TETRA TECH

July 30, 2021

ISSUED FOR USE
734-2122790100-LTR-V0001-00
Via Email: b.elliott@nipawin.com

Barry Elliott, RMA, CLGM, CMMA
Chief Administrative Officer
Town of Nipawin
PO Box 2134
Nipawin, SK S0E 1E0

Attention: Mr. Elliot

Subject: Groundwater Condition Assessment at Snow Dump Site in Nipawin, Saskatchewan

1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) is pleased to present this report to the Town of Nipawin (Town) describing our interpretation of the shallow groundwater conditions present beneath the property used as the Town snow dump on the north edge of the Town of Nipawin, Saskatchewan. The general objective of this assessment was to determine local shallow groundwater conditions and whether the seasonal operation of a snow dump on the site would result in potential flooding conditions to adjacent properties.

The results of this assessment have determined that the site is underlain by a water bearing sand and gravel unit with local spring groundwater levels within 0.7 m of the ground surface at the snow dump site. This water level condition is assumed to be indicative of the larger area. Review of provincial groundwater elevation monitoring station records for a similar near surface sand unit suggest that currently hydrogeological conditions are representative of a relatively wet period with seasonal water level fluctuations being limited to 1.0 m from spring (May-June) maximums. On-site assessment of the water bearing sand unit shows a relatively high conductivity resulting in infiltration of most meltwater/ precipitation but also allowing for the rapid dissipation of this inflow over a large area. Based on theoretical assumptions relating to the size and melt rate of a typical snow dump site, there is the potential for the snow dump to contribute to a 0.1 m increase in water levels in the general area, however these would still be considered within the seasonal range of naturally occurring water level fluctuations and within the remaining 0.6 m unsaturated surficial soil zone.

In accordance with previous assessment of the lower terrace portion of the Town of Nipawin, these shallow groundwater conditions represent a potential limitation to development in this area. Additional details relating to the scope of this assessment and our findings are provided in the following paragraphs.

2.0 SITE CONDITIONS

2.1 General Site Description

The snow dump site is located on the north side of Nipawin Road West, approximately 110 m west of Gordon Street, in the northwest corner of Nipawin. This site is a vacant, largely open grassed lot with treed areas along the east and west edges. Legally, this site consists of Survey Parcel B, Plan BV3592 (western and central portions) and Parcel AA, Plan 101619930 (eastern edge), and encompasses approximately 2.8 hectares of land.

The adjacent properties surrounding the subject site consists of the following.

- North: A railroad embankment followed by agricultural land.
- East: A forested wetland area followed by Gordon Street.
- South: Nipawin Road West followed by a forested wetland area.
- West: A forested area with a commercial/ industrial shop and yard area, approximately 30 m west of the snow dump property line, and 40 m west of the open grassland area.

The location of the subject site and the surrounding site development are shown on Figure 1, provided in Appendix A. Photographs of the site are presented in Appendix B.

2.1.1 Site Topography

Visual inspection of the site shows it to be relatively flat with no distinct topographical features other than the elevated railway embankment on the north end and the elevated roadway on the south side of the site. The site has been subject to surficial grading with some excess soil apparent as having been piled in the northeastern corner of the site, while the grass has been scraped away and sand has been pushed out along the eastern edge of the open area, potentially as part of general site clean-up following the melt of the snow previously piled at this site.

A previous topographical survey of this portion of the Town was provided by the Town of Nipawin and showed the local area to be relatively flat with ground surface elevations across the open grassland and within the forest lands to the east varying by only 50 mm. The roadway was approximately 150 mm higher than the grassland area, while the railway embankment was 650 mm higher. The only notable surface gradient feature was the presence of an off-site drainage creek in the forested area south of Nipawin Road West. This topographical mapping of the snow dump site is provided as Figure 2 in Appendix A.

While on-site, Tetra Tech undertook a limited topographic survey of the snow dump site. Measurement of ground surface elevations relative to an arbitrary on-site datum of 100.00 m were collected along the southern edge of the site, adjacent to Nipawin Road West and showed a slight gradient down to the east. Although there is no formal drainage ditch along the Nipawin Road West roadway, and no culvert was apparent crossing under the roadway allowing for drainage to the south, drainage flow along the roadway is expected to flow easterly, towards Gordon Street. Topography on the site suggests a very slight downward gradient to the north and east with a ground surface elevation drop in the order of 500 mm from the southwest corner of the site to the northeast corner.

The snow dump site and surrounding features are located on a flood plain naturally developed along the Saskatchewan River, that extends out from the river for anywhere from 30 m to 1.5 km, and referred to as the Lower Terrace. In the vicinity of the snow dump site, the flood plain is approximately 1.4 km wide, extending approximately 800 m to the north and 350 m to the south. This flood plain is defined to the south by a 4 m to 6 m high escarpment with the Town itself being developed at this higher elevation, referred to as the Mid Terrace. A second flood plain escarpment is found along the southern edge of the town leading to the Upper Terrace.

2.1.2 Surface Water Features

During the site investigation, low lying areas containing small pools of standing water were identified to the northeast of the site. Surface water runoff appears to flow towards the low-lying area located on the north edge of the site, and then flows east to a point where it meets a drainage ditch that flows north along Gordon Street. According to the residents in area, the drainage ditch along Gordon Street continuously flows from spring to fall. Further north of the site, the land slopes down toward the Saskatchewan River, located approximately 1 km north of the site.

