISCRETE ANALYZER
Total Organic Carbon	INST 0170	SM 5310 B	COMBUSTION
Total Phosphorus	WATR 0200; INST 0140	SM 3030 E; SM 3120 B TW	ICP/OES
Total Kjeldahl Nitrogen	INOR-171-6220	SM 4500-N org D TW	SPECTROPHOTOMETER





# AGAT Laboratories

## SAMPLE INTEGRITY RECEIPT FORM

### RECEIVING BASICS - Shipping

Company/Consultant: WSP

Courier: 0/0 Prepaid Collect

Waybill# \_\_\_\_\_

Branch: EDM GP FN FM RD VAN LYD FSJ EST Other: -

If multiple sites were submitted at once:  Yes No

Custody Seal Intact: Yes No  NA

TAT: <24hr 24-48hr 48-72hr  Reg Other \_\_\_\_\_

Cooler Quantity: 1

### TIME SENSITIVE ISSUES - Shipping

ALREADY EXCEEDED HOLD TIME? Yes  No

Inorganic Tests (Please Circle):  Mibi, BOD, Nitrate/Nitrite, Turbidity, Microtox, Ortho PO4, Tedlar Bag, Residual Chlorine, Chlorophyll\*, Chloroamines\*

Earliest Expiry: 14-DEC-19 7:26pm

Hydrocarbons: Earliest Expiry N/A

### SAMPLE INTEGRITY - Shipping

Hazardous Samples: YES  NO Precaution Taken: \_\_\_\_\_

Legal Samples: Yes  No

International Samples: Yes  No

Tape Sealed: Yes  No

Coolant Used: Icepack Bagged Ice Free Ice Free Water  None

Temperature ( Bottles/Jars only) N/A if only Soil Bags Received

### FROZEN (Please Circle if samples received Frozen)

1 (Bottle/Jar) 17 + \_\_\_ + \_\_\_ = 17 °C    2 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C

3 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C    4 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C

5 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C    6 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C

7 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C    8 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C

9 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C    10 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C

(If more than 10 coolers are received use another sheet of paper and attach)

### LOGISTICS USE ONLY

Workorder No: 19C055977

Samples Damaged: Yes  No If YES why?

No Bubble Wrap Frozen Courier

Other: \_\_\_\_\_

Account Project Manager: \_\_\_\_\_ have they been notified of the above issues: Yes No

Whom spoken to: \_\_\_\_\_ Date/Time: \_\_\_\_\_

CPM Initial \_\_\_\_\_

General Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\* Subcontracted Analysis (See CPM)



# Attachment E

CASCADE PONDS DAY USE AREA



## SURVEY DATA



BOREHOLE AS-BUILT(M)						
POINT #	DESC.	DATE OF AS-BUILT	NORTHING	EASTING	TOP ELEVATION	GROUND ELEVATION
4005	CP19-MW-02GRND	17-Dec-19	5674614.601	602506.051	-	1395.873
4006	CP19-MW-02CAP	17-Dec-19	5674614.551	602506.088	1396.941	-
4184	CP19-SURFACEWATER02	20-Dec-19	5674267.442	602487.987	-	1390.978
4186	GRNDP19-P18-01	20-Dec-19	5674614.850	602412.438	1396.034	1396.034
4187	TOPPVCPIPECP19-P18-01	20-Dec-19	5674614.798	602412.469	1396.917	-
4189	GRNDP19-01	20-Dec-19	5674574.940	602418.319	-	1395.939
4190	TOPPVCPIPECP19-01	20-Dec-19	5674574.920	602418.380	1396.967	-
4191	GRNDP19-02	20-Dec-19	5674579.794	602395.298	-	1395.920
4192	TOPPVCPIPECP19-02	20-Dec-19	5674579.769	602395.346	1396.907	-
4193	CP19SURFACEWATER01	20-Dec-19	5674614.285	602627.706	-	1392.790



LEGEND:

X SURVEYED POINT

NOTES:

1. ALL ELEVATIONS AND DIMENSIONS ARE IN METERS AND DECIMALS THEREOF UNLESS SHOWN OTHERWISE.
2. DISTANCES SHOWN ARE BASED UPON NAD83 UTM GRID.
3. NORTH IS SHOWN RELATIVE TO NAD83 UTM SURVEY CONTROL.
4. BEARINGS AND COORDINATES ARE BASED ON THE NAD83 DATUM AND WERE DERIVED FROM GNSS OBSERVATIONS HOLDING PUBLISHED COORDINATE VALUES FOR A.S.C.M 320218.
5. ELEVATIONS ARE GEODETIC AND DERIVED FROM A.S.C.M 320218 (ELEVATION 1400.507)

THE INFORMATION CONTAINED ON THIS DRAWING, AND ANY DOCUMENTATION PERTAINING TO THIS DRAWING IS CURRENT AS OF December 20, 2019, AND AS PER REVISION SHOWN BELOW. ANY FACILITIES UNDER OR ABOVE GROUND INSTALLED AFTER THE AFORE MENTIONED DATE MAY NOT HAVE BEEN CONSIDERED IN THE PREPARATION OF THIS DOCUMENT, OR ITS SUPPORT DOCUMENTS.

REVISION TABLE

NO.	DATE (mm-dd-yy)	DESCRIPTION	BY	CHK
00	01-08-20	ORIGINAL ISSUE	PK	KS

DRAWING TITLE:  
BANFF GEOTECHNICAL TOPO SURVEY  
BOREHOLE AS-BUILT  
CASCADE POND DUA

CLIENT:



SCALE: 1:2000	DRAWING NUMBER: 19M-01812-G0-000-00-CSTAB002 - Sh3	REV. 0
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237 4th Ave SW, Suite 3200  
Calgary, Alberta  
T2P 4K3  
PH:(403)-266-2800



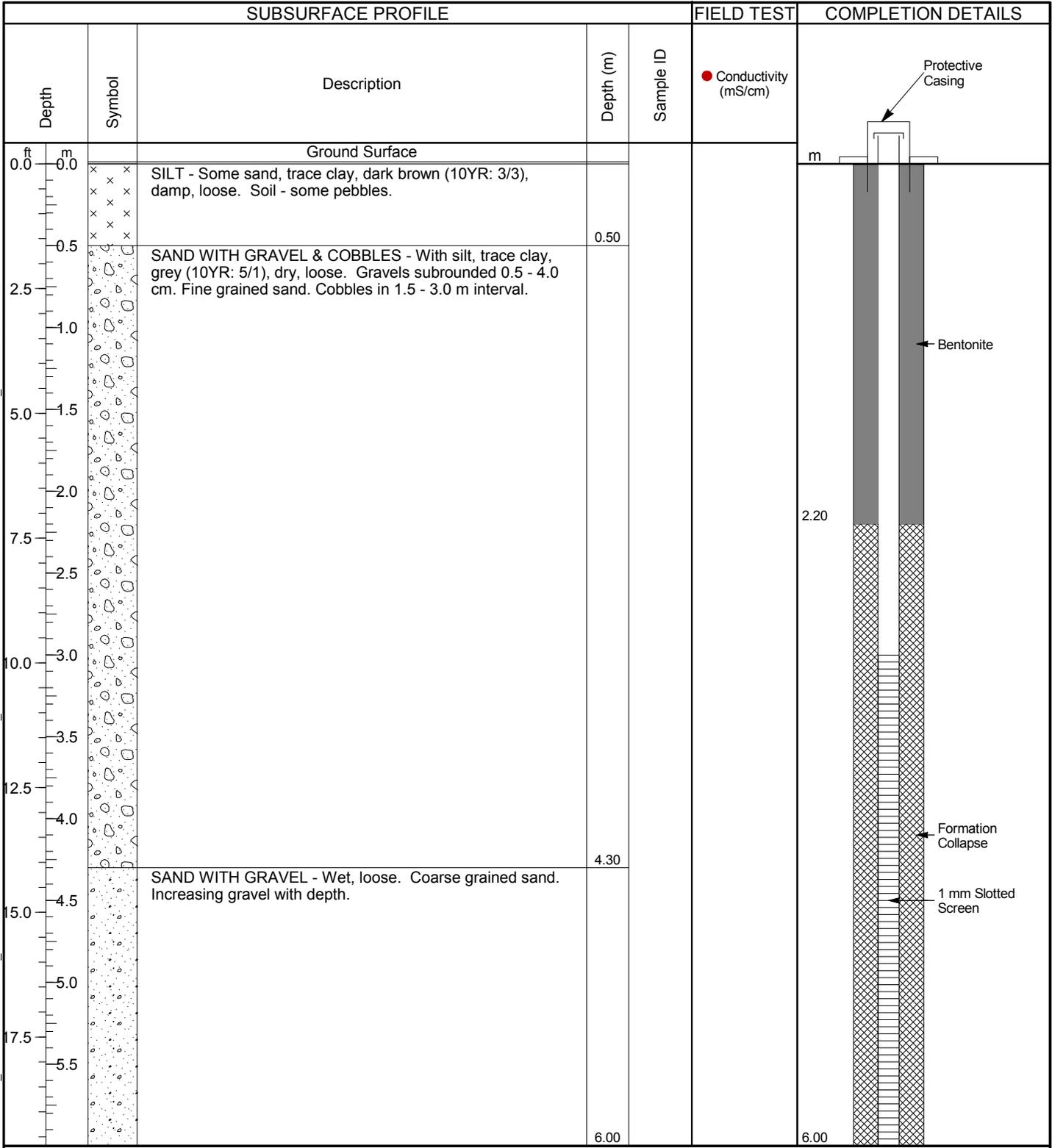
## BOREHOLE LOGS



**Client:** Parks Canada  
**Project:** Cascade Pond  
**Location:** 13-07-026-11 W5M

**Well ID:** P18-01  
**Borehole:** 18BH01

Drill Date: 21 October 2018      Drilled by: ERNCO Environmental      Datum: NAD83UTM (Zone 11) Total Depth: 6.00 m  
 Drill Method: Direct Push      Logged by: AB      Accuracy +/-:      Ground Elevation: 1400.000 m  
 Boring Diameter: 10.16 cm (4")      Compiled by: MAB      Northing: 5674612      Casing Elevation:  
 Well Diameter: 5.08 cm (2")      Soil Classification System: USCS      Easting: 602405      Surface Completion: Above-ground



T:\CLIENTS\PROJECTS\_2014\IN\LOCATION\_PROJECTS\PARKS CANADA\181-13597-12\_CAMPGROUND GEO AND SEPTIC WORKING\CASCADE\_POND\_GPJ\_2411/19

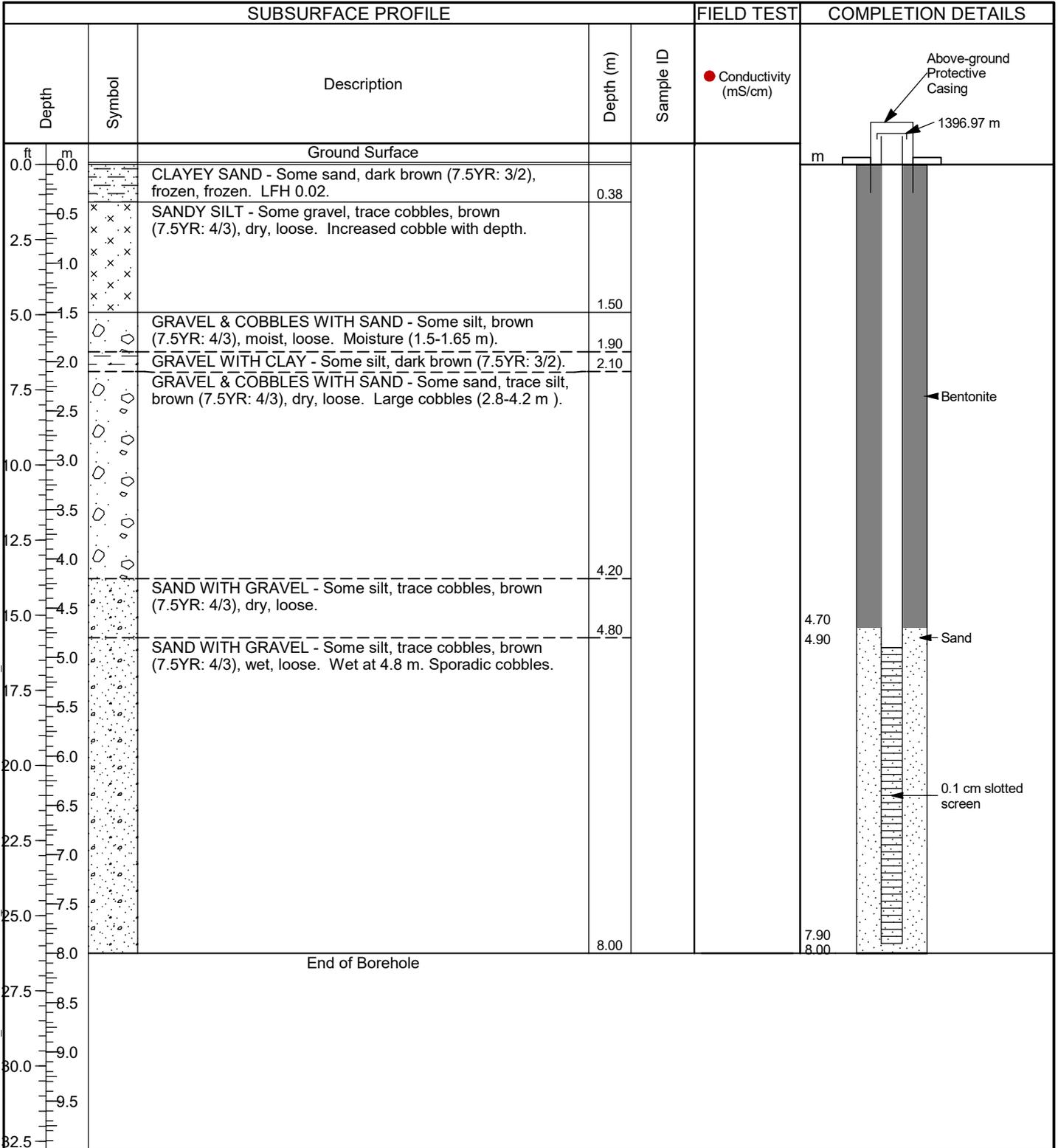


**Client:** Parks Canada  
**Project:** Cascade Ponds Day Use Area  
**Location:** 13-07-026-11 5

**Well ID:** P19-1  
**Borehole:** 19BH01

Drill Date: 2019 December 8      Drilled by: ERNCO Environmental      Datum: NAD83UTM (Zone 11) Total Depth: 8.00 m  
 Drill Method: Direct Push      Logged by: PL      Accuracy +/-:      Ground Elevation: 1395.939 m  
 Boring Diameter: 10.16 cm (4")      Compiled by: Steven Minckler      Northing: 5674574.94      Casing Elevation: 1396.967 m  
 Well Diameter: 5.08 cm (2")      Soil Classification System: USCS      Easting: 602418.319      Surface Completion: Above-ground

T:\ENV\ROCLIENTS\PROJECTS\_2014\NOLOCATION\_PROJECTS\PARKS CANADA\19M-018\2-00\_CASTLE MT\NBORHOLE LOGS\CASCADE PONDS DUA.GPJ 20/2/27



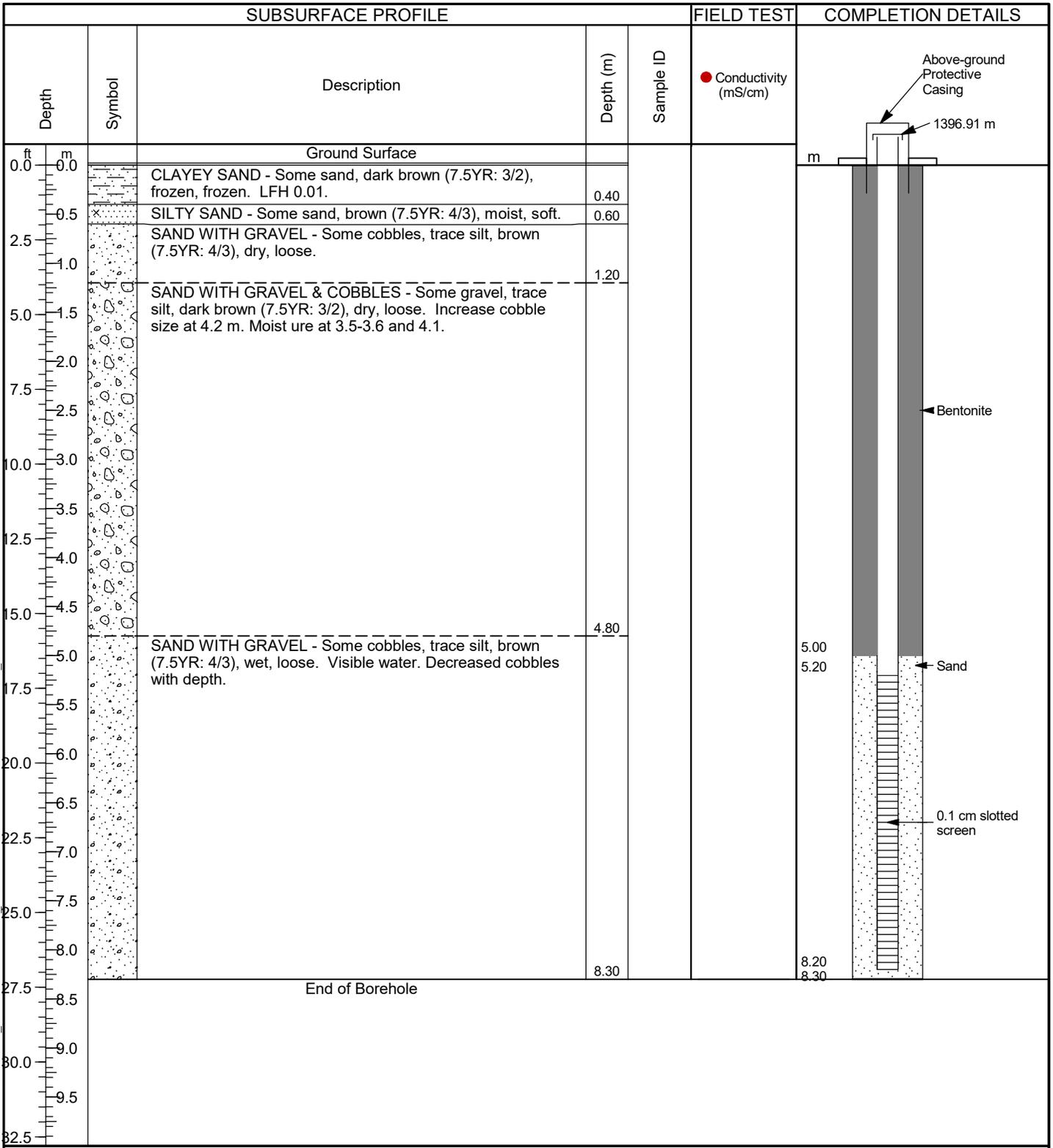


**Client:** Parks Canada  
**Project:** Cascade Ponds Day Use Area  
**Location:** 13-07-026-11 5

**Well ID:** P19-2  
**Borehole:** 19BH02

Drill Date: 2019 December 8      Drilled by: ERNCO Environmental      Datum: NAD83UTM (Zone 11) Total Depth: 8.30 m  
 Drill Method: Direct Push      Logged by: PL      Accuracy +/-:      Ground Elevation: 1395.920 m  
 Boring Diameter: 10.16 cm (4")      Compiled by: Steven Minckler      Northing: 5674579.794      Casing Elevation: 1396.907 m  
 Well Diameter: 5.08 cm (2")      Soil Classification System: USCS      Easting: 602395.298      Surface Completion: Above-ground

T:\ENV\ROCLIENTS\PROJECTS\_2014\NOLOCATION\_PROJECTS\PARKS CANADA\19M-018\2-00\_CASTLE MT\NBREHOLE LOGS\CASCADE PONDS DUA.GPJ 20/2/27





