Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

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March 14, 2024
File: 2021.4670.00

Agnes Wittman, Director
Environmental Approvals Branch
Environment and Climate Change
14 Fultz Boulevard
Winnipeg MB R3Y 0L6

Re: APPLICATION FOR AN ENVIRONMENT ACT LICENCE FOR A WATER TREATMENT PLANT IN THE RURAL MUNICIPALITY OF SPRINGFIELD

Dear Agnes:

On behalf of the Rural Municipality of Springfield and the Manitoba Water Services Board, Associated Engineering (Sask.) Ltd., is submitting the Application for a new Environment Act Licence for a Water Treatment Plant located in the Rural Municipality of Springfield, Manitoba (NE-9-11-5E).

The $7,500 Licence Application Fee for a Class 2 Development is enclosed and being sent by Associated Engineering (Sask.) Ltd., on behalf of the Rural Municipality of Springfield. Please contact the undersigned if further information is required at pastorind@ae.ca or 204-942-6391.

Yours truly,

[redacted]

Desiree Pastorin, C.E.T.
Project Manager

RG/aqs

Environment Act Proposal Form

Manitoba

Name of the development:

Dugald Oakbank Water System Regional Water Treatment Plant Upgrades

Type of development per Classes of Development Regulation (Manitoba Regulation 164/88):

Class 2 Development

Legal name of the applicant:

Rural Municipality of Springfield c/o Associated Engineering (Sask.) Ltd.

Mailing address of the applicant: Box 219, 100 Springfield Centre Drive Oakbank

Contact Person: Phillip Pawluk, P. Eng., Manager of Water and Waste

City: Winnipeg Province: MB Postal Code: R0E 1J0

Phone Number: (204) 444-3321 Fax: email: ppawluk@rmofspringfield.ca

Location of the development:

Contact Person: Phillip Pawluk, P. Eng., Manager of Water and Waste

Street Address: 49°54'52.99"N, 96°51'10.76"W

Legal Description: NE-9-11-5E

City/Town: Oakbank Province: MB Postal Code: R0E 1J0

Phone Number: (204) 444-3321 Fax: email: ppawluk@rmofspringfield.ca

Name of proponent contact person for purposes of the environmental assessment:

Desiree Pastorin C.E.T., Associated Engineering (Sask.) Ltd.

Phone: (204) 942-6391
Fax:

Mailing address: 410 - 5 Donald Street
Winnipeg, MB R3L 2T4

Email address: pastorind@ae.ca

Webpage address: https://www.ae.ca/

Date: 2024-03-13

Signature of proponent, or corporate principal of corporate proponent:

Printed name: Desiree Pastorin, C.E.T.

PRINT RESET

A complete **Environment Act Proposal (EAP)** consists of the following components:

- ☑ **Cover letter**
- ☑ **Environment Act Proposal Form**
- ☑ **Reports/plans supporting the EAP** (see "Information Bulletin - Environment Act Proposal Report Guidelines" for required information and number of copies)
- ☑ **Application fee** (Cheque, payable to Minister of Finance, for the appropriate fee)

Per Environment Act Fees Regulation (Manitoba Regulation 168/96):

Class 1 Developments	$1,000
Class 2 Developments	$7,500
Class 3 Developments:	
Transportation and Transmission Lines	$10,000
Water Developments	$60,000
Energy and Mining	$120,000

Submit the complete EAP to:
Director
Environmental Approvals Branch Manitoba
Environment and Climate
14 Fultz Boulevard
Winnipeg, Manitoba R3H 0W4

For more information:
Email: EABDirector@gov.mb.ca
Phone: (204) 945-8321
Fax: (204) 945-5229
https://www.gov.mb.ca/sd/permits_licenses_approvals/eal/licence/index.html

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$1,000.....C1 B-02
$7,500.....C2 B-02
$10,000....TT B-02
$60,000.....WD B-02
$120,000...EM B-02

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ENVIRONMENT ACT PROPOSAL

Rural Municipality of Springfield

Dugald Oakbank Water Supply System Upgrades
New Regional Water Treatment Plant

MARCH 2024

EXECUTIVE SUMMARY

The Rural Municipality (RM) of Springfield and the Manitoba Water Services Board retained Associated Engineering (Sask.) Ltd. to prepare an Environment Act Proposal for a Class 2 Development Licence under the Manitoba Environment Act for a new Water Treatment Plant (WTP), raw water pipeline and ancillary services (the Project). This report provides the required information under Manitoba Environment and Climate Change's Environment Act Proposal Report Guidelines and Supplementary Guidelines for Municipal Water Supply Systems.

This Environment Act Proposal includes the construction of a new WTP that will be located on RM of Springfield property, midway located between the communities Dugald and Oakbank. Water treated at this new facility will serve both communities. With the treatment facility, the proposed development includes the following:

- Construction of three (3) new raw water wells south of the existing Dugald Well Field.
- Raw water supply pipeline extensions.
- Connection to satellite reservoirs at the existing Dugald and Oakbank Reservoirs through a combination of both existing distribution pipelines, as well as one (1) new pipeline extension.
- Construction of a concentrate water retention pond.
- Construction of a concentrate water pipeline from the new WTP to the concentrate water retention pond.

Under this Environment Act Proposal, the withdrawal of the water from the raw water new wells is considered out of scope and will be submitted separately. The environmental effects resulting from these wells will be considered in the subsequent proposal. For completeness, well installation activities and plans will be described in this Environment Act Proposal by an authorized groundwater hydrogeologist.

The Project is designed based on a 20-year population projection. The ultimate capacity of the facility is set to 120 L/s. While, Dugald and Oakbank have separate water treatment facilities, the new WTP facility will serve both communities. Based on census population data from 2006, 2011, 2016 and 2021 the communities of Dugald and Oakbank saw a combined population growth of over 98% and an annualized growth rate of 4.7% per year. Currently the combined population is 5,655 people based on the 2021 Census.

The proposed developments will increase the treatment capacity for the RM of Springfield and account for the growth in these communities. The proposed development is assessed to have minor impacts to the natural environment, and corresponding environmental management measures are proposed to mitigate or avoid those impacts altogether.

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1 INTRODUCTION

The Rural Municipality (RM) of Springfield and the Manitoba Water Services Board retained Associated Engineering (Sask.) Ltd. to prepare an Environment Act Proposal for a Class 2 Development Licence under the Manitoba Environment Act for a new Water Treatment Plant (WTP), raw and treated water pipelines and ancillary services (the Project). This report provides the required information under Manitoba Environment and Climate Change's Environment Act Proposal Report Guidelines and Supplementary Guidelines for Municipal Water Supply Systems. This Environment Act Proposal includes components for the pipelines, and new regional WTP.

1.1 Background Information

The Project is located in the RM of Springfield. The RM of Springfield is located adjacent to and on the east side of Winnipeg. Currently, in the area there are two (2) existing well fields that service two (2) separate WTPs. One of the existing fields, known as the Dugald Raw Water Well Field (also known as the Suthwyn Well Field), supplies water to the Dugald WTP. The other, known as the Heatherdale Raw Water Well Field, supplies water to the Oakbank WTP. Although the Dugald Oakbank Water System consists of separate facilities, treated water from the Oakbank WTP is currently blended with raw water at the Dugald WTP prior to distribution in that community. Both treatment and distribution systems operate under Environment Act Licence Number 3303.

1.1.1 Previous Studies

The following studies were reviewed to prepare the Environment Act Proposal.

RM of Springfield, Dugald Oakbank Water System Upgrades Phase 3, New Regional Water Treatment Plant Functional Design Report.

In November 2022, Manitoba Water Services Board and the RM of Springfield retained Associated Engineering to complete a Functional Design Report for the proposed project. Accompanying the Functional Design Report were two Technical Memos, *Population and Water Demand Projections* and *WTP Location Options.* These documents determined the WTP sizing, capacity, distribution, concentrate water disposal and treatment system.

Hydrogeological Study – Dugald Raw Water Field Phase 2 Expansion SW32-10-6EPM RM of Springfield, Manitoba.

In April 2022, Friesen Drillers prepared a hydrogeological study undertaken for the potential expansion of the regional groundwater supply in the RM of Springfield. The study included an appraisal of technical considerations, discussions related to public consultations planning, and reporting to summarize the results and provide recommendations to expand the existing water supply, according to the volumes requested by the RM of Springfield. This report is attached in Appendix A.

RM of Springfield Water Treatment Plant – RM of Springfield, MB, Geotechnical Investigation Report, TREK Geotechnical Inc., 2023.

In 2022 TREK Geotechnical Inc. (TREK) was retained by Associated Engineering to complete geotechnical investigations for the proposed WTP. TREK provided a report with recommendations for the Project and all ancillary services. These recommendations included foundation, concrete floor slab, pavement, temporary excavation and backfill recommendations considered a complete sub-surface investigation, analysis of stratigraphy, power auger refusal, groundwater conditions and site drainage. This report is attached in Appendix B.

1.1.2 Population

Currently, Dugald and Oakbank have separate water treatment facilities however, the new WTP facility will serve regionally. Based on census population data from 2006, 2011, 2016 and 2021 the communities of Dugald and Oakbank saw a combined population growth of over 98% and an annualized growth rate of 4.7% per year. The combined population growth trend is shown in Figure 1-1 below and described in Table 1-1.

Figure 1-1 Historical Population of Dugald and Oakbank (Combined)

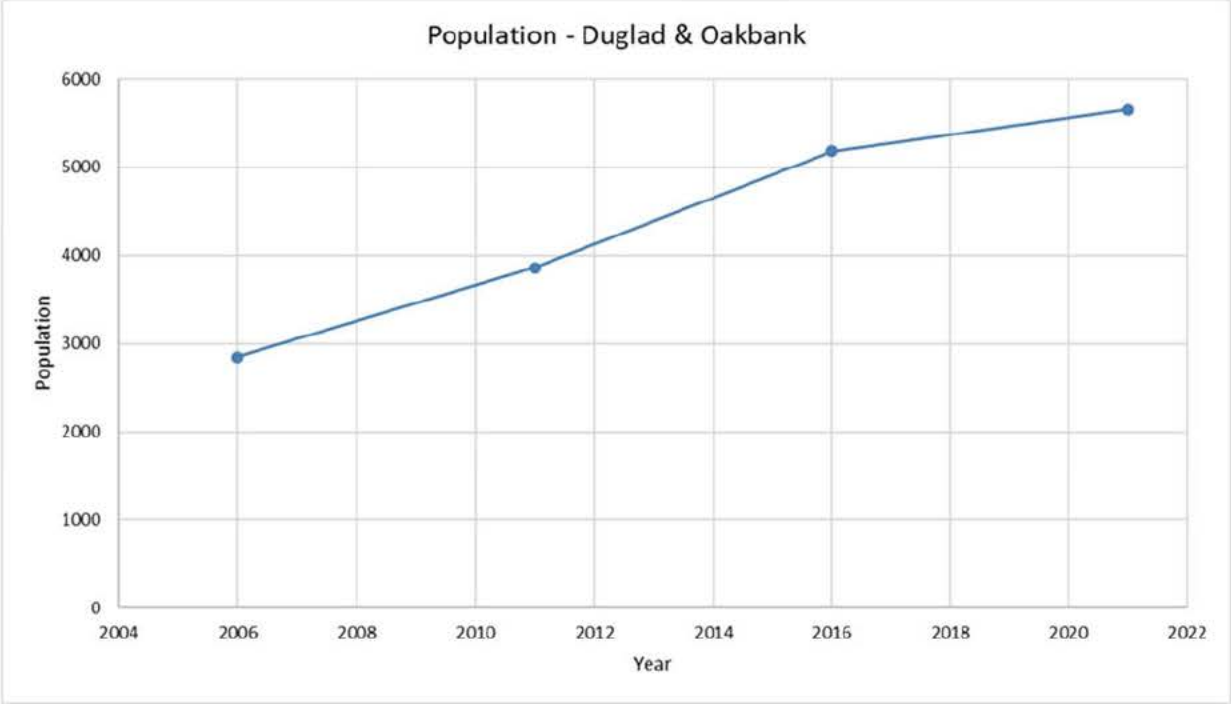


Table 1-1 Historical Population Data

Community	2006 Census Population	2011 Census Population	2016 Census Population	2021 Census Population
Dugald	422	386	580	614
Oakbank	2,427	3,474	4,604	5,041
Total	**2,849**	**3,860**	**5,184**	**5,655**

Following the linear trend of the 2006 to 2021 Census, the 20-year combined population estimation is 21,460 people.

1.1.3 Current and Projected Water Use

Typically, in Canada the estimated per capita water consumption is 200 to 250 L/c/day. The estimated per capita demand for Dugald and Oakbank respectively is 108 L/c/day and 202 L/c/day. This is based on the historical water and population records used to determine the Max Day Factor for the communities. Combined, the per capita demand is 181 L/c/day.

The projected average day demand in 2041 using the historical data is 4,292 m^3/day with a Max Day Demand of 8,584 m^3/day. The Project is being designed to meet the Max Day Demands over 20 hours of operation. Using historical projection, the required ultimate treatment capacity is 120 L/s. As this is based on growth assumptions, it will be achieved through a phased approach.

1.1.4 Raw Water Source

The Dugald Raw Water Well Field consists of two (2) wells on Suthwyn Road (Road 59 N) southeast of Dugald. The wells were constructed in 2020 and provide raw water via approximately 8.7 km of 250 mm diameter HDPE pipeline to the existing Dugald WTP. The two (2) wells are located 336 m apart and draw water from the Winnipeg Formation Sandstone Aquifer. Raw water from the Dugald Raw Water Well Field's Suthwyn Wells is pumped to the Dugald WTP.

The Heatherdale Raw Water Well Field consists of two wells on Heatherdale Road (Road 25E) northwest of Oakbank. These wells provide raw water via approximately 6.8 kms of 250 mm diameter PVC pipeline to the existing Oakbank WTP. The two wells are located roughly 100 m apart, and they draw water from the Moosenose Aquifer. This aquifer is classified as GUDI (Groundwater Under the Direct Influence of Surface Water) due to the wells' proximity to a large, deep gravel pit. Due to the GUDI designation, the RM of Springfield intends to discontinue use of these wells at some point in the future and therefore, will be unavailable as a raw water supply for the new WTP.

1.1.5 Water Rights Act

The existing Municipal Groundwater Supply in Dugald and Oakbank as serviced by the Heatherdale and Dugald Raw Water Well Fields are covered under the same provincial Water Rights Licence No. 2019-107 which lists the maximum yearly allowance as 646.6 ML and instantaneous flow rate as 0.132 m^3/sec (132 L/s). Based on the 2041 demand projections, the instantaneous flow rate is sufficient, however the RM of Springfield will apply to increase the yearly allocation to accommodate the new capacity. The current Water Rights Licence is attached in Appendix D.

1.1.6 Water Quality

The Heatherdale Raw Water Well Field and the Dugald Raw Water Well Field supply water to both the Dugald and Oakbank WTPs. Treated water from the Oakbank WTP is being used to service both communities. The Dugald Raw Water Well Field supplies raw water to the Dugald WTP where it is treated with chlorine disinfection. Following disinfection, that water is blended with the Oakbank WTP feed water prior to distribution. Blending is required due to the high fluoride levels that are present in the Dugald raw water. Table 1-2 presents the raw and blended water quality along with the applicable guidelines from the Canadian Drinking Water Quality standards (GCDWQ). Samples used to collect this data were taken in January and February of 2022. Raw water quality from the Dugald Raw Water Well Sites is attached in Appendix H.

Table 1-2 Dugald WTP, Dugald Well Field Raw Water Quality

Parameter	Units	West Well #1 Jan. 21, 2022	East Well #2 Feb. 2, 2022	Blended w/ Oakbank Feb. 2, 2022	GCDWQ Regulation
Alkalinity, Total (as $CaCO_3$)	mg/L	311	308	n/a	-
Ammonia (NH_3)	mg/L	0.452	0.57	n/a	-
Antimony (Sb)	mg/L	<0.00010	<0.00010	<0.00010	0.006 MAC

Parameter	Units	West Well #1 Jan. 21, 2022	East Well #2 Feb. 2, 2022	Blended w/ Oakbank Feb. 2, 2022	GCDWQ Regulation
Arsenic (As)	mg/L	0.00014	0.00011	0.00182	0.010 MAC or ALARA
Barium (Ba)	mg/L	0.0179	0.0212	0.0382	2.0 MAC
Boron (B)	mg/L	1.37	1.75	1.35	5.0 MAC
Cadmium (Cd)	mg/L	<0.0000050	<0.0000050	<0.0000050	0.007 MAC
Chloride (Cl)	mg/L	105	94.5	79.6	250 AO
Chromium (Cr)	mg/L	0.00017	<0.00010	<0.00010	0.05 MAC
Colour	-	<5.0	<5.0	n/a	<15.0 AO
Copper (Cu)	mg/L	0.00091	<0.00050	0.00329	2.0 MAC / 1.0 AO
Fluoride (F)	mg/L	1.61	1.59	1.24	1.5 MAC
Hardness (as $CaCO_3$)	mg/L	31.8	41.8	114	80 – 100 PO (<180 is typical in MB)
Iron (Fe)	mg/L	0.201	0.204	0.083	0.3 AO
Lead (Pb)	mg/L	0.000596	<0.000050	0.000055	0.005 or ALARA
Langelier Index @ 4°C	-	0.27	0.34	n/a	
Langelier Index @ 60°C	-	1.0	1.1	n/a	
Manganese (Mn)	mg/L	0.00330	0.00764	0.00532	0.12 MAC / 0.02 AO
pH	-	8.62	8.59	8.46	7-10.5
Selenium (Se)	mg/L	0.000074	<0.000050	<0.000050	0.05 MAC
Sodium (Na)	mg/L	193	223	175	200 AO
Total Dissolved Solids	mg/L	607	575	604	500 AO
Uranium (U)	mg/L	0.000028	0.000081	0.000621	0.02 MAC
UV Transmittance	%T/cm	92.9%	94.6%	n/a	
Zinc (Zn)	mg/L	0.0049	<0.0030	<0.0030	5.0 AO

ALARA = As Low As Reasonably Achievable
AO = Aesthetic Objective
PO = Practical Objective
MAC = Maximum Acceptable Concentration

Raw water from the Heatherdale Well Field is treated at the Oakbank WTP. Since the Heatherdale Wells are designated as GUDI, ultraviolet (UV) treatment is required for primary disinfection and chlorine for secondary disinfection, and no other treatment methods are necessary. Table 1-3 presents the raw water quality along with the applicable guidelines from the GCDWQ. Samples used to collect this data were taken in September of 2016.

Table 1-3 Oakbank WTP, Heatherdale Well Field Raw Water Quality

Parameter	Units	North Well #1 Sept. 8, 2016	GCDWQ Regulation
Alkalinity, Total (as $CaCO_3$)	mg/L	277	-
Ammonia (NH_3)	mg/L	0.021	-
Antimony (Sb)	mg/L	<0.00020	0.006 MAC
Arsenic (As)	mg/L	0.00698	0.010 MAC or ALARA
Barium (Ba)	mg/L	0.0853	2.0 MAC
Boron (B)	mg/L	0.047	5.0 MAC
Cadmium (Cd)	mg/L	<0.000010	0.007 MAC
Chloride (Cl)	mg/L	5.11	250 AO
Chromium (Cr)	mg/L	<0.0010	0.05 MAC
Colour	-	<5.0	<15.0 AO
Copper (Cu)	mg/L	0.00142	2.0 MAC / 1.0 AO
Fluoride (F)	mg/L	0.241	1.5 MAC
Hardness (as $CaCO_3$)	mg/L	290	80 – 100 PO
Iron (Fe)	mg/L	0.095	0.3 AO
Lead (Pb)	mg/L	0.000138	0.005 or ALARA
Langelier Index @ 4°C	-	0.33	-
Langelier Index @ 60°C	-	1.1	-
Manganese (Mn)	mg/L	0.0117	0.12 MAC / 0.02 AO
pH	-	7.79	7-10.5
Selenium (Se)	mg/L	<0.0010	0.05 MAC
Sodium (Na)	mg/L	6.26	200 AO
Total Dissolved Solids	mg/L	314	500 AO
Uranium (U)	mg/L	0.00164	0.02 MAC
UV Transmittance	%T/cm	96.6%	-
Zinc (Zn)	mg/L	0.0045	5.0 AO

ALARA = As Low As Reasonably Achievable
AO = Aesthetic Objective
PO = Practical Objective
MAC = Maximum Acceptable Concentration

2 DESCRIPTION OF PROPOSED DEVELOPMENT

2.1 Project Description

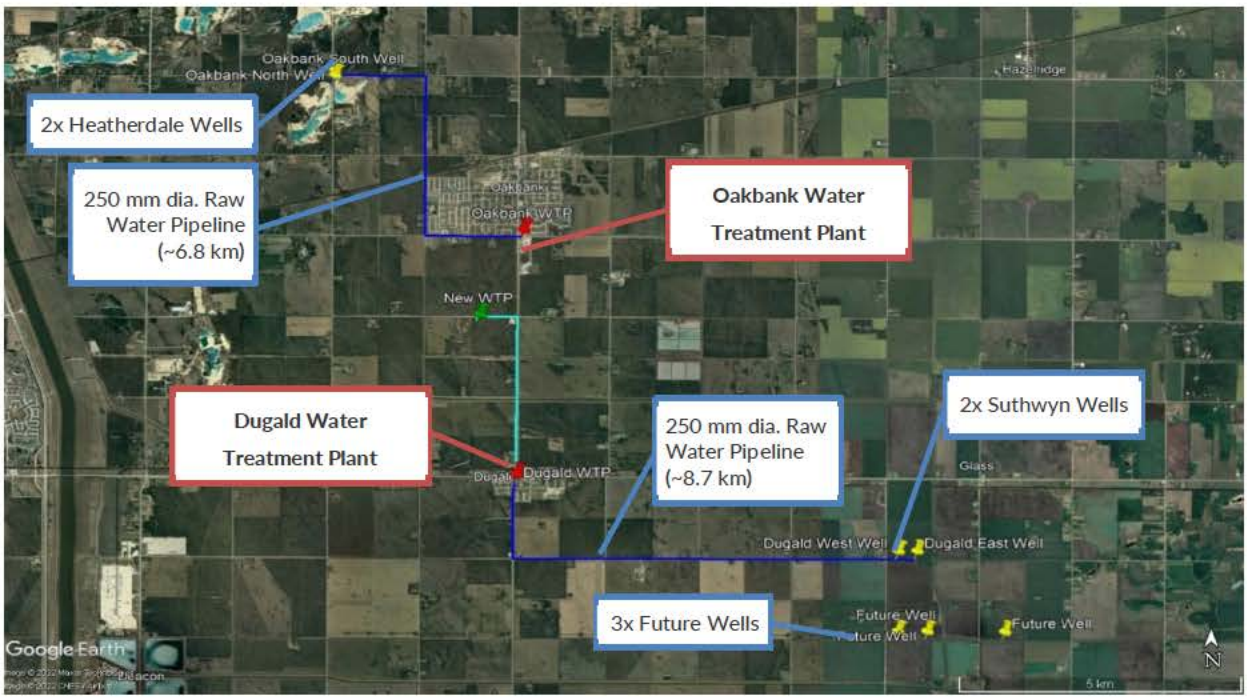
The proposed development includes the construction of a new WTP sited on RM of Springfield's property known as Site 146, located between Dugald and Oakbank. Along with the treatment facility, the proposed development includes construction of the following:

- Three (3) raw water wells south of the existing Dugald Well Field.
- Raw water supply pipeline extension from the new well field into Dugald.
- Raw water supply pipeline extension from the Dugald WTP to the new WTP site.
- Connection to satellite reservoirs at the existing Dugald and Oakbank WTPs through a combination of existing distribution system pipelines, as well as a new pipeline into Oakbank.
- Construction of a concentrate water retention pond.
- Construction of a concentrate water pipeline from the new WTP to the concentrate water retention pond.

Under this Environment Act Proposal, the construction of the new raw water is considered out of scope. Therefore, environmental effects resulting from these wells are not considered in this proposal. For completeness, well installation activities and plans will be described, however these effects will be considered in a Notice of Alteration to Licence No. 3303.

The Project will increase water treatment capacity to account for future population growth and community development. The capacity of the facility is being designed based on a 20-year phased growth projection. Figure 2-1 shows a location map of the new WTP.

Figure 2-1 Proposed Development Map



Three (3) Project locations were assessed for the proposed new regional WTP. Various advantages and disadvantages were evaluated before selection, such as, but not limited to; area available for development, site suitability, site accessibility and proximity to new and future well sites. The sites assessed include the existing Dugald WTP, the existing Oakbank WTP and Site 146 (midway between Dugald and Oakbank on Municipal land). Ultimately, Site 146 was selected due to the ample development area and central location between the two services communities.

2.1.1 Water Source

Raw water will continue to be supplied from the Winnipeg Formation Sandstone Aquifer. The Dugald Raw Water Well Field wells, drilled in 2020 by Friesen Drillers, are identified on Figure 2-1 as the Suthwyn Wells. The new raw water well field will be located south of the Dugald Raw Water Well Field. This study and details of the exact location of these wells are attached in Appendix A.

2.1.1.1 Well Installations

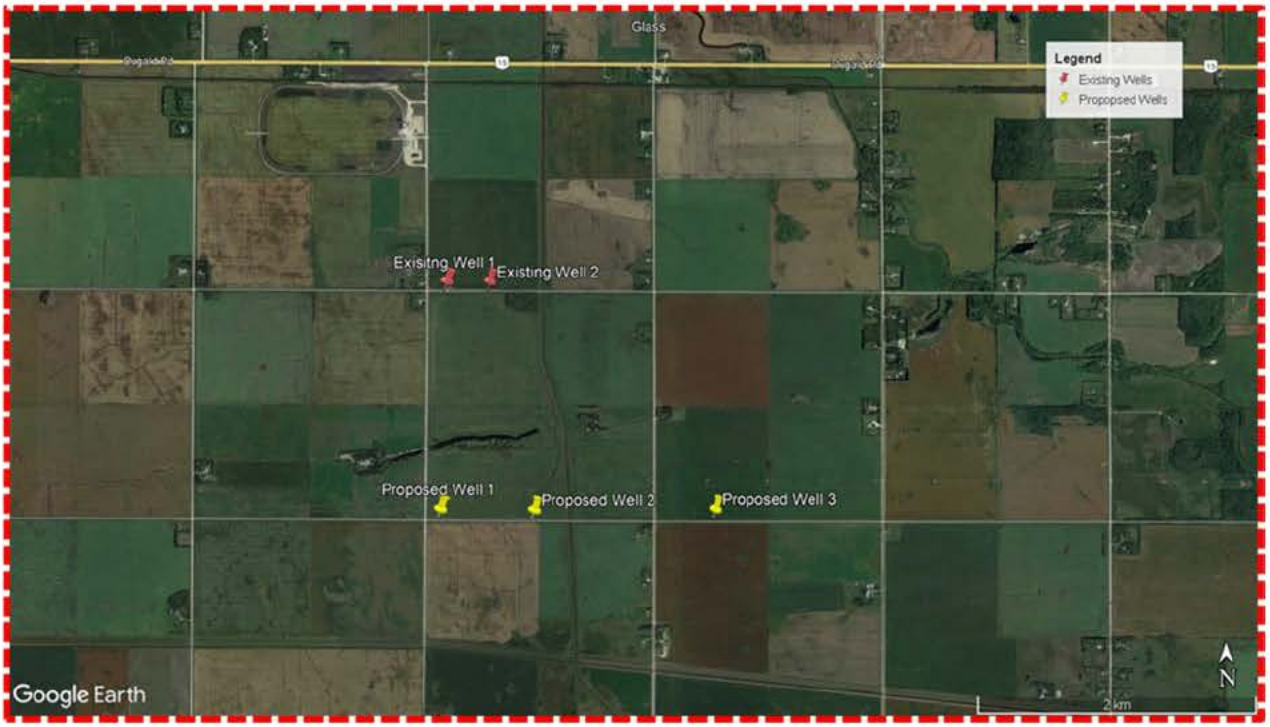
For this Environment Act Proposal, the withdrawal of the water from the new wells will be considered out of scope and submitted separately. Therefore, environmental effects resulting from these wells will be considered in the subsequent proposal. For completeness, well installation activities and plans are described in this Section. Friesen Drillers Ltd. completed a *Hydrogeological Study* of the proposed developments well site expansion. This study determined that based on both aquifer capacity, source water protection and consistency of groundwater geochemistry, that any new municipal wells should be constructed in the Winnipeg Formation Sandstone Aquifer, similarly to the existing Dugald Raw Water Well Field. The proximity of the existing and future wells to each other and the proposed development are presented below in Figure 2-2.

Figure 2-2 Well Site Locations

The existing Dugald Raw Water Wells are rated at 35.5 L/s each (two wells) but during simultaneous pumping, Friesen Drillers Ltd. indicates the maximum combined pumping rate is 56.7 L/s (900 USGPM). This is sufficient to supply raw water to one (1) treatment process train which requires 42 L/s of raw supply but completion of the future well development is required to supply water for the additional Stage 1 WTP capacity (80 L/s), as well as for the ultimate Stage 2 capacity (120 L/s). Therefore, these future wells will need to be installed to meet the regions future raw water needs.

The new wells will be constructed in a similar manner to the existing Suthwyn Wells. Installation considerations, as outlined by Friesen Drillers Ltd. in their *Hydrogeological Study* are as follows; the top of the Sandstone layer is estimated at approximately 75 - 80 m below grade and the total well depths are estimated in the range of 90 - 100 m (Friesen Drillers, 2022). Figure 2-3 identifies the proposed layout of the new and existing well sites.

Figure 2-3 Proposed Well Sites



2.1.1.2 Raw Water Quality

Raw water quality from the existing Dugald Raw Water Well is presented in Table 1-2. A summary of the notable parameters that are targeted/affected by the proposed treatment system are listed in Table 2-1.

Table 2-1 Raw Water Quality for Treatment at New WTP

Parameter	Units	Suthwyn West Well #1	Suthwyn East Well #2	Average	GCDWQ Regulation
Ammonia (NH_3)	mg/L	0.452	0.57	0.511	-
Fluoride (F)	mg/L	1.61	1.59	1.60	1.5 MAC

Parameter	Units	Suthwyn West Well #1	Suthwyn East Well #2	Average	GCDWQ Regulation
Iron (Fe)	mg/L	0.201	0.204	0.203	0.3 AO
Manganese (Mn)	mg/L	0.00330	0.00764	0.00547	0.12 MAC / 0.02 AO
pH	-	8.62	8.59	-	7-10.5
Sodium (Na)	mg/L	193	223	208	200 AO
Total Dissolved Solids	mg/L	607	575	591	500 AO

Friesen Drillers Ltd.'s *Hydrogeological Study* predicts that the Raw Water Quality of the three (3) proposed wells will be of similar or better quality than the existing Suthwyn Wells. Until water quality data is available, treatment strategies are based on the available data (existing Suthwyn Wells only). The key parameters identified above are Fluoride, Sodium, and Total Dissolved Solids. These parameters are being targeted during treatment.

2.1.1.3 Raw Water Pipeline

The proposed development requires approval to construct a 12.0 km, 300 mm diameter raw water pipeline extension from the new well field expansion to the existing Dugald WTP and the new Site 146 WTP. The raw water pipeline proposed to be constructed on provincial highway and municipal roadway right of ways. Approximately an additional 4.2 km, 450 mm extension is required from the Suthwyn wells to the Dugald WTP. Pipeline routes are attached in Appendix C.

2.1.2 Water Treatment Plant

The proposed facility in the RM of Springfield is classified as a Class 2 WTP. The proposed treatment system consists of five (5) greensands filters with dual Reverse Osmosis polishing 20% of the filtered stream. The ultimate capacity of the plant is 120 L/s with three Reverse Osmosis trains. Stage 1 (80 L/s) will accommodate the 10-year population demand and the addition of the third Reverse Osmosis train will accommodate the 20-year population demand (120 L/s).

For design purposes, membrane system projections from the proposed equipment supplier Delco Water are used to predict ion concentrations in the treated permeate, blended, and concentrate water. Using the raw water quality from, Table 1-2, the treated water quality is being predicted based on the Greensands and Reverse Osmosis treatment. In Table 2-2, the predicted water quality is outlined.

Table 2-2 Predicted Water Quality of Treated Water

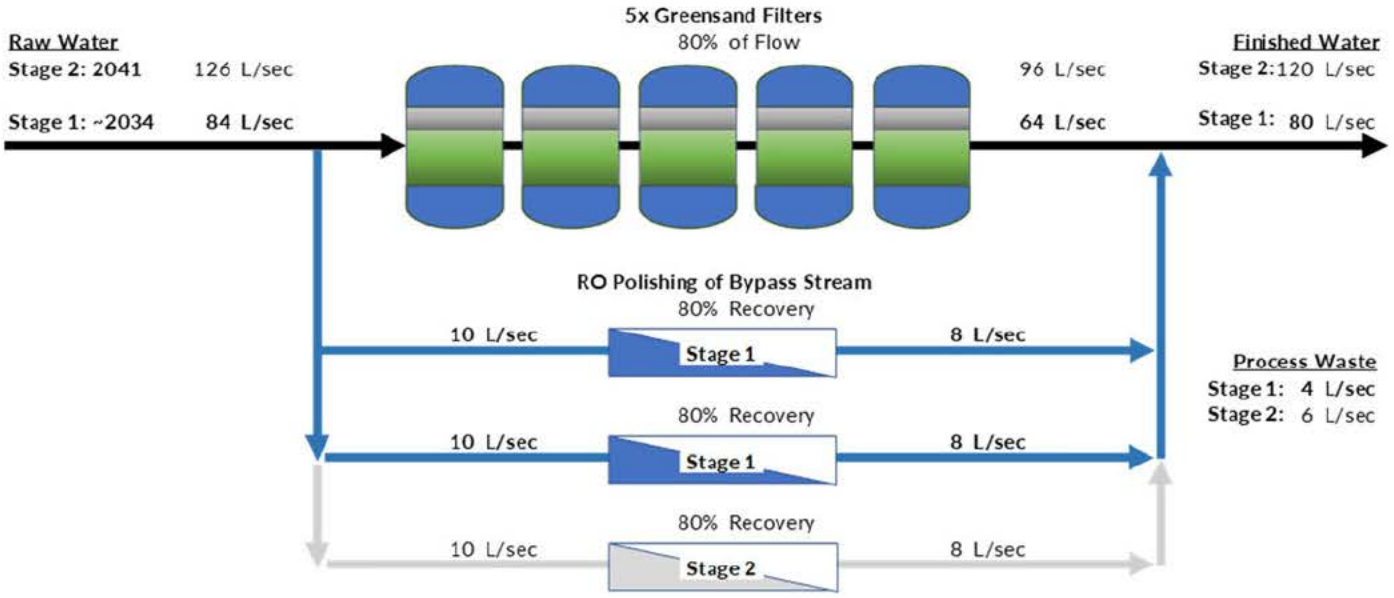
Parameter	Units	Average Raw Water Quality	Greensand Filtrate	RO Permeate (20% of Filtrate)	Final Blended Water Quality	GCDWQ
Stage 1 Flow Rates:		84 L/s	84 L/s	20 L/s	80 L/s	
Ammonia (NH_3)	mg/L	0.511	0.511	0.1533	0.440	-
Fluoride (F)	mg/L	1.60	1.60	0.032	1.29	1.5 MAC
Iron (Fe)	mg/L	0.203	0.002	0.0	0.0016	0.3 AO

Parameter	Units	Average Raw Water Quality	Greensand Filtrate	RO Permeate (20% of Filtrate)	Final Blended Water Quality	GCDWQ
Manganese (Mn)	mg/L	0.00547	0.0003	0.0	0.0002	0.12 MAC / 0.02 AO
Sodium (Na)	mg/L	208	208	4	167	200 AO
Total Dissolved Solids	mg/L	591	591	12	475	500 AO

AO = Aesthetic Objective MAC = Maximum Acceptable Concentration

The detailed design of the WTP process and all ancillary systems will be completed based on the environmental license requirements, environmental approvals, and equipment supplier proposals. Once designs are finalized, they will be tendered. Figure 2-4 presents the WTP flow rate schematic through greensand filtration with a bypass stream for Reverse Osmosis polishing.

Figure 2-4 Greensand Flow Schematic at 80 L/s (120 L/s Ultimate)



The existing WTPs in Dugald and Oakbank will be decommissioned. Once the new Site 146 WTP is constructed, the existing Dugald and Oakbank WTPs will operate as satellite reservoirs, providing local storage and distribution pumping capacity to each community. A reservoir under the new WTP will provide additional storage that is available on demand to either community.

2.1.3 Concentrate Disposal

The Reverse Osmosis concentrate stream and the backwash water from the filter flushing will be directed to a process waste cell in the WTP. Neither the Dugald or Oakbank WTP processes currently generate a waste stream or have a concentrate water disposal system. Therefore, the current license (Licence No. 3303) does not involve a concentrate water discharge system. The predicted concentrate flow in Stage 1 is 4 L/s and will increase to 6 L/s once the ultimate plant capacity is achieved. Due to the proposed development's location, continuous discharge to the Cooks Creek

Diversion from this cell is not available. A concentrate water retention pond will be used to seasonally store the concentrate during low flow months and winter.

Water quality of the receiving body, Cooks Creek Diversion is presented in Table 2-3. The sampled location is located upstream of the proposed development, 1 km south of Millbrook Road, Sample Station No. MB05OJS007. Samples were taken on July 7, 2022, and were provided by Government of Manitoba's Environment and Climate Change, Water Science and Watershed Management Branch, the Acceptable Use Letter is attached in Appendix F.

Table 2-3 Receiving Body Water Quality: Cooks Creek

Parameter	Units	COOKS CREEK 07-Jul-22
Alkalinity, Total (as $CaCO_3$)	mg/L	296
Ammonia (NH_3)	mg/L	0.045
Antimony (Sb)	mg/L	0.0002
Arsenic (As)	mg/L	0.00252
Barium (Ba)	mg/L	0.0596
Boron (B)	mg/L	0.044
Cadmium (Cd)	mg/L	0.0000088
Chloride (Cl)	mg/L	5.59
Chromium (Cr)	mg/L	0.00026
Colour	CU	53.4
Copper (Cu)	mg/L	0.00092
Hardness (as $CaCO_3$)	mg/L	300
Iron (Fe)	mg/L	0.227
Lead (Pb)	mg/L	0.000153
Manganese (Mn)	mg/L	27.6
pH	-	8.28
Selenium (Se)	mg/L	0.000234
Sodium (Na)	mg/L	7.47
Total Dissolved Solids	mg/L	297
Uranium (U)	mg/L	0.000953
Zinc (Zn)	mg/L	0.0056

The Project proposes that the concentrate water be seasonally discharged (approximately April 1st to November 15th) from the retention pond to Cooks Creek Diversion, via a new Oakbank Diversion Drain that will be constructed adjacent to the WTP.

2.1.4 Operation and Maintenance

The RM of Springfield is responsible for the operation and maintenance of the well sites, WTP, retention pond and concentrate water disposal. Operators will be required to inspect, monitor, and maintain all equipment and system performance. Operators will submit bi-weekly bacteriological samples to the Office of Drinking Water and testing in accordance with the *Manitoba Drinking Water Quality Standards Regulation*.

Certified operators will oversee and maintain the WTP in a safe and efficient manner, ensuring that all operation and Drinking Water Safety Act Regulations are followed, and relevant operation manuals used. Operation requirements include measurements, monitoring, sampling, testing, record-keeping, and reporting. Operators will be certified and receive the appropriate training from the treatment process equipment suppliers during the commissioning phases of the construction. Typical costs include chemicals, maintenance personnel, electricity, general repairs, and water and testing.

2.2 Certificate of Title

The proposed development will be constructed on land owned by the RM of Springfield. Appendix E provides the Certificate of Title for Site 146, the location of the regional WTP. The concentrate water pond and concentrate water pipeline will be constructed on Site 146.

The raw water wells and mechanization infrastructure will be installed in the municipal right of way. The raw water supply pipelines and distribution pipelines will be installed within municipal right of ways along Poplar Road, Suthwyn Road and Provincial Road 206. Easements from the appropriate authorities having jurisdiction will be requested as required to facilitate the installation of the pipelines.

2.3 Mineral Rights

The mineral rights on all project lands belong to the Crown.

2.4 Existing and Adjacent Land Use

The proposed WTP is located on Municipal owned land (Site 146), and the ancillary services (i.e. pipelines) are located on highway and roadway right of ways. Adjacent to the sites, the land is primarily designated as Rural/Agricultural (Government of Manitoba, n.d.), except for Dugald and Oakbank. Dugald, 3.0 km south of the proposed WTP and the location of the Dugald WTP, (future satellite reservoir), is designated primarily as Residential, Rural Residential and Commercial. Oakbank, 2.5 km north of the proposed development and currently the location of the Oakbank WTP (future satellite reservoir), is primarily designated as Residential, Commercial and Mixed Use (Government of Manitoba, n.d.).

2.5 Project Schedule

The development of the Project will be a single-phase construction project. The Project schedule is anticipated to begin construction in the third quarter of 2024, dependant on funding and environmental reviews and approvals and completed in 2026.

2.6 Project Funding

It is expected that the design and construction of this project will be funded in part by the Government of Manitoba, through the Manitoba Water Services Board, and the RM of Springfield.

2.7 Regulatory Approvals

To gain regulatory approval the appropriate department and branches are provided the necessary information on the Project. These regulatory bodies are:

- Manitoba Environment and Climate Change
- Manitoba Office of Drinking Water
- Manitoba Transportation and Infrastructure
- Historic Resources Branch

Before any work begins, all underground and overhead services will be cleared by their respective locators (Bell MTS, Manitoba Hydro, etc.).

2.8 Storage of Petroleum Products and Other Chemicals

Fuel will not be stored on-site at any time or location along the proposed construction route or near any well. Fuel will be supplied by fuelling trucks, which are regulated under the Storage and Handling of Petroleum Products and Allied Products Regulation. Records of fuel volumes and an Emergency Response Plan, which includes spill prevention, notification and response will be implemented as part of the Construction Safety Plan. No fuelling activities will be permitted within 100 m of watercourses during construction. During construction, contractors will be required to ensure that all equipment is properly maintained to prevent leaks of fuel and motor fluids.

During normal operation of the WTPs after construction, there will be minor storage of diesel fuel for the backup generators. These generator fuel tanks will utilize double wall containment with leak detection monitoring, and re-filling will be per regulations. Chemicals associated with the operation of the WTP will be stored in designated areas within the WTP complete with spill containment. Maintenance activities for the wells do not require any refuelling activities on-site.

2.9 Public Consultation

A Public Consultation Open House was held on August 29, 2023, regarding the WTP project. This open house was held at the Dugald Community Centre and attended by over 50 community members. An invitational event was held on December 14, 2023, regarding the new Raw Water Well Field. Invitations were sent out based on proximity to the new well fields. A second public open house was held at Oakbank Baptist Church on January 23, 2024, and attended by 75 community members. Open Houses were advertised on the RM of Springfield's website and published in local newspapers.