Additional areas of standing water and a flowing stream were noted to be located directly south of the site, across Nipawin Road West, and appears to flow south. There were no indications of a culvert crossing under Nipawin Road West suggesting that the road acts as a flow boundary forcing all on-site flow to the north.

2.1.3 Regional Hydrogeology

An initial review of local geological and hydrogeological conditions as presented on the Saskatchewan Geological Surficial Geology Map of Saskatchewan (1997), the regional surficial geology in the site area generally comprises glaciolacustrine and alluvial deposits of saline mud and sand accumulations which have been deposited from meltwater inflows in glacial lakes and riverbeds. These overburden deposits are up to 100 m thick in the Nipawin area and overlay Sedimentary bedrock formation including the Ashville and Swan River Formations which are comprised by siltstone, mudstone, shale, sandstone, and conglomerate bedrock.

Review of Saskatchewan Water Security Agency borehole records for the area, indicated that the subsurface stratigraphy in the northern portion of Nipawin consisted of a surficial topsoil layer followed by between 6 m and 15 m of sand overlying clay. Shallow groundwater was reportedly present in the sand unit at a depth of 1.2 m below grade in the area to the west of the snow dump site, and at depths of 5 m to 9 m below grade in the higher elevation developed town area to the south. A *Basic Planning Statement* developed for the Town of Nipawin in 1998 indicated that in the area around the snow dump site, groundwater could be expected to be found 1.2 m to 2.0 m below ground surface.

Shallow groundwater systems are subject to seasonal fluctuations in water levels as a result of naturally occurring recharge to the system (e.g., infiltration of snow melt and precipitation) and discharge to local receptors (e.g., springs, creeks and rivers). The Saskatchewan Water Security Agency has established a network of monitoring stations through the province to record these fluctuations to demonstrate general expectations and long term trends in groundwater conditions. The closest monitoring station to Nipawin is located near Smoky Burn, approximately 65 km east of Nipawin. This monitoring well is installed to a depth of 6.1 m below grade in a fine to very coarse sand, similar to the conditions at the snow dump site. Long term water level fluctuations in this shallow well indicate that seasonal fluctuations are typically in the range of 1.0 m to 3.0 m, with the lowest water levels being experienced in March – April and the maximum levels being in May – June. The range in seasonal variations is generally associated with wet period/ dry (drought) period precipitations cycles. Although spring levels are generally within 1.0 m of each other year after year, yearly average and low water levels can vary by 3.0 m between wet and dry periods. The period prior to 2004 was noted to be relatively dry, while 2004 to present is relatively wet. The current trend appears to be showing a gradual decrease in water levels since 2016.

3.0 SUBSURFACE ASSESSMENT

In order to confirm the soil and shallow groundwater conditions below the site, intrusive site investigations, as described below were undertaken between May 11 and May 26, 2021.

3.1.1 Site Safety

The presence of underground and aboveground site services and utilities on site was investigated prior to mobilization to the site using the provincial online locate service (https://www.sask1stcall.com). The Town of

Nipawin was also contacted to request locates for any possible municipal water and wastewater utility lines in the area. In addition, Mobile Augers of Regina, Saskatchewan undertook additional site reviews to locate any private utilities and confirm the location of any public utilities within the work area.

Prior to the start of the drilling activities on May 11, 2021 a health and safety toolbox meeting was conducted during which the scope of the project, the job hazards and the safety procedures that would be employed to mitigate those hazards were discussed.

3.1.2 Borehole Drilling and Soil Sampling

The borehole drilling program was completed under the observation of Tetra Tech staff, on May 11, 2021 and consisted of the drilling of three boreholes, initially identified as BH01, BH02 and BH03. The boreholes were drilled by Mobile Augers using an M-10 drill rig equipped with 127 mm diameter, solid stem augers. Each borehole was drilled to a depth of 6.0 m below grade. Subsurface stratigraphy was evaluated through visual inspection of the drill cuttings obtained, and the soil conditions encountered were recorded on individual borehole logs in general accordance with the Unified Soil classification System (USCS) listing soil type, colour, texture, moisture content, and noticeable inclusions. The borehole locations are presented on Figure 1 in Appendix A. The borehole logs are present in Appendix C.

The general site stratigraphy encountered at the site consisted of a surficial layer of black topsoil to depths ranging from at grade level to 0.75 meters below grade, underlain by a brown fine-grained sand to 1.5 m below grade and then by a grey fine and coarse grained sand with some small gravel. This sand and gravel unit extended to the base of the borehole at 6.0 m below grade. Water was encountered at a depth of approximately 0.6 m below grade in each borehole. The native wet sand was noted to start collapsing into the borehole at depths below 3.0 m below grade.

During the course of borehole drilling, representative soil samples were collected for further examination and possible laboratory testing. Two soil samples were subsequently submitted to ALS Global laboratories in Winnipeg, Manitoba and subjected to general soil classification testing. The results of the soil sample collected from the sand unit encountered in borehole BH01 at 2.25 m below grade showed to be 98 % sand. The results of the soil sample collected from the base of the topsoil/ top of the sand as found in borehole BH03 at 0.75 m below grade, showed a sandy loam soil containing approximately 55% sand and 40% silt. The formal grain size classification for these soil samples is summarized in Table 1, presented in Appendix D. The formal laboratory analytical report is included as Appendix E.