## GEO TECHNICAL LAB DATA



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

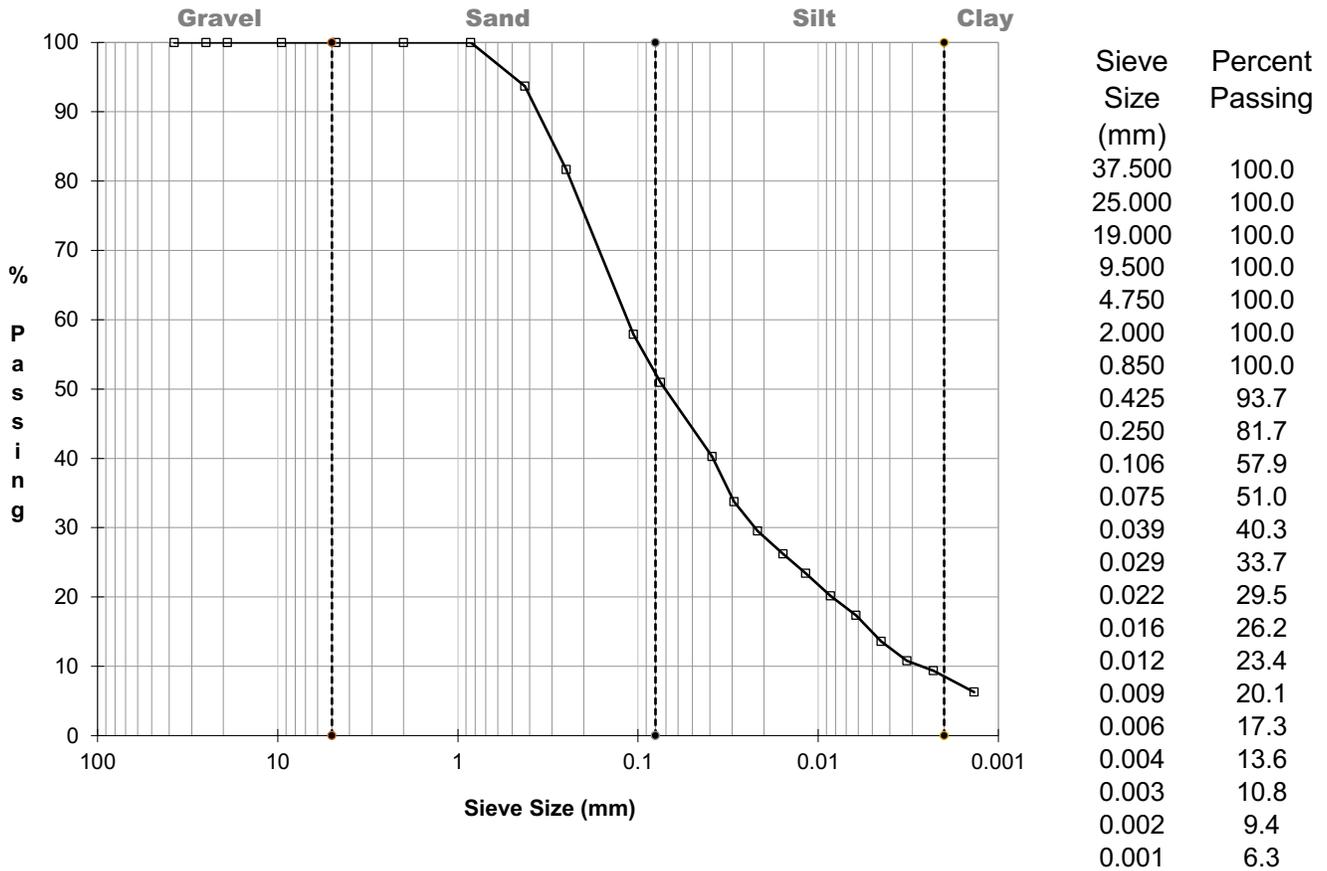
# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-01  
 Sample Depth: 1 m  
 Source: Cascade Mountain  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 6, 2020 Date Received: December 18, 2019



Sand = 0.0 %  
 Sand = 49.0 %  
 Silt = 41.6 %  
 Clay = 9.4 %

Sample Description: Silty SAND trace of clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

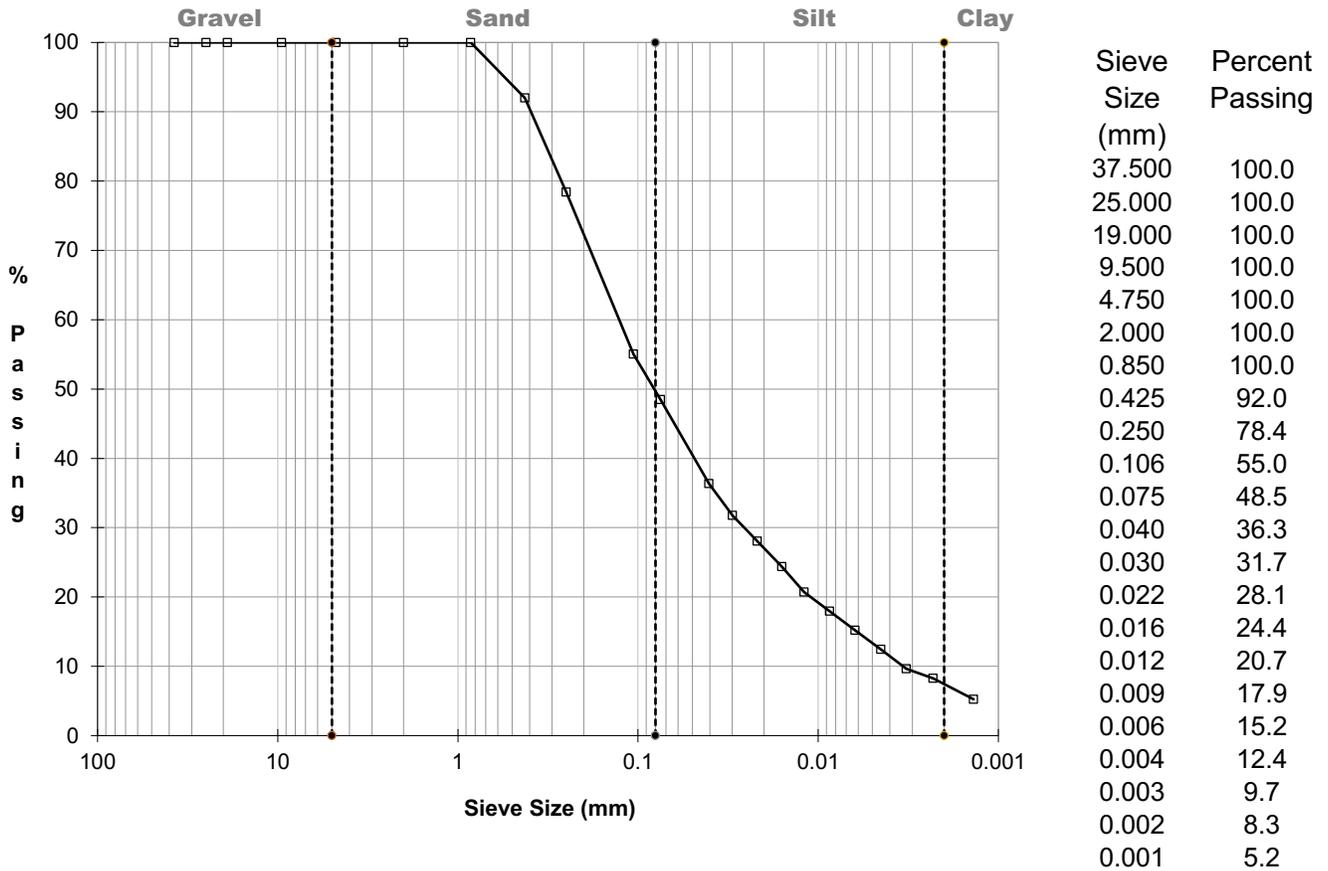
# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-01  
 Sample Depth: 2 m  
 Source: Cascade Mountain  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 6, 2020 Date Received: December 18, 2019



Gravel = 0.0 %  
 Sand = 51.5 %  
 Silt = 40.2 %  
 Clay = 8.3 %

Sample Description: Silty SAND trace of clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

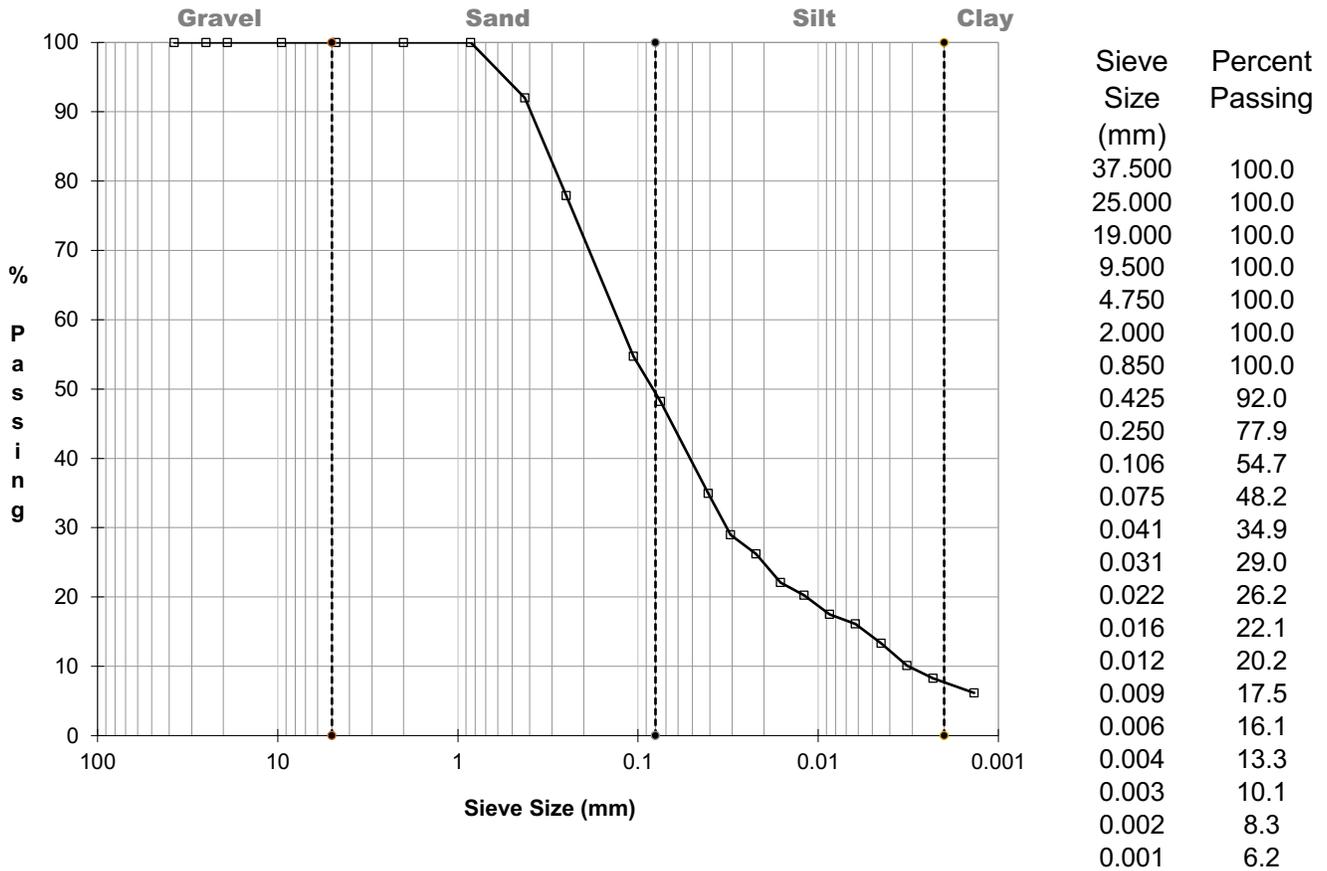
# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-01  
 Sample Depth: 3 m  
 Source: Cascade Mountain  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 6, 2020 Date Received: December 18, 2019



Gravel = 0.0 %  
 Sand = 51.8 %  
 Silt = 39.9 %  
 Clay = 8.3 %

Sample Description: Silty SAND trace of clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

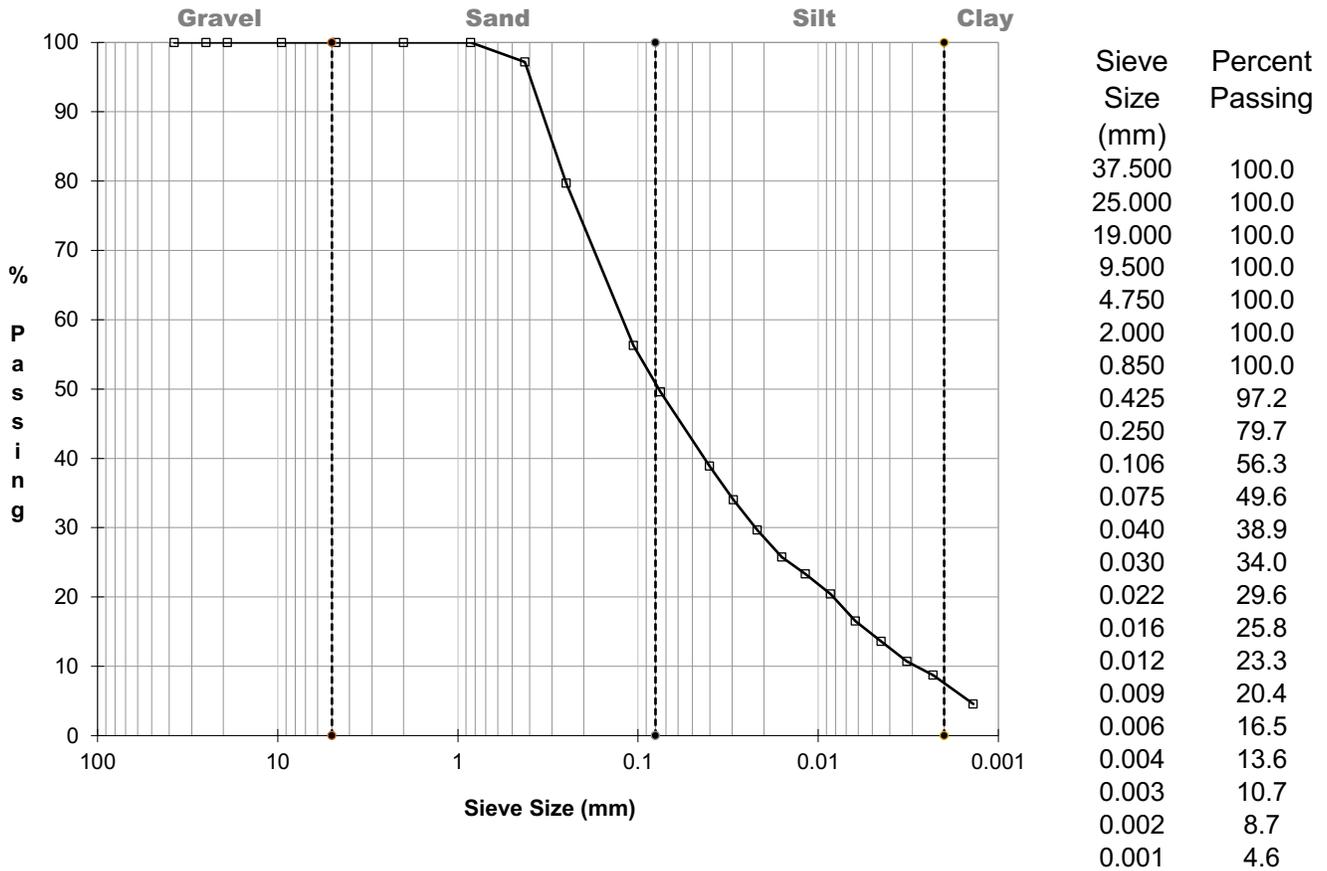
# Sieve Analysis

Report Date: January 10, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-02  
 Sample Depth: 2m  
 Source: Cascade Mountain  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 6, 2020 Date Received: December 18, 2019



Gravel = 0.0 %  
 Sand = 50.4 %  
 Silt = 40.9 %  
 Clay = 8.7 %

Sample Description: Silty SAND trace clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

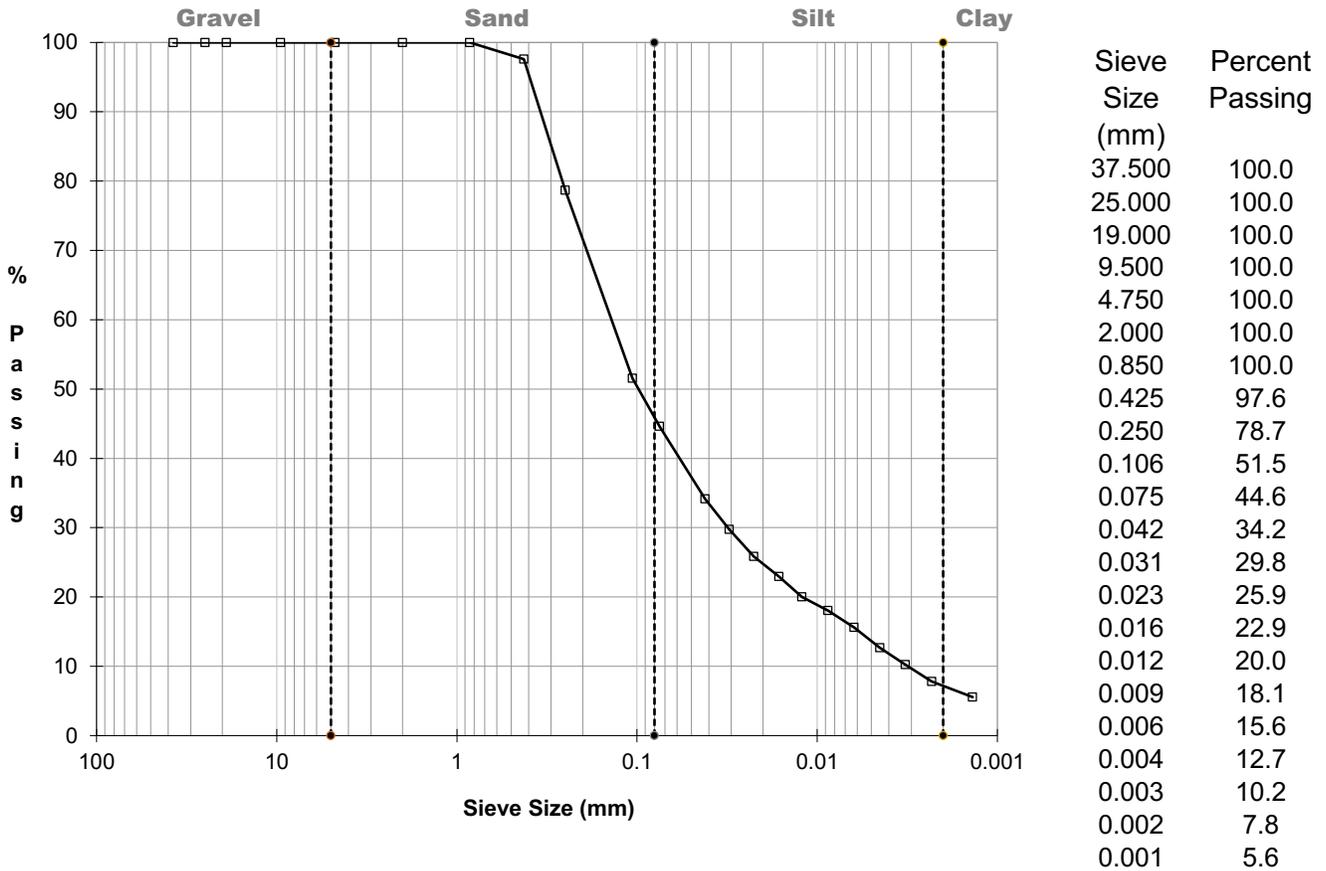
# Sieve Analysis

Report Date: January 10, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: BH19-02  
 Sample Depth: 3m  
 Source: Cascade Mountain  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 6, 2020 Date Received: December 18, 2019



Gravel = 0.0 %  
 Sand = 55.4 %  
 Silt = 36.8 %  
 Clay = 7.8 %

Sample Description: Silty SAND trace clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



## HYDRAULIC CONDUCTIVITY



WSP  
 1200, 10909 Jasper Avenue  
 Edmonton, Alberta  
 T5J 3L9

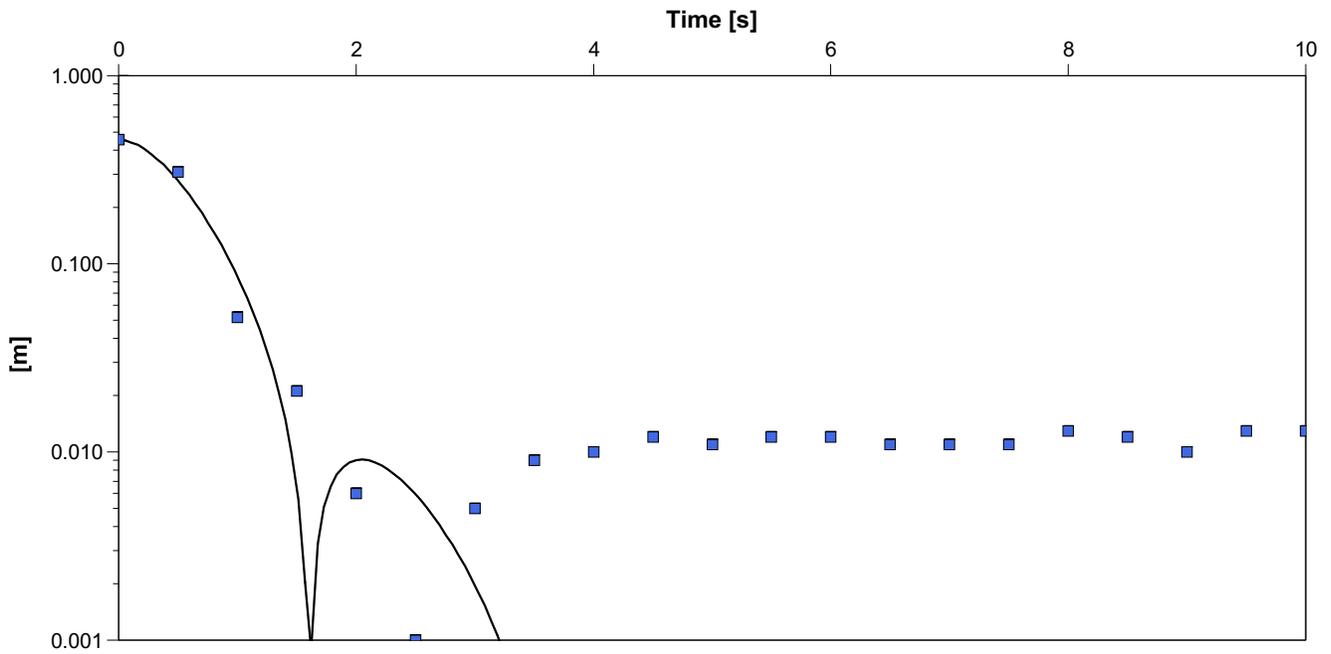
**Slug Test Analysis Report**

Project: Cascade Ponds DUA

Number: 19M-01812-00

Client: Parks Canada

Location:	Slug Test: P18-01 Rising Head 1	Test Well: P18-01
Test Conducted by: Alyssa Barker		Test Date: 18/12/2019
Analysis Performed by: Steven Minckler	Butler High-K	Analysis Date: 10/01/2020
Aquifer Thickness: 6.00 m		