2.10 Duty to Consult

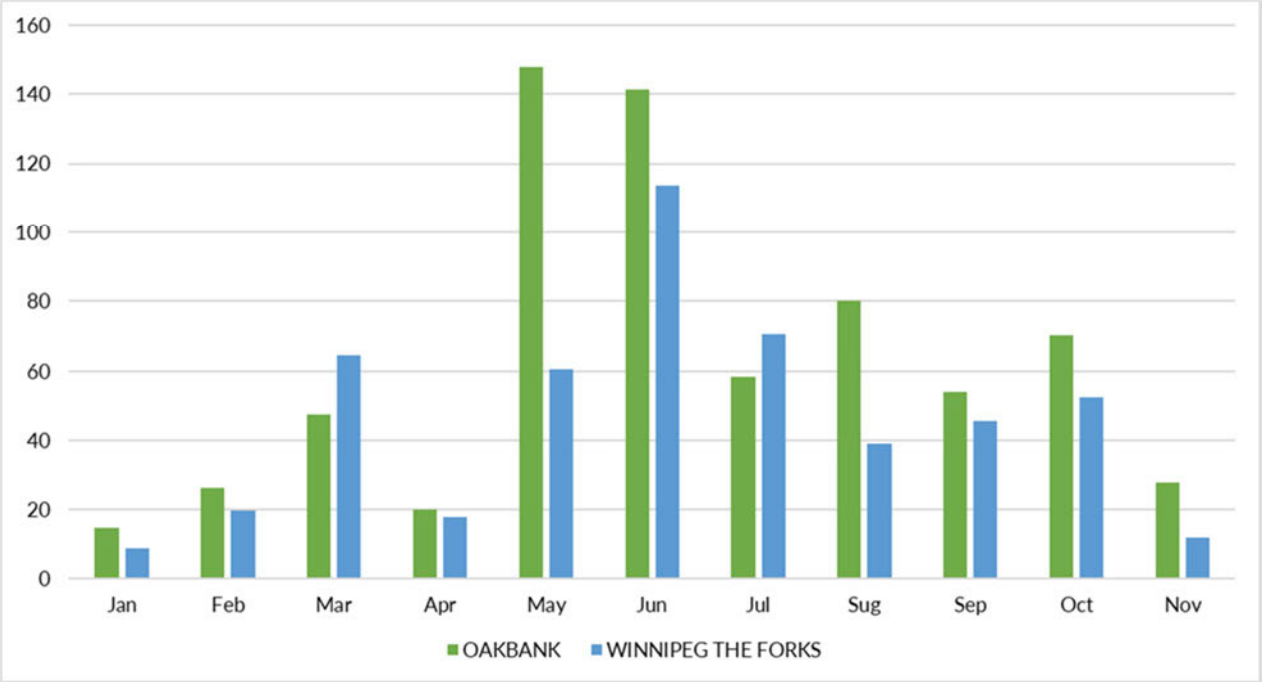
The proposed project does not involve any federally owned or reserve lands. Brokenhead Ojibway Nation is the closest First Nation, located approximately 40 km north of the proposed development.

3 PHYSICAL ENVIRONMENT

3.1 Physiographic Setting and Climate

The Project is in southwestern Manitoba, approximately 20 km east of Winnipeg in the interior plain's region. The topography has slight elevation changes varying between 235 m to 245 m geodetic elevation. Using historical data publicly available from Environment and Climate Change Canada, the most recent precipitation records are from 2007. The closest stations to the proposed development are; Oakbank (-96.85, 49.93) and Winnipeg The Forks (-97.13, 49.89). Figure 3-1 presents the historical data.

Figure 3-1 Historical Precipitation Data



The data determined that in the Oakbank area, the average monthly precipitation is around 62 mm (Government of Canada, 2023). The mean annual temperature in the area is approximately 3.5 °C.

3.2 Hydrogeology

The hydrogeology for this Project was investigated in Friesen Drillers Ltd.'s *Hydrogeological Study* for the well expansion. This study is attached in Appendix A. Items from this report are summarized below.

The Project is identified under the Western Canadian Sedimentary Basin Hydrogeological Region of Canada, in southeastern Manitoba. The bedrock under the RM of Springfield, similarly to the rest of southeastern Manitoba is carbonate bedrock. This bedrock beneath the RM of Springfield is Winnipeg Formation shale and sandstone, with overlaying Red River Formation dolostone and limestone. Underlying the Carbonate Aquifer is the Sandstone Aquifer. This sandstone is generally well sorted and composed of very fine to fine-grained, well rounded silica sand (Betcher, et al., 1995). The hydraulic conductivity of the sandstone is relatively uniform at approximately 2.5 x 10 - 5 m/s and is expected to have uniform value for transmissivity (Betcher, et al., 2008). In the region there are two key aquifers, Moosenose Aquifer, and the Winnipeg Formation Sandstone Aquifer. As the Moosenose Aquifer is classified as GUDI

due to its proximity to large deep gravel pits, it is understood that the RM of Springfield intends to only draw from the Winnipeg Formation Sandstone Aquifer.

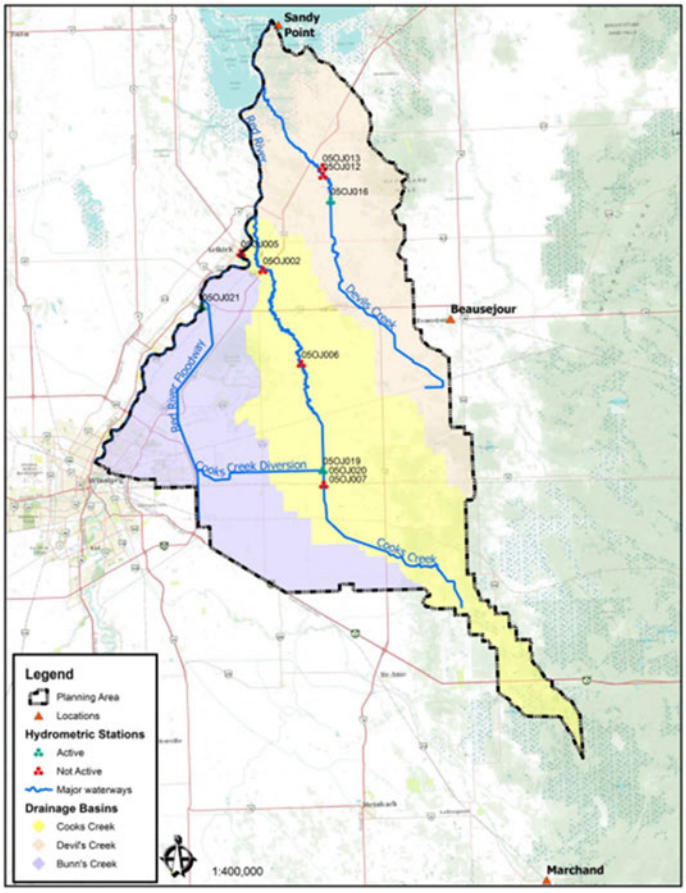
Currently, as discussed in Section 1.1.5 the existing Water Rights License allows an annual allocation of 646.6 dam^3 and an instantaneous pumping rate as 0.132 m^3/sec (132 L/s). Although the instantaneous pumping rate is sufficient for the 2041 projections, the RM of Springfield will apply to increase the yearly allocation.

The aquifer is geographically extensive and receives regular freshwater recharge. Based on Friesen Drillers Ltd.'s considerations of aquifer capacity, source water protection, and consistency of groundwater geochemistry, the aquifer can sustainably supply the proposed development in the RM of Springfield. The full range of the aquifer's transmissivity, its storability value, project pumping rate, recharge mechanism, discharge mechanism, drawdown and sustainability of the well can be estimated using the study performed by Friesen Drillers Ltd., and using data from the wells constructed in 2020. However these factors will be determined through the full-scale pumping tests to be completed in 2024 and will be included in the future Notice of Alteration as discussed previously. The Winnipeg Formation Sandstone Aquifer is shown to be a reliable groundwater source at the current well sites.

3.3 Surface Water Hydrology

Cooks Creek and the Cooks Creek Diversion are tributaries that run through the RM of Springfield. Figure 3-2 presents the entire drainage patterns and surface water management programs of the area.

Figure 3-2 Surface Water Management Cooks Creek Diversion



Both Cooks Creek and the Cooks Creek Diversion discharge into the Red River. The land within the immediate area of the WTP is considered low relief. The drainage areas of the region are split between the Cooks Creek Drainage Basin and the Bunn's Creek Drainage Basin as presented in Figure 3-2. Cooks Creek flow levels and discharge rates south/up stream of the Cooks Creek Diversion are recorded daily by Water Survey of Canada at Station 05OJ019. Flow data is recorded seasonally when there is flow through the tributary, the most recent data for this Station is 2021. In 2021, mean monthly flow varied from 4.8 L/s to 104.7 L/s, and flow levels varied from 0.3 m to 0.9 m. Daily flow level and discharge data are presented below in Figure 3-3 and Figure 3-4 respectively (Government of Canada, 2021).

Figure 3-3 2021 Daily Flow Level

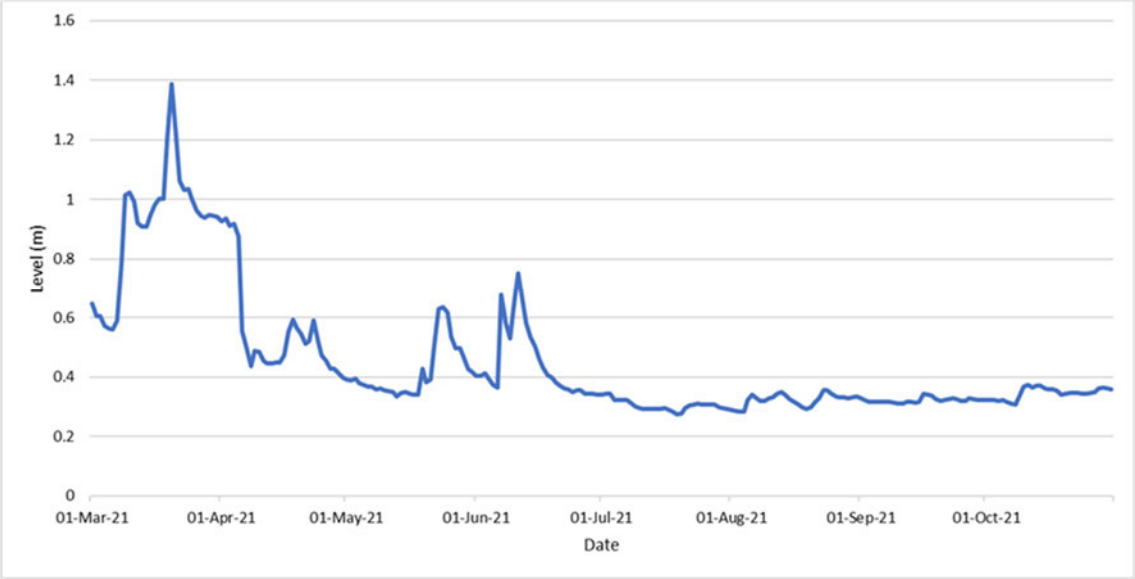
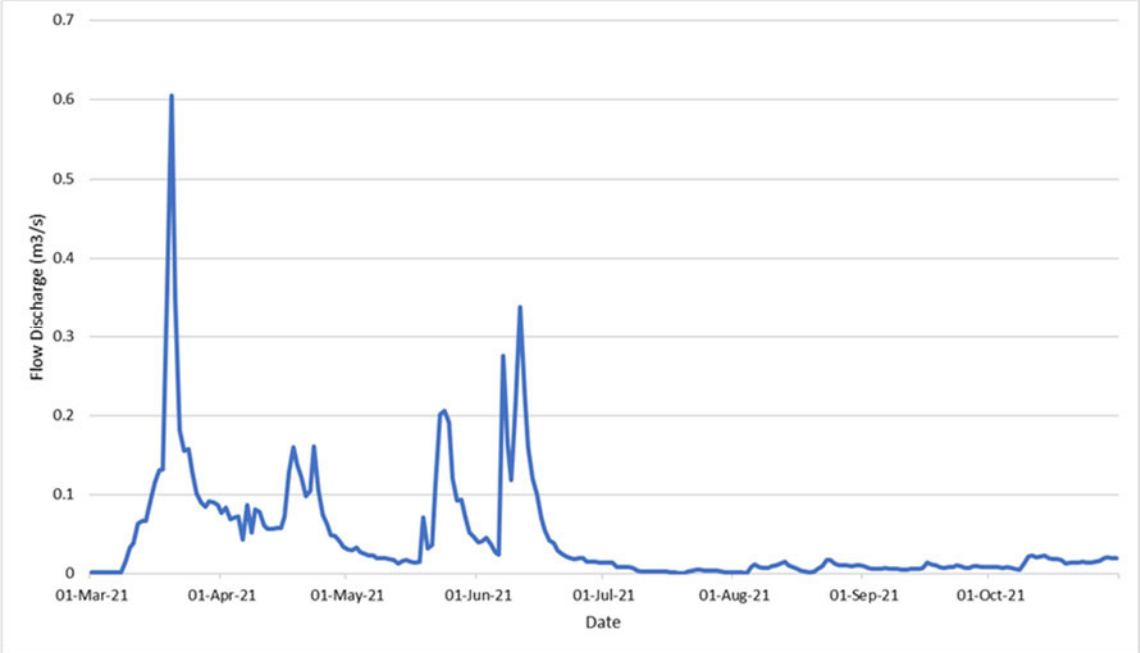


Figure 3-4 Daily Discharge Rates



The concentrate and backwash water from the regional WTP will be directed to a process waste cell in the WTP and then to the retention pond just south of the WTP on the same site. The discharge into the Cooks Creek Diversion will be gravity fed and the flow rate will be determined once the pipe is sized. The Cooks Creek Diversion and Cooks Creek experience high seasonal variations between summer and winter. During the months of November to February flows are not recorded as there are no/low flows through the creek. Therefore, the proposed development will be a seasonally discharging facility.

Concentrate effluent from the WTP must be able to pass the LC50 acute lethality testing on appropriate species. To accomplish this, the concentrate water quality must meet all effluent requirements stipulated in *Manitoba Water Quality Standards, Objectives, and Guidelines*. This development will follow *Tier I Water Quality Standards for Industrial and Municipal Wastewater Effluents Discharged to a Water Body*. As presented in Table 3-1, the *Tier I Water Quality Standards* are outlined (Government of Manitoba, 2011). All regulation limits are satisfied by the proposed Project.

Table 3-1 Tier I Water Quality Standards

Effluent Parameter	Units	Regulation Limit	Concentrate Discharge
Total Phosphorus	mg/L	1	0.15
Total Ammonia	mg/L	Site Specific	0.77
Total Nitrogen	mg/L	15	0.016
Fecal Coliform	mg/L	200	<200
Carbonaceous Biochemical Oxygen Demand (cBOD)	mg/L	25	<25
Biochemical Oxygen Demand (BOD)	mg/L	25	<25
Total Suspended Solids (TSS)	mg/L	25	<25

Tier II Water Quality Objectives are presented in Table 3-2. These water quality objectives form the basis for the water quality-based approach when additional restrictions need to be developed to protect important uses of surface water beyond what has been defined under Tier I.

Table 3-2 Tier II Water Quality Objectives

Effluent Parameter	Period	Duration	Allowable Exceedance	Design Flow	Objective
Ammonia	Water >5°C or Early Life Stages Present	30 days	<1 in 3 years	30Q10	1.030 mg/L
	Water >5°C or Early Life Stages Present	4 days	<1 in 3 years	7Q10	2.576 mg/L
	All Periods	1 hour	<1 in 3 years	1Q10	4.902 mg/L
	Water ≤ 5°C or Early Life Stages Absent	30 days	<1 in 3 years	30Q10	1.030 mg/L

Effluent Parameter	Period	Duration	Allowable Exceedance	Design Flow	Objective
	Water ≤ 5°C or Early Life Stages Absent	4 days	<1 in 3 years	7Q10	2.576 mg/L
	All Periods	1 hour	<1 in 3 years	1Q10	4.902 mg/L
	Early Life Stages Present	30 days	<1 in 3 years	30Q10	1.030 mg/L
	Early Life Stages Present	4 days	<1 in 3 years	7Q10	2. 576 mg/L
	All Periods	1 hour	<1 in 3 years	1Q10	3.274 mg/L
	Early Life Stages Absent	30 days	<1 in 3 years	30Q10	1.030 mg/L
	Early Life Stages Absent	4 days	<1 in 3 years	7Q10	2.576 mg/L
	All Periods	1 hour	<1 in 3 years	1Q10	3.274 mg/L
Arsenic	All Periods	4 days	<1 in 3 years	7Q10	150 ug/L
	All Periods	1 hour	<1 in 3 years	1Q10	340 ug/L
Cadmium	All Periods	4 days	<1 in 3 years	7Q10	<0.53 ug/L
	All Periods	1 hour	<1 in 3 years	1Q10	<5.85 ug/L
Chlorine	All Periods	4 days	<1 in 3 years	7Q10	11 ug/L
	All Periods	1 hour	<1 in 3 years	1Q10	19 ug/L
Chromium III	All Periods	4 days	<1 in 3 years	7Q10	<182.25 ug/L
	All Periods	1 hour	<1 in 3 years	1Q10	<1404.06 ug/L
Chromium IV	All Periods	4 days	<1 in 3 years	7Q10	11 ug/L
	All Periods	1 hour	<1 in 3 years	1Q10	16 ug/L
Copper	All Periods	4 days	<1 in 3 years	7Q10	<22.90 ug/L
	All Periods	1 hour	<1 in 3 years	1Q10	<37.84 ug/L
Lead	All Periods	4 days	<1 in 3 years	7Q10	<8.13 ug/L
	All Periods	1 hour	<1 in 3 years	1Q10	<208.58 ug/L
Nickel	All Periods	4 days	<1 in 3 years	7Q10	<131.74 ug/L

Effluent Parameter	Period	Duration	Allowable Exceedance	Design Flow	Objective
	All Periods	1 hour	<1 in 3 years	1Q10	<1186.07 ug/L
Nitrate – Nitrate Nitrogen	All Periods	Not to be Exceeded	Not to be Exceeded	N/A	10 mg/L
Total Dissolved Solids	All Periods for Greenhouses	7 days	N/A	7Q10	700 mg/L
	All Periods for Irrigation	7 days	N/A	7Q10	500 – 3500 mg/L
Zinc	All Periods	4 days	<1 in 3 years	7Q10	299.68 ug/L
	All Periods	1 hour	<1 in 3 years	1Q10	297.25 ug/L

Tier II Water Quality Objectives provide objective water quality standards as a general water quality approach, not specific to waste. These projections are presented in Table 3-3.

Table 3-3 Tier II Water Quality Objectives for Cooks Creek near Dugald for July Conditions

Parameter	Raw Water (mg/L)	Concentrate Discharge (mg/L)	Cooks Creek Diversion Quality (mg/L)	Combined Flow (mg/L)	Discharge Regulation Limit (mg/L)	Comments
Alkalinity, Total (as CaCO3) (mg/L)	309.50	888.91	296.00	804.71	-	No set Tier II objective.
Ammonia (NH_3) (mg/L)	0.51	0.77	0.045	0.67	1.030	Function of July pH and temperature using Eqn. 1 from MWQSOG Tier II objectives, complies with objective.
Antimony (Sb) (mg/L)	0.0001	0.00030	0.0002	0.00028	-	No set Tier II objective.
Arsenic (As) (mg/L)	0.0001	0.00036	0.0025	0.00066	0.15	Complies with objective, background > effluent conc.
Barium (Ba) (mg/L)	0.02	0.056	0.059	0.057	-	No set Tier II objective.
Boron (B) (mg/L)	1.56	4.48	0.044	3.85	-	No set Tier II objective

Parameter	Raw Water (mg/L)	Concentrate Discharge (mg/L)	Cooks Creek Diversion Quality (mg/L)	Combined Flow (mg/L)	Discharge Regulation Limit (mg/L)	Comments
Cadmium (Cd) (mg/L)	0.00001	0.000015	0.0000088	0.000014	0.00053	Func. of July hardness, complies with objective.
Chloride (Cl) (mg/L)	99.75	286.49	5.59	246.60	-	No set Tier II objective.
Chromium (Cr) (mg/L)	0.0001	0.00039	0.00026	0.00037	0.011	Func. of July hardness, complies with objective
Copper (Cu) (mg/L)	0.0007	0.0020	0.00092	0.0017	0.0229	Func. of July hardness, complies with objective
Fluoride (F) (mg/L)	1.60	4.60	-	-	-	No set Tier II objective.
Hardness (as $CaCO_3$) (mg/L)	36.80	105.69	300.00	133.29	-	No set Tier II objective.
Iron (Fe) (mg/L)	0.20	3.91	0.23	3.39	-	No set Tier II objective.
Lead (Pb) (mg/L)	0.003	0.0010	0.000153	0.00084	0.00813	Func. of July hardness, complies with objective
Nitrate (N) (mg/L)	0.0053	0.016	0.26	0.050	10	Complies with objective.
Manganese (Mn) (mg/L)	0.0055	0.11	0.0413	0.10	-	No set Tier II objective.
Selenium (Se) (mg/L)	0.0001	0.00018	0.000234	0.00019	-	No set Tier II objective.
Sodium (Na) (mg/L)	208.00	617.58	7.47	530.93	-	No set Tier II objective.
Total Dissolved Solids (mg/L)	591.00	1754.75	297.00	1547.73	500-3500*	Partially complies with objective for irrigation.
Uranium (U) (mg/L)	0.0001	0.00016	0.000953	0.00027	-	No set Tier II objective.
Zinc (Zn) (mg/L)	0.004	0.012	0.0056	0.011	0.297	Complies with objective.

*See discussions below for clarifications.

Following winter storage, it is estimated that concentrate water will be discharged into the Cooks Creek Diversion at a flow rate of 29 L/s for three (3) weeks in April. Combined concentrations have been calculated based on these

three (3) weeks of discharge and complete mixing. Following these three (3) weeks, the concentrate water will be continuously discharged through a gravity fed pipe from April 1st to November 15th, and the flow rate will be reduced significantly.

Discharge regulation limits have been selected based on a worst-case scenario, 7Q10 flow regulations. The exception to this is Ammonia as the worst-case scenario is based on the 30Q10 flow regulation. The Ammonia concentration levels comply with the Tier I and II Water Quality Standards and Objectives. Further reduction in Ammonia by natural stripping occurring through the plant processes and in the retention pond is expected based on Ammonia concentrations in concentrate and backwash effluents in similar WTPs in Manitoba.

The regulation for Total Dissolved Solids was selected based on the surrounding land use. These regulations require a Total Dissolved Solids of below 700 mg/L in areas where greenhouse irrigation is likely to occur and a regulation range of 500 to 3500 mg/L (crop dependent) when field, park, and garden irrigation is likely to occur. Using satellite imagery in the surrounding area there are no known greenhouses, however the surrounding land use is predominantly farmland therefore it can be assumed the field irrigation is present. Therefore, the regulation range of 500-3500 mg/L Total Dissolved Solids is likely the governing regulation in this area.

3.4 Fish and Fish Habitat

Using the Canadian Data Report of Fisheries and Aquatic Sciences 1247, the Cooks Creek Diversion is classified as a Type D habitat and has a Designation of Drain of three (D.W. Milani, 2013). This means that it is a Simple Habitat with Non-Indicator Species. Common species to Type D habitats with DES 3, like the Cooks Creek Diversion are the Fathead Minnow, Brook Stickleback, Creek Chubb and Western Blacknose Dace. The Cooks Creek Diversion flows adjacent to the proposed development and ultimately drains to the Red River Floodway. The Cooks Creek Diversion is fed by Cooks Creek. Recreational angling has been identified on Cooks Creek. The Cooks Creek Diversion does not provide habitat for any aquatic species at risk (Fisheries and Oceans Canada, 2023).

3.5 Wildlife Habitat and Vegetation

The Project is in the Prairie Ecozone in the Manitoba Plain Ecoregion, Winnipeg Ecodistrict. Characteristic wildlife in the area includes waterfowl, white tailed deer, coyote, rabbit, and ground squirrels. Characteristic vegetation in the area includes trembling aspen/oak groves and rough fescue grasslands.

The Manitoba Conservation Data Centre species database for rare and protected wildlife in the region was reviewed, and a few species were identified. Within a 1 km radius of the Proposed developments (i.e. WTP, Concentrate Water Pond, Pipeline, Well Sites) are included in Table 3-4. It is noted that this list is not necessarily site specific.

Table 3-4 Wildlife and Vegetation of Conservation Concern Reported within 1 km of the Project

Documented Species	Informal Taxonomy	NatureServe Global Status	Federal Ranking (Species at Risk Act)
Juglans cinerea Butternut	Dicots	G3	Endangered Species
Bombus terricola Yellow-banded Bumble Bee	Bumble Bees	G3	Special Concern

Documented Species	Informal Taxonomy	NatureServe Global Status	Federal Ranking (Species at Risk Act)
Coccinella transversoguttata Transverse Lady Beetle	Other Beetles	G5	Special Concern
Symphyotrichum sericeum Western Silvery Aster	Dicots	G5	Threatened Species
Agalinis aspera Rough Purple False Foxglove	Dicots	G5	Endangered Species
Dolichonyx oryzivorus Bobolink	Birds	G5	Threatened Species

G3: Vulnerable
G5: Secure

Using the Manitoba Herps Atlas database, there are no records of amphibian species near the Project site. The closest and most recent amphibian sighting was in 2018, approximately 10 km north of the site (iNaturalist, 2023)

3.6 Socioeconomic

The main project area is located within the RM of Springfield between Dugald and Oakbank. The RM of Springfield has a total land area of 1096 km^2 and a population of approximately 15,342 people based on the 2016 Census. The Project will distribute regionally and be located between Dugald and Oakbank. These communities have a combined area of approximately 10 km^2 and combined population of 5,655 people based on the 2021 Census. From 2006 to 2021 Dugald and Oakbank saw a combined population growth of over 98% and an annualized growth rate of 4.7% per year. Following this linear trend of the 2006 to 2021 Census, the 20-year combined population is approximately 21,460 people.

3.7 Heritage Resources

The Provincial Heritage Resources Branch was contacted to review the location of the Project components in order to screen the locations and identify areas where heritage and cultural resources may likely be found. This document is attached in Appendix G. Project activities will occur in previously disturbed municipal and provincial right of ways and lands. If heritage resources are encountered during the Project construction, construction will be stopped and the Project Team will contact the Heritage Resources Branch to determine required mitigation measures. Further discussions on Heritage Resources are presented in Section 5.9.

The Archaeological Assessment Services Unit in the Historic Resources Branch examined the location in conjunction with Branch records for areas of potential concern. There is no immediate concern with the Project as it is currently proposed. As such, there are no previously recorded archeological sites within or in proximity to the proposed project footprint.

4 POTENTIAL ENVIRONMENTAL EFFECTS

Potential environmental effects include any change to the environment because of the Project. The environmental attributes that could be affected by project activities are, but not limited to:

- Air quality

- Soils
- Fish and fish habitat
- Water quality
- Groundwater levels
- Socioeconomic aspects of the area
- Climate change

Based on potential adverse interactions, mitigation measures and follow-up strategies were determined.

The withdrawal of the water from the new Dugald Raw Water Field is considered out of scope therefore any environmental effects resulting from the withdrawal, testing, and pumping are not considered in this evaluation.

4.1 Air Quality

Construction activities can create dust and emissions from construction machinery. Dust control with water sprays or mists will be used to reduce dust potential and suppress dust should it occur. Air quality effects due to dust will be localized to construction sites and are considered to be temporary effects. Emissions from construction equipment will temporarily affect the air quality in the area when machines are running, however this will be temporary and for a short period of time. This is reduced by ensuring that machines are in good working condition and are outfitted with appropriate mufflers (where applicable) to reduce emissions. Spills on site can affect air quality. Adherence to environmental protection practices will reduce the effects of spills on air quality.

It is anticipated that during operation of the WTP there will not be any release of pollutants to the air.

4.2 Soils

During construction there is a risk for fuel and chemical spills and/or leaks of lubricant from equipment and activities on site. The risks associated with fuel and chemical spills and/or leaks of lubricant and the release of hazardous materials into the soil, water and generally the environment. These spills may occur due to poorly kept equipment or unsafe handling procedures. The storage of fuel or lubricants within the area of the well sites and pipelines near Cooks Creek and the Cooks Creek Diversion will not be permitted.

During operation, there will be little to no effect on the soils. No fuel trucks will be brought to site on a regular basis and all chemicals that are brought to site will be delivered using standard protection measures. The potential for adverse soil effects is low during operation.

4.3 Surface Water, Fish and Fish Habitat

During construction, blown dust and exposed soil/surfaces may increase run-off and affect surface water, fish and fish habitat. To mitigate this, the Project work sites will be re-vegetated quickly once construction is complete and work will only occur within the site footprint. Effects to surface water, fish and fish habitat are expected to be minor during construction and typical mitigation measures will be in place to reduce these effects.

During operation, the WTP will discharge concentrate water to the Cooks Creek Diversion. The Cooks Creek Diversion is a man-made diversion that diverts water from Cooks Creek to the Red River Floodway near Highway 15 and the east perimeter. Figure 4-1 presents a surface water map.

Figure 4-1 Surface Water Map

The Cooks Creek Diversion is considered a Type D habitat for fish (D.W. Milani, 2013). The Cooks Creek Diversion does not provide habitat for any aquatic species at risk (Fisheries and Oceans Canada, 2023). Discharge will occur seasonally during periods where flows can support the concentrate water and to avoid sensitive spawning times for fish. Discharge will occur from April 1st to November 15th. Concentrate water flow will be gravity fed, therefore the pipe size selected will determine the discharge rate. Pipe size will be determined following the detailed design. It is expected that the impacts to water quality from the release of concentrate water will be negligible.

4.4 Groundwater

The new Dugald Raw Water Well Field drilling and construction is outside of the scope of this Environment Act Proposal. The potential for adverse effects to ground water (quality and levels) is low.

4.5 Wildlife Habitat and Vegetation

The WTP Site, is farmland that is tilled seasonally. There is low variability in vegetation in the area. Seeded grass or farmland is present at all project activity locations and all locations are within Municipal property or right of ways that have been previously disturbed and regularly managed. These areas are generally grasses. During operation, potential effects to vegetation are considered negligible. For this reason, the potential for rare plants, Dicots, listed in Section 3.5, to occur in the Project footprint is low to negligible. As presented in Figure 4-2, vegetation at the Cooks Creek Diversion is shown.

Figure 4-2 Vegetation at Cooks Creek Diversion

The WTP is located on idle land and contains habitat for wildlife. Clearing of the construction site has potential to impact bird nesting, rearing and roosting activities. The Project is in nesting Zone B4/B5, the nesting period associated with these zones is mid April to late August and late April to late August, respectively. Mitigation measures for nesting migratory birds is provided in Section 5.5. Other animals that are only foraging or migrating through the site are expected to continue to move by the site with little to no interaction with the Project. Using the Manitoba Herps Atlas database there are no records of amphibian species near the Project site. The closest amphibian that has been documented was observed previously 10 km away in 2018 (iNaturalist, 2023). Impacts on protected species are expected to be negligible.

4.6 Noise and Vibration

During construction there is potential for sound emissions. These emissions come from various common construction equipment, such as, dump trucks, directional drills, excavators, and hand tools. To reduce noise and vibration effects, construction will be scheduled during daytime hours and construction equipment will be in good working condition and have the appropriate mufflers.

Once the new WTP is operational, there will be minimal noise and vibration effects.

4.7 Employment/Economy

Socioeconomic interactions during construction are expected to be minor as construction is short-term. Opportunities for economic activity will likely take place for both Dugald and Oakbank since construction personnel on site will use local facilities (e.g. gas stations, restaurants). Some economic implications may exist due to the costs of developing the water system, however the RM of Springfield will have sustainable potable water as a result.

During operations, staff are required to operate the WTP and are expected to live in the adjacent communities. In the long-term the facility will support community growth with a larger distribution system and a reliable water source.

4.8 Human Health and Well Being

The potential adverse effects of the Project on human health are negligible to minor. There may be short term increases to noise and dust during construction and an increase in vehicle traffic in the area. Overall, the potential effects on human health and well being will be positive and provide a long-term benefit to the RM of Springfield.

4.9 Climate Change

There are no predicted impacts directly related to climate change because of the Project activities. The WTP is considered a Post Disaster Structure and will be designed and constructed based on those codes and standards. The WTP is a resilient structure engineered against extreme weather conditions.

5 ENVIRONMENTAL MANAGEMENT MEASURES

Environmental management practices proposed to prevent or mitigate environmental effects determined to be averse to the area are identified and described in this section. The contractor is required to follow standard best management practices and all permit conditions to construct this Project.

5.1 Air Quality

Dust control during construction using water or approved dust suppressants will limit the impacts of dust to the air quality in the area. Prompt re-vegetation following construction and covering stockpiles will also reduce the impacts of dust.

Emissions during construction will be reduced by ensuring all equipment is in good working condition and that unnecessary transportation and idling are reduced. The effects of spills on air quality will be reduced by adhering to environmental best practices. Burning will not be permitted on any construction site.

5.2 Soils

During construction, the preparation and implementation of an Emergency Response Plan to mitigate potential impacts to soil will greatly reduce negative impacts. The use and availability of on-site spill clean-up equipment and materials will be used if a spill does occur. To reduce the likelihood of a spill, equipment will be properly maintained and in good working condition and monitored when fueling. Any excavations, stripping or disturbance will be re-vegetated promptly to minimize the amount of soil disturbance. Travel and project works will be limited to the construction site.

5.3 Surface Water, Fish and Fish Habitat

Best management practices will be used during construction to minimize potential impacts to surface water. Mitigation of surface water issues will be achieved by redirecting surface water runoff, pumping accumulated water to adjacent ditches, and providing erosion control practices as required. The Project areas will be re-vegetated as soon as the Project is complete to reduce run-off and minimize erosion. Petroleum, chemical and/or lubricant leaks will be mitigated by use of properly maintained equipment, and appropriate spill clean up equipment. A 100 m setback to

watercourses will be maintained for fuelling activities. Efforts will be made to remain within the Project footprint to reduce soil disturbance and erosion.

An Emergency Response Plan will be implemented by the construction contractor if a spill does occur. In the event of a reportable spill, a spill that may create a hazard to human life or health, to other organisms, or to the physical environment, Authorities Having Jurisdiction (e.g. Manitoba Environment and Climate Change, the RM of Springfield) will be notified through the emergency response line. Appropriate remediation measures will be taken according to local requirements.

Concentrate water will be released to the Cooks Creek Diversion, just south of the WTP Project site. As previously discussed, impacts to water quality form the release of concentrate is expected to be negligible. The proponent may choose to conduct long-term monitoring of the Cooks Creek Diversion upstream and downstream of the drainage point to assess any long-term impacts on water quality.

Aquatic invasive species (e.g., zebra mussels) are known to occur in the province and can spread through transporting sands, sediments, and contaminated construction equipment. To prevent aquatic invasive species spreading during construction near the aquatic environments, the contractor will:

1. Ensure construction equipment is clean, drained, and dry before entering the site; and,
2. Never move organisms or water from one body to another.

5.4 Groundwater

Although groundwater is not expected to interact with the in-scope Project activities, measures will be implemented to reduce potential impacts. These measures include having a qualified contractor compete the construction and installation of the wells and concentrate water pond liner specifically. This includes following applicable legislation/permits/approvals and implementing a quality assurance program.

5.5 Wildlife Habitat and Vegetation

Once construction is complete, the disturbed areas will be revegetated using topsoil and seed to restore suitable ground cover. Standard right of way seeding will be used in the appropriate areas. This will limit wind and water erosion and help to establish protected plant species that may be present in the seed bank. Minimal ground disturbance outside the Project footprint is anticipated during the construction phase by setting limits on the site area. Clearing of the construction site has the potential to impact bird nesting, rearing and roosting activities. To reduce these impacts, clearing should avoid the time-sensitive windows for migratory birds (e.g., Bobolink) and wildlife, from mid-April to end of August. If it is not possible to avoid the time-sensitive windows, it is recommended that pre-clearing nest surveys be completed so nests can be removed at appropriate times.

Mitigation for the yellow banded bumble bees will be developed once their presence at the Site has been confirmed. These bees nest underground and are active for one season. The specific overwintering habitats of bee queens are unknown, but bumble bees typically burrow 2 - 15 cm deep in loose soil or rotting logs. The queens do not survive more than one winter so there is no return to an overwintering site. If these bees, or any species identified under the Species at Risk Act, listed in Section 3.5 are found, work will pause, the RM of Springfield will be notified, and an appropriate mitigation plan will be developed.

Any potential effects to wildlife habitat and vegetation during operation can be mitigated by ensuring that operations are limited to areas that have been previously disturbed by construction.

5.6 Noise and Vibration

Limiting any noise-creating activities, including regular maintenance, and monitoring activities to normal working hours, and limiting unnecessary long-term idling can mitigate any potential increased noise and vibration in the area.

5.7 Water Conservation

Water conservation measures can include metering of water use in the future and any water conservation information will be posted or included in community bulletins.

Potential leak detection will take place through monitoring flows leaving the WTP and water levels in the reservoirs. Any leaks should be repaired in a reasonable time to avoid excessive water loss and associated costs.

5.8 Socioeconomic Implications

There are no known negative socioeconomic impacts from the proposed Project. It will provide a safe and reliable drinking water system to enhance the quality of life and economic potential for the community.

5.9 Heritage Resources

If heritage resources (including human remains and palaeontological resources) are encountered in association with these lands during testing and development, there is an obligation to report any heritage resources and a prohibition on destruction, damage, or alteration of said resources. The Heritage Resources Branch may require that an acceptable heritage resource management strategy be implemented by the proponent/developer to mitigate the effects of their activity on the heritage resources. This heritage resource management strategy will need to describe operational procedures to limit effects to heritage resources. This plan will be used to assist proponents, landowners, managers, employees, and /or contractors on what to do and whom to call if heritage resources are encountered if the Heritage Resource Impact Assessment is performed onsite.

CLOSURE

This report was prepared by Associated Engineering Ltd. (Sask.) on behalf of the Rural Municipality of Springfield and the Manitoba Water Services Board to present the anticipated environmental impacts associated with the construction and development of the new regional water treatment plant and associated pipeline.

The services provided by Associated Engineering (Sask.) Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,

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No. 396 Date: 03/14/2024

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APPENDIX A - HYDROGEOLOGICAL REPORT

Friesen DRILLERS

April 1, 2022

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Dear Phillip,

Subject **Desktop Hydrogeological Study - Dugald Raw Water Field Phase 2 Expansion**
SW32-10-6EPM Rural Municipality of Springfield, Manitoba

Friesen Drillers Limited (FDL) is pleased to present this report to detail the results of a desktop hydrogeological study undertaken for a potential expansion of the Oakbank-Dugald municipal groundwater supply in the Rural Municipality of Springfield (RM).

The study included an appraisal of technical considerations, discussions related to public consultations planning, and reporting to summarize the results and provide recommendations to expand the existing water supply, according to the volumes requested by the RM. The analysis was limited to a desktop review and did not include field work components.

Project Background

A municipal water supply for the communities of Oakbank and Dugald was developed in the early 1990s by ID Engineering (Woodbury, 1995). The municipal system was constructed to mitigate concerns of poor water quality related to aging private domestic supplies and limited well yields due to marginal aquifer conditions within the community of Oakbank.

Due to the low yields and challenging to treat water quality (at the time) in the Carbonate Aquifer around Oakbank, the original municipal supply wells were constructed in the Moosenose Ridge, an unconfined area of the Birds Hill Glacio-Fluvial complex located west of Oakbank. Two supply wells were installed and a pipeline was constructed to a small treatment plant in Oakbank. The distribution was originally limited to Oakbank, although a pipeline to Dugald was eventually constructed. The consulting hydrogeologist also recommended that strict environmental sampling and well head protection studies should be carried out due to the small and unconfined nature of the source aquifer (Woodbury, 1995).

All regulations, applicable at the time of development, were followed in the construction of the Moosenose water supply; however, shortly after the Walkerton, Ontario incident in 2000, regulations related to the protection of municipal water supplies were changed to address aspects of well head protection and surface water treatment requirements. As a result of these changes, basic chlorination of surface water was no longer acceptable and strict definitions were developed to distinguish surface water from groundwater sources. In Manitoba, the Office of Drinking Water was established to oversee municipal water supply operations.

In 2013, FDL was retained to assess the well head capture zone for the Moosenose supply wells. The results indicated that the water source was groundwater under direct influence of surface water (GUDI), a designation that requires additional treatment under current regulations. Due to the inherent risks associated with the Moosenose supply, a study was commissioned to locate an additional water source for the municipal system (FDL, 2016). The new groundwater source was intended to provide additional well head protection over the Moosenose wells and to provide supplemental water supply capacity to meet future population growth within the community.

Following recommendations of the 2016 desktop study, an extensive field-testing program was undertaken in 2017-2018 to select a new wellfield location (FDL, 2019a). One of the key aspects of this program was to select a water supply that was under confined conditions to provide additional protection of the municipal water supply. The test program included test well drilling, water quality sampling, and aquifer capacity testing. In addition, a public consultation process was undertaken by Landmark Planning and Design. In consultations with RM staff and the water treatment plant design consultant, WSP, two new municipal supply wells were constructed into the confined Sandstone Aquifer, at a location approximately four miles east of Dugald. The wellfield locations are shown on the following page in Figure 1. Although the technical and regulatory aspects of the project met with success, a few local residences required additional sampling and monitoring considerations, and two private domestic well replacements were undertaken by the RM.

Project Background (Cont'd)

In 2019 the RM applied for Water Rights (Licence No. 2019-107) and Environment Act (Licence No. 3303) licenses to authorize the newly constructed Dugald municipal groundwater supply. The application requested an additional allocation of 323 dam³/year; at the time, the additional allocation was projected to meet the RM demands through the year 2041 (WSP, 2018). The new Dugald wellfield was put into operation in 2021. A copy of the Water Rights and Environment Act licences are attached.

The new Water Rights Licence (Licence No. 2019-107) was issued for the entire Oakbank-Dugald municipal system, which includes both the Moosenose wellfield at NE30-11-5E, and the Dugald wellfield at SW32-10-6E.

The licence noted the following conditions:

- Total annual allocation of 646.6 dam³/year (524.20 acre-ft./year).
- Maximum instantaneous flow rate of 0.1320 m³/second (2,091 U.S.G.P.M.).
- Operation of supply wells only permitted while aquifer water levels are above the bottom of the well casing in each supply well.
- License valid until September 20, 2036.

The Moosenose wellfield previously operated under licence no. 2016-102, with the following parameters:

- Total annual allocation of 323.3 dam³/year (262.1 acre-ft./year).
- Maximum instantaneous flow rate of 0.061 m³/second (966 U.S.G.P.M.).

It should be noted that the current Water Rights Licence (2019-107) does not specify allocations or pumping rates between the two wellfields. However, based on the above information, the new Dugald wellfield was inferred to have the following operating parameters.

- Total annual allocation: 323.3 dam³/year (262.1 acre-ft./year).
- Maximum instantaneous flow rate: 0.071 m³/second (1,125 U.S.G.P.M.). This rate equates to 562.5 U.S.G.P.M. (35.5 L/s) per well.

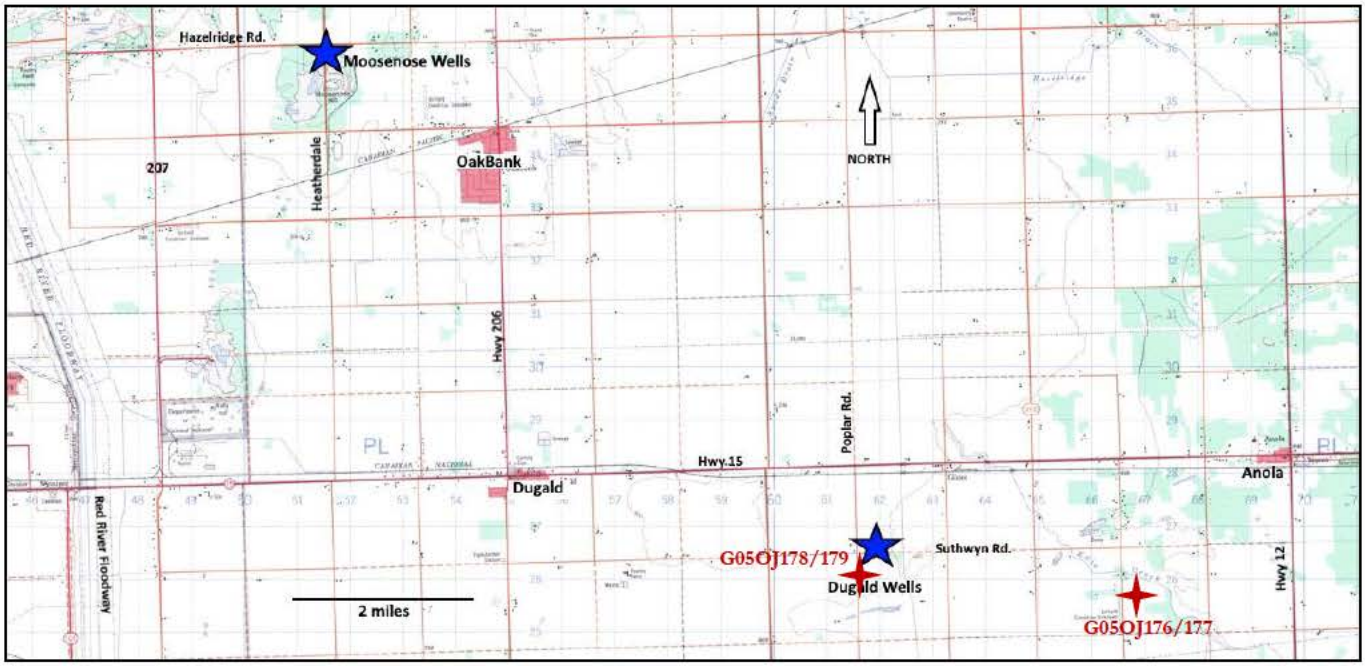

Figure 1 – Location of the Moosenose and Dugald wellfields relative to the Oakbank and Dugald communities; provincial monitoring stations around the Dugald wellfield also shown.