Upon completion of the borehole drilling, monitoring wells were installed in each of the three boreholes, as described below.

3.1.3 Monitoring Well Installation

Boreholes BH01, BH02, and BH03 were each completed as groundwater monitoring wells. The groundwater monitoring wells were constructed of 50 mm diameter schedule 40 polyvinyl chloride (PVC) casing threaded into 1.5 m lengths of No. 10 factory slot well screen. The monitoring wells were installed to depths of 3.0 m to 3.6 m below grade and completed at a height of approximately 1.0 m above grade. Due to the wet soft sand conditions encountered, the boreholes generally collapsed below a depth of 3.0 m below grade. The monitoring wells were therefore pushed down through the wet sand so that the lower portion of the borehole annulus adjacent to the screened section of the wells ended up being backfilled with native sand. The remaining portion of the annulus adjacent to the screen section, and the lower 0.5 m of the solid casing, was backfilled with clean silica sand. The remaining 1.0 m length of annulus around the solid casing was filled with bentonite pellets to act as a surficial seal. The wells were completed with a protective steel stick-up casing.

On May 26, 2021, the ground surface elevation at each monitoring well and the elevation of the top of each monitoring well casing were measured using a Leica laser level with respect to an arbitrary on-site benchmark having an assigned elevation of 100.000 meters. The benchmark used was the ground north of the SaskPower pole located in the southwestern portion of the site. Monitoring well and grade elevations were collected in order to determine groundwater flow direction and gradient.

Additional well construction details are shown on the borehole logs presented in Appendix C.

3.1.4 Groundwater Elevation Monitoring

Groundwater elevation monitoring was performed on May 11, 2021 and consisted of the inspection of the three monitoring wells for depth to the static groundwater level using an electronic water level indicator. The depth to groundwater was again measured on May 26, 2021. These measurements showed the groundwater to be present at depths of 0.36 m to 0.66 m below grade, and the depths to be relatively consistent between monitoring events. The resulting calculated groundwater elevations showed water level variations of only 70 mm across the site, with monitoring well MW02, located in the west-central portion of the site, showing the lowest elevation value. Based on these elevations, the groundwater flow direction appears to be north-northwesterly with a shallow gradient of 0.0007 m/m. Groundwater monitoring results for both site visits are presented in Table 2 in Appendix D.

Between these measurement dates, the groundwater levels were noted to decrease slightly in each well, by between 10 mm and 20 mm. Review of the local precipitation records maintained by Environment Canada for a station in Nipawin indicated that between May 21 and May 25, 2021, the area received approximately 19.5 mm of rain fall. These infiltration rates appear to have been insufficient to influence the local groundwater levels.

3.1.5 Hydraulic Conductivity Calculation

A hydraulic conductivity assessment was performed by Tetra Tech on shallow groundwater monitoring well MW02 using slug test methodologies on May 26, 2021. The depth to groundwater at equilibrium was initially recorded in the monitoring well. A solid PVC slug was then used to displace the groundwater in the monitoring well, resulting in the near instantaneous rise in the water level in the well casing. The subsequent decrease in the water level in the well casing (i.e. falling head) was measured at regular intervals using a data logging pressure transducer until the depth to groundwater returned to near equilibrium levels. The solid slug that was used to displace the groundwater in the monitoring well during the falling-head test was removed from the monitoring well, resulting in a near instantaneous drop in the water level in the well casing. The subsequent increase in the water level in the well casing (i.e., rising head) was measured at regular intervals until the depth to groundwater returned to near equilibrium levels. This process was repeated twice in monitoring well MW02.

Analysis of this change in water level over time was performed using the AquiferTest Pro™ software for hydrogeological analysis which incorporates subsurface soil and groundwater conditions observed and well construction details to provide an indication of the ability of water to flow through the subsurface. Review of the pressure transducer records indicated that due to the ability of the sand to easily transmit water, recovery to static water levels required only a few seconds. The initial falling head test could not be analyzed due to excessive interference with water splashing around in the casing following slug insertion, however the remaining three data sets showed an average value of 5×10^{-4} m/s. This value is consistent with the industry established range of values for a fine grained clean sand unit. A summary of the calculated hydraulic conductivity results is shown in Table 3 in Appendix D.

4.0 DISCUSSIONS/ CONCLUSIONS

Review of the local hydrogeological conditions for the northern portion of the Town of Nipawin shows the area to be underlain by a conductive water bearing sand unit with a relatively flat groundwater surface and a northerly flow direction, toward the adjacent Saskatchewan River. In the lower elevation floodplain area, around the snow dump site, the groundwater level has been observed to be within 0.7 m of the ground surface under natural springtime, seasonally high water groundwater level conditions. Visual examination of the subsurface sand unit indicated a consistent colour change in each of the three boreholes from brown to grey at depths of approximately 1.5 m to 1.8 m below grade, which would indicate the lower range of seasonal water level fluctuations since the brown colour is likely associated with iron oxidation. This seasonal range of fluctuation is consistent with that observed in the Smoky Burn shallow groundwater monitoring station.

Review of local runoff conditions suggest that the roadway to the south acts as a drainage divide with the area to the north of the road showing a northerly decreasing gradient, towards the rail line embankment. Drainage along the southern roadway and northern railway both appear to be to the east, towards Gordon Street. There is evidence of some surface water in these drainage ditches and standing water in limited locations, resulting in wetland conditions within the undeveloped area to the east of the site. Despite these areas of standing water, the relatively flat ground surface and silt/ sand composition of the surficial soil layer suggests limited runoff potential with most water infiltrating into the lower sand unit. The extent of this sand unit however provides for significant storage potential and immediate migration of flow outwards from any areas of localized recharge such as melting snow.