Calculation using Butler High-K

Observation Well	tD/t	Hydraulic Conductivity m/s	CD
P18-01	$2.45 \times 10^0$	$1.64 \times 10^{-3}$	$1.56 \times 10^0$



WSP  
 1200, 10909 Jasper Avenue  
 Edmonton, Alberta  
 T5J 3L9

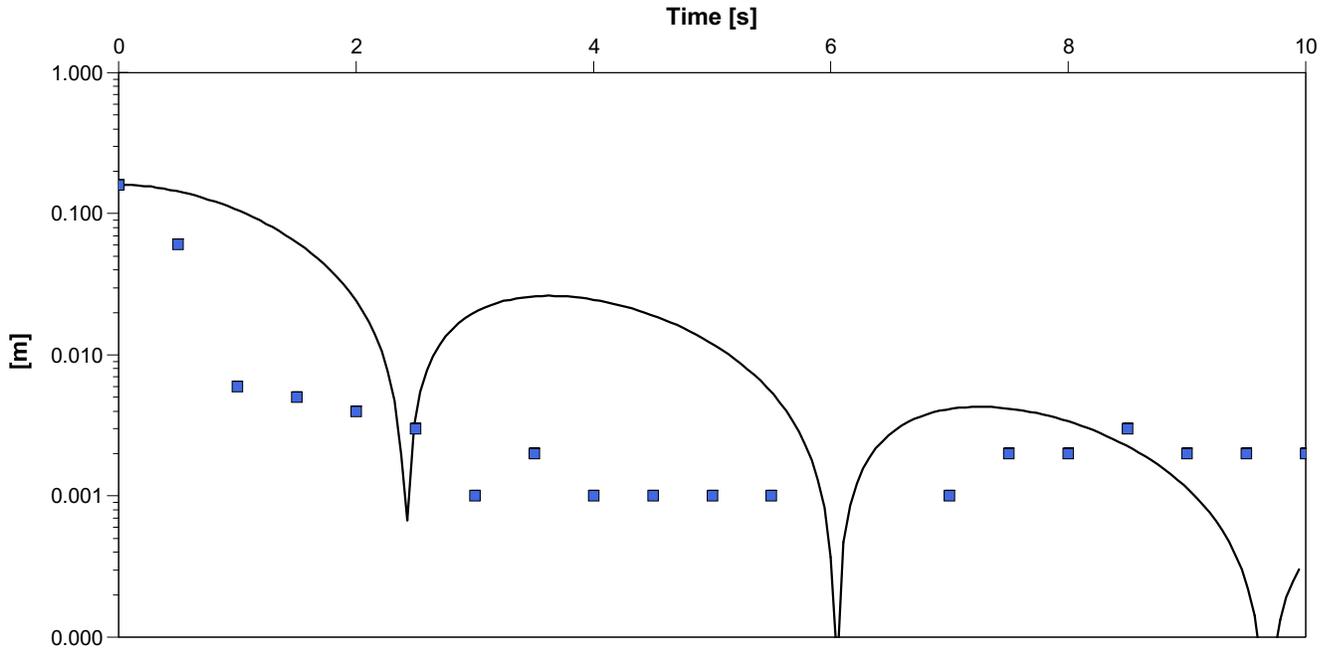
**Slug Test Analysis Report**

Project: Cascade Ponds DUA

Number: 19M-01812-00

Client: Parks Canada

Location:	Slug Test: P18-01 Rising Head 2	Test Well: P18-01
Test Conducted by: Alyssa Barker		Test Date: 18/12/2019
Analysis Performed by: Steven Minckler	Butler High-K	Analysis Date: 10/01/2020
Aquifer Thickness: 6.00 m		



Calculation using Butler High-K

Observation Well	tD/t	Hydraulic Conductivity m/s	CD
P18-01	$1.00 \times 10^0$	$1.04 \times 10^{-3}$	$1.00 \times 10^0$



WSP  
 1200, 10909 Jasper Avenue  
 Edmonton, Alberta  
 T5J 3L9

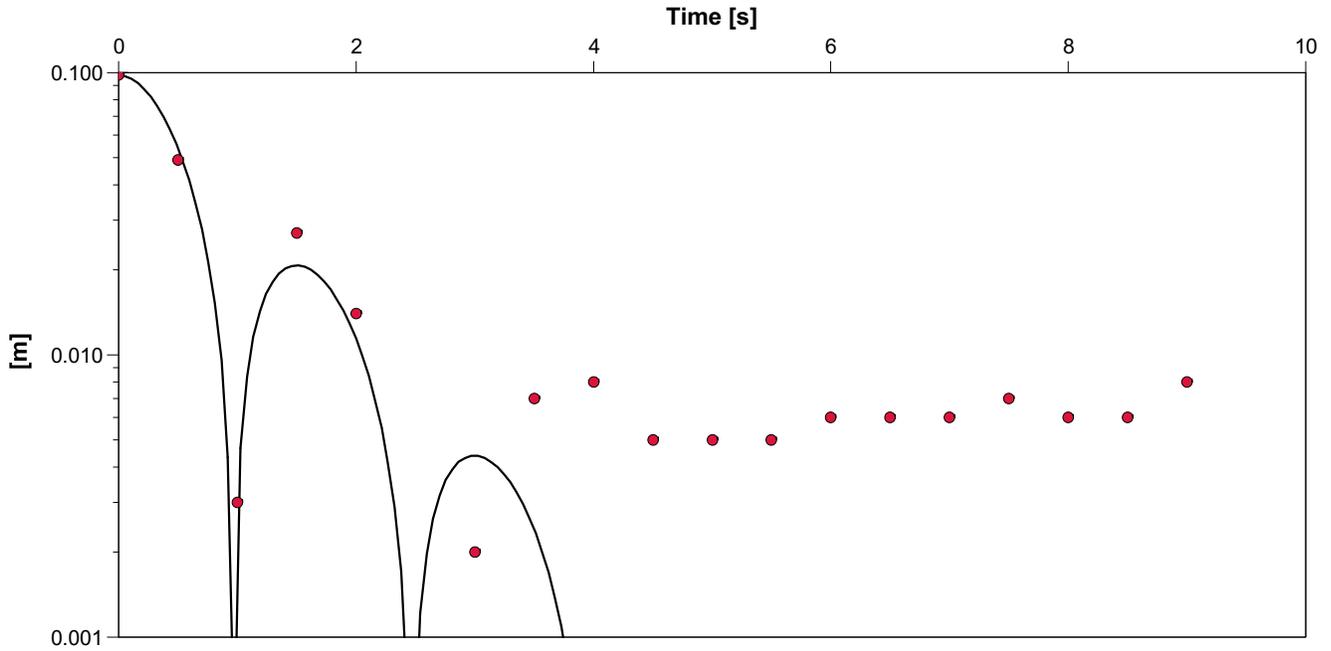
**Slug Test Analysis Report**

Project: Cascade Ponds DUA

Number: 19M-01812-00

Client: Parks Canada

Location:	Slug Test: P19-01 Rising Head 1	Test Well: P19-01
Test Conducted by: Alyssa Barker		Test Date: 18/12/2019
Analysis Performed by: Steven Minckler	Butler High-K	Analysis Date: 10/01/2020
Aquifer Thickness: 8.86 m		



Calculation using Butler High-K

Observation Well	tD/t	Hydraulic Conductivity m/s	CD
P19-01	$2.34 \times 10^0$	$3.18 \times 10^{-3}$	$8.86 \times 10^{-1}$



WSP  
 1200, 10909 Jasper Avenue  
 Edmonton, Alberta  
 T5J 3L9

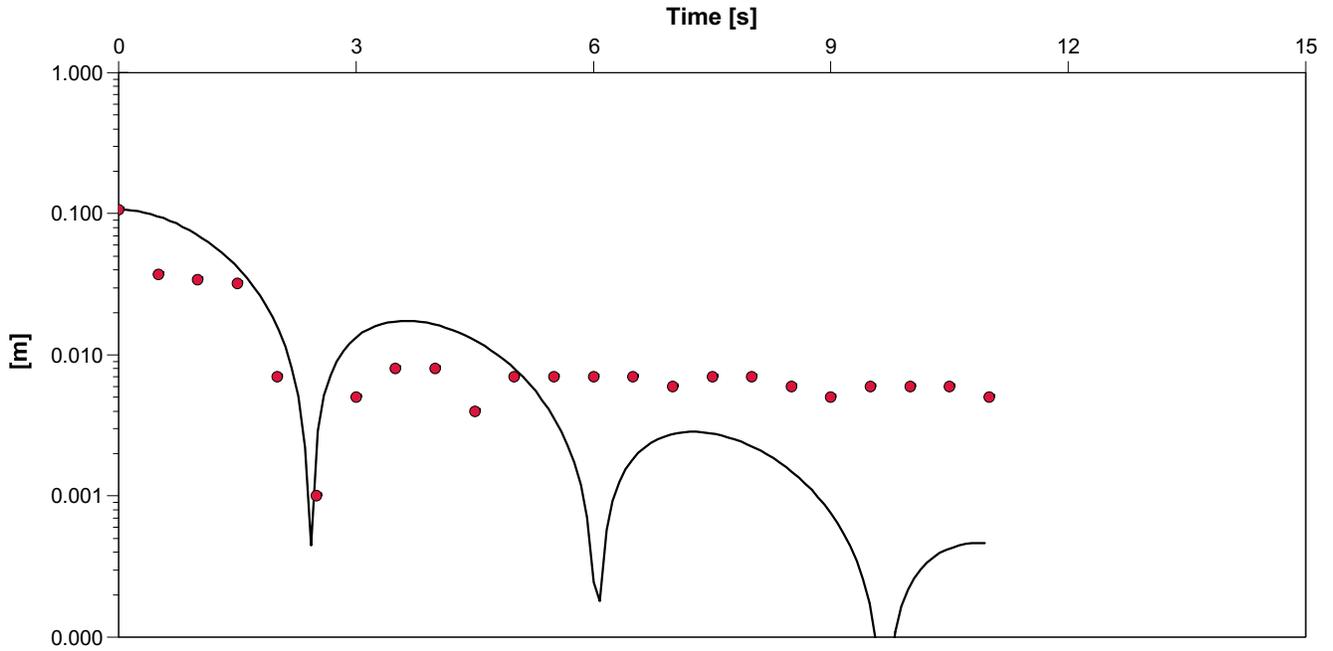
**Slug Test Analysis Report**

Project: Cascade Ponds DUA

Number: 19M-01812-00

Client: Parks Canada

Location:	Slug Test: P19-01 Rising Head 2	Test Well: P19-01
Test Conducted by: Alyssa Barker		Test Date: 18/12/2019
Analysis Performed by: Steven Minckler	Butler High-K	Analysis Date: 10/01/2020
Aquifer Thickness: 8.86 m		



Calculation using Butler High-K

Observation Well	tD/t	Hydraulic Conductivity m/s	CD
P19-01	$1.00 \times 10^0$	$1.21 \times 10^{-3}$	$1.00 \times 10^0$



WSP  
 1200, 10909 Jasper Avenue  
 Edmonton, Alberta  
 T5J 3L9

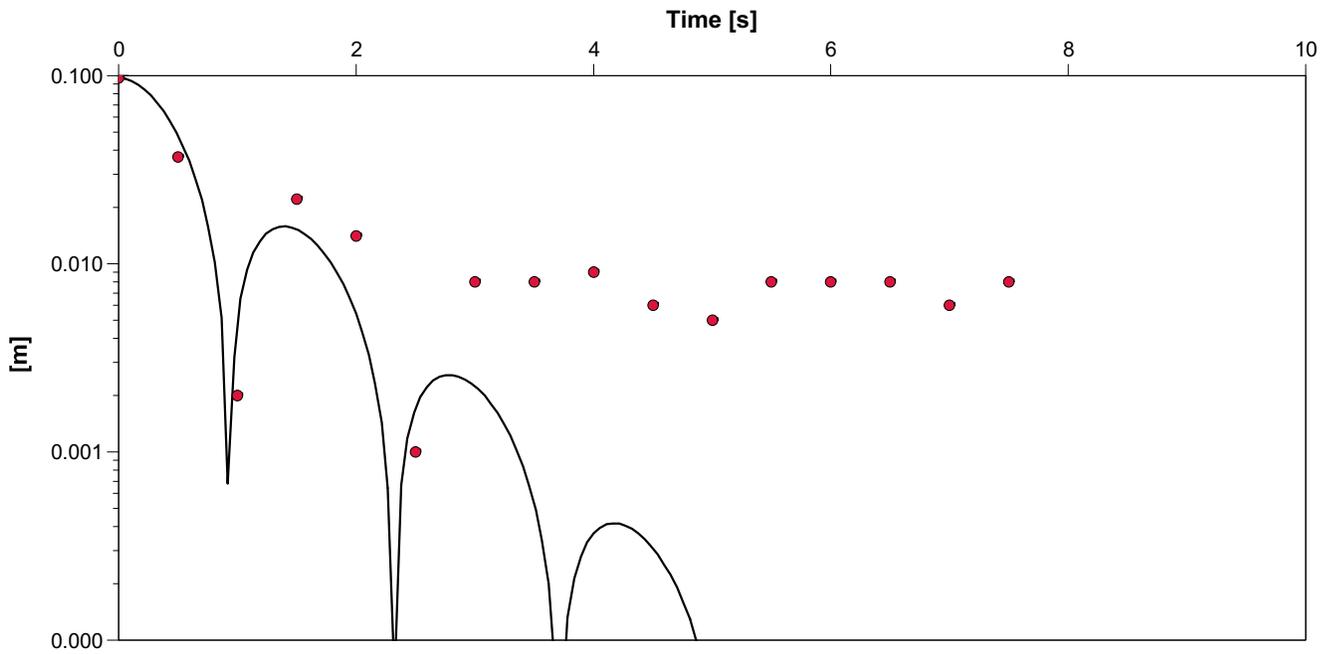
**Slug Test Analysis Report**

Project: Cascade Ponds DUA

Number: 19M-01812-00

Client: Parks Canada

Location:	Slug Test: P19-01 Rising Head 3	Test Well: P19-01
Test Conducted by: Alyssa Barker		Test Date: 18/12/2019
Analysis Performed by: Steven Minckler	Butler High-K	Analysis Date: 14/01/2020
Aquifer Thickness: 8.86 m		



Calculation using Butler High-K

Observation Well	tD/t	Hydraulic Conductivity m/s	CD
P19-01	$2.61 \times 10^0$	$3.14 \times 10^{-3}$	$1.00 \times 10^0$



WSP  
 1200, 10909 Jasper Avenue  
 Edmonton, Alberta  
 T5J 3L9

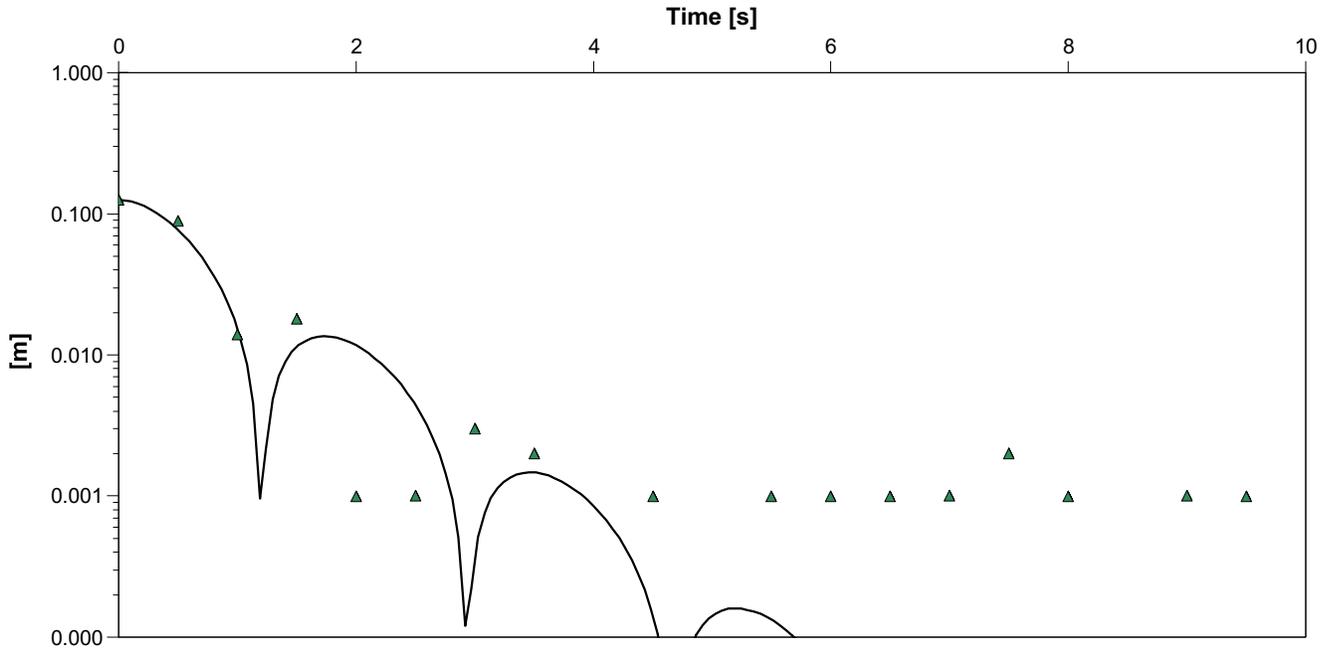
**Slug Test Analysis Report**

Project: Cascade Ponds DUA

Number: 19M-01812-00

Client: Parks Canada

Location:	Slug Test: P19-02 Rising Head 1	Test Well: P19-02
Test Conducted by: Alyssa Barker		Test Date: 18/12/2019
Analysis Performed by: Steven Minckler	Butler High-K	Analysis Date: 14/01/2020
Aquifer Thickness: 8.30 m		



Calculation using Butler High-K

Observation Well	tD/t	Hydraulic Conductivity m/s	CD
P19-02	$2.22 \times 10^0$	$2.26 \times 10^{-3}$	$1.15 \times 10^0$



WSP  
 1200, 10909 Jasper Avenue  
 Edmonton, Alberta  
 T5J 3L9

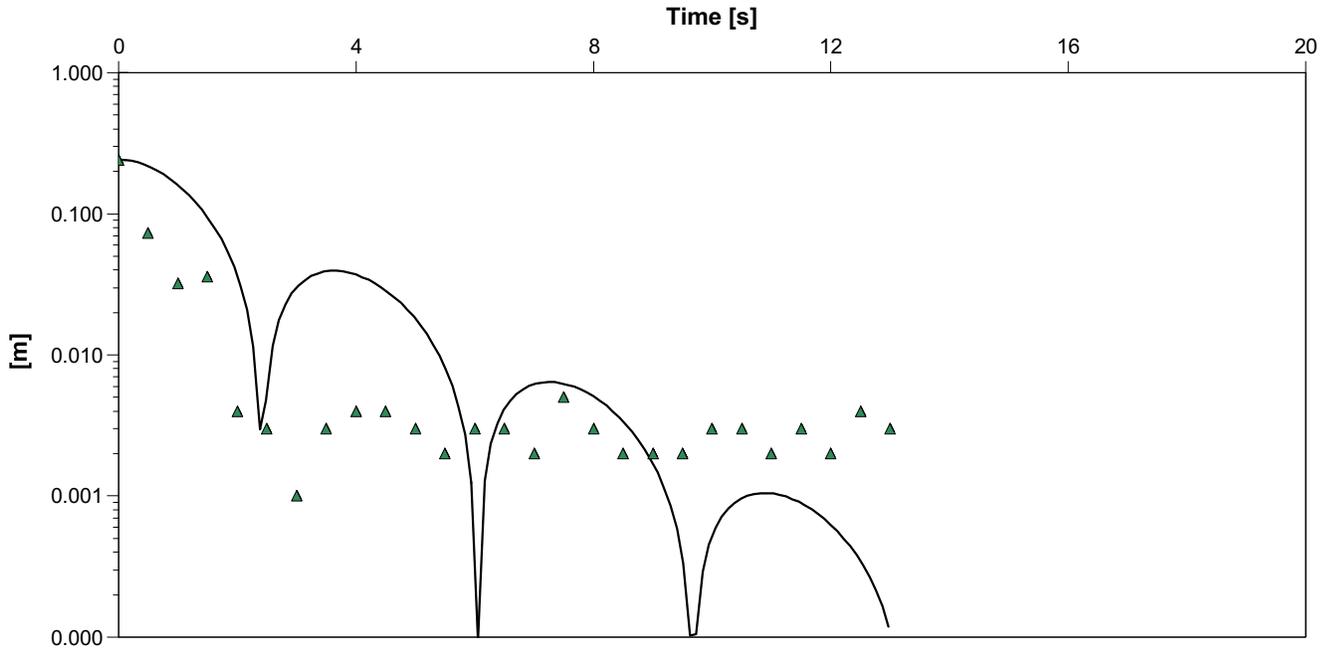
**Slug Test Analysis Report**

Project: Cascade Ponds DUA

Number: 19M-01812-00

Client: Parks Canada

Location:	Slug Test: P19-02 Rising Head 2	Test Well: P19-02
Test Conducted by: Alyssa Barker		Test Date: 18/12/2019
Analysis Performed by: Steven Minckler	Butler High-K	Analysis Date: 14/01/2020
Aquifer Thickness: 8.30 m		



Calculation using Butler High-K

Observation Well	tD/t	Hydraulic Conductivity m/s	CD
P19-02	$1.00 \times 10^0$	$1.18 \times 10^{-3}$	$1.00 \times 10^0$