Proposed Water Supply Expansion

The Dugald wellfield was developed to produce a target flow rate of up to 40 L/s (634 U.S.G.P.M.) and an annual allocation of 323.3 dam^3/year. It is understood that these targets were derived from a Stantec Master Plan (2016) and a WSP study (2018). In 2018, the RM determined that a new, supplemental water supply equal to that of the existing Moosenose supply (323.3 dam^3/year, or 262.1 acre-ft./year) would be sufficient to meet the RM water supply needs until 2041 (FDL, 2019a). The contract documents for the work identified 40 L/s as a desired yield target.

Development of the Dugald wellfield included an extensive public consultation process. In this process, the target parameters of the water supply, including the projected annual groundwater allocations, were shared with the public. These details are a vital component in the communications and often form the basis of understanding and trust between members of the public and the project team in general. It is generally understood that population projections have an inherent margin of error; however, where projections are significantly off the mark, the credibility of the project overall is more easily undermined. This situation has the potential to generate challenging conditions for future water supply projects in the immediate area.

It is our understanding that growth projections for the RM have been revised since 2018 and that a total of 1,600 dam^3/year will be necessary to meet the future needs of the RM municipal system (Pers. Comm. – RM Staff, 2021). This represents an increase of about 1,000 dam^3/year, or about two and a half times above the existing allocation. FDL was retained by the RM to review the existing supply systems and provide options for the potential expansion of the municipal water supply.

Scope of Work

The following scope of work was developed for a review and evaluation of the proposed expansion of the municipal water supply:

- Obtain and review available geochemistry and hydrograph data for the area.
- Conduct background technical research to assess aquifer capability and well capacities around the Dugald municipal well field. Include details relating to possible well construction designs, testing requirements, and long-term monitoring plans for new supply wells.
- Discuss the public consultation aspects of the project with consultation professionals and report on the response.
- Prepare a report to summarize the results and provide recommendations for the water supply expansion.

Hydrogeological Conditions

Hydrograph Review

The province maintains a network of groundwater monitoring stations throughout the province. The network includes stations within the RM of Springfield, commonly as paired wells completed into the Carbonate and Sandstone aquifers. One set of stations, G05OJ178/179, is located adjacent to the new Dugald Wellfield (Glass); another set, G05OJ176/177, is located a few miles east of the Dugald wells, at section SW26-10-06E. The monitoring well locations are shown on Figure 1.

The most recent monitoring data from the nearby provincial stations was obtained from the provincial Groundwater Management Section (Hydata, 2021). The most recent monitoring data includes a relatively short period of time with the new Dugald municipal system in operation. Monitoring data from the Sandstone Aquifer is plotted in Figure 2, while data from the Carbonate Aquifer is plotted in Figure 3. The hydrographs allow for a comparison of groundwater levels at the Dugald wellfield with levels outside the radius of pumping influence. This allows the influences from new pumping to be more clearly delineated.

Several comments were provided from a review of the hydrographs:

- Groundwater levels in both aquifers were near the lowest elevations observed on the chart records. This was consistent with regional observations and was attributed to the recent drought conditions experienced in the province. However, overall groundwater levels remained well above the top of the aquifers, with approximately 200 ft. of available drawdown in the Sandstone Aquifer.

Hydrograph Review (Cont'd)

- The duration of pumping from the new wellfield was relatively short. Consequently, the full extend of drawdown development around the wellfield was not observed in the available monitoring data. Additional monitoring will be necessary to assess the full impacts of the new pumping wells over time.

- Fluctuations at stations in the Sandstone Aquifer were strongly correlated over the medium to long-term (OJ176/178 - Figure 2), with a difference of about 6 m between the two stations. New pumping appeared to have lowered static water levels around the wellfield by about 0.7 m (2.3 ft.). Maximum short-term drawdown from municipal pumping was up to 5.4 m (18 ft.) at the sandstone monitoring well (G05OJ178).

- Fluctuations at stations in the Carbonate Aquifer were moderately correlated over the medium to long-term (OJ177/179 - Figure 3), with a difference of 6-9 m between the two stations. Pumping influences appeared to be much less pronounced in the Carbonate Aquifer. Changes in the static water levels at the wellfield appear to be on the order of 0.5 m (1.6 ft.) or less. Maximum short-term drawdown from municipal pumping was up to 0.7 m (2.3 ft.) at the carbonate monitoring well (G05OJ179).

It should be noted that in areas where both bedrock aquifers are fresh, it was common to drill domestic water wells through both formations in search of softer water. As such, many of these multi-aquifer wells still exist in the area, despite this practice being abandoned by the water well industry in the early 1990s. The province took further steps in the most recent amendment to the Groundwater and Water Well Act to ban multi-aquifer completions entirely. Despite these actions, the hydraulic separation between the bedrock aquifer is not guaranteed at all locations. Therefore, diligence must be maintained in the groundwater protection and monitoring requirements. Long term changes in the groundwater quality of the two Paleozoic aquifers tend to occur gradually over time.

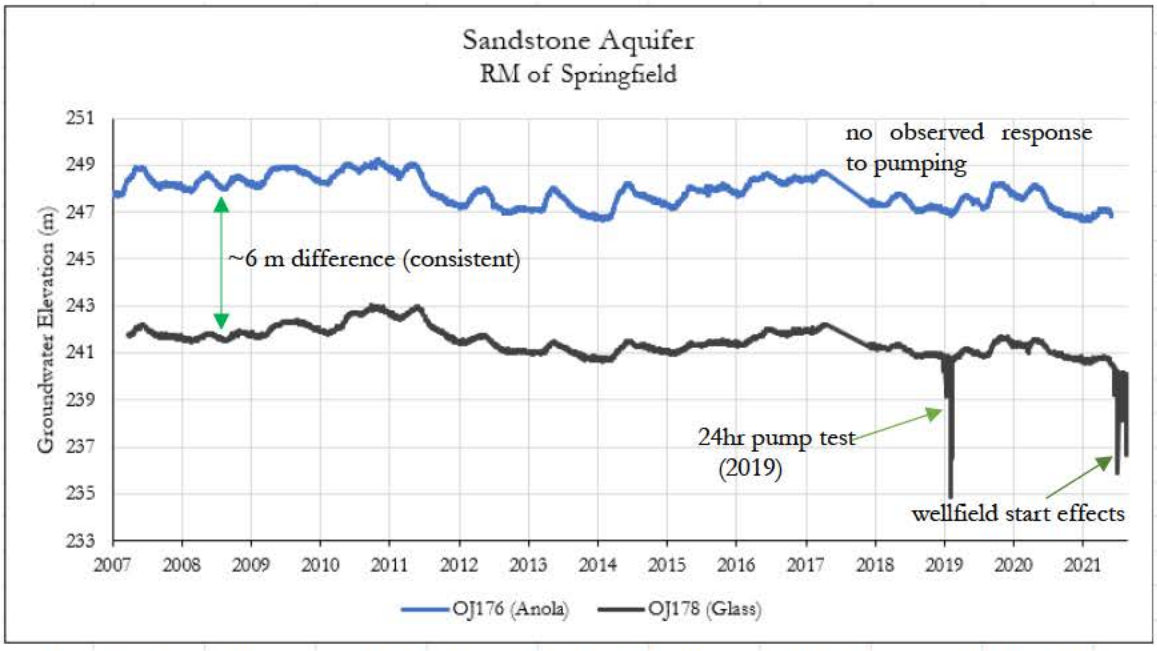

Figure 2 - Provincial stations in the Sandstone Aquifer; RM of Springfield. (Data source – Hydata, 2021)

Hydrograph Review (Cont'd)

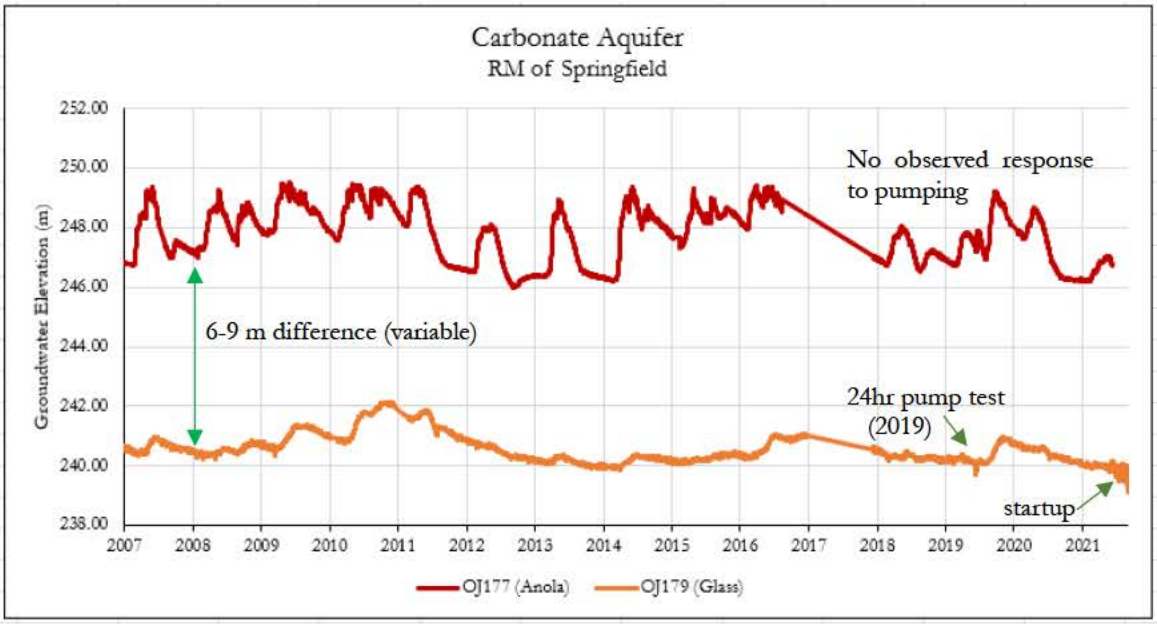

Figure 3 – Provincial stations in the Carbonate Aquifer; RM of Springfield. (Data source – Hydata, 2021)

Groundwater Geochemistry Review

Groundwater geochemistry within the major bedrock aquifers is highly variable throughout the RM of Springfield. It is likely that both the Sandstone and Carbonate aquifers were entirely saline prior to the recent glacial periods (Ferguson et al., 2007). Through numerous cycles of glacial advance and retreat, influxes of freshwater were flushed into the aquifers, gradually displacing saline waters towards the north and west. The current distribution of permeable glacial deposits allows for major recharge zones along the eastern side of the RM. As a result, groundwater quality is typically fresher in the southeast and gradually deteriorates towards the north and west. The continuous freshwater flushing action of new recharge has a natural softening effect on groundwater in the Winnipeg Formation. It has also been noted that the freshwater does not move uniformly through the Carbonate Aquifer (Phipps et al., 2008). Instead, areas where the freshwater flow is less active may result in pockets where the older, poorer groundwater quality is preserved. The saline/freshwater boundary generally represents a transition from subglacial freshwater recharge to ancient basin brines (Betcher, 1986).

Groundwater quality in the Sandstone Aquifer at the new Dugald wellfield location was noted to be suitable for municipal water supply purposes. It was further noted that groundwater quality in the sandstone was slightly fresher in areas east-southeast of the existing production wells (FDL, 2019a/b).

Dugald Municipal Well Field

Well Construction Details

The current municipal production wells were constructed using a similar design and methodology. Each well included full, 12-inch diameter completion to the base of the Winnipeg Formation sandstone (approx. 330 ft. below grade).

The production wells were drilled using a Foremost Barber Industries DR-24 Dual Rotary casing advancement drill rig. The lower drive was used to set 16-inch diameter casing into the carbonate rock at a depth of 75 feet below grade. The carbonate bedrock was drilled open hole with compressed air using a 15-inch diameter bit to a depth of 250 feet. At the base of the carbonate formation, the drilling technique was switched to clean water circulation so that the sandstone formation could be drilled with minimal disturbance. The sandstone was drilled with this technique to a depth of approximately 330 feet below grade.

Well Construction Details (Cont'd)

A stainless steel, wire-wound screen assembly was installed. The well screen was 60 feet long with 12-inch, pipe size diameter and 15-slot (0.015 inch) openings. The screen was equipped with centralizers every 20 feet. The screen was placed into the open borehole filled with clean water, and 0.55 Unimin Silica sand was placed around the screen. 12-inch diameter black welded steel casing (0.375-inch wall thickness) was extended to surface. The annular space between the 16 inch and 12-inch diameter casing was filled with bentonite chips from the top of the sand pack to the top of the shale (~255 ft. - 240 ft. below grade). Washed gravel was placed over the interval of the Carbonate Aquifer (~240-74 ft. below grade) and alternating bentonite chips and washed gravel were placed from 74 ft. to surface.

The well screen was noted to have a maximum transmitting capacity of 13.1 U.S.G.P.M./ft., based on the manufacturers recommended maximum intake velocity of 0.1 ft/sec. With 60 feet of screen, the maximum transmitting capacity of the screen would be 786 U.S.G.P.M.

The well construction described here is typical for the Winnipeg Formation in southeast Manitoba. However, variations in the formation depths and thickness are to be expected. New production wells should be designed and constructed according to site-specific conditions.

Well Field Capacity and Operation Details

It is our understanding that the Dugald supply wells were mechanized with submersible electric pumps that produce 562 U.S.G.P.M. (35.5 L/s) per well. It is also understood that the supply wells are operated in a duty/standby configuration, with only a single well pumping at a time. The associated drawdown at distance resulting from a single pumping well in the Sandstone Aquifer is shown in Table 1. From the Table, drawdown interference effects between the two production wells in the Sandstone Aquifer, located about 1,000 ft. apart, were calculated to be up to about 30 feet.

Wellfield capacity details are shown in Table 2. Based on previous well testing, the existing production wells can sustain a maximum instantaneous flow rate of 562 U.S.G.P.M., under normal conditions (FDL, 2019a). This rate is limited by the specific capacity of the wells along with the amount of available drawdown. As both of these parameters can vary slightly over time, the overall well capacities can also fluctuate over time. If both wells are to be pumped simultaneously, the resultant flow rate would reduce to about 450 U.S.G.P.M. (28.4 L/s) per well, or a combined 900 U.S.G.P.M. (56.8 L/s). The reduction is due to drawdown interference effects between the wells.

Table 1
Calculated Drawdown at Distance – Sandstone Aquifer
Dugald Municipal Wells - Pumping Rate: 562 U.S.G.P.M.

Radius	500 ft.	1,000 ft.	2,000 ft.	3,000 ft.	4,000 ft.	5,280 ft. (1 mile)
Drawdown	36.7 feet	28.0 feet	17.1 feet	11.4 ft.	7.3 ft.	3.4 ft.

Table 1 – Calculated drawdown pumping at a combined rate of 562 U.S.G.P.M. for 24 hours, following Theis (1935) equation.

Table 2
Maximum Pumping Rates – Existing Production Wells
Dugald Municipal Wellfield, SW32-10-6EPM

Duty/Standby				
Well ID	**Configuration**	**Specific Capacity[1]**	**Available Drawdown[2]**	**Maximum Pumping Rate[3]**
West well	Duty/Standby	2.5 U.S.G.P.M./ft.	220 ft.	562 U.S.G.P.M.
East Well	Duty/Standby	2.5 U.S.G.P.M./ft.	220 ft.	562 U.S.G.P.M.
			Maximum Instantaneous Rate (Duty/Standby):	**562 U.S.G.P.M.**
Simultaneous Well Pumping				
Well ID	**Configuration**	**Specific Capacity[1]**	**Available Drawdown[2]**	**Maximum Pumping Rate[3]**
West well	Simultaneous pumping	2.5 U.S.G.P.M./ft.	180 ft.	450 U.S.G.P.M.
East Well	Simultaneous pumping	2.5 U.S.G.P.M./ft.	180 ft.	450 U.S.G.P.M.
			Combined Maximum Instantaneous Rate (Simultaneous):	**900 U.S.G.P.M.**

Notes: [1] Specific capacity from the testing results (FDL, 2019a)
[2] Available drawdowns calculated as the difference between a 20 ft. static water level and 15 ft. above the casing bottom (256 ft.).
- An additional 40 ft. of drawdown from well interference was assumed for the Simultaneous Pumping Scenario.

[3] Available drawdown multiplied by specific capacity.

Table 2 – Hydraulic capacity of existing production wells. (Data source – FDL, 2019a)

Well Field Capacity and Operation Details (Cont'd)

As previously noted, the annual allocation of 323.3 dam^3/year (262.1 acre-ft./year) was based on the RM projections of their future water supply requirements. The current allocation (323.3 dam^3/year) is equivalent to a well pumping continuously at a rate of 200 U.S.G.P.M., or pumping the current wells approximately 20% of the time at maximum capacity. The available information for the supply wells and local aquifer suggests that the annual allocation of the existing wellfield could potentially be increased in the future. However, concerns for third party interference were noted for the existing sites. In general, it is desirable to have new pumping wells operate consistently and to increase pumping rates gradually to allow the natural systems and existing infrastructure to respond to the new conditions and stresses. Consequently, an expansion of allocation for the current supply wells should proceed on the basis of the monitoring results and recommendations that are produced from the analysis of the monitoring data.

Considerations for Well Field Expansion

Regulatory Considerations

The maximum pumping rates and annual groundwater allocations are limited as per conditions of the Water Rights Licence (2019-107). In addition, aspects of the pipeline and water supply infrastructure are also subject to conditions of the Environment Act Licence (No. 3303). Modification or expansion of the existing water supply system will require the existing licences to be revised. In some cases, the revisions can be achieved through a basic amendment process. In other cases, a new application may be necessary. The necessary revision process is at the discretion of the respective governing authorities.

In the author's experience, the license amendment process has been sufficient in cases where the changes or expansions are relatively minor. In situations where changes are more significant, a more extensive application is often necessary. An expansion of the existing Dugald wellfield by 1,000 dam^3/year is likely to require a new application, as this would represent a significant increase. These requirements should be confirmed with the appropriate authorities prior to any new development.

It is important to note that the Environment Act has a public consultation requirement which can add considerable time and effort to a project. The Water Rights Licensing process is done internally by the Drainage and Water Use Licensing Section and does not have the same public requirements.

Technical Considerations

The Winnipeg Formation Sandstone Aquifer is shown to be a reliable groundwater source at the Dugald wellfield location. The aquifer is geographically extensive and receives regular freshwater recharge. In addition, the capacity of new supply wells in the Sandstone Aquifer is relatively predictable and typically requires less extensive testing than the Carbonate Aquifer. Based on considerations of aquifer capacity, source water protection, and consistency of groundwater geochemistry, it is recommended that any new municipal supply wells also be constructed into the Sandstone Aquifer.

The 12-inch diameter well construction is ideally suited to the hydraulics of the Sandstone Aquifer and accommodates pumping equipment that provides the maximum flow rate with the fewest number of wells. A typical 12-inch diameter production well completed into the Sandstone Aquifer could be expected to produce a maximum instantaneous flow rate of up to about 500 U.S.G.P.M. (~32 L/s). If pumping at this rate for 12 hrs per day, with 12 hrs for recovery (50% duty/standby), the annual yield per well would be approximately 400-500 dam^3/year (~320-400 acre-ft./year).

Base on the above assumptions, increasing the total allocation by 1,000 dam^3/year would require approximately 2-3 additional, 12-inch diameter production wells that are efficiently constructed and developed into the Sandstone Aquifer.

As noted in the previous section of this report, pumping wells should be spaced sufficiently apart to minimize pumping interference effects and ensure maximum pumping capacity per well. It is also recognized that a balance must be achieved between adequate well spacing and feasibility of piping infrastructure costs. Based on the calculations presented in this assessment, a minimum well-pair spacing of 1,000-1,500 ft. This would result in about 20-30 ft. of interference drawdown between a given well-pair in the Sandstone Aquifer. It should be noted that additional drawdown could be observed if more wells are added in the nearby vicinity, which would reduce the maximum pumping rate from each well.

Technical Considerations (Cont'd)

The approximate locations recommended for additional municipal supply wells are shown in Figure 4. The new wells should be constructed in a similar manner to the existing supply wells, as described above, with 12-inch diameter steel casing and stainless well screens installed in the Sandstone Aquifer. The top of the sandstone layer is estimate to lie at a depth of 245-280 ft. below grade. Total well depths are estimated to be in the range of 300-340 ft. A test well should be drilled at each new well location to confirm the local stratigraphy and groundwater quality. Each production well should be constructed according to site-specific conditions.

Figure 4 – Proposed locations (approximate) for additional pumping wells (yellow); existing wells plotted in red; existing residential noted in blue. (Source – Google Earth, 2021)

Public Consultations Planning and Well Inventory

The proposed expansion of the municipal groundwater supply is fairly significant and would generate additional observable drawdown around the pumping wells in the Sandstone Aquifer. As new pumping wells are added, the individual drawdown cones would be expected to interact and generate a regional potentiometric surface that is altered from the predevelopment condition. Theses changes will likely be observable at existing private residences in the area. Eight areas with existing residential development, shown on Figure 4, were noted within a mile of the proposed new supply well locations.

It is important to note that it is a responsibility of the RM to ensure that existing groundwater supplies are not negatively impacted by the municipal pumping. This is a condition of the Water Rights License. Consequently, public consultations will be necessary to address the public concerns and mitigate any potential negative impacts to existing groundwater users.

Landmark Planning and Design Inc. (Landmark Planning) completed a public consultation process for the Dugald municipal wellfield development. Their process utilized a Stakeholder Tier System which organized stakeholders (including landowners, residents, organizations, businesses, and adjacent municipalities) based on direct or indirect potential impacts from the project. The key concerns from stakeholders were noted to include sufficiency of water supply, water quality, and the need to mitigate any possible negative impacts on existing wells (Landmark Planning, 2018).

Public Consultations Planning and Well Inventory (Cont'd)

The public engagement process was considered both thorough and adequate for the scale and nature for the project (Landmark Planning, 2018). Participants were generally satisfied that their concerns were understood and would be addressed as the project moved forward. However, well interreference complaints were raised during the initial wellfield development which required notable effort on the part of the project team and the RM to address. It is also noted that public consultations will likely be required according to the Environment Act licensing process for an expanded water supply. The previous events and licensing requirements highlight the importance of a public consultation process to be included as part of any water supply expansion program.

It is anticipated that an expansion of this nature will result in a significant amount of public interest in the area. As the proposed expansion is occurring only a short time after the initial development, it is highly likely that this project could experience difficulties. The residents in the area have been told that the previous project would supply growth for 20 years. This could create some issue with respect to credibility on behalf of the project. Public consultations and an effective strategy to communicate the reasons for the change in annual water allocations will likely be an important aspect of the project.

Conclusions and Recommendations

The location of the new Dugald wellfield has several real benefits over the Moosenose Ridge wellfield, including natural wellhead and source water protections and expansion potential. The benefits are derived from the doubly confined aquifer conditions and large geographical extent of the Winnipeg Formation Sandstone Aquifer. The thickness and grain size of the Sandstone Aquifer is fairly consistent in the region and typically requires minimal test work to develop new production wells. This characteristic provides both time and cost savings over the fractured Carbonate Aquifer, which typically requires extensive test work to identify suitable well locations. The water quality in the Sandstone Aquifer also tends to improve in the east-southeastward directions, which will likely provide further benefit for the water treatment process.

The available information suggests that, from a technical perspective, the allocation of existing Dugald supply wells could likely be increased in the future. However, concerns for third party well interference were noted for the existing development site. In general, it is desirable to have new pumping wells operate consistently and to increase pumping gradually to allow natural systems and existing infrastructure to respond to the new conditions and stresses. Consequently, an expansion of allocation for the current supply wells should proceed on the basis of the ongoing monitoring results and the recommendations that are generated from the monitoring data analyses.

Based on the above comments, it is recommended that any additional municipal water supply requirements be developed from the Sandstone Aquifer in the area of the Dugald wellfield. Although the Dugald wellfield is technically well suited to expansion, attention must also be given to the licensing processes and the potential for third party impacts.

Based on the desktop review, the following recommendations are provided:

- The projected long-term water demands should be reviewed and confirmed prior to proceeding with any expansion projects.
- Licensing requirements for the proposed expansion should be confirmed with the Water Rights Licensing and Environment Act Licensing sections of the province. It should be determined whether an amendment or new application would be required.
- A projected water demand increase of 1,000 dam^3/year, is estimated to require an additional two to three, 12-inch diameter production wells in the Sandstone Aquifer.
- New production well locations are recommended along Mission Road, between Poplar and Millbrook Roads (Figure 4). It is assumed that new production wells could be installed in the municipal right-of-way. This should be confirmed by the RM. It is understood that a small parcel of land was procured to allow for construction and continued access to the existing supply wells. These considerations should also be reviewed by the RM for the proposed expansion areas.
- A public consultation process should be established for the proposed expansion project. This program should build on the existing work that was done in the initial wellfield development. Public consultations should be initiated prior to any test work in the field.

Conclusions and Recommendations (Cont'd)

- If new supply wells are necessary, the following field-testing, analysis and well construction activities should be undertaken:
    - Initiate public consultations.
    - Obtain a Groundwater Exploration Permit (GEP) for the test work from Manitoba Environment, Climate, and Parks (formerly Conservation and Climate).
    - Confirm preferred well locations with RM and establish property/right-of-way boundaries and utility clearances.
    - Drill and construct a 5-inch diameter, PVC cased test well at each proposed well location to confirm local stratigraphy. The top of the sandstone layer was estimate to lie at a depth of 245-280 ft. below grade. Total well depths were estimated to be in the range of 300-340 ft.
    - Collect groundwater samples from each test well and submit to an accredited laboratory for analysis of routine geochemistry and any additional parameters requested by the RM or the WTP design consultants. The groundwater quality should be reviewed and approved by the RM according to the design parameters of the WTP.
    - Confirm the well design for each new production well site; each well should be designed based on site-specific data.
    - Construct 12-inch diameter production well(s) with steel casing and stainless well screens installed in the Sandstone Aquifer. To maximize well efficiencies, the well screens should be 12-inch pipe size diameter.
    - Conduct a pumping test on the new production well according to the provincial licensing requirements. All conditions of the GEP must be following in carrying out the well testing activities. The work should be supervised by a qualified hydrogeologist/ hydrogeological engineer registered in Manitoba.
    - Groundwater samples should be collected from the production wells at intervals throughout the high-rate pumping test. Samples should be submitted to an accredited laboratory for analysis of routine geochemistry and any additional parameters requested by the RM or the WTP design consultants.
    - Generate a final report to detail the testing, well construction and hydrogeological analysis results. The report should satisfy all requirements of the GEP and the Environment Act application process, including a detailed well inventory. Contingent on successful testing outcomes, the report should be suitable for submission to the province, pursuant to a new or amended licence. The report should be sealed by a qualified hydrogeologist/hydrogeological engineer registered in Manitoba.
    - As the proposed expansion represents a significant development within an important regional aquifer system, a numerical groundwater model of the aquifer should be developed. The model would be valuable to evaluate the aquifer response to pumping and would further aid in the ongoing management of the groundwater resources in the region. The modelling work should be undertaken by qualified professional with experience in the development of numerical groundwater models.

We appreciate the opportunity to be of continued service to the RM of Springfield. Please feel free to contact the undersigned with any questions about this work. We can be reached at 204-326-2485.

Sincerely,

[redacted] eviewed by,

Friesen Drillers Limited **iesen Drillers Limite**

[redacted]

Justin Neufeld, B.Sc.(G.Sc.), P.G [redacted] .Sc.(G.E.), P.E
Groundwater Geologist [redacted] ogical Engine

Attachments Water Rights Licence No. 2019-187 – RM of Springfield
Environment Act Licence No. 3303 – RM of Springfield

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Limitations

The scope of this report is limited to the matters expressly covered and is intended solely for the client to whom it is addressed. Friesen Drillers Limited makes no warranties, expressed or implied, including without limitation, as to the marketability of the site, or fitness to a particular use. The assessment was conducted using standard engineering and scientific judgment, principles, and practices, within a practical scope and budget. It is based partially on the observations of the assessor during the site visit in conjunction with archival information obtained from a number of sources, which is assumed to be correct. Except as provided, Friesen Drillers Limited has made no independent investigations to verify the accuracy or completeness of the information obtained from secondary sources or personal interviews. Generally, the findings, conclusions, and recommendations are based on a limited amount of data (e.g. number of boreholes drilled or water quality samples submitted for laboratory analysis) interpolated between sampling points and the actual conditions on the site may vary from that described above. Any findings regarding the site conditions different from those described above upon which this report was based will consequently change Friesen Drillers Limited's conclusions and recommendations.

Disclaimer

This Friesen Drillers Limited report has been prepared in response to the specific requests for services from the client to whom it is addressed. The content of this document is not Intended to be relied upon by any person, firm, or corporation, other than the client of Friesen Drillers Limited, to who it is addressed. Friesen Drillers Limited denies any liability whatsoever to other parties who may obtain access to this document by them, without express prior written authority of Friesen Drillers Limited and the client who has commissioned.

Licence to Use Water for Municipal Purposes

Manitoba

Issued in accordance with the provisions
The Water Rights Act and regulations made thereunder.

Project:	Oakbank/Dugald
Licence No.:	**2019-107**
(Previous Lic. No.:	2016-102)
U.T.M.:	651468 E 5536224 N

Subject to the terms and conditions contained in this Licence, the Minister of Sustainable Development authorizes:

The Rural Municipality of Springfield

in the Province of Manitoba (the "LICENSEE") to construct, operate, establish and maintain a project consisting of water well(s), pump(s), transmittal pipeline(s) and other works specific to the type of use (the "WORKS") and divert water from a **Sand and gravel and Sandstone** aquifer located on the following land:

NE 30-11-5 EPM and SW 32-10-6 EPM

as more particularly located and shown on the attached Exhibit "A" for **Municipal** purposes on the following lands:

Oakbank and Dugald Service Area

This licence is issued upon the express condition that it shall be subject to the provisions of The Water Rights Act and Regulation and all amendments thereto and, without limiting the generality of the aforesaid, to the following terms and conditions, namely:

1. The water shall be used solely for **Municipal** purposes.

2. The WORKS shall be operated in accordance with the terms herein contained.

3. a) The maximum rate at which water may be diverted pursuant hereto shall not exceed **0.1320 cubic metres per second (4.66 cubic feet per second)**.

   b) The total quantity of water diverted in any one year shall not exceed **646.60 cubic decametres (524.20 acre feet)**.

4. Water shall not be diverted during any period when the water level in the aquifer is below the casing of any project well.

5. The LICENSEE does hereby remise, release and forever discharge Her Majesty the Queen in Right of the Province of Manitoba, of and from all manner of action, causes of action, claims and demands whatsoever which against Her Majesty the LICENSEE ever had, now has or may hereafter have, resulting from the use of water for **Municipal** purposes.

6. In the event that the rights of others are infringed upon and/or damage to the property of others is sustained as a result of the operation or maintenance of the WORKS and the rights herein granted, the LICENSEE shall be solely responsible and shall save harmless and fully indemnify Her Majesty the Queen in Right of the Province of Manitoba, from and against any liability to which Her Majesty may become liable by virtue of the issue of this Licence and anything done pursuant hereto.

7. This Licence is not assignable or transferable by the LICENSEE and when no longer required by the LICENSEE this Licence shall be returned to the Water Use Licensing Section for cancellation on behalf of the Minister.

8. Upon the execution of this Licence the LICENSEE hereby grants the Minister or the Minister's agents the right of ingress and egress to and from the lands on which the WORKS are located for the purpose of inspection of the WORKS and the LICENSEE shall at all times comply with such directions and/or orders that may be given by the Minister or the Minister's agents in writing from time to time with regard to the operation and maintenance of the WORKS.

9. This Licence may be amended, suspended or cancelled by the Minister in accordance with The Water Rights Act by letter addressed to the LICENSEE at **Box 219, Oakbank, MB, R0E 1J0, Canada** and thereafter this Licence shall be determined to be at an end.

10. Notwithstanding anything preceding in this Licence, the LICENSEE must have legal control, by ownership or by rental,

lease, or other agreement, of the lands on which the WORKS shall be placed and the water shall be used.

11. The term of this Licence shall expire on September 20, 2036 and this Licence shall become effective only on the date of execution hereof by a person so authorized in the Department of Sustainable Development. The LICENSEE may apply for renewal of this Licence not more than 365 days and not less than 90 days prior to the expiry date.

12. This Licence expires automatically upon the loss of the legal control of any of the lands on which the WORKS are located or on which water is used, unless the Licence is transferred or amended by the Minister upon application for Licence transfer or amendment.

13. The LICENSEE shall keep records of daily and annual water use and shall provide a copy of such records to the Water Use Licensing Section not later than February 1st of the following year.

14. A flow meter must be installed, positioned to accurately measure instantaneous pumping rate and accumulative withdrawals from the water source.

15. The LICENSEE does hereby agree to correct, to the satisfaction of the Minister, any water supply problems to wells or other forms of supply, which were constructed and operating prior to the date of the original application for the project and which are partly or wholly attributable, in the opinion of the Minister, to the diversion of water as authorized by this Licence.

16. The LICENSEE shall hold and maintain all other regulatory approvals that may be required and shall comply with all other regulatory requirements for the construction, operation, or maintenance of the WORKS or to divert or use water as provided by this Licence.

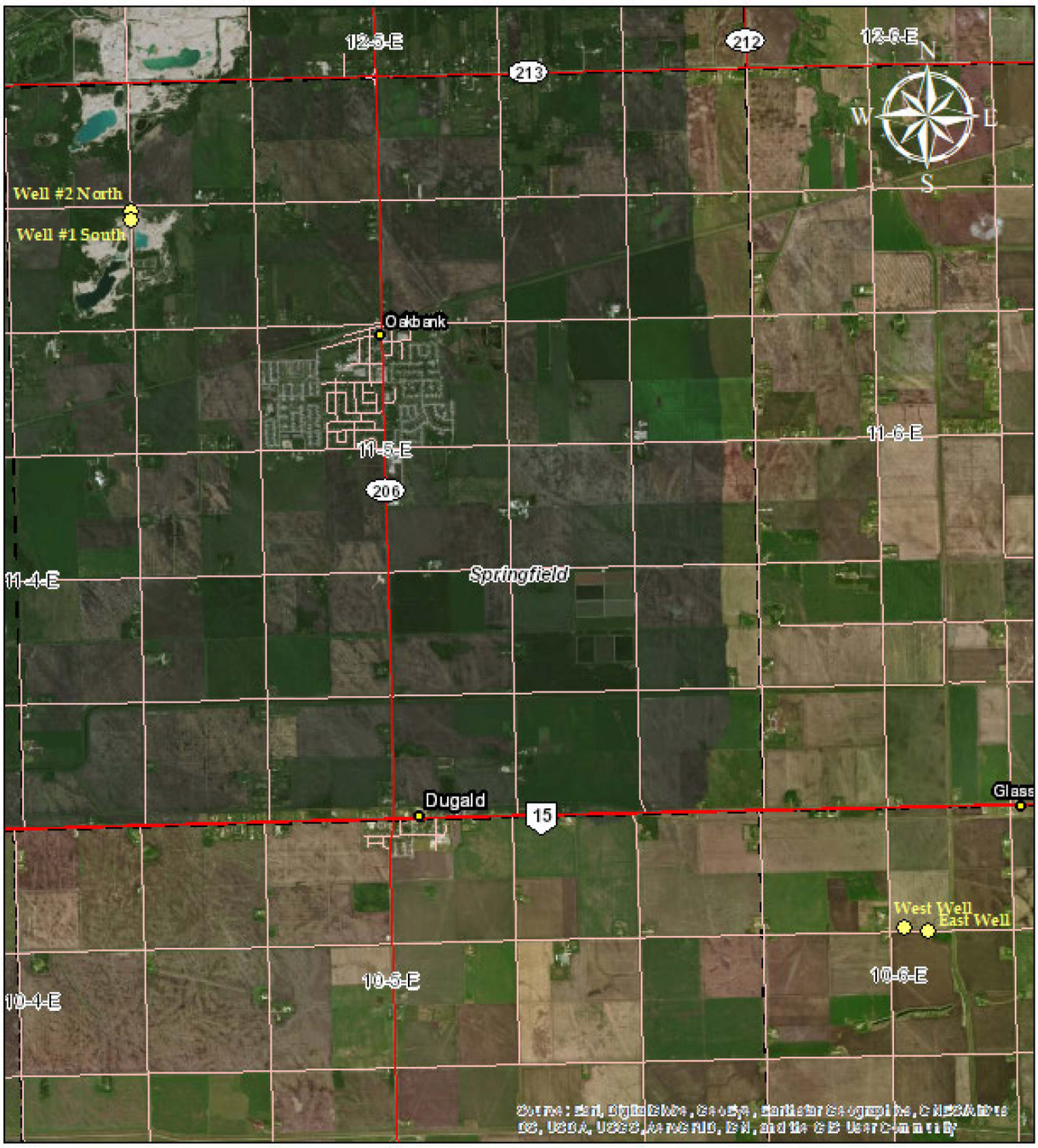
FOR OFFICE USE ONLY

Issued at the City of Winnipeg, in the Province of Manitoba, this _____ day of _____ A.D. 20___.

_____ _____

Print Name Signature

Signed by he Minister charged wi h the administration of the Water Rights Act (or her/his designate)



LOCATION OF SUPPLY WELLS
IN SW 32-10-6 EPM and NE 30-11-5 EPM
R. M. OF SPRINGFIELD (OAKBANK & DUGALD)
MUNICIPAL PURPOSES

EXHIBIT "A"

THIS PLAN IS AN INTEGRAL PART OF
LICENCE NO. ___2019-107___
ISSUED UNDER THE WATER RIGHTS ACT

1,500 750 0 1,500 Meters

Manitoba
Conservation and Climate
Environmental Stewardship Division
Environmental Approvals Branch
1007 Century Street, Winnipeg, Manitoba R3H 0W4
T 204 945-8321 F 204 945-5229

CLIENT FILE NO.: 6013.00

November 4, 2019

Santokh Singh Randhawa, P. Eng.
Rural Municipality of Springfield
Box 219, 100 Springfield Centre Drive
Oakbank, MB R0E 1J0
Srandhawa@rmofspringfield.ca

Dear Mr. Randhawa:

Enclosed is **Environment Act Licence No. 3303,** issued to **Rural Municipality of Springfield** for the construction and operation of the Development being a groundwater supply, treatment and distribution system in the Rural Municipality of Springfield, in accordance with the Proposal filed under The Environment Act.

Environment Act Licence No. 2105 for the existing north supply system is rescinded by this licence, and provisions for these components of the system are included in the new licence.

In addition to the enclosed Licence requirements, please be informed that all other applicable federal, provincial and municipal regulations and by-laws must be complied with. A Notice of Alteration must be filed with the Director for approval prior to any alteration to the Development as licensed.

If you have any questions on this matter, please contact Nada Suresh, Environment Officer, at 204-945-8214 or Nada.Suresh@gov.mb.ca.

Pursuant to Section 27 of The Environment Act, this licensing decision may be appealed by any person who is affected by the issuance of this Licence to the Minister of Conservation and Climate within 30 days of the date of the Licence.

Yours truly,

[redacted]

Cordella Friesen
Director
The Environment Act

c: S. Kohler/Y. Hawryliuk/N. Suresh: Environmental Compliance and Enforcement
Jeff Bell, Friesen Drillers/Brenda Tesarski, Landmark Planning and Design / Bill Brant, WSP
Bruce Webb: Environmental Approvals
Public Distribution List (page 2)
Public Registries

NOTE: **Confirmation of receipt of this Licence No. 3303 (by the Licencee only) is required by the Director of Environmental Approvals. Please acknowledge receipt by signing in the space below and email a copy of this letter to Bruce.Webb@gov.mb.ca by November 18, 2019.**

On behalf of Rural Municipality of Springfield **Date**

Public Distribution List:

Layton Warren
Heather Erickson
Garry Brown, Melinda Warren and Jack and Cherryl Brown
Darryl Speer
Sylvia Vaags
Paul Kun
Dan Giesbrecht
Janet Nylen
Harvey and Joyce Vaags

THE ENVIRONMENT ACT
LOI SUR L'ENVIRONNEMENT

Manitoba

LICENCE

Licence No. / Licence n°: 3303

Issue Date / Date de délivrance: November 4, 2019

In accordance with The Environment Act (C.C.S.M. c. E125)
Conformément à la Loi sur l'environnement (C.P.L.M. c. E125)

Pursuant to Sections 11(1) / Conformément au Paragraphe 11(1)

THIS LICENCE IS ISSUED TO: / CETTE LICENCE EST DONNÉÉ À:

RURAL MUNICIPALITY OF SPRINGFIELD; "the Licencee"

for the construction and operation of the Development being a groundwater supply, treatment and distribution system for municipal purposes in accordance with the proposal and additional information filed under The Environment Act dated August 25, 1994 and December 7, 1994 respectively for the north supply system and the proposal dated May 15, 2019 for the south supply system, and subject to the following specifications, limits, terms and conditions:

DEFINITIONS

In this Licence,

"approved" means approved by the Director or an assigned Environment Officer in writing;

"Director" means an employee so designated pursuant to The Environment Act;

"Environment Officer" means an employee so designated pursuant to The Environment Act; and

GENERAL TERMS AND CONDITIONS

This Section of the Licence contains requirements intended to provide guidance to the Licencee in implementing practices to ensure that the environment is maintained in

such a manner as to sustain a high quality of life, including social and economic development, recreation and leisure for present and future Manitobans.

1. The Development includes the following components:
   North Supply System:
   a) two supply wells in NE 30-11-5E (Heatherdale Road) in an unconfined sand and gravel aquifer;
   b) a pipeline connecting the wells with the Oakbank water treatment plant and reservoir;
   c) a water treatment plant providing chlorination in Oakbank;
   d) a distribution system serving the community of Oakbank;
   e) a pipeline connecting the Oakbank and Dugald water treatment plants and reservoirs;
   South Supply System:
   f) two supply wells in 32-10-6E in the Winnipeg Formation Sandstone Aquifer;
   g) a pipeline connecting the wells with the existing Dugald water treatment plant and reservoir;
   h) a water treatment plant providing chorination in Dugald; and
   i) a distribution system serving the community of Dugald.

2. The Licencee shall at all times maintain a copy of this licence at the Development or at the premises from which the Development's operations are managed.

3. In addition to any of the limits, terms and conditions specified in this Licence, the Licencee shall, upon the request of the Director:
   a) sample, monitor, analyze or investigate specific areas of concern regarding any segment, component or aspect of pollutant storage, containment, treatment, handling, disposal or emission systems, for such pollutants, ambient quality, aquatic toxicity, leachate characteristics and discharge or emission rates, and for such duration and at such frequencies as may be specified;
   b) determine the environmental impact associated with the release of any pollutant from the Development;
   c) conduct specific investigations in response to the data gathered during environmental monitoring programs; or
   d) provide the Director, within such time as may be specified, with such reports, drawings, specifications, analytical data, descriptions of sampling and analytical procedures being used, bioassay data, flow rate measurements and such other information as may from time to time be requested.

4. The Licencee shall submit all information required to be provided to the Director or Environment Officer under this Licence, in written and electronic format, in such form (including number of copies) and of such content as may be required by the Director or Environment Officer, and each submission shall be clearly labeled with the Licence Number and Client File Number associated with this Licence.