In an effort to quantify the potential for the snow dump impact on the local groundwater system a theoretical scenario has been reviewed which involves the deposition of a 6 m high snow pile covering an area of approximately 1.0 ha, which is most of the cleared grass land portion of the site. Under redeposited and partially compacted conditions, the volume of water contained in this snow is assumed to be 20,000 m^3. Initially, a portion of the meltwater would initially drain as surface run off over the frozen ground conditions, with infiltration occurring during the later portions of the melt period. In the absence of site specific details, we have assumed that approximately 25% of the melt is drained as run off with the remaining 75% (15,000 m^3) infiltrating into the subsurface over a period of 30 days required to melt the snow dump.

The resulting daily 500 m^3 of infiltrating water represents a potential 143 mm increase in water levels over the subject site, accounting for the available porosity of a sand unit. As evidenced during the slug test conducted by Tetra Tech any such localized increase in water level is quickly dissipated into the surrounding area. Based on the calculated hydraulic conductivity, the local rate of groundwater flow would be in the order of 17.7 m/day. Allowing for outflow from the southern half of the site only, the resulting outflow area has an adsorption capacity of 1544 m^3/ day. The daily 500 m^3 of increased meltwater therefore represents a potential increase in groundwater elevations around the snow dump site of 100 mm. This 100 mm increase in groundwater levels is within the approximated seasonal average water level fluctuations of at least 1.0 m.

As indicated in the previously developed Nipawin Basic Planning Statement, the naturally occurring shallow groundwater table does represent a limit to potential local development.

5.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Town of Nipawin and their agents. Tetra Tech Canada Inc. (operating as Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than the Town of Nipawin, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in the Appendix or Contractual Terms and Conditions executed by both parties.

6.0 CLOSURE

We trust this document meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

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CA/initials

APPENDIX A

FIGURES

LEGEND

- PROPERTY LINE (ASSUMED)
- ## GROUNDWATER ELEVATION
- △ MONITORING WELL
- → GROUNDWATER FLOW DIRECTION

REFERENCE DRAWINGS: GOOGLE MAPS 2019

NO.	DATE	DESCRIPTION	ISSUED BY

REVISIONS / ISSUE

TETRA TECH

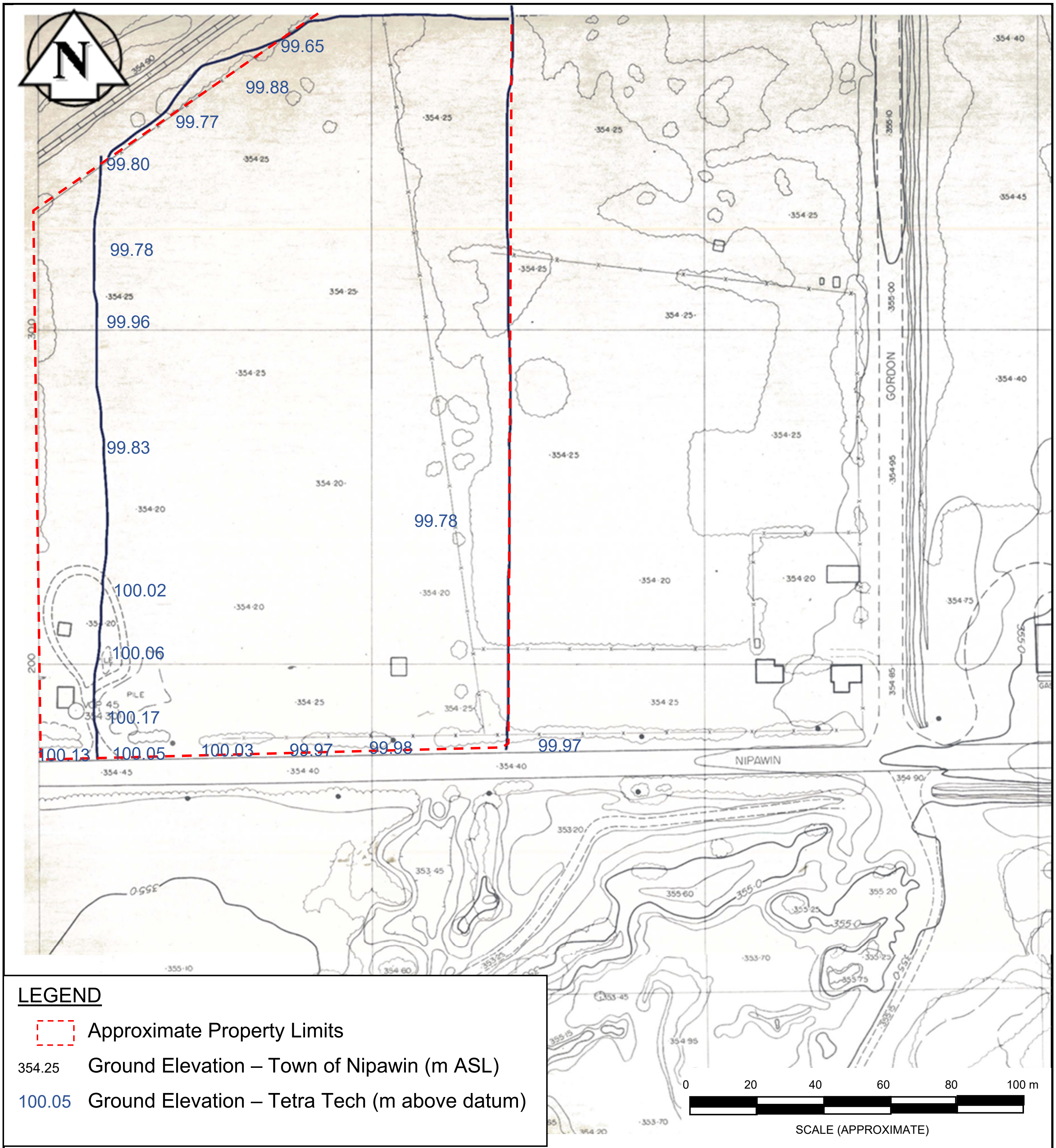
AUTHORIZED BY: BH
DATE 21.06.18
CLIENT DRAWING NO.