WSP  
 1200, 10909 Jasper Avenue  
 Edmonton, Alberta  
 T5J 3L9

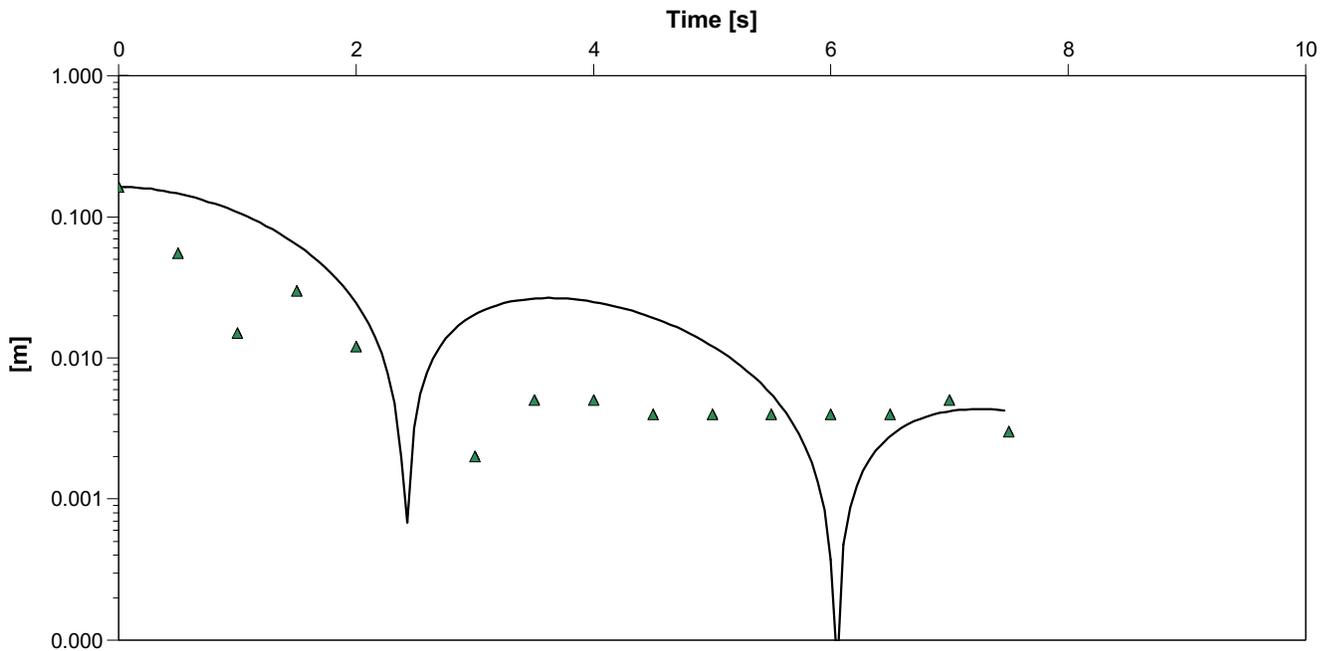
**Slug Test Analysis Report**

Project: Cascade Ponds DUA

Number: 19M-01812-00

Client: Parks Canada

Location:	Slug Test: P19-02 Rising Head 3	Test Well: P19-02
Test Conducted by: Alyssa Barker		Test Date: 18/12/2019
Analysis Performed by: Steven Minckler	Butler High-K	Analysis Date: 14/01/2020
Aquifer Thickness: 8.30 m		



Calculation using Butler High-K

Observation Well	tD/t	Hydraulic Conductivity m/s	CD	
P19-02	$1.00 \times 10^0$	$1.18 \times 10^{-3}$	$1.00 \times 10^0$	



## MONITORING DATA

**TABLE 1. MONITORING WELL SUMMARY**  
**Parks Canada - Banff National Park - Cascade Ponds Day Use Area**

Monitoring Well	Elevation (masl)			Depth						Hydraulic Conductivity (m/s)	Method	Lithology of Screened Interval
	Ground Surface	Top of Casing	Water Elevation 13-Dec-19	Total Drilled (mbgs)	Top of Screen (mbgs)	Base of Screen (mbgs)	Measured Well Depth (mbtoc)	Water Level (mbgs) 13-Dec-19	Water Level (mbtoc) 13-Dec-19			
P18-01	1396.034	1396.917	1391.699	6.00	3.00	6.00	6.72	4.34	5.22	1.04 to 1.64 x 10 <sup>-3</sup>	B&R and Butler	Sand with gravel
P19-01	1395.939	1396.967	1391.585	8.00	4.90	7.90	8.00	4.35	5.38	1.21 to 3.18 x 10 <sup>-3</sup>	Butler	Sand with gravel, some silt, trace cobbles
P19-02	1395.920	1396.907	1391.593	8.30	5.20	8.20	8.30	4.33	5.31	1.18 to 2.26 x 10 <sup>-3</sup>	Butler	Sand with gravel, some cobbles, trace silt

Note: B&R - Bouwer and Rice analysis method (Bouwer and Rice, 1976)  
 Butler - Butler High-K analysis method (Butler, 2003)  
 masl - metres above sea level  
 mbgs - metres below ground surface  
 mbtoc - metres below top of casing

**TABLE 2. WATER QUALITY RESULTS - ROUTINE AND INDICATOR ANALYSIS**  
**Parks Canada - Banff National Park - Cascade Ponds Day Use Area**

Monitoring Well	Sample Date	Electrical Conductivity (EC) ( $\mu\text{S}/\text{cm}$ )	Sodium Adsorption Ratio (SAR)	pH	Total Dissolved Solids (TDS) (mg/L)	Ion Balance (%)	Alkalinity (Total as $\text{CaCO}_3$ ) (mg/L)	Hardness ( $\text{CaCO}_3$ ) (mg/L)	Bicarbonate ( $\text{HCO}_3$ ) (mg/L)	Carbonate ( $\text{CO}_3$ ) (mg/L)	Hydroxide ( $\text{OH}$ ) (mg/L)	Chloride (Cl) (mg/L)	Fluoride (F) (mg/L)	Sulphate ( $\text{SO}_4$ ) (mg/L)	Nitrate+Nitrite-N ( $\text{NO}_3\text{-N}+\text{NO}_2\text{-N}$ ) (mg/L)	Nitrate-N ( $\text{NO}_3\text{-N}$ ) (mg/L)	Nitrite-N ( $\text{NO}_2\text{-N}$ ) (mg/L)	Phosphorous (P) (mg/L)	Calcium (Ca) (mg/L)	Magnesium (Mg) (mg/L)	Potassium (K) (mg/L)	Sodium (Na) (mg/L)	Iron (Fe) (mg/L)	Manganese (Mn) (mg/L)	Fecal Coliforms (MPN) (MPN/100 mL)	Total Coliforms (MPN) (MPN/100 mL)	Ammonia, Total (as N) (mg/L)	Total Organic Carbon (mg/L)	Total Kjeldahl Nitrogen (mg/L)
AT1 - Natural Area (coarse-grained)		NS	NS	6.5-8.5	500	NS	NS	NS	NS	NS	NS	120	1.5	429 <sup>1</sup>	NS	3	0.02 <sup>2</sup>	NS	NS	NS	NS	200	0.3	0.05	NS	NS	NS	NS	NS
P18-01	13-Dec-19	447	0.07	8.14	242	105	144	226	175	<5	<5	1	0.15	71	0.29	0.29	<0.01	1.32	61.5	17.6	0.8	2.4	<0.1	<0.005	<1	<1	<0.20	2	0.2
P19-01	13-Dec-19	456	0.06	8.00	247	107	152	235	185	<5	<5	<1	0.15	70	0.11	0.11	<0.01	0.32	64.6	18.0	0.8	2.2	<0.1	<0.005	<1	<1	<0.20	1	<0.1
P19-02	13-Dec-19	449	0.07	8.12	244	106	147	229	180	<5	<5	1	0.15	70	0.11	0.11	<0.01	0.32	62.4	17.8	0.9	2.5	<0.1	<0.005	<1	<1	<0.20	2	0.3

Note: "-" - Not Analyzed

"<" - Below laboratory detection limits; detection limits are less than the applied guideline

NS - No Standards

AT1 - Alberta Tier 1 Soil and Groundwater Remediation Guidelines - Coarse-Grained (AEP, 2019)

SWQG - Surface Water Quality Guidelines (SWQG) for the Protection of Freshwater Aquatic Life - Environmental Quality Guidelines for Alberta Surface Waters (Government of Alberta, 2018)

<sup>1</sup> SWQG Table 1.7 - Guideline varies with hardness at each sample location. Range represents site-specific minimum and maximum guideline values (Government of Alberta, 2018)

<sup>2</sup> SWQG Table 1.4 - Guideline varies with chloride at each sample location (Government of Alberta, 2018)

Shading indicates values above the applicable guidelines





# LABORATORY REPORT



CLIENT NAME: WSP CANADA INC.  
10909 JASPER AVE, SUITE 1200  
EDMONTON, AB T5J 3L9  
(780) 435-4477

ATTENTION TO: Alyssa Barker

PROJECT: 19M-01812-00 / Cascade Ponds

AGAT WORK ORDER: 19C555986

WATER ANALYSIS REVIEWED BY: Dev Vyas, Inorganics Laboratory Manager

DATE REPORTED: Dec 19, 2019

PAGES (INCLUDING COVER): 11

VERSION\*: 1

Should you require any information regarding this analysis please contact your client services representative at (403) 735-2005

\*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.



## Certificate of Analysis

AGAT WORK ORDER: 19C555986

PROJECT: 19M-01812-00 / Cascade Ponds

2910 12TH STREET NE  
 CALGARY, ALBERTA  
 CANADA T2E 7P7  
 TEL (403)735-2005  
 FAX (403)735-2771  
<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY:

### Microbial Analysis

DATE RECEIVED: 2019-12-14

DATE REPORTED: 2019-12-15

Parameter	Unit	G / S	RDL	SAMPLE DESCRIPTION:		
				CP-19-01	CP-19-02	P18-01
				Water	Water	Water
				2019-12-13 09:30	2019-12-13 09:55	2019-12-13 10:55
				800136	800137	800138
Total Coliforms (MPN)	MPN/100 mL	1	<1	<1	<1	<1
Fecal Coliforms (MPN)	MPN/100 mL	1	<1	<1	<1	<1

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Calgary (unless marked by \*)

Certified By:



## Certificate of Analysis

AGAT WORK ORDER: 19C555986

PROJECT: 19M-01812-00 / Cascade Ponds

2910 12TH STREET NE  
CALGARY, ALBERTA  
CANADA T2E 7P7  
TEL (403)735-2005  
FAX (403)735-2771  
<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY:

### Routine Chemistry Water Analysis (WSP)

DATE RECEIVED: 2019-12-14

DATE REPORTED: 2019-12-17

Parameter	Unit	SAMPLE DESCRIPTION:				
		G / S	RDL	CP-19-01	CP-19-02	P18-01
				Water	Water	Water
				2019-12-13 09:30	2019-12-13 09:55	2019-12-13 10:55
				800136	800137	800138
pH	pH Units	7.0-10.5	N/A	8.00	8.12	8.14
p - Alkalinity (as CaCO <sub>3</sub> )	mg/L		5	<5	<5	<5
T - Alkalinity (as CaCO <sub>3</sub> )	mg/L		5	152	147	144
Bicarbonate	mg/L		5	185	180	175
Carbonate	mg/L		5	<5	<5	<5
Hydroxide	mg/L		5	<5	<5	<5
Electrical Conductivity	uS/cm		5	456	449	447
Electrical Conductivity	dS/m		0.05	0.46	0.45	0.45
Chloride	mg/L	(250)	1	<1	1	1
Fluoride	mg/L	1.5	0.01	0.15	0.15	0.15
Nitrate	mg/L	45	0.1	0.5	0.5	1.3
Nitrate-N	mg/L	10	0.02	0.11	0.11	0.29
Nitrite	mg/L	3	0.05	<0.05	<0.05	<0.05
Nitrite-N	mg/L	1	0.01	<0.01	<0.01	<0.01
Nitrate+Nitrite - Nitrogen	mg/L		0.02	0.11	0.11	0.29
Sulfate	mg/L	(500)	1	70	70	71
Dissolved Calcium	mg/L		0.3	64.6	62.4	61.5
Dissolved Magnesium	mg/L		0.2	18.0	17.8	17.6
Dissolved Sodium	mg/L	(200)	0.6	2.2	2.5	2.4
Dissolved Potassium	mg/L		0.6	0.8	0.9	0.8
Dissolved Iron	mg/L	(0.3)	0.1	<0.1	<0.1	<0.1
Dissolved Manganese	mg/L	0.12 (0.02)	0.005	<0.005	<0.005	<0.005
Calculated TDS	mg/L		0.6	247	244	242
Sodium Adsorption Ratio	N/A			0.06	0.07	0.07
Hardness	mg CaCO <sub>3</sub> /L		1	235	229	226
Ion Balance	%		1	107	106	105

Certified By:



**AGAT** Laboratories

# Certificate of Analysis

AGAT WORK ORDER: 19C555986

PROJECT: 19M-01812-00 / Cascade Ponds

2910 12TH STREET NE  
CALGARY, ALBERTA  
CANADA T2E 7P7  
TEL (403)735-2005  
FAX (403)735-2771  
<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY:

## Routine Chemistry Water Analysis (WSP)

DATE RECEIVED: 2019-12-14

DATE REPORTED: 2019-12-17

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to 2019 Canadian Drinking Water Quality MAC (AO)  
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

800136-800138 < - Values refer to Report Detection Limits.

If sodium results in mg/L are less than detection, SAR is non-calculable and is reported as 0.

Analysis performed at AGAT Calgary (unless marked by \*)

Certified By:



## Certificate of Analysis

AGAT WORK ORDER: 19C555986

PROJECT: 19M-01812-00 / Cascade Ponds

2910 12TH STREET NE  
 CALGARY, ALBERTA  
 CANADA T2E 7P7  
 TEL (403)735-2005  
 FAX (403)735-2771  
<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY:

### Water Analysis - NH3, TOC, T-P

DATE RECEIVED: 2019-12-14

DATE REPORTED: 2019-12-19

Parameter	Unit	G / S	RDL	SAMPLE DESCRIPTION:		
				CP-19-01	CP-19-02	P18-01
				Water	Water	Water
				2019-12-13 09:30	2019-12-13 09:55	2019-12-13 10:55
				800136	800137	800138
Ammonia, Total (as N)	mg/L		0.20	<0.20	<0.20	<0.20
Total Organic Carbon	mg/L		1	1	2	2
Total Phosphorus	mg/L		0.08	0.32	0.32	1.32

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Calgary (unless marked by \*)

Certified By:



## Certificate of Analysis

AGAT WORK ORDER: 19C555986

PROJECT: 19M-01812-00 / Cascade Ponds

2910 12TH STREET NE  
 CALGARY, ALBERTA  
 CANADA T2E 7P7  
 TEL (403)735-2005  
 FAX (403)735-2771  
<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY:

### Water Analysis - TKN

DATE RECEIVED: 2019-12-14

DATE REPORTED: 2019-12-17

		SAMPLE DESCRIPTION:		CP-19-01	CP-19-02	P18-01
		SAMPLE TYPE:		Water	Water	Water
		DATE SAMPLED:		2019-12-13 09:30	2019-12-13 09:55	2019-12-13 10:55
Parameter	Unit	G / S	RDL	800136	800137	800138
Total Kjeldahl Nitrogen	mg/L		0.1	<0.1	0.3	0.2

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Analysis performed at AGAT Edmonton (unless marked by \*)

Certified By:

## Quality Assurance

CLIENT NAME: WSP CANADA INC.

AGAT WORK ORDER: 19C555986

PROJECT: 19M-01812-00 / Cascade Ponds

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY:

Water Analysis															
RPT Date:			DUPLICATE				Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE		MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Measured Value		Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Routine Chemistry Water Analysis (WSP)															
pH	791389		8.14	8.07	0.9%	N/A	100%	90%	110%	NA			NA		
T - Alkalinity (as CaCO <sub>3</sub> )	791389		114	114	0.4%	< 5	109%	80%	120%	NA			NA		
Electrical Conductivity	791389		376	379	0.8%	< 5	107%	80%	120%	NA			NA		
Chloride	805446	805446	6	6	4.7%	< 1	99%	80%	120%	96%	80%	120%	94%	80%	120%
Fluoride	805446	805446	0.06	<0.06	NA	< 0.01	92%	80%	120%	83%	80%	120%	97%	80%	120%
Nitrate	805446	805446	<0.5	<0.5	NA	< 0.1	102%	80%	120%	102%	80%	120%	97%	80%	120%
Nitrite	805446	805446	<0.20	<0.20	NA	< 0.05	98%	80%	120%	97%	80%	120%	95%	80%	120%
Sulfate	805446	805446	55	55	0.8%	< 1	100%	80%	120%	102%	80%	120%	NA	80%	120%
Dissolved Calcium	800098		58.9	57.2	2.9%	< 0.3	108%	80%	120%	100%	80%	120%	NA	80%	120%
Dissolved Magnesium	800098		32.1	31.4	2.1%	< 0.2	104%	80%	120%	96%	80%	120%	NA	80%	120%
Dissolved Sodium	800098		4.0	4.0	1.4%	< 0.6	103%	80%	120%	94%	80%	120%	96%	80%	120%
Dissolved Potassium	800098		0.8	0.9	NA	< 0.6	106%	80%	120%	92%	80%	120%	97%	80%	120%
Dissolved Iron	800098		<0.1	<0.1	NA	< 0.1	100%	80%	120%	99%	80%	120%	94%	80%	120%
Dissolved Manganese	800098		0.036	0.035	1.6%	< 0.005	99%	80%	120%	93%	80%	120%	84%	80%	120%

Comments: If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution.

If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

pH has been analyzed past the recommended holding time of 15 minutes from sampling (field measurement ideal if more accurate data required)

Nitrate and Nitrite: The regulatory hold time for the analysis of nitrate and/or nitrite in water is 72 hours.

### Microbial Analysis

Total Coliforms (MPN)	2705	136	<1	<1	NA	< 1
Fecal Coliforms (MPN)	2705	136	<1	<1	NA	< 1

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

### Water Analysis - NH<sub>3</sub>, TOC, T-P

Ammonia, Total (as N)	811925		<0.05	<0.05	NA	< 0.05	101%	80%	120%	103%	80%	120%	91%	80%	120%
Total Organic Carbon	800100		11	11	2.7%	< 1	96%	80%	120%	119%	80%	120%	NA	80%	120%
Total Phosphorus	811925		0.17	0.16	NA	< 0.08	100%	80%	120%	88%	80%	120%	84%	80%	120%

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

### Water Analysis - TKN

Total Kjeldahl Nitrogen	351	800136	< 0.1	< 0.1	NA	< 0.1	97%	80%	120%
-------------------------	-----	--------	-------	-------	----	-------	-----	-----	------

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.



## Quality Assurance

CLIENT NAME: WSP CANADA INC.

AGAT WORK ORDER: 19C555986

PROJECT: 19M-01812-00 / Cascade Ponds

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY:

### Water Analysis (Continued)

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Certified By: \_\_\_\_\_

## Method Summary

CLIENT NAME: WSP CANADA INC.

AGAT WORK ORDER: 19C555986

PROJECT: 19M-01812-00 / Cascade Ponds

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Total Coliforms (MPN)	MIC 0205	SM 9223	INCUBATOR
Fecal Coliforms (MPN)	MIC-0205	SM 9223	INCUBATOR
pH	INST 0101, INST 0104	SM 4500 H+	PH METER
p - Alkalinity (as CaCO <sub>3</sub> )	INST 0101	SM 2320 B	TITRATION
T - Alkalinity (as CaCO <sub>3</sub> )	INST 0101	SM 2320 B	TITRATION
Bicarbonate	INST 0101	SM 2320 B	PC TITRATE
Carbonate	INST 0101	SM 2320 B	PC TITRATE
Hydroxide	WAT 0310	SM 2320 B	TITRATION
Electrical Conductivity	INST 0101, INST 0120	SM 2510 B	CONDUCTIVITY METER
Chloride	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Fluoride	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Nitrate	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Nitrate-N	INST 0150	SM 4110 B	CALCULATION
Nitrite	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Nitrite-N	INST 0150	SM 4110 B	CALCULATION
Nitrate+Nitrite - Nitrogen	INST 0150	SM 4110 B	CALCULATION
Sulfate	INST 0150	SM 4110 B	ION CHROMATOGRAPH
Dissolved Calcium	INST 0140	SM 3120 B DW -R	ICP/OES
Dissolved Magnesium	INST 0140	SM 3120 B DW -R	ICP/OES
Dissolved Sodium	INST 0140	SM 3120 B DW -R	ICP/OES
Dissolved Potassium	INST 0140	SM 3120 B DW -R	ICP/OES
Dissolved Iron	INST 0140	SM 3120 B DW -R	ICP/OES
Dissolved Manganese	INST 0140	SM 3120 B DW -R	ICP/OES
Calculated TDS		SM 1030E	CALCULATION
Sodium Adsorption Ratio		CARTER & GREGORICH 2007	CALCULATION
Hardness		SM 2340 B	CALCULATION
Ion Balance		SM 1030E	CALCULATION
Ammonia, Total (as N)	INST-0420	SM 4500-NH <sub>3</sub> G	DISCRETE ANALYZER
Total Organic Carbon	INST 0170	SM 5310 B	COMBUSTION
Total Phosphorus	WATR 0200; INST 0140	SM 3030 E; SM 3120 B TW	ICP/OES
Total Kjeldahl Nitrogen	INOR-171-6220	SM 4500-N org D TW	SPECTROPHOTOMETER



# AGAT

## Laboratories

2910 12 Street NE  
 Calgary, Alberta T2E 7P7  
 P: 403.735.2005 • F: 403.735.2771  
 webearth.agatlabs.com

### Laboratory Use Only

Arrival Temperature: 1.7°C  
 AGAT Job Number: 19655986  
 Date and Time: 14-DEC '19 AM 7:16

### Chain of Custody Record

Emergency Support Services Hotline **1-855-AGAT 245 (1-855-242-8245)**

**Report Information**

Company: WSP  
 Contact: Alyssa Barker  
 Address: Edmonton  
 Phone: \_\_\_\_\_ Fax: \_\_\_\_\_  
 LSD: Cascade Parks  
 Client Project #: km - 0812-00  
 Sampled By: April Bakos

**Report Information**

1. Name: Alyssa Barker  
 Email: alyssa\_barker@wsp.com  
 2. Name: Patrick Long  
 Email: Patrick.Long@wsp.com  
 3. Name: \_\_\_\_\_  
 Email: \_\_\_\_\_

**Turnaround Time Required (TAT)**

Regular TAT  5-7 Business Days  
 <24 Hours (200%)  
 Rush TAT  Two Day / Next Day (100%)  
 (Surcharge)  Three Day (50%)  
 Four Day (25%)  
 Date Required: \_\_\_\_\_

SEE BACK FOR SURCHARGE BREAKDOWN. CONTACT YOUR CPM FOR ADDITIONAL INFORMATION.