5. The Licencee shall construct and operate the water supply system in accordance with Manitoba Regulations under The Public Health Act, The Drinking Water Safety Act, and all operating requirements as recommended by Manitoba Conservation and Climate.

6. The Licencee shall collect and dispose of all used oil products and other regulated hazardous wastes generated by the machinery used in the construction and operation of the Development in accordance with applicable Manitoba Conservation and Climate and legislation requirements.

7. The Licencee shall not permit the interconnection of a private water supply system with the Development.

8. The Licencee shall maintain the water supply wells associated with the Development to prevent the contamination of groundwater by surface water:
   a) entering the well casings through the top of the casings; and
   b) entering the well casings through the sides of the casings.

SPECIFICATIONS, LIMITS, TERMS AND CONDITIONS

Construction - General

9. The Licencee shall notify the assigned Environment Officer not less than two weeks prior to beginning construction of the Development. The notification shall include the intended starting date of construction and the name of the contractor responsible for the construction.

10. The Licencee shall, prior to the construction of the Development, obtain a Permit to Construct or Alter a Public Water System from the Office of Drinking Water of Manitoba Conservation and Climate.

11. The Licencee shall dispose of non-reusable construction debris from the Development at a waste disposal ground operating under the authority of a permit issued pursuant to Manitoba Regulation 37/2016 respecting Waste Management Facilities, or any future amendment thereof, or a Licence issued pursuant to The Environment Act.

12. The Licencee shall comply with the requirements of The Heritage Resources Act, and suspend construction and immediately notify the Historic Resources Branch if heritage resources are encountered during the construction of the Development.

13. The Licencee shall locate fuel storage and equipment servicing areas established for the construction and operation of the Development a minimum distance of 100 metres from any waterbody and 30 metres from any well, and shall comply with the requirements of Manitoba Regulation 188/2001 respecting Storage and Handling of Petroleum Products and Allied Products, or any future amendment thereof.

14. The Licencee shall, during construction and maintenance of the Development, operate, maintain and store all materials and equipment in a manner that prevents any deleterious substances (fuel, oil, grease, hydraulic fluids, coolant, paint, uncured concrete and concrete wash water, etc.) from entering watercourses or any well, and have an emergency spill kit for in-water use available on site during construction.

15. The Licencee shall, in the case of physical or mechanical equipment breakdown or process upset where such breakdown or process upset results or may result in the release of a pollutant in an amount or concentration, or at a level or rate of release, that causes or may cause a significant adverse effect, immediately report the event by calling the 24-hour environmental accident reporting line at 204-944-4888 (toll-free 1-855-944-4888). The report shall indicate the nature of the event, the time and estimated duration of the event and the reason for the event.

16. The Licencee shall, following the reporting of an event pursuant to Clause 15,
    a) identify the repairs required to the mechanical equipment;
    b) undertake all repairs to minimize unauthorized discharges of a pollutant;
    c) complete the repairs in accordance with any written instructions of the Director and/or the Environment Officer; and
    d) submit a report to the Director about the causes of breakdown and measures taken, within one week of the repairs being done.

17. The Licencee shall, during construction and maintenance of the Development, prevent the introduction and spread of foreign aquatic and terrestrial biota by cleaning equipment prior to its delivery to the site of the Development and complying with the requirements of Manitoba Regulation 173/2015 respecting Aquatic Invasive Species, or any future amendment thereof.

18. The Licencee shall revegetate soil exposed during the construction of the Development with native or introduced grasses or legumes. Native species shall be used to revegetate areas where native species existed prior to construction.

Construction – Pipelines

19. The Licencee shall, prior to constructing components of the Development on or adjacent to highway rights-of-way, obtain all necessary approvals from Manitoba Infrastructure.

20. The Licencee shall not release chlorinated water from pipeline testing and startup activities associated with the Development to a surface water body until total residual chlorine concentrations are equal to or less than 0.02 milligrams per litre. Releases of chlorinated water at higher concentrations may be made to vegetated land or dry waterways, provided that total residual chlorine concentrations have decayed to 0.02 milligrams per litre or less before the released water reaches any body of surface water.

21. The Licencee shall construct waterway crossings on flowing waterways by augering, tunneling or boring. Open cut crossings on flowing waterways shall not be made unless prior consultation with Manitoba Conservation and Climate and Department of Fisheries and Oceans staff has occurred and the prior written approval of the Director has been obtained. Dry or non-flowing (i.e. hydraulically unconnected to downstream flowing water) natural and artificial waterways may be crossed with open cut techniques where approval has been obtained where necessary from the authority responsible for the channel.

22. The Licencee shall complete augered, tunneled or bored waterway crossings in accordance with the September, 2004 publication "Planning Horizontal Directional Drilling for Pipeline Construction", published by the Canadian Association of Petroleum Producers, and notify the Environment Officer if a frac out occurs.

23. The Licencee shall, where conditions allow, excavate endpoints for directional drilling operations a minimum of 30 m from the high water mark of third and higher order waterways, and a minimum of 15 m from the high water mark of first and second order waterways.

24. The Licencee shall construct open cut stream crossings associated with the Development in accordance with the methodologies described in the October, 2005 publication "Pipeline Associated Watercourse Crossings Third Edition", published by the Canadian Pipeline Water Crossing Committee, and the May, 1996 publication "Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat", published by the Department of Fisheries and Oceans and Manitoba Natural Resources.

25. The Licencee shall, where open cut stream crossing techniques are used on intermittent waterways and artificial drainage channels, not construct open cut crossings associated with the Development between March 15 and June 15 of any year.

26. The Licencee shall, where open cut stream crossing techniques are used on intermittent waterways and artificial drainage channels, minimize disturbance to riparian areas and restore the bottom and banks of the waterways to their original elevations and shapes.

27. The Licencee shall not alter local drainage patterns by the construction of the Development.

Decommissioning of Existing Wells

28. The Licencee shall decommission municipal and private wells made redundant by the Development in accordance with the requirements of Manitoba Regulation 215/2015 respecting Well Standards, or any future amendment thereof.

Operation

29. The Licencee shall obtain and maintain classification of the Development pursuant to Manitoba Regulation 77/2003 respecting Water and Wastewater Facility Operators, or any future amendment thereof and maintain compliance with all requirements of the regulation including, but not limited to, the preparation and maintenance of a Table of Organization, Emergency Response Plan and Standard Operating Procedures.

30. The Licencee shall carry out the operation of the Development with individuals properly certified to do so pursuant to Manitoba Regulation 77/2003 respecting Water and Wastewater Facility Operators, or any future amendment thereof.

31. The Licencee shall operate the Development with respect to the volume and rate of water diverted in accordance with a Water Rights licence issued pursuant to The Water Rights Act.

32. The Licencee shall develop, maintain and implement a wellhead protection plan for the wells of the Development that addresses disruption and contamination due to natural disasters, spills of contaminants and vandalism.

33. The Licencee shall develop and implement a groundwater level monitoring program for the Development. The program shall address monitoring well locations, monitoring frequency and equipment to be used in monitoring.

REVIEW AND REVOCATION

A. Environment Act Licence No. 2105 (north supply system) is hereby rescinded.

B. If, in the opinion of the Director, the Licencee has exceeded or is exceeding or has or is failing to meet the specifications, limits, terms, or conditions set out in this Licence, the Director may, temporarily or permanently, revoke this Licence.

C. If, in the opinion of the Director, new evidence warrants a change in the specifications, limits, terms or conditions of this Licence, the Director may require the filing of a new proposal pursuant to Section 11 of The Environment Act.

[redacted]

Cordella Friesen
Director
The Environment Act

Client File No.: **3876.00 (north supply system)**
6013.00 (south supply system)

APPENDIX B - GEOTECHNICAL INVESTIGATION REPORT

TREK GEOTECHNICAL

Quality Engineering | Valued Relationships

Associated Engineering (Sask) Ltd.

RM of Springfield Water Treatment Plant – RM of Springfield, MB

Geotechnical Investigation Report

Prepared for:
Desiree Pastorin, C.E.T
Project Manager
Associated Engineering (Sask.) Ltd.
203 - Number Five Donald Street,
Winnipeg, MB
R3L 2T4

Project Number: 0115 069 00

Date: February 2, 2023

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TREK GEOTECHNICAL Quality Engineering | Valued Relationships

February 2, 2023 Our File No. 0115 069 00

Desiree Pastorin, C.E.T
Project Manager
Associated Engineering (Sask.) Ltd.
203 - Number Five Donald Street,
Winnipeg, MB
R3L 2T4

RE: RM of Springfield Water Treatment Plant – RM of Springfield, MB
Geotechnical Investigation Report

TREK Geotechnical Inc. is pleased to submit our final report for the geotechnical investigation for the above noted project.

Please contact the undersigned should you have any questions.

Sincerely,

TREK Geotechnical Inc.
Per:

[redacted]

Nelson Ferreira Ph.D., P.Eng.
Senior Geotechnical Engineer

Encl.

Revision History

Revision No.	Author	Issue Date	Description
0	MK	February 2, 2023	Final Report

Authorization Signatures

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1.0 Introduction

This report summarizes the results of the geotechnical investigation completed by TREK Geotechnical Inc. (TREK) for the proposed water treatment plant (WTP) on Cedar Lake Rd 62N located midway between Oakbank and Dugald, Manitoba. The terms of reference for the investigation are included in our proposal to Associated Engineering Ltd (AE), dated October 4, 2021. The scope of work includes a sub-surface investigation, laboratory testing, and the provision of geotechnical design and construction recommendations for the proposed water treatment.

TREK had previously been retained by AE to complete geotechnical investigations for two other WTP expansions in The RM of Springfield under this assignment located in Dugald, MB and Oakbank, MB (2021). A new WTP is now proposed to be constructed approximately midway between Oakbank and Dugald on Cedar Lake Rd 62N. Information provided regarding the new WTP is preliminary as details have not been finalized such as the size of the new WTP building and the size and depth of the below grade reservoirs. Reservoir bases have been assumed to be in the order of 4 m below grade to aid in determination of design and construction recommendations.

This report provides recommendations for a new WTP located on Cedar Lake Rd 62N and associated support infrastructure. The results of the Oakbank WTP and Dugald WTP have been provided under separate covers.

2.0 Field Program

2.1 Site Conditions

The proposed WTP and reservoir is located at the northwest corner of quarter section NE 9 11 5 E1. The site is bounded by PR 206 to the east, Cedar Lake Rd 62N to the north and a residential property to the west. The site is existing farmland that is predominantly flat with a shallow ditch on the north edge. At the time of the investigation, the field was covered in approximately 0.1 m to 0.15 m of snow. A general site plan of the proposed WTP and reservoir location is shown on Figure 01.

2.2 Sub-surface Investigation

A sub-surface investigation was completed on December 8, 2022, under the supervision of TREK personnel to determine the soil stratigraphy and groundwater conditions at the site. Six test holes (TH22-01 to 06) were drilled within or near the footprint of the proposed WTP and reservoir. Three test holes were drilled to power auger refusal ranging from 10.9 m to 11.1 m depth below ground surface, while the remaining test hole were drilled to depths between 8.5 m and 9.1 m to determine till contact elevations. Test hole locations are shown on Figure 01.

The test holes were drilled by Paddock Drilling Ltd. using a track mounted Acker MP5 geotechnical drilling rig equipped with 125 mm solid stem augers. A 25 mm diameter PVC standpipe piezometer (SP22-06) fitted with a slotted tip was installed in TH22-06 at 10.9 m depth. A sand pack was installed from the tip of the standpipe to a height of 3.3 m. with bentonite chips above. The standpipe is protected

with an above ground steel cover. All other test holes were backfilled with bentonite chips and auger cuttings to surface.

Sub-surface soils observed during drilling were visually classified based on the Unified Soil Classification System (USCS). Disturbed (auger cutting and split spoon) samples were taken at regular intervals and relatively undisturbed (Shelby tube) samples were collected at select depths. Standard Penetration Tests (SPT's) were completed at depths where split spoon samples were taken. All samples retrieved during drilling were transported to TREK's testing laboratory in Winnipeg, Manitoba. Laboratory testing consisted of moisture content determination on all samples as well as Atterberg limit and grain size determination (hydrometer method) on select samples, and bulk unit weight measurements and unconfined compression tests on Shelby tube samples. Laboratory testing results are included in Appendix A.

The test hole locations and elevations (shown on Figure 01) were recorded by AE using a Leica RTK-GPS. Test hole logs are attached describing soil units encountered and other pertinent information such as test hole location, elevation, groundwater conditions and a summary of the laboratory testing results.

2.3 Stratigraphy

A brief description of the soil units encountered at the test hole location is provided below. All interpretations of soil stratigraphy for the purposes of design should refer to the detailed information provided on the attached test hole log.

The soil stratigraphy encountered at the drilling locations generally consists of clay fill overlying silty clay, and silt till. A layer of intermediate plastic clay is present either within the high plastic silty clay or under the fill in three test holes (TH22-01, 02, and 03).

Clay fill was encountered at the surface in three of the six test holes (TH22-01, 03, 04) and is approximately 0.3 m to 0.6 m thick. The clay fill is silty, contains some sand, trace gravel and trace rootlets, is moist, stiff to very stiff, and of high plasticity. The intermediate plasticity clay ranges in thickness from 0.5 m to 1.5 m. The intermediate plastic clay is brown to grey, is mixed with silt, contains some sand and is firm. Silty clay underlays the clay fill or the intermediate plastic clay in TH22-01 to 04 and is observed at ground surface in TH22-05 and 06. The silty clay layer is approximately 5 m to 8 m thick, is moist, stiff, and of high plasticity, becoming firm with depth. Silt till is encountered at 7.6 m to 8.1 m depth, containing some gravel, trace clay, trace sand, is moist, loose and of no to low plasticity. The silt till becomes compact to dense below 9 m, and dense to very dense below 10.5 m depth.

2.4 Power Auger Refusal

Power auger refusal was observed in the silt till at depths of 11.1 m, 10.9 m and 10.9 m in TH22-01, 05 and 06, respectively.

2.5 Groundwater Conditions

Seepage was observed within the intermediate plastic clay at a depth of 3.0 m in TH22-01. Seepage and sloughing conditions were not observed in the remainder of test holes during the geotechnical investigation. The standpipe installed in TH22-06 will be monitored in the spring of 2023. An addendum to this report will be issued following the monitoring event.

Groundwater observations made during drilling are considered short term and should not be considered reflective of (static) groundwater levels at the site which would require monitoring over an extended period of time to determine. It is important to recognize that groundwater conditions may vary seasonally, annually, or as a result of construction activities.

3.0 Foundation Recommendations

Based on the sub-surface conditions encountered during the investigation, raft foundations founded on firm to stiff silty clay is a suitable foundation alternative for the proposed reservoir. Cast in place concrete (CIPC) piles end bearing in dense to very dense silt till are also suitable for the reservoir, and for other potential buildings if heavier loads are expected.

Limit States Design and construction recommendations in accordance with National Building Code of Canada (NBCC, 2010) are provided below.

3.1 Limit States Design (NBCC, 2010)

Limit States Design recommendations for foundations in accordance with the National Building Code of Canada (NBCC, 2010) are provided below. Limit States Design requires consideration of distinct loading scenarios comparing the structural loads to the foundation bearing capacity using resistance and load factors that are based on probabilistic reliability criteria. Two general design scenarios are evaluated corresponding to the serviceability and ultimate capacity requirements.

The **Ultimate Limit State (ULS)** is concerned with ensuring that the maximum structural loads do not exceed the nominal (ultimate) capacity of the foundation units. The ULS foundation bearing capacity is obtained by multiplying the nominal (ultimate) bearing capacity by a resistance factor (reduction factor), which is then compared to the factored (increased) structural loads. The ULS bearing capacity must be greater or equal to the maximum factored load to provide an adequate margin of safety.

The **Service Limit State (SLS)** is concerned with limiting deformation or settlement of the foundation under service loading conditions such that the integrity of the structure will not be impacted. The Service Limit State should generally be analysed by calculating the settlement resulting from applied service loads and comparing this to the settlement tolerance of the structure. However, the settlement tolerance of the structure is typically not yet defined at the preliminary design stage. As such, recommendations are provided for evaluating the SLS that are developed on the basis of limiting settlement to 25 mm or less. A more detailed settlement analysis should be conducted to refine the estimated settlement and/or adjust our recommendations if a more stringent settlement tolerance is required. Table 1 summarizes the resistance factors that can be used for the design of shallow

foundations and deep foundations, respectively, as per the NBCC (2010) depending upon the method of analysis and verification testing completed during construction.

Table 1: ULS Resistance Factor for Foundations (NBCC, 2010)

Case	Resistance Factor
Shallow Foundations	
Vertical resistance by semi-empirical analysis using laboratory and *in situ* test data	0.5
Deep Foundations	
Semi-empirical analysis using laboratory and in-situ test data	0.4
Uplift resistance by semi-empirical analysis.	0.3

3.2 Shallow Foundations (Raft)

A raft foundation may be subject to some seasonal movement due to volumetric changes in the underlying clay soils. Provided this is acceptable, a raft foundation bearing on directly on firm to stiff silty clay installed at about 4 m below existing grade can be designed based on the values provided in Table 2. Additional recommendations regarding the design and construction of raft foundations are provided below:

Table 2: ULS and SLS Resistances for Shallow Foundations

Bearing Unit	Assumed Depth (m)	ULS Capacity (kPa)	SLS Capacity (kPa)
Silty Clay	4.0	140	105

Resistance against buoyancy should be checked during design assuming a groundwater level at ground surface.

Raft Foundations Design Recommendations

1. All organics, fill soils and all other deleterious materials should be removed such that the bearing surface for the raft foundations consist of firm to stiff silty clay.
2. Excavation should be completed by an excavator equipped with a smooth bladed bucket operating from the edge of the excavation to minimize disturbance to the exposed subgrade. Care should be taken not to over-excavate and to minimize the subgrade disturbance at all times. A raft placed on a disturbed bearing surface will result in a reduction in SLS resistance and may lead to intolerable settlement over time.
3. The bearing surface should be protected from freezing, drying, inundation with water and mechanical disturbance at all times. If any of these conditions occur, the disturbed material should be removed in its entirety such that only undisturbed, firm to stiff silty clay is present.
4. If groundwater seepage is encountered, it should be controlled and removed from the bearing surface, such that concrete is placed under dry conditions.
5. The raft should be founded at least 3 m below final grade (i.e. Elev 240 m, asl).
6. The final bearing surface should be inspected and documented by TREK prior to concrete

placement to verify the adequacy of the bearing surface and proper installation of the foundation.

7. If a levelling course is required or the ground surface must be built up, a granular fill material meeting Manitoba Transportation and Infrastructure (MI) Granular Subbase Class C (GSB-C) specifications. The granular fill should be placed in lifts no greater than 150 mm and compacted to a minimum of 100% of the Standard Proctor Maximum Dry Density (SPMDD). Alternatively, a concrete mud-slab with a minimum compressive strength of 2 MPa may be used.
8. Utility lines connecting to the expansion (e.g. a line passing through a wall of the expansion) should be designed to accommodate differential movements.
9. The raft should be designed by a qualified structural engineer to resist all applied loads from the proposed structures and potential uplift due to the groundwater table.

3.3 Cast-in-Place Concrete End Bearing Piles

Mechanically cleaned CIPC piles end bearing on dense to very dense silt till will derive their resistance primarily in end bearing with a relatively small contribution from shaft friction (adhesion). TREK recommends the piles be designed with a straight shaft, as belled piles may not be constructible due to the known presences of cobbles and boulders in the till. Table 3 provides the recommended factored ULS and SLS end bearing and shaft friction resistance values for axial-compressive and axial-tensile (uplift) loading conditions for mechanically cleaned piles end bearing on dense to very dense silt till. Piles designed based on the SLS resistances are expected to exhibit less than 20 mm of settlement at the pile toe. Elastic shortening of the pile should be added to the tip displacement to calculate the pile head settlement.

The foundation contractor should expect to encounter cobbles and boulders during installation of CIPC piles. Chopping and removal of boulders may be necessary to advance the pile shafts to the dense to very dense silt till.

Table 3: Recommended Resistances for End Bearing CIPC Piles

Pile Depth Below Existing Site Grade (m approx.)	SLS Unit Resistance (kPa)	Factored ULS Unit Resistance (kPa)		
		Compression $\phi = 0.4$		Uplift $\phi = 0.3$
		Shaft Adhesion	End Bearing (1)	Shaft Adhesion
0 to 11.0	12	14	-	11
> 11.0	500	40	600	30

Additional Design Recommendations:

1. The weight of the embedded portion of the pile may be neglected in design.
2. Pile bases must be founded in dense to very dense silt till, with a minimum embedment depth of 11.0 m below existing grade.
3. Shaft adhesion in compression and uplift within the upper 2.4 m below ground surface should be neglected from design.
4. Piles should have a minimum spacing of 3 pile diameters measured centre to centre. If a closer spacing is required, TREK should be contacted to provide an efficiency (reduction) factor to

account for potential group effects.

5. Piles require steel reinforcement designed by a structural engineer for the anticipated axial (compression and tension), lateral and bending loads induced from the structure as well as forces induced from seasonal movements (i.e. shrinkage/swelling and frost-related movements) of the bearing soils.

Additional Installation Recommendations:

1. Temporary steel casings (i.e., sleeves) should be available and used if sloughing of the pile hole occurs and/or to control groundwater seepage. Care should be taken in removing sleeves to prevent sloughing (necking) of the shaft walls and a reduction in the cross-sectional area of the pile.
2. Pile bases should be free of debris, loose cobbles and boulders, and any other deleterious material. If ponded water accumulates at the base of the drilled shaft, the source of water should be cut off, and the base of the shaft should be advanced deeper and mechanically cleaned to expose undisturbed dense to very dense silt till.
3. Concrete should be placed in one continuous operation immediately after the completion of drilling the pile hole and under dry conditions to avoid construction problems such as sloughing or caving of the pile hole and groundwater seepage.
4. Concrete placed by free-fall methods should be directed through the middle of the pile shaft and steel reinforcing cage to prevent striking of the pile walls to protect against soil contamination of the concrete.
5. The installation of all piles should be observed and documented by TREK to verify the soil conditions and proper installation of the piles.

3.4 Lateral Pile Capacity

Lateral capacity is not expected to be a concern for design; however, limit states design values can be provided if necessary, once lateral loads are known.

3.5 Pile Caps and Grade Beams

A minimum 150 mm void should be provided underneath all grade beams and pile caps to avoid uplift pressures from developing on the underside of the pile cap as a result of swelling or frost action. The void can consist of a compressible layer such as low-density polystyrene void form. Void forms should be selected such that they can deform a minimum of 150 mm with tolerable stresses transferred to the structure. Excavations for grade beams and pile caps should be backfilled with granular fill compacted to a minimum of 98% of the Standard Proctor Maximum Dry Density (SPMDD).

3.6 Ad-freezing Effects

Ad-freezing effects are not expected to occur along buried concrete walls assuming free draining soil (e.g. clean stone) is used as backfill against the reservoir walls and a granular drainage system is used. Type 4 material specified in MTI Spec 1001 is considered free draining and is appropriate for use. If this is not the case, TREK should be contacted to provide unit adhesion values for ad-freeze forces on below-grade walls.

Concrete piles, pile caps, grade beams subjected to freezing conditions should be designed to resist ad-freeze and uplift forces related to frost action acting along the vertical face of the member within the depth of frost penetration (2.4 m). In this regard, concrete members may be subject to an ad-freeze bond stress of 65 kPa within the depth of frost penetration.

Ad-freeze forces will be resisted by structural dead loads and uplift resistance provided by the length of the wall or foundation element below the depth of frost penetration. The following design recommendations apply to ad-freeze forces:

1. A load factor (α) of 1.2 may be used in the calculation of ad-freezing forces.
2. A reduction factor of 0.8 may be used in calculation of the geotechnical resistance for the ULS condition with an ultimate (nominal) resistance of 50 kPa.
3. Structural dead loads should be added to the resistance.
4. The calculated geotechnical resistance plus the structural dead loads must be greater than the factored ad-freezing forces.
5. Piles subject to ad-freezing forces should be a minimum of 8.0 m or as calculated by the method above, whichever is greater.
6. Measures such as flat lying rigid polystyrene insulation could be considered to reduce frost penetration depths and thereby ad-freezing and uplift forces. Ad-freezing and uplift forces may also be reduced by backfilling with non-frost-susceptible (granular) material within the depth of frost penetration.

3.7 Foundation Concrete

All foundation concrete should be designed by a qualified structural engineer for the anticipated axial (compression and uplift), lateral, and bending loads from the structure. Based on local experience gathered through previous work near Winnipeg, the degree of exposure for concrete subjected to sulphate attack is classified as severe according to Table 3, CSA A23.1-14 (Concrete Materials and Methods of Concrete Construction). Accordingly, all concrete in contact with the native soil should be made with high sulphate-resistant cement (HS or HSb). Furthermore, the concrete should have a minimum specified 56-day compressive strength of 32 MPa and have a maximum water to cement ratio of 0.45 in accordance with Table 2, CSA A23.1-14 for concrete with severe sulphate exposure (S2). Concrete that may be exposed to freezing and thawing should be adequately air entrained to improve freeze-thaw durability in accordance with Table 4, CSA A23.1-14.

3.8 Foundation Inspection Requirements

In accordance with Section *4.2.2.3 Field Review* of the NBCC (2010), the designer or other suitably qualified person shall carry out a field review on:

a) continuous basis during:
   i. the construction of all deep foundation units with all pertinent information recorded for each *foundation unit*,
   ii. during the installation and removal of retaining structures and related backfilling operations,

iii. during the placement of engineered fills that are to be used to support the *foundation units*, and

b) as-required, unless otherwise directed by the *authority having jurisdiction*,

i. in the construction of all *shallow foundation units,* and

ii. in excavating, dewatering and other related works.

In accordance with Engineers and Geoscientists of Manitoba, a Professional Engineer, or delegated staff responsible to them must perform site reviews for the work presented in the documents they've sealed. For conformance with the NBCC and EGM requirements, TREK should be retained on a full-time basis to observe and document the installation of all foundations, shoring or engineered fills supporting the structure, and on an as-required basis for other components such as subgrade inspections and compaction testing. TREK is familiar with the geotechnical conditions present and the underlying design assumptions of our foundation recommendations. TREK is therefore solely qualified to evaluate any design modifications deemed to be necessary should altered sub-surface conditions be encountered.

4.0 Concrete Floor Slabs

It is anticipated that adjacent structures may be supported on exterior grade supported concrete floor slabs. Vertical deformation of grade supported slabs should be expected due to moisture and volume effect changes of the underlying soils. Measures to reduce the risks of these movements are provided below. If these risks are considered unacceptable, a structural slab supported on footings and piers, or rafts is recommended. Slabs in unheated areas may be subject to additional movements from freeze/thaw of the subgrade soils.

The following additional recommendations apply to grade-supported slabs:

1. Organics, silt, and fill soils and any other deleterious material should be stripped such that the subgrade consists of undisturbed firm to stiff silty clay.
2. Excavation should be completed with an excavator equipped with a smooth bucket operating from the edge of the excavation. Care should be taken to minimize the subgrade disturbance at all times.
3. After excavation, the subgrade should be inspected by TREK personnel to confirm the subgrade consists of firm to stiff silty clay.
4. The exposed subgrade surface should be protected from freezing, inundation, drying, or disturbance. If any of these conditions occur, the subgrade should be scarified, moisture conditioned as appropriate, and re-compacted to a minimum of 95% of the SPMDD for clay subgrade.
5. In heated areas, the floor slab should be placed on a 150 mm thick layer of granular sub-base material meeting GSB-C specifications underlying a 150 mm thick base consisting of 20 mm down granular base course meeting GBC-I to GBC-S specifications. The granular should be placed in lifts no greater than 150 mm and compacted to a minimum of 98% of the Standard Proctor Maximum Dry Density (SPMDD). In unheated areas (e.g. exterior slabs) the thickness of the granular sub-base should be increased to 250 mm.
6. A vapour barrier should be placed above the granular base and beneath the floor slab.
7. Floor slabs should be designed to resist all structural loads and to minimize slab cracking associated

with movements as a result of swelling, shrinkage, and thermal expansion and contraction of the subgrade soils.

8. To accommodate slab movements, it may be desirable to provide control joints to reduce random cracking and isolation joints to separate the slab from other elements. Allowances should be made to accommodate vertical movements of light weight structures (e.g. partitions) bearing on the slab.

4.1 Structural Slabs

If movement of floor slabs cannot be tolerated, a structural slab supported on footings or piles is required. A minimum void space of 150 mm beneath structural floors is recommended to accommodate volumetric changes in the underlying subgrade soils (i.e. swelling, shrinkage, and thermal expansion and contraction in unheated areas). The void can consist of a compressible layer (*e.g.* void form) to permit subgrade soil movements without engaging the floor slab, or alternatively, a crawl space. Void forms should be selected such that they can deform a minimum of 100 mm without transferring stresses to the structure. A vapour barrier should be placed between the floor slab and the void form (if present).

5.0 Pavement Recommendations

Recommended pavement sections for parking areas, access roads, and areas subject to heavier vehicular loads are provided in Table 4.

The pavement structure should be constructed in accordance with the MI specifications. Granular materials should be in accordance with MI Standard Construction Specification No.901(1) (Granular Course).

Table 4: Recommended Pavement Sections for Asphalt Roads and Parking Areas

Material	Layer Thickness		Compaction Requirements
	Car Parking Areas	Heavy Vehicular Loads	
Asphalt (if required)	100 mm	100 mm	98% Marshall
MI 'GBC-I to GBC-S' Granular Surface	75 mm	100 mm	100% of the SPMDD
MI 'GSB-C' Granular Sub-Base	250 mm	350 mm	98% of the SPMDD
Non-Woven Geotextile (TE-8 or equivalent)	Required	Required	Install as per manufacturer's recommendations

Additional Pavement Recommendations:

1. Organics and fill soils, and other deleterious materials should be completely removed such that the sub-grades consist of undisturbed silty clay. Due to the high silt content within the clay of some areas within the depth of frost penetration, there is some risk of seasonal movement with the recommended pavement structures and should be expected. To reduce the risk of seasonal

movements, increasing the thickness of the granular structure proposed in Table 4 would improve performance and should be considered.

2. Excavation should be completed with an excavator equipped with a smooth bucket and operating from the edge of the excavation in order to minimize disturbance to the exposed sub-grade. If the sub-grade has an appreciable silt content, which is anticipated, the sub-grade should be expected to be highly sensitive to disturbance.
3. After excavation, the sub-grade should be inspected by TREK. The sub-grade should be proof rolled with a fully loaded tandem axle truck to detect soft areas. Soft areas should be repaired as per directions provided by TREK. This will likely consist of excavating an additional 300 mm of soil and placing a non-woven geotextile on the sub-grade and backfilling with a suitable granular sub-base material compacted to 98% of SPMDD to restore grades back to the design sub-grade elevation.
4. The sub-grade should be protected from mechanical disturbance, freezing, drying, or inundation with water at all times. If any of these conditions occur the sub-grade should be scarified, moisture conditioned as appropriate, and re-compacted to a minimum of 95% of the SPMDD, if possible, or the disturbed zone may have to be excavated and replaced with granular sub-base.
5. A non-woven geotextile should be placed in accordance with the manufacturer's recommendations on the prepared subgrade prior to placement of granular fill. Titan Environmental TE-8 or equivalent would be appropriate for use.
6. The granular sub-base and base materials should be placed in lift thicknesses no greater than 150 mm and compacted as per recommendations in Table 4.
7. Fill required to raise grades should consist of well-graded 100 or 50 mm down limestone or sand and gravel compacted to 98% SPMDD.

6.0 Temporary Excavations and Backfill

Excavations must be carried out in compliance with the appropriate regulations under the Manitoba Workplace Safety and Health Act. Any open-cut excavations greater than 3 m deep must be designed and sealed by a professional engineer and should be reviewed by the geotechnical engineer of record (TREK). If space is limited or the stability of adjacent structures may be endangered by an excavation, a shoring system may be required to prevent damage to, or movement of, any part of adjacent structures, and the creation of a hazard to workers and the public.

Design and construction of stable excavations is the responsibility of the Contractor for the duration of construction. Excavations should be monitored regularly and flattened as necessary to maintain stability recognizing that excavation stability is time and weather dependent. Excavated slopes should be covered with polyethylene sheets to prevent wetting and drying.

Stockpiles of excavated material and heavy equipment should be kept away from the edge of any excavation by a distance equal to or greater than the depth of excavation, or a minimum of 1 m, whichever is greater. If heavy equipment is required to work near the edge of an open excavation, workers should not be permitted to work within the excavation at that time.

Seepage, sloughing, or caving conditions may be encountered in excavations and may require additional measures such as further slope flattening, shoring, or the incorporation of gravel buttresses. Dewatering measures should be completed as necessary to maintain a dry excavation and permit proper completion of the work. If seepage is encountered, it should be directed to a sump pit and pumped out of the excavation.

Surface water should be diverted away from the excavation and the excavation should be backfilled as soon as possible following construction. If excessive seepage and sloughing occurs TREK should be contacted to provide additional recommendations.

TREK recommends that the inspection of any open excavations be carried out once a day for the length of time the excavation remains open. Daily inspections may be performed by qualified on-site personnel.

6.1 Lateral Earth Pressures

The backfill material may consist of either high plasticity clay or granular material. If high plasticity clay is used within 2 m of the foundation walls, the values for clay should be used in calculating lateral earth pressures. Unit weights and at-rest earth pressure coefficients (K_o) are provided in Table 5, below. The at rest earth pressure is suitable for use provided the wall is not free to rotate.

Table 5: Backfill Parameters

Backfill Material	Unit Weight (kN/m^3)	At-Rest Earth Pressure Coefficient (K_o)
High plasticity clay	18	0.7
Granular Material (1)	20	0.5

(1) For a well-graded sand and gravel

Where backfill drainage is expected, such as a sub-drainage system at the base of the wall to prevent the build-up of hydrostatic pressures, the total lateral earth pressure force is the area of the triangular pressure distribution acting on a below grade wall which can be derived based on the following equation:

$$P = K\gamma D$$

where,
P = lateral earth pressure at depth D (kPa)
K = earth pressure coefficient (unitless)
γ = bulk unit weight of retained soil (20 kN/m^3)
D = depth below finished grade to where earth pressure is being calculated (m)

If drainage is not expected, the following equation should be used:

$$P = K_0\, \gamma' D + \gamma_w D$$

where,

P = lateral earth pressure at depth D (kPa)
K = earth pressure coefficient (unitless)
γ' = effective unit weight of retained soil (8 kN/m^3)
D = depth below finished grade to where earth pressure is being calculated (m)
γ_w = unit weight of water (9.81 kN/m^3)

Lateral earth pressures from surcharge loads (if applicable), or for heavy compaction equipment (if used) should be accounted for in design.

TREK understands that the reservoir excavation is to be backfilled for its full depth. Lateral earth pressures induced by compaction against rigid structural walls may be greater than the at-rest pressure and earth pressure coefficients of 1.0 or higher are possible. The earth pressure coefficient is difficult to predict as it depends on several factors including the type, geometry and moisture content of the backfill material and the compactive effort applied. In this regard, it is recommended to lightly compact (in the order of 92% of SPMDD) the backfill within 1 m of buried walls. The perimeter of the reservoir should be capped with 1 m of clay backfill to limit surface water infiltration around the perimeter of the foundation.

Compensation for any settlement can be made in the final grading by placing additional fill and to provide positive drainage away from the structure. Backfill compacted in this manner (lightly) will ultimately settle by a maximum of about 2 to 4 % of the fill depth.

7.0 Site Drainage

Drainage adjacent to structures and exterior slabs should promote runoff away from the structures. A minimum gradient of about 2% should be used for both landscaped and paved areas and maintained throughout the life of the structures. The water discharge from roof leaders and run-off from exposed slabs should be directed away from the structures.

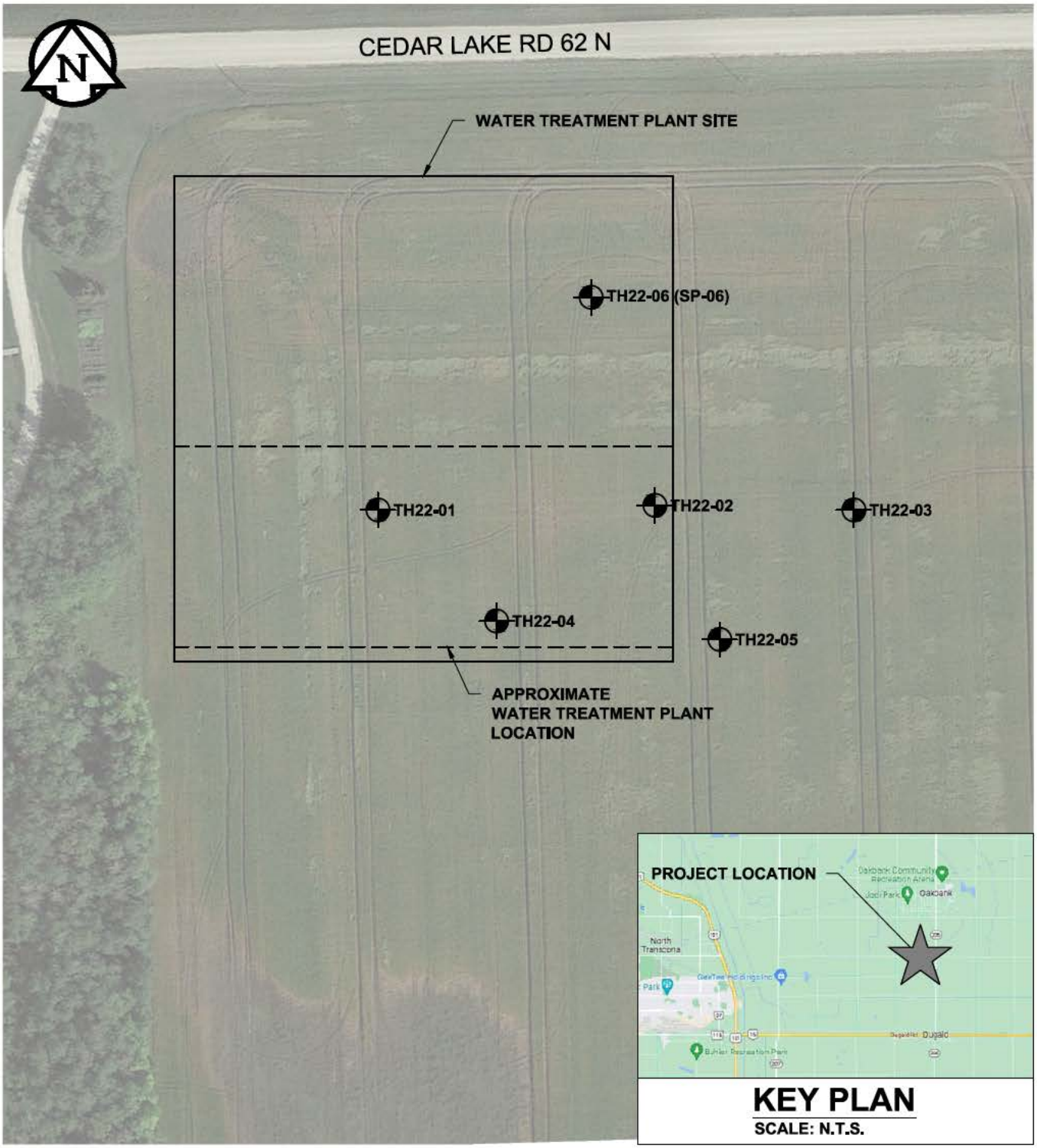
8.0 Closure

The geotechnical information provided in this report is in accordance with current engineering principles and practices (Standard of Practice). The findings of this report were based on information provided (field investigation and laboratory testing). Soil conditions are natural deposits that can be highly variable across a site. If sub-surface conditions are different than the conditions previously encountered on-site or those presented here, we should be notified to adjust our findings if necessary.

All information provided in this report is subject to our standard terms and conditions for engineering services, a copy of which is provided to each of our clients with the original scope of work, or a mutually executed standard engineering services agreement. If these conditions are not attached, and you are not already in possession of such terms and conditions, contact our office and you will be promptly provided with a copy.

This report has been prepared by TREK Geotechnical Inc. (the Consultant) for the exclusive use of Associated Engineering (Sask) Ltd. (the Client) and their agents for the work product presented in the report. Any findings or recommendations provided in this report are not to be relied upon by any third parties, except as agreed to in writing by the Client and Consultant prior to use.

Figure



KEY PLAN
SCALE: N.T.S.