CLIENT
TOWN OF NIPAWIN

DRAWING DESCRIPTION

FIGURE 1: SITE PLAN
SNOW DUMP HYDROGEOLOGICAL STUDY
NIPAWIN, SASKATCHEWAN

DESIGNED BY: C.A.	DRAWN BY: C.A.	DRAWING NO.	REV.
REVIEWED BY: BH	SCALE: As Shown	734-2122790100-SKT-V0001	00



LEGEND

🟥 Approximate Property Limits

354.25 Ground Elevation – Town of Nipawin (m ASL)

100.05 Ground Elevation – Tetra Tech (m above datum)

REFERENCE DRAWINGS: Town of Nipawin Topographic Mapping

NO.	DATE	DESCRIPTION	ISSUED BY

REVISIONS / ISSUE

TETRA TECH

AUTHORIZED BY: BH

DATE 21.06.18

CLIENT DRAWING NO.

CLIENT

TOWN OF NIPAWIN

DRAWING DESCRIPTION

FIGURE 2: GENERAL SITE TOPOGRAPHY
SNOW DUMP HYDROGEOLOGICAL STUDY
NIPAWIN, SASKATCHEWAN

DESIGNED BY: B.H.

DRAWN BY: B.H.

DRAWING NO. 734-2122790100-SKT-V0001

REV. 00

REVIEWED BY: BH

SCALE: As Shown

APPENDIX B

SITE PHOTOGRAPHS

Photo 1: General view of the site. View facing northwest. (May 26, 2021)

Photo 2: General view of the site. View facing west. (May 26, 2021)

Photo 3: General view of the site. View facing southwest. (May 26, 2021)

Photo 4: View of soil piled along the eastern and northeastern edges of the site. (May 26, 2021)

Photo 5: View of the stream located directly south of the site, following Nipawin Road W. View facing south. (May 11, 2021)

Photo 6: View of the low-lying area located southwest of the site, following Nipawin Road W. View facing south. (May 11, 2021)

Photo 7: General view of the low-lying area located south the site. Small bodies of water are in this area, but do not appear to flow into any other surface water body. View facing south. (May 11, 2021)

Photo 8: View of the low-lying area located north of the site. Note the pile of soil along the northeastern portion of the site. View facing west. (May 11, 2021)

Photo 9: View of Nipawin Road W and the southern edge of the site. View facing east. (May 11, 2021)

Photo 10: View of the drainage ditch located along Gordon Street. View facing south. (May 11, 2021)

Photo 11: View of the drainage ditch located along Gordon Street. View facing north. (May 11, 2021)

Photo 12: View of the drainage ditch located along Nipawin Road West, located east of Gordon Street. The drainage ditch flows west along Nipawin Road West, until it flows under Nipawin Road West on flows north along Gordon Street. View facing east (May 11, 2021)

Photo 13: General view of the brown silty sand layer found on the site. (May 11, 2021)

Photo 14: General view of the grey sand layer found on site. (May 11, 2021)

Photo 15: View of monitoring well MW01. View facing south. (May 11, 2021)

Photo 16: View of monitoring well MW02. View facing south. (May 11, 2021)

Photo 17: View of monitoring well MW03. View facing north. (May 11, 2021)

APPENDIX C

BOREHOLE LOGS

TETRA TECH

734-2122790100

RECORD OF BOREHOLE

BH01

Sheet 1 of 1

CLIENT: Town of Nipawin

DATE DRILLED: May 11, 2021

DATUM: Assumed

PROJECT TITLE: Snow Dump Hydrogeological Study

PROJECT SITE: Nipawin, Saskatchewan

NORTHING: 5913408

EASTING: 564972

BOREHOLE LOCATION: Located in the southwestern portion of the site; along the west border