**Invoice To** Same  Yes  No

Company: \_\_\_\_\_  
 Contact: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 Phone: \_\_\_\_\_ Fax: \_\_\_\_\_  
 PO/AFE# \_\_\_\_\_  
 Standing Offer #: \_\_\_\_\_

**Requirements** (Selection may impact detection limits)

CCME  Alberta Tier 1  
 Agricultural  Agricultural  
 Industrial  Industrial  
 Residential/ Park  Residential/ Park  
 Commercial  Commercial  
 FWAL  Natural Area  
 Drinking Water  Alberta Surface Water  
 Other  Chronic  
 Acute

**Report Format**

Single Sample Per Page  
 Multiple Samples Per Page  
 Export

Detailed Salinity:  AB  BC  SK  D50  
 CCME / AB: BTEX/FL-F4  CCME / AB: BTEX/FL-F2  
 BC: BTEX/VPH/EPH  BC: LEPH/HEPH  
 SK: BTEX/TVH/C11-C22, C23-C60  
 Soil Metals:  HWS-B  SP-B  Hg  Cr6+  
 Water Metals:  Dissolved  Total  Hg  Cr6+  
 Routine Water Chemistry  
 Landfill:  AB Class 2  BC  SK  
 Coliforms:  Total  Fecal  E. coli  
 Particle Size:  Sieve (75 µm)  Texture  
 AMMONIA  
 TCC  
 TKN  
 T-Phosphorus

LABORATORY USE (LINE/ LAB ID#)	SAMPLE IDENTIFICATION	DEPTH	DATE/ TIME SAMPLED	SAMPLE MATRIX	COMMENTS (Filtered, Preserved, Hazardous*) *Additional Fee	# of CONTAINERS				Detailed Salinity	CCME / AB: BTEX/FL-F4	BC: BTEX/VPH/EPH	SK: BTEX/TVH/C11-C22, C23-C60	Soil Metals: HWS-B, SP-B, Hg, Cr6+	Water Metals: Dissolved, Total, Hg, Cr6+	Routine Water Chemistry	Landfill: AB Class 2, BC, SK	Coliforms: Total, Fecal, E. coli	Particle Size: Sieve (75 µm), Texture	
						Vials/ Jars	Bags	Bottles												
1 <u>201/24</u>	<u>CP-10-01</u> ✓		<u>Dec 13 9:00</u>	<u>W</u>																
2 <u>138</u>	<u>CP-12-02</u>		<u>Dec 13 9:58</u>	<u>W</u>																
3 <u>138</u>	<u>PR-01</u> ✓		<u>Dec 13 10:08</u>	<u>W</u>																
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				

Samples Relinquished By (Print Name and Sign): April Bakos Date/ Time: Dec 13 10:27:23

Samples Relinquished By (Print Name and Sign): [Signature] Date/ Time: 14-000-19 7:16

Samples Relinquished By (Print Name and Sign): \_\_\_\_\_ Date/ Time: \_\_\_\_\_

Samples Relinquished By (Print Name and Sign): \_\_\_\_\_ Date/ Time: \_\_\_\_\_

Page \_\_\_\_\_ of \_\_\_\_\_  
**107286**  
 N°: AB



# AGAT Laboratories

## SAMPLE INTEGRITY RECEIPT FORM

### RECEIVING BASICS - Shipping

Company/Consultant: WSP

Courier: 0/D Prepaid Collect

Waybill# \_\_\_\_\_

Branch: EDM GP FN FM RD VAN LYD FSJ EST Other: -

If multiple sites were submitted at once:  Yes No

Custody Seal Intact: Yes No  NA

TAT: <24hr 24-48hr 48-72hr  Reg Other \_\_\_\_\_

Cooler Quantity: 1

### TIME SENSITIVE ISSUES - Shipping

ALREADY EXCEEDED HOLD TIME? Yes  No

Inorganic Tests (Please Circle):  Mibi, BOD, Nitrate/Nitrite, Turbidity, Microtox, Ortho PO4, Tedlar Bag, Residual Chlorine, Chlorophyll\*, Chloroamines\*

Earliest Expiry: 14-00-19 3:30PM

Hydrocarbons: Earliest Expiry N/A

### SAMPLE INTEGRITY - Shipping

Hazardous Samples: YES  NO Precaution Taken: \_\_\_\_\_

Legal Samples: Yes  No

International Samples: Yes  No

Tape Sealed: Yes  No

Coolant Used: Icepack Bagged Ice Free Ice Free Water  None

Temperature (Bottles/Jars only) N/A if only Soil Bags Received

### FROZEN (Please Circle if samples received Frozen)

1 (Bottle/Jar) 1.7+1.7+1.7=1.7 °C 2 (Bottle/Jar) \_\_\_+\_\_\_+\_\_\_=\_\_\_ °C

3 (Bottle/Jar) \_\_\_+\_\_\_+\_\_\_=\_\_\_ °C 4 (Bottle/Jar) \_\_\_+\_\_\_+\_\_\_=\_\_\_ °C

5 (Bottle/Jar) \_\_\_+\_\_\_+\_\_\_=\_\_\_ °C 6 (Bottle/Jar) \_\_\_+\_\_\_+\_\_\_=\_\_\_ °C

7 (Bottle/Jar) \_\_\_+\_\_\_+\_\_\_=\_\_\_ °C 8 (Bottle/Jar) \_\_\_+\_\_\_+\_\_\_=\_\_\_ °C

9 (Bottle/Jar) \_\_\_+\_\_\_+\_\_\_=\_\_\_ °C 10 (Bottle/Jar) \_\_\_+\_\_\_+\_\_\_=\_\_\_ °C

(If more than 10 coolers are received use another sheet of paper and attach)

### LOGISTICS USE ONLY

Workorder No: 19C055986

Samples Damaged: Yes  No If YES why?

No Bubble Wrap Frozen Courier

Other: \_\_\_\_\_

Account Project Manager: \_\_\_\_\_ have they been notified of the above issues: Yes No

Whom spoken to: \_\_\_\_\_ Date/Time: \_\_\_\_\_

CPM Initial \_\_\_\_\_

General Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\* Subcontracted Analysis (See CPM)



# Attachment F

PEYTO PIT



## GEO TECHNICAL LAB DATA



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

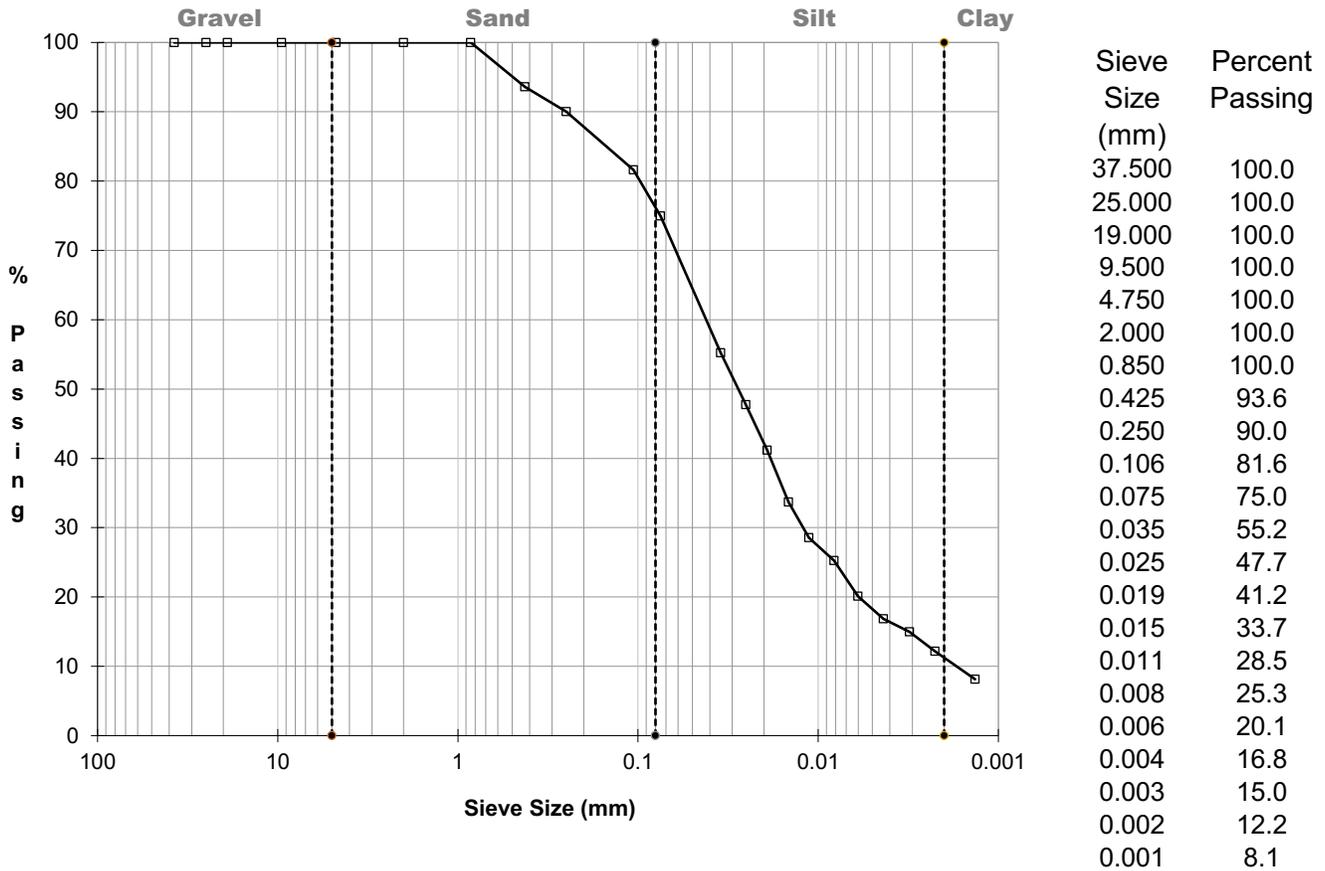
# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: TP19-01  
 Sample Depth: 1.0 - 1.5m  
 Source: Peyto Pit  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 7, 2020 Date Received: December 18, 2019



Sand = 0.0 %  
 Sand = 25.0 %  
 Silt = 62.8 %  
 Clay = 12.2 %

Sample Description: Sandy SILT some clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

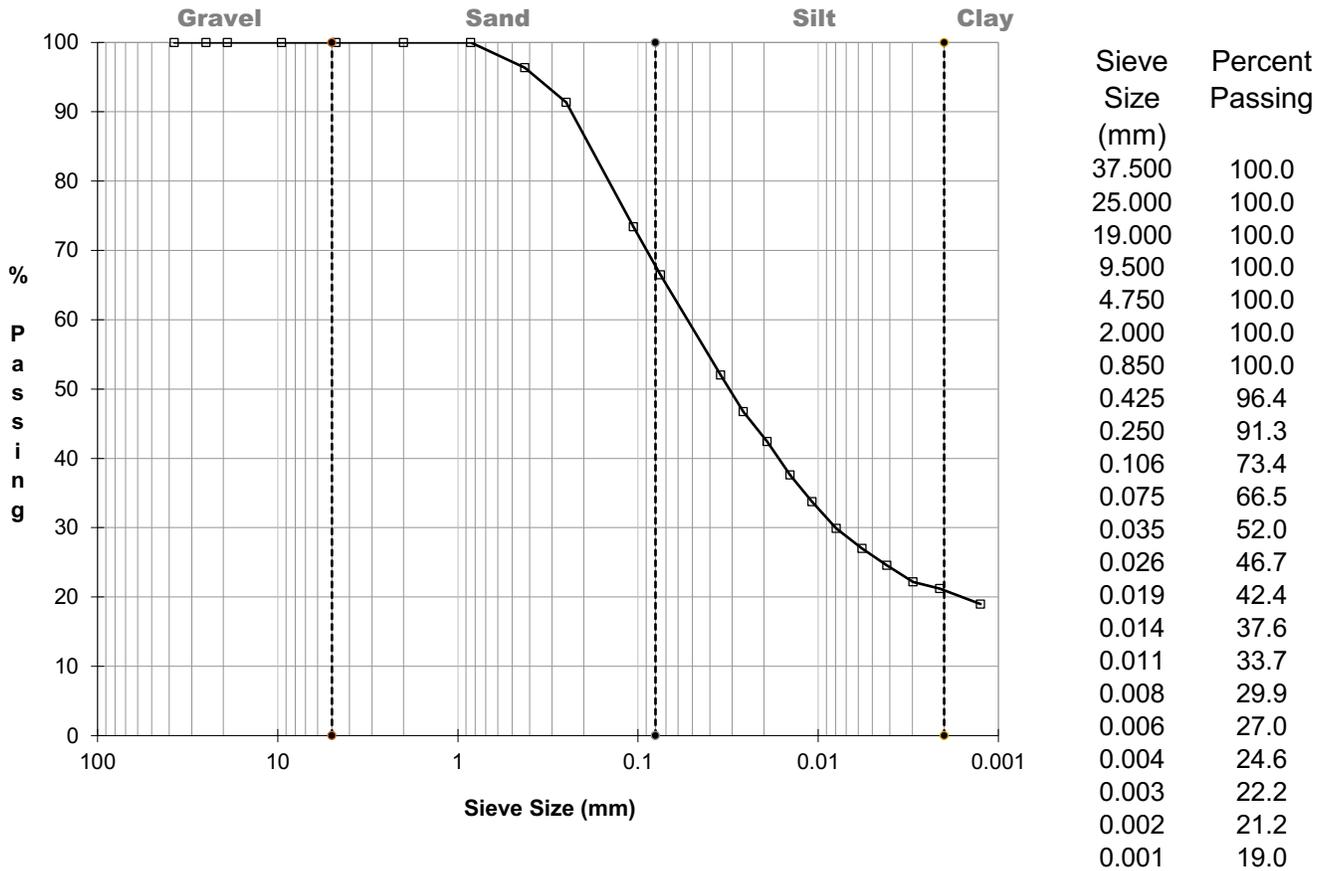
# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: TP19-01  
 Sample Depth: 2.5 - 3.0m  
 Source: Peyto Pit  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 7, 2020 Date Received: December 18, 2019



Gravel = 0.0 %  
 Sand = 33.5 %  
 Silt = 45.3 %  
 Clay = 21.2 %

Sample Description: Clayey Sandy SILT  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

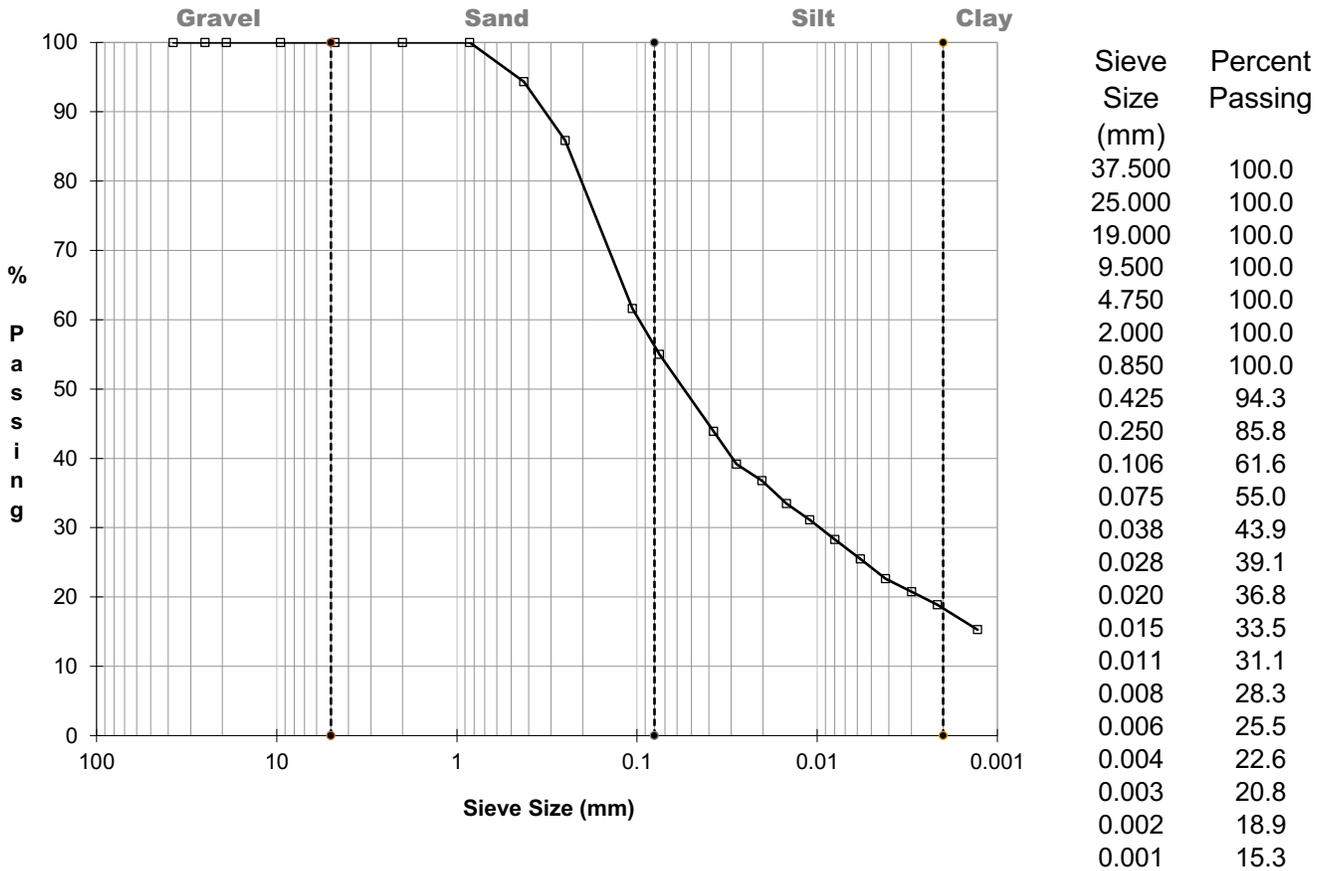
# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: TP19-02  
 Sample Depth: 1.0 - 1.5m  
 Source: Peyto Pit  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 7, 2020 Date Received: December 18, 2019



Gravel = 0.0 %  
 Sand = 45.0 %  
 Silt = 36.1 %  
 Clay = 18.9 %

Sample Description: Silty SAND some clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

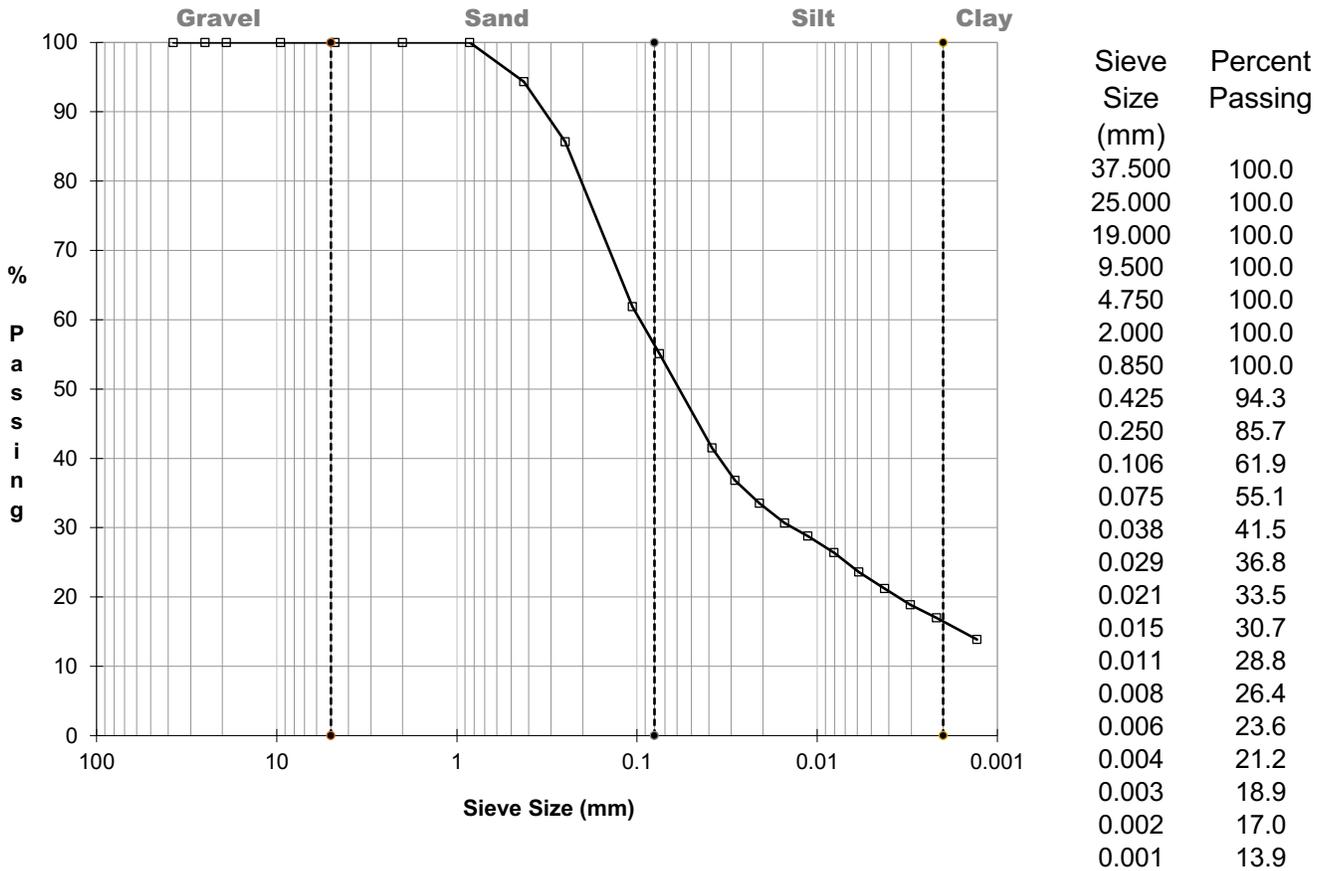
# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: TP19-02  
 Sample Depth: 2.5 - 3.0m  
 Source: Peyto Pit  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 7, 2020 Date Received: December 18, 2019