LEGEND:

TEST HOLE (TREK, 2022)

NOTES:

1. AERIAL IMAGERY FROM GOOGLE EARTH (2022).

0 10 20 30 40 50 m
SCALE = 1 : 1 250 (216 mm x 279 mm)

Figure 01
Test Hole Location Plan

Test Hole Logs

EXPLANATION OF FIELD AND LABORATORY TESTING

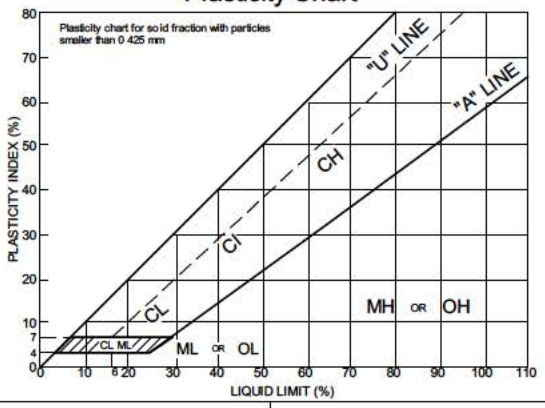
GENERAL NOTES

1 Classifications are based on the United Soil Classification System and include consistency moisture and color Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate

2 Descriptions on these test hole logs apply only at the specific test hole locations and at the time the test holes were drilled Variability of soil and groundwater conditions may exist between test hole locations

3 When the following classification terms are used in this report or test hole logs the primary and secondary soil fractions may be visually estimated

Major Divisions			USCS Classification	Symbols	Typical Names	Laboratory Classification Criteria
Coarse-Grained soils (More than hal the material is larger than No 200 sieve size)	Gravels (More than hal o coarse raction is larger than 4 75 mm)	Clean gravel (Little or no ines)	GW		Well-graded gravels gravel-sand mixtures little or no fines	Determine percentages o sand and gravel rom grain size curve depending on percentage o ines (raction smaller than No 200 sieve) coarse-grained soils are classi ied as ollows Less than 5 percent GW GP SW SP More than 12 percent GM GC SM SC 6 to 12 percent Borderline case4s requiring dual symbols* $C_U = \frac{D_{60}}{D_0}$ greater than 4 $C_C = \frac{(D_{30})^2}{D_0 \times D_{60}}$ between 1 and 3
			GP		Poorly-graded gravels gravel-sand mixtures little or no fines	Not meeting all gradation requirements or GW
		Gravel with ines (Appreciable amount o ines)	GM		Silty gravels gravel-sand-silt mixtures	Atterberg limits below "A" line or P less than 4 / Above "A" line with P between 4 and 7 are borderline cases requiring use o dual symbols
			GC		Clayey gravels gravel-sand-silt mixtures	Atterberg limits above "A" line or P greater than 7
	Sands (More than hal o coarse raction is smaller than 4 75 mm)	Clean sands (Little or no ines)	SW		Well-graded sands gravelly sands little or no fines	$C_U = \frac{D_{60}}{D_0}$ greater than 6 $C_C = \frac{(D_{30})^2}{D_0 \times D_{60}}$ between 1 and 3
			SP		Poorly-graded sands gravelly sands little or no fines	Not meeting all gradation requirements or SW
		Sands with ines (Appreciable amount o ines)	SM		Silty sands sand-silt mixtures	Atterberg limits below "A" line or P less than 4 / Above "A" line with P between 4 and 7 are borderline cases requiring use o dual symbols
			SC		Clayey sands sand-clay mixtures	Atterberg limits above "A" line or P greater than 7
Fine-Grained soils (More than hal the material is smaller than No 200 sieve size)	Silts and Clays (Liquid limit less than 50)		ML		norganic silts and very fine sands rock floor silty or clayey fine sands or clayey silts with slight plasticity	Plasticity Chart
			CL		norganic clays of low to medium plasticity gravelly clays sandy clays silty clays lean clays	
			OL		Organic silts and organic silty clays of low plasticity	
	Silts and Clays (Liquid limit greater than 50)		MH		norganic silts micaceous or distomaceous fine sandy or silty soils organic silts	
			CH		norganic clays of high plasticity fat clays	
			OH		Organic clays of medium to high plasticity organic silts	
	Highly Organic Soils		Pt		Peat and other highly organic soils	Von Post Classification Limit — Strong colour or odour and often fibrous texture



Particle Size	ASTM Sieve sizes	mm
Material		
Sand		
Coarse	#10 to #4	2 00 to 4 75
Medium	#40 to #10	0 425 to 2 00
Fine	#200 to #40	0 075 to 0 425
Silt or Clay	< #200	< 0 075

Particle Size	ASTM Sieve Sizes	mm
Material		
Boulders	> 12 in	> 300
Cobbles	3 in to 12 in	75 to 300
Gravel		
Coarse	3/4 in to 3 in	19 to 75
Fine	#4 to 3/4 in	4 75 to 19

* Borderline classi ications used or soils possessing characteristics o two groups are designated by combinations o groups symbols
For example GW-GC well-graded gravel-sand mixture with clay binder

Other Symbol Types

	Asphalt		Bedrock (undifferentiated)		Cobbles
	Concrete		Limestone Bedrock		Boulders and Cobbles
	Fill		Cemented Shale		Silt Till
			Non-Cemented Shale		Clay Till

EXPLANATION OF FIELD AND LABORATORY TESTING

LEGEND OF ABBREVIATIONS AND SYMBOLS

LL - Liquid Limit (%)
PL - Plastic Limit (%)
PI - Plasticity Index (%)
MC - Moisture Content (%)
SPT - Standard Penetration Test
RQD - Rock Quality Designation
Qu - Unconfined Compression
Su - Undrained Shear Strength

VW - Vibrating Wire Piezometer
SI - Slope Inclinometer

▽ Water Level at Time of Drilling

▼ Water Level at End of Drilling

▼ Water Level After Drilling as Indicated on Test Hole Logs

FRACTION OF SECONDARY SOIL CONSTITUENTS ARE BASED ON THE FOLLOWING TERMINOLOGY

TERM	EXAMPLES	PERCENTAGE
and	and CLAY	35 to 50 percent
"y" or "ey"	clayey, silty	20 to 35 percent
some	some silt	10 to 20 percent
trace	trace gravel	1 to 10 percent
with *	with silt, with sand	> 35 percent

* Used when the material is classified based on behaviour as a cohesive material

TERMS DESCRIBING CONSISTENCY OR COMPACTION CONDITION

The Standard Penetration Test blow count (N) of a non-cohesive soil can be related to compactness condition as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very loose	< 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	> 50

The Standard Penetration Test blow count (N) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very soft	< 2
Soft	2 to 4
Firm	4 to 8
Stiff	8 to 15
Very stiff	15 to 30
Hard	> 30

The undrained shear strength (Su) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	Undrained Shear Strength (kPa)
Very soft	< 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	> 200

Sub-Surface Log

Test Hole TH22-01
1 of 1

TREK GEOTECHNICAL

Client:	Associated Engineering (Sask.) Ltd.	**Project Number:**	0115 069 00
Project Name:	RM of Springfield Water Treatment Plant	**Location:**	UTM N-5531330.621, E-654124.641
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	243.28 m
Method:	125 mm Solid Stem Auger, Acker MP5-T Track Mount	**Date Drilled:**	December 8, 2022

Sample Type: Grab (G) | She by Tube (T) | Split Spoon (SS) / SPT | Split Barrel (SB) / LPT | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
243.0	0		CLAY (FILL) - silty, trace sand, trace gravel (<10 mm diam.), trace organics (rootlets), dark grey, moist, very stiff, high plasticity		G01	
	1		CLAY - silty, trace silt inclusions (<5 mm diam.), trace organics - grey - moist, stiff - high plasticity		G02	
	2				G03	
240.8			CLAY - with silt, some sand - brown, moist, soft, intermediate plasticity		G04	
240.2	3		CLAY - silty - brown - moist, firm to stiff - high plasticity		ST05	
	4				G06	
	5		- trace silt inclusions (<5 mm diam.) below 4.9 m		G07	
	6					
	7				G08	
235.4	8		SILT (TILL) - some gravel (<20 mm diam.), trace clay, trace sand - light brown - moist, loose - no to low plasticity		G09	
	9		- dense below 9.25 m		SS10	31
	10				G11	
232.2	11		- very dense below 10.75 m		SS12	112

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL
Undrained Shear Strength (kPa): 0 50 100 150 200 250
Test Type: △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 11.1 m IN SILT (TILL)

Notes:
1. Power auger refusal was observed at 11.1 m depth.
2. Seepage observed at 3.0 m depth.
3. Sloughing was not observed.
4. Test hole open to 11.1 m depth and dry immediately after drilling.
5. Test hole backfilled with auger cuttings and bentonite to ground surface.

Logged By: Jagdeep Sidhu **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2022-12-09 RM SPR NGFIELD WTP 0-A JSS 0115-069-00.GPJ TREK.GDT 1/31/23

Sub-Surface Log

Test Hole TH22-02
1 of 1

Client:	Associated Engineering (Sask.) Ltd.	**Project Number:**	0115 069 00
Project Name:	RM of Springfield Water Treatment Plant	**Location:**	UTM N-5531332.283, E-654184.524
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	243.22 m
Method:	125 mm Solid Stem Auger, Acker MP5-T Track Mount	**Date Drilled:**	December 8, 2022

Sample Type: Grab (G) | She by Tube (T) | Split Spoon (SS) / SPT | Split Barrel (SB) / LPT | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
	0		CLAY - silty, trace organics (rootlets) - dark grey - moist, stiff - high plasticity		G13	
	1		- no organics, trace silt inclusions (<5 mm diam.) below 1.0 m		G14	
241.7			CLAY - with silt, some sand trace silt inclusions (< 10 mm diam.) - brown, moist, stiff, intermediate plasticity		ST15	
241.1	2		CLAY - silty, trace silt inclusions (<5 mm diam.) - brown - moist, stiff - high plasticity		G16	
	3		- firm below 3.0 m			
	4		- grey below 3.7 m		G17	
	5				G18	
	6					
	7				G19	
235.6			SILT (TILL) - some gravel (<25 mm diam.), trace clay, trace sand - brown - moist, loose - no to low plasticity		G20	
234.1	9					

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL
Undrained Shear Strength (kPa): 0 50 100 150 200 250
Test Type: △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 9.1 m IN SILT (TILL)

Notes:
1. Seepage or sloughing were not observed.
2. Test hole open to 9.1 m depth and dry immediately after drilling.
3. Test hole backfilled with auger cuttings and bentonite to ground surface.

Logged By: Jagdeep Sidhu **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2022-12-09 RM SPR NGFIELD WTP 0-A JSS 0115-069-00.GPJ TREK.GDT 1/31/23

Sub-Surface Log

Test Hole TH22-03
1 of 1

Client:	Associated Engineering (Sask.) Ltd.	**Project Number:**	0115 069 00
Project Name:	RM of Springfield Water Treatment Plant	**Location:**	UTM N-5531331.437, E-654227.525
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	243.17 m
Method:	125 mm Solid Stem Auger, Acker MP5-T Track Mount	**Date Drilled:**	December 8, 2022

Sample Type: Grab (G) | She by Tube (T) | Split Spoon (SS) / SPT | Split Barrel (SB) / LPT | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
242.9	0		CLAY (FILL) - silty, trace sand, trace gravel (<10 mm diam.), trace organics (rootlets), dark grey, moist, very stiff, high plasticity		G21	
	1		CLAY - with silt, trace to some silt inclusions (<5 mm diam.) - mottled brown and grey - moist, stiff - intermediate plasticity		G22	
241.3			- some sand, brown below 0.9 m		G23	
	2		CLAY - silty, trace silt inclusions (< 5 mm diam.) - brown - moist, firm to stiff - high plasticity		G24	
	3					
	4		- firm, dark grey below 3.7 m		G25	
	5				ST26	
	6				G27	
	7					
235.5			SILT (TILL) - some gravel (<20 mm diam.), trace clay, trace sand - brown - moist, loose - no to low plasticity		G28	
234.0	8					
	9					

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ | ✤ Pocket Pen. ✤ | ☒ Qu ☒ | ○ Field Vane ○

END OF TEST HOLE AT 9.1 m IN SILT (TILL)

Notes:
1. Seepage or sloughing were not observed.
2. Test hole open to 9.1 m depth and dry immediately after drilling.
3. Test hole backfilled with auger cuttings and bentonite to ground surface.

Logged By: Jagdeep Sidhu **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2022-12-09 RM SPR NGFIELD WTP 0-A JSS 0115-069-00.GPJ TREK.GDT 1/31/23

Sub-Surface Log

Test Hole TH22-04
1 of 1

Client: Associated Engineering (Sask.) Ltd.
Project Number: 0115 069 00
Project Name: RM of Springfield Water Treatment Plant
Location: UTM N-5531307.429, E-654150.32
Contractor: Paddock Drilling Ltd.
Ground Elevation: 243.22 m
Method: 125 mm Solid Stem Auger, Acker MP5-T Track Mount
Date Drilled: December 8, 2022

Sample Type: Grab (G) | She by Tube (T) | Split Spoon (SS) / SPT | Split Barrel (SB) / LPT | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
242.6	0		CLAY (FILL) - silty, some sand, trace gravel (<10 mm diam.), trace organics (rootlets), dark grey to black, moist, stiff, high plasticity		G29	
	1		CLAY - silty, trace silt inclusions (< 5 mm diam.) - mottled brown and grey - moist, firm to stiff - high plasticity		G30	
	2				G31	
	3					
	4		- grey below 3.7 m		G32	
	5				G33	
	6				ST34A	
	7				G34B	
235.3	8					
234.7			SILT (TILL) - some gravel (<25 mm diam.), trace clay, trace sand - brown, moist, loose, no to low plasticity		G35	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL
Undrained Shear Strength (kPa): 0 50 100 150 200 250
Test Type: △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 8.5 m IN SILT (TILL)

Notes:
1. Seepage or sloughing were not observed.
2. Test hole open to 8.5 m depth and dry immediately after drilling.
3. Test hole backfilled with auger cuttings and bentonite to ground surface.

Logged By: Jagdeep Sidhu **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2022-12-09 RM SPR NGFIELD WTP 0-A JSS 0115-069-00.GPJ TREK.GDT 1/31/23

TREK GEOTECHNICAL

Sub-Surface Log

Test Hole TH22-05
1 of 1

Client:	Associated Engineering (Sask.) Ltd.	**Project Number:**	0115 069 00
Project Name:	RM of Springfield Water Treatment Plant	**Location:**	UTM N-5531302.606, E-654198.516
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	243.19 m
Method:	125 mm Solid Stem Auger, Acker MP5-T Track Mount	**Date Drilled:**	December 8, 2022

Sample Type: Grab (G) | She by Tube (T) | Split Spoon (SS) / SPT | Split Barrel (SB) / LPT | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
	0		CLAY - silty - dark grey - moist, stiff - high plasticity		G36	
	1		- brown below 0.9 m		G37	
	2		- firm, trace silt inclusions (<5 mm diam.) below 1.8 m		G38	
	3					
	4				G39	
	5				G40	
	6					
	7				G41	
235.0	8					
	9		SILT (TILL) - some gravel (<25 mm diam.), trace clay, trace sand - light brown - moist, loose - no to low plasticity		G42A	
	10		- compact below 9.1 m		SS42B	22
					G43	
232.3			- very dense below 10.9 m		SS44	53 / 152mm

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type: △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○

0 50 100 150 200 250

END OF TEST HOLE AT 10.9 m IN SILT (TILL)

Notes:
1. Power auger refusal was observed at 10.9 m depth.
2. Seepage or sloughing were not observed.
3. Test hole open to 10.9 m depth and dry immediately after drilling.
4. Test hole backfilled with auger cuttings and bentonite to ground surface.

Logged By: Jagdeep Sidhu **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2022-12-09 RM SPR NGFIELD WTP 0-A JSS 0115-069-00.GPJ TREK.GDT 1/31/23

Sub-Surface Log

Test Hole TH22-06
1 of 1

Client:	Associated Engineering (Sask.) Ltd.	**Project Number:**	0115 069 00
Project Name:	RM of Springfield Water Treatment Plant	**Location:**	UTM N-5531377.112, E-654170.717
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	243.27 m
Method:	125 mm Solid Stem Auger, Acker MP5-T Track Mount	**Date Drilled:**	December 8, 2022

Sample Type: Grab (G) | She by Tube (T) | Split Spoon (SS) / SPT | Split Barrel (SB) / LPT | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Backfill Legend: Bentonite | Cement | Drill Cuttings | Filter Pack Sand | Grout | Slough

Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
	0	CLAY - silty, trace organics (rootlets) - black - moist, stiff - high plasticity		G45	
	1	- no organics, brown below 0.9 m		G46	
	2	- 0.25 m thick silt seam at 1.8 m - firm below 1.8 m - trace silt inclusions (<5 mm diam.) below 2.1 m		G47	
	3			G48	
	4			G49	
	5			G50	
	6				
	7			G51	
235.2	8	SILT (TILL) - some gravel (<15 mm diam.), trace clay, trace sand - light brown - moist, loose - no to low plasticity		G52	
	9				
	10	- compact below 9.6 m		G53	
232.5		- very dense below 10.5 m		SS54	77 / 149mm

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type: △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○

0 50 100 150 200 250

END OF TEST HOLE AT 10.9 m IN SILT (TILL)

Notes:
1. Power auger refusal was observed at 10.9 m depth.
2. Seepage and sloughing were not observed.
3. Test hole open to 10.9 m depth and dry immediately after drilling.
4. Standpipe (SP-06) installed to 10.9 m depth.
5. Test hole backfilled with sand around standpipe tip, auger cuttings and bentonite to surface.
6. Standpipe measured to be dry immediately after installation.

Logged By: Jagdeep Sidhu **Reviewed By:** Nelson Ferreira **Project Engineer:** Nelson Ferreira

SUB-SURFACE LOG LOGS 2022-12-09 RM SPR NGFIELD WTP 0-A JSS 0115-069-00.GPJ TREK.GDT 1/31/23

Appendix A

Laboratory Testing

TREK GEOTECHNICAL Quality Engineering | Valued Relationships

MEMORANDUM

Date	January 3, 2023
To	Jagdeep Sidhu, TREK Geotechnical
From	Angela Fidler-Kliewer, TREK Geotechnical
Project No.	0115-069-00
Project	RM of Springfield Water Treatment Plant Expansions
Subject	Laboratory Testing Results – Lab Req. R22-677
Distribution	Matt Klymochko, Nelson Ferreira

Attached are the laboratory testing results for the above noted project. The testing included moisture content determinations, Atterberg limits, particle size distribution (Hydrometer method) and unconfined compression test with related testing on Shelby tube sample.

Regards,

Angela Fidler-Kliewer, C.Tech.

Review Control:

Prepared By: AD	*Reviewed By:* AFK	*Checked By:* NJF

TREK GEOTECHNICAL

LABORATORY REQUISITION

CLIENT Associated Engineering (Sask.) Ltd. **PROJECT NO:** 0115 069 00

PROJECT NAME RM of Springfield Water Treatment Plant Expansions [redacted] **TECHNICIAN:** Jagdeep Sidhu

TEST HOLE NUMBER	SAMPLE NUMBER	DEPTH OF SAMPLE (ft)	TARE NUMBER (LAB USE ONLY)	MOISTURE	VISUAL CLASS.	ATTERBERG LIMITS	HYDROMETER	GRADATION	STD. PROCTOR	UNCONFINED AND AUXILLARY TESTS					Soil Description/Comments
TH22-01	G01	0.0 - 1.0		X											
TH22-01	G02	4.0 - 5.0		X											
TH22-01	G03	6.0 - 7.0		X											
TH22-01	G04	8.0 - 9.0		X		X	X								
TH22-01	ST05	10.0 - 12.0		X						X					
TH22-01	G06	12.0 - 13.0		X											
TH22-01	G07	16.0 - 17.0		X											
TH22-01	G08	22.0 - 23.0		X											
TH22-01	G09	26.0 - 27.0		X											
TH22-01	SS10	30.0 - 31.5		X											
TH22-01	G11	33.0 - 34.0		X											
TH22-01	SS12	35.0 - 36.5		X											
TH22-02	G13	1.0 - 2.0		X											
TH22-02	G14	3.0 - 4.0		X											
TH22-02	ST15	5.0 - 7.0		X						X					
TH22-02	G16	7.0 - 8.0		X											
TH22-02	G17	12.0 - 13.0		X											
TH22-02	G18	17.0 - 18.0		X											
TH22-02	G19	22.0 - 23.0		X											
TH22-02	G20	26.0 - 27.0		X											
TH22-03	G21	0.0 - 1.0		X											
TH22-03	G22	2.0 - 3.0		X											
TH22-03	G23	4.0 - 5.0		X											
TH22-03	G24	6.0 - 7.0		X											
TH22-03	G25	12.0 - 13.0		X											
TH22-03	ST26	15.0 - 17.0		X						X					
TH22-03	G27	19.0 - 20.0		X											
TH22-03	G28	27.0 - 28.0		X											
TH22-04	G29	1.0 - 2.0		X											
TH22-04	G30	4.0 - 5.0		X											
TH22-04	G31	8.0 - 9.0		X		X	X	WWC							
TH22-04	G32	12.0 - 19.0		X											
TH22-04	G33	17.0 - 18.0		X											
TH22-04	ST34	20.0 - 22.0		X						X					
TH22-04	G34A	22.0 - 23.0		X											

REQUESTED BY: Jagdeep Sidhu **REPORT TO:** JS / NJF / MK

REQUISITION DATE: NOV 9/22 **DATE REQUIRED:**

COMMENTS:

REQUISITION NO. R22 - 677

TREK LABORATORY REQUISITION LOGS 2022-12-09 RM SPRINGFIELD WTP 0-A_JSS 0115-069-00.GPJ TREK GEOTECHNICAL.GDT 9/12/22

TREK GEOTECHNICAL

LABORATORY REQUISITION

CLIENT Associated Engineering (Sask.) Ltd. **PROJECT NO:** 0115 069 00

PROJECT NAME RM of Springfield Water Treatment Plant Expansions (D[illegible]) **FIELD TECHNICIAN:** Jagdeep Sidhu

TEST HOLE NUMBER	SAMPLE NUMBER	DEPTH OF SAMPLE (ft)	TARE NUMBER (LAB USE ONLY)	MOISTURE	VISUAL CLASS.	ATTERBERG LIMITS	HYDROMETER	GRADATION	STD. PROCTOR	UNCONFINED AND AUXILLARY TESTS					Soil Description/Comments
TH22-04	G35	27.0 - 28.0		X											
TH22-05	G36	1.0 - 2.0		X											
TH22-05	G37	3.0 - 4.0		X											
TH22-05	G38	7.0 - 8.0		X											
TH22-05	G39	12.0 - 13.0		X											
TH22-05	G40	17.0 - 18.0		X											
TH22-05	G41	22.0 - 23.0		X											
TH22-05	G42	28.0 - 29.0		X											
TH22-05	G43	32.0 - 33.0		X											
TH22-05	SS44	35.0 - 35.8		X											
TH22-06	G45	0.0 - 1.0		X											
TH22-06	G46	3.0 - 4.0		X											
TH22-06	G47	6.0 - 7.0		X											
TH22-06	G48	9.0 - 10.0		X											
TH22-06	G49	14.0 - 15.0		X											
TH22-06	G50	18.0 - 19.0		X											
TH22-06	G51	23.0 - 24.0		X											
TH22-06	G52	27.0 - 28.0		X											
TH22-06	G53	32.0 - 33.0		X											
TH22-06	SS54	35.0 - 35.5		X											

REQUESTED BY: Jagdeep Sidhu **REPORT TO:** JS / NJT

REQUISITION DATE: _____ **DATE REQUIRED:** _____

COMMENTS: _____

REQUISITION NO. R22-677

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Winnipeg, MB R3H 0L3
Tel: 204.975.9433 Fax: 204.975.9435

Moisture Content Report
ASTM D2216-10

Project No. 0115-069-00
Client Associated Engineering (Sask) Ltd.
Project RM of Springfield Water Treatment Plant Expansions

Sample Date 08-Dec-22
Test Date 19-Dec-22
Technician TR

Test Hole	TH22-01	TH22-01	TH22-01	TH22-01	TH22-01	TH22-01
Depth (m)	0.0 - 0.3	1.2 - 1.5	1.8 - 2.1	2.4 - 2.7	3.7 - 4.0	4.9 - 5.2
Sample #	G01	G02	G03	G04	G06	G07
Tare ID	N04	Z70	Z114	P09	Z88	E131
Mass of tare	8.8	8.8	8.7	8.9	10.0	8.8
Mass wet + tare	212.2	211.6	228.8	412.3	236.5	214.1
Mass dry + tare	164.2	165.3	179.6	331.3	164.1	147.3
Mass water	48.0	46.3	49.2	81.0	72.4	66.8
Mass dry soil	155.4	156.5	170.9	322.4	154.1	138.5
Moisture %	30.9%	29.6%	28.8%	25.1%	47.0%	48.2%

Test Hole	TH22-01	TH22-01	TH22-01	TH22-01	TH22-01	TH22-02
Depth (m)	6.7 - 7.0	7.9 - 8.2	9.1 - 9.6	10.1 - 10.4	10.7 - 11.1	0.3 - 0.6
Sample #	G08	G09	SS10	G11	SS12	G13
Tare ID	D56	W70	N73	E28	H50	AC27
Mass of tare	9.0	8.8	8.7	8.5	8.6	7.0
Mass wet + tare	218.7	263.2	242.0	192.3	203.2	242.1
Mass dry + tare	149.6	234.7	213.4	150.5	175.0	180.5
Mass water	69.1	28.5	28.6	41.8	28.2	61.6
Mass dry soil	140.6	225.9	204.7	142.0	166.4	173.5
Moisture %	49.1%	12.6%	14.0%	29.4%	16.9%	35.5%

Test Hole	TH22-02	TH22-02	TH22-02	TH22-02	TH22-02	TH22-02
Depth (m)	0.9 - 1.2	2.1 - 2.4	3.7 - 4.0	5.2 - 5.5	6.7 - 7.0	7.9 - 8.2
Sample #	G14	G16	G17	G18	G19	G20
Tare ID	Z15	N110	W90	P31	F91	H56
Mass of tare	8.5	8.5	8.5	8.4	8.5	8.5
Mass wet + tare	224.3	234.6	210.5	244.5	256.7	215.2
Mass dry + tare	174.5	163.7	143.1	165.8	185.0	187.5
Mass water	49.8	70.9	67.4	78.7	71.7	27.7
Mass dry soil	166.0	155.2	134.6	157.4	176.5	179.0
Moisture %	30.0%	45.7%	50.1%	50.0%	40.6%	15.5%

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Moisture Content Report
ASTM D2216-10

Project No. 0115-069-00
Client Associated Engineering (Sask) Ltd.
Project RM of Springfield Water Treatment Plant Expansions

Sample Date 08-Dec-22
Test Date 19-Dec-22
Technician TR

Test Hole	TH22-03	TH22-03	TH22-03	TH22-03	TH22-03	TH22-03
Depth (m)	0.0 - 0.3	0.6 - 0.9	1.2 - 1.5	1.8 - 2.1	3.7 - 4.0	5.8 - 6.1
Sample #	G21	G22	G23	G24	G25	G27
Tare ID	F10	AC39	E135	Z138	AB13	N59
Mass of tare	8.7	6.9	8.6	8.6	7.0	8.5
Mass wet + tare	213.0	234.9	210.8	224.6	225.3	235.3
Mass dry + tare	162.6	186.5	165.6	161.6	161.1	160.2
Mass water	50.4	48.4	45.2	63.0	64.2	75.1
Mass dry soil	153.9	179.6	157.0	153.0	154.1	151.7
Moisture %	32.7%	26.9%	28.8%	41.2%	41.7%	49.5%

Test Hole	TH22-03	TH22-04	TH22-04	TH22-04	TH22-04	TH22-04
Depth (m)	8.2 - 8.5	0.3 - 0.6	1.2 - 1.5	2.4 - 2.7	3.7 - 5.8	5.2 - 5.5
Sample #	G28	G29	G30	G31	G32	G33
Tare ID	W35	F22	Z41	H43	F105	K34
Mass of tare	8.3	8.6	8.6	8.6	8.5	8.6
Mass wet + tare	237.2	210.7	233.4	401.3	236.3	207.1
Mass dry + tare	199.0	152.2	173.4	271.7	167.4	138.8
Mass water	38.2	58.5	60.0	129.6	68.9	68.3
Mass dry soil	190.7	143.6	164.8	263.1	158.9	130.2
Moisture %	20.0%	40.7%	36.4%	49.3%	43.4%	52.5%

Test Hole	TH22-04	TH22-04	TH22-05	TH22-05	TH22-05	TH22-05
Depth (m)	6.7 - 7.0	8.2 - 8.5	0.3 - 0.6	0.9 - 1.2	2.1 - 2.4	3.7 - 4.0
Sample #	G34A	G35	G36	G37	G38	G39
Tare ID	H29	N112	D34	N84	N41	H80
Mass of tare	8.5	8.5	9.1	8.7	8.6	8.8
Mass wet + tare	247.3	227.6	231.6	216.4	203.6	212.6
Mass dry + tare	169.8	191.0	164.2	157.5	146.9	141.5
Mass water	77.5	36.6	67.4	58.9	56.7	71.1
Mass dry soil	161.3	182.5	155.1	148.8	138.3	132.7
Moisture %	48.0%	20.1%	43.5%	39.6%	41.0%	53.6%

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Moisture Content Report
ASTM D2216-10

Project No. 0115-069-00
Client Associated Engineering (Sask) Ltd.
Project RM of Springfield Water Treatment Plant Expansions

Sample Date 08-Dec-22
Test Date 19-Dec-22
Technician TR

Test Hole	TH22-05	TH22-05	TH22-05	TH22-05	TH22-05	TH22-06
Depth (m)	5.2 - 5.5	6.7 - 7.0	8.5 - 8.8	9.8 - 10.1	10.7 - 10.9	0.0 - 0.3
Sample #	G40	G41	G42	G43	SS44	G45
Tare ID	Z99	W27	AB100	Z60	W69	C13
Mass of tare	8.5	8.3	6.9	8.5	8.5	8.5
Mass wet + tare	240.7	225.7	261.9	243.2	184.2	235.8
Mass dry + tare	158.8	150.4	233.9	213.2	167.4	166.7
Mass water	81.9	75.3	28.0	30.0	16.8	69.1
Mass dry soil	150.3	142.1	227.0	204.7	158.9	158.2
Moisture %	54.5%	53.0%	12.3%	14.7%	10.6%	43.7%

Test Hole	TH22-06	TH22-06	TH22-06	TH22-06	TH22-06	TH22-06
Depth (m)	0.9 - 1.2	1.8 - 2.1	2.7 - 3.0	4.3 - 4.6	5.5 - 5.8	7.0 - 7.3
Sample #	G46	G47	G48	G49	G50	G51
Tare ID	W49	Z08	H41	N18	H74	Z101
Mass of tare	8.6	8.4	8.6	8.6	8.5	8.5
Mass wet + tare	207.1	236.7	231.1	234.9	234.4	209.2
Mass dry + tare	155.6	171.7	162.2	160.9	161.1	142.7
Mass water	51.5	65.0	68.9	74.0	73.3	66.5
Mass dry soil	147.0	163.3	153.6	152.3	152.6	134.2
Moisture %	35.0%	39.8%	44.9%	48.6%	48.0%	49.6%

Test Hole	TH22-06	TH22-06	TH22-06			
Depth (m)	8.2 - 8.5	9.8 - 10.1	10.7 - 10.8			
Sample #	G52	G53	SS54			
Tare ID	F129	A30	W189			
Mass of tare	8.7	8.5	8.7			
Mass wet + tare	265.0	256.8	233.4			
Mass dry + tare	232.9	233.0	217.3			
Mass water	32.1	23.8	16.1			
Mass dry soil	224.2	224.5	208.6			
Moisture %	14.3%	10.6%	7.7%			

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Atterberg Limits
ASTM D4318-10e1

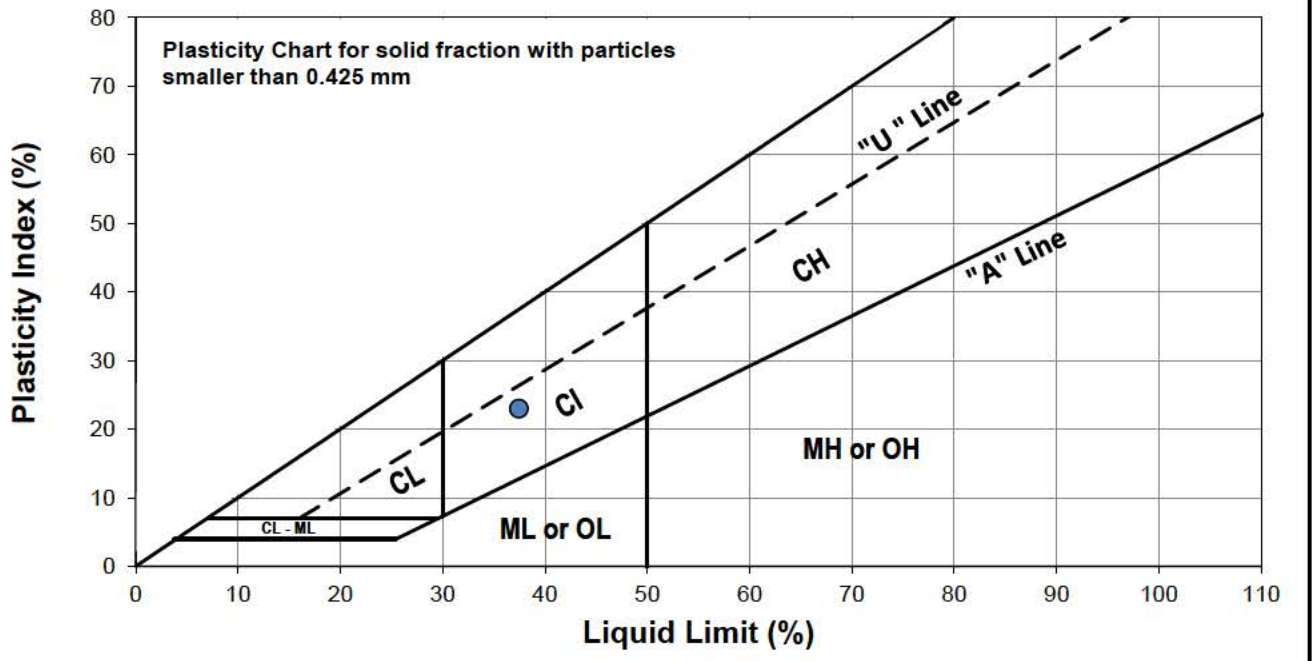
CERTIFIED BY CCIL Canadian Council of Independent Laboratories For specific tests as listed on www.ccil.com

Project No.	0115-069-00
Client	Associated Engineering (Sask) Ltd
Project	RM of Springfield Water Treatment Plant Expansions
Test Hole	TH22-01
Sample #	G04
Depth (m)	2.4 - 2.7
Sample Date	08-Dec-22
Test Date	22-Dec-22
Technician	MT

Liquid Limit	37
Plastic Limit	14
Plasticity Index	23

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	17	25	34		
Mass Tare (g)	14.190	14.033	14.209		
Mass Wet Soil + Tare (g)	28.669	25.333	26.666		
Mass Dry Soil + Tare (g)	24.543	22.252	23.401		
Mass Water (g)	4.126	3.081	3.265		
Mass Dry Soil (g)	10.353	8.219	9.192		
Moisture Content (%)	39.853	37.486	35.520		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.215	14.096			
Mass Wet Soil + Tare (g)	25.416	23.194			
Mass Dry Soil + Tare (g)	23.992	22.050			
Mass Water (g)	1.424	1.144			
Mass Dry Soil (g)	9.777	7.954			
Moisture Content (%)	14.565	14.383			

Note: Additional information recorded/measured for this test is available upon request.

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Atterberg Limits
ASTM D4318-10e1

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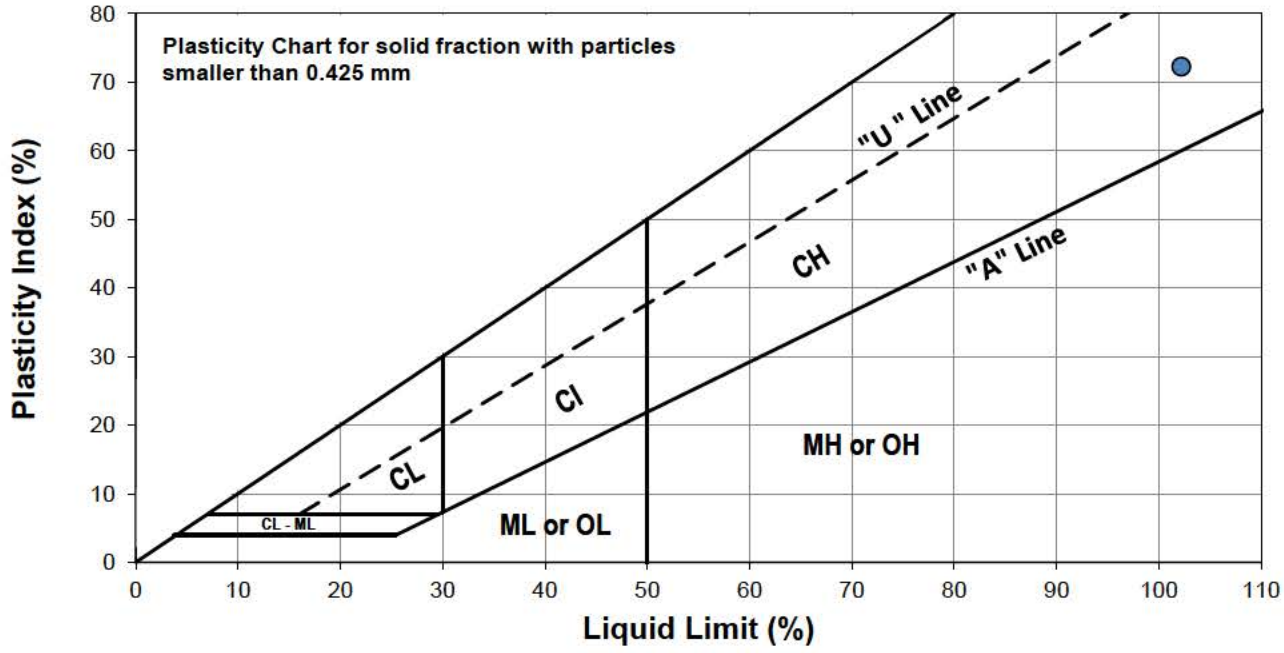
Project No.	0115-069-00
Client	Associated Engineering (Sask) Ltd
Project	RM of Springfield Water Treatment Plant Expansions
Test Hole	TH22-04
Sample #	G31
Depth (m)	2.4 - 2.7
Sample Date	08-Dec-22
Test Date	22-Dec-22
Technician	MT

Liquid Limit	102
Plastic Limit	30
Plasticity Index	72

Liquid Limit

Trial #	1	2	3		
Number of Blows (N)	17	24	29		
Mass Tare (g)	13.999	14.078	14.093		
Mass Wet Soil + Tare (g)	26.652	24.402	24.377		
Mass Dry Soil + Tare (g)	20.160	19.175	19.210		
Mass Water (g)	6.492	5.227	5.167		
Mass Dry Soil (g)	6.161	5.097	5.117		
Moisture Content (%)	105.373	102.551	100.977		



Plastic Limit

Trial #	1	2	3	4	5
Mass Tare (g)	14.045	13.913			
Mass Wet Soil + Tare (g)	23.007	28.261			
Mass Dry Soil + Tare (g)	20.930	24.974			
Mass Water (g)	2.077	3.287			
Mass Dry Soil (g)	6.885	11.061			
Moisture Content (%)	30.167	29.717			

Note: Additional information recorded/measured for this test is available upon request.

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Grain Size Analysis (Hydrometer Method)
AASHTO T 88

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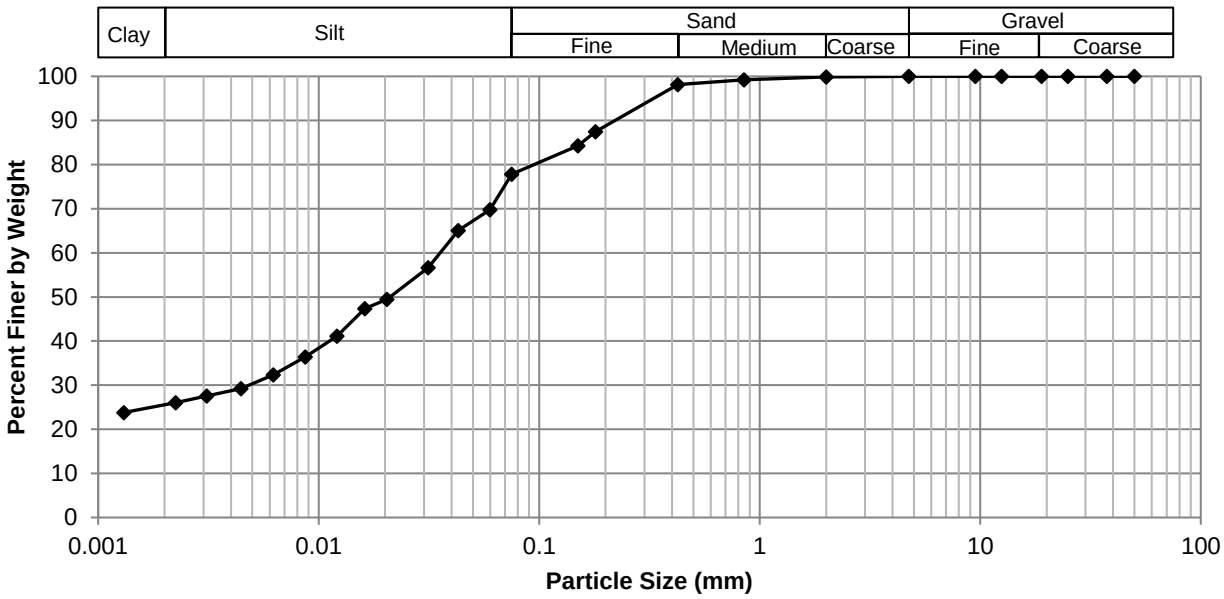
For specific tests as listed on www.ccil.com

Project No.	0115-069-00
Client	Associated Engineering (Sask) Ltd
Project	RM of Springfield Water Treatment Plant Expansions
Test Hole	TH22-01
Sample #	G04
Depth (m)	2.4 - 2.7
Sample Date	8-Dec-22
Test Date	22-Dec-22
Technician	JC

Gravel	0.0%
Sand	22.2%
Silt	52.4%
Clay	25.4%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	77.80
37.5	100.00	2.00	99.84	0.0597	69.77
25.0	100.00	0.850	99.21	0.0430	65.09
19.0	100.00	0.425	98.17	0.0314	56.66
12.5	100.00	0.180	87.49	0.0204	49.48
9.50	100.00	0.150	84.25	0.0162	47.34
4.75	100.00	0.075	77.80	0.0121	41.10
				0.0087	36.41
				0.0062	32.35
				0.0044	29.19
				0.0031	27.55
				0.0022	26.03
				0.0013	23.80

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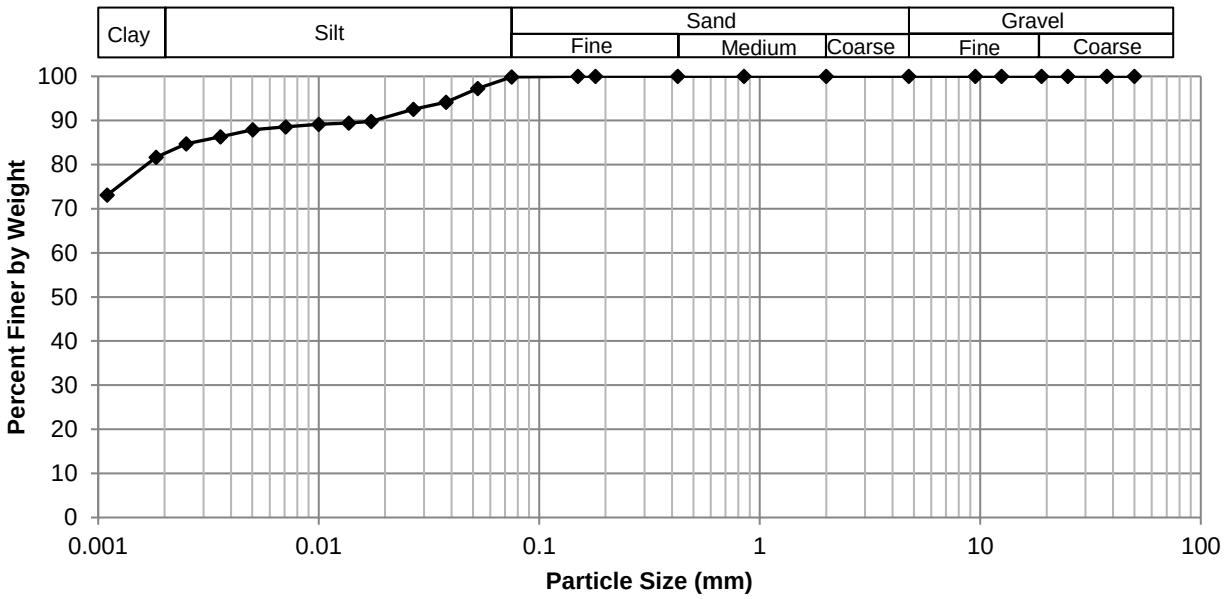
Grain Size Analysis (Hydrometer Method)
AASHTO T 88

Project No.	0115-069-00
Client	Associated Engineering (Sask) Ltd
Project	RM of Springfield Water Treatment Plant Expansions
Test Hole	TH22-04
Sample #	G31
Depth (m)	2.4 - 2.7
Sample Date	8-Dec-22
Test Date	22-Dec-22
Technician	JC

Gravel	0.0%
Sand	0.1%
Silt	17.5%
Clay	82.4%

Particle Size Distribution Curve



Gravel		Sand		Silt and Clay	
Particle Size (mm)	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**	**Particle Size (mm)**	**Percent Passing**
50.0	100.00	4.75	100.00	0.0750	99.86
37.5	100.00	2.00	99.99	0.0526	97.27
25.0	100.00	0.850	99.99	0.0378	94.15
19.0	100.00	0.425	99.99	0.0269	92.58
12.5	100.00	0.180	99.99	0.0173	89.77
9.50	100.00	0.150	99.99	0.0137	89.46
4.75	100.00	0.075	99.86	0.0100	89.14
				0.0071	88.55
				0.0050	87.93
				0.0036	86.33
				0.0025	84.70
				0.0018	81.64
				0.0011	73.13

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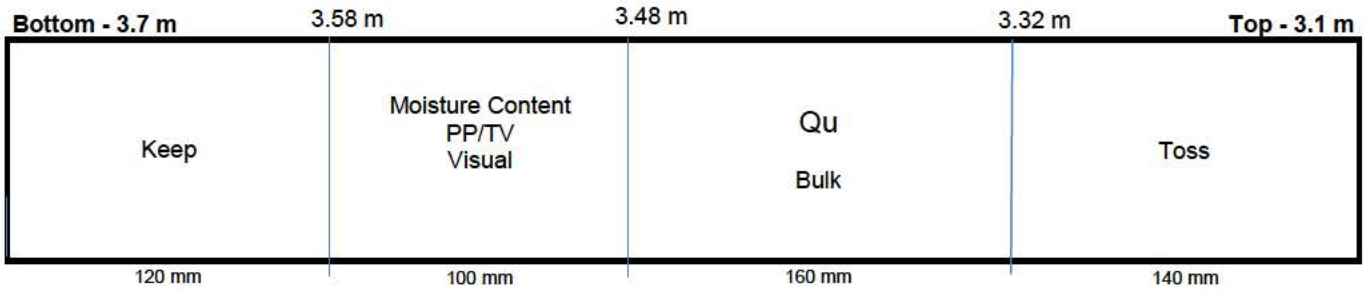
Shelby Tube Visual