BORING METHOD: Mobile Augers,M-10 Solid Stem
Auger - Solid Stem

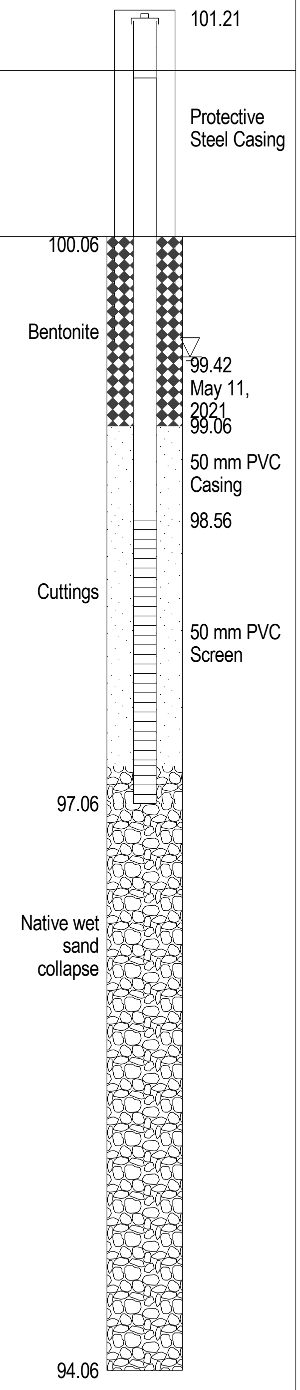
SUBSURFACE PROFILE

ELEV DEPTH (m)	DESCRIPTION
100.06 0.00	Ground Surface
	Topsoil Black
99.76 0.30	**Sand** Light brown, fine-grained with some black topsoil
99.46 0.60	**Sand** Light brown, fine-grained, wet
98.56 1.50	**Sand** Grey, fine-grained sand
98.23 1.83	**Sand** Grey, fine-grained and coarse grained sand. Some small gravel from 2.3 m to 3.0 m.
94.06 6.00	***End of Borehole at 6.00m***

SAMPLES

NUMBER	TYPE	SPT(N)/RQD(%)	RECOVERY(%)	LAB TESTING
BH03 (0.75)	A			X

MONITORING WELL MW01



SCALE 1: 40.0

LOGGED C. Ateah

CHECKED B. Horning

TETRA TECH

734-2122790100

RECORD OF BOREHOLE

BH02

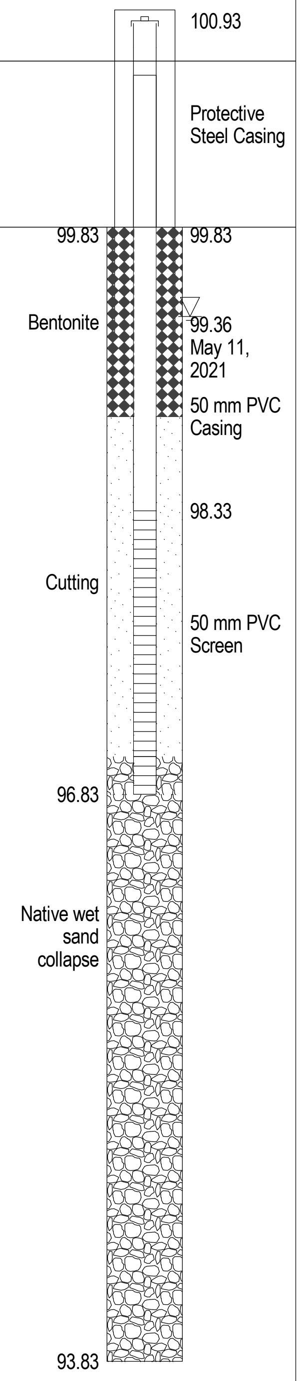
Sheet 1 of 1

CLIENT: Town of Nipawin
DATE DRILLED: May 11, 2021
PROJECT TITLE: Snow Dump Hydrogeological Study
PROJECT SITE: Nipawin, Saskatchewan
BOREHOLE LOCATION: Located in the middle of the site, along the western border

DATUM: Assumed
NORTHING: 5913470
EASTING: 564974

BORING METHOD	DEPTH SCALE m	ELEV DEPTH (m)	DESCRIPTION	SYMBOLS	NUMBER	TYPE	SPT(N)/RQD(%)	RECOVERY(%)	LAB TESTING
	0.00	99.83	Ground Surface						
Mobile Augers,M-10 Solid Stem Auger - Solid Stem			**Topsoil** Black						
		99.08 0.75	**Sand** Brown, fine-grained, little clay, wet						
		98.33 1.50	**Sand** Grey, fine-grained and coarse grained, some small gravel, trace silt, wet						
		96.03 3.80	**Sand** Grey, fine-grained and coarse grained, some small gravel, wet						
		93.83 6.00	***End of Borehole at 6.00m***						