Gravel = 0.0 %  
 Sand = 44.9 %  
 Silt = 38.1 %  
 Clay = 17.0 %

Sample Description: Silty SAND some clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

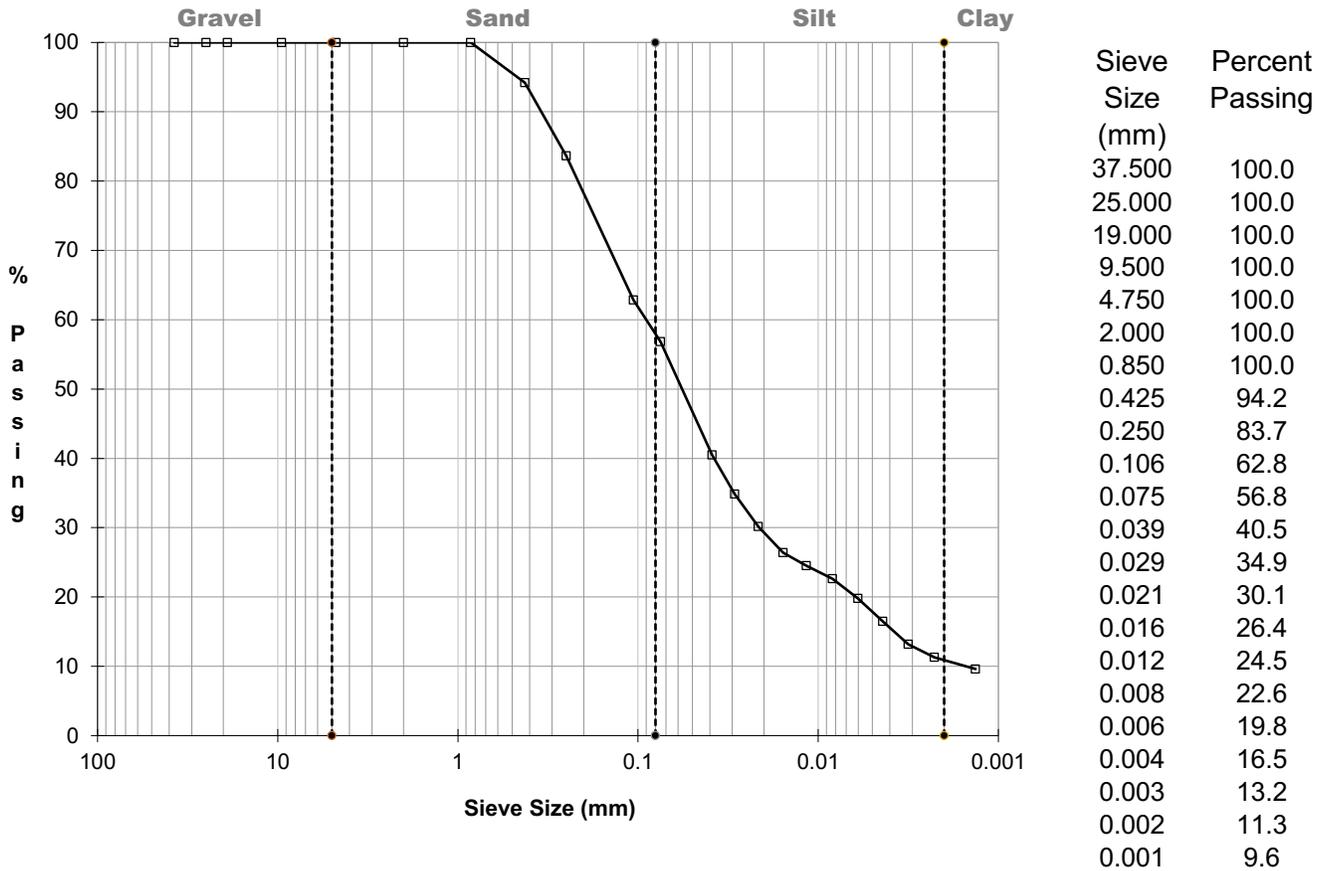
# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: TP19-03  
 Sample Depth: 1.0 - 1.5m  
 Source: Peyto Pit  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 7, 2020 Date Received: December 18, 2019



Gravel = 0.0 %  
 Sand = 43.2 %  
 Silt = 45.5 %  
 Clay = 11.3 %

Sample Description: Sandy SILT some clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



WSP Canada Inc.

405 - 18 Street SE  
Calgary, AB, T2E 6J5.

# Sieve Analysis

Report Date: January 09, 2020  
Project Number: 19M-01812-00  
Report Number: 19-052

To: Parks Canada

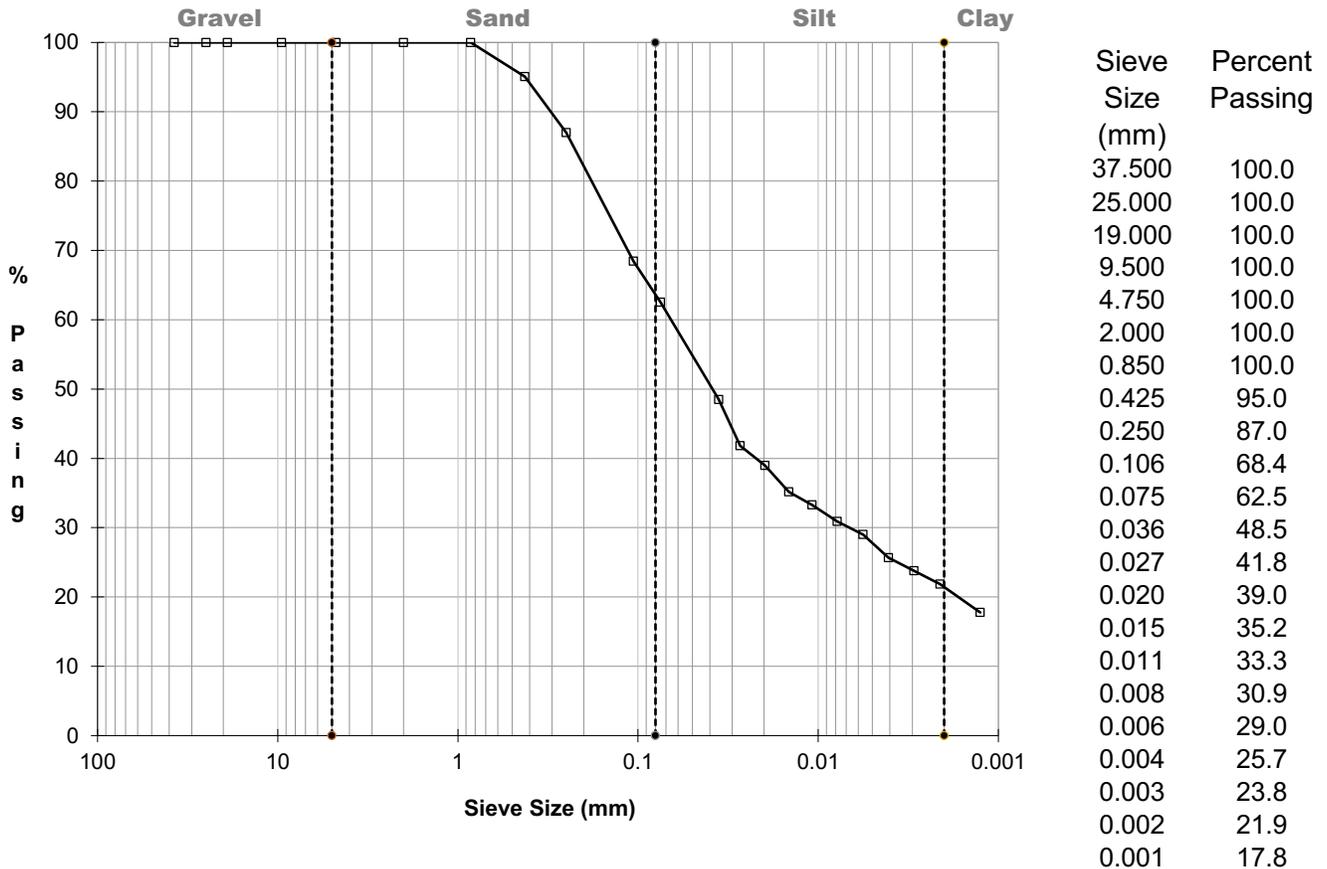
Project: Castle Mountain Campground Geotech

Borehole No.: TP19-03  
Sample Depth: 2.5 - 3.0m  
Source: Peyto Pit  
Sampled By: N/A  
Tested By: PC

n/a

Date Tested: January 7, 2020

Date Received: December 18, 2019



Sand = 0.0 %  
 Sand = 37.5 %  
 Silt = 40.6 %  
 Clay = 21.9 %

Sample Description: Clayey Sandy SILT  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



WSP Canada Inc.

405 - 18 Street SE  
Calgary, AB, T2E 6J5.

# Sieve Analysis

Report Date: January 09, 2020  
Project Number: 19M-01812-00  
Report Number: 19-052

To: Parks Canada

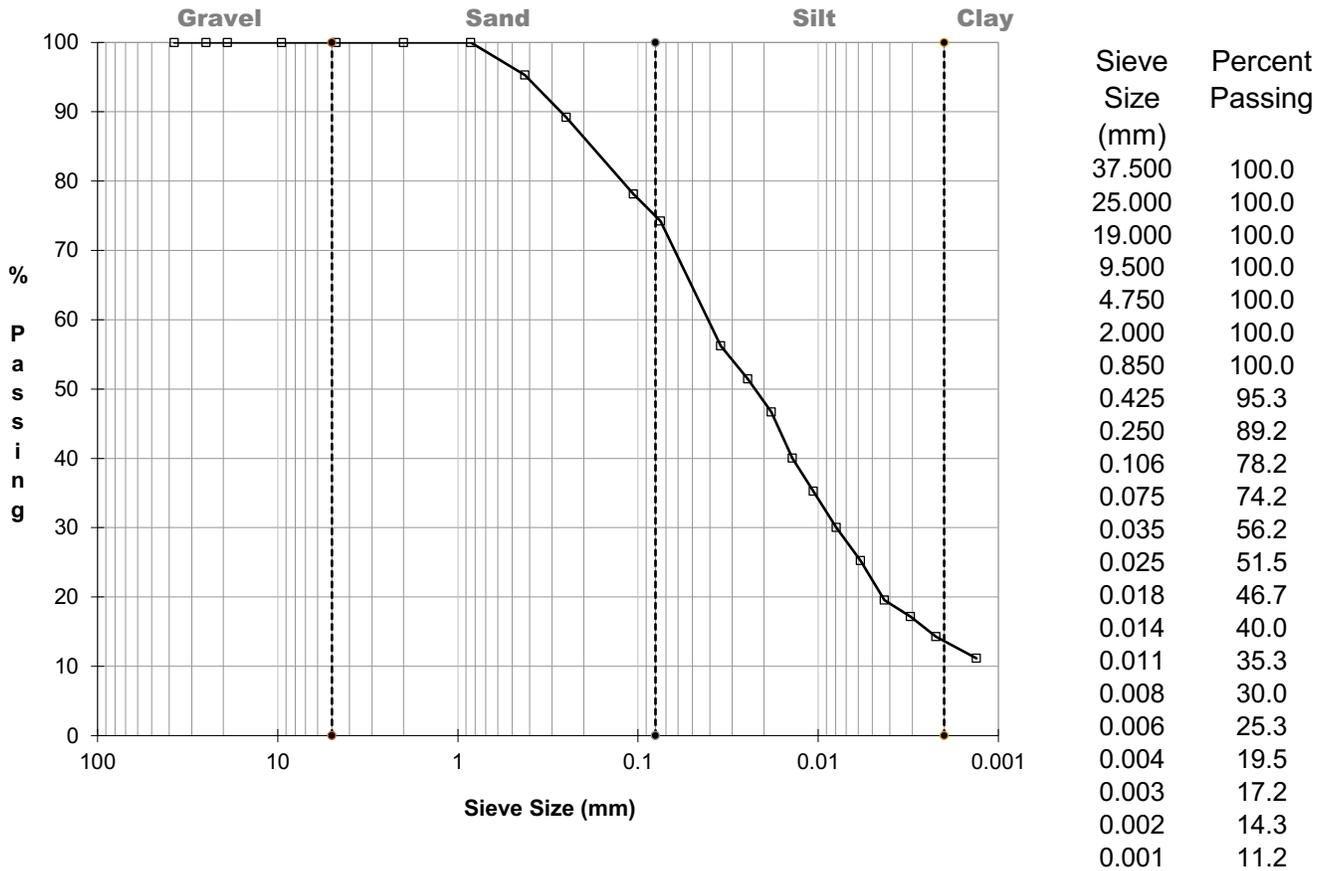
Project: Castle Mountain Campground Geotech

Borehole No.: TP19-04  
Sample Depth: 1.0 - 1.5m  
Source: Peyto Pit  
Sampled By: N/A  
Tested By: PC

n/a

Date Tested: January 7, 2020

Date Received: December 18, 2019



Gravel = 0.0 %  
 Sand = 25.8 %  
 Silt = 59.9 %  
 Clay = 14.3 %

Sample Description: Sandy SILT some clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



**WSP Canada Inc.**  
 405 - 18 Street SE  
 Calgary, AB, T2E 6J5.

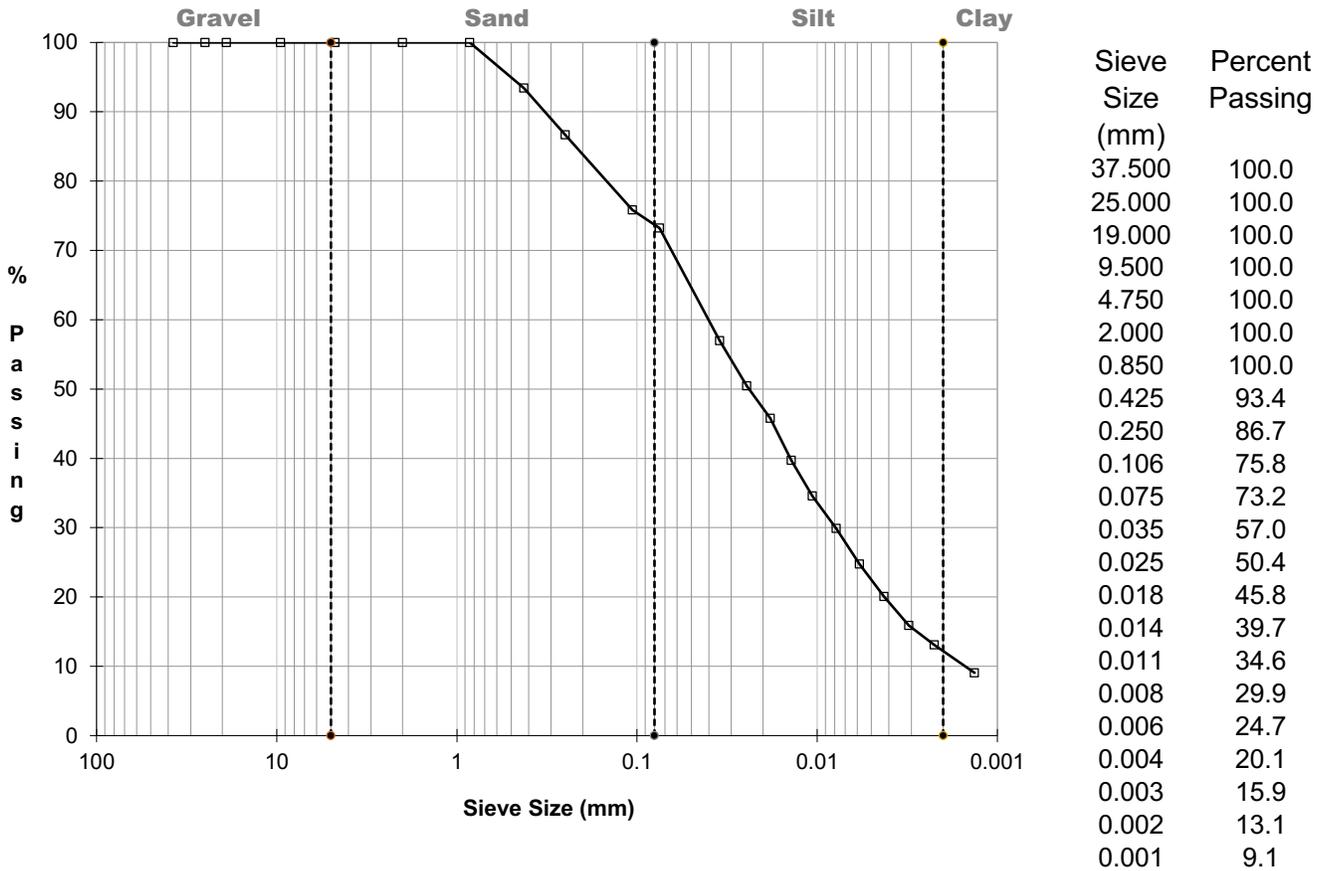
# Sieve Analysis

Report Date: January 09, 2020  
 Project Number: 19M-01812-00  
 Report Number: 19-052

To: Parks Canada  
 Project: Castle Mountain Campground Geotech

Borehole No.: TP19-04  
 Sample Depth: 2.5 - 3.0m  
 Source: Peyto Pit  
 Sampled By: N/A  
 Tested By: PC

n/a Date Tested: January 7, 2020 Date Received: December 18, 2019



Gravel = 0.0 %  
 Sand = 26.8 %  
 Silt = 60.1 %  
 Clay = 13.1 %

Sample Description: Sandy SILT some clay  
 Remarks: Separation made on No 40 sieve (0.425mm).