Project No.	0115-069-00
Client	Associated Engineering (Sask.) Ltd.
Project	RM of Springfield Water Treatment Plant Expansions
Test Hole	TH22-01
Sample #	ST05
Depth (m)	3.0 - 3.7
Sample Date	08-Dec-22
Test Date	13-Dec-22
Technician	JC

Tube Extraction

Recovery (mm) 520



Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<10 mm diam.)	
trace gravel (<15 mm diam.)	
trace sand	
trace oxidation	
trace organics	
Color	brown
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.80
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	78.5

Pocket Penetrometer

Reading	**1**	1.80
	2	1.50
	3	1.70
	Average	1.67
Undrained Shear Strength (kPa)		81.7

Moisture Content

Tare ID	H50
Mass tare (g)	8.8
Mass wet + tare (g)	279.6
Mass dry + tare (g)	190.9
Moisture %	48.7%

Unit Weight

Bulk Weight (g)		1115.4
Length (mm)	**1**	151.90
	2	152.00
	3	151.36
	4	151.52
Average Length (m)		0.152
Diam. (mm)	**1**	72.84
	2	73.12
	3	73.07
	4	73.26
Average Diameter (m)		0.073
Volume (m^3)		6.36E-04
Bulk Unit Weight (kN/m^3)		17.2
Bulk Unit Weight (pcf)		109.5
Dry Unit Weight (kN/m^3)		11.6
Dry Unit Weight (pcf)		73.6

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Unconfined Compressive Strength

ASTM D2166

Project No.	0115-069-00
Client	Associated Engineering (Sask.) Ltd.
Project	RM of Springfield Water Treatment Plant Expansions

Test Hole	TH22-01
Sample #	ST05
Depth (m)	3.0 - 3.7
Sample Date	8-Dec-22
Test Date	13-Dec-22
Technician	JC

Unconfined Strength

	kPa	ksf
Max q_u	67.7	1.4
Max S_u	33.9	0.7

Specimen Data

Description CLAY - silty, trace silt inclusions (<10 mm diam.), trace gravel (<15 mm diam.), trace sand, trace oxidation, trace organics, brown, moist, stiff, high plasticity

Length	151.7	(mm)
Diameter	73.1	(mm)
L/D Ratio	2.1	
Initial Area	0.00419	(m^2)
Load Rate	1.00	(%/min)

Moisture %	49%	
Bulk Unit Wt.	17.2	(kN/m^3)
Dry Unit Wt.	11.6	(kN/m^3)
Liquid Limit	-	
Plastic Limit	-	
Plasticity Index	-	

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	**kPa**	**ksf**
0.80	78.5	1.64

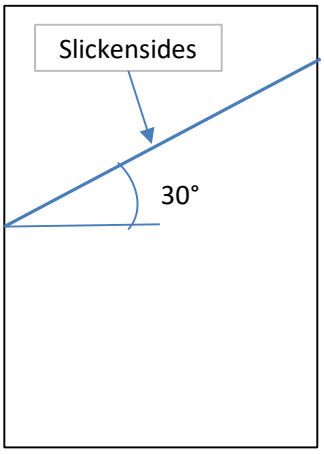
Vane Size
m

Pocket Penetrometer

	Reading	Undrained Shear Strength	
	tsf	**kPa**	**ksf**
	1.80	88.3	1.84
	1.50	73.6	1.54
	1.70	83.4	1.74
Average	**1.67**	**81.8**	**1.71**

Failure Geometry

Sketch:



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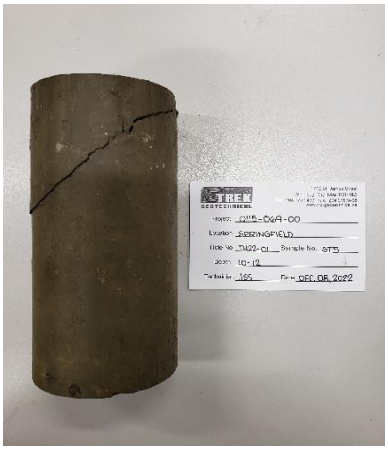

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Unconfined Compressive Strength

ASTM D2166

Project No. 0115-069-00
Client Associated Engineering (Sask.) Ltd.
Project RM of Springfield Water Treatment Plant Expansions

Unconfined Compression Test Graph

Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.37	0.0000	0.00	0.004194	0.0	0.00	0.00
10	0.74	0.2540	0.17	0.004201	18.6	4.44	2.22
20	1.51	0.5080	0.33	0.004208	57.5	13.66	6.83
30	2.26	0.7620	0.50	0.004215	95.3	22.60	11.30
40	2.89	1.0160	0.67	0.004222	127.0	30.08	15.04
50	3.58	1.2700	0.84	0.004229	161.8	38.26	19.13
60	4.06	1.5240	1.00	0.004236	186.0	43.90	21.95
70	4.57	1.7780	1.17	0.004243	211.7	49.89	24.94
80	5.02	2.0320	1.34	0.004251	234.4	55.14	27.57
90	5.40	2.2860	1.51	0.004258	253.5	59.54	29.77
100	5.76	2.5400	1.67	0.004265	271.7	63.70	31.85
110	6.00	2.7940	1.84	0.004272	283.8	66.42	33.21
120	6.12	3.0480	2.01	0.004280	289.8	67.72	33.86
130	5.90	3.3020	2.18	0.004287	278.7	65.02	32.51
140	5.14	3.5560	2.34	0.004294	240.4	55.99	27.99
150	4.20	3.8100	2.51	0.004302	193.0	44.88	22.44
160	3.47	4.0640	2.68	0.004309	156.2	36.26	18.13
170	2.88	4.3180	2.85	0.004317	126.5	29.31	14.65

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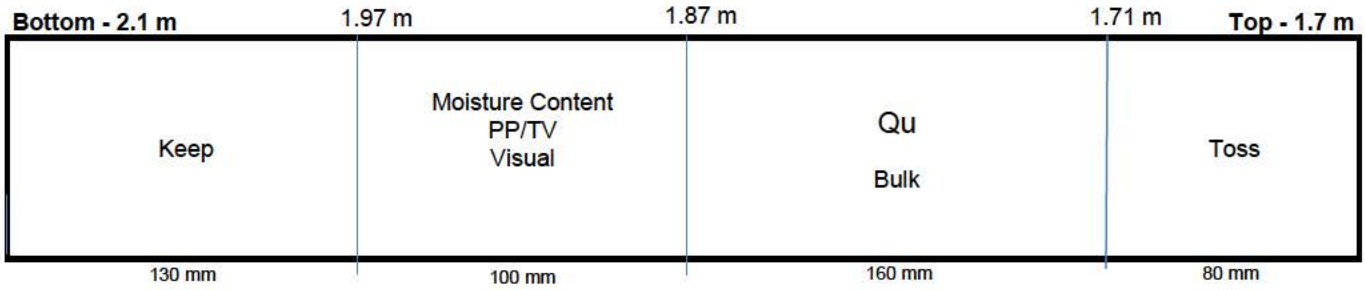
Shelby Tube Visual

Project No.	0115-069-00
Client	Associated Engineering (Sask.) Ltd.
Project	RM of Springfield Water Treatment Plant Expansions
Test Hole	TH22-02
Sample #	ST15
Depth (m)	1.5 - 2.1
Sample Date	08-Dec-22
Test Date	13-Dec-22
Technician	JC

Tube Extraction

Recovery (mm) 470



Visual Classification

Material	CLAY
Composition	silty
trace oxidation	
trace organics	
Color	brown
Moisture	moist
Consistency	very stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.44
Vane Size (s,m,l)	s
Undrained Shear Strength (kPa)	107.9

Pocket Penetrometer

Reading	1	2.70
	2	2.40
	3	2.60
	Average	2.57
Undrained Shear Strength (kPa)		125.9

Moisture Content

Tare ID	Z114
Mass tare (g)	8.6
Mass wet + tare (g)	341.2
Mass dry + tare (g)	271.9
Moisture %	26.3%

Unit Weight

Bulk Weight (g)		1232.0
Length (mm)	1	152.68
	2	152.47
	3	152.34
	4	152.33
Average Length (m)		0.152
Diam. (mm)	1	72.35
	2	72.58
	3	73.16
	4	72.98
Average Diameter (m)		0.073
Volume (m^3)		6.34E-04
Bulk Unit Weight (kN/m^3)		19.1
Bulk Unit Weight (pcf)		121.3
Dry Unit Weight (kN/m^3)		15.1
Dry Unit Weight (pcf)		96.0

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Unconfined Compressive Strength

ASTM D2166

Project No.	0115-069-00
Client	Associated Engineering (Sask.) Ltd.
Project	RM of Springfield Water Treatment Plant Expansions

Test Hole	TH22-02
Sample #	ST15
Depth (m)	1.5 - 2.1
Sample Date	8-Dec-22
Test Date	13-Dec-22
Technician	JC

Unconfined Strength

	kPa	ksf
Max q_u	128.9	2.7
Max S_u	64.4	1.3

Specimen Data

Description CLAY - silty, trace oxidation, trace organics, brown, moist, very stiff, high plasticity

Length	152.5	(mm)	**Moisture %**	26%	
Diameter	72.8	(mm)	**Bulk Unit Wt.**	19.1	(kN/m^3)
L/D Ratio	2.1		**Dry Unit Wt.**	15.1	(kN/m^3)
Initial Area	0.00416	(m^2)	**Liquid Limit**	-	
Load Rate	1.00	(%/min)	**Plastic Limit**	-	
			Plasticity Index	-	

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	**kPa**	**ksf**
0.44	107.9	2.25

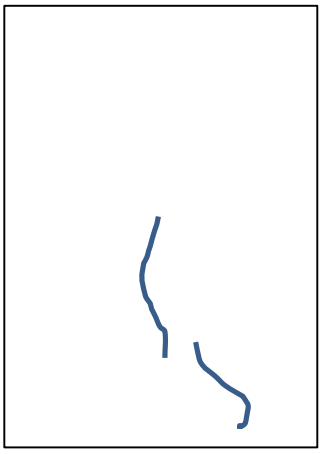
Vane Size
s

Pocket Penetrometer

	Reading	Undrained Shear Strength	
	tsf	**kPa**	**ksf**
	2.70	132.4	2.77
	2.40	117.7	2.46
	2.60	127.5	2.66
Average	**2.57**	**125.9**	**2.63**

Failure Geometry

Sketch:



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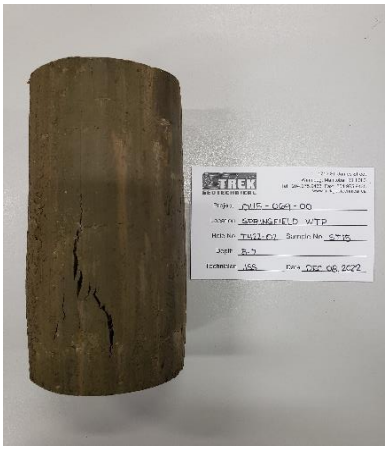

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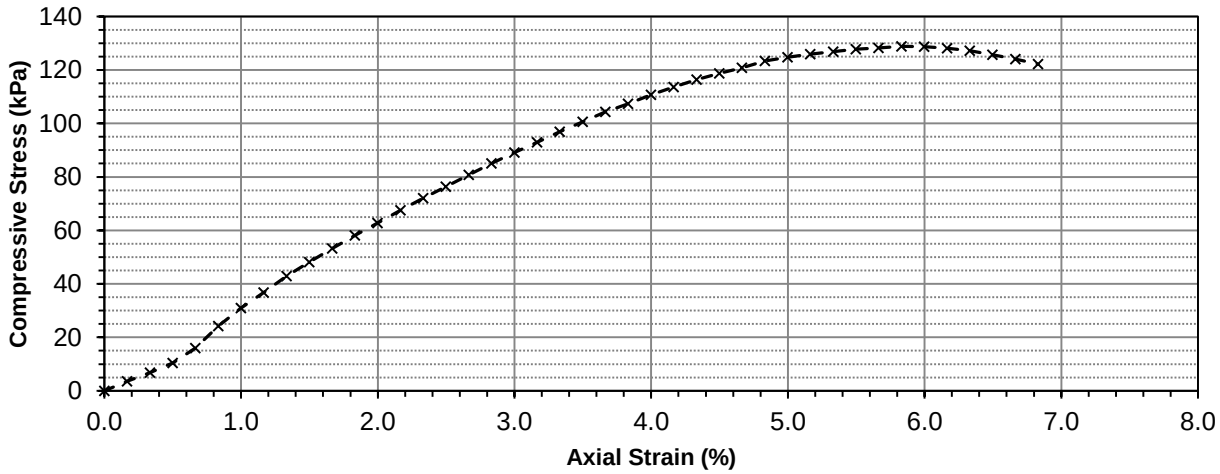
Unconfined Compressive Strength

ASTM D2166

Project No. 0115-069-00
Client Associated Engineering (Sask.) Ltd.
Project RM of Springfield Water Treatment Plant Expansions

Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.38	0.0000	0.00	0.004159	0.0	0.00	0.00
10	0.67	0.2540	0.17	0.004166	14.6	3.51	1.75
20	0.94	0.5080	0.33	0.004173	28.2	6.76	3.38
30	1.24	0.7620	0.50	0.004180	43.3	10.37	5.19
40	1.71	1.0160	0.67	0.004187	67.0	16.01	8.01
50	2.40	1.2700	0.83	0.004194	101.8	24.28	12.14
60	2.96	1.5240	1.00	0.004201	130.0	30.96	15.48
70	3.45	1.7780	1.17	0.004208	154.7	36.77	18.39
80	3.97	2.0320	1.33	0.004215	180.9	42.93	21.46
90	4.41	2.2860	1.50	0.004222	203.1	48.11	24.05
100	4.85	2.5400	1.67	0.004229	225.3	53.27	26.64
110	5.27	2.7940	1.83	0.004236	246.5	58.18	29.09
120	5.66	3.0480	2.00	0.004244	266.1	62.71	31.36
130	6.08	3.3020	2.17	0.004251	287.3	67.59	33.79
140	6.47	3.5560	2.33	0.004258	307.0	72.09	36.04
150	6.84	3.8100	2.50	0.004265	325.6	76.34	38.17
160	7.23	4.0640	2.67	0.004273	345.3	80.81	40.40
170	7.60	4.3180	2.83	0.004280	363.9	85.03	42.51
180	7.96	4.5720	3.00	0.004287	382.1	89.11	44.56
190	8.30	4.8260	3.17	0.004295	399.2	92.95	46.47
200	8.65	5.0800	3.33	0.004302	416.8	96.89	48.45
210	8.98	5.3340	3.50	0.004310	433.5	100.58	50.29
220	9.32	5.5880	3.67	0.004317	450.6	104.38	52.19
230	9.59	5.8420	3.83	0.004324	464.2	107.35	53.67

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Unconfined Compressive Strength

ASTM D2166

Project No. 0115-069-00
Client Associated Engineering (Sask.) Ltd.
Project RM of Springfield Water Treatment Plant Expansions

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	9.90	6.0960	4.00	0.004332	479.8	110.77	55.38
250	10.16	6.3500	4.17	0.004340	492.9	113.59	56.80
260	10.42	6.6040	4.33	0.004347	506.0	116.41	58.21
270	10.64	6.8580	4.50	0.004355	517.1	118.75	59.38
280	10.84	7.1120	4.66	0.004362	527.2	120.86	60.43
290	11.08	7.3660	4.83	0.004370	539.3	123.42	61.71
300	11.22	7.6200	5.00	0.004378	546.4	124.81	62.41
310	11.34	7.8740	5.16	0.004385	552.4	125.97	62.99
320	11.44	8.1280	5.33	0.004393	557.5	126.90	63.45
330	11.54	8.3820	5.50	0.004401	562.5	127.82	63.91
340	11.60	8.6360	5.66	0.004408	565.5	128.28	64.14
350	11.67	8.8900	5.83	0.004416	569.0	128.85	64.43
360	11.68	9.1440	6.00	0.004424	569.6	128.74	64.37
370	11.65	9.3980	6.16	0.004432	568.0	128.17	64.08
380	11.58	9.6520	6.33	0.004440	564.5	127.15	63.57
390	11.47	9.9060	6.50	0.004448	559.0	125.67	62.84
400	11.35	10.1600	6.66	0.004456	552.9	124.09	62.05
410	11.20	10.4140	6.83	0.004464	545.4	122.18	61.09

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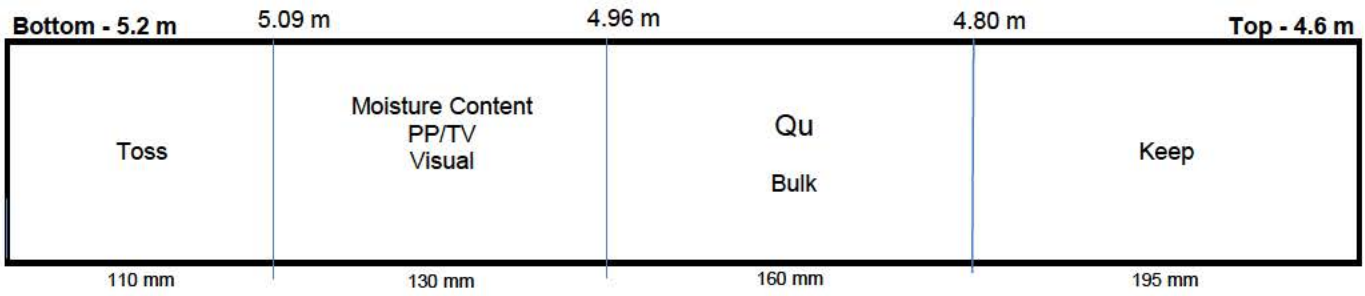
Shelby Tube Visual

Project No.	0115-069-00
Client	Associated Engineering (Sask.) Ltd.
Project	RM of Springfield Water Treatment Plant Expansions
Test Hole	TH22-03
Sample #	ST26
Depth (m)	4.6 - 5.2
Sample Date	08-Dec-22
Test Date	15-Dec-22
Technician	JC

Tube Extraction

Recovery (mm) 595



Visual Classification

Material	CLAY
Composition	silty
trace silt inclusion (<15 mm diam.)	
trace organics	
trace oxidation	
trace precipitate (sulphates <20 mm diam.)	
Color	mottled (grey and brown)
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.68
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	66.7

Pocket Penetrometer

Reading	**1**	1.80
	2	1.90
	3	1.80
	Average	1.83
Undrained Shear Strength (kPa)		89.9

Moisture Content

Tare ID	K23
Mass tare (g)	8.8
Mass wet + tare (g)	302.2
Mass dry + tare (g)	202.6
Moisture %	51.4%

Unit Weight

Bulk Weight (g)		1099.2
Length (mm)	**1**	151.84
	2	152.09
	3	151.77
	4	151.51
Average Length (m)		0.152
Diam. (mm)	**1**	72.63
	2	71.76
	3	73.02
	4	73.24
Average Diameter (m)		0.073
Volume (m^3)		6.29E-04
Bulk Unit Weight (kN/m^3)		17.1
Bulk Unit Weight (pcf)		109.0
Dry Unit Weight (kN/m^3)		11.3
Dry Unit Weight (pcf)		72.0

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Unconfined Compressive Strength

ASTM D2166

Project No.	0115-069-00
Client	Associated Engineering (Sask.) Ltd.
Project	RM of Springfield Water Treatment Plant Expansions

Test Hole	TH22-03
Sample #	ST26
Depth (m)	4.6 - 5.2
Sample Date	8-Dec-22
Test Date	15-Dec-22
Technician	JC

Unconfined Strength

	kPa	ksf
Max q_u	110.6	2.3
Max S_u	55.3	1.2

Specimen Data

Description CLAY - silty, trace silt inclusion (<15 mm diam.), trace organics, trace oxidation, trace precipitate (sulphates <20 mm diam.), mottled (grey and brown), moist, stiff, high plasticity

Length	151.8	(mm)	**Moisture %**	51%	
Diameter	72.7	(mm)	**Bulk Unit Wt.**	17.1	(kN/m^3)
L/D Ratio	2.1		**Dry Unit Wt.**	11.3	(kN/m^3)
Initial Area	0.00415	(m^2)	**Liquid Limit**	-	
Load Rate	1.00	(%/min)	**Plastic Limit**	-	
			Plasticity Index	-	

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	**kPa**	**ksf**
0.68	66.7	1.39

Vane Size
m

Pocket Penetrometer

	Reading	Undrained Shear Strength	
	tsf	**kPa**	**ksf**
	1.80	88.3	1.84
	1.90	93.2	1.95
	1.80	88.3	1.84
Average	**1.83**	**89.9**	**1.88**

Failure Geometry

Sketch:

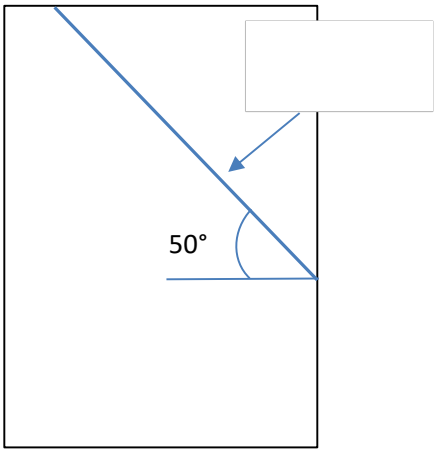

Photo:

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Unconfined Compressive Strength

ASTM D2166

Project No. 0115-069-00
Client Associated Engineering (Sask.) Ltd.
Project RM of Springfield Water Treatment Plant Expansions

Unconfined Compression Test Graph

Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.38	0.0000	0.00	0.004147	0.0	0.00	0.00
10	0.58	0.2540	0.17	0.004154	10.1	2.43	1.21
20	0.81	0.5080	0.33	0.004161	21.7	5.21	2.60
30	1.04	0.7620	0.50	0.004168	33.3	7.98	3.99
40	1.42	1.0160	0.67	0.004175	52.4	12.56	6.28
50	1.98	1.2700	0.84	0.004182	80.6	19.28	9.64
60	2.58	1.5240	1.00	0.004189	110.9	26.47	13.24
70	3.09	1.7780	1.17	0.004196	136.6	32.55	16.28
80	3.61	2.0320	1.34	0.004203	162.8	38.73	19.37
90	4.10	2.2860	1.51	0.004210	187.5	44.53	22.27
100	4.54	2.5400	1.67	0.004217	209.7	49.72	24.86
110	4.93	2.7940	1.84	0.004225	229.3	54.29	27.14
120	5.38	3.0480	2.01	0.004232	252.0	59.55	29.78
130	5.79	3.3020	2.18	0.004239	272.7	64.33	32.16
140	6.17	3.5560	2.34	0.004246	291.8	68.73	34.36
150	6.50	3.8100	2.51	0.004254	308.5	72.52	36.26
160	6.88	4.0640	2.68	0.004261	327.6	76.89	38.45
170	7.25	4.3180	2.84	0.004268	346.3	81.13	40.56
180	7.60	4.5720	3.01	0.004276	363.9	85.11	42.56
190	7.98	4.8260	3.18	0.004283	383.1	89.44	44.72
200	8.29	5.0800	3.35	0.004290	398.7	92.93	46.46
210	8.61	5.3340	3.51	0.004298	414.8	96.52	48.26
220	8.92	5.5880	3.68	0.004305	430.4	99.98	49.99
230	9.19	5.8420	3.85	0.004313	444.1	102.96	51.48

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Unconfined Compressive Strength

ASTM D2166

Project No. 0115-069-00
Client Associated Engineering (Sask.) Ltd.
Project RM of Springfield Water Treatment Plant Expansions

Unconfined Compression Test Data (cont'd)

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
240	9.41	6.0960	4.02	0.004320	455.1	105.35	52.67
250	9.60	6.3500	4.18	0.004328	464.7	107.38	53.69
260	9.77	6.6040	4.35	0.004335	473.3	109.17	54.58
270	9.86	6.8580	4.52	0.004343	477.8	110.02	55.01
280	9.92	7.1120	4.69	0.004351	480.8	110.52	55.26
290	9.94	7.3660	4.85	0.004358	481.9	110.56	55.28
300	9.92	7.6200	5.02	0.004366	480.8	110.14	55.07
310	9.89	7.8740	5.19	0.004374	479.3	109.60	54.80
320	9.71	8.1280	5.35	0.004381	470.3	107.33	53.67
330	9.51	8.3820	5.52	0.004389	460.2	104.85	52.42
340	9.28	8.6360	5.69	0.004397	448.6	102.02	51.01

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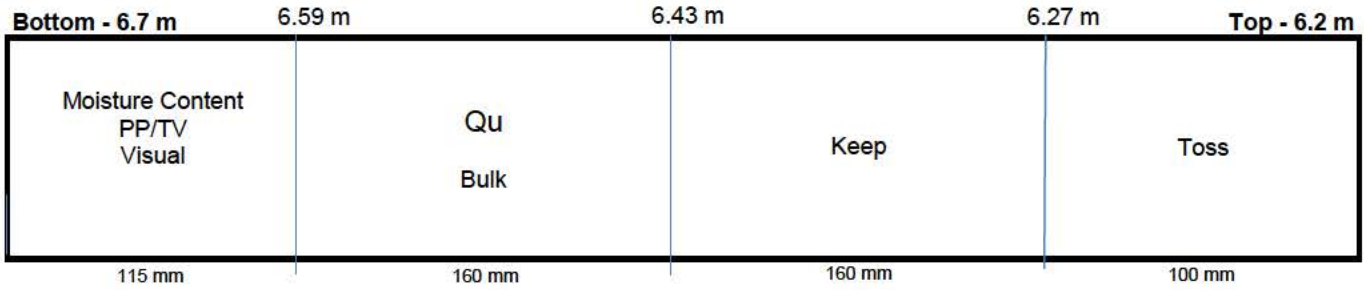
Shelby Tube Visual

Project No.	0115-069-00
Client	Associated Engineering (Sask.) Ltd.
Project	RM of Springfield Water Treatment Plant Expansions
Test Hole	TH22-04
Sample #	ST34
Depth (m)	6.1 - 6.7
Sample Date	08-Dec-22
Test Date	15-Dec-22
Technician	JC

Tube Extraction

Recovery (mm) 535



Visual Classification

Material	CLAY
Composition	silty
trace silt inclusions (<10 mm diam.)	
trace gravel (<30 mm diam.)	
trace oxidation	
Color	brown
Moisture	moist
Consistency	stiff
Plasticity	high plasticity
Structure	-
Gradation	-

Torvane

Reading	0.83
Vane Size (s,m,l)	m
Undrained Shear Strength (kPa)	81.4

Pocket Penetrometer

Reading	**1**	1.90
	2	2.00
	3	2.20
	Average	2.03
Undrained Shear Strength (kPa)		99.7

Moisture Content

Tare ID	F97
Mass tare (g)	8.4
Mass wet + tare (g)	296
Mass dry + tare (g)	205.4
Moisture %	46.0%

Unit Weight

Bulk Weight (g)		1097.4
Length (mm)	**1**	147.92
	2	147.53
	3	147.97
	4	147.62
Average Length (m)		0.148
Diam. (mm)	**1**	73.37
	2	73.18
	3	73.03
	4	73.39
Average Diameter (m)		0.073
Volume (m^3)		6.23E-04
Bulk Unit Weight (kN/m^3)		17.3
Bulk Unit Weight (pcf)		110.0
Dry Unit Weight (kN/m^3)		11.8
Dry Unit Weight (pcf)		75.4

www.trekgeotechnical.ca
1712 St. James Street
Winnipeg, MB R3H 0L3
Tel: 204.975.9433 Fax: 204.975.9435

Unconfined Compressive Strength

ASTM D2166

Project No.	0115-069-00
Client	Associated Engineering (Sask.) Ltd.
Project	RM of Springfield Water Treatment Plant Expansions

Test Hole	TH22-04
Sample #	ST34
Depth (m)	6.1 - 6.7
Sample Date	8-Dec-22
Test Date	15-Dec-22
Technician	JC

Unconfined Strength

	kPa	ksf
Max q_u	173.7	3.6
Max S_u	86.9	1.8

Specimen Data

Description CLAY - silty, trace silt inclusions (<10 mm diam.), trace gravel (<30 mm diam.), trace oxidation, brown, moist, stiff, high plasticity

Length	147.8	(mm)	**Moisture %**	46%	
Diameter	73.2	(mm)	**Bulk Unit Wt.**	17.3	(kN/m^3)
L/D Ratio	2.0		**Dry Unit Wt.**	11.8	(kN/m^3)
Initial Area	0.00421	(m^2)	**Liquid Limit**	-	
Load Rate	1.00	(%/min)	**Plastic Limit**	-	
			Plasticity Index	-	

Undrained Shear Strength Tests

Torvane

Reading	Undrained Shear Strength	
tsf	**kPa**	**ksf**
0.83	81.4	1.70

Vane Size
m

Pocket Penetrometer

	Reading	Undrained Shear Strength	
	tsf	**kPa**	**ksf**
	1.90	93.2	1.95
	2.00	98.1	2.05
	2.20	107.9	2.25
Average	**2.03**	**99.7**	**2.08**

Failure Geometry

Sketch:

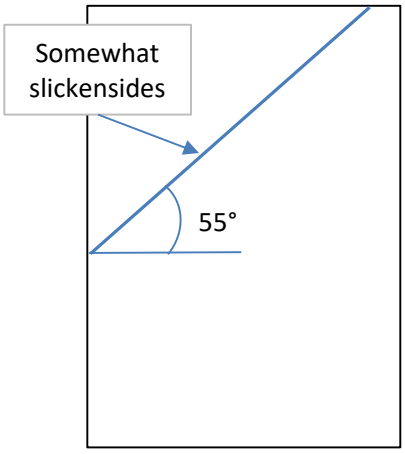
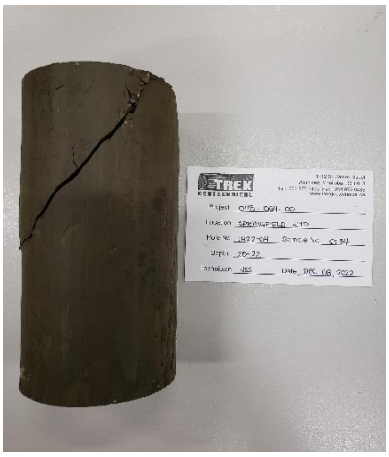


Photo:



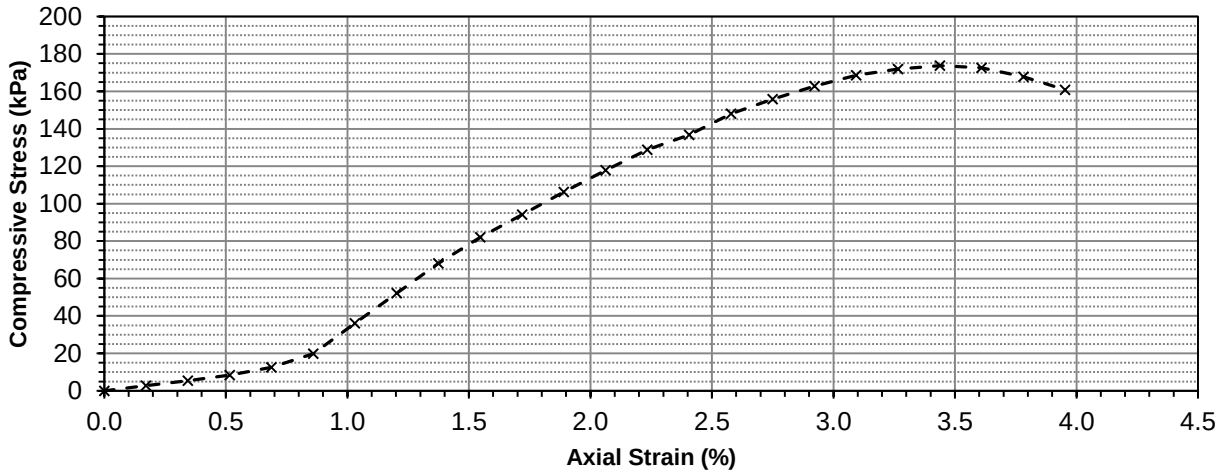
www.trekgeotechnical.ca
1712 St. James Street
Winnipeg, MB R3H 0L3
Tel: 204.975.9433 Fax: 204.975.9435

Unconfined Compressive Strength

ASTM D2166

Project No. 0115-069-00
Client Associated Engineering (Sask.) Ltd.
Project RM of Springfield Water Treatment Plant Expansions

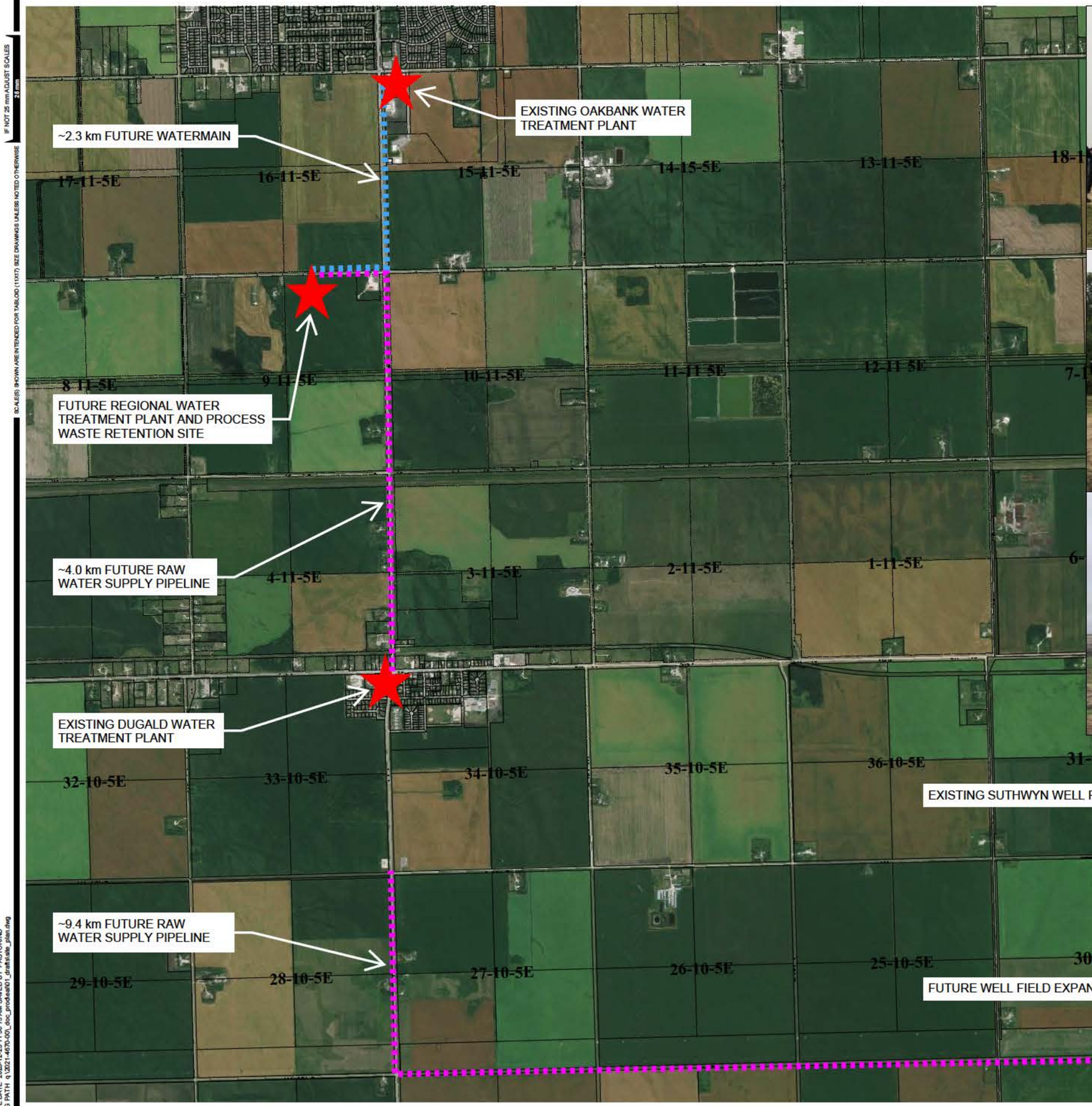
Unconfined Compression Test Graph



Unconfined Compression Test Data

Deformation Dial Reading	Load Ring Dial Reading	Deflection (mm)	Axial Strain (%)	Corrected Area (m^2)	Axial Load (N)	Compressive Stress, q_u (kPa)	Shear Stress, S_u (kPa)
0	0.39	0.0000	0.00	0.004213	0.0	0.00	0.00
10	0.62	0.2540	0.17	0.004220	11.6	2.75	1.37
20	0.84	0.5080	0.34	0.004228	22.7	5.36	2.68
30	1.09	0.7620	0.52	0.004235	35.3	8.33	4.17
40	1.45	1.0160	0.69	0.004242	53.4	12.59	6.30
50	2.06	1.2700	0.86	0.004250	84.2	19.81	9.90
60	3.44	1.5240	1.03	0.004257	153.7	36.11	18.06
70	4.81	1.7780	1.20	0.004265	222.8	52.24	26.12
80	6.16	2.0320	1.38	0.004272	290.8	68.08	34.04
90	7.36	2.2860	1.55	0.004279	351.3	82.09	41.05
100	8.40	2.5400	1.72	0.004287	403.7	94.18	47.09
110	9.45	2.7940	1.89	0.004294	456.7	106.34	53.17
120	10.45	3.0480	2.06	0.004302	507.1	117.87	58.93
130	11.40	3.3020	2.23	0.004310	554.9	128.77	64.38
140	12.10	3.5560	2.41	0.004317	590.2	136.72	68.36
150	13.09	3.8100	2.58	0.004325	640.1	148.01	74.01
160	13.79	4.0640	2.75	0.004332	675.4	155.90	77.95
170	14.41	4.3180	2.92	0.004340	706.7	162.82	81.41
180	14.93	4.5720	3.09	0.004348	732.9	168.56	84.28
190	15.25	4.8260	3.27	0.004355	749.0	171.96	85.98
200	15.43	5.0800	3.44	0.004363	758.1	173.74	86.87
210	15.36	5.3340	3.61	0.004371	754.5	172.62	86.31
220	14.96	5.5880	3.78	0.004379	734.4	167.71	83.85
230	14.39	5.8420	3.95	0.004387	705.6	160.86	80.43

APPENDIX C - PIPELINE ROUTE




OAKBANK WATER TREATMENT PLANT


DUGALD WATER TREATMENT PLANT


SUTHWYN WELL FIELD

Associated Engineering

BEST MANAGED COMPANIES
Platinum member

MUNICIPALITY OF SPRINGFIELD • MANITOBA •

FIGURE 1-1

RM OF SPRINGFIELD
DUGALD OAKBANK WATER SYSTEM UPGRADES

CIVIL
OVERALL SITE AND PIPELINE ROUTE PLAN

AE PROJECT No.	2021-4670-00
SCALE	1:35000
APPROVED	D. PASTORIN
DATE	2023DEC22
REV	0
DESCRIPTION	ISSUED FOR INFORMATION

APPENDIX D - WATER RIGHTS LICENCE

Licence to Use Water for Municipal Purposes

Manitoba
Sustainable Development
200 Saulteaux Cresc.
Winnipeg, Manitoba
R3J 3W3

Issued in accordance with the provisions
The Water Rights Act and regulations made thereunder.

Project:	Oakbank/Dugald
Licence No.:	**2019-107**
(Previous Lic. No.:	2016-102)
U.T.M.:	651468 E 5536224 N

Subject to the terms and conditions contained in this Licence, the Minister of Sustainable Development authorizes:

The Rural Municipality of Springfield

in the Province of Manitoba (the "LICENSEE") to construct, operate, establish and maintain a project consisting of water well(s), pump(s), transmittal pipeline(s) and other works specific to the type of use (the "WORKS") and divert water from a **Sand and gravel and Sandstone** aquifer located on the following land:

NE 30-11-5 EPM and SW 32-10-6 EPM

as more particularly located and shown on the attached Exhibit "A" for **Municipal** purposes on the following lands:

Oakbank and Dugald Service Area

This licence is issued upon the express condition that it shall be subject to the provisions of The Water Rights Act and Regulation and all amendments thereto and, without limiting the generality of the aforesaid, to the following terms and conditions, namely:

1. The water shall be used solely for **Municipal** purposes.

2. The WORKS shall be operated in accordance with the terms herein contained.

3. a) The maximum rate at which water may be diverted pursuant hereto shall not exceed **0.1320 cubic metres per second (4.66 cubic feet per second)**.

   b) The total quantity of water diverted in any one year shall not exceed **646.60 cubic decametres (524.20 acre feet)**.

4. Water shall not be diverted during any period when the water level in the aquifer is below the casing of any project well.

5. The LICENSEE does hereby remise, release and forever discharge Her Majesty the Queen in Right of the Province of Manitoba, of and from all manner of action, causes of action, claims and demands whatsoever which against Her Majesty the LICENSEE ever had, now has or may hereafter have, resulting from the use of water for **Municipal** purposes.

6. In the event that the rights of others are infringed upon and/or damage to the property of others is sustained as a result of the operation or maintenance of the WORKS and the rights herein granted, the LICENSEE shall be solely responsible and shall save harmless and fully indemnify Her Majesty the Queen in Right of the Province of Manitoba, from and against any liability to which Her Majesty may become liable by virtue of the issue of this Licence and anything done pursuant hereto.

7. This Licence is not assignable or transferable by the LICENSEE and when no longer required by the LICENSEE this Licence shall be returned to the Water Use Licensing Section for cancellation on behalf of the Minister.

8. Upon the execution of this Licence the LICENSEE hereby grants the Minister or the Minister's agents the right of ingress and egress to and from the lands on which the WORKS are located for the purpose of inspection of the WORKS and the LICENSEE shall at all times comply with such directions and/or orders that may be given by the Minister or the Minister's agents in writing from time to time with regard to the operation and maintenance of the WORKS.

9. This Licence may be amended, suspended or cancelled by the Minister in accordance with The Water Rights Act by letter addressed to the LICENSEE at **Box 219, Oakbank, MB, R0E 1J0, Canada** and thereafter this Licence shall be determined to be at an end.

10. Notwithstanding anything preceding in this Licence, the LICENSEE must have legal control, by ownership or by rental,

lease, or other agreement, of the lands on which the WORKS shall be placed and the water shall be used.

11. The term of this Licence shall expire on September 20, 2036 and this Licence shall become effective only on the date of execution hereof by a person so authorized in the Department of Sustainable Development. The LICENSEE may apply for renewal of this Licence not more than 365 days and not less than 90 days prior to the expiry date.

12. This Licence expires automatically upon the loss of the legal control of any of the lands on which the WORKS are located or on which water is used, unless the Licence is transferred or amended by the Minister upon application for Licence transfer or amendment.

13. The LICENSEE shall keep records of daily and annual water use and shall provide a copy of such records to the Water Use Licensing Section not later than February 1st of the following year.

14. A flow meter must be installed, positioned to accurately measure instantaneous pumping rate and accumulative withdrawals from the water source.

15. The LICENSEE does hereby agree to correct, to the satisfaction of the Minister, any water supply problems to wells or other forms of supply, which were constructed and operating prior to the date of the original application for the project and which are partly or wholly attributable, in the opinion of the Minister, to the diversion of water as authorized by this Licence.

16. The LICENSEE shall hold and maintain all other regulatory approvals that may be required and shall comply with all other regulatory requirements for the construction, operation, or maintenance of the WORKS or to divert or use water as provided by this Licence.