MONITORING WELL
MW02



SCALE 1: 40.0
LOGGED C. Ateah
CHECKED B. Horning

TETRA TECH

734-2122790100

RECORD OF BOREHOLE

BH03

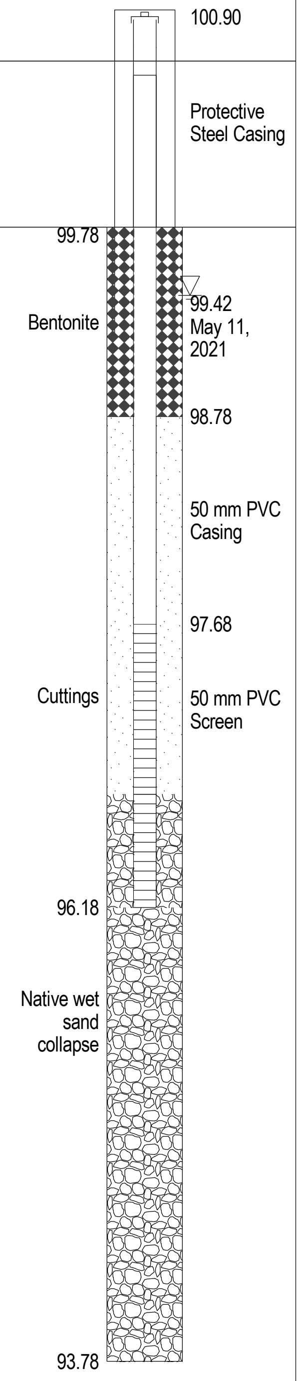
Sheet 1 of 1

CLIENT: Town of Nipawin
DATE DRILLED: May 11, 2021
DATUM: Assumed
PROJECT TITLE: Snow Dump Hydrogeological Study
PROJECT SITE: Nipawin, Saskatchewan
NORTHING: 5913446
BOREHOLE LOCATION: Located in the southeastern portion of the site, along the eastern border
EASTING: 565077

BORING METHOD: Mobile Augers,M-10 Solid Stem; Auger - Solid Stem

ELEV DEPTH (m)	SUBSURFACE PROFILE DESCRIPTION	SAMPLES NUMBER	TYPE	SPT(N)/RQD(%)	RECOVERY(%)	LAB TESTING
99.78 0.00	Ground Surface					
	Topsoil Black					
99.03 0.75	**Sand** Grey, fine grained with some clay and silt	BH03(0.75)	A			
97.98 1.80	**Sand** Brown and grey, fine and coarse grained, some gravel					
93.78 6.00	***End of Borehole at 6.00m***					

MONITORING WELL
MW03



SCALE 1: 40.0
LOGGED C. Ateah
CHECKED B. Horning

APPENDIX D

TABLE

TABLE 1

Soil Grain Size Analytical Results - May 11, 2021
Snow Dump Hydrogeological Study
Town of Nipawin, Saskatchewan

Sample Identification	% Sand	% Silt	% Clay	Soil Texture
BH01 (2.25)	98.0	1.2	<1.0	Sand
BH03 (0.75)	55.3	40.3	4.5	Sandy Loam

Notes:
% Sand = 2.00 mm - 0.5 mm
% Silt = 0.05 mm - 2 µm
% Clay = < 2 µm

TABLE 2

Groundwater Elevation Monitoring Results
Snow Dump Hydrogeological Study
Town of Nipawin, Saskatchewan

			Tuesday, May 11, 2021		Wednesday, May 26, 2021	
Well No.[a]	**Well Casing Elevation (m above datum)**	**Ground Elevation (m above datum)**	**Depth to Groundwater (m below ground)**	**Groundwater Elevation (m above datum)**	**Depth to Groundwater (m below ground)**	**Groundwater Elevation (m above datum)**
MW01	101.21	100.06	0.64	99.42	0.66	99.39
MW02	100.93	99.83	0.47	99.36	0.49	99.34
MW03	100.90	99.78	0.36	99.42	0.37	99.41

Notes:

[a] 3 wells were installed at this site. 3 wells were monitored during this investigation.

TABLE 3

Hydraulic Conductivity Test Results - May 26, 2021
Snow Dump Hydrogeological Study
Town of Nipawin, Saskatchewan

Test Identification	Hydraulic Conductivity (m/s)
Falling Head Test 1	Not Available
Rising Head Test 1	3.3E-04
Falling Head Test 2	4.9E-04
Rising head Test 2	6.8E-04
Average Value	5.00E-04

Notes: Falling Head Test 1 data set could not be analyzed due to excessive distrubance of the water surface during slug installation

APPENDIX E

ANALYTICAL RESULTS

Tetra Tech Canada Inc.
ATTN: BRENT HORNING
400-161 Portage Ave East
Winnipeg MB R3B 0Y4

Date Received: 19-MAY-21
Report Date: 28-MAY-21 08:19 (MT)
Version: FINAL

Client Phone: 204-954-6860

Certificate of Analysis

Lab Work Order #: L2589791

Project P.O. #: NOT SUBMITTED
Job Reference: 734-2122790100
C of C Numbers:
Legal Site Desc: NIPAWIN, SK

Hua Wo
Chemistry Laboratory Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2589791-1 BH01 (2.25) Sampled By: C. ATEAH on 11-MAY-21 @ 10:35 Matrix: SOIL							
Particle Size Analysis:Mini-Pipet Method							
% Sand (2.0mm - 0.05mm)	98.0		1.0	%	25-MAY-21	26-MAY-21	R5469798
% Silt (0.05mm - 2um)	1.2		1.0	%	25-MAY-21	26-MAY-21	R5469798
% Clay (<2um)	<1.0		1.0	%	25-MAY-21	26-MAY-21	R5469798
Texture	Sand				25-MAY-21	26-MAY-21	R5469798
L2589791-2 BH03 (0.75) Sampled By: C. ATEAH on 11-MAY-21 @ 11:55 Matrix: SOIL							
Particle size - Pipette removal OM & CO3							
% Sand (2.0mm - 0.05mm)	55.3	PSAL	1.0	%	26-MAY-21	27-MAY-21	R5472413
% Silt (0.05mm - 2um)	40.3	PSAL	1.0	%	26-MAY-21	27-MAY-21	R5472413
% Clay (<2um)	4.5	PSAL	1.0	%	26-MAY-21	27-MAY-21	R5472413
Texture	Sandy loam	PSAL			26-MAY-21	27-MAY-21	R5472413

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
PSAL	Limited sample was available for Particle Size Analysis (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
PSA-1-SK	Soil	Particle Size Analysis:Mini-Pipet Method	SSIR-51 Method 3.2.1

Dry, < 2 mm soil is treated with sodium hexametaphosphate to ensure complete dispersion of primary soil particles. After treatment, sub-samples of the homogenized soil suspension are taken at specific times and sampling depths as determined by Stoke's Law. The dry weight of soil found in each sub-sample is used determine the silt and clay content. The sand fraction is determined by difference.