Per: \_\_\_\_\_



## MONITORING DATA

**TABLE 1. SOIL QUALITY RESULTS - INORGANIC PARAMETERS**  
**Parks Canada - Banff National Park - Peyto Pit**

Sample Description			Salinity															Trace Metals																						
Sample Location and Depth	Sample Date		Saturation	Chloride	Chloride	Electrical Conductivity	pH (CaCl <sub>2</sub> Extraction)	Sodium Adsorption Ratio	Calcium	Calcium	Magnesium	Magnesium	Sodium	Sodium	Potassium	Potassium	Sulphate	Sulphate	Theoretical Gypsum Requirement	Antimony	Arsenic (Inorganic)	Barium	Beryllium	Boron (Saturated Paste Extract)	Cadmium	Chromium (hexavalent)	Chromium (total)	Cobalt	Copper	Lead	Mercury (Inorganic)	Molybdenum	Nickel	Selenium	Silver	Thallium	Tin	Uranium	Vanadium	Zinc
			(%)	(mg/L)	(mg/kg)	(dS/m)	(Units)	(Units)	(mg/L)	(mg/kg)	(mg/L)	(mg/kg)	(mg/L)	(mg/kg)	(mg/L)	(mg/kg)	(mg/L)	(mg/kg)	(mg/L)	(mg/kg)	(t/ha)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
<b>Alberta Tier 1 Soil and Groundwater Remediation Guidelines</b>		<b>Natural Area - Coarse Grained</b>	-	-	-	-	6.0 - 8.5	-	-	-	-	-	-	-	-	-	-	-	-	20	17	750	5	3.3	3.8	0.4	64	20	63	70	12	4	45	1	20	1	5	33	130	250
<b>Boreholes: (4 Borehole Samples Reported)</b>																																								
19TP01	1.0-1.5 m	Dec-12-2019	60	127	76	2.05	7.63	0.47	225	135	95	57	33	20	127	76	423	254	<0.01	<0.5	6.3	124	0.6	<0.5	0.8	N/A	13.6	5.2	12.1	15.7	<0.5	1.9	17.9	0.9	<0.5	<0.5	0.6	0.9	19.6	80
	2.5-3.0 m	Dec-12-2019	31	135	42	2.56	7.82	1.14	206	64	118	37	83	26	185	57	426	132	<0.01	<0.5	2.9	68.6	<0.5	<0.5	<0.5	<0.3	8.6	3.5	6.6	4.9	<0.5	0.8	9.2	<0.5	<0.5	<0.5	<0.5	0.5	8.8	26
19TP02	1.0-1.5 m	Dec-12-2019	35	32	11	0.49	7.61	0.48	65	23	18	6	17	6	4	<2	21	7	<0.01	<0.5	3.3	47.8	<0.5	<0.5	<0.5	<0.3	8.5	2.8	5.5	4.7	<0.5	<0.5	8.3	<0.5	<0.5	<0.5	<0.5	<0.5	7.5	20
	2.5-3.0 m	Dec-12-2019	34	40	14	0.54	7.62	1.04	56	19	18	6	35	12	6	2	26	9	<0.01	<0.5	2.9	51.6	<0.5	<0.5	<0.5	<0.3	9.3	3.2	6.2	4.6	<0.5	0.6	9.6	<0.5	<0.5	<0.5	<0.5	<0.5	9.0	24
19TP03	1.0-1.5 m	Dec-12-2019	34	44	15	0.64	7.66	1.14	70	24	17	6	41	14	7	2	46	16	<0.01	<0.5	3.8	63.3	<0.5	<0.5	<0.5	<0.3	10.5	3.4	6.7	5.5	<0.5	0.7	10.3	<0.5	<0.5	<0.5	<0.5	<0.5	11.1	26
	2.5-3.0 m	Dec-12-2019	31	59	18	0.61	7.62	0.83	70	22	21	7	31	10	8	2	40	12	<0.01	<0.5	3.8	58.2	<0.5	<0.5	<0.5	<0.3	9.5	3.2	6.5	5.9	<0.5	0.6	9.8	<0.5	<0.5	<0.5	<0.5	<0.5	10.8	25
19TP04	1.0-1.5 m	Dec-12-2019	66	419	277	1.78	7.41	3.25	141	93	42	28	171	113	16	11	115	76	<0.01	<0.5	4.7	158	0.8	<0.5	0.9	N/A	19.0	6.7	14.3	11.6	<0.5	1.1	23.6	1.0	<0.5	<0.5	<0.5	1.1	25.7	106
	2.5-3.0 m	Dec-12-2019	67	402	269	1.82	7.37	3.44	142	95	40	27	180	121	25	17	151	101	<0.01	<0.5	4.8	109	0.5	<0.5	0.5	N/A	14.3	4.8	10.3	25.6	<0.5	1.0	16.1	0.8	<0.5	<0.5	<0.5	0.8	17.7	68

Note  
 Denotes values that exceed Alberta Tier 1 Soil and Groundwater Remediation (AT1) Guidelines (AEP, 2019).  
 ND Not Detected (below detection limit)  
 - No Guideline or Not Applicable



**TABLE 2. SOIL QUALITY RESULTS - POLYAROMATIC HYDROCARBONS**  
Parks Canada - Banff National Park - Peyto Pit

Sample Description			Physical Properties	Hydrocarbons										Polycyclic Aromatic Hydrocarbons																			
Sample Location and Depth	Sample Date	Moisture Content (%)	F1-BTEX	C6 - C10 (F1)	F2	F3	F4	Benzene	Toluene	Ethylbenzene	Xylenes (o, m & p)	Toluene-d8	Acenaphthene	Acenaphthylene	Acridine	Anthracene	Benzo(a)anthracene	Bi(a)P TPE	Benzo(b&j)fluoranthene	Benzo(k)fluoranthene	Benzo(g,h,i)perylene	Benzo(a)pyrene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	2-Methylnaphthalene	Naphthalene	Phenanthrene	Pyrene	Quinoline	
			(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(%)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Alberta Tier 1 Soil and Groundwater Remediation Guidelines*	Natural Land Use: Coarse Surface Soil	-	210	-	150	300	2800	0.078	0.12	0.14	1.9	-	0.38	-	-	0.0056	6.2	-	6.2	6.2	-	0.60	6.2	-	0.055	0.34	-	-	0.017	0.061	0.15	-	
	Natural Land Use Coarse Subsoil	-	420	-	300	600	5600	0.078	0.12	0.14	1.9	-	0.38	-	-	0.0056	6.2	-	6.2	6.2	-	0.60	6.2	-	0.055	0.34	-	-	0.017	0.061	0.15	-	
<b>Boreholes: (4 Borehole Samples Reported)</b>																																	
19TP01	1.0-1.5 m	Dec-12-2019	24	<10	<10	<10	57	21	<0.005	<0.05	<0.01	<0.05	100	<0.005	<0.005	<0.05	<0.004	0.02	0.023	<0.03	<0.02	<0.05	<0.03	<0.05	<0.005	0.02	<0.01	<0.02	0.008	0.01	0.02	0.03	<0.05
	2.5-3.0 m	Dec-12-2019	8	<10	<10	<10	15	<10	<0.005	<0.05	<0.01	<0.05	100	<0.005	<0.005	<0.05	<0.004	<0.02	0.023	<0.03	<0.02	<0.05	<0.03	<0.05	<0.005	<0.01	<0.01	<0.02	0.006	<0.005	<0.02	<0.01	<0.05
19TP02	1.0-1.5 m	Dec-12-2019	9	<10	<10	<10	33	28	<0.005	<0.05	<0.01	<0.05	100	<0.005	<0.005	<0.05	<0.004	<0.02	0.023	<0.03	<0.02	<0.05	<0.03	<0.05	<0.005	<0.01	<0.01	<0.02	<0.005	<0.005	<0.02	<0.01	<0.05
	2.5-3.0 m	Dec-12-2019	9	<10	<10	<10	63	80	<0.005	<0.05	<0.01	<0.05	104	<0.005	<0.005	<0.05	<0.004	<0.02	0.023	<0.03	<0.02	<0.05	<0.03	<0.05	<0.005	<0.01	<0.01	<0.02	<0.005	<0.005	<0.02	<0.01	<0.05
19TP03	1.0-1.5 m	Dec-12-2019	10	<10	<10	<10	30	40	<0.005	<0.05	<0.01	<0.05	102	<0.005	<0.005	<0.05	<0.004	<0.02	0.023	<0.03	<0.02	<0.05	<0.03	<0.05	<0.005	<0.01	<0.01	<0.02	<0.005	<0.005	<0.02	<0.01	<0.05
	2.5-3.0 m	Dec-12-2019	10	<10	<10	<10	109	164	<0.005	<0.05	<0.01	<0.05	101	<0.005	<0.005	<0.05	0.006	0.02	0.027	<0.03	<0.02	<0.05	<0.03	<0.05	0.005	0.04	<0.01	<0.02	0.008	0.005	0.03	0.05	<0.05
19TP04	1.0-1.5 m	Dec-12-2019	24	<10	<10	<10	70	51	0.011	<0.05	0.02	<0.05	98	<0.005	<0.005	<0.05	<0.004	<0.02	0.023	<0.03	<0.02	<0.05	<0.03	<0.05	<0.005	<0.01	<0.01	<0.02	0.005	0.006	<0.02	0.01	<0.05
	2.5-3.0 m	Dec-12-2019	26	<10	<10	21	141	67	0.014	0.09	<0.01	<0.05	100	<0.005	<0.005	<0.05	<0.004	<0.02	0.023	<0.03	<0.02	<0.05	<0.03	<0.05	<0.005	0.02	<0.01	<0.02	0.008	0.011	<0.02	0.02	<0.05

Note  
 Denotes values that exceed Alberta Tier 1 Soil and Groundwater Remediation (AT1) Guidelines (AEP, 2019).  
 ND Not Detected (below detection limit)  
 - No Guideline or Not Applicable





# LABORATORY REPORT

CLIENT NAME: WSP CANADA INC.  
10909 JASPER AVE, SUITE 1200  
EDMONTON, AB T5J 3L9  
(780) 435-4477

ATTENTION TO: Alyssa Barker

PROJECT: 19M-01812-00 / Peyto Pit

AGAT WORK ORDER: 19C556068

SOIL ANALYSIS REVIEWED BY: Jennifer Liu, Analyst

TRACE ORGANICS REVIEWED BY: Elena Gorobets, Report Writer

DATE REPORTED: Dec 19, 2019

PAGES (INCLUDING COVER): 14

VERSION\*: 1

Should you require any information regarding this analysis please contact your client services representative at (403) 735-2005

\*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.



## Certificate of Analysis

AGAT WORK ORDER: 19C556068

PROJECT: 19M-01812-00 / Peyto Pit

2910 12TH STREET NE  
CALGARY, ALBERTA  
CANADA T2E 7P7  
TEL (403)735-2005  
FAX (403)735-2771  
<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY: April

### Soil Analysis - Salinity (pH Calcium Chloride)

DATE RECEIVED: 2019-12-14

DATE REPORTED: 2019-12-19

Parameter	Unit	SAMPLE DESCRIPTION:															
		19TP01 1.0-1.5		19TP01 2.5-3.0		19TP02 1.0-1.5		19TP02 2.5-3.0		19TP03 1.0-1.5		19TP03 2.5-3.0		19TP04 1.0-1.5		19TP04 2.5-3.0	
		G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL
pH (CaCl2 Extraction)	pH Units	N/A	7.63	7.82	7.61	7.62	7.66	7.62	7.41	7.37							
Electrical Conductivity (Sat. Paste)	dS/m	0.05	2.05	2.56	0.49	0.54	0.64	0.61	1.78	1.82							
Sodium Adsorption Ratio	N/A		0.47	1.14	0.48	1.04	1.14	0.83	3.25	3.44							
Saturation Percentage	%	1	60	31	35	34	34	31	66	67							
Chloride, Soluble	mg/L	5	127	135	32	40	44	59	419	402							
Calcium, Soluble	mg/L	1	225	206	65	56	70	70	141	142							
Potassium, Soluble	mg/L	2	127	185	4	6	7	8	16	25							
Magnesium, Soluble	mg/L	1	95	118	18	18	17	21	42	40							
Sodium, Soluble	mg/L	2	33	83	17	35	41	31	171	180							
Sulfur (as Sulfate), Soluble	mg/L	2	423	426	21	26	46	40	115	151							
Calcium, Soluble (meq/L)	meq/L	0.05	11.2	10.3	3.24	2.79	3.49	3.49	7.04	7.09							
Calcium, Soluble (mg/kg)	mg/kg	1	135	64	23	19	24	22	93	95							
Chloride, Soluble (meq/L)	meq/L	0.14	3.58	3.81	0.90	1.13	1.24	1.66	11.8	11.3							
Chloride, Soluble (mg/kg)	mg/kg	2	76	42	11	14	15	18	277	269							
Magnesium, Soluble (meq/L)	meq/L	0.08	7.82	9.71	1.48	1.48	1.40	1.73	3.46	3.29							
Magnesium, Soluble (mg/kg)	mg/kg	1	57	37	6	6	6	7	28	27							
Potassium, Soluble (meq/L)	meq/L	0.05	3.25	4.73	0.10	0.15	0.18	0.20	0.41	0.64							
Potassium, Soluble (mg/kg)	mg/kg	2	76	57	<2	2	2	2	11	17							
Sodium, Soluble (meq/L)	meq/L	0.09	1.44	3.61	0.74	1.52	1.78	1.35	7.44	7.83							
Sodium, Soluble (mg/kg)	mg/kg	2	20	26	6	12	14	10	113	121							
Sulfur (as Sulfate), Soluble (meq/L)	meq/L	0.04	8.81	8.87	0.44	0.54	0.96	0.83	2.39	3.14							
Sulfur (as Sulfate), Soluble (mg/kg)	mg/kg	2	254	132	7	9	16	12	76	101							
Theoretical Gypsum Requirement	tonnes/ha	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01							

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

801547-801554 If sodium results in mg/L are less than detection, SAR is non-calculable and is reported as 0.

Analysis performed at AGAT Calgary (unless marked by \*)

Certified By:



## Certificate of Analysis

AGAT WORK ORDER: 19C556068

PROJECT: 19M-01812-00 / Peyto Pit

2910 12TH STREET NE  
CALGARY, ALBERTA  
CANADA T2E 7P7  
TEL (403)735-2005  
FAX (403)735-2771  
<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY: April

### Tier 1/SK PNG031, 033 Metals + Hg + Sat Paste B + Cr6 (Soil)

DATE RECEIVED: 2019-12-14

DATE REPORTED: 2019-12-19

Parameter	Unit	SAMPLE DESCRIPTION:															
		19TP01 1.0-1.5		19TP01 2.5-3.0		19TP02 1.0-1.5		19TP02 2.5-3.0		19TP03 1.0-1.5		19TP03 2.5-3.0		19TP04 1.0-1.5		19TP04 2.5-3.0	
		G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL
Antimony	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	mg/kg	0.5	6.3	2.9	3.3	2.9	3.8	3.8	3.8	4.7	4.8						
Barium	mg/kg	0.5	124	68.6	47.8	51.6	63.3	58.2	158	109							
Beryllium	mg/kg	0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	0.5							
Boron (Saturated Paste)	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5							
Cadmium	mg/kg	0.5	0.8	<0.5	<0.5	<0.5	<0.5	<0.5	0.9	0.5							
Chromium	mg/kg	0.5	13.6	8.6	8.5	9.3	10.5	9.5	19.0	14.3							
Chromium, Hexavalent	mg/kg	0.3	N/A	<0.3	<0.3	<0.3	<0.3	<0.3	N/A	N/A							
Cobalt	mg/kg	0.5	5.2	3.5	2.8	3.2	3.4	3.2	6.7	4.8							
Copper	mg/kg	0.5	12.1	6.6	5.5	6.2	6.7	6.5	14.3	10.3							
Lead	mg/kg	0.5	15.7	4.9	4.7	4.6	5.5	5.9	11.6	25.6							
Mercury	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5							
Molybdenum	mg/kg	0.5	1.9	0.8	<0.5	0.6	0.7	0.6	1.1	1.0							
Nickel	mg/kg	0.5	17.9	9.2	8.3	9.6	10.3	9.8	23.6	16.1							
Selenium	mg/kg	0.5	0.9	<0.5	<0.5	<0.5	<0.5	<0.5	1.0	0.8							
Silver	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5							
Thallium	mg/kg	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5							
Tin	mg/kg	0.5	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5							
Uranium	mg/kg	0.5	0.9	0.5	<0.5	<0.5	<0.5	<0.5	1.1	0.8							
Vanadium	mg/kg	0.5	19.6	8.8	7.5	9.0	11.1	10.8	25.7	17.7							
Zinc	mg/kg	1	80	26	20	24	26	25	106	68							

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

801547 N/A- Unable to perform Chromium Hexavalent analysis due to colour interferences.

801553-801554 N/A- Unable to perform Chromium Hexavalent analysis due to colour interferences.

Analysis performed at AGAT Calgary (unless marked by \*)

Certified By:



## Certificate of Analysis

AGAT WORK ORDER: 19C556068

PROJECT: 19M-01812-00 / Peyto Pit

2910 12TH STREET NE  
CALGARY, ALBERTA  
CANADA T2E 7P7  
TEL (403)735-2005  
FAX (403)735-2771  
<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY: April

### Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS) (Methanol Field Stabilized)

DATE RECEIVED: 2019-12-14

DATE REPORTED: 2019-12-19

Parameter	Unit	SAMPLE DESCRIPTION:															
		19TP01 1.0-1.5		19TP01 2.5-3.0		19TP02 1.0-1.5		19TP02 2.5-3.0		19TP03 1.0-1.5		19TP03 2.5-3.0		19TP04 1.0-1.5		19TP04 2.5-3.0	
		G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL	G / S	RDL
Benzene	mg/kg	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.011	0.014	
Toluene	mg/kg	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.09	
Ethylbenzene	mg/kg	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	
Xylenes	mg/kg	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
C6 - C10 (F1)	mg/kg	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	
C6 - C10 (F1 minus BTEX)	mg/kg	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	
C10 - C16 (F2)	mg/kg	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	21	
C16 - C34 (F3)	mg/kg	10	57	15	33	63	30	109	70	141							
C34 - C50 (F4)	mg/kg	10	21	<10	28	80	40	164	51	67							
Gravimetric Heavy Hydrocarbons	mg/kg	1000	N/A	N/A	N/A	N/A											
Moisture Content	%	1	24	8	9	9	10	10	24	26							
Surrogate	Unit	Acceptable Limits															
Toluene-d8 (BTEX)	%	50-150	100	100	100	104	102	101	98	100							
o-Terphenyl (F2-F4)	%	50-150	105	99	96	109	100	98	101	100							

Certified By:

*Elena Gorobets*



## Certificate of Analysis

AGAT WORK ORDER: 19C556068

PROJECT: 19M-01812-00 / Peyto Pit

2910 12TH STREET NE  
CALGARY, ALBERTA  
CANADA T2E 7P7  
TEL (403)735-2005  
FAX (403)735-2771  
<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY: April

### Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS) (Methanol Field Stabilized)

DATE RECEIVED: 2019-12-14

DATE REPORTED: 2019-12-19

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

801547-801554

Results are based on the dry weight of the sample.  
 The C6-C10 (F1) fraction is calculated using toluene response factor.  
 The C10 - C16 (F2), C16 - C34 (F3), and C34 - C50 (F4) fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.  
 Gravimetric Heavy Hydrocarbons (F4g) are not included in and cannot be added to the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.  
 Quality control data is available upon request.  
 Assistance in the interpretation of data is available upon request.  
 This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.  
 nC6 and nC10 response factors are within 30% of Toluene response factor.  
 nC10, nC16 and nC34 response factors are within 10% of their average.  
 C50 response factor is within 70% of nC10 + nC16 + nC34 average.  
 Linearity is within 15%.  
 The chromatogram returned to baseline by the retention time of nC50.  
 C6 -C10 (F1 minus BTEX) is a calculated parameter. The calculated value is F1 minus BTEX. The calculated parameter is non-accredited. The parameters that are components of the calculation are accredited.  
 C>10 - C16 (F2- Napthalene) is a calculated parameter. The calculated value is F2 - Napthalene (if requested). The calculated parameter is non-accredited. The parameters that are components of the calculation are accredited.  
 C>16 - C34 (F3-PAH) is a calculated parameter. The calculated value is F3-PAH (if requested). The calculated parameter is non-accredited. The parameters that are components of the calculation are accredited.  
 Xylenes is a calculated parameter. The calculated value is the sum of m&p-Xylenes + o-Xylene. The calculated parameter is non-accredited. The parameters that are components of the calculation are accredited.  
 Extraction and holding times were met for this sample.

Analysis performed at AGAT Calgary (unless marked by \*)

Certified By:

*Elena Gorobets*



## Certificate of Analysis

AGAT WORK ORDER: 19C556068

PROJECT: 19M-01812-00 / Peyto Pit

2910 12TH STREET NE  
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<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY: April

### Polyaromatic Hydrocarbon Analysis - Soil

DATE RECEIVED: 2019-12-14

DATE REPORTED: 2019-12-19

Parameter	Unit	SAMPLE DESCRIPTION:															
		19TP01 1.0-1.5		19TP01 2.5-3.0		19TP02 1.0-1.5		19TP02 2.5-3.0		19TP03 1.0-1.5		19TP03 2.5-3.0		19TP04 1.0-1.5		19TP04 2.5-3.0	
		SAMPLE TYPE:	Soil	Soil	Soil												
		DATE SAMPLED:	2019-12-12	2019-12-12	2019-12-12	2019-12-12	2019-12-12	2019-12-12	2019-12-12	2019-12-12	2019-12-12	2019-12-12	2019-12-12	2019-12-12	2019-12-12	2019-12-12	
		G / S	RDL	801547	801548	801549	801550	801551	801552	801553	801554	801555	801556	801557	801558	801559	
Acenaphthene	mg/kg	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Acenaphthylene	mg/kg	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Anthracene	mg/kg	0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.006	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	
Acridine	mg/kg	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
Quinoline	mg/kg	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
Naphthalene	mg/kg	0.005	0.010	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	0.006	0.011	0.005	0.006	0.011	0.011	0.011	
2-Methylnaphthalene	mg/kg	0.005	0.008	0.006	<0.005	<0.005	<0.005	<0.005	0.008	0.005	0.008	0.005	0.005	0.008	0.008	0.008	
Fluorene	mg/kg	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Phenanthrene	mg/kg	0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	
Fluoranthene	mg/kg	0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	<0.01	0.02	<0.01	0.04	<0.01	0.02	0.02	
Pyrene	mg/kg	0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	0.01	0.02	<0.01	0.05	0.01	0.02	0.02	
Benzo[a]anthracene	mg/kg	0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	
Chrysene	mg/kg	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
Benzo[b+j]fluoranthene	mg/kg	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	
Benzo[k]fluoranthene	mg/kg	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	
Benzo[a]pyrene	mg/kg	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	
Indeno[1,2,3-cd]pyrene	mg/kg	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	
Dibenzo[ah]anthracene	mg/kg	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	
Benzo[ghi]perylene	mg/kg	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
B[a]P TPE	mg/kg	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.027	0.023	0.023	0.023	0.027	0.023	0.023	0.023	
IACR (Coarse Soil)		0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.015	0.014	0.014	0.014	0.015	0.014	0.014	0.014	
IACR (Fine Soil)		0.026	0.027	0.026	0.026	0.026	0.026	0.026	0.029	0.026	0.026	0.026	0.029	0.026	0.026	0.026	
Surrogate	Unit	Acceptable Limits															
2-Fluorobiphenyl (PAH)	%	50-150	121	127	124	121	123	129	139	130	130	130	139	139	130	130	
p-Terphenyl-d14 (PAH)	%	50-150	118	131	124	127	129	136	140	133	133	133	140	140	133	133	

Certified By:

*Elena Gorobets*



**AGAT** Laboratories

# Certificate of Analysis

AGAT WORK ORDER: 19C556068

PROJECT: 19M-01812-00 / Peyto Pit

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CALGARY, ALBERTA  
CANADA T2E 7P7  
TEL (403)735-2005  
FAX (403)735-2771  
<http://www.agatlabs.com>

CLIENT NAME: WSP CANADA INC.

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY: April

## Polyaromatic Hydrocarbon Analysis - Soil

DATE RECEIVED: 2019-12-14

DATE REPORTED: 2019-12-19

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

801547-801554 Results are based on the dry weight of the sample.  
Based on GC/MS target ion analysis.