FOR OFFICE USE ONLY

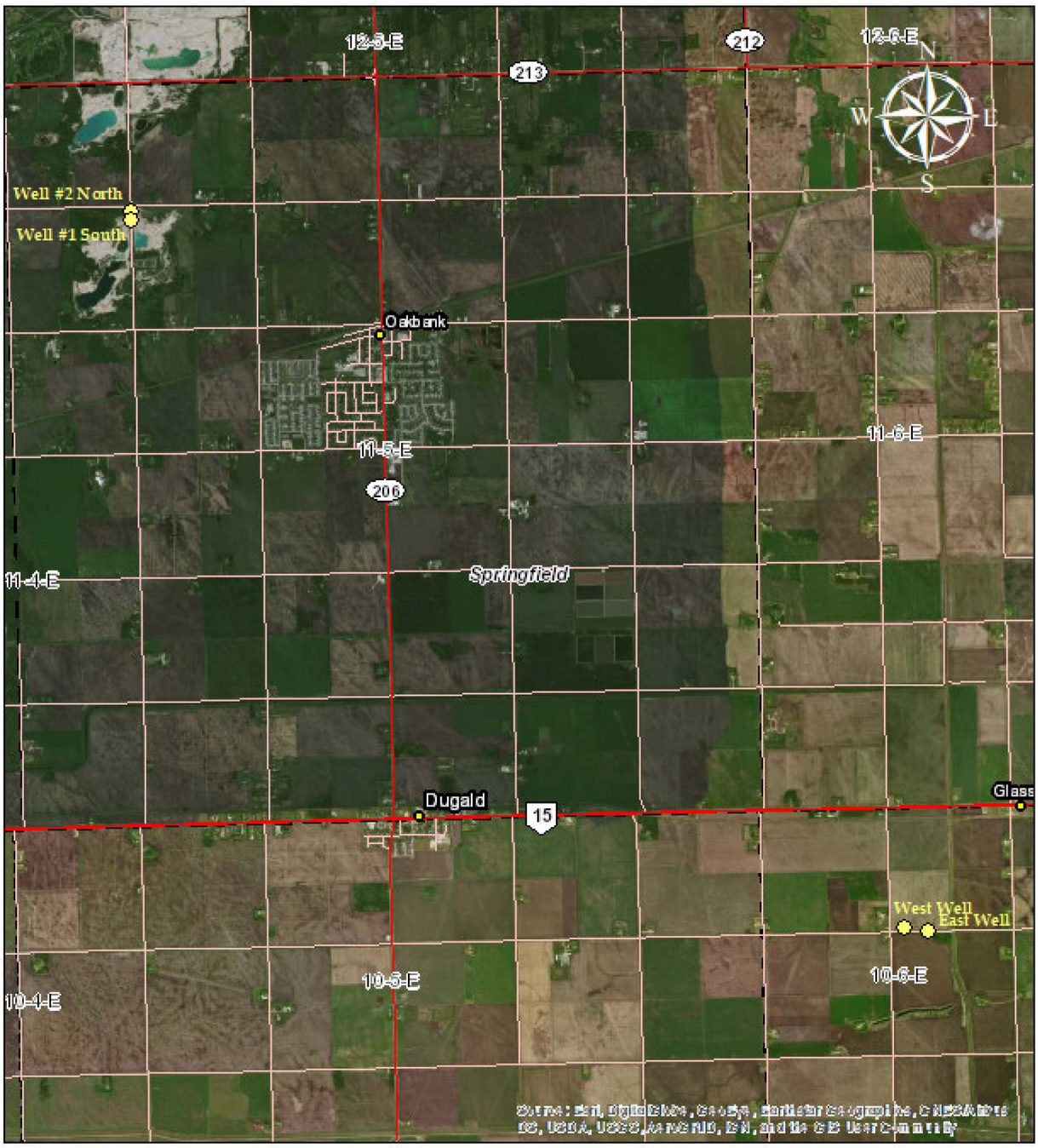
Issued at the City of Winnipeg, in the Province of Manitoba, this 30th day of December A.D. 20 19.

Perry Stonehouse

Print Name

[redacted]

Signed by the Honourable Minister of Sustainable Development (or her/his designate)



LOCATION OF SUPPLY WELLS
IN SW 32-10-6 EPM and NE 30-11-5 EPM
R. M. OF SPRINGFIELD (OAKBANK & DUGALD)
MUNICIPAL PURPOSES

EXHIBIT "A"

THIS PLAN IS AN INTEGRAL PART OF
LICENCE NO. ___2019-107___
ISSUED UNDER THE WATER RIGHTS ACT

1,500 750 0 1,500 Meters

APPENDIX E - CERTIFICATE OF TITLE

STATUS OF TITLE

Title Number **2401344/1**
Title Status **Accepted**
Client File 2021.4670-DOWS

Manitoba Land Titles Registry

1. REGISTERED OWNERS, TENANCY AND LAND DESCRIPTION

THE RURAL MUNICIPALITY OF SPRINGFIELD

IS REGISTERED OWNER SUBJECT TO SUCH ENTRIES RECORDED HEREON
IN THE FOLLOWING DESCRIBED LAND:

THE NE 1/4 OF SECTION 9-11-5 EPM
EXC FIRSTLY ALL THAT PORTION CONTAINED WITHIN THE FOLLOWING LIMITS:
COMMENCING AT THE SE CORNER OF SAID 1/4 SECTION, THENCE WLY ALONG
THE SOUTHERN LIMIT OF SAID 1/4 SECTION 2000 FEET, THENCE NLY AT RIGHT
ANGLES TO SAID SOUTHERN LIMIT 73.3 FEET, THENCE ELY IN A STRAIGHT
LINE TO A POINT IN THE EASTERN LIMIT OF SAID 1/4 SECTION DISTANT
NLY THEREON 71.8 FEET FROM SAID SE CORNER, THENCE SLY ALONG SAID
EASTERN LIMIT TO THE POINT OF COMMENCEMENT
SECONDLY: POWER TRANSMISSION LINE PLAN 2903 WLTO
THIRDLY: THE ELY 16.5 FEET AND
FOURTHLY: PLAN 49212 WLTO
TOGETHER WITH A RIGHT-OF-WAY FOR ALL PURPOSES AND AS APPURTENANT
TO ALL THAT PORTION OF THE LAND ABOVE DESCRIBED WHICH LIES EAST OF
THE STRAIGHT PRODUCTION NLY OF THE WESTERN LIMIT OF THE LAND FIRSTLY
ABOVE EXCEPTED OVER AND UPON THE SLY 30 FEET PERP OF THE NLY 1340
FEET PERP OF THE LAND THIRDLY ABOVE EXCEPTED

The land in this title is, unless the contrary is expressly declared, deemed to be subject to the reservations and restrictions set out in section 58 of *The Real Property Act.*

2. ACTIVE INSTRUMENTS

Instrument Type:	**Caveat**
Registration Number:	**3729371/1**
Instrument Status:	**Accepted**
Registration Date:	2009-01-27
From/By:	TM MOBILE INC.
To:	
Amount:	
Notes:	No notes
Description:	LEASE AGREEMENT

3. ADDRESSES FOR SERVICE

R.M. OF SPRINGFIELD
BOX 219
628 MAIN STREET
OAKBANK MB
R0E 1J0

4. TITLE NOTES

No title notes

5. LAND TITLES DISTRICT

Winnipeg

6. DUPLICATE TITLE INFORMATION

Duplicate not produced

7. FROM TITLE NUMBERS

1937355/1 Balance

8. REAL PROPERTY APPLICATION / CROWN GRANT NUMBERS

No real property application or grant information

9. ORIGINATING INSTRUMENTS

Instrument Type:	**Transfer Of Land**
Registration Number:	**3838510/1**
Registration Date:	2009-10-02
From/By:	HOWARD DALE BREDIN AND PAMELA LEE BREDIN
To:	THE RURAL MUNICIPALITY OF SPRINGFIELD
Consideration:	$317,550.00

10. LAND INDEX

NE 9-11-5E
EXC PT & EXC PL 2903, 49212

CERTIFIED TRUE EXTRACT PRODUCED FROM THE LAND TITLES DATA STORAGE SYSTEM OF TITLE NUMBER 2401344/1

APPENDIX F - ACCEPTABLE USE LETTER

Manitoba
Environment and Climate
Water Science and Watershed Management Branch
Box 14, 14 Fultz Blvd., Winnipeg, Manitoba, Canada R3Y 0L6
T 204-945-0002 **F** 204-948-2357
www.manitoba.ca/water

December 5, 2023

Robyn Grahame
Associated Engineering (Sask.) Ltd.
410-5 Donald Street
Winnipeg, MB R3L 2T4

Dear Ms. Robyn Grahame,

WATER QUALITY DATA: COOKS CREEK AND COOKS CREEK DIVERSION-GENERAL CHEMISTRY, PHYSICAL PARAMETERS, IONIC CONSTITUENTS, CARBON CONSTITUENTS, NUTRIENTS, TRACE METALS (2020-2022)

In accordance with your request, please find attached water quality data for the above mentioned water body. Although we have taken all reasonable measures to ensure that the enclosed data are correct and free of errors, it is recommended that you review these data carefully in the context of your intended application. Please note that concentrations preceded by an "L" were measured as less than the method detection limit.

Should these data be used in a report, technical manuscript, presentation, or other document, would you please reference as follows:

Water Quality Management Section
Manitoba Environment and Climate Change
Box 14, 14 Fultz Blvd.
Winnipeg MB R3Y 0L6

Please provide a copy of any report or manuscript arising from the use of these data to the undersigned. *Any requests for these data from a third party must be directed to the undersigned.*

Should you have any questions with regard to this information, or identify data that may be anomalous, please do not hesitate to contact our section at the above address, or by e-mail at Desiree.Stratton@gov.mb.ca.

Sincerely,

Desiree Stratton
Water Quality Monitoring Specialist
Manitoba Environment and Climate Change

Surface Water Quality Data Request Form

Instructions

1. Indicate the date of your request.
2. Provide your first and last name, the name of your organization, email address, and phone number.
3. Describe your project and explain how you intend to use these data, including if and where your interpretation of these data will be published.
4. Indicate the sample type by selecting the appropriate medium and specifying the parameters of interest. Indicate the relevant monitoring station(s) and date range.
5. Read the usage agreement and check the box to indicate your agreement.
6. After completing the form (all sections are mandatory), click SUBMIT REQUEST (Adobe Acrobat) or save the form and email to waterquality@gov.mb.ca

Date

Date of request (*MM/DD/YYYY*): 2023-12-08

Contact Information

Name: Robyn Grahame

Email address: grahamer@ae.ca

Organization: Associated Engineering (Sask.) Ltd.

Phone no.:

Project Information

Project title: Dugald Oakbank Water System Upgrades Phase 3

Project description (max 150 words):

The proposed Project is the construction of a New Water Treatment Plant that will be located in the Rural Municipality of Springfield, between Dugald and Oakbank. This WTP will distribute regionally and be able to service nearby future residential developments. Along with the treatment facility, the proposed development includes, raw water extension, distribution updates and construction of a seasonally discharging process waste retention pond. We are requesting a heritage review for the area shown on the map (WTP site and pipelines). Please reach out if further information is required.

Manitoba

Intended use of data (max 150 words):

The intended use of this data is to provide baseline samples of the Surface Water Quality of Cooks Creek or Cooks Creek Diversion for the Projects EAP. The project is proposing to seasonally discharge from the process waste to Cooks Creek Diversion. Data will be published and open for public comment through the Government of Manitoba's Environment Assessment and Licensing Public Registry.

Data Request Information

Media (CTRL+Click to select):
Select one or more from list

- Water - Surface
- Water - Euphotic
- Water - Bottom
- Sediment

Parameter(s):

General Chemistry, Physical Parameters, Ionic Constituents, Carbon Constituents, Nutrients, Trace Metals.

Monitoring stations:

Water body: Cooks Creek Diversion, Cooks Creek

Drainage basin: Red River

Date range (*MM/DD/YYYY*):

Data start date: 01/01/2020 Data end date: 11/23/2023

Usage Agreement

Conditions agreed upon include the opportunity for government staff to review and provide feedback on any report or manuscript (i.e. prior to publication) arising from the use of the information provided. The dataset provided by the Province of Manitoba is not to be published in a non-commercial, open access repository.

☑ By checking this box, I agree to the usage agreement above.

SUBMIT REQUEST

Manitoba

APPENDIX G - CORRESPONDENCE WITH HISTORIC RESOURCES BRANCH

Memorandum

DATE: **2024-01-15**

TO: **Associated Engineering (Sask.) Ltd.**
c/o Robyn Grahame
Junior Project Engineer
410-5 Donald Street,
Winnipeg MB R3L 2T4

FROM: **Archaeological Assessment Services Unit**
Historic Resources Branch
Manitoba Sport, Culture, Heritage and Tourism
Main Floor – 213 Notre Dame Avenue
Winnipeg, MB
R3B 1N3

FOR: **Rural Municipality of Springfield**

T: (204) 945-2118 F: (204) 948-2384
e: HRB.archaeology@gov.mb.ca

SUBJECT: **Heritage Screening Request – Proposed Dugald Oakbank Water System Upgrades**
AAS File AAS-23-21281
Rural Municipality of Springfield

No Concerns at this Time

Further to your e-mail regarding the above noted application, the Manitoba Historic Resources Branch (HRB) has examined the location in conjunction with Branch records for areas of potential concern. The potential to impact to heritage resources is believed to be low based on analysis of current data and evaluated by the type of action proposed, therefore, the HRB has no concerns with the proposed project at this time. This evaluation is only appropriate for this respective request.

Legislation

Under Section 46 and 51 of the Heritage Resources Act (the Act), if at any time, heritage resources are encountered in association with these lands during testing and development, there is an obligation to report any heritage resources and a prohibition on destruction, damage or alteration of said resources. HRB may require that an acceptable heritage resource management strategy be implemented by the proponent/developer to mitigate the effects of their activity on the heritage resources.

If you have any questions, please contact as above for proper assignment and queueing.

Historic Resources Branch
Archaeological Assessment Services Unit

Archaeological Assessment Services Unit

Heritage Screening Request

Manitoba
Sport, Culture and Heritage

Historic Resources Branch, Main Floor, 213 Notre Dame Avenue, Winnipeg, Manitoba, Canada, R3B 1N3
T 204.945.2118 | F 204.948.2384 | www.manitoba.ca | hrb.archaeology@gov.mb.ca

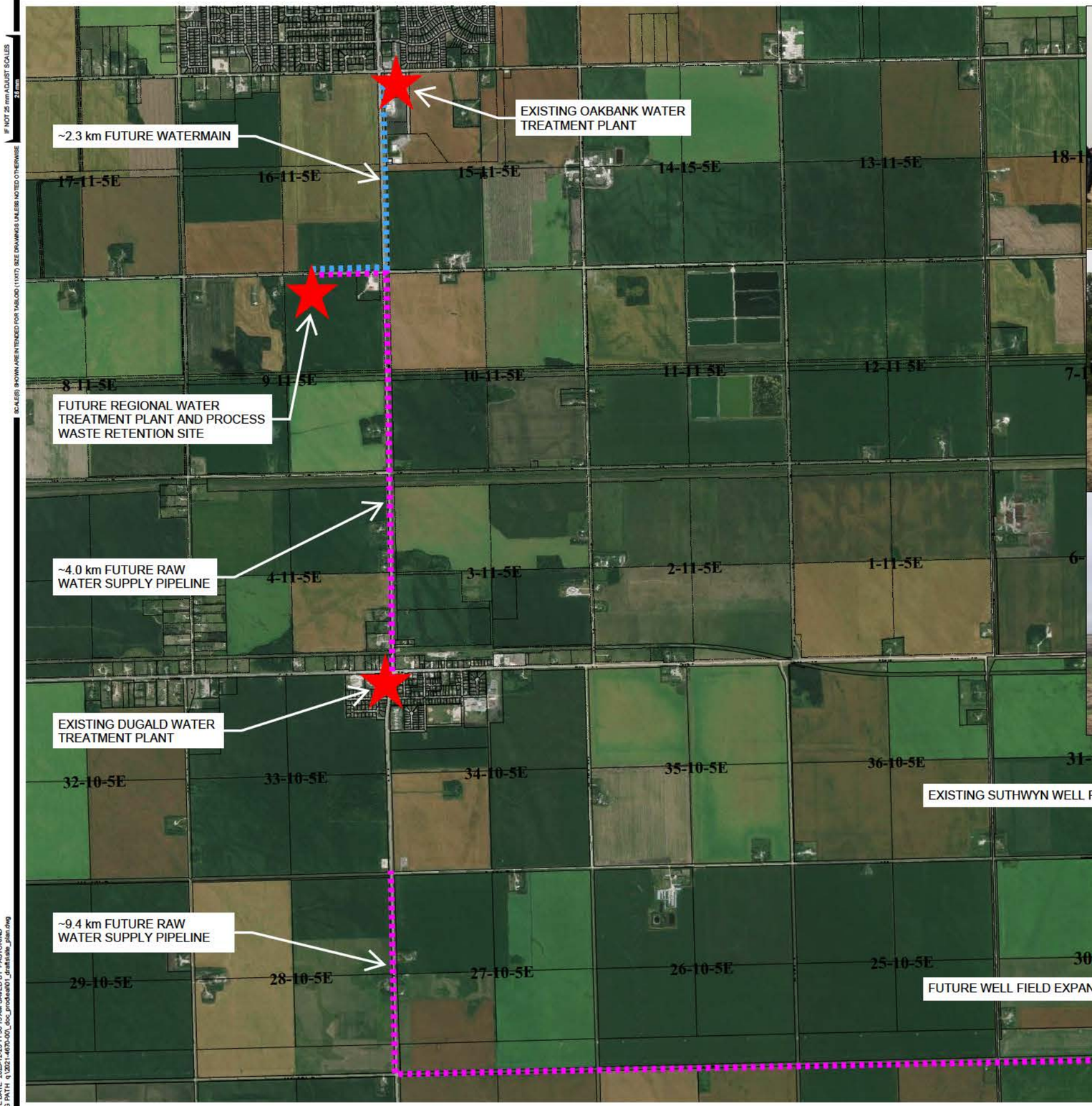
General Information			
Date of Request :	2023-12-08		
Name of Organization :	RM of Springfield (c/o Associated Engineering Sask. Ltd.)		
Contact Name :	Robyn Grahame		
Address :	410 – 5 Donald Street		
City :	Winnipeg	**Prov/State :**	MB
Postal/zip code :	R3L 2T4	**Phone :**	
e-mail :	grahamer@ae.ca		

Type of Request	
Type of project :	Environmental assessment proposal
Identify other :	
Project name (if applicable) :	Dugald Oakbank Water System Upgrades Phase 3 New Regional Water Treatment Plant
Roll/lot/parcel information :	See attached map.
Street Address :	49°54'52.99"N, 96°51'10.76"W
Legal description : LSD/quarter-Sec-Twp-Rge-PM	NE 9-11-5E
Municipality	Springfield
Nearest settlement :	Oakbank, MB

Project description

Please provide a brief description of your project below. Identify how heritage site locations will be utilized/incorporated into your project (if applicable). Please include relevant supporting documentation (e.g., figures, maps, photographs).

The proposed Project is the construction of a New Water Treatment Plant that will be located in the Rural Municipality of Springfield, between Dugald and Oakbank. This WTP will distribute regionally and be able to service nearby future residential developments. Along with the treatment facility, the proposed development includes, raw water extension, distribution updates and construction of a seasonally discharging process waste retention pond. We are requesting a heritage review for the area shown on the map (WTP site and pipelines). Please reach out if further information is required.




OAKBANK WATER TREATMENT PLANT


DUGALD WATER TREATMENT PLANT


SUTHWYN WELL FIELD

Associated Engineering

BEST MANAGED COMPANIES
Platinum member

MUNICIPALITY OF SPRINGFIELD • MANITOBA •

FIGURE 1-1

RM OF SPRINGFIELD
DUGALD OAKBANK WATER SYSTEM UPGRADES

CIVIL
OVERALL SITE AND PIPELINE ROUTE PLAN

AE PROJECT No.	2021-4670-00
SCALE	1:35000
APPROVED	D. PASTORIN
DATE	2023DEC22
REV	0
DESCRIPTION	ISSUED FOR INFORMATION

APPENDIX H - RAW WATER QUALITY

RM of Springfield - Oakbank Water Treatment Plant
ATTN: GREG AGNEW
Dugald (Oakbank) - PWS
Box 219
Oakbank MB R0E 1J0

Date Received: 21-JAN-22
Report Date: 27-JAN-22 14:18 (MT)
Version: FINAL

Client Phone: 204-444-2241

Certificate of Analysis

Lab Work Order #: L2680531
Project P.O. #: NOT SUBMITTED
Job Reference: DUGALD (OAKBANK) - PWS 55.35
C of C Numbers:
Legal Site Desc: 26719

[redacted]
Hua Wo
Chemistry Laboratory Manager

ANALYTICAL REPORT

Physical Tests (WATER)

				ALS ID	L2680531-1	
				Sampled Date	21-JAN-22	
				Sampled Time	11:00	
				Sample ID	DUGALD RM OF SPRINGFIELD 1 - RAW - WELL PUMP 1	
Analyte	Unit	Guide Limit #1	Guide Limit #2			
Colour, True	CU	15	-		<5 0	
Conductivity	umhos/cm	-	-		1100	
Hardness (as CaCO3)	mg/L	-	-		31.8	HTC
Langelier Index (4 C)	No Unit	-	-		0.27	
Langelier Index (60 C)	No Unit	-	-		1.0	
pH	pH units	7.00-10.5	-		8.62	
Total Dissolved Solids	mg/L	500	-		607	
Transmittance, UV (254 nm)	%T/cm	-	-		92.9	
Turbidity	NTU	-	-		1.31	

Federal Guidelines for Canadian Drinking Water Quality (MAR, 2021)
#1: GCDWQ - Aesthetic Objective/Other Value (Jan.2020)
#2: GCDWQ - Maximum Acceptable Concentrations (MACs-Jan.2020)

Anions and Nutrients (WATER)

				ALS ID	L2680531-1
				Sampled Date	21-JAN-22
				Sampled Time	11:00
				Sample ID	DUGALD RM OF SPRINGFIELD 1 - RAW - WELL PUMP 1
Analyte	Unit	Guide Limit #1	Guide Limit #2		
Alkalinity, Total (as CaCO3)	mg/L	-	-		313
Ammonia, Total (as N)	mg/L	-	-		0.452
Bicarbonate (HCO3)	mg/L	-	-		355
Bromide (Br)	mg/L	-	-		0.170
Carbonate (CO3)	mg/L	-	-		13.7
Chloride (Cl)	mg/L	250	-		105
Fluoride (F)	mg/L	-	1.5		1.61
Hydroxide (OH)	mg/L	-	-		<0.34
Nitrate (as N)	mg/L	-	10		0.0056
Nitrite (as N)	mg/L	-	1		0.0113
Sulfate (SO4)	mg/L	500	-		86.7

Federal Guidelines for Canadian Drinking Water Quality (MAR, 2021)
#1: GCDWQ - Aesthetic Objective/Other Value (Jan.2020)
#2: GCDWQ - Maximum Acceptable Concentrations (MACs-Jan.2020)

Organic / Inorganic Carbon (WATER)

				ALS ID	L2680531-1
				Sampled Date	21-JAN-22
				Sampled Time	11:00
				Sample ID	DUGALD RM OF SPRINGFIELD 1 - RAW - WELL PUMP 1
Analyte	Unit	Guide Limit #1	Guide Limit #2		
Dissolved Organic Carbon	mg/L	-	-		1.53
Total Organic Carbon	mg/L	-	-		1.39

Federal Guidelines for Canadian Drinking Water Quality (MAR, 2021)
#1: GCDWQ - Aesthetic Objective/Other Value (Jan.2020)
#2: GCDWQ - Maximum Acceptable Concentrations (MACs-Jan.2020)

Detection Limit for result exceeds Guide Limit. Assessment against Guide Limit cannot be made.
Analytical result for this parameter exceeds Guide Limit listed on this report.
* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Total Metals (WATER)

Analyte	Unit	Guide Limit #1	Guide Limit #2	ALS ID: L2680531-1 Sampled Date: 21-JAN-22 Sampled Time: 11:00 Sample ID: DUGALD RM OF SPRINGFIELD 1 - RAW - WELL PUMP 1
Aluminum (Al)-Total	mg/L	0.1	2.9	0.0789
Antimony (Sb)-Total	mg/L	-	0.006	<0.00010
Arsenic (As)-Total	mg/L	-	0.01	0.00014
Barium (Ba)-Total	mg/L	-	2	0.0179
Beryllium (Be)-Total	mg/L	-	-	<0.00010
Bismuth (Bi)-Total	mg/L	-	-	<0.000050
Boron (B)-Total	mg/L	-	5	1.37
Cadmium (Cd)-Total	mg/L	-	0.005	<0.0000050
Calcium (Ca)-Total	mg/L	-	-	7.41
Cesium (Cs)-Total	mg/L	-	-	0.000025
Chromium (Cr)-Total	mg/L	-	0.05	0.00017
Cobalt (Co)-Total	mg/L	-	-	0.00016
Copper (Cu)-Total	mg/L	1	2	0.00091
Iron (Fe)-Total	mg/L	0.3	-	0.201
Lead (Pb)-Total	mg/L	-	0.005	0.000596
Lithium (Li)-Total	mg/L	-	-	0.0733
Magnesium (Mg)-Total	mg/L	-	-	3.23
Manganese (Mn)-Total	mg/L	0.02	0.12	0.00330
Molybdenum (Mo)-Total	mg/L	-	-	0.00341
Nickel (Ni)-Total	mg/L	-	-	<0.00050
Phosphorus (P)-Total	mg/L	-	-	<0.050
Potassium (K)-Total	mg/L	-	-	10.6
Rubidium (Rb)-Total	mg/L	-	-	0.00580
Selenium (Se)-Total	mg/L	-	0.05	0.000074
Silicon (Si)-Total	mg/L	-	-	2.77
Silver (Ag)-Total	mg/L	-	-	<0.000010
Sodium (Na)-Total	mg/L	200	-	193
Strontium (Sr)-Total	mg/L	-	7	0.0770
Tellurium (Te)-Total	mg/L	-	-	0.00028
Thallium (Tl)-Total	mg/L	-	-	<0.000010
Thorium (Th)-Total	mg/L	-	-	<0.00010
Tin (Sn)-Total	mg/L	-	-	0.00014
Titanium (Ti)-Total	mg/L	-	-	0.00248

Federal Guidelines for Canadian Drinking Water Quality (MAR, 2021)
#1: GCDWQ - Aesthetic Objective/Other Value (Jan.2020)
#2: GCDWQ - Maximum Acceptable Concentrations (MACs-Jan.2020)

Detection Limit for result exceeds Guide Limit. Assessment against Guide Limit cannot be made.
Analytical result for this parameter exceeds Guide Limit listed on this report.
* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Total Metals (WATER)

				ALS ID	L2680531-1
				Sampled Date	21-JAN-22
				Sampled Time	11:00
				Sample ID	**DUGALD RM OF SPRINGFIELD 1 - RAW - WELL PUMP 1**
Analyte	Unit	Guide Limit #1	Guide Limit #2		
Tungsten (W)-Total	mg/L	-	-		<0.00010
Uranium (U)-Total	mg/L	-	0.02		0.000028
Vanadium (V)-Total	mg/L	-	-		<0.00050
Zinc (Zn)-Total	mg/L	5	-		0.0049
Zirconium (Zr)-Total	mg/L	-	-		<0.00020

Federal Guidelines for Canadian Drinking Water Quality (MAR, 2021)
#1: GCDWQ - Aesthetic Objective/Other Value (Jan.2020)
#2: GCDWQ - Maximum Acceptable Concentrations (MACs-Jan.2020)

Detection Limit for result exceeds Guide Limit. Assessment against Guide Limit cannot be made.
Analytical result for this parameter exceeds Guide Limit listed on this report.
* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-CO3CO3-CALC-WP	Water	Alkalinity, Carbonate	CALCULATION
The Alkalinity of water is a measure of its acid neutralizing capacity.Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contr buted by carbonate is calculated and reported as mg CO3 2-/L.			
ALK-HCO3HCO3-CALC-WP	Water	Alkalinity, Bicarbonate	CALCULATION
The Alkalinity of water is a measure of its acid neutralizing capacity.Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contr buted by bicarbonate is calculated and reported as mg HCO3-/L			
ALK-OHOH-CALC-WP	Water	Alkalinity, Hydroxide	CALCULATION
The Alkalinity of water is a measure of its acid neutralizing capacity.Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contr buted by hydroxide is calculated and reported as mg OH-/L.			
ALK-TITR-WP	Water	Alkalinity, Total (as CaCO3)	APHA 2320B
The Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. Total alkalinity is determined by titration with a strong standard mineral acid to the successive HCO3- and H2CO3 endpoints indicated electrometrically.			
BR-L-IC-N-WP	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)-LR
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
C-DOC-HTC-WP	Water	Dissolved Organic Carbon by Combustion	APHA 5310 B-WP
Filtered (0.45 um) sample is acidified and purged to remove inorganic carbon, then injected into a heated reaction chamber where organic carbon is oxidized to CO2 which is then transported in the carrier gas stream and measured via a non-dispersive infrared analyzer.			
C-TOC-HTC-WP	Water	Total Organic Carbon by Combustion	APHA 5310 B-WP
Sample is acidified and purged to remove inorganic carbon, then injected into a heated reaction chamber where organic carbon is oxidized to CO2 which is then transported in the carrier gas stream and measured via a non-dispersive infrared analyzer.			
CL-L-IC-N-WP	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
COLOUR-TRUE-WP	Water	Colour, True	APHA 2120C
True Colour is measured spectrophotometrically by comparison to platinum-cobalt standards using the single wavelength method (450 - 465 nm) after filtration of sample through a 0.45 um filter. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.			
EC-SCREEN-WP	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other test eg. IC, TDS, TSS, etc			
EC-WP	Water	Conductivity	APHA 2510B
Conductivity of an aqueous solution refers to its ability to carry an electric current. Conductance of a solution is measured between two spatially fixed and chemically inert electrodes.			
ETL-LANGELIER-4-WP	Water	Langelier Index 4C	Calculated
ETL-LANGELIER-60-WP	Water	Langelier Index 60C	Calculated
F-IC-N-WP	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
HARDNESS-CALC-WP	Water	Hardness Calculated	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
IONBALANCE-CALC-WP	Water	Ion Balance Calculation	APHA 1030E

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance (as % difference) cannot be calculated accurately for waters with very low electrical conductivity (EC), and is reported as "Low EC" where EC < 100 uS/cm (umhos/cm). Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-T-CCMS-WP	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020B (mod.)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-COL-WP	Water	Ammonia by colour	APHA 4500 NH3 F

Ammonia in water samples forms indophenol when reacted with hypochlorite and phenol. The intensity is amplified by the addition of sodium nitroprusside and measured colourmetrically.

NO2-L-IC-N-WP	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WP	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-WP	Water	pH	APHA 4500H

The pH of a sample is the determination of the activity of the hydrogen ions by potentiometric measurement using a standard hydrogen electrode and a reference electrode.

SO4-IC-N-WP	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-WP	Water	Total Dissolved Solids (TDS)	APHA 2540 SOLIDS C,E

A well-mixed sample is filtered through a glass fiber filter paper. The filtrate is then evaportaed to dryness in a pre-weighed vial and dried at 180 – 2C. The increase in vial weight represents the total dissolved solids.

TURBIDITY-WP	Water	Turbidity	APHA 2130B (modified)

Turbidity in aqueous matrices is determined by the nephelometric method.

UV-%TRANS-WP	Water	UV Transmittance (Calculated)	APHA 5910B

Test method is adapted from APHA Method 5910B. A sample is filtered through a 0.45 um polyethersulfone (PES) filter and its UV Absorbance is measured in a quartz cell at 254 nm. UV Transmittance is calculated from the UV Absorbance result and reported as UV Transmittance per cm. The analysis is carried out without pH adjustment.

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

Chain of Custody Numbers:

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

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Reference Information

GLOSSARY OF REPORT TERMS

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

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2680531 Report Date: 27-JAN-22

Client: RM of Springfield - Oakbank Water Treatment Plant
Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0

Contact: GREG AGNEW

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TITR-WP	**Water**							
Batch R5707697								
WG3688911-10 DUP		**L2680487-3**						
A kalinity, Total (as CaCO3)		71.7	70.4		mg/L	1.8	20	25-JAN-22
WG3688911-9 LCS								
A kalinity, Total (as CaCO3)			100.1		%		85-115	25-JAN-22
WG3688911-6 MB								
A kalinity, Total (as CaCO3)			<1.0		mg/L		1	25-JAN-22
BR-L-IC-N-WP	**Water**							
Batch R5707998								
WG3687727-6 LCS								
Bromide (Br)			101.2		%		85-115	22-JAN-22
C-DOC-HTC-WP	**Water**							
Batch R5709666								
WG3689619-3 DUP		**L2680694-9**						
Dissolved Organic Carbon		9.33	9.27		mg/L	0.6	20	26-JAN-22
WG3689619-2 LCS								
Dissolved Organic Carbon			101.8		%		80-120	26-JAN-22
WG3689619-1 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	26-JAN-22
WG3689619-4 MS		**L2680694-10**						
Dissolved Organic Carbon			94.8		%		70-130	26-JAN-22
C-TOC-HTC-WP	**Water**							
Batch R5709667								
WG3689623-3 DUP		**L2681227-2**						
Total Organic Carbon		7.21	7.14		mg/L	1.0	20	26-JAN-22
WG3689623-2 LCS								
Total Organic Carbon			103.0		%		80-120	26-JAN-22
WG3689623-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	26-JAN-22
WG3689623-4 MS		**L2681227-3**						
Total Organic Carbon			101.0		%		70-130	26-JAN-22
CL-L-IC-N-WP	**Water**							
Batch R5707998								
WG3687727-6 LCS								
Chloride (Cl)			96.9		%		90-110	22-JAN-22
COLOUR-TRUE-WP	**Water**							

Quality Control Report

Client: RM of Springfield - Oakbank Water Treatment Plant
Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0
Contact: GREG AGNEW

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
COLOUR-TRUE-WP	**Water**							
Batch R5706862								
WG3688260-3 DUP		**L2680406-1**						
Colour, True		10.3	9.6		CU	7.3	20	21-JAN-22
WG3688260-2 LCS								
Colour, True			97.6		%		85-115	21-JAN-22
WG3688260-1 MB								
Colour, True			<5.0		CU		5	21-JAN-22
EC-WP	**Water**							
Batch R5707697								
WG3688911-10 DUP		**L2680487-3**						
Conductivity		1490	1480		umhos/cm	0.3	10	25-JAN-22
WG3688911-8 LCS								
Conductivity			100.1		%		90-110	25-JAN-22
WG3688911-6 MB								
Conductivity			<1.0		umhos/cm		1	25-JAN-22
F-IC-N-WP	**Water**							
Batch R5707998								
WG3687727-6 LCS								
Fluoride (F)			96.6		%		90-110	22-JAN-22
WG3687727-5 MB								
Fluoride (F)			<0.020		mg/L		0.02	22-JAN-22
MET-T-CCMS-WP	**Water**							
Batch R5708016								
WG3687967-4 DUP		**WG3687967-3**						
Aluminum (Al)-Total		0.0157	0.0146		mg/L	7.3	20	24-JAN-22
Antimony (Sb)-Total		0.00015	0.00016		mg/L	4.7	20	24-JAN-22
Arsenic (As)-Total		0.00359	0.00355		mg/L	1.3	20	24-JAN-22
Barium (Ba)-Total		0.00720	0.00703		mg/L	2.5	20	24-JAN-22
Beryllium (Be)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	24-JAN-22
Bismuth (Bi)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	24-JAN-22
Boron (B)-Total		<0.010	<0.010	RPD-NA	mg/L	N/A	20	24-JAN-22
Cadmium (Cd)-Total		<0.0000050	<0.000005(	RPD-NA	mg/L	N/A	20	24-JAN-22
Calcium (Ca)-Total		7.58	7.76		mg/L	2.3	20	24-JAN-22
Cesium (Cs)-Total		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	24-JAN-22
Chromium (Cr)-Total		0.00015	0.00016		mg/L	7.1	20	24-JAN-22
Cobalt (Co)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	24-JAN-22
Copper (Cu)-Total		0.00092	0.00090		mg/L	2.3	20	24-JAN-22

Quality Control Report

Client: RM of Springfield - Oakbank Water Treatment Plant
Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0
Contact: GREG AGNEW

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WP	**Water**							
Batch R5708016								
WG3687967-4 DUP		**WG3687967-3**						
Iron (Fe)-Total		0.034	0.033		mg/L	3.4	20	24-JAN-22
Lead (Pb)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	24-JAN-22
Lithium (Li)-Total		0.0012	0.0012		mg/L	3.7	20	24-JAN-22
Magnesium (Mg)-Total		2.06	1.99		mg/L	3.0	20	24-JAN-22
Manganese (Mn)-Total		0.00172	0.00171		mg/L	0.5	20	24-JAN-22
Molybdenum (Mo)-Total		0.000139	0.000142		mg/L	2.0	20	24-JAN-22
Nickel (Ni)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	24-JAN-22
Potassium (K)-Total		0.827	0.813		mg/L	1.7	20	24-JAN-22
Phosphorus (P)-Total		<0.030	<0.030	RPD-NA	mg/L	N/A	20	24-JAN-22
Rubidium (Rb)-Total		0.00177	0.00172		mg/L	3.0	20	24-JAN-22
Selenium (Se)-Total		0.000124	0.000160	J	mg/L	0.000036	0.0001	24-JAN-22
Silicon (Si)-Total		1.82	1.75		mg/L	3.8	20	24-JAN-22
Silver (Ag)-Total		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	24-JAN-22
Sodium (Na)-Total		1.69	1.65		mg/L	2.2	20	24-JAN-22
Strontium (Sr)-Total		0.0265	0.0261		mg/L	1.5	20	24-JAN-22
Tellurium (Te)-Total		<0.00020	<0.00020	RPD-NA	mg/L	N/A	20	24-JAN-22
Thallium (Tl)-Total		<0.000010	0.000014	RPD-NA	mg/L	N/A	20	24-JAN-22
Thorium (Th)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	24-JAN-22
Tin (Sn)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	24-JAN-22
Titanium (Ti)-Total		0.00031	<0.00030	RPD-NA	mg/L	N/A	20	24-JAN-22
Tungsten (W)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	24-JAN-22
Uranium (U)-Total		0.000054	0.000054		mg/L	0.2	20	24-JAN-22
Vanadium (V)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	24-JAN-22
Zinc (Zn)-Total		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	24-JAN-22
Zirconium (Zr)-Total		<0.00020	<0.00020	RPD-NA	mg/L	N/A	20	24-JAN-22
WG3687967-2 LCS								
Aluminum (Al)-Total			92.2		%		80-120	24-JAN-22
Antimony (Sb)-Total			98.2		%		80-120	24-JAN-22
Arsenic (As)-Total			101.0		%		80-120	24-JAN-22
Barium (Ba)-Total			101.3		%		80-120	24-JAN-22
Beryllium (Be)-Total			86.1		%		80-120	24-JAN-22
Bismuth (Bi)-Total			100.6		%		80-120	24-JAN-22
Boron (B)-Total			85.3		%		80-120	24-JAN-22

Quality Control Report

Client: RM of Springfield - Oakbank Water Treatment Plant
Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0

Contact: GREG AGNEW

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WP	**Water**							
Batch R5708016								
WG3687967-2 LCS								
Cadmium (Cd)-Total			96.7		%		80-120	24-JAN-22
Calcium (Ca)-Total			88.7		%		80-120	24-JAN-22
Cesium (Cs)-Total			97.3		%		80-120	24-JAN-22
Chromium (Cr)-Total			89.9		%		80-120	24-JAN-22
Cobalt (Co)-Total			90.8		%		80-120	24-JAN-22
Copper (Cu)-Total			88.5		%		80-120	24-JAN-22
Iron (Fe)-Total			86.0		%		80-120	24-JAN-22
Lead (Pb)-Total			98.5		%		80-120	24-JAN-22
Lithium (Li)-Total			91.9		%		80-120	24-JAN-22
Magnesium (Mg)-Total			91.5		%		80-120	24-JAN-22
Manganese (Mn)-Total			92.7		%		80-120	24-JAN-22
Molybdenum (Mo)-Total			97.8		%		80-120	24-JAN-22
Nickel (Ni)-Total			89.9		%		80-120	24-JAN-22
Potassium (K)-Total			93.0		%		80-120	24-JAN-22
Phosphorus (P)-Total			90.9		%		80-120	24-JAN-22
Rubidium (Rb)-Total			100.8		%		80-120	24-JAN-22
Selenium (Se)-Total			86.5		%		80-120	24-JAN-22
Silicon (Si)-Total			94.1		%		80-120	24-JAN-22
Silver (Ag)-Total			88.3		%		80-120	24-JAN-22
Sodium (Na)-Total			87.8		%		80-120	24-JAN-22
Strontium (Sr)-Total			98.5		%		80-120	24-JAN-22
Tellurium (Te)-Total			92.0		%		80-120	24-JAN-22
Thallium (Tl)-Total			96.1		%		80-120	24-JAN-22
Thorium (Th)-Total			98.2		%		80-120	24-JAN-22
Tin (Sn)-Total			96.1		%		80-120	24-JAN-22
Titanium (Ti)-Total			87.5		%		80-120	24-JAN-22
Tungsten (W)-Total			93.3		%		80-120	24-JAN-22
Uranium (U)-Total			95.5		%		80-120	24-JAN-22
Vanadium (V)-Total			96.2		%		80-120	24-JAN-22
Zinc (Zn)-Total			92.1		%		80-120	24-JAN-22
Zirconium (Zr)-Total			94.5		%		80-120	24-JAN-22
WG3687967-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	24-JAN-22
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	24-JAN-22

Quality Control Report

Client: RM of Springfield - Oakbank Water Treatment Plant
Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0
Contact: GREG AGNEW

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WP	**Water**							
Batch R5708016								
WG3687967-1 MB								
Arsenic (As)-Total			<0.00010		mg/L		0.0001	24-JAN-22
Barium (Ba)-Total			<0.00010		mg/L		0.0001	24-JAN-22
Beryllium (Be)-Total			<0.00010		mg/L		0.0001	24-JAN-22
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	24-JAN-22
Boron (B)-Total			<0.010		mg/L		0.01	24-JAN-22
Cadmium (Cd)-Total			<0.000005C		mg/L		0.000005	24-JAN-22
Calcium (Ca)-Total			<0.050		mg/L		0.05	24-JAN-22
Cesium (Cs)-Total			<0.000010		mg/L		0.00001	24-JAN-22
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	24-JAN-22
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	24-JAN-22
Copper (Cu)-Total			<0.00050		mg/L		0.0005	24-JAN-22
Iron (Fe)-Total			<0.010		mg/L		0.01	24-JAN-22
Lead (Pb)-Total			<0.000050		mg/L		0.00005	24-JAN-22
Lithium (Li)-Total			<0.0010		mg/L		0.001	24-JAN-22
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	24-JAN-22
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	24-JAN-22
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	24-JAN-22
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	24-JAN-22
Potassium (K)-Total			<0.050		mg/L		0.05	24-JAN-22
Phosphorus (P)-Total			<0.030		mg/L		0.03	24-JAN-22
Rubidium (Rb)-Total			<0.00020		mg/L		0.0002	24-JAN-22
Selenium (Se)-Total			<0.000050		mg/L		0.00005	24-JAN-22
Silicon (Si)-Total			<0.10		mg/L		0.1	24-JAN-22
Silver (Ag)-Total			<0.000010		mg/L		0.00001	24-JAN-22
Sodium (Na)-Total			<0.050		mg/L		0.05	24-JAN-22
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	24-JAN-22
Tellurium (Te)-Total			<0.00020		mg/L		0.0002	24-JAN-22
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	24-JAN-22
Thorium (Th)-Total			<0.00010		mg/L		0.0001	24-JAN-22
Tin (Sn)-Total			<0.00010		mg/L		0.0001	24-JAN-22
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	24-JAN-22
Tungsten (W)-Total			<0.00010		mg/L		0.0001	24-JAN-22
Uranium (U)-Total			<0.000010		mg/L		0.00001	24-JAN-22

Quality Control Report

Client: RM of Springfield - Oakbank Water Treatment Plant
Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0
Contact: GREG AGNEW