The soil texture is determined according to the CSSC soil texture triangle.

ALS Test Code	Matrix	Test Description	Method Reference**
PSA-3-SK	Soil	Particle size - Pipette removal OM & CO3	SSIR-51 Method 3.2.1

Dry, < 2 mm soil is treated hydrochloric acid top remove carbonates, then hydrogen peroxide to remove organic matter. The soil is then treated with sodium hexametaphosphate to ensure complete dispersion of primary soil particles. After treatment, sub-samples of the homogenized soil suspension are taken at specific times and sampling depths as determined by Stoke's Law. The dry weight of soil found in each sub-sample is used determine the silt and clay content. The sand fraction is determined by difference.

The soil texture is determined according to the CSSC soil texture triangle.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

ALS Environmental

Quality Control Report

Workorder: L2589791 Report Date: 28-MAY-21

Client: Tetra Tech Canada Inc.
400-161 Portage Ave East
Winnipeg MB R3B 0Y4
Contact: BRENT HORNING

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PSA-1-SK	**Soil**							
Batch R5469798								
WG3539690-1 DUP		**L2589791-1**						
% Sand (2.0mm - 0.05mm)		98.0	97.6	J	%	0.4	5	26-MAY-21
% Silt (0.05mm - 2um)		1.2	1.6	J	%	0.4	5	26-MAY-21
% Clay (<2um)		<1.0	<1.0	RPD-NA	%	N/A	5	26-MAY-21
WG3539690-2 IRM		**2020-PSA_SOIL**						
% Sand (2.0mm - 0.05mm)			48.9		%		44.2-54.2	26-MAY-21
% Silt (0.05mm - 2um)			30.8		%		26.4-36.4	26-MAY-21
% Clay (<2um)			20.2		%		14.3-24.3	26-MAY-21
PSA-3-SK	**Soil**							
Batch R5472413								
WG3539692-1 DUP		**L2589791-2**						
% Sand (2.0mm - 0.05mm)		55.3	59.4	J	%	4.1	10	27-MAY-21
% Silt (0.05mm - 2um)		40.3	35.7	J	%	4.5	10	27-MAY-21
% Clay (<2um)		4.5	4.9	J	%	0.4	10	27-MAY-21
WG3539692-2 IRM		**2020-PSA_SOIL**						
% Sand (2.0mm - 0.05mm)			54.1		%		42.5-62.5	27-MAY-21
% Silt (0.05mm - 2um)			31.5		%		22.5-42.5	27-MAY-21
% Clay (<2um)			14.5		%		5-25	27-MAY-21

Quality Control Report

Workorder: L2589791 Report Date: 28-MAY-21

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2589791-COFC

COC Number: 17 - 751875

Page 1 of 1

Report To
Contact and company name below will appear on the final report

Company: TetraTech Canada Inc.
Contact: Brent Horning
Phone: 204-981-5317

Company address below will appear on the final report

Street: 400-161 Portage Ave E
City/Province: Winnipeg / Manitoba
Postal Code: R3B 0Y4

Invoice To
Same as Report To ☒ YES ☐ NO
Copy of Invoice with Report ☐ YES ☒ NO
Company:
Contact:

Report Format / Distribution
Select Report Format: ☒ PDF ☒ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☒ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax labresultsmb@tetratech.com
Email 2 brent.horning@tetratech.com
Email 3 kelly.jones@tetratech.com

Invoice Distribution
Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax labresultsmb@tetratech.com
Email 2 kelly.jones@tetratech.com

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)
Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days)
4 day [P4-20%] ☐
3 day [P3-25%] ☐
2 day [P2-50%] ☐

EMERGENCY
1 Business day [E - 100%] ☐
Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information
ALS Account # / Quote #:
Job #: 734-2122790100.
PO / AFE:
LSD: Nipawin, SK.

Oil and Gas Required Fields (client use)
AFE/Cost Center:
PO#
Major/Minor Code:
Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only): L2589791
ALS Contact: Judy D.
Sampler: C. Ateah

Analysis Request
Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Particle Size by Hydrometer (% sand, silt, clay)	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	BH01 (2.25)	11-05-21	10:35	SOIL	1	X		
	BH03 (0.75)	11-05-21	11:55	SOIL	1	X		

Drinking Water (DW) Samples[1] (client use)
Are samples taken from a Regulated DW System?
☐ YES ☐ NO
Are samples for human consumption/ use?
☐ YES ☐ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)
Frozen ☐ SIF Observations Yes ☐ No ☐
Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C
FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)
Released by: Carly Ateah
Date: May 18/21
Time: 14:00

INITIAL SHIPMENT RECEPTION (lab use only)
Received by: T.L.
Date: 5/19/21
Time: 12:47

FINAL SHIPMENT RECEPTION (lab use only)
Received by:
Date:
Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

JUNE 2018 FRONT

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[1] If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**