Isomers Benzo(b)fluoranthene and Benzo(j)fluoranthene have the same GC retention time and are reported as the sum based on the Benzo(b)fluoranthene response.  
B[a]P TPE, IACR (Coarse) and IACR (Fine) are calculated parameters. They are calculated according to the Alberta Tier 1 Soil and Groundwater Remediation Guidelines, January 10, 2019. Note that if the analysis returns non-detects for a parameter, 1/2 the detection limit is entered into the formulas. As per the Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment Volume 4 Analytical Methods (2016).

Analysis performed at AGAT Calgary (unless marked by \*)

Certified By:

*Elena Gorobets*

## Quality Assurance

CLIENT NAME: WSP CANADA INC.  
 PROJECT: 19M-01812-00 / Peyto Pit  
 SAMPLING SITE:

AGAT WORK ORDER: 19C556068  
 ATTENTION TO: Alyssa Barker  
 SAMPLED BY: April

Soil Analysis														
RPT Date: Dec 19, 2019			DUPLICATE				Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE		MATRIX SPIKE	
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Measured Value		Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits
							Lower	Upper	Lower		Upper	Lower		Upper

**Soil Analysis - Salinity (pH Calcium Chloride)**

pH (CaCl <sub>2</sub> Extraction)	3635	1547	7.63	7.64	0.1%	N/A	100%	90%	110%					
Electrical Conductivity (Sat. Paste)	805323		1.12	1.10	1.8%	< 0.05	97%	90%	110%					
Saturation Percentage	805323		42	42	0.3%	< 1	97%	80%	120%					
Chloride, Soluble	800212		12	12	NA	< 5	102%	80%	120%					
Calcium, Soluble	800527		77	76	0.6%	< 1	106%	80%	120%					
Potassium, Soluble	800527		25	24	1.6%	< 2	107%	80%	120%					
Magnesium, Soluble	800527		21	21	0.2%	< 1	102%	80%	120%					
Sodium, Soluble	800527		29	28	0.9%	< 2	105%	80%	120%					
Sulfur (as Sulfate), Soluble	800527		27	28	3.3%	< 2	95%	80%	120%					

Comments: If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution.  
 If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

**Tier 1/SK PNG031, 033 Metals + Hg + Sat Paste B + Cr6 (Soil)**

Antimony	801547	801547	<0.5	<0.5	NA	< 0.5	80%	80%	120%				NA	80%	120%
Arsenic	801547	801547	6.3	6.1	3.0%	< 0.5	115%	80%	120%				105%	80%	120%
Barium	801547	801547	124	125	0.5%	< 0.5	108%	80%	120%				109%	80%	120%
Beryllium	801547	801547	0.6	0.6	NA	< 0.5	87%	80%	120%				88%	80%	120%
Boron (Saturated Paste)	800527		<0.5	<0.5	NA	< 0.5	109%	80%	120%						
Cadmium	801547	801547	0.8	0.8	NA	< 0.5	101%	80%	120%				NA	80%	120%
Chromium	801547	801547	13.6	13.2	2.9%	< 0.5	95%	80%	120%				105%	80%	120%
Chromium, Hexavalent	802269		<0.3	<0.3	NA	< 0.3	103%	80%	120%	104%	80%	120%	100%	80%	120%
Cobalt	801547	801547	5.2	5.1	2.1%	< 0.5	100%	80%	120%				99%	80%	120%
Copper	801547	801547	12.1	11.9	1.7%	< 0.5	101%	80%	120%				105%	80%	120%
Lead	801547	801547	15.7	14.6	7.4%	< 0.5	106%	80%	120%				NA	80%	120%
Mercury	801547	801547	<0.5	<0.5	NA	< 0.5	87%	80%	120%				NA	80%	120%
Molybdenum	801547	801547	1.9	1.8	NA	< 0.5	92%	80%	120%				NA	80%	120%
Nickel	801547	801547	17.9	17.8	0.5%	< 0.5	99%	80%	120%				98%	80%	120%
Selenium	801547	801547	1.2	0.7	NA	< 0.5	83%	80%	120%				NA	80%	120%
Silver	801547	801547	<0.5	<0.5	NA	< 0.5	92%	80%	120%				114%	80%	120%
Thallium	801547	801547	<0.5	<0.5	NA	< 0.5	106%	80%	120%				98%	80%	120%
Tin	801547	801547	0.6	0.6	NA	< 0.5	95%	80%	120%				113%	80%	120%
Uranium	801547	801547	0.9	0.9	NA	< 0.5	105%	80%	120%				118%	80%	120%
Vanadium	801547	801547	19.6	19.6	0.3%	< 0.5	89%	80%	120%				111%	80%	120%
Zinc	801547	801547	80	80	0.1%	< 1	100%	80%	120%				99%	80%	120%

Comments: If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution.  
 If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.

## Quality Assurance

 CLIENT NAME: WSP CANADA INC.  
 PROJECT: 19M-01812-00 / Peyto Pit  
 SAMPLING SITE:

 AGAT WORK ORDER: 19C556068  
 ATTENTION TO: Alyssa Barker  
 SAMPLED BY: April

### Soil Analysis (Continued)

RPT Date: Dec 19, 2019			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE		MATRIX SPIKE				
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Certified By: \_\_\_\_\_



## Quality Assurance

CLIENT NAME: WSP CANADA INC.

AGAT WORK ORDER: 19C556068

PROJECT: 19M-01812-00 / Peyto Pit

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY: April

### Trace Organics Analysis

RPT Date: Dec 19, 2019			DUPLICATE				Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Measured Value		Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits		
								Lower	Upper		Lower	Upper		Lower	Upper	
Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS) (Methanol Field Stabilized)																
Benzene	5295	801548	<0.005	<0.005	NA	< 0.005	95%	80%	120%	80%	80%	120%	101%	60%	140%	
Toluene	5295	801548	<0.05	<0.05	NA	< 0.05	99%	80%	120%	91%	80%	120%	110%	60%	140%	
Ethylbenzene	5295	801548	<0.01	<0.01	NA	< 0.01	91%	80%	120%	94%	80%	120%	106%	60%	140%	
Xylenes	5295	801548	<0.05	<0.05	NA	< 0.05	89%	80%	120%	91%	80%	120%	103%	60%	140%	
C6 - C10 (F1)	5295	801548	<10	<10	NA	< 10	101%	80%	120%	110%	80%	120%	126%	60%	140%	
C10 - C16 (F2)	6491	801548	<10	<10	NA	< 10	97%	80%	120%	101%	80%	120%	89%	60%	140%	
C16 - C34 (F3)	6491	801548	15	18	NA	< 10	97%	80%	120%	104%	80%	120%	119%	60%	140%	
C34 - C50 (F4)	6491	801548	<10	<10	NA	< 10	97%	80%	120%	96%	80%	120%	67%	60%	140%	

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated. The sample spikes and dups are not from the same sample ID.

#### Polyaromatic Hydrocarbon Analysis - Soil

Acenaphthene	2090	781913	<0.005	<0.005	NA	< 0.005	124%	70%	130%	107%	70%	130%	99%	70%	130%
Acenaphthylene	2090	781913	<0.005	<0.005	NA	< 0.005	122%	70%	130%	101%	70%	130%	94%	70%	130%
Anthracene	2090	781913	<0.004	<0.004	NA	< 0.004	100%	70%	130%	102%	70%	130%	82%	70%	130%
Acridine	2090	781913	<0.05	<0.05	NA	< 0.05	130%	70%	130%	121%	70%	130%	121%	70%	130%
Quinoline	2090	781913	<0.05	<0.05	NA	< 0.05	121%	70%	130%	124%	70%	130%	127%	70%	130%
Naphthalene	2090	781913	<0.005	<0.005	NA	< 0.005	126%	70%	130%	108%	70%	130%	100%	70%	130%
2-Methylnaphthalene	2090	781913	<0.005	<0.005	NA	< 0.005	110%	70%	130%	98%	70%	130%	90%	70%	130%
Fluorene	2090	781913	<0.01	<0.01	NA	< 0.01	114%	70%	130%	98%	70%	130%	92%	70%	130%
Phenanthrene	2090	781913	<0.02	<0.02	NA	< 0.02	118%	70%	130%	101%	70%	130%	92%	70%	130%
Fluoranthene	2090	781913	<0.01	<0.01	NA	< 0.01	111%	70%	130%	108%	70%	130%	98%	70%	130%
Pyrene	2090	781913	<0.01	<0.01	NA	< 0.01	118%	70%	130%	118%	70%	130%	107%	70%	130%
Benzo[a]anthracene	2090	781913	<0.02	<0.02	NA	< 0.02	111%	70%	130%	109%	70%	130%	101%	70%	130%
Chrysene	2090	781913	<0.05	<0.05	NA	< 0.05	125%	70%	130%	123%	70%	130%	80%	70%	130%
Benzo[b+j]fluoranthene	2090	781913	<0.03	<0.03	NA	< 0.03	105%	70%	130%	91%	70%	130%	84%	70%	130%
Benzo[k]fluoranthene	2090	781913	<0.02	<0.02	NA	< 0.02	108%	70%	130%	94%	70%	130%	84%	70%	130%
Benzo[a]pyrene	2090	781913	<0.03	<0.03	NA	< 0.03	103%	70%	130%	90%	70%	130%	84%	70%	130%
Indeno[1,2,3-cd]pyrene	2090	781913	<0.02	<0.02	NA	< 0.02	98%	70%	130%	74%	70%	130%	76%	70%	130%
Dibenzo[ah]anthracene	2090	781913	<0.005	<0.005	NA	< 0.005	100%	70%	130%	81%	70%	130%	82%	70%	130%
Benzo[ghi]perylene	2090	781913	<0.05	<0.05	NA	< 0.05	102%	70%	130%	82%	70%	130%	81%	70%	130%

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated. The sample spikes and dups are not from the same sample ID.

  
 Certified By:



## Method Summary

CLIENT NAME: WSP CANADA INC.  
 PROJECT: 19M-01812-00 / Peyto Pit  
 SAMPLING SITE:

AGAT WORK ORDER: 19C556068  
 ATTENTION TO: Alyssa Barker  
 SAMPLED BY: April

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
pH (CaCl <sub>2</sub> Extraction)	SOIL-0110; INOR-401-0120; SOIL-0260	SHEPPARD 2007; MILLER 2007; SM 4500 H+	PH METER
Electrical Conductivity (Sat. Paste)	SOIL-0110; INOR-401-0120; SOIL-0140; INST-0120	CARTER & GREGORICH 2007, SM 2510 B	CONDUCTIVITY METER
Sodium Adsorption Ratio	SOIL 200	CARTER & GREGORICH 2007-SAR	CALCULATION
Saturation Percentage	SOIL 0140; SOIL 0110; SOIL 0120	CARTER & GREGORICH 2007	GRAVIMETRIC
Chloride, Soluble	SOIL 0110; SOIL 0120; INST 0500	Carter & Gregorich 2007; SM 4500E	COLORIMETER
Calcium, Soluble	SOIL-0110; INOR-401-0120; SOIL-0140; INST-0140	CARTER & GREGORICH 2007, SM 3120B	ICP/OES
Potassium, Soluble	SOIL-0110; INOR-401-0120; SOIL-0140; INST-0140	CARTER & GREGORICH 2007, SM 3120B	ICP/OES
Magnesium, Soluble	SOIL-0110; INOR-401-0120; SOIL-0140; INST-0140	CARTER & GREGORICH 2007, SM 3120B	ICP/OES
Sodium, Soluble	SOIL-0110; INOR-401-0120; SOIL-0140; INST-0140	CARTER & GREGORICH 2007, SM 3120B	ICP/OES
Sulfur (as Sulfate), Soluble	SOIL 0110; SOIL 0120; SOIL 0140; INST 0140	CARTER & GREGORICH 2007, SM 3120B-S	ICP/OES
Antimony	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Arsenic	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Barium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Beryllium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Boron (Saturated Paste)	SOIL-0110; INOR-401-0120; SOIL-0140; INST-0140	CARTER & GREGORICH 2007, SM 3120 B	ICP/OES
Cadmium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Chromium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP/MS
Chromium, Hexavalent	SOIL 0600	BARTLETT, R.J., JAMES, B.R. (1996) S	SPECTROPHOTOMETER
Cobalt	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Copper	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Lead	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Mercury	SOIL-0110; INOR-401-0120; SOIL-0390; INST-0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Molybdenum	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Nickel	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Selenium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Silver	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Thallium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Tin	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS

## Method Summary

CLIENT NAME: WSP CANADA INC.

AGAT WORK ORDER: 19C556068

PROJECT: 19M-01812-00 / Peyto Pit

ATTENTION TO: Alyssa Barker

SAMPLING SITE:

SAMPLED BY: April

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Uranium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP/MS
Vanadium	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Zinc	SOIL 0390; SOIL 0110; SOIL 0120; INST 0141	EPA SW 846-3050; SM 3125 B	ICP-MS
Trace Organics Analysis			
Benzene	TO-0543	EPA SW-846 5021 & 8260	GC/MS
Toluene	TO-0543	EPA SW-846 5021 & 8260	GC/MS
Ethylbenzene	TO-0543	EPA SW-846 5021 & 8260	GC/MS
Xylenes	TO-0543	EPA SW-846 5021 & 8260	GC/MS
C6 - C10 (F1)	TO-0543	CCME Tier 1 Method	GC/FID
C6 - C10 (F1 minus BTEX)	TO-0543	CCME Tier 1 Method	GC/FID
C10 - C16 (F2)	TO-0560	CCME Tier 1 Method	GC/FID
C16 - C34 (F3)	TO-0560	CCME Tier 1 Method	GC/FID
C34 - C50 (F4)	TO-0560	CCME Tier 1 Method	GC/FID
Gravimetric Heavy Hydrocarbons	TO-0560	CCME Tier 1 Method	GC/FID
Moisture Content	TO-0560	CCME Tier 1 Method	GRAVIMETRIC
Toluene-d8 (BTEX)	TO-0543	EPA SW-846 5021 & 8260	GC/MS
o-Terphenyl (F2-F4)	TO 0560	CCME Tier 1 Method	GC/FID
Acenaphthene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Acenaphthylene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Anthracene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Acridine	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Quinoline	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Naphthalene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
2-Methylnaphthalene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Fluorene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Phenanthrene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Fluoranthene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Pyrene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Benzo[a]anthracene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Chrysene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Benzo[b+j]fluoranthene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Benzo[k]fluoranthene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Benzo[a]pyrene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Indeno[1,2,3-cd]pyrene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Dibenzo[ah]anthracene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
Benzo[ghi]perylene	TO 0210	EPA SW-846 3570 & 8270	GC/MS
2-Fluorobiphenyl (PAH)	TO 0210	EPA SW-846 3570 & 8270	GC/MS
p-Terphenyl-d14 (PAH)	TO 0210	EPA SW-846 3570 & 8270	GC/MS
B[a]P TPE		CCME	GC/MS
IACR (Coarse Soil)		CCME	GC/MS
IACR (Fine Soil)		CCME	GC/MS



# AGAT

## Laboratories

2910 12 Street NE  
 Calgary, Alberta T2E 7P7  
 P: 403.735.2005 • F: 403.735.2771  
 webearth.agatlabs.com

### Laboratory Use Only

Arrival Temperature: 1.3°C  
 AGAT Job Number: 19C-12068  
 Date and Time: 14 DEC '19 AM 7:20

### Chain of Custody Record

Emergency Support Services Hotline **1-855-AGAT 245 (1-855-242-8245)**

#### Report Information

Company: WSP  
 Contact: Alyssa Barker  
 Address: Edmonton  
 Phone: \_\_\_\_\_ Fax: \_\_\_\_\_  
 LSD: Pesto Pit  
 Client Project #: 1911-0181000  
 Sampled By: April

#### Report Information

1. Name: Alyssa Barker @wsp.com  
 Email: Alyssa.Barker@wsp.com  
 2. Name: Patricia Legg  
 Email: patricia.legg@wsp.com  
 3. Name: AP  
 Email: \_\_\_\_\_

#### Turnaround Time Required (TAT)

Regular TAT  5-7 Business Days  
 Rush TAT (Surcharge)  <24 Hours (200%)  
 Two Day / Next Day (100%)  
 Three Day (50%)  
 Four Day (25%)  
 Date Required: \_\_\_\_\_

SEE BACK FOR  
 SURCHARGE BREAKDOWN.  
 CONTACT YOUR CPM FOR  
 ADDITIONAL INFORMATION.

#### Invoice To

Same  Yes  No

Company: \_\_\_\_\_  
 Contact: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 Phone: \_\_\_\_\_ Fax: \_\_\_\_\_  
 PO/AFE# \_\_\_\_\_  
 Standing Offer #: \_\_\_\_\_

#### Requirements (Selection may impact detection limits)

- CCME  Alberta Tier 1
- Agricultural  Agricultural
- Industrial  Industrial
- Residential/ Park  Residential/ Park
- Commercial  Commercial
- FWAL  Natural Area
- Drinking Water  Alberta Surface Water
- Other  Chronic
- Acute

#### Report Format

- Single Sample Per Page
- Multiple Samples Per Page
- Export

LABORATORY USE (LINE/ LAB ID#)	SAMPLE IDENTIFICATION	DEPTH	DATE/ TIME SAMPLED	SAMPLE MATRIX	COMMENTS (Filtered, Preserved, Hazardous*) *Additional Fee	# of CONTAINERS			Detailed Salinity	AB	BC	SK	D50	CCME / AB: BTEX/FL-F4	BC: BTEX/ VPH/ EPH	BC: LEPH/ HEPH	SK: BTEX/ TVH/ C11-C22, C23-C60	Soil Metals: <input checked="" type="checkbox"/> HWS-B <input checked="" type="checkbox"/> SP-B <input checked="" type="checkbox"/> Hg <input checked="" type="checkbox"/> Cr6+	Water Metals: <input type="checkbox"/> Dissolved <input type="checkbox"/> Total <input type="checkbox"/> Hg <input type="checkbox"/> Cr6+	Routine Water Chemistry	Landfill: <input type="checkbox"/> AB Class 2 <input type="checkbox"/> BC <input type="checkbox"/> SK	Coliforms: <input type="checkbox"/> Total <input type="checkbox"/> Fecal <input type="checkbox"/> E. coli	Particle Size: <input type="checkbox"/> Sieve (75 µm) <input type="checkbox"/> Texture	DAH	HOLD FOR 30 DAYS NO ANALYSIS (Additional Fee)	HOLD FOR 30 DAYS AFTER ANALYSIS (Additional Fee)	
						Vials/	Jars	Bags																			
1	19 TPO1	1.0-1.5	Dec 12/19	Soil		4			/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
2	19 TPO1	2.5-3.0	Dec 12/19	Soil		4			/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
3	19 TPO2	1.0-1.5	Dec 12/19	Soil		4			/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
4	19 TPO2	2.5-3.0	Dec 12/19	Soil		4			/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
5	19 TPO3	1.0-1.5	Dec 12/19	Soil		4			/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
6	19 TPO3	2.5-3.0	Dec 12/19	Soil		4			/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
7	19 TPO4	1.0-1.5	Dec 12/19	Soil		4			/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
8	19 TPO4	2.5-3.0	Dec 12/19	Soil		4			/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/

Samples Relinquished By (Print Name and Sign): April Bates ABaker

Date/ Time: Dec 13 7:23pm

Samples Relinquished By (Print Name and Sign): [Signature] 14-DEC-19

Date/ Time: 7:20

Samples Relinquished By (Print Name and Sign): \_\_\_\_\_

Date/ Time: \_\_\_\_\_

Samples Relinquished By (Print Name and Sign): \_\_\_\_\_

Date/ Time: \_\_\_\_\_

Page \_\_\_\_\_ of \_\_\_\_\_  
**107284**  
 N°: AB



# AGAT Laboratories

## SAMPLE INTEGRITY RECEIPT FORM

### RECEIVING BASICS - Shipping

Company/Consultant: WSP

Courier: 010 Prepaid Collect

Waybill# \_\_\_\_\_

Branch: EDM GP FN FM RD VAN LYD FSJ EST Other: -

If multiple sites were submitted at once: Yes  No

Custody Seal Intact: Yes No  NA

TAT: <24hr 24-48hr 48-72hr  Reg Other \_\_\_\_\_

Cooler Quantity: 1

### TIME SENSITIVE ISSUES - Shipping

ALREADY EXCEEDED HOLD TIME? Yes  No

Inorganic Tests (Please Circle): Mibi , BOD , Nitrate/Nitrite , Turbidity , Microtox , Ortho PO4 , Tedlar Bag , Residual Chlorine , Chlorophyll\* , Chloroamines\*

Earliest Expiry: N/A

Hydrocarbons: Earliest Expiry 26-DEC-19

### SAMPLE INTEGRITY - Shipping

Hazardous Samples: YES  NO Precaution Taken: \_\_\_\_\_

Legal Samples: Yes  No

International Samples: Yes  No

Tape Sealed: Yes  No

Coolant Used: Icepack Bagged Ice Free Ice Free Water  None

Temperature (Bottles/Jars only) N/A if only Soil Bags Received

### FROZEN (Please Circle if samples received Frozen)

1 (Bottle/Jar) 1.3 + 1.3 + 1.3 = 1.3 °C    2 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C

3 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C    4 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C

5 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C    6 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C

7 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C    8 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C

9 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C    10 (Bottle/Jar) \_\_\_ + \_\_\_ + \_\_\_ = \_\_\_ °C

(If more than 10 coolers are received use another sheet of paper and attach)

### LOGISTICS USE ONLY

Workorder No: 19C JTB 068

Samples Damaged: Yes  No If YES why?

No Bubble Wrap Frozen Courier

Other: \_\_\_\_\_

Account Project Manager: \_\_\_\_\_ have they been notified of the above issues: Yes No

Whom spoken to: \_\_\_\_\_ Date/Time: \_\_\_\_\_

CPM Initial \_\_\_\_\_

General Comments: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\* Subcontracted Analysis (See CPM)