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WP	**Water**							
Batch R5708016								
WG3687967-1 MB								
Vanadium (V)-Total			<0.00050		mg/L		0.0005	24-JAN-22
Zinc (Zn)-Total			<0.0030		mg/L		0.003	24-JAN-22
Zirconium (Zr)-Total			<0.00020		mg/L		0.0002	24-JAN-22
WG3687967-5 MS		**WG3687967-3**						
Aluminum (Al)-Total			100.9		%		70-130	24-JAN-22
Antimony (Sb)-Total			108.9		%		70-130	24-JAN-22
Arsenic (As)-Total			110.0		%		70-130	24-JAN-22
Barium (Ba)-Total			112.7		%		70-130	24-JAN-22
Beryllium (Be)-Total			97.9		%		70-130	24-JAN-22
Bismuth (Bi)-Total			109.7		%		70-130	24-JAN-22
Boron (B)-Total			89.1		%		70-130	24-JAN-22
Cadmium (Cd)-Total			108.1		%		70-130	24-JAN-22
Calcium (Ca)-Total			N/A	MS-B	%		-	24-JAN-22
Cesium (Cs)-Total			107.8		%		70-130	24-JAN-22
Chromium (Cr)-Total			101.6		%		70-130	24-JAN-22
Cobalt (Co)-Total			100.5		%		70-130	24-JAN-22
Copper (Cu)-Total			97.6		%		70-130	24-JAN-22
Iron (Fe)-Total			100.4		%		70-130	24-JAN-22
Lead (Pb)-Total			107.7		%		70-130	24-JAN-22
Lithium (Li)-Total			104.5		%		70-130	24-JAN-22
Magnesium (Mg)-Total			N/A	MS-B	%		-	24-JAN-22
Manganese (Mn)-Total			104.0		%		70-130	24-JAN-22
Molybdenum (Mo)-Total			105.0		%		70-130	24-JAN-22
Nickel (Ni)-Total			100.2		%		70-130	24-JAN-22
Potassium (K)-Total			102.9		%		70-130	24-JAN-22
Phosphorus (P)-Total			98.9		%		70-130	24-JAN-22
Rubidium (Rb)-Total			109.9		%		70-130	24-JAN-22
Selenium (Se)-Total			97.6		%		70-130	24-JAN-22
Silicon (Si)-Total			96.2		%		70-130	24-JAN-22
Silver (Ag)-Total			105.8		%		70-130	24-JAN-22
Sodium (Na)-Total			91.6		%		70-130	24-JAN-22
Strontium (Sr)-Total			N/A	MS-B	%		-	24-JAN-22
Tellurium (Te)-Total			103.9		%		70-130	24-JAN-22
Thallium (Tl)-Total			103.4		%		70-130	24-JAN-22

Quality Control Report

Client: RM of Springfield - Oakbank Water Treatment Plant
Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0

Contact: GREG AGNEW

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WP	**Water**							
Batch R5708016								
WG3687967-5 MS		**WG3687967-3**						
Thorium (Th)-Total			111.5		%		70-130	24-JAN-22
Tin (Sn)-Total			107.3		%		70-130	24-JAN-22
Titanium (Ti)-Total			101.1		%		70-130	24-JAN-22
Tungsten (W)-Total			105.1		%		70-130	24-JAN-22
Uranium (U)-Total			102.9		%		70-130	24-JAN-22
Vanadium (V)-Total			105.9		%		70-130	24-JAN-22
Zinc (Zn)-Total			103.6		%		70-130	24-JAN-22
Zirconium (Zr)-Total			109.6		%		70-130	24-JAN-22
NH3-COL-WP	**Water**							
Batch R5709482								
WG3689550-11 DUP		**L2680487-1**						
Ammonia, Total (as N)		0.028	0.026		mg/L	6.2	20	25-JAN-22
WG3689550-10 LCS								
Ammonia, Total (as N)			92.8		%		85-115	25-JAN-22
WG3689550-9 MB								
Ammonia, Total (as N)			<0.010		mg/L		0.01	25-JAN-22
WG3689550-12 MS		**L2680487-1**						
Ammonia, Total (as N)			84.7		%		75-125	25-JAN-22
NO2-L-IC-N-WP	**Water**							
Batch R5707998								
WG3687727-6 LCS								
Nitrite (as N)			98.0		%		90-110	22-JAN-22
WG3687727-5 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	22-JAN-22
NO3-L-IC-N-WP	**Water**							
Batch R5707998								
WG3687727-6 LCS								
Nitrate (as N)			97.2		%		90-110	22-JAN-22
WG3687727-5 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	22-JAN-22
PH-WP	**Water**							
Batch R5707697								
WG3688911-10 DUP		**L2680487-3**						
pH		7.71	7.70	J	pH units	0.01	0.2	25-JAN-22
WG3688911-7 LCS								

Quality Control Report

Client: RM of Springfield - Oakbank Water Treatment Plant
Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0
Contact: GREG AGNEW

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PH-WP	**Water**							
Batch R5707697								
WG3688911-7 LCS								
pH			7.01		pH units		6.9-7.1	25-JAN-22
SO4-IC-N-WP	**Water**							
Batch R5707998								
WG3687727-7 DUP		**L2680487-1**						
Sulfate (SO4)		2.13	2.11		mg/L	0.8	20	22-JAN-22
WG3687727-6 LCS								
Sulfate (SO4)			98.1		%		90-110	22-JAN-22
WG3687727-5 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	22-JAN-22
WG3687727-8 MS		**L2680487-1**						
Sulfate (SO4)			104.2		%		75-125	22-JAN-22
TDS-WP	**Water**							
Batch R5707496								
WG3688010-4 DUP		**L2680487-2**						
Total Dissolved Solids		50	51		mg/L	2.0	20	24-JAN-22
WG3688010-3 LCS								
Total Dissolved Solids			96.7		%		85-115	24-JAN-22
WG3688010-1 MB								
Total Dissolved Solids			<4.0		mg/L		4	24-JAN-22
TURBIDITY-WP	**Water**							
Batch R5706516								
WG3688190-3 DUP		**L2680585-1**						
Turbidity		0.55	0.55		NTU	1.6	15	22-JAN-22
WG3688190-2 LCS								
Turbidity			98.0		%		85-115	22-JAN-22
WG3688190-1 MB								
Turbidity			<0.10		NTU		0.1	22-JAN-22
UV-%TRANS-WP	**Water**							
Batch R5706394								
WG3688255-3 DUP		**L2680531-1**						
Transmittance, UV (254 nm)		92.9	94.8		%T/cm	2.1	20	22-JAN-22
WG3688255-1 IRM		**BLANK**						
Transmittance, UV (254 nm)			100.0		%		99.5-100.5	22-JAN-22
WG3688255-2 LCS								
Transmittance, UV (254 nm)			105.9		%		85-115	22-JAN-22

Quality Control Report

Workorder: L2680531 Report Date: 27-JAN-22

Client: RM of Springfield - Oakbank Water Treatment Plant
Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0
Contact: GREG AGNEW

Legend:

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

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Workorder: L2680531 Report Date: 27-JAN-22

Client: RM of Springfield - Oakbank Water Treatment Plant
Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0
Contact: GREG AGNEW

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH							
	1	21-JAN-22 11:00	25-JAN-22 12:00	0.25	97	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2680531 were received on 21-JAN-22 12:37.

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.

L2680531-COFC

Conservation and Climate
Office of Drinking Water
1007 Century Street, Winnipeg, Manitoba,
Canada R3H 0W4

stody (COC)
Drinking Water Systems

Regular Service (default):	☑ Regular Service (is 5-7 Days):
Unless otherwise requested	☐ 1 Day, rush / priority ☐ 2 Day, rush / priority ☐ 3 Day, rush / priority

Report to Operator (email PDF):	
Contact:	Greg Agnew
Address:	Box 219, Oakbank, MB R0E1J0
Phone:	(204) 444-2241
Email:	gagnew@rmofspringfield.ca PPawluk@rmofSpringfield.ca

Report to Owner (email PDF):	
Contact:	Colleen Draper
Address:	Box 219, Oakbank, MB R0E 1J0
Phone:	(204) 444-3321
Email:	

Email PDF copy to:	
DWO:	Dylan Lyng
DWO Address:	Box 6000 75-7th Ave, Gimli, MB R0C1B0
DWO Phone:	(204) 391-1811
DWO Email:	Dylan.Lyng@gov.mb.ca
Additional Email:	Joern.Muenster@gov.mb.ca; Nancy.Eidse@gov.mb.ca

If an update in Owner or Operator contact information is required, please contact your Drinking Water Officer

Client / Project Information:	**Lab:**	**Account:**	Agency Code: 382	Report Type: EMS (Lab-MWS)	Project: DWQ-C

Operation Name:	DUGALD (OAKBANK) - PWS	Expected Sample Time:	January-2022
Operation Code:	55.35		
Operation ID:	26719		
Sampled by:	Slade Zanewich		

Please record Free & Total Chlorine residuals for Distribution By-product Sampling

DO NOT COPY or RE-USE this form. Sample Number are unique to the Office of Drinking Water and provided by Drinking Water Officer.

Sample Number	Station Number	Sample Identification	Free Chlorine (mg/L)	Total Chlorine (mg/L)	Sample Date dd-mmm-yyyy	Sample Time hh:mm	Sample Matrix	Sample Type	MB-CH-PWS-V2013	# of Containers
2201DL5001	MB05OJD081	Dugald RM of Springfield 1 - Raw well pump 1	N/A	N/A	21-01-2022	11:00AM	6	1	X	4
2201DL5002	MB05OJD081	Dugald RM of Springfield 1 - Raw					6	1	X	4

Failure to complete all portions of this form may delay analysis.	Sample Matrix: 6-Raw Water, 9-Distributed Water, 10-Treated Water
Please fill in this form LEGIBLY.	Sample Type: 1-Grab Sample

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified by the Laboratory.
For ALL other testing, please use Laboratory specific forms.

Relinquished By:	[redacted]	Date & Time	JAN 21/22 11:00AM	Validated By (lab use only):	Date & Time:
				Sample Condition (lab use only)	
Received By: (lab use only)	TL	Date & Time: (lab use only)	JAN 21 2022 12:37	Temperature 9.4°C	Samples Received in Good Condition? Y / N

RM of Springfield - Oakbank Water Treatment Plant
ATTN: GREG AGNEW
Dugald (Oakbank) - PWS
Box 219
Oakbank MB R0E 1J0

Date Received: 02-FEB-22
Report Date: 22-FEB-22 07:06 (MT)
Version: FINAL

Client Phone: 204-444-2241

Certificate of Analysis

Lab Work Order #: L2682979
Project P.O. #: NOT SUBMITTED
Job Reference: DUGALD (OAKBANK) - PWS 55.35
C of C Numbers:
Legal Site Desc: 26719

[redacted]
Hua Wo
Chemistry Laboratory Manager

ANALYTICAL REPORT

Physical Tests (WATER)

Analyte	Unit	Guide Limit #1	Guide Limit #2	ALS ID: L2682979-2 Sampled Date: 02-FEB-22 Sampled Time: 10:30 Sample ID: DUGALD RM OF SPRINGFIELD 1 - RAW @ WP2
Colour, True	CU	15	-	<5 0
Conductivity	umhos/cm	-	-	1040
Hardness (as CaCO3)	mg/L	-	-	41.8 HTC
Langelier Index (4 C)	No Unit	-	-	0.34
Langelier Index (60 C)	No Unit	-	-	1.1
pH	pH units	7.00-10.5	-	8.59
Total Dissolved Solids	mg/L	500	-	575
Transmittance, UV (254 nm)	%T/cm	-	-	94.6
Turbidity	NTU	-	-	0.73

Federal Guidelines for Canadian Drinking Water Quality (MAR, 2021)
#1: GCDWQ - Aesthetic Objective/Other Value (Jan.2020)
#2: GCDWQ - Maximum Acceptable Concentrations (MACs-Jan.2020)

Anions and Nutrients (WATER)

Analyte	Unit	Guide Limit #1	Guide Limit #2	ALS ID: L2682979-2 Sampled Date: 02-FEB-22 Sampled Time: 10:30 Sample ID: DUGALD RM OF SPRINGFIELD 1 - RAW @ WP2
Alkalinity, Total (as CaCO3)	mg/L	-	-	308
Ammonia, Total (as N)	mg/L	-	-	0.57
Bicarbonate (HCO3)	mg/L	-	-	354
Bromide (Br)	mg/L	-	-	0.157
Carbonate (CO3)	mg/L	-	-	10.4
Chloride (Cl)	mg/L	250	-	94.5
Fluoride (F)	mg/L	-	1.5	1.59
Hydroxide (OH)	mg/L	-	-	<0.34
Nitrate (as N)	mg/L	-	10	<0.0050
Nitrite (as N)	mg/L	-	1	<0.0010
Sulfate (SO4)	mg/L	500	-	77.8

Federal Guidelines for Canadian Drinking Water Quality (MAR, 2021)
#1: GCDWQ - Aesthetic Objective/Other Value (Jan.2020)
#2: GCDWQ - Maximum Acceptable Concentrations (MACs-Jan.2020)

Organic / Inorganic Carbon (WATER)

Analyte	Unit	Guide Limit #1	Guide Limit #2	ALS ID: L2682979-2 Sampled Date: 02-FEB-22 Sampled Time: 10:30 Sample ID: DUGALD RM OF SPRINGFIELD 1 - RAW @ WP2
Dissolved Organic Carbon	mg/L	-	-	1.53
Total Organic Carbon	mg/L	-	-	1.40

Federal Guidelines for Canadian Drinking Water Quality (MAR, 2021)
#1: GCDWQ - Aesthetic Objective/Other Value (Jan.2020)
#2: GCDWQ - Maximum Acceptable Concentrations (MACs-Jan.2020)

Detection Limit for result exceeds Guide Limit. Assessment against Guide Limit cannot be made.
Analytical result for this parameter exceeds Guide Limit listed on this report.
* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Total Metals (WATER)

Analyte	Unit	Guide Limit #1	Guide Limit #2	ALS ID: L2682979-2 Sampled Date: 02-FEB-22 Sampled Time: 10:30 Sample ID: DUGALD RM OF SPRINGFIELD 1 - RAW @ WP2
Aluminum (Al)-Total	mg/L	0.1	2.9	0.0277
Antimony (Sb)-Total	mg/L	-	0.006	<0.00010
Arsenic (As)-Total	mg/L	-	0.01	0.00011
Barium (Ba)-Total	mg/L	-	2	0.0212
Beryllium (Be)-Total	mg/L	-	-	<0.00010
Bismuth (Bi)-Total	mg/L	-	-	<0.000050
Boron (B)-Total	mg/L	-	5	1.75
Cadmium (Cd)-Total	mg/L	-	0.005	<0.0000050
Calcium (Ca)-Total	mg/L	-	-	9.56
Cesium (Cs)-Total	mg/L	-	-	0.000054
Chromium (Cr)-Total	mg/L	-	0.05	<0.00010
Cobalt (Co)-Total	mg/L	-	-	<0.00010
Copper (Cu)-Total	mg/L	1	2	<0.00050
Iron (Fe)-Total	mg/L	0.3	-	0.204
Lead (Pb)-Total	mg/L	-	0.005	<0.000050
Lithium (Li)-Total	mg/L	-	-	0.0739
Magnesium (Mg)-Total	mg/L	-	-	4.35
Manganese (Mn)-Total	mg/L	0.02	0.12	0.00764
Molybdenum (Mo)-Total	mg/L	-	-	0.00353
Nickel (Ni)-Total	mg/L	-	-	<0.00050
Phosphorus (P)-Total	mg/L	-	-	<0.050
Potassium (K)-Total	mg/L	-	-	11.6
Rubidium (Rb)-Total	mg/L	-	-	0.00624
Selenium (Se)-Total	mg/L	-	0.05	<0.000050
Silicon (Si)-Total	mg/L	-	-	3.54
Silver (Ag)-Total	mg/L	-	-	<0.000010
Sodium (Na)-Total	mg/L	200	-	223
Strontium (Sr)-Total	mg/L	-	7	0.0877
Tellurium (Te)-Total	mg/L	-	-	<0.00020
Thallium (Tl)-Total	mg/L	-	-	<0.000010
Thorium (Th)-Total	mg/L	-	-	<0.00010
Tin (Sn)-Total	mg/L	-	-	<0.00010
Titanium (Ti)-Total	mg/L	-	-	0.00090

Federal Guidelines for Canadian Drinking Water Quality (MAR, 2021)
#1: GCDWQ - Aesthetic Objective/Other Value (Jan.2020)
#2: GCDWQ - Maximum Acceptable Concentrations (MACs-Jan.2020)

Detection Limit for result exceeds Guide Limit. Assessment against Guide Limit cannot be made.
Analytical result for this parameter exceeds Guide Limit listed on this report.
* Please refer to the Reference Information section for an explanation of any qualifiers noted.

ANALYTICAL REPORT

Total Metals (WATER)

				ALS ID	L2682979-2
				Sampled Date	02-FEB-22
				Sampled Time	10:30
				Sample ID	**DUGALD RM OF SPRINGFIELD 1 - RAW @ WP2**
Analyte	Unit	Guide Limit #1	Guide Limit #2		
Tungsten (W)-Total	mg/L	-	-		<0.00010
Uranium (U)-Total	mg/L	-	0.02		0.000081
Vanadium (V)-Total	mg/L	-	-		<0.00050
Zinc (Zn)-Total	mg/L	5	-		<0.0030
Zirconium (Zr)-Total	mg/L	-	-		<0.00020

Federal Guidelines for Canadian Drinking Water Quality (MAR, 2021)
#1: GCDWQ - Aesthetic Objective/Other Value (Jan.2020)
#2: GCDWQ - Maximum Acceptable Concentrations (MACs-Jan.2020)

Detection Limit for result exceeds Guide Limit. Assessment against Guide Limit cannot be made.
Analytical result for this parameter exceeds Guide Limit listed on this report.
* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-CO3CO3-CALC-WP	Water	Alkalinity, Carbonate	CALCULATION
The Alkalinity of water is a measure of its acid neutralizing capacity.Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contr buted by carbonate is calculated and reported as mg CO3 2-/L.			
ALK-HCO3HCO3-CALC-WP	Water	Alkalinity, Bicarbonate	CALCULATION
The Alkalinity of water is a measure of its acid neutralizing capacity.Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contr buted by bicarbonate is calculated and reported as mg HCO3-/L			
ALK-OHOH-CALC-WP	Water	Alkalinity, Hydroxide	CALCULATION
The Alkalinity of water is a measure of its acid neutralizing capacity.Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. The fraction of alkalinity contr buted by hydroxide is calculated and reported as mg OH-/L.			
ALK-TITR-WP	Water	Alkalinity, Total (as CaCO3)	APHA 2320B
The Alkalinity of water is a measure of its acid neutralizing capacity. Alkalinity is imparted by bicarbonate, carbonate and hydroxide components of water. Total alkalinity is determined by titration with a strong standard mineral acid to the successive HCO3- and H2CO3 endpoints indicated electrometrically.			
BR-L-IC-N-WP	Water	Bromide in Water by IC (Low Level)	EPA 300.1 (mod)-LR
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
C-DOC-HTC-WP	Water	Dissolved Organic Carbon by Combustion	APHA 5310 B-WP
Filtered (0.45 um) sample is acidified and purged to remove inorganic carbon, then injected into a heated reaction chamber where organic carbon is oxidized to CO2 which is then transported in the carrier gas stream and measured via a non-dispersive infrared analyzer.			
C-TOC-HTC-WP	Water	Total Organic Carbon by Combustion	APHA 5310 B-WP
Sample is acidified and purged to remove inorganic carbon, then injected into a heated reaction chamber where organic carbon is oxidized to CO2 which is then transported in the carrier gas stream and measured via a non-dispersive infrared analyzer.			
CL-L-IC-N-WP	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
COLOUR-TRUE-WP	Water	Colour, True	APHA 2120C
True Colour is measured spectrophotometrically by comparison to platinum-cobalt standards using the single wavelength method (450 - 465 nm) after filtration of sample through a 0.45 um filter. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.			
EC-SCREEN-WP	Water	Conductivity Screen (Internal Use Only)	APHA 2510
Qualitative analysis of conductivity where required during preparation of other test eg. IC, TDS, TSS, etc			
EC-WP	Water	Conductivity	APHA 2510B
Conductivity of an aqueous solution refers to its ability to carry an electric current. Conductance of a solution is measured between two spatially fixed and chemically inert electrodes.			
ETL-LANGELIER-4-WP	Water	Langelier Index 4C	Calculated
ETL-LANGELIER-60-WP	Water	Langelier Index 60C	Calculated
F-IC-N-WP	Water	Fluoride in Water by IC	EPA 300.1 (mod)
Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.			
HARDNESS-CALC-WP	Water	Hardness Calculated	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
IONBALANCE-CALC-WP	Water	Ion Balance Calculation	APHA 1030E

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**

Cation Sum, Anion Sum, and Ion Balance (as % difference) are calculated based on guidance from APHA Standard Methods (1030E Checking Correctness of Analysis). Because all aqueous solutions are electrically neutral, the calculated ion balance (% difference of cations minus anions) should be near-zero.

Cation and Anion Sums are the total meq/L concentration of major cations and anions. Dissolved species are used where available. Minor ions are included where data is present. Ion Balance (as % difference) cannot be calculated accurately for waters with very low electrical conductivity (EC), and is reported as "Low EC" where EC < 100 uS/cm (umhos/cm). Ion Balance is calculated as:

Ion Balance (%) = [Cation Sum-Anion Sum] / [Cation Sum+Anion Sum]

MET-T-CCMS-WP	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020B (mod.)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-COL-WP	Water	Ammonia by colour	APHA 4500 NH3 F

Ammonia in water samples forms indophenol when reacted with hypochlorite and phenol. The intensity is amplified by the addition of sodium nitroprusside and measured colourmetrically.

NO2-L-IC-N-WP	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WP	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-WP	Water	pH	APHA 4500H

The pH of a sample is the determination of the activity of the hydrogen ions by potentiometric measurement using a standard hydrogen electrode and a reference electrode.

SO4-IC-N-WP	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-WP	Water	Total Dissolved Solids (TDS)	APHA 2540 SOLIDS C,E

A well-mixed sample is filtered through a glass fiber filter paper. The filtrate is then evaportaed to dryness in a pre-weighed vial and dried at 180 – 2C. The increase in vial weight represents the total dissolved solids.

TURBIDITY-WP	Water	Turbidity	APHA 2130B (modified)

Turbidity in aqueous matrices is determined by the nephelometric method.

UV-%TRANS-WP	Water	UV Transmittance (Calculated)	APHA 5910B

Test method is adapted from APHA Method 5910B. A sample is filtered through a 0.45 um polyethersulfone (PES) filter and its UV Absorbance is measured in a quartz cell at 254 nm. UV Transmittance is calculated from the UV Absorbance result and reported as UV Transmittance per cm. The analysis is carried out without pH adjustment.

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

Chain of Custody Numbers:

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

Laboratory Definition Code	Laboratory Location
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Reference Information

GLOSSARY OF REPORT TERMS

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

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2682979 Report Date: 22-FEB-22

Client: RM of Springfield - Oakbank Water Treatment Plant
Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0

Contact: GREG AGNEW

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TITR-WP	**Water**							
Batch R5713588								
WG3692578-10 DUP		**L2682979-2**						
A kalinity, Total (as CaCO3)		308	313		mg/L	1.6	20	04-FEB-22
WG3692578-9 LCS								
A kalinity, Total (as CaCO3)			102.9		%		85-115	04-FEB-22
WG3692578-6 MB								
A kalinity, Total (as CaCO3)			<1.0		mg/L		1	04-FEB-22
BR-L-IC-N-WP	**Water**							
Batch R5713054								
WG3691751-2 LCS								
Bromide (Br)			103.1		%		85-115	02-FEB-22
WG3691751-1 MB								
Bromide (Br)			<0.010		mg/L		0.01	02-FEB-22
C-DOC-HTC-WP	**Water**							
Batch R5714327								
WG3693128-3 DUP		**L2682853-1**						
Dissolved Organic Carbon		10.5	10.3		mg/L	2.1	20	04-FEB-22
WG3693128-2 LCS								
Dissolved Organic Carbon			105.4		%		80-120	04-FEB-22
WG3693128-1 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	04-FEB-22
WG3693128-4 MS		**L2682853-2**						
Dissolved Organic Carbon			103.3		%		70-130	04-FEB-22
C-TOC-HTC-WP	**Water**							
Batch R5714328								
WG3693131-3 DUP		**L2682853-1**						
Total Organic Carbon		10.2	9.68		mg/L	4.9	20	04-FEB-22
WG3693131-2 LCS								
Total Organic Carbon			104.9		%		80-120	04-FEB-22
WG3693131-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	04-FEB-22
WG3693131-4 MS		**L2682853-2**						
Total Organic Carbon			102.0		%		70-130	04-FEB-22
CL-L-IC-N-WP	**Water**							
Batch R5713054								
WG3691751-2 LCS								
Chloride (Cl)			99.3		%		90-110	02-FEB-22
WG3691751-1 MB								

Quality Control Report

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-L-IC-N-WP	**Water**							
Batch R5713054								
WG3691751-1 MB								
Chloride (Cl)			<0.10		mg/L		0.1	02-FEB-22
COLOUR-TRUE-WP	**Water**							
Batch R5712942								
WG3691877-6 DUP		**L2682667-1**						
Colour, True		15.7	15.1		CU	3.8	20	02-FEB-22
WG3691877-5 LCS								
Colour, True			101.5		%		85-115	02-FEB-22
WG3691877-4 MB								
Colour, True			<5.0		CU		5	02-FEB-22
EC-WP	**Water**							
Batch R5713588								
WG3692578-10 DUP		**L2682979-2**						
Conductivity		1040	1040		umhos/cm	0.5	10	04-FEB-22
WG3692578-8 LCS								
Conductivity			100.3		%		90-110	04-FEB-22
WG3692578-6 MB								
Conductivity			<1.0		umhos/cm		1	04-FEB-22
F-IC-N-WP	**Water**							
Batch R5713054								
WG3691751-2 LCS								
Fluoride (F)			103.0		%		90-110	02-FEB-22
WG3691751-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	02-FEB-22
MET-T-CCMS-WP	**Water**							
Batch R5713670								
WG3691856-4 DUP		**WG3691856-3**						
Aluminum (Al)-Total		0.0063	0.0080	J	mg/L	0.0017	0.006	04-FEB-22
Antimony (Sb)-Total		0.00041	0.00038		mg/L	9.0	20	04-FEB-22
Arsenic (As)-Total		0.00051	0.00057		mg/L	12	20	04-FEB-22
Barium (Ba)-Total		0.124	0.124		mg/L	0.0	20	04-FEB-22
Bismuth (Bi)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	04-FEB-22
Cadmium (Cd)-Total		0.000188	0.000197		mg/L	4.7	20	04-FEB-22
Calcium (Ca)-Total		112	118		mg/L	5.8	20	04-FEB-22
Cesium (Cs)-Total		0.000103	0.000099		mg/L	4.3	20	04-FEB-22

Quality Control Report

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Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0
Contact: GREG AGNEW

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WP	**Water**							
Batch R5713670								
WG3691856-4 DUP		**WG3691856-3**						
Chromium (Cr)-Total		0.00745	0.00760		mg/L	2.1	20	04-FEB-22
Cobalt (Co)-Total		0.00011	<0.00010	RPD-NA	mg/L	N/A	20	04-FEB-22
Copper (Cu)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	04-FEB-22
Iron (Fe)-Total		0.019	0.019		mg/L	1.6	20	04-FEB-22
Lead (Pb)-Total		0.00168	0.00172		mg/L	2.3	20	04-FEB-22
Magnesium (Mg)-Total		63.5	62.9		mg/L	0.9	20	04-FEB-22
Manganese (Mn)-Total		0.110	0.108		mg/L	1.8	20	04-FEB-22
Molybdenum (Mo)-Total		0.00498	0.00513		mg/L	2.9	20	04-FEB-22
Nickel (Ni)-Total		0.0238	0.0239		mg/L	0.5	20	04-FEB-22
Potassium (K)-Total		81.4	79.4		mg/L	2.5	20	04-FEB-22
Phosphorus (P)-Total		<0.030	0.037	RPD-NA	mg/L	N/A	20	04-FEB-22
Rubidium (Rb)-Total		0.0286	0.0281		mg/L	1.8	20	04-FEB-22
Selenium (Se)-Total		0.000157	0.000156		mg/L	1.0	20	04-FEB-22
Silicon (Si)-Total		8.44	8.40		mg/L	0.4	20	04-FEB-22
Silver (Ag)-Total		0.000013	0.000014		mg/L	4.6	20	04-FEB-22
Sodium (Na)-Total		15200	15000		mg/L	1.1	20	04-FEB-22
Strontium (Sr)-Total		1.77	1.81		mg/L	2.4	20	04-FEB-22
Tellurium (Te)-Total		0.00040	0.00034		mg/L	18	20	04-FEB-22
Thallium (Tl)-Total		0.000026	0.000022		mg/L	16	20	04-FEB-22
Thorium (Th)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	04-FEB-22
Tin (Sn)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	04-FEB-22
Titanium (Ti)-Total		0.00053	0.00064		mg/L	19	20	04-FEB-22
Tungsten (W)-Total		0.00028	0.00028		mg/L	2.0	20	04-FEB-22
Uranium (U)-Total		0.00154	0.00154		mg/L	0.0	20	04-FEB-22
Vanadium (V)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	04-FEB-22
Zinc (Zn)-Total		0.0905	0.0883		mg/L	2.4	20	04-FEB-22
Zirconium (Zr)-Total		<0.00020	<0.00020	RPD-NA	mg/L	N/A	20	04-FEB-22
WG3691856-2 LCS								
Aluminum (Al)-Total			104.2		%		80-120	04-FEB-22
Antimony (Sb)-Total			110.8		%		80-120	04-FEB-22
Arsenic (As)-Total			100.9		%		80-120	04-FEB-22
Barium (Ba)-Total			102.0		%		80-120	04-FEB-22
Bismuth (Bi)-Total			102.8		%		80-120	04-FEB-22

Quality Control Report

Client: RM of Springfield - Oakbank Water Treatment Plant
Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0
Contact: GREG AGNEW

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WP	**Water**							
Batch R5713670								
WG3691856-2 LCS								
Cadmium (Cd)-Total			102.5		%		80-120	04-FEB-22
Calcium (Ca)-Total			106.0		%		80-120	04-FEB-22
Cesium (Cs)-Total			100.1		%		80-120	04-FEB-22
Chromium (Cr)-Total			101.5		%		80-120	04-FEB-22
Cobalt (Co)-Total			100.2		%		80-120	04-FEB-22
Copper (Cu)-Total			101.0		%		80-120	04-FEB-22
Iron (Fe)-Total			101.6		%		80-120	04-FEB-22
Lead (Pb)-Total			103.9		%		80-120	04-FEB-22
Magnesium (Mg)-Total			109.1		%		80-120	04-FEB-22
Manganese (Mn)-Total			102.0		%		80-120	04-FEB-22
Molybdenum (Mo)-Total			100.0		%		80-120	04-FEB-22
Nickel (Ni)-Total			100.2		%		80-120	04-FEB-22
Potassium (K)-Total			99.3		%		80-120	04-FEB-22
Phosphorus (P)-Total			101.1		%		80-120	04-FEB-22
Rubidium (Rb)-Total			102.5		%		80-120	04-FEB-22
Selenium (Se)-Total			103.8		%		80-120	04-FEB-22
Silicon (Si)-Total			101.2		%		80-120	04-FEB-22
Silver (Ag)-Total			91.6		%		80-120	04-FEB-22
Sodium (Na)-Total			103.4		%		80-120	04-FEB-22
Strontium (Sr)-Total			100.5		%		80-120	04-FEB-22
Tellurium (Te)-Total			92.5		%		80-120	04-FEB-22
Thallium (Tl)-Total			102.6		%		80-120	04-FEB-22
Thorium (Th)-Total			101.9		%		80-120	04-FEB-22
Tin (Sn)-Total			101.2		%		80-120	04-FEB-22
Titanium (Ti)-Total			97.3		%		80-120	04-FEB-22
Tungsten (W)-Total			99.9		%		80-120	04-FEB-22
Uranium (U)-Total			101.8		%		80-120	04-FEB-22
Vanadium (V)-Total			100.8		%		80-120	04-FEB-22
Zinc (Zn)-Total			102.9		%		80-120	04-FEB-22
Zirconium (Zr)-Total			92.9		%		80-120	04-FEB-22
WG3691856-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	04-FEB-22
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	04-FEB-22
Arsenic (As)-Total			<0.00010		mg/L		0.0001	04-FEB-22

Quality Control Report

Client: RM of Springfield - Oakbank Water Treatment Plant
Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0
Contact: GREG AGNEW

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WP	**Water**							
Batch R5713670								
WG3691856-1 MB								
Barium (Ba)-Total			<0.00010		mg/L		0.0001	04-FEB-22
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	04-FEB-22
Cadmium (Cd)-Total			<0.000005(		mg/L		0.000005	04-FEB-22
Calcium (Ca)-Total			<0.050		mg/L		0.05	04-FEB-22
Cesium (Cs)-Total			<0.000010		mg/L		0.00001	04-FEB-22
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	04-FEB-22
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	04-FEB-22
Copper (Cu)-Total			<0.00050		mg/L		0.0005	04-FEB-22
Iron (Fe)-Total			<0.010		mg/L		0.01	04-FEB-22
Lead (Pb)-Total			<0.000050		mg/L		0.00005	04-FEB-22
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	04-FEB-22
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	04-FEB-22
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	04-FEB-22
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	04-FEB-22
Potassium (K)-Total			<0.050		mg/L		0.05	04-FEB-22
Phosphorus (P)-Total			<0.030		mg/L		0.03	04-FEB-22
Rubidium (Rb)-Total			<0.00020		mg/L		0.0002	04-FEB-22
Selenium (Se)-Total			<0.000050		mg/L		0.00005	04-FEB-22
Silicon (Si)-Total			<0.10		mg/L		0.1	04-FEB-22
Silver (Ag)-Total			<0.000010		mg/L		0.00001	04-FEB-22
Sodium (Na)-Total			<0.050		mg/L		0.05	04-FEB-22
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	04-FEB-22
Tellurium (Te)-Total			<0.00020		mg/L		0.0002	04-FEB-22
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	04-FEB-22
Thorium (Th)-Total			<0.00010		mg/L		0.0001	04-FEB-22
Tin (Sn)-Total			<0.00010		mg/L		0.0001	04-FEB-22
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	04-FEB-22
Tungsten (W)-Total			<0.00010		mg/L		0.0001	04-FEB-22
Uranium (U)-Total			<0.000010		mg/L		0.00001	04-FEB-22
Vanadium (V)-Total			<0.00050		mg/L		0.0005	04-FEB-22
Zinc (Zn)-Total			<0.0030		mg/L		0.003	04-FEB-22
Zirconium (Zr)-Total			<0.00020		mg/L		0.0002	04-FEB-22
WG3691856-5 MS		**WG3691856-3**						
Aluminum (Al)-Total			127.0		%		70-130	04-FEB-22

Quality Control Report

Client: RM of Springfield - Oakbank Water Treatment Plant
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Oakbank MB R0E 1J0
Contact: GREG AGNEW

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WP	**Water**							
Batch R5713670								
WG3691856-5 MS		**WG3691856-3**						
Antimony (Sb)-Total			99.2		%		70-130	04-FEB-22
Arsenic (As)-Total			104.3		%		70-130	04-FEB-22
Barium (Ba)-Total			N/A	MS-B	%		-	04-FEB-22
Bismuth (Bi)-Total			90.3		%		70-130	04-FEB-22
Cadmium (Cd)-Total			87.6		%		70-130	04-FEB-22
Calcium (Ca)-Total			N/A	MS-B	%		-	04-FEB-22
Cesium (Cs)-Total			104.5		%		70-130	04-FEB-22
Chromium (Cr)-Total			105.7		%		70-130	04-FEB-22
Cobalt (Co)-Total			94.3		%		70-130	04-FEB-22
Copper (Cu)-Total			86.3		%		70-130	04-FEB-22
Iron (Fe)-Total			101.4		%		70-130	04-FEB-22
Lead (Pb)-Total			86.3		%		70-130	04-FEB-22
Magnesium (Mg)-Total			N/A	MS-B	%		-	04-FEB-22
Manganese (Mn)-Total			N/A	MS-B	%		-	04-FEB-22
Molybdenum (Mo)-Total			103.4		%		70-130	04-FEB-22
Nickel (Ni)-Total			90.0		%		70-130	04-FEB-22
Potassium (K)-Total			N/A	MS-B	%		-	04-FEB-22
Phosphorus (P)-Total			127.6		%		70-130	04-FEB-22
Rubidium (Rb)-Total			N/A	MS-B	%		-	04-FEB-22
Selenium (Se)-Total			89.7		%		70-130	04-FEB-22
Silicon (Si)-Total			128.3		%		70-130	04-FEB-22
Silver (Ag)-Total			87.4		%		70-130	04-FEB-22
Sodium (Na)-Total			N/A	MS-B	%		-	04-FEB-22
Strontium (Sr)-Total			N/A	MS-B	%		-	04-FEB-22
Tellurium (Te)-Total			88.3		%		70-130	04-FEB-22
Thallium (Tl)-Total			87.5		%		70-130	04-FEB-22
Thorium (Th)-Total			95.0		%		70-130	04-FEB-22
Tin (Sn)-Total			93.2		%		70-130	04-FEB-22
Titanium (Ti)-Total			119.9		%		70-130	04-FEB-22
Tungsten (W)-Total			96.5		%		70-130	04-FEB-22
Uranium (U)-Total			89.1		%		70-130	04-FEB-22
Vanadium (V)-Total			113.9		%		70-130	04-FEB-22
Zinc (Zn)-Total			89.6		%		70-130	04-FEB-22

Quality Control Report

Client: RM of Springfield - Oakbank Water Treatment Plant
Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0
Contact: GREG AGNEW

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WP	**Water**							
Batch R5713670								
WG3691856-5 MS		**WG3691856-3**						
Zirconium (Zr)-Total			106.3		%		70-130	04-FEB-22
NH3-COL-WP	**Water**							
Batch R5713570								
WG3692608-3 DUP		**L2682028-3**						
Ammonia, Total (as N)		0.042	0.047		mg/L	11	20	04-FEB-22
WG3692608-2 LCS								
Ammonia, Total (as N)			100.2		%		85-115	04-FEB-22
WG3692608-1 MB								
Ammonia, Total (as N)			<0.010		mg/L		0.01	04-FEB-22
WG3692608-4 MS		**L2682028-3**						
Ammonia, Total (as N)			89.8		%		75-125	04-FEB-22
NO2-L-IC-N-WP	**Water**							
Batch R5713054								
WG3691751-2 LCS								
Nitrite (as N)			101.5		%		90-110	02-FEB-22
WG3691751-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	02-FEB-22
NO3-L-IC-N-WP	**Water**							
Batch R5713054								
WG3691751-2 LCS								
Nitrate (as N)			100.4		%		90-110	02-FEB-22
WG3691751-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	02-FEB-22
PH-WP	**Water**							
Batch R5713588								
WG3692578-10 DUP		**L2682979-2**						
pH		8.59	8.57	J	pH units	0.02	0.2	04-FEB-22
WG3692578-7 LCS								
pH			7.03		pH units		6.9-7.1	04-FEB-22
SO4-IC-N-WP	**Water**							
Batch R5713054								
WG3691751-2 LCS								
Sulfate (SO4)			100.6		%		90-110	02-FEB-22
WG3691751-1 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	02-FEB-22

Quality Control Report

Workorder: L2682979 Report Date: 22-FEB-22

Client: RM of Springfield - Oakbank Water Treatment Plant
Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0
Contact: GREG AGNEW

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TDS-WP	**Water**							
Batch R5713536								
WG3692120-3 DUP		**L2682407-1**						
Total Dissolved Solids		809	816		mg/L	0.9	20	03-FEB-22
WG3692120-2 LCS								
Total Dissolved Solids			92.6		%		85-115	03-FEB-22
WG3692120-1 MB								
Total Dissolved Solids			<4.0		mg/L		4	03-FEB-22
TURBIDITY-WP	**Water**							
Batch R5713057								
WG3691825-3 DUP		**L2682197-1**						
Turbidity		0.92	0.91		NTU	0.9	15	02-FEB-22
WG3691825-2 LCS								
Turbidity			98.5		%		85-115	02-FEB-22
WG3691825-1 MB								
Turbidity			<0.10		NTU		0.1	02-FEB-22
UV-%TRANS-WP	**Water**							
Batch R5713804								
WG3692284-6 DUP		**L2683318-1**						
Transmittance, UV (254 nm)		90.0	91.8		%T/cm	2.1	20	03-FEB-22
WG3692284-4 IRM		**BLANK**						
Transmittance, UV (254 nm)			100.0		%		99.5-100.5	03-FEB-22
WG3692284-5 LCS								
Transmittance, UV (254 nm)			104.0		%		85-115	03-FEB-22

Quality Control Report

Workorder: L2682979 Report Date: 22-FEB-22

Client: RM of Springfield - Oakbank Water Treatment Plant
Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0
Contact: GREG AGNEW

Legend:

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

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Workorder: L2682979 Report Date: 22-FEB-22

Client: RM of Springfield - Oakbank Water Treatment Plant
Dugald (Oakbank) - PWS Box 219
Oakbank MB R0E 1J0
Contact: GREG AGNEW

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH							
	2	02-FEB-22 10:30	04-FEB-22 12:00	0.25	49	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2682979 were received on 02-FEB-22 12:43.

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.

L2682979-COFC

Conservation and Climate
Office of Drinking Water
1007 Century Street, Winnipeg, Manitoba,
Canada R3H 0W4

Regular Service (default):	☑ Regular Service (is 5-7 Days):
Unless otherwise requested	☐ **1 Day, rush / priority** ☐ **2 Day, rush / priority** ☐ **3 Day, rush / priority**

Report to Operator (email PDF):		**Report to Owner (email PDF):**		**Email PDF copy to:**	
Contact:	Greg Agnew	Contact:	Scott Smith	DWO:	Closed System
Address:	Box 219, Oakbank, MB R0E1J0	Address:	Box 219, Oakbank, MB R0E1J0	DWO Address:	, , MB
Phone:	(204) 444-2241	Phone:	(204) 444-3321	DWO Phone:	
Email:	gagnew@rmofspringfield.ca	Email:		DWO Email:	Fake@email.com
				Additional Email:	Joern.Muenster@gov.mb.ca; Nancy.Eidse@gov.mb.ca

If an update in Owner or Operator contact information is required, please contact your Drinking Water Officer

Client / Project Information:	**Lab:**	**Account:**	Agency Code: 382	Report Type: EMS (Lab-MWS)	Project: DWQ-C

Operation Name:	DUGALD (OAKBANK) - PWS	Expected Sample Time:	March-2021
Operation Code:	55.35		
Operation ID:	26719		
Sampled by:	SLADE ZANEWICH		

Please record Free & Total Chlorine residuals for Distribution By-product Sampling

DO NOT COPY or RE-USE this form. Sample Number are unique to the Office of Drinking Water and provided by Drinking Water Officer.

Sample Number	Station Number	Sample Identification	Free Chlorine (mg/L)	Total Chlorine (mg/L)	Sample Date dd-mmm-yyyy	Sample Time hh:mm	Sample Matrix	Sample Type	MB-CH-PWS-V2013	# of Containers
21035*001	MB05OJD081	Dugald RM of Springfield 1 - Raw					6	1	X	5
21035*002	MB05OJD081	Dugald RM of Springfield 1 - Raw WP2	—	—	02-02-2022	10:30AM	6	1	X	5

Failure to complete all portions of this form may delay analysis.		Sample Matrix:	6-Raw Water, 9-Distributed Water, 10-Treated Water
Please fill in this form LEGIBLY.		Sample Type:	1-Grab Sample

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified by the Laboratory.
For ALL other testing, please use Laboratory specific forms.

Relinquished By:	Greg Agnew	Date & Time	Feb 2/22 10:30AM	Validated By (lab use only):	Date & Time:
				Sample Condition (lab use only)	
Received By: (lab use only)	O.A.	Date & Time: (lab use only)	2/2/22, 12:43pm	Temperature 14.4°C	Samples Received in Good Condition? Y